PROCEEDINGS

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Harnessing Emerging Technologies for Efficient Animal Production



Welcome to the E-Proceedings of the 43rd Malaysian Society of Animal Production (MSAP) Annual Conference. This compilation of research papers and presentations represents the cutting-edge developments and scholarly contributions in the field of animal production.

Each submission has undergone a rigorous review process conducted by our esteemed scientific committee, ensuring that the highest standards of academic integrity and scientific merit are upheld. The diverse range of topics covered in this e-proceedings reflects the innovative approaches and critical advancements that are shaping the future of animal production.

We are proud to present this collection and hope that it serves as a valuable resource for researchers, practitioners, and stakeholders in the agricultural community. Thank you to all the contributors and reviewers for their dedication and hard work.

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Category: Keynote address

HUMANIZING TECHHNOLOGY FOR EFFICIENT ANIMAL PRODUCTION

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Abstract

Every nation aspires to address the issue of food self-sufficiency as effectively as possible. Many strategies towards optimum animal production have been recommended in countless policies and position papers, and central to the strategies have often been the utilization of technology. This discourse will argue on the premise that there is a need to attain the outcomes of technology utilization as opposed to merely using technology as a tool. In many systems, technology push is the more dominant form of execution compared to technology as a response to the demand needs. As such at times, the full potential of technology utilization may not be realized. This is the argument posed by this discourse and the term “humanizing technology” has been aptly chosen. In many systems, the concept of “humanizing technology” can be defined as (i) the inability for systems or program aspirations to be attained when the adoption or utilization of technology has been ineffectively used (ii) the inability to extend the potential of technology adoption when the issues of digital divide and being inclusive remain to be significant challenges. How has the animal production effort with technology faired? The existing challenges with possible recommendations shall be discussed for animal production.

Category: Plenary 1

POLICY AND DIRECTION IN MODERNIZING THE AGRI-FOOD SECTOR TO ACHIEVE THE GOALS OF THE NATIONAL AGRI-FOOD POLICY

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Abstract

The Agricultural Modernization Division under Malaysia's Ministry of Agriculture and Food Security focuses on modernizing the agri-food sector to achieve the goals of the National Agrofood Policy 2.0. It aims to increase productivity and competitiveness through technological adoption. Key functions include formulating, monitoring, and evaluating policies, programs, and projects related to agricultural modernization, promoting sustainable and competitive agricultural technologies, and managing funding and smart farming initiatives. The division also coordinates research and development activities and collaborates with relevant ministries and agencies.

Category: Plenary 2

EVOLUTIONARY ALGORITHM-BASED FOR OPTIMIZATION OF LIVESTOCK FEED FORMULATION: A SURVEY

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Abstract

The composition of livestock feed plays a critical role in ensuring optimal nutrition and health for animals. It has a significant impact on the overall health and productivity of animals. Given the rise in population due to the heightened demand for processed animal products to improve of feeding efficiency. This study examines the utilization of evolutionary algorithms (EA) to optimize feed compositions in the context of Indonesia. The EAs offer a novel approach to address the ever-changing and intricate characteristics of feed compositions, optimize nutritional utilization, and minimize expenses. We perform a comprehensive literature analysis to examine the application of several evolutionary strategies, such as genetic algorithms, particle optimization, and differential evolution, in developing feed diets that are both balanced and cost-effective for a range of species often found in Indonesia. We also deliberated on the potential advantages, challenges, and prospective avenues in the incorporation of EAs to achieve sustainable feed optimization in the cattle sector of Indonesia.

Keywords: Evolutionary Algorithm, Genetic Algorithm, Livestock feed optimization, PSO

Introduction

Improving animal feed content is an important aspect of animal husbandry in Indonesia. The utilization of evolutionary algorithms is aimed at optimizing feed composition. This aims to eliminate Antibiotic Growth Promoters (AGPs) and to improve gut health and overall animal performance. The utilization of Multi-Objective Evolutionary Algorithms (MOEA), such as NSGA-II, can facilitate the development of animal feeds that effectively meet the nutritional needs of animals (1).

Investigation of local agro-industrial by-products that have potential as feed sources for ruminant animals is particularly important in Indonesia, given the widespread implementation of feed composition requirements from the National Research Council (NRC) (2). The shift towards alternative feed sources is in line with evolving regulations in improving animal gut health (3). In addition, an examination of production costs at several animal feed companies in Indonesia serves to illustrate the economic implications associated with optimizing feed composition (4). The importance of tailoring feed formulations to meet the specific needs of livestock in Indonesia is to increase the expertise of animal nutritionists and the utilization of local feed resources such as sorghum and sago hull (5-7). In addition, restrictions on the use of AGPs in

Indonesia necessitate the exploration of alternative options, such as probiotics, to maintain animal performance and welfare (8).

Utilizing evolutionary algorithms in precision animal feed formulation can revolutionize the industry by simultaneously considering several objectives and constraints (9). By integrating big data analytics and machine learning, it can develop predictive models that enhance feed efficiency and overall animal performance (10). In addition, the development of precise feed composition tables and the implementation of statistical screening procedures might potentially facilitate the production of precise formulations tailored to the unique nutritional requirements of animals in Indonesia (11). Evolutionary algorithms may greatly enhance animal health, performance, and overall agricultural sustainability in the region by focusing on local demands, economic factors, and nutritional requirements**.**

Evolutionary Algorithm

Evolutionary algorithms are a class of computational techniques inspired by the principles of natural selection and evolution. These algorithms iteratively improve a population of candidate solutions through selection, crossover, and mutation, mimicking the mechanisms of biological evolution. Commonly employed EAs include genetic algorithms (GAs), particle swarm optimization (PSO), and differential evolution (DE), each with its unique characteristics and optimization strategies.

Optimizing animal feed composition in Indonesia using evolutionary algorithms presents a promising avenue for enhancing the efficiency and effectiveness of feed formulation processes. With the abundance of resources like sago hampas and sorghum that are underutilized in Indonesia (1,2), evolutionary algorithms can play a crucial role in maximizing the utilization of these feed sources for livestock. The optimization of feed composition, although traditionally laborious (3), can benefit significantly from the computational power and problem-solving capabilities of evolutionary algorithms (4). By leveraging algorithms like genetic algorithms and evolutionary strategies, researchers can address the complexities of formulating animal diets that meet nutritional requirements while considering cost-effectiveness and constraints. These algorithms have been proven effective in optimizing feed formulations for various livestock, such as beef cattle and poultry (5,6). By applying evolutionary algorithms tailored to the specific nutritional needs and constraints in Indonesia, such as the minimization of costs and maximization of shelf life (7), the country can potentially revolutionize its animal feed industry, leading to improved livestock health and productivity.

Genetic Algorithm (GA)

Genetic Algorithms have been acknowledged for their effectiveness in solving optimization problems, particularly in the context of livestock feed formulation (8). By implementing Genetic Algorithms, livestock producers in Indonesia can efficiently optimize feed mixes to meet the nutritional requirements of different animal species while considering cost-effectiveness (9). This strategy aligns to enhance livestock productivity through improved feed production, which is essential for sustainable livestock development in the region (10). Moreover, the genetic diversity of local livestock species, such as the Indonesian swamp buffalo, provides a valuable genetic resource that can be leveraged through optimized feed formulations to enhance

animal adaptation and performance across different regions (11). Additionally, the utilization of alternative feed resources like sorghum and sago hampas can be optimized through Genetic Algorithms to ensure a balanced and sustainable feed supply for livestock (1,2). Therefore, integrating Genetic Algorithms into livestock feed optimization strategies in Indonesia offers a systematic and efficient way to enhance livestock productivity, promote resource sustainability, and support the economic viability of livestock farming in the region. Generally, the steps of the genetic algorithm include initialization, reproduction, evaluation, and selection as shown in Figure 1. In the initialization step, it is to generate a set of new random/random solutions consisting of several chromosome strings and placed in a shelter called a population. In this phase, the population size should be determined. This value indicates the number of individuals/chromosomes housed in the population. The length of each chromosome string (stringLen) is calculated based on the precision of the variable solution we're looking for. Then, reproduction is done to produce offspring of individuals present in the population. And this assembly of descendants is placed in the shelter of the offspring. The two genetic operators used in this process are crossover and mutation. (mutation). Evaluation is used to calculate the fitness of each chromosome. Furthermore, the selection step addresses selecting individuals from the population assembly and the offspring that are kept alive for the next generation. The greater the fitness value of a chromosome, the more likely it is to be selected. Te next generation that's better than the current one. The most common selection methods are roulette wheel, binary tournament, and elitism.

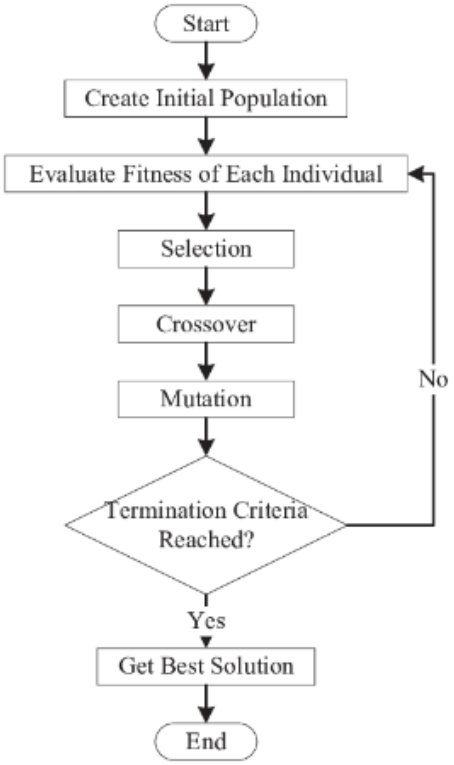


Figure 1. Steps of Genetics Algorithm

Particle Swarn Optimization (PSO)

Livestock feed optimization in Indonesia can be significantly enhanced through the application of the Particle Swarm Optimization (PSO) algorithm. PSO is a powerful optimization technique that mimics the behavior of swarms in nature to find optimal solutions. By utilizing PSO, the formulation of livestock feed can be fine-tuned to meet the specific nutritional requirements of different livestock species, ensuring optimal growth and health. Research by Zeng & Li (2021) demonstrates the successful application of PSO in formulating pig feed, highlighting its fast convergence speed and strong optimization capabilities (12). Moreover, the study by Niu et al. (2013) showcases the effectiveness of an improved PSO algorithm in optimizing fermentation processes, indicating its potential for optimizing various parameters in livestock feed production (13). By leveraging PSO, Indonesia can harness its abundant resources like sago solid waste Sumardiono et al. (2018) to develop cost-effective and nutritionally balanced feed options for livestock (14). This approach aligns to enhance livestock productivity and overall agricultural sustainability in Indonesia (15).

The PSO algorithm consists of three stages, including particle position and velocity generation, update velocity, and position update. Particles change their positions from one move (iteration) to another based on the update velocity.

The first step is position, and the velocity of the group of particles is generated randomly (rand) using the upper limit (xmax) and the lower limit (xmin) as shown in the Eq. 1 and Eq. 2.

$$x_0^i = x_{min} + rand(x_{max} - x_{min}) \quad (1)$$

$$v_0^i = x_{min} + rand(x_{max} - x_{min}) \quad (2)$$

The second step is updating the velocity for all particles at k+1 time using the fitness value of the current particle position at k time. The fitness value can be determined by the particle that has the best global value on the current swarm, and also the best position of each particle at all times now and before. The update velocity formulation also uses some random parameters. The formula update velocity can be seen in the Eq. 3 as follows (16):

$$v_{k+1}^i = \omega * v_k^i + c_1 * rand * {p_{best}}^i - x_k^i + c_2 * rand * g_{best} - x_k^i \quad (3)$$

where:

v_k^i = the velocity of the particle *i* on k^{th} iteration

ω = *inertia* (weight function)

c_1 = *self confidence*

c_2 = *swarm confidence*

rand = random value between 0 and 1

x_k^i = particle position *i* on k^{th} iteration

${p_{best}}^i$ = best position of particle *i*

g_{best}= the best value of swams (p_{best})

$$\omega = \omega_{max} - \frac{\omega_{max} - \omega_{min}}{iter_{max}} x\ iter \quad (4)$$

The last step is to update the position of each particle. If there is a change in velocity, then the position of the particle will also change on each iteration that can be searched through Eq.5 (16).

$$x_{k+1}^{i} = x_{k}^{i} + v_{k+1}^{i} \quad (5)$$

The three steps that have been shown will be repeated until the convergence criterion is met. Convergence criteria are crucial in avoiding the addition of evaluation values after an optimal solution is obtained. Setting the maximum number of iterations can also be used as a stopping condition of an algorithm (16). The steps to optimize the feed composition of dairy cows using the PSO algorithm are shown in Figure 2.

a. To input in the form of feed type data available to users and PSO parameters including: number of iterations, swarm size, maximum inertial weight (ωmax), minimum inertial weight (ωmin), acceleration coefficient 1 (c1), and acceleration coefficient 2 (c2).
b. To initialize particle
c. To update particle velocity and position
d. To calculate fitness function
e. To get personal best and global best updates.
f. For iteration 1 to the maximum iteration, do step c to step e.
g. The global best with the best fitness value, namely the most optimal dairy cow feed composition.

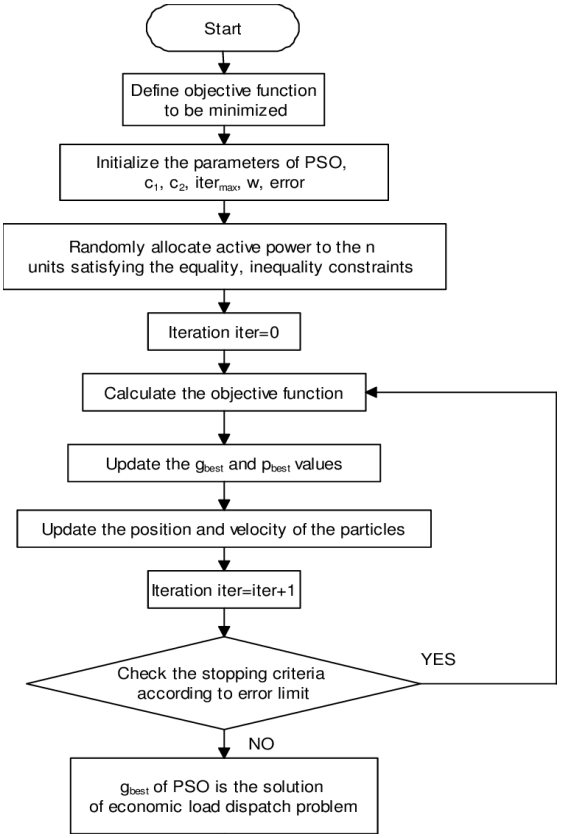


Figure 2. The steps of the Particle Swarm Optimization Algorithm

Application in Livestock Feed Formulation Optimization

In the context of Indonesia, where livestock rearing encompasses diverse species such as poultry, cattle, goats, and aquaculture, the optimization of feed formulation presents multifaceted challenges. EAs offer versatile tools for addressing these challenges by efficiently searching the vast solution space to identify feed compositions that optimize nutritional content, palatability, and cost-effectiveness. Researchers and practitioners have leveraged EAs to formulate feed rations tailored to the specific requirements of different animal species, considering factors such as age, weight, physiological status, and production objectives.

Livestock animal feed formulation in Indonesia is crucial for ensuring optimal animal health, productivity, and sustainability in the agricultural sector. By utilizing advanced techniques such as multi objective genetic algorithms (17), modified feed formulations (18), and goal programming approaches (19), the livestock industry can effectively optimize feed blends to meet economic, environmental, and nutritional criteria. Models like the Tabu-Genetic Algorithm-Based Model for Poultry Feed Formulation (20) and precision animal feed formulation methods (21) can enhance the utilization of locally available feed resources, contributing to balanced and cost-effective feed formulations. Additionally, the application of probiotics (22) and the exploration of alternative feed sources such as insect meal (23) and sorghum (1) can further enhance livestock health and immunity. Developing comprehensive feed libraries (24), simulation tools (7), and expert systems (25)Angadi et al. (2016) can help streamline feed formulation processes, promote sustainable animal production, and address challenges like limited feed resources and fluctuating maize prices (26). Embracing a circular economy approach (27) and evaluating feed quality (28) are essential steps towards improving livestock productivity and ensuring the long-term viability of the livestock sector in Indonesia.

Challenges and Opportunities

Despite their potential benefits, the integration of evolutionary algorithms in livestock feed optimization faces several challenges. These include the need for accurate and comprehensive data on nutrient requirements, feed ingredient characteristics, and animal responses, as well as computational complexities associated with large-scale optimization problems. Moreover, there is a necessity for interdisciplinary collaboration between animal nutritionists, geneticists, computational scientists, and industry stakeholders to harness the full potential of EAs in feed formulation. However, with advancements in computing technology, the availability of big data analytics, and ongoing research efforts, there are ample opportunities to overcome these challenges and foster the adoption of EAs for sustainable livestock production in Indonesia.

Optimizing animal feed in Indonesia presents both challenges and opportunities when utilizing evolutionary algorithms. Evolutionary algorithms have been recognized for their potential to address complex optimization problems (29). By leveraging these algorithms, researchers can explore a wide range of possibilities efficiently to find optimal solutions, as seen in studies focusing on root water foraging strategies in plants (30). Furthermore, the use of evolutionary algorithms in feed formulation, such as in shrimp feed, has shown promise in handling constraints effectively (31). However, applying evolutionary algorithms to optimize animal feed in Indonesia

requires considering the specific local resources available, like sago hampas for ruminants, to enhance production independence and efficiency (2) This approach aligns with the strategic goal of maximizing the utilization of indigenous feed resources. Additionally, the integration of evolutionary algorithms with machine-learning techniques can offer a comprehensive solution by jointly learning features and hyperparameters for optimized and explainable machine learning (32). Therefore, while challenges exist in adapting evolutionary algorithms to the unique context of animal feed optimization in Indonesia, the potential benefits in efficiency and resource utilization make it a promising avenue for further research and application.

Conclusion

In conclusion, evolutionary algorithms offer a promising paradigm for optimizing livestock feed formulations in Indonesia, enabling enhanced productivity, profitability, and sustainability in the livestock industry. By leveraging the computational power of EAs and integrating them with domain knowledge and practical insights, stakeholders can navigate the complexities of feed optimization to meet the evolving demands of animal agriculture in the region. Continued research, innovation, and collaboration are essential to realize the full potential of EAs in shaping the future of livestock nutrition and food security in Indonesia

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Category: Plenary 3

APPLICATION OF DIGITAL TECHNOLOGIES TO ENHANCE AGRICULTURAL PRODUCTIVITY

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Introduction

The general understanding of digital technologies in agriculture is primarily focused on expanding data gathered in the field. Digital technologies in agriculture have been deployed in various segments of farming, including farm equipmentation, animal handling facilities, agronomy, and communication. Interestingly, digital agriculture widely covers diverse aspects of the agri-food sector from basic application, such as using mobile device to get technical assistance and perform farm monitoring, to a more comprehensive implementation, such as using satellites to map fields and predict weather conditions. At the advanced level, specialized farm management information systems help producers to control their farm from a centralized platform, including tasks such as planning, inventory management, and financial tracking. The history of digital agriculture dates back to the mid-20th century, when computers were used to analyze farm data. Nonetheless, digital agriculture found its way into the 21st century, when powerful and affordable computing systems and technologies, including smartphones, drones, and sensors, are becoming increasingly available.

Precision agriculture, which was developed in early 1990s, is the basis of digital agriculture. More recently, new technologies such as Artificial Intelligence (AI), Internet of Things (IoT), wireless sensors, automation and robotics, big data analytics and blockchain have enabled digital agriculture with the potential to boost farm productivity and improve the utilization of water and other farming resources. These technologies can aid in fostering resilience and long-term sustainability in food production. Based on the current understanding of digital agriculture implementation and its potential applications across various food production systems, the following questions are relevant:

- Which digital technologies have been used in agriculture?
- How these technologies can affect the agricultural industry in regards to sustainable food production?
- What is the adoption status of these technologies?
- What are the challenges of deploying these technologies in agriculture?

Keywords: Agri-food system, Digital agriculture, Precision agriculture, Smart agriculture,

Methodology

The following sources of information were used: Scopus (https://www.scopus.com/), Springer Link (http://link.springer.com/), Science Direct (http://www.sciencedirect.com/) and the National Agricultural Library (https://www.nal.usda.gov/). Google Scholar (https://scholar.google.com/) was also used to extend the search for potentially useful publications that were not indexed in the sources mentioned above. These databases were selected because they contain essential metadata and allow for easy data extraction compared to other databases. Scopus was searched using the following key search terms: Precision Agriculture, Smart Agriculture, Digital Agriculture, Precision Technologies, Intelligent Agriculture.

Discussion

Digital agriculture is based on the following five levers for action which, when mobilized together, lead to innovation: (1) abundance of data due to the development of sensors (from nano sensors to satellites) and facilitated communication and storage, (2) increase in computing power, which makes it possible to implement AI and new modeling methods, (3) connectivity and information exchange interfaces, (4) knowledge management and engineering for decision support in agriculture, (5) automation, control and robotics. In the past three decades, farming practices have been revolutionized by the widespread adoption of technologies such as automation and control systems, data analysis tools, web-based and mobile applications. The primary goal of these innovations has been to maximize productivity from agricultural lands and resources. From the early 1990s until 2010, farmers monitored their field and identified deficiencies using precision positioning systems, satellite maps, and local sensing equipment such as data loggers. This approach is known as precision agriculture. Moving forward, precision agriculture and smart farming practices have evolved toward digitalization with the emergence of Unmanned Aerial Vehicles (UAVs), long-range wireless sensors, and IoT devices. This has offered new hope to ensure the sustainability of agri-food systems.

To identify problems and enhance agricultural productivity by effectively utilizing available resources, precision agriculture uses available data collected from various sources, such as satellite imagery and remote/proximal sensing platforms. Simultaneously, smart and digital agriculture utilize robotics, wireless systems, mobile applications, and IoT-based automation to detect, assess, and control the condition of the soil, water supplies, and weather fluctuations on croplands to increase field efficiency and minimize expenses. In the field of automation, the deployment of smart irrigation, water loss control, and continuous identification of soil nutrient levels in remote places have all benefited from wireless sensors and IoT devices.

The adoption and use of digital agriculture technologies vary across different regions of the world, and there are several factors that influence this variation. In Europe, there is a relatively high level of adoption and use of digital agriculture technologies, particularly in countries with a high level of agricultural production, such as France, Germany, and the Netherlands. In North and South America, the adoption and use of digital agriculture technologies are relatively high, and the United States, Brazil, and Canada being among the leading countries. These countries have been early adopters of precision agriculture practices and have been investing in research and

development of new technologies. In Asia, the adoption and use of digital agriculture technologies are growing rapidly, and China is leading the way. The Chinese government has been promoting the use of precision agriculture technologies to increase crop/animal productivity and reduce environmental impact. In Africa, the adoption and use of digital agriculture technologies are still relatively low, due to various factors such as limited access to technology and infrastructure, and low levels of investment in research and development.

Technologies such as big data analytics, wireless sensor networks, blockchain and cyber-physical systems have not been extensively studied in the agri-food domain. The high cost of implementing complex and advanced technologies in the agriculture sector during the early stages of adoption could be one of the primary reasons for this gap. However, IoT has gained significant traction in farms. This is primarily attributed to the diverse range of functions that IoT offers, including monitoring, tracking, tracing, agriculture machinery, and precision agriculture. IoT is a significant area of focus in digital agriculture, however, few studies have taken into account aspects such as data security and reliability, scalability, and interoperability in the development of intelligent agricultural systems. The majority of IoT use cases in the agricultural sector are still in the prototype stage. AI in the facets of machine learning and deep learning, in combination with IoT, big data and cloud computing, is regarded as one of the key drivers behind the digitization of agriculture. These technologies have the potential to enhance crop and animal production and improve real-time monitoring, processing, and marketing.

Conclusion

The possibility of using advanced technologies to improve crop and animal production under normal and stress conditions can promote the development of digital farms in a scalable manner to sustain livelihood and increase food supply. Although digital technology has enormous potential to contribute significantly to increased crop and animal production, the application of this modern technology also comes with risks, such as the lack of privacy, the over-concentration of service providers, exclusion and even job losses for specific occupations, and cyber security breaches.

Category: Plenary 4

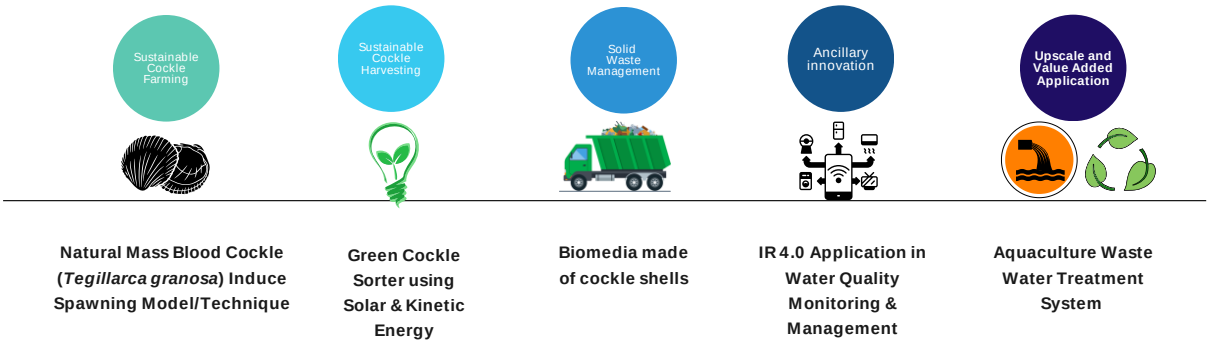
IMPLEMENTATION OF SMART AQUACULTURE SYSTEMS TO ENHANCE EFFICIENCY IN AQUACULTURE

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Abstract

The aquaculture industry faces significant sustainability and efficiency challenges that necessitate innovative solutions. The Smart Aquaculture System integrates emerging technologies to optimize aquaculture operations. This framework incorporates Internet of Things (IoT) sensors, automation, and renewable energy technologies, facilitating real-time water quality monitoring, automated processes, and energy-efficient practices. This initiative aligns with the United Nations Decade of Ocean Science for Sustainable Development, specifically under the "Sustainable Total Value Chain of Cockle Industry" project. This project aims to reduce the environmental impact of aquaculture while enhancing productivity and sustainability through technological integration. The application of this system has led to notable improvements in operational efficiency and sustainability, demonstrating the system's ability to enhance traditional aquaculture practices through the adoption of modern technology. The adoption of such systems exemplifies a strategic approach to addressing the global challenges of sustainable aquaculture, ensuring economic viability while maintaining ecological balance. The integration of smart technologies through the Smart Aquaculture System initiative marks a pivotal shift towards sustainable practices, setting a precedent for future aquaculture operations.



Category: Plenary 5

GENOMICS TOOLS AND APPLICATIONS FOR IMPROVING EFFICIENCY AND SUSTAINABILITY IN LIVESTOCK PRODUCTION

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Abstract

Genomics is rapidly reshaping livestock production, offering innovative solutions to optimize breeding programs for enhanced efficiency, sustainability, and animal welfare. This presentation will explore the technical advances driving the widespread adoption of genomic tools in livestock breeding and production.

Initially confined to the research realm, the decreasing cost and increasing accessibility of genomic technologies have accelerated their integration into national livestock improvement strategies. We will discuss how next-generation sequencing (NGS) has enabled extensive genetic characterization of livestock populations. We will also examine role of genotyping arrays and sequencing-based genotyping as cost-effective and efficient methods for screening 10s to 100s of thousands of genetic markers simultaneously. This presentation will overview applications of genomics in parentage verification, identifying genes linked to economically important traits, and implementing genomic selection for accelerated breeding progress.

This analysis will highlight the potential of genomics to improve the accuracy of estimated breeding values (EBVs), enhance the management of genetic diversity, and support informed decisions to address challenges like disease resistance and climate adaptation. By integrating genomic tools into livestock production systems, we can drive advancements in productivity, animal health, and the overall sustainability of the sector.

Category: Plenary 6

APPLICATION OF NUTRITIONAL AND FEED TECHNOLOGY IN SUPPORTING THE PERFORMANCE OF LOCALLY DEVELOPED LIVESTOCK BREEDS

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Abstract

Nutritional and feed technology plays a critical role in supporting the sustainability, efficiency, and competitiveness of the livestock and animal feed industry by optimizing feed utilization, enhancing animal health and performance, and minimizing environmental impact. By leveraging nutritional and feed technology, the performance, productivity, and profitability of locally developed livestock breeds like Ayam Saga could be enhanced and later contributing to the sustainability and competitiveness of the poultry industry. Additionally, promoting knowledge transfer, capacity building, and adoption of best practices in poultry nutrition and feed management ensures the successful integration of nutritional and feed technology into poultry production systems. In this paper, the application of nutritional and feed technology in improving low-quality feed ingredients aimed at enhancing their nutritional value, digestibility, and utilization in animal feeds briefly described.

Introduction

The poultry industry is one of the major contributors to the agricultural sector and the country's economy. It plays an important role in providing a stable supply of affordable protein in the form of chicken meat and eggs to Malaysians. The industry has seen steady growth over the years, driven by increased demand for poultry products due to population growth, urbanization and changing dietary preferences. In 2021, poultry products contributed about 54% of the ex-farm value of livestock products (over RM12 billion) [1]. The consumption of chicken meat continues to increase as people have higher purchasing power. Similarly, the feed industry in Malaysia is closely related to the poultry sector, as feed is a critical input for poultry production, i.e. over 70% of production cost. The animal feed industry produces a wide range of feed products, including compound feed, premixes and concentrates, to meet the nutritional needs of the poultry, livestock and aquaculture sectors.

Unfortunately, Malaysian poultry industry relies on imported inputs, including breeding stock, feed ingredients, and additives. Dependency on imports makes the industry vulnerable to supply chain disruptions, currency fluctuations, and trade restrictions, which can affect availability and affordability of inputs. In order to achieving sustainable poultry farming and ensuring food security, two of many strategies could be adopted, which are promoting the development of local breeds that are well-suited to local

environmental conditions and consumer preferences and optimizing feed efficiency and nutrition.

To unlock the potential of local village chickens for intensified production, efforts have been made to improve genetics, feeding, health, and management systems. One notable initiative is the research conducted by the Malaysian Agricultural Research and Development Institute (MARDI) on chicken breeding. Through this research, a new breed called Ayam Saga has been successfully developed from local genetic resources. Ayam Saga exhibits several advantages over common village chickens, including more uniform body size, feathering, and appearance. Moreover, Ayam Saga demonstrates superior growth and laying performances compared to traditional village chickens [2]. These improvements represent a significant step forward in enhancing the productivity and competitiveness of the village chicken industry in Malaysia.

Reducing reliance on imported corn and soybean meal in local chicken feed and increasing the utilization of local feed ingredients requires several technical approaches. The use of locally produced grains, such as grain corn and feed rice, agricultural by-products and residues, such as rice bran, palm kernel expeller cake (PKE), broken rice (*temukut*), tapioca and sago, as feed ingredients to supplement energy and fiber content should be encouraged. Alternative protein sources that are locally available and cost-effective can be explored, including oilseed cakes from local food industry (e.g., canola meal, sesame seed meal), insect meal (e.g., black soldier fly larvae), local fish meal, poultry by-products (e.g. offal meal, feather meal) and leaf meal (e.g. moringa, sesbania, leucaena) [3]. However, it is important to recognize that developing local feed ingredients also presents challenges and trade-offs, such as limitations in availability, variability in quality, and competition with other land uses. The quality of local feed ingredients can vary due to factors such as nutrient composition, variability in raw materials, processing methods, storage conditions, and contamination risks. Variability in nutrient content and composition, anti-nutritional factors, such as toxins, allergens, or enzyme inhibitors, and poor physical quality, such as dustiness, particle size distribution, and foreign material contamination, are some common problems associated with local feed ingredients. These problems can impact the consistency and accuracy of feed formulation, can interfere with nutrient absorption, digestion, and animal performance and also affect feed flowability, handling characteristics, and feed efficiency. Therefore, this paper describes the application of nutritional and feed technology in improving low-quality feed ingredients aimed at enhancing their nutritional value, digestibility, and utilization in animal feeds.

What is Nutritional and Feed Technology

Nutritional and feed technology encompasses a wide range of scientific and technological advancements aimed at optimizing the nutritional quality, formulation, production, and utilization of animal feeds, including poultry feeds. It involves the application of various disciplines, including animal nutrition, feed science, feed technology, biotechnology, and engineering, to address key challenges and opportunities in feed production and utilization.

Feed formulation is one of the key aspects of nutritional and feed technology. It enables the formulation of balanced diets tailored to the specific nutrient requirements of different animal species, breeds, ages, and production stages. This involves

selecting and combining feed ingredients to meet the nutritional needs for growth, reproduction, health, and performance while optimizing feed efficiency and cost-effectiveness. In order to ensure the consistency, integrity, and safety of feed ingredients and finished feeds, evaluation of the nutritional composition, quality, and safety of feed ingredients are conducted through laboratory analysis, testing, and quality control measures. Feed evaluation and quality control are also aimed to minimize risks of contamination, spoilage, and nutrient deficiencies. With the rising demand for sustainable and cost-effective feed sources, nutritional and feed technology explores the utilization of alternative feed ingredients, such as by-products, agro-industrial residues, and novel protein sources. This involves assessing the nutritional value, digestibility, and suitability of alternative ingredients for inclusion in animal feeds while minimizing environmental impact and reliance on imported feed sources [4].

Feed additives and supplements are another key aspect of nutritional and feed technology. The development, evaluation, and application of feed additives and supplements is to enhance feed efficiency, animal health, and performance. This includes probiotics, prebiotics, enzymes, organic acids, antioxidants, and growth promoters, which modulate gut health, nutrient utilization, immunity, and overall animal well-being [5]. Advancements in nutritional and feed technology enable precision feeding strategies and management practices, leveraging data analytics, automation, and real-time monitoring systems. This allows for precise control over feed intake, nutrient delivery, and feed conversion efficiency, optimizing animal performance, minimizing feed wastage, and reducing environmental impact. Nutritional and feed technology drives ongoing research and innovation to address emerging challenges and opportunities in animal nutrition and feed production. This includes advancements in feed processing technologies, formulation techniques, feed additives, and feed management practices to enhance sustainability, efficiency, and profitability in animal production systems [6].

Utilization of non-conventional feedstuffs

Palm kernel expeller (PKE) is a major feed ingredient in Malaysia, derived as a by-product from the oil palm industry. It contains moderate levels of crude protein and fiber but is not highly palatable and lacks certain essential amino acids, particularly lysine. Several studies have investigated the use of PKE in poultry production. While some research found no significant differences in body weight and feed consumption in broilers fed with PKE, feed conversion efficiency decreased at higher inclusion levels [7, 8]. It is suggested that using PKE in poultry diets needs to be balanced with high-energy fat sources, and more research is needed to understand its impact on amino acid availability and overall nutrient digestibility. Improving the nutrient quality of PKE through enzymatic or bioprocessing methods could potentially enhance its suitability for poultry diets and reduce feed production costs.

Leaf meal can be a suitable ingredient for poultry feed, depending on the type of leaves used and their nutritional composition. Leaves from certain plants like moringa, sesbania, indigofera and leucinea contain valuable nutrients such as protein, vitamins, and minerals, making them potential candidates for inclusion in poultry diets. The maximum inclusion rate of leaf meal in broiler feed depends on various factors, including the nutritional content of the specific leaf meal, the overall composition of the

feed, and the nutritional requirements of the broilers. In general, leaf meal can typically be included in broiler feed at levels up to 5-10% without adversely affecting performance or health [9]. However, it is essential to consider factors such as the presence of anti-nutritional factors (e.g., tannins, phytates) in the leaf meal, as well as the need to balance the amino acid profile and energy content of the feed. Excessive inclusion of leaf meal may dilute the nutrient density of the feed, leading to suboptimal growth and performance in broilers. Therefore, careful formulation and evaluation of feed ingredients, including leaf meal, should be conducted to determine the appropriate inclusion rate that maximizes nutritional benefits while ensuring optimal growth and performance of broilers. Additionally, supplementation with enzymes like tannase, can help mitigate any anti-nutritional effects associated with leaf meal inclusion.

Bioconversion of PKE as feed ingredient for poultry

The process of converting palm kernel expeller cake (PKE) into a feed ingredient involves a series of microbial and enzymatic steps aimed at enriching its nutritional content, improving its digestibility, and making it suitable for incorporation into animal diets. PKE, a by-product of the palm oil industry, is frequently utilized as a livestock feed component, especially in poultry diets, due to its high protein content. However, PKE comes with inherent drawbacks such as its elevated fiber levels, presence of anti-nutritional factors, and reduced protein digestibility, all of which can impact its nutritional quality and its usefulness in animal feeding. Bioconversion techniques offer a solution to these challenges, enhancing the overall nutritive value of PKE.

This innovative approach involves the creation of fermented palm kernel cake expeller (PKE) using a fungal strain through solid substrate fermentation (SSF), followed by its incorporation into broiler feed. Notably, fermented PKE exhibits a markedly higher true metabolisable energy (TME) value compared to non-fermented PKE [10]. Studies have demonstrated that broiler chickens fed a diet containing 30% fermented PKE perform similarly in terms of growth and carcass quality to those consuming a conventional corn-soybean meal-based diet. Furthermore, the inclusion of fermented PKE has led to improved feed efficiency (FCR), with no significant differences observed in final live weight, body weight gain, or average daily gain when compared to chickens on the standard diet. In addition to enhancing growth performance, chickens fed the fermented PKE diet display increased resilience to heat stress and lower mortality rates compared to those on the standard diet. Furthermore, the carcass composition and organ weights of chickens fed on the fermented PKE diet are comparable to those of birds fed conventional diets, with the added benefit of reduced abdominal fat content [11]. Importantly, the incorporation of fermented PKE into broiler rations significantly reduces the reliance on imported corn and soybean meal by approximately 30% and 22%, respectively. This substantial reduction in imports translates to significant savings for the Malaysian poultry industry, potentially amounting to RM850 million in foreign exchange annually.

Table 1 Digestibility of nutrients in PKE and fermented PKE

Component	PKE	Fermented PKE
TME (MJ/kg)	5.43 ± 0.34 b	8.05 ± 0.99 a
TMEn (MJ/kg)	4.45 ± 0.36 b	7.08 ± 0.97 a
Dry matter digestibility (%)	30.08 ± 4.44 b	43.88 ± 6.80 a
Crude fibre digestibility (%)	3.06 ± 0.93 b	8.56 ± 1.45 a
Crude protein digestibility (%)	11.76 ± 4.22 b	21.23 ± 8.20 a
Crude far digestibility (%)	3.91 ± 1.04 a	1.38 ± 0.15 b
NDF digestibility (%)	30.08 ± 3.75 a	29.99 ± 4.33 a

Values with same superscript within a row are not significantly different (P<0.05), PKE: palm kernel cake; TME: true metabolizable energy; TMEn: TME with nitrogen correction; NDF: neutral detergent fibre
Note: Noraini et al (2008) [10]

The technology for producing fermented PKE holds promise beyond its application in poultry diets, as it can be adapted to enhance the nutritional value of other fibrous agro-industrial wastes and by-products locally available in Malaysia. Importantly, the production and utilization of fermented PKE can be seamlessly integrated into existing feed processing and farm infrastructure, eliminating the need for additional equipment or facilities. By substituting expensive imported feedstuffs with locally sourced and improved alternatives like fermented PKE, the Malaysian poultry industry stands to benefit from stabilized feed prices and reduced production costs, contributing to its long-term sustainability and economic viability.

Production of enzyme as feed additives

Enzymes can be used to break down anti-nutritional factors and improve the digestibility of poor-quality feed ingredients. For example, carbohydrases can hydrolyze complex carbohydrates into simpler sugars, while proteases can degrade proteins into smaller peptides and amino acids, making nutrients more accessible to the animal's digestive system. The production of enzymes as feed additives via solid-state fermentation offers numerous advantages, including efficient substrate utilization, high enzyme yields, reduced water and energy consumption, lower costs, enhanced stability, and environmental benefits. These advantages make SSF an attractive and sustainable option for enzyme production in the feed industry.

Fibre degrading enzymes

The utilization of PKE in poultry diets is limited by its high fiber content, predominantly mannans. However, with the supplementation of enzymes, its efficacy can be enhanced. Enzymes that degrade PKE through solid substrate fermentation, which are then incorporated into PKE-based broiler feed were developed. These PKE-degrading enzymes, known as Pkzyme^{TM}, exhibit favorable effects by enhancing the digestibility of nutrients in PKE-based feeds. This innovation is noteworthy for its utilization of locally abundant microorganisms and substrates in the production of Pkzyme^{TM}, with optimization of process conditions tailored to the local climate. Pkzyme^{TM} displays a remarkable specificity for degrading PKE fibers, boasting high β-mannanase activity (615.46 ± 93.31 U/g PKE), along with mannosidase, cellulase, xylanase, galactanase, and minor amounts of proteases. Supplementation with Pkzyme^{TM} enhances the breakdown of PKE fibers in the hindgut of poultry, leading to

improvements in feed efficiency and final body weight of the birds. At certain supplementation levels, inclusion of PKE in starter diets can be increased up to 25% without detrimental effects on growth performance. This innovation facilitates the utilization of PKE at higher inclusion levels and enables the partial substitution of imported corn and soybean meal in poultry feed formulations.

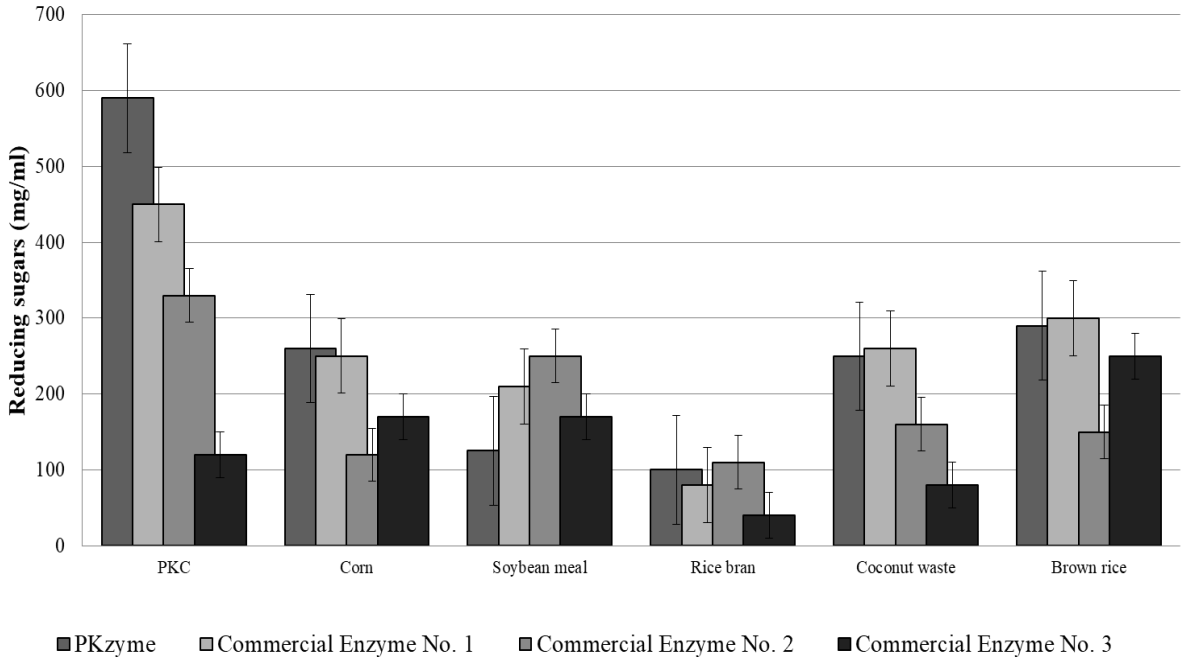


Figure 2. Hydrolysis products from selected feed ingredients after 24 hours incubation with Pkzyme and other commercial enzymes

Optimising phytase efficacy

Phytate, an anti-nutrient commonly found in plant-based feed ingredients, also serves as a valuable nutrient source. Breaking down phytate leads to the liberation of phosphorus and other nutrients bound within it, enhancing their absorption by poultry. The supplementation of exogenous microbial phytases is the most practical and efficient method for degrading phytate in poultry feed. Studies have shown that phytase enhances phytate breakdown in certain parts of the chicken's digestive tract, especially in the crop and proventriculus-gizzard. However, little degradation occurs in other sections like the duodenum-jejunum or ileum. In order to maximize phytate breakdown, reformulation of feed with addition of fat and superdose phytase at 1500 FTU/kg significantly increased feed intake, body weight gain, ileal phytate degradation, and ileal phosphorus digestibility [12]. Additional 5% fat in the superdosing phytase feed delayed the transit time of digesta in the crop of chickens and enhanced phytate-P degradation which demonstrated the role of fat in improving phytase efficacy in broilers. Slower passage of food through the crop allows more time for enzymes to break down nutrients, potentially leading to better digestion and absorption.

Table 2. The effects of dietary fat and dietary fibre on digesta mean retention time (MRT) in gastrointestinal tract (GIT) of 21 d broilers fed on wheat/corn diet

Inclusion level (%)		Digesta mean retention time (min)				
Fat	Fibre	Crop	Proventriculus & gizzard	Duodenum & jejunum	Ileum	Total GIT
1	0	21	42	51	72	194
1	4	23	49	59	72	203
5	0	13	46	61	69	189
5	4	23	43	66	66	198
SEM[1]		0.07	2.90	0.05	3.93	12.8
Main effect						
1		22	46	55	72	198
5		18	44	64	67	193
	0	17	44	56	70	191
	4	23	46	63	69	200
Effects		*-----P-value*				
Fat x fibre		0.829	0.396	0.553	0.845	0.996
Main effect of fat inclusion		0.292	0.793	0.951	0.569	0.841
Main effect of fibre inclusion		0.450	0.830	0.331	0.878	0.737

[a,b,c] Means within a column and main effects not sharing a common superscript differ significantly ($P<0.05$).
[1]Means represent the average response of 5 chicks per replicate pen and 5 replicates (25 chicks) per treatment.
Note: Samat & Miller (2023) [13]

Tannase

Tannins present in leaf meal can indeed be utilized as a component of animal feed. Tannins are a group of polyphenolic compounds found in various plants, including leaves, and they can have both positive and negative effects on animal nutrition, depending on their concentration and type. Tannins have antioxidant, anti-carcinogenic, antibacterial, and antiparasitic properties. However, due to their anti-nutritional content, they have certain harmful impacts on poultry. In comparison to ruminants, poultry are more sensitive to tannins. High tannin levels cause performance losses in chicken, such as decreased appetite, lower feed intake, and poor nutrient absorption. Tannins, which are also known as strong liver and kidney toxins, cause bone diseases and pathological changes in poultry tissues, including esophageal irritation and necrosis in the crop, gizzard, and duodenum.

Tannase, an enzyme that catalyzes the hydrolysis of tannins, can be employed to enhance the nutritional quality and digestibility of leaf meal used in animal feed. This enzyme hydrolyses the ester and peptide bonds of hydrolysable tannins and gallic acid esters. It breaks down tannic acid, releasing gallic acid and glucose [14]. Incorporating tannase into animal feed formulations containing leaf meal can therefore optimize nutrient utilization, improve feed efficiency, and promote better animal performance and health. This approach aligns with efforts to develop sustainable and environmentally friendly feeding strategies in livestock and poultry production.

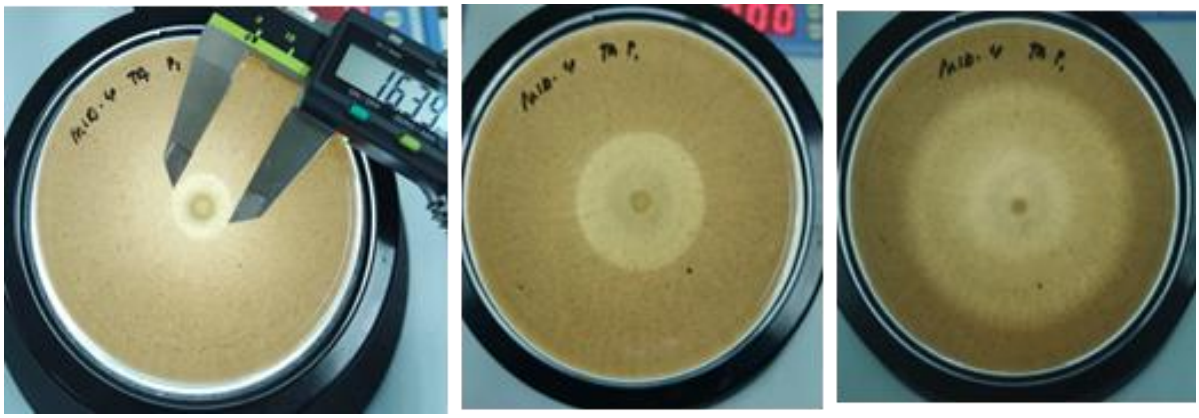


Figure 3. Clear zone on tannin-enriched agar plate shows tannase production by A. niger
Note: Amanina Haziqah et al (2023) [15]

Use of prebiotic in poultry

Prebiotic, a non-digestible dietary compound, is one of the potential feed additives which regulate host immunity, intestinal microbiota, and the intestinal ecosystem, by selectively stimulating the growth or activity of the limited number of bacterial species inhabiting the digestive tract, without being digested. Common prebiotics used in poultry feed include MOS (mannan oligosaccharides), FOS (fructo-oligosaccharides), and GOS (galacto-oligosaccharides). MOS, a prominent prebiotic utilized in poultry nutrition, has been shown to improve the average daily feed intake, feed conversion ratio and overall performance of broiler chicks when incorporated into their diet. The efficacy of oligosaccharides in modulating the intestinal microflora of animals has been demonstrated in vitro. In recent study, supplementation with MOS prepared from PKE, also known as PKMos, was found to promote the growth of beneficial lactobacillus and bifidobacteria in the small intestine of young chickens, while effectively controlling the population of pathogenic (*C. perfringens*) or pathogenic-related (*E. coli*) microorganisms, exhibiting comparable performance to commercial MOS. Moreover, chickens fed with PKMos demonstrated improved growth performance, evidenced by a significant increase in body weight gain compared to the control group (667.08 ± 16.88a g/bird vs. 468.61 ± 76.20). Incorporating prebiotics into poultry diets represents a sustainable and effective strategy for optimizing gut health and maximizing performance, ultimately leading to improved productivity and profitability in the poultry industry.

The conversion of underutilised plants and agro-industrial by-products into insect protein for livestock

In recent years, there has been growing interest in utilizing insects as an ingredient in animal feed. Insects possess the ability to efficiently convert diverse organic materials, including animal and plant wastes, into valuable proteins and lipids suitable for animal feed. Studies have highlighted the potential of insects to play a crucial role in converting organic waste streams into nutritious feed ingredients, offering a promising solution to address sustainability challenges in animal nutrition. Underutilized plants and agro-industrial by-products often contain valuable nutrients but may not be directly suitable for animal consumption. By feeding these materials to insects, they can efficiently convert them into protein-rich biomass that can be used as feed for livestock.

Research conducted by MARDI (Malaysian Agricultural Research and Development Institute) has explored the utilization of three insect species - superworm (Zophobas morio), black soldier fly (Hermetia illucens), and yellow mealworm (Tenebrio molitor) in converting leaf meal (moringa, sesbania) and rice bran into insect meal and later included in feed formulations. Studies have shown promising results, indicating that these insect-based ingredients can serve as valuable protein sources for animals. The digestible protein value of superworm meal was reported to be comparable to soybean meal, suggesting its suitability as a protein source in animal diets. Moreover, the digestible coefficients of nutrients from these insect meals were found to be over 80%, indicating high nutritional value [16, 17]. Superworm meal, being an animal-based protein, is particularly well-suited for formulating feeds for carnivorous or omnivorous fish species. Additionally, replacing up to 40% of the diet of freshwater seabass (Lates calcarifer) with black soldier fly larvae (BSFL) had no adverse effects on growth performance. Consumer acceptance studies revealed no significant taste differences between fish fed with insect meal and those fed with conventional diets. Furthermore, insect meal has shown promise as a replacement for soybean meal in poultry feed.
Incorporating BSFL meal into broiler diets led to improvements in live weight, gut morphology, and feed conversion ratio [18]. Given the increasing prices of conventional feed ingredients, insect meals offer a sustainable and economically viable alternative for diverse animal species. These findings highlight the potential of insects as valuable feed ingredients for enhancing animal nutrition and promoting sustainable livestock production practices.

Conclusion

Overall, nutritional and feed technology plays a critical role in supporting the sustainability, efficiency, and competitiveness of the livestock and animal feed industry by optimizing feed utilization, enhancing animal health and performance, and minimizing environmental impact.

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Category: Plenary 7

LIVESTOCK ASSISTED REPRODUCTIVE TECHNOLOGY UTILIZATION: MARDI'S PERSPECTIVE

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Introduction

Animal biotechnologies related to reproduction have contributed to many improvements in agriculturally important traits in livestock (Hernandez Gifford and Gifford., 2013). Advancements in reproductive biotechnology have added new dimensions to research in farm animal seed stock production which proved to be more efficient. The use of these reproductive biotechnologies has been a widespread strategy for improving the genetics of livestock in a shorter period of time. Given the current global awareness and push for sustainable livestock production, a deeper comprehension of the full potential of these procedures by farmers has led to significant progress in implementing reproductive technologies. The earliest biotechnology procedure used was artificial insemination (AI), followed by embryo transfer (ET) and in vitro fertilization (IVF). Numerous reproductive technologies have been developed over the years. There are two main applications of Assisted Reproductive Technology (ART) with regards to in vivo and in vitro techniques particularly in cattle. The in vivo application of ART such as AI, ET and Twinning has made it feasible to increase the production and ensuring sustainability of the various livestock species. In vitro technique refers to the production or manipulation of cells or gametes under laboratory conditions. Laboratory production of embryos by In Vitro Fertilization (IVF), Intracytoplasmic Sperm Injection (ICSI) and Somatic Cell Nuclear Transfer (SCNT) are relatively more advanced reproductive biotechnologies with many potential applications in livestock production in this country. Some highlights on the progress of ART research in MARDI perspectives are discussed.

In vivo reproductive biotechnologies

Artificial Insemination (AI)

AI is the oldest assisted reproductive technology utilized for genetic improvement among domesticated animals (Kubkomawa., 2018; Van Doormaal and Kistemaker., 2003). The discovery of glycerol as cryoprotectant for semen freezing, has led to widespread acceptance of AI as a breeding tool for genetic improvement and conservation of livestock (Polge et al., 1949). The genetic improvement within a country or across countries has been facilitated through the ease of dissemination of frozen semen from superior sires. The main constraint in the application of AI is the accuracy of oestrus detection in females which impacts the conception rate. The use of hormone for oestrous synchronization has made it possible the utilise pre-determine or fixed time AI. The application of AI among dairy or beef cattle has been enhanced by the use of sexed semen. This advancement provides dairy or beef farmers with

greater flexibility in choosing to increase the number female or male calves on the farm for milk and beef production.

Multiple Ovulation Embryo Transfer (MOET)

The second generation of reproductive biotechnology involves the application of MOET in the genetic improvement of large and small ruminant production (Abdul Rashid and Habsah, 2019). The objective is to enhance the genetic potential of the female while AI is utilised to improve the genetic contribution of males. Initially livestock embryos were produced in vivo from selected genetically superior live donors through MOET.

The constraints in MOET include variable responses to superovulation, resulting in unpredictable embryo production and the cost of the procedure which confines its application to elite group of breeder animals. In Malaysia, a unique problem arises from the ban on the use of porcine-derived follicle stimulating hormone (pFSH) due to religious reasons leaving the less favoured equine chorion gonadotrophin (eCG) as an alternative hormone to induce superovulation (Mapletoft et al., 2002). In our study, the superovulatory response (SR), embryo production rate, and quality of embryos collected from Charoke cows treated with either FSH or eCG hormones were compared (Habsah et al. 2021). No significant differences ($p > 0.05$) between all the parameters were observed in the FSH- and eCG-treated groups. The number of donors with positive SR was higher in cows treated with FSH (56%) compared to those in the eCG group (40%). The type and dosage of hormones used for superovulation may contribute to the differences in the results observed. An average of three transferable embryos were collected per animal receiving either FSH or eCG hormones. The study indicated that both FSH and eCG can be used to superovulate donor cows under local conditions.

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Twinning

Twinning is a highly desirable trait which can increase the reproductive capacity of an animal. However, it has low heritability in farm animals (Noris, 2001). Twinning can be exploited to improve the efficiency of beef cattle production. Increased frequency of twinning would enhance the potential of obtaining more progenies from a genetically superior female, thereby allowing these females to play a larger role in a selection program. Thus, a successful application of twinning procedure would require optimized supporting reproductive biotechnologies as well as improved animal management such as pre-calving diagnosis of twin pregnancies, appropriate animal nutrition and management, and suitable calving facilities.

However, twinning is also associated with a number of detrimental effects including lower perinatal calf survival and poorer cow reproductive performance. The exploitation of twin birth presents a potential means of improving the efficiency of beef production. Thus, in studies to elevate twinning rate in farm animals, a multipronged approach by combining embryo production techniques to produce mass embryos, together with an efficient twinning procedure through AI and ET programme would be implemented to develop the cattle industry in Malaysia.

In vitro reproductive biotechnologies

A number of in vitro reproductive biotechnologies has the potential to contribute towards enhancing livestock breeding programmes in Malaysia. Production of embryos by IVF, ICSI and embryo manipulation could be some of the biotechniques that offer immediate practical application in increasing the population of quality livestock in this country.

In vitro fertilisation (IVF)
In vitro embryo production (IVEP) is an important technology to mass produce embryos at low cost and could be used to develop the cattle industry in Malaysia. However, the success of an IVEP programme depends on the development of improved in vitro techniques and better understanding of the composition of culture medium required for subsequent embryo development.

Knowledge of bovine oocyte maturation and fertilization under in vitro conditions has expanded rapidly since their initiation in 1960s. These techniques are today employed worldwide. However, only approximately 30 – 40% of the bovine oocytes matured and fertilized under in vitro conditions would develop to the transferable stages of morula and blastocyst (Rodriquez and Farin, 2004, Habsah et al., 2010, Crowe et al., 2021). Although proper culture conditions after initial cleavage are essential, special attention must be given to the process of in vitro oocyte maturation for successful zygote formation. Additionally, it underscores the need to focus on developing chemically-defined media for IVC which is crucial for optimising the conditions necessary for successful oocyte maturation. The use of CR1 medium with the addition of amino acids helped further improvement of cleavage and blastocyst rates. It is well established that the culture conditions employed for IVM of mammalian oocytes can significantly influence IVF success rates and subsequently embryonic development (Rose and Bavister, 1992). Studies have indicated that oestradiol-17B alone improved blastocyst development (Saeki et al., 1991), while the inclusion of oestradiol-17B to the maturation medium improved the maturation rates of poorer quality oocytes, namely Groups B and B', but not the higher quality oocytes categorised as Group A (Habsah, 1997).

Low molecular weight thiol compounds such as cysteamine and B-mercaptoethanol (β-ME) added during in vitro maturation (IVM), was reported to increase intracellular glutathione (GSH) synthesis and consequently improving embryo development and quality (De Matos and Furnus, 2000). Observations were made on embryo development following supplementation of the IVM medium with 200uM cysteamine or 200uM β-ME and/or the culture medium with 4% serum or 100uM β-ME (Habsah et al., 2010). In both group of oocytes, the combination of β-ME and serum resulted in higher cleavage and blastocyst rates reaching 75.32% and 40.68%, for Group A and 60.68% and 24.96%, for Group B, respectively. The addition of β-ME during IVM along with serum supplementation at day 5 of IVC enhanced the in vitro development of bovine oocytes. In this study, the proportion of bovine oocytes reaching the blastocyst stage was higher compared to our previous study where no cysteamine or β-ME was utilized. The previous study only recorded blastocyst rates of 10.47% and 7.43% in Groups A and B oocytes, respectively. The incorporation of β-ME and serum in maturation and culture medium, respectively, shows promise for mass production of bovine embryos for embryo transfer using abattoir materials.

In Malaysia, availability of sources and number of bovine oocytes are limited. Most of the oocytes used in in vitro embryo production were harvested from slaughterhouse ovaries where majority of the cows were old and the oocytes were mostly of poor quality.

Intracytoplasmic Injection (ICSI)

Intracytoplasmic sperm injection (ICSI) is an important assisted reproductive technology with vast application in the treatment of human infertility (Merchant et al., 2011) and the conservation of endangered animal species (Parmar et al., 2013). It involves the injection of a spermatozoon into a matured oocyte using micromanipulator equipment. ICSI is advantageous when only very few spermatozoa are available for insemination. In livestock, this technique offers great opportunity for the studies of in vitro oocyte activation and fertilization, development of transgenic animals, and production of sex-preselected offspring. Generally, the success of ICSI procedure was related to the quality of spermatozoon and oocyte, effective activation of oocytes, and ability of oocytes to cleave after sperm injections (Eftekhar et al., 2012). However, ICSI remains a low efficiency technology and has less widespread application in farm animals in comparison to IVF.

The efficiency of ICSI technique in cattle reproduction is limited by the necessity for additional oocyte activation before or after the ICSI procedure. Induced activation is required for oocyte to progress beyond the pronuclear stage formation and for subsequent embryo developmental competence (Garcia-Rosello et al. 2009). Therefore, three experiments were conducted to study the fertilisability and development of oocytes following ICSI (Habsah et al., 2016a). Among the treatments, either pre- or post-oocyte calcium ionophore activation treatment was more effective than a combination of both treatments. The majority of fertilisation and development failures in oocytes regardless of the presence of polar bodies were associated with either the failure of sperm head decondensation and male pronucleus formation despite activation or the development competence of ICSI oocytes. The pregnancy rates of recipient dams following transfer of ICSI- and in vivo-derived embryos were 25% and 50% respectively. In conclusion, treatment with 5 µM calcium ionophore A23187 before or after ICSI could induce oocytes activation leading to pregnancy of recipient dams.

Somatic Cell Nuclear Transfer (SCNT)

Bovine cloning by Somatic cell nuclear transfer (SCNT) is an advanced reproductive biotechnology with many potential applications in livestock production. Cloning of bovine embryos never resulted in large scale commercial application; however, interest in nuclear transfer and cloning of livestock continues (Tian et al., 2003). The low efficiency of SCNT in producing animal clones is one of the major constraints of this technology.

In Malaysia, MARDI attempted to develop a nuclear transfer protocol with regards to activation and development of enucleated-reconstructed oocytes after SCNT as well as parthenogenetic development of non-enucleated oocytes (Habsah et al., 2016b). Adult skin fibroblast cells were chosen as the donor karyoplasts which provided the diploid genome because these cells were easy to obtain and easy to culture and propagate. The proliferation rate of skin fibroblast cells derived from different locations

on the animal also has been studied. Most adult somatic cell cloning used skin-derived fibroblast cells (Hill et al., 2000; Hwang et al., 2013) compared to tail (Wakayama and Yanagimachi, 1999) and leg (Powel et al., 2004) as donor karyoplast. However, leg skin fibroblast cells had higher proliferation rates compared to those from tail and ear (Habsah et al., 2015). These cells reached the plateau phase at 120 h of in vitro culture. This showed that initially the cells proliferated rapidly but declined after 129h of culture due to contact inhibition. The Population Doubling Times (PDTs) were 54 h, 43 h and 40 h for leg, tail, and ear skin fibroblast cells, respectively. These indicated that most of the skin fibroblast cells derived from the leg, tail and ear were G0/G1 stage, the preferable stage of donor cells for cloning.

In the study, 36.4% of SCNT-reconstructed embryos using bovine ear skin fibroblast cells as donor karyoplasts cleaved to the two-cell stage compared to 23.5% oocytes which cleaved parthenogenetically in the absence of sperm and fertilization (Habsah et al., 2016b). Furthermore, the SCNT-embryos produced from the procedures developed in MARDI, developed to the 16-cell stage. In comparison, the parthenogenotes were arrested at the 8-cell stage. The pregnancy rates of eight recipient dams based on the transfer of cloned and in vivo-derived embryos were both 25%. However, only in vivo-derived embryo developed to term but the cloned embryos were aborted naturally at 5 months of gestation. This showed that the developed SCNT protocol using ear skin fibroblast cells could be used to produce cloned bovine embryos in the near future.

Conclusion

In vivo and in vitro embryo production have been highlighted as the most remarkable biotechnologies in dairy and beef cattle operations. This is due to the enhanced genetic gains in resulting from the utilization of these reproductive biotechnologies which can accelerate cattle genetic improvement program to boost animal production. With the current global focus on sustainable livestock production, there has been significant progress in implementing reproductive biotechnologies due to better understanding of their potential by end users.

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Category: Plenary 8

SPEARHEADING NATIONAL MILK PRODUCTION THROUGH TECHNOLOGY: FARM FRESH EXPERIENCE

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Abstract

The Malaysian dairy milk industry is an ever-growing sector in the local agriculture industry. The milk consumption rate has increased steadily since 2010 at an average rate of 8% while still relying largely on imported dairy products. To aim for self-sufficiency, the local growth of the dairy industry is crucial. Established in 2010, Farm Fresh Berhad (FFB) (previously known as The Holstein Milk Company Sdn. Bhd.) are currently the leading force behind the national milk production. Over the past decade, several cows that are resilient to the local extreme weather, with high milk yield have been identified. These 'Superstar' cows are to be propagated hastily to create a milking herd with strong resistance and high performances. To identify these cows, milk yield data for each lactation was recorded manually. Facing technology limitation during that time, very few data were able to be reported on these cows. Regarding this, FFB has invested in various technology, research and development to achieve the desired outcomes. The introduction of advanced technology of Electronic Identification (EID) and the rotary parlour allowed milk data to be collected automatically during milking session. With the growing herd size, rotary parlour with EID detection is a gamechanger for a more organized and seamless operation. Data from the rotary parlour are directly connected to a data management software with correspondence to the animal EID. The technology is very beneficial for herd management and herd size monitoring. Herd data and record-keeping is important for tracking health record, production and reproduction history. In terms of animal husbandry, artificial insemination (AI) is a very common assisted reproductive technology (ART) used in the industry to breed and reproduce the herd efficiently. With the aim to duplicate more 'Superstar' cows, FFB has venture into another ART technique which is in vitro insemination to further propagate the best individuals with superior genetics in the farm. The in vitro production (IVP) started in 2021 with limited resources and challenges. Donors are selected among the cows with high milk production, good reproductive performance. The IVP of embryos involves the procedure of ovum pick-up (OPU), in vitro maturation (IVM), in vitro fertilization (IVF) and in vitro culture (IVC). OPU is performed without any hormone stimulation, following its natural cycle. Donors enter OPU program once every two weeks over the span of two months. The selected oocyte is cultured in IVM media for maturation followed by fertilization process (IVF) after 20-24 hours. To increase the likelihood of getting female calves, conventional semen used undergoes reverse-sexing process to isolate the X-sperm prior to fertilization. 17 hours post-fertilization, the oocytes are then cultured in the incubator for 6 to 8 days. Embryos produced were recorded in the data management software where they were either cryopreserved or freshly transferred. Recipients for fresh

embryo transfer (ET) were heat-synched to ensure transfer on day 7 and 8 in accordance with the embryo age. Up until now, FFB has successfully recorded 84 IVF-derived calving in a span of three years. The past three years was considered as trial period to finalize and improvise lab procedure. Between January and March 2024, 47 recipients were confirmed pregnant. These achievements were realized over the past decade and entering the upcoming decade, FFB is very dedicated and committed in utilizing and exploring accessible ART to spearhead the national dairy milk industry in Malaysia.

Category: Plenary 9

DISEASE TRACEABILITY TECHNOLOGY IN MEAT PRODUCTION

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Introduction

Traceability is crucial in the prevention, control and eradication of animal diseases. The prompt detection of disease sources or outbreaks, at-risk populations including infected animals and their close contacts, relevant disease event locations, and other contributing factors is essential for effective disease control and eradication. Speed is particularly critical when there is a risk of zoonotic transmission to prevent harm to public health or the development of an epidemic or pandemic.

In recent years, the agriculture industry has been confronted by a myriad of unforeseen challenges, which include extreme climate change and the emergence or re-emergence of animal disease outbreaks. These circumstances have evolved into threats to food security and pushed the urgent search for innovative solutions for ensuring a reliable and safe food supply. To address these challenges, rapid advancements in digital technology are being leveraged as reliable tools to support disease control efforts and minimize transmission. This paper delves into the application of this technology in animal traceability with a specific focus on disease prevention and control, along with its impact on agricultural practices.

Keywords: animal, disease traceability, disease control, meat production, technology,

Discussion

The production of meat is a significant part of the agricultural sector, with poultry being the most popular choice followed by pork, beef, and mutton. In 2021, global meat production reached approximately 357.4 million tonnes, showing a remarkable 51% increase over the past decade. The surge in demand for animal protein due to rapid population growth has led to an increased reliance on technology in animal production. Animal identification and records play a vital role in the overall animal traceability system. Information on general health, movements, health screenings, and medical and husbandry management is crucial for national disease monitoring and surveillance as well as to assess the effectiveness of disease control measures and biosecurity protocols. Before 2009, animal identification records were paper-based. Permit applications for interstate movement of animals and animal products were manually processed using paper-based methods, requiring separate submissions to state veterinary offices in both outgoing and receiving states. The inherent inefficiencies of these procedures led to data loss, redundancy, mismanagement, operator errors, as well as significant time and effort being invested into reorganizing, compiling, and analyzing data from multiple sources. With the growing complexities of data management and the concurrent rise of digital technology in Malaysia, the Department

of Veterinary Services (DVS) has embarked on digitalizing animal traceability in the country by primarily establishing the eVetPermit System, an online database system that tracks animal registration and real-time movement of animals from place of birth to destination. The system's primary objective is to improve disease prevention and control through the rapid tracing of infected animals and halting disease spread. The eVetPermit System is one of the modular systems under the Malaysia Animal Traceability System (MATs), and continuously undergoes improvement to accommodate the increased demand for quicker automated workflows, better data transparency, and less costly processes for both client and operator.

A holistic implementation of a nationwide traceability system particularly in disease prevention and control requires legislative support, which for Malaysia, falls under Sections 36 and 79 of the Animals Act, 1953. In the event of a disease outbreak, enforcement of disease control, prevention and eradication are effectively executed under Section 36 of the Act through the declaration of disease areas and protection zones by the Chief Minister of the affected state. In addition, the DVS is currently strengthening veterinary services relating to animal traceability through the National Strategic Plan for Animal Traceability 2018-2022 and the Malaysian Veterinary Services Strategic Plan 2020-2030. Standard operating procedures (SOPs) on animal identification, and the movement of animals and animal products between states and within states in Malaysia reinforce the structure of this system and act as a dynamic guideline.

The effectiveness of the eVetPermit System has been tested and demonstrated through several disease outbreaks since its establishment. In a Foot and Mouth Disease incident in 2022, tracing affected animals became crucial for quickly detecting susceptible populations and premises across several states. This allowed strategic and targeted disease control, minimizing its spread and impact on the ruminant industry. A recent network analysis using data from the system during the African Swine Fever epidemic in Melaka (2021-2022) has highlighted the importance of tracing animals and their meat at every stage of the value chain to effectively control the risk of disease recurrence and prevent further damage to domestic production.

However, Malaysia still has a long way to go in establishing a comprehensive traceability system. Smuggling across international borders, illegal livestock movement, and animals without proper identification continue to pose ongoing challenges that extend beyond simply digitalizing the system. These issues are currently being tackled through improved enforcement measures and enhanced cooperation between agencies to more effectively address these gaps.

Conclusion

Traceability plays a crucial role in the meat production industry by allowing for the tracking of various stages in the value chain, from birth to distribution and destination. This process can effectively control and manage the spread of animal diseases. Malaysia's agricultural future hinges on transitioning to a comprehensive nationwide animal traceability system, especially with the increasing integration of the Internet of Things. It is imperative that we work together to create an enabling environment for a well-established traceability system.

Category: Plenary 10

PERIPHERAL BLOOD MONONUCLEAR-STEM CELLS AND ITS POTENTIAL APPLICATION TO WILDLIFE REPRODUCTION

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Abstract

The success of wildlife conservation hinges on the success for humans to collaborate, pointing out that the recent extinction of the Hairy Rhinoceros, *Dicerorhinus sumatrensis* was mainly due to failure to collaborate. Assisted reproductive technology (ART) stands out as a promising tool for critically endangered species. Though the case study in the Malayan Tiger, *Panthera tigris jacksoni* suggests that reproductive senescence and poor response to ovarian stimulation remains as a challenge. Meanwhile, the black-footed ferret, *Mustela nigripes* is a success cloning story whereas the potential reintroduction of Woolly Mammoth, *Mammuthus primigenius* back to the tundra to combat climate change proves to be exciting. A lesson learnt from these cases is the importance of biobanking stem cells to allow for future technology such as cloning to be more accessible. Though there are many types of stem cells, peripheral blood mononuclear-stem cells (PBMSCs) emerge advantageous allowing for a least invasive and easy to maintain cell line. Therefore, this study was performed to identify the potential of PBMSCs as a source of mesenchymal stem cells for cloning. Cows and horse blood were obtained from the jugular vein, intravenously. Blood was collected in 15 mL blood tubes with heparin, BD Vacutainer®, maintained at room temperature (24-27 °C) for not more than 3 hours. Blood isolation includes the usage of Ficoll-Paque Plus and centrifugation steps to create a gradient layer to separate the cloudy interface presumably containing the PBMSCs. Isolated cells are plated in PBMSC Primary Culture Medium, a low glucose Dulbecco's Modification Eagle's Medium (DMEM), Corning® based medium with mixture of fetal bovine serum, L-glutamine, antibiotic and dexamethasone at a low concentration. Standard care and maintenance of cells were applied and once the PBMSCs cells reach confluency, Trypsin in EDTA were used to passage the cells and the cells were maintained in the PBMSC Expansion Medium. Freezing of bovine PBMSCs were done in 10% Dimethyl sulfoxide (DMSO), in cryovials or straws and stored in liquid nitrogen. Thawing and reseeding are routine, briefly thawed at 37 ˚C, centrifuged before plated into a T25 flask. Validation of PBMSCs can be performed using Flow Cytometer to identify the stem cell marker. Hand-made cloning (HMC) was performed using equine PBMSCs and bovine ovaries to produce the cloned embryos. The in vitro culture (IVC) was incubated in a water jacketed tri gas incubator. The efficiency of two-person cloning is moderate resulting to the final cloning experiment which yielded a single, 6-cells embryo stage (Table 1). Beginning with 1.5kg of ovaries, this typically yields around 1,000 oocytes which were allocated to various experiments. The cloning experiment was allocated with 200 (cumulus oocyte complex) COCs which gave to 96 first grade COCs. The search for MII continued providing 47 matured

oocytes. Oocyte splitting had the second lowest development after embryo reconstruction at 43% and 40% respectively. There were 8/12 (67%) cytoplast-cells that had successfully fused and upon in-vitro culture had produced 1/8 (12.5%) embryo. The first successful cloning using HMC technique and PBMSCs producing an embryo suggest the possibility to train cloning within three months of intensive training. The HMC, despite requiring initial development of psychomotor skills allows for a low entry point to perform cloning without a prerequisite for micromanipulator.

Table 1: Efficiency of cloning performed by two persons using a Well-of-the-Well (WOW) system during invitro culture (IVC) due to the zona-free nature of the cloned cytoplast-cell.

Step	Quantity	Percentage (%)
Obtain ovaries (abattoir)	1.5kg	-
Aspirate follicles for COCs	200 COCs	-
Select first grade COCs	96/200 COCs	50%
In-vitro maturation (IVM) MII	47/96 oocytes	48%
Remove cumulus cells and zona pellucida	35/47 oocytes	74%
Oocyte splitting and selection of caryoplasts	30/70 caryoplasts	43%
Embryo reconstruction	12/30 pairs	40%
Fusion of cytoplast-cell pairs	8/12 fused	67%
In-vitro culture (IVC)	1/8 develop to embryo stage	12.5%

Category: Plenary 11

APPLICATION OF TECHNOLOGY IN WILDLIFE EX-SITU CONSERVATION: PERHILITAN APPROACH

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Abstract

PERHILITAN is responsible in spearheading wildlife conservation for the wellbeing of Malaysians. One of its objectives is to strengthen wildlife conservation programmes through management, enforcement, enrichment and research of wildlife. Wildlife ex-situ Conservation activities by PERHILITAN were started since year 2004. The main objective of ex situ programmes is to support conservation by ensuring the survival of threatened species in the wild and the maintenance of associated genetic diversity for their survival. Wildlife ex-situ conservation in PERHILITAN includes planning, management and coordination of captive breeding of endangered wildlife, wildlife commercial breeding, rewilding, husbandry, rescue operation, rehabilitation and releasing back to the wild. To further facilitate the conservation effort, advanced technologies were concurrently applied such as for wildlife biobanking, forensics analysis, zoonotic diseases surveillance and assisted reproductive technology (ART).

Keywords: Ex-situ conservation, PERHILITAN, technology, wildlife conservation, wildlife survival.

Category: Sustainable Farming

CAGE-FREE EGG PRODUCTION: A SUSTAINABLE APPROACH TO LIVESTOCK FARMING

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Introduction

Cage-free egg production represents a paradigm shift in poultry farming emphasizing animal welfare and addressing sustainability, growing global market demands and societal concerns. This abstract delves into the welfare implications, challenges, sustainable farming practices, and global initiatives associated with cage-free egg production.

Keyword: sustainable, cage-free, global initiatives

Welfare Considerations

Cage-free systems offer hens the opportunity to express natural behavior, including perching, nesting, and dust bathing, improving welfare compared to conventional battery cage systems (Appleby et al., 2004; Dawkins et al., 2017). Studies highlight the positive impact of cage-free environments on hen welfare, including enhanced physical and psychological well-being.

Challenges

Transitioning to cage-free egg production presents challenges related to infrastructure modification, higher initial investment costs, and management adjustments (Newberry et al., 2019). Balancing hen welfare with economic viability remains a key challenge for producers (Johnson et al., 2018). Mitigation strategies, including proper housing design and biosecurity measures, are crucial to address these challenges effectively.

Sustainable Farming Practices

Adopting sustainable farming practices within cage-free systems involves optimizing housing design, implementing efficient waste management systems, and integrating renewable energy sources (Rollin et al., 2015; Weeks et al., 2020). Implementing sustainable practices in cage-free egg production involves optimizing feed efficiency, managing waste, and integrating renewable energy.

Global Initiatives

Consumer demand, corporate commitments, and legislative initiatives are propelling the global shift towards cage-free egg production. Retailers, hospitality industries, food service companies, and governments worldwide have pledged to transition to cage-

free to address concerns about animal welfare and sustainability (Tuyttens et al., 2014; Rodenburg et al., 2018). The European Union, Australia, Israel, Bhutan, and several U.S. states have enacted legislation or industry commitments mandating the transition away from conventional cage egg production.

Conclusion

Cage-free egg production represents a significant advancement in sustainable poultry farming, offering improved welfare for hens while addressing consumer concerns and regulatory mandates. However, challenges related to infrastructure, management, and cost must be carefully addressed to ensure the successful transition. By prioritizing animal welfare, and r consumer demand, cage-free systems represent a viable alternative. Collaboration among stakeholders and continued research and innovation are essential to ensure the success of cage-free egg production in fostering a more sustainable future towards humane and ethical farming.

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Category: Sustainable Farming

SWIFTLET'S NEST FROM *AERODRAMUS FUCIPHAGUS* AS A SUBSTRATE FOR PROBIOTICS AS WELL AS GUT BACTERIA

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Introduction

The swiftlet nest industry has its own identity. In Southeast Asia countries, swiftlet's habitats are limited to humid tropical habitats. In Malaysia, the swiftlet nest sector supports the national economic growth. With regard to nutritional properties, protein content in swiftlet nest *Aerodramus fuciphagus* can be from 60% to 65%, whereas the glycan content is from 10% to 30%, depending on the harvested place (Daud et al. 2021). Previously, Ghassem et al. (2017) reported that some peptide chains of the swiftlet nest can withstand the human protease digestive enzymes and have antioxidant activity. Meanwhile, the swiftlet nest protein was found to be readily digestible by the digestive system, while the glycan showed resistance to digestion (Daud et al. 2019). The glycopeptides from swiftlet nests are soluble compounds, resistant to the digestive system, and thus remain intact. In this study, the swiftlet nest glycoprotein and digested glycopeptides (hydrolysates) were tested as a potential substrate for the growth of probiotic bacteria. To study the glycopeptides as substrates for gut bacteria, a simulated *in-vitro* human digestion and gut bacterial fermentation were conducted on the swiftlet nest.

Keywords: swiftlet nest, glycopeptides, digestion, fermentation, beneficial bacteria

Materials and Methods

Swiftlet nest as substrates for probiotics: Glucose, molasses, swiftlet nest in the form of intact glycoproteins, and digested glycopeptides (hydrolysates) were added to MRS broth media containing *Lactobacillus acidophilus*, respectively. The broth media was incubated at 37 ˚C for 24 hours. MRS broth without substrate was used as the control.
Swiftlet nest as substrates for gut bacteria: Non-digestible compounds from the digestive system of the swiftlet nest were collected and subjected to batch culture fermentation with the addition of diluted gut bacteria. Bacterial enumeration was done using the fluorescent *in-situ* hybridization method. Samples were prepared in triplicate. Data collected were analyzed using analysis of variance (ANOVA) and Duncan's test.

Results and Discussion

The swiftlet nest has the potential as a substrate for probiotic growth media in a hydrolyzed form (Figure 1), such as in swiftlet nest soup. On the other hand, swiftlet nest glycopeptides can also provide prebiotic benefits to beneficial gut bacteria. Fermentation also provides beneficial metabolites such as short-chain fatty acids.

These metabolites may contribute to metabolic energy, cell membrane renewal, and maintenance.



Figure 1. Probiotics count (CFU/ml) from MRS broth media containing glucose, molasses, swiftlet nests, and swiftlet nest hydrolysates, respectively, after 24 hours of incubation. Different alphabets showed significant differences between samples at $p<0.05$. (please label the axis)

Conclusion

The benefits of swiftlet nests on the growth of probiotics and beneficial gut bacteria, leading to health improvements, contribute to the sustainability of this industry.

Acknowledgement

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Category: Sustainable Farming

DEEP LEARNING MODEL IN IDENTIFYING COW'S LUMPY SKIN DISEASE

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Introduction

Lumpy skin disease (LSD) is a viral infection that primarily impacts cattle, leading to reduced milk production, stunted growth, reproductive issues, and in severe cases, death, resulting in substantial financial losses for the livestock industry. Early and accurate detection of LSD is crucial for implementing prompt control measures and limiting its spread (Khan et al., 2021). However, conventional diagnostic methods like clinical evaluations and laboratory testing can be labor-intensive, time-consuming, and susceptible to human error. The advent of deep learning, a form of machine learning that leverages artificial neural networks to learn from data and make predictions, has revolutionized various industries, including disease diagnosis and detection (Jackulin, et al., 2022). Deep learning algorithms show promise for automating the identification of LSD lesions in cattle due to their exceptional performance in image recognition tasks. In this research, we introduce a method to automatically identify the cow's LSD using deep learning. From the 1011 cow's images, we managed to obtain 84.73% accuracy in distinguishing cows infected with LSD and normal healthy cows.

Keywords: lumpy skin disease, computer vision, deep learning, TensorFlow

Materials and Methods

There are four main steps in building a function to automatically identify the infected cow with LSD images using deep learning. The first step is data preparation such as collecting the images of cows, and label it accordingly as either healthy or infected with LSD. Second step is to split the data into training and testing. 80% of data will be used for training and 20% will be used for testing. The third step is to build a deep learning model from the dataset. The last step is to compute the performance of the deep learning model using CNN-TensorFlow (Convolutional Neural Networks using TensorFlow) in identifying the infected cows with LSD. On the other note, conventional machine learning models such as Multilayer Perceptron (MLP) and Support Vector Machine (SVM) are also tested as comparison between deep learning and conventional machine learning algorithm.

Results and Discussion

Table 1 illustrates our performance in classifying the status of the cows from our database.

Table 1. Confusion matrix and accuracy performance in predicting LSD

CNN-Tensorflow			**SVM**			**MLP**		
	Predicted Normal	Predicted Infected		Predicted Normal	Predicted Infected		Predicted Normal	Predicted Infected
Actual Normal	134	13	Actual Normal	130	17	Actual Normal	99	48
Actual Infected	18	38	Actual Infected	21	35	Actual Infected	18	38
Overall Accuracy	**84.73%**		**Overall Accuracy**	**81.28%**		**Overall Accuracy**	**67.49%**	

From the Table 1, it can be seen that deep learning model using CNN-TensorFlow outperform traditional machine learning algorithms in predicting the LSD in cows from image data. The overall accuracy for CNN, SVM and MLP are 84.73%, 81.28% and 67.49% respectively.

Conclusion

From the experiment, using deep learning in predicting LSD from the image of cows is possible to be implemented. Few hyperparameters can be optimized to achieve higher accuracy. This can be a stepping stone to develop application for farmers, breeders and veterinarians in early detection of LSD in cows. It is hoped that when early detection is possible, meaning the sustainability of livestock production can be secured.

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Category: Sustainable Farming

DETERMINANT FACTORS OF BEHAVIOURAL INTENTIONS TO BUY CAGE-FREE EGGS IN KLANG VALLEY

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Introduction

With increasing attention to environmental, social, and governance (ESG) issues and alignment with the Sustainable Development Goals (SDGs), consumer interest in animal welfare-friendly products (cage-free eggs) has surged. The current industry may need more information in terms of customer intentions toward cage-free egg consumption. Thus, there is a huge importance and need to understand the egg consumers in Malaysia, especially in Klang Valley. This study investigates the determinants shaping consumer behavioral intentions toward purchasing cage-free eggs in Malaysia's Klang Valley. The researcher proposes and tests five hypotheses to elucidate the causal connections between key independent variables—namely, green, and ethical values, human-nature connectedness, trust in labels, attitude towards cage-free eggs, and attitude towards animal welfare and the dependent variable, behavioral intentions (Chang et al., 2023). The objective of the study is to determine the influence of independent variables and behavioral intentions towards cage-free eggs.

Keywords: poultry, cage-free eggs, Klang Valley, behavioral intentions, animal welfare.

Materials and Methods

A survey was hosted as an online questionnaire using the Google Forms platform at the link :(https://docs.google.com/forms/d/e/1FAIpQLScbFOfmhfeR9JJmjwV4P2ZBJ0jgSH5vlPOpBaF5v1dEhfgTKw/formResponse). The questionnaire consisted of 28 research questions (independent and dependent variables) and 10 demographic questions. A total of 213 valid responses and analyzed using Jeffreys's Amazing Statistics Program (JASP). The data was analyzed using a reliability test, descriptive analysis, correlation analysis, and regression analysis.

Results and Discussion

Cronbach's Alpha for independent variables instrument scores of 0.70 and above are considered adequate for the instrument's reliability (Nunnally, 1978). Behavior intentions have the most of strongest inter-correlation with other independent variables such as values, human-nature connectedness, trust in labels, attitude toward animal welfare, and attitude toward cage-free eggs (***as shown in Figure 1: Research Model Analysis)***. The study will reveal the null hypothesis rejected in further analysis because the p-value of the ANOVA table is below the acceptable significance threshold. Thus, these five (5) independent variables are

associated positively with customers' behavior and intentions. For this reason, to increase the behavioral intentions of consumers to be friendly with cage-free eggs; the poultry industry as producers of the eggs and the entire supply chain must pay careful attention to and pay attention to consumer needs strategically.

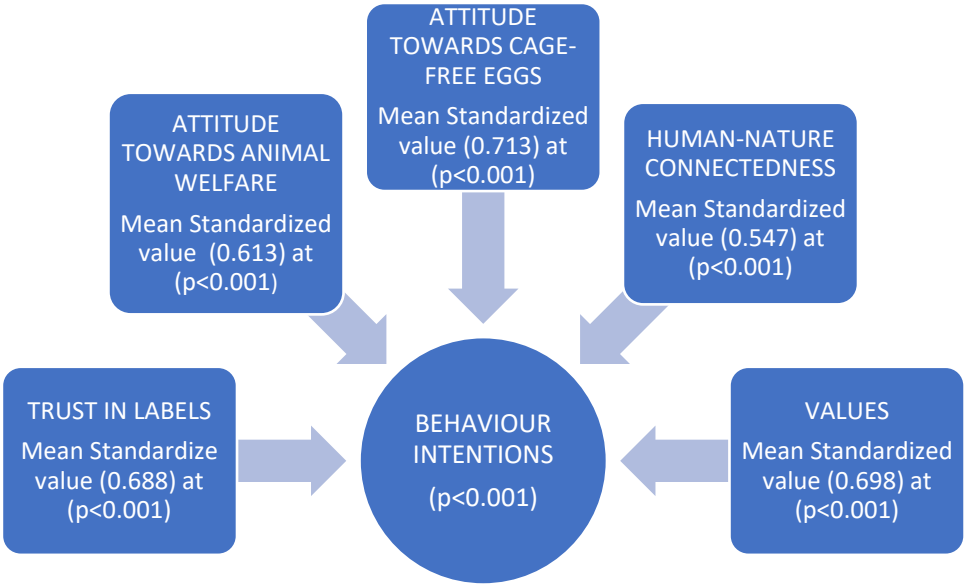


Figure 1. Research Model Analysis ((Variance Mean standardized and ***p-value)

Conclusion

This study reveals significant positive associations between consumers' attitudes towards animal welfare, green and ethical values, human-nature connectedness, trust in labels, and intentions to purchase cage-free eggs. The perception towards environment, health, society, and goodness more commonly creates higher values in a person, and that influences the positive attitude and behavioral intentions to favor animal welfare-friendly products. To improve the factors that have a positive and significant relationship with behavioral intentions, attitudes, values, human-nature connectedness, and trust in labels would be essential to highlight in Klang Valley groups of consumers. This research offers practical insights into consumer behavior concerning animal welfare-friendly cage-free eggs in the Klang Valley, Malaysia.

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Category: Animal Biotechnology and Reproduction

THE ROLE OF EDIBLE BIRD'S NEST IN PREVENTING THE HARMFUL EFFECTSOF CADMIUM TOXICITY ON PREGNANCY SUCCESS AND QUALITY OF EMBRYOS PRODUCED

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Introduction

Cadmium (Cd) is a common environmental heavy metal pollutant known to induce reproductive toxicity in mammals that can be accompanied by oocyte degeneration, embryo mortality, and reduced pregnancy rates (Tania et al., 2017; Agarwal A, 2005). Edible Bird's Nest (EBN), a natural product derived from Swiftlets has been praised for a wide range of health benefits including reproductive wellbeing (Albishtue et al., 2019) and the present study aimed to evaluate its role in mitigating the toxic effects of cadmium on pregnancy success and quality of embryos produced using rats as a model.

Keywords: Edible bird's nest, cadmium toxicity, pregnancy rate, blastocyst quality, rats

Materials and Methods

Thirty female Sprague Dawley rats equally divided into five groups (control, EBN 120mg/kg bw, Cd 5mg/kg bw, Cd + 90mg/kg bw, and Cd + 120mg/kg bw) were treated four weeks. During the last five days, rats were exposed to breeding and subsequently sacrificed to check for pregnancy and harvest embryos through uterine flushing for quality assessment. The EBN solution was administered to the rats orally by gavage while Cd was injected intraperitoneal.

Results and Discussion

The results revealed significant differences in the pregnancy rates, with EBN 120mg/kg bw showing higher blastocyst production rates compared to Cd-exposed groups. High score quality blastocysts harvested from the EBN 120mg/kg bw group were also significantly higher. The protective role of the EBN supplement is believed to be attributed to its potent antioxidant property and great nutritional and hormonal composition. Similar protective functions of EBN in cycling female rats accompanied by enhanced antioxidant effect and reduction in Cd deposition in the reproductive tissues (Quddus et al., 2021) as well as modulation of reproductive hormones and

growth factors (Albishtue et al., 2019) were reported in our previous study, providing additional explanation to the potential mechanism of action of EBN.

Conclusion

In conclusion, oral exposure of rats to Cd at 5 mg/kg BW resulted in noteworthy alterations in embryonic development and impacted embryo quality. Meanwhile, EBN at a dose of 120 mg/kg bw appeared to provide the highest protection against Cd-induced reproductive toxicity compared to the 90 mg/kg bw of EBN supplement.

Acknowledgement

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Category: Animal Biotechnology and Reproduction

LOW LEVEL OF GENETIC DIVERSITY IN INDIGENOUS KATJANG GOATS OF MALAYSIA

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Introduction

This research topic explores mitochondrial DNA (mtDNA) analysis to characterise indigenous Katjang goats in Peninsular Malaysia. The breed is the only native domestic goat breed in the country and is native to Indonesia, Thailand, and the Philippines (Devendra, 1966a, 1966b). Its domestication in Southeast Asia began 2,900 years after its dispersion from Southwest China (Peng et al., 2022). Recently, a study revealed its nearly identical genetic composition to its ancestor, the Neolithic goats in the Zagros, present-day Iran (Nijman et al., 2022). The influx of exotic breeds has resulted in either the replacement or indiscriminate crossbreeding of the Katjang goat (Devendra, 2017). This study was designed to update the diversity status of Katjang goats in Peninsular Malaysia. The objectives were to infer the genetic diversity of the Katjang goats by analysing partial mtDNA d-loop regions, to elucidate past demographic events, and to assess for a median-joining network of haplotypes, utilising the same genetic marker.

Keywords: genetic characterisation, conservation, mitochondrial DNA, demographic history, small ruminant

Materials and Methods

Thirty-six blood samples of Katjang goats were collected across five distinct localities in Peninsular Malaysia. The blood samples were subjected to DNA isolation and mtDNA D-loop amplification, spanning 481 bp, through an optimised protocol of Polymerase Chain Reaction in a thermal cycler. The amplified DNA samples were forwarded for sequencing (1st Base Sdn. Bhd., Malaysia). ARLEQUIN software version 3.5.2.2 (Excoffier & Lischer, 2010) was employed to infer primary genetic diversity indices. DnaSP version 6.12.03 (Rozas et al., 2017) was utilised for the demographic history (Nei, 1987). Two wild goats (Capra aegagrus), three ancient Neolithic goats, and 95 goats from various countries were assessed for their mtDNA

D-loop sequences data from NCBI GenBank databases. Haplotypes were then generated under the DnaSP version 6.12.03 (Rozas et al., 2017). PopART (Leigh & Bryant, 2015) was employed to construct the median-joining networks for inferring intraspecific phylogenies (Bandelt et al., 1999).

Results and Discussion

All populations exhibited low genetic diversity compared to most goat studies (Bengi & Okan, 2011; Okpeku et al., 2017; Akis et al., 2014; Ganbold et al., 2020). The mismatch distribution analysis demonstrated multiple peaks and valleys in the observed frequency. The data do not fully support a simple model of recent population expansion, implying that other demographic factors such as population structure, historical migration, or multiple demographic events may have shaped the current genetic diversity of the Katjang goats. The median-joining network analysis demonstrated a direct and near link of the Katjang populations to both Neolithic domestic goats and the wild goat, Capra aegagrus (Figure 1), and nearer to the Southeast Asian goats.

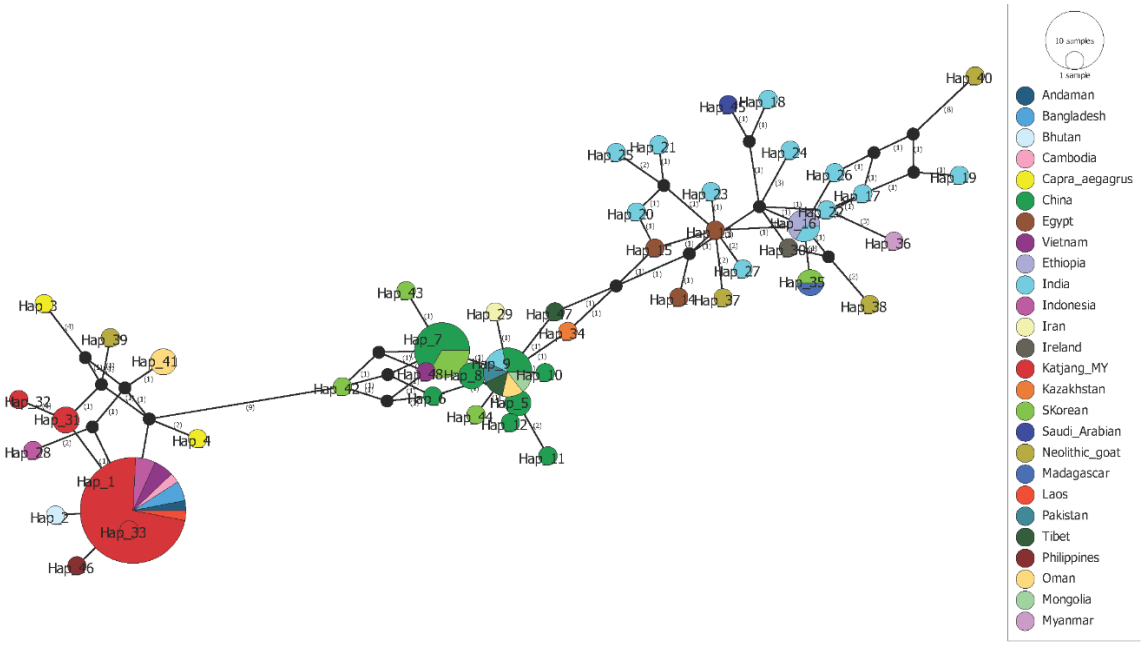


Figure 1. Median-joining network of the Katjang goats, wild goats, Neolithic goats and other transboundary breeds.

Conclusion

The findings provided substantial data for facilitating the groundwork of targeted conservation strategies, including the inclusion of diverse genetic lines in breeding programs. The analysis of Katjang's position and its relationship with Capra aegagrus and Neolithic goats within a median-joining network reflects patterns of migrations and historical interactions between goat populations and human societies.

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Category: Animal Breeding & Genetics

DNA-BASED RESEARCH IN ANIMAL PRODUCTION WITH CONSERVATION CONCERN: TALES ON KELAH & INDIGENOUS MALIN SHEEP

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Introduction

In animal production, there is a concerning trend of decreasing populations and loss of genetic diversity that highlights the critical need for effective conservation measures to ensure and maintain food security. Our research focuses on two local species: the Kelah and indigenous Malin sheep. The decline in Kelah's wild population is attributed to its commercial and aesthetic values (Walton et al. 2017), while the Malin sheep serves as a promising genetic resource for sustainable local livestock industries (Mahdzar et al. 2023). Therefore, DNA-based studies can be utilized to understand both species' biology and autecology thoroughly. We have conducted DNA-metabarcoding and microsatellites-genotyping to fulfil different mission-critical needs. For predatory fishes such as Kelah, DNA-metabarcoding analyses provide more precise estimates and help quantify their dietary composition (Deagle et al. 2019). Meanwhile, we used microsatellite-based genotyping for population genetics assessment of selected Malin sheep populations in Peninsular Malaysia. These analyses will complement and enrich the existing research on Malin sheep (Suriaty et al. 2018) and explore the genetic diversity of Malin herds across various locations in Peninsular Malaysia. Findings will offer a foundation for developing informed conservation and management strategies.

Keywords: Metabarcoding, freshwater fish, Microsatellites, Livestock, Conservation

Materials and Methods

To determine dietary and prey taxa composition of Kelah, we applied cytochrome-oxidase I (COI) metabarcoding with Kelah from seven different locations of wild and farm origins based on fish gut digesta sample. Multivariate statistical analyses were performed to depict differences in prey community composition of Kelah between locations and populations. For Malin sheep, Analysis of Molecular Variance (AMOVA) was achieved to study population differentiation of herds collected across three states (Kelantan, Pahang, Perak) based on four microsatellite loci recommended in FAO (2011).

Results and Discussion

Prey COI sequences were grouped into 54 taxa based on the lowest taxonomic rank. Less than a quarter of the total taxa overlapped between both fish origins. Non-metric multidimensional scaling (NMDS) indicates greater prey taxonomic diversity and composition in wild fish across different rivers compared to those in farmed fish (PERMANOVA, pseudo-F = 1.959, $p < 0.05$).

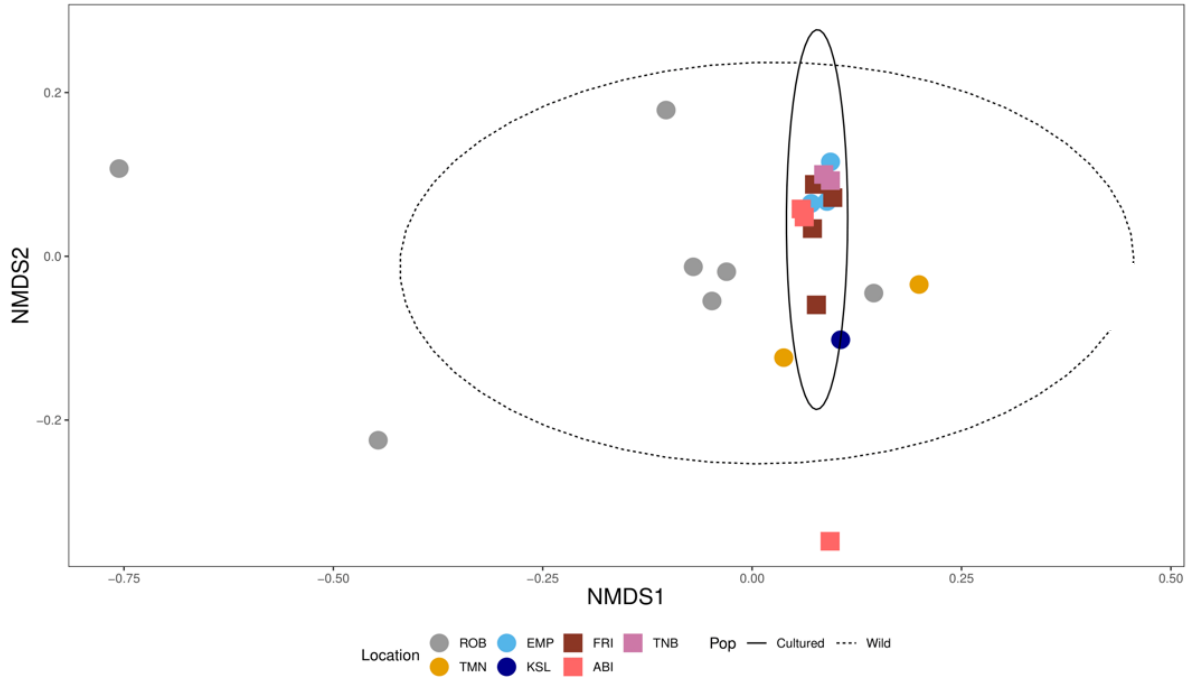


Figure 1. NMDS plot shows the clustering of Kelah individuals based on their diet composition. Samples with similar diet composition clustered together, and vice versa.

Table 1. Analysis of molecular variance (AMOVA) of 152 individual genotypes from Malin sheep herds across three populations (Kelantan, Pahang, Perak)

Source of variation	DF	SS	MS	Est. Var.	%T	F (p-value)
Among populations	2	23.98	11.991	0.109	9	F_{ST} = 0.095 (0.001)
Among individuals	149	239.23	1.608	0.561	49	F_{IS} = 0.537 (0.001)
Within individuals	152	73.50	0.484	0.484	42	F_{IT} = 0.581 (0.001)
Total	303	337.71		1.154	100	

df = degree of freedom; SS = sum of squares; MS = mean squares; Est. Var = estimate of variance; %T = % of variance

AMOVA analysis of Malin sheep estimates the distribution of intra-population and inter-population genetic variation. As depicted in Table 1, the majority of genetic variability within studied Malin populations stems from differences among individuals within population (49%), with comparatively less attributed to population differentiation. The inbreeding coefficient, F_{IS} value > 0 suggests a potential homozygotes excess,

possibly indicative of selective pressures (Cutter 2019). This phenomenon is likely due to fragmented population sizes and geographical constraints.

Conclusion

DNA-based approaches detect diverse diet selection among Kelah in the wild suggesting the importance of conducting *ex-situ* habitat preservation for this fish, whilst population genetics assessment on Malin sheep reveals the need to address inbreeding issues that could impact livestock's performance.

Acknowledgement

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Category: Animal Breeding & Genetics

VARIATION DETERMINATION OF NUCLEOTIDE POLYMORPHISM OF FATTY ACID BINDING PROTEIN 4 (*FABP4*) GENE OF NEW ZEALAND ROMNEY SHEEP

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Introduction

FABP4 is a member of the intracellular lipid-binding protein family, which plays a crucial role in the intracellular transport and metabolism of long-chain fatty acids (LCFA). In sheep, FABP4 expression is primarily localized in adipocytes and muscle cells, particularly during periods of active growth and development. This study investigates the genetic factors influencing the intramuscular fat profile in sheep meat, focusing on FABP4 gene in chromosome 9 of New Zealand Romney sheep. The study highlights the potential role of the marker obtained from FABP4 gene, which encodes a fatty acid binding protein involved in lipid metabolism, in modulating the fatty acid profile of sheep meat. FABP4 has potential to be use as a marker to determine the quality meat traits. Therefore, the objective of this research is to identify and further profile nucleotide variation of FABP4 as a potential marker associated to meat quality traits of New Zealand sheep.

Keywords: FABP4, sheep, lamb, meat quality, PCR-SSCP, gene marker

Materials and Methods

Blood samples from 200 lambs were collected on FTA card prior to slaughter. Genomic DNAs were extracted and purified using two step method (Zhou et al., 2006). Selected region of ovine FABP4 was investigated using Polymerase Chain Reaction – Single Stranded Conformational Polymorphism (PCR-SSCP) to ascertain if sequence variation is present from the investigated lambs. Sequence variation was revealed with PCR-SSCP optimisation and observed as different gel electrophoresis banding patterns. The different variants for each gene were nucleotide sequenced using Sanger sequencing to further understand the nature of the genetic variation that was discovered.

Result and Discussion

Four unique homozygous banding patterns observed from Exon 3 Intron 3 of FABP4 gene, labelled as AA, BB, CC and DD (Figure 1). The variation denoted as ‘AA’ in Figure 1 appears to align with the variation denoted as ‘BB’ identified by Yan et al., (2012), which demonstrated high frequencies of fat selection lines in Coopworth

sheep. It is anticipated that this observed variation of 'AA' could serve as a potential marker associated with lamb meat quality. Variation in FABP4 has been found to be associated with growth, fat deposition and carcass traits in cattle. Michal et al., (2006) reported that variation in FABP4 was associated with the intramuscular fat (IMF) or marbling, and subcutaneous fat depth in Wagyu × Limousin F2 cattle crosses, while Lee et al., (2010) reported that variation in FABP4 was associated with IMF and carcass weight in Korean Hanwoo cattle.

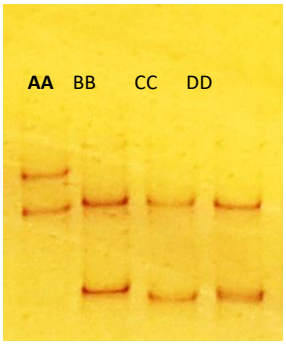


Figure 1: PCR-SSCP banding pattern for ovine FABP4. Four unique patterns corresponding to four different allele sequences A, B, C and D in the exon 3 Intron 3 region.

Conclusion

These findings contribute to a better understanding of the genetic marker and the mechanisms underlying meat quality traits in sheep, with implications for selective breeding strategies aimed at improving the nutritional value and health benefits of sheep-derived products.

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Category: Ruminant Production

LACTATION PERFORMANCE OF HOLSTEIN FRIESIAN COWS IN MALAYSIA

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Introduction

In 2022, dairy industry constitutes only about 57.3% of the self-sufficiency rate (SSR) in milk products in Malaysia (DVS, 2023). Malaysia targets to achieve 100% SSR by the year 2030 (DAN, 2021). However, there are numerous aspects that need to be improved, particularly concerning the breed. Malaysia imports cows from countries such as Australia to meet local milk demand. One of the popular breeds is Holstein-Friesian. Under optimal feeding conditions, this breed is capable to produce high milk production and faster growth rates compared to local dairy breeds. Understanding factors that influencing lactating performance, such as nutrition, management practices, and environmental conditions, is essential for optimizing milk production and ensuring the sustainability of the dairy industry in Malaysia. This paper aims to assess the milking performance of dairy cows during the first lactation under the Malaysian climate, with optimum feeding and environmental management.

Keywords: lactation performance, Holstein-Friesian

Materials and Methods

Data was collected from ANGKASA-KOMARDI Farm in Projek Pertanian Moden, Kluang Johor. A total of 40 Holstein-Friesian cows (50:50%, primiparous) aged 26 months old and in their first lactation were housed in pens under an extensive system. The calving period ranged from October to December 2022. Thirty cows were still lactating, while others were dried off. The average lactation period was 255 days. The pens were equipped with automatic cow cooling system. Cows were fed fresh Napier grass and concentrate (a mixture of soybean meal, wheat pollard, rice bran, corn, palm kernel cake, palm oil, vitamin and mineral premixed and limestone). Milk production was recorded twice daily using an automatic milking system (AMS). Descriptive analysis was performed using Microsoft Excel version 2402.

Results and Discussion

Table 1 presents the first lactation performance of Holstein-Friesian cows under the Malaysian climate. The days in milk (DIM) are lower than those reported by Sattar et al. (2005) and Sandhu et al. (2011), with an average of 255 days in our study compared to 291 and 319 days, respectively. However, the highest lactation period observed in

our study was 324 days. The average daily milk yield was 11.0 ± 1.38 litres per day, with the highest daily yield averaging 19.3 ± 3.16 litres. Solechah et al. (2020) reported the similar finding in their observation, with 11.5 litre/day. The total milk yield for the entire lactation period was 3,348.3 ± 69.87 litres. These results are consistent with previous studies that reported milk yield for Holstein-Friesian cows during the first lactation ranging between 2,772 to 3,976 kg (Sattar et al., 2005; Sandhu et al., 2011; Hartanto et al., 2020). Furthermore, peak lactation was achieved during the early lactation stage, specifically the second post-calving period, reaching a peak of 440 litres during that period. This finding is in line with other studies (Hutjens, 2002; Nugroho et al., 2015), which indeed indicated that the highest milk production generally occurs around 40-60 days after calving.

Table 1. First lactation performance of Holstein-Friesian cows under Malaysia climate.

Parameters	Mean	SD
Days in milk	255.4	65.10
Daily milk yield, litre/day	11.0	1.38
Highest milk yield, litre/day	19.3	3.16
Total milk yield, litre	3,348.3	69.87

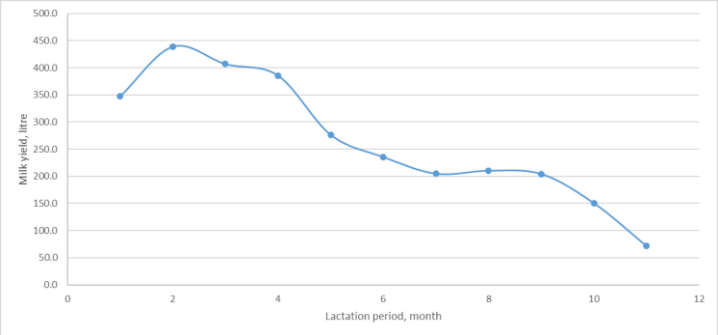


Figure 1. Milk production of dairy cows over the whole lactation period

Conclusion

In summary, the results show that there is potential for the performance of Holstein-Friesian to be improved and become the main dairy breed in Malaysia. Findings from this study can contribute to a better understanding of Holstein-Friesian cow lactation performance in the Malaysian climate and provide valuable insights for dairy farm management and breeding programs.

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Category: Animal Nutrition and Feeding

THE GROWTH PERFORMANCE AND APPARENT DIGESTIBILITY OF SHEEP FED WITH ENSILED *BRACHIARIA DECUMBENS*

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Introduction

Ingesting *Brachiaria decumbens* can seriously affect ruminants' growth performance and apparent digestibility, especially sheep as it contains a high concentration of steroidal saponin (Chung et al., 2018; Jaapar et al., 2023). Therefore, this study aimed to determine the growth performance and apparent digestibility by feeding ensiled *B. decumbens* to the sheep throughout 98 days of the feeding trial.

Keywords: Ensiling, steroidal saponin, feed conversion ratio, apparent digestibility, sheep

Materials and Methods

A total of 18 male Dorper cross sheep aged 8 months old were used in this study, which was further divided randomly into three treatments which consisted of (T1) *Pennisetum purpureum* as the control group, (T2) fresh *B. decumbens*, and (T3) ensiled *B. decumbens*. The total feed intake and feed refusal were recorded daily, while the body weight was recorded weekly and apparent digestibility was recorded at the end of the study.

Results and Discussion

Results showed that sheep fed with ensiled *B. decumbens* (T3) had significantly higher ($P < 0.05$) body weight gain (BWG) and average daily gain (ADG) leading to better feed conversion ratio (FCR) as compared to T1 and T2 groups (Table 1). Additionally, the sheep fed with ensiled *B. decumbens* (T3) exhibited significantly higher CP, NDF, and ADF apparent digestibility ($p <0.05$), but the inclusion of silage did not result in any significant difference ($p> 0.05$) in DM, and OM apparent digestibility compared to T1 and T2 (Figure 1).

Table 1: Growth performance of sheep fed with ensiled *B. decumbens.*

Item	Experimental diets			P-value
	T1	T2	T3	α < 0.05
Total DMI (kg)	77.43 ± 0.58^{a}	72.20 ± 0.67^{c}	75.18 ± 0.47^{b}	<0.0001
IBW (kg)	23.00 ± 0.13	23.00 ± 0.26	23.00 ± 0.25	0.3788
FBW (kg)	31.63 ± 0.17^{a}	30.88 ± 0.17^{b}	31.85 ± 0.18^{a}	<0.0010
BWG (kg)	8.63 ± 0.06^{b}	7.88 ± 0.03^{c}	8.85 ± 0.07^{a}	<0.0001
ADG (g)	88.01 ± 0.59^{b}	80.41 ± 0.36^{c}	90.31 ± 0.70^{a}	<0.0001
FCR	8.98 ± 0.02^{b}	9.16 ± 0.01^{c}	8.51 ± 0.01^{a}	<0.0001

Note: All values were expressed as mean ± SEM; ^{a,b,c} values with superscript within row are significantly different at p < 0.05. DMI: Dry matter intake (kg); IBW: Initial body weight; FBW: Final body weight (kg); BWG: Body weight gain (kg); ADG: Average daily gain (g); FCR: Feed conversion ratio.

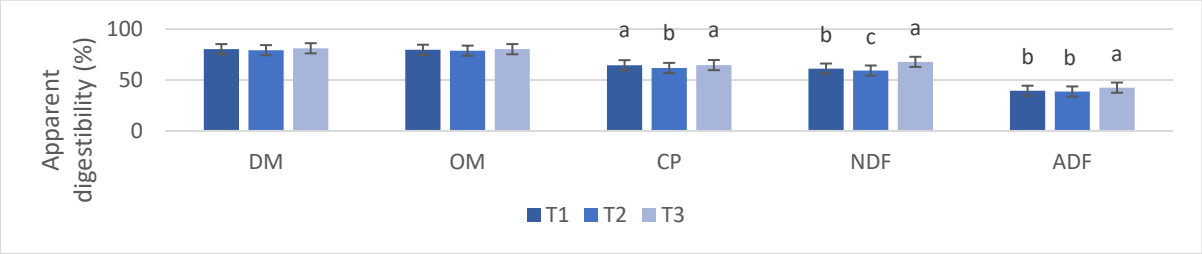


Figure 1: The apparent digestibility of sheep fed with ensiled *B. decumbens.* ^{a,b,c} values with superscript among treatments are significantly different at p<0.05. DM: Dry matter; OM: Organic matter; CP: Crude protein; NDF Neutral detergent fiber; ADF: Acid detergent fiber.

Conclusion

In conclusion, ensiling *B. decumbens* can be used as a method to eliminate saponin in *B. decumbens* and potentially be used as an enhanced basal diet which ultimately improves the growth performance and apparent digestibility of the sheep.

Acknowledgement

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Category: Animal Nutrition and Feeding

UTILISING BIOGENIC SELENIUM-RESISTANT *(STENOTROPHOMONAS MALTOPHILIA)* BACTERIA TO PRODUCE ORGANIC SELENIUM

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Introduction

The biogeochemical cycles of trace elements involve methylation and demethylation, which are mediated by microbes. Trace elements undergo different processes such as biotransformation. According to Valls and Lorenzo (2002), bioremediation offers an eco-friendly in situ sustainable technique for the elimination of harmful trace elements, together with cost-effective and efficient technology. *Stenotrophomonas maltophilia* (ADS18), is a selenium (Se) tolerant bacterium that could convert toxic sodium selenite (SS) into organic Se intra and extracellularly (Piacenza et al., 2018). It has the potential to replace the toxic inorganic Se (SS) in the diet of livestock. The present study optimises the different temperature conditions and growth medium to maximise the biomass cell growth of organic Se produced by ADS18.

Keywords: *Stenotrophomonas maltophilia* ADS18*,* Temperature, Organic selenium, Cell biomass, Colony-forming units

Materials and Methods

Bacteria strain, medium and culture preparation

The biogenic bacterial strain ADS18 was previously isolated by Dalia et al. (2017) from the Selayang hot spring, in Selayang, Selangor was used in the study. Three broths; Nutrient broth (NB) as control, Tryptic Soy broth (TSB) and Brain Heart Infusion broth (BHI) were used to compare the growth of ADS18. The revived ADS18 was sub-cultured every 48 h.

Organic Se level in the supernatant and pellets of ADS18 in different mediums

The selected isolate was incubated at room temperature in NB, TSB, and BHI. Total Se was determined following Garbisu et al. (1996). Culture samples were fractionated into supernatant and pellet components, and organic Se levels were analysed using ICP-MS (Perkin Elmer, USA).

Cell biomass determination with varying temperatures and incubation period

The ADS18 were transferred from the stock into 10 mL of NB, TSB and BHI and incubated at 30, 35, 37, 39, and 41˚C for one week. Serial dilutions of culture samples in a growth medium devoid of SS were prepared, and the viable colonies were enumerated by plating on the same medium (Log^{10}) (Lampis et al., 2017).

Results and Discussion

Organic Se level in the supernatant and pellets of ADS18 in different mediums

Organic Se was significantly ($p < 0.05$) accumulated with ADS18 colonies grown in NB (45.103 mg/g) despite the least CFU formed compared to BHI as in Figure 1. No significant difference ($p > 0.05$) in the supernatant for the entire medium used.

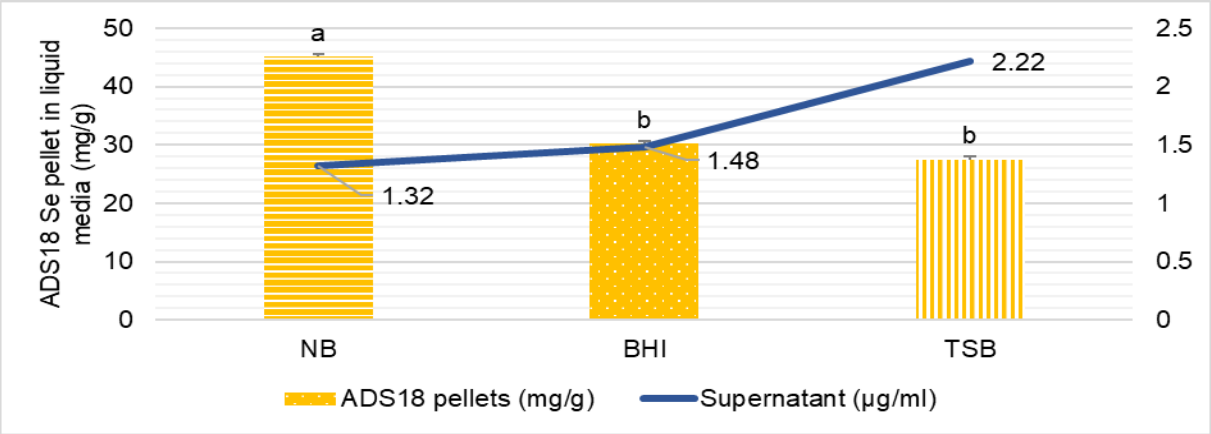


Figure 1: Organic Se pellet availability in NB, TSB, and BHI media incubation for 48 h.

Cell biomass determination with varying temperatures and incubation period

The growth curve of cell production was affected by varying temperatures and the duration of incubation. It was observed that the lowest growth curve happens after 48 h of the incubation period and as the temperature increases, the ADS18 growth declines for all media. Among all the tested media, the BHI medium was found to be superior media for higher biomass compared to TSB and least in NB.

Conclusion

ADS18 bacteria can efficiently reduce SS to nontoxic elemental organic Se. BHI supports higher cell biomass at 35˚C for 48 hours. NB showed highest intracellular bioavailability of Se. Medium suitability for ADS18 cultivation depends on temperature and incubation time. This information is crucial for developing ADS18 cultivation processes for large-scale production of organic Se. Hence, the benefit can be conveyed to livestock via dietary supplementation.

Acknowledgement

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Category: Poultry Nutrition

PERFORMANCE OF VILLAGE CHICKENS (AYAM SAGA) FED ON DIETS WITH VARIOUS LEVELS OF BLACK SOLDIER FLY LARVAE MEAL (BSFLM)

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Introduction

A growing amount of literature and experts recognize that using insect meals in feed formulation could be a novel way to improve feed and food security. With the increase in the price of fishmeal and soybean meal, there is an urgent need for substitutes such as insect meal to reduce the use of imported ingredients in animal diets. Studies have reported that insects have a high protein content, essential amino acids, minerals, and vitamins (Spranghers et al., 2017). While insects are a natural part of poultry feed, recent studies suggested that incorporating insect meals into feed formulation could enhance the sustainability of the poultry supply chain. Black soldier fly (BSF) or *Hermetia illucens*, is an insect with high protein and fat, making it a good candidate for use in poultry feed and it is one of the most suitable insect species for commercial production. The inclusion of black soldier fly larvae (BSFL) in feed has no significant effect on the feed intake of the chicken (Auza et al., 2023). Thus, this study examined the performance of local village chickens namely Ayam Saga fed with BSFL, and determined the optimal level of this insect meal in the chicken diet.

Keywords: black soldier fly larvae, feeding trial, growth performance, alternative protein source

Materials and Methods

Experimental Design

A hundred forty-four Ayam Saga were randomly divided into four groups, assigned to four different dietary treatments with 6 replicates per treatment and 6 chickens per replicate). The feeding trial was started at the grower phase when the chickens aged 6 weeks and finished at the age of 12 weeks. The BSFL meal was included in the isonitrogenous and isocaloric diets at increasing levels i.e. 0% (BSFL0 as a control), 5% (BSFL5), 10% (BSFL10), and 15% (BSFL15) in the expense of commercialized soybean meal. The experiments were conducted using a complete randomized design (CRD).

Growth Performance and Collection Data

Weekly body weight and feed records were used to evaluate the chicken's feeding trial performance. The initial body weight (IW), final body weight (FW) weekly body weight,

and feed residues were recorded. Average daily gain (ADG), body weight gain (BWG), feed intake (FI), and feed conversion ratio (FCR) were calculated during the trial. Daily chicken mortality and health were also monitored. One-way analysis of variance (ANOVA) utilizing the General Linear Model (GLM) procedure in SAS version 9.4 (2013, SAS Institute, Inc., Cary, NC, USA) was conducted.

Results and Discussion

Figure 1 shows the weight of the chickens increased in all four trial groups over the 6-week feeding trial. FW, ADG, and BWG of birds fed on the BSFL15 diet were significantly lower than other treatments although the IW of the birds was similar. FCR and FI were also numerically lower although did not differ significantly. This indicates that 15% BSFL meal negatively affected the performance of Ayam Saga and could be the upper limit of BSFL inclusion in the diet of Ayam Saga. From this study, the maximum inclusion of BSFL in the grower diet was at 10% due to insignificant differences in the performance parameters with a control group (BSLF0). The FCR of Saga chickens was much lower than that of native chickens for the growing phase (6-12 weeks) in Timor, Indonesia (Kemba et al., 2023).

Table 1. Growth performance of Saga chickens fed on test diets over a 6-week feeding trial.

Parameter	Dietary treatment				*p*-value
	BSFL0	BSFL5	BSFL10	BSFL15	
IW (g)	636.04 ± 8.23	630.59 ± 2.96	635.57 ± 5.32	631.75 ± 2.86	0.8512
FW (g)	1720.75 ± 41.66^{a}	1694.72 ± 15.09^{a}	1654.94 ± 34.67^{ab}	1506.92 ± 1.78^{b}	0.0079
SR (%)	0	0	0	2(5.6%)	
ADG (g/day)	24.65 ±1.04^{a}	24.19 ± 0.38^{a}	23.17 ± 0.79^{ab}	19.89 ± 1.42^{b}	0.0116
BWG (g/bird)	1084.71 ± 45.85^{a}	1064.13± 16.77^{a}	1019.37± 34.95^{ab}	875.18 ± 62.41^{b}	0.0116
FI (g)	3159.69 ± 56.04	3115.96 ± 57.93	3021.45 ± 80.73	2828.20± 57.69	0.1095
FCR	2.94 ± 0.13	2.93 ± 0.05	2.97 ± 0.06	3.26 ± 0.11	0.0676

Mean ± standard error of the mean in the same row with different alphabets are significantly different at $p<0.05$ (ANOVA, Tukey test).

Conclusion

The inclusion of BSFL meals up to 10% in the diet for Ayam Saga did not impair its growth performance. This study showed the potential of BSFL in substituting conventional protein sources used in poultry diets, which contributes to sustainable production while maintaining performance standards. However, further study is recommended on the harvesting age of BSFL particularly at an early age to reduce chitin content, which could contribute to increased nutrient digestibility and feed ingredient substitution percentage in poultry diet.

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Category: Poultry Nutrition

EFFECTS OF PARTIAL SUBSTITUTION OF GROWER-FINISHER DIET WITH WHOLE FULL-FAT INSECT MEALS ON GROWTH PERFORMANCE, MEAT QUALITY TRAITS AND GUT HEALTH PARAMETERS IN BROILER CHICKENS

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Introduction

There are growing interests on the potential of insect meals in improving the energetic efficiency of poultry diet. The research on insects as livestock feeds has been extensive, illustrating its importance in future-proofing the industry. Insects are high in protein (27% to 61%) and fat contents (7% to 42%), though their compositions are highly variable (Elahi et al. 2022). Among the reported benefits of feeding diets containing insect meals include improved growth performance, nutrient digestibility and health status in chickens. In this study, two insect species – black soldier fly (BSFL; *Hermetia illucens*) larvae and house crickets (*Acheta domesticus*), were selected. The study aimed to assess the effect of substituting the basal diet with up to 10% insect meals on the growth performance, meat quality traits and gut health parameters in broiler chickens.

Keywords: insect meals, broiler, performance, meat quality, gut health

Materials and Methods

A total of 180 day-old male Cobb 500 broiler chicks were placed in battery cages inside an open-sided house with *ad libitum* access to feed and water. The birds received starter diets from 0 – 21 days, grower-finisher diets from 21 – 42 days. The diets were formulated according to the designated growth phases, to meet the basic nutrient requirements. No insect-based diet was fed to the birds during the starter phase. Starting from day 22, the birds were randomly assigned to 5 dietary treatments (6 replicates with 6 birds per replicate). The dietary treatments were: CON (basal diet); HI-5% (5% *H. illucens* larvae meal substitution); HI-10% (10% *H. illucens* larvae meal substitution); AD-5% (5% *A. domesticus* meal substitution); and AD-10% (10% *A. domesticus* meal substitution). The weekly feed intake and body weight were recorded. At slaughter, breast muscle samples (40 g; both sides/bird; vacuum packed) were subjected to meat quality analyses (pH, drip loss, and shear force). For gut health evaluation, tissues from different intestinal segments were sampled and subjected to histomorphological assessment. The caecal content was also analyzed for ammonia-N and short-chain fatty acid contents.

Results and Discussion

Table 1 summarizes the effect of dietary treatments on the growth performance, selected meat quality traits, intestinal histomorphology and caecal content. The diet effects on the measured variables were mostly not significant, except for intestinal histomorphology parameters. All insect meals fed broilers showed a better feed conversion ratio (FCR) than CON, except for AD-5% group. This observation may indicate that substituting the basal diet with up to 10% insect meals does not affect the performance of broilers. The ratios of villus height to crypt depth (VH:CD) in duodenum and jejunum were mostly lower in insect meals fed groups. Nevertheless, in ileum – the major site for nutrient absorption, the insect meals fed groups showed higher VH:CD. The development of the villi might be due to increase the stimulation of ileal absorptive function resulted from rising load of nutrients deriving directly from the duodenum to the ileum (Moniello G et al. 2019). The presence of chitin within the insect exoskeleton lowering the nutrient digestibility hence inducing an increased amount of the potential digestible nutrients in the ileum.

Table 1. Effect of dietary treatments on the growth performance, selected meat quality traits, intestinal histomorphology and caecal content.

Parameters	Dietary Treatments					SEM	*p* value
	CON	HI-5%	HI-10%	AD-5%	AD-10%		
Growth performance (22-42 days)							
Cumulative FI (kg)	15.84	16.69	16.90	16.49	18.22	0.63	0.133
Cumulative BWG (kg)	9.62	10.27	10.74	9.72	11.83	0.63	0.122
Cumulative FCR	1.65	1.56	1.59	1.72	1.54	0.06	0.208
Selected meat quality traits							
pH	6.18	6.15	6.22	6.17	6.13	0.04	0.560
Drip loss (%)	4.55	4.36	6.70	6.19	3.94	0.88	0.165
Shear force (g)	1123.7	1447.8	1297.5	1225.7	1163.5	89.6	0.120
Intestinal histomorphology							
Duodenum VH:CD	6.52^{a}	6.59^{a}	4.18^{c}	5.09^{b}	4.09^{c}	0.27	<0.001
Jejunum VH:CD	5.31^{a}	4.87^{ab}	2.88^{d}	3.54^{c}	4.63^{b}	0.18	<0.001
Ileum VH:CD	4.04^{d}	4.35^{d}	6.83^{a}	5.84^{b}	5.07^{c}	0.18	<0.001
Caecal content							
Ammonia-N (mM)	0.047	0.051	0.053	0.053	0.055	0.003	0.306
Total SCFA (mM)	6.56	9.39	5.65	8.61	5.26	1.39	0.180
HAc:HPr	22.18	26.43	21.51	24.72	21.51	2.25	0.441

Note: CON: Basal diet, HI-5%: 5% H. illucens larvae meal substitution, HI-10%:10% *H. illucens* larvae meal substitution, AD-5%: 5% *A. domesticus* meal substitution, AD-10%: 10% *A. domesticus* meal substitution. Values with different superscripts within column of the same response variable are significantly ($P < 0.05$) different. FI: Feed intake; BWG: Body weight gain; FCR: Feed conversion ratio, VH:CD: Ratio of villus height to crypt depth; SCFA: Short-chain fatty acids; HAc:HPr: Ratio of acetic acid to propionic acid.

Conclusion

Substituting the basal diet with up to 10% whole full-fat insect meals during the grower-finisher phase does not negatively affect the performance of broilers, as well as the meat quality traits and caecal fermentation characteristics.

Acknowledgement

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Category: Food/Feed Safety

CHANGES IN FATTY ACID PROFILES AND LIPID OXIDATION ON *PECTORALIS MAJOR* OF BROILER CHICKENS USING DIFFERENT STORAGE TEMPERATURES AND TIME DURATIONS

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Introduction

The growing population and demand for high-quality proteins cannot be overstated. Poultry meat proteins quickly match this need due to their increased nutritional value, especially PUFA, affordability, and ease of preparation from raw to cooked (Wazir et al., 2019). Changes in broiler chicken *Pectoralis' major* fatty components significantly affect nutritional content, shelf-life, and lipid oxidation (Chmiel et al., 2019). Thus, temperature and storage period are crucial when evaluating *Pectoralis major* of broiler chicken fatty acid profiles. Maintaining chicken meat's nutritional content and quality requires careful preservation. The current study examines the effects of different storage temperatures and time durations on broiler chicken *Pectoralis major* fatty acid profiles and lipid oxidation.

Keywords: Breast muscle, Lipid oxidation, Temperature, Time, Unsaturated fatty acids.

Materials and Methods

Five commercially purchased breast muscles from freshly slaughtered chickens were split in half. The first component was stored at 28.01±1.80 ºC ambient temperature, while the other was stored at -20 ºC freezer temperature. Post-treatment samples were obtained at 0, 10, 24, 48, and 72 hours. Fatty acid profiles were assessed using gas chromatography. Folch et al. (1957) techniques.

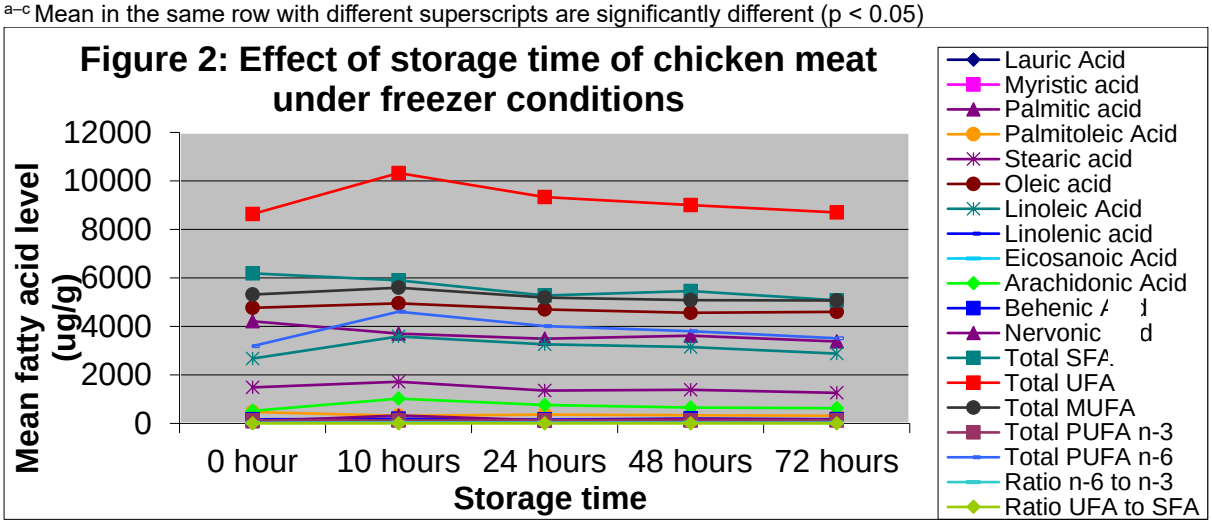
Results and Discussion

Table 1 demonstrated that mincing released fatty acids (FA) in both treatment groups, and most had increased after 10 hours. Figures 1–4 indicate that most FA values, including frozen ones, declined within 24 hours. In Table 2, lauric acid, palmitic acid, linolenic acid, eicosanoic acid, total unsaturated fatty acids, n-3 and n-6 PUFA, and omega n-6:n-3 ratio exhibited the most significant concentration reduction. Total MUFA, nervonic acid, palmitoleic acid, stearic acid, oleic acid, linoleic acid, arachidonic acid, behenic acid, and nervonic acid were least affected by room temperature storage. FA concentrations changed in freezers. Only arachidonic acid, nervonic acid, the omega n-6:n-3 ratio, and the UFA: SFA ratio were significant in Table 3. After 10 hours of mincing, most fatty acids quadrupled and then dropped. Chop or mince meat releases lipase, according to Abril et al. (2023) and Lu et al. (2022). Releases unbound animal lipid fatty acids (Favé et al., 2004; Kulkarni & Mattes, 2014; Petricorena, 2015; Toldrá, 2021). Temperature oxidizes and degrades free fatty acids. Meat pH drops, and lipase action stops as storage duration increases, lowering meat lipid availability (Addis, 2015).

Table 1. Effect of storage durations on fatty acid composition under room temperature.

Fatty acids	Sampling time (hours)				
	0	10	24	48	72
Lauric acid (μg/g)	71.25± 9.15^{a}	105.00± 10.16^{b}	63.00± 3.61^{a}	51.20± 4.33^{a}	59.00± 6.25^{a}
Palmitic acid (μg/g)	4211.50± 251.27^{bc}	4890.60± 372.47^{c}	4065.20± 327.68^{bc}	3366.60± 234.19^{ab}	3038.00± 113.64^{a}
Linoleic acid (μg/g)	2674.50± 63.85^{ab}	3963.40± 146.92^{c}	3250.40± 292.61^{b}	2484.20± 227.23^{a}	2140.00± 120.81^{a}
Eicosanoic acid(μg/g)	92.25± 32.58^{ab}	79.60± 11.33^{a}	83.20± 18.19^{a}	22.20± 63.84^{bc}	259.40± 58.62^{c}
Total SFA (μg/g)	6187.25± 375.20^{bc}	6970.20± 479.05^{c}	5786.00± 402.72^{ab}	5120.60± 309.09^{ab}	4780.40± 192.75^{a}
Total UFA (μg/g)	8633.25± 440.83^{b}	10742.20± 539.73^{c}	9079.60± 932.72^{bc}	7989.00± 446.95^{ab}	6587.40± 595.65^{a}
Total PUFA n-3 (μg/g)	127.25± 7.88^{b}	146.40± 5.79^{b}	92.00± 5.28^{a}	84.60± 7.92^{a}	78.80± 6.51^{a}
Total PUFA n-6 (μg/g)	3189.25± 109.31^{ab}	4544.40± 155.91^{c}	3758.20± 306.33^{b}	3019.80± 236.94^{a}	2584.00± 117.75^{a}
Ratio n-6 to n-3 (μg/g)	25.22± 0.88^{a}	31.24± 1.71^{ab}	40.77± 2.08^{c}	35.93± 1.18^{bc}	33.93± 3.92^{bc}

$^{a–c}$ Mean in the same row with different superscripts are significantly different ($p < 0.05$)



Conclusion

The study concluded that polyunsaturated fatty acids like C20:4, C18:3, and PUFA n-3 degraded rapidly in room storage. Freezer storage at low temperatures delays FA degradation. Some meat FAs, such as arachidonic acid, degraded even when preserved in the freezer.

Acknowledgement

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Category: Animal Health and Production System

CLINICO-PATHOLOGICAL RESPONSES OF SHEEP FED WITH ENSILED *BRACHIARIA DECUMBENS*

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Introduction

Over 80% of Malaysia's native grasslands consist of *Brachiaria decumbens*, which serves as primary feed for ruminants. Despite possessing good forage potential, there have been reported cases of its toxicity to animals, especially sheep (Muniandy et al., 2021). This study aimed to assess the clinical signs, gross morphology, and histopathology effects of including ensiled *B. decumbens* into the diet of sheep.

Keywords: *Brachiaria decumbens,* Clinical signs, Organ morphometric, Pathology, Sheep.

Materials and Methods

Eighteen Dorper cross sheep were randomly allocated to three treatments and placed in individual metabolic cages. The study applied a diet with a ratio of 70:30 roughage and concentrate, consisting of three different roughage treatments. These treatments included fresh *Pennisetum purpureum* (T1), fresh *B. decumbens* (T2), and ensiled *B. decumbens* (T3). Throughout 98 days of the experiment, data on temperature, heart rate, respiration rate, rumen motility, and clinical signs were gathered weekly. All 18 sheep were slaughtered at the end of the experiment, and the organs were collected for organ morphometric, gross morphology, and histological purposes.

Results and Discussions

The results indicate significant differences ($p<0.05$) in the health performance of the sheep across different feeding groups. T3 sheep fed with ensiled *B. decumbens* reported no significant ($p<0.05$) changes in all parameters measured similar to the control sheep. During the last 21 days of the trial, only T2 sheep had pale ocular mucous membranes. The gross pathology reported the significance ($p<0.05$) of the organ's width and weight, displaying higher values indicating organ inflammation (Table 1). Only the lung organ exhibited gross abnormality, characterized by the pus accumulation at the right caudal lobes in T2 sheep (Figure 1). In addition, there were mild to moderate histological lesions in the lung, liver, kidney, jejunum, and ileum in sheep within Treatment 2.

Table 1. Gross morphology of sheep fed with fresh *P. purpureum,* fresh *B. decumbens,* & ensiled *B. decumbens.*

Organs	Treatments			p-value
	T1	T2	T3	
Width (cm)				
Heart	7.0 ± 0.1^{b}	7.9 ± 0.1^{a}	7.2 ± 0.1^{b}	<0.01
Lung	16.3 ± 0.3^{b}	19.2 ± 0.2^{a}	18.0 ± 0.9^{c}	<0.01
Liver	20.8 ± 0.2	21.3 ± 0.2	20.5 ± 0.4	0.11
Kidney	4.4 ± 0.1	4.5 ± 0.1	6.7 ± 0.1	0.39
Spleen	9.1 ± 0.1^{b}	10.6 ± 0.3^{a}	9.8 ± 0.3^{c}	<0.01
Weight (g)				
Heart	127.25 ± 0.05	136.25 ± 0.02	133.00 ± 0.07	0.52
Lung	263.17 ± 0.01^{c}	349.23 ± 0.01^{a}	305.66 ± 0.01^{b}	<0.01
Liver	371.75 ± 0.03^{c}	446.25 ± 0.01^{a}	427.00 ± 0.06^{b}	<0.01
Kidney	69.25 ± 0.01^{b}	75.75 ± 0.01^{c}	81.75 ± 0.01^{a}	<0.01
Spleen	43.00 ± 0.01^{b}	49.00 ± 0.01^{a}	49.25 ± 0.01^{a}	<0.01

Note: All values were expressed as mean ± SEM; $^{a, b, c}$ values with superscript within the same row are significantly different at p<0.05. T1: Fresh *P. purpureum* (control group), T2: Fresh *B. decumbens*, T3: Ensiled *B. decumbens.*

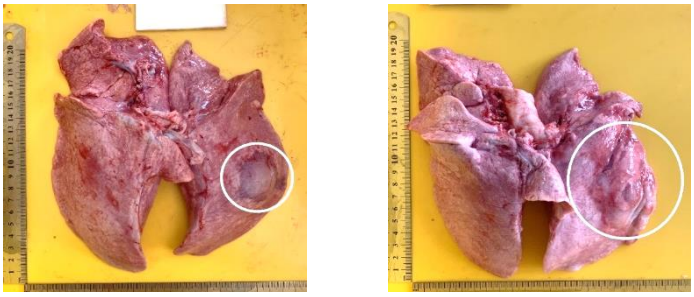


Figure 1. Pus accumulation on the caudal lobe of the right lung of sheep in Treatment 2 in two different sheep (white circle).

Conclusion

In general, feeding ruminants with ensiled *B. decumbens* has been reported to be more advantageous for the animal compared to feeding with a diet of fresh *B. decumbens*. This study can be utilized for further investigation of the influence of *B. decumbens* on small ruminants specifically in sheep.

Acknowledgment

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Category: Animal Health and Production System

SOCIAL DOMINANCE EFFECTS ON MILK PRODUCTION, BEHAVIOUR, AND PHYSIOLOGICAL PERFORMANCE OF LACTATING DAIRY COWS

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Introduction

Dairy cattle establish social hierarchies through dominance, impacting resource allocation and competitive advantage (Hermann, 2017). Dominant cows control resources, affecting productivity, while subordinates experience competition-related stress (Phillips and Rind, 2002). Social hierarchy influences milk production, feeding, and resting behaviour, along with their physiological performance (Moberg, 1991; Judd et al., 1994). Increases in cortisol levels could reflect social stress, while estrogen influences social behaviour (Goymann et al., 2001; Kavaliers et al., 2004a). Understanding these dynamics can improve farm management and animal welfare under varying environmental conditions. The objectives of this research were to investigate the effects of social dominance on milk production, feeding and resting behaviour, and cortisol, estrogen, and progesterone levels of lactating dairy cows under the Malaysian feedlot system.

Keywords: Social dominance, behaviour, milk production, welfare, dairy cows

Materials and Methods

A total of 50 lactating Friesian × Jersey cows, managed under Farm Fresh management system at UPM, Serdang, Selangor, were used in this study. Cows' dominance value (DV) was calculated based on all observed cases of social interactions over 14 recording days indicating dominance and submission between cows (Beilharz & Mylrea, 1963). A total of 36 cows that have been attributed DV and classified as dominant (D; top 12 cows), mid-ranking (M; mid 12 cows), and subordinate (S; bottom 12 cows) according to their ranking in the top, the middle and bottom half of the social hierarchy of DV were observed for feeding and resting behaviours over 7 days for 8 hours from 0800 to 1600 h. Milk yield was recorded manually during morning and evening milking during behavioural observation days, and milk samples were collected on day 1 for cortisol, estrogen, and progesterone concentration level determination with the aid of commercial ELISA kits. Pearson's correlation coefficient and one-way ANOVA were used to analyse relationships between DV and all parameters using SAS statistical package (SAS Institute Inc., 2005).

Results and Discussion

Table 1. The effects of social dominance on milk yield, behaviour, cortisol, estrogen, and progesterone level of lactating dairy cows according to social group (D = dominant; M = mid-ranking; S = subordinate).

Parameters	D		M		S		P-value
	Mean	SEM	Mean	SEM	Mean	SEM	
Milk yield (L/day)	19.7	1.1	21.8	1.0	17.4	1.0	0.126
Feeding (mins/8 h)	167.4	7.5	169.6	17.0	171.1	9.4	0.974
Drinking (mins/8 h)	10.2	1.1	10.6	2.7	9.5	1.7	0.920
Ruminating (mins/8 h)	119.3^{a}	3.6	93.9^{b}	11.1	96.3^{b}	6.1	0.037
Standing (mins/8 h)	337.2	10.7	299.7	30.7	320.2	11.7	0.399
Lying (mins/8 h)	202.9	10.7	191.7	20.6	219.8	11.7	0.407
Cortisol (ng/ml)	2.3^{b}	0.4	3.2^{a}	0.2	3.4^{a}	0.2	0.026
Estrogen (ng/ml)	5.6	1.1	5.5	1.4	4.8	0.9	0.876
Progesterone (ng/ml)	3.1	0.4	2.5	0.2	2.7	0.2	0.506

($^{a-b}$) Means of the same variable in the same row with different subscripts differ for one factor LSD

Study found that dominant cows exhibited longer rumination duration, suggesting longer resting time than subordinate cows. Rumination is an indicator of resting behaviour (Lindgren, 2009). Presumably, dominant cows are able to eat in preferred time and place, fill up more quickly, and start ruminating in addition to harvesting more forage per bite and unit of time (Gregorini, 2012; Ungerfeld et al., 2014). This highlights competition for resources in intensive farming systems, with lower-ranking cows experiencing shorter resting time than their dominant herd members. The losses experienced by mid-ranking and subordinate cows in the social interactions, may contribute to their social stress which were reflected in their high cortisol level. This is in agreement with Williamson et al. (2019), where they found lower ranking individuals had significantly higher plasma corticosterone levels than dominant individuals. Although there was no significant difference found, however numerically, dominant cows have higher progesterone levels, suggesting better reproductive states in higher-ranking cows than lower ranking cows. These findings underscore the impact of social dominance on behavioural patterns and stress levels in dairy cows. Therefore, future study addressing social dynamics in group management may alleviate stress and improve reproductive performance in lower-ranking cows, benefiting both animal welfare and production outcomes.

Conclusion

Dominant cows have longer resting time than subordinate cows, and lower ranking lactating dairy cows experience higher social stress which are reflected in their high cortisol level.

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Category: Animal Biotechnology and Reproduction

UNDERSTANDING THE PERSPECTIVES ON THE USE OF ASSISTED REPRODUCTIVE TECHNOLOGIES AMONG CATTLE FARMERS IN PAHANG, MALAYSIA

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Introduction

Farmers often rear cattle of local breeds that require minimum inputs in terms of feed quality, disease resistance and the ability to withstand extreme environmental changes. However, the performance of Malaysian indigenous cattle breeds, namely Kedah-Kelantan breed, is at present impacted by inbreeding, which results in low productivity and reproductive efficiency (Abdelwahid et al., 2019; Islam et al., 2021). In 2016, the Department of Veterinary Services (DVS) formulated a Strategic Breeding Action Plan spanning from 2022 to 2030 for Malaysia's livestock sector. This plan prioritizes key strategic objectives, such as bolstering the advancement of native breeds and hybrid varieties, improving the crossbreeding of *Bos taurus* and *Bos indicus* cattle, expanding livestock breeding services, enhancing livestock population and genetics, implementing assisted reproductive technology (ART) in livestock breeding, establishing effective stratified livestock breeding system, devising frameworks and protocols for field reproductive services, and augmenting the expertise of officers involved in livestock breeding services (Saifullizam et al., 2023). In Pahang, there was a decline in the cattle population from 154,721 to 149,362 between 2020 and 2023. Hence, this initial study aims to gather fundamental data on the utilization of assisted reproductive technology and identify constraints to its adoption among cattle keeping farmers in Pahang.

Keywords: assisted reproductive technology (ART), artificial insemination (AI), technology adoption, livestock production

Materials and Methods

This study focuses on 11 districts of Pahang including Bentong, Raub, Bera, Lipis, Jerantut, Kuantan, Maran, Pekan, Temerloh, Rompin and Cameron Highlands (Figure 1). The survey was conducted from November 2022 to May 2023. The survey locations for each district were based on the service given by VetEC Tenggara, respectively. Farmers' perceptions of assisted reproductive technology were gathered through structured questionnaires survey. Statistical analysis was performed using SPSS version 23 to assess the mean and standard deviation adoption under varying socioeconomic factors. In total, 129 persons participated in the survey of which different ages, gender and ethnicity. The participating farmers were asked about their perceptions on artificial insemination technology and the willingness to adopt the technology.

Results and Discussion

Table 1 presents the prevalent factors that influenced the application of artificial insemination (AI) among farmers in Pahang. Overall, traditional breeding was the major breeding practice (65.9%) among cattle keeping farmers in the study areas, with 47.2% of them keeping indigenous Kedah-Kelantan cattle breed for breeding purposes. However, 60.5% of the respondents believed that artificial insemination is better than natural mating. The main reasons cited by farmers for not utilizing AI included limited access to veterinary extension services (60.5%), insufficient understanding of cattle behavioral heat signs (33.2%), lack of awareness regarding existence of AI technology (45.7%) and financial constraints (43.1%). However, it is worth noting that 94.6% of farmers expressed interest in adopting AI technology, believing that its implementation could yield satisfactory profits (73.6%).

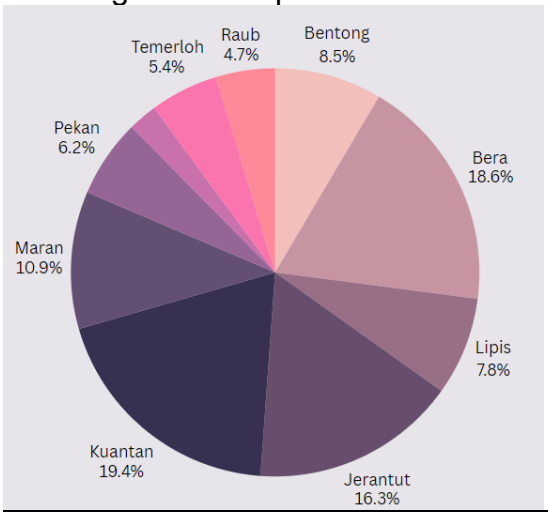


Figure 1. Pahang districts surveyed in the year of 2022-2023.

Table 1. Prevalent factors that influenced the application of artificial insemination (AI) among farmers in Pahang.

Using artificial insemination (AI) service			
Yes		34.1	
No		65.9	
Statement	**Percentage**	**Mean**	**Std. Deviation**
Factors affecting artificial insemination (AI) adoption			
Q1. Lack of knowledge on cattle behavioral heat sign.	33.2	1.26	0.44
Q2. Limited AI service availability is an obstacle in adopting technology.	60.5	3.71	1.13
Q3. Not familiar/aware the existence of AI.	45.7	3.83	0.99
Q4. Implementation of assisted reproductive technology involved high cost.	43.4	3.65	0.99
Willingness to adopt artificial insemination (AI) technology			
Q5. I am interested to apply AI technology.	94.6	1.39	0.49
Q6. I have a thorough record of my cattle's breeding and nutrition.	65.9	1.34	0.48
Q7. I believe that by applying AI, it gives satisfactory profit.	73.6	1.46	0.50
Q8. I believe AI has a higher conception rate than natural mating	60.5	4.39	0.76

Conclusion

The utilization of AI among cattle farmers in Pahang is currently low and requires attention. The application remains restricted due to the limited availability of artificial insemination services and lack of knowledge among farmers. It is essential to address barriers such as access to information, affordability and concerns about effectiveness in order to encourage wider adoption. Collaborative efforts between policymakers, veterinary extension services and farmers are essential to facilitate the application of the technology into daily practices, which will ultimately improve productivity and reproductive efficiency of the cattle industry.

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Category: Animal Biotechnology and Reproduction

COMPARATIVE ANALYSIS OF DILUTION STEP TECHNIQUES ON THE QUALITY OF CHILLED AND POST-THAWED JERSEY-FRIESIAN BULL SEMEN

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Introduction

The Jersey-Friesian breed, renowned for its milk production traits, represents a valuable genetic asset in the dairy industry. Preserving their semen optimally is crucial for enhancing breeding programs and maintaining genetic diversity. The success of semen freezing depends on factors such as diluent type, dilution, and freezing techniques. While Tris egg yolk-based extender is commonly used, debate surrounds the various dilution methods due to raising concerns on glycerol potential toxicity when added at room temperature (García et al., 2012; Sharafi et al., 2022). The one-step dilution is practical, mixing the extender with semen at room temperature before freezing, whilst the two- and three-step method involves adding glycerol in a separate step. The different dilution techniques used are not yet scientifically compared on Jersey-Friesian bull semen. Therefore, it is necessary to evaluate the most appropriate and practical dilution techniques in an effort to improve the quality of frozen semen for Jersey-Friesian bull. Thus, this study was designed to determine the effect of one-step, two-step and three-step dilution technique on chilled and post-thawed quality of Jersey-Frisian bull semen.

Keywords: Bovine, Jersey-Friesian, Dilution step, Semen quality

Materials and Methods

Semen were collected from two four-year old Jersey-Friesian bulls. Semen that had >70% motile sperm and <20% sperm abnormality was divided into three tubes and diluted with Tris egg yolk-base extender (TEY) using three different dilution techniques: One-step dilution (100% TEY with 12% glycerol) diluted at room temperature (RT), two-step dilution (50% TEY without glycerol at RT and 50% TEY with 12% glycerol after 2h equilibrated at 4 °C); and three-step dilution (50% TEY without glycerol at RT and 50% TEY with 12% glycerol added twice at 1h and 1.5h at 4 °C). The diluted semen was loaded into 0.25 mL mini straws, place at 10cm above level of liquid nitrogen vapor for 9 minutes and then plunged into liquid nitrogen. Sperm motility, viability, membranes integrity, and normal morphology were evaluated after 4h equlibrated at 4 °C and after semen straws were frozen for 24h.

Results and Discussion

Table 1. Sperm traits of Jersey-Friesian bull chilled semen in the tris egg yolk-based extender on different dilution step techniques.

Sperm Traits	Dilution techniques		
	One-step	Two-step	Three-step
Total motility (%)	61.40 ± 9.84 [a]	72.55 ± 11.65 [b]	50.17 ± 6.08 [c]
Viability (%)	80.21 ± 5.12 [a]	83.72 ± 4.74 [a]	70.45 ± 10.42 [c]
Normal morphology (%)	80.14 ± 3.45 [a]	85.39 ± 5.27 [b]	72.15 ± 11.07 [c]
Membrane integrity (%)	76.15 ± 12.16 [a]	82.08 ± 8.06 [b]	79.33 ± 12.75 [b]

Data show all mean±SEM. Difference superscripts in the same row indicate significant differences ($p<0.05$).

In this study, the different dilution process exhibited a noteworthy impact, revealing that the sperm quality of chilled and post-thawed Jersey-Frisian bull semen in extenders, utilizing a two-step dilution approach, was notably better compared to both one-step and three-step dilutions. The percentage of total motility and normal morphology of semen subjected to two-step dilution was significantly higher compared to one-step and three-step dilutions for both chilled (Table 1) and post-thawed (Figure 1) samples. The inclusion of glycerol at 4°C during the dilution process resulted in superior outcomes compared to adding glycerol at room temperature. This is attributed to the reduced permeability of sperm cell membranes to glycerol at 4°C-5°C, thus minimizing the toxic effects of glycerol (Jha et al., 2019).

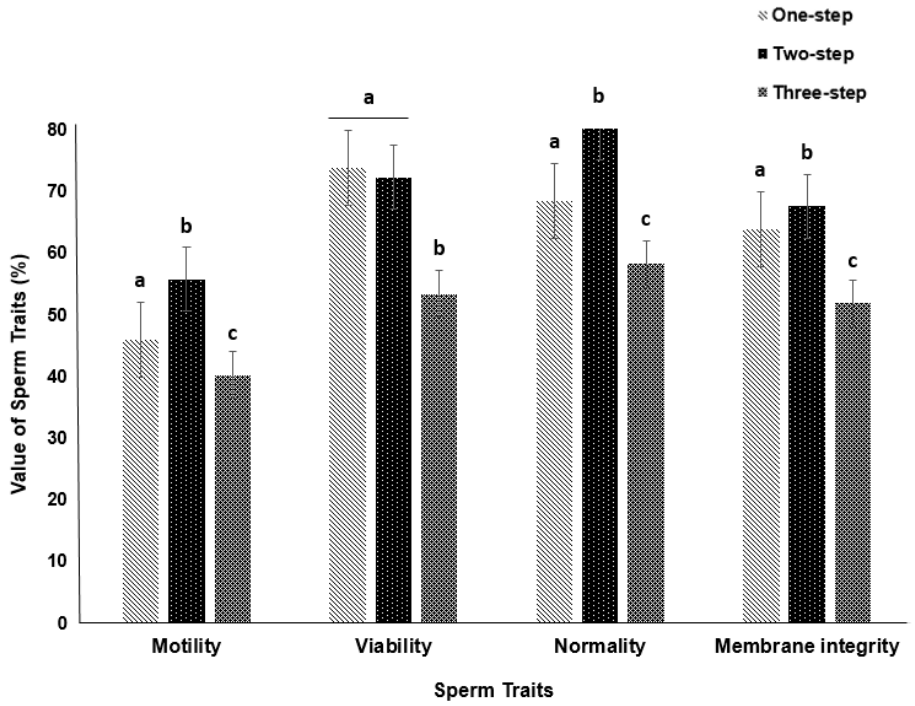


Figure 1. Sperm traits of post-thawed Jersey-Friesian bull semen in the tris egg yolk-based extender of different dilution step techniques. Bar with different letters differed significantly ($p<0.05$).

Diluting semen using a three-step technique significantly diminishes semen quality. Total motility, viability, and normal morphology of three-step were notably lower compared to one and two-step approaches in chilled semen, while all sperm parameters for three-step dilution were poorer compared to other groups for post-thawed semen. The gradual dilution technique induces repeated temperature fluctuations (Almeida et al., 2015) due to the opening and closing of the tube containing the semen. Moreover, additional extenders induce a change in osmotic pressure. The two additions of Part B extender (in three-step dilutions) not only prompt temperature changes but also disrupt the extender's osmotic pressure twice. These unstable temperature and osmotic pressure conditions subject sperm to stress, potentially leading to molecular alterations, DNA damage, changes in the plasma membrane, and increased reactive oxygen species (ROS) (Meyers et al., 2005; Mannucci et al., 2022). These factors collectively contribute to decreased motility, consequently diminishing overall sperm quality.

Conclusion

Based on the study results, we suggest a two-step dilution for the tris egg yolk-base extender for the production of chilled and frozen Jersey-Friesian bull semen.

Acknowledgement

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Category: Animal Biotechnology and Reproduction

EFFECT OF FLUSHING USING RUMEN-PROTECTED FAT ON REPRODUCTIVE PERFORMANCE OF BOER GOAT

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Introduction

Providing supplemental feeds with rumen-protected fat to does, three weeks before the breeding season, will increase the ovulation and kidding rates when the body condition score (BCS) is between 2 and 3.5. Poor BCS with between 1 and 2 scores will have lower conception rates, reduced multiple births, and metabolic disorders. (Selmi et al., 2020). One of the rumen-protected fats commonly fed in ruminant rations is palm fatty acid distillates (PFAD). The function of PFAD as rumen-protected fat is to protect the beneficial unsaturated fatty acids from microbial biohydrogenation (Kumar, 2017), increasing energy density. This study aimed to evaluate the effects of flushing using PFAD at three inclusion levels on the body weight (BW), BCS and reproductive performance of Boer goat.

Keywords: PFAD, flushing, Boer goat, BCS, reproductive performance

Materials and Methods

The experiment was done in MARDI Kluang, Johor. Eighty healthy Boer goats aged from 2.5 to 3.5 years old, with a body weight range from 25 to 30kg, were randomly allocated equally into four treatment groups. The treatments consisted of 0%, 3.5%, 5.0%, and 10.0% inclusion of PFAD in the concentrated feed. The concentrate and fresh-cut *Bracharia humidicola* grass were given based on the estimated dry matter intake (DMI) at 3.0% of body weight. The flushing process started 21 days before the introduction of the bucks. The does were weighed and their BCS were recorded on a rating scale from 1 to 5 (1:skinny,2: thin, 3: good, 4: fat and 5:obese) at the initial and final feeding trial period. The reproductive parameters, namely conception rate and litter size were also recorded. Data were analyzed using SAS ver 9.4. The differences in parameters between treatment groups were analysed using the GLM model.

Results and Discussion

The nutrient content of dietary treatments and the reproductive performance parameters are shown in Table 1. The initial BCS of control and 5% treatment were significantly different ($p<0.05$). However, the final BW and BCS of the animals were not affected ($p>0.05$) by the treatments, which is similar to a previous report indicating that body weight gain was not affected by rumen-protected fat (Behan et al., 2019). In addition, each animal in every treatment showed an increment in the final BCS, which

ranged from 2 to 3 body scores. On the other hand, there were no differences (p>0.05) on the reproductive performance of Boer among the dietary treatments. Although insignificant, conception rate and litter size were numerically higher in all groups that received rumen-protected fat in their diet. The results of this study were consistent with the findings that the use of rumen-protected fat during flushing at a short-term period increased the reproductive performance of the Zaraibi goat. (Hafez, 2011).

Table 1. Nutrient content, BW, BCS, and reproductive performance of does between the treatments.

Parameters/ Treatments	0 (control)	3.5%	5.0%	10.0%
Dry Matter (DM) (%)	89.75±0.35	87.99±0.11	87.99±0.02	88.78±0.16
Ether Extract (EE)(%)	3.6±0.1	3.8±0.05	3.9±0.06	4.2±0.14
Gross Energy (GE) (MJ/Kg)	14.5±0.01	14.3±0.02	14.3±0.01	14.4±0.07
Body weight and BCS				
Initial				
BW (kg)	29.4±1.46	30.4±1.4	30.2± 1.18	28.5± 1.51
BCS	2.3 ±0.14^{b}	2.4±0.12^{ab}	2.8 ±0.12^{a}	2.4±0.13^{ab}
Final				
BW (kg)	34.4 ±1.58	35.9 ±1.83	36.0 ±1.28	33.3 ±1.62
BCS	2.8 ± 0.15	3 ± 0.19	3.2 ± 0.1	2.9 ± 0.13
Reproductive Performance				
Conception Rate (%)	55	64.7	70	60
Litter Size	1.27 ±0.12	1.36 ±0.11	1.29 ±0.09	1.33 ±0.09

^{a,b,c} means having different superscripts in each row are significantly different ($p < 0.05$)

Conclusion

The inclusion of PFAD as rumen-protected fat in animal feed during flushing before breeding may have some effects on the BW, BCS, and reproductive performance of does. Further research is needed to determine the impact of rumen-protected fat in animal feed on animal production.

Acknowledgement

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Category: Animal Biotechnology and Reproduction

MOLECULAR CHARACTERIZATION OF VERY VIRULENT INFECTIOUS BURSAL DISEASE STRAIN FROM VACCINATED VILLAGE CHICKEN FARM

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Introduction

Infectious Bursal Disease (IBD) caused by the Infectious Bursal Disease Virus (IBDV) remains a significant concern for the poultry industry worldwide despite vaccination efforts (Aliyu *et al.,* 2021). The IBDV potentially invades immature lymphocytes, causing immunosuppressive effects that lead to secondary viral and bacterial infections (Michel *et al.,* 2017, Jiang. *et al.,* 2021). Two IBDV serotypes are recognized, with only serotype I being pathogenic to chickens. The serotype 1 strain has varying antigenicity and pathogenicity which are classified into classical, very virulent, and antigenic variants (Aliyu *et al.,* 2021). The viral genome consists of two segments: A and B. Segment A encodes precursor polyproteins, while segment B encodes RNA-dependent RNA polymerase. Both segments contribute to the virulence of virulent viruses (Michel *et. al*., 2017). The VP2 protein, the major capsid protein, carries the protective antigen and has antigenic properties (Xu *et. al*., 2015). Variations in this region can significantly affect the vaccine's effectiveness (Aliyu *et al.,* 2021). Genetic mutations and genome reassortment events occur typically in the IBDV (Letzel *et al.,* 2007, Aliyu *et al.,* 2021). This situation can lead to changes in virulence and antigenicity that make vaccinations less effective (Alkie *et al.,* 2016). Therefore, this study was performed to compare vaccine strains in field samples and to identify mutations associated with virulence reversion.

Keywords: Infectious Bursal Disease, Infectious Bursal Disease virus, VP2

Materials and Methods

In February 2015, a bursal sample and a live IBDV vaccine were used in a commercial village chicken farm were sent for laboratory testing at Veterinary Research Institute, Ipoh, Malaysia. The bursa tissue sample and vaccine were further processed prior to molecular detection. RNA was extracted using Trizol LS (Invitrogen, USA). Then, Reverse Transcriptase (RT)-PCR was conducted in T100 thermal cycler (Biorad) by using a specific primer based on the partial VP2 gene (Xu *et. al.,* 2015). The amplified PCR products were cut from the gel and sent for Sanger sequencing (Apical Scientifics(M) Sdn Bhd). The nucleotide sequence was edited using Seqman (DNA Star). The primer used in DNA sequencing are the same as those used in RT-PCR amplification. The sequences were aligned using ClustalW multiple alignment in Bioedit Sequence Alignment Software (Version 7.2.1). The phylogenetic tree was constructed using the neighbor-joining method in Molecular Evolutionary Genetic

Analysis (MEGA) Version 6.0 with up to 1000 bootstrap replicates. Twenty-four (24) published sequences were downloaded from Genbank for comparison and phylogenetic analysis (http://www.ncbi.nlm.nih.gov/genbank/).

Result and Discussion

The RT-PCR confirmed that both a bursal sample and vaccine were positive for IBDV and gel electrophoresis showed a specific band at 1442 bp. Phylogenetic trees were constructed based on the aligned nucleotide sequences of the reference IBDV strains retrieved from GenBank and the partial *VP2* gene (hypervariable region) of the study strains. The phylogenetic tree analysis revealed that the sequences from the 1881/2015/Malaysia bursal sample was grouped into genogroup 3 and characterized by a very virulent IBDV (vvIBDV) strain. Meanwhile, the vaccine IBDV sample was grouped in genogroup 1 alongside other classical strains and commonly used as a vaccination for IBDV.

The *VP2* gene consists of hypervariable region antigenic determinant of IBDV for molecular characterization of the virus (Aliyu *et al.,* 2021). According to Xu *et. al.,* 2015 and Aliyu *et al.,* 2021, the typical genetic hallmark of amino acids characteristic vvIBDV is similar at position A222, I256, I294 and S299 of VP2. Four deduced amino acids in the 1881/2015/Malaysia field samples exhibited identity to the vvIBDV pattern. In contrast, the vaccine sample showed S222, I256, L294, and N299 amino acid patterns which is difference to field samples. Besides that, the amino acid at position 222 is an important residue due to location at the tip of the P_{BC} loop and change at position 222 could result in vaccine failure (Aliyu *et al.,* 2021). As mentioned by Letzel *et al.,* 2007, mutations in residue 222 were discovered to be involved in immunological evasion, viral replication, and pathogenicity of the virus IBDV.

Conclusion

In conclusion, the present study describes the 1881/2015/Malaysia IBDV field samples demonstrated a very virulent strain with an antigenic drift compared to vaccine samples based on the sequences and phylogenetic analyses. This genetic information could be useful to control the disease in Malaysia poultry industry.

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Category: Animal Breeding and Reproduction

GENOME-WIDE RELATIONSHIPS BETWEEN MALAYSIAN LOCAL GOAT BREEDS UTILIZING SNPS ASSOCIATED WITH FERTILITY-RELATED GENES

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Introduction

Genomic selection using molecular markers such as microsatellites (SSRs) and single sequence markers (SNPs) are widely used in the study of genetic diversity, genetic populations, evolutionary relationship patterns and breed detection in livestock. It can also help in selecting livestock with the characteristics required by the industry, such as growth rate or good fertility (Mishra et al., 2017). Numerous genes have been reported to be associated with fertility traits involving many reproductive physiological aspects such as ovulation, oocyte maturation, fertilization, ovarian follicular development, fecundity, and litter size (Saleh et al., 2022). In this study, SNP molecular markers related to fertility were utilized to analyse populations as well as for gene identification and gene expression related to fertility in goats.

Keywords: Fluidigm, Single nucleotide polymorphisms (SNP), genetic characterization, local goats

Materials and Methods

A total of 95 local goats located in MARDI Kluang Station were used in this study with the following breakdown: Katjang-Boer hybrid goats (n:57); two Boer goat populations (MARDI Kluang old: (n=15); new (n=20) and Katjang (n=3). Genomic DNA was extracted from blood samples using Wizard® Genomic DNA Purification Kit with modifications according to the manufacturer's protocol.

Candidate genes related to reproductive, fertility and litter size traits were obtained from the bibliomic search and public databases (GWAS Atlas & Animal QTL). Functional annotation was then performed using STRING database to obtain the gene ontology terms and pathways related to reproductive and fertility traits. The SNPs were identified by querying the Goat Ensembl database (http://asia.ensembl.org/Capra_hircus /Info/Index). Functional annotation of SNPs was performed using Variant Effect Predictor (http://asia.ensembl.org/Capra_hircus /Tools/VEP) and filtered with missense and deleterious effects for further selection.

The Fluidigm 96.96 Dynamic Array™ IFC was used to genotype 95 goat samples against 96 SNPs. SNP quality controls were applied to obtain high-quality SNPs using snpReady by following these parameters: (i) only the animals with call rate higher than 95% were included, and (ii) SNPs with a minor allele frequency (MAF) of less than 0.01 were removed. The remaining missing SNPs were imputed with the Wright method using snpReady. Genome-wide relationships between individuals were estimated using a unified additive relationship (UAR) matrix using snpReady. snpReady was used to calculate the basic statistics consisting of individual counts, observed heterozygosities (Ho), expected heterozygosities (He), polymorphic information content (PIC), MAF, and the inbreeding coefficient (Fis) per locus and population

Results and discussion

101 SNPs containing 60 candidate fertility-related genes, spanning from chromosome 1 to chromosome 24, including one scaffold (LWLT01000021.1), were identified from the Ensembl Variant Database. SNPs chosen were related to reproductive traits, fertility traits, oocyte meiosis process, litter size, birth weight in goats, pubertal development and reproductive ability pathways. Functional enrichment of these candidate genes revealed 17 genes (*AMHR2, GDF9, KCNU1, STK3, PRP6, RSPH6A, ESR1, BMP15, BMPR1B, LEP, SYCE3, AR, PRP1, LRRC52, ANTR1, FSHR, GLRB*) and were associated with reproductive and fertility ontology terms. Out of the 96 SNPs utilized in this study, 55 SNPs (57.3%) were polymorphic, while 40 SNPs (41.7%) were monomorphic. When further analysed for MAF < 0.01 and call rate >=95%, 45 of the 95 SNPs can be categorised as high-quality SNPs. When comparing the three breeds utilizing the 45 SNPs, the PIC ranged between 0.14- 0.19, MAF between 0.13 – 0.17, and the Ho ranged between 0.25 – 0.26 (Table 1).

Table 1. Population indexes by breed (Boer, Katjang & BK) using 45 SNPs

	Boer	Katjang	BK
GD (Nei's genetic diversity)	0.23	0.17	0.21
PIC (polymorphic information content)	0.19	0.14	0.17
MAF (minor allele frequency)	0.17	0.13	0.16
Ho (observed heterozygosity)	0.26	0.26	0.25
F (inbreeding coefficient)	-0.18	-0.46	-0.12

BK - Katjang-Boer hybrid goats

Conclusion

Genotyping of goat SNPs were successfully performed using the Fluidigm system. This genotyping platform provides outstanding data quality and efficient workflow. Forty-five polymorphic SNPs identified in 95 individuals belonging to three local goat breeds could be used as markers in future genomic-based breeding schemes. More downstream analysis will be conducted using these 45 SNPs, such as trait-association markers.

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Category: Animal Breeding & Genetics

EFFECT OF CLOPROSTENOL AND DINOPROST TROMETHAMINE INJECTION ON CONCEPTION RATE OF LOCAL BEEF CATTLE

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Introduction

Efficient reproduction plays a crucial role in achieving optimum production in ruminant animals. Timely and synchronized reproductive events lead to more predictable production cycles, reducing labor and management costs. Estrous synchronization programs are designed based on the specific needs and goals of the livestock operation. Estrous synchronization and fixed-time artificial insemination (FTAI) offer several benefits in beef cattle production. PGF2α (Prostaglandin F2α) is a major uterine luteolytic prostaglandin and has been identified as the key luteolytic hormone in many species. In ruminants, through multiple mechanisms, endometrial PGF2α is the luteolytic hormone that causes functional and structural luteolysis. (Arosh JA et. al., 2016). Numerous studies have been done to evaluate the effectiveness of various $PGF_{2\alpha}$ products, but no study on local beef cattle in Malaysia under intensive systems has been reported. The objective of this study is to evaluate the efficacy of cloprostenol and dinoprost tromethamine on conception rates in local beef cattle in Malaysia.

Keywords: estrus synchronization, Cloprostenol, dinoprost tromethamine, Brakmas cattle

Materials and Methods

19 Brakmas cows were synchronized using a 7-day CIDR, GnRH, and PGF2α treatment. Each cow was inserted CIDR for 7 days, and on the day of CIRD in, 2.5 ml of GnRH was administered intramuscularly. On day 7, CIDR was removed, and 2 / 5ml of PGF2α was injected intramuscularly. All cows were given 2.5 mL of GnRH intramuscularly just before fixed-time AI (FTAI). Artificial insemination (AI) was done 65 hours after the PGF2α injection. Pregnancy to AI was diagnosed via transrectal palpation 60 days after artificial insemination. We analyzed data using IBM® Statistical Package for Social Sciences (SPSS) software version 27.0. Univariable analysis was conducted to determine the association between the conception rate and presumed factors using a Chi-square test at a 5% level of significance.

Results and Discussion

Table 1: Table of pregnancy rate by treatment group of Brakmas cattle.

	No. of inseminated	***No of Conceive***	***Conception rate***	***X^2***	***P value***
Treatment					
Cloprostenol	10	2	20.0%	1.310[a]	0.252
Dinoprost tromethamine	9	4	44.4%		

The result revealed that six cows out of 19 were conceived, which indicates 31.6% in this study. 20% of cows in the Cloprostenol treatment group were pregnant, and 44.4% of cows in the Dinoprost tromethamine treatment group were pregnant. According to the result, there were no significant differences in pregnancy rate when using two different hormones in the oestrus synchronization protocol Although active ingredients and their properties differ between the two products, both dinoprost tromethamine and cloprostenol induce luteolysis by triggering a cascade of endogenous events that ultimately lead to the regression of the corpus luteum (CL). According to the study done by Salverson et al., 2002, there was a lack of difference in the efficacy of dinoprost tromethamine and Cloprostenol to induce estrus in beef heifers. It can be related to the current study, in which there is no significant difference in pregnancy rates when using dinoprost, tromethamine, and cloprostenol in the oestrus synchronization protocol.The cost of Cloprostenol in this study was a bit higher as compared to 5 mg of dinoprost tromethamine, which is RM17.20 and RM11.01 per animal, respectively.

Conclusions

Treatment (dinoprost tromethamine vs. cloprostenol) did not affect estrus timing, pregnancy to AI, or final pregnancy rates. These results indicate breeders can utilize either dinoprost tromethamine or cloprostenol in their synchronization protocol to perform artificial insemination in beef cattle breeding programs. Utilization of dinoprost tromethamine showed less cost as compared to Cloprostenol.

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Category: Animal Breeding & Genetics

ANCESTRAL POPULATIONS: IMPACT ON CROSSBRED PERFORMANCE

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Introduction

Purebreds are bred from the same breed parents, ensuring the propagation of specific traits, while crossbreds exhibit a blend of characteristics. Intentional breeding presents challenges and benefits, with crossbreeding often utilized to overcome inbreeding depression and enhance adaptability to local environments (Leroy et al., 2016). The study delves into the dairy industry's exploration of crossbreeding, focusing on the Holstein breed's pivotal role and the development of 3-breed rotational crossbreeding systems like ProCROSS (Randers, Denmark & Roulans, France and Grazecross (Heins et al., 2011). These systems aim to capitalize on heterosis but pose challenges in understanding the impact of reference populations on genomic ancestry estimation (Dechow & Hansen, 2017). The study's objectives include characterizing genomic ancestry, comparing pedigree and genomic estimations, and correlating ancestry with production and health traits. Results emphasize the influence of reference populations on breed composition estimation and highlight the need for careful interpretation of admixture results in crossbreeding programs.

Keywords: Crossbred, admixture, performance traits, breed ancestry.

Materials and Methods

The datasets used in this study were sourced from the University of Minnesota West Central Research and Outreach Center (UMN) dairy herd in Morris, Minnesota, USA. These datasets comprised 150K Single nucleotide polymorphisms (SNP) genotypes of 378 ProCROSS and 229 Grazecross cattle, along with information on major production traits (Milk, Fat, and Protein Yield) and one health trait (Somatic Cell Score). Both ProCROSS and Grazecross herds were produced through rotational crossbreeding involving Viking Red (VKR), Holstein (HOL), and Montbeliarde (MON) breeds for ProCROSS, and VKR, Normande (NOR), and Jersey (JER) for Grazecross. Quality control measures were applied to SNP data, and principal component analysis (PCA) was conducted to assess population structure. Genomic breed composition was estimated using ADMIXTURE software, revealing insights into the admixed populations and their ancestral breeds.

A predictive model was developed using linear regression in R, incorporating genomic breed composition (GBC), breed generation (Gen), and sire breed (Sire) as covariates.

Genomic breed composition was obtained from Admixture analysis. The effect of different variables on admixed animals' performance was assessed using this model. Subsequently, animals from extreme performance tails (top 20% high-performance and lowest 20% low-performance) were evaluated for differences in genomic breed composition using Student's t-test. Normality of each group was determined using the Shapiro Test, and associations were assessed based on p-values. The significance threshold was set at $p < 0.05$.

Results and Discussion

The correlation between genomic breed composition and four traits was examined, revealing significant effects of major breeds on production traits in ProCROSS and health traits in Grazecross. In ProCROSS, HOL and MON composition were significantly higher in animals with higher production traits, reflecting their contributions to milk yield and milk solids. In contrast, in Grazecross, NOR and VKR showed significant differences related to health traits, aligning with the breed's characteristics for efficient grazing and higher fertility and health performance. The influence of JER ancestry in Grazecross, not present in ProCROSS, may explain variations in VKR correlation to health traits. The analysis also highlighted the significant role of heterosis, particularly in animals from the sixth generation, supporting the advantages of a 3-breed rotational crossbreeding system in retaining high heterosis levels.

Conclusion

The study aimed to assess how different ancestral populations impact on crossbred cattle performance. Despite significant differences in breed composition estimates from admixture compared to pedigree estimates, both estimates showed similar relationships between breed composition and performance traits. HOL, MON, NOR, and VKR were all found to be equally important for performance in both ProCROSS and Grazecross. It emphasizes the importance of selecting appropriate reference animals for admixture analysis to accurately interpret population structure and relationships. Caution is advised when using admixture output in breeding programs, as the choice of reference populations can impact the estimation of breed-specific effects in admixed animals.

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Category: Animal Breeding & Genetics

A PRELIMINARY SCREENING OF A1 AND A2 SNP IN DAIRY CATTLE IN MELAKA

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Introduction

A1 and A2 variants can be distinguished by the type of amino acid located at position 67 in the beta-casein chain. In A1 variant, amino acid located at position 67 is histidine, while the amino acid found in A2 variant is proline (Bhat et al. 2017). Remarkably, the reason behind the amino acid differences in both variants is due to a single substitution of nucleotide in the *beta-casein* gene.

During digestion, milk proteins are hydrolysed and bioactive peptides are released, one of which is BCM-7, an opioid peptide with activities similar to morphine (Chitra 2021). Proline in A2 variant prevents the release of BCM-7 (Sharma et al. 2013). However, histidine in A1 variants releases BCM-7 four times higher as compared to A2 variant (Chitra 2021).The presence of BCM-7 in A1 milk is associated with the risk of ischemia heart disease, diabetes mellitus type 1, sudden infant death syndrome (SIDS), autism and schizophrenia (Kaminski et al. 2007).

Screening of dairy cattle population for A1 and A2 beta-casein has been widely conducted across the world. The advantage of knowing the genotype of the animals could be used in selecting the preferred animals for breeding. However, such research is yet to be conducted in Malaysia. Therefore, this study was conducted to screen the population of dairy cattle in three small farms in Melaka and to analyse the frequencies of A1 and A2 alleles and genotypes in those cattle.

Keywords: CSN2, polymorphism, BCM-7, genotypic frequencies, allelic frequencies

Materials and Methods

A total of 40 blood samples were collected from three small farms in Melaka. Approval for animal ethics was granted by the UKM Animal Ethical Committee. Genomic DNA was isolated from the whole blood using DNeasy Blood and Tissue Kit (QIAGEN) and stored at -20°C for long term storage. Extracted DNA samples were then amplified via polymerase chain reaction (PCR) in a thermal cycler (miniPCR bio™) for 35 cycles. PCR products were then subjected to gel electrophoresis using 1% agarose gel and was examined using the Omega Fluor™ Gel Documentation System (Gel Company, Inc.). PCR products were then sent to Apical Scientific Sdn. Bhd. (Malaysia) for DNA sequencing. Sequencing results were aligned and screened for SNPs using Sequencher, Mega7 and BioEdit software. Subsequently, the frequencies of alleles A1 and A2 as well as the genotypes were calculated.

Results and Discussion

The findings from the screening of SNP in all samples including the genotypic and allelic frequencies are shown in Table 1. Out of 40 samples, 20 samples are of the A2A2 genotype, followed by A1A2 (n=18) and A1A1 (n=2). The frequencies of genotypes in Melaka were the highest for A2A2 (0.50), followed by A1A2 (0.45) and A1A1 (0.50).

Table 1. Genetic and allelic frequencies of all samples in Melaka.

Genotype	No. of Individuals	Genotypic Frequency	Allele Frequency	
A1A1	2	0.05	A1	A2
A1A2	18	0.45	0.275	0.725
A2A2	20	0.50		

Conclusion

This preliminary screening of A1 and A2 SNP in beta-casein alleles in dairy cattle from three farms in Melaka is the first step in investigating this issue in a larger scale. The results reported here does not represent the state nor the country, as the sample number is considered small. Future studies should include more samples and preferably pedigree data and traits measurement.

Acknowledgement

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Category: Animal Health and Production System

EVALUATION OF *PASTEURELLA MULTOCIDA* TYPE B (HAEMORRHAGIC SEPTICAEMIA) VACCINE

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Introduction

Haemorrhagic septicemia (HS) caused by *Pasteurella multocida* serotypes B: 2 and E:2 may cause fatal septicemia with high mortality in cattle and buffaloes in Asian and African countries (De Alwis, 1999; WOAH, 2021). The disease is geographically distributed in Asia, Africa, the Middle East and southern Europe. It is a reportable disease to World Organisation for Animal Health (WOAH) and Department of Veterinary Services (DVS) Malaysia. Malaysia is categorised as a HS endemic country by FAO-WHO-OIE (Benkarine and De Alwis, 2002).

Vaccination of animals is commonly practiced and acts as an effective measure against HS. Currently, the Veterinary Research Institute (VRI) Malaysia utilized *Pasteurella multocida* Type B strain C82 culture for the production of HS Alum Precipitated (HSAP) and HS Double Adjuvant (HSDA) vaccines. The current work aims to evaluate efficacy of HSDA vaccine produced by Veterinary Research Institute (VRI) for local used.

Keywords: Haemorrhagic septicemia, *Pasteurella multocida*, cattle, buffaloes

Materials and Methods

Isolated colonies of *Pasteurella multocida* Carters type B strain C82 cultured on blood agar (BA - Oxoid; Cambridge, United Kingdom) was reconstituted into 200 mL of Haemorrhagic Septicaemia Broth (HSB) and incubated at 37 °C for 24 h. Biomass production of HSDA vaccine were conducted using conventional vortex tank installed with churning motor and incubated at 37 °C for 24 h operating with continuous flow of filtered air stream. For each production the optical density (OD) of the culture was measured using a spectrophotometer (Thermo Scientific, USA) at 660nm absorbance.

The culture from vortex tank were inactivated using formalin at a final concentration of 0.5% in the solution followed by emulsification process. HSAP and HSDA were produced by emulsified *Pasteurella multocida* (*P. multocida*) antigen with the adjuvant of alum and alum with oil, respectively. The biomass production of *P. multocida* in VRI was described somewhere with few modifications (Thomas, 1968; De Alwis, 1999).

Final product safety and potency test were conducted in Swiss Albino mice according to WOAH Terrestrial Manual 2021. Mice were injected with 0.2 ml of HSDA vaccine on Day 0 and booster at day 14 followed by inoculation of *Pasteurella multocida* Carters type B strain C82 on Day 21. All mice were observed and post-mortem was performed after being challenged. At the end of the experiment, all animal were culled and disposed.

Results and Discussion

The *Pasteurella multocida* Carters type B strain C82 seed is being used in VRI for the past 20 years for HSAP and HSDA vaccine production. In this study, efficacy of HSDA vaccine produced by VRI was evaluated in mice. The median lethal dose (LD^{50}) was calculated to obtain the dose that is sufficient to protect animals. According to WOAH, 2021, vaccines prepared in the manner described should give at least 10^4 units protection in the vaccinated mice (WOAH, 2021). Our results showed that the protective value of HSDA in vaccinated mice is $\log^{10}$ protection 4.57 which is more than standard $\log^{10}$ protection of 4. Safety and potency test was conducted in mice as recommended by WOAH (Sotoodehnia et al., 2005).

Conclusion

As a conclusion, this vaccine is proven to be safe and give sufficient protection. HSDA vaccine produced by VRI could protect vaccinated animals when used accordingly in the field.

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Category: Animal Health and Production System

RABIES POST-VACCINATION MONITORING IN MALAYSIAN IMMUNE BELT

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Introduction

Rabies remains an important global health concern, with an estimated global annual human death of 25 to 159 cases (Hampson et al., 2015). Dogs' vaccination program is a main factor to prevent and control the disease. However, the status of anti-rabies antibodies in vaccinated dogs in Malaysia is uncertain. This study aimed to evaluate the immune response after vaccination to ensure the vaccinated dogs have protective antibody titer against rabies.

Keywords: rabies, FAVN, vaccination

Materials and Methods

This study focused on dogs owned by individuals living in the immune belt zone of Kedah and Kelantan. Thirty (n=30) sera were collected during this study. Virus neutralization assay (VNA) was determined by the fluorescent antibody virus neutralization (FAVN) as described by Cliquet et al., 1998. The titers of serum samples were expressed in International Units per milliliter (IU/ml) by comparing the results obtained with those of the positive standard. The threshold of positivity used was 0.1 IU/ml and the protective antibody titer was expressed in 0.5 IU/ml.

Result and Discussion

The dogs showing a protective antibody titer above 0.5 IU/ml were 77% (23/30) whereas 13% (4/30) were below the protection level. The remaining 10% (3/30) were negative antibodies against rabies. The FAVN results revealed a significant protective antibody titer against rabies in the dog's serum. However, some of the dogs showed low protective antibodies and others had none. This may be due to insufficient vaccination doses and the dogs were not received any vaccination before respectively. Vaccination of dogs has been repeatedly shown to be the most effective strategy to control rabies in a sustainable way (Fahrion et al., 2017). Continuous monitoring of antibody levels and periodic boosters are essential to maintain long-lasting immunity in dogs.

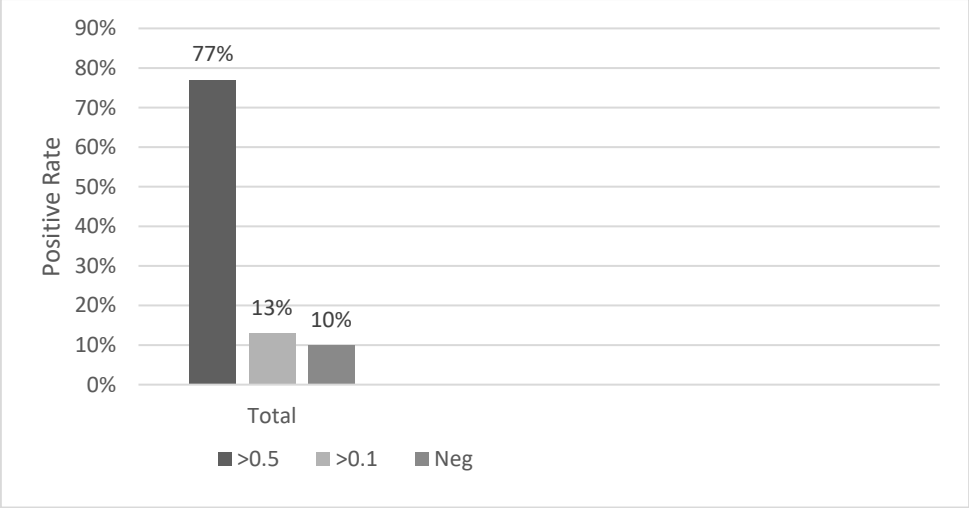


Figure 1: Sero-Positive rate against rabies virus in vaccinated dogs (n=30). The threshold of positivity used was 0.1 IU/ml and the protective antibody titer was 0.5 IU/ml.

Conclusion

This study contributes valuable insights into the protective antibody titer level in vaccinated dogs in Malaysia, emphasizing the significance of vaccination compliance for canine health and public safety.

Acknowledgment

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Category: Animal Health and Production System

COMPLETE GENOME ANNOTATION OF AFRICAN SWINE FEVER VIRUS (ASFV) FROM THE FIRST OUTBREAK IN SABAH, MALAYSIA

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Introduction

African swine fever (ASF) is a disease that mostly affects pigs and wild boars, caused by the ASF virus (ASFV). ASF results in significant economic losses, threatens global food security (Luo *et al*, 2022), and is included in the World Organization of Animal Health (WOAH) list of notifiable diseases. The first outbreak in Malaysia was confirmed in February 2021 where the first incident involved the mortality of backyard pigs in Pitas, Sabah (Khoo *et al*, 2021). The disease is then spread to peninsular Malaysia in December 2021 affecting wild boar and pig farms in several peninsular states (WOAH, 2024). Although some post-epidemic study has been carried out, a comprehensive genomic analysis of ASFV remains to be done. Hence, whole genome sequencing of ASFV samples has been carried out and gene annotation was performed to determine the genetic information encoded within the DNA of the virus. This study encompasses gene identification and functions within a genome using computational analysis. This study aims to provide the complete genome annotation information based on the sample of first ASFV outbreak in Sabah, Malaysia during the ASFV outbreak in 2021 .

Keywords: African Swine Fever, ASFV, Pigs, Wild boars

Materials and Methods

The sample used in this study and subsequent confirmation and genotyping of ASFV have been previously reported (Khoo, C.K. et al, 2021). One of the samples, VRI-001160-2021 were used in this study and subjected to whole genome sequencing using the Nanopore sequencing technology developed by Oxford Nanopore Technologies (ONT) (Niedringhaus *et al*, 2011), which was performed using MinION with R9.4.1 flow cell. Raw fastq files were combined and were quality controlled using Porechop v0.2.4. Low quality reads (q<20) were removed using ea-utils fastq-mcf (V1.04.807). Reads were then mapped to the reference genome (Georgia 2007/1, NC_044959.2). The Genome Annotation Transfer Utility (GATU) and Proksee were used for annotation and visualization of the assembled ASFV genomes.

Results and Discussion

The assembled genomes of 190,556 bp with a GC content of 41.46% including 193 open reading frames (ORFs) containing the percentage of adenine (A), cytosine (C), guanine (G) and thymine (T) with 29.72%, 20.08%, 28.83% and 21.37% respectively. The assembled genome named ASFV/Sabah/Malaysia/1160/21 is shown in a circular genome map in Figure 1.

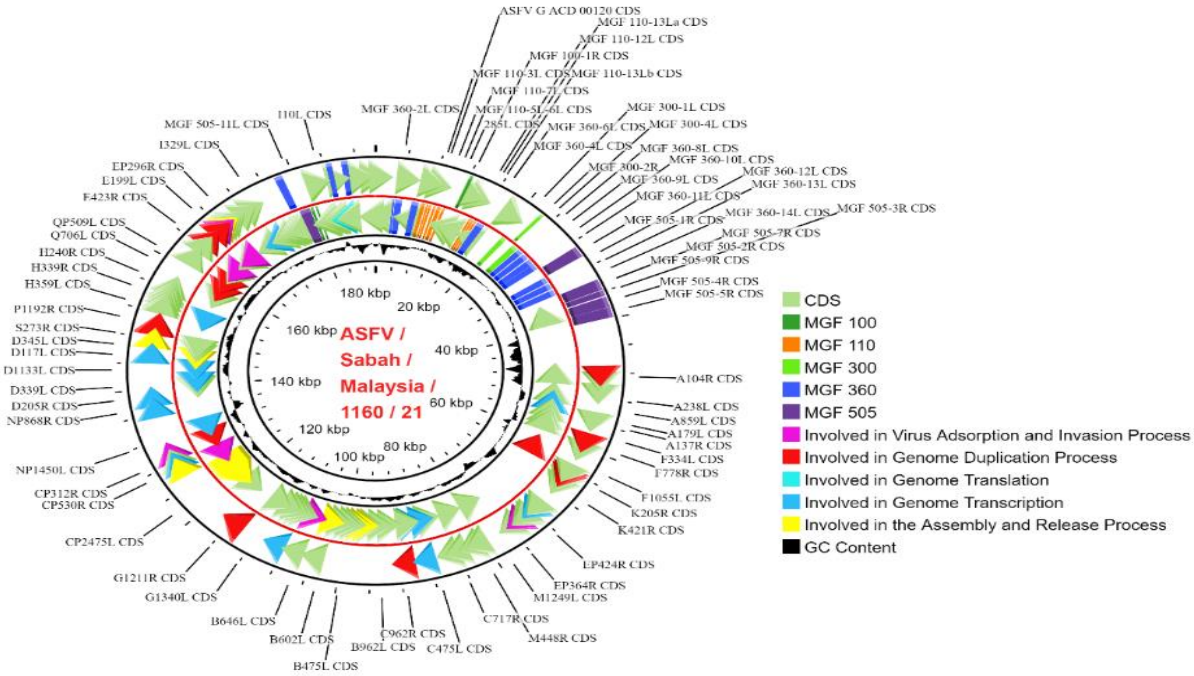


Figure 1. Genomic circular annotated map for ASFV/Sabah/Malaysia/1160/21

Conclusion

The annotation led to the identification of numerous genes, which will serve as the basis for further studies into molecular evolution, diagnostic advancement, and ASFV control strategies. Further research on the phylogeny, characterization, and gene expression of Malaysia's first ASFV is required to discover more about its characteristics and features.

Acknowledgement

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Category: Animal Health and Production System

NIPAH STATUS IN MALAYSIA FROM DIFFERENT SPECIES OF ANIMALS BASED ON LABORATORY ELISA TEST CONDUCTED FROM YEAR 2012 TO 2023

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Introduction

The Nipah virus (NiV), a Paramyxoviridae virus in the genus Henipavirus (DeBuysscher *et al.*, 2013), is closely related to the Hendra virus and may have infected Malaysian pigs from Pteropid fruit bat reservoirs (Mills *et al.* (2009). The NiV was first appeared in Malaysia in 1998 (Chua *et al.*, 2000). In Malaysia and Singapore, close contact with pigs caused an outbreak of severe encephalitis (Chua *et al.*, 2000). Malaysia had experienced the NiV outbreak in Negeri Sembilan, Perak and Selangor from September 1998 to May 1999. The Department of Veterinary Services (DVS) launched a Nationwide Surveillance Programme due to the severity of NiV infection in pigs and humans. This programme was implemented in pigs and other domestic and wild animals for the virus. Over two decades, the Veterinary Research Institute (VRI) has tested over 70,000 sera samples using an in-house ELISA developed by VRI. The continuous efforts and dedication of the VRI and DVS have resulted in no positive infections being detected from 2012 up until 2023, showing a significant achievement in the ongoing battle against the NiV. This study aimed to describe information on laboratory findings on the NiV test by ELISA in VRI from 2012 to 2023.

Keywords: Nipah virus, ELISA, local animals, surveillance, Malaysia

Materials and Methods

This study was based on sera samples from cats, dogs, pigs, and horses that were sent to the VRI, Ipoh, Perak, from different states of Malaysia between 2012 and 2023. These samples were sent for national surveillance or import and export animal permits from Malaysia to other countries. The data were extracted from VRI's Laboratory Information and Management System (LIMS), and analysed using Microsoft Excel software, version 2021. The detection of IgG antibodies in all samples were carried out using an in-house indirect ELISA test, which was developed after the country's virus outbreak (White *et al.*, 2000). The antigen used in this test was prepared in the Biosafety level 3 (Animal Facilities) laboratory, VRI.

Results and Discussion

From January 2012 to December 2023, a total of 44,755 serum samples from animals were tested for the presence of NiV antibodies using the ELISA test. The samples

consisted of 3,359 from cats, 3,713 from dogs, 11,297 from horses, and 26,507 samples were obtained from pigs. The high number of pigs is due to Malaysia's efforts to monitor and keep pigs free from NiV through a National Surveillance Program. Surveillance is the key for controlling infectious diseases, like the NiV, which poses a serious public health risk (Murray *et al*., 2017). Pigs are especially monitored as they can easily contract and transmit the virus. Selangor had contributed the largest number of samples, with a total of 13,489, and 50% of it came from horses, which could be related to the high number of equestrian sports activities and the rapid growth of the equine industry in Selangor. The number of samples tested notably increased in 2018, possibly due to the re-emergence of the NiV outbreak in Kerala, India. This raised concerns about the virus spreading to Malaysia, leading to heightened surveillance measures. Testing also extended to cats and dogs due to their potential to spread the virus, known for causing deadly encephalitis and affecting domestic animals. International trade regulations need inspection of a disease for import and export permissions and spillover prevention procedures for the lawful wildlife trade, such as import permits and animal health certifications (Chua, 2010). None of the serum samples were positive for NiV infections.

Conclusion

According to research conducted in 2007 on the NiV in Malaysia, flying foxes from various areas of Peninsular had high levels of antibodies against the virus (Sohayati *et al.* 2008). NiV also has been detected in fruit bats, either by virus isolation or viral RNA from Malaysia, Bangladesh, India, Cambodia, Thailand, Indonesia, and East Timor (Breed *et.al.,* 2013). Hence, Malaysia must be prepared to deal with the possibility of the virus spreading rapidly. To date, laboratory testing in Malaysia has identified no positive cases. The surveillance and control programs in Malaysia are effective and, so far, successful, as indicated by the country’s NiV-free status.

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Category: Animal Health and Production System

EFFECTS OF ONE HOUR ROAD TRANSPORTATION WITH DIFFERENT STOCKING DENSITIES ON CLINICAL PATHOLOGY AND ELECTROENCEPHALOGRAM PARAMETERS OF LOCAL BREED GOATS

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Introduction

Goats are one of the essential species in Malaysian agriculture, raised for meat and milk. Transportation, whether between farms, to markets, or slaughterhouses, is crucial but often stressful, impacting their welfare and productivity.

While long-distance transportation's effects are well studied (Othman et al, 2021; Kumar et al, 2023), the implications of short-distance transportation, which are common in Malaysia, remain poorly understood. Improved transportation standards are important to improve the welfare of the animal, mitigate stress, and increase the profits of the farmers, as stress significantly affects animal health and carcass quality post-slaughter.

Research in Malaysia's distinctive climate, characterized by fluctuating temperatures and pronounced weather patterns is still lacking. Previous studies were primarily conducted from temperate regions (Kadim et al., 2006; Ambore et al., 2009). Hence, this study was conducted with the intent to effectively address these concerns and support lawmakers in creating suitable rules and regulations.

Keywords: Blood parameters, electroencephalogram, goats, stocking densities, transportation stress

Materials and Methods

18 male goats (mean weight of 33 kg) were categorised into three groups: CONT (control), HSD (high stocking density during transportation; 0.2 m^2 per goat), and LSD (low stocking density during transportation; 0.4 m^2 per goat). In this study, the short-distance transportation is defined as one hour journey, in a three-tonne lorry, with a maximum speed of 60 km/h and no sudden acceleration or deceleration. EEG data and blood samples were obtained before (pre-T) and after transportation (post-T).

Results and Discussion

Total white blood cells, albumin and glucose levels were significantly increased ($p<0.05$) after transportation in all groups. EEG F_{50}, an indicator of stress in goats, were significantly increased ($p<0.05$) at post-T (Table 1). Nevertheless, all blood and EEG parameters were not significantly different between the stocking density groups.

Table 1. Electroencephalogram parameters of goats subjected to one-hour of road transportation of different stocking densities.

Parameters	Group	Pre-T (mean ± SD)	Post-T (mean ± SD)
F_{50}	CONT	3.73 ± 0.56	2.84 ± 0.73
	HSD	3.09 ± 0.63	55.19 ± 25.51*
	LSD	5.32 ± 1.34	41.45 ± 18.65*

F_{50}=median frequency
*Values within the same row are considered significantly different at 0.05.

Conclusion

In conclusion, one hour road transportation is stressful to goats, regardless of stocking densities.

Acknowledgement

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Category: Animal Health and Production System

EFFECTS OF SOCIAL DOMINANCE ON MILK PRODUCTION AND PHYSIOLOGICAL PERFORMANCE OF LACTATING DAIRY COWS

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Introduction

Dairy cattle are gregarious animals with their social hierarchy that dominant cows control resources, affecting productivity, while subordinates experience competition-related stress (Hasegawa et al., 1997; Phillips and Rind, 2002). Studies reported that social dominance significantly affect milk production in lactating dairy cows and high levels of social competition over basic resources associate with high levels of stress in subordinate animals (Sottysiak and Nogalski, 2010; Hussein et al., 2026; González et al., 2008; Gupta et al., 2007). To date, there is little data on the effects of social dominance on the milk production, and physiological performance of lactating cows, especially under the Malaysian dairy feedlot system. Therefore, the objectives of this study was to determine the effects of social dominance on milk production and physiological performance of lactating dairy cows, under the Malaysian feedlot system.

Keywords: social dominance, dairy cows, milk production, physiological performance, stress biomarkers.

Materials and Methods

Experimental site and herd management
This study was conducted at Farm Fresh, Ladang 16, UPM, Serdang, Selangor, Malaysia. A total of 52 lactating, Friesian × Jersey, multiparous dairy cows, grouped and managed together under a feedlot system were involved in this study. All cows were in their mid-lactation phase (DIM = 147±10), ranged between 2.6 and 6.0 years of age, with average milk yield of 11.6±0.6 L/day. Cows were milked at 0630 and 1830h and then kept in the same barn and offered same feeding ration twice daily.

Determining dominance value
To determine the cow's DV, direct visual observations on cows' social behaviour were conducted between morning and evening milking (0630 – 1830h) for 14 continuous days. All observed cases of social interaction such as butting (swinging their head in the direction of the other animals), pushing (uses part of their body other than the head to displace another cow), mounting (one cow climbs on the back of another cow), and allogrooming (one cow licks the head or the neck regions of another cow; Phillips & Rind 2002), were recorded on a win and loss basis (Beilharz and Mylrea, 1963) by a single trained observer. Each type of behaviour performed and observed were then given a score depending on the level of aggression (Butting score = 4; pushing score = 3; mounting = 2; allogrooming score = 1; Sottysiak and Nogalski, 2010). Cows that

successfully displaced other cow by perfoming one of these behaviours were classified as a winner. The DV determined for each cow was based on a minimum of one social interaction (won or lost by the individual) with at least 10 other cows (Beilharz & Mylrea 1963). The ratio of wins to losses for each cow was transformed to a normal distribution using the following formula:

$$DV = \sin^{-1} (\Sigma x/x + y)^{½}$$

Where x = number of wins, and y = number of losses (Beilharz & Mylrea 1963).

Production and physiological performance

Cow's milk yield were recorded during morning and evening milking for 14 continuous days. On day 1, 50ml milk samples from each cows were collected during morning milking to determine milk composition (milk fat, protein, and lactose), and 5ml blood samples were collected after the morning milking to determine stress biomarkers such as Serum Amyloid-A, Haptoglobin, Heat-shock Protein 70, Immunoglobulin A and Immunoglobulin G levels with the aid of commercial ELISA kits.

Results and Discussion

Table 1. The effects of social dominance on milk production, milk composition, and stress biomarkers of lactating dairy cows (D = dominance; M = mid-ranking; S = subordinate).

Parameters	D	M	S	P value
Milk yield/day (L)	10.107±0.724	10.658±0.865	12.508±0.738	0.1063
Fat %	3.823±0.277	3.66±0.312	2.885±0.406	0.1422
Protein %	3.43±0.098	3.367±0.06	3.232±0.105	0.3087
Lactose %	4.422±0.063	4.482±0.051	4.487±0.037	0.6202
Serum Amyloid A (ng/ml)	0.067 ± 0.003	0.065 ± 0.002	0.061 ± 0.003	0.2648
Haptoglobin (ng/ml)	0.097 ± 0.006	0.111 ± 0.008	0.117 ± 0.006	0.1573
Heat Shock Protein-70 (ng/ml)	0.193 ± 0.013	0.219 ± 0.026	0.234 ± 0.023	0.4195
Immunoglobulin A (ng/ml)	0.129 ± 0.008	0.135 ± 0.010	0.147 ± 0.016	0.5481
Immunoglobulin G (ng/ml)	0.050 ± 0.001	0.050 ± 0.001	0.049 ± 0.001	0.8696

This study observed that social dominance had no significant effect on milk production and physiological performance. This suggested that social dominance may not directly affect milk production and physiological performance in animals due to several reasons. Milk production is primarily regulated by hormonal processes related to lactation, influenced by factors such as pregnancy, nursing, and the nutritional needs of offspring, and although social dominance might affect stress levels, indirectly influencing lactation, its direct impact on hormonal regulation is limited (Picciano, 2003; McKittrick et al., 2009). Overall, while social dominance can influence behavior and resource access within animal groups, its direct effects on milk production and physiological performance may be limited compared to other factors such as genetics, hormonal regulation, nutrition, and environmental conditions.

Conclusion

In conclusion, social dominance has no significant effect on the milk production and physiological performance of lactating cows under the Malaysian feedlot system.

Acknowledgement
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Category: Animal Health and Welfare

TRANSITIONING FROM WOOD TO ALUMINUM ALLOY: ANALYZING COST PROFILES IN DAIRY GOAT HOUSING TRANSFORMATION

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Introduction

The welfare for goat housing in the intensive goat farming system is crucial because it directly influences the health and productivity of goats. The welfare indicators encompass psychological measurements, behavioural observation and product quality (Sanchez-Hidalgo et al., 2020). The necessity of goat housing in intensive farming acts as a protective shield against climate change (Seijan et al., 2018), including extreme heat, cold, rain, and wind. Clean and appropriately designed facilities, facilitate the implementation of biosecurity measures by farmers, thus mitigating the risk of disease spread within the goat herd (Win et al., 2020). In Malaysia, wood is frequently chosen as the primary material for constructing goat shelters. However, relying on wood as the primary construction material leads to environmental odor pollution, heightened asthma risks, increased maintenance needs, and shorter lifespans due to elevated humidity levels (Awang, R., 2020). In contrast, compared to alloy materials like aluminium, wood lacks key attributes such as durability, weather resistance, hygiene and pest resistance. Therefore, the objective of study aims to conduct a cost analysis by comparing dairy goat housing constructed with wood to those made using Aluminium Alloy 6063 (T5) and galvanized iron wire mesh.

Keywords: Goat housing, Al Alloy 6063 (T5), Intensive Farming, Cost Profiling

Materials and Methods

This research commencing with the procurement of goat housing specifications obtained from local farmers and the Department of Veterinary Services (DVS). These specifications encompass diverse elements including spatial arrangement, floor elevation, fence height, feeding apparatus, drinking nipples, and treatment areas. Following this, two goat shelters have been compared, each with dimensions of 2400cm (W) x 3600cm (L) and 2000cm (H), to accommodate 10 goats in each shelter. One of the shelters using wood, while the other utilize aluminium alloy and galvanized iron. The researcher included all the expenditures involve to develop the cash flow, covered the goat housing, goats, daily operational expenses, feeding and maintenances. Data collection spans a period of three years.

Results and Discussion

The cost analysis results is shown in Table 1. The cash flow analysis, return on investments and breakeven point shows favourable results for the aluminium goat housing as below.

Table 1: Cost Analysis Results	Wood Housing			Aluminium Housing		
Year	1	2	3	1	2	3
A) Initial & Operating Costs						
Housing Cost	13,600			9,500		
Female Goat (5)	5,000			5000		
Total Initial Cost **	**18,600**			14,500		
* Feeding and Maintenance Cost	3,244	4,810	7,775	2,776	3,948	6,435
Total Costs	**21,844**	**4,810**	**7,775**	**17,276**	**3948**	**6435**
B) Revenue						
Goat Milk	15,000	18,000	42,600	15,000	18,000	42,600
Fertiliser and Young Male Goat	200	1,900	1,600	200	1,900	1,600
Total Revenue	**15,200**	**19,900**	**44,200**	**15,200**	**19,900**	**44,200**
Total Net Income	-6,644	15,090	36,425	**-2,076**	**15,952**	**37,765**
Average Monthly Income	1,267	1,658	3,683	**1,267**	**1,658**	**3,683**
Return On Investment (ROI)	**-30%**	**314%**	**469%**	**-12%**	**404%**	**587%**
Break even point (BEP)		**18 Months**			**16 Months**	

Conclusion

The profiling costs analysis between the wood and aluminium housing provides a short-term investment result that is within three years. Overall, the net income yield from the goat rearing using aluminium material is much higher than the wood housing material. Over three years, the return on investment using the aluminium material is much higher. Likewise, the breakeven point is achieved slightly earlier; i.e in 16 months for the project using aluminium material. This cost saving is much higher in the long run for the project using the aluminium material because it is free maintenance costs over five years. This is unlikely for the goat housing using wood material which requires higher maintenance cost and also parts replacement cost. In addition, this profiling costs analysis is one of the advantages out of several other non-financial advantages of using the aluminium housing such as a more sustainable waste management system.

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Category: Animal Health and Welfare

DIAGNOSIS OF LUMPY SKIN DISEASE (LSD) OUTBREAKS IN NORTHERN REGION OF MALAYSIA: A YEAR 2021 REVIEW

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Introduction

Lumpy Skin Disease virus (LSDV) belongs to the genus *Capripoxvirus* in the subfamily *Chordopoxvirinae*, family *Poxviridae.* LSDV is a contagious virus that affects cattle contributing to skin damage, reduced milk production, weight loss, and fertility issues that may lead to significant economic losses. LSD is transmittable via vectors such as blood-feeding insects, mosquitos, flies, ticks, and midgets. LSD is categorized as a subacute or acute illness that can be identified by extension skin lesions besides developing fever, nasal discharge, lacrimation, and hypersalivation. (Lin et al., 2022). Polymerase Chain Reaction (PCR) assay using specific primers is a method for LSD. This study aims to review the outbreak status and to determine the suitable samples for LSD in Northern Region of Malaysia.

Keywords: Lumpy Skin Disease (LSD), cattle, district, PCR, MVZU

Materials and Method

A total of 142 diagnostic samples from cattle were received by Virology Section, Makmal Veterinar Zon Utara (MVZU). The samples were processed, extracted, and optimised using PCR parameters with published primers designed by Ireland & Binepal, 1998) for Lumpy Skin Disease (LSD) targeting at highly conserved region within the G protein-coupled receptor gene. The PCR parameters were optimised with annealing temperature of 58°C, 10 X PCR Buffer, Mg^{2+} concentration of 2.5mM, Taq Polymerase concentration of 0.5U per reaction and amplification of 40 cycles. The LSD extracted positive control: NVRL-CPV-LS-NA-001 (Pirbright) reference strain was obtained from Veterinary Research Institute (VRI). The amplified PCR products were visualized by gel electrophoresis with 1.5% agarose (WOAH, 2018).

Results and Discussion

A total of 142 samples were documented with 102 samples tested positive for LSD in MVZU in the year 2021. LSD was found to be the highest at 100% in Seberang Perai Selatan (SPS) district, but no incident was found in the districts of the Seberang Perai Utara (SPU), Baling, Padang Terap, and Kuala Kedah (Table 1). LSD in the northern region was suspected to be transmitted through vectors, thus challenging to control vectors, especially in extensive farming systems which is vector control practices are limited (Samuel, 2020). During this outbreak, the scab (skin lesion) samples showed the highest number of positive results. Additionally, the percentage of LSD detection

levels for nasal and blood samples for LSD is 77.97% and 48.15% respectively (Figure 1). According to Lin Li et al., 2022, the LSD virus DNA in cattle blood was less to be found in comparison to scab samples due to the very short-lived nature of LSD viremia in blood (between 4 to 11 days). In contrast, the virus can persist up to 92 days in scab samples. This shows the importance of utilising various sampling methods for effective disease surveillance and control strategies.

Table 1: Occurrence of LSD in the Northern Region according to district for samples received in Makmal Veterinar Zon Utara (MVZU) in year 2021.

State	District	Number of samples	Number of positive samples	Percentage (%)
Kedah	Kulim	15	6	39.4
	Baling	14	0	0
	Padang Terap	3	0	0
	Bedong	11	11	100
	Kuala Kedah	1	0	0
	Sungai Lalang	9	3	33.3
Penang	Seberang Perai Selatan	87	82	94.3
	Seberang Perai Utara	2	0	0

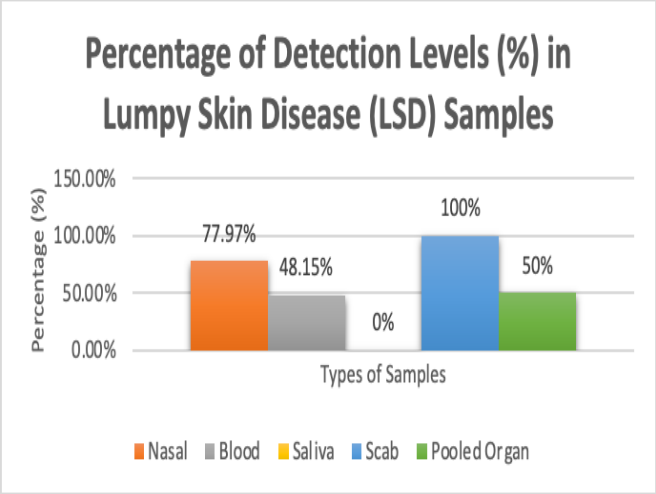


Figure 1. Detection of LSD in Northern Region according to the types of samples received in Makmal Veterinar Zon Utara (MVZU) in year 2021.

Conclusion

Overall, continued guidance for the public by introducing the Protokol Veterinar Malaysia: Lumpy Skin Disease (LSD) (PVM 2(11): 1/2021) is essential to improve disease management strategies. In addition, various sampling methods with the preference of scab samples are also important in obtaining the optimum results.

Acknowledgment

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Category: Animal Health and Welfare

EVALUATION ON SEROLOGICAL PROFILES OF NEWCASTLE DISEASE VACCINE VIRUS ADMINISTERED VIA DRINKING WATER IN MINIMUM DISEASE PATHOGEN FREE (MDF) CHICKENS

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Introduction

Newcastle disease (ND) is a highly contagious disease that can cause significant financial strain for poultry farmers worldwide. Thus, the appropriate vaccination methods for ND must be looked for, especially in smallholder and rural chicken producers that cannot be benefited from the current conventional vaccine delivery systems (Mebrahtu et al., 2018). For years, live ND vaccines have been administered via oral, intra-muscular, intra-ocular, or intra-nasal routes to individual chickens on a regular basis (Oakeley, 2000). However there are limited studies on evaluation of ND vaccine given via drinking water. NDV vaccine 1174/08 strain of duck origin was selected as vaccine candidate and developed as live NDV vaccine at Veterinary Research Institute (VRI). Therefore, this study aims to assess the serological profile of MDF chickens following the administration of NDVAC 1174/08 through drinking water.

Keywords: Newcastle disease, drinking water, chickens

Materials and Methods

Preparation of vaccine
In this experiment, the freeze-dried NDVAC 1174/08 was utilized. The vaccine was reconstituted, one vial in 1liter drinking water before being administered to the chickens.

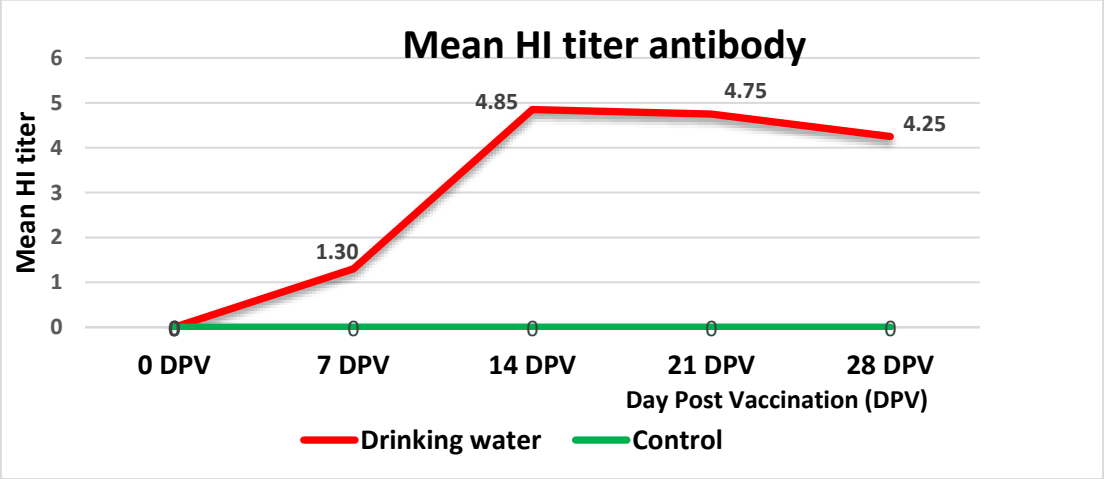
Experimental design
A total of 30 MDF chickens 14 day-old (d/o) were used for this experiment, which the chickens were divided into two groups: the vaccinated group (Group 1) and the control group (Group 2). Group 1 was vaccinated once with 10 doses of ND vaccine 1174/08 strain per chicken via drinking water. Group 2 was given phosphate-buffered saline (PBS) as a control group. The water supply is stopped for one hour, then added the prepared ND vaccine to the drinking water, which then was removed after one hour.

Serological analysis

Blood samples from all chickens were obtained weekly until 28th day post vaccination (DPV) to determine the antibody titer against NDV using hemagglutination inhibition (HI) test.

Results and Discussion

The mean HI titre (log_2) exhibited a gradual increase from 1.30 to 4.85, followed by a decline subsequently at 21 DPV and 28 DPV with mean HI titre 4.75 and 4.25. It showed the drinking water route can offer a protective antibody level exceeding 4.00. The Hemagglutination Inhibition Test's Geometry Mean Titre (GMT) assessment standard states that an accumulated titer of 16 or more or HI log 2^4 is considered protective against ND, whereas an accumulated titer of less than 16 or HI log 2^4 is considered non-protective against ND (OIE, 2012). Several factors were found to affect the antibody titre, including the route of vaccine administration. In the group vaccinated by drinking water and spray, the percentage of chickens with antibody titres ≥log 2^3 following the first and booster vaccinations is comparable to that of the hens vaccinated by eye drop technique (Mebrahtu et al., 2018). Additionally, the age of the animal could also influence the antibody response, apart from the administration route. Young chicks with high levels of maternal antibodies may experience a reduced level of immunity development, thus affecting the effectiveness of a live vaccine (Butcher & Miles, 2003).



Conclusion

In conclusion, administering the NDV vaccine through drinking water resulted in a significant antibody response. This method may be a viable option for ND vaccine administration in chickens.

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Category: Animal Nutrition and Feeding

MEAT QUALITY OF BROILER CHICKENS SUPPLEMENTED WITH WOOD VINEGAR

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Introduction

Antibiotic growth promoters are mostly incorporated into poultry feed at lower therapeutic dosages to enhance growth performance, promote gastrointestinal health and prevent diseases. However, the indiscriminate antibiotic usage in poultry diets has raised significant apprehensions due to the emergence of antibiotic-resistant bacteria and antibiotic residues in animal-derived products, potentially impacting consumer health. This necessitates the formulation of diets devoid of antibiotics, with research exploring alternatives like postbiotics, organic acids, and plant extracts (Loh et al., 2014; Bagal et al., 2016). Wood vinegar, also referred to as pyroligneous acid, is a by-product derived from the distillation process of wood smoke and represents a complex combination of water and organic compounds**.** It contains phenolic compounds, organic acids, alcohols, and various other carbon-based molecules. This unique composition has led to its exploration in diverse applications, including animal feed additives, food processing, insect repellent, pharmaceuticals, and odour-remover (Theapparat et al., 2018). Therefore, this study aimed to determine the effects of wood vinegar on meat quality in broiler chickens.

Keywords: Wood vinegar, broiler chickens, meat quality

Materials and Methods

432-day-old chicks (Cobb 500) were procured from a commercial hatchery. The chicks were wing-tagged individually, then randomly distributed into six treatments with six replicates and twelve birds per replicate in a completely randomised design. The treatment groups contained T1 = negative control (Basal diet), T2 = positive control (Basal diet) + 0.02% oxytetracycline (w/v), T3 = (Basal diet) + 1:100 (v/v) wood vinegar, T4 = (Basal diet) + 1:200 (v/v) wood vinegar, T5 = (Basal diet) + 1:500 (v/v) wood vinegar and T6 = (Basal diet) + 1:1000 (v/v) wood vinegar. The starter, grower and finisher diets were provided from days 0-14, 15-28 and 29-35, respectively. Twelve birds from each treatment were randomly selected at the end of the feeding trial (35 days) and slaughtered to determine meat quality. The breast meat was used for all meat quality assessments.

Result and Discussion

The results of meat quality indicated that drip loss, cooking loss, pH, shear force and yellowness (b*) were not significantly ($p>0.05$) affected across treatment groups. However, the supplementation of wood vinegar in broiler chicken significantly affected lightness (L*) and redness (a*). The result for cooking loss and shear force obtained in this study is in line with the report of Kareem *et al.* (2015). The pH of breast meat is within the normal range value reported by Nalunga et al. (2021).

Conclusion

The result from the current study demonstrated that drip loss, cooking loss, pH, shear force and yellowness were not significantly affected. Nevertheless, wood vinegar potentially enhance meat quality.

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Category: Animal Nutrition and Feeding

EVALUATING ORGANOLEPTIC PROPERTIES OF COMPLETE FEED ENSILED USING EXPIRED COMMERCIAL SYRUP AS A GLUCOSE SOURCE FOR DAIRY GOATS' FEED

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Introduction

Expired or rejected commercial syrup (ECS), typically unsuitable for human consumption, can potentially be repurposed as a silage additive for livestock feed if properly stored. Studies by Sadarman et al. (2023) demonstrated that adding 10% ECS to silage aids in preserving nutrient content and enhancing physical qualities like aroma, fungal inhibition, and color. Additionally, substituting molasses with ECS in corn stover silage improved aroma, texture, and color (Anokhina et al., 2023). This study investigates the influence of incorporating ECS on the pH, aroma, texture, and color of complete feed silage for dairy goats.

Keywords: Complete feed, pH, physical properties, syrup, silage

Materials and Methods

The experiment followed a Completely Randomized Design with 5 treatments and 5 replications. Treatments included: P1 (control): Complete feed, P2: P1 + 2.50% DM ECS, P3: P1 + 5% DM ECS, P4: P1 + 7.50% DM ECS, P5: P1 + 10% DM ECS. Complete feed was mixed with respective ECS levels, transferred to sealed silos, and ensiled for 30 days. After ensiling, pH and physical quality were evaluated by 53 untrained panellists using a questionnaire.

Results and Discussion

Table 1. Effect of ECS as silage additive on organoleptic parameters.

Expired Commercial Syrup in Complete Feed Silage	pH Silage	Mold Growth in Silage	Aroma	Texture	Color
P1: Complete Feed (control)	4.62^{a}±0.15	2.25^{a}±0.09	1.99^{a}±0.03	2.35^{a}±0.10	1.99^{a}±0.14
P2: P1+ ECS 2.50% DM	4.44^{b}±0.09	2.31^{ab}±0.09	2.03^{a}±0.09	2.69^{b}±0.06	2.25^{b}±0.25
P3: P1+ ECS 5% DM	4.33^{bc}±0.06	2.43^{bc}±0.20	2.23^{a}±0.18	2.87^{c}±0.05	2.31^{b}±0.16
P4: P1+ ECS 7.50% DM	4.22^{c}±0.12	2.54^{c}±0.11	2.62^{b}±0.31	3.06^{d}±0.14	2.43^{b}±0.17
P5: P1+ ECS 10% DM	4.05^{d}±0.04	2.73^{d}±0.06	3.22^{c}±0.11	3.51^{e}±0.03	3.00^{c}±0.07

Data shown are mean ± standard deviation. The addition of commercial syrup had a significant effect on the pH of complete feed silage ($P<0.05$).

The study reported that by adding 10% DM expired commercial syrup yielded the most favorable outcomes, including optimized pH (4.05), enhanced aroma (3.22), improved texture (3.51), and desirable color (3.0). This study also was in line with data reported with Sadarman et al., 2023 and Anokhina et al., 2023.

Conclusion

These findings demonstrate the potential of utilizing expired commercial syrup as an effective silage additive to enhance the overall quality of complete feed silage for dairy goats.

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Category: Animal Nutrition and Feeding

EVALUATING THE EFFECT OF ANCHOVY WASTE AS A REPLACEMENT FOR CONVENTIONAL PROTEIN SOURCE ON THE GROWTH, HEALTH PERFORMANCE AND MEAT QUALITY OF VILLAGE CHICKEN

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Introduction

The Malaysian poultry industry has attained significant self-sufficiency in meeting national demands for poultry products but faces rising concerns regarding antibiotic use in commercial farming, leading to increased demand for free-range native chickens (Ferlito, 2020). Factors such as feed costs, reliance on imported feedstuff, and disruptions from the COVID-19 pandemic, are exacerbating production expenses (Ferlito, 2020). This has prompted a focus on exploring alternative, locally available feed ingredients to enhance profitability, especially for smallholder farms (Zulfahmi et al., 2022). This study serves as a preliminary investigation aimed at evaluating the effects of anchovy waste on the growth performance of village chickens, addressing the need for cost-effective feed solutions.

Keywords: anchovy waste, chicken, protein source, performance

Materials and Methods

The study included 120 one-day-old chicks, divided into four dietary treatments, adhering to NRC's nutritional requirements for male broilers. Group 1 as the control diet without anchovy waste, Group 2 received a commercial pellet diet; Group 3: fish meal was 100% replaced by anchovy waste, and Group 4: a combination of 100% replaced fish meal and 50% replaced soybean meal with anchovy waste. The replacements were made at rates of 25%, 50%, and 75%, as documented by Saleh & Alzawqari (2021). Chicks were housed at a density of ten birds per square meter with ad-libitum access to feed and water (Saleh & Alzawqari, 2021). Weekly measurements of live weight (LW) and feed intake (FI) were taken to assess the growth trend of the hybrid village chickens.

Results and Discussion

There are trends in feed intake, weight gain, and FCR, however, none of these differences is statistically significant. The FCR values are better compared to a study by Mueller et al., (2019) and Abdullah et al., (2010) at 2.62 and 2.21 with higher feed intake (3185g and 4172g) and higher weight gain (1215.2g and 1886g). The study

found that replacing anchovy in the diet showed promising results, indicating potential nutritional benefits and cost-effectiveness (Boumendil et al., 2023). Although statistical significance wasn't evident, practical implications are applicable for poultry farmers seeking to improve feed efficiency without sacrificing growth. Further research, particularly with larger sample sizes, is needed to dig into the specific mechanisms behind these differences and gain clearer insights into factors influencing feed efficiency and overall poultry growth.

Table 1. Performance of hybrid village chicken in different treatment group.

Treatment Group	Total Feed Intake (g)	Weight Gain (g)	Feed Conversion Ratio (FCR)
T1	2390.902 ± 79.059	1126.739 ± 50.157	2.125 ± 0.027
T2	2319.085 ± 129.940	1172.783 ± 90.765	1.989 ± 0.052
T3	2341.138 ± 46.372	1148.829 ± 40.283	2.041 ± 0.036
T4	2282.522 ± 96.800	1112.478 ± 17.763	2.052 ± 0.082

*T1 (Control): The baseline group without any specific dietary modifications. T2 (Commercial Pellet): Fed with commercial pellets. T3 (Anchovy Replaced Fish Meal): Fish meal fully replaced with anchovy. T4 (Anchovy Replaced Fish Meal and Half of Soybean): Both fish meal and half of soybean replaced with anchovy.

Conclusion

Replacing conventional protein sources with anchovy waste did not yield statistically significant differences in feed intake, weight gain, and FCR among treatment groups, indicating potential benefits for village chicken diets but requiring further research for optimization.

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Category: Animal Nutrition and Feeding

PRELIMINARY STUDY ON THE NUTRIENT COMPOSITION OF INDIGOFERA ZOLLINGERIANA

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Introduction

Indigofera zollingeriana, a leguminous plant, has been the subject of various studies exploring its nutritive potential, including green manure, fuel, as a shade for young coconut, coffee, tea, and cocoa trees. The forage plant has high herbage productivity, quality, and high edible herbage portion for animals. Additionally, the plant has been found to have a high protein content, making it a valuable resource for improving livestock productivity, particularly in ruminants (Hutasoit et al., 2022). There are several factors which greatly affect the quantity as well as the quality of the green fodder, for example, the plant varieties, the season of the year (dry or rainy season), fertilizer application, soil fertility, irrigation, plantation method and harvesting technique. A short cutting interval prevents the plants to accumulate enough nutrients for later regeneration, while a long cutting interval delays the harvest until after the dry season, which results in a decrease in yield. (Kien et al., 2020). Therefore, it is important to determine an appropriate cutting interval in order to develop the production of green fodder from leguminous plant sources.

This study was designed to evaluate the effects of cutting age on the nutritive values of *Indigofera zollingeriana* in terms of the percentage of dry matter (DM), crude protein (CP), crude fibre (CF), Total digestible nutrient (TDN) and metabolizable energy (ME).

Keywords: *Indigofera zollingeriana*, nutrient composition, cutting age

Materials and methods

The experiment was conducted on an existing Indigofera plant plot. This plot has an area of 15 meters by 3 meters, which has 50 trees, with a spacing of 1.5 meters by 1.5 meters for each tree. This experiment was conducted with 7 treatments representing 7 different cutting intervals of 6, 7, 8, 9, 10, 11 and 12 weeks. Each treatment was represented by three randomly selected trees in the same plot with an estimated total sampling of 6% of the total number of trees in the plot. Fresh material (leaves and young branches) was cut early in the morning manually and cut about 1 meter high from the ground level. Fresh materials were harvested, weighed, and sent to the laboratory for proximate analysis. All data were subjected to analysis of variance

by the SAS procedure. The differences among mean values were compared by Fisher's Least Significant Different (LSD) at the 5% significance level.

Results and Discussion

The results of the experiment are shown in Table 1. Based on the result, the cutting interval significantly influenced the production of dry matter (DM) and crude protein (CP) in the fodder. When cutting intervals increased from 6 to 12 weeks, the value of DM significantly increased from 14.40% to 18.67%, while the CP value decreased from 29.60% (6-week interval) to 24.73% (12-week interval). Apart from that, crude fiber (CF), total digestible nutrient (TDN), and metabolism energy (ME) showed no significant difference between weeks.

Table 1: Nutrient composition of *Indigofera zollingeriana* for different cutting interval (weeks)

Weeks	Parameters				
	Dry Matter (DM), %	**Crude Protein (CP), %**	**Crude Fibre (CF), %**	**Total Digestible Nutrient (TDN), %**	**Metabolism Energy (ME), MJ/kg**
6	14.40^{e}	29.60^{a}	22.00^{b}	68.37^{a}	10.36^{ab}
7	15.67^{d}	28.27^{ab}	22.20^{b}	67.97^{a}	10.54^{ab}
8	16.33^{d}	28.00^{ab}	22.83^{ab}	66.60^{a}	10.07^{b}
9	17.43^{c}	27.07^{bc}	22.87^{ab}	67.80^{a}	10.27^{ab}
10	17.60^{bc}	26.63^{bc}	23.07^{ab}	69.73^{a}	10.59^{ab}
11	18.33^{ab}	25.93^{cd}	23.27^{ab}	70.50^{a}	10.76^{a}
12	18.67^{a}	24.73^{d}	24.03^{a}	70.33^{a}	10.68^{ab}

*Means within the same column with different superscript are significantly different at (p<0.05).

Conclusion

The study shows that cutting interval has an effect on the dry matter (DM) and crude protein (CP) on the *Indigofera zollingeriana*. As, this is still a preliminary study, further experiment will be conducted to get the maximum benefit from that forage tree legume.

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Category: Animal Nutrition and Feeding

EFFECT OF SELENIUM SUPPLEMENTATION ON THE ABNORMAL SPERM OF MATURED BOER BUCKS

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Introduction

Selenium (Se) is well recognized for its impact on the male reproductive performance of livestock (Bano et al., 2018). Supplementation with Se has affected the structure of testes, libido, sperm quality, and testosterone levels (Lukusa and Lehloenya, 2017). Supplementation with Se has improved sperm quality by increasing semen volume, sperm motility, semen concentration, sperm viability, and reducing the number of abnormal sperm in male goats (Lukusa and Lehloenya, 2017). However, there is a lack of information on the effect of Se supplementation on abnormal sperm in terms of primary, secondary, and tertiary abnormalities in male goats. Therefore, this study aimed to determine the effect of Se supplementation on abnormal sperm of primary, secondary, and tertiary in matured Boer bucks.

Keywords: Organic selenium, Boer, matured bucks, abnormal sperm

Materials and Methods

A six-month trial was carried out at MARDI Bachok, Kelantan. A total of 18 matured bucks aged two years old were randomly assigned to three different dietary treatments: Groups A and B were given 0.18 and 0.36 mg Se/kg DM, respectively, while group C received no Se supplementation (control group). The average initial body weight was 53.28 ± 0.62 kg. They were fed a basal diet consisting of 60% formulated pellet and 40% *Brachiaria dictyoneura* grass at 3% DM of body weight. Se-enriched yeast (Selemax® 2000, Brazil) as an organic Se source was mixed with the formulated pellet's ingredients and pelleted. The bucks were placed in individual pens. Drinking water was provided *ad libitum*. Fresh semen samples were collected from each buck using an artificial vagina (AV) in the morning every two months. Abnormal sperm were determined by using an eosin-nigrosin stain under 400X magnification of the microscope. Morphological abnormalities of primary, secondary, and tertiary were examined and recorded, according to Julie (2018).

Results and Discussion

Abnormal sperm (primary, secondary, and tertiary) of matured Boer bucks fed with the dietary treatments are shown in Table 1.

Table 1. Abnormal sperm (primary, secondary, and tertiary) of matured Boer bucks fed with the dietary treatments (±SEM)

Variables	Abnormal sperm		
	Primary (%)	Secondary (%)	Tertiary (%)
Dietary treatment			
Group A (n=6)	0.61±0.29^{b}	1.67±0.49^{a}	17.83±2.23^{b}
Group B (n=6)	0.00±0.00^{a}	0.72±0.30^{a}	12.33±0.87^{a}
Group C (n=6)	0.72±0.25^{b}	4.33±0.87^{b}	40.83±2.91^{c}
P-value			
Treatment	0.03	<0.01	<0.01
Time	0.01	<0.01	<0.01
Treatment*time	0.11	0.14	0.01

Note: ^{a,b,c} superscripts are significantly different (P<0.05) in the same column (two-way ANOVA, Duncan' test). SEM–Standard error of the mean. Group A- Supplemented with 0.18 mg organic Se/kg DM. Group B- Supplemented with 0.36 mg organic Se/kg DM. Group C- No Se supplementation (control), n= number of animals.

Abnormal sperm of primary, secondary, and tertiary was decreased (P<0.05) by Se supplementation at 0.36 mg/kg DM compared to Se supplementation at 0.18 mg/kg DM and the control group. The decreased sperm abnormality by Se supplementation at 0.36 mg/kg DM could be due to Se participation in the spermatogenesis process by influencing the activity of selenoprotein P (Bano et al., 2018). Selenium also increases the integrity of the lipid component of the sperm acrosome (Lukusa and Lehloenya, 2017).

Conclusion

Se supplementation at 0.36 mg/kg DM potentially influence sperm morphology by reducing abnormal sperm of primary, secondary, and tertiary in matured Boer bucks.

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Category: Animal Nutrition and Feeding

OPTIMIZING NUTRIENT REQUIREMENTS OF GRAIN CORN PRODUCTION IN MALAYSIA

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Introduction

The productivity of grain corn is dependent on its nutrient requirement and management, particularly that of nitrogen, phosphorus and potassium (Asghar et al, 2010). Grain corn requires nutrients such as nitrogen (N), phosphorus (P), and potassium (K) more than others, leading to symptoms of deficiency of these elements. Inadequate fertilization practices, lack of proper fertilization recommendations, and limited knowledge of nutrients beyond N, P, and K can limit crop production. Factors such as low maintenance, environmental conditions, and soil fertility levels can also contribute to low plant productivity (Nziguheba et al, 2009). Understanding the fertilizer response reference is crucial to improving the effectiveness and efficiency of fertilization in maize. The relative response of maize to N-P-K fertilizer tends to decrease with improved soil quality. Soil type plays a significant role in various aspects, including resource capture efficiency. While fertilizers have long been known to enhance plant growth and yield, the optimal ratio of macro elements, particularly N, P, and K, needs to be determined for optimize nutrient requirement specifically for grain corn plant. This study aims to investigate nutrient requirement the ideal N:P:K ratio for maximizing growth and yield in grain corn plant.

Keywords: grain corn, mineral soil, nitrogen, phosphorus, potassium.

Materials and methods

The experiments were carried out at the research field at MARDI Headquarters, Serdang using a total area of 80 m × 20 m. Each experimental unit has a dimension of 5 m x 5m plot and the two seeds were sown per hole at a depth of 3-5 cm with spacing of 75x20 cm. Treatment rate NPK fertilizer application to increase the growth and yield of grain corn production. T1 : No fertilizer (Control), T2 : 100% rate NPK 15:15:15 + UREA, T3 NPK 15:15:15 (50% rate) (15 DAS) + UREA + 2 (N biobooster), T4 : 200kg N + 40kg P + 80kg K, T5 : 200kg N + 40 kg P + 60kg K, T6 : 160kg N + 40 kg P + 80kg K, T7 160kg N + 40 kg P + 60kg K, T8 : 120kg N + 40 kg +80 kg K, T9 : 120kg N + 40 kg+60 kg K. Treatments were arranged in a Randomized Complete Block Design (RCBD) consisting of seven treatments with three replications. The data obtained was analyzed using ANOVA in the SAS software (Version 9.4, SAS Institute Inc. Cary, North Carolina, USA) and differences between treatment means were

compared using Duncan Significant Difference (HSD) at P ≤ 0.05%. Five plants were randomly selected from each treatment. Harvesting at 105 DAS, data which were total fruit, weight fruit w/o husk per treatment (kg), fruit length (cm), diameter fruit (mm), weight fruit per plant (g), number of grain per fruit, 1000-grain weight (g) and yield before drying (kg/ha).

Result and Discussion

Effect of ratio NPK fertilizer on yield of grain corn

The yield components of total fruit, weight fruit without husk, fruit length, diameter fruit, weight fruit per plant, number of grain per fruit, 1000-grain weight, and yield before drying showed significant differences ($p<0.05$) among treatments at 105 days after sowing (table 1). The NPK ratio in T5 resulted in the highest total fruit (47.25), weight fruit without husk (9.75 kg), weight fruit per plant (413.78 g), number of grain (507.0), 1000-grain weight (360.03 g), and yield before drying (11,1169 kg/ha) compared to other treatments. However, T9 had higher fruit length and diameter. The effects were more pronounced with higher nitrogen levels, particularly in T5 (200kg N + 40 kg P + 60 kg K), leading to significantly better yield parameters. Studies have shown that higher nitrogen levels promote strong root and shoot development, enhancing nutrient absorption and ultimately increasing grain yield. This improved productivity is attributed to better soil fertility conditions, allowing for increased moisture and nutrient uptake, leading to higher biological yield. These results align with the findings of Amanullah et al. (2010), highlighting the positive impact of higher nitrogen application on corn grain yield optimization.

Table 1: Effect of ratio NPK fertilizer on yield of grain corn

Trt	Total fruit/trt	Weight fruit w/o husk/trt (kg)	Fruit length (cm)	Diameter fruit (mm)	Weight fruit/plant (g)	No. of Grain/ fruit	1000-grain weight (g)	Grain yield before drying (kg/ha)
T1	22^{b}	1.75^{c}	11.24^{c}	38.33^{b}	71.34^{c}	189.9^{d}	113.38^{b}	2190^{c}
T2	40^{a}	8.6^{ab}	18.5^{ab}	49.68^{a}	250.38^{b}	489.3^{abc}	344.69^{a}	9985^{ab}
T3	37^{ab}	7.35^{b}	17.06^{b}	49.09^{a}	217.89^{b}	451.4^{c}	323.11^{a}	8247^{b}
T4	38^{a}	$9.25a^{b}$	19.27^{ab}	51.05^{a}	276.35^{ab}	522.3^{a}	358.56^{a}	11053^{a}
T5	42.75^{a}	9.75^{a}	18.97^{ab}	48.32^{a}	413.78^{a}	507.0^{ab}	360.03^{a}	11169^{a}
T6	40.25^{a}	9.05^{ab}	18.7^{ab}	49.44^{a}	254.4^{b}	494.25^{abc}	349.03^{a}	10427^{ab}
T7	38.25^{a}	8.5^{ab}	17.8^{ab}	49.4^{a}	236.63^{b}	464.8^{bc}	345.08^{a}	10009^{ab}
T8	38^{a}	8.00^{ab}	19.94^{a}	49.54^{a}	243.11^{b}	490.3^{abc}	337.1^{a}	10557^{ab}
T9	38^{a}	8.05^{ab}	19.62^{a}	50.36^{a}	267.66b	502.6^{ab}	356.64^{a}	9536^{ab}
p-value	*	**	**	**	**	**	**	**

Note: ns: ** Significant at 1% probability level, *Significant at 5% probability level, ns: Not significant. Means in each column with the same letters are not significantly different at $P \leq 0.05\%$ level according to Duncan's Multiple New Range Test (DMNRT) (Mean ± SE, n=3).

Conclusion

The research finding revealed that application rate of T5= 200kg N + 40 kg P + 60kg K recommended for increasing in the T5 showed the highest parameter in total fruit (47.25), weight fruit without husk per treatment (9.75 kg), weight fruit per plant (413.78 g), number of grain per fruit (507.0), 1000-grain weight (360.03 g) and yield before drying (11,1169 kg/ha) compare the all treatment.

Acknowledgement
This research was funded by project Pembangunan RP 4: Pembangunan Varieti Dan Sistem Pengeluaran Kos Efektif Jagung Bijian Sebagai Makanan Ternakan. The authors would like to thank staff of MARDI Industrial Crop Research Centre (IC)

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Category: Food/ Feed Safety

FOODBORNE PATHOGENS IN ANIMAL-BASED SAMPLES FROM SOUTHERN REGION OF MALAYSIA (2021-2023)

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Introduction

Department of Veterinary Services (DVS) is one of the authorities responsible in ensuring supply of safe and quality food for consumers in Malaysia. In achieving this, DVS has tested animal-based and other samples under the national food safety monitoring program. This study reports findings of pathogens (*Salmonella* spp., *Campylobacter* spp., *Yersinia enterocolitica* and *E. coli* O157:H7) in samples from food safety monitoring program in southern region of Malaysia for year 2021 to 2023.

Keywords: food safety, foodborne pathogens, *Salmonella* spp., *Campylobacter* spp., *Yersinia enterocolitoca*

Materials and Methods

About 4,177 tests of 3,166 samples had been conducted between 2021 to 2023 in The Veterinary Laboratory of Southern Zone (Johor Bahru). Samples were meat-based, milk and dairy products, egg-based, edible birdnest (EBN)-based and swabs from abattoirs environment. All samples were tested for *Salmonella* spp., raw chicken meat was also tested for *Campylobacter* spp., *Yersinia enterocolitica* was tested in raw pork and *E. coli* O157:H7 in raw meat. All tests were using isolation and identification methods (DVS, 2016), except for *Campylobacter* spp where rapid test (Simplate® method) was used.

Results and Discussion

All raw meat samples from local abattoirs and imported meat were negative for *E. coli* O157:H7. Meanwhile, only 0.7% (2/298) raw pork samples were detected with *Yersinia enterocolitica*; all in year 2021.

Overall, 21% (34/166) of raw chicken meat samples were detected with *Campylobacter* spp. (24% in year 2021, 23% in year 2022 but decreased to 9% in year 2023). DVS's guideline has outlined that no bacterial pathogens were allowed to be present in food (DVS, 2011). Meanwhile, European countries approached were slightly different in which the limit for *Campylobacter* spp. in carcass of broilers were set at 1,000cfu/g (EU, 2017). Our study used quantitative Simplate® method where positive samples were detected to contain *C. jejuni* and/or *C. coli.* From 34 positive samples of *Campylobacter* spp., only two samples (year 2021) had bacteria higher than 1,000 cfu/g (1,680cfu/g and 1,480cfu/g, respectively) whereas the majority of the positive

samples had readings below 500cfu/g. However, the current method only detected *C. jejuni* and *C. coli* while other *Campylobacter* species which may also be present but was not detected might contribute to higher *Campylobacter* load to the samples.

About 6% (192/3,000) of samples were detected with *Salmonella* spp. (8% in year 2021, 7% in year 2022 and 5% in year 2023). Majority of the *Salmonella*-positive samples were that of chicken-based samples (48%), followed by imported buffalo meat (25%), pork-based samples (20%), beef-based samples (5%) and lastly EBN samples (2%). All milk or dairy-products and egg-based samples as well as swabs from abattoirs environment were not detected positive for *Salmonella* spp. Among commonly *Salmonella* serovars identified were Brancaster, Corvallis, Senftenberg, Stanley and others. For serovars of concern, chicken-based samples were mostly contaminated with Enteritidis whereas pork-based samples contained Typhimurium.

Conclusion

Foodborne pathogens in the animal-based samples were relatively low. However, quite high occurrence of *Campylobacter* spp. in chicken meat samples might indicate possible contamination during production despite following the food safety measures. These findings could assist DVS in evaluating the effectiveness of its' programs in ensuring supply of safe food.

Acknowledgement

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Category: Forage Science and Feeding

NEW SORGHUM VARIETIES AS ALTERNATIVE SOURCE OF FORAGE IN RUMINANT

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Introduction

Sorghum (*Sorghum bicolor L*.), a drought-tolerant cereal crop from the *Poaceae* family native to North Africa (de Morais Cardoso et al., 2017), is widely used in Australia for animal feeding due to its ability to regain growth after water shortage periods (Naharudin et al., 2021). It is an excellent source of bioactive compounds beneficial for animal health, with a chemical composition and nutritional value similar to rice, corn, and wheat (de Morais Cardoso et al., 2017). Along with Napier grass (*Pennisetum purpureum*), known for its high biomass fresh dry matter yield compared to other grasses (Win Muang & San, 2020), sorghum is one of the grass genera widely used for food, feed, and forage worldwide (Harinarayana et al., 2004). Considering Malaysia's low pasture quality, this study aims to investigate the potential of a new sorghum variety as a promising, locally adapted ruminant feed.

Keywords: Sorghum, nutritional value, ruminant animals

Materials and Methods

Three sorghum varieties (UPM SB Line A – 1-3-5, UPM SB Line B – 1-4-3, and UPM SB Line C – 1-1-6) were evaluated. Plants were collected at maturity, separated into whole plant, stem, and grain portions, and subjected to proximate analysis following AOAC (1990) methods to determine dry matter (DM), organic matter (OM), crude protein (CP), and crude fibre (CF). Fibre fractions (NDF, ADF, ADL) were analyzed using the Van Soest method.

Results and Discussion

The analysis shows significant differences in nutritional parameters among varieties and plant parts (Table 1). Across all plant parts, Variety B continuously displayed the highest DM content. The genotypes with the highest OM content were A for grain and B for stem and whole plant. The highest CF concentration was found in variety B for the stem and whole plant, and in variety C for the grain. Variety B had the highest ADF

content of any portion. The varieties with the highest GE content were B for grain, A for stem, and C for the whole plant. The varieties with the highest CP content were A for the entire plant and C for the grain and stem.

Table 1: Analyzed composition (% of dry matter) of three varieties of sorghum.

Nutrient (%)		A	B	C	*P - value*
Dry matter	grain	74.80 ± 0.00 ^{b}	75.68 ± 0.00 ^{a}	74.28 ± 0.00 ^{c}	<.0001
	stem	28.44 ± 0.00 ^{c}	29.63 ± 0.00 ^{a}	28.72 ± 0.00 ^{b}	<.0001
	whole	31.64 ± 0.00 ^{b}	35.30 ± 0.00 ^{a}	30.92 ± 0.00 ^{c}	<.0001
Organic matter	grain	97.60 ± 0.04 ^{a}	97.31 ± 0.07 ^{ab}	96.93 ± 0.26 ^{b}	0.0567
	stem	96.63 ± 0.10 ^{a}	96.83 ± 0.04 ^{a}	96.05 ± 0.04 ^{b}	0.0005
	whole	95.72 ± 0.96	96.80 ± 0.09	93.13 ± 2.98	0.3934
Crude fiber	grain	8.65 ± 0.87	11.56 ± 1.48	12.53 ± 0.80	0.1020
	stem	29.83 ±0.26 ^{b}	35.22 ± 0.98 ^{a}	31.38 ± 1.09 ^{b}	0.0111
	whole	25.60 ± 0.41	29.15 ± 0.98	28.75 ± 1.43	0.0956
Neutral detergan fiber	grain	31.15 ± 1.49	29.67 ± 1.08	45.74 ± 15.28	0.4222
	stem	47.05 ± 10.27	41.75 ± 10.78	50.98 ± 6.31	0.7894
	whole	49.23 ± 7.14	55.15 ± 1.98	55.07 ± 0.60	0.5660
Acid detergent fiber	grain	17.59 ± 0.43 ^{b}	20.15 ± 0.27 ^{a}	19.62 ± 0.71 ^{ab}	0.0245
	stem	34.21 ± 2.15	39.23 ± 0.43	35.44 ± 0.46	0.0759
	whole	33.20 ± 0.15 ^{b}	36.36 ± 0.20 ^{a}	32.15 ± 0.08 c	<.0001
Acid detergent lignin	grain	151.41 ± 15.07	144.77 ± 65.10	186.27 ± 31.22	0.7693
	stem	224.75 ± 58.04	192.38 ± 48.02	315.16 ± 66.13	0.4647
	whole	274.80 ± 103.54	156.50 ± 54.50	158.40 ± 50.46	0.4739
Gross energy	grain	4706.00 ± 28.73 ^{c}	5173.67 ± 45.83 ^{a}	5021.33 ± 9.26 ^{b}	0.0001
	stem	4997.33 ± 24.84 ^{a}	4793.00 ± 32.00 ^{b}	4872.33 ± 32.84 ^{ab}	0.0085
	whole	4804.30 ± 115.91	4879.30 ± 112.69	4893.30 ± 77.32	0.8133
Crude protein	grain	8.69 ± 0.06 ^{b}	8.40 ± 0.12 ^{b}	9.81 ± 0.11 ^{a}	0.0045
	stem	2.26 ± 0.06	2.06 ± 0.03	2.74 ± 0.21	0.0724
	whole	4.08 ± 0.03 ^{a}	3.48 ± 0.04 ^{b}	4.01 ± 0.08 ^{a}	0.0085

^{a,b,c} Means with different superscripts within a column are different at P<0.05 (ANOVA, Tukey' test). Values are given in means ± standard error.

According to Tedde et al., 2021, DM is a component of feed that contains the nutrients required for growth, pregnancy, and lactation. As stated by Weiss and Tebbe (2018), gross energy is necessary to calculate net energy requirements and estimate digestible energy from total digestible nutrients. Similar to maize, the CP content can range from 7.04 to 9.35% (Holman et al., 2018). The study's results indicate that the CP content of the grain portion remains within this reported data range.

Conclusion

The findings provide important new information about the nutritional composition of the different parts of the plant. To sum up, variety B of sorghum has demonstrated a greater nutritional potential. Thus, it could potentially replace Napier grass as fodder for ruminants. Further study is required to compare the antinutritional factors in the three sorghum varieties due to the high levels of antinutritional factors.

Acknowledgement

The authors extend immense gratitude to the Department of Animal Science, Universiti Putra Malaysia.

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Category: Forage Science and Feeding

IN VITRO ACARICIDAL ACTIVITY OF SENNA ALATA LEAVES CRUDE EXTRACT AGAINST RABBIT EAR MITES, PSOROPTES CUNICULI

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Introduction

The ectoparasitic mite, *Psoroptes cuniculi* causes a skin condition known as mange to rabbits (Mohamad-Radzi et al., 2020). Currently, farmers frequently employ chemical pesticides to reduce the ear mites infestation on rabbits, a practice that ultimately results in the development of resistance to these pesticides over time. *Senna alata*, also known as gelenggang in Malaysia shows a promise as a possible botanical pesticide due to its effectiveness and safety (Fatmawati et al., 2020). Many studies have reported the biocidal activities of gelenggang, such as antimicrobial and anti-tick (Oladeji et al., 2020). However, no empirical study was conducted to assess the effectiveness of *Senna alata* against rabbit ear mites, *Psoroptes cuniculi* thus far. Therefore, the objectives of this study are to assess the acaricidal activity of *Senna alata* leaves crude extract against rabbit ear mites and to determine the optimum concentration of the extract to kill the mites by *in vitro* test.

Keywords: Gelenggang, botanical pesticide, mange

Materials and Methods

This study was carried out at the laboratory of the Besut Campus, Universiti Sultan Zainal Abidin. The *Senna alata* leaves were collected from Besut, Terengganu. The crude extract was prepared by drying the leaves dried for a week at 40°C. The ground leaves then were macerated in 100mL distilled water for 120 minutes at 55°C.

Mites were collected from naturally infested rabbits at Expert Rabbitry Global Empire, Kg. Tempinis, Jerteh, Terengganu. Mite bioassays were conducted by following a method from Fichi et al., (2007). The *in vitro* test were conducted in triplicate in six treatments: i) T0 (distilled water only as control); ii) T1 (20% of extract + distilled water); iii) T2 (40% of extract + distilled water); iv) T3 (60% of extract + distilled water); v) T4 (80% of extract + distilled water); vi) T5 (100% of extract).

The extract was spread evenly across the surface of petri dishes (10cm in diameter) using a sterile swab. Then, 20 adults mites (n=20) were placed in each petri dish. The plates were placed in a climatic chamber and the mite's death were counted every two hours within 24 hours. The efficacy of *S. alata* extract againts *Psoroptes cuniculi* were assessed by observing the immobility of the mites, even when stimulated with a needle and the lack of reaction (Ravindran et al., 2012). The percentage of mites mortality was recorded.

Results and Discussion

Figure 1 showed that Treatment 1 with 20% crude extract did not differ from the control treatment, as they both demonstrated a 3.33% mortality rate. The treatment with 40% extract concentration (Treatment 2) showed the lowest mite mortality at 8.33%, while the treatment utilizing 100% *Senna alata* crude extract resulted in the highest mortality rate of 23.33%.

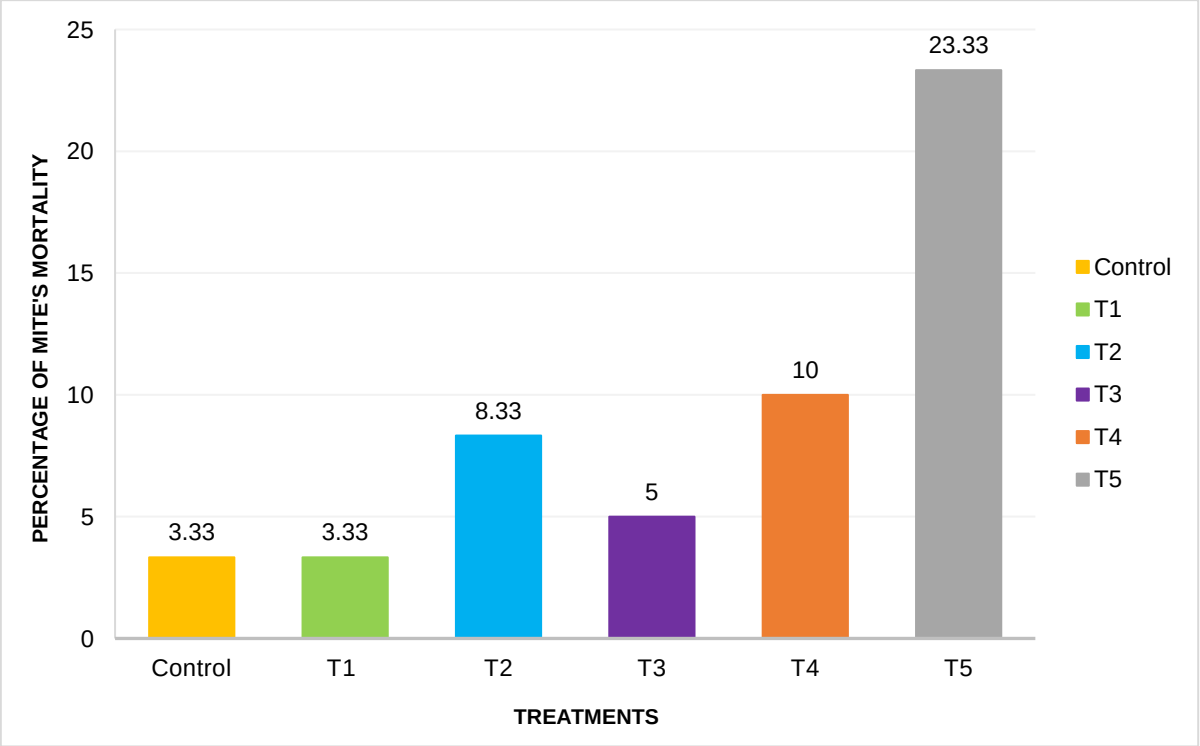


Figure 1. Percentage of mite's mortality for each treatment of T0= Control, T1= 20% of crude extract, T2= 40% of crude extract, T3= 60% of crude extract, T4= 80% of crude extract and T5= 100% of crude extract.

Conclusion

The study demonstrated that treatments with Senna alata extract at concentrations ranging from 40% to 100% exhibited acaricidal activity against rabbit ear mites, *Psoroptes cuniculi*. The treatment utilizing a 100% concentration of the *Senna alata* extract showed the highest mortality rate among the treatments.

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Category: Non-ruminant Production

ENHANCING EGG SHELF LIFE WITH VEGETABLE OIL COATING

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Introduction

Eggs are a rich source of protein, commonly consumed or used as ingredients. Humans typically consume at least 1 or 2 eggs per day. Improper storage of eggs can affect the egg qualities. While refrigeration effectively maintains the quality of fresh eggs in the short term, a vegetable oil coating offers an alternative approach to enhance their shelf life at room temperature. The objective of the study was to investigate the application of vegetable oil coatings, comparing them to uncoated eggs, as safer and more natural materials for egg preservation.

Keywords: eggshell coating, vegetable oil, shelf life

Materials and Methods

A total of twelve clean eggs with an average mean weight about 47 to 48g were collected from 28 local breed hens (Ayam Saga, 43 weeks-old), which were fed a corn-soy diet for eight weeks and kept in an open house with a deep litter floor system under tropical conditions. The chickens were specifically selected for their resistance to heat and adaptation to the local climate. The condition of the open house had a temperature range of 25.2 to 34.7 °C and humidity levels between 49 to 83%.

The eggs were divided into three treatment groups which were fresh eggs, uncoated eggs stored after 28 days, and oil-coated eggs stored after 28 days. For the oil-coated eggs group, eggshells were coated with a thin layer of vegetable oil through an oily kitchen towel which has been wrung thoroughly so it is not dripping before being used. The eggs were put in clean plastic packaging materials. The quality of fresh eggs, uncoated and oil-coated eggs which were stored for 28 days in room temperature from 20.3 to 29.8 ºC and relative humidity of 47–88% were studied.

Haugh units which measure egg protein quality and yolk percentage as an indicator of yolk quality were studied. In egg quality assessment, Haugh unit is determined by measuring the albumen height, which correlates with the egg weight. A higher Haugh unit indicates fresher and higher quality eggs with thicker whites. All data were analysed by one way of analysis of variance (ANOVA) and Duncan's Multiple Range Test was used to compare treatment means.

Results and Discussion

The study investigated the impact of vegetable oil coating on the shelf life of eggs. After 28 days of storage at room temperature, the quality of eggs from uncoated and oil-coated eggs groups declined as shown by significantly ($p<0.05$), increased in yolk percentage and decreased in Haugh unit when compared to fresh eggs. This decline is attributed to the liquefaction of albumen and the yolk absorb water from the surrounding albumen during storage. However, with the average Haugh unit above 61, all the eggs were ranked A according to USDA grade which means the albumen was reasonably firm (Ryu et al., 2011).

Interestingly, oil-coated eggs had better albumen and yolk quality than uncoated eggs although no significant difference was observed between them. These findings suggest that palm oil coating may positively influence the freshness and characteristics of eggs.

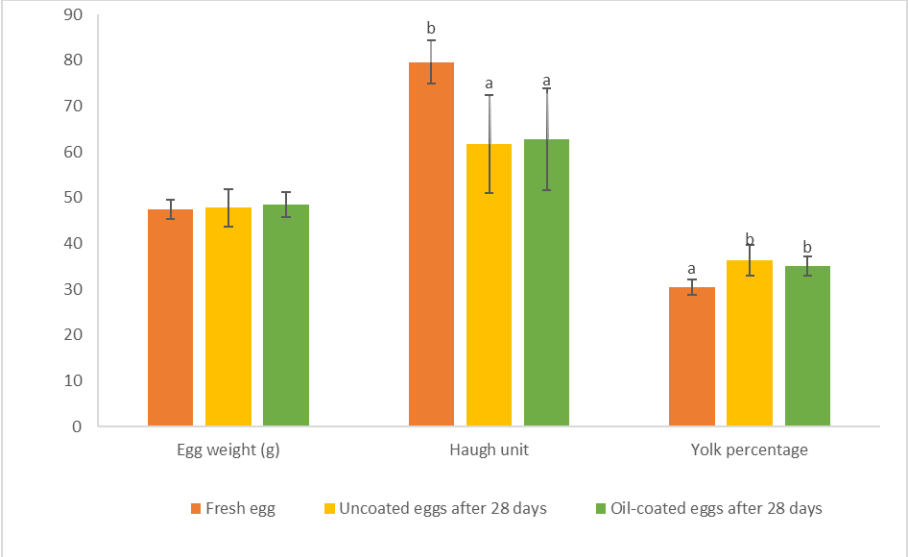


Figure 1. Qualities of fresh eggs, uncoated and oil-coated eggs after stored for 28 days at room temperature.

Conclusion

The study showed that the vegetable oil coating had positive effects on enhancing the egg shelf life within 4 weeks by maintaining the freshness and quality of eggs at room temperature. From production to packaging, storage, and distribution, it promises a bright future for the egg industry.

Acknowledgement

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Category: Poultry Nutrition

EFFECT OF SELENIUM AND SELENIUM-OMEGA-3 FATTY ACIDS MIXTURE ON EGG QUALITY IN AYAM SAGA HENS

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Introduction

Selenium (Se), an essential trace mineral, and omega-3 fatty acids, crucial for various bodily functions, are of particular interest due to their antioxidant properties and role in preventing chronic diseases such as cardiovascular diseases, macular degeneration, and rheumatoid arthritis. By studying egg quality parameters, we seek to understand how these nutrients influence egg quality and potentially offer a functional food that is beneficial for consumption. Thus, the objective of the study was to evaluate the effect of selenium and selenium-omega-3 fatty acids mixture on the quality of eggs from Ayam Saga hens.

Keywords: selenium, omega-3 fatty acids, egg qualities

Materials and Methods

A total of 84 local breed hens of Ayam Saga, aged 21 weeks, were randomly allocated into 3 treatments of 4 replications in randomized complete block design (RCBD). Each treatment composed of 28 birds with 7 birds per replication. Then hens were kept in a floor pen with the size of 54 $feet^2$ in an open house, where the hens had space to move around, dustbathing, scratching and laying on the deep litter floor system. The temperature and humidity of the open house were 24.1 to 35.2℃ and 48 to 83%, respectively. The hens were fed with either corn-soy diet without added Se (control diet, 0% selenium), corn-soy diet with added Se (0.29mg/kg) or corn-soy diet with added Se and omega-3 fatty acids (0.29 mg/kg Se, 0.47% omega-3). After six weeks of feeding, eggs were collected and analysed for the egg weight, Haugh unit and the quantity of Se was analysed by inductively coupled plasma mass-spectrometry (ICP-MS). Haugh unit is a measure used to assess the quality of egg albumen and its unit score was derived from the equation describe by Roush (1981):

$$\text{Haugh unit: } 100 \times \log (h - 1.7\, w^{0.37} + 7.6)$$

where h is the albumen height in mm and w is the egg weight in grams.

All data were statistically analysed according to the IBM SPSS Statistics Version 27 using one way analysis and the Duncan's multiple range test to determine the significance between means.

Results and Discussion

Figure 1 shows the effect of supplementation of selenium and selenium-omega-3 fatty acids mixture on Ayam Saga's egg quality after 6 weeks feeding trial. The study showed that the Se and omega-3 fatty acids diet group had the highest Se content ($P<0.05$) in the egg yolk, followed by the Se diet group and the control diet group. All the groups had no significant difference in egg weight and Haugh unit. However, the Se and omega-3 fatty acids diet group had the highest Haugh unit score. When hens are fed a diet enriched with both selenium and omega-3 fatty acids, a synergistic effect occurs (Kralik et al., 2023). As a result, more selenium gets incorporated into the egg during the egg formation process. These results suggest that the Se and omega-3 fatty acids diet may improve certain aspects of egg quality, i.e. selenium content and albumen quality, without significantly affecting egg weight. Selenium-enriched eggs with reasonable size and thicker albumen (higher Haugh unit) would be preferred by egg producers and consumers.

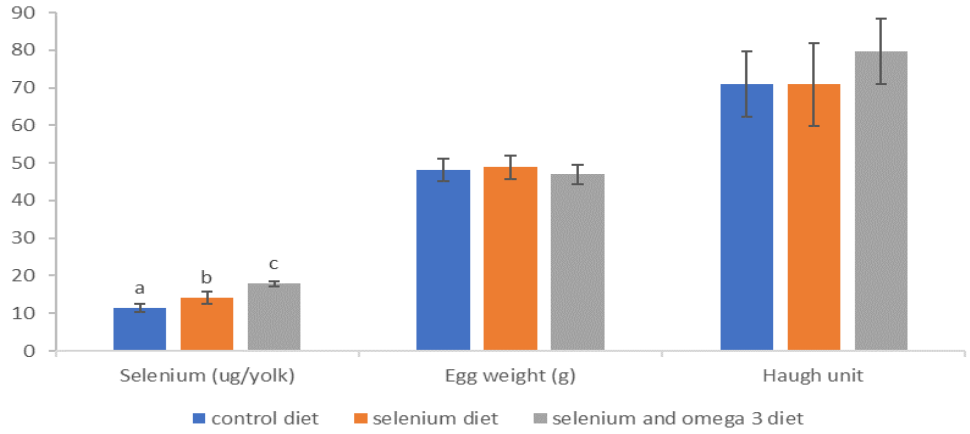


Figure 1. Effect of supplementation of selenium and selenium-omega-3 fatty acids mixture on Ayam Saga's egg quality after 6 weeks feeding trial.

Conclusion

Based on this study, the addition of omega-3 fatty acid in Se supplemented layer diet could be a strategic approach to enhance the nutritional value and quality of eggs, particularly in enhancing selenium content in egg yolks of Ayam Saga.

Acknowledgement

The authors acknowledge the support of Feed and Nutrition Programme, MARDI and all partners to conduct this study. This work was supported by Development Project from Ministry of Agriculture and Food Security.

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Category: Poultry Nutrition

EVALUTION OF GROWTH PERFORMANCE ON SAGA CHICKEN FED WITH *INDIGOFERA ZOOLINGERIANA* LEAVES MEAL SUPPLEMENTATION AS ALTERNATIVE IN POULTRY FEED

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Introduction

Animal feed is the most crucial element for poultry industry and until today the industry is struggling with the unstable price involving importation of feed ingredients especially soybean meal and corn. *Indigofera zoolingeria* is a potential new alternative protein source to substitute soybean meal in animal feed. The crude protein content of *Indigofera zoolingeriana* fresh leaves is relatively high, which is about 27.89% (Abdullah et al., 2010) is a promising to protein substitute in feed. It is expected that high protein content may give a contribution on fulfill protein required for poultry (Zaqi et al., 2019*).* A preliminary study was conducted to determine the growth performance of SAGA chicken fed with feed containing *Indigofera zoolingeriana* leave meal.

Keywords*: Indigofera zoolingerianna*, growth, village chicken, poultry feed, body weight

Methodology

A total of seven hundred one-day-old Saga chicks were randomly allocated to two types of dietary treatment which are Treatment A- commercial feed and Treatment B- formulated feed containing 10% *Indigofera zoolingerian* leave meal*.* Feed B was formulated according to the nutrient requirement for Saga chicken The feed was formulated according to the nutrient recommendations which comply with Ayam Saga nutrient requirement. The feeding trial was started in the 3rd week at starter phase with 0% (control) and 5% *Indigofera*. The trial continued in the 5th week at the grower phase with 0% (control) and 10% *Indigofera* inclusion. The weights of the birds were recorded at the start of experiment and every two weeks until the end of the experiment (Week 11). Weekly feed given and feed residue, daily health check and temperature of poultry house also recorded. Levene's test was conducted to evaluate the normality and homogeneity of variances within the data set. Independent Sample T-Tests was performed to identify significant differences among treatments at a significance level of 5% ($p<0.05$). Statistical analyses were carried out using SPSS Statistics software, version 26.

Result and Discussion

Table 1: Growth Performance of Saga Chickens Fed Commercial Feed (CF) and Indigofera-Supplemented Feed (ISF).

TRT	Week 0* (g)	Week 3 (g)	Week 5 (g)	Week 7 (g)	Week 9 (g)	Week 11 (g)
CF	35.9±4.15	310.8±17.89	611.6±72.50	1170±0.13	1390±0.07	1580±0.25
ISF	36.6±4.71	305.0±24.12	582.0±51.65	1230±0.08	1360±0.06	1600±0.19

Note: Values are presented as mean ±SD. TRT = Treatment, *Week 0 = Day old chick, CF = Commercial feed, ISF = Indigofera-supplemented feed

The results showed that there is no significant difference ($p>0.05$), in body weight of Saga chickens between the CF and ISF groups throughout the experimental period, indicating that at 10% inclusion of *Indigofera zoolingeriana* leaves meal in formulated feed similar body weight of Saga chickens can be achieved as good as those fed with commercial feed. This is supported according (L.N Muhammad, et al) substitution of soybean meal with 15% *Indigofera Zoollingeriana* increased the carcass weight of the grower phase of native chickens.

Conclusion

In conclusion based on this study, *Indigofera* leaves meal can be included in village chicken feed as high as 10% and able to achieve good performance compared to the performance of Saga chickens fed commercial feed. Further research is needed to explore the effects of different inclusion rate of *Indigofera zoollingeriana* leaves meal supplementation on the growth performance of Saga chickens to develop sustainable and cost-effectiveness in feed strategies for the poultry industry.

Acknowledgement

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Category: Poultry Nutrition

INFLUENCE OF MATERNAL BREEDER AGE OF AYAM SAGA HENS ON CHICK GROWTH DYNAMICS DURING THE STARTER PHASE

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Introduction

Ayam Saga, a local village chicken breed and it is a dual-purpose breed for meat and egg production. The meat-producing Ayam Saga can be harvested at 10-12 weeks, with male and female chickens reaching a minimum weight of 1.5kg and 1.2kg, respectively. Maternal breeder factors such as body weight, age, and sex can influence the growth performance of broiler chickens. The same holds true for village chicken meat production. This study investigated the effects of maternal breeder age on chick weight and growth rate of Ayam Saga during the starter phase, elucidating the importance of considering maternal age in poultry management practices.

Keywords: Ayam Saga, maternal breeder age, growth dynamic, starter phase

Materials and Methods

The research was conducted at the Poultry Unit of the Livestock Science Research Centre, MARDI Kluang, Johor. Day-old Ayam Saga chicks were obtained from the Ayam Saga Grandparent Stock Farm located at MARDI Muadzam Shah, Pahang. A total of 600-day old chicks (DOC) from two (2) groups of breeders aged 26 and 65-week-old were allocated into 6 floor pens, following a randomised complete block design with three replications. The experiment lasted four weeks, during which chicks received *ad-libitum* feed and clean water. Beak trimming was performed at two weeks old using commercial electric de-beakers, with anti-stress treatment administered before and after the procedure. Body weight data were collected weekly from 30 randomly selected chicks per treatment. Levene's test was conducted to evaluate the normality and homogeneity of variances in the dataset. Independent Sample T-Tests was performed to identify significant differences among treatments at a significance level of 5% ($p<0.05$). Statistical analyses were conducted using IBM SPSS Statistics software (version 26).

$$\text{Growth Rate} = \frac{\text{Final Weight (g)} - \text{Initial Weight (g)}}{\text{Number of Weeks}}$$

Result and Discussion

Chicks from 65-week-old hens showed a significantly higher initial weight (34.90 ± 2.76g) compared to those from 26-week-old hens (28.53 ± 1.53g) ($p<0.05$) at day-old. However, from week 1 onwards, chicks from 26-week-old hens consistently achieved higher growth rates than 65-week-old hens. On Weeks 2 and 3, chicks from 26-week-old hens demonstrated significantly greater weight gains (86.17g and 71.13g, respectively) compared to those from 65-week-old hens (69.83g and 61.27g, respectively) ($p<0.05$). By week 4, although the difference was not statistically significant, chicks from younger hens still maintained a slightly higher weight than those from older hens, with gains of 97.44g and 85.07g, respectively. While chicks from older hens initially showed a higher birth weight, they subsequently displayed slower growth rates (61.27g/week) than those from younger hens with growth rates 63.94g/week.

Table 1: Effect of breeder age of Ayam Saga breed on progeny live weight during 4 weeks of starter phase.

Breeder age	Live weight of chickens (g)				
	Week 0 (Day 1)	Week 1	Week 2	Week 3	Week 4
26 weeks old hen	28.53±1.53[a]	57.10±7.56[a]	115.70±14.99[a]	186.83±24.69[a]	284.27±20.32[a]
65 weeks old hen	34.90±2.76[b]	58.30±7.29[a]	104.73±19.87[b]	166.00±26.17[b]	279.97±14.77[a]

[a, b] Means values within each column with different superscripts differed significantly ($p< 0.05$) Note: Values are presented as mean ±SD.

Kadam et al. (2018) stated that chick growth performance was adversely affected by maternal age, with chicks from older hens displaying slower growth rates than younger ones. Silva et al. (2007) mentioned that breeder age significantly impacted broiler chickens' growth and physiological development, with older breeders often producing offspring with reduced growth rates and altered physiological parameters compared to younger breeders.

Conclusion

In conclusion, maternal breeder age significantly influences the chick growth performance of Ayam Saga during the starter phase, with chicks from younger hens exhibiting faster growth rates compared to those from older hens. Poultry management practices should consider maternal breeder age to optimise chick growth and overall productivity. The selection of younger hens for breeding may contribute to improved growth performance during the starter phase.

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Category: Poultry Nutrition

IMPACT OF FISH OIL DIETARY SUPPLEMENTATION ON GROWTH PERFORMANCE OF AYAM SAGA HENS

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Introduction

Indigenous village chicken breeds play a significant role in the agricultural sector due to their adaptability to local environments and potential for sustainable poultry production. However, enhancing the growth performance and productivity of indigenous village chicken remains a challenge for poultry researchers and farmers. Ayam Saga, a local village chicken breed, represents a valuable genetic resource known for its adaptability to local environment and robustness. Previous research has indicated that dietary manipulation, including the incorporation of specific nutrients like fish oil, can significantly impact poultry growth and performance (Garcia et al., 2020). Therefore, the present study investigated the effect of fish oil dietary supplementation on the growth performance of Ayam Saga hens.

Keywords: Dietary supplementation, growth performance, Ayam Saga, indigenous village chicken, fish oil.

Materials and Methods

The study was conducted at the Poultry Unit of the Livestock Research Centre, MARDI Kluang, Johor. A total of 63 Ayam Saga hens aged 29-week-old were randomly assigned to three dietary treatments: T1: basal diet (CO), T2: basal diet + 0.3969% fish oil (FO1), T3: basal diet + 0.4410% fish oil (FO2) according to randomised complete block design (RCBD). Each treatment consisted of 3 replicates, with seven hens per replicate. The hens were fed *ad libitum* with approximately 100g/day of mash feed and supplied with clean water *ad libitum* throughout the study period. Body weight data were recorded at the beginning of the study (week 0) and subsequently at 4-week intervals until 12 weeks. The Shapiro-Wilk test was conducted to evaluate the parametric dataset's normality and homogeneity of variances. Analysis of variance (ANOVA) was performed to identify significant differences among treatments at a significance level of 5% ($p<0.05$). Significant differences among treatments were determined using Duncan's Multiple Range Test (DMRT) ($p<0.05$). Statistical analyses were conducted using SPSS Statistics software (version 26).

Result and Discussion

Table 1: Effect of fish oil dietary diets on body weight of Ayam Saga Hens.

Dietary diets	Live weight of chickens (kg)			
	Week 0	Week 4	Week 8	Week 12
CO	2.18[a]	2.07[a]	2.25[a]	2.25[a]
FO1	2.05[a]	2.11[a]	2.27[a]	2.28[a]
FO2	2.10[a]	2.25[a]	2.48[b]	2.48[b]

[a, b] Means values within each column with different superscripts differed significantly ($p < 0.05$)
Note: Values are presented as mean ±SD. CO = basal diet (control), FO1 = 0.3969% fish oil + basal diet, FO2 = 0.4410% fish oil + basal diet

The results of the feeding trial are presented in Table 1. At the initiation of the feeding trial (Week 0), all treatment groups exhibited similar mean body weights, as indicated by the absence of significant differences ($p>0.05$) among the control (2.18kg), FO1 (2.05kg) and FO2 (2.10kg). As the trial progressed, notable differences in body weight emerged among the treatment groups. By Week 8, hens in the FO2 group exhibited a statistically significant increase ($p<0.05$) in mean body weights of 2.48kg compared to both the control and FO1 groups of 2.25kg and 2.27kg, respectively. This trend persisted through Week 12, with hens in the FO2 group maintaining a significantly higher ($p<0.05$) mean body weight of 2.48 kg, while those in the control and FO1 groups had mean body weights of 2.25 kg and 2.28kg, respectively. The observed increase in body weight in the FO2 group suggests a positive effect of high-dose fish oil supplementation on the growth performance of Ayam Saga hens. This finding is consistent with previous research by Song et al. (2018), who reported enhanced growth performance in broiler chickens fed diets supplemented with fish oil.

Conclusion

In conclusion, dietary supplementation with fish oil, particularly at 0.4410% (FO2), can positively impact the growth performance of Ayam Saga hens. However, further research is required to explore the potential additional effects of fish oil supplementation beyond body weight gain, such as on egg production and internal and external egg quality.

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Category: Poultry Nutrition

EFFECT OF *INDIGOFERA ZOOLINGERIANA* INCLUSION ON CARCASS YIELD AND ABDOMINAL FAT OF AYAM SAGA

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Introduction

Alternative local protein sources are rapidly studied to substitute imported materials whose prices keep increasing. *Indigofera sp*., a plant-based protein source has the potential to be included in feed with total crude protein content ranging from 22-28%, 3.7% crude fat and 14.96% crude fibre (Santi, 2018). A previous study by Warmana et al., 2023, reported that the administration of Indigofera leaf had no significant difference in growth and carcass on native chicken. Thus, the aim of this study was to evaluate the effect of Indigofera inclusion in feed on the carcass yield of Ayam Saga.

Keywords: Ayam Saga, Carcass, Indigofera

Materials and Methods

Small farm trial with a total of 660-day-old chick (DOC) of the local breed Ayam Saga, were conducted by randomly allocating the birds into 2 dietary treatments. For each treatment group, 330 birds were housed in an open house with intensive deep litter floor system. The temperature and humidity of the open house were not over 36℃ and around 70%, respectively. The chickens were fed with isocaloric and isonitrogenous feed formulated based on the nutritional requirement for Ayam Saga. The chickens were fed on corn-soybean meal diet from day 1 till end of week 2 (starter phase). The feeding trial was started on the 3rd week during starter phase with 2 diets, 0% (control) and 5% Indigofera. The trial continued on the 5th week at the grower phase with 2 grower diets, i.e. 0% (control) and 10% Indigofera inclusion. At the end of the experimental trial (week 11), ten birds from each treatment were randomly selected, weighed, and slaughtered according to the Halal procedure described in the Malaysian Standard (Malaysia, 2009). Processed weight is defined as chicken without feathers, head, legs, and internal organ.

All data were statistically analysed using the one-way analysis of variance (ANOVA) procedure from the SAS 9.4 program and Duncan's multiple range test was used to determine the significance between means at a level of P value <0.05.

Results and Discussion

Table 1 shows the effect of Indigofera inclusion on carcass yield and abdominal fat on Ayam Saga. There was no significant effect (P<0.05) of feeding diets containing *Indigofera* to female Ayam Saga on live weight, process weight, carcass yield and

abdominal fat. Meanwhile, for male Ayam Saga, a significant 3% increment of carcass yield and 67% reduction of abdominal fat with 10% *Indigofera* inclusion were observed.

Table 1. Effects of *Indigofera* inclusion on carcass yield and abdominal fat of Ayam Saga.

Parameter	Saga male			Saga female		
	Control	10% *Indigofera*	*p*-value	Control	10% *Indigofera*	*p*-value
Live weight (g)	1717.4 ± 27.26	1740.7 ± 42.35	0.6563	1281.9 ± 13.28	1279.5 ± 22.64	0.927
Processed weight (g)	1153.4 ± 19.26	1223.8 ± 35.27	0.1179	883.2 ± 16.58	885.20 ± 22.87	0.945
Carcass yield (%)	67.16 ±0.48^{b}	70.28 ±0.63^{a}	0.0042	68.89 ±0.95	69.20 ±1.40	0.860
Abdominal Fat (%)	0.72 ±0.05^{a}	0.24 ±0.02^{b}	0.001	1.00 ± 0.09	0.79 ± 0.06	0.100

Mean ± standard error of the mean in the same row with different alphabets are significantly different at $p<0.05$.

Conclusion

Based on this study, *Indigofera* was shown to be a potential feedstuff for chicken without compromising the final body weight of the chicken and it was even able to improve carcass yield with leaner meat. It could be a strategic approach to enhance the application of plant-based protein in poultry feed for higher processed yield and lesser fat chicken.

Acknowledgement

The authors acknowledge the support of Feed and Nutrition Programme, MARDI, and all partners to conduct this study. This work was supported in part by Development Project from Ministry of Agriculture and Food Security.

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Category: Ruminant Production

EVALUATION OF FORMULATED PROTECTED FAT FROM USED COOKING OIL (UCO) ON GAS PRODUCTION, NUTRIENT DIGESTIBILITY, AND RUMEN FERMENTATION: AN *IN-VITRO* STUDY

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Introduction

Used cooking oil (UCO), a residual product derived from cooking oils such as palm olein, is deemed unsuitable for human consumption (Orjuela & Clark, 2020; Teixeira et al., 2018). However, it serves as a valuable fat source for animal feed due to its characteristics and can fulfill low-cost material needs not met by other food crops (Panadare & Rathod, 2015). Therefore, in this study, UCO was utilized in the preparation of formulated protected fat (PF) through fusion process. Despite its potential, there is limited research on the effects of diets supplemented with used cooking oil protected fat (UCOPF) on *in-vitro* gas production, nutrient digestibility, and rumen fermented products. Thus, this study aims to investigate these effects, along with comparing UCOPF with other dietary fat supplements such as palm olein (PO), palm oil protected fat (POPF), and commercial protected fat (CPF) on *in-vitro* fermentation.

Keywords: Used cooking oil protected fat, animal supplement, *in-vitro*

Materials and Methods

1. Preparation of protected fat: Used cooking oil underwent purification and saponification processes before being dried and ground into flakes.
2. Dietary fat and substrate formulation: Various dietary fat treatments, including protected fats, are compared in a diet with a roughage-to-concentrate ratio of 70:30, using guinea grass and commercial concentrates.
3. *In-vitro* fermentation protocol: *In-vitro* incubation involves placing dietary fats and substrate in syringes, infusing with rumen liquid, and recording gas production over time, followed by pH and nutrient analysis.
4. Data analysis: Gas production data were analyzed using a non-linear model, while pH, dry matter digestibility, ammonia, and volatile fatty acids were measured to assess fermentation outcomes.

Results and Discussion

It indicated no significant difference (P<0.05) in cumulative gas production among dietary treatments during the incubation period.

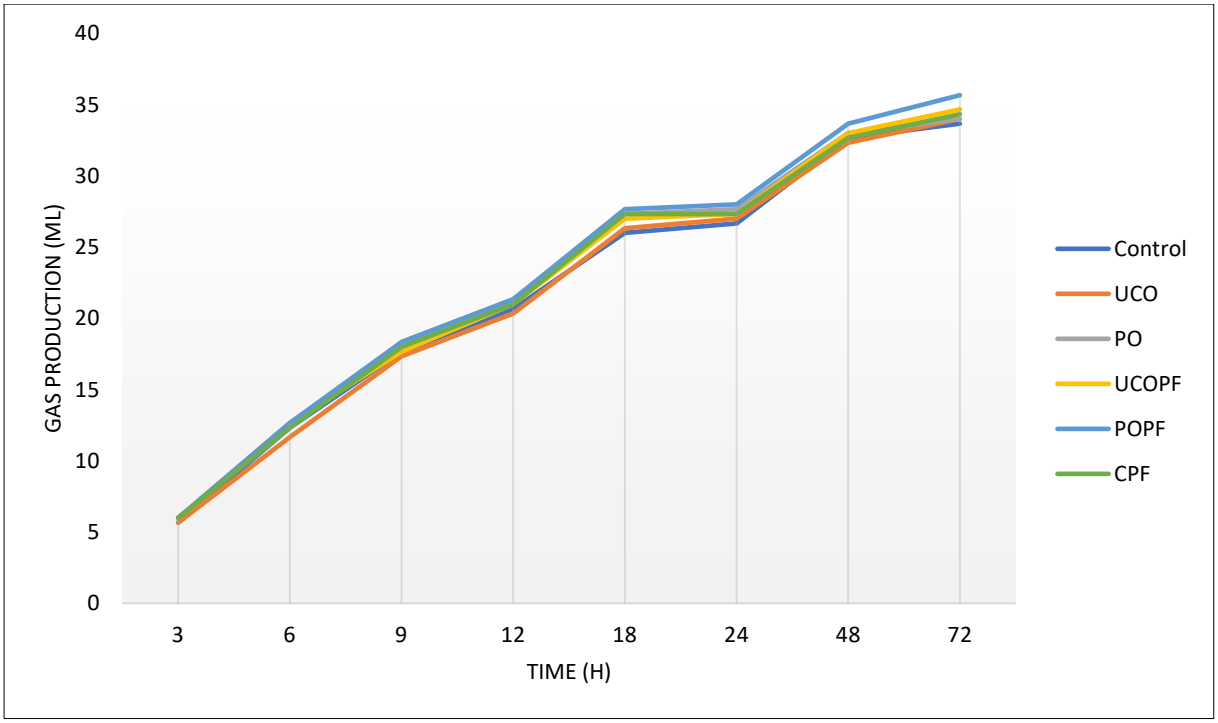


Figure 1: The effect of formulated UCOPF with comparison of different fat supplement on gas production.

Gas production kinetics, including fermentation of soluble and insoluble fractions, were similar across all dietary groups compared to the control. However, soluble fraction fermentation was notably higher in the UCOPF group than the POPF group, suggesting easier fat digestion. Our findings imply that UCOPF may offer less protection against rumen microorganism metabolism compared to POPF. Gas generated during incubation reflects substrate degradability and fermentability, crucial for rumen microorganisms' energy supply. Despite predictions of UCO and PO inhibiting fermentation due to their unprotected forms, inclusion rates of 6% were insufficient. Previous studies support minimal impact of similar fat additions on gas production, highlighting the nuanced effects of different fat sources on rumen fermentation.

Conclusion

The addition of fat in the form of oil and protected fat to *in-vitro* setups up to 6% did not adversely affect the characteristics of rumen fermentation suggests that fat has a smaller impact on production of gas, digestibility of nutrients, and rumen fermentation products.

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Category: Ruminant Production

MILK YIELD COMPARISON OF JERSEY FRIESIAN AND SAHIWAL FRIESIAN REARED IN KENINGAU, SABAH

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Introduction

The Dairy Cattle Project in Sabah started in 1980 at the Sebrang Livestock Breed stations, Keningau and Tawau (Malaysia Plan, 1981-1985). This project involved small land holders with the intention of forming the dairy industry and thereby increasing urban residents' income in conjunction with the New Economic Foundation (Salleh, 1989). In 2018, Sabah contributed 22.7% (9.2 million litres) of the total milk production in Malaysia (DVS, 2018). The breeds of dairy cattle reared in Sabah were crossbred Sahiwal and Friesian. Meanwhile, local born cattle is known as Sabah Sahiwal Friesian (SSF). However, to maintain and improve the milk production from year to year, rearing an improved breed of dairy cattle should be emphasised. Introducing a new breed in the population is one of the alternatives that can help to enhance the production. In 2018, Jersey Friesian was chosen as a potential breed to rear in Sabah and distributed to farmers. This study was conducted to compare the milk yield between Jersey Friesian and Sahiwal Friesian in Keningau.

Keywords: Jersey Friesian, milk yield, Sahiwal Friesian, Keningau

Materials and Methods

A total of 24 animals of Sahiwal Friesian (n=12) and Jersey Friesian (n=12) were used in this experiment. This experiment was conducted at a dairy farm in Keningau, Sabah. Formulated feeds were fed at 3.5% of their body weight and fresh grass were given *ad-libitium*. The total volume of milk produced were recorded daily. Data was analyzed using SPSS statistical software program 16.0 (SPSS Inc., Chicago, IL, USA). The groups were compared using t-Test at $P<0.05$.

Results and Discussion

Figure 1 shows that the milk yield of Sahiwal Friesian and Jersey Friesian were not much differ starting from month 2 towards the end of the lactation cycle. However, Jersey Friesian shows more milk production compared to Sahiwal Friesian. The highest peak of milk yield recorded was 224.65kg of Jersey Friesian at third month of milking compared to Sahiwal Friesian. However, an optimum milk yield can be achieved with a good feed formulation (Wan Zahari and A.R. Alimon, 2013).

Table 1. Nutrient composition of formulated feed

Nutritive value	Formulated feed
ME, (MJ/kg)	14.98
CP (%)	13.80
CF (%)	14.20
Fat (%)	5.23
Ash (%)	7.23
Ca (%)	0.86
P (%)	1.19

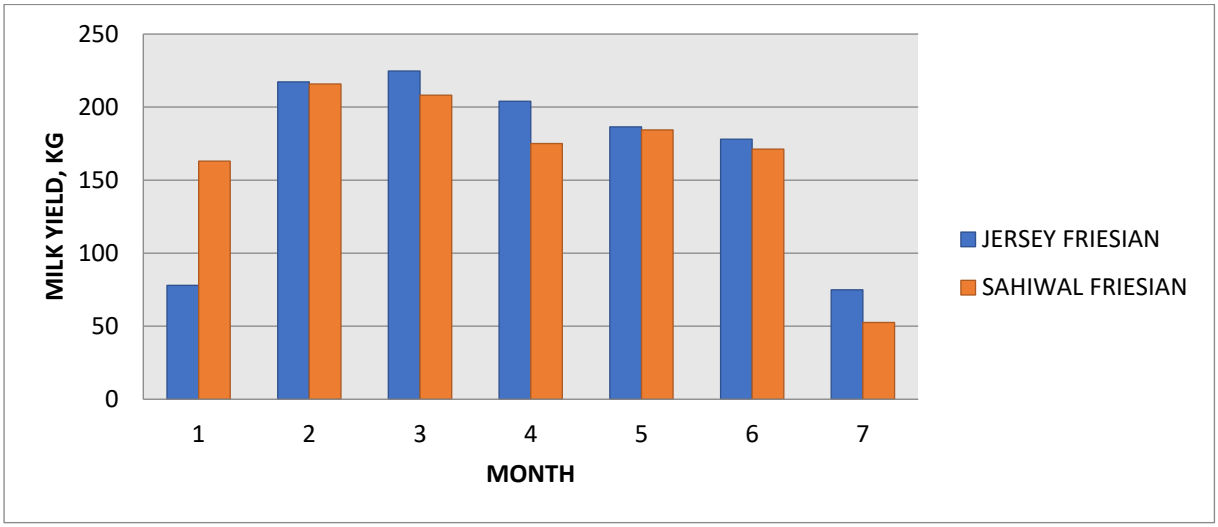


Figure 1. Milk yield of Jersey Friesian and Sahiwal Friesian in Keningau

Conclusion

As a conclusion, Jersey Friesian can be considered as a potential breed in dairy industry for Sabah. However, further research in various factors need to be done in future.

Acknowledgement

Above all, to the Great Almighty, the author of knowledge and wisdom, for his countless love. The authors also would like to acknowledge DoVSAI and MARDI for their support and funding.

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Category: Ruminant Production

THE USE OF THE FOURIER TRANSFORM INFRARED (FTIR) SPECTROSCOPY TO DETERMINE THE ADULTERANTS IN RAW COW MILK AND ITS IMPACT ON TOTAL SOLID (TS)

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Introduction

Fourier Transform Infrared Spectroscopy, (FTIR) is an analytical technique used to identify organic, polymeric, and inorganic materials (https://rtilab.com/techniques/ftir-analysis/). This method has been applied to detect adulterants in milk and for milk quality analysis. The main purpose of milk/food adulteration is to alter the quality of milk/food products for economic advantage. Some of the major adulterants in milk that have serious adverse health effects are urea, formalin, detergents, ammonium sulphate, boric acid, caustic soda, benzoic acid, salicylic acid, hydrogen peroxide, sugars and melamine. In Malaysia, FTIR method had been used to discriminate and quantify urea as an adulterant in UHT milk (Tan et al., 2023) and to classify raw bovine's milk samples according to their geographical origin in Peninsular Malaysia (Ketty et al., 2017). This study aims to test FTIR machine's accuracy in detecting adulterants in raw cow milk samples, to detect the effects of adulterants on Total Solid (T) value and to determine the correlation between adulterants and the Total Solid (TS) value in milk.

Keywords: Fourier Transform Infrared Spectroscopy, adulterants, milk total solid

Materials and Methods

Five adulterants were used, namely urea, sucrose, sodium bicarbonate, potassium nitrate and formaldehyde. A set of concentration for each adulterant was used based on Limit of Detection (LOD) of the milk analyzer. All of the concentration were set up below/equal/above LOD value in multiples of two for each concentration (Table 1). Milk samples were stored at 4°C and was tested within 24 hours using Milkoscan Mars Machine. The data was analyzed by regression method using Excel 2007 and Statistical Analysis SPSS version 22.

Results and Discussion

The correlation coefficient (R^2) between the expected and predicted values and the calibration curve's linear regression equation demonstrated that all adulterants performed best with the R^2 value were more than 0.99 and the accuracy was nearest to zero (Table 2). Previous research successfully proved that the infrared technique is very robust, sensitive (Fazal et al., 2019) and accurate (Laerte et al., 2011) in detecting the presence of adulterants in milk. Analysis revealed that the TS value increased as the adulterant concentration increased. However, sodium bicarbonate showed the

reverse effect. Analysis of R^2 between TS and type of adulterant shows a very strong relationship where all the adulterant has a high value of correlation, that is more than 99.0%. However, the addition of adulterants in milk can be harmful to human health and should be avoided.

Table 1. Types of adulterants, LOD values and concentration used

ADULTERANTS USED	LOD (%)	CONCENTRATION (%))
Urea, BioXtra	0.04	0.02, 0.04, 0.08, 0.16, 0.32, 0.64
ACS Reagent Sucrose	0.25	0.13, 0.25, 0.5, 1.0, 2.0, 4.0
Sodium bicarbonate, ≥99.5%,	0.06	0.01, 0.02, 0.04, 0.08, 0.16, 0.32
Potassium nitrate	0.02	0.01, 0.02, 0.04, 0.08, 0.16, 0.32
Analytical grade 37% formaldehyde	0.07	0.04, 0.07, 0.14, 0.28, 0.56,

Table 2. The correlation coefficient (R^2) and the accuracy value

Adulterants	Correlation Coefficient (R^2)/%	Standard Error of Estimation (Se)
Urea (% w/v) *	0.9993/ 99.93%	0.008
Sucrose (% w/v) *	0.9997/ 99.97%	0.035
Sodium bicarbonate (% w/v)*	0.9997/ 99.97%	0.006
Potassium nitrate (% w/v)*	1.00/ 100.00%	0.002
Formaldehyde (% v/v)*	0.9995/ 99.95%	0.006

*R^2= coefficient of determination; Se= accuracy; % w/v= grams adulterant in 100mL of milk; % v/v= mL adulterant in 100mL of milk

Conclusion

In conclusion, the FTIR machine demonstrated good accuracy in detecting a variety of potential adulterants in milk. This study also clearly shows that the addition of adulterants in milk has a significant effect on increasing the TS value of milk. However, some adulterants are too harmful to be overlooked. Therefore, the authorities strictly need to check the quality of the milk before it is marketed to the public to ensure safety.

Acknowledgements

The authors wish to thank the Director General of DVS and Director of VRI, Ipoh, Perak for permission to present this article. We would also like to thank all the staff involved in this study for their help and support.

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Category: Ruminant Production

PRELIMINARY ANALYSIS OF MILK COMPOSITION AND STRUCTURAL CHARACTERISTICS IN 'PADI' HORSES FROM THE EAST COAST OF PENINSULAR MALAYSIA

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Introduction

The increasing horse population in Malaysia due to the growth of the economic sector from equestrian sports has become an eye-opener for the equine industry to grow bigger possibly in the dairy sector (Lindberg et al., 2015). Locals from the east coast of Peninsular Malaysia have been seen to be drinking horse milk on a small scale, but it shows there might be a demand and marketplace for this unpopular dairy source. However, the lack of research on horse milk in Malaysia has restricted the possibility of introducing horse milk into our daily lives in a variety of fields, including medicine, human nutrition, and product development. Despite its global importance, the status and development of horse milk production in Malaysia remain largely unknown. Therefore, the study aims; to determine milk composition and to evaluate the structure of milk Padi Horses.

Keywords: Padi horses, equine milk, milk composition, FTIR.

Materials and Methods

The milk sample was collected from horse stables around Bachok, Kelantan and Gong Badak, Terengganu. Laboratory work was conducted in the Sensitive 1 Laboratory, Faculty of Bioresources & Food Industry, Unisza.

Ethics approval

The UniSZA Animal and Plant Research Ethics Committee authorized the sampling method and experimental methods with permit no: UAPREC/008/019.

Animal selection

Animals were selected based on the same characteristics such as BCS 5-7, symmetrical udder, health status, and breed. The lactating horses were all of the same breed which is Padi breed, regardless of their age and parity status.

Sample Collection

Milk samples were collected from 5 healthy Padi mares (n=5). 50 mL milk samples were collected from each mare and stored inside the freezer for further analysis.

Sample preparation and Analysis

This study used 2 analytical instruments for milk analysis namely Fourier Transform Infrared Spectroscopy (FTIR) and Milkotester Ultrasonic Milk Analyzer (Bulgaria) for determining the content of the horse's milk. The milk samples were thawed and mixed well before analyzing. The Milkotester provided information on percentage of the horse milk composition which measures the fat content, solids-non-fat (SNF), protein and lactose. Samples were run several times, and the average value was recorded. All spectra were recorded in the mid-infrared range (4000-650 cm^{-1}) with air as background and were recorded in absorbance mode to enable quantitative analysis using the Lambert-Beer law. The data was controlled using the TQ Analyst® program.

Data Management and Statistical Analysis

The Microsoft Excel spreadsheet was used to manage and record raw data from sampling and analysis. Descriptive data, such as the percentage of protein and fat, were used to summarize the proportion of milk composition using one-way ANOVA (Minitab version) to observe fat composition between lactation stages. Data were expressed as average± SE. P value was considered significant if $P < 0.05$. FTIR analysis was plotted in one graph to represent the milk structure of Padi horses.

Results and Discussion

Figure 1 demonstrated that horse milk composition between 5 Padi horses shows an average value where solid-non-fat exhibits the highest percentage among other content in milk composition with 8.61%. The second-highest compound found was lactose with a total amount of 4.69%. Next, protein was found in horse milk composition with an average of 3.13%. The lowest amount of compound in horse milk composition was fats with 1.93%. Similar observations were also reported by (Мусаев et al., 2021). Although equine milk differs in composition from that of other domestic species, it shares a notable resemblance to human breast milk (Claeys et al., 2014).

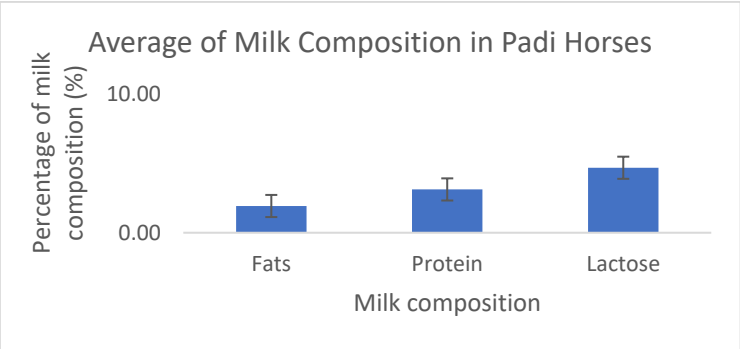


Figure 1: Average milk composition in Padi horses

Based on figure 2, protein was observed based on amide I and amide II bands falling in the spectral range from 1700 cm−1 to 1600 cm−1 and 1570 to 1550 cm−1, respectively, while fat was perceived based on the C-H bond. The peak at wavenumbers of 3320 cm^{-1} was due to -OH stretching vibration coming from water

contents of milk as shown in Figure 2. Specifically, absorption peaks presented characterized the amide bands at 1635 cm^{-1} and 1455 cm^{-1}. This was consistent with the milk composition results, which showed a high lactose and protein but low in fat composition. The findings were consistent with a prior study where these components were found in significant levels in horse milk (Barreto et al., 2019).

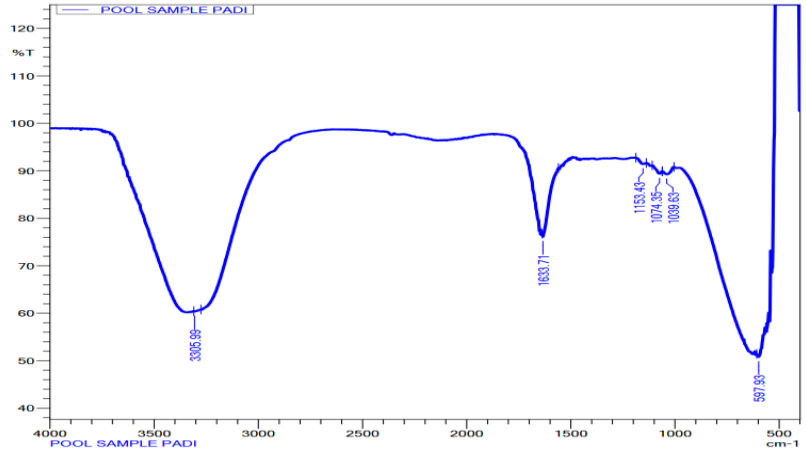


Figure 2: FTIR spectra of horse milk.

Conclusion

The current study provides a comprehensive understanding of the horse milk composition and structural characteristics of the milk from local breed which is 'kuda padi'. This finding suggests that horse milk exhibits almost similar structure to human milk. Therefore, it is not suitable to be consumed by people with lactose intolerant conditions.

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Category: Ruminant Production

EFFICIENCY IN GOAT MEAT PRODUCTION: A CASE STUDY

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Introduction

The current food system encounters two significant challenges: first, addressing the environmental externalities generated by food production, and second, ensuring that the growing global population can access sufficient food to meet its nutritional needs. Implementing strategies such as efficiency, sufficiency, and consistency is crucial to ensure that the global population has access to an adequate food supply. One commonly used metric for assessing efficiency in meat production is the dressing percentage, which is the ratio of carcass weight to the live weight of the animal. Typically, the dressing percentage for goats varies between 35% and 56%, depending on breed, sex, age, weight, and conformation (Assan, 2015). Moreover, the Food and Agriculture Organization of the United Nations (FAO), through its Global Livestock Environmental Assessment Model, recommends a dressing percentage of 48% for goats in East and Southeast Asian countries. Consequently, this study was undertaken with the aim of evaluating the efficiency of meat production by determining the dressing percentage of goats.

Keywords: dressing percentage, goat, carcass weight, meat production, breed

Materials and Methods

A total of 163 samples were successfully gathered from goat slaughtering activities conducted at a slaughterhouse in Shah Alam, Selangor. Measurements of live weight and carcass weight of goats were obtained using a digital scale and recorded on a standardized data collection form. Information on gender, age, and breed is also recorded for every sample collected. Descriptive statistics were employed to determine the mean of live weight and carcass weight, while an ANOVA test was carried out to assess the influence of breed on the mean carcass weight.

Results and Discussion

Data analysis shows that majority of the slaughtered goats are classified as other breeds (50.9%), followed by Katjang (28.8%), Boer (11.7%), and Jamnapari (8.6%). However, the specific types within the "others" breed were not detailed. Age-wise, 74.5% of the goats were mature, aged between 3 and 4 years, while only 1.2% were below 3 years old at the time of slaughter, and 24.2% were older than 5 years (adult). In terms of live weight, the majority of the slaughtered goats weighed over 30 kilograms, with only 11% under this mark and 13.5% exceeding 60 kilograms. The

average live weight (mean) was 43.84±11.39 kilograms. For carcass weights, 20.9% weighed 15 kilograms or less, 76.7% fell between 16 to 30 kilograms, and 2.5% were over 30 kilograms. The average carcass weight measured was 20.31±5.56 kilograms, and the recorded average dressing percentage was 46.19%. The ANOVA test conducted revealed significant differences in average carcass weights among the goat breeds [$F(3, 159) = 15.10$, $p<0.05$]. Further analysis using Tukey's post-hoc test classified the average carcass weights into two distinct groups: Group K1 (Katjang and Others) and Group K2 (Boer and Jamnapari). These analytical details are outlined in Table 2. Based on the analysis conducted, it is likely that the goat samples categorised under "others" consist of crossbred Katjang goats. This inference is supported by the research of Ernie Muneerah, M.A. et al (2021), which highlights the low availability of purebred Katjang goats and the risk of extinction facing the Malaysian indigenous Katjang breed.

Table 2. Carcass weight (kilogram) and dressing percentage for samples collected according to breed.

Breed	No. of samples	Carcass Weight	Dressing Percentage
Katjang	47	17.69±3.77[a]	45.38±0.73
Boer	19	26.16±4.87[b]	47.20±0.81
Jamnapari	14	23.56±6.76[b]	46.41±2.38
Others	83	19.92±5.18[a]	46.39±0.71

Mean values of carcass weight with different alphabets[ab] are significantly different at $p<0.05$ (ANOVA, Tukey' test). Values are given in mean±standard deviation.

Conclusion

The results of this study indicate that the average dressing percentage of goats stands at 46.19%, which is within the previously recorded range of 35% to 56%. However, this value is 2 percentage points below the 48% benchmark recommended by FAO. To enhance meat production, it is recommended that farmers select either the Boer or Jamnapari breeds, as these demonstrated higher carcass weights, suggesting greater meat production efficiency.

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Category: Ruminant Production

EFFECT OF DIFFERENT ENERGY LEVEL IN CATTLE FEED ON BRAKMAS YEARLINGS GROWTH PERFORMANCE

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Introduction

Energy level in animal feed, is essential as it supports animal growth and functional development. There are many kinds of commercially available animal feed to support animal feed requirement. Due to the current surge in feed ingredient prices, the existing feed options have become prohibitively expensive for small-scale farmers. *Bos indicus* differ from *Bos taurus* in its size, meat percentage within carcass and its ability to deposit fat intra-muscularly. Since the 1970s, the practice of crossbreeding *B. indicus* with *B. taurus* has been undertaken to enhance the body structure and increase the meat percentage within *B. indicus* carcasses. To cater its nutritive need, commercial feed nutritive values are formulated based on *B. taurus* cattle requirement. Nevertheless, due to inability of *B. indicus* (local cattle) and its crosses to deposit fat intramuscularly, these excessive energy in form of fat often deposited within peritoneum cavity, affecting its dressing percentage. In order to reduce feed cost, formulating feed for local cattle should be based on *B. indicus* requirement and utilizing locally available feedstuffs as much as possible in the formulation. The objective of this study was to evaluate the feeding effect of different type of feed with different energy levels on Brakmas (*B. taurus* crosses) male yearlings bodyweight gain; daily weight gain and feed conversion efficiency.

Keywords: Brakmas, yearlings, energy manipulation, body weight gain, feed efficiency

Materials and Methods

A total of 18 heads of Brakmas male yearlings weight between 250 to 300 kg were randomly allocated to three groups. Two groups were assigned to one of the two experimental diets with different energy levels i.e. 50.17 MJ/day (according to energy requirement of *B. indicus* cattle) and 55.8 MJ/day (11% higher than energy requirement). Commercial feed was assigned to the last group of cattle as a comparison group. All Brakmas yearlings were individually fed at 3% (w/w) of its bodyweight. Feed was in the form of total mixed ration (TMR), comprised of 40% (w/w; 100% dry matter) fresh grass and 60% (w/w; 100% dry matter) formulated feed. At the beginning of experiment and every 30 days after experiment started, the weight of every animal was recorded and used to determine the amount of feed to be given to each of them. All animals were subjected to feed familiarization for two weeks followed by 120 days of feeding trial. Feed residue was recorded daily. Body weight gain,

average daily gain (ADG) and feed conversion ratio (FCR) were calculated for every Brakmas yearlings. Data were analysed by one-way of analysis of variance (ANOVA) and Duncan's Multiple Range Test was used to compare treatment means using SAS version 9.4 software.

Results and Discussion

Table 1 showed 10% increase in the level of energy than requirement in experimental cattle feed, weight gain and ADG of Brakmas male yearlings were significantly increased and FCR was numerically improved. From the study, it is also shown that the growth performance of the yearlings fed on commercial feed is similar to those fed with the requirement feed indicating it met the energy requirement of *B. taurus* cattle. Interestingly the FCR of those fed with commercial feed was significantly better than both, requirement, and experimental feed. This indicates that the commercial feed was efficiently consumed by the cattle and may contain high quality ingredients which is easier to digest and absorb (Mike Varley; 2011). The desired FCR value should be between 4.5 to 7.5 for beef cattle (Dan W. Shike; 2013), therefore, both, requirement and experimental feed are still adequate in providing the necessary nutrients for the yearlings even though most of the ingredients used were locally sourced. The quality of experimental feed could be further improved in order to achieve FCR value closer to 7.

Table 1: The effect of different energy levels in cattle feed on growth performance parameters of Brakmas yearlings.

Feed/ energy level	Weight gain (kg)	ADG (kg/day)	FCR
Commercial	98.08 ± 11.97 [a]	0.837 ± 0.103 [a]	6.927 ± 0.558 [a]
Requirement (50.17 MJ/day)	103.50 ± 13.71 [a]	0.887 ± 0.118 [a]	8.505 ± 0.964 [b]
Experiment (55.80 MJ/day)	126.67 ± 16.75 [b]	1.083 ± 0.146 [b]	8.042 ± 0.923 [b]

[a,b] – Mean values in the same column with same letter shows no significant difference at p>0.05

Higher FCR value in cattle consuming control and experimental feed is similar to findings by (Krehbiel *et. al;* 2000) suggesting that *B. taurus* crossbred cattle consume more food due to its bigger size; thus, relatively energy requirements is higher. Even though commercial and control feed performed similar on animal weight gain and daily weight gain, lower FCR value for commercial feed suggesting the feed component is made of high-quality ingredient which is easier to digest and absorb (Mike Varley; 2011).

Conclusion

Animal feed on requirement feed perform similar to animal on commercial feed, in terms of animal bodyweight and daily weight gain. Better FCR value for animal feed on commercial feed may due to the quality of feed ingredient used. Increasing the energy level up to 10% significantly improved all parameters studied; except on FCR value for commercial feed. Higher levels of energy may not bring better performance on animal, and will increase feed price making it unprofitable for farmers. The effectiveness of the requirement and experimental feed should be further evaluated until carcass analysis and quality to see whether these (requirement, experimental)

feed able to improve dressing percentage and meat percentage (%) within carcass by reducing the amount of fat accumulation in the peritoneum cavity.

Acknowledgement
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Category: Sustainable Farming

PRESENCE OF HEAVY METALS IN WASTEWATER FROM SELECTED PIG FARMS IN KUALA LANGAT, SELANGOR

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Introduction

Pig farming activity can lead to environmental pollution if the generated waste is not properly treated. According to the Department of Environment (DOE), pig farming significantly contributes to pollution loads in Malaysian rivers, particularly in terms of Biochemical Oxygen Demand (BOD), Suspended Solids (SS), and Ammoniacal Nitrogen (AN) (DOE, 2022). With around 1.5 million pigs in Malaysia (DVS, 2023), approximately 60,000 tons of wastewater from pig farms are produced daily (Liang et al., 2016). Aside from high organic content, pig farm wastewater also contains heavy metals originating from feed additives (Li et al., 2022). This study determined the presence and concentrations of heavy metals in wastewater from selected pig farms in Kuala Langat, Selangor, across different stages of wastewater treatment.

Keywords: livestock, manure, pollution, water quality, water treatment

Materials and Methods

Two pig farms in Kuala Langat, Selangor were involved in this study. Water samples from the stall, retention ponds and drain outside the premise were collected from each farm. The concentration of heavy metals was determined using Inductively Coupled Plasma Mass Spectrometry (Perkin Elmer, NexION 350x).

Results and Discussion

The analysis revealed that heavy metals are present in pig farm wastewater. The concentration of heavy metals from the samples are as summarized in Table 1. The standard value refers to the limit of heavy metals for Standard B industrial effluent allowed in the Environmental Quality (Industrial Effluent) Regulations 2009. Generally, the concentration of heavy metals was higher in the stall compared to the retention pond. This is because the raw wastewater from the stall undergoes anaerobic process in the retention pond, causing the concentration to reduce. However, some heavy metals concentration, particularly iron (Fe) and manganese (Mn), are found higher in the drain compared to the pond. This may be due to the other industrial activities surrounding the premise which contribute to increased concentration in the drain.

Table 1. Concentration of heavy metals in pig farm wastewater from Kuala Langat.

Sample		Concentration (mg/L)									
		Al	**As**	**Ba**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Zn**
Standard		15.00	0.10	2.00	1.05	1.00	5.00	1.00	1.00	0.50	2.00
Farm A	Stall	0.29	<0.05	0.52	<0.05	0.22	8.53	4.47	<0.05	<0.02	1.07
	Pond	0.18	<0.05	0.02	<0.05	<0.05	1.03	0.32	<0.05	<0.02	0.10
	Drain	0.54	<0.05	0.05	<0.05	0.08	0.70	0.33	<0.05	<0.02	0.33
Farm B	Stall	0.27	<0.05	0.16	<0.05	0.70	9.82	5.63	<0.05	<0.02	1.19
	Pond	<0.01	<0.05	0.03	<0.05	0.23	1.03	0.18	<0.05	<0.02	0.45
	Drain	2.59	<0.05	<0.02	<0.05	<0.05	11.06	1.46	<0.05	<0.02	0.75

The concentrations of other heavy metals, such as aluminium (Al), arsenic (As), barium (Ba), chromium (Cr), nickel (Ni), and lead (Pb) remained below the respective standard limits.

Conclusion

The lower concentration of heavy metals in the pond samples compared to the stall suggests that the retention pond may be responsible in removing heavy metals from pig farm wastewater prior to discharge. However, the increased concentration in the drain sample might be caused by external factors such as discharge from other industrial activities nearby the premise.

Acknowledgement

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Category: Sustainable Farming

LOWER GHG EMISSION FROM DAIRY WASTE PONDS BY THE SLURRY ACIDIFICATION

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Introduction

Emissions of greenhouse gases (GHG) from slurry storage can be mitigated in several ways. Greenhouse gases mitigation approaches includes the use of inhibitors, diet, animal handling, manure management, and technologies, among others. The most common approach adopted by commercial farms is slurry acidification. The objective of this study was to provide an initial evaluation of the potential use of acids to inhibit CH_4 emission and NH_3 volatilization from stored dairy slurry in Malaysian farming perspectives.

Keywords: methane emission, slurry acidification, slurry storage, greenhouse gas

Materials and Methods

Approximately 40kg of dairy cattle slurry was transferred into 130L high-density polyethylene (HDPE) and the slurries were acidified to pH 5.0 using concentrated hydrochloride acid (HCl), concentrated sulphuric acid (H_2SO_4), lactic acid ($C_3H_6O_3$) and nitric acid (HNO_3). The slurries' pH is monitored periodically and reacidification to pH 5.0 is carried out every 3 weeks. Methane gas fluxes were sampled using a steady-state static chamber technique from the barrel headspace through a butyl rubber septum during a closed system. Cumulative gas emissions for the storage period were calculated by interpolating the measurements between adjacent sampling points using the trapezoidal rule.

Results and Discussion

Continuous acidification on cattle slurry using four different types of acids showed various trends in CH_4 emissions. Based on Figure 1, utilisation of concentrated HCl and H_2SO_4 inhibits CH_4 at 17.7 dan 19.3%, respectively as compared to control (Ctrl). Utlisation of HNO_3 has the highest inhibition rate at 57.0%. In contrast, utilisation of $C_3H_6O_3$ resulted in a larger CH_4 release at 151%. The slurry can be acidified at different stages in the manure handling chain. Acidifying the slurry at the start of the manure management chain means that emissions (NH_3 and CH_4) are reduced in animal housing, in slurry storage and after field application. The use of acids in this study is to evaluate strong and weak acids for its CH_4 inhibition potential. The choice of correct chemical is important, as the use of H_2SO_4 leads to a higher hydrogen sulfide (e.g. as H_2S) gas production, and higher sulfur content for the slurry (Sørensen & Eriksen, 2009; Wang et al., 2014), while nitric acid (HNO_3) leads to significant N_2O

production (Berg et al., 2006). A greater volume of weak acid is needed to acidify slurries, such as lactic acid, (pKa 3.86) as per this study. The continuous acidification of cattle slurries were initiated due to significant increase in slurry pH following the microbial and organic matter breakdown. In some countries, such as Denmark, the farmers practice slurry acidification using HCl or H_2SO_4 although this would also meant a higher cost in the farming operation, but as a returning benefits, N availability (NH_3 emissions are reduced during slurry storage and slurry spreading) is higher in the farm for crop uptake. Similar to this study, the slurry acidification technique is a practical approach to reduce NH_3 loss and inhibit CH_4 emission (Sørensen & Eriksen, 2009; Petersen et al., 2012).

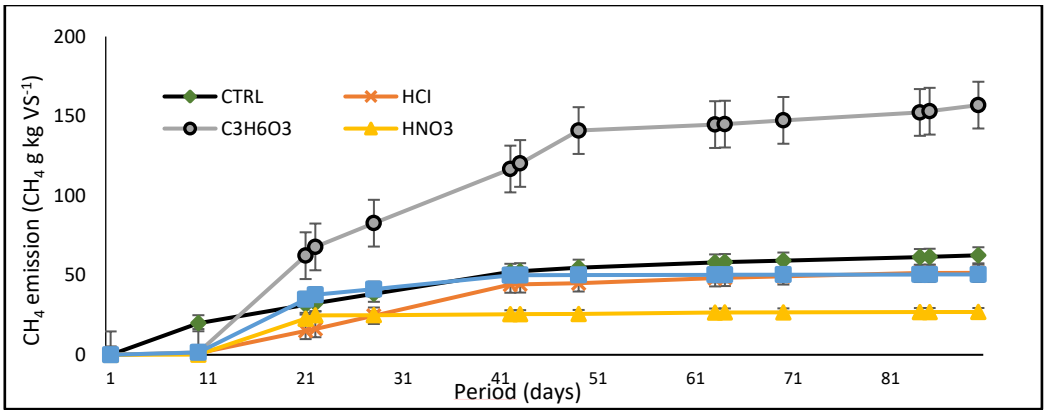


Figure 1. Cumulative methane emission from dairy slurry during storage period

Conclusion

Continuous acidification by the use of concentrated acids to the dairy slurry is a promising manure management strategy for combating climate change and global warming. The uses of HNO_3, HCl and H_2SO_4 in inhibiting CH_4 emission rate are at 57.0%, 17.7% and 19.3% compared to Ctrl. However, their inhibition effect on ammonia volatilization needs to be further determined.

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Category: Sustainable Farming

ESTIMATION OF ENTERIC METHANE EMISSION FROM BEEF CATTLE IN MALAYSIA

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Introduction

Kedah-Kelantan (KK) cattle is a favourable breed in Malaysia due to its status as an indigenous breed fully adapted to utilize local feed resources and can withstand hot and humid conditions (Islam et al., 2021). However, their growth rate is lagged behind imported breeds. Therefore, to address this, MARDI enhanced the genetics of KK cattle breed, aiming for traits including feed adaptability and productivity. The introduction of KK Elite in 2018, with improved size and growth could support Malaysian beef industry to achieve 50% SSR by 2030 (DAN, 2021). However, increased cattle numbers could contribute to methane (CH_4) emissions. Previous estimates based on default emission factor (EF) developed by Intergovernmental Panel on Climate Change (IPCC), may not accurately represent local conditions. The quality of the emission reported depends on the reliable EFs and activity data (Pavel, 2019; Ibidhi et al., 2021). This study introduced country-specific EFs based on KK Elite data to accurately quantify enteric fermentation CH_4 emissions from cattle in Malaysia, in comparison with IPCC values. Such research will aid in understanding and mitigating environmental impacts while supporting the growth of Malaysia's livestock industry.

Keywords: enteric methane emission, beef cattle

Methodology

The 2006 tier-1 methodology from the Inter-governmental Panel on Climate Change (IPCC) for estimating enteric CH_4 emissions from beef cattle serves as the foundation. Activity data, encompassing the local beef cattle population from 2017 to 2021, were sourced from the Department of Veterinary Services' annual livestock statistics. Two EF values were used for the estimation of enteric CH_4 emission; i) default EF provided by IPCC (2006) as a baseline and ii) country-specific EF derived from prior works by Azizi (2021). Default EF is the values developed by IPCC to be used for countries with no country-specific EF to calculate CH_4 emissions. While, the country-specific EFs were developed from KK Elite data acquired at MARDI Kemaman including as body weight, weight gain and others. Total CH_4 emissions were subsequently converted into carbon dioxide (CO_2) equivalent using a 100-year time period global warming potential of 25, as per IPCC (2007) guidelines.

Results and Discussion

Table 1 presents the EFs of male and female matured cattle, comparing country-specific values developed from KK Elite data (Azizi, 2021), with the default values provided by the IPCC (2006). The male cattle had a higher EF of 59.6kg CH_4/head/year than IPCC default value. In contrast, EF value from IPCC guideline for female cattle was higher than EF derived from KK Elite data. This discrepancy between country-specific and default EFs raises important considerations, which could highlight the significance of tailoring EFs to local conditions and specific cattle breeds (Ibidhi et al. 2021). The variation in EFs between male and female KK Elite cattle also underscores the importance of gender-specific data in emission estimations. Furthermore, enteric CH_4 emission estimated using IPCC EF was lower than country specific EF (Figure 1). This is in line with study by Ibidhi et al. (2021), that estimated enteric CH_4 EF using country-specific EF for cows was higher than IPCC by 15%. Therefore, accurate measurement is needed to assist in development and establishment of management strategies aimed at mitigating methane emissions, such as selective breeding or dietary interventions.

Table 1. Enteric CH_4 EF values based on KK Elite and IPCC default.

Emission factors	Emission Factors, EF (kg CH_4/head/year)		
	Male (mature/breeding bull)	Female (mature/ breeding cow)	Average
IPCC Default[1]	47.0	47.0	47.00
KK Elite (country specific)[2]	59.6	43.1	51.35

[1]IPCC (2006); [2]Azizi (2021)

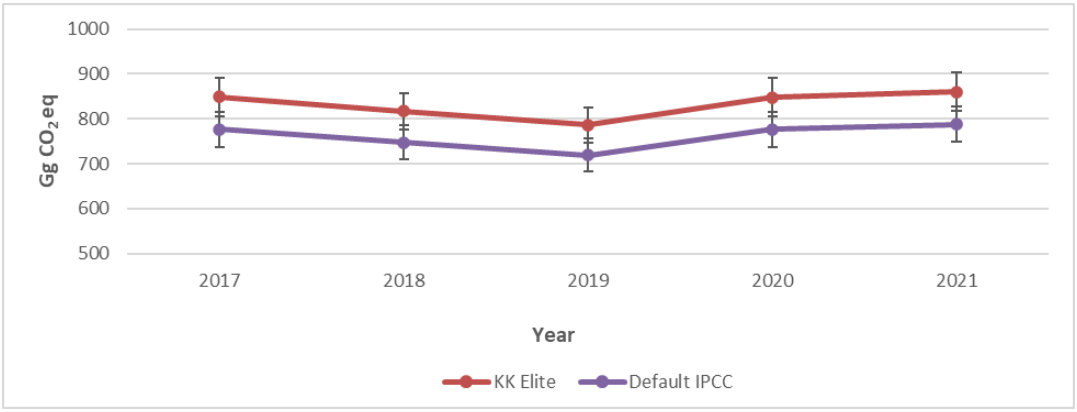


Figure 1. Time-series chart on the enteric CH_4 emissions from beef cattle calculated using different EFs

Conclusion

Accurate EF value is required in estimating CH_4 emissions from livestock. However, a series of experiment is needed to ensure the accuracy of the EF value. Further research into the factors influencing CH_4 production in different cattle breeds can

contribute to more effective mitigation strategies and sustainable livestock management practices.

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Category: Sustainable Farming

ENTERIC METHANE EMISSIONS FROM LOCAL BEEF CATTLE UTILISING DIFFERENT EMISSION FACTORS

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Introduction

The estimation of a country's greenhouse gas emissions relies on IPCC 2006 methodology, utilizing activity data (AD) and emission factors (EFs). In Malaysia, previous reports used IPCC default EFs for enteric methane (CH_4) emissions from local beef cattle. However, these may inaccurately estimate emissions due to regional parameters (Azizi et al., 2017). Recently, country-specific EFs (CSEFs) based on the indigenous Kedah-Kelantan (KK) beef cattle breed were developed, reflecting the majority of Malaysia's cattle population. In current updates, a CSEF for Brakmas cattle has been used, but updating with new values is vital to reflect sector changes and national policy. This study compares EFs for KK breed and its crosses with default EFs, aiming to enhance the accuracy of national GHG inventory reporting. Using accurate EFs is crucial for improving emission estimates and reducing uncertainty.

Keywords: Kedah-Kelantan cattle, enteric methane, emissions, emission factor, greenhouse gas

Materials and Method

The IPCC 2006 tier-1 methodology is used to estimate enteric CH_4 emissions from beef cattle. Activity data spanning 2017 to 2021 were obtained from the Department of Veterinary Services to create emission trends over 5 years. Enteric CH_4 emission factors are based on previous studies by Azizi et al., 2017; 2022 and IPCC (2006) default EFs. Calculated CH_4 emissions are converted to CO_2 equivalent using a global warming potential of 25 over a 100-year period (IPCC, 2007).

Results and Discussion

Table 1. Enteric CH_4 EF for different KK breed and crosses

KK breed and its derivatives	Emission Factors, EF (kg CH_4/head/year)		
	Male (mature/ breeding bull)	Female (mature/ breeding cow)	Average
Brakmas (Brahman x KK)	65.7	51.6	58.65
KK crosses	52.5	39.7	46.10
IPCC Default	47.0	47.0	47.00

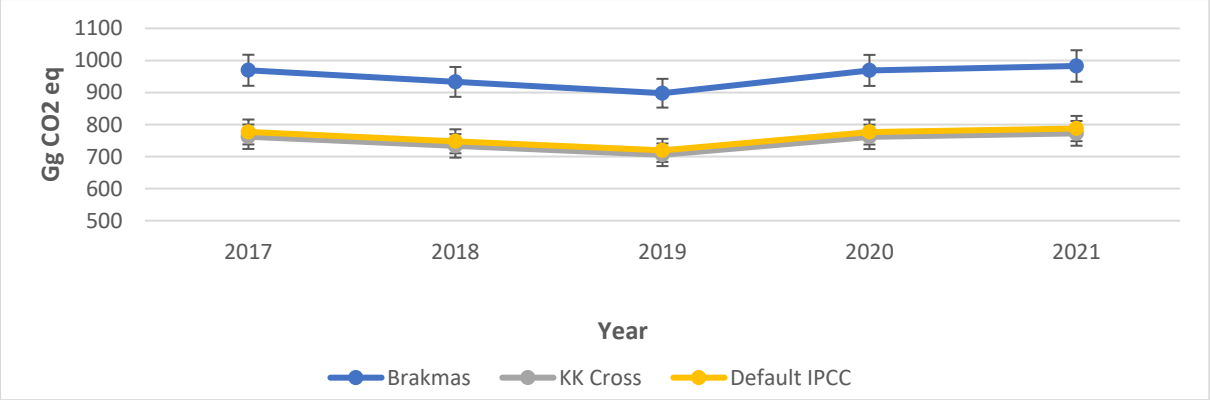


Figure 1. Time-series trends chart on the enteric CH_4 emissions from beef cattle calculated using different EFs based on different KK breed.

EFs for various KK breed and derivatives are summarized in Table 1 and used in emission estimates. Figure 1 shows different enteric CH_4 emission trends based on EFs. Brakmas-based EF yields the highest trend, while KK cross-based EF yields the lowest. Trends parallel population data over years, offering clear highs and lows for comparison.

Conclusion

Using EFs based on KK crosses is optimal for current emission estimations in Malaysia, given the breed's prevalence. Although trends mirror those from default EFs, variation exists between male and female cattle. Specific EFs based on local breed parameters are crucial for accurate estimates, aligning with IPCC Tier-2 methodology. Brakmas-based EFs, representing only 0.8% of Malaysia's beef cattle population and declining (Mohd Saufi, et al., 2023), may no longer suffice. These findings underscore the importance of tailored EFs for local beef production, improving accuracy in emission estimates.

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