PROGRAMME & PROCEEDINGS BOOK

40th MALAYSIAN SOCIETY OF ANIMAL PRODUCTION ANNUAL CONFERENCE

3rd – 4th AUGUST 2021



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The Malaysian Society of Animal Production

In collaboration with:

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MFM AGROVET di tubuhkan pada tahun 2016 di mana pada peringkat awal kami menawarkan rawatan dan khidmat konsultasi ternaka kepada penternak di lapangan sahaja. Pada tahun 2017, kami melebarkan sayap dengan mewujudkan klinik veterinar yang berpengkalan di Selangor. Sehingga sekarang perkhidmatan untuk ternakan diperluaskan lagi dengan secara “mobile” keseluruh Semenanjung Malaysia.

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Terima kasih di atas sokongan anda

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Welcome Remarks



On behalf of the Malaysian Society of Animal Production (MSAP), I am pleased to welcome all members and participants to our 40th MSAP Annual Online Conference. This is our first time organising an online conference due to an unprecedented situation with this current global COVID 19 pandemic.

MSAP takes pride in organising these important conferences, not only as an event for scientists to present their research findings but also as a platform where players of the livestock industry meet and share their concerns and experiences. The theme of the conference "Livestock Industries Surviving the COVID-19 Pandemic" was chosen by the Society as an expression of concern with regards to the state of development of the livestock industry which are facing numerous challenges against the background of ensuring food security especially during this COVID-19 crisis. This pandemic has uncovered a plethora of issues with livestock industry in our country and is predicted to have enormous consequences on livestock systems.

However, the MSAP beliefs there are opportunities, options and solutions that can be explored together by all players of the industry to have better understanding on the magnitude or severity of the pandemic on this sector. The linkages and bond between scientists, government officers, producers, service providers, farmers and stakeholders of the animal industry, need to remain strong so that together we can initiate changes and improvement of the industry towards fulfilling the growing demand for food especially to recover agriculture and food trade from the pandemic.

The Conference will cover all aspects of scientific achievements within animal production, including farm management, animal breeding and genetics, aquaculture, health and welfare as well other related livestock farming aspects. Participants will have the opportunity to attend a number of plenary papers and oral presentations from speakers; local and abroad, and view exciting posters from research conducted by local scientists and post-graduate students.

Additionally, the Conference will also pay attention on sharing experiences and knowledge within players of the livestock sector by having a special session dedicated to farmers. This exceptional avenue will facilitate new ideas creation and we encourage all participant especially young scientists and students to attend and listen from the farmers' perspectives. The topic for this year's Farmers Session is on 'Challenges & Opportunities during & Post COVID-19 Pandemic'.

Last but not least, I wish to also thank Universiti Putra Malaysia (UPM), Universiti Malaysia Kelantan (UMK), Malaysian Agricultural Research and Development Institute (MARDI), Department of Veterinary Services (DVS) and all individuals that have contributed in organising and support these conferences. I wish to thank the Organizing Committee for their contributions and hard work in making this Conference a success. I am sure that all of us will have a productive meeting.

Prof. Dr. Anjas Asmara Bin Samsudin
PRESIDENT
Malaysian Society of Animal Production
2020 / 2022

Welcome Remarks



It is with my greatest pleasure to welcome all speakers, participants and guests to the 40th MSAP Annual Conference 2021. Having missed last year's conference due to the COVID-19 pandemic, the organizing committee decided that for this year, "the conference must go on". Hence, the 40th MSAP Annual Conference 2021 is held fully in virtual mode from 3rd – 4th August 2021. Thanks so much for the tremendous support and commitment from all the organizing committee and everyone involved.

The theme of this year's conference is "Livestock Industries Surviving the COVID-19 Pandemic". In line with the current challenges inflicted by the pandemic, this year's conference focuses on topics related to the Sustainable Development Goals, with food security in mind. Among the focus, is the need to industrialize farming systems via leading-edge technologies so that the ASEAN region, particularly Malaysia can be less dependent on imports for animal products and animal feeds.

This year's annual conference has brought together international and local speakers and participants from various research institutions and universities, government agencies, farmers and entrepreneurs to exchange insights and information on the current challenges of global and domestic livestock industries while discussing strategies and possible solutions in warranting food safety and food security. This conference will also provide a platform to promote better networking and linkages to ensure efficient transfer of knowledge and technologies. It is our aims that research findings presented in this conference can help to reduce cost of production and improve farm efficiency to make livestock industry in Malaysia more competitive and sustainable especially in this challenging times.

For this year's conference, the best oral and poster presentation awards will be held to recognize scientific papers of exceptional quality delivered by the presenters. The award winners will be announced through the MSAP website after this conference ends. The winners will receive a certificate and monetary award. Hence, I wish all presenters all the best and grab the opportunity to win this award. This year's conference is also complimented with a Farmer's 'Borak' Session that will highlight experiences by farmers on how they mitigate and survive the pandemic.

Il would like to express my gratitude and appreciation to the co-organizers of 40th MSAP Conference 2021; Universiti Putra Malaysia (UPM), Malaysian Agricultural Research and Development Institute (MARDI), Department of Veterinary Services (DVS), sponsors and all individuals that have contributed in organizing and support for this conference. I also take this opportunity to express my sincere thanks and congratulate the organizing committee members for their commitment and tremendous effort in ensuring the success of this conference.

Finally, I wish all of you a truly enjoyable and productive time at our very first virtual conference. It is always a pleasure to meet with colleagues and friends albeit virtually while gaining more knowledge on advancement and development of livestock industries in the ASEAN region. Hope this will be an enlightening session. May Allah blessed us all and please stay safe.

Dr. Ainu Husna MS Suhaimi
Chairman of Organizing Committee
40th Malaysian Society of Animal Production Annual Conference (MSAP)



About MSAP

The Malaysian Society of Animal Production (MSAP) was formally established in 24th September 1973. Members of the society comprises personnel and individuals from the government, semi-government and private organization with interest in animal production, either in research, education, consultancy or associated with the practical and trading industries. All private and public organization and companies involved in any aspect of animal production are eligible for corporate membership of the society.

The objectives of the Society are:

- To give due importance and status to the science and state of the art of animal production as a profession in the country's agricultural and economic development

- To act as a body by and through which persons associated and/or interested in the general field of animal production could meet to forge and establish social contact and a sense of mutual fellowship with each other

- To act as a body that would provide the opportunities for personal development of personnel involved and/or interested in the field of animal production

- To act as a body that would represent all members, in matters related to their interests as professionals in this field

- To identify problems in various areas of animal production and to encourage investigations into these

- To encourage co-operation between science, education, extension and commerce in the field of animal production

- To encourage animal production and to stimulate the incorporation into practice of advances from research

---

We welcome and encourage all individuals and professionals, from academicians to industry personnel, government or private institution or just about anyone interested to join us and become a member of MSAP. All members will get special benefits and privileges in all society activities all year round.

MSAP Executive Committee 2020/2022

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40th MSAP ANNUAL CONFERENCE

ORGANISING COMMITTEE

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Chairman	Dr. Ainu Husna M S Suhaimi
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40th MALAYSIAN SOCIETY OF ANIMAL PRODUCTION ANNUAL CONFERENCE

THEME: LIVESTOCK INDUSTRIES: SURVIVING THE C19 PANDEMIC

TENTATIVE PROGRAMME

2 AUGUST (MONDAY): Pre-conference day	
0800– 1600	VIRTUAL LINK TRAIL / REHEARSAL CONFERENCE REGISTRATION & SUBMISSION OF SPEAKERS' PRESENTATION
3 AUGUST (TUESDAY): Day 1	
0800 – 0845	PRE-LIVE
OPENING SESSION	
0900-0915	**WELCOMING SPEECH** Dr Ainu Husna M S Suhaimi Organizing Chairman of MSAP 2021 Conference **OPENING SPEECH** Prof. Dr. Anjas Asmara Samsudin President MSAP 2020-2022
KEYNOTE SESSION	
Moderator: Prof. Dr. Anjas Asmara Samsudin President MSAP 2020-2022	

0915 – 1015	**KEYNOTE ADDRESS** **Challenges In the Livestock Industry During the Covid-19 Pandemic and Their Solutions** Dr. Akma Ngah Hamid Deputy Director General (Veterinary Health), Department Of Veterinary Services, Malaysia
1015 – 1045	PLENARY 1: **The Impact of Covid-19 on the Malaysian Livestock Sector** Tuan Hj. Tapsir Bin Serin Deputy Director General (Development & Operations), MARDI
1045 – 1100	BREAK: poster session (online)
SCIENTIFIC SESSION 1 ***(LIVESTOCK SUPPLY CHAIN)*** CHAIRMAN: Dr. Ainu Husna Binti M S Suhaimi Deputy Director of Advanced & Reproductive Technologies Programme, Livestock Science Research Centre, MARDI	
1100– 1130	PLENARY 2: **Marketing Strategy / Supply Chain Management During the Pandemic** En Azmi Zainal Chief Operating Officer (COO), Farm Fresh (M) Sdn Bhd
1130 – 1200	PLENARY 3:

	Animal Tourism in the Post Covid-19: The Need for Paradigm Change Prof. Dr. Badaruddin Mohamed Professor & Lecturer; Universiti Sains Malaysia, Malaysia
1200 - 1230	PLENARY 4: **The Effects of Covid-19 Pandemic on Beef Cattle Industry in Thailand** Assoc. Prof. Dr. Opart Pimpa Lecturer; Prince of Songkla University, Thailand.
1230-1400	BREAK: poster session (online)
SCIENTIFIC SESSION 2 (NON-RUMINANT INDUSTRY)	
CHAIRMAN: Dr. Saifulizam bin Abd Kadir Director, Division of Genetics Development and Animal Husbandry Technology, Department of Veterinary Services, Malaysia	
1400- 1430	PLENARY 5: **Alternative Animal Feed Additives to Substitute Antimicrobial Growth Promoter in Animal Feeding** Prof. Dr. Loh Teck Chwen Professor & Lecturer, University Putra Malaysia (UPM), Malaysia
1430- 1500	PLENARY 6: **Frontiers In Precision Sustainable Aquaculture Using Advanced Genomics and Biotechnology** Prof. Dr. Subha a/p Bhassu Professor & Lecturer; Universiti Malaya, Malaysia

1500–1530	PLENARY 7: **Evolution Of Poultry Diseases, Vaccines & Vaccine Delivery Technology in The Coming Decade** Dr Lee Jin Ee: CEVA Asia
1530 – 1545	*Scientific paper 1:* **Shrimp Farmers' Intention to Adopt New and Improved Technologies** Amira Hanani Azali
1545 – 1600	*Scientific paper 2:* **Economic Assessment of MARDI's Feed Formulation for Red Tilapia Fish** Mohd Syauqi Nazmi
1600 – 1615	*Scientific paper 3:* **Cryopreservation of bovine oocytes using cryotop and vitrification solution** Nabila Jasmine Afifi Mohd Nawi
1615 – 1630	*Scientific paper 4:* **Wastewater Treatment by Using Aerated Biofilter Reactor** Tan Teck Leon

4 AUGUST (WEDNESDAY): Day 2	
SCIENTIFIC SESSION 3 **(LIVESTOCK HEALTH AND NUTRITION)**	
CHAIRMAN: Dr. Mohd Mokrish Md. Ajat Lecturer, Faculty of Veterinary Medicine Universiti Putra Malaysia	
0815 – 0845	PLENARY 8: **New Developments in Forage Crops Production for Ruminants in Thailand** Assoc. Prof. Dr. Kannika Umpuch Lecturer; Valaya Alongkorn Rajabhat University, Thailand
0845 – 0900	*Scientific paper 5:* **Field Trial Application of The Nano-Fungicide on Grain Corn Samples** Noor Azlina Masdor
0900 – 0915	*Scientific paper 6:* **Effects of Selenium Enriched Bacterial Protein (ADS-18) and Vitamin E (Alpha-Tocopherol) as a Source of Antioxidant Inclusion in Diet of Lohman Brown hens.** Nur Izzah Mohd Hemly
0915 – 0930	*Scientific paper 7:* **Application of Organic Based Selenium and Vitamin E on Cecal Bacterial Population in Layer Chicken**. Norafiqah Najwa Zainudin

0930 - 0945	*Scientific paper 8:* **Knowledge and Attitude towards Dairy Cattle Udder Health Management among Veterinary-Related Personnel in Selangor, Malaysia** Faizatul Akmar Ahmad Kamshah
0945- 1000	*Scientific paper 9:* **Caprine mammary protease-activated receptor 2 expression with Staphylococcus aureus and MRSA based mastitis** Muhammad Zikree Sukiman
1000 - 1015	*Scientific paper 10:* **Evaluation of Point-of-Care Glucometers for Use in Goats** Nadiah Sakinah Muzaffar Shah
1015 - 1045	BREAK: poster session (online)

SCIENTIFIC SESSION 4 (RUMINANT INDUSTRY)	
CHAIRMAN: Dr. Noraini Binti Samat Deputy Director of Feed and Nutrition Programme Livestock Science Research Centre, MARDI	
1045 – 1115	PLENARY 9: **Crossbreeding is not a One Stop Solution for Livestock Sector with Diverse Production Systems: Case Studies in Indonesia** Dr. Nuzul Widyas Lecturer; Universitas Sebelas Maret, Indonesia
1115 – 1145	PLENARY 10: **Challenges and Opportunities of the Malaysian Ruminant Industry** Prof. Dr. Mohd Azam Khan Bin Goriman Khan Professor & Lecturer; Universiti Malaysia Kelantan (UMK), Malaysia
1145 – 1215	PLENARY 11: **Breeding problems in small ruminants** Dr. Saifullizam Bin Abd Kadir Director, Division of Genetics Development and Animal Husbandry Technology, Department of Veterinary Services, Malaysia

1215 – 1230	*Scientific paper 11:* **Multiple Anthelmintic Resistance Against Parasitic Gastroenteritis Among Naturally Infected Dorper Sheep Reared in a Semi-Intensive Farming System in Perlis** Noor Al Majidah Abd Majid
1230 – 1245	*Scientific paper 12:* **Molecular Detection of Haemoparasites Among Imported Thailand and Australian Brahman Cattle Reared in Perlis.** Muhammad Iqbal Ishak
1245 – 1300	CLOSING CEREMONY
1300 – 1400	BREAK: poster session (online)

FARMERS' BORAK SESSION	
Moderator: Prof. Dr. Abdul Razak Alimon & Dr Abu Hasan Muhammad Ali	
1400 - 1630	FARMERS' BORAK SESSION: **Cabaran & peluang semasa & selepas wabak Covid 19** a) Nasrullah Mujadidi, Rukambu Livestock b) Ts. Dr. Mazrul Fahmi Hj Mahadzir, MFM AGROVET c) Dr Noor Hisham Mohd Harun, Pengarah Bahagian, Bahagian Perancangan Strategik dan Penilaian Veterinar, Jabatan Perkhidmatan Veterinar (DVS) *d)* Zainudin bin Isa, Head of Animal Nutrition, FGV Integrated Farming Holdings Sdn Bhd

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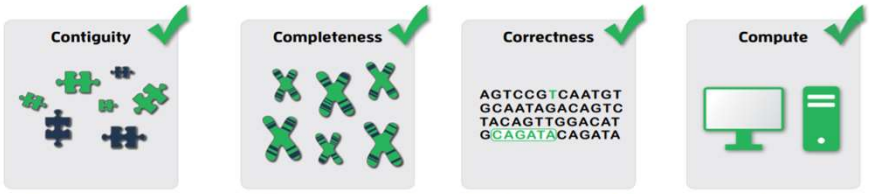




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LIVESTOCK INDUSTRIES SURVIVING THE COVID-19 PANDEMIC

LIVESTOCK INDUSTRIES: SURVIVING THE COVID-19 PANDEMIC

Proceedings of the 40th Malaysian Society of Animal Production Annual Conference 2021

3rd – 4th August 2021
Malaysia

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Organised by

The Malaysian Society of Animal Production

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PREFACE

The 40th MSAP Annual Conference with the theme 'Livestock Industries: Surviving the COVID-19 Pandemic' is held in the midst of immediate and immense challenges for nation's economy and community well-being due to the novel corona virus (COVID-19) pandemic.

Over the last few years, we have seen great changes in the livestock industry. However, since the end of 2019, a greater challenge came affecting the whole world including the food supply chain where no countries were spared and everyone is affected in one way or another. While governments give more focus on public health, social and economic sectors, the agriculture sector which is the backbone for food supply of a country must not be forgotten. The pandemic has disrupted normal ways of food production and dissemination causing farmers to face many challenges in marketing their produce and products. Uncertainties still cloud on the effects of the pandemic on the sustainability and growth of the livestock sector and the food supply chain in Malaysia in the future. With the implementation of the movement control order and stay-at-home policy, there is a sudden increase in demand for meal and groceries delivery services. Disruption of flow at any part of the supply chain will therefore have immediate impact both upstream and downstream of livestock production as well as other agriculture products.

Eminent researchers including from the neighbouring region, members of the academia, producers and policy implementors gathered at this conference are in cognizance of these issues and are well aware of the dire needs to address them. The Malaysian Society of Animal Production hoped that in this conference, invited speakers and participants will have fruitful discussions and idea exchange to overcome the challenges during this uncertain pandemic

This proceeding is a compilation of the scientific papers presented which includes 11 invited speakers from both local and international institution. Over 60 scientific papers were compiled covering topics ranging from challenges in livestock industry, policies, alternative medicine, animal feed, animal production, animal health and the livestock industry itself in general.

The success in publishing of this Proceeding is due to the hard working and dedication of the members of the Scientific Committee as well as the Organising Committee and this is gratefully acknowledged. It is hoped that the information contained herein will contribute towards the knowledge required to implement the activities towards enhancing and development of the Malaysian Livestock industry.

Editors
Scientific Committee of 40th MSAP Conference

SCIENTIFIC PAPERS

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12. Breeding Problems in Small Ruminants
    Saifullizam Abd Kadir

(KEYNOTE PAPER)

Challenges in The Livestock Industry During the COVID-19 Pandemic and Their Solutions

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The coronavirus disease 19 (COVID-19) pandemic is a global health crisis that is already having devastating impacts on the world economy. Since December 2019, it started from a single city then spread to 192 countries across the world and infected more than 181.2 million people by June 2021. The COVID-19 pandemic disease is caused by a coronavirus (CoV) named SARS-CoV-2. To date, findings from experimental infection studies show that poultry (turkey, duck and chicken), pig, rabbit and cattle are not susceptible to infection.

The impact of the Covid-19 pandemic on the food supply chain, and specifically livestock production was unexpected. Clusters of cases among workers in meat processing plants evolved quickly to affect human, animal, and environmental welfare in several countries. In processing plants, the hygiene focus is on product quality and food safety. The rapidly growing number of Covid-19 cases among workers in refinery and workplace-related clusters is very concerning. This is due to their work nature of high proximity and lack of physical distancing among these employees during working hours. Moreover, the lack of available sick leave and health insurance may have resulted in most of these infected workers continuing their presence at the workplace.

In the United States (U.S.) many processing plants shut down when they identified major outbreaks, putting pressure especially on pig and poultry industries. There was a 45% reduction in pig processing capacity meaning about 250,000 pigs per day were not slaughtered. This resulted in longer transport distances to plants in operation with extra capacity, but also causing overcrowding of animals in farms. Producers were encouraged to slow growth rates, but some had to cull animals on farms causing suffering to the animals and unhappiness to the owners and workers. Carcass disposal was also associated with potential biosecurity risks and detrimental effects on the environment (1). In Bangladesh, an estimated 0.3 million dairy farmers and 65-70 thousand poultry farms have been affected and many of them were forced to

closed down or halted production due to the burden of continuous losses. Reports showed that about 12-15 million liters of milk remained unsold that caused a daily loss of 6.7 million USD. The poultry sector also encountered a loss of 1.35 billion USD within two weeks (2). The closure of slaughterhouses and poultry processing plants also occurred in Malaysia as there were workers who had been infected by the Covid-19 virus. Screening tests on workers and sanitation to the processing plants and slaughterhouses have been conducted to ensure that the pandemic can be controlled. This situation causes a decrease in production, processing, distribution and marketing potential.

The livestock commodity industry in Malaysia for the year 2020 is worth RM 22,957.42 million when compared to 2019 worth RM 24,280.19, a decrease of 5.76%. The livestock production in 2020 decreased by 2.73% compared to 2019 as shown in Table 1. The production of livestock commodities involved was beef (1.22%), mutton (4.33%), pork (0.66%), chicken (3.62%) and skin (2.77%). While other commodities showed an increase such as chicken/duck eggs (18.03%) and fresh milk (6.26%) (4).

Table 1. Output of Livestock Products by Commodity, Malaysia, 2014-2020[p]

Comodity	2014	2015	2016	2017	2018	2019	2020[p]
Beef (m.tonne)	52,857.00	50,493.10	47,956.00	46,333.10	46,923.60	44,024.40	43,492.40
Mutton (m.tonne)	4,542.90	4,406.70	4,991.60	4,400.10	4,433.70	4,200.60	4,026.40
Pork (m.tonne)	217,558.20	222,597.50	195,175.60	218,177.20	223,862.00	222,791.10	221,324.50
Chicken ('000 m.tonne)	1,584.10	1,633.40	1,755.20	1,664.90	1,653.70	1,655.30	1,597.50
Eggs (m.tonne)	727.6	795.9	842.5	865	824.2	677	825.9
Fresh milk (million L)	34.1	36.5	36.7	36.6	38.5	40.6	43.3

[p] – provisional

During the COVID-19 pandemic, Malaysia continued to export mainly eggs and poultry, especially to Singapore. But since then, there has been a relatively high increase in food costs of almost 20% which has caused farmers to be squeezed by high operating costs. Also with the Movement Control Order (MCO) in place, the premises and canteens could not be fully operational causing the demand for chicken and eggs to decline and causing losses to industry players. Limits on the mobility of people across borders and lockdowns are contributing to labor shortages for the livestock sector. Services that are limited to 50 or 60% based on lockdown standard operating procedure (SOP) make it difficult for industry players to transport their livestock for slaughter and distribution. Limits on individual mobility are also affecting the provision of key food safety, quality and certification checks, including those that are required to facilitate trade, such as physical inspections of goods to certify compliance with

sanitary and phytosanitary requirements (SPS) (3). Furthermore, during this pandemic, there was a decrease in governmental capacities to prevent, control and treat animal diseases such as foot and mouth disease (FMD), lumpy skin disease (LSD) and other infectious animal diseases by following the minimal staff operating capacity under the stated SOP.

Thus, to address the issue of movement restrictions for livestock industry players, the capacity of workers has been increased from 50-60% to 100% to ensure that slaughtering activities in slaughterhouses and poultry processing plants can function optimally to ensure an adequate supply of meat and eggs for the people. DVS has also issued a letter of endorsement to make it easier for farmers to ensure that livestock and livestock products can be marketed, including all activities involved in the food chain. Other proposed solutions include a proposal to allocate 10% out of the export market for Palm Kernel Expeller (PKE) and/or Palm Kernel Cake (PKC) for domestic consumption to reduce the feed cost burden in the ruminant sector. Prioritize COVID-19 vaccination to all workers in the livestock industry and government employees to ensure there is no existence of pandemic clusters among them, thus ensuring the minimum effect of the pandemic and ensuring the industry can operate optimally and fluent veterinary services can be provided to the stake holders of the livestock industry.

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The Impact of COVID-19 on the Malaysian Livestock Sector

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Malaysia has achieved impressive economic growth over the past four decades which makes it the third-largest economy in South East Asia, behind Indonesia and Thailand in 2018 (Statisticstimes, 2019). Currently, an upper-middle-income country like Malaysia is attempting to achieve a nation's high-income status by 2024 (Aziz, 2019). Since independence, Malaysia has pursued various economic reforms and has transitioned through phases which can be grouped into three broad economic areas, which are: agricultural (1960-1974); industrial (1975-1999), and urbanization (2000 – present) (Olaniyi *et al*., 2013). Particularly, during the urbanization era, the services sector (estimated at 55% of GDP-Gross Domestic Product) and manufacturing sector (estimated at 37% of GDP) have increasingly spearheaded the country's economic growth, while the agricultural sector's contribution has declined from around 43.7% of GDP in 1960 to 1990 and further down to 8.4% in 2020 (Rozhan, 2015)

The agricultural sector remains an essential part of the economy, employing nearly 11% of the 14.94 million people for the labor force (Izad, 2012). In addition, 65% of the agricultural sector GDP comes from international trade, especially in palm oil, rubber, and timber. On the other hand, the country also relies on imports of key products including wheat, rice, dairy products, and more. In 2017, agricultural products contributed 13.5% of the total export and 10.4% of imports (Rozhan, 2019). Thailand, Indonesia, and China are currently Malaysia's top trading partners for agricultural products (International Trade Administration, 2020). Nevertheless, the goal of economic development towards a high-income developed country appears to be affected due to the COVID-19 pandemic that hit Malaysia and the rest of the world starting in early 2020.

As of 15 November 2020, there have been 47,417 confirmed cases of COVID-19 in Malaysia since the country was hit by a pandemic in January 2020. On 6th November 2020, Malaysia recorded 1,755 new cases which is the highest single-day report of confirmed cases

since the beginning of the outbreak (WHO, 2020). In response to that, Malaysia has implemented several measures to contain the COVID-19 outbreak. Proclamation of Emergency was declared on 12 January 2021 intended as a proactive measure in preventing the spread of COVID-19 in the country. Besides, A Movement Control Order (MCO) was put in place in March 2020 by the government as a preventive action, forcing schools and non-essential businesses to close, banning interstate travel, and introducing curfews. Following a drop in infections, restrictions were gradually eased as Malaysia entered a Conditional MCO (CMCO) phase in May. In June, the government announced a Recovery MCO (RMCO) allowing almost all activities to resume and businesses to reopen, after which cases again surged and new restrictions were set in place. After that, with daily cases currently rising again since early October, Kuala Lumpur, Putrajaya, and Selangor, as well as Labuan and Sabah state have been placed under CMCO's, while MCOs have been implemented in other severely affected areas (WHO 2020, Martinus 2020).

The agriculture industry was classified as critical by the government during the application of the MCO, allowing businesses to operate as usual. Nevertheless, food production and distribution have been disrupted due to the limited supply of raw materials and inputs, shortages in labor, and market access, hindrances in global supply chains and exports, as well as decreasing bulk demand from the hospitality and tourism sector (Shaharudin 2020, and Vaghefi 2020). At the same time, food prices have risen due to the unpredictable market and changes in consumer patterns (Abdullah *et al*., 2020). The transportation restrictions have slowed down the agricultural services and hampered farmers from selling their products or buying the agricultural inputs. This has resulted from the losses and/or decline of production and consequently affected farmers' income. At the same time, post-harvest loss incidents and food waste were become more frequent, while consumers have been facing difficulties in assessing enough food to meet their daily dietary needs (Abdullah *et al*., 2020; Veghefi, 2020). The nation's agriculture sector depends on foreign workers to a large extent, and with movement restrictions took place, labor shortages have been felt along entire value chains, impacting food availability as well as market prices (Vaghefi, 2020).

Because of the lockdowns, cooking at home is more preference among households and this has led to a change in consumer behavior as demand for fresh food items at local markets and supermarkets has been increased (Abdullah *et al,* 2020). Moreover, the pandemic has led to changes in consumer behavior and purchasing modalities, with the MCO resulting in increased purchases of staple and ready-to-eat food, and also increased online groceries shopping, increased home deliveries, and cooking at home (Abdullah *et al*., 2020; Veghefi,

2020). In reality, Malaysia, still depends heavily on food imports, despite having achieved a satisfactory level of food security by international standards. Domestic food production as the present is insufficient to meet the domestic demand whereby the population's keep growing. When time passed by, the low prices of food imports have led Malaysian farmers to switch to grow cash crops instead of food crops. As foreign transportation has been disrupted that caused to increase food import prices, there is much work still needed to achieve a stable food supply and to ensure resilience against future threats (Abdullah *et al*., 2020).

Observations of the macro situation in the livestock industry provide only indications of insignificant changes before and during the COVID-19 pandemic. This situation may be due to limited official up-to-date data for the last 2 years. Nevertheless, some indicators of the demand and supply situation of some major livestock commodities can be explained. Fig 1. for example shows that the gap between production and consumption for all commodities still generally showed the same situation before and during the pandemic. The production and consumption pattern during the pandemic, in most of the livestock sector, shows a normal trend except for poultry meat and chicken egg. The poultry meat sector shows a decreasing trend in production due to some restrictions during the pandemic. Meanwhile, the consumption of poultry meat also shows a declining trend as well. The possible reason as reported in news was the rising prices of poultry meat at the retail price. However, the production and consumption of chicken/duck eggs show a slightly increasing trend during the pandemic.

MARDI in collaboration with the Ministry of Agriculture and Food Industry (MAFI) has conducted an online study during the implementation of MCO 1.0 in which the aim was to determine the socio-economic situation of livestock farmers during the COVID-19 pandemic. Figure 2 below shows that the COVID-19 effect on livestock farmers. Of all of the livestock farmers surveyed, 90% of them have recorded effected on their income from farming activities. In addition, more than 70% of livestock farmers have been facing difficulties in getting farm sources of materials/input as well as a few distractions in business relationships due to movement restrictions implemented by the government. Figure 3 below shows that livestock production by state. More than 30% of livestock farmers in Perlis, Kedah, Selangor, Kelantan, Terengganu, Pahang, Sabah, and Sarawak have temporarily stopped their operation due to the COVID-19 pandemic.

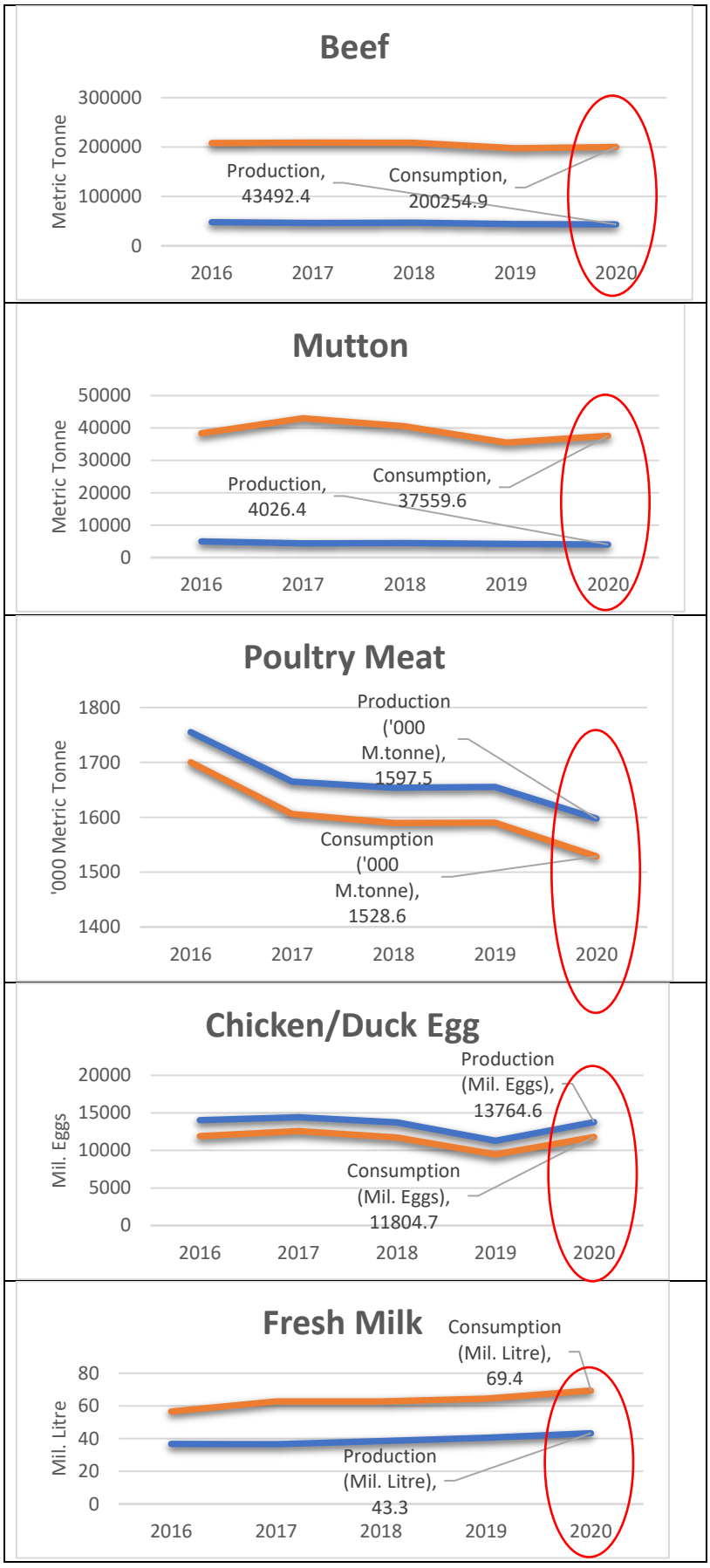


Figure 1: Production and consumption trend among selected livestock sectors in Malaysia

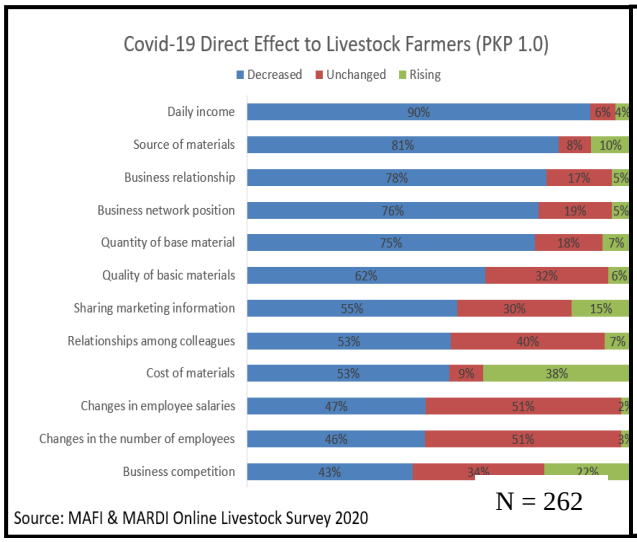


Figure 2: Covid-19 effect on livestock farmers

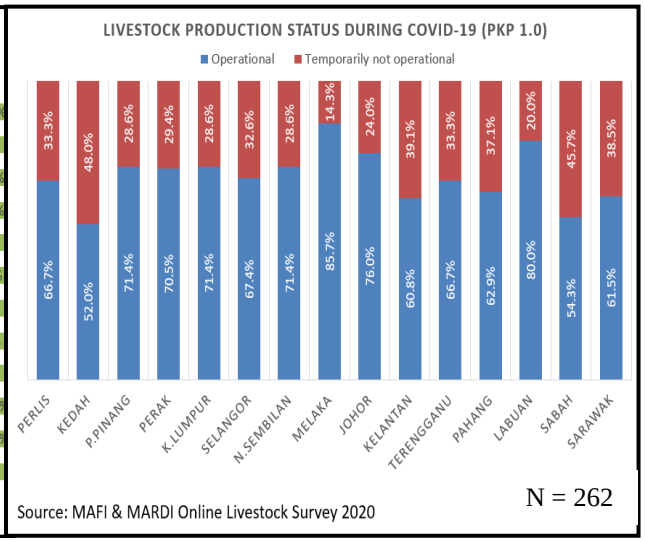


Figure 3: Livestock production during Covid-19

Sales of livestock production are one of the major indicators in farm business sustainability. Figure 4 below shows that the sales by livestock farmers by state. Penang state has shown increasing sales (50%), followed by Negeri Sembilan (18%) and Kelantan (15%). Meanwhile, most of the state has shown decreasing in sales on average 49.8% during the pandemic. One of the reasons livestock farmers having decreasing sales was restrictions in logistics and they have to learn new platforms for the selling process. Figure 5 below shows the method of livestock sales practices by livestock farmers. The result shows that 71% of livestock farmers have to use an E-commerce platform due to restrictions on movement by the government during the pandemic, otherwise the rest of livestock farmers remains on the conventional sales system.

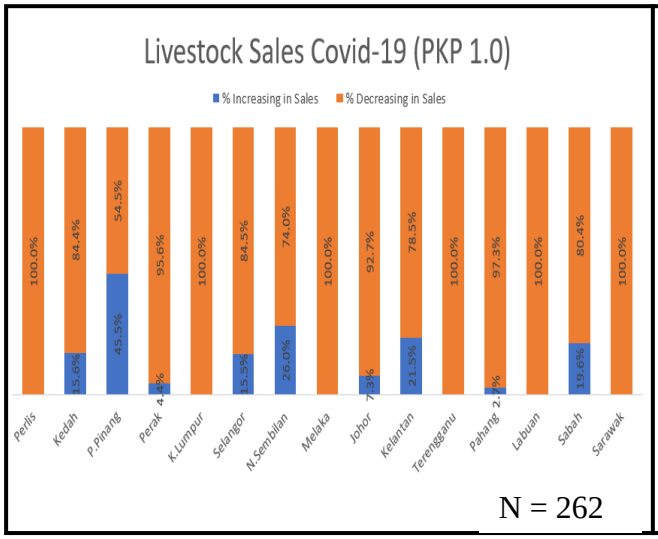


Figure 4: Livestock sales by state

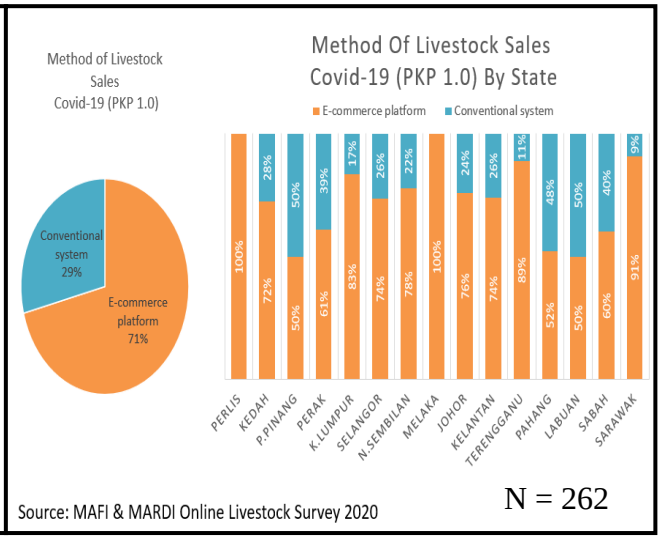


Figure 5: Method of livestock sales by state

Figure 6 below shows the livestock farmer's perception of the impact of COVID-19 on their farm business. The result shows more than 50% of livestock farmers feeling that it's the hardest moment they have to face in terms of the ability to earn income, selling livestock products, ability to carry out animal husbandry, and difficulty to obtain permission to cross state borders to get livestock input.

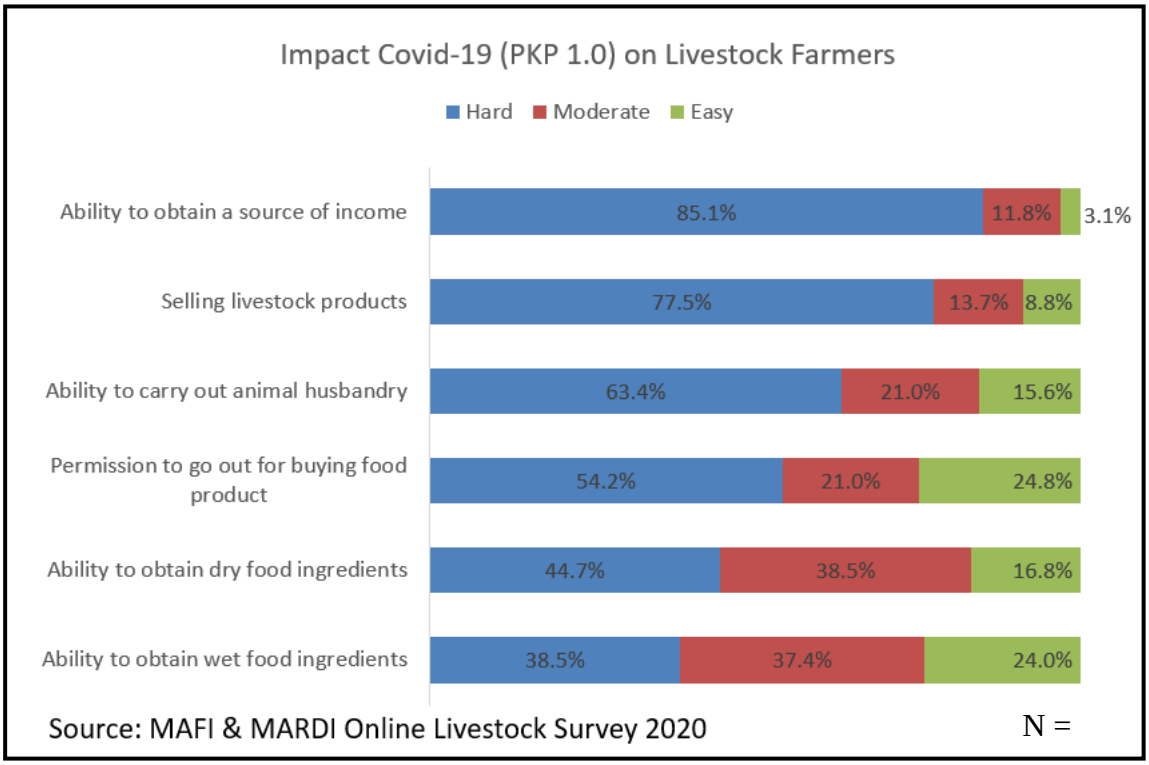


Figure 6: Impact COVID-19 on livestock farmers

The COVID-19 pandemic continues to threaten lives, health, livelihood, and well-being worldwide. In Malaysia, the livestock sector needs to be given attention during the crisis to ensure food security and protect livestock farmer's livelihood. The MCO has been the main issue that is affecting livestock supply to all areas. On the other hand, the government has introduced various initiatives to assist affected people. Some measurements initiated by the government in terms of financial assistance to the livestock farmers are to ensure they have enough cash flows running their businesses. Therefore, the livestock farmers are encouraged to continue using the digital platform as a new marketing device for them. Nevertheless, government investments to facilitate online marketing need to be conducted with caution. This is because there are also views from livestock farmers (30%) who say they will revert to conventional methods when the pandemic situation recovers.

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Marketing Strategy / Supply Chain Management During the Pandemic

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----------Abstract Not available----------

Animal Tourism in the Post COVID-19: The Need for Paradigm Change

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Abstract

Early 2020 marked the dramatic changes in the tourism sector as a result of the spread of the COVID-19. Tourism was the first sector to be badly affected and the World Tourism Organization projects that this sector will only be fully recovered by the 2024 or perhaps by 2025. The impacts have been phenomenal and unprecedented. Industries within tourism have been severely impacted due lockdowns and the ban on cross border travels as well as interstate movements. While most news focus on the closure of hotels and resorts, airlines going red, travel agencies had to close down, loss in jobs among tourism related works, and others, the impacts on the niche market segments such as animal tourism have been very much ignored. The COVID-19 had brought about many challenges to tourism but at the same time has also presented a window of opportunities for paradigm change on the way we manage animal tourism.

The Effect of COVID-19 Pandemic on Beef Cattle Industry in Thailand

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Abstract

COVID-19 pandemic has hit the world badly, including Thailand affecting the lives and livelihoods of the people. Mitigating the impact of COVID-19 epidemic on agriculture, including beef cattle production, is essential to maintain a sustainable food production for the nation and the livelihood of the farmers. Beef cattle farming plays an important role in all provinces across Thailand, representing an annual national turnover of at least 20,000 million baht (approximately US$ 645 million) and with the potential to be developed into a main occupation sector generating income for nearly 1.2 million farms in Thailand. In year 2021, Thailand has about 7.66 million beef cattle, making up of 2.37 million cows producing 1.40 million calves of which 1.06 million heads are slaughtered annually. Before the COVID-19 pandemic, Thailand has put in place a national strategy for the development of beef cattle with the aim of exporting to the neighboring ASEAN countries. It is estimated that Thai beef cattle industry has a market value of 41,810 million baht (US$ 1,350 million). Following the outbreak of COVID-19 in Thailand (January 2020), the national priority was to balance between saving of lives and livelihoods of its people which led to a lockdown in some affected areas. The total number of people infected with COVID-19 (up to July 27, 2021) has reached 497,965. The population of beef cattle before the pandemic (2019) was 5,824,270 heads and based on the latest statistic it has increased to 7,662,210 heads because of increasing market demand and governmental policy to promote beef cattle farming. In the short-term, COVID-19 pandemic has little effect on beef production in Thailand because beef cattle are mainly raised by small farmers in the rural areas which are not affected much by the pandemic outbreak. However, in medium- and in the long-term, meat retailing shops and restaurants need to adjust their business models, including to deliver the meat and meat-products directly to the consumer's home as the purchasing habits changed as the result of the pandemic. Large-scale livestock farming, including beef cattle farms required large number of laborers whom are largely made up of

immigrants from the neighboring countries. Many of them returned to their respective countries because of the pandemic leading to a shortage of labors in some of the large beef farms. At the same time, however, many local population lost their jobs from the manufacturing sectors in and around the cities because of the pandemic lockdown. Some of the above unemployed factory workers returned to their villages to work in the agricultural sector, including working in the cattle farms. Overall, Covid-19 pandemic has little effect on the beef cattle industry in Thailand for now, however, the long-term effects will depending on the recovery of the pandemic.

Introduction

The Covid-19 pandemic negatively influences animal production through reducing access to animal movement and production inputs' availability (Nesrein et al., 2020) such as feeds, farm management input and services as well as markets and consumers. Animal production activity, including feeding, management and disease control, have been adversely affected as a result of lockdown due to the Covid -19 pandemic (Frederick et al., 2021). It also reduced animal processing capacity and compromised storage ability which in turn disrupted the supply chain (Muawuz et al., 2021). The socio-economic status and purchasing trends of many consumers were also affected, the market for livestock products also changed causing chaos with over supply and increased food loss and waste. All the above adversities are observed in all, particularly the low and medium income countries including Thailand. The lessons for livestock sector to learn to improve its resilience and be more sustainable in the future are importance. This presentation intends to share Thailand's experience on the impact of COVID-19 to the beef cattle industry and to exchange practical knowledge to enable producers to overcome challenges during this pandemic period and to develop long-term strategies for a more sustainable beef cattle industry in the future.

Status of beef cattle farming in Thailand

13 million out of the total 66 million population in Thailand are involved in farming, with the pig and poultry industries are operated by large business corporations while the ruminant sector is distributed among approximately 1.2 million smallholder farmers. Today (2021) the total population of beef cattle in Thailand is 7.66 million heads, making up less than 1% of the global 990 million beef cattle. The major beef cattle countries are India (300 million), Brazil (220 million), China (100 million), and the United States (92 million). Thailand has about

2.37 million breeder-cows producing about 1.4 million calves per year and a slaughtering rate of about 2,900 heads / day or 1.06 million heads / year. In the past, beef cattle in Thailand was dominantly native cattle but has now developed to mostly of European and Brahman crossbreds.

COVID 19 and its effects on Thailand's economy

The sequence of spread of Covid-19 in Thailand can be summarized as the following there were 3 periods:

1. As on 13 January, 2020, Thailand being the first country to have a confirmed case of COVID-19 outside of China. It was detected through the screening of immigrants with initially a few cases but the number of cases then rose sharply in mid-March 2020, with the largest cluster emerged from a Thai boxing match at the Lumpinee Stadium in Bangkok.

2. Later, a new outbreak was found in the fish market in Samut Sakhon province, around the middle of December 2020, suspected of coming from foreign workers native to the neighboring countries. This led to a 20% increase in the number of infections in the country by the end of December led to an immediate closure of the businesses in Bangkok was enforced, causing tens of thousands of workers to return to their homelands.

3. In April 2021, a new outbreak cluster was found from an entertainment center in Bangkok and other venues including Prison. This led to another lockdown in the hotspot areas of Bangkok and in other provinces, and an emergency was declared. In brief, the number of people infected with COVID-19 through July 27, 2021 has reached 497,965 in Thailand (Department of Disease Control, 2021).

The GDP of Thailand was growing on average of 2.5% annually, but with the pandemic there was negative growth with a drop of 5-6%. However, the livestock sector grew by 2.7% due to increased production volume to support the market demand both domestically and internationally. The most adversely affected business is tourism – a main income earner of Thailand. The problem has spread to hotels, restaurants and other businesses decreased by 40% and more. About half of the 10 million people working in the tourism business may have lost their jobs leading to a loss in purchasing power of consumers affecting other businesses.

Effect of COVID-19 pandemic on beef cattle industry in Thailand

Beef cattle production is dispersed in all regions of the country, with an economic turnover of not less than 20,000 million baht (US$ 645 million) per year. It provides opportunities to develop into a main occupation, generate income for farmers and strengthen

the national economy, and be a base of inclusive and competitive growth in Thailand. However, changes in this enterprise were evident from the impacts of the Covid-19 pandemic. Before the pandemic, Thailand had put in place an important strategy for the development of beef cattle production, including the use of agricultural by-products that can be used as cattle feed. The goal was set to produce beef cattle for export to the ASEAN countries. The strategy also include enhancing the quality of farming standards, and with slaughterhouses to meet the safety standards required for international export.

Thai beef cattle industry has a potential market value of 41,810 million baht (US $1,348 million), which include export of live beef cattle valued at 5,250 million baht (US $170 million) annually. Covid-19 pandemic period, beef cattle exports continued, below are some of the key changes in beef cattle production before and after the pandemic.

1. From year 2018 to 2019, Thailand imported about 120,000 live cattle per year (US$ 55.55 million per year) and 9,000,000 kg of beef and beef product with an average value of US$ 104.38 million per year. Exports included 200,000 live cattle per year, valued at US$ 188 million, beef 122,000 kg and products 1,500,000 kg valued at US$ 1.39 million. However, in year 2020, import of live cattle dropped to about 62,605 heads (about US$ 36.91 million), but for beef and beef product increased to 19,505,933 kg a value of US$ 130.21 million. Similarly exports of live cattle dropped to US$ 174 million and beef and products declined to US$ 1.06 million (Table 1; Office of Agricultural Economics, 2021).

Table 1 International trading of beef cattle in Thailand as affected by COVID19 pandemic

Description	Average year 2018-2019	2020	2021(Jan.-May)
Imports			
Live cattle (million US$/year)	55.55	36.91	4.04
Meat and products (million US$/year)	104.38	130.21	69.22
Export			
Live cattle (million US$/year)	188	174	57.75
Meat and products (million US$/year)	1.39	1.06	0.27

Source: Office of Agricultural Economics (2021).

2. The number of beef cattle in 2019 (before the pandemic) was 5,824,270 heads, and after the pandemic (2021) increased to 7,662,210 (Department of Livestock Development, 2021). The increase in number of cattle was caused by government promotion program and the unemployed workers returned home to raise more cattle.

3. The Covid-19 crisis has led to an improvement in overall farm management through tighter controls on people entering and leaving the farm. However, smallholder farms are scattered all over the countryside and have no effect on cattle raising practices.

4. There is an overall marginal decline in farm income of farmers and slowdown in farm activities and reducing of farm workers including reluctant in accepting students to train in the farms. To raise the level of prevention of Covid-19 in personnel working within the farm- has a high cost burden.

5. Animal feed raw materials are more expensive. This comes from many factors, both the drought conditions of countries that affect soybean and cassava production. Some agricultural products are subsidized by the government but transportation is more inconvenient than before the pandemic.

6. Covid-19 has also made it more difficult for veterinary officers to help with animal health issues. Veterinarians find it more difficult to access farms and provide services to farmers, including training, knowledge promotion, and pharmaceutical and animal health services, or artificial insemination. The impacts of promotion and training in raising and management were reduced by more than 30%. Guidelines were set for building strong groups with local leaders. Social media, Line and FaceBook are used to spread information, while social distancing is observed.

7. In the marketing of live cattle, the export market seems to have no problem, even though the border checkpoints are closed, but there are shipments to China, Laos, and Vietnam. The local market system with middlemen has been adjusted to groups and cooperatives but most farmers are looking for new business models such as cooperatives butcher shops. They are members who raise cattle for meat production.

8. People are buying more meat to cook at home as most restaurants are closed with fresh meat in market and shopping centers are selling well but more preferred pork or other cheaper meat than beef. In the short term, overall sale of meat decreased by 50%. In the medium term, meat shop entrepreneurs and restaurants have to adjust the business to bring the meat to the consumer's home as the consumption habits change.

9. Effects on government policies to mitigate Covid-19 crisis has created many new opportunities. As many have lost their jobs due to closure of factories, they returned home to be farmers growing vegetables and animals including beef cattle. People consumed more local products. The use of online technology for wholesale direct to home consumers has emerged.

Ways forward.

- To increase the number of beef cattle to 8.8 million and to increase production levels by increasing carcass weight by 10% over the next 5 years through breeding, feeding and management to mitigate the effects of Covid-19 pandemic. Increase forage crops and by-products as a feed sources, intensive farm agriculture and set up a community feed center.
- 2,000 million baht (US$ 64.5 million) has been financed to support the project by the government through the Bank for Agriculture and Cooperatives. Building consumer confidence in meat safety to food safety from farm raising to slaughterhouses using traceability technology (Traceability), registration, having cattle numbers (National Livestock Identification and Registration System, NID), including vaccination database.

- Fixing the problems with import of illegal meat is associated with contagion problems. Develop personnel throughout the production chain. Create food service entrepreneurs and related businesses, developing functional foods from cattle meat.
- Build a strong farmer group in the community such as farmer cooperatives to help each other.

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Alternative Animal Feed Additives to Substitute Antimicrobial Growth Promoter in Animal Feeding

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Abstract

The poultry and livestock industry is a globalised industry, and poultry is one of the fastest-growing sectors in Malaysia. Even though our self-sufficiency level (SSL) is high for poultry and swine production, there is a need for us to be able to meet the increasing meat demands, not just locally but also at the international market. Animal feedstuffs and feed additives, which are imported mainly, are getting costlier by the day, resulting in a higher cost of production. This is a significant setback for our local animal production industry. This has prompted animal scientists to seek alternatives to formulate a more cost-effective feed that can meet the minimum nutrient requirements of animals without compromising the quality of the output. The focus has been given to postbiotic metabolites produced from lactic acid bacteria (LAB) and other additives such as prebiotic, probiotic, organic acids and phytogenic compound due to various factors such as food safety reasons. Locally available agricultural waste which is produced abundantly by our agriculture sector such as palm kernel cake is essential in our research as feedstuff in animal feeding. The mechanisms of action of postbiotic metabolites and their importance are discussed herein. Today's lecture covers the need for constant research in this area and to explore newer approaches for animal production. On the application aspect, this lecture is hoped to provide important information on prospects of environmental friendly feed additive and precision in feed formulation.

Frontiers in Precision Sustainable Aquaculture Using Advanced Genomics and Biotechnology

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Abstract

Aquaculture is the next frontier in all areas for economy growth in which this sector will fill the void of poverty reduction, sustaining livelihood of people and creates new jobs for future generation. Blue ocean strategy which incorporates IR 4.0, industry based on fundamental science, applied and innovation which then give aquaculture a new brand creation. There-fore in this study, question arises how will advanced genomics and biotechnology pave way to contribute in its way to provide a solution to tackle problems that arise in aquaculture expansion. Problems such as domestication and seed supply, genetic trait improvement, that involves molecular markers used to aid in breeding, genomics aided by bioinformatics will help to perform mining of functional important use in sustainable aquaculture and advanced biotechnology tools which can be used in advancing the aquaculture. In order for one to push its potential to be a fast growing sector as economic growth for Malaysia, we will also discuss the potential of genetics, genomics and biotechnology application in ensuring sustainability and directed to precision approach for sustainable aquaculture and ensuring steady growth in aquaculture viewed as Blue economy with successful case studies in Malaysia such as single crop and multitrophic aquaculture that fits into sustainable value chain analysis and may have a indirect effect on poverty reduction.

Keywords: Precision aquaculture, genomics and biotechnology, innovation and sustainability

Evolution of Poultry Diseases, Vaccines and Vaccine Delivery Technology in the Coming Decade

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Abstract

The history of vaccination in poultry started more than 100 years ago with the wide use of live vaccines and subsequent development of inactivated vaccines. The innovation of live vaccine development begins when the industry shifted from mainly focusing on efficacy of vaccines to a safer vaccine and a vaccine which is not dependent on cold chain delivery in the early 1990's. Subsequently, other innovations such as reverse genetics & immune complex have been widely used in early 2000's. The development of vector vaccines begins in the late 2000's and prosper in early 2010's. Most widely used vectors such as Herpesvirus of Turkey, Fowl Pox and Adenovirus were well accepted by the industry. Several important poultry diseases was incorporated into these vectors for the past 10 years namely Newcastle Diseases, Infectious Bursal Diseases, Infectious Laryngotracheitis and Avian Influenza. It begins with donor genes from one disease incorporated into a vector while now we are seeing more commonly a vector carrying two entirely different diseases in the industry. Besides the advancement in vector technology, the industry has seen the increase in emerging diseases where autogenous vaccines is required to combat niche diseases. In Malaysia, Autogenous vaccins played a crucial role in controlling Low Pathogenic Avian Influenza H9 and Inclusion Body Hepatitis Outbreak before it went out of control. One of the breakthroughs in this industry is in-ovo vaccination which vaccinate the embryo at 18.5 days of embryonic age before they are hatched. This technology induces early immunity while minimizing the human error factor compared to the traditional injections. In-ovo vaccination provides many solutions to the problems faced in the midst of Covid-19 Pandemic and severe shortage of labour. Agility in adopting transformation in the healthcare of poultry industry is seemed to be the make-or-break factor in ensuring sustainability in the business.

New Developments in Forage Crops Production for Ruminants in Thailand

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Abstract

Bureau of Animal Nutrition Development, Department of Livestock Development or DLD is a main unit that responsible for forage crop production development in Thailand and there are many animal feed research and development centers across a country. In 2021, a project "Increasing a production efficiency to farmers in suitable area in 2021" is doing that includes two objectives that are first is to establish 850 beef cattle farm prototypes for feeding management in 56 provinces and second is to promote the cultivation of forage crops to raise cattle, reduce risks, increase income, increase production efficiency, and create a stable career for farmers. However, other activities of the center or other university staffs are to do research and develop new way to increase animal farm production from forage and pasture management. Basically, forage crop productions managements for ruminant animal such as direct cutting or cut and carry system, forage preservation as silage and hay have been recommended to farmers for a long time by government and researchers. Therefore, in this paper, some recent developments by scientific research for forage crops production in Thailand will be reviewed. Development of forage crop production in Thailand were regularly occurred by researching processes, such as finding new or promising forage cultivar, agricultural practices or new techniques that help farmers easily to manage their crop production. Further studies will focus on breeding program on tropical forages to tolerant to drought/harsh environment resulted from rising of global warming condition.

Biomass Yield Management

Agricultural practices increase forage crops production. Cultivars, fertilizer application, defoliation, etc. are all important factors affecting crop yields.

1. Selection new/promising cultivars. Selection of forage crops produced high yield per area, high nutritive value, and can adapt to various conditions are important. In Thailand, there are many promising species of forage such as *Pennisetum purpureum*, *Brachiaria ruziziensis*,

Stylosanthese spp., *Panicum maximum*, and so on. Napier Grass (*P. purpureum*) is a promising forage crop in southeast Asian countries because this region has a high annual rainfall and the temperature suitable for its growth. In Thailand, napier grass planting, supported by government, began by using fresh herbages for the cut and carry system across the country. Nowadays, many varieties/cultivars which are imported from other countries are studied by universities and government organizations for many purposes such as silage making, animal grazing and bioenergy crop producing. Thus, napier grass production in Thailand can be grouped into roughly three systems/aims. Firstly, planting for the cut and carry system and silage ensiling. An appropriate age for the cut and carry system is about 30-45 days and 45-60 days for ensiling. Thai farmers use this way to produce fresh herbage and silage for livestock in their farms. Secondly, aiming for the grazing system. Ideal characteristics of napier grass that are suitable for grazing should be leafy, tolerant to animal grazing and drought, and also has a high level of crude protein content. In Thailand, Mott and Muaklek are two cultivars that matched this aspect. Suitable plant spacing for grazing is 75x75 cm, first grazing after grass well-established should be at 60 days and utilized every 30-45 days with rotational grazing system. Lastly, planting napier grass as an energy crop. Napier Grass can be used as a bioenergy crop in both tall and dwarf-type cultivars in many processes such as gasification, direct combustion, and fermentation. Harvesting at four times a year would get the highest dry matter yields in the range of 46.3-58.4 t/ha/yr with a high level of energy production. Bana, Common and Tifton as well as Wruk wona are promising cultivars. A plant spacing is 75x75 cm is the best with highest dry matter yield. Agricultural practices to produce biomass crops are the same as all previous systems (Rengsirikul et al., 2011). Since 2011, *P. purpureum* cv. Pak Chong 1 has been a new cultivar of napier grass researched by the Animal Feed Development Center, Pak Chong District, Nakhon Ratchasima Province of the Department of Livestock Development. By mixing napier grass from Austria and Netherlands with Thai grass. Therefore, it became a fast-growing grass species with weather resistance, growing well and high in protein content for feeding ruminants. Currently, the species has been cultivated in every Feed Development Center and promoted to dairy farmers. It was later developed by silage making experiments which produced high methane gas comparable to energy crops such as sugarcane. But the cost of cultivation is lower because it is planted only once but can be harvested 5-6 times/year and it is easy to reproduce.

Donsawai et al. (2017) studied the effect of rootstock age to forage yield of napier Pak Chong1 (*Pennisetum purpureum* x *Pennisetum glaucum* Pakchong1). Three rootstock ages of 2, 3, and 4 months were planted in a randomized complete block design with 4 replicates during

January 2013 to July 2015 with the precipitation of 988, 1164 and 1252 mm. respectively. The results revealed that the percentages at 7 days of Pak Chong 1 canes with the ages of 2, 3 and 4 months were 68.4, 32.7 and 34.2, respectively, and the remaining canes of all ages germinated within 14 days. The remaining forage yield after cutting for canes with the ages of 2, 3 and 4 months were not significantly different, with DMY of 12.27, 11.72 and 11.26 t/ha/yr, respectively. Whereas their crude protein contents were significantly different, with the percentage of 11.2, 9.8 and 7.3, respectively. The total forage yield of 2 years among these 3 treatments were not significantly different, with dry matter yield of 39.13, 39.16 and 39.11 t/ha. In forage legume, *Leucaena leucocephala* and *Stylosanthese* sp. are popular among ruminant farmers. During 2011-2014, effects of plant spacing (PS) on yield and quality of seed of *L. leucocephala*. subsp. Glabrata was studied. Treatments were 4 different PS (between plant x between row), including 1 x 2, 2 x 2, 2 x 4 and 4 x 4 m (plant densities were 5000, 2500, 1250 and 625 plants/ha, respectively). The experiment lasted 2 years. Results showed that in the first year, seed yields of Leucaena with the PS of 1 x 2 m were 2.28 t/ha not different ($p>0.05$) from that with the PS of 2 x 2 meters at 2.01 t/ha but higher than ($p<0.05$) those with the PS of 2 x 4 at 1.32 t/ha and 4 x 4 m at 0.83 t/ha. In the second year, there were no significant differences among treatments for seed yields ($p>0.05$) with an overall average of 0.57 t/ha. The effects of PS on seed purity, seed germination percentage, and 1,000-seed weights did not differ among treatments. The recommended PS for growing leucaena to produce seeds was at 1 x 2 m. However, regarding seed yields and quality in the second year, the PS did not show significant effects (Juntipbadee et al., 2017). A study about *Stylosanthese* sp. was conducted to investigate the influence of plant density on seed yield and seed quality of *S. guianensis* CIAT 184. Five levels of plant density, 6250, 5625, 5000, 4375 and 3750 plants/ha were used. Plant density affected the canopy width of the plant ($P<0.05$) and seed yield ($P<0.01$), but did not affect the plant height, seed moisture content, seed yield/plant, pure seed yield per plant, thousand seed weight, and seed quality. The canopy width of the plant was highest ($P<0.05$) at the plant density level at 4375 plants/ha. Seed yield i.e., seed yield/ha, and pure seed yield/ha were highly significant differences at the plant density level at 5625 plants/ha, there were 0.77 and 0.76 t/ha, respectively. The plant density at 5625 plants/ha was the optimum level which affected the highest seed yield per area. (Kaeokliang et al., 2018)

2. Fertilizer application. Appropriate management of nitrogen fertilizer will affect the efficiency of nitrogen use of pasture grass. For a decade, Thai researchers have conducted research projects relevant to an optimum application of fertilizer (chemical and non-chemical) for forage crops, because the tropical soil fertility is changing all the time and affects biomass

yield. Jehmad et al., (2019) compared nitrogen fertilizer managements on yield and nitrogen use efficiency of Pak Chong 1 grass. Application of fertilizer according to soil analysis gave yield higher than the application rate based on DLD recommendation. Nitrogen fertilizer applied in a form of urea, ammonium sulphate and cattle manure significantly affected on DMY, nitrogen uptake and nitrogen use efficiency. While phosphorus fertilizer is essential for leguminous species. Klum-em et al. (2018) found that the average DMY of *L. leucocephala* subsp. Glabrata 34/92 was significantly increased under 62.5, 125 and 187.5 kg P_2O_5/ha/year at application rates 25.01, 24.66, 25.12 t/ha/year, respectively compared with non-phosphorus fertilizer application (22.66 t/ha/year). In term of chemical composition, DM, CP, NDF, ADF, and ADL were not affected by applications of phosphorus fertilizer. For organic fertilizer, study of organic fertilizers on yield and chemical composition of Pak Chong 1 was conducted. Treatments were control (no fertilizer), cow manure, swine manure, sheep manure and goat manure (at the rate 3.75 t/ha). Yield and DMY for the 45-day cutting interval were significantly different ($P<0.01$). Goat and sheep manure seemed to have highest in yield when compared with other organic fertilizer (Manwicha et al., 2019). Beside livestock manure, vermicompost or earthworm fertilizer is recognized and accepted by general farmers. In forage legume, Umpuch and Rungsang (2020) applied vermicompost to *Centrosema pascuorum* cv. Cavalcade in pot scale for a period of 12 weeks. The result revealed that the use of vermicompost mixed with commercial soil gave the best dry matter yield, followed by using chemical fertilizers and commercial soil at 21.15, 12.78 and 10.35 g/sqm., respectively ($P<0.05$).

3. Defoliation. In this topic, cutting frequency, cutting height, and animal grazing are presented by some findings. Yields, forage characterizations and nutritive values of ruzi grass and mulato II grass (*B.ruziziensis x B. decumbens x B.brizantha*) at 30, 45 and 60 days of cutting ages were compared. Mulato II grass had significantly ($P<0.05$) higher yields, tiller number, tiller height, tiller diameter and leaf/stem ratio than those of ruzi grass. For nutritive values, mulato II grass had significantly ($P<0.01$) higher crude protein than those of ruzi grass. While EE, CF, NDF, ADF and ADL of ruzi grass and mulato II grass were not significantly different. Higher cutting ages resulted in higher tiller number, tiller height, ash, and all fibers, so mulato II grass that was suitable for feeding the animals was at 30 and 45 days of cutting ages (Thongrueng et al., 2020). The effect of cutting height on production and chemical composition of napier grass was investigated by using 3 levels of cutting heights: 5, 15 and 30 cm for a 3-month interval over a 2-yr period. Three napier grass cultivars were used: Bana napier, Common napier, and Muaklek napier. The cutting height has a great impact on forage yield. DMY decreases as cutting height increases that were 48.37, 47.0 and 43.25 t/ha in the first year

for cutting at 5, 15 and 30 cm, respectively and 33.12, 31.0 and 29.37 t/ha in the second year (P<0.05). Bana and Common napier produced higher forage yield than Muaklek napier grass in both years. For chemical components, they were not different from cutting heights, while cultivar has a direct effect (P<0.05) on carbon, hydrogen, nitrogen, energy, and ash as well as cell wall contents (Rengsirikul et al., 2013). For the grazing trial, Umpuch et al. (2018) studied on ADG of the dairy calf between grazing and TMR systems. Three treatments, three repetitions with three calves per treatment were set. T1: calves were fed total mixed ration (TMR) in free stall according to the Dairy Farming Promotion Organization of Thailand (DPO), T2 and T3: calves of each group grazed Pak Chong 1 and Muaklek napier grass+21% CP concentrate, respectively with two cycles of grazing, 30 days each. The ADG of all calves, DMY and nutritive value of two cultivars and production costs were determined. At the end of the experiment, the ADG of the calves in the control group was higher than that shown in the two grazing groups ($P < 0.05$). Both types of napier grass continuously reproduced with sufficient yield for the calves throughout the dry season. Pak Chong 1 gave a higher dry matter yield than Muaklek in the first cycle of grazing ($P < 0.05$), whereas the yield was not different in the second one ($P > 0.05$). In both grazing cycles, Muaklek had better nutritive value than Pak Chong 1. There were higher crude protein contents in the leaf and stem of Muaklek than found in Pakchong 1 ($P < 0.01$). Overall, dairy calves raised by TMR systems had lower production costs than grazing systems supplemented with concentrated diets.

Pasture Utilization Management

1. Cut and carry system. This system has been used by small-scale farmers since dairy farming was introduced to Thailand. *B.mutica*, *B. ruziziensis*, *P.maximum*, and *Pennisetum sp.* are top forage grown for this system. In addition to cutting fresh herbage to feed animals on their own farms, farmers now have other options: cultivate, cut, and sell fresh herbage to farmers who do not have their own grasslands or convert their paddy field into pasture to harvest fresh forage crops and sell all year round. For example, a rice farmer in northeast Thailand changes a paddy field that sometimes does not have any profit in the dry season, to cultivate purple guinea grass (*P. maximum*) and sell it as cash crop. For a fertile area in central Thailand, *P. purpureum* is the most popular cash crop for feeding ruminant animals directly or making silage by selling it online and onsite.

2. Silage Making. Technology development about making silage depends on farm size, available local materials, and forage crops species. Most ruminant farms are small scale, thus the way they make silage is simple, but still based on academic basis from DLD and university

researchers. Type of forage has an influence on silage quality. In Thailand, many forage crops can be used. But the most popular is corn because WSC content, DMY, and other attributes of corn are suitable for making silage without any additional additives. Thus, most of the researchers are focusing on new grass, legume, or agricultural residues to make silage. For example, Sontimool and Umpuch (2020) compared the quality between purple napier grass silage and hamil grass silage ensiled for 29 days. There was a difference in silage pH ($P<0.01$). The quality score of grasses were classified as particularly good and good for purple napier grass silage and hamil grass silage, respectively. Agricultural residues fermented are also widely used outside city. For example, cassava (*Manihot esculenta* (L.) Crantz) leaves, crop residue of cassava production, containing high levels of CP can be used as complementary forage for lone quality field grass. Kaewkanya et al., (2020) evaluated the potential of cassava leaf different varieties for use as good quality silage. The results showed that cassava leaf clone KU 72 gave the highest dry matter and No. 59 gave the highest crude protein (39.0 and 25.64 %) respectively. While NDF, ADF, DMI, and DDM were not significantly different between clones. In terms of physical quality of cassava leaf silage (color, odor, texture, and pH), all treatments had very good quality. Whereas fermented cassava pulp (FCP) with *A. oryzae* and *S. cerevisiae*, can be used as an energy source of concentrate for Brahman-cross beef cattle (Srisaikham et al., 2019)

On average, the period of fermentation for silage is 21 days. However, there are many periods depending on type of forage and the amount of oxygen after closing the silo. Umpuch et al. (2019) studied the chemical composition, quantity of microorganisms and organic acids between napier grass during the different ensiling periods without feed additives. Sixty days old of Pack Chong1 grass was fermented, ensiling for the period of 21 and 28 days. The results showed that most of the chemical composition did not differ in terms of the ensiling period ($P>0.05$). While the dry matter content was higher in the 21-day silage but lower in the fat content compared to having ensiled at 28 days ($P <0.05$). For the organic acids, lactic acid, acetic acid, and butyric acid contents increased in response to the increasing period of fermentation ($P <0.05$), while the total bacteria and lactic acid bacteria contents decreased when the fermentation period increased to 28 days. It is known that unqualified plants need to add additives such as microorganisms or molasses to speed up the fermentation process and increase nutritive value of silage. Kabploy et al. (2019) determined the effect of *Trichoderma asperellum* (NST-009) on chemical composition of napier grass silage. Napiergrass ensilaged with *T. asperellum* (NST-009) significantly decreased the concentration of DM ($P<0.01$) and NDF ($P<0.01$) and significantly increased CP percentage ($P<0.01$). However, ADF contents were not

significantly different (P>0.05). Aoundee et al. (2019) used yeast-fermented rice straw (YFRS) compared with grass silage and fed to ten male Angus crossbreds. The results showed that intake of YFRS was lower than grass silage (P<0.01) leading to low growth performance of beef fed YFRS (P<0.05). In terms of fecal composition, organic matter and neutral detergent fiber proportions were lower in beef fed with YFRS than grass silage (P<0.05).

3. Hay Making or Grass Farm Project. Grass farming is a career in growing forage grass or legume to produce hay, fresh grass, or silage for sale there. This project has been initiated by DLD since 2002, which aims to create a business of producing animal supplies for sale. And a new career for farmers by establishing 200 grass farm groups to grow 125,000 ha of forage crops in 32 provinces, which were later expanded throughout the country. Forage crops that DLD promotes to farmers such as, *Digitaria eriantha*; syn. *D. decumbens* or pangola grass, *Centrosema pascuorum* cv. Cavalcade. The word "grass farm" or "Na Ya" came from rice fields that had previously grown rice in Phichit Province using pangola grass which prefers lowland areas in irrigated areas but in fact, this paddy field includes other forage plants and can be planted in upland areas such as purple guinea grass grown in the northeast. *P. atratum* is grown in the south. Bana grass is grown in the north and cavalcade beans are grown in the east, etc. However, it is recommended that farmers should select only the varieties suitable for the cultivation of the grass only.

Conclusion

Development of forage crop production in Thailand were regularly occurred by researching processes, such as finding new or promising forage cultivars, agricultural practices or new techniques that help farmers easily manage their crop production. Further studies will focus on breeding tropical forages tolerant to drought/harsh environment resulted from rising global warming condition.

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Crossbreeding Is Not a One Stop Solution for Livestock Sector with Diverse Production Systems: Case Studies in Indonesia

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Abstract

Crossbreeding is a favored solution to improve the productivity of tropical livestock industry. The implemented crossbreeding programs, however, often yielded results below of what was expected. This paper is based on a case study in Indonesia which provides discussions on whether crossbreeding can really be a one stop solution to deal with productivity problems in native and local livestock breeds. Our study found that crossbred livestock were more productive compared to the locals; however, the investments needed to keep them were also substantially higher. Factors affecting the success of crossbreeding including access to stock, facilities to optimally express the genetic potential and efficient market chain. Crossbred animals are suitable for production system with standard management and sufficient resources such as feedlot companies. Crossbred genotypes, however, were not suitable for smallholder farmers. Smallholder farmers in Indonesia adopted low-input low-output farming systems. Due to their limited resources and investments, crossbred livestock cannot express their full genetic potentials in these types of production systems. Hence, we concluded that crossbreeding would not exhibit optimum benefits in every production system in tropical and developing countries.

Introduction

As the second largest biodiversity, Indonesia possesses a collection of native and local livestock breeds. These types of livestock, however, are globally considered as less efficient (Steinfeld et al., 2006) and less productive (Widi et al., 2014) when compared to the genetically improved breeds. Many countries promote intensification to improve livestock production to meet the increasing demands of urban consumers and to contribute to poverty alleviation of

rural households. Crossbreeding is a part of the intensification program in livestock and has been an opt commonly taken by developing countries to increase their livestock productivity. It is when a native and/or local female livestock is mated either artificially or naturally with genetically improved exotic livestock breeds (Agus and Widi, 2018; Leroy et al., 2016) with an aim of producing crossbred offspring which have both productivity and adaptability inherited from their respective parental breeds (Bourdon, 2014).

Notes need to be made, however, that the success of a crossbreeding program can neither be assessed based on the improvements of a set of traits nor the final output only. Livestock development policies generally focus on intensification and marketed production, and thereby neglect the multiple functions of livestock at farm and livelihood level (Udo and Cornelissen, 1998). A thorough consideration including inputs-outputs and multiple aspects surrounding the livestock's production system are needed to give an unbiased assessment of suitable genotypes in a specific farm (Leroy et al., 2016; Madalena et al., 1990; Tri Satya Mastuti Widi et al., 2020; Widi et al., 2014). This paper provides discussions on whether crossbreeding can really be a one stop solution to deal with productivity problems in native and local livestock breeds. We are focusing our case study on beef cattle and goat where crossbreeding practices are common in Indonesia.

Crossbreeding

With an aim of improving the livestock's productivity while maintaining their adaptability; crossbreeding seems promising and has been vastly adopted by developing countries, especially in tropical areas, since early 20th century. The benefits of crossbreeding are mainly due to heterosis and between breeds complimentary for adaptive and productive traits (Falconer and Mackay, 1996; Gregory et al., 1994; Leroy et al., 2016; Prastowo et al., 2017; Widyas et al., 2019). There are records that crossbred had improved production traits compared to local in dairy cattle (Galukande et al., 2013; Madalena et al., 1990; McDermott et al., 2010), beef cattle (Skrypzeck et al., 2000) and also goats (Nugroho et al., 2018). *Bos indicus* and their crossbred offspring showed superiority in terms of adaptability towards tropical environment stressors inclusive heat, drought, diseases and parasites when compared to purebred *Bos taurus* (Burrow, 2014; Prayaga et al., 2009; Prayaga and Henshall, 2005).

Among the widely used crossbreeding strategies are including terminal crossing, rotational crossing, upgrading and formation on synthetic breed (Bourdon, 2014; Falconer and Mackay, 1996; Hardjosubroto, 1994; Leroy et al., 2016). Each of these strategy have their own characteristics regarding the use of heterosis, involvement of adaptive genes, conservation of

local breed and the stability of their genetic compositions (Leroy et al., 2016). Terminal and rotational crossing are among the most widely adapted strategies in tropical livestock production.

Policy and practice in Indonesia

Indonesia is a country where crossbreeding is widely promoted; and in Indonesia, research on livestock breeds and crossbreeding is usually restricted to animal performances and economic results. The majority of livestock farmers in Indonesia are rural smallholders with less than 5 heads of livestock per household (Widi, 2015). The motivation of farmers in keeping livestock vary and mostly not as the main job. Further, it is also confirmed that this type of farmer is categorized as low-input low-output system where they invest less on their livestock and mostly rely on the available resources including feed, water, housing and also labour (Agus and Widi, 2018; Leroy et al., 2016; Widi, 2015). There is a completely different farming system, which is the feedlot cattle fattening system. Here, imported crossbred cattle from Australia (typically Brahman cross) are fattened with standard management and sufficient resources and later sold for slaughtering.

In small ruminant breeds, changes started around 80 years ago. Farmers have gradually replaced their Javanese thin-tailed sheep with fat-tailed sheep, originating from West-Asia (Budisatria et al., 2007). This change in breed was the result of the preference of farmers for animals with a larger body size and the consumer preferences for meat of fat-tailed sheep. Government's programs, both before and after independence, promoted the replacement of the smaller local Kacang goats by Etawah-grade goats. The Dutch colonial administration imported Etawah (Jamnapari) goats from India to increase the body size of goats and to introduce milking of goats. Both fat-tailed sheep and Etawah-grade goats are now considered to be local breeds. The majority of small ruminants are kept in small numbers in sheds or in a combination of confinement and grazing (Budisatria, 2006). Importation of goats, mostly from Australia, have recently started. A few farmers have started specializing in sheep fattening and goat breeding using both in true breeding and crossbreeding with the imported exotic breeds.

Aspects to be considered

Farmers' decisions on keeping specific livestock are taken on the basis of agro-ecological and socio-economic rationalities. On the other hand, the introduction of exotic livestock breeds to answer an increasing urban food demand through government initiatives in developing countries is primarily based on linear sectoral policies (Agus and Widi, 2018). Policy decisions on animal genetic resources are primarily evaluated in terms of production

performances of animals only. In practice, technocratic decisions on breeding strategies affect the livelihoods and the ecological and socio-cultural environments of a region.

The absence of well-designed national crossbreeding program and lack of control mechanisms during the application of the program in Indonesia (especially in smallholder farmers) had contributed to the below-expectation success of crossbreeding measured by the national meat production. The sustainability of the current crossbreeding program is also questionable; which is indicated by the rise of unidentified crossbreds with high variations and hence, difficult to manage and pose a threat to local animal genetic resources.

Leroy et al., (2016) listed the factors affecting the success of a crossbreeding program; which were access to adequate stock, the opportunity of the improved livestock to express its genetic potential and the efficiency of market chain. Among the aforementioned crossbreeding strategies, none of them was truly adopted; because each time, either one or all of the factors of success was not obtainable. The breeding stock stability is hard to obtain at smallholder farmers population. Although Indonesian government is consistent in maintaining the AI centers, but the purebred local female livestock is getting scarcer in the market. Instead, each generation there are more crossbred female livestock of unknown origin were used as breeding stock.

Crossbred livestock does not fit well in the majority of smallholder farmers' livelihoods, where cattle and small ruminants have multiple functions beyond food production. Smallholder farmers managed their livestock based on the available and affordable resources (Budisatria et al., 2007; Widi et al., 2014); one could presume that the opportunity of crossbred livestock to express their genetic potentials was not optimum.

The final yield of crossbred cattle and goats in smallholder farmers were indeed higher than local cattle; but investments required to keep them were considerably higher from economic point of view (Nugroho et al., 2018; Widi et al., 2020; Widi et al., 2014). On the other hand, local cattle (such as Bali and Ongole Grade) were very robust and could survive without any issue under environmental stresses and minimum feed quality as well as quantity (Sutarno and Setyawan, 2015; Widi et al., 2014; Widyas et al., 2017). The majority of the resource-limited rural farmers do not seem to profit from the livestock intensification through crossbreeding.

Conclusion

1. Crossbreeding policies in Indonesia are implemented without well-designed program, clear breeding objectives, sufficient knowledge of positive and negative effects on food production, genetic diversity, environmental impact, resource use, and the social and economic sustainability of the majority of farming systems and rural livelihoods.

2. Crossbreeding is not suitable for all production systems. It is a high input – high output program; hence, more suitable for feedlot fattening system which owned by private companies with standard management and sufficient investments.
3. Smallholder farmers with limited resources are better off with local cattle which requires less investments.
4. Government might initiate to employ smallholder farmers to keep local cattle as female breeding stock to be inseminated with semen from exotic cattle. Hence, act as weaned calves' supplier for feedlot companies.
5. By applying point number 4, crossbreeding program can be controlled and local cattle genetic resources can be maintained.

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Challenges and Opportunities of the Malaysian Ruminant Industry

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Abstract

As far as livestock production is concerned, ruminants contribute to the national agricultural livestock sector and national Gross Domestic Product (GDP) to the tune of 15.3% in 2019. Whilst poultry and pig has dominated this sub-sector, ruminants comprising cattle, buffaloes, goat, sheep, and deer have lagged, to a point where we are only able to meet self-sufficiency level (SSL) ranging at best from 10% to 22% (10.6 to 19%) in the last ten years. The former has achieved self-sufficiency mainly with the active participation of the private sector. The ruminant industry is beset with several fundamental factors that have hampered the National Agriculture Policy 1 to 4. This paper delves into the ruminant sector, opportunities, constraints, issues and challenges and strategies to overcome shortcomings in achieving its goal. To achieve SSL in Malaysia, all hands need to be on deck to outs the several limitations bedevilling the ruminant industry. Land resources, investment, breed quality, border porosity and disease issues should be expeditiously addressed. Impactful policies, access to inexpensive quality animal feed, target driven extension services, upskilling and eased access to funding are proactive remedies adaptable for a true ruminant industry SSL success.

Introduction

Ruminants are loosely classified as large (cattle and buffaloes) or small (sheep and goats). In Malaysia, ruminants are the second primary source of meat (after poultry) and milk. They are generally kept in intensive to semi-intensive management systems. Per DVS data, the Self-Sufficiency level (SSL) for Beef, Mutton, Pork, poultry meat, eggs, and milk as of 2019 are 21.59%, 10.02%, 90.35%, 103.95%, 117.95% and 59.02%, respectively (DVS, 2020). As of 2013, there existed a gap of about 150,000 MT for beef and 24,000 MT for mutton between

demand and supply. This has resulted in the heavy reliance of Malaysia on imports from Australia, New Zealand, India, and Thailand. The import dependency ratio for ruminant products has continuously increased (76.6 for beef, 87.9 for mutton, and 43.9 for fresh milk) through 2019. We are way below the 35% national self-sufficiency target for ruminant products (The Department of Statistics Malaysia, 2020). Recent data has shown a decline in beef production and slaughter (2014 to 2019) and mutton (from 2019). However, milk production steadily increased year-o-year from 2013 to 2109. Does this signify a failure on meat industry players and policymakers, or does it indicate a paradoxical shift from meat to milk production in the country? In other words, have the limitations hindering ruminant production in Malaysia been cushioned or reduced over the years? The response to these questions is not direct nor classical instead requires an in-depth sector reassessment. This paper discusses the status, challenges, and remedies for revamping the ruminant industry in Malaysia.

Methodology:

This submission depicts a bird's eye view of the ruminant industry in Malaysia utilising decades of personal experience, literature, and government data archives to infer the state of the ruminant industry in Malaysia. It is presented not in a relatively unstructured qualitative research manner using secondary data and first-hand feel of the industry.

Precept:

The deficit in the supply of meat and milk products for local consumption have long been identified. With Malaysians' rising income and social well-being, it was expected that the annual production to demand ratio for meat products would be 1.12 between 2011 and 2020 (NAP, 2010). Hence, a 50% SSL was targeted by 2025 for beef and 24.6% for mutton. These targets were meant to boost the livestock production industry to set Malaysia on a course to become a nation that enjoys food security and sustainable growth and development.

Policy:

A National Agricultural Policy – 1 (NAP1) was established in 1984, subsequently improved and NAP2 (1992-2010) and revised NAP3 (1998 -2010) to address challenges to the agriculture as Malaysia went through a rapid expansion of the manufacturing sector, which altered the relative importance of the agriculture sector. The NAP 1 to 3 were developed to ensure that agriculture remains a relevant engine for economic growth, address rural poverty and income balance between commercial and traditional farmers. It was also meant to increase and sustain production and competitiveness, change the economic structure from lack of arable

land, shortages of labour and efficiency and utilisation of resources to improve competitiveness. NAP4 was later formulated to enhance self-sufficiency and reduce importation of agro-food products, self-sufficiency being the main indicator for agriculture performance. In short, the National Agriculture Policy builds on the various policy statements within the sector, providing guiding principles to improve agriculture productivity in the wake of various national, regional, and global opportunities and challenges.

Results And Discussion

This section does explain aspects of the ruminant industry in Malaysia while proffering remediating measures for improving the same. Table 1 shows a time series presentation of the number of ruminants, output from the ruminant sector, consumption of ruminant products and self-sufficiency levels from 2015 to 2019. It is clear that while efforts were made to spur the livestock sector through the various NAP's to meet targeted self-sufficiency levels by 2020, the performance in this sector has not been encouraging. The number of ruminants has generally shown a downward trend. The targets were largely unmet in the last five years. Hence, we should ponder the reasons why.

In contrast, milk production increased by 11% in 2019, but despite this, demands have exceeded supply such that self-sufficiency levels have not improved over the last five years. Thus, the reality remains that despite the rise in consumption of meat and milk in Malaysia, the demand is yet to be met domestically. The deficits are then imported at the expense of the local economy and increased per capita spending. In a broad sense, it may seem that importation of such meat products may serve as a stopgap and easy measure. It drastically burdens the local currency and puts high pressure on the demand for foreign currencies instead of the ringgit. Both policymakers, stakeholders and industrial players are then compelled to investigate the factors challenging the sustainability of meat (ruminant) production in Malaysia. Limiting factors identified over the years includes the shortage of industrial-scale investors, spatial imbalance quality breeds, border issues, and disease. Other factors are climate and animal feeds and their associated high cost, the lack of incentivised land-use policies for grazing and pasture development, and the socio-cultural tendencies of the local population (Shanmuganvelu, 2014).

Table 1: Time Series Number of Ruminants, Output, Consumption and Self-Sufficiency Levels (Malaysia), 2015 – 2019

	2015	2016	2017	2018	2019
Animal (numbers)					
Cows	742,338	737,827	703,832	676,686	683,501
Goats	431,651	416,529	385,304	359,200	371,747
Sheep	147,033	138,479	130,658	128,298	127,796
Total	**150,922**	**131,267**	**117,977**	**105,706**	**105,923**
Numbers slaughtered					
Cows	69,748	64,902	64,414	79,735	80,945
Goat	17,232	20,717	18,422	24,119	23,576
Sheep	4,407	4853	4275	4296	4087
Output (Livestock Products)					
Beef (M.Tonne)	50,493	47,956	46,331	46,923	45,353
Mutton/Chevon (M. Tonne)	4,407	4,992	4,400	4,434	4,310
Milk (Litres, Million)	36.5	36.7	36.6	38.5	40.6
Consumption (Livestock Products)					
Beef (M.Tonne)	218,937	208,154	208,997	205,082	210,090
Mutton/Chevon (M. Tonne)	38,477	38,386	43,003	40,500	43,008
Milk (Litres, Million)	56.6	56.6	62.8	62.8	68.8
Self-Sufficiency					
Beef	23%	23%	22.2%	22.9%	21.3%
Mutton	11.4%	13%	10.2%	10.9%	10.0%
Milk	64.8%	64.8%	58.2%	61.3%	59%

Limitations, Challenges and Remediations

Arable land for livestock farming:

Currently, a considerable majority of the ruminant population is still operated by smallholders and special interest groups ("*Lembu Sado*" interest group in Kelantan and "*Lembu Katang*" in Terengganu). Smallholders do not have the land size to grow pastures to sustain their livestock compared to other commercial and government farms with well-established infrastructures and pastures. Other government initiatives where lands were reserved for grazing to rear livestock were not efficiently utilised. These land sizes for livestock were smaller than those allocated for other primary agriculture commodities such as paddy, rubber, and oil palm. There is also an imbalance between land used for mechanised industrial sectors and pasture development, particularly in urban to semi-urban areas. Those areas allocated for livestock grazing has also dwindled in size over the years. One solution to land issues and farming ruminants has been integrating ruminants with permanent crops such as oil palm and

rubber. However, there was a lack of participation among smallholders, and few plantation companies are prepared to participate in this farming system.

The government need to relook at initiatives to gazette specific areas for animal feed production, particularly greens, in robust, environmentally friendly ways such as hydroponics, aquaponics, vertical farming. The bottom line is a change in approach is needed. Farmers can be encouraged to produce locally sourced and relatively inexpensive animal feed resources (such as rice and cassava) on allocated lands. Feeds can then be composited through research to incorporate rice and cassava. These two crops can be readily farmed within the country and associated with the beef production success in northeast Thailand (Bunmee, Chaiwang, Kaewkot & Jaturasitha, 2018).

Farmers' skills:

Despite many years of animal husbandry in Malaysia, the technical know-how of farmers is still rudimentary. Melissa (2016) found out that one of the issues farmers identified as limiting their productivity is the lack of skills for animal production. This does not mean that hands-on experiences gained by the farmer are not beneficial to successful ruminant farming. In this modern era where food sourcing is increasingly dwindling even with a rising population, reproductive technologies and innovative farming adaptation cannot be overemphasised. Farmers across the country need to be continuously trained in the art and skill of animal breeding, including the techniques of farm-based oestrous synchronisation and composting feed meat or milk purposes. Farmers need to be made aware of the locally available cheap alternatives to imported feeds through the transfer of knowledge derived from decades of highly funded ruminant research. In the same manner, oestrus synchronisation, artificial insemination and possibly embryo programmes.

Investment draught:

The shortage of industrial-scale investors or corporate sector investments is perhaps another reason the ruminant industry has lagged compared to poultry and pigs. In the mid 80's Guthrie Plantations pioneered integrating sheep under oil palm and rubber and subsequently abandoned those initiatives in the early '90s. Afterwards, FELDA and RISDA, two government-linked companies, partake in integrating cattle in their plantations (Rahman and Syafiqah, 2020). The number of livestock has, however, not shown a respectable increment despite these initiatives. The industry has always been essentially a small-scale type of entrepreneurship. Whilst it is presumed that industrial-scale investors may impact areas such as employment and incomes, the push factor is the extra burden of ensuring environmental

sustainability. Other factors are uncertainty with livestock health issues and land rights issues with smallholders integrating livestock production into plantations. This lack of participation is also amidst fear of potential damage to crops and causing soil compaction (Rahman and Syafiqah, 2020). Adopting Thailand's beef cooperative society systems may not be a bad idea when looking for a way out of the meat SSL dilemma in Malaysia. Farmers (smallholders and large-scale) should form vested interest cooperatives to fast-track the mobilisation of resources, coordination of production strategies and influencing the direction of a free meat market in the country.

Spatial imbalance of quality breeds:

The location of specific breeds of imported ruminants for dairy and beef poses some productivity challenges to the industry. Challenges emanate from the relative adaptability of the foreign breeds in Malaysia to microenvironments due to their peculiarities. For instance, the Friesian-Holstein cattle would perform better in cooler regions than when the north-eastern parts where temperatures are often higher by 1°C or more cattle across. Veterinary and Animal Science field officers should continuously engage with farmers to provide breed selection and maintenance in specific regions.

Border issues:

The nature of the shared geographical boundaries between Malaysia and proximate countries exposes it to different challenges. These challenges are in transboundary diseases and often illegal trade in live and other animal products. Thailand been close to Malaysia, targets the ever-growing halal market, and have increasingly transformed their animal products to meet the required standards in Malaysia.

Access to funding:

One of the significant factors limiting investment in the ruminant sector among local farmers is funding. They often find it challenging to access starter or soft loans to establish and improve their farms. As earlier suggested, ruminant farmers can register multiple cooperative societies to assist them in accessing funding from national and international bodies. Government funding policies should encompass the ruminant industry and implement grant schemes for meat and milk production across the country. Complimenting the grant scheme with access to low or interest-free loans is necessary to ensure success.

Disease and high production cost:

Endemic infectious diseases such as brucellosis, tuberculosis pasteurellosis, tick fever, mastitis, helminthiasis and ectoparasitism (Chandrawatani et al., 2018), should be strategically controlled or eradicated to boost productivity. Conditions such as dystocia resulting from foeto-maternal disproportion in hybrids and the cost of managing such morbidities have been discouraging to peasant farmers across the country. Furthermore, the high cost of local feed drives farmers to rely on cheaper less nutritious alternatives. Another constraint associated with high cost is the non-profitability of meat due to seasonal price controls. While the motive and intent for price controls are valid (to relieve) the suffering of the masses, the World Bank Group (2020) has warned of the ample negative consequences of such controls. One of the significant consequences is the 'dampening of investment and growth, which in the Malaysian context means that smallholders bear the brunt of the meagre margins of profit for the tedious work of producing beef and mutton. Freeing the reigns of price controls to allow for competition would, in the long run, entice more local investors, attract foreign investors, and boost national production levels.

Conclusion

Malaysia is still meat and milk self-insufficient in 2021, a status that underscores the urgent need to review strategies to reaching our desired national animal productivity goals. As rightly predicted, there is a continuous rise in demand for meat and milk in Malaysia. The demands are yet to be matched with adequate local supply, thus subjecting the country to rely on importation to balance the deficits. The importations burden the economy and strain the currency. Productivity limitations should be thoroughly and insightfully addressed to enable Malaysia to exit this cycle of low SSLs for ruminant products. Identified limiting factors in this paper include land resource management, drought in investment, breed quality adaptation for localities, lack of access to funding, border porosity, disease, and the need for upscaled extension services. Extension services so suggested includes upskilling the farmers' experience and sustaining a robust assisted reproductive technology program across the country. A thriving Malaysian meat and milk industry would reduce reliance on exportation and capture the rapidly growing halal market.

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Breeding Problems in Small Ruminants

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Introduction

Small ruminants which are sheep and goats, are ubiquitous, and contribute significantly to the subsistence, economic and social livelihoods of a large human population in low-input, smallholder production systems in developing countries. According to the Food and Agriculture Organization (FAO), in 2019, there were 1.09 billion goats and 1.23 billion sheep in the world. However, around 80% of all small ruminants were in developing countries, many of them placed in tropical areas (1). According to Department of Veterinary Services (DVS) statistic, there are 320,203 of goats and 121,173 of sheep in Malaysia in 2020 (2).

Increasing human population, urbanization and incomes, coupled with changing consumer preferences are creating more demand for these animals and their products. This demand can effectively be met by substantially increasing the productivity of these animals. The total increase of meat and milk production in the developing countries is mainly a result of increased livestock numbers rather than a rise in productivity per animal. The development in the animal productivity has been particularly poor in developing countries. As the room for a continued increase in livestock numbers, at least for the ruminant species, is very limited, special attention will have to be given to measures which improve the productivity per animal. These measures will have to include a whole range of activities such as improvements in animal health, feeding and management, as well as work in animal breeding and genetics. Improvement in one field cannot be seen in isolation from that of the others.

Efficient breeding and genetic improvement programs can boost output and profitability for the farmers. However, there is a lack of information on sustainable conventional genetic improvement and breeding programs in developing countries. Consequently, methods for implementing and the factors influencing the success of livestock breeding and genetic improvement programs should be studied. This review focuses on the issues and problems

affecting the breeding and genetic improvement of small ruminants especially in Malaysia, from the aspects of breeding strategy, reproduction and infrastructure.

Breeding Strategy Issues and Problems

Animal breeding, genetics, and genomics is the branch of science concerned with maximizing desirable genetic traits, and one of the pillars of livestock development (alongside animal health, animal nutrition and husbandry issues such as housing). It is a broad field, ranging from characterization to conservation to genetic improvement, and involves actions at local, national, regional and global scales. These genetic advances can increase production while reducing environmental impacts (3)

The genetic variation within livestock populations also provides the raw material both for evolution through natural selection in response to changing conditions and for human-managed genetic improvement programmes. It is vital both to efforts to increase production and to the adaption of livestock populations to challenges such as climate change, emerging diseases and pressures on feed especially in tropical country like Malaysia.

Previous attempts to launch breeding programs in developing countries have too often failed for several reasons. Long-term and simple strategies are necessary as is the need to efficiently exploit the potential of indigenous breeds. Increased productivity per animal or area of land used also need to be considered. However, that must be achieved while also considering the variable socio-economic and cultural values of livestock in different societies or regions. Basic questions concerning the choice of an overall breeding strategy include the emphasis on improving indigenous breeds versus the use of tropical breeds from other areas or 'exotic' breeds. This section highlights some of these key issues involved in designing of a breeding program at breed level.

The Breeding Policy

Animal breeding programs should be seen in the context of long-term development programs contributing to both more food and other livestock commodities produced and to improve resource utilization and livelihood of the livestock owners (4). Thus, livestock breeding programs may be seen as important parts of national agricultural policies, aiming at improving the food and income of a country, region or locality and of livestock keepers. Indeed, in most cases the agricultural development policy sets the scene. The long-term vision of the national interests and the breeding objectives must coincide, although there might be some discrepancies between short-term political goals and the more long-term breeding goals. Some compromises might be necessary and interim solutions applied, while maintaining the long-

term goals. Food imports may, for example, be necessary while awaiting the domestic production to increase through whatever means.

Malaysia has embarked on developing the breeding policy since 1980s. In Port Dickson in April 1980, under the auspices of the Department Veterinary Services (DVS), the First Meeting of the Committee on Cattle Breeding Policy was convened. This meeting was attended by experts from the University of Malaya, University Pertanian Malaysia, MARDI, MAJUTERNAK and the Department of Veterinary Services. The committee came up with recommendations on the breeding of dairy cattle, beef cattle and buffaloes. This was followed by a second meeting of the same committee in July 1986. This committee played an instrumental role in addressing issues on the breeding of cattle and buffaloes at that time. The solutions proposed could not be fully implemented at that time due to limited resources which did not support a comprehensive policy. However, in 2015, DVS has revised and produced the Malaysian Livestock Breeding Policy (MLBP) to guide the industry and farmers in developing proper breeding program and strategies for each livestock sector (5).

Matching genotypes with the environment and production system

Clearly, to improve any breed or population, one must understand both the inherent genetic constitution of the population and how this interacts with the environment, which itself should also be well understood. It is only then that meaningful genetic improvement program can be developed. Given that not all components of the environment can be changed, particularly in low-input tropical production systems, one needs to know which genotypes can be used under such environmental conditions which is, different types of production environments need different types of animals. Specifically, specialized exotic breeds are unlikely to survive, let alone produce, in the typically harsh tropical environments (6). However, continuous improvements and changes of some environmental factors, such as feed availability, veterinary services and development of new production systems, will also be necessary to meet future demands on animal agriculture. In doing so, the environmental stress will decrease and some exotic breeds or crosses may become relevant and valuable for parts of the tropics. To guide the farmers, MLBP has outlined and proposed the suitable breeds for each sector of livestock in Malaysia which is based on the research and experience in our local condition.

When establishing or planning a livestock improvement program for a tropical environment, there are two main approaches: one is to alter the environment, making it less rigorous and the other is to select stock which is likely to be the most adaptable to local

conditions, including climatic stresses, that also has potential for increased productivity. To what extent should efforts be made to modify production environments to accommodate animals of the highest genetic potential for production, as opposed to concentrating on the productivity of genotypes which withstand the harsh environment, while neglecting the scope for its amelioration. In tropical livestock production systems, levels of animal management and nutrition cannot support the potential of the improved breeds. At the same time, the absence of scientifically based knowledge is leading to inadequate husbandry and, consequently, the observed current poor performance by indigenous livestock populations. The extent to which these environments can be freed of the limitations imposed by climate, disease, parasites and nutrition is often limited. However, where efficient infrastructure is in place, control of diseases and feed resources can improve the situation considerably. Thus, there is a strong case for utilization of the best locally available, adapted genotypes in combination with improvements in the environment, wherever feasible and economical, while also considering development of appropriate breeding programs for further development of these breeds (7).

Unfortunately, many national governments in the tropical world lack appropriate livestock policies and have not given due consideration to development of indigenous livestock breeds. Indeed, there is a tendency to focus on the imported breeds and often neglect desirable characteristics of indigenous breeds. However, in some tropical situations, such as in highlands and in peri-urban production systems with improved environments, there are successful examples of introducing exotic breeds and their crosses with indigenous breeds (8). In Malaysia, as the recommendation of the First Meeting of the Committee on Cattle Breeding Policy, has embarked in crossbreeding the local breed with the imported breed. In the 1980's, the University of Malaya embarked on a breeding program to develop a synthetic goat breed called Jermasia, using German Fawn and Katjang as foundation breeds. This breed is in demand, but the breeding stock is limited. This breed was developed for both milk and meat production. Numbers of animals in the foundation herd at the University of Malaya are limited (200-250 heads). The DVS assisted the University of Malaya to multiply its Jermasia breed at its Kampung Kuala Pah Livestock Breeding Centre and now has been relocated at Jeram Pasu Livestock Breeding Centre, Pasir Putih, Kelantan. However, due to the lack of infrastructure and multiplier farm support, the further development of the breed has been stopped.

Successful matching of genotypes with environments assumes availability of a wide range of genotypes. The tropical world is endowed with numerous genotypes. What is required is knowledge of their relative merits and appropriate exploitation of these merits (9). Developing countries should look at what is available locally or in other tropical areas before

importing exotic breeds. Even when some sort of crossbreeding is opted for, the countries must maintain parallel program of evaluation, improvement and conservation of the indigenous parental breeds.

The current distribution of indigenous breeds in most tropical developing regions is mostly a result of history, tradition and local convenience. The kind of strategy which is needed to effectively utilize these indigenous livestock genetic resources is a key question for which answers must be provided. A basic question is which breeds or genotypes to use or target for use and improvement. A good understanding of the environment in addition to knowledge of available breed resources is required to make appropriate decisions on breed choice and necessary improvement interventions (10). Where opportunity exists for improving the production environment, a shift towards more commercialized meat (e.g. beef) or dairy production or both, may be desirable. In such cases, there are two options. One is to identify a suitable breed from the wide range of indigenous breeds. For example, Malaysia has imported the Damara sheep breed since 2015 and has established nucleus farms to further developed the breed. This will provide our farmers with alternative sheep breed which considered suitable with our local tropical condition.

Matching breeds with the market

Many small ruminant genetic improvement programs in developing countries have not been very successful may be due to failure to perceive the multidirectional aspect of the problem; for example, implementing genetic improvement programs without taking into consideration other vital needs of the farmers and market. Any breeding program is totally dependent on environmental conditions, the production system, the culture of the people for whom the animals are bred, and the market to which the animals and animal products are sold. Production without access to market is also a problem for many livestock producers in tropical countries. Whatever the environment, to be sustainable, the breeding program must be market oriented, which were demand-driven, yet considering the multi-purpose use of the animals and the long-term benefits to the farmer. To develop a program that considers both the present circumstances and possible future situations, including market conditions, is a challenging task. This is because there is a considerable time lag between implementation of the program and when the benefits of genetic gains are realized. Therefore, breeding program should be somewhat flexible and responsive to variable scenarios for the future needs of the program (11).

In Malaysia, main market for live animal of sheep and goats is for akikah/korban and not the commercial special cut. Therefore, it is very important to choose the right breed of

animal for each unique market. The consumer will not buy the animal with high matured weight which exceeded 30 kg due to the high cost. But for the commercial special cut, the farmers need the breed which can achieve 30 kg weight and can be slaughtered at 6 months of age to be profitable. That is why majority (71.8%) of the small ruminant farmers in Malaysia have chosen crossbred animal because of high productivity compared to the local indigenous breed but need less maintenance than imported breed (12).

Lack of Multiplier Farms and Data Recording

Small ruminant breeding programs found in the tropics differ in design. Some are three-tiered with a nucleus, multiplier and commercial level while others are two tiered, involving only central performance evaluation station (nucleus) and farmer flocks. Some do not operate a nucleus at all (13). Certain programs select only males while others select both sexes (14). The design of the breeding program will depend on the ecological region and the production system the breeding programs aimed at (15).

Another dilemma in breeding and genetic improvement programs in developing countries in the tropics including Malaysia is how to effectively organized breeding scheme involving farmers at multiplier farms, how to record such flocks, and to monitor progress (Osinowa and Abu Bakar, 1988). To involve farmers, it is advisable to back the breeding program with an effective extension service for maximum effect. The selection program should be preceded with several years of extension work to train the farmers boost their skills and experiences in small ruminant production techniques. During that period, the farmers should be made aware of the benefits derived from recording activity (16).

In Malaysia, the role of nucleus farms is maintained by government farm such as PPK Gajah Mati and PPK Kampung Pah for Damara breed and PPK Chalok for Barbados Blackbelly. We also have many commercial farms which practiced crossbreeding mating system for producing animal into the market. However, the problem is, in this country, there is not many private farms taken the role as multiplier farms to propagate purebred animals for the commercial level. This factor will lead to the failure of development of new breed such as Jermasia goat as mentioned above.

Reproduction Problems, Disease and Feeding

Efficient reproduction is of the utmost importance for the sustainable improvement of animal productivity and is a critical factor influencing the economic viability of livestock farmers. Low fertility is often identified as one of the primary constraints hindering the effectiveness of livestock production systems in developing countries. Decreasing the age at

first calving, the interval from parturition to conception, interval between parturitions, and perinatal mortality, and increasing conception rate, litter size, and productive life are the key targets and crucial factors in improving livestock productivity.

Reproductive problems mainly arise due to nutritional deficiencies and some pathogens, including bacteria, viruses, parasites and also by environmental stress conditions. The primary reproductive diseases which are commonly associated with the reproductive system of small ruminants are brucellosis, leptospirosis, toxoplasmosis fever, listeriosis, campylobacteriosis along with nutritional deficiencies, socio-sexual and photoperiods also affect the reproductive system. Vaccination and nutrition are mainly advised to control these issues of reproduction. The environment control system can also compensate for this economic loss.

Limited feeding resources may cause a decrease in reproductive performance according to the required limit and reproductive status. High feed intake can increase the reproductive output. While for short and long term under-nutrition may exert a negative effect on ovarian activity in goats. The feed flushing system has been incorporated into the sheep and goat management system to increase the seasonal breeding period. The interaction between nutrition and reproduction having a major role in sheep reproductive performance. The relationship between ovary functioning and nutrition is a fundamental rule to maximize reproductive efficiency. However, low animal feed quality for local feed/forage ingredients and processing technology have not been support growth of the animal especially improved imported breeds. (17).

Infrastructure and Land Problems

Infrastructure includes a broad range of essential inputs, which must be available for the breeding program to succeed. These include trained staff, facilities for breeding animals and logistics for dissemination of germplasm, methods and means for recording, handling of data and evaluation of animals, decision-making bodies and finances. One often over-looked assumption is the required integration of all activities constituting a breeding program. This applies both at the government level and at the practical organizational level. Another potential problem in developing countries is lack of or an inadequate number of people with appropriate training or incentives to successfully run a breeding program. Lack of required infrastructure is one of the most serious constraints to developing indigenous breeds in tropical countries (18).

In Malaysia, initially, government farms were set up to function as breeding stations to disseminate genetic material in the form of live animals to farmers. A good example is the Veterinary Institute Malaysia (IVM) in Kluang, Johor. The main breeding practices in these

farms involved natural mating. Due to many advantages of artificial insemination and not to be left out in the stream of time and technology development, the country decided to adopt this technology. During this time, artificial insemination works were carried out at limited scale and coverage.

The need to intensify artificial breeding of livestock using state of the art technology for producing quality semen was realized in the 1970's. Initially this role was undertaken by the National Animal Breeding Center (NABC) which was located at Pantai, Negeri Sembilan then relocated to the Air Hitam Livestock Breeding Center in Johor. To further enhance the needs for genetic improvement in the country, new facilities were required. Thus, in 1989, the National Institute of Animal Biotechnology (NIAB) complex in Jerantut, Pahang was finally established for operation. Besides producing frozen semen, the Institute is also involved in multiple ovulation and embryo transfer program (MOET). It was formally opened by the Hon. Minister of Agriculture on August 30th 1997. With the establishment of the NIAB, the NABC ceased operations and all its staff were relocated to the NIAB complex. The institute has recently been renamed in 2010 as the National Institute of Veterinary Biodiversity (NIVB). The scope of the institute has been further widened to include conservation and sustainable development of livestock genetic resources. MARDI is also involved in breeding work through their National Embryo Center in Kluang, Johor.

In Sabah, pure line breeding of Brahman and Bali is carried out at Livestock Breeding Station in Tawau. A Biotechnology Center in Keningau has been established to produce cattle frozen semen to meet the local demand.

Land ownership

The land ownership, farm size and animal ownership do not seem to be related to animal breeding directly, but are an important source of information on general household characteristics. Land is required for the grazing of animals or for production of fodder. The concept of land tenure, however, might be a constrain to small ruminant production, and consequently also to small ruminant breeding. Tenure refers to the right that individuals have over their land and allows the holder to make management decisions about the use of the land (19). Lack of access to land is of particular importance to extensive farmers. The development of nature conservation areas, expanding agricultural areas and other land reformation projects have excluded extensive farmers from their traditional grazing lands, causing them to move further away or to overgraze areas where they still have access (20). To solve the problem of overgrazing, many areas have been converted into private property of the farmers because it is

being assumed that this is the most efficient and sustainable form of land use. However, this does not always need to be the best solution because individual tenure could deny farmers extensive rangelands. The concept of communal lands has existed for many generations and allows all members of the community to share equally in the productive use of the resource (21).

In Malaysia, to cater of the land scarcity problem for livestock farming, government has announced Taman Kekal Pengeluaran Makanan (TKPM) scheme which can be rented by farmers. However, like other countries, there were intense competition in the land use for agriculture and industrial. The same issue faced by Pusat Ternakan Haiwan (PTH) or government farms which have to be relocated due to demand for commercial projects. At the same time, DVS has encouraged the farmers to transform their farm from the traditional grazing system to the intensive system with proper barn. A survey conducted by DVS in 2014 showed that 48.3% of small ruminant farmers already practised intensive production system and 40.2% semi intensive production system (12).

Conclusion

Many important circumstances determine the scope of opportunities for and constraints to the breeding program of small ruminants in our country. Agricultural and land use policies, market information and access, environmental conditions, characteristics of animal populations and infrastructure available are examples of such factors. For the breeding program of small ruminant to succeed, it needs concerted effort of all parties (government and private) and matching all the available resources such as breed type and market opportunity with suitable production system in our tropical environment.

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Scientific Oral Presentation

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Shrimp Farmers' Intention to Adopt New and Improved Technologies

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The fishing sector has been a significant source of protein for the Malaysian population (1). In 2017, the country's overall fishery production was 1.7 million tonnes, with nearly 1.5 million tonnes coming from capturing and 0.2 million tonnes coming from aquaculture (excluding seaweeds) (1). In Malaysia, there are several culture practices that are used, consists of brackish water aquaculture, freshwater pond aquaculture and marine aquaculture. In 2019, the highest marine fish landing and production of aquaculture were contributed by brackish water aquaculture (5.9%), followed by freshwater aquaculture (3.3%) and marine fish (0.2%) (2). Two marine shrimp species, native giant tiger prawn (*Penaeus monodon*) and non-native white shrimp (*Litopenaeus vannamei*) are mostly farmed in Malaysia in a brackish water. Although giant tiger prawn is considered a local wild population and native to Malaysia, it is discovered as a carrier for major shrimp diseases including White Spot Syndrome Disease (WSSD). Nowadays, disease problem has grown to be a significant issue as it can cause a huge economic loss (3). The disease is commonly caused by bacterial, viral, fungus, and protozoa which significantly affected the giant tiger prawn and white shrimp production (4). Generally, shrimps do not have a specific immune system and become an easy target for pathogen attack. Therefore, cheap antibiotics and antimicrobials drugs are mainly used by shrimp farmers at the farm level and overuse of these antibiotics and antimicrobials drugs has triggered antimicrobial resistance (AMR) problems in shrimp farming. Antimicrobial resistance (AMR) refers to microbial organisms that can withstand the effects of drugs and chemicals intended to kill them (5). The accumulation of antibiotic residues in edible tissues is obviously one of the non-negligible implications of using high doses of antibiotics in food-producing animals (6). However, the adoption of new technologies related to antibiotics and antimicrobials is reported to be low at the farm level due to the high price and farmers' unwillingness to adopt the

technologies. Hence, the new affordable and improved technologies related to antibiotics and antimicrobials should be developed and made available in the market.

The main objective of this study was to determine the intention of shrimp farmers to adopt new and improved technologies. A structured questionnaire consisting of relevant questions on the intention to adopt antibiotics and antimicrobials technologies was established and used as a research instrument among target shrimp farmers located in Peninsular Malaysia. Based on semi-structured interviews, administered by trained enumerators, a total of 20 responses were gathered from the shrimp farmers. Several analyses were carried out to analyse the data. Descriptive analysis was employed to identify socio-economic profiles of farmers while Pearson correlation analysis was performed to determine the strength of the relationship between attitude, perceived behavioural control, subjective norm, and perceived resources towards the intention of the farmers to adopt the new and improved technologies. Meanwhile, Chi-square analysis was carried out to determine the associations between socio-economic profiles of farmers and their intention to adopt new and improved technologies.

Based on the analyses, the results revealed that there were significant positive correlations between attitude ($r= 0.002$, $p<0.01$), perceived behavioural control ($r= 0.001$, $p<0.01$), subjective norm ($r= 0.001$, $p<0.01$), and perceived resources ($r= 0.001$, $p<0.01$), at 1% level of significance. The results of Chi-square analysis indicated that marital status ($p=0.006$) and total household ($p=0.0582$) have significant associations with farmers' intention to adopt new and improved technologies at 1% and 10% levels of significance. However, this study is still ongoing and the result is not the end result due to the implementation of Movement Control Order (MCO). Thus, investigating the factors that influence the shrimp farmers' intention to adopt new and improved technologies is important to provide prior information on the risk of antimicrobial resistance in shrimp farms.

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Economic Assessment of MARDI's Feed Formulation for Red Tilapia Fish

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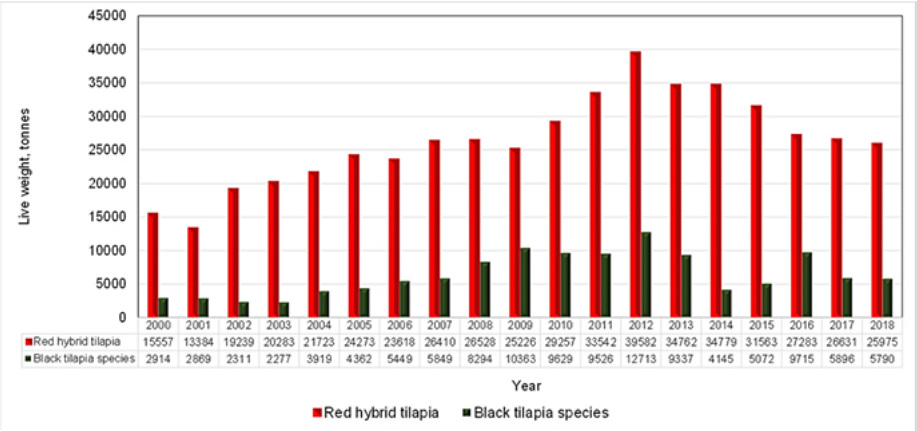
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Red tilapia contributes approximately 90% of the total tilapia production in Malaysia. The production of red tilapia has increased from 8,214 tonnes in 1998 to 31,844 tonnes in 2019, with an expansion rate of 288% for over 20 year's time period (Annual Fisheries Statistics, 1999; 2019). Tilapia is the most farmed freshwater fish in Malaysia (DOF, 2019), followed by Freshwater catfish (Keli) and River catfish (Patin). Red tilapia is considered most preferable cultured by the farmers which account for more than 94 percent of the total tilapia production (Fig. 1). The species *Oreochromis spp*, in general, is widely cultured in ponds, cages, and tanks.



Source: Department of Fisheries (2020)
Fig.1: Production of red and black tilapia fish in Malaysia

Red tilapia fish farming in Malaysia started in many years ago but the production still not very promising. According to the Department of Fisheries (2020), there was a decreasing trend in the production of red tilapia from 2012 (39,581 mt) to 2017 (25,975 mt). Currently, the average retail price of red tilapia fish RM13.00/kg. This makes the red tilapia fish is second cheapest fish in the market after African catfish. Therefore, red tilapia fish were known as "fish for the people".

The feed accounts for over 50 percent of the production cost of red tilapia fish. Although considerable variation exists, cereal grains are the usual sources of carbohydrate in most aquafeed and these cannot be economically supplemented with other sources. Therefore, fishmeal is the single most important source of protein. The increased cost of energy (petroleum prices), climate change, and increasing demand had resulted in a global increase in fishmeal prices. The world price for fishmeal ranges between USD500 and USD1,300 per tonne during the period 2000-2021 (IMF, 2021).

MARDI through Livestock Science Research Centre, Socio Economic Market Intelligence and Sociology Research Centre with the support Department of Fisheries (DOF) Putrajaya has conducted a study to discover local-based alternative sources of raw materials that can replace a fish meal and at least it would lower the cost of red tilapia fish around 15 – 25 percent as expected. The objective was to; i) determine feasibility feed formulation for red tilapia fish based on local sources of raw materials developed by MARDI and; ii) to determine costs and benefits towards MARDI's feed formulation for red tilapia fish as compared with commercial feeds.

Table 1 shows the commercial-scaled feeding trial MARDI's feed formulation for red tilapia fish against the commercial feed. The stocking density of 3000 fish, the final weight and feed cost of MARDI's feed formulation for red tilapia fish were recorded lower than commercial feed. Table 2 shows a partial budgeting analysis for MARDI's red tilapia feed formulation against commercial feed shows that the total benefits were exceeded the implications of RM1,529.87/cycle. The surplus benefit value means MARDI's red tilapia feed formulation has found some advantages as compared with commercial feed. In other words, it is more profitable rather than commercial feed.

Table 1: Commercial-scaled feeding trial for red tilapia fish in 1 cycle

Items	MARDI's Feed Formulation	Commercial Feed
1. Stocking density	3000 fish	3000 fish
2. Final weight (gram/fish)	233.3g	280.0g
3. Feed intake (gram/fish)	325.5g	408.88g
4. Weight gain(gram/fish)	223.53g	270.2g
5. Feed Conversion Ratio (FCR)	1.46	1.51
6. Mortality rate (%)	1.32%	16.26%
7. Aquaculture feed cost (RM/kg)	RM2.64	RM3.50

Table 2: Partial budgeting analysis for MARDI's red tilapia feed formulation against commercial feed

Technical parameters on Partial Budgeting: 1. Red tilapia stocking density: 3000 fish/commercial red tilapia farm 2. Numbers of pond/cage: 9 (pond/cage)/commercial red tilapia farm	
A) Benefit (MARDI's feed formulation for red tilapia fish)	B) Implication (Commercial feed)
Additional revenue (a) Mortality rate (14.94%) RM1,045.20 @RM10/kg (Farm's price) Reduced cost (b) MARDI feed formulation RM638.87	Additional cost (c) Reduced revenue (d) Final weight (46.7gram/fish) RM154.20 @RM10/kg (Farm's price)
Total Benefit (a+b) RM1,684.07	Total Implication (c+d) RM154.20
(+) Benefit RM1,529.87/cycle	

Finally, it may conclude that the MARDI's feed formulation on red tilapia fish has achieved the objective to reduce the cost of aquaculture feed by 15%-20% as compared with commercial feed. Therefore, we have to sacrifice that the performance of MARDI's feed formulation based on final weight is a bit lower than commercial feed.

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Cryopreservation of Bovine Oocytes Using Cryotop and Vitrification Solution

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Vitrification is one of the methods used in oocytes freezing which consist of producing solidified glass-like solutions at lower temperatures in the absence of intracellular ice crystals formation [1]. High concentration of cryoprotectant in the vitrification media prevents the formation of ice crystals. Besides vitrification, a cryodevice referred to as Cryotop was developed to assist during oocyte cryopreservation. Cryotop allows direct exposure of oocytes to liquid nitrogen, which results in extremely high cooling rates during the freezing process. Cryotop consists of a fine and transparent polypyrene film attached to a plastic handle and is equipped with a straw-like cover, in which oocytes in small amount of vitrification media can be loaded during the freezing process [5].

Ovaries were collected from a local abattoir and transferred to the laboratory for oocyte extraction and evaluation. The selected cumulus-oocytes-complexes (COCs) were examined and graded into A, B, and B' based on cumulus morphology and then matured in vitro for 20 to 24 hours at 38.5°C in high humidity and 5% carbon dioxide (CO2). After maturation, the COCs were denuded before divided into three groups. Control group (Group 1) was subjected to fixing and staining for maturation status, whereas Group 2 and 3 were cryopreserved using two freezing techniques, namely vitrification solution (VS) and cyotop techniques. In the VS technique, 3 to 5 oocytes in VS2 medium were loaded into a straw with sucrose bubbles at both ends of the straw, whereas in cryotop technique, the oocytes were loaded onto a cryotop sheet and enclosed with protective cover before plunging them into liquid nitrogen (LN_2). For both freezing techniques, oocytes samples were stored in LN_2 for five days and later thawed in a 37°C warming solution after cryopreservation**.** Finally, oocytes were cultured for 30 minutes to stabilize them and stained using Giemsa dye to determine their status of maturation. All data was analysed using analysis of variance (ANOVA) in the Statistical Analysis (SPSS, version 24) software to determine the significance of parameters measured at $p<0.05$.

The present study showed that the mean percentage of oocyte reaching metaphase II (MII) in Groups A, B and B' oocytes were higher in the control group compared to cryotop and vitrification techniques as shown in Table 1. The mean percentages of metaphase II in Groups A, B and B' oocytes, respectively were 58.21% vs 45.90% vs 52.80% in control group, 57.81% vs 45.83% vs 29.17% in cryotop and 51.43% vs 34.84% vs 23.39% in vitrification techniques. However, no significant differences ($P>0.05$) were observed between the three techniques in all three groups of oocytes. Significant differences ($P<0.01$) in number of oocytes arrested at metaphase II were observed in Groups A and B oocytes compared to the other developmental stages in all techniques. In Group B' oocytes, control group showed similar trend as in Group A and B oocytes. Significantly ($P<0.01$) higher mean percentage of unidentified chromosome and zygotene stages were observed in the vitrification and cryotop groups, respectively.

Despite small differences in mean percentage, this study found that both vitrification and cryotop technique were effective for preserving bovine oocytes in terms of developmental competence and maturation rate. Fresh oocytes, on the other hand had the highest maturation rate when compared to vitrified oocytes, suggesting that fresh oocytes did not undergo various physiological changes that caused cell damage [3]. The maturation rates recorded in the three treatments indicated that the high rate in group A oocytes could be due to the presence of cumulus cell layers which influence the meiotic competence in oocytes [2]. Furthermore, the highest occurrence of unidentified chromosome in the vitrification group compared to control and cryotop was due to the oocytes being subjected to a variety of conditions during the vitrification procedure, including thermal, mechanical, and chemical stress [4], which reduces their ability to resume meiosis.

The study showed that both vitrification and cryotop methods could be used in retaining the developmental competence and maturation rate of bovine oocytes. Cryotop seemed to be a better approach than vitrification in terms of maturation rate, since the meiotic competence of oocytes was higher. To improve the developmental competence of cryopreserved oocytes, more research on evaluating cryotop method is required.

Table 1. Mean percentage of meiotic resumption of bovine oocytes in control, vitrification and cryotop techniques in all three groups of oocytes.

Group	Treatment	Developmental Stages						
		n	Zy	Pa	Dia	MI	MII	Unident
A	Control	22	9.23 ± 5.25^{a,x}	7.95 ± 4.52^{a,x}	0.00 ± 0.00^{a,x}	0.00 ± 0.00^{a,x}	58.21 ± 12.13^{b,x}	1.54 ± 1.54^{a,x}
	Vitrification	39	3.93 ± 2.58^{a,x}	6.25 ± 6.25^{a,x}	4.06 ± 2.20^{a,x}	8.39 ± 4.32^{a,x}	51.43 ± 9.73^{b,x}	13.44 ± 6.28^{a,x}
	Cryotop	33	16.15 ± 6.12^{a,x}	9.90 ± 6.20^{a,x}	0.00 ± 0.00^{a,x}	9.90 ± 4.01^{a,x}	57.81 ± 9.72^{b,x}	6.25 ± 4.09^{a,x}
B	Control	16	7.69 ± 7.69^{a,x}	10.26 ± 7.90^{a,x}	0.00 ± 0.00^{a,x}	0.00 ± 0.00^{a,x}	45.90 ± 12.90^{b,x}	5.30 ± 4.02^{a,x}
	Vitrification	31	7.81 ± 4.48^{a,x}	8.02 ± 3.85^{a,x}	1.25 ± 1.25^{a,x}	5.94 ± 3.51^{a,x}	34.84 ± 9.09^{b,x}	10.89 ± 4.09^{a,x}
	Cryotop	15	10.42 ± 7.00^{a,x}	16.67 ± 8.33^{a,x}	4.17 ± 4.17^{a,x}	10.42 ± 7.00^{a,x}	45.83 ± 9.83^{b,x}	0.00 ± 0.00^{a,x}
B’	Control	35	0.00 ± 0.00^{a,x}	5.13 ± 3.07^{a,x}	0.00 ± 0.00^{a,x}	2.56 ± 2.56^{a,x}	52.80 ± 10.84^{b,x}	16.45 ± 7.27^{a,x}
	Vitrification	34	4.02 ± 3.19^{ab,x}	6.94 ± 4.26^{ab,x}	0.00 ± 0.00^{a,x}	15.87 ± 7.30^{abc,x}	23.29 ± 8.72^{bc,x}	31. 15 ± 10.29^{c,x}
	Cryotop	10	35.42 ± 15.57^{b,y}	7.29 ± 6.58^{ab,x}	0.00 ± 0.00^{a,x}	9. 36 ± 6.58^{ab,x}	29.17 ± 15.98^{ab,x}	6.25 ± 6.25^{ab,x}

$^{x, y, z}$ means within column within group with different superscripts were significantly different at P<0.05. $^{a, b, c}$ means within row within treatment with different superscripts were significantly different at P<0.05. n means number of oocytes.

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Wastewater Treatment by using Aerated Biofilter Reactor

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Abattoir generates wastewater mainly in cleaning of slaughtered farm animals such as cattle and goat, washing of slaughtering equipment as well as personnel and facilities (1). Therefore, the utilization of water in the meat processing industry has been essential part of meat processing routines mainly for the general processing and cleaning purposes (2). Aerated Biofilter Reactor (ABR), also known as Biological Aerated Filtration (BAF) was designed, constructed for wastewater treatment for a cattle abattoir at Banting, Kuala Langat of Selangor state. The objective of this study is to monitor the performance of the Aerated Biofilter Reactor (ABR) system by using polyethene (PE) as media and evaluating the efficiency in removing pollutants.

This ABR process consists of upflow filtration through a cylindrical biological bed of plastic media. The plastic media used is called *Cosmo-Balls* and it is specially designed to provide more than 160 m2/m3 surface area for bacterial attachment. The filtration media which displaced the reactor volume by 62 % and has a capacity about 12.0 m^3 .The reactor performance was examined with organic strength up to 930 mg/L BOD_5, at hydraulic loadings up to 1.8 kg m^{-3} d^{-1} and surface organic loadings up to 4.4 kg m^{-2} d^{-1}. In this study, the performance of the reactor was evaluated based on the values of biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), total suspended solid (TSS), ammonia nitrogen (AN), oil and grease (O & G) and turbidity are presented in Table 1. All of the mentioned parameters were determined and carried out as described in the Standard Methods for Water and Wastewater Examination (3). The reactor demonstrated the capability of removal efficiencies for BOD_5 ranging from 83% to 96%, the system performance slightly deteriorated with time. Overall, for total suspended solid (TSS), 93% reduction was observed and consistently lower than 100 mg/l.

The effluent criteria were also monitored for the removal efficiencies of biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), ammonia nitrogen (AN), oil and grease (O & G) and turbidity. BAF system have shown the average elimination rates of 91%, 88%, 24%, 40%, and 91% respectively.

Based on demonstrated performance, the BAF reactor was viable for the project. The performance improved and met the effluent discharged criteria stated by Malaysia Environmental Quality Act (4) in effluent discharge for BOD_5, COD and TSS. However, the BAF system performance was not excellent for AN and O&G and were consistently exceeding the discharge value of 20 mg/L and 10 mg/L respectively. This could be due the inefficient recovery system caused by high organic load and solid waste that originated from wastes during slaughtering activities such as blood and animal fats.

Table 1. Summary of treatment performance of wastewater treatment plant on BOD_5, COD, TSS, AN, O&G, and turbidity parameters

Parameters	**Influent Mean ± SD**	**Effluent Mean±SD**	**Environmental Quality Act (2009) Standard B***	**Removal Efficiency (%)**
Biochemical Oxygen Demand, BOD5 (mg/L)	441 ± 36.7	41 ± 54.6	50	91 ± 4.6
Chemical Oxygen Demand, COD (mg/L)	1665 ± 50.3	173 ± 47.5	200	88 ± 6.1
Total Suspended Solid, TSS (mg/L)	667 ± 48.9	40 ± 73.7	100	93 ± 8.0
Ammonia Nitrogen, AN (mg/L)	90 ± 29.4	68 ± 30.8	20	24 ± 67.2
Oil and Grease, O&G (mg/L)	87 ± 25.8	51 ± 33.0	10	40 ± 42.5
Turbidity, (NTU)	448 ± 49.4	36 ± 49.8	N.A	91 ± 4.9

N.A = Not Available

*B = Standard B used for discharge of downstream of water intake points. Standard B was used in this study.

Therefore, it is essential to improve the treatment system by providing proper separation processes and treatment before effluent are released and continuous monitoring also need to be carried out effectively to meet the discharge limits stated in Environmental Quality Act in Malaysia.

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Field Trial Application of the Nano-Fungicide on Grain Corn Samples for Controlling Fungal and Mycotoxin Contamination

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Corn (Zea mays L.) grain is a major energy source in the diet of livestock. It has been used extensively as the main source of calories in the feeding of pigs, sheep and cattle due to a combination of desirable nutritional characteristics such as high energy, low fibre, easy digestibility and is cheaper than other feed options. *Aspergillus flavus* a facultative, plant-parasitic pathogen, is one of the fungi that may cause economic losses due to their infection on corn. Even though effective and efficient control of *A. flavus* can be achieved by a combination of storage technologies, physical methods and synthetic chemical fungicides, alternative control methods are still needed. A nano-fungicide emulsion spray as an alternative method to control the growth of *A. flavus* has been developed that can be applied during the drying process. This technology helps in reducing *A. flavus* contamination and maintaining the quality of grain crops during the storage period.

The application of nano-fungicide on grain corn was conducted to evaluate the effectiveness of nano-fungicide in preventing the growth of *A. flavus* on grain corn. This experiment was carried out at Mardi Seberang Perai, Penang. After the harvesting process, 2 tons of grain corn were dried at 80°C until achieved 13% (±1) of moisture content. A 10 L of nano-fungicide was sprayed on the grain corn, while the untreated samples were kept as the control sample. The observation of the growth of *A. flavus* on both of the samples were carried out until sixth month of storage.

The result in Figure 1 shows that the percentage of the growth of *A. flavus* on the untreated grain corn was increased to 100% after fifth month of storage. While the treated samples were still free from *A. flavus.*

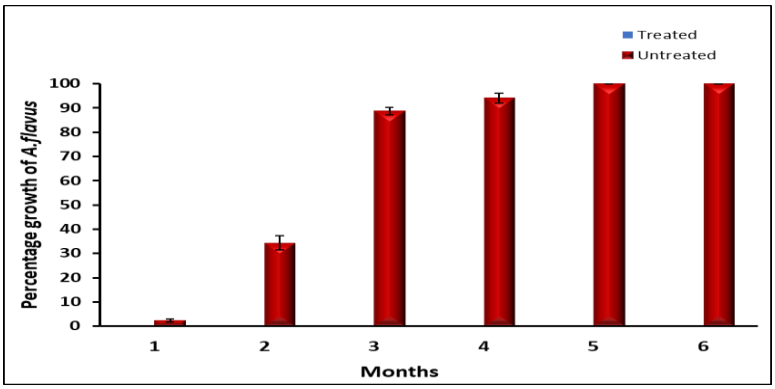


Figure 1. Comparison of the *A. flavus* growth percentage on treated and untreated nano-fungicide grain corn samples. Error bars represent mean ± std deviation (n=3)

Figure 2 shows the observation of treated dan untreated grain corn samples after sixth month of storage. The growth of *A. flavus* was based on the occurrence of the green colour type of fungal mycelia on the grain corn. Correlated with the percentage of the previous results, the untreated grain corn samples were full with *A. flavus* while the treated still showed no sign of *A. flavus* growth.



|Figure 2. The physical observation between treated (left) and untreated (right) grain corn samples

No *A. flavus* contamination was found on the treated grain corn samples after sixth month of storage compared with the untreated samples, suggesting that the application of the nano-fungicide can be an alternative method to guarantee grain corns safety on storage. Corn is subject to postharvest contamination by mycotoxigenic fungi. Thus, postharvest storage with proper drying temperature is needed to reduce grain moisture and halt fungal development. The presents of essential oil as a natural fungicide help in preventing the growth of fungi in corn. In a previous study carried out by Hua et al. (2014) (1), they had found that the presence of essential oil reduces the growth of *Aspergillus ochraceus*. Sinha et al. (1993) (2) also proved that essential oil exhibited maximum inhibitory action on *Aspergillus flavus*. Furthermore, the fungal activity of formulated essential oil-based nano-fungicide is much stronger than in free

essential oil (3). This is because the antimicrobial efficacy of nano-fungicide with essential oil is strongly influenced by the essential oil components, nano-fungicide composition, and internal phase droplet size. These factors may influence the transport of the essential oil to the fungal cell membrane and their interaction with the multiple molecular sites at the cell membrane. Therefore, we conclude that the developed nano-fungicide was effective in controlling *A. flavus* contamination and can be applied in the field during the drying process.

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Effects of Selenium Enriched Bacterial Protein (ADS-18) on Laying Performance and Egg Quality of Lohman Brown Hens.

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Selenium (Se) is an important microelement used in the diet of poultry. Decades of inorganic selenium in poultry diet are gradually being substituted with higher bioavailability and less toxic organic selenium. To date, there are various sources of organic selenium blooming in the industry to compete with selenium yeast (SY) absorptive qualities in business (1). Integration of organic selenium has been proven to alleviate laying performance and egg qualities especially with inclusion of vitamin E in the diet of layer hen (2). The current study is therefore intended to evaluate the efficacy of bacterial organic Se extracted from *Stenotrophomonas maltophilia* bacteria in combination with vitamin E as a source of Se for Lohman Brown hen laying performance and egg quality.

One hundred and twenty (n=120) Lohman Brown layer aged 50 weeks, weighing 1500g – 2000g were used. The hens were subjected to treatment diet for eight weeks as follows: T1: Basal diet (Vitamin E,100mg/kg), T2: Basal diet + Sodium Selenite, SS (0.3mg/kg), T3: Basal diet + Selenium-yeast, SY (0.3mg/kg), and T4: Basal diet + ADS-18 Selenium, ADS18 (0.3mg/kg). Laying performance were determined through feed to egg conversion ratio (FCR) and hen weekly egg production (HDEP) while for quality of egg yolk colour and egg quality (Haugh unit, HU) were measured during the experiment. The data were analysed using Proc GLM procedure of the statistical analysis software (SAS). Means of each analysis were compared using Tukey's honestly significant difference (HSD) at $P < 0.05$.

There was a significance difference ($P<0.05$) in feed conversion ratio (FCR) of organic selenium treated groups during weeks 51, 52, 54 and 55 of age. Similar trend was found in HDEP, with a $P<0.05$ significant difference in selenium treated groups compared to control in weeks 51, 52 and 56 of age. Furthermore, when compared to other selenium sources and their combinations, Haugh unit were much greater in ADS-18 combined with vitamin E fed hen eggs

in week 53 of age. However, there was no significant different ($p > 0.05$) in yolk colour between hen fed different selenium sources.

Table 1: Supplementation of different sources of selenium on hens laying performance

Parameters	Week	Dietary Treatments				P-value
		Control	Sodium selenite (SS)	Selenium Yeast (SY)	ADS-18	
Laying Performance FCR	W50	1.94 ± 0.03^{t}	1.90 ± 0.03^{t}	1.94 ± 0.03^{t}	1.89 ± 0.03^{t}	0.5724
	W51	$1.77 \pm 0.03^{a\ v}$	$1.57 \pm 0.09^{b\ wx}$	$1.57 \pm 0.06^{b\ v}$	$1.71 \pm 0.03^{ab\ w}$	0.0236
	W52	$1.79 \pm 0.03^{a\ v}$	$1.76 \pm 0.03^{a\ tvw}$	$1.59 \pm 0.05^{b\ v}$	$1.83 \pm 0.03^{a\ tv}$	<.0001
	W53	$1.95 \pm 0.03^{a\ t}$	$1.85 \pm 0.04^{b\ tv}$	$1.94 \pm 0.03^{a\ t}$	$1.87 \pm 0.03^{ab\ t}$	0.0735
	W54	$1.57 \pm 0.03^{a\ x}$	$1.24 \pm 0.10^{b\ y}$	$1.17 \pm 0.10^{b\ w}$	$1.57 \pm 0.04^{a\ x}$	<.0001
	W55	$1.66 \pm 0.04^{a\ w}$	$1.64 \pm 0.06^{a\ vwx}$	$1.31 \pm 0.06^{b\ w}$	$1.40 \pm 0.04^{b\ y}$	<.0001
	W56	$1.75 \pm 0.03^{ab\ vw}$	$1.78 \pm 0.04^{ab\ tvw}$	$1.71 \pm 0.04^{b\ v}$	$1.83 \pm 0.03^{a\ tv}$	0.0782
	W57	1.72 ± 0.03^{vw}	1.53 ± 0.13^{x}	1.63 ± 0.07^{v}	1.76 ± 0.03^{vw}	0.1707
P-value		<.0001	<.0001	<.0001	<.0001	
HDEP (%)	W50	74.50 ± 2.58^{x}	77.83 ± 2.21^{w}	79.50 ± 4.23^{w}	81.83 ± 1.99^{x}	0.3577
	W51	$84.00 \pm 2.28^{b\ w}$	$91.67 \pm 1.59^{a\ t}$	$88.00 \pm 1.69^{ab\ v}$	$90.83 \pm 1.60^{a\ tv}$	0.0303
	W52	$83.83 \pm 2.02^{b\ w}$	$90.50 \pm 2.47^{a\ tv}$	$90.33 \pm 1.20^{a\ tv}$	$92.33 \pm 1.31^{a\ tv}$	0.0194
	W53	95.67 ± 1.54^{t}	93.00 ± 2.99^{t}	96.83 ± 1.11^{t}	94.50 ± 1.20^{t}	0.5255
	W54	91.83 ± 1.28^{tv}	94.83 ± 1.33^{t}	90.67 ± 2.31^{tv}	94.50 ± 1.43^{t}	0.2353
	W55	89.00 ± 1.89^{vw}	93.17 ± 2.02^{t}	89.33 ± 2.26^{tv}	93.67 ± 1.71^{t}	0.2332
	W56	$77.00 \pm 1.34^{b\ x}$	$88.33 \pm 3.01^{a\ tv}$	$90.33 \pm 1.89^{a\ tv}$	$85.33 \pm 1.69^{a\ wx}$	0.0011
	W57	$87.67 \pm 1.31^{ab\ vw}$	$83.50 \pm 3.84^{b\ vw}$	$92.33 \pm 2.75^{a\ tv}$	$87.83 \pm 0.87^{ab\ vw}$	0.1320
P-value		<.0001	0.0003	0.0014	<.0001	

Means in the same row with different superscripts ($^{a, b, c, d}$) are significantly different ($p<0.05$) and means in the same column with different superscripts ($^{t, v, w, x, y}$) are significantly different ($p<0.05$)

Table 2: Effects of different sources of selenium inclusion in internal egg qualities

Parameters	Week	Dietary Treatments				P-value
		Control	Sodium Selenite (SS)	Selenium Yeast (SY)	ADS-18	
Yolk colour	W50	3.08 ± 0.35	3.17 ± 0.24	2.92 ± 0.31	3.08 ± 0.23	0.9413
	W53	2.92 ± 0.31	3.67 ± 0.26	2.92 ± 0.36	3.25 ± 0.31	0.2084
	W57	3.00 ± 0.25	3.83 ± 0.29	3.00 ± 0.28	3.33 ± 0.28	0.1235
P-value		0.9300	0.1979	0.9773	0.8076	
Haugh unit (HU)	W50	74.38 ± 0.72^{t}	71.90 ± 1.17	74.15 ± 1.00	72.43 ± 0.99^{v}	0.2091
	W53	$71.39 \pm 0.99^{b\ tv}$	72.70 ± 0.72^{b}	73.27 ± 0.84^{ab}	$75.47 \pm 0.82^{a\ t}$	0.0132
	W57	73.34 ± 1.12^{v}	74.23 ± 0.97	76.29 ± 1.19	75.66 ± 0.83^{t}	0.1901
P-value		0.0983	0.2413	0.1145	0.0238	

Means in the same row with different superscripts ($^{a, b}$) are significantly different ($P<0.05$) and means in the same column with different superscripts ($^{t, v}$) are significantly different ($P<0.05$)

Supplementation of selenium with vitamin E definitely are an important step to alleviate laying performance and egg qualities. The present study suggested that the combination of 100mg/kg vitamin E and different sources of selenium at a level of 0.3mg/kg in diet can

improve laying performance and some egg quality characteristics in laying hens. In addition, improving performance and egg quality traits of laying hens by vitamin E and selenium supplementation is relatively an interesting result, however, mechanism of antioxidative effect of vitamin E and selenium could be the subject of further studies.

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Application of Organic Based Selenium and Vitamin E on Cecal Bacterial Population in Laying Hens.

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The poultry industry is the major contributor to livestock sector in Malaysia. Layer is one of the groups in poultry production. Stress in poultry production may responsible for economic losses due to the productive and reproductive performance of the layer. Molecular level of nutritional, environmental, and internal stresses may cause by overproduction of free radicals, disturbance of redox balance and oxidative stress. This is when antioxidant plays the important role to protect the animals from those free radicals that were build-up when the animals are stress.

In this study, different type of selenium with vitamin E on cecal bacterial population in laying hens was evaluated. Different type of selenium with vitamin E will be used as the antioxidant source were given to a total of 120 Lohman brown layer, aged 59 weeks old for 12 weeks. The animals were randomly separated into four treatments and 6 replicates equally. Treatment 1 (T1) was control soybean – corn basal diet, treatment 2 (T2) was basal diet with a supplementation of 0.3 mg/kg sodium selenite and 100mg/kg vitamin E as the addition of an antioxidant source. In treatment 3 (T3), 0.3 mg/kg selenium-enriched yeast and 100mg/kg vitamin E were supplemented into the basal diet as the antioxidant source. Lastly, treatment 4 (T4) comprised of 0.3 mg/kg selenium-enriched bacterial protein (*Stenotrophomonas maltophilia* ADS18) and 100mg/kg vitamin E. From this study, the cecum digesta were collected from each bird and transferred into 2mL eppendorf tubes. Digesta were stored in -20°C freezeruntil used to quantify total bacteria, *Lactobacillus* spp. and *Enterobacteria* spp. population. Briefly, DNA from the cecum samples were extracted using QIAamp® DNA Stool Mini Kits (Qiagen, Hilden, Germany), then using Thermo Multiskan® GO (Thermo Scientific, Waltham, MA, USA) to check the quality and integrity of the samples DNA. The DNA samples were proceed using master mix, QuantiNova SYBR Green PCR Master Mix (Cat. No. 208054) for the qPCR reaction using Bio-Rad CFX Manager™ 3.1 real-time PCR system (Bio-Rad,

Hercules, CA, USA). Data obtained for the microbial quantification were subjected to a generalised linear model analysis using SAS system. The significant difference of means was compared using Duncan multiple range test.

Table 1. Effect of different of Se sources and vitamin E on cecal bacterial population in laying hens.

Parameter	T1	T2	T3	T4	P - value
Bacterial population (log 10 copy no./g cecum)					
Total bacteria	9.8927±0.084^{c}	10.1585±0.181^{bc}	10.9104±0.254^{a}	10.4291±0.108^{ab}	0.0031
Enterobacteria spp.	5.0954±0.124^{a}	4.6616±0.084^{b}	4.7327±0.059^{b}	4.5671±0.179^{b}	0.0011
Lactobacilli spp.	7.2158±0.446^{bc}	7.7951±0.048^{a}	6.6336±0.400^{c}	7.6321±0.046^{ab}	0.0505

^{a,b,c} Different superscripts in each row are significantly different (P < 0.05).
(T1) basal diet
(T2) basal diet + 0.3 mg/kg sodium selenite and 100mg/kg vitamin E
(T3) basal diet + 0.3 mg/kg selenium-enriched yeast and 100mg/kg vitamin
(T4) basal diet + 0.3 mg/kg selenium- enriched bacterial protein (*Stenotrophomonas maltophilia* ADS18) and 100mg/kg vitamin E

Based on the study, significance difference (P< 0.05) was observed on the total bacteria population between the treatment group with T3 recorded with the highest population followed by T4, T2 and T1 respectively. Liu ey al. (2014) also reported that laying hens that supplemented with antioxidant supplementation (quercetin) resulting improvement in total bacteria population. However, for *Enterobacteria spp*., significance difference (P< 0.05) was observed in the control group (T1) that have the same finding with Muhammad et al. (2021) where control group shows a significant higher number of *Enterobacteria spp.* to treatment group. T2 shows a significance difference (P< 0.05) among the treatment groups for *Lactobacillus spp.* population. This finding was similar to Zhu et al. (2015) where there was a significant increase in *Lactobacillus spp* in broiler supplemented with polymannuronate as antioxidant source. Antioxidant does improve oxidative stress that leads to improvement of gut microflora of the animals.

Based on results obtained, feeding Lohman brown layers with Selenium-based minerals either inorganic or inorganic form and Vitamin E may improve the microbiology population of the animals especially those that were supplemented with the organic form of selenium due to the presence of antioxidant properties from both selenium and Vitamin E that reduce the

population of harmful microbes and at the same time might improve the intestinal environment that lead to better intestinal absorption.

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Knowledge and Attitude towards Dairy Cattle Udder Health Management among Veterinary-Related Personnel in Selangor, Malaysia

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Udder health is considered to be one of the important components under herd health programme. Hence, effective communication between veterinary professionals and dairy farmers is imperative to achieve optimal mastitis control in dairy animals. In this study, knowledge and attitude on udder health management among veterinary-related personnel in Selangor were assessed.

A semi-quantitative, cross-sectional, questionnaire-based developed based on previous studies (1, 2, 3) and validated questionnaires were distributed to 19 individuals. Most of the personnel had a working experience of 4-8 years (7/19, 36.84%) while 26.32% (5/19) worked for less than 3 years. Three out of nineteen personnel (15.79%) were with 13 years of working experience and the rest with 9-13 years working experience (4/19, 21.05%). Thirteen out of eighteen respondents (13/9, 68.42%) spent 1-3 hours with cases or animals per working days and 2-3 days (10/19, 52.6%) is the most frequent number of working days per week for the respondents.

Questions selected for this section served as basic items for knowledge in udder health and score of 10 would be regard as Good meanwhile >10 as Poor. Personnel with good knowledge on udder health management was 5.26% (1 out of 19 respondents) and a mean score of 8.0 ± 0.88 (SD). Good attitude were defined as a total of first four questions answered all correct by the respondents where 36.8% (7 out of 19 respondents) were found to have good attitude and the mean score among veterinary-related personnel was 8.1 ± 1.05 (SD). Educational qualification between degree in veterinary medicine and diploma was seen significant towards knowledge scores meanwhile Malaysian Certificate of Education (SPM)-Diploma group was significant in attitude scores among the respondents (Table 1). It was

observed that educational tools on udder health management were provided to the farmers such as practical guide on udder health (57.9%) however 21.20% did not provide any educational tools to the farmers. Milking machine and environment/housing components being agreed as the most important strategies to improve udder health.

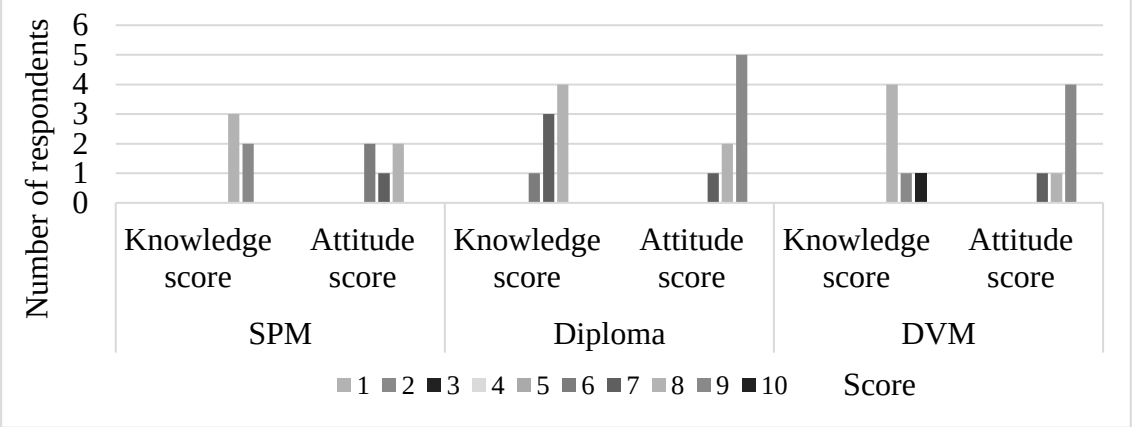


Figure 1. Knowledge and attitude score of the personnel with different educational qualification

Table 1: Kruskal-Wallis H test between knowledge score and attitude score with educational qualification

Test Statistics[a,b]

	Knowledge score	**Attitude score**
Kruskal-Wallis H	7.672	7.161
df	2	2
Asymp. Sig.	0.022	0.028
a. Kruskal Wallis Test		
b. Grouping Variable: Educational qualification		

In conclusion, veterinary-related personnel in Selangor had an unsatisfactory level of knowledge and attitude pertaining to the topic. Future efforts should be focusing on improving the engagement of the professionals in order to increase level of acceptance of the farmers toward advices and proposed management strategies.

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Caprine Mammary Protease-Activated Receptor 2 Expressions with *Staphylococcus aureus* and MRSA Based Mastitis

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Mastitis is an inflammation of mammary glands resulting from imbalance interaction between the agent, the susceptible animal, and the environment [1,2]. Clinically, it is characterized by fever, warm, painful, and swollen mammary gland [3,4]. PAR2 a cell surface G protein- coupled receptor, plays an important role in the induction and amplification of the inflammatory response through proteolytic cleavage by serine proteases [5]. In ruminants, increased protease activity has been observed in milk from mastitis animals [6]. The objective of this study was to quantify PAR2 mRNA expression in the healthy and inflamed mammary gland tissue of goats due to infection caused by *S. aureus* and MRSA.

A total of 30 clinically healthy mix breed lactating goats were used in an experimental model of mastitis. The experimental goats were divided into three groups (n=10 per group) challenged by intramammary infusion of *S. aureus* (Group 1), MRSA (Group 2) or sterile PBS saline (control). The animals were monitored for the signs of mastitis and its severity was scored. Clinical parameters, milk samples and mammary gland tissues were recorded and collected 24 and 48 hours post infection (hpi). Somatic cell count was measured by direct microscopic method. The presence of PAR2 mRNA in the mammary gland samples was detected by real- time PCR.

Goats from group 1 developed mild to moderate clinical signs. Group 2 exhibited moderate to severe clinical signs in comparison with the control group. SCC was found to be higher in both challenged groups than control group. PAR2 mRNA expression was detected

in all mammary gland samples. PAR2 mRNA expressions levels in Group 2 were two times higher (P<0.0001) than that of the control group at 24 hpi (Figure 1a). There was no significant difference (P>0.05) in the Group 1 mammary gland tissue PAR2 mRNA expression compared with the control group at 24 hpi (Figure 1c). At 48 hpi, PAR2 mRNA expression levels in Group 1 and Group 2 were 10 (P<0.0001) and 11 (P<0.0001) times higher compared to that of the control group, respectively (Figures 1b and 1d). The gene expressed significantly highly in mammary gland tissue with severe clinical signs. There was a significant positive correlation between the mean SCC values and the PAR2 mRNA expression in the Group 1 (24 hpi, rs = 0.57, P<0.05; 48 hpi, rs = 0.51, P<0.05) and MRSA (24 hpi, rs = 0.68, P<0.05; 48 hpi, rs = 0.64, P<0.05) infected mammary tissues. The goats challenged with both *S. aureus* and MRSA showed high SCC values and PAR2 mRNA expressions when comparing with the control group These results reflect on the pathogenicity and the virulence factors produced by bacterial strains, which are modulated by a complex transcriptional regulator network [7].

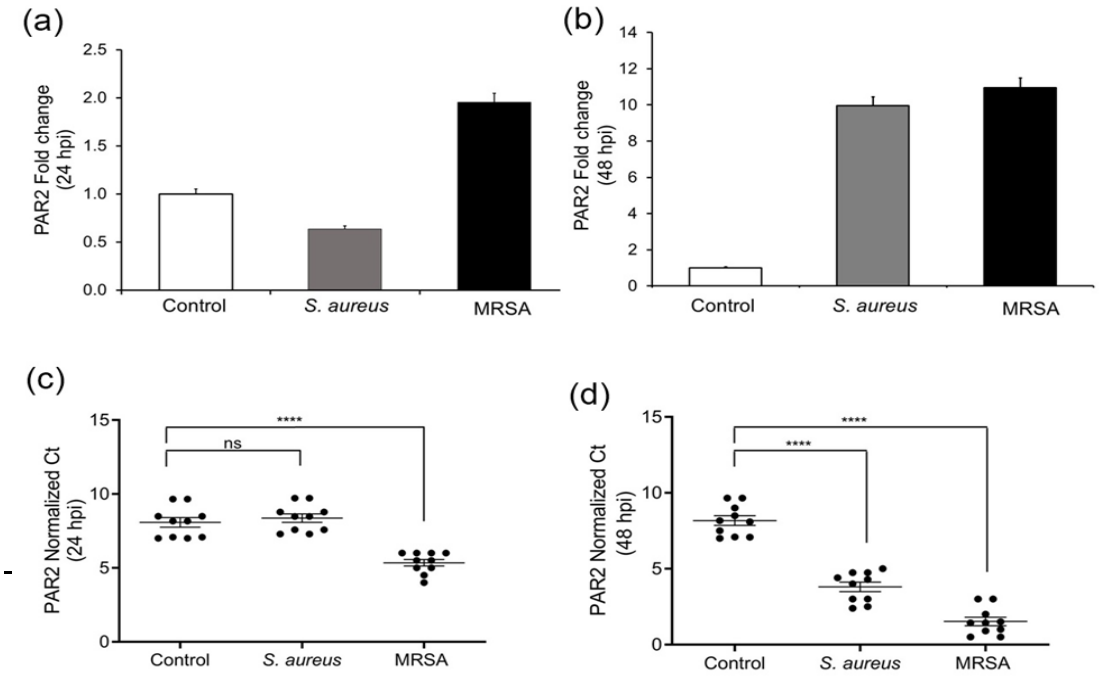


Figure 1. Protease-activated 2 (PAR2) mRNA expression in mammary gland tissue. Data are presented as mean ± SEM (One-way ANOVA, ****P <0.0001). ns = not significant.

PAR2 expression in caprine mammary gland is a novel and important finding, and supports the hypothesis that serine proteases are involved in the development of mastitis. PAR2 expression is also associated with severity of mastitis caused by different strains of *S.*

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Evaluation of Point-of-Care Glucometers for Use in Goats

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Glucose concentration is commonly measured in sick animals to assess their health to provide appropriate treatment. Over the years, veterinarians have been using glucometers developed for humans on goats to obtain fast results. However, few studies have been carried out to validate glucometers as a point-of-care tool for goats.

In this study, two types of glucometers were evaluated - Accu-check Guide® and Accu-check Active®. Readings from both glucometers were compared to the standard laboratory-based analyser, Biolis 24i clinical chemistry analyser which served as the reference method. The aim of this study was to evaluate the utility of different handheld glucometers in measuring glucose concentration in goats and determine the accuracy between the glucometers and the laboratory-based analyser. A total of 50 healthy adult goats were recruited from 5 farms in Selangor. Blood samples were taken through the jugular venipuncture. A drop of blood was immediately placed onto the test strip for both glucometers while the rest of the blood was stored inside a sodium fluoride and potassium oxalate test tube for analysis with the laboratory-based analyser. The data recorded were analysed using One-way ANOVA and the significant difference between means were expressed as means ± SE. The relative bias was calculated using the formula: (Glucometer – Laboratory-based analyzer) / (0.5 X [Glucometer + Laboratory-based analyser]) X 100. The maximum deviation for relative bias cannot exceed 5% from the reference value for the readings of glucometers to be accepted.

From table 1, the result obtained from Accu-chek Guide® shows that 14% (n=7) were hypoglycaemics and 86% (n=43) were normoglycemic. When using Accu-chek Active®, 34% (n=17) were hypoglycaemic and 66% (n=33) were normoglycemic. When tested with laboratory-based analyser, 16% (n=8) were hypoglycaemic and 84% (n=42) were

normoglycemic. The readings obtained from Accu-chek Guide® were consistently closer with the value of laboratory-based analyser.

Table 1. Blood glucose concentration obtained from different methods

Method	Laboratory-based analyzer	Accu-chek Guide®	Accu-chek Active®
Hypoglycemic (<2.8 mmol/L)	17	7	8
Normoglycaemic (2.8mmol/L-4.2mmol/L)	33	43	42
Hyperglycaemic (>4.2mmol/L)	-	-	-
Total	50	50	50

One-way ANOVA showed that there was a significant difference in readings from all 3 methods ($P<0.05$). Accu-check Guide® overestimated (3.24 ± 0.42 mmol/L) while Accu-check Active® underestimated (2.97 ± 0.53 mmol/L) the mean blood glucose concentration when compared to the laboratory-based analyser (3.12 ± 0.39 mmol/L). Using Pearson's correlation coefficient, Accu-check Guide® ($r=0.887$) was more highly correlated with laboratory-based analyser than Accu-check Active® ($r=0.814$). Since the relative bias for both glucometers were within the 5% maximum deviation from reference value, they could be used in goats. In conclusion, Accu-check Guide® is the glucometer of choice as it produced readings that were consistently closer to the laboratory-based analyser with higher correlation and lower relative bias.

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Multiple Anthelmintic Resistance Against Parasitic Gastroenteritis Among Naturally Infected Dorper Sheep Reared in A Semi-Intensive Farming System in Perlis

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In Malaysia, 87.5% of sheep were reported to be infected with at least one species of gastrointestinal parasite (1). Strongyle was revealed to be the most prevalent gastrointestinal parasites among sheep predominated by *Haemonchus contortus* and *Trichostrongylus spp* in small ruminants (2). Chemical anthelmintic is currently the main approach to control gastrointestinal parasite infestations. However, widespread and improper use of anthelmintics has resulted in severe anthelmintic resistance worldwide including in Malaysia. Therefore, this study was conducted to evaluate the status of anthelmintic resistance against parasitic gastroenteritis (PGE) among Dorper sheep reared in a semi-intensive farming system in Perlis.

Over the past four years, anthelmintic drugs namely fenbendazole, albendazole and ivermectin have been used alternately at least once a year as a part of deworming program in the farm. A total of 80 sheep of both sexes ranging from two to three years of age were screened for PGE infection by using modified McMaster's technique for faecal egg count (FEC). Fifty-eight sheep detected with more than 150 eggs per gram (epg) of faeces were then selected and divided into a control and four treatment groups namely albendazole, fenbendazole, levamisole and zolimectin. Faecal samples were collected again at 14 days post-treatment for Faecal Egg Reduction Test (FECRT) to determine anthelmintic resistance status of each anthelmintic used in this study. Strongyle population will be classified as 'resistant' if Feacal Egg Count Reduction (FECR) percentage is less than 95% and confidence level of 95% is less than 90% (3). In addition, faecal samples at pre- and post-treatment were pooled and subjected to a faecal culture method to identify the species of infective stage larvae (L3).

The FECRT showed moderate to severe level of resistance among Dorper sheep in the farm following treatment of albendazole, fenbendazole, levamisole and zolimectin (Table 1). Levamisole was the most effective anthelmintics with FECR of 88% while albendazole and fenbendazole showed high degree of resistance at 52% and 43% respectively. Zolimectin was the most ineffective anthelmintic against PGE with FECR of -45%. Figure 1 shows that FEC decreased in all treatment groups except zolimectin with the highest mean of post-treatment FEC; 1841 (±1930) eggs per gram of faeces (epg).

Pre-treatment faecal culture showed that *Haemoncus contortus* was the most predominant L3 (88%) while *Trichostrongylus spp*. and *Oesophagostomum spp*. were encountered at the same level of frequency (6%). Post-treatment samples showed L3 percentage reduction of *H. contortus* in fenbendazole and levamisole groups were 9% and 22% respectively; while slightly increased in albendazole (6%) and zolimection (2%) groups. This indicates that levamisole was the only effective anthelmintic in combatting PGE that was due to *H. contortus*. *Trichostrongylus spp.* was the only susceptible species against albendazole treatment as the population decreased to 2% while rose and maintained the same in other anthelmintic groups. In addition, *Oesphagostomum spp* was resistant against fenbendazole and levamisole treatments; at 11% and 23% respectively but showed the same level of efficacy following albendazole and zolimection treatment (5%).

Table 1: Faecal egg reduction test (FECRT) percentage with 95% confidence limit against four anthelmintics group

Group	Number of animals	Arithmetic mean (EPG)		FECR (%) 95% CI	Resistance status
		Before	After		
Levamisole	12	1192	146	88 (70; 96)	Resistant
Albendazole	11	1295	609	52 (-1; 77)	Resistant
Fenbendazole	12	1175	725	43 (-32; 75)	Resistant
Zolimectin	11	1294	1841	-45 (-250; 40)	Resistant

Note: EPG = eggs per gram; FECR =faecal egg count; CI = confidence interval

In conclusion, multiple anthelmintic resistance against PGE have been developed among Dorper sheep raised in a semi-intensive farming system in Perlis. Therefore, new helminth control strategies in reducing reliance on anthelmintics should be implemented. This

includes rotational grazing, Strategic Prophylactic Treatment (SPTs) based on FEC monitoring and FAMACHA© system, and the use of bioactive forage.

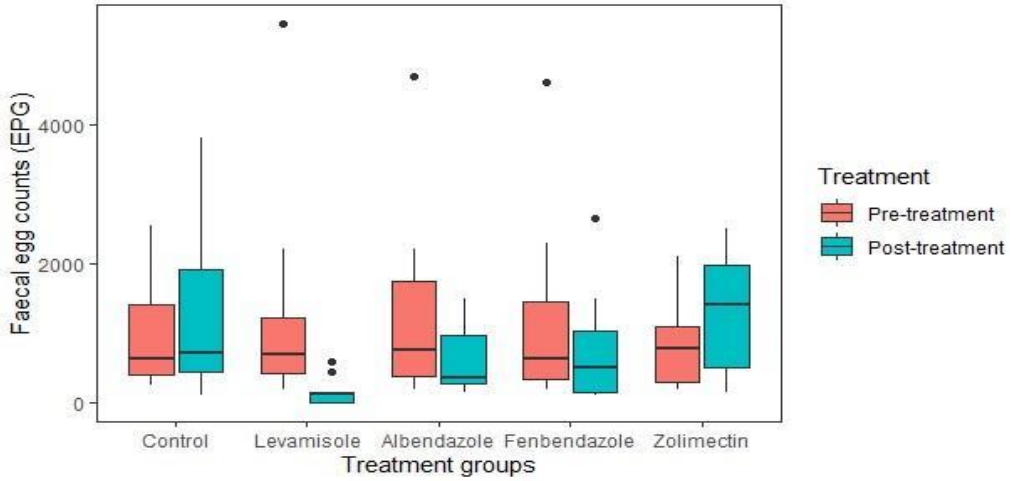


Figure 1: Box plot of pre- and post-treatment faecal egg counts (EPG) of Dorper sheep treated with different anthelmintics

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Molecular Detection of Haemoparasites Among Imported Thailand and Australian Brahman Cattle Reared in Perlis.

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Haemoparasite infections cause economic losses in beef cattle and often found in tropical regions such as Thailand, Malaysia and Indonesia. There are several haemoparasites that are commonly found in Malaysia such as *Anaplasma* sp, *Babesia* sp, *Mycoplasma* sp, *Theileria* sp and *Trypanosoma* sp. Infestation can be sub-clinical, in which the infection left undiagnosed and become potential asymptomatic carriers that can contribute the source of infection to the other cattle. Conducive tropical climate that are hot and humid in Malaysia become one of the most important catalyst for survival of the vectors that help in transmitting these haemoparasites. This study is conducted to detect the presence of haemoparasites among imported Thailand and Australian Brahman cattle by using molecular detection.

In this study, 71 Brahman cattle were selected randomly at the farm in Chuping, Perlis that include 33 cattle originated from Thailand (Group 1) and 38 cattle originated from Australia (Group 2). All of the cattle are reared in extensive rearing system. Blood samples were collected approximately 5.0 ml via coccygeal vein from each cattle by using EDTA tube. Fresh blood (300µl) samples were preserved in lysis buffer (1.2 ml) for detection and identification of haemoparasites by polymerase chain reaction (PCR) assay. Deoxyribonucleic acid (DNA) was extracted from whole blood using the Geneaid gSYNC DNA Extraction Kit according to the manufacturers' protocol (Geneaid, Taiwan). PCR amplification was carried out to amplify nuclear and ribosomal gene fragments of the various haemoparasites using species specific primer set and thermocyclic profiles [1]. The primers and amplicon size used in this study for *Anaplasma marginale* (MSP4_F and MSP4_R) (761 bp), *Babesia bigemina* (AMA-1_F and AMA-1_R) (211 bp), *Babesia bovis* (VESA 1α_F and VESA 1α_R) (166 bp), *Theileria*

orientalis (MPSP_F and MPSP_R) (776 bp) and *Trypanosoma evansi* (RoTat 1.2_F and RoTat 1.2_R) (205 bp). Positive controls template DNA are used from positive samples sequencing of the PCR amplicons at the same farm and negative controls are replaced with nuclease free water. The data were analyzed in percentage by using Microsoft Excel (Microsoft, Washington DC, USA). The percentage of positive samples were calculated by divided number of total positive with total sample and multiplied by one hundred. Descriptive statistics analyse were used in this study to compare the percentage of positive and negative samples.

Table 1 shows that all targeted haemoparasites were detected by using PCR from 71 Brahman cattle tested. The most prevalent haemoparasites was *Anaplasma marginale* that was detected 100% in both groups. High infection rates were also contributed by *Babesia bigemina* in Group 1 (100%) and Group 2 (99%). Futhermore, *Babesia bovis* were detected 100% in Group 1 and 95% in Group 2. The other haemoparasites detected were *Trypanosoma evansi* (100% in Group 1 and 93% in Group 2) and *Theleria orientalis* (97% in Group 1 and 81% in Group 2).

Table 1: Number of Brahman cattle and percentage of infection with haemoparasites species

Type of blood parasites	*Group 1	Percentage (%)	*Group 2	Percentage (%)	Total number of cattle	Average percentage (%)
Anaplasma marginale	33/33	100	38/38	100.0	71/71	100
Babesia bigemina	33/33	100	37/38	97	70/71	99
Babesia bovis	33/33	100	34/38	89	67/71	95
Trypanosoma evansi	33/33	100	33/38	87	66/71	93
Theleria orientalis	32/33	97	25/38	66	57/71	81

* Group 1: Cattle originated from Thailand; * Group 2: Cattle originated from Australia.

Overall, cattle that are originated from Thailand (Group 1) shows slightly higher infection percentages than cattle originated from Australia (Group 2). In tropical areas, haemoparasite are usually spread during the rainy season because moisture helps in the growth of vectors [2]. On the other hand, Australia is considered as one of the biggest exporting country for beef cattle in comparison to Thailand which involve in import and export of live animals. These might help to explained the higher infection rate among beef cattle imported from Thailand. In addition, 78.7% of beef cattle in Thailand are infected with at least one haemoparasite such as *Theileria orientalis, Babesia bigemina,* or *Babesia bovis* [3]. Among

imported Australian feeder cattle imported to Indonesia shows that out of 280 samples, 253 were positive (90.4%) of blood parasites and infected cattle showed no clinical symptoms, potentially become carrier of the diseases [4]. This indicate that cattle were imported from Thailand and Australia have high chances of getting haemoparasites infection. Effective control measures must be implemented to prevent spread of haemoparasites infection to local cattle including prevention of the vectors.

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Scientific Poster Presentation

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Nutrient Composition of Forage Sorghum in Mineral Soil

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Currently many parts of the world are being affected by the Covid-19 pandemic issue. During these times, there may be a restriction of the importation of feed materials as feed cost may increase due to the current crisis situation. This might lead to shortage of feed supply to sustain livestock production. Hence, it is important to ensure that food security is maintained to ensure sufficient supply of food resources. As such, there is a need for alternative feed resources to meet the local feed supply demand. Forage sorghum (*Sorghum bicolor*) is known to be a drought tolerant crop. It is suitable as livestock feed due to its high dry matter yield and nutrient contents that is enough to meet the nutritional requirements of ruminants. Furthermore, this type of sorghum is a multicut type (can be cut several times) as it can regrow (ratoon). A study was conducted to evaluate nutrient composition of four types of forage sorghum varieties planted with different planting densities in mineral soil.

A factorial experimental design was used in this study which was conducted in MARDI, Serdang. The four sorghum varieties were Sugar graze (SG), Brown Midrib (BMR), Megasweet (MS) and SPV422 with four planting densities (mechanised: 75 cm x 9.3 cm, 75 cm x 11.3 cm; semi-mechanised: 45 cm x 10cm, 45 cm x 20 cm) arranged in a split-plot design with the varieties as the sub-plot with three replicates. Plants were harvested for 2 cycles, over a total duration of 100 days, at an interval of 50 days. The plants that were cut 10-15cm above the ground level were chopped and oven dried at 60^{o}C and further ground through a 1 mm sieve, and stored at room temperature before being subjected to proximate analysis. For the data obtained, analysis of variance (ANOVA) and Duncan's Multiple Range Test using SAS 9.3 was run to test the level of significance ($P<0.05$).

Results are presented in Table 1 (first harvest cycle) and Table 2 (second harvest cycle). Based on the results obtained in the first and second harvest cycle, there were no significant

differences among all the nutrient parameters among the four sorghum varieties and four planting densities. The dry matter and NDF percentage in the second harvest were higher than the first harvest, although not significantly different among all varieties and planting densities. Other parameters did not show differences between the two cycles. On the whole, although the results were not significant, their values were within the range of the results observed from other studies (1,2). Thus, this present study suggests that forage sorghum might have the potential to be an alternative feed source for ruminants. As a conclusion, it can be seen that the nutrient composition was not significantly different between SG, BMR, MS and SPV422 in all planting densities in mineral soil.

Table 1. Nutrient composition of the four sorghum varieties for the first harvest cycle

Variety	Planting density (cm)	Total Dry Matter (%)	Crude Protein (% DM)	Crude Fibre (% DM)	Lignin (% DM)	Neutral Detergent Fibre (NDF) (% DM)	Acid Detergent Fibre (ADF) (% DM)	Digestible Dry Matter – Calculated Value (DDM) (%)
Sugar graze (SG)	A	16.8^{ab}	6.9^{a}	31.4^{abc}	6.1^{abc}	66.8^{a}	56.9^{b}	44.6^{a}
	B	16.5^{ab}	6.2^{a}	32.8^{abc}	7.7^{abc}	68.9^{a}	56.5^{b}	44.9^{a}
	C	13.8^{ab}	6.2^{a}	30.1^{c}	5.5^{c}	69.6^{a}	58.2^{ab}	43.6^{ab}
	D	12.7^{b}	7.1^{a}	31.1^{abc}	7.7^{abc}	68.9^{a}	60.7^{ab}	41.6^{ab}
Brown midrib (BMR)	A	15.6^{ab}	4.4^{a}	31.4^{abc}	8.2^{abc}	68.4^{a}	59.9^{ab}	42.2^{ab}
	B	17.8^{a}	7.6^{a}	31.9^{abc}	10.3^{ab}	71.6^{a}	65.9^{ab}	37.6^{ab}
	C	15.8^{ab}	5.3^{a}	33.7^{a}	8.3^{abc}	70.8^{a}	64.9^{ab}	38.3^{ab}
	D	15.1^{ab}	7.3^{a}	30.4^{bc}	5.6^{bc}	68.8^{a}	57.0^{b}	44.5^{a}
Mega sweet (MS)	A	14.8^{ab}	5.4^{a}	31.6^{abc}	10.7^{a}	70.7^{a}	60.0^{ab}	42.2^{ab}
	B	14.6^{ab}	4.7^{a}	33.6^{ab}	9.3^{abc}	70.4^{a}	58.9^{ab}	43.0^{ab}
	C	14.3^{ab}	6.8^{a}	32.0^{abc}	9.8^{abc}	73.3^{a}	69.8^{a}	34.5^{b}
	D	14.5^{ab}	7.3^{a}	34.2^{a}	10.2^{abc}	71.8^{a}	63.3^{ab}	39.6^{ab}
SPV 422	A	16.7^{ab}	6.5^{a}	32.2^{abc}	10.5^{a}	68.6^{a}	58.7^{ab}	43.2^{ab}
	B	16.3^{ab}	6.1^{a}	33.6^{ab}	8.8^{abc}	71.6^{a}	59.3^{ab}	42.7^{ab}
	C	14.4^{ab}	5.7^{a}	32.6^{abc}	7.6^{abc}	69.3^{a}	64.5^{ab}	38.7^{ab}
	D	12.8^{b}	5.3^{a}	31.1^{abc}	7.0^{abc}	68.3^{a}	56.2^{b}	45.1^{a}
P-Value*		**0.2203**	**0.5109**	**0.1079**	**0.1572**	**0.9103**	**0.3225**	**0.3225**

∗ ^{abc} Min values with different superscript are significantly different at P<0.05,
A: 75 x 9.3 cm; B: 45 x 10 cm; C: 75 x 11.3 cm; D: 45 x 20 cm

Table 2. Nutrient composition of the four sorghum varieties for the second harvest cycle

Variety	Planting density (cm)	Total Dry Matter (%)	Crude Protein (% DM)	Crude Fibre (% DM)	Lignin (% DM)	Neutral Detergent Fibre (NDF) (% DM)	Acid Detergent Fibre (ADF) (% DM)	Digestible Dry Matter – Calculated Value (DDM) (%)
Sugar graze (SG)	A	26.2^{a}	6.9^{a}	29.2^{ab}	6.1^{a}	76.8^{b}	59.7^{ab}	42.4^{ab}
	B	16.8^{b}	7.8^{a}	31.9^{a}	6.5^{a}	76.2^{b}	59.6^{ab}	42.5^{ab}
	C	23.1^{ab}	7.7^{a}	28.8^{ab}	5.7^{a}	79.4^{b}	58.1^{ab}	43.6^{ab}
	D	17.9^{ab}	6.9^{a}	29.5^{ab}	4.5^{a}	77.2^{b}	52.4^{b}	48.1^{a}
Brown midrib (BMR)	A	20.4^{ab}	7.4^{a}	30.0^{ab}	6.4^{a}	80.9^{ab}	55.2^{ab}	45.9^{ab}
	B	18.6^{ab}	6.8^{a}	28.3^{b}	6.6^{a}	80.6^{ab}	58.7^{ab}	43.2^{ab}
	C	17.3^{b}	6.9^{a}	28.6^{ab}	6.1^{a}	79.7^{ab}	55.6^{ab}	45.6^{ab}
	D	18.0^{ab}	7.7^{a}	31.6^{ab}	5.8^{a}	81.5^{ab}	53.5^{b}	47.3^{a}
Mega sweet (MS)	A	18.6^{ab}	7.4^{a}	29.5^{ab}	6.2^{a}	80.6^{ab}	60.8^{ab}	41.6^{ab}
	B	22.9^{ab}	7.8^{a}	31.0^{ab}	5.9^{a}	80.2^{ab}	57.0^{ab}	44.5^{ab}
	C	17.5^{b}	7.3^{a}	29.6^{ab}	6.9^{a}	82.0^{ab}	57.4^{ab}	44.2^{ab}
	D	17.0^{b}	7.3^{a}	30.7^{ab}	7.2^{a}	78.8^{b}	55.4^{ab}	45.8^{ab}
SPV 422	A	16.8^{b}	7.5^{a}	29.2^{ab}	6.6^{a}	77.9^{b}	56.2^{ab}	45.1^{ab}
	B	20.6^{ab}	8.9^{a}	31.3^{ab}	6.6^{a}	81.1^{ab}	63.9^{a}	39.1^{b}
	C	18.9^{ab}	6.8^{a}	28.4^{b}	5.3^{a}	77.7^{b}	58.9^{ab}	43.0^{ab}
	D	18.4^{ab}	7.7^{a}	30.3^{ab}	5.0^{a}	85.8^{a}	52.2^{b}	48.3^{a}
P-Value*		**0.3770**	**0.8592**	**0.2093**	**0.9357**	**0.1199**	**0.2528**	**0.2528**

∗ ^{abc} Min values with different superscript are significantly different at P<0.05,
A: 75 x 9.3 cm; B: 45 x 10 cm; C: 75 x 11.3 cm; D: 45 x 20 cm

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Effects of Different Levels of Urea Treatment on Nutrient Composition of Oil Palm Frond

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Sustainable and profitable livestock productivity in tropical regions is often limited by fresh roughage shortages and the use of high-cost conventional feed resources. Oil palm frond (OPF) is one of the major biomass residues of oil palm (*Elaeis quineensis* Jacq.) plantation and has been successfully being utilised as a roughage source for ruminants in tropical regions (1). However, the inherent limitations of OPF as a ruminant feed include its low crude protein (CP) and metabolisable energy content, as well as high lignocellulosic content (2–5). Ammoniation of OPF with non-protein nitrogen (N), such as urea has been shown to improve the nutritional value and digestibility of OPF in ruminants (3). Therefore, this study was conducted to evaluate the effects of treating OPF in relation to without (control) or with different urea levels (1–5%) with regards to its nutrient composition.

The freshly chopped OPF were mixed with different levels of urea (0, 1, 2, 3, 4 and 5%) separately and dissolved in 6% molasses to increase its feeding value and to raise the moisture content to about 70%. The mixtures were filled in a drum, compacted and sealed to exclude the air condition to reach an ideal anaerobic condition for 7 weeks at room temperature. After the ensiling period, the proximate analysis of the treated OPF without or with urea was carried out to determine the dry matter (DM), moisture content (MC), CP, ether extract (EE) and ash contents using AOAC methods (6). The MC was determined by drying the samples using a moisture analyser, while the total ash content was determined by igniting the samples for 2 h in a muffle furnace at 600 °C. The CP content was determined according to the Kjeldahl method by using a Kjeltec^{TM} Model 2300 protein analyzer, and the EE content was determined using the EE method using a SOXTHERM® Fully Automatic Rapid Extractor. The samples were analysed consecutively for fibre fractions, including neutral detergent fibre (NDF), acid

detergent fibre (ADF) and acid detergent lignin (ADL) using a Fibertec™ 2010 following the methods for detergent analysis (7). The gross energy (GE) content was measured using an IKA Bomb Calorimeter. All proximate analyses of samples were carried out in triplicate and expressed as g/kg DM.

Proximate analysis showed the treated OPF with urea (1–5%) had significantly lower ($P< 0.05$) DM and ash contents and significantly higher MC contents ($P< 0.05$) than that of the control. The EE contents were linearly decreasing ($P<0.05$) when increasing supplementation with urea particularly at 5% treatment. OPF treated with 5% urea had the greatest increase in CP (95.6 g/kg DM), followed by treatments with 4%, 3%, 2%, and 1% urea, with an increase of 76.7, 58.7, 42.5 and 21.2 g/kg DM, respectively, compared with that of the control. The NDF and ADL contents of treated OPF decreased (linear $P< 0.05$) with increasing levels of urea supplementation (1– 5%), and the highest reduction was from OPF treated with 5% urea. OPF treated with 3 and 5% urea had a significantly lower ($P<0.05$) ADF value than control and 2% urea, but was not significantly different ($P>0.05$) from those of the OPF treated with 1 and 4% urea. The GE was significantly ($P< 0.05$) lower in OPF treated with 2%, 3%, 4% and 5% urea than in control and OPF treated with 1% urea.

In conclusion, the nutritive values of OPF were improved by urea treatment and the impact was more pronounced with 5% urea. The inclusion of urea as ingredients in the OPF treatment could alter the chemical compositions by improving the nutritional values of OPF which could promote positive impacts on ruminal fermentation profiles and animal production.

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Pellet Durability Index of Tilapia Starter Feed Pellet with Varying Inclusion Levels of Palm Fatty Acid Distillates

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Fish require dietary lipid sources to meet their essential fatty acid requirements (1). Lipid feedstocks from the oil palm industry have a huge opportunity to substitute for fish oil utilization in aqua feed industry at a lower price due to the abundant supply throughout the year. The physical quality of fish feed pellets is crucial because it influences the rate of nutrient absorption by the fish, resulting in improved overall growth performance. This study was conducted to evaluate the pellet durability index (PDI) of tilapia starter feed pellet with varying inclusion levels of palm fatty acid distillates (PFAD).

Four tilapia starter diets (5, 8, 10% PFAD and control (CNT) – without PFAD) were formulated and produced using a twin-screw extruder to have similar level of nutrients with a commercial (COM) diet (as the positive control). The PDI was measured using a Pellet Durability Tester (NHP100, TEKPRO, UK). The tester works by loading a manually weighed sample of pellets into a test chamber, cascades them in an air stream at 70mBar, which causing the pellets to collide with each other and the perforated hard surfaces of the test chamber. Fines-free pellet from each treatment diet (in triplicate) with approximately 100g were weighed, added to the test chamber, and tested for 60 seconds. The tested pellets left inside the test chamber were weighed and PDI was calculated as the percentage of the pellets retained divided by the total mass of pellets. All data was subjected to analysis of variance (ANOVA). Mean differences among treatments were analysed by Duncan's Multiple Range Test using SAS 9.1™ statistical package. Significance was set at $P<0.05$.

The PDI results of tilapia starter feed pellet of different treatments are shown in Figure 1. The PDI of the COM feed pellets was significantly higher ($P<0.05$) than the other treatments. Feeds containing various PFAD levels at 5, 8 and 10% meet the PDI requirement of >90%. There was no significant difference ($P>0.05$) in PDI between 5 and 8% PFAD feed pellets but

was significantly higher (P<0.05) when compared to the 10% PFAD feed pellet. The lowest PDI was found in the CNT feed pellet, which was below the recommended PDI level and significantly lower (P<0.05) when compared to all other treatments.

The results were similar to (2-4), which indicated that the inclusion of fats at various levels in the feed influenced feed durability, with fat inclusion levels consistently found to have an inverse correlation with feed pellet durability. However, the inclusion of fat as the energy source in feed formulation is still needed when developing high energy density diets. Therefore, the addition of natural or synthetic binding agents, such as wheat pollard or lignosulfonate, can be used to improve feed starch gelatinization and thus improve PDI. In conclusion, tilapia starter feed pellets with the inclusion of PFAD of up to 10% have shown good PDI values that meet the durability requirements for producing high quality fish feed pellets.

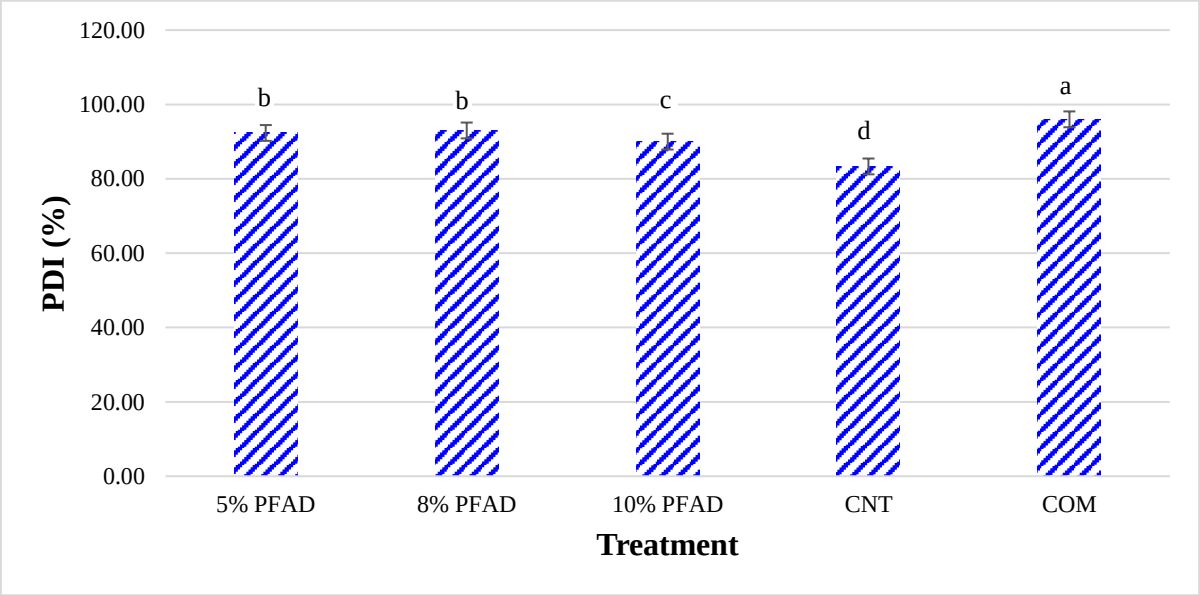


Figure 1. Pellet durability index of tilapia starter feed pellets of different treatments.
Note: PFAD – palm fatty acid distillates; CNT – control; COM – commercial.
Significant differences (P<0.05) between treatment groups are indicated by different letters.

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Development of Antibody-based Kit for the Detection of Ochratoxin in Grain Corn

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Rapid development in livestock and husbandry industries has indirectly increased feed production and output, especially grain corn-based feed. However, due to certain factors, processed and non-processed grain corns can produce harmful mycotoxins along the production chain which can lead to serious health issue towards livestock and human. *Aspergillus* and *Penicillium* species are potent fungi that can produce ochratoxins in grain corns [1]. Storage environment such as poor aeration and high humidity, in addition to natural Malaysian weather, are potential factors that can speed up the fungi growth and production of ochratoxins [2].

An early ochratoxin detection method should be developed in order to screen the presence of the target analyte in grain corn before it can be marketed and consumed. The conventional methods such as chromatography and mass spectrometry are undoubtedly reliable and accurate. However, the procedure is time consuming, tedious and requires large sample volume. An antibody-based ELISA kit promises high sensitivity [3] as the antibody are specifically developed for ochratoxin A, which reduce any potential cross-reactivity with other mycotoxins.

Ochratoxin A antibody was developed in two rabbits (Animal Ethics Committee of MARDI - Approval number 20190215/R/MAEC00045) and successfully characterised. The sensitivity of ochratoxin A antibody was determined using competitive direct ELISA. 100 µL 1 mg/mL mycotoxin antibody was immobilised in 96-well microplate (n=3) overnight at 4 °C. The plate was washed three times with 350 µL washing buffer (0.05 % Tween 20). The plate then was filled with 250 µL blocking buffer (0.05 % dry milk) and incubated for an hour at 37 °C. The plate was washed again. 50 µL serial dilutions of ochratoxin A standard were immobilised in the well followed by 50 µL HRP conjugate. The mixture was allowed to incubate for 2 hours at 37 °C. The plate was washed again before was filled with 100 µL TMB substrate. The plate was read at 370 nm after 15 minutes (corn matrix) or 30 minutes (PBS) incubation using an ELISA reader.

Ochratoxin A displayed non-significant cross-reactivity towards all groups of mycotoxins (Fig. 1a). The performance of ochratoxin A antibody in competitive assay was highly selective towards its respective target analyte. The sensitivity of the developed antibody were determined in PBS and corn matrix (Fig. 1 b and c). The performance of antibody was better in corn matrix compared in PBS, as ochratoxin A was detectable at much lower concentration (lower LOD and LOQ). This also proved that matrix study was successful in eliminating possible interferences in corn matrix.

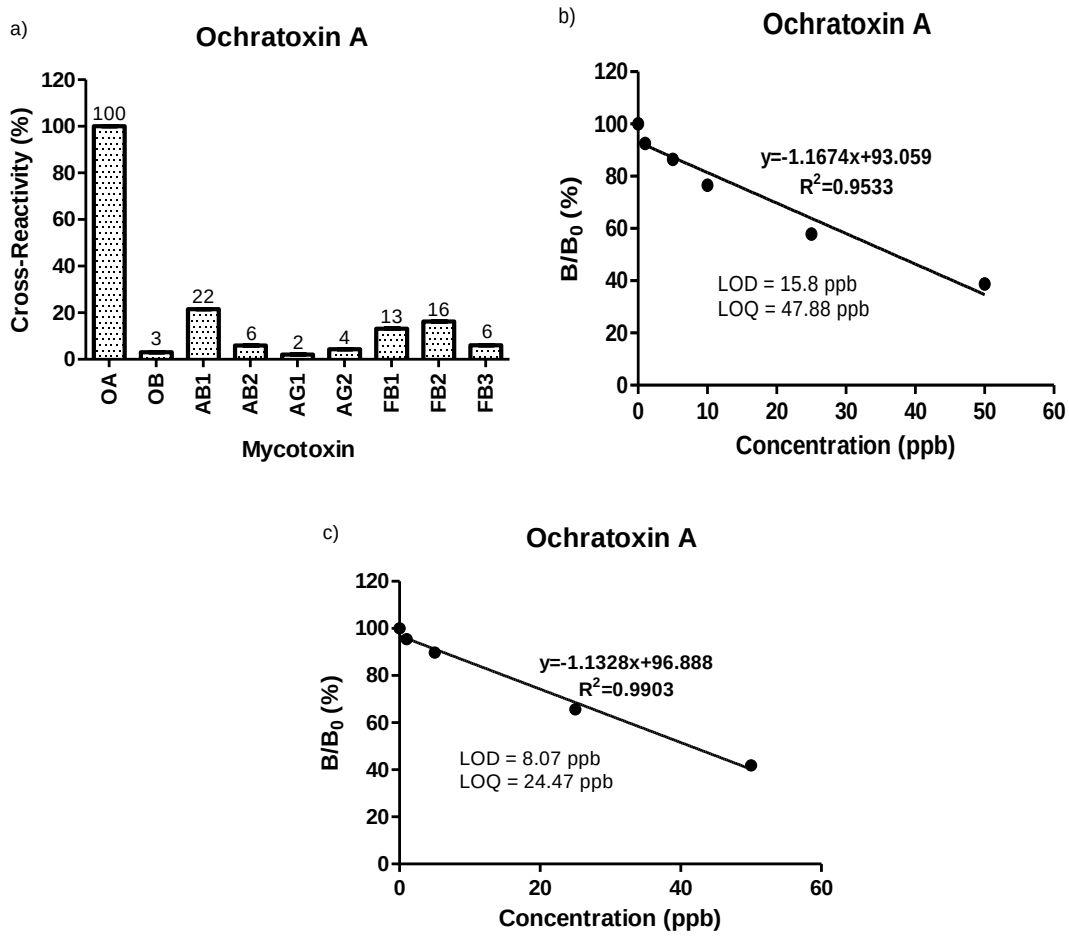


Figure 1. a) Cross-reactivity of ochratoxin A antibody against mycotoxins and standard curve of ochratoxin A in b) PBS and c) corn matrix.

A detection method of ochratoxin A in grain corns has been successfully developed using optical measurement involving biological reactions between antibody and ochratoxin A in ELISA protocol. This method has produced high selectivity, sensitivity and accuracy and can detect the presence of ochratoxin A in low concentration. In addition, this method can be applied to other feed sources such as nuts, paddy, wheat and grass.

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Nutritional Values of Corn Silage by the Addition of Lactic Acid Bacteria

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Farmers are able to store forage in the form of silage, providing a cost-effective feed when required. However, the challenge is to ensure that the valuable dry matter, energy and protein are not lost. Sweet corn is a popular crop in Malaysia. After its cobs have been harvested, the stover still remains a good source of nutrients, suitable for cattle feeding. The metabolizable energy (ME) value (7.82 MJ/kg of fresh stover) with 9.6% of crude protein (CP) content is comparable to or in some cases better than most fodder grass species being used in Malaysia. Ensiling the stover is thought to be the best form of conservation [1]. Silage is the product resulting from fermentation of fresh forage under anaerobic conditions. Efficient fermentation ensures a more palatable and digestible feed which encourages optimal dry matter intake that translates into improved animal performance. More nutrients will be retained when the fermentation process completed faster. Since silage is a product resulting from the action of bacterial enzymes on the material stored, attempts have been made to regulate silage fermentation through the addition of microbial inoculants. The primary purpose for adding bacterial inoculants is to increase the number of lactic acid-producing bacteria, encouraging more lactic acid production and well-preserved forage mass [2]. In this study, we examined the effects of lactic acid bacterial inoculants on the quality of corn stover silage.

The bacteria were isolated from the rumen of local Kedah-Kelantan cattle in MARDI Kemaman, where the rumen liquor was withdrawn from fistulated cattle and kept in anaerobic condition, filtered using nylon cloth to remove debris and were cultured on MRS agar plate until a single colony was formed. The collected colonies were identified by 16sRNA sequencing and blast using the NCBI Blast system. The identified isolates are in the group of lactic acid

bacteria (LAB). Corn stover (variety SS232, at the harvesting age of 75 days) silage was prepared using a small scale system of silage fermentation. There are two groups of silage; control without any additive, and silage with the addition of lactic acid bacteria at a rate of 10^5 cfu/g fresh stover [3]. Silages were opened at 21 days of fermentation. The chemical composition including proximate, energy, and fiber were determined. All data were analyzed by Student's t-test using SAS 9.4 program. There is no significant difference in pH, dry matter, and chemical compositions between treated and untreated silage except for their CP, ash, and crude fiber (CF) values. LAB-treated silage contains higher CP than untreated silage. Mean total percentage of CP content in LAB-treated silage improved by 17% compared to untreated silage. However, the ME values obtained in control and treated silage of this study were lower than fresh stover (as quoted above). This may be due to the use of energy during the fermentation process for microbial activity as they breakdown nutrient nutrients to produce volatile fatty acids and to synthesize microbial protein [4].

As a conclusion, a sufficient amount (10^5 cfu/g of fresh stover) of LAB in silage could preserve protein and fiber content in corn stover silage at the age of 21 days of fermentation.

Table 1. Nutritive values of corn stover silage in addition of lactic acid bacteria

	CS			LAB_CS		
Energy						
ME (MJ/kg)	7.70	±	0.14	7.62	±	0.42
Total digestible nitrogen (TDN) (%)	55.84	±	0.87	55.35	±	2.56
Proximate						
CP (%)	8.53	±	0.74	9.97	±	0.41*
Ash (%)	6.47	±	0.22	7.06	±	0.31*
Nitrogen-free extracts (NFE) (%)	65.09	±	1.17	61.78	±	1.07
Crude fat (%)	1.13	±	0.28	0.86	±	0.42
Dry matter (%)	22.38	±	0.21	22.00	±	0.57
Fibre						
CF (%)	25.70	±	0.96	27.27	±	0.72*
Acid detergent fiber (ADF) (%)	34.53	±	0.49	33.58	±	1.22
Non-detergent fiber (NDF) (%)	61.90	±	1.14	62.67	±	0.36
Lignin (%)	8.17	±	0.54	8.29	±	0.31
Hemicellulose (%)	27.37	±	0.86	29.09	±	0.43
Cellulose (%)	26.35	±	0.49	25.28	±	0.52
pH silage	3.77	±	0.06	3.72	±	0.05

CS: Corn silage; LAB_CS: LAB treated corn silage
Values were tabulated in mean ± standard deviation
*significantly different from control group at $p<0.05$

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Nutritional and Digestibility Value of an Insect Meal as Feed Ingredient for Fish

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The use of non-conventional feed ingredient in formulating fish diet has now getting more attention to overcome the unsustainable usage of conventional feed ingredient such as fishmeal and soybean meal. Many researches have been conducted in countries around the world specially to introduce the locally available potential feed ingredients. There are many types of non-conventional feed ingredients which could be from animal or plant based. Insect-based protein is one of the non-conventional feedstuffs being studied nowadays with more than 100 species has been enlisted to be commercially produced in the European and Meditteranean Plant Protection Organization region and in North America (1). Despite that, the reduction in fishmeal production and its shortage source has urge researchers to seek other protein alternative which has similar nutrient contents and essential amino acids as fishmeal (2). *Zophobas morio* or known as superworm is one of the potential insects that could be found in Malaysia. This particular insect has been famously used among the fish tackle as bait. The high protein content of this insect is seen to have potential as protein source in fish diet. Thus, an experiment was conducted in MARDI to evaluate the nutritional value of superworm through digestibility study in red hybrid tilapia, *Oreochromis* sp.

Superworm were purchased from a local pet shop and reared in rectangular plastic container in a room temperature of around 24-30˚C. Wheat pollard was used as bedding material and also served as feed for this animal. Potatoes were also placed in the container which provides moisture for the animal. The superworm which has obtained mature size (darker in colour) were sorted and used to produce superworm meal. The superworm were packed in an air tight plastic bag and were euthanized humanely by freezing the superworm in the freezer (-10˚C) until all the superworm are dead. Dead superworm were then thawed and placed in the oven (60˚C) until dry and then ground to form meal. The meal was then analysed for proximate composition based on the AOAC 2012 method.

For digestibility study, direct method (total collection) was used in this study. The study consisted of two treatments (reference diet and experimental diet) with 3 replicates for each treatment. The experimental diet consisted of 70% of the reference diet (basal diet with fishmeal as sole protein source) and 30% of the test ingredient (superworm meal). Digestibility of the test ingredient was performed by total collection method. Ten juvenile tilapias (*Oreochromis* sp.) (±20g body weight, 3 inches total length) were placed in a 100-L glass aquarium for the trial. The fish were fed once a day till satiation in the morning at 0900. All uneaten feed were collected an hour after feeding, and the feces were collected 4-5 hours after feeding and also on the next morning. The feces samples were dried in the oven at temperature of 60˚C until dry. Feces samples were collected until it is sufficient for chemical analysis. Analyses of dry matter, protein, amino acids and energy content of the feed and feces were determined and used in calculating its digestibility value.

Table 1. Digestibility values of superworm meal in tilapia

Nutrient	Digestible values
Dry Matter (%)	71.81
Protein (%)	43.61
Energy (MJ/kg)	20.58
Essential amino acids (%)	
Arg	1.71
Thr	1.74
Cys	0.14
Val	2.47
Met	0.71
Ile	1.75
Leu	2.74
Phe	1.70
His	0.19
Trp	0.40
Lys	1.46

The digestibility values of dry matter, protein, energy and essential amino acids are shown as in Table 1. The digestible coefficients of all nutrient were above 80% indicating that superworm meal is considered to be digestible in tilapia and can be used as protein source specially in tilapia diet. The digestible protein value is 43.61%, which is comparable to the conventional soybean usually used in fish feed. However, this finding is in contrast with a study done by Abd Rahman Jabir *et al.* (3) which the digestible coefficient of protein for superworm was found to be 50.53%. Furthermore, superworm is animal-based protein and is more suitable to be used in formulating carnivorous or omnivorous type fish. The digestible energy is also

relatively high with 20.58 MJ/kg and may occupy the energy requirement of tilapia. Superworm seem to be a very potential candidate of local source to be explored and utilized as feed ingredient in aquafeed.

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Tilapia Feed from Local Feed Ingredients

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Aquaculture industry has rapidly expanding in Malaysia and is now considered as one of the main industries to sustain the growing population in terms of food security and as a major supplier of animal protein (1). Feed is the major concern in any livestock production including aquaculture. The use of non-conventional feedstuffs from local sources may help to reduce the use of imported feedstuffs (2) which is among the reason of high feed cost in aquaculture. Four local feedstuffs from agricultural by-product such as feather meal, copra cake, rice polish and palm kernel meal (PKM) were evaluated for its availability as feed source for tilapia. All feeds serve as protein and energy sources in the diet of tilapia. Hence, a trial was conducted to evaluate the growth performance of red hybrid tilapia, *Oreochromis* sp. fed with MARDI formulated feeds.

Protein digestibility of the feed ingredients ranges from 60% to 99% with feather meal was found to be the most digestible among them. As for energy digestibility, the highest was found in feather meal as well with 95% and the lowest is in PKM with 60% respectively. Amino acids digestibility was also found to be poorest in PKM compared to other feedstuffs. Based on these digestible values, 2 least cost feed formulations (A and B) were developed containing the local feedstuffs with 32% of protein and 13 MJ/kg energy. Both diets contained the same local feed ingredients (PKM, feather meal, rice polish) except that diet B did not have fishmeal at all. A commercial feed was used as the control in this trial. The fish used in this trial is juvenile tilapia with average initial weight of 44±1g.

Six hundred juvenile tilapia were randomly assigned to 3 treatments with 4 replications each. Each replicate contains 50 fishes. The fishes were reared in a 1000-litre circular blue polyethylene tank with aeration equipped for 24 hours. Fishes were fed twice a day at 3-5% of body weight which were adjusted every fortnight. The feed was given at a higher percentage during juvenile stages and were reduced as the fish grow bigger. Water exchange was done every 4-5 days and is depending on the water quality of each tank. Water parameters were

measured weekly using YSI Multiprobe Meter for dissolved oxygen (DO), temperature, ammonia (NH_3) and pH. The data collected for growth parameter measurement were weight gain, final weight, feed intake and feed efficiency ratio (FCR). This trial was conducted for 12 weeks. Results were analysed by general linear model and treatment means was compared by Tukey's test using SAS Version 9.3.

Table 1. Growth performance of tilapia at week 12 of feeding trial.

Treatment	Diet A	Diet B	Commercial Diet
Initial Weight (g)	45.45±3.26[a]	45.40±2.77[a]	45.65±3.30[a]
Final Weight (g)	166.30±5.10[a]	174.77±4.05[a]	246.12±17.23[b]
Weight Gain(g)	120.85±5.32[a]	129.37±4.36[a]	200.47±15.81[b]
Feed Intake(g)	174.1±7.45[a]	173.06±14.14[a]	223.63±15.74[b]
FCR	1.44±0.10[a]	1.34±0.09[a]	1.12±0.03[b]

FCR- Feed Conversion Ratio

From the growth performance trial, fish fed with diet B showed better performance than diet A, even though no fishmeal was used in diet B, however, it is not significantly different ($p>0.05$). This may seem to be promising as fishmeal supply is getting scarcer and may be very competitive in future. There has also some studies done to reduce the use of fishmeal in the diets of farmed fishes. It is projected that the use of fishmeal in the diets of shrimp would be reduced from 16 to 8%, 26 to 12% for marine fish, and 2-3% to 1% for carps and tilapias (3). Best performance was noted in fish fed commercial diet with lowest feed conversion ratio of 1.12±0.03, and the weight gain was also better than both experimental diet ($p<0.05$). The price of producing a kilogram of diet A is RM 2.57 and RM 2.28 for diet B. Whereas, for commercial feed the price per kilogram is RM 3.50. Cost per kilogram of fish produced is RM 3.70 and RM 3.06 respectively for diet A and B compared to the commercial feed which is RM 3.92 per kilogram. It can be concluded that diets formulated by MARDI even though is slightly lower in terms of growth performance than commercial feed, it can still be use as a potential alternative feed as the cost of fish produced using this feed is much cheaper than commercial feed. With the current pandemic we are facing now, it is crucial to start exploring or using local feed ingredients in order to strive this challenging time and safeguard our future aquafeed production.

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Preliminary Study of Gender Effect on the Growth Performance of Saanen Kids

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Saanen goat appeared to be one of the best dairy goat breed, for its strong constitution to their health, high production and high adaptability to the new environment (1). Due to the high demand in Malaysia, farmer need to make sure the growth performance of the young goats is at optimum level. In this study, the growth of different gender were observed and research was conducted at UniSZA Pasir Akar Farm. There are two objectives in the present study; 1) to determine live weight of pre and post-weaning Saanen kids and 2) to measure body condition score (BCS) between male and female pre and post-weaning kids. 10 pre and post-weaning Saanen kids (purebred) represented n=5 male and n=5 female respectively used in this study.

Results were expressed as mean+standard deviation; p value was calculated from T-test. Table 1 showed both pre and post-weaning Saanen kids had gained weight steadily from week 1 to week 6, where mostly male heavier than female. However, p value indicated that there was no difference in live weight between male and female Saanen kids for both groups. Meanwhile, Figure 1 demonstrated BCS over pre and post-weaning Saanen kids, which increased from Week 1 to Week 6.

Table 1: Live-Weight of Pre & Post-Weaning between Male and Female Saanen Kids

	Pre-Weaning	Post-Weaning
	Mean±Standard Deviation	Mean±Standard Deviation
1	7.2±0.84 vs. 6.6±1.34 (p=0.43)	15.30±2.67 vs. 15.40±2.32 (p=0.93)
2	7.8±1.30 vs. 7.8±0.84 (p=1.00)	15.65±2.75 vs. 15.80±2.14 (p=0.98)
3	8.0±1.22 vs. 8.0±0.71 (p=1.00)	16.25±3.10 vs. 16.15±2.52 (p=0.93)
4	8.4±1.52 vs. 8.4±0.89 (p=1.00)	16.65±3.14 vs. 16.65±2.45 (p=1.00)
5	8.6±1.14 vs. 8.8±0.84 (p=0.76)	17.10±3.11 vs. 16.75±2.19 (p=0.78)
6	9.0±1.41 vs. 8.8±1.10 (p=0.81)	17.85±3.36 vs. 17.55±2.25 (p=0.82)

*p value was calculated from T-test where $p<0.05$ is considered significant. Male vs. female showed $p>0.05$ for both pre & post-weaning groups respectively

Previous study reported male kids were heavier than female due to breed and environmental factors, which positively related to growth performance (2). The current result was parallel with the other study that stated there was no significant weight difference between male and female Saanen kids in pre-weaning stage, however the result was contradict in post-weaning group (3). BCS can be influenced by diets and metabolism status (4) and this explains why it is slightly lower in Week 6 compare to Week 5. The live weight of pre-weaning was insignificant due to pre-weaning kids were still in a growing phase (5). Furthermore, this study used very small animal numbers, which looked not much differed compared to previous studies. In fact, this is only a preliminary study to see the gender effect of Saanen kids growth performance, which used a very limited number of animals, perhaps more parameters will be involved so the study can be an interesting research to discover.

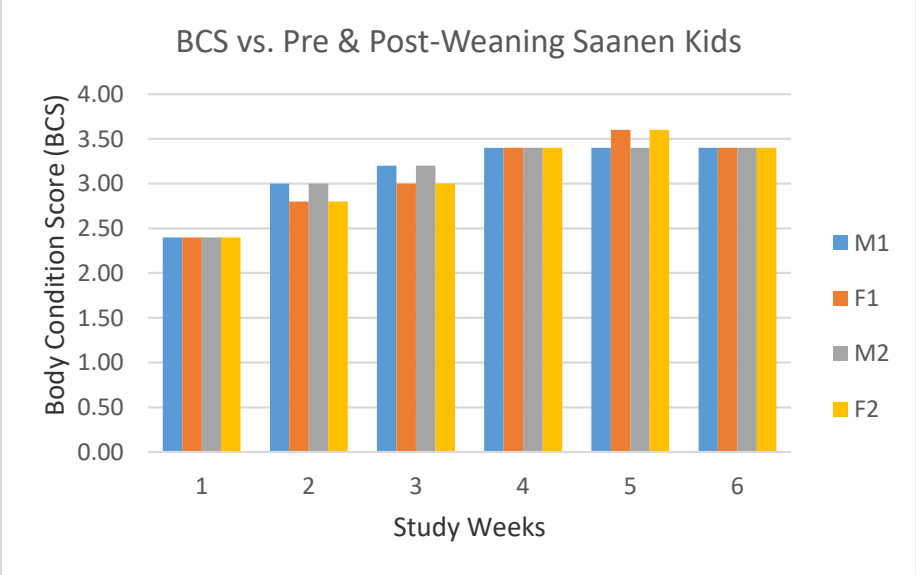


Figure 1: Body Condition Score over Pre & Post-Weaning between Male and Female Saanen Kids

*M1 and F1 referred to male and female of pre-weaning, while M2 and F2 for male and female post-weaning kids.

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Malaysian Beef Cattle Industry Scenario: A Survey on Beef cattle Farms in Malaysia

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Malaysia's beef cattle population was reported at 676,686 head in 2018, worth RM1,595.87 million (1). However, these numbers were only producing 46,923 metric tonnes (mt) of meat, contributed to 23% of the total national beef consumption, which was estimated at 200,000 mt. Although livestock enumeration is conducted periodically across Malaysia, data on breed, age and liveweight were not collected. All these data are important to understand the current scenario for future development of the cattle breeding industry in Malaysia.

Therefore, a field survey was conducted to collect beef cattle breeds, genital, age, weight and etc. from selected beef cattle farm (n=32) in Malaysia. The survey has shown that Malaysia has various cattle breeds, mainly Kedah-Kelantan (KK) crossbred. There were also some unidentified breeds with typical colour of KK crossbreed. This is due to unknown parental breeding, purchased of unknown parental breeding, and improper breeding program among small holder farmers. A KK and KK crossbred remain the major cattle breed reared (71.6 %) and mostly reared via integration with palm oil plantation. In addition, Malaysia palm oil plantations with over 3.2 million hectares is suitable for cattle integration at a stocking rate at between 1.9 and 3.7 head ha^{-1}. The KK crossbred cattle are well-adapted to Malaysian climate, highly resistant to diseases and easily managed although they tend to have lower live weight. The census data obtained showed that estimated KK crossbred's live weight were between 80-350 kg for cattle aged 2 years old and above and is marketable for aqiqah and qurban activities. However, KK elite breed was reported to gain between 430-460 kg weights under intensive farming at 3-4 years old age (2). Thus, higher body weight among KK crossbred is possible to gain under intensive farming system for maximum profit. The cattle genital fraction found to be 59.4% dominated by male cattle, however the born ratio was higher for female cattle with 59.5%. Similarly, the number female cattle that estimated to live in a year was higher than male,

with the percentage of 62%, as they were kept for breeding proposes. Although selling live cattle has been so popular for local market, yet there is small percentage selling as young cattle, carcass meat or retail meat to the consumer (Table 1).

The census also showed that the largest farming system in Malaysia was intensive farming (40.6%), followed by extensive (31.3%) and semi-intensive (12.5%) in compared to 'intensive and extensive' farming (12.5%). Generally, intensive system has higher liveweight gains (fattening) and carcass ratio. However, these farmers are lack of business-oriented strategy and remained as traditional backyard farming. Our data revealed 76.7% of the farmers run the cattle beef farm on a part-time basis and practicing backyard farming, similar to report by Jalaludin and Halim (3), which may explain why 68.8% cattle farming activity remains as self-ownership without SSM registered, and the rest were Enterprise at 18.8% and Sdn. Bhd at 12.5%. Therefore, nearly half of the farmers also reared other animals such as goat, sheep, chicken and others on their farms.

Table 1: Beef cattle farm information and scenarios from farms survey in Malaysia (n farms = 32)

Farming Own ship scope	Percentage (%)	Type of Production system	Percentage (%)
Own	68.8	Intensive	40.6
Enterprise	18.8	Extensive	31.3
Sdn. Bhd.	12.5	Intensive and extensive	15.6
		Semi intensive	12.5
Farming model		Involve in other livestock production	
Part time	76.7	Yes	46.9
Full time	23.3	No	53.1
Breeds		Cattle age breakdown (male and female)	
KK and crosses	71.6	<1 year	21.8
LID and crosses	16.6	1-3 year	30.4
Charolais and crosses	3.6	> 3 year	47.7
Brahman and crosses	6.4		
Limousine and crosses	0.8		
Etc.	0.9		

Genital ratio	Live animal (%)	Birth ratio (%)	NAPA* (%)
Male	59.4	42.6	39.3
Female	40.6	57.4	60.7

KK and KK crosses estimated live weight (kg)		Selling tendency / frequency rate	%
<1 year	25-80	Live adult	61.9
1-3 year	80-250	Others	38.1
>3 year	150-350	(Young cattle and carcass/retail)	

Manure management		%
Solid	Unmanage solid	25.9
	Manage solid as organic fertilizer	22.2
Liquid	Liquid unmanage (lagoon / pond /etc)	51.9

*NAPA: Number of days animals estimated to live in a year

Even though most farmers preferred keeping the cattle under intensive farming system typically feed lotting, there was lack of proper manure management. This is evidenced by 54 % of farmers who channels animal waste to holding pond/lagoon without proper utilization afterwards and also with 20 % of farms which recycle animal waste as organic fertilizer.

In general, the Malaysian beef cattle industry is still at a small-production scale, it is growing and moving towards more sustainable agriculture. However, the growth of the industry is still inadequate to cater for the population need and to enhance food security.

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Nutritional Flushing with Three Energy Levels on Dorper Ewes' Reproductive Performance.

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A common practice used in animal breeding is nutritional flushing before breeding. Flushing is an essential regulator for reproduction, and body condition score (BCS) used as an indicator to identify which animals are prepared for breeding (1). Poor BCS of ewes will decrease conception, lambing, and twinning rate (2). Thus, an energy-based supplementary feeding before breeding (flushing) will improve the BCS subsequently enhances reproductive efficiency by increasing the reproductive performance in sheep. The objectives of this study are to evaluate the effects of supplementation with three energy levels on the BCS, body weight and reproductive performance of Dorper ewes.

The experiment was done in MARDI Muadzam Shah, Pahang. Sixty healthy ewes aged from 2.5 to 4 years old, with average body weight (BW) of 53.4 ±7.2kg, were randomly allocated equally in the 3 treatments group. The treatments were formulated for flushing ewes of 50 kg live-weight based on the nutrient requirements for sheep (3). The treatments were isonitrogenous with high energy (HE) concentrate (18.5 MJ/kg), intermediate energy (IE) concentrate (14.23 MJ/kg; control) and low energy (LE) concentrate (9.96 MJ/kg). The concentrate was given based on estimated dry matter intake (DMI) of 2.5% of body weight. The ewes were allowed to graze *Bracharia humidicola* pasture for 4 hours before supplemented with the concentrate feeds. Flushing started 21 days before the introduction of the rams. The ewes were weighed, and BCS on a rating scale from 1= skinny, 2= thin, 3= good, 4= fat and 5= obese was recorded at the initial and final period of the feeding trial. The breeding period was 60 days. Pregnancy diagnosis was made at 3 months after the introduction of rams. The reproductive parameters that recorded were conception and lambing rate.

The nutrient content of treatments and the results of the study were shown in Table 1. Ewes in HE, IE and LE groups showed the mean final body weight, and BCS were 60.5 ±

1.53kg and 3.9 ± 0.9, 59.9 ± 1.37kg and 3.2 ± 0.14 and 56.4 ± 1.07kg and 2.9 ± 0.11, respectively. Final BW and BCS of HE groups showed the highest compared to IE and LE. The final BW and BCS of ewes in treatment HE and IE were significantly increased ($P<0.05$) compared to the LE treatment group. The mean conception and lambing rate for HE, IE and LE groups were 70% ± 0.12 and 90 % ± 0.12, 85% ± 0.81 and 115% ± 0.11, 80% ± 0.91 and 90% ± 0.08, respectively. Ewes in the IE group showed significantly higher ($P<0.05$) conception and lambing rates than the HE group. Ewes in the HE group has the lowest conception rate among the treatments, yet no significant difference in lambing rate with the LE group. The mean final body weight and BCS of ewes in this study increase along with the level of energy in the treatments, which agreed to a previous study (4). The conception and lambing rate in the IE group showed the highest rate compared to the other treatment with increasing of lambing percentage by 25%. Malpura ewes with a BCS of 3.0–3.5 had a higher conception rate than ewes with lower and higher BCS (5). A study (5) showed that ewes with a BCS of 3.0 has a higher conception rate but decreased in ewes with BCS of 4.0 agreed to the result in this study, ewes in the HE group with BCS of 3.9 ± 0.9 has lower conception rate. While lambing rates in this study were in contrast to a study previously (6), lambing rates in Cheviot ewe increased up to a BCS of 2.50–2.75 before declining. However, a previous study (7) concluded that BCS only accounted for a small percentage of the total variation in lambing rate. It can be concluded that Dorper ewes required flushing feed with approximately 14.23MJ/kg of energy level to reach optimum reproductive performance.

Table 1. Nutrient content of treatments and body weight, body condition score and reproductive performance of ewes between the treatments.

Treatments/ Nutrient content	**HE**	**IE**	**LE**
DM (%)	89.7	89.9	90.1
GE (MJ/Kg)	18.50	14.23	9.96
CP (%)	15.8	16.0	15.7
CF(%)	27.8	24.7	20.64
Parameters	**n=20**	**n=20**	**n=20**
Initial			
Bodyweight (kg)	54.4 ± 1.87	53.9 ± 1.45	55.1 ± 1.20
BCS	2.49 ± 0.15	2.3 ± 0.14	2.54 ± 0.19
Final			
Bodyweight (kg)	60.5 ± 1.53^{a}	58.9 ± 1.37^{a}	56.4 ± 1.07^{b}
BCS	3.9 ± 0.9^{a}	3.2 ± 0.14^{a}	2.9 ± 0.11^{b}
Reproductive performance (%)			
Conception rate	70 ± 0.12^{b}	85 ± 0.81^{a}	80 ± 0.91^{a}
Lambing rate	90 ± 0.12^{b}	115 ± 0.11^{a}	90 ± 0.08^{b}

DM: Dry matter, GE: Gross Energy, CP: Crude Protein and CF: Crude Fiber.
[a, b] Means with different superscript letters are significantly different ($p< 0.05$)

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Carcass Traits and Composition of Katjang Goats Fed with Oil Palm Byproducts Based Feed Pellet

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This study was conducted to evaluate the effects of the oil palm by-products based feed pellet on the carcass traits and composition of Katjang goats. The treatment groups consisted of oil palm by-products based (OPB), control (without addition of oil palm by-products, CNT), and commercial (COM) pellets. Twelve male Katjang goats (12-months old) were assigned to one of the three treatment groups (n=4). The CNT pellet was formulated using corn, soybean meal, soybean oil, rice bran, rice straw and feed additives, whereas the OPB pellet was formulated using the same feed ingredients but with oil palm by-products (oil palm frond, palm kernel meal, empty fruit bunch and palm fatty acid distillates) instead of rice straw. Both CNT and OPB pellets were formulated to be isonitrogenic and isocaloric to the COM feed pellet, as well as to meet the maintenance requirement for growing goats. A 14-weeks feeding trial was conducted in which each group was offered Napier grass (*ad libitum*) and respective feed pellets at 1.5% of body weight. At the end of the feeding trial, all goats were slaughtered for carcass traits and composition analyses. Feed cost was calculated based on the price per tonne of the raw materials needed to produce one tonne of pelleted feed.

Carcass traits and composition of Katjang goats fed with different feed pellets are shown in Table 1. There were no significant differences (P>0.05) in carcass traits between goats fed with OPB, CNT and COM. Overall, the slaughter weight of goats from all treatments ranged between 19.00 to 19.55 kg, whereas hot and cold carcasses weights were ranged between 8.10 to 9.13 kg and 8.00 to 8.98 kg, respectively. The lowest dressing percentage was observed in goats fed with CNT at 43.84%, which is slightly lower than the general dressing percentage of 45 to 50% for male goats as reported by (1). However, dressing percentage result in this study was within the range as reported by (2) which is between 37-55%. The goats fed with OPB had no significant differences (P>0.05) on carcass composition such as meat, bone and fat percentage when compared with CNT and COM. This finding was consistent with the

observation by (3), who reported that feeding 25% oil palm by-products in the diet of goats had no effect on the carcass yield when compared to the group fed with 100% commercial pellet. (4) also reported that feeding oil palm by-products to goats did not significantly affect their dressing and meat percentages.

Table 2 shows cost analysis of katjang goat fed with different diets. Calculation of feed cost/kg gain (RM/kg) revealed that goats fed with OPB pellet had the lowest feed cost of RM 9.06, followed by COM and CNT with RM 9.44 and RM 10.05, respectively. Utilizing local feed materials from oil palm industry can produce feed with competitive price as OPB diet provide feed cost saving of RM0.38 per kg gain as compared to COM. As a conclusion, feed pellet containing oil palm by-products has shown comparable to commercial feed pellet in terms of carcass traits and compositions of the Katjang goats as well as feed cost calculation.

Table 1. Carcass traits and composition of Katjang goats fed with different diets[#]

Parameter	OPB	CNT	COM	*p*-value
Carcass traits				
Slaughter weight (kg)	19.55 ± 1.24	19.00 ± 2.11	19.40 ± 1.66	0.90
Hot carcass weight (kg)	9.13 ±1.11	8.10 ± 1.05	9.10 ± 0.80	0.37
Cold carcass weight (kg)	8.97 ± 1.06	8.00 ± 1.05	8.98 ± 0.81	0.39
Dressing percentage (%)	46.81 ±2.06	43.84 ± 1.60	47.04 ± 4.12	0.38
Offal[*] (% of slaughter weight)	21.20 ± 1.10	20.50 ± 1.77	20.93 ± 1.58	0.85
Pluck[**] (% of hot carcass weight)	5.82 ± 0.46	6.52 ± 0.97	6.50 ± 0.78	0.46
Carcass composition (% of cold carcass weight)				
Meat	66.14 ± 1.13	66.84 ± 2.50	68.19 ± 4.10	0.68
Bone	22.94 ± 2.17	21.66 ± 1.66	22.07 ± 1.42	0.66
Fat	10.92 ± 3.28	11.50 ± 2.34	9.74 ± 2.86	0.76
Meat:bone	2.90 ± 0.23	3.10 ± 0.30	3.11 ± 0.37	0.65
Meat:fat	6.51 ± 2.28	6.03 ± 1.58	7.57 ± 2.59	0.66

[#]Data published in (5). OPB–oil palm by-products based formulated pellet, CNT–pellet without oil palm by-product inclusion, COM–commercial pellet, Offal[*]–head, leg, and skin, Pluck[**]–heart, liver, kidney, lungs, and spleen. Values shown are means ± s.d. (n=4).

Table 2. Cost analysis of katjang goat fed with different diets

Parameter	OPB*	CNT	COM*	SEM
Feed Consumption (kg)	184.78	183.35	178.96	1.30
Total Price (RM)	59.30	69.66	59.55	1.48
Total BW Gain (kg)	6.75	7.15	6.55	0.35
Feed Cost/kg Gain (RM/kg)	9.06	10.05	9.44	0.57

OPB–oil palm by-products based formulated pellet, CNT–pellet without oil palm by-product inclusion, COM–commercial pellet, SEM - standard error of mean, *Cost of raw materials only.

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Screening of Fungal Contamination of *Aspergillus* and *Fusarium* Mycotoxin in Grain Corn from Peninsular Malaysia

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Aspergillus and *Fusarium* are oligotrophic fungi that can grow in an aerobic environment and produce a mycotoxin that attacks crops during pre- and post-harvest [2,3]. This study was conducted to investigate the fungal contamination by *Aspergillus* and *Fusarium* mycotoxins; aflatoxins (AF), ochratoxin (OTA), fumonisin (FUMs), zearalenone (ZEN), T-2-toxin and deoxynivalenol (DON) in 194 samples of grain corn meant for poultry feeds from locally grown areas in Peninsular Malaysia in 2019. The ELISAs kit used is a competitive enzyme immunoassay and had a limit of detection (LOD) of 1.7 ppb for AF, 0.5 ppb for OTA, 0.2 ppm for FUMs, 17 ppb for ZEN, 12ppb for T-2 toxin and 18.5 ppb for DON (RIDASCREEN®enzyme immunoassays). Samples were grounded and thoroughly mixed prior to proceeding with the extraction procedure. A mixture of organic solvent and water was used for the extraction procedure. The extracted samples were filtered and diluted prior to ELISAs test accordingly. The mycotoxin concentrations for each sample were evaluated by spectrophotometer at 450nm using RIDA®SOFT Win.net (Germany) software. Statistical analysis was performed using SPSS (Window version 11.5). All results were expressed as mean± standard deviation (SD). The data was statistically treated by one way ANOVA and Duncan's post hoc test with $p<0.05$ considered to be statistically significant. The results of fungal contamination by *Aspergillu*s and *Fusarium* mycotoxin in grain corn using ELISAs method are shown in Table 1. Overall, more than 50% of the samples were contaminated with *Aspergillus* and *Fusarium* mycotoxins above their LODs; however, only five analysed samples (2.8%) were contaminated exceeding the EU regulatory limits for AF. The exceeded levels of AF were found to be from the central region of Peninsular Malaysia in a range of 41 – 403.2 ppb. Aflatoxins are amongst the most poisonous mycotoxins and are produced by *Aspergillus;*

commonly known as a post-harvest mould [3]. The contaminated grain is insecure for use because these toxins are resilient and stable against thermal, physical and chemical treatments during feed processing. Practically, the contaminated food and feed end up as discarded waste [2]. Based on regions, the fungal contamination was highly found with *Fusarium* mycotoxins; FUMs, ZEN and DON. All samples analysed from the central region, east coast and southern region were contaminated with FUMs and ZENs; while all samples from the northern region were contaminated with DON.

Table 1 Fungal contamination in grain corn from Peninsular Malaysia

Location		***Aspergillus* mycotoxins**		***Fusarium* mycotoxins**			
		****AF (ppb)**	****OTA (ppb)**	****FUMS (ppm)**	****ZEN (ppb)**	**T-2 toxin (ppb)**	****DON (ppb)**
Central Region	Positive samples (%)	87.4	50	100	100	*ND	72.7
	Mean±SD	15.6^{a}±58.2	0.5±0.6	1.2^{b}±1.2	86.4^{a}±42.3	-	64.1±75.2
	N	103	58	56	46	60	22
	Minimum	0.0	0.0	0.2	20.4	-	0.0
	Maximum	403.2	1.6	5.2	159.7	-	220.0
East coast	Positive samples (%)	93.8	100	100	100	*ND	80
	Mean±SD	4.0^{a}±1.9	0.8±0.1	0.8^{ab}±1.0	151.4^{b}±67.2	*ND	176.0±92.8
	N	16	11	7	6	12	10
	Minimum	0.0	0.7	0.2	47.6	-	0.0
	Maximum	8.3	1.0	3.1	226.4	-	220.0
Northern region	Positive samples (%)	50	42.8	91.3	70	*ND	100
	Mean±SD	2.2^{a}±3.2	0.3±0.4	1.4^{b}±1.6	112.2^{ab}±78.6	*ND	220.0±0.0
	N	28	7	23	23	2	2
	Minimum	0.0	0.0	0.0	0.0	-	220.0
	Maximum	14.8	0.9	5.6	189.5	-	220.0
Southern region	Positive samples (%)	70.6		79.2	100		
	Mean±SD	3.7^{a}±3.5		0.3^{a}±0.3	96.2^{b}±48.5		
	N	34		24	24		
	Minimum	0.0		0.0	21.3		
	Maximum	13.2		1.1	181.2		
Total positive samples (%)		79.0	56.6	93.6	92.9	*ND	76.5

ab Means within a column with different superscripts are different (P<0.05)
*ND = not detected above LODs
**AF: aflatoxins, OTA: ochratoxin, FUMS: fumonisin, ZEN: zearalenone, DON: deoxynivalenol

According to FAO report, the genus *Fusarium*, which is a pathogen occurring during plant growth, produces more than 70 different toxins of which the most important are

fumonisins, deoxynivalenol, zearalenone and trichothecenes, which include T-2 toxin. From these observation data none samples were contaminated with T-2 toxin above the LODs. The mean levels for AF, OTA, FUMs, ZEN and DON were 10.3 ppb, 0.6 ppb, 1.0 ppm, 98.7 ppb and 106.2 ppb respectively and were significantly different between region at $P<0.05$ for FUMs and ZEN. A continuous fungal contamination monitor programme in grain corn by the authority in all regions besides good agricultural practices.

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Estimation of Fresh, Short-Term Feed Intake of Dairy Cows Based on Liveweight Changes

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One of the goals in precision dairy farming is to monitor and maximise individual animal performance. It is a common practice in dairy farms to offer feed to cows based on average group requirements, despite cows of different size and production level requiring different amount of feed. Feed intake is known to be quite variable among dairy cows, therefore individual monitoring is important for cow's performance and health status. The objective of this study was to develop and validate a method based on liveweight changes (LWC) to estimate short-term feed intake of individual cows.

Nine cows were used with a cross-validation approach to assess the applicability and accuracy of intake model; i.e., using 8 cows for model development and 1 cow for validation purpose, with the process repeated over 9 iterations with a different cow each time. Intake models were developed using a linear mixed model containing LWC, water intake, urine and faeces (kg) as covariates; weighing intervals as fixed effect; and day, cow and day x cow interactions as random effects. Individual LWC was obtained by subtracting the initial liveweight (LW) from LW recorded at 2, 4, 6 and 8 hours subsequent to initial weighing. Cows were weighed using conventional stationary type, and a set of walk-over weighing (WoW) scales in order to compare the accuracy of both scales in estimating intake.

The predictions were considered as very satisfactory and accurate, relatively good, and unsatisfactory when the root mean square error of prediction (RMSEP) values expressed as a percentage of the observed mean were below 10%, 10-20%, and more than 20%, respectively (1). A Lin's concordance correlation coefficient (CCC) value approaching 1.0 indicates a perfect correlation (2). The results showed r^2, RMSEP and CCC for intake estimated models were significantly higher ($P < 0.01$) than using direct LWCs calculation (Table 1). The r^2 values

and CCC values ranged between 0.73 to 0.94 and 0.85 to 0.97 for model-based stationary (MSI) and 0.66 to 0.93 and 0.80 to 0.96 for automated WoW intake (MWI), respectively. Intake calculated directly from the LWCs without modelling (SI and WI) was less accurate, with r^2 and CCC values ranging between 0.44 to 0.67 and 0.53 to 0.72 for stationary and 0.00 to 0.46 and 0.00 to 0.53 for WoW scales, respectively. An r^2 of 0.93 was achieved by González-García et al. (3) in the estimation of sheep intake using the LWC method. The authors speculated that the r^2 value of less than 1 might be due to urine and faeces excreted, and weight loss associated with metabolic heat loss were not measured in their study. Similarly, Huckle et al. (4) reported a close agreement between actual and estimated intake in dairy cows based on LWC. Erizian (5) mentioned that the accuracy of this technique depends on the accuracy of measuring the metabolic heat loss. This could explain the low accuracy of SI and WI because the heat loss was not measured in the present study. The use of linear mixed models in developing intake models increases the possibility of obtaining more accurate and precise estimates of fresh, short-term, feed intake. As on-cow and off-cow remote sensors are developed that would allow accurate measurement of urination and defecation, our results indicate the potential of using automatically recorded LW and model-corrected LWC's, to estimate short-term feed intake with relatively high accuracy.

Table 1. Goodness of fit statistics of actual vs model-predicted fresh feed intake of dairy cows from live weight change. Values shown are means (range).

Method	r^2	Mean bias (kg)	CCC	RMSEP (%)
SI[1]	0.58[b]	-1.52[b]	0.65[b]	45.4[b]
	(0.44, 0.67)	(-3.28, -0.30)	(0.53, 0.72)	(36.80, 57.58)
WI[1]	0.24[c]	-0.43[ab]	0.36[c]	78.3[a]
	(0.00, 0.46)	(-2.55, 1.01)	(0.003, 0.53)	(59.75, 118.63)
MSI[2]	0.89[a]	-0.003[a]	0.93[a]	16.5[c]
	(0.73, 0.94)	(-0.75, 0.92)	(0.85, 0.97)	(11.44, 24.50)
MWI[2]	0.84[a]	-0.02[a]	0.88[a]	21.0[c]
	(0.66, 0.93)	(-0.88, 1.40)	(0.80, 0.96)	(12.36, 27.25)
P-value	< 0.01	0.003	< 0.01	< 0.01

[1]SI and WI = feed intake calculated directly from the stationary and automated liveweight change (LWC), respectively

[2]MSI and MWI = feed intake estimated from the prediction models derived from stationary and automated LWC, respectively

[abc]Means with different superscripts within a column are significantly different ($P < 0.01$)

Automated liveweight change is LWC obtained from LW measured by WOW scale LWC

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Nutritional Content and Water Stability Characteristics of Giant Freshwater Prawn Feed Supplemented with Different Types of Oil Palm Carotene

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This study was conducted to determine the nutritional content and water stability characteristics of giant freshwater prawn feed supplemented with different types of oil palm carotene. There were five different feed samples of giant freshwater prawn including: T1 (commercial feed); T2 (without oil palm carotene supplementation); T3 (crude palm oil (CPO)); T4 (palm pressed fibre oil (PFO)) and T5 (*EVTeneFeed*^{TM}*).* The T2, T3, T4 and T5 feeds were formulated to be isonitrogenous and isocaloric with T1 using FORMAT software and produced using a meat mincer at the Feed Research Group (FRG) Laboratory, MPOB Keratong, Pahang. All samples were subjected to nutritional content and water stability analyses for feed quality determination. The samples were analysed for proximate composition and fibre content according to AOAC (1) [and] Van Soest *et al.* (2) procedures. Meanwhile, water stability was determined using the method described by Epa *et al.* (3).

The nutritional content of giant freshwater prawn feed supplemented with oil palm carotene is summarized in Table 1. All samples had a total moisture content ranged from 5.75 to 7.70%, whereas the total ash content ranged from 11.54 to 12.63%. T3 had the highest crude fat content of 7.31%, while T1 had the lowest fat content with 6.63%. On the other hand, the crude fibre content for all treatment groups was within the specification of prawn feed of not more than 5%. All feed samples were also isonitrogenous and isocaloric, with the crude protein content ranging between 37.74 to 40.45% and the gross energy content ranging between 4400 to 4700 cal/g.

Prawn feed quality is determined not only by the nutritional compositions, but also by physical properties, especially water stability. Table 2 shows the water stability characteristic of giant freshwater prawn feed supplemented with oil palm carotene. A gradual reduction in water stability was observed after the feeds were immersed into the water after 5 minutes and onwards. However, all feed samples demonstrated greater than 85% of feed stability in water

at the end of the experiment (30 minutes). Among the five treatment groups, T1 had the highest feed stability ($P<0.05$). This might be because T1 was produced through an extrusion process at the feed mill, whereas the other treatments were produced manually in the laboratory. The high temperature, pressure and shear applied during the extrusion process improved the gelatinization of the dietary starch, resulting in the extruded pellets having superior water stability (4).

Overall, oil palm carotene inclusion in the giant freshwater prawn feed showed good nutritional content that meets the nutrient requirements for prawn. The processing method, on the other hand, has affected the water stability characteristics of the oil palm carotene supplemented prawn feed pellets.

Table 1. Nutritional content of giant freshwater prawn feed supplemented with different types of oil palm carotene

NUTRITIONAL CONTENT	T1	T2	T3	T4	T5
Total moisture (%)	7.20 ± 0.19^{a}	6.97 ± 0.18^{a}	7.70 ± 0.21^{a}	6.60 ± 0.21^{ab}	5.75 ± 0.09^{b}
Total ash (%)	11.54 ± 0.02	12.42 ± 0.21	12.63 ± 0.08	12.55 ± 0.02	12.49 ± 0.29
Crude fat (%)	6.63 ± 0.29	6.98 ± 0.76	7.31 ± 0.84	6.76 ± 0.28	7.00 ± 0.35
Crude protein (%)	37.74 ± 0.11	40.45 ± 0.31	38.64 ± 0.35	38.93 ± 0.69	39.14 ± 0.44
Crude fiber (%)	2.81 ± 0.03	2.26 ± 0.25	2.18 ± 0.53	2.32 ± 0.62	2.04 ± 0.62
Gross energy (cal/g)	4667 ± 0.51	4478 ± 32.24	4517 ± 30.71	4528 ± 17.55	4521 ± 56.22

Note: T1 – Commercial; T2 – Control; T3 – CPO; T4 – PFO; T5 – EVTeneFeed™
$^{a-b}$ Means in the same row with different superscripts are statistically different ($P<0.05$)

Table 2. Water stability of giant freshwater prawn feed supplemented different types of oil palm carotene

Duration (minutes)	WATER STABILITY (%)				
	T1	T2	T3	T4	T5
5	99.24 ± 0.69	99.45 ± 0.84	99.79 ± 4.71	99.29 ± 2.55	99.49 ± 2.58
10	98.83 ± 4.42^{a}	99.39 ± 1.20^{a}	97.49 ± 1.98^{a}	94.61 ± 2.62^{b}	93.29 ± 1.12^{b}
15	98.82 ± 2.78^{a}	97.36 ± 0.54^{ab}	95.06 ± 2.76^{ab}	92.02 ± 1.69^{b}	91.61 ± 1.08^{b}
20	98.23 ± 4.15^{a}	96.76 ± 4.60^{ab}	94.81 ± 2.85^{b}	89.66 ± 3.62^{c}	90.64 ± 2.16^{bc}
25	97.88 ± 1.63^{a}	91.45 ± 3.49^{b}	94.56 ± 2.86^{b}	86.79 ± 2.76^{c}	89.07 ± 1.63b^{c}
30	97.37 ± 3.55^{a}	90.64 ± 5.70^{b}	92.73 ± 3.46^{b}	85.46 ± 1.85^{c}	88.38 ± 4.79b^{c}

Note: T1 – Commercial; T2 – Control; T3 – CPO; T4 – PFO; T5 – EVTeneFeed™
$^{a-c}$ Means in the same row with different superscripts are statistically different ($P<0.05$)

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Estimating the Costs of Egg Production at Small, Medium and Commercial-Scale Layer Farms in Malaysia

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In November 2018, Malaysia experienced a sharp increase in egg price due to the closure of a major poultry farm in Perak and Pulau Pinang (1). Besides, the feed prices increased due to unfavourable monetary exchange rates which affected the price of eggs. Therefore, this study was conducted with the objective to estimate the current egg production costs at small, medium, and commercial-scale layer farms.

This study involved 30 layer farms randomly selected according to the production scale defined by DVS; a) small-scale (<10,000 birds), b) medium-scale (10,000-50,000 birds) and c) commercial-scale (>50,000 birds). A survey method was used to collect the primary data. The template for calculating egg production costs was structured by taking into account the fixed costs, variable costs 1 and variable costs 2.

In this study, both small-scale farms visited have been operating for more than 5 years. As indicated in Table 1, Farm A recorded a higher mortality rate than Farm B, resulting in higher production costs per egg for Farm A. The management of Farm B has other six-layer farms that running under the same company which reflects the least cost in input procurement. All medium-scale layer farms visited in this study are using an open-house system, and the average estimated costs of egg production in Peninsular Malaysia are presented in Figure 1. The study also discovered that all visited farms with the capacity of 25,001-50,000 birds have been operating for over 40 years which contributes to lower production costs. The average estimated costs of egg production for commercial-scale farms in Peninsular Malaysia and East Malaysia are depicted in Figure 2 and Figure 3 respectively. The production costs were higher in East Malaysia as compared to Peninsular Malaysia, mostly due to higher feed prices in that region.

Table 1. Estimated egg production costs for small-scale layer farms in the year 2019

Parameters		**Farm A**	**Farm B**
Housing system	:	Open-house	Open-house
Number of day-old chicks	:	9,000 birds/cycle	8,500 birds/cycle
Mortality rate per cycle	:	12.5%	3.0%
Current number of hens	:	3,500 birds	6,790 birds
Average egg production	:	80%	80%
Egg production period	:	50 weeks	71 weeks
Total gross return	:	9,450.00	43,609.95
Total variable costs 1	:	333,490.00	595,183.68
Total variable costs 2	:	33,915.38	111,616.87
Total fixed costs	:	13,914.28	85,494.62
Estimated egg production cost (RM)	**:**	**0.36**	**0.25**

Source: Survey Data 2019

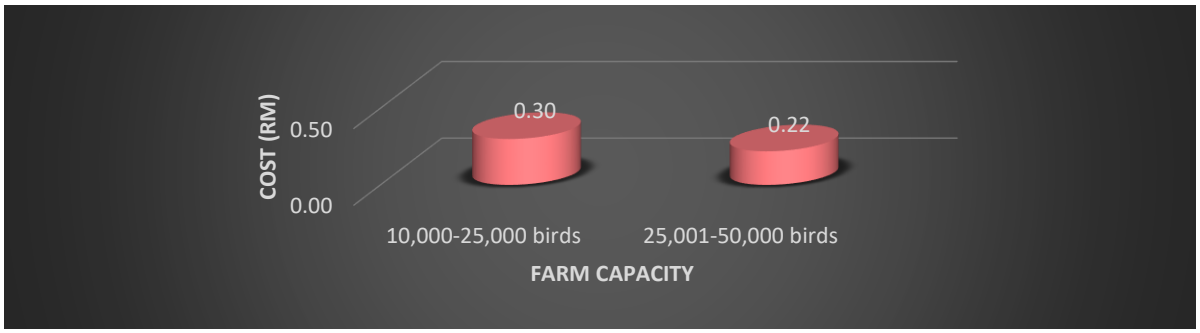


Figure 1. Average estimated costs of egg production for medium-scale layer farms in the year 2019

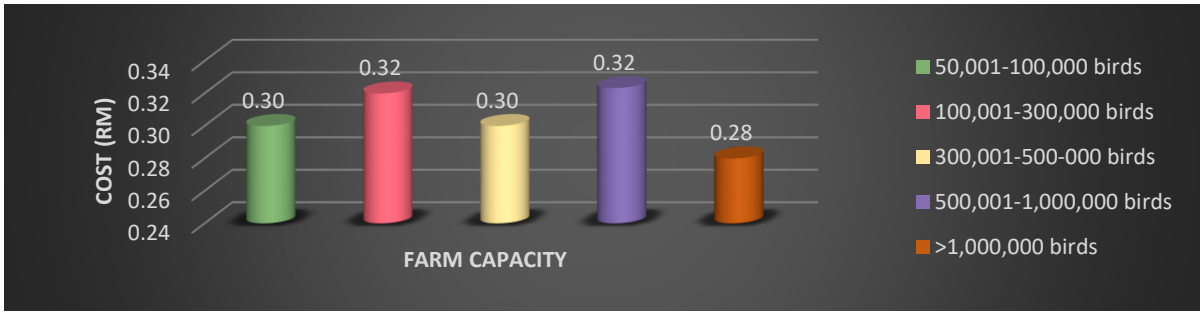


Figure 2. Average estimated cost of egg production for commercial-scale layer farms in the year 2019 in Peninsular Malaysia

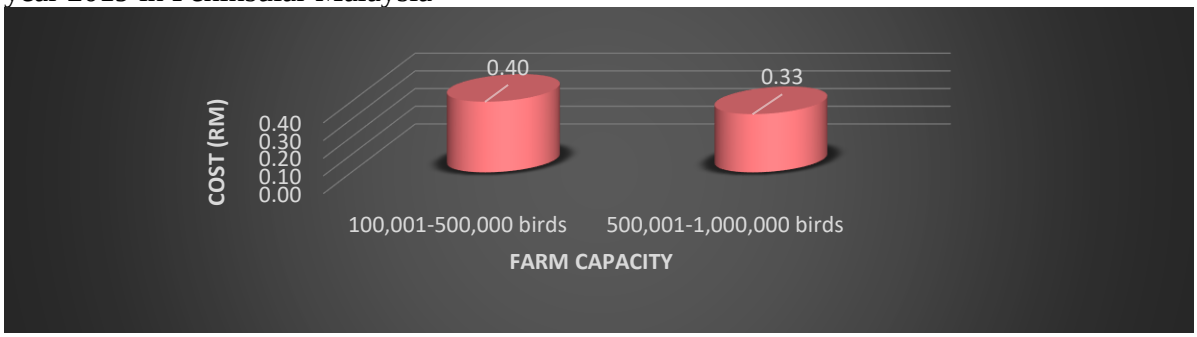


Figure 3. Average estimated cost of egg production for commercial-scale layer farms in the year 2019 in East Malaysia

Several layer producers depend entirely on imported feeds. A few farmers, however, have formulated feed locally and consumed it together with commercial feed to reduce the costs of egg production (2). Further study related to alternative poultry feeds need to be undertaken to produce high-quality poultry feed formulations at competitive prices. It is also proposed that the government intensify research and development activities to develop and diversify feed sources from local raw materials.

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Observation on Sexual Behaviour of Katjang x Boer bucks in MARDI Kluang

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During the breeding of goats, sexual behaviour is an important factor that influences the efficiency and productivity of farming goats (Karaca *et al*, 2016). Sexual behaviours can be different depending on various factors such as experience, age, sex, race, feeding, and day length of day (Karaca *et al*, 2016; Tuncer *et al*, 2016). This study aimed to observe the sexual behaviour between young and adults of Katjang x Boer bucks. The study was conducted in MARDI Kluang. Ten (10) bucks of two different ages were equally divided into two groups; G1 (young bucks at 12-months of age) and G2 (adult bucks at 21-months of age). In this study, each male was exposed individually to a teaser for 15 minutes (Figure 1) once a week for three weeks in a 10 x 5 feet pen. The behaviour was recorded between 8 to 11 am using a common HD video camcorder. The observation of behaviour was done by counting the numbers of sniffing, flehmen response, kicking, vocalization, licking, mounting, and nudging. The time elapsed from the entrance to the first mount was also recorded. All data was analysed using T-test, IBM SPSS statistics version 26 (2019). In Table 1, findings showed that there were no significant differences ($p>0.05$) in all parameters except for the number of nudging behaviours. Group G2 was significantly higher ($p<0.05$) in the nudging behaviour compared to group G1. A similar finding was reported by Darwish and Mahboub (2011) where there was no significant differences ($p>0.05$) between younger and older Damascus and Egyptian-Nubian buck in sniffing and vocalization. However, the recorded number of nudging in this study was contrasted with the study. There were similarities in sniffing, licking and flehmen response of local goat breeds of Rohilkhand Region, India (Kerketta *et al*, 2014) with this study. Suyadi (2012) also reported a similar finding where different ages (11-13, 15-16 and 18-25 months) did not affect ($p>0.05$) the time elapsed of the first mount in the Boer bucks. In conclusion,

observation on the sexual behaviour of Katjang x Boer bucks was not affected by age except for nudging. These indicate that in sexual behaviour the experience and learning processes of the bucks may have a major influence in the sexual behaviour of Katjang x Boer bucks.



Figure 1: Buck was exposed individually to a teaser for 15 minutes

Table 1: The sexual behaviour of Katjang x Boer bucks at MARDI Kluang (±SEM)

Parameter	G1	G2	p value
Sniffing	1.60±0.47[a]	3.80±1.08[a]	ns
Flehmen Response	0.60±0.29[a]	1.20±0.43[a]	ns
Kicking	9.33±3.58[a]	5.47±1.87[a]	ns
Vocalization	6.33±3.47[a]	3.40±1.41[a]	ns
Licking	3.73±1.80[a]	3.07±1.48[a]	ns
Number of Mounting	2.40±0.94[a]	5.60±1.74[a]	ns
Nudging	0.13±0.13[b]	3.40±1.23[a]	*
Time elapse of First Mount (sec)	25.27±17.93[a]	108.93±46.12[a]	ns

[a,b] superscript are significantly different ($p<0.05$) in the same row, NS:Not significant ($p>0.05$), *Significant at ($p<0.05$), SEM:Standard error of the mean. G1: group of young bucks with 12 months of age, G2: group of adult bucks (21 months), n: counting numbers, sec: seconds.

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Occurrence of Aspergillosis Infection among Poultry in Northern Region of Malaysia from Year 2014-2018.

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Aspergillosis is an opportunistic fungal airborne infection caused by ubiquitous saprophytic molds that belong to the *Aspergillus sp*. (1). Aspergillosis is one of the most common problems in commercial and backyard poultry farming usually seen in birds of 7 to 40 days of age (2). The disease occurs under immune compromised situations of the host or when the birds are exposed to an overwhelming of spores. This study was conducted to determine the positive cases of aspergillosis infection among poultry in the Northern Region of Malaysia based on the poultry cases received by Regional Veterinary Laboratory Bukit Tengah (RVL-Bukit Tengah), Penang from 2014 to 2018. All samples were processed by a standard method of isolation of fungus. The organ or tissue were cut into small pieces or macerated with sterile scissors. Small amount of sample were then transfer using sterile hard needle or hook 6 to 7 places onto one plate of Sabouraud's Dextrose Agar (SBA) with antibiotics and one plate of SAB without antibiotics. The samples then were gently pushed into the agar. Samples were incubating at 25°C-29°C for 3 to 5 days. Method then followed by identification of fungus. Small drop of lactophenol cotton blue was placed in the centre of a clean glass slide. Small portions of fungal cultured were taken using a bacteriologic needle and tease apart in the drop of lactophenol cotton blue stain. The preparation was then covered with cover slip and observed under compound microscope. The data were analyzed by descriptive and cross tabulation statistic using IBM SPSS Statistics Version 21.0 USA. Over a 5-year period, a total of 1,268 cases of unhealthy poultry were referred to the Bacteriology Section with 123 positive reported cases with aspergillosis. Although these cases represent only 9.7% of the total reported cases, the analysis is considered important due to the paucity of information regarding the occurrence of aspergillosis among poultry especially in the northern region of Malaysia. Analysis of these

data revealed that 58.5% of poultry were infected with *A. niger* followed by *A. flavus* (24.4%) and *A. fumigatus* (17.1%) (Table 1). Figure 1 showed that sixteen (16) chicken breeds were analyzed in this study and the breeds most commonly infected with aspergillosis were Cobb, Ross, village chicken and Kelly. The Cobb breed was highly infected with *A. niger* (50%) and *A. flavus* (46.7%), while the Ross breed and village chickens were highly infected by about 15.3% and 13.9%, respectively with *A. niger* ,while *A. fumigatus* was the lowest infected among the chicken breed in this study. This study showed that *A. niger* was the most common species isolated from the poultry. This is almost equivalent to a study conducted by Kwanashie et al. (3) reported that 6.70% of *A. niger* were isolated from sixty (60) samples in their study involving poultry while (4) reported that *A. niger* was second most highest (8%) isolated from one-hundred (100) samples lung tissues of chicken. Heavy exposure of poultry to elements such as dead leaves, stored grain, compost piles and other decaying vegetation which is common residing habitat of *A. niger* as stated by (5) is another possibility which could have contribute to the high rate of *A. niger* infection. High infection of Cobb breeds may be due to the receipt of large samples from this breed.

Table 1. Number of samples positive for Aspergillosis

Aspergillosis species	Number	Percentage (%)
A.niger	72	58.5
A.flavus	30	24.4
A.fumigatus	21	17.1
Total	123	100

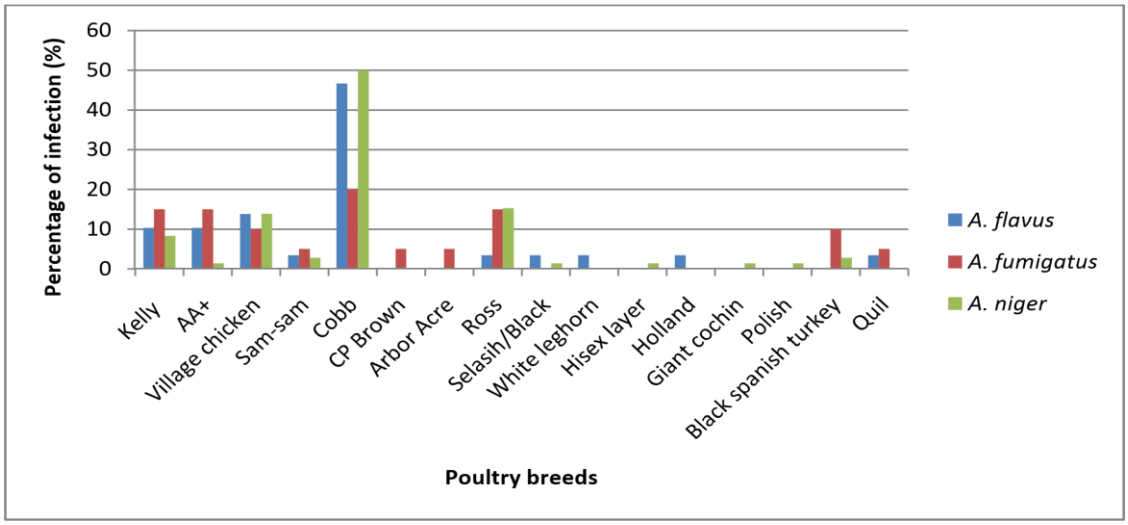


Figure 1. Percentage of aspergillosis species infection in poultry animal breeds

In conclusion, necessary preventive measures should be taken to control aspergillosis among poultry in the northern region of Malaysia even though the infection rate is low because infection may lead to high mortality among young birds which may lead to great losses in production and economy.

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Mature Size and Rate of Maturing of Katjang-Boer Goat Using Gompertz Growth Curve Model

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The Malaysian goat population in 2018 was 359,200 heads and increased to 371,747 heads in 2019 (1). It is lower compared to cattle population but still higher than sheep. The self- sufficiency for small ruminant meat was only 10.02% in 2019 (1). Many efforts have been taken by the Government to achieve 35% of self-sufficiency level - a feat which requires an increment of more than 1.5 million heads (2). One of the initiatives is the development of Katjang hybrid as the local Katjang goat possessed good adaptability towards Malaysian climate but low in growth rate. The proposed crossbreeding of native breeds (Katjang buck) with exotic breeds (Boer does) was to fully utilize the adaptability traits in local goat and higher growth rate traits in exotic breed to increase the economic gains by higher meat yield. Katjang-Boer goats have the potential for commercial production due to its higher growth performance compared to purebred Katjang goats (3).

The growth, influenced by genetic and environmental factors, has been defined mathematically by Brody, Gompertz, Logistic, Richard's, and Von Bertalanffy growth models, each of which is defined as a non-linear function (4). These nonlinear models are more effective than linear model because the growth has a sigmoid curve. The objective of this study was to determine the mature size and rate of maturing for body weight, body length and height at withers of Katjang-Boer goat using Gompertz's growth model.

Data of body weight, body length and height at withers were collected from 78 heads of male Katjang-Boer goats from MARDI Kluang, Johor from birth to 48-month-old. The goats are raised under semi-intensive grazing system. The animals are let out to graze *Panicum*

maximum from morning until afternoon (1000 to 1600) and were fed with supplementary concentrate (15% crude protein) during the rest of the day in slatted raised floor-houses. Water was provided *ad-libitum*. The data were fitted to Gompertz non-linear model for the estimation of mature size (A), constant of integration (B) and rate of maturing (k) for body weight, body length and height at withers.

Table 1: Means for mature size (A), constant of integration (B) and rate of maturing (k) for body weight, height at withers and body length of male Katjang-Boer goats derived from Gompertz's non-linear model, correlation of A and k (r) and coefficient of determination (R^2)

Traits	Growth curve parameters			r	R^2
	A	**B**	**k**		
Body weight (kg)	38.95±0.89	1.91±0.09	0.13±0.01	-0.69	0.95
Height at withers (cm)	62.78±0.74	0.80±0.04	0.32±0,02	-0.51	0.99
Body length (cm)	53.83±0.80	0.83±0.06	0.50±0.05	-0.53	0.98

Gompertz's growth model gave a high goodness of fit for body weight, height at withers and body length, as shown by the R^2 values at 0.95, 0.99 and 0.98, respectively. The Gompertz model could only explain 95% of the variability in body weight compared to 99% in height at withers. The estimated mature weight of Katjang-Boer goats as derived from Gompertz's model was 38.95 kg. Katjang and Katjang-German Fawn goat breed have a lower mature weight (31.8 kg and 35.5 kg, respectively) (5). The frame size of Katjang-Boer goat breed in this study as indicated by estimation of height at withers at maturity was 62.78 cm and could be associated with heavier weight at maturity for the breed. The estimated rate of maturing (k) for body weight, body length and height at withers of Katjang-Boer goats was higher than Boer goat (6). The correlation between mature size and rate of maturing was found negative in this study, indicating that goats with higher rate of maturing will attain its mature size earlier compared to goats with lower rate of maturing. This negative relationship was also found in Dorper sheep (4).

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Yield and Nutritive Value of *Azolla Microphylla* at Two Different Harvesting Interval

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Azolla microphylla, also known as water fern or mosquito fern, is a small free floating aquatic fern species that belongs to the genus in the family of *Azollaceae* which is native to Asia, Africa and America. *Azolla microphylla* hosts symbiotic blue green algae, *Anabaena azollae*, which is responsible for the fixation and assimilation of atmospheric nitrogen which makes this fern species is a good source of protein as well as containing almost all essential amino acids, minerals such as manganese, phosphorus, potassium, magnesium, calcium and iron (1). The ability of this plant to easily grow in stagnant water drains, canals, ponds, rivers and water bodies at a temperature range of 15-35°C, makes it an unconventional super-fast growth and a cheap protein source for animal feed (2). *Azolla microphylla* can be fed to livestock on a fresh basis or further dried to be used in mixed feed formulation.

A study was done by using six 120 x 50 cm (diameter x depth) poly tanks. Cow dunk was evenly distributed at the bottom of all poly tanks at a level of 1 to 2 inches and followed by a second layer of topsoil with the same level of 1 to 2 inches of thickness. Last but not least, filling the poly tank with three quarters (3/4) of chlorine free water. The pH level of the water used in this study is maintained around 5 to 6 to ensure the best condition for *Azolla microphylla* growth. Once the growing media is ready, each poly tank was inoculated with 200-300 gram/m^2 fresh *Azolla microphylla* culture and was let rest for seven days before proceeding for the first harvest. Notably, to ensure an active multiplication phase during the growing period, periodic addition of cow dunk at 3kg per tank is required for every 2 to 3 weeks. Fresh harvests were done at 7 days intervals and 14 days intervals. All data were subjected to independent sample T-test using IBM SPSSS statistical program (Version 20).

The proximate analysis of fresh *Azolla microphylla* is as Table 1 for 7 and 14 days harvesting interval. The result of the statistical analysis for all parameter of yield, dry matter (DM), dry matter week (DMW), crude protein (CP), crude fiber (CF), and total digestible nutrient (TDN) showed that there were highly significance differences ($P \leq 0.01$) for the day 7

and day 14 experimental treatments, while the value of metabolic energy (ME) has no significant difference in both of the treatment. There is a significant increment of yield value of 11.64 tonne/ha for day 7 and 18.48 tonne/ha for day 14 but a decrease in CP value of 36.28% for day 7 to compare with 30.19% for the latter.

Table 1: Nutrient composition of *Azolla microphylla* at different harvesting interval. (mean ± SE)

Parameter	Day 7	Day 14
Yield (tonne/ha)	11.64 ± 0.55**	18.48 ± 0.53**
Dry Matter Week (DMW), %	0.50 ± 0.03**	1.42 ± 0.08**
Dry Matter (DM), %	4.28 ± 0.10**	7.67 ± 0.38**
Crude Protein (CP), %	36.28 ± 0.88**	30.19 ± 0.57**
Crude Fiber (CF), %	14.08 ± 0.39**	16.61 ± 0.39**
Total Digestible Nutrient (TDN), %	35.23 ± 0.83**	48.39 ± 1.70**
Metabolic Energy (ME), MJ/kg	6.93 ± 0.15	7.51 ± 0.24

**Indicates significant differences at probability level ($P \leq 0.01$)

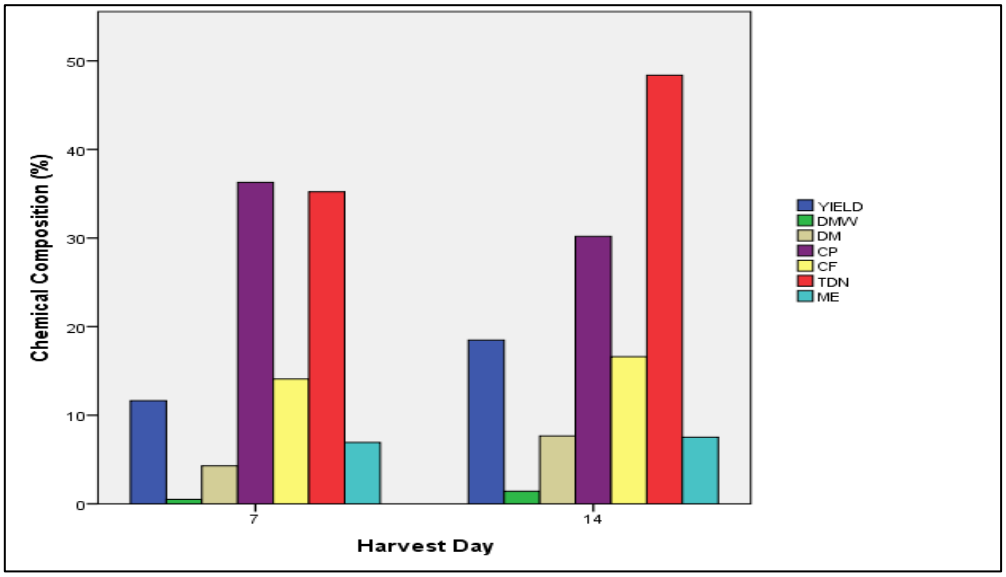


Figure 1: Chemical composition of *Azolla microphylla* at different harvesting interval

This indicates that by harvesting *Azolla microphylla* at 14 days interval, a significant improvement of total yield and better digestible nutrient can be obtained despite lower CP content. The lower CP content on day 14 found in this study still met the feeding nutrient requirements of livestock such as dairy cattle and broiler which requires around 18% and 23% of CP in their daily feed (3). From this study incorporating *Azolla microphylla* in daily animal feed ration either through fresh basis or dry basis shows high potential as this crop is easily grown and manage, low production cost and most importantly this unique plant accommodates

high nutrient value. Studies have shown that this plant can compensate up to 30% replacement to conventional concentrate and fodder (4). In a conclusion, the average nutritive value of *Azolla microphylla* at 7 and 14 days harvesting interval shows promising quality for livestock feeds.

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Evaluation of Microbial Quality and Safety of Imported Meat Sampled from Border Inspection Stations in Johor

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This study evaluates the microbial quality and safety of imported meat which was sampled by Malaysian Quarantine and Inspection Services (MAQIS) agency at border inspection stations in Johor, and were analysed by Makmal Veterinar Zon Selatan from the year 2018 to 2020. The raw meat samples were tested for total plate count (TPC or mesophilic aerobic bacteria), generic *E. coli*, coliforms bacteria and pathogens (*Salmonella* spp. and *E. coli* O157:H7). Quantification of indicator microorganisms (mesophilic aerobic bacteria, coliforms and *E. coli)* was performed as an evaluation of food quality and hygiene, whereas the presence of the pathogenic bacteria would relate to the food safety concern.

Microbial enumeration tests (TPC, coliforms and *E. coli*) were carried out using standard Petrifilm^{TM} method. For *E. coli* O157:H7 test, enriched sample were streaked onto Cefixime-Tellurite-Sorbitol MacConkey agar, confirmation with E. coli H7 latex tests as well as EMB agar. As for *Salmonella* spp. test, enriched sample was streaked onto selective agar, followed by biochemical tests and later for serotyping using antisera (1). Results for enumeration of bacterial loads are expressed as means ± standard deviation (SD), and subjected to Independent Student's T-test/ analysis of variance (ANOVA). All statistical tests were performed using SPSS version 22, and results were considered significant at $p<0.05$.

Throughout the years, a total of 758 samples have been tested from two border inspection stations in Johor. Only one beef and two mutton samples were tested while the rest (99.6%) was buffalo meat samples. Tenderloin made up around 85% of all the samples, with striploin, slice, chuck, brisket and various cut making up the rest. Those samples were coming from certified abattoirs in three countries which have been approved for importation by Department of Veterinary Services (DVS).

The imported meat samples were having TPC load at an average of 4.53 ± 0.65 log cfu/g, and it was significantly higher in the year 2020 (4.71 ± 0.68 log cfu/g) than year 2019

(4.28 ± 0.49 log cfu/g). They are no microbiological standards for limits of TPC, *E. coli* and coliforms in raw meat stated in Malaysia Food Act (2). Hence, reference was made to microbiological guideline established by DVS (3), which shown that the sample was not exceeding the TPC limit for raw meat at $2.5x10^6$ cfu/g (approximately 6.397 log cfu/g). Only 4/758 (0.5%) samples were having TPC load higher than the limit. Coliforms load was at an average of 2.22 ± 0.47 log cfu/g, with a significantly higher value in the year 2020 than the previous year. However, the coliforms load was still lower than the limit (3.041 log cfu/g). For *E. coli* load, it was at an average of 2.07 ± 0.26 log cfu/g with not much differences in each year. The value was just slightly higher than its' limit at 2.0 log cfu/g. When referring to the TPC and *E. coli* limits from Australia Standards (4), meat sample from the current study would fall under acceptable category. Meanwhile, results showed that around 58 (8%) samples were detected with *Salmonella* spp. and it was all from buffalo meat. Some of the *Salmonella* serovars identified were *S. Senftenberg*, *S. Bareilly*, *S. Saintpaul*, *S. Stanley*, *S. Typhimurium*, *S. Agona*, *S. Weltevreden*, *S. Newport*, *S. Cremieu*, *S. Kentucky* and *S. Noya*. All samples were negative of *E. coli* O157:H7.

Overall, the imported meat was in good quality and satisfied hygiene level. However, detection of *Salmonella* spp. might indicate possibilities of contamination from various sources such as at the farm level, abattoirs, processing plant, transportation or even storage. Consumer should always apply safe food handling and proper cooking method to ensure safe food.

Table 1. Microbial load of imported meat samples analysed in the year 2018 to 2020.

Samples	**Year**			**Total**
	2018	**2019**	**2020**	
Sample, n	246	275	237	758
TPC (mean ± SD)	NA	4.28^b ± 0.49	4.71^a ± 0.68	4.53 ± 0.65
E. coli (mean ± SD)	2.08 ± 0.23	2.04 ± 0.19	2.08 ± 0.34	2.07 ± 0.26
Coliforms (mean ± SD)	NA	2.13^b ± 0.34	2.31^a ± 0.55	2.22 ± 0.47

Data represents means ± SD, expressed in log cfu/g.

[ab] Values within the same row with different superscript are significantly different ($p<0.05$).

n: no. of samples, NA: Not available (for year 2018, TPC and *E. coli* tests were not carried out).

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Evaluation of Fumonisin B1 Contamination in Corn Grain

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Malaysia has developed corn production to reduce the high dependency on imported corn grain for animal feed and consequently support the livestock industry (1). However, the contamination issue of mycotoxins in corn grain has become a major concern in food and feed safety worldwide (2). The infection of *Fusarium spp.* fungus in corn throughout the cultivation period not only lead to the typical rot diseases but it also produces the fumonisin mycotoxin which classified as toxigenic to human, animal and plant (3). The stability of fumonisin at high temperatures during post-harvest or drying storage increases the level of contamination (4). Therefore, this study was performed to evaluate the presence of *Fusarium spp.* and determine the fumonisin B1 contamination in corn grain.

This study was conducted on commercial corn grain (GWG 888). The contamination screening was evaluated by direct plating of corn kernels (without pre-treatment) and control sample (sterilized and autoclaved for 15 mins at 121°C) on media plates, which then incubated at 30°C for 5 days. This followed by single isolation of contaminated microbial and morphological observation. The contamination level of fumonisin B1 in 100g of sample was also determined by using the analytical method of liquid chromatography-tandem mass spectrometry (LC-MS/MS).

There was various natural contaminated microbial grown on the media plate after 5 days of incubation (Figure 1). The contamination had little effect on corn-kernel germination ability which indicates the prevalence of corn as host-specificity. The single isolation was morphologically distinguished as *Fusarium spp*., *Aspergillus spp.* and also bacteria. The *Fusarium spp.* was characterized based on the abundant white cottony mycelium. Meanwhile, the detected levels of fumonisin B1 in untreated and control samples were 2.22 mg/kg and 0.54 mg/kg respectively. This contamination level is 4-fold higher compared to the control sample, but still lower than the permissible maximum residues level (MRL) of Codex standard (4 mg/kg) for grain corn (5). According to FDA guidance, the maximum recommended total

fumonisin level in corn feed for ruminant and poultry should be less than 50% of the diet (dry weight basis) (6).

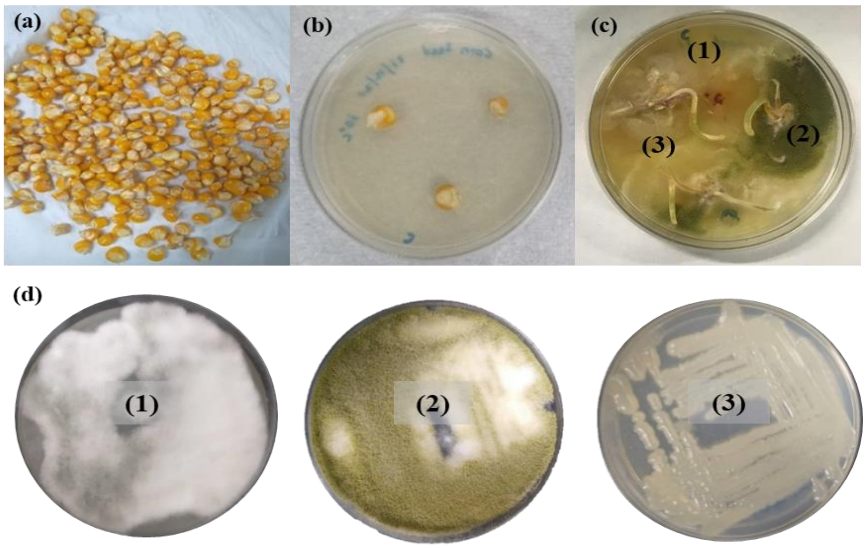


Figure 1. Microbiological analysis by using plate culturing method; (a) corn kernels, (b) control sample at day 5, (c) tested sample at day 5, and (d) single isolation of 1) *Fusarium spp*., 2) *Aspergillus spp.*, and 3) bacteria

In summary, these results describe the infection of *Fusarium spp*. in corn grain and its relation with fumonisin B1 contamination. A molecular identification by polymerase chain reaction (PCR) test can be applied in a future study to elucidate the specific fungal species. As the contamination of fumonisin is typically related to the moisture content, inadequate storage temperature and relative humidity (4), thus these factors need to be optimized during the pre-drying or storage to maintain the high quality and safety of dried corn for animal feed.

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Detection of Mutations in Third Exon of Myostatin Gene of Pure Breed Belgian Blue, Brahman and Piedmontese Cattle

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The growth traits have become one of the important traits in influencing the national economy. According to Department of Veterinary Services (DVS) statistic, there are 200,254.5 matric tonne of consumption meat in Malaysia in 2020 (1). One of the Government approaches to increase production of beef cattle is through genetic improvement of cattle breeds by doing crossbreeding between local breeds and imported breeds using artificial insemination (AI) technology. It is seen to be effective and has received encouraging response among breeders to produce large cattle with high carcass yield. Two breeds were selected with double musculing phenotype also known as muscular hypertrophy (mh) phenotype refers to skeletal muscle mass increase, which are found in Belgian Blue and Piedmontese cattle. There were studies (2,3,4) reported that the mutations occur in myostatin gene caused by the distruptions in the active myostatin protein of third exon region in both breeds. The myostatin gene, also known as growth differentation factor 8 (GDF8), mapped on bovine chromosome 2 which consists of two introns and three exons. The objective of this study is to identify the mutations in third exon of myostatin gene for these breeds which were Belgian Blue, Brahman and Piedmontese.

Samples consists of seven Brahman cows, Belgian Blue bull and Piedmontese bull. A total of 10ml blood of Brahman cows were collected using EDTA tube while a total of 0.25ml Belgian Blue and Piedmontese frozen semen samples were used for DNA extraction and conventional polymerase reaction chain (PCR) using DNeasy Blood & Tissue Kits (Qiagen, Germany) A pair of primer used to amplified third exon of myostatin gene as follows: forward 5-`GGAAGAATCAAGCCTAGTGT-3` and reverse 5`-GCTTGTGCTTAAGTGACTGT-3`. The size of PCR product using this primer approximately 660 base pair (bp) (2). These amplified regions are carefully examined for a DNA pattern and sizes through 4% Metaphor agarose gel under Alpha Innotech (Alpha Manager) Gel Documentation and analysis system.

The PCR product were undergone sequencing performed by 1st BASE using ABI PRISM 3720XL Genetyc Analyzer (Applied Biosystem, USA).

Refer to Figure 1, Belgian Blue showed 11-deletion in the third exon of myostatin gene that is not found in other examined animals. This deletion results in a frame-shift mutation that eliminates the most abundant portion of the myostatin protein retained among members of the TGF-β family (2,3). Piedmontese breed tested have nucleotide transition G→A in the same region that changes a cysteine residue to a tyrosine as shown in Figure 2 (4). In addition, variant sequence also found in both breeds insertion of nucleotide T which probably neutral polymorphism. In Brahman breed, there were three nucleotide changes NT5102 (A/C), NT5108 (C/T) and NT5180 (C/A). Altough there were alterations in amino acid, but these does not effect the the biological activities of the protein. Based on the findings, identification of the myostatin gene mutations in Belgian Blue and Piedmontese cattle can be useful as double muscling marker. Thus, the chances to increase the Malaysian local cattle productivity in the future is high through breeds selection and proper breeding scheme using selected gene marker.

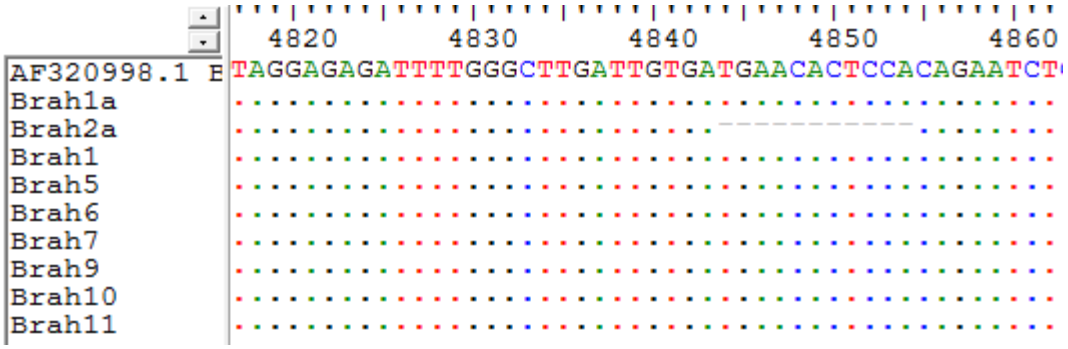


Figure 1: Deletion of 11 base pairs of myostatin gene in Brah2a (Belgian Blue cattle) compare with Genbank (Acc.No. AF320998.1), Brah1a (Piedmontese cattle) and rah1, Brah5, Brah6, Brah7, Brah9, Brah10, Brah11 (Brahman cattle)

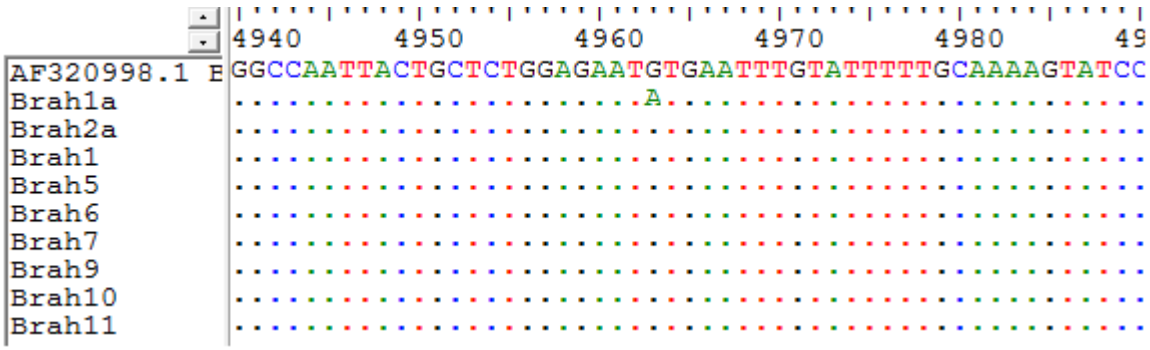


Figure 2: The transition of nucleotide G→A in third exon of myostatin gene in Brah1a (Piedmontese cattle)

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Production and Characterization of Polyclonal Antibodies against Aflatoxin B1 for the Development of Rapid Detection Kit in Grain Corn

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Mycotoxins are low molecular weight natural compound produced as secondary metabolites by certain filamentous fungi (more specifically the molds) that may occur in almost all food and feed commodities. This study aims to produce polyclonal antibody which is specific to aflatoxin B1 in developing a rapid detection kit for the toxin in monitoring safety of the grain corn as animal feed. Some mycotoxins (e.g. aflatoxin B1) have been proven as strong carcinogenic agents while others are still under suspicions. Due to its acute toxicity and carcinogenicity, the EUs and many countries have established stringent regulations in order to control the contamination. Conventional mycotoxin analysis normally entails sophisticated and lab-based instrumentations as well as tedious sample preparation (Thin-layer chromatography, High-performance liquid chromatography and Liquid chromatography–mass spectrometry). With this regard, immunoassay-based tool such as enzyme-linked immunosorbent assay (ELISA) using antibody is favoured to be produced locally for easily and rapidly estimation for aflatoxin detection in a large number of samples.

The antibody production against aflatoxin B1 (AFB1) in rabbit (two replicates) protocol was reviewed and has been approved by the Animal Ethics Committee of Malaysian Agricultural Research and Development Institute, Malaysia (Approval number 20171103/R/MAEC27). Blood samples were collected a week after each immunization and treated with Protein A affinity column to obtain pure anti- aflatoxin B1 IgG antibodies. The developed polyclonal antibodies then were characterized using ELISA protocol to find the best antibodies for further research. The antibody titration activity was determined using indirect ELISA method with Aflatoxin-KLH (65 µg/mL) as the antigen. Pre-immune antibody used as control study showed no significant binding with the coated antigens (data not shown). For further study, the 4th bleed antibody for both rabbit A1 and A2 will be used since the 4th bleed

antibody showed high absorbance, more stable after dilution and high titration activity which the lowest concentration can be detect the antigen is 0.0001 (10^{-4}) antibody dilution.

The specificity of this aflatoxin B1 with others in the aflatoxin family was conducted by replacing aflatoxin with AFB2, AFG1 and AFG2 and other mycotoxins (ochratoxins A and B, and fumonisins B1, B2, and B3) which could be found in the same food commodities. For aflatoxins, the antibody was relatively specific to AFB1, as indicated by the cross-reactivity studies shown in Figure 1. AFG1 cross-reacted at 60-100% relative to AFB1, AFB2 at 50-60% when the % cross reactivity values were compared (Figure 1a). However, the cross reaction for AFG2, showed low cross reactivity (less than 20%) respectively. The cross reactivity was in the order of AFB1 > AFG1 > AFB2 > AFG2. This result is the same as reported by (1) and (2). No cross reaction was observed with other mycotoxins such as ochratoxins A and B, and fumonisins B1, B2, and B3 at 2, 4, 6, 8 and 10 mg/kg (Figure 1b). Overall, aflatoxin B1 showed high reactivity towards same group compounds and low cross-reactivity towards different group compounds. This is might be due to similar chemical structure of compounds in aflatoxin group.

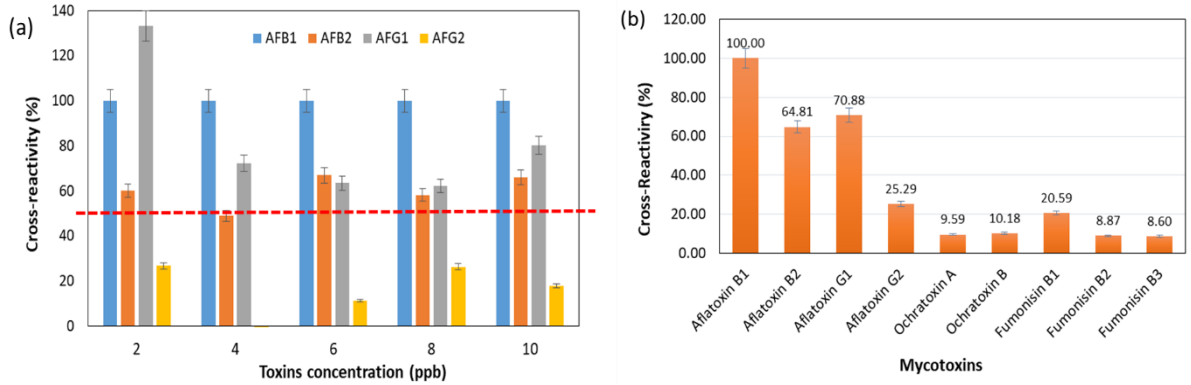


Figure 1. Specificity study of polyclonal antibody against Aflatoxin B1 with (a) other Aflatoxin group; and (b) Ochratoxin and Fumonisin groups

The antibody isolated here represents a candidate for the development of diagnostics. The use of antibody against aflatoxin in disease detection system is appealing because antibody against aflatoxin can be produced at low cost on a large scale, resulting in an affordable and user-friendly diagnostic system (i.e., for lateral flow strip and biosensor device). These ELISA analytical systems are excellent screening devices, provide quantitative results in a short time period, and as previously mentioned, they can often be used at the location of sampling, too.

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Development and Initiative in Malaysian Cattle Industry

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Malaysia's livestock production industry is a very important component of the country's agricultural sector. It provides lucrative employment and serves the population's domestic meat, milk, and dairy product demands. This industry's growth will strengthen food security and safety while also reducing the country's dependency on imported meat. This paper is aimed to provide the status of Malaysia's cattle production industry for the year 2018 to 2020 based on published and official information as well as to report some DVS initiatives and programs meant to improve the national livestock productivity.

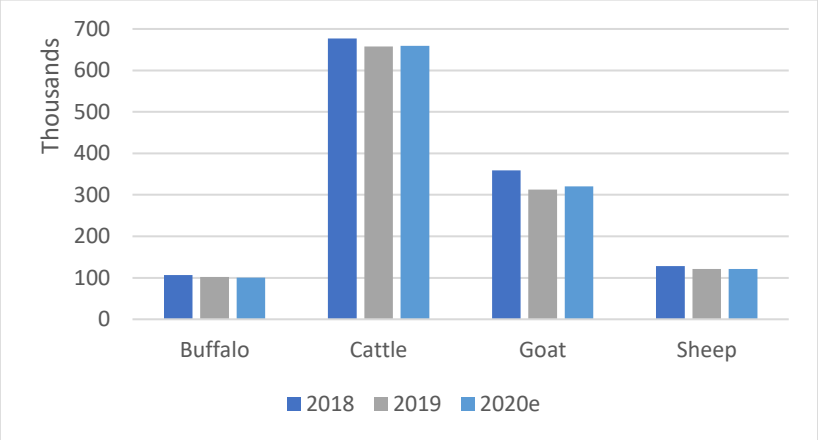


Figure 1: Number of ruminant livestock production, 2018-2020[e]

Beef is an important source of animal protein in Malaysia made up from cattle and buffalo consumed by more than 60% of the population. The estimated number of ruminant livestock population recorded in year 2020 for buffalo, cattle, goat and sheep was 100,242, 659,317, 320,203 and 121,173 respectively. According to annual productivity of ruminant livestock for three years as shown in Figure 1, there were no notable differences between species group and still has the potential to be developed to ensure the continuity of food supply in the country as well as reduce dependence on imported meat. However, the increasing demand

for fresh and processed beef products has exceeded domestic beef supply. Table 1 shows per capita consumption (PCC), self-sufficient level (SSL) and total beef consumption (C) from year 2018 to 2020[e]. The SSL value has not changed much over the last three years although domestic demand increased 4% with total consumption climbing from 180,931 tonnes in 2019 to 188,459 tonnes in 2020. Per capita consumption also increased from 6.1 kg in 2018 to 6.4 kg in 2020, an increase of 5% p.a. over 3-year period.

Malaysia has imported a total of 165,439.2 metric tons of beef and buffalo meat worth more than 2 million ringgit in year 2020 to meet domestic needs. To encourage sustainable meat production, the government has established various guidelines and programs, to assist farmers in increasing livestock yields in accordance with National Agrofood Policy 2011-2020 to modernize and improve the existing farming environment and practices. The livestock industry transformation is currently focused on commercial livestock production, the development of high-quality livestock breeds, the expansion of Good Veterinary Hygiene Practices (GVHP), and the manufacturing of high-quality feed formulations at a competitive price.

Table 1: Per capita consumption (PCC), self-sufficient ratio (SSL) and total beef consumption (C), 2018-2020[e]

YEAR	PCC (KG)	SSL (%)	C (TONNES)
2018	6.1	22.49	191,750
2019	6.1	22.28	180,931
2020[E]	6.4	21.72	188,459

Several oil palm focus areas named Target Area Concentration (TAC) have been identified to implement the integration of ruminant livestock industry development with oil palm plantation. The program is monitored and focused by DVS so that the delivery of veterinary services provided is more effective. This involves 29 TAC locations along with 1,184 cattle breeders and 35 buffalo breeders. Apart from that, the government has implemented various programs to farmers such as offering livestock schemes, credits and grants. Programs such as TRUST (2003), DJBM (2008), EPP (2017), RINTIS (2017) and the latest are the PROPER program was implemented with the aim of increasing the population of ruminants, increasing meat production as well as improving farmers' income. Various reforms have been achieved as a result of government initiatives and incentives to increase the capacity of this industry, such as improving farmer living standards, launching many new farms from young farmers, growing agro-tourism activities, and raising the production of livestock based product. In addition to the national policies on industry 4.0 (IR 4.0), DVS has taken multiple initiatives in applying technology, such as the use of smartphone applications, blockchain, GIS, and

various automation methods to help farmers and enhance livestock production. DVS also holds frequent virtual sharing sessions and dialogues with farmers in the form of virtual forums or seminars to keep farmers informed about the current situation on livestock industry.

Livestock industry is an important to ensure the protein supply is sufficient. Thus, some regulation and incentives have been implemented to assist the development of this industry which is still in need of improvement. Hopefully, government intervention through implementation of few initiatives and programmes would be able to achieve sustainable livestock production in Malaysia.

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Factors Influencing Local Beef Production: A Brief Review in Malaysian Context

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Malaysian beef production, defined by meat produced from both domestic and imported slaughter cattle and buffalo, confer to merely 22.28% of total beef consumption in year 2019 (1). The inadequacy of local beef output necessitated the importation of chilled, frozen, and processed beef and buffalo meat, in tandem with live bovine animals. Primary source for imported live bovine animals was from Australia at 84.1% of the imported segment market share in the year 2020 (2). In parallel, frozen bovine meat was sourced primarily from India (mainly buffalo meat) at 79.9% of the market share, with the imported chilled beef from Australia at 87.5% from whole chilled beef imports. The import market is susceptible to the global price, currency fluctuations, availability, and accessibility of the stock from the exporting country. Importation requirements including disease status of the exporting country also influence the beef import market. Presently, local beef supply chain is affected by regulations imposed to reduce the spread COVID-19 (3), with Australia (4) reported 68% year-on-year declined of export live cattle and beef to Malaysia in the first two months of 2021. Restrictions also have been placed on the entry of live cattle and buffalo from Thailand following the recent Lumpy Skin Disease outbreak in the region (5). In view of these, it is therefore imperative to ensure consistent local supply and maximize beef production locally. In this paper, we gathered factors related to local beef production from published research findings based on various approach including simulation models (Table 1).

Table 1: Assessment of factors related to local beef production in Malaysia.

Focus Area & Methods	Findings (Key Factors/Dynamic Factors)	References
Beef production system - System dynamic approach (with sensitivity analysis)	***Validation with behaviour sensitivity analysis*** 1) Beef cattle number decreased with low beef price and high feed price. ***Validation with policy analysis*** 1) Grazing/ fodder development boost the cattle production significantly. 2) Genetic improvement increases the number of beef cattle, with the 100% level increment upsurge the total number drastically in 20 years. 3) Integration with oil palm required investment in genetic improvement technology and extension services to produce more beef output from the same resources.	Abdulla et al. 2016 (6)
Beef market analysis and importation policy- Beef market model and simulation of policy analysis	***Beef market analysis*** 1) Retaining female cattle for longer period in beef cattle farming will increase breeding cattle population. 2) Death loss from female cattle contributes to low productivity. ***Importation policy*** To improve self-sufficiency level, beef importation for breeding is maintained, while importation of cattle for slaughter increased by 20% to stabilize beef price (assuming substitutability with other meat).	Buda & Mohamed 2021 (7)
Dynamics of beef market (Beef supply and demand)-Johansen Cointegration Error Correction Model	***Dynamic factors affecting beef market*** 1) Number of slaughtered female cattle over 3 years old (female cattle can be used as investments to the breeding herd and for slaughter). 2) Buying power and price of other protein sources (mutton, fish, poultry, pork) affected the quantity of beef consumed in Malaysia.	Abd Latif et al. 2013 (8)
Importation Policies and Managements- Model of Vintage Approach Systematic Model Matric (VASIMM)	***Recommended scenario to increase local beef production*** 1) Increasing importation of the female breeding stock. 2) Lowering rate mortality and increasing calving rate. 3) Diverting to integrated production system . 4) Reduce beef importation especially from the low-cost countries to encourage locals to enhance their production (consistent pricing policy).	Mohamed et al 2013 (9)
Analysis Benefits of integrated oil palm smallholders' farmers in Johor)- Net-Return Profit Model	***Benefits-*** Contribute to higher net income/hectare for farmers. Analyses showed that 81% of revenue came from fresh fruit bunches, 15% from livestock constitute, 3% from Palm Oil Fronds (POF) and 0.03% from and animal dung. ***Constraint-*** Most farmers fail to maintain the recommended stocking rate - seldom replace their death palms immediately.	Gabdo & Abdlatif 2003 (10)
Efficiency of TAC (integrated system)- Translog & Cobb Douglas stochastic frontier production functions	Beef operation in the TAC has an increasing return to scale. For increased production in integrated area- improvements in technical efficiency (planning and management skill by farmers/managers, experience, advisory services by extension agents, higher calving rate, using crossbreed cattle, involvement of government and health management service).	Serin et al. 2008 (11)

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Development of DVS H9N2 Online System for Registration and Monitoring of Autogenous H9N2 Vaccination in Malaysia

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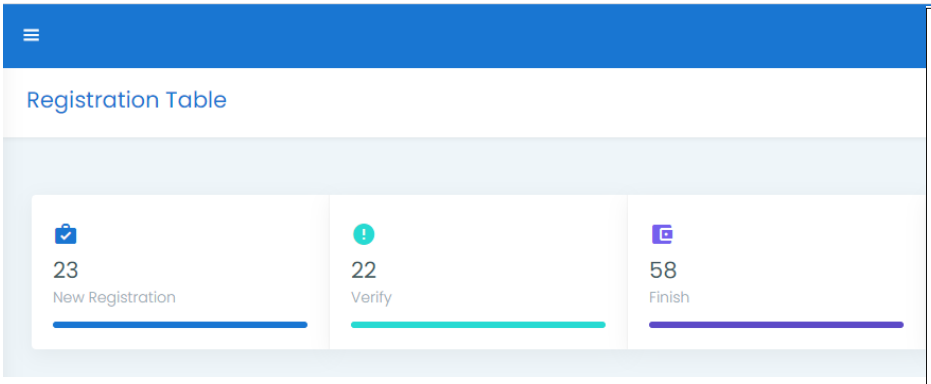
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Avian influenza (AI) is a highly contagious viral disease affecting birds. Typically, AI viruses are classified into highly pathogenic avian influenza (HPAI) virus and low pathogenic avian influenza (LPAI) virus, depending on the severity of the disease in susceptible birds [1] Although H9N2 viruses are considered as low pathogenic avian influenza (LPAI), they pose a significant threat to public health as they can potentially become zoonotic and can cause a pandemic. Currently, some H9N2 strains are also known to be zoonotic causing only mild respiratory illness in humans. H9N2 is a respiratory virus that is transmitted rapidly by both the faecal-oral route and aerosol (airborne) in commercial chicken flocks [2]. H9N2 was first reported in Malaysia in 2015 and since then, it has become endemic in Malaysia. Hence, control measures such as test and slaughter or stamping out approaches may not be sustainable in the long run because of high economic cost [3]. Thus, in July 2020 Malaysia has approved the use of H9N2 vaccination in poultry breeders and layers using an autogenous H9N2 strain Y280, but with a control measures in place to ensure vaccination safety and efficacy.

Department of Veterinary Services (DVS) is the local authority that control, prevent and eradicate animal and zoonotic diseases. Thus, the DVS has laid out vaccination protocol and monitoring methods for use of the vaccine at farm level. The need for monitoring methods is to ensure that the vaccination is safe and efficient as the H9N2 can potentially be infectious to other birds and also humans. There is a need for routine, continuous and thorough surveillance, paired with risk-assessment of circulating H9N2 viruses in Malaysia to identify the evolution and adaptation of viruses as preparation for possibility potential outbreak. As part of controlling and monitoring the usage of LPAI vaccine, an online system has been developed by the Veterinary Research Division of DVS through in house development. This system was divided

to three main parts which are registration, verification and approval with specified user level for access.

This real time centralize database was created by using basic programming language such as html, PHP, CSS, and SQL. The database is collected in a server with the UNIX operating system and MySQL database installed. The system uses a simple interface and is user-friendly. A simple world-wide web (WWW) user interface was also developed using common gateway interface (CGI) scripts written in the PHP language. The rationale of this approach was to simplify what the user needed to do in order to access the data. The system is made to be user-friendly for the interface and mobile friendly so it can be accessed across multiple devices.



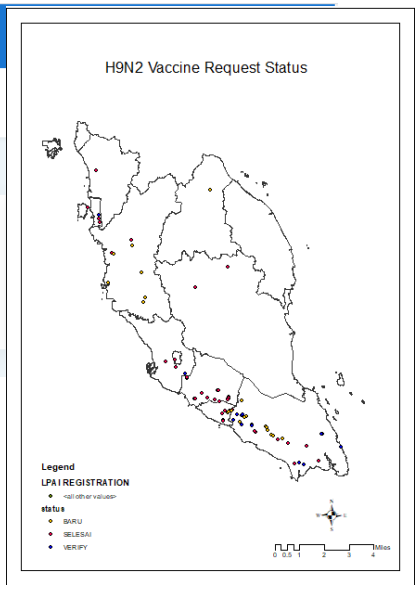


Figure 1a: Administrative System Interface for LPAI online system form. (UP)
Figure 1b: Map distribution of registered farms for H9N2 vaccination was generated based on geotagging or address field, and can be accessed by specified user at https://research.dvs.gov.my/lpai/ (RIGHT)

From the H9N2 online system, all information that has been collected is stored and can be used for monitoring and further analysis (Fig 1a and 1b). The information collected includes farm basic information, biosecurity information, production, surrounding environment and other data which will help the DVS conduct monitoring efficiently.

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Survey on Aflatoxin Awareness Among Dairy Cattle Farmers in Johor

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Aflatoxins are a category of mycotoxins produced by specific fungus naturally occurring as food and feed contaminants with toxic effects on both humans and animals (1). Previous studies on aflatoxins in Malaysia are mostly considered as contaminants to human food, but there is scarce information on feeds. Moreover, no study has been conducted to evaluate the awareness of aflatoxins among farmers, especially on ruminant farmers. The survey on aflatoxins awareness among dairy cattle farmers in Johor was carried out to obtain data and create awareness among the farmers through the questionnaire method.

This study was conducted in collaboration with the Dairy Industry Servicing Centres (Pusat Perkhidmatan Industri Tenusu, PPIT in the Malay acronym), Kluang, Batu Pahat, Labis, Muar, Tangkak, Air Manis (Kulai), Sungai Tiram, and Johor Baharu. A survey on aflatoxins awareness from dairy cattle farmers in Johor was conducted by prepared a questionnaire contained 20 different questions. Five questions in Part A are about the demographic characteristics of survey respondents. Fifteen questions in Part B are related to the respondent's knowledge about fungus, mycotoxins, and aflatoxins.

This survey was carried out from 25 March to 22 October 2019. Data has been collected personally from each farm owner, manager, and staff available at the farm during the visit. More focus was emphasized on getting information from the farmers to create more awareness about aflatoxins. Ninety-five questionnaires were collected and a total of six districts were covered to collect the data. Among the six districts, 25 questionnaires were collected from Kluang, five from Batu Pahat, 15 from Segamat, one from Mersing, 13 from Tangkak, and 36 from Johor Baharu.

All collected data were imported into Microsoft Excel 2010 (Microsoft, Redmond, WA, USA) and analysed using IBM SPSS Statistics V21.0. Demographic information collected in the survey included age of farmers (<20 years, 21 – 30 years, 31 – 39 years, and >40), sex (male

and female), an education level (none, primary school, secondary school, and college/ universities or more). There are only 3% farmers below 20 years old, 14% are between 21 to 30 years old, 26% are between 31 to 40 years old, and 57% are more than 40 years old. Out of 95 farmers, 96% are male, while 4% are female farmers. Two percent of farmers never attended any formal education, 18% of farmers attended primary school only, 58% of farmers attended until secondary school, while 22% of farmers get further education in colleges and universities.

Table 1: Demographic characteristics of questionnaires respondents from '*Do you know about Aflatoxin?'*

Category	**Characteristics**	**Do you know about Aflatoxin?**	
		Yes	**Don't know**
Age	20 years old and less (n=3)	0 (0)	3 (100%)
	21 to 30 years old (n= 13)	1 (8%)	12 (92%)
	31 to 40 years old (n= 25)	5 (20%)	20 (80%)
	More than 40 years old (n= 54)	12 (22%)	42 (78%)
Gender	Male (n= 89)	17 (19%)	72 (81%)
	Female (n=6)	1 (17%)	5 (83%)
Education	None (n= 2)	1 (50%)	1 (50%)
	Primary school (n= 17)	3 (18%)	14 (82%)
	Secondary school (n= 55)	8 (15%)	47 (85%)
	College/Universities/or more (n= 21)	6 (29%)	15 (71%)

In this aflatoxins survey, it has been observed that only 19% of farmers are aware of aflatoxins, therefore it is a need to make the remaining 81% of farmers aware of aflatoxins and problems caused due to consumption of aflatoxins by livestock. The lack of farmers' knowledge and awareness of aflatoxins-contaminated on feeds and feed ingredients in Malaysia will increase the risk of toxins carryover into the animal products for human consumption. This study has found a low awareness of aflatoxins contamination among farmers. Hence, this points to a need to further increase awareness-raising efforts to the public, especially to our farmers.

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Preliminary Study: Consumers' Acceptance of Rabbit Meat

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Rabbit industry in Malaysia has become more popular due to its demand as an alternative meat for consumers. Rabbit meat offers more nutritive values compared to other white meat. It contains high contents of polyunsaturated fatty acids, proteins, essential amino acids, moderately high energy values, low fat and low cholesterol levels, source of B vitamins (mainly B12 vitamin), low sodium content and rich in phosphorus [2,3]. In this present report, we provide an overview of the consumers' acceptance towards rabbit meat, their knowledge on nutritive value, market price and appropriate market price suggested by the public.

This survey was conducted via an online questionnaire. A set of structured questionnaires was distributed over the internet (email, social media platform and other possible ways) and 825 respondents had filled out the questionnaire. The data were analysed using Statistical Package for Social Science (Ver. 21.0).

A Chi-square test was used to test the association between gender and knowledge of the nutrients present in the rabbit meat/rabbit products. There was a significant association between gender and knowledge of the nutrients present in rabbit meat/rabbit products (Table 1). The crosstab table showed that 59.4% of male respondents are more knowledgeable about the nutrients present in rabbit meat/rabbit products while female respondents are 40.6%. Male respondents also dominate the rabbit meat acceptance survey. This result is in line with previous studies by Beal et. al. (2004), González-Redondo (2010) and McLean-Meyinsse (2000) [1,4,5]. Their studies showed that there is a relationship between rabbit meat consumption and gender.

The descriptive analysis was used to analyse the findings in Table 2 and Table 3. Table 2 indicated the market price per kilogram of rabbit meat commonly bought by respondents.

Results showed that 56.1% of respondents never bought rabbit meat (not relevant), 20.7% of respondents bought at RM 30.00- RM35.00 per kilogram, followed by 13.3% less than RM30.00, 5.6% bought between RM36.00-RM40.00, 2.5% with a price above RM45.00 and 1.9% bought with a price between RM41.00 - RM45.00.

Data on the appropriate price for a kilogram of rabbit meat suggested by respondents is presented in Table 3. The result showed that 73.2% of the respondents felt that the price between RM25.00-RM30.00 is the most suitable for a kilogram of rabbit meat, 15.8% is suitable for RM31.00 - RM35.00, 6.4% is suitable for RM36.00 - RM40.00 and only 4.7% states that it is suitable for a price of RM41.00 and above for a kilogram of rabbit meat.

The demand for rabbit meat does exist and producing rabbits has become a more popular farming activity as a small and medium scale operation for cash income. Therefore, the development of agribusiness including breeding, marketing, feeding, product processing and manpower resources could be the further assessment that is interesting to be explored.

Table 1: The association between gender and knowledge of the nutrients present in the rabbit meat/rabbit products.

Gender	**Knowledge of The Nutrients Present in Rabbit Meat/Rabbit Products n (%)**		**χ^2 (df)**	**P value***
	Yes	**No**		
Male	205 (59.4%)	245 (51.9%)	4.548(1)	0.033
Female	140 (40.6%)	227 (48.1%)		

*Chi-square test

Table 2: The market price per kilogram of rabbit meat commonly bought by respondents.

Price/kg	**n (%)**
Less than RM30.00	92 (13.3%)
RM30.00-RM35.00	143 (20.7%)
RM36.00-RM40.00	39 (5.6%)
RM41.00-RM45.00	13 (1.9%)
More than RM45.00	17 (2.5%)
Not Relevant	388 (56.1%)

Table 3: The appropriate price for a kilogram of rabbit meat suggested by respondents.

Price/kg	**n (%)**
RM25-30	598 (73.2%)
RM31-35	129 (15.8%)
RM36-40	52 (6.4%)
More than RM41	38 (4.7%)

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Vector-Borne Diseases of Veterinary Importance in Malaysia

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Vector-borne diseases (VBDs) are essentially diseases that can be transmitted to humans, plants, or animals via agents such as arthropods, or fomites. Vectors are normally considered to be invertebrate animals, usually arthropods, but they may also include fomites [1]. Several VBDs are of importance to international trade and are listed as notifiable diseases. One-quarter of the terrestrial vertebrate pathogens of concern to the World Organisation for Animal Health (OIE) are vector borne [2]. Vector-borne viruses account for 29 percent of the 593 known mammalian viruses. These pathogens have three times the host range compared to nonvector-borne viruses, meaning that multiple animal species may act as hosts or reservoirs for any particular VBD. Hence, VBDs may broadly affect animal health over a range of species, but it also poses challenges for disease control that targets hosts rather than vectors [3]. This paper aims to highlight the VBDs that have been reported in Malaysia for the past five (05) years, since 2016 up to 2021, with the apparent prevalence, and mode of transmission of each particular VBD.

During the year 2016, Theileriosis have been detected from both terrestrial and wildlife throughout Malaysia. However, this disease has been sporadically reported in Malaysia since 2005 [4]. This disease is caused by Theileriae which are obligate intracellular protozoan parasites, and is transmitted by ixodid ticks via infected saliva, and can infect both domestic and wild Bovidae [5]. In Malaysia, multiple species have been recorded being infected with Theileriosis since 2005, from the Bovidae family. The apparent prevalence of Theileriosis is 33.33%, but with no mortality being recorded [4]. In the year 2017, surra, which is caused by a hemoparasite, *Trypanosoma evansi* was detected from wildlife and also horses in the state of Johor, Malaysia. Being an isolated incident, the apparent prevalence was only 1.93% in 2017 and has been 0% ever since. Surra is most frequently diagnosed in horses and camels. This disease is transmitted mechanically by hematophagous biting flies of the species *Tabanus* and *Stomoxys* [6]. Even though no VBDs were reported in Malaysia in 2018 and 2019, this does not mean there were no VBDs present during the time period. Lack of

centralized and uniformed reporting with gaps in uniform surveillance impedes accurate and integral epidemiologic monitoring [3]. African Horse Sickness (AHS) has never been historically reported in Malaysia, however due to transboundary movement of animals, the disease was reported in Terengganu, Malaysia in the year 2020 [4]. AHS is caused by a virus of the family *Reoviridae*, genus *Orbivirus*. Usual mode of transmission is the biological vector *Culicoides* spp. Other mosquitoes, ticks and also possibly biting flies may also act as vectors in transmitting AHS [7]. The incidence of ASF in the year 2020 was an isolated incident thus the prevalence for AHS was only 0.2% and in 2021 is 0% thus far. African Swine Fever (ASF) was reported in East Malaysia in the year 2021. Even though this disease primarily transmits via infected body fluids and direct contact, ticks may act as a vector, thus aid in disease transmission in livestock and wildlife animals [8]. ASF has a morbidity rate of 93.74 %, and a mortality rate of 61.15% in Sabah, where the disease is currently contained [4]. Finally, Lumpy Skin Disease (LSD) which is primarily transmitted via biting insects has also been reported in Malaysia in June 2021. In LSD, there is little hard data incriminating any particular insect species as a vector of LSD. Thus, all biting insects may become vectors for LSD [9]. Currently, cases in Malaysia have a 30.0% morbidity rate with no mortalities [4]. All the above mentioned VBDs have significant impact on the livestock industry. VBDs, if left unchecked, can quickly become endemic when introduced to a new area, especially when the environmental conditons are favourable to the presence of insect vectors. Thus, measures to control VBDs have to be strategically put in place to avoid an explosion of VBDs in the future.

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Effect of Extender Supplemented with Date Palm Pollen Grain (DPPG) on Semen Qualities in Rabbit

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Extender derived from natural extract such as date palm pollen grain (DPPG) and pomegranate has been proven to improved semen quality (1)(2). DPPG helps increased the level of testosterone, vital for sperm motility (2). However, information on effect of extender supplemented by natural products on rabbit semen quality is scarce. The objective of this study was to evaluate the effect of extender supplementation with different concentration of Date Palm Pollen Grain (DPPG) on rabbit semen.

Semen was collected and pooled from 6 males White New Zealand rabbit and divided to 4 treatments. Treatments A, B, C and D were extender supplemented with 0%, 4%, 6% and 8% DPPG respectively. Samples were evaluated using Computer Assisted Sperm Analysis (CASA) for sperm motility and morphology. Data was subjected to analysis of variance (ANOVA).

The study showed that there were no significant differences for sperm motility for all treatments. For sperm morphology coiled tail sperm was analyzed between treatments. Percentage of coiled tail sperm for extender supplemented with 6% DPPG indicated the lowest 13.9±0.97% (Figure 1).

DPPG contain sugar and antioxidant to prevent sperm from having bacterial contamination (3). The supplementation of 6% DPPG may have improved the performance of sperm morphology which reduced the percentage of coiled tail sperm compared to other treatments. DPPG proved to be rich in natural antioxidant which is high in vitamin A, E and C, phenolic, carotenoid and flavonoid compound that are also used as dietary supplement to improve reproductive performance in both male and female (4). In conclusion, the study suggested that 6% of DPPG supplemented in extender can improve the sperm morphology in rabbit.

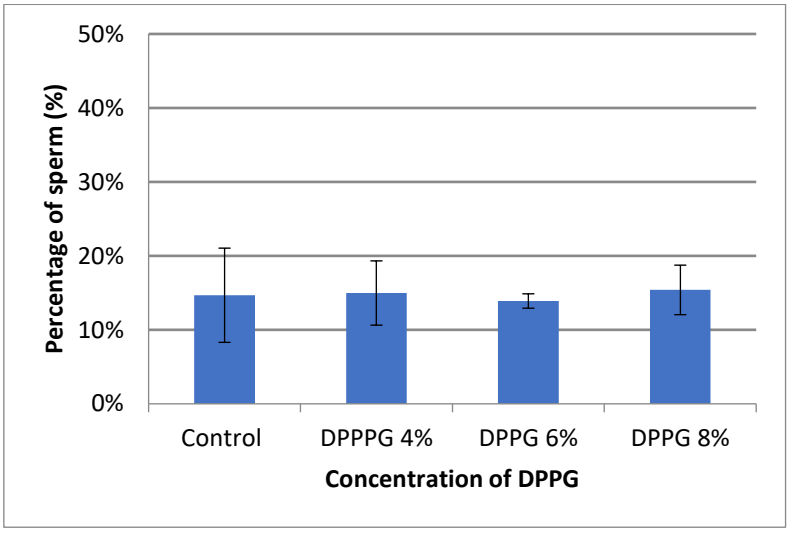


Figure 1. The effect of DPPG supplementation in sperm morphology (coiled tail)

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Distribution of Newcastle Disease (ND) Diagnosed in Northern Region of Malaysia from Year 2014 To 2018.

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Newcastle Disease (ND) is a highly contagious viral disease that affects all species of domestic and wild birds. [1]. ND is caused by Newcastle Disease Virus (NDV), which belongs to the genus *Avulavirus* in the family *Paramyxoviridae.* The disease causes high economic losses in the poultry industry due to high mortality, morbidity, stress, decreased egg production and hatchability [2]. Virus isolation is one of the common diagnostic techniques that are performed in Malaysia. The understanding about the distribution of ND are fundamentals in the proper diagnosis and development of controlling strategies for prevention of a disease [4].

Virus isolation was carried out as outlined by OIE, 2013. The detection of the virus was conducted for the diagnostics samples by the slide Haemagglutination Inhibition (HI) test using chicken red blood cells (1%).

The five years records from 2014 to 2018; received by the Virology Section, RVLBT was subjected to retrospective analysis by using the data from SIMMAK. A total of 360 cases in poultry were documented with 55 cases (15%) disease diagnosed positive for ND. The highest incidence of ND was recorded in 2016 with 22 %, whilst the lowest incidence rate of ND was recorded in 2015 with 1%. In this study, although the year of 2016 showed the highest positive case, eventually the positive cases gradually declined throughout the year of 2017 and 2018 with 17% of the year specific rate for both years. Chickens have the highest rate of ND incidence recorded at 21 % followed by turkeys at 6%. All other types of birds showed negative ND throughout the five years. In chickens, broilers recorded the highest incidence of ND at 22 % followed by kampong chickens at 18%. No ND was recorded in layers or breeders. In general, both layers and breeders are termed long life birds thus are kept in with good husbandary practices. Thus, the chances of layers and breeders contracting ND are lesser than with broilers which may not have good husbandary practices. Apart from that, storage and transport of ND viruses at high temperatures is a problem in tropical countries which contributes

to vaccine failures. This might be attributed to the fact that broilers were seen to be more prone to ND [5]. ND was common among chickens that were kept in confinement, such as commercially raised chicken, in which most of them are overcrowded, also with lack of sufficient biosecurity measures which might cause contact between healthy and infected chicken and this agrees with the findings of [3].

Therefore, farmers should be properly educated to improve the biosecurity with appropriate disinfectants and farming systems as well as ensuring appropriate ways of handling vaccine and vaccination to minimize transmission of disease in Malaysia.

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Katjang x Boer Growth Performance on Formulated Rations with Fresh and Silage Napier Pak Chong

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Katjang x Boer breed was being developed in MARDI Kluang Research Station to tolerate local disease and adaptability to the local climate. This breed is ideal for semi-intensive systems and integration with plantations, according to Hifzan et al. (2020). Since 2015, Pak Chong Napier has become a popular grass in our country in term of high yield production and crude protein concentration at 16-18% (Kiyothong, 2014). However, tropical grass such as Napier Pak Chong tends to reach faster maturity, become fibrous and lignified (Zailan*et al*., 2018). Therefore, silage suitable for preserving the nutritional quality of Napier grass in the optimum harvesting age. The information of growth performance on feeding Pak Chong Napier as fresh-cut or silage in Katjang x Boer breed is still lacking. This study aimed to determine the growth performance of Katjang x Boer male fed with fresh and silage Pak Chong Napier.

The study was conducted on an experimental farm at MARDI Kluang, Johor. Ten (10) male of Katjang x Boer at 4 months of age were divided into two treatment groups (G1: 6 week age of fresh-cut Napier Pak Chong; G2: 6 week age of Silage Napier Pak Chong) and were placed in an individual pen randomly using completely randomized design (CRD). Both groups were fed with an isonitrogenous and isocaloric formulated diet, which was formulated according to NRC for goat requirement as shown in Table 1 and water was given ad-libitum. During the experiment, the animals were fed with 3.5 % of live weight per day and feed residues were weighed and recorded. The live weight was recorded every two weeks until 99 days. All data were collected and subjected to statistical analysis using PROC GLM of Statistical Analysis System (SAS) programme (version 9.3).

In Table 2, results showed no significant differences (P>0.05) between G1 and G2 for initial body weight, final body weight and dry matter intake. However, the results showed significantly different (P<0.05) in weight gain, average daily gain and the feed conversion ratio (FCR) between both groups. G1 had significantly higher (P<0.05) weight gain (5.24 kg) and average daily gain (53.51g/day) compared to G2 (3.04 kg; 31.04 g/day). Meanwhile, in FCR calculation, G1 showed (3.15) significantly lower (P<0.05) compared to G2 (4.20). Significant difference of final body weight could not be detected because mean different of both group for initial body weight and final body weight is small (0.84 kg; 1.37). The finding showed a better feed conversion ratio for diet G1 than G2 in Katjang x Boer indicated that fresh-cut of Napier Pak Chong give animal better consumption. The result was similar to Chaowarit and Metha, (2018) who found that it is different in chemical composition and feeding value even the forage was harvested at the same time in silage and hay of dwarf Napier grass. In conclusion, a diet with fresh-cut Napier showed a better option for Katjang x Boer in the intensive production system.

Table 1: Composition of diet fed to Katjang x Boer

Ingredient	Group 1 (%)	Group 2 (%)
Napier Pak Chong (Fresh)	70.24	-
Napier Pak Chong (Silage)	-	69.91
Commercial Feed	27.94	28.79
Di Calcium Phosphate	1.09	1.04
CaCo3	0.73	0.26
Total	100.00	100.00

Table 2: Growth performance of Katjang x Boer fed with 2 formulated diet (±SEM)

	G1	G2	P value
Initial body weight (kg)	9.17±0.43	10.01 ±0.90	0.426
Final body weight (kg)	14.42±0.68	13.05±1.19	0.347
Weight gain (kg)	5.24±0.52[a]	3.04±0.35[b]	0.008
Average daily gain (g/day)	53.51±5.35[a]	31.04±3.58[b]	0.008
Dry matter intake (kg/day)	0.36 ±0.02	0.32±0.02	0.181
Feed conversion ratio (FCR)	3.15±0.25[b]	4.20±0.31[a]	0.030

[a,b] superscript are significantly different (p<0.05) in the same row, (p>0.05), SEM:Standard error of the mean.

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Effect of Stocking Density on the Growth Performance of Boer Male Goats

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In housing management, floor space management, in particular, is an essential aspect of goat husbandry, which provides both comfort and cleanliness with minimal risk of injury. It is also a well-known fact that a floor space plays a significant role in the welfare and production of animals and can affect their performance. *Space* is generally defined as the average area offered per animal, and it is considered a defining feature of all animal production systems due to its economic implications (1). For Boer goat, the floor space requirement for the weaned kids is 0.75m^2 (2). Boer is one of the breeds that popular among stakeholders. They are preferred over other breeds as they are known to provide good production performance in the Malaysian environment. The objective of this study was to determine the optimum floor space requirement for Boer goats taking into consideration the animal performance and welfare to increase their production.

The experiment was conducted at Small Ruminant Unit, Veterinary Institute Malaysia, Kluang, Johor. Fifteen male Boer goats with an average initial body weight of 15.70 kg to 16.34 kg at four months old age were used in this experiment. All animals were individually weighed and divided into three groups: Group A, Group B, and Group C, with four, five and six animals in the group, respectively. Each group has the same size of pens which is 3m2 per pen. Animals were reared by an intensive system. Group A is considered a control group due to the size of the pen-based on floor requirement of 0.75m^2/Boer goat (2). Group B and C are the treatment groups with 0.6m^2/goat and 0.5m^2/goat, respectively. The experiment was carried out for a period of 100 days. All groups were fed fresh cut and carried Napier grass, Calliandra and Palm Kernel Cake (PKC). They were given the same quantity and quality of Napier, Calliandra and PKC. Fodder and concentrate were offered based on the average animal weight. The animals were weighed at twice a month interval before feeding. The data were analysed using the Statistical Analysis System (SAS). Statistical significance of differences between group means

was tested by one-way analysis of variance (ANOVA) followed by Duncan's Multiple Range Test (DMRT). A 'p' value of less than 0.05 ($p<0.05$) is considered statistically significant.

The growth performances of the experimental goats are shown in Table 1. The analysis showed that the floor space did significantly influenced average weight gain (AWG), average daily gain (ADG) and feed conversion ratio (FCR), whereas non-significantly differences detected for other traits, namely average initial weight (AIW), average final weight (AFW) and average dry matter intake (ADMI). As for the performance, even though AFW showed a non-significant difference between all groups, Group A had the highest AFW with 24.7kg compared to Group B and Group C with 22.56kg and 19.97kg respectively. In addition, animals in Group A showed a higher ADG with 0.09kg than Group B (0.06kg) and Group C (0.04kg). The performance of ADG for each group also reflected their AWG with Group A as the highest (8.6 kg) compared to Group B (6.22 kg) and Group C (4.27 kg). Overall, Group A showed a better performance in all the traits mentioned within 100 days of the experimental period.

Table 1: Growth Performance of Boer Goats

Parameters	**Group A n=4**	**Group B n=5**	**Group C n=6**
Average Initial Weight (kg)	$16.10^{a} \pm 3.17$	$16.34^{a} \pm 2.37$	$15.70^{a} \pm 2.59$
Average Final Weight (kg)	$24.70^{a} \pm 5.00$	$22.56^{a} \pm 3.45$	$19.97^{a} \pm 3.76$
Average Weight Gain (kg)	$8.6^{a} \pm 1.92$	$6.22^{ab} \pm 1.82$	$4.27^{b} \pm 2.18$
Average Daily Gain (ADG)(kg/day)	$0.09^{a} \pm 0.02$	$0.06^{ab} \pm 0.02$	$0.04^{b} \pm 0.02$
Average Dry Matter Intake (DMI)(kg/day)	$0.83^{a} \pm 0.008$	$0.83^{a} \pm 0.02$	$0.83^{a} \pm 0.03$
Feed Conversion Ratio (FCR)	$9.22^{a} \pm 0.008$	$13.83^{b} \pm 0.01$	$20.75^{c} \pm 0.09$

Note: Means with a same superscript letter in the same row are not significantly different ($p>0.05$)

From this study, it can be concluded that the floor space significantly influenced the growth performance of Boer goats, especially for ADG and AWG. It indicated that the bodyweight of goats reared on $0.6m^2$ (Group B) and $0.5m^2$ (Group C) were less 8.6% and 19.1%, respectively, than the goats reared on recommended floor space of $0.75m^2$ (Group A) at 24.7 kg. These findings were supported by the previous study (3, 4), which indicated that the bodyweight of goats was affected by reducing the floor space per goat. Hence, the proper planning for floor space requirements was crucial for the better performance of the animal. It was suggested that $0.75m^2$/goat (2) for Boer was ideal as far as the good marketing and welfare of the animals are concerned.

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Estimation Costs of Broiler Production in Malaysia

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Malaysian poultry meat consumption stands at 48.7 kg per capita in 2019, making it the world's third-highest chicken meat consumption, according to the OECD-FAO Agricultural data. The poultry industry was the highest contributor among the livestock industry in the 2016 Economic Census – Livestock sub-sector, with a gross output of RM9.058 billion in 2015(1). The industry also proved to be an essential component in Malaysia's economy as one of the main daily food supply for Malaysians. Malaysia has achieved more than 100 percent self-sufficient level (SSL) for poultry production since 2004, according to the Department of Veterinary Services' Livestock Statistics report. However, Malaysia still imported 73,289.9 million tonnes of poultry meat in 2019(3), which were used to make processed foods. An economic analysis was conducted to calculate the costs of production for broiler farms to ensure the poultry industry continues to increase the country's SSL for poultry products, not only for fresh poultry meat but also processed food products and exports to the other countries.

In 2019, data was collected from 26 broiler farms which were randomly selected around Malaysia, including those in Sabah and Sarawak. 3 farms were small scale farms with capacity less than 10,000 birds,12 farms were medium scale (10,000-50,000 birds) and 11 farms were commercial scale (>50,000 birds). A set of questionnaires was structured to collect demographic and economic data from the selected farms. The estimated costs to produce 1kg of poultry meat were calculated using the formula in Table 2. The cost of broiler production was calculated per batch, which ranged between 35 to 45 days of rearing per cycle. According to the study, the average estimated cost of producing 1 kg of poultry meat in Malaysia in 2019 was RM4.40/kg. In Peninsular Malaysia the average cost was RM4.14/kg, while in East Malaysia it was RM5.50/kg, which shows a major difference in the costs of producing poultry between the two parts of the country.

Table 2: Cost of Production formula

$$\text{Cost of production/ kg poultry meat} = \frac{\sum \text{Variable Cost} + \sum \text{Fixed Cost} - (\sum \text{By-product revenue})}{\text{---------- kg poultry meat}}$$

To conduct the comparative study, the data collected in the questionnaire was divided into five main parameters. The parameter that contributes the most cost in broiler farming can be determined by comparing the percentage of costs in each parameter.

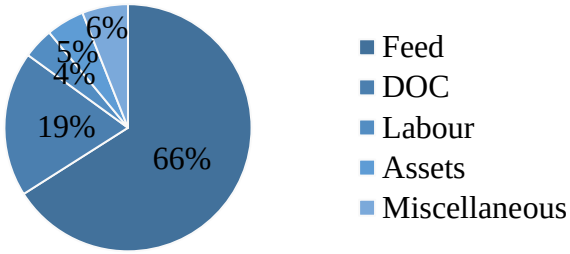


Figure 1: Percentage of costs of broiler production in Malaysia

Figure 1 illustrates the cost of production in Malaysian broiler farms as a percentage ratio. Feed prices were the costliest of all parameters, accounting for 66% of the total, followed by DOC costs (19%). Labour and assets costs account for 4% and 5% respectively, while miscellaneous costs account for 6%.

Table 3:Percentage of costs of production in broiler farms in Malaysia according to farm scale

Parameter	Small scale	Medium Scale	Commercial
Feed	68%	68%	64%
Day-old Chicks (DOC)	21%	20%	19%
Labour	3%	5%	3%
Assets	4%	3%	8%
Miscellaneous expenses	4%	4%	6%
Average cost of production	RM4.70	RM4.29	RM4.43

Table 3 shows the ratio of cost percentages according to the farms' scale. Small-scale and medium-scale farms have nearly comparable cost percentages, with feed price being the highest at 68%. Meanwhile, commercial farms' feed cost was 64%. Although it took the most expenses in broiler production, it was 4% lower than small and medium scale farms and 2%

lower than the Malaysian average. DOC percentage cost in commercial farms is also lower than small and medium scale farms at 19%. However, the assets' cost for commercial-scale farms shows a significant difference compared to small and medium scale farms. Commercial-scale farm assets account for 8% of its costs, whereas small and medium-scale farm assets account for just 4% and 3% of their costs respectively. Based on the data collected, it was understood that to accommodate a large number of flocks, commercial farms usually invest in a closed house system which is far more expensive compared to the open or semi-closed house system that is commonly used in small and medium-scale farms.

To increase the country's SSL in poultry production, a strategic plan needs to be designed to encourage more investment in the poultry industry. From this study, the estimated average cost to produce 1kg of poultry meat in Malaysia was RM4.40/kg. According to DVS' report, the average ex-farm price for a live broiler in 2019 was RM5.05/kg [(4)]. Therefore, the estimation average profit for farmers was RM0.65/kg. In broiler farming, feed costs take up the most expense, as Malaysian broiler farmers still rely on imported feed sources such as corn and soy. With the Malaysian Ringgit now weak against the US Dollar, more competitive measures are required to manage feed prices which directly correspond to the price of poultry in the general market for public consumption.

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Effect of Harvesting Period on Leave Yield and Plant Height of *Moringa oleifera*

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Since the covid epidemic struck, many sectors of the economy have been affected including the agriculture and livestock sectors. Lack of livestock feed supply, pressure on rising feed prices as well as difficulties in marketing livestock products force farmers to find and utilize local feedstuff to maintain livestock and reduce dependence on commercial feed. Fodder trees such as *Sesbania grandiflora*, *Leucaena leucocephala* and *Moringa oleifera* are well recognized for their ability to act as feed supplement to the livestock. *Moringa oleifera* is a remarkably fast-growing tree and capable of producing high foliage yield with valuable nutrient contents (1). The great potential benefits owned by this plant need to be assessed in terms of harvesting practices to optimize the biomass production. The main objective of the study was to determine the effect of harvesting frequency on the leave yield and plant height of *Moringa oleifera*.

The plot trial was laid out according to randomized complete block design (RCBD) with 3 treatments. harvesting period which were 50 days (T1), 70 days (T2) and 90 days (T3) and replicated 3 times per treatment for 3 harvesting batches cycle. Irrigation was applied every day for 30 minutes (exception in rainy days) using a sprinkler irrigation system. All the trial plots were manually maintained from weeds. Insect pest and plant disease were not observed in this study. At 6 months old, all the plants were pruned 100cm from ground level to tree apex to generate plant uniformity before data collection begins. The harvesting of leaves was carried out manually using pruning shears at equal height of 100cm above ground throughout the research and the leave yields were recorded. The plant height was also recorded by measuring the heights of four plants which were randomly selected in each trial plot before harvesting the leaves. Measurements were obtained starting from 100cm above ground level to the tip of the uppermost plant leaf. The total aboveground fresh biomass was brought to the laboratory for

the separation process of leaves and stems. All data was subjected to analysis of variance (ANOVA) using SAS statistical programme (Version 9.1).

The results of analysis of variance (ANOVA) are presented in Table 1. It was observed that leaves yield and plant height were significantly affected by harvesting period. However, no significant interaction was shown between harvesting period and batch cycle. The results of leaves yield and plant height were presented in Figure 1 and 2, respectively. Leave yield was increased in a quadratic manner, with a peak at 70 days (152.99 gram/plant). On the other hand, plant height showed a linear increase over time. This indicates that delaying harvesting frequency to 70 days significantly increases plant height by 109.5%. Subsequent delay of harvesting up to 90 days, plant height will further increase by 33.9%.

Table 1. Mean square of ANOVA on effect of harvesting period on *Moringa oleifera* leaves yield and plant height

Source of variance	**Parameters**	
	Plant Height	**Leaves Yield**
Batch cycle	0.97	21.01
Rep	26.49	17.23
Rep (cycle)	0.91	46.81
Harvesting period (Hvp)	18341.45**	22024.15**
Hvp x cycle	5.11	60.17
Grand mean	97.63	101.237
C.V. (%)	6.58	7.79

Note: mean followed by * is significant at 0.05; mean followed by ** is significant at 0.01

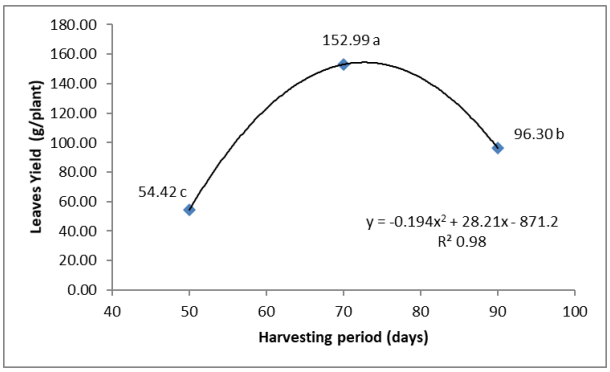


Figure 1. The relationship between leaves yield and harvesting period of *Moringa oleifera*

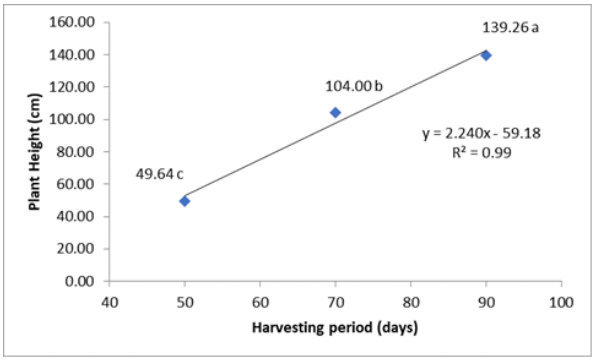


Figure 2. The relationship between plant height and harvesting period of *Moringa oleifera*

Knowing the exact harvesting period allows the farmers to obtain the optimal leaves yield to be supplied to livestock. Hence, it is suggested to harvest the Moringa leaves at a 70 days interval. Although plant height is higher at 90 days' interval, the production of leaves begins to decrease. Therefore, it is not advisable to harvest *Moringa oleifera* at 50 days and 90 days.

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Quantitative Determination of Oxytocin in Milk by UPLC-MS/MS

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Oxytocin is a hormone released from the anterior pituitary gland in animals as well as human beings. It is a peptide of nine amino acids (a nonapeptide) and plays an important role in mammals including both uterogenic and galactogenic effects that result in uterine contractions and milk let down (1). In dairy animals, oxytocin is injected before milking to stimulate uterine contractions and hence allow for easy flow of milk. However, the use of oxytocin in animals is painful as the action of hormone causes the equivalent of labour pains and destroys its reproductive system prematurely (2). Furthermore, the injection of oxytocin may result in over production of milk and traces of oxytocin, which may cause harmful effects on humans. This study was carried out to develop a method for the detection and quantitation of oxytocin in milk by ultra-performance liquid chromatography-tandem mass spectrometry (UPLC-MS/MS).

In this study, buffalo milk samples were collected by the Selangor State Veterinary Services Department from several farms in Selangor and submitted to the laboratory for analysis. For quality control and quantification, two blank samples, three spiked samples at 200 ng/ml and matrix-matched calibration curve (concentrations from 20 ng/ml to 500 ng/ml) were prepared. Milk samples (5 ml) were extracted by precipitation with trichloroacetic acid and passed through the solid phase extraction column (Sep-Pak C18 3cc vac cartridge, 500 mg). Oxytocin was eluted and evaporated to dryness under a gentle stream of nitrogen. The residue was dissolved in 0.1% formic acid and filtered through 0.2 µm GHP syringe filter prior to injection on the UPLC-MS/MS.

The UPLC-MS/MS system consisted of a Waters Acquity UPLC I Class interfaced to a Waters Xevo TQ-XS mass spectrometer equipped with an electrospray ionization (ESI) source.

Chromatographic separation was performed on a C18 column (Waters Acquity UPLC BEH C18, 1.7µm, 2.1mm x 50mm) held at a temperature of 30ºC using a gradient solvent system. Mobile phase A was 0.1% formic acid in water and mobile phase B was 0.1% formic acid in acetonitrile. The flow rate was 0.4 ml/min. The UPLC-MS/MS system was operated with an ESI source in positive mode, heated at 100ºC and capillary voltage was set at 0.8 kV. The multiple reaction monitoring (MRM) approach was performed for the detection of the two most intense transitions at their respective m/z ratios. Data was processed using the MassLynx software version 4.2.

The optimization of mass parameters were conducted by infusing standard solutions of oxytocin at the concentration of 1000 ng/ml. Two selective MRM transition ions (504.4 > 933.4 and 504.4 > 723.2) were then optimized for oxytocin quantitation. The specificity of the method was determined by the successive injections of blank milk samples and 200 ng/ml spiked samples as shown in chromatograms (Figure 1 and Figure 2). Good linearity was obtained with coefficient of determination (R^2) at 0.997. For the evaluation of method accuracy, spiked samples were prepared at concentration of 200 ng/ml. The recovery was obtained in the range of 85% to 115%. The limit of detection (LOD) was 20 ng/ml. In this study, it was observed that all ten milk samples were not detected with oxytocin residues.

In conclusion, a sensitive and reliable method has been developed for the quantitation of oxytocin in milk by UPLC-MS/MS. The method clearly demonstrated with good accuracy and ability to quantify the presence of residue. Therefore, it could be applied as a confirmatory method in monitoring of oxytocin residue in milk samples.

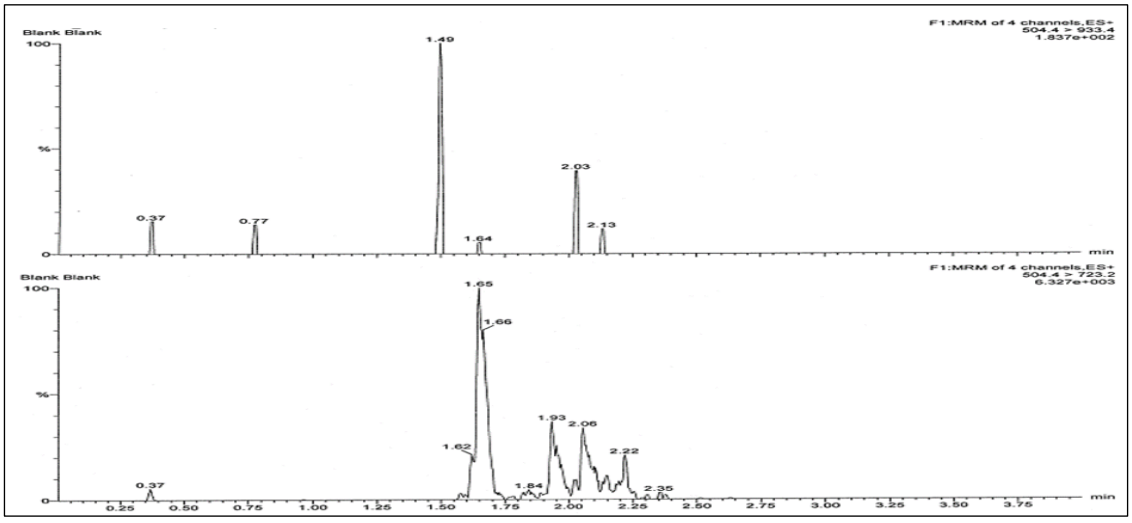


Figure 1. Chromatogram of blank milk sample

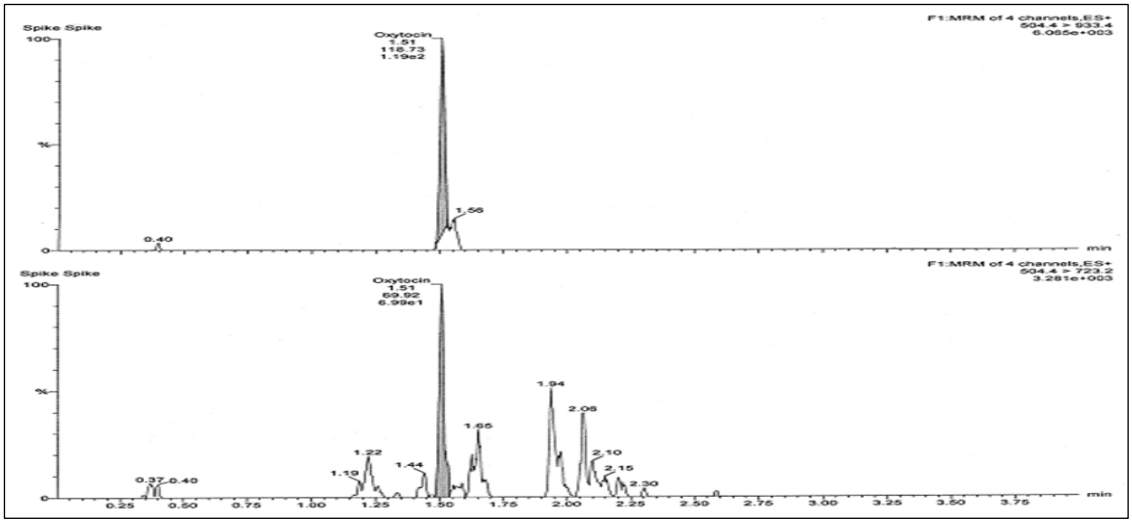


Figure 2. Chromatogram of spiked milk sample at 200 ng/ml

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Fast Screening of Fake Eggs by Handheld ATR-FTIR

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Cases of imitation or fake food materials are often produced and sold for purposes of economic fraud. However, while some imitation or fake food materials merely incorporate lower quality or cheaper alternative ingredients that are safe to eat, others fakes are produced using non-edible or hazardous ingredients that are unsafe for consumption. This includes fake eggs which are often difficult to identify by eye. Such fakes made from ingredients such as sodium alginate, carboxyl methyl cellulose, calcium chloride, tartrazine dye and gypsum powder (1).

The objective of this study is to evaluate the use of Attenuated Total Reflectance-Fourier Transform Infrared (ATR-FTIR) spectroscopy method coupled with a multivariate principal component analysis (PCA) for fast non-destructive screening of fake eggs. In this study, eight fake eggs were prepared according to Hush (4) and 60 real chicken eggs were purchased from two popular brands. Then FTIR spectroscopic were collected from both the fake eggs and real chicken eggs. Classification of the fake and real eggs was tested using FTIR spectroscopy (4000–650 cm−1) with multivariate analysis methods and waveband optimization.

The spectrum of the real mixed albumen and yolk reveals several distinct peaks at around 3000-2800, 1750, 1550-1000 cm−1 shown by the blue circle in Fig. 1. These distinct peaks were given by yolk characteristics. While the spectrum obtained for the fake albumen and yolk in Fig 2 shows general organic peaks at 3250 and 1600 cm-1 with no additional distinctive peaks. The principal component analysis (PCA) plot for real and fake albumen and yolk samples are shown in Fig. 3. The plot provides a clear classification between real eggs (red circle) and fake eggs (blue circle). There were also three real eggs placed out of the main classification might be due to their freshness quality.

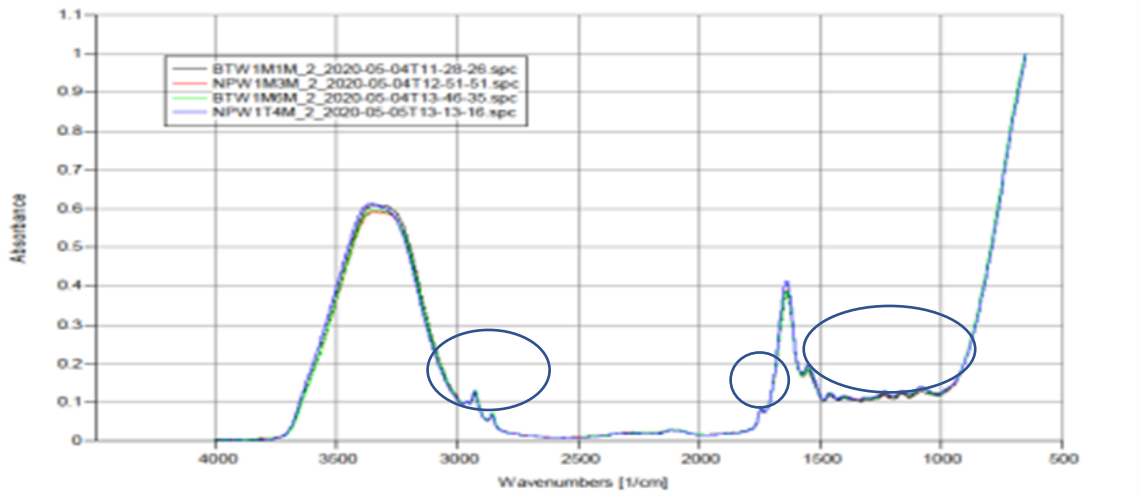


Fig 1. FTIR profile for real egg

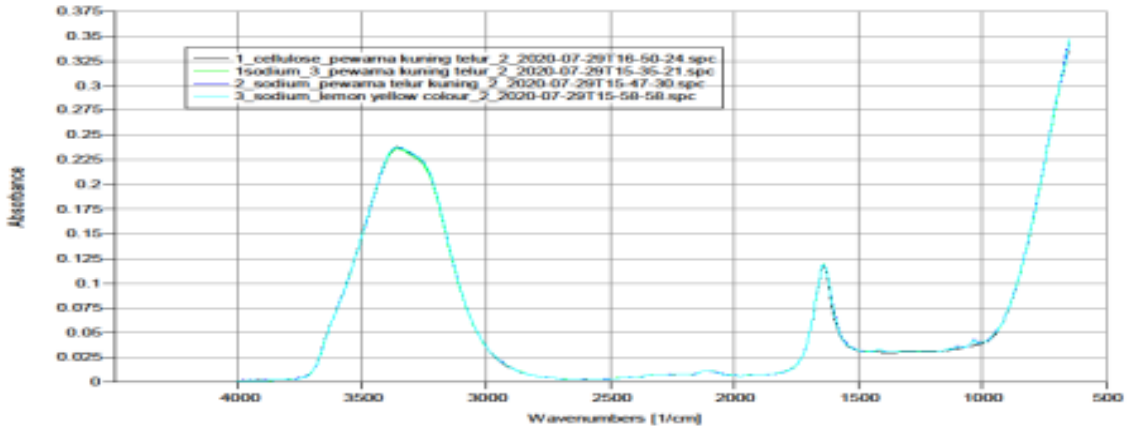


Fig 2. FTIR profile for fake egg

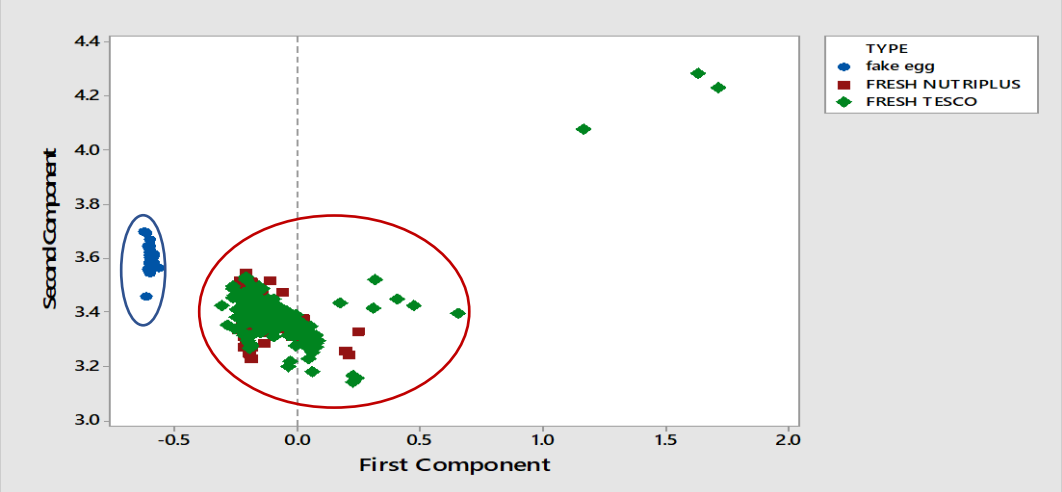


Fig 3. The PCA score plots for real and fake eggs.

The results demonstrated that this technique is able to differentiate fake eggs from real eggs in a very short analysis time with no cost involved. Since the ATR-FTIR instrument that we used was portable handheld type, this analysis can also be done at field besides laboratory. Therefore, this technique is very good for regulatory agency such as DVS to monitor and avoiding fake eggs in the market to ensure consumer safety.

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Effects of Environmental Factors on Growth Performance of Four Napier Grass Varieties (*Pennisetum purpureum*)

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Pennisetum purpureum or Napier grass recognized as one of the main grass being planted for ruminant feed in Malaysia. Environmental factors such as rainfall distribution and characteristics within varieties played important roles on determining the success of cultivating Napier grass. This study aims to look for the external environmental factors that may reflect the growth performance while assessing the best internal factors within the Napier varieties itself that can adapt and perform well under environmental condition in Malaysia. Four varieties of Napier grass including crossbred were used for this study. The planting activities were performed according to standard agronomic practice for planting Napier grass as suggested by MARDI and during the start of rainy season which was on July according to data provided by Meteorology Department and the growth performance being evaluated accordingly throughout a year. Method of planting is through plot establishment of RCBD 4m x 4m plots with triplicates [1]. Four varieties of Napier grass which were C04 Napier, C05 Napier, Pak Chong Napier and Taiwan Napier were planted accordingly. Harvesting take placed after 60days of growing and drying samples are subjected to evaluation of dry matter yield for every harvesting cycle (Figure 1).

Dry matter (DM) yield (tonne/ha) of Napier grass from four harvesting show increase in yield together with increase in monthly rainfall amount (mm) and total number of rain days. All varieties of Napier grass produced highest yield on 2nd harvest which was on November where it received about 543 mm monthly rainfall amount on average and highest total number of rain days which was 35 days on average for 2 months [2]. Factors such as height, stem internode length, formation of tiller and leaf width were among the internal factors being studied. From the data taken during each harvesting period, height and stem internode length were highly

correlated significantly with dry matter yield of Napier while formation of tiller was correlated significantly with leaf width formation. This is due to the longer internode length will produce higher stem of Napier grass which later yield an increase in dry matter of Napier grass during harvesting. Formation of higher tiller numbers will produce more Napier stem thus producing more leaf per stem within the plot [3]. Overall, external and internal factors being studied did play an important role in determining the true potential of Napier grass varieties growth performance under Malaysia's hot and humid tropical climate.

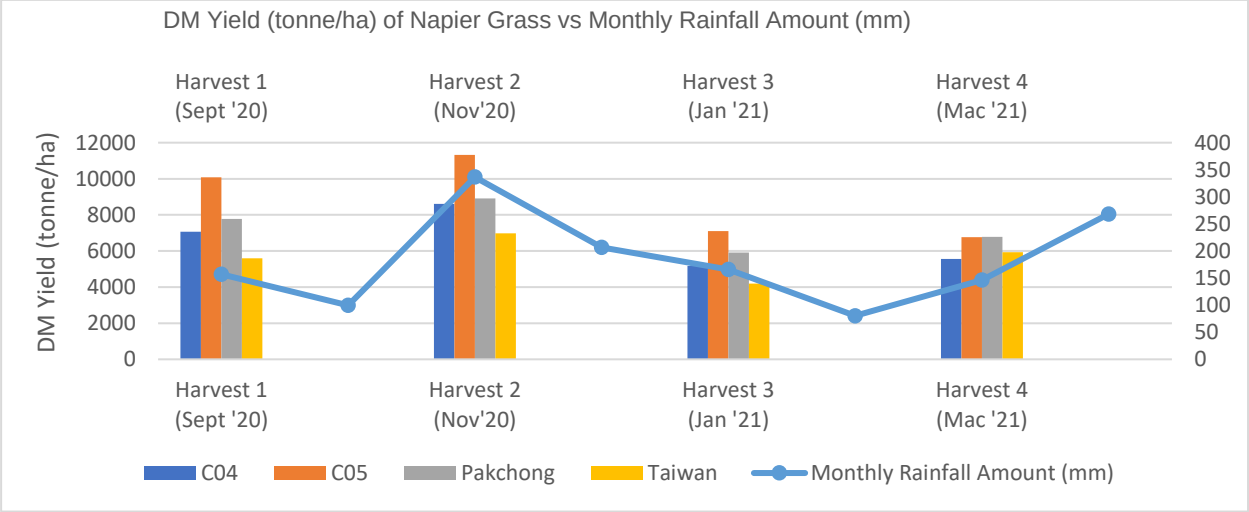


Figure 1. Dry matter yield (tonne/ha) of Napier grass vs monthly rainfall amount (mm)

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The Effects of Grain Corn GWG 888 and GWG 5005 Based Diets on Laying Performance of Lohmann Brown

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MARDI has been involved in local cultivation of grain corn hybrid since year 2011. The cultivation of grain corn hybrid under Malaysian climate was able to produce grain corn with comparable nutritive values as imported one to meet the nutritional requirement of poultry (1). In 2016, development of Malaysian grain corn industry has started as one of the country's new initiatives to reduce the dependency on imported corn. Based on experimental plot studies at MARDI, location played a major role on the performance of certain hybrid seeds as well as the nutritional value of corn (2, 3). Thus, this experiment was conducted to investigate the effects of feeding different grain corn hybrid-based diet on egg quality and performance of layer chicken.

A total of 48 Lohmann Brown Layer chicken allocated to 3 treatments of 4 replicates (four birds per replicate) were randomly assigned to 3 dietary treatments: (T1) imported corn as control, (T2) local commercial grain corn hybrid GWG 888 and (T3) local commercial grain corn hybrid GWG 5005. Egg production was recorded daily for each treatment throughout 9 weeks of feeding trial. Eggs were collected weekly from each replicate to determine the egg weight, specific gravity and Haugh unit. All data was subjected to analysis of variance (ANOVA). The significance of difference between means was determined by Tukey ($P<0.05$) using SAS statistical programme (Version 9.4).

Table 1. Egg quality and egg production of laying hens (means ± SE)

Parameter	T1	T2	T3
Egg weight (g)	60.41±0.774[a]	61.24±0.797[a]	59.67±0.816[a]
Specific gravity	1.09±0.00 [a]	1.09±0.001[a]	1.09±0.001[a]
Haugh unit	90.29±1.033[a]	91.60±1.160[a]	91.62±1.153[a]
Laying rate (%)	91.90±0.992[a]	91.25±1.167[a]	92.78±1.030[a]

Mean values with different superscript are significantly different ($P<0.05$)

T1- imported corn, T2- local commercial grain corn hybrid GWG 888, T3- local commercial grain corn hybrid GWG 5005

Results show that there were no significant different (P>0.05) between treatments for all parameters, indicates that egg quality and egg production of laying hens were not affected by different grain corn hybrid and source. According to Menezes *et. al.*, higher Haugh unit indicates better egg quality (4). GWG 5005 grain corn hybrid gave slightly higher Haugh unit value and laying rate but slightly lower egg weight compared to other treatments. Specific gravity was positively correlated with egg shell quality (5). All treatments gave same highest values of specific gravity (1.09) which indicate good egg shell quality as well as the eggs freshness for all treatments. Thus, it is concluded that local commercial grain corn hybrid has similar feeding values as imported grain corn for egg production.

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Egg Production of *Ayam SAGA* Fed on Diets with Different Levels of Dietary Protein and Energy

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Recently, MARDI dual purpose village chicken has been rebranded to SAGA Chicken or *Ayam Saga*. Specific nutritional requirement for *Ayam Saga* for egg production has not been fully established and currently commercial feed is used to feed this breed (1). It is important to produce a formula that fulfil the nutritional requirement of this slow growing chicken and to avoid nutrient wastage. By formulating cost-effective feed, it may lead to the lower cost of production that could attract more farmers to venture into *Ayam Saga* farming, thereby enhancing living standards of small and medium income farmers. Therefore, the objective of this study to determine the effect of different levels of energy and protein on the performance of female *Ayam Saga* at laying stage

Total 500-day old chicks of *Ayam* Saga were brought from MARDI Muadzam Shah hatchery. Chickens were placed in floor pens, bedded with sufficient litter (wood shavings) with capacity of maximum 35 chicks per meter square and reared until laying stage. About 10 layers per pen aged 31 weeks were reallocated into 18 floor pens and this experiment was conducted for 8 weeks until the layers reached the age of 38 weeks This experiment was arranged in a Completely Randomized Design (CRD) with 6 treatments and 3 replicates per treatment. The experimental diets were formulated to contain one of the 3 levels of protein (14%, 16% and 18%) and one of the 2 levels of metabolizable energy 11MJ for high level of energy and 13MJ for high energy level. The birds were fed *ad libitum* and water was given throughout the experiment. The eggs were collected twice daily in the morning and afternoon. Daily egg production and egg weight were subjected to analysis of two -way variance (ANOVA). The significance of difference between means was determined by Tukey ($P<0.05$) using SAS statistical programme (Version 9.4).

In general, the egg production was significantly affected ($p<0.05$) by protein level. Feeding *Ayam S*aga laying chickens with higher protein diet resulted in higher egg production. While, with low energy diet with increasing level of protein, there was no significant effect on egg production was observed as cited in AR. Roziatul Erin and colleagues in 2020. (1)

The overall performance of egg production in *Ayam Saga* layers fed 18% protein showed higher egg production in the beginning and was getting low as the layers get older. This finding is consistent with a previous study conducted by Shim and colleagues in 2013. (2) In treatment with combination of 11MJ/kg energy and 16% protein, the egg production increased from week 31 to week 34 and then sharply decreased from week 34 to week 36 with highest 64.64 % of hen day egg production. However, from 36 weeks to 38 weeks, the production started to increase again as shown in Figure 1. It was also observed that egg production dropped between week 34 to 36 week for all treatment but the reason for this situation is remained unknown. The range of egg weight for *Ayam SAGA* is between 46-53 grams for the period of 8 weeks between 31 to 38 weeks of age. Layers fed on high level of energy and protein diet have highest 64.29 % of hen day egg production with average of 58.21 % hen day for duration between 31 to 38 weeks. Layers fed on low level of energy and protein diet have lowest 29% of hen day egg production with average of average 42.47 % hen day for duration between 31 to 38 weeks. In conclusion, treatment with 13MJ energy and 18% crude protein 18 is the most suitable for *Ayam Saga* layers for breeding purpose based on the optimum egg production performance found from the trial done. Breeder farmers may gain benefits by saving feed cost and reduce wastage with the use of this specific and effective feed.

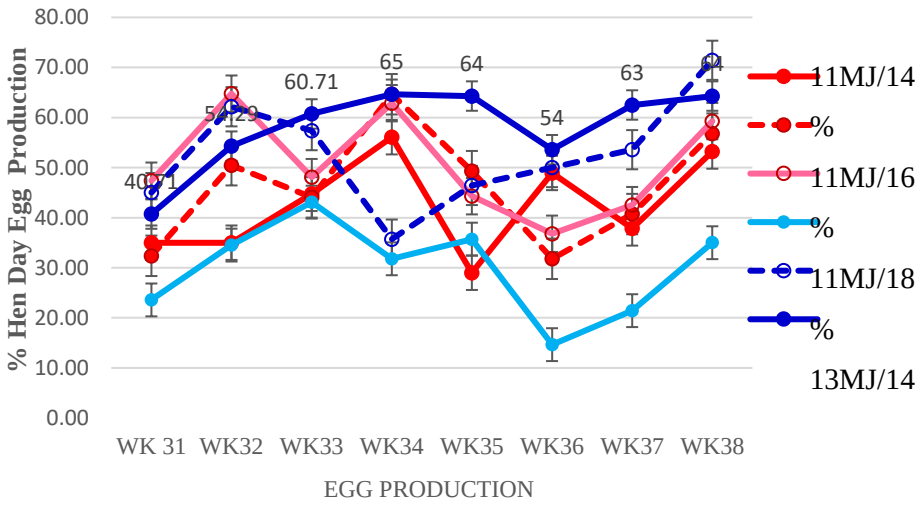


Figure 1: Percentage Hen Day Egg Production of Ayam SAGA Breeders

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Biomass Production and Nutritional Composition of *Azolla filiculoides* Cultivated in a Different Livestock Manure

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Azolla filiculoides has recommended as bio-remediation agents (1) due to the high tolerant character of lower biochemical oxygen demand (BOD) and higher heavy metal absorption ability (2). However, uncontrolled propagation had resulted in changes in the physic-chemical structure of aquatic habitat and imbalanced nutrient of the ecosystem. Utilizing this species as a feed source could be one of the solutions to prevent under-utilizing source from the local environment. Therefore, this study was conducted to identify the effect of using livestock manure from different sources on biomass production, crude protein, fibre components and digestibility of *Azolla filiculoides* as animal feed.

Four (4) different nutrient sources which were NPK green as control (C) and manure of broiler (T1), sheep (T2) and cow (T3) were used in this study. Different manures were obtained from different locations including Poultry Research Facility, Small Ruminant Complex of MARDI Serdang and Department of Animal Science Ruminant Husbandry at UPM Serdang. Seeds of *Azolla* were collected from duck slurry pond in Semenyih for propagation in the inoculating tank. Sixteen pieces of 200L tanks was arranged according to RCBD with 4 replicates each treatment. Observations on water quality, pest and plant growth were done daily for 14 days. At the harvesting day, fresh weight for *Azolla* was measured and expressed as weight produced/area used (g/m^2). Then, samples were prepared for proximate analysis. Dry matter, crude protein, inorganic matter, crude fat, crude fibre and other fiber component (NDF, ADF and lignin) were determined according to published methods (3,4). Sample of Azolla with highest yield, highest crude protein and lowest lignin content were selected for in vitro digestibility assay. All data were subjected to analysis of variance (ANOVA). The significance of difference between means was determined by Duncan's Multiple Range Test ($P<0.05$) using SPSS (Version 25.0). Values are expressed as means ± SE.

Yield component, nutrition composition and fiber components of cultivated *Azolla filiculoides* in different nutrient sources were shown in Table 1. Fresh weight of T2 was higher ($p<0.05$) compared to T1 and T3 and was no different from control group that used NPK 15:15:15 ($p>0.05$). This could be attributed to the short doubling time (2.14 days) and higher RGR (0.32 gram/day). The rapid propagation ability of *Azolla filiculoides* in T2 could be due to appropriate concentration of nitrogen and potassium to achieve maximize yield and growth performance (5). The results also showed that different livestock manure significantly affected DM, CP and CF of this plant. Total dry matter was significantly lower in T3 compared to control and other treatments. While crude protein was significantly higher in control compared to treatment group. Among the manure used, the highest CP content was obtained in T2-sheep manure (21.29%) followed by T1-broiler manure (20.24%) and T3-cow manure (19.42%). Similarly, significant differences was observed in CF ($P<0.05$) in all manure sources with T3 and T1 has the highest and the lowest CF content i.e., 16.38% and 12.47%, respectively. The percentage of crude fiber is important to archive a good A: P ratio and low methane production in beef cattle (6). NDF was a significantly lower ($P<0.05$) in T2 and T1 (36.71% and 36.50%, respectively) compared to T3-cow manure (37.57%), whereas for ADL, the control (9.02%) and T1-broiler manure (8.56%) were significantly higher ($P<0.05$) compared to T2-sheep manure (7.61%) However, no significant difference ($P>0.05$) was observed in ADF. The range of ADF percentage in all treatments was between 27.64 - 29.16%. Based from this result, fibre components including CF, NDF, ADL and hemicellulos were significantly affected by different types of manure used during cultivation of Azolla. This might influence the level of palatability and digestibility of Azolla in ruminant.

Table 1 Fresh weight of *Azolla filiculoides* that cultivated using livestock manure from different source (n=4)

Parameter	C	T1	T2	T3
Fresh Weight (kg/m2)	23.08 ± 0.054^{a}	19.52 ± 0.296^{b}	22.05 ± 0.083^{a}	20.13 ± 0.243^{b}
Doubling Time (days)	2.14 ± 0.003^{a}	2.91 ± 0.023^{a}	2.14 ± 0.003^{c}	2.87 ± 0.007^{b}
Relative Growth Rate (g/day)	0.32 ± 0.000^{a}	0.24 ± 0.003^{b}	0.32 ± 0.000^{a}	0.24 ± 0.000^{b}
Dry Matter (%)	7.48 ± 0.108^{a}	6.25 ± 0.462^{ab}	7.36 ± 0.163^{a}	5.69 ± 0.735^{b}
Crude Protein (%)	23.37 ± 0.571^{a}	20.24 ± 0.028^{bc}	21.25 ± 0.190^{b}	19.42 ± 0.385^{c}
Crude Fiber (%)	14.62 ± 0.162^{b}	12.47 ± 0.070^{c}	14.37 ± 0.146^{b}	16.38 ± 0.167^{a}
NDF (%)	37.41 ± 0.153^{a}	36.50 ± 0.215^{b}	36.71 ± 0.154^{b}	37.57 ± 0.164^{a}
ADF (%)	29.16 ± 0.472^{a}	29.03 ± 0.588^{a}	27.64 ± 0.565^{a}	28.05 ± 0.133^{a}
ADL (%)	9.02 ± 0.059^{a}	$8.56 \pm 0.167b^{a}$	7.61 ± 0.476^{c}	8.03 ± 0.025^{bc}
Cellulose (%)	20.14 ± 0.454^{a}	20.47 ± 0.627^{a}	20.03 ± 0.532^{a}	20.02 ± 0.136^{a}
Hemicellulose (%)	8.24 ± 0.422^{ab}	7.47 ± 0.616^{b}	9.07 ± 0.622^{a}	9.52 ± 0.147^{a}

[a,b,c,d] Mean ± SE values with different superscript are significantly different.
C - NPK green (15:15:15), T1 - Broiler manure, T2 - Sheep manure T3 - Cow manure

In conclusion, manure from any livestock could be the best source of fertilizer over chemical fertilizer for cultivation of *Azolla filiculoides* with the highest biomass yield and protein obtained from those supplemented with sheep manure. Azolla could be used as a source of fibre in ruminant feed with the inclusion of other feedstuff and forage.

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Polymorphism of Chicken Growth Hormone Gene in MARDI Chickens *(Ayam Saga)*

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Kampung Chicken (*Ayam Kampung)* have long existed in Malaysia. The arrival of colonizers, traders and miners who brought in chickens from their country of origin has led to the hybrids between *Kampung* Chicken and foreign chickens and eventually produced local *Kampung* Chicken with various physical characteristics. To enhance the chicken industry, evaluation studies on the breeding of *Kampung* Chicken with genetic improvements, growth performance and feed formulation have been successfully conducted by MARDI. MARDI Chicken *(Ayam Saga)* is a hybrid of selected *Kampung* Chicken breeds obtained from the West and East of Peninsular Malaysia.

Nowadays, slow growing *Kampung* Chicken meat and eggs have been becoming increasingly popular among Malaysian consumers due to its taste and sustainable poultry farming for farmers. However, the *Kampung* Chicken is low in production due to their lower growth rates than broilers. To encounter the problems, genetic improvements were studied to improve growth rates and demands of consumers.

Growth traits are controlled by sets of complex genes and detection through molecular mechanism of growth will contribute to more efficient selection for growth traits (1). The growth hormone gene polymorphism has been studied in various animals. The candidate gene approach has become a powerful technique for genetic improvement in chicken breeding programs. The chicken growth hormone (*cGH*) is a promising candidate gene for selection based on growth performance in chickens.

Chicken growth hormone (*cGH*) is a polypeptide hormone synthesized and secreted by the pituitary gland which contains five exons and four introns with the length of 4,101 base pairs (2). The gene of *cGH* is highly polymorphic, which involves a wide variety of physiological parameters such as growth, body composition, appetite control, egg production, aging and reproduction (3). Therefore, the objective of this project is conducted to evaluate the

polymorphism of *cGH* in *Ayam Saga* using Polymerase Chain Reaction-Restriction Fragment Length Polymorphism (PCR-RFLP) techniques.

Blood samples of 224 birds of *Ayam Saga* were collected from MARDI Serdang. DNA was isolated using DNeasy Blood Tissue kit (Qiagen, Germany). The purity and quantity of the extracted DNA was determined by Nanodrop spectrophotometer and quality of DNA was assessed by 0.7% agarose gel electrophoresis. Total DNA were amplified with PCR using *cGH* gene (forward primer 5'-ATCCCCAGGGCAAACATCCTC-3' and reverse primer 5'-CCCTCGACATCCAGCTCACAT-3') (3). The PCR reaction was performed in 25 µl mixture containing 50 ng/µl of template DNA, 20 pmol primers, MyTaq Red Mix, 2x (comprise all the reagents of Taq DNA Polymerase, $MgCl_2$, PCR Buffer, dNTPs including stabilizers) (Bioline, UK) and distilled water. The amplification of DNA began with initial denaturation at 95ºC for 5 minutes, followed by 35 cycles of denaturation steps at 95ºC, 30 second, 60ºC annealing temperature for 30 second, 72ºC for 30 second and ending with the final extension at 72ºC for 7 minutes. The digestion of PCR products was carried out using *EcoRV* restriction enzyme (Promega, USA). Restriction patterns were separated on 2 % agarose gel at 80 V for 30 min and visualized by AlphaEaseFC Stand Alone Software of the gel documentation system (Alpha Innotech, California).

The analyses of 429 bp *cGH* revealed polymorphism with three genotypes GG (429 bp), AG (429, 296 and 133 bp) and AA (296 and 133 bp). Based on the Hardy-Weinberg equation, the genotype frequencies of GG and AG were 0.52 and 0.4, respectively (Table 1). Allele G is predominantly higher than allele A.

Previous studies, reported that polymorphism in introns of the *cGH* gene was associated with chicken growth and carcass traits (4). Allele A of *cGH* has negative effects for body weight and chickens with genotypes AA had the lowest body weight compared to those with other genotypes (5). The selected *cGH* genotypes GG or AG will have better growth performance and has greater potential to improve chicken breeds. Therefore, *cGH* gene polymorphism may be useful in chicken breeding programs as genetic markers to improve growth traits. Further studies are being carried out to verify that polymorphism of *cGH* is associated with growth traits in *Ayam Saga*.

Table 1. The genotype and allele frequencies of chicken growth hormone (*cGH*) gene in *Ayam Saga*

cGH	**Genotype Frequencies**			**Allele Frequencies**	
	AA	AG	GG	A	G
chicken, n=224	0.08	0.40	0.52	0.28	0.72

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The Pre-weaning Growth Performance of Kedah-Kelantan (KK) Elite Calves Fed on Lactation Ration

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Nutrition is a major factor in the development of the livestock industry which also consumed up to 70% cost of production (1). Providing the required nutrients can increase the production potential, reduce feed cost, and improve nutrient utilization thereby also reducing nutrient waste and decreasing environmental concerns. In an attempt to reduce production cost for livestock production, stage feeding was introduced for Kedah-Kelantan (KK) Elite cattle. KK Elite has better growth performance and body dimension compared to local KK (2). Therefore, stage feeding studies have been carried out to fulfil the nutrient requirement of this breed in MARDI Kemaman. The objective of this study is to determine the pre-weaning growth performance of KK Elite calves fed on lactation ration.

Rations were formulated according to the nutrient requirements for tropical beef cattle at lactating stage (3). The formulated rations utilized up to 58.2% of local feedstuffs (palm kernel meal, urea, molasses, vitamin premix, crude palm oil, wheat bran and calcium carbonate). A total of 16 mature KK Elite with an average weight of 250.8 ± 35.7 kg and their 16 male pre-weaning calves (about 1-2 months old) with an average weight of 45.6 ± 10.2 kg were selected and randomly divided into two groups of dietary treatments and reared in intensive system. Mature cows (mother) in Group A and B were fed requirement ration with metabolism energy (ME) of 10.32 MJ/kg and ration formulated with higher ME (11.85 MJ/kg), respectively. A descriptive study of metabolised energy (MJ/kg), crude protein supplied (g/day) and percentage dry matter intake (%) supplied through dry matter intake of feed were calculated based on proximate analysis of formulated ration (Table 1). Each group consists of four cattle

with their calves and each treatment has two groups per replicates. The cows were fed based on 2.5%/ body weight dry matter intake (DMI) twice daily with diet consisting of 60% formulated ration and 40% Napier silage for six months after an adaptation period of 10 days. During the experiment, the animals had access to ample clean drinking water. All animals were weighed at the beginning of the trial, followed by every two weeks for six months of the trial period. Feed residues were removed and weighed each time a new batch of feed was placed.

The performance characteristics of the calves in this study were presented in Table 2. Weight gain and average daily weight gain (ADG) of the calves between treatment groups were analysed with SPSS 10 using independent sample T-test. The weaning weight and average daily weight gain (ADG) of male calves in Group B was significantly higher ($P<0.05$) as compared to Group A. Increment of performance for weaning weight and ADG for calves in Group B is 12.9% and 15.3% respectively. These indicated that during lactation stage, the cattle need an extra energy due to the increased energy demand. As stated by Lalman & Richard (4), an average milking beef cow requires nearly 50% more total digestible nutrient (TDN) or net energy than she does when dry. Inadequate energy during the last third of gestation and during the critical time from calving to rebreeding can lead to poor rebreeding. From this study, it was found that the calves reared in intensive system could also reach the weaning weight of local KK at the age of 4-5 months which is at an earlier age compared to in an extensive system where weaning age is at 6-7 months (2). It will be benefited the industry as the faster rate of growth will reduce the cost of production for beef cattle management.

Table 1. Nutrient composition of treatment diet for Group A and B

Nutrient composition	**Group A**	**Group B**
Energy (MJ/kg)	10.32	11.85
Crude protein (%)	18.43	18.43
Calcium (%)	0.97	1.01
Phosphorus (%)	0.65	0.66
Neutral detergent fibre (NDF)(%)	28.86	28.86

Group A- Requirement ration, Group B- Lactating stage ration (+ 10% ME)

Table 2. Growth performance of KK Elite calves fed on lactation ration

Production stage	**Treatment**		**Increment of performance (%)**
	Group A	**Group B**	
Weaning weight (kg)	$93.5^{a} \pm 5.1$	$105.6^{b} \pm 2.8$	12.9
Average daily weight gain / (ADG) (kg/day)	$0.47^{a} \pm 0.04$	$0.55^{b} \pm 0.03$	15.3

[ab] Min values with different superscript are significantly different. Values are expressed as means ± SE. Group A- Requirement ration, Group B- Lactating stage ration (+ 10% ME)

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Evaluation of Xanthophylls Supplementation on Laying Performance of Hyline Brown

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Xanthophylls are yellow pigments that belongs to one of the groups of carotenoids but different from carotene in which it contains oxygen atoms in the form of a hydroxyl group or epoxides. Interestingly, xanthophylls found to be accumulated in the macular region of retina and brain. It plays a protective role in eye with reduced risk of age-related macular degeneration (AMD) and cataract (1). Xanthophylls has also been reported to have protective effect against cardiovascular diseases, stroke and certain cancers (1,2). Besides, it can maintain cognitive function and memory (3). Xanthophylls can only be obtained from diet, for example, yellow corn, egg yolk and dark-green leafy vegetable such as kale and spinach. However, many studies showed that intake level of xanthophylls was far below the recommended daily intake value. The consumption of xanthophyll enriched eggs could be one of the ways to increase intake of xanthophylls from natural foods and these eggs could be produced by feeding laying hens with diet high in xanthophylls. However, egg farmers might aware of potential risk in production losses and ultimately egg business that may arise in with the supplementation of xanthophylls. Thus, this study was carried out to study the effects of feeding xanthophylls enriched diet on performance of laying hens.

A total of forty-eight, aged 32 weeks old, vaccinated Hyline Brown laying hens were raised under open housing and kept in wire layer cages (n=2 per cage) at stocking rate of 1000 cm^2/bird. The temperature of open house ranged from 24 to 38℃. The birds were randomly allocated into three treatments in randomized complete block design (RCBD). Each treatment had 16 hens which composed of four replications with four birds per replication. The layers were fed with basal diet, basal diet with 0.0014% xanthophylls and basal diet with 0.0028% xanthophylls. Water was supplied *ad libitum*. The duration of the feeding trial was 4 weeks. The eggs were collected daily for hen-day egg production (% per hen). Feed intake and egg weights were recorded weekly. Egg mass (g/hen) was determined by multiplying hen-day egg

production (%) by egg weight (g) and divided by 100. While, feed conversion ratio or FCR (g feed/g egg) was calculated by dividing feed intake (g/hen) by egg mass (g/hen).

After four weeks feeding, the effects of different levels of xanthophylls on laying performance were statistically analysed using SPSS Statistic 25 and presented in Table 1. The results showed that there were no significant differences (P>0.05) between the treatments in hen-day egg production, feed intake, FCR and egg mass. Higher egg weight (P<0.05) was found in laying hens fed with diet supplemented with 0.0014% xanthophylls. This finding was different with the report by Tatiana et al. (4) which stated lower egg weight was found when supplemented with 0.0016% xanthophylls. The study (4) also showed higher feed intake, FCR and laying performance with 0.0016% xanthophylls.

Table 1. Effect of xanthophylls supplementation on egg production, feed intake, FCR, egg weight and egg mass

	Basal diet	Basal diet with 0.0014% xanthophylls	Basal diet with 0.0028% xanthophylls
Hen-day egg production (%/hen)	88.10±5.84	88.89±5.50	88.10±6.52
Daily feed intake (g/hen)	87.49±10.51	83.15±10.58	87.98±10.44
FCR (g feed/ g egg)	1.76±0.11	1.60±0.36	1.79±0.13
Egg weight (g)	56.22±0.92a	59.21±1.65b	55.95±1.32a
Egg mass (g/hen)	49.53±3.43	52.54±5.02	49.23±2.58

In conclusion, supplementation up to 0.0028% xanthophylls had no detrimental effects on egg production, feed intake, FCR, egg weight and egg mass. The commercial laying hens has been shown to be able to efficiently transfer xanthophylls into egg yolk and it can be served as one of the means to increase the xanthophylls intake levels by human to exert the beneficial effects.

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Sensitive Detection of Porcine DNA by Loop Mediated Isothermal Amplification (LAMP)

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Meat fraud problem is becoming more prevalent due to more globalised and sophisticated food supply systems. For religious faith reasons, meat adulteration with pork is particularly objectionable to the world population.

Therefore, a rapid, highly sensitive diagnostic method is essential to ensure the halal products in the market are safely consumed by all the Muslim communities. Real-time PCR is the most commonly used detection method for the porcine DNA in food products. Although Real-time PCR is reliable and highly sensitive, but it is involving sophisticated laboratory equipment, required well-trained personals, expensive and only can be carried out in laboratories. Antibody based lateral flow strip and ELISA have been developed for the same purposes, however antibody based diagnostic methods are having sensitivity and specificity issues while detecting the targets. Hence, there is a tangible need to develop a rapid, sensitive and on-site detection diagnostic kit for the detection of porcine DNA in the food.

In this study, a loop mediated amplification (LAMP) assay was developed to precisely detect porcine DNA in food. LAMP is a nucleic acid amplification method developed in 2000 [1]. It has been widely used due to its high efficiency, specificity, simplicity and quickness.This experiment was conducted with two simple steps which are DNA extraction and LAMP. The DNA extraction of meat was carried out using The NucleoSpin Tissue kit Macherey-Nagel GmbH & Co. KG (Düren, Germany). A small amount of meat tissue (25 mg) was added with 180 µl of tissue lysis (TL) buffer. The DNA extraction method was then continued with the protocol provided by the manufacturer. It followed by LAMP using the designed LAMP primers (Table 1). The LAMP primers were designed based on the sequence of *Sus scrofa* Mitochondrial ND1 gene (KF888634). A LAMP Primer Mix was prepared with all 4 primers (Table 1) which containing 40 µM FIP, 40 µM BIP, 5 µM F3 and 5 µM B3. Briefly 25 µL reactions (1X ThermoPol Buffer, 6mM MgSO4, 1.4 mM each dNTP, 8U Bst DNA polymerase,

3 µl of primer mix) were performed at 65 °C for 40 mins using 1 µL of the extracted nucleic acid (concentration of gDNA was depended on the experimental design). Following amplification, 3 µL of the LAMP reaction was verified by gel electrophoresis.

Table 1: Sequences of LAMP primers involved in this study.

Primer	**Primer sequence (5' - 3')**
F3	CCTCACCCTAGTAGAACGAA
B3	GCTTGACATGGCTAGCAT
FIP	GGTGAATAGTTTTAGGGCATCGGCTTTTACTACGAAAAGGACCCAACG
BIP	TTGCACCAATCCTAGCCTTATCCCTTTTGGGTAGGGTATTGGTAGTGGA

To investigate the sensitivity of primers (Figure 1), gDNA from *Sus scrofa* ranging from 1 pg to 100 ng were used to perform LAMP. From the pictures of gel electrophoresis, successful amplified DNA was observed in gDNA sample 5 pg and higher DNA concentration samples using primer set-11. No bands were observed when the amount of input gDNA was decreased below 5 pg as well as the control reaction containing no genomic DNA.

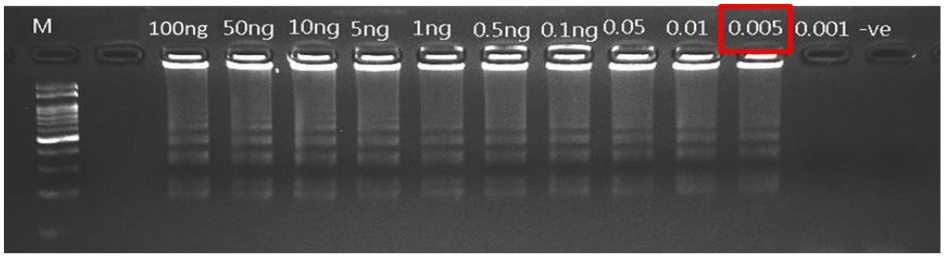


Figure 3: Sensitivity test of LAMP primer. Gel electrophoresis images of corresponding LAMP reactions performed on different concentration of gDNA sample (100 ng, 50 ng, 5 ng, 1 ng, 0.5 ng, 0.1 ng, 5 pg and 1 pg).

Figure 1: Sensitivity test of LAMP primer. Gel electrophoresis images of corresponding LAMP reactions performed on different concentration of gDNA samples (100 ng, 50 ng, 5 ng, 1 ng, 0.5 ng, 0.1 ng, 5 pg and 1 pg).

LAMP was carried out to identify the specificity of the primers using 1ng of gDNA from pork, chicken, lamb and beef. The result showed successful LAMP amplification on pork sample using the designed LAMP primers but no amplification was observed in chicken, lamb and beef samples (Figure 2). This indicates the designed LAMP primer is specific to the target.

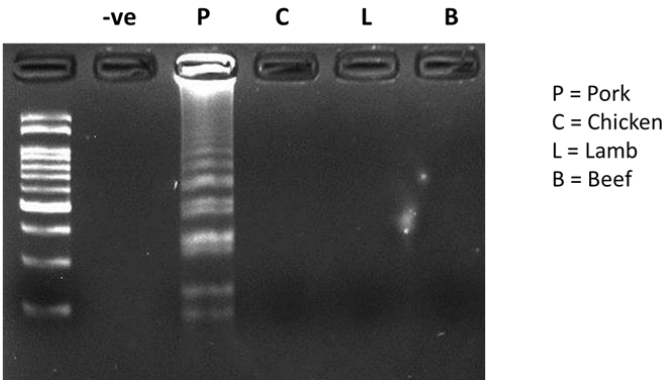


Figure 4: Specificity study of primer set-11 using LAMP. A total amount of 10 ng gDNA from pork, chicken, lamb and beef were used as DNA templates.

Figure 2: Specificity study of designed LAMP primers. A total of 10 ng gDNA from pork, chicken, lamb and beef were used as DNA templates.

In conclusion, the designed a set of LAMP primers are highly sensitive and specific for the detection of porcine DNA. This technology fits the criteria for specificity, robustness, and sensitivity, and its practical application will substantially benefit in the fight against food adulteration.

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Effects of Different Levels of Palm Pressed Fibre Oil Inclusion in Laying Hen Diets on Egg Weight and Egg Quality

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The continuous increase in the price of energy-rich conventional feedstuffs, such as corn and soybean meal, has driven the search for alternative cost-effective energy sources in the diet of laying hens (1). Palm pressed fibre oil (PPFO) is the residual oil extracted from palm pressed fibre (5 – 6% on a dry basis) via one of three common techniques: water screw-pressed technology, solvent extraction using n-hexane and supercritical carbon dioxide extraction (2). Because of its high concentrations of carotenoids (4000 – 6000 ppm), vitamin E (2400 – 3500 ppm), sterols (4500 – 8500 ppm) (3), phospholipids, and free fatty acids (4), PPFO is suitable for use in non-food applications such as animal feed. To date, there are lack of research articles reported on the utilization of PPFO in the diet for laying hens. Thus, this study aimed to investigate the effects of different levels of PPFO inclusion in the layer diet on egg weight and egg quality.

A total of 150 16-wk-old Hisex Brown laying hens were randomly assigned to one of five treatments, each treatment consisting of five levels of dietary PPFO with five replicates. The experimental diets were formulated to be isocaloric and isonitrogenous included ration with 0% PPFO (T1), 1% PPFO (T2), 2% PPFO (T3), 3% PPFO (T4) and 4% PPFO (T5). The hens were fed with T1 during four weeks of adaptation period followed by eight weeks of feeding trial (from 20 to 28 weeks of age). Eggs were collected and weighed daily throughout the feeding trial. The egg content was separated to determine the egg yolk weight and albumen weight. The eggshell weight was determined by drying it in an oven to a constant weight. Statistical analysis of the results was performed using SAS University Edition (SAS Institute Inc., Cary, NC). All data were subjected to a one-way analysis of variance (ANOVA). Means of data were separated using Duncan's multiple range test. All differences were considered significant at $P<0.05$.

The effects of PPFO inclusion in laying hen diets at various levels on egg weight, egg yolk weight, albumen weight and eggshell weight from 20 to 28 weeks of age are shown in Table 1. There was no significant difference (P>0.05) in the egg weight for all treatment groups, ranging between 47.04 to 47.72 g. T3, T4 and T5 produced significantly higher (P<0.05) egg yolk weight with 13.78, 13.79 and 13.93 g, respectively, compared to that of T1 and T2 with 13.34 and 13.33 g, respectively. However, T2 produced heavier albumen weight (29.14 g) but was significantly higher (P<0.05) only to T4 (28.08 g). Dietary treatments of PPFO at different levels did not influence (P>0.05) the weight of the eggshell. The eggshell weight produced were in the range of 5.21 to 5.31 g. In conclusion, the findings of this study demonstrated that the inclusion of different levels of PPFO in laying hens diet affects the weight of egg yolk and albumen, but no changes in the egg weight and eggshell weight were detected.

Table 1. Effects of palm pressed fibre oil inclusion in laying hen diets at various levels on egg weight, yolk weight, albumen weight and eggshell weight from 20 to 28 weeks of age

Treatment	Egg Weight (g)	Egg Yolk Weight (g)	Albumen Weight (g)	Eggshell Weight (g)
T1	47.04	13.34^{b}	28.39^{ab}	5.31
T2	47.72	13.33^{b}	29.14^{a}	5.25
T3	47.36	13.78^{a}	28.37^{ab}	5.21
T4	47.16	13.79^{a}	28.08^{b}	5.29
T5	47.65	13.93^{a}	28.50^{ab}	5.22
SEM	0.16	0.06	0.13	0.03

T1= 0% PPFO; T2 = 1% PPFO; T3 = 2% PPFO; T4 = 3% PPFO; T5 = 4% PPFO; PPFO = palm pressed fibre oil; SEM = standard error mean

^{a,b} Values in the same column with different superscripts differ significantly at P<0.05.

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A Preliminary Report on the African Swine Fever Virus Analysed in Imported Pork Products from Johor Entry Point.

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African swine fever (ASF) is a fatal viral disease that affects pigs of all ages and breeds. ASF virus (ASFV) is highly virulent and remains a global threat because of the lack of a vaccine and the ability of the virus to survive in various environmental conditions. In August 2018, China reported the first outbreak of ASF in Asia (1). Since ASF arrived in China, the virus has been spread throughout Asian countries: Vietnam, Mongolia, Cambodian, Lao PDR, Myanmar, North and South Korea, Indonesia, The Philippines, Timor-Leste, Papua New Guinea, India and Malaysia (2). Although Thailand has declared it ASF-free status, the ASFV has been found on confiscated pork products brought into Thailand (3). According to a statement by the Ministry of Agriculture and Agro-based Industry (MOA) in 2019, the Department of Veterinary Services Sarawak (DVVS) has found DNA of African Swine Fever virus in an imported can of luncheon meat from China. The virus was detected in one out of 17 imported canned pork products (2). Due to the detection of ASF virus from the imported products, The Department of Veterinary Services (DVS) has widened the temporary ban on products such as canned pork, sausage casings, sliced pork, smoked ham and pork enzymes from affected countries such as China, Poland, Russia, Hungary, Moldova and Ukraine. Also, DVS has been conducting surveillance program of ASF on pork products brought into Malaysia. These products were sent to nearby veterinary laboratories by Malaysian Quarantine and Inspection Services (MAQIS) for ASF testing before being allowed to be brought in for public consumption.

A total of 375 pork products imported from Singapore including sausage, ham and pork luncheon meat were randomly sampled at quarantine inspections posts and sent to Veterinary Laboratory Southern Zone from the year 2019 to 2020. All samples were homogenized using sterile sand and 5ml Medium Essential Media (MEM) with a mortar and pestle. The suspension then was centrifuged at 3000xg for 5 min, and the resulting supernatant was removed for further testing. The supernatant was stored at 4°C until DNA extraction (within 24h). Two hundred

microlites homogenated supernatant was extracted using QiAmp cador Pathogen Mini kit (Qiagen, Manchester, UK) and 50 µl AVE buffer. DNA extract were stored at -20°C before further analysis. DNA extract were analysed using qPCR Virotype ASFV Kit assay (Indical Bioscience). A total of 5ul DNA was used according to the manufacturer's instructions and this commercially-available kit contains all the necessary reagent for the detection of ASFV DNA, including a Positive and Negative Control. An internal control was also used as it may exclude the possibility of false-negative results. Using this kit, ASF was detected using the FAM channel, while the internal control was detected using the HEX channel of the instrument. The assays were performed on eppendorf realplex4 machine.

The ASFV C_T values achieved by qPCR assays following automated extraction are shown in Table 1, while figure 1 shown a graph of Fluorescence profile for a few samples. Results from all of the analysed samples did not show the presence of DNA African Swine Fever virus.

Table 1. C_T values generated using qPCR assays

Samples	**C_T value**
Luncheon meat product	-
sausage	-
Negative Control Kit	-
Positive Control kit	32.2

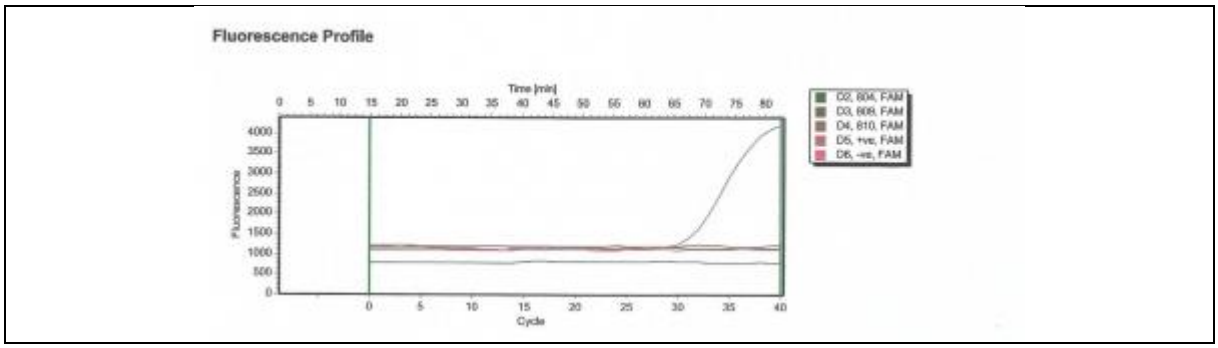


Figure 1: Relative fluorescence vs. cycle number

This report is indeed an excellent indication that for the time being, pork products imported from Singapore are free from African Swine Fever Virus. This may be due to the strict Singapore Food Agency (SFA) export and transhipment regulations imposed on licensed traders who intend to export food products from Singapore. The licensed traders are required to fulfil SFA's export requirements, as well as the import requirements of the country of destination (4).

In conjunction with animal health surveillance programs, testing pork products could be important to prevent ASF contaminated products from entering the food chain and being diverted to animal feed through food waste. Since the ASFV DNA has been detected in imported can of luncheon meat from China, therefore, the sampling of pork products at border control points could provide an essential control strategy to prevent such an incursion of diseases. Further comprehensive studies in testing imported pork product for bacterial pathogens such as *Salmonella* spp. and *Listeria* spp. together with ASFV should be made. Hence, it is essential to maintain and, where possible, strengthen efforts to control ASF for food security.

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Relationship of Scrotal Circumference with Age, Bodyweight, Testicular Parameters, and Heart Girth in Malaysian Kedah-Kelantan (KK) Bulls (*Bos indicus*)

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This study was conducted to determine the relationship of scrotal circumference with age, bodyweight, testicular parameters, and heart girth in Kedah-Kelantan bulls. The animals were monitored into three age periods as pre-pubertal from 13 to 16 months, pubertal from 17 to 20 months, and post-pubertal from 21 to 24 months for evaluating the age of puberty and maturity of bulls. Puberty was defined as when a bull produces an ejaculate containing a minimum of 50×106 sperm cells with at least 10% motile (1). Maturity was determined when an ejaculate contained ≥ 30% motile and ≥ 70% normal sperm morphology (2). Age was calculated from birth dates recorded at the breeding farm. The average birth weight and initial body weight of selected bulls were 16.67± 0.79 kg and 88.22±3.31kg respectively. Bodyweight, scrotal circumference, and testicular parameters were monthly measured using scrotal measuring tape. Results were expressed as mean ± SEM after computing, tabulating, and analyzing the research data by the SPSS computer. One-way analysis of variance (ANOVA) was used to determine mean differences of all studied parameters.

Table 1 describes the body weight, scrotal circumference, testicular length, testicular width, paired testicular weight, and heart girth in KK bulls at pre, pubertal and post-pubertal age. All studied parameters were significantly (P<0.05) different between pre-pubertal, pubertal, and post-pubertal ages. All experimental bulls attained their puberty and maturity at the mean age of 18.00±.58 and 22.00±.71months, respectively.

Table 1. Growth, scrotal circumference, scrotal biometry and heart girth in pre, pubertal and post pubertal stage of purebred KK bulls

Parameters	Pre-pubertal (13-16-month)	Pubertal (17-20-month)	Post pubertal (21-24-month)
Age (month)	14.5±.65[a]	18.00±.58[b]	22.00±.71[c]
Body weight	100.90±3.78[a]	138.47±6.96[b]	187.72±7.22[c]
Scrotal circumference	18.25±.40[a]	20.53±.75[b]	23.2±.98[c]
Testicular length	8.06±.34[a]	10.01±.27[b]	11.56±.20[c]
Testicular width	6.48±.19[a]	8.37±.44[b]	10.58±.27[c]
Paired testicular weight	190.62±17.95[a]	394.03±50.45[b]	753.96±54.63[c]
Heart girth	114.64±2.11[a]	125.83±1.90[b]	138.32±1.11[c]

Means with similar superscripts within the same row do not differ significantly

Bodyweight, scrotal circumference, scrotal biometry, heart girth, and body condition scores at different ages in KK bulls are shown in Table 2, which indicate significantly (P<0.05) differences between various ages. This study revealed that scrotal circumference, testicular length, testicular width, and paired testicular weight were increasing in trends until 30-month, while body weight and heart girth declined after 2 years of age. These results might be due to the effect of feeding and watering management, which was disrupted due to the movement control order (MCO) placed associated with the Covid-19 pandemic in Malaysia.

Correlation coefficients matrix of body weight and testicular parameters and heart girth are shown in Table 3. Positively, strongly and highly (P<0.01) correlation was observed between scrotal circumference with TL (r=.987), TW (.990), PTW (.986), and HG (.988). Similarly, all others parameters are also highly (P<0.01) correlated to each other. Furthermore, scrotal circumference with age (Figure 1) and body weight (Figure 2) of Kedah-Kelantan cattle bulls were highly correlated with scrotal circumference.

Table 2. Comparison of body weight, scrotal circumference, scrotal biometry, heart girth and body condition score in different period of ages in pure KK bulls

Parameters	13-month	18-month	24-month	30-month
Body weight (kg)	89.00±6.46[a]	141.08±8.98[b]	199.83±9.68[c]	179.17±11.09[cd]
Scrotal circumference (cm)	17.33±1.06[a]	20.83±.833[ab]	24.33±.88[b]	26.11±.82[bc]
Testicular length (cm)	7.43±.68[a]	10.05±.52[b]	12.03±.38[c]	14.33±.33[d]
Testicular width (cm)	6.15±.53[a]	8.33±.46[b]	11.13±.43[c]	10.58±.37[cd]
Paired testicular weight (g)	171.94±38.21[a]	402.07±64.19[a]	831.68±69.72[b]	897.45±76.86[bc]
Heart girth (cm)	108.88±2.57[a]	125.32±2.70[b]	140.98±2.77[c]	135.00±2.78[cd]
Body condition score (1-9)	5.08±.08[a]	5.50±.32[a]	5.83±.17[a]	4.83±.31[ab]

Means with similar superscripts within the same row do not differ significantly

Table 3. Correlation coefficients matrix of growth and reproductive traits of pure KK bulls

Breed	BW	SC	TL	TW	PTW	HG
Age	.994**	.997**	.999**	.990**	.986**	.989**
BW		.994**	.983**	.994**	.994**	.985**
SC			.987**	.990**	.986**	.988**
TL				.988**	.966**	.991**
TW					.991**	.990**
PTW						.974**

**=significant at 0.01 level, Body weight (WB), Scrotal circumference (SC), Testicular weight (TL), Testicular width (TW), Paired testicular weight (PVT), heart girth (HG),

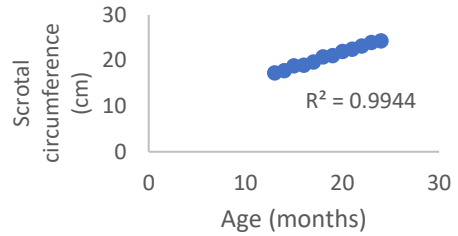


Figure 1: Relationship of scrotal circumference with age in KK cattle bulls

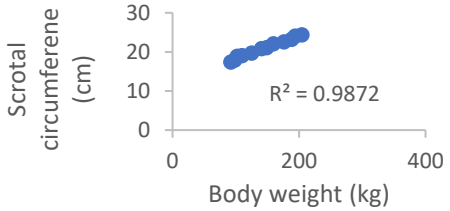


Figure 2: Relationship of scrotal circumference with body weight in KK cattle bulls

In conclusion, KK bulls passed the set criteria of puberty and maturity at the age of 18 and 22 months, respectively. Kedah-Kelantan cattle bulls. Finally, scrotal circumference is predicted to be the best suitable indicator for selecting young KK bulls for breeding purposes.

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Effect of Soyhull Supplementation on Quality of *Indigofera zollingeriana* Silage

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The covid pandemic that hit the world caused food shortages and rising feed prices. The current worrying situation is causing farmers to look for alternative quality foodstuffs so as not to rely entirely on commercial feed. Abundant of green feedstuffs sources could be converted to more valuable form of feed through the ensiling process. Silage is a method of storing fresh fodder and agricultural waste that contain moisture between 35 -75% in the absence of oxygen (1). *Indigofera zollingeriana* is classified as a leguminous species legume species that has high nutrient quality. The crop also has a high yield, is very tolerant of abiotic stress, high salinity and acidic soil conditions making it easy to grow (2). However, the high moisture content in *Indigofera* leaves, i.e., around 75%, will result in low silage quality. Therefore, in this study, soyhull was evaluated as a water absorbent material as well as a source of digestible energy to anaerobic microbes to increase the digestion activities in *Indigofera zollingeriana* leaves silage.

The experiment was conducted according to Completely Randomized Design (CRD) with 5 treatments. The inclusion percentage of soyhull used were 0% (T0), 20% (T1), 30% (T2), 40% (T3) and 50% (T4) with 4 replicates per treatment. Fresh *Indigofera zollingeriana* leaves were harvested from the MARDI Kluang nursery plot. The leaves were separated from the stems and tightly packed into 300ml of glass containers according to their respective treatments. The lid on the glass containers were sealed to ensure no air ingress. The silage containers were then placed in a dark room and were opened after 50 days ensiling. The pH readings were taken and repeated 4 times for each treatment. The samples were then dried in an oven at 105ºC for 2 hours and dry matter content was calculated. All data was analysed with analysis of variance (ANOVA) using SAS statistical programme (Version 9.1).

The results of analysis of variance (ANOVA) are shown in Table 1. It was observed that pH and dry matter content were significantly affected by addition of soyhull in *Indigofera* silage. The pH reading showed a quadratic response to soyhull inclusion (Figure 1) and it was the highest at 0% soyhull (4.88). Meanwhile, an addition of 20% soyhull showed the lowest pH reading (4.48) among other treatments. This finding suggests that an addition of soyhull

between 20 to 30% is suitable as absorbent for *Indigofera* silage. Various studies have shown that silage with a pH of <4.5 is more stable and less prone to spoilage. On the other hand, there was a linear increase ($p < 0.01$) in dry matter (DM) content with soyhull inclusion. (Figure 2). DM content was significantly lowest at 0% soyhull (25.76%) and highest at an addition of 50% soyhull. The increasing pattern of DM content with soyhull inclusion explained the simultaneous increased of pH in *Indigofera* silage. High DM may lead to dryer silage and reduce the metabolic water required for the growth of lactic acid bacteria and consequently increase pH of the silage as the lactic acid production is limited (3).

In conclusion, soyhull could be used as a moisture absorbent for *Indigofera* silage and other fodder feedstuffs and agricultural waste that contains high percentage of moisture content (35 -75%) which at the same time able to improve the quality of silage. An addition of 20-30% soyhull can be used to produce a good quality of *Indigofera* silage.

Table 1: Mean square of ANOVA on effect of soyhull supplementation on Indigofera silage quality

Source of variance	Parameter	
	pH	DM
Treatment	0.11**	657.90**
Grand mean	4.64	44.04
C.V. (%)	1.46	5.35

Note: mean followed by * is significant at 0.05; mean followed by ** is significant at 0.01

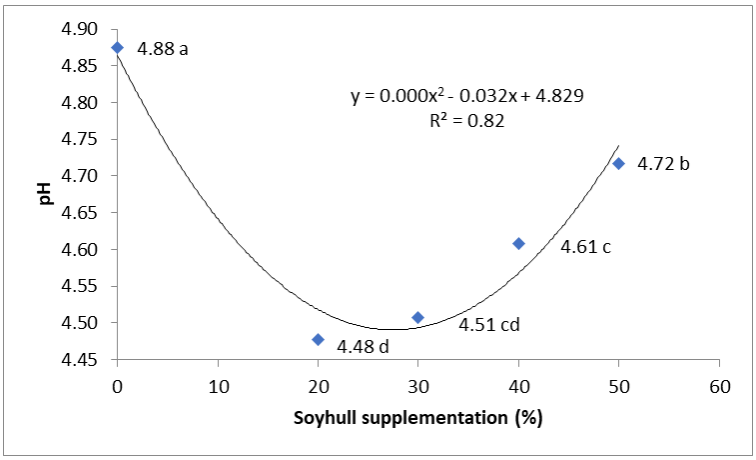


Figure 1: The changes of pH with soyhull supplementation of *Indigofera* silage

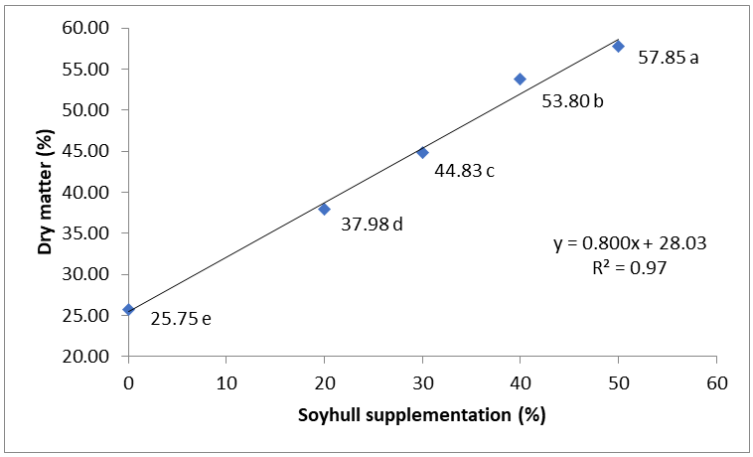


Figure 2: The changes of dry matter content with soyhull supplementation of *Indigofera* silage

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ACKNOWLEDGEMENTS

The organising committee for

40th MALAYSIAN SOCIETY OF ANIMAL PRODUCTION (MSAP) ANNUAL CONFERENCE 2021

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All committee members for their time and effort and all those relevant parties and individuals who have contributed to the success of this event in one way or another. Looking forward to seeing you again in our future conferences.

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Malaysian Society of Animal Production

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