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"Sustainable Livestock Production in Facing Economic and Environmental Challenges"

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"Sustainable Livestock Production in Facing Economic and Environmental Challenges"

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Proceedings of the 42nd Malaysian Society of Animal Production (MSAP) Annual Conference

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Foreword from the Organizing Chairman

The livestock industry plays a crucial role in supporting the livelihood and nutrition of people. However, it faces considerable challenges and concerns regarding its adverse effects on the environment, animal welfare and public health. Thus, there is a need to drive the transition of the livestock sector towards sustainable and efficient production systems, while enabling it to offer numerous benefits for people.

This book with the theme of "*Sustainable Livestock Production in Facing Economic and Environmental Challenges*" presents scientific knowledge and practical experiences on sustainable livestock production in different regions and contexts. It covers topics, ranging from forage science and feeding, food safety and security, animal nutrition and feeding, animal reproduction, animal and feed biotechnology, animal production and economics to wildlife and sustainable farming. The book contains various research findings and practical insights gathered by experts, professionals, government officials, researchers, academics, students and private stakeholders.

The aim of this book is to share useful knowledge and practices that can contribute to a more sustainable future. It shows the innovations and development in the livestock industry for researchers, academics, practitioners, students, and anyone who is interested in learning more about livestock production issues and solutions to economic and environmental challenges.

We hope this book will inspire action taken for a better future where sustainable livestock production thrives for the good of all!

ASSOCIATE PROFESSOR DR. ROZAIHAN MANSOR
Organizing Chairman
42nd MSAP Annual Conference

ACHIEVING SUSTAINABLE LIVESTOCK PRODUCTION IN A FAST CHANGING WORLD

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Introduction

More than 1.3 billion people depend on livestock for their livelihoods, making livestock production an essential part of global food security and a major contributor to the economy (FAO, 2018). Forty percent of agricultural output worldwide (World Bank, 2021) and 11.2% of global greenhouse gas (GHG) emissions comes from the livestock sector (FAO, 2022). However, the industry has a number of economic and environmental obstacles that must be overcome if it is to survive in the long run.

This paper aims to discuss the economic and environmental challenges facing livestock production and explore strategies and solutions to achieve sustainable livestock production. The United Nations Sustainable Development Goals (UN SDGs) initiatives will be discussed, with a focus on Malaysia's and ASEAN's perspectives on sustainable livestock production. The importance of technology, policy, and market incentives in supporting sustainable practices will also be highlighted.

Keywords: livestock, sustainability, sustainable development goals

Economic Challenges

The livestock sector faces several economic challenges that impact its growth and sustainability. Feed prices have increased due to competition with human food and biofuel production. This has led to higher production costs, making it challenging for farmers to maintain profitability. As a result, the volatility of prices and revenues in the livestock sector affects the predictability of income and financial stability for producers (FAO, 2016). Trade barriers, such as tariffs and non-tariff measures have also limited the expansion of markets for livestock products and hinder the sector's growth (FAO, 2016).

The global population is expected to reach 9.7 billion by 2050 (UN, 2019), leading to a projected increase in demand for animal products by 70% (Alexandratos & Bruinsma, 2012). This increase in demand will put additional pressure on the livestock sector to meet the demand sustainably. The transition towards sustainable livestock practices is economically challenging since the farmers have to bear high upfront costs with low access to credit, and low returns are expected during the transition period (Garcia et al., 2017).

2.0 Environmental Challenges

Livestock production is resource-hungry as it requires vast amounts of land, water, nutrients, and energy. Thus, livestock production contributes to several environmental issues such as deforestation, land degradation, loss of biodiversity, greenhouse gas emissions, water pollution, and environmental degradation (FAO, 2018; Varijakshapanicker et al., 2019). With increasing demand for livestock products, the sector needs to produce more with less resources, and may produce more pollution if not managed properly.

2.1 Greenhouse gas emissions: The livestock sector contributes to approximately 11.2% of global anthropogenic greenhouse gas emissions, with the largest sources being enteric fermentation, manure management, and land-use changes (Gerber et al., 2013; FAO, 2022). Addressing these emissions is essential to mitigate the sector's impact on climate change.

2.2 Land use and deforestation: Livestock production is responsible for significant land use, occupying about 70% of global agricultural land (FAO, 2006). Conversion of forests to pasture and cropland for feed production results in deforestation, habitat loss, and reduced biodiversity (Steinfeld et al., 2006). Sustainable land management practices are necessary to minimize these impacts.

2.3 Water consumption and pollution: Livestock production is a major consumer of freshwater resources, accounting for 29% of global water use (FAO, 2006). The sector also contributes to water pollution through nutrient runoff from manure and the release of pollutants from concentrated animal feeding operations (CAFOs) (FAO, 2006). Improved water management practices and pollution control measures are critical to safeguard water resources.

2.4 Biodiversity loss: Livestock production contributes to the loss of biodiversity through habitat destruction, overgrazing, and the introduction of invasive species (FAO, 2006). Maintaining biodiversity is vital for the resilience of ecosystems and the long-term sustainability of agriculture.

2.5 Soil degradation: Unsustainable grazing and manure management practices can result in soil degradation, erosion, and nutrient depletion (FAO, 2006). Implementing sustainable land management and grazing practices can help protect soil health and maintain productivity.

2.6 Waste generation: Livestock production generates large amounts of waste, including manure and other by-products (FAO, 2006). Proper waste management and utilization strategies are essential to minimize the environmental impacts and create value-added products, such as bioenergy and organic fertilizers.

Addressing these environmental challenges requires the adoption of sustainable livestock production practices that minimize the sector's ecological footprint while maintaining productivity and profitability. The integration of technological innovations, policy interventions, and market-based incentives can play a crucial role in promoting sustainable livestock production.

3.0 UN SDGs and Sustainable Livestock Production

The UN Sustainable Development Goals (SDGs) present a framework for addressing global issues, including those related to livestock. Several SDGs align with the principles of sustainable livestock production, emphasizing environmental protection, food security, and equitable development.

3.1 SDG 2: Zero Hunger

Livestock production, which provides essential nutrients and income, can play a significant role in achieving this goal. By improving feed efficiency, reducing waste, and promoting resource-efficient systems, we can promote food security while minimizing environmental impact.

3.2 SDG 6: Clean Water and Sanitation

The livestock sector, as a significant consumer of freshwater, must manage water resources responsibly to achieve this goal. Strategies include implementing water-saving technologies, reducing pollution, and promoting water-efficient production systems.

3.3 SDG 12: Responsible Consumption and Production

This goal emphasizes the importance of resource efficiency and sustainable consumption. By improving efficiency in the livestock value chain, minimizing waste, and promoting responsible consumption, the sector can make substantial contributions to this goal.

3.4 SDG 13: Climate Action

Mitigating greenhouse gas emissions from livestock is crucial for SDG 13. By improving animal genetics, managing waste better, and encouraging carbon-sequestering land practices, the sector can help combat climate change.

3.5 SDG 15: Life on Land

This goal requires the preservation of ecosystems and biodiversity. Sustainable livestock production, through responsible land use and integrated farming practices, can contribute to maintaining ecosystem health and biodiversity.

4.0 Malaysia's Perspective

The livestock sector is a significant contributor to the national economy and food security. As a developing country with a growing population and increasing demand for animal products, Malaysia faces unique challenges in balancing economic growth and environmental stewardship in the livestock sector. This sector faces challenges, such as limited land resources and increasing demand for animal products together with the increased price of inputs such as feed, utilities, labour and building materials. To address these challenges and promote sustainable livestock production, Malaysia has developed several policies and initiatives, such as the National Agrofood Policy 2021-2030 (DAN 2.0), which emphasize the importance of sustainable agricultural practices. Besides that, the Ministry of Environment and Water (KASA) and Malaysian Green Technology and

Climate Change Corporation (MGTC) is currently developing green practice guidelines for industries including livestock. This guideline will serve as a guidance for the stakeholders to implement green practices in the livestock production chain and thus encourage sustainable livestock sector in the nation.

5.0 Strategies

Mixed crop-livestock systems have been suggested as a more environmentally and economically friendly way of farming. Crop-livestock integration is also thought to increase system autonomy and resilience from an environmental and economic point of view. However, the potential benefits of livestock farming must be balanced against the negative impacts on the environment and the economy.

Efforts to mitigate the negative impacts of livestock farming include precision livestock farming (PLF), which applies intelligent farming to animal husbandry. Organic farming practices have also been suggested as a way to reduce the environmental impact of livestock farming. Additionally, integrated management of livestock and cropping systems can help to improve farm household diet and provide income while rehabilitating the soil through better on-farm nutrient recycling within the farm.

Conclusion

Sustainable livestock production is vital for addressing the economic and environmental challenges associated with the sector. By implementing sustainable practices and strategies, we can promote a balance between economic growth and environmental stewardship, contributing to the achievement of the United Nations Sustainable Development Goals and enhancing food security.

Acknowledgement

Department of Veterinary Services (DVS).

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REPRODUCTIVE BIOTECHNOLOGY FOR CATTLE PRODUCTION IN THAILAND

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The technique of ultrasound-guided transvaginal follicular aspiration for ovum pick-up (OPU), is a non-invasive procedure for recovering oocytes from antral follicles in live animals. This technique was developed in the human (Gleichert et al., 1983; Dellenbachet al., 1984) to assist human infertility. When people realized its application prospect, considerable research have been aimed at applying this technology in the bovine. In 1987, an ultrasonic-guided aspiration of bovine follicular oocytes was first proposed in Denmark (Callesen et al., 1987). In 1988, a real OPU was first established in cattle by a Dutch team (Pieterse et al., 1991). Together with in vitro fertilization (IVF) of oocytes, OPU has been taken as a most flexible and repeatable technique to produce embryos from any given live donor. Unlike multiple ovulation and embryo transfer (MOET), OPU does not interfere with the normal reproduction and production cycles of the donor. Any female starting from 6 months of age to the third month of pregnancy and even soon after calving (2-3 weeks) could be a suitable donor. It has been shown to be a feasible and practical alternative to the conventional MOET program (Bousquet et al., 1991; Kruip et al., 1991). It is being more and more used for commercial applications in the world (Faber et al., 2003; Pontes et al., 2010). The first in vitro produced (IVP) calf was born in 1981 (Brackett et al., 1982). Both OPU and IVF could be seen as mature technologies in the current world. The total number of transferable IVP bovine embryos worldwide was 453,471 in 2011 (Stroud, 2011), and rising to more than one million in a year to date. Although there is a large variation between donors, it is capable of producing over 50 calves per donor cow per year if the two technologies, OPU and IVF are combined. In addition, with the complementing of bovine genome sequencing and key genes for traits of economic interest becoming available in the recent years, OPU-IVP has proven invaluable in rapidly multiplying rare genes and provides the basis for more advanced technologies such as cloning (Yang et al., 2005; Yang et al., 2008) and transgenic. Brazil dominated the IVP production by performing 53,019 OPU sessions averaging 15 oocytes and 6 embryos per session. There are many embryo technology companies in Brazil, who are specializing in the production of in vitro embryos, embryo transfer or embryo related technologies training to farmers or people related. This kind of companies or groups also exists in North America, South America, EU, South Africa, Asia and Australia. In Thailand, the first OPU-IVP company was established in 2020 and total four companies are operating to date. Bovine IVP embryos have been transferred to at least 3,000 recipients in a year and achieved pregnancy rate 40-45% for fresh embryos and 20-25% for frozen embryos. Recently, vitrification of IVP bovine embryos is implemented which can improved pregnancy rate up to 35-40%. OPU-IVP-ET technique in Thailand will be invaluable in rapidly multiplying elite genetics bovine and will replace MO-ET technique very soon.

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FUTURE TRENDS AND CHALLENGES IN FEEDING RUMINANTS UNDER INTENSIVE SYSTEMS

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Introduction

The world is expected to see its population grow to more than 9 billion people in the year 2050. With the increase in population there will be an increase in the demand for food including animal food products. About 20% of the world population is undernourished while about 700 million people do not have access to sufficient food. The demand for animal products is estimated to increase by 65%. To feed the world more land needs to be cleared for cultivation of food crops and for growing feed crops for animals. With the world being threatened with global warming and weather-related calamities, world leaders have agreed to take steps in reducing greenhouse gasses (GHGs) emission through limiting new land areas to be cleared for cultivation of crops and pasture for ruminant livestock. While ruminants may contribute to the world's GHGs emission, the population of ruminant animals will inevitably have to increase to meet and cater for the world's demand for meat, milk and fibre. It has been suggested that through global warming the world may face high temperatures, drying of pasture lands and water bodies and emergence of diseases which may result in poor harvest of feed crops.

Farming and the environment

Much has been said about ruminants as a contributor to increased GHGs emission to the atmosphere. It has been accepted that ruminants contribute about 18% of the world's GHGs emission. But ruminants also contribute to the meat, milk, leather and fibre for human consumption. The global call to take steps to reduce ruminant animals may be detrimental to human welfare in terms of protein supply, especially in the developing countries. In the present scenario, Malaysia, which is already in short supply of land for animal grazing and for feed crops cultivation, faces high costs of producing food animals especially, in terms of feed, fuel, labour and logistics. A large portion of management costs goes to feed which are mostly imported. Other constraints to developing ruminant industry in Malaysia includes unavailability of breeding stock, poor productivity of indigenous animals, diseases, poor management practice and low adoption of technology and these factors may hinder the achievement of security in animal food products in the next few years.

Status of Livestock Industry in Malaysia

The Malaysian ruminant industry has not been expanding to meet the demand for animal products. In fact, Malaysia still imports 80% of meat, 90% of milk products and other livestock products, though in general, poultry products and swine are considered self-sufficient. The number of ruminant population over the last few years in Malaysia are consistently decreasing (Table 1) while per capita consumption of animal products seems to fluctuate over the years (Table 2). Significant amounts of beef and mutton are still

imported. It was thought that the high number of cattle smallholder farmers would contribute to the supply of local beef, yet local farms only produce about 20% of the demand. A major proportion of beef consumed locally is imported beef (and buffalo meat) The fact is that the number of smallholder cattle farms are on the decrease due to several reasons, amongst them the scarcity of high quality breeding stock, increasing costs of supplementary feeds, increasing age of farmers, increasing non acceptance of farming activities in village areas and low acreages of land ownership which is insufficient to sustain increased animal numbers. With increased costs of living, maintaining a few heads of cattle may no longer be economically viable and would not be enough to provide for the household. The feed industry relies almost all on corn, soya bean meal and many other ingredients for producing animal feeds, which are mostly poultry feed. Areas allocated for pasture and cattle farming in Malaysia is less than 18,000 ha. Growing corn has proven to be difficult and requires high inputs.

Table 1. Population of livestock in Malaysia for 2016-2020

Livestock	**2016**	**2017**	**2018**	**2019**	**2020**
Buffalo	119,133	114,013	106,988	101,695	100,242
Cattle	737,827	703,832	676,686	657,407	659,317
Goat	416,529	385,304	359,200	312,571	320,203
Sheep	138,479	130,658	128,298	121,677	121,173

Source: 2019/2020 Livestock Statistics by Department of Veterinary Services

Table 2. Per capita consumption of livestock commodities in Malaysia for 2016-2020

Commodities	**2016**	**2017**	**2018**	**2019**	**2020**
Beef (kg)	6.6	6.5	6.4	6.1	6.1
Mutton (kg)	1.2	1.3	1.3	1.1	1.2
Pork (kg)	6.8	7.4	7.6	7.4	7.4
Poultry Meat (kg)	53.7	50.1	49.1	48.9	46.8
Eggs (pcs)	376.4	392.6	362.5	291.2	360.9
Fresh Milk (L)	1.8	2.0	1.9	2.0	2.1

Source: 2019/2020 Livestock Statistics by Department of Veterinary Services

Why intensive feeding?

In recent years the Malaysian government has launched programs to encourage rearing cattle under an integrated farming system with oil palm, developing an intensified feedlot system and a proposed integrated system. It was thought that with about 5 million hectares of land under the oil palm integrated farming system would be the future farming system for cattle. However, recent studies showed that corporate oil palm plantations are not willing to accommodate cattle in the plantation, and smallholder farmers are reluctant to shepherd animals daily to graze. Under the present conditions raising animals under an intensive system seems to be the best option to increase animal population. It is common that some farming activities are preferred to be intensive, for example, dairying is an intensive farming system, be it grass-fed or fully housed. Many small ruminant farms are intensive in nature. Malaysia cannot afford (due to lack of pasture areas) raising

grass-fed/pasture fed cows for milk, simply because it is uneconomical to grow pasture for grazing. Furthermore, a large number of dairy farms are owned by smallholders who manage less than 50 milking cows.

Advantages of intensive management system

In brief, in view of the current situation such as climatic constraints, lack of arable land, increasing population, animal welfare demands and economic uncertainty, I would like to summarize the following:

1. More animals per unit area- increase population.
2. More efficient in management- suitable for feedlotting
3. Feeding and nutrition under control-compound feed usually given
4. Detection of ill health/disease – use of technology in disease detection
5. Breeding program can be implemented with ease
6. Facilitate the use of green technology – other technologies
7. Automation of certain activities – e.g. feeding, weighing, etc.
8. Facilitate handling of wastes and effluent
9. Welfare issues can easily be implemented and monitored

Disadvantages of Intensive system

Of course, there are also many disadvantages of raising ruminants under an intensive system. Intensive indicates high concentration of animals in a unit area and subsequently invites diseases, pollution of the environment and problems of waste disposal. In summary the disadvantages of intensive systems of production are as follows:

1. High cost of housing
2. High labour input, high carbon footprint
3. High level of effluent discharge per unit area
4. Compound feed need to be provided, cut and carry system, TMR
5. Possible soil pollution and compaction
6. Possible pollution of underground water and rivers
7. Poor management of animal welfare.

In this presentation I shall elaborate on how these problems can be alleviated through technology. With advanced technology and strict implementation of regulations, I am of the opinion that these negative aspects of intensive systems can be solved. I would like to propose that regulations for intensive ruminant production be imposed and adhered closely by farmers. Some of the terms and conditions that farmers need to follow are as follows:

Terms and conditions of intensive farming systems

1. Number of animals needs to be specific, so that there is a balance between input and output of waste and effluent so as not to pollute the environment.
2. Monitoring of effluent need to be regular and consistent
3. Type of land/soil to suitable for housing of animals
4. Location and design of buildings to ensure low leaching
5. Calculated and regulated feeding and watering

6. Security of animals and disease control
7. Use of technology to reduce effluent and GHGs emission
8. Animal welfare monitoring

Feedstuffs of the future

Under the Malaysian context, not much cereals, for example grain corn, are produced that can be used as animal feed, nor do we grow pasture on a large scale simply because of land constraints. Furthermore, a large chunk of arable land is used for the lucrative oil palm cultivation, on the highlands, for vegetable productions. What raw ingredients do we have in large quantities? Table 3 shows some of the available waste /by-products that can be used as feed. Undoubtedly, the feeds available in sufficient amounts to meet the requirements of animals are not many. For ruminants, roughages and grasses available may not match that required by animals in terms of quantity and quality. Like it or not selected species of grasses and legumes need to be cultivated to provide the necessary fibre. Palm kernel expeller is one of the oil palm by-products that are available in large quantities. Unfortunately, less than 20% of this product is used locally, while the rest is exported. That available locally too is quite costly and prevents farmers from including this material at high levels in their ration formulations. Here I would like to propose that the government take the initiatives to regulate the exports and make this product more available and at reasonable costs. By lowering the price of PKE ruminant farmers would be able to use it at higher levels in ration to replace the energy and protein ingredients, and not depend on the imported feeds. New novel feed ingredients are currently being researched, such as Black Soldier Fly larvae (BSF), mealworms, food wastes, insects, DDGS etc. These have been investigated for many years but the progress is still slow. Looking at new varieties of legumes, such as broad beans, winged beans, Indigofera, calliandra, as protein sources are possible options. Growing water hyacinths, azolla on wastewater bodies can be a good source of roughage and protein, respectively.

Table 3. Some waste products that can be used as ingredients in feed for intensive ruminant production

	By-products	Availability and constraints
1	Palm kernel expeller	Abundant, yet costly at retail. Mainly for export
2	Soya hull	Available for ruminants but in small quantities
3	Crude palm oil	Used in small quantities
4	Rice bran	Available but not sufficient to meet requirement
5	Milling by-products	Available but mainly used for non-ruminants
6	Kitchen waste/ restaurant waste	Large quantities, but not industrially processed
7	Others/ fruit wastes, copra waste, tofu waste	Localized, non-commercial, and seasonal
8	Black soldier fly larvae	Small quantities, but high potency for production

Conclusion

The objective of this paper is to propose an intensive system of ruminant production which is based on locally available feedstuffs. To achieve the optimum number of animals to provide for the meat, milk and other animal products for the increasing population, we cannot depend on smallholder farmers, as profitability of animal farming depends heavily on the number of animals per unit area. Traditionally small holder farmers feed their animals with whatever feeds that are available and pay little attention to quality and consistency resulting in poor growth rates. Modern farming system demands precise feeding, breeding management and low waste and GHGs emission. Growth rates and production cycle can be monitored to ensure high efficiency, hence an intensive feeding system of ruminants can ensure the supply of animal food products for expected increase in the human population.

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Potential application of circular economy concept in livestock production © 2020.Malaysia Productivity Corporation (MPC) Lorong Produktiviti Off Jalan Sultan, 46200 Petaling Jaya, Selangor www.mpc.gov.my

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STRATEGIC BREEDING PLANNING FOR THE DEVELOPMENT OF RUMINANT INDUSTRY IN MALAYSIA

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1. Introduction

The livestock industry is currently facing challenges that are new and multifaceted. Malaysia and the other developing countries are currently undergoing "The Livestock Revolution", in which demand for livestock products is increasing at an incremental rate. Hence, the livestock industry is challenged to reinvent itself to meet the needs of the nation. The total increase of meat and milk production in the developing countries is mainly due to the increase of livestock numbers rather than a rise in productivity per animal. Generally, livestock productivity is particularly poor in developing countries. Therefore, it is important to focus on the approaches to improve the productivity per animal. Efficient breeding and genetic improvement programs can boost output and profitability for the farmers.

Previous attempts to launch breeding programs in developing countries have too often failed for several reasons, although there are success stories to learn from as well (Kosgey and Okeyo, 2007). In the light of these developments, the Ministry of Agriculture and Food Security (KPKM) perceives the imperative need to have a comprehensive policy document on livestock breeding, covering all the major commodities including dairy cattle, beef cattle, meat goats, dairy goats, sheep, deer, poultry and pigs. This endeavour will also be in line with Strategic Priority 3 (Establish and strengthen national sustainable use policies) and Strategic Priority 4 (Establish national species and breed development strategies and programs) of the Food and Agriculture Organization's Global Plan of Action for Animal Genetic Resources.

2. Malaysian Livestock Breeding Policy (MLBP)

In April 1980, under the auspices of the Department of Veterinary Services (DVS), the First Meeting of the Committee on Cattle Breeding Policy was convened. This meeting was attended by experts from the University of Malaya, Universiti Pertanian Malaysia, MARDI, MAJUTERNAK and the Department of Veterinary Services. The committee came up with recommendations on the breeding of dairy cattle, beef cattle and buffaloes. This was followed by a second meeting of the same committee in July 1986. This committee played an instrumental role in addressing issues on the breeding of cattle and buffaloes at that time. The solutions proposed could not be fully implemented at that time due to limited resources which did not support a comprehensive policy. However, in 2016, DVS

revised and produced the Malaysian Livestock Breeding Policy (DVS, 2016) to guide the industry and farmers in developing proper breeding programs and strategies for each livestock sector. The MLBP pertains to the breeding of farm animals for food including cattle, buffaloes, goats, sheep, deer, poultry and pigs.

Animal breeding programs should be envisioned in the context of long-term development programs contributing to more food production and other livestock commodities to improve resource utilization and livelihood of the livestock owners. Thus, livestock breeding programs may be seen as important parts of national agricultural policies, aiming at improving the food and income of a country, region or locality and of livestock keepers.

3. Strategic Breeding Action Plan 2022 - 2030

Based on the breeding policy which developed in 2016, DVS has embarked on the effort to develop a strategic breeding action plan for the livestock industry in Malaysia. The action plan (AP) is arranged based on livestock commodity and for ruminants, the AP involved are AP1 to AP6.

The Action Plan focused on several main strategic cores which are:

- Enhance the development of indigenous breeds and local hybrids
- Enhance the development of the crossbred cattle of *Bos taurus* and *Bos indicus*
- Develop the livestock data and registration system
- Increase livestock breeding services
- Increase livestock population and genetics
- Apply Assisted Reproductive Technology (ART) in livestock breeding
- Develop proper stratified livestock breeding strata
- Develop field reproductive services framework and procedures
- Increase human capital of officers for livestock breeding services
- Enhanced National Institute of Veterinary Biodiversity (IBVK) as centre of excellent in breeding technology

3.1 Targeted Outputs

Derived from the Action Plan Strategic Cores, ten targeted outputs have been layout to be achieved by 2030 which are:

i. Four indigenous breeds and ruminant livestock are strengthened which are Kedah-Kelantan Cattle, Katjang Goats, Swamp Buffalo and Malin Sheep.
ii. Five local hybrid breeds based on Charolais, Limousin, Belgian Blue, Blonde and Piedmontese crossbred are commercialized.
iii. Two Breed Livestock data systems developed.

iv. Increased in ruminant livestock population by 5% every year.
v. Three potential ruminant livestock breeds to be commercialized which are KK Elit, Mafriwal and Wagyu cattle.
vi. Malaysia is the leader in the application of Assisted Reproductive Technology (ART) in breeding services.
vii. Development of commercial nucleus farms owned by DVS and private. Eight nucleus farms and 5 multiplier farms will be commercialized.
viii. Organizational structuring for livestock breeding services and commercialization of private intelligent insemination services (private DIY-AI).
ix. The number of competent departmental and national consulting officers in the field of reproductive science and technology will be increased
x. IBVK became a center of excellence for the production of frozen semen and a reference in the field of breeding technology and conservation of local tropical ruminant livestock.

3.2 Achievement Until 2023

3.2.1 Sado Hybrid Cattle

Sado Hybrid Cattle is produced through artificial insemination (AI) breeding using frozen semen from cattle that have natural double muscle characteristics such as the Belgian Blue and Charolais breeds. In Malaysia, it is often used to describe a bull that is used for breeding purposes, typically for producing offspring with desirable physical traits, such as heavier body weight, and higher meat quality.

Overall, the focus on producing Sado Hybrid Cattle is an important aspect of the Malaysian livestock industry, as it contributes to the production of high-quality beef and provides a source of income for farmers and producers.

3.2.2 Development of Breeding Services and Infrastructure

Artificial insemination (AI) is a common reproductive technology that has been widely used in cattle breeding. Malaysia has been promoting AI as a means of improving cattle genetic potential and productivity since 1980's. For cattle farmers and breeders, AI services provide a cost-effective, efficient and safer method of breeding without the need for herd bulls. The use of AI also allows breeders to access superior genetics and improve the production quality of their herd.

Cattle artificial insemination services in Malaysia are currently available through trained government staff and private AI service providers. Table 1 showed the current status of trained and active AI men in Malaysia for 2023. The Malaysian government has implemented various programs and initiatives to support the use of AI in the cattle industry, including subsidies for AI services and training programs for farmers and veterinary professionals to learn and adopt AI techniques.

The services provided by DVS also include semen collection, processing and storage, as well as insemination procedures. The semen usually comes from imported or locally produced high-quality bulls and is processed under stringent quality control measures in IBVK.

3.2.3 Technology Application

Major changes in livestock production have occurred during the past few decades due to the introduction of several new technologies such as artificial insemination, embryo transfer, and associated reproductive technologies (genomics and transgenic). These speed up reproduction and enable more efficient genetic improvement. To further boost the use of the latest reproductive technology in livestock breeding, the government has allocated RM9 million in RMKe-12 to IBVK for the acquisition of the latest equipment.

4. Issues and Challenges

The application of breeding strategy for development of livestock industry faces several issues and challenges which are:

i. Allocation and status of land for livestock breeding
ii. Minimal use of reproductive biotechnology due to limited expertise
iii. Shortage of reproductive hormones used in embryo transfer and AI
iv. Less interest of private companies to involve in stratified breeding structure
v. Climate change and natural disasters which affect animal feed production.

Conclusion

The role of animal breeding in the development of the livestock industry is highly recognized by the Malaysian government. The diversity of livestock genetic resources is very wide, both in variety and variability in terms of species, breeds, populations and unique genotypes. Animal breeding for food producing animals needs to be continuously supported to ensure food security.

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Table 1. Current Status of Active AI Man in Malaysia 2023

STATE	PRIVATE AI MAN	DVS AI MAN	TOTAL
Kelantan	38	17	55
Terengganu	20	6	26
Perak	5	2	7
Kedah	11	6	17
Perlis	3	2	5
Johor	7	6	13
Pahang	12	3	15
Selangor	-	16	16
Pulau Pinang	-	2	2
Melaka	3	5	8
Negeri Sembilan	-	1	1
TOTAL	**99**	**66**	**165**

ENHANCEMENT OF EXTENSION SYSTEMS IN LIVESTOCK PRODUCTION INNOVATION

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Introduction

Human population has increased yearly. This suggests that the contribution made by the agriculture sector to the nation's overall food supply is still relatively low and has a tendency to fall in the future. Because food is one of the most fundamental needs of people, nations are required to give the problem of food supply their undivided attention because it is one of the most essential needs. In addition, in order to satisfy the requirements of a growing population, there is a need to increase animal output.

The fact is, food production is directly linked to the food industry. The first issue of utmost significance for food production is the availability of food resources, which are connected to the production of livestock and other supporting industries. The productivity of livestock producers is a critical factor in determining the amount of food that can be produced in the livestock sector. There are a number of factors that frequently contribute to problems with the implementation of extension programs. These factors include the level of job satisfaction of extension workers, the level of managerial and technical competency of extension workers, and the level of understanding of the potential resources, needs and culture of the farming community. Currently, the application of innovations is needed to improve production efficiency. It is today possible to integrate automated feeding systems, manure management, milking robots, and instrumentation, genetics, animal breeding, and nutrition in order to maximize production efficiency. Besides, precision livestock farming (PLF) technologies, Internet of Things (IoTs) allow farmers to increase their production (Guntoro et al., 2019; Guntoro et al., 2022). Additionally, institutions of agricultural extension, research institutions, educational institutions, training institutions, agribusiness institutions, and farmers' local organizations are the several types of institutions that make up the agriculture extension system (AES). AES has also fundamentally altered its conceptions, which include both operational and institutional polarization on the application of the function of IT expansion (Sharma, 2006). Farmers' abilities to deal with day-to-day challenges and maximize their progress toward commercialization are hindered further by a lack of access to basic agricultural information and extension services (Mapiye et al., 2021). According to the Food and Agriculture Organization of the United Nations, public extension systems in developing countries are generally plagued by severe under-resourcing, over-stretch, a lack of qualified human resource and infrastructural support, and an overall drop in investment. In addition, the number of trained extension agents is limited, which results in high farmer-to-extension agent ratios (Davis et al., 2016). According to Myeni et al. (2019), the

decreased impact from extension services shows that it is important to characterize the existing extension approaches and develop measures to revolutionize them.

As mentioned above, the role of livestock extension is indispensable for livestock production which could help to increase the performance of livestock farmers. Thus, the paper aims to describe the enhancement of extension systems in livestock production innovation.

Keywords: livestock production, extension, innovation, diffusion.

Livestock Production Development

The livestock industry is an important component of the global food system and a factor in the alleviation of poverty, maintenance of food security, and expansion of agricultural production. According to the FAO, livestock production accounts for forty percent of the global value of agricultural output. Furthermore, this sector ensures the economic well-being as well as the food and nutritional security of around 1.3 billion people. At the same time, there is a significant opportunity to enhance livestock sector practices in order to make them more environmentally friendly, more egalitarian, and less hazardous to animal and human health (World Bank, 2021).

The global supply of meat will increase to 377Mt by 2031 as predicted in order to satisfy the growing demand. The expansion of herds and flocks around the world, particularly in China, in conjunction with ongoing advancements in animal breeding, management, and technology, will lead to a rise in productivity, particularly in low- and middle-income nations, which will ultimately drive an increase in production (OECD/FAO, 2022). Global population is expected to reach 7.8 billion in 2020, 9.8 billion in 2050, and 11.2 billion in 2100 (Kurth, 2017). About 2 billion of the 7.8 billion people are undernourished as a result of protein, micronutrient, and vitamin deficits (Ritchie and Roser, 2019). According to Pica-Ciamarra et al. (2011), 60 percent of rural households in developing nations depend entirely or mainly on livestock for their livelihoods. Livestock also provides necessary protein and micronutrients for underprivileged populations. Livestock farming is a crucial strategy for lowering stunting and wasting in children on a global scale (Ritchie et al., 2018). In order to end poverty, malnutrition, and promote child development, the livestock industry can therefore be a key factor in achieving a number of SDGs. Based on the determined emissions reduction strategy of deforestation and forest degradation in the Ecuadorian Amazon Region, good livestock practices must next be implemented (Torres et al., 2021).

Livestock management is changing toward cautious stewardship and sustainable intensification in response to the demands of a growing population, particularly in emerging nations (Torres et al., 2022). This management aims to integrate livestock and agriculture, which could be a significant contributor to the SDGs' advancement (Lal, 2020). Because it provides smallholders with income, sustainable livestock management can support multiple SDGs, including SDG 1 (No Poverty) (Wurzinger, 2019).

Additionally, it offers a balanced diet that includes beef to help 2 billion people globally who suffer from malnutrition.

A high growth in per-capita income in Asian countries, as well as a high growth in population in Sub-Saharan Africa, will contribute to an increase in the demand for international meat commerce, which will lead to an expansion of this market. Because more people in middle-income and high-income Asian nations are adopting diets that incorporate greater quantities of animal products, the demand for imported goods has been continuously growing over the several years (OECD/FAO, 2022).

Despite the possibility of keeping numerous species in households and the likelihood of management interactions, livestock production systems in developing nations tend to focus on a single type of animal. In addition, insufficient housing, poor breeding, health, and biosecurity measures frequently limit cattle productivity in poorer nations (Conan et al. 2013). Investments in feeding and shelter must therefore be dispersed over a variety of livestock species in resource-poor households that manage many livestock species. Herd size has been found to have a significant impact on farmers' revenue (Maltsoglou and Rapsomanikis 2005). Additionally, while certain livestock species are raised primarily for the purpose of sale, others are raised primarily for domestic use or to assist other agricultural operations, such as the use of cattle for draught power (Yamamoto, 2004). In order to engage with livestock producers to increase livestock output, it is crucial to understand the husbandry elements that affect the various purposes of livestock rearing. The function of an extensioner should be carried out in this manner.

Livestock Production Innovations

In the livestock industry, there has been a varying acceptance of digital technologies in an effort to increase livestock productivity (Guntoro et al., 2022). However, farmers have shown a greater interest in adopting technology that automates tasks rather than those that record data or analyse it in order to make decisions. Utilization of various information technologies has contributed to a shift in the dynamic that exists between extension workers and members of society. During the process of making contact, young people transform into willing members. More people have access to the internet through their smartphones than through their computers. Internet browsing on a mobile device is instantly elevated to a higher level of entertainment as a result (Guntoro et al., 2022). The examples of innovative livestock farming practices that were given in table 1 are provided below.

Table 1. Some instances of the applications in livestock farming.

Feature	Commercial applications, now in use in the livestock industry	Commercial applications, potential in use in the livestock industry
Sensors for data capture	On-animal devices (also known as "wearables"), sensors that measure milk yield, sensors that measure pasture and soil, the	Near-term applications include sensors for recording vocalizations, image analysis (such as analyzing the facial

	use of satellite imagery for evaluating pastures, automated weighing of animals (such as pigs and cattle), and electronic identification are all examples of sensors.	expressions of pigs, cattle, and sheep), and location tracking. applications.
Automation and robotics	Automated/individual feeding, automated barn maintenance, and robotic dairy animal milking.	On large-scale farms, virtual fencing (cattle, goats, sheep) and mechanized milking have evolved.
IoT and connectivity	Devices connected to the Internet of Things are integrated into barn systems to enable real-time monitoring of animal behaviour as well as the temperature of their surroundings.	5G connectivity to enable the rapid exchange of data (for example, for the purpose of image collection and analysis using drones or planes).
Cloud computing and data analytics	Cloud-based storage and analytics are replacing hard drive-based storage and analytics in digital technologies.	Near-edge computing, digital twins, blockchain technology for increasing efficiency and trust in livestock value chains, artificial intelligence for discovering complicated patterns (such as disease prevention in pigs and optimizing pigs' food consumption, for example).
Nanotechnologies and gene editing	Gene editing and clustered regularly interspaced short palindromic repeats are two examples.	Nanotechnologies and nanoparticles for application of fertilizers and pesticides
Novel farming methodologies	Urban and vertical cultivation.	Crowdfarming.

Source: Eastwood et al. (2021)

Currently, the utilization of new innovations and technologies bring advantages to farmers. Several industries are being transformed by technologies like sensors, cloud computing, machine learning, and artificial intelligence. There is still mistrust against this strategy despite the fact that data collecting is currently commonly used in some agriculture and farming scenarios, such as chicken farming (Cravero and Seplveda, 2021). Poultry production, one of the species with the quickest rate of growth in production, uses highly standardized management techniques and a high degree of integration, which creates the perfect environment for the implementation of new technical advancements. A decade ago, the majority of animal farmers lacked access to contemporary technologies like high-speed internet, smartphones, and affordable processing power (Sharma et al., 2022). Sadly, a lot of big data integration, exchange, and analysis methodologies are still in the early stages of development. Astonishingly

large amounts of data (big data) can be produced by hardware sensors, such as cameras or vision sensors, infrared thermal imaging sensors, temperature sensors, radio frequency identification tags, accelerometers, motion sensors, or microphones (Neethirajan, 2020). Similar developments in sequencing technologies allow for an ongoing growth in the genomes and gene expression profiles of hosts, microorganisms, and pathogens.

By using these tools, extension services are an effective method for transferring new knowledge to agricultural practitioners. As a result, the role that the extension service plays in today's livestock industry is extremely important.

Role of Extension in Livestock Production

According to Nikola et al. (2019), one of the primary issues that hinders the ability of smallholder farmers to sell their products is the uneven access to agricultural extension services that they have due to the minimal public extension support that they receive. According to Sani et al. (2014), an effective method of disseminating technological breakthroughs is advantageous to the enhancement of the livestock production on small farms and the family income generated by these farms. According to Mapiye et al. (2021), the function of agricultural extension and consulting services is key to driving the rural development imperative through smallholder agricultural output. This is because these services are essential to affecting change and bringing about rural development. The extension service provides many benefits to farmers, including facilitates access to markets and credit facilities, farming information and inputs, and promotes the organization and producer groups for improved production, livelihoods, training of smallholder farmers and the subsequent growth in household income and well-being (Myeni et al., 2019). The extension service provides various benefits to farmers, such as knowledge and inputs for farming, in spite of the fact that it does not always work properly.

Extension's fundamental responsibility, according to Baig and Aldosari (2013), is to tailor and ease the distribution of research findings to farmers, in light of the fact that scientific information is produced as a result of research carried out by a wide variety of research institutions and organizations. According to Danso-Abbeam et al. (2018), the extension acts as a bridge between scientists, who work to find solutions for farmer difficulties via the use of technical means, and farmers, who implement the solution measures to support their agricultural systems. The scientists work to find answers through the use of technical means.

However, low-skilled farmers who grow animals for food generally practice livestock farming. According to Mairiga et al. (2016), livestock extension activities in West Africa are currently mostly focused on disseminating knowledge about animal management on a local level and in animal health clinics or camps. The example from Assefa et al., (2021), in comparison to crop production, farmers in sub-Saharan Africa believe there are fewer extension services focusing on livestock production (Assefa et al., 2021). Additionally, research has indicated that small-scale livestock farmers have difficulties with the quality of the extension services they receive and are more likely to seek advice from non-

extension agencies (Assefa et al., 2021). Extension programs are crucial in helping livestock farmers spread knowledge that is based on science. This may be difficult because of ineffective communication among research institutions, extension services, and end users, which hinders the application of scientifically grounded knowledge in the real world. The livestock sector needs to develop in specific contexts, and there is a lack of data on the information needs, sources, and pathways of livestock farmers as well as information about the types of farms that can be targeted through extension (Assefa et al., 2021).

The Challenges of Extension in Transferring Innovations

Recent years have witnessed the emergence of new technologies that have the ability to quickly and accurately meet the informational and communicational demands of farmers worldwide, both in industrialized and developing nations. This ICT revolution is fuelled by technological advancements in a variety of sectors, including big data, satellite systems, computing power, and (remote) sensing (Wolfert et al., 2017).

Accordingly, it is impossible to overstate the critical role that agricultural extension (farmer education) has had in the social and economic growth of the country (Kamarulzaman et al., 2016). The effectiveness of the extension Mahmoud workers affects the organization's ability to succeed because they do a fantastic job of influencing farmers' knowledge and attitudes and inspiring a desire to enhance their way of life by honing their agricultural abilities. Agriculture extension services, according to Lafta (2016), are the cornerstone of agricultural development; nevertheless, the industry cannot flourish without an efficient and successful agricultural extension organization.

According to Ommani and Noorivandi (2014), due to socio-economic developments and reforms in the agriculture sector, extension services began to face certain difficulties in the past ten years. In order for the Razza agricultural extension organization to respond favourably to new concepts, they must be well instructed on how to incorporate the concepts or practices into their farming operations. However, the agricultural extension organization's incapacity to favourably adapt to fresh concepts or innovations might be blamed for the sluggish development of agriculture (Saleh et al., 2016).

The Enhancement of Extension System for Livestock Production Innovation

At every single level of administration, monitoring and assessment of the agricultural extension programs are carried out. In addition, in order to guarantee the public's accountability and transparency, it is essential to incorporate all of the agricultural extension's stakeholders, including farmers, extension agents, and actors from the agribusiness industry. In this age, AES has also fundamentally altered on its conceptions, which include both operational and institutional polarization on the application of the function of IT expansion (Sharma, 2006)

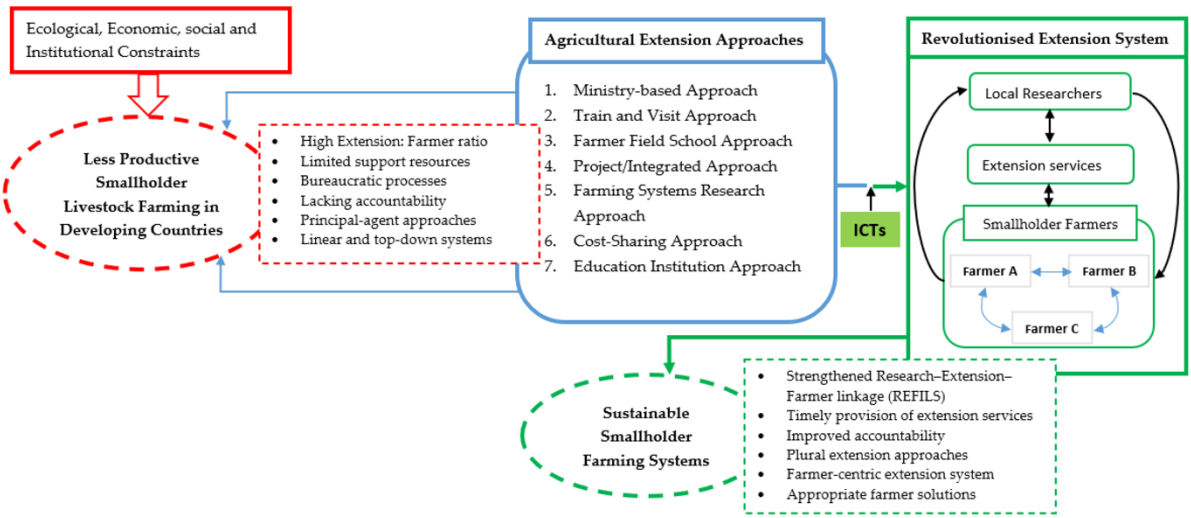

Figure 1. The potential for information and communication technologies to completely transform agricultural extension (Mapiye et al., 2021).

Because the public extension system is unable to provide adequate assistance to the rapidly growing smallholder livestock industry, it is imperative that novel approaches be developed in order to completely overhaul the system. According to Akpalu (2013), this points to the necessity of reforming the extension system so that it becomes more cost-effective, smallholder farmer-centred, and pluralistic. According to Hazell et al. (2007), there is a severe deficiency in the number of creative institutions in developing countries, particularly those that provide support for smallholder farmers. This deficiency makes it difficult to implement innovative tactics in these nations.

Conclusion

Smallholder farmers in developing countries rely on public extension as their primary source of extension services. Livestock extension serves to bring livestock production information, inputs, and improved technology to smallholder farmers. It also facilitates smallholder farmers' access to markets and financial facilities, which ultimately results in increased productivity and improved livelihoods. Precision livestock farming or Internet of Things, is one of the ways that the extension system can be improved.

Acknowledgement

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THE POTENTIAL OF A LOCAL POULTRY BREED AND FEEDSTUFFS IN ENSURING SUSTAINABLE PROTEIN PRODUCTION

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Malaysia's poultry industry is highly dependent on imported inputs including breed, feed ingredients, feed additives and labour. As the cheapest sources of protein, prices of chickens and eggs in the country should be stable and affordable to the people. Unfortunately, due to the Covid-19 pandemic and international wars, the supply chains for chickens and eggs production have been disrupted. The increase in feed prices is one of the main contributors to the increase in the cost of chicken production, resulting in a shortage of chicken meat and eggs and increasing their retail prices. With the current pressure on the cost and supply of imported corn and soybean meal, it is timely to broaden our view in considering alternative feedstuffs for poultry. In order to ensure the sustainability of Malaysia's poultry production, the dependency on the imported chicken breeds should also be considered and reduced. Village chickens are famous among the locals for their solid meat and unique taste, although physiologically, they have slower growth rate and lower harvest weight compared to commercial broilers. The advancement of the village chicken industry is relatively slow, represented by only 4.4% of the country's poultry population in 2020. The limiting factors of this industry include inconsistent supply and quality of day-old chicks, growth performance and phenotype characteristics. However, local village chickens could be developed for intensified production under improved genetics, feeding, health and management systems to increase meat and egg production. Recognizing the potential solution, MARDI carried out research on chicken breeding and has successfully produced a breed, called Ayam Saga, from local genetic resources, more uniform body size, feathers and appearance and have better growth and laying performances compared to common village chickens. In order to support the development of the local chicken breed industry, feed cost needs to be addressed. Two types of diets were formulated and tested, i.e., "temukut" or broken rice-based diet and palm kernel expeller cake-based diet (PKFeed). These diets were formulated according to energy and protein requirements of Ayam Saga. Although the performance of Ayam Saga fed on temukut diet was significantly lower than those fed on commercial diet, feed cost per kg meat was RM 0.15 cheaper and able to substitute more than 40% imported corn and soybean meal. Ayam Saga fed on PKFeed had similar final weight and FCR with those fed on commercial diet. Similarly, the growth performance of Ayam Saga fed on PKFeed Plus (PKFeed supplemented with enzymes) did not differ significantly ($P>0.05$) from those birds fed on commercial diet, with final weight of 1.84 ± 0.05 and 1.92 ± 0.04 kg, respectively. The formulation costs for PKFeed and PKfeed Plus were also lower between 6.78 to 11.82 % than those of typical corn-soybean meal formulations. With these technologies, dependency on imported breeds, imported feed ingredients and the production cost of chicken meat and egg could be reduced. Beside supporting a

sustainable chicken production, this also assists in ensuring protein supply and national food and feed security in the long run.

Keywords: Village chicken, Ayam Saga, local feed formulation, chicken meat, eggs

ALTERNATIVE PROTEIN SOURCE FROM A LOCAL PLANT AS POULTRY FEED

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Introduction

It is always worth considering an alternative protein source, especially when prices for conventional ingredients increase. The rise in the price of animal feed components in the international market is a major challenge to poultry industries, and small farmers are the most affected. To overcome the challenges, the poultry sector will have to focus on cheaper protein sources that are locally available (Hien *et al., 2017*).

Recently, the use of *Trichanthera gigantea* (Tg) leaves or known locally as ketum ayam and Azolla pinnata (Ap) as alternative protein sources in the poultry diet is becoming more popular in Malaysia, especially among small scale village chicken farmers. This plant is easily planted in Malaysia because of the suitable environment.

However, in this country, there is lack of scientific evidence on the effectiveness of both plants to replace the protein source. With its relatively high protein content, approximately 23% in Tg, and 24.82% in Ap, the leaves may have a potential to be used as a partial replacement for alternative protein source in broiler feed (Heuze *et al.,* 2017). The presence of anti-nutritive components (phenol, saponin and steroid) in the plant leaves may have a significant impact.

Keywords: *Trichanthera gigantea*, *Azolla pinnata*, alternative protein, anti-nutritive

Materials and Methods

The experiment was conducted to determine the effects of varying levels: 0, 5, 10 and 15% of dried Tg and Ap leaves meal inclusion in broiler diet on growth performance and carcass yield at grower-finisher stage using a completely randomized design.

(T1) Basal diet/control diet containing no TG / Ap or 100% soybean meal (SBM) component.

(T2) Basal diet containing 5% TG / Ap meal.

(T3) Basal diet containing 10% TG / Ap meal.

(T4) Basal diet containing 15% TG / Ap meal.

Results and Discussion

A decreasing trend in growth performance was seen as Tg level increased where the final body weight reduced, cumulative weight gain and cumulative feed conversion ratio (FCR) increased at 15% inclusion. The gizzard weight increased at 10% and 15% levels, dressing percentage reduced at 15% level, the liver size reduced at 5% level, and the highest abdominal fat content was produced at 10% level (Sklan *et al.,* 2004). The inclusion of Ap up to 15% in broiler chicken feed ration showed no adverse effect on the growth performance, nutrient digestibility, meat production and meat quality of the birds. In conclusion, both leaves have a potential to be a protein source in broiler diets up to 10%. However, the adverse effects observed on the higher inclusion. This may be due to high content of anti-nutritional components in the leaves to be digested by monogastric avian type (Riascos Villejos *et al.,* 2020).

Acknowledgement

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CONSERVING ENDANGERED WILDLIFE SPECIES USING MOLECULAR AND CELLULAR TECHNOLOGIES AND ITS APPLICATION IN LIVESTOCK FARMING

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Introduction

Malaysia is a rain forest country that has various types of wildlife. Urbanization activities like deforestation and plantation have significantly disturbed our ecology and biodiversity which leads to extinction problems. In November 2019, the last Sumatran Rhinoceros in Malaysia died that triggered the awareness of Malaysians to be concerned about wildlife. The death of the last Sumatran Rhinoceros underscores how critically essential the collaborative efforts driving the preservation and conservation of the endangered species. From time to time, the number of the other endangered species are reducing. However, it is not too late to start the collection of samples such as tissue, gametes, and cells from the endangered species that are still available in Malaysia and will be deposited in the established frozen zoo.

Assisted Reproductive Technology (ART) could benefit conservation activities by focusing on breeding and establishing the genomic database. Somatic cell nuclear transfer (SCNT) and induced pluripotent stem cell (IPSC) technologies are two useful technologies in conserving the endangered species at cell line level. The production of the viable embryo is the main focus.

The number of endangered animals is decreasing from time to time. For instance, IUCN has classified the Malayan tiger as endangered while the number of the tiger population continues to decrease. In which, according to the PERHILITAN, less than 200 tigers are still available in Malaysia. It alarms and pressures us to enhance the efforts on conservation activities which include the ART approach. This gives us the indication to actively take necessary and appropriate ways of conservation.

Figure 1. Example of endangered species available in Frozen Zoo, IIUM

Materials and Methods

This project is divided into several phases which are reviving the cells of the endangered species; producing the viable embryo via SCNT approach; via iPSC technique; morphology, biochemistry, and genetic changes of the cryopreserved embryo. The findings from this study will serve as a guideline for the development of the endangered species' embryo which will be ready for the breeding activities. Therefore, it is very crucial to develop the viable embryo of the endangered species. Shall it be adopted or adapted in animal farming activities?

The protocols of ART in clinical settings for humans are already established. On the contrary, the protocol for the animals might be different, especially for the endangered species. In ART, the method for the gametes collection is very crucial to ensure the success of the ART. The nature of the endangered species could be different in which the knowledge on the sample collection is very important to be discovered.

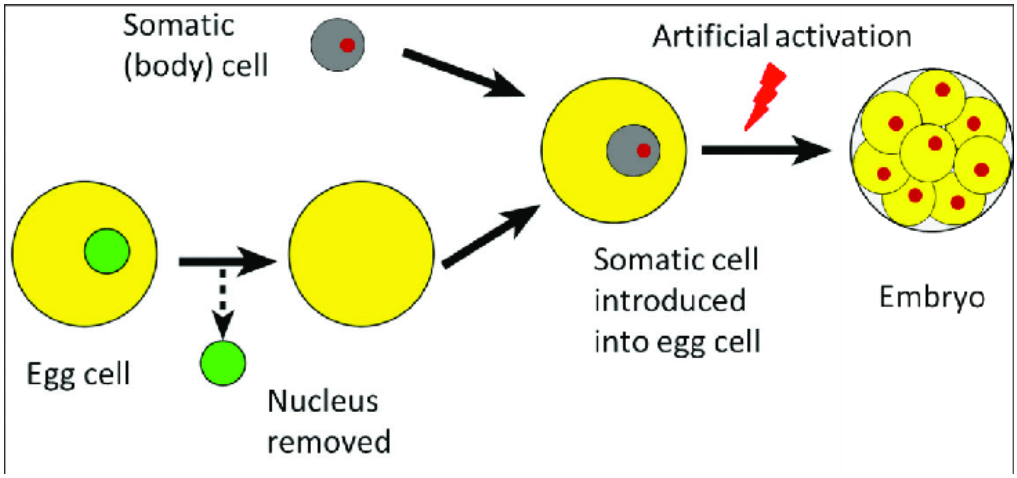

Figure 2. The overview of somatic cell nuclear transfer (SCNT) procedure.

(Credit photo: Pepper, Gouveia & Nőthling Slabbert, 2015)

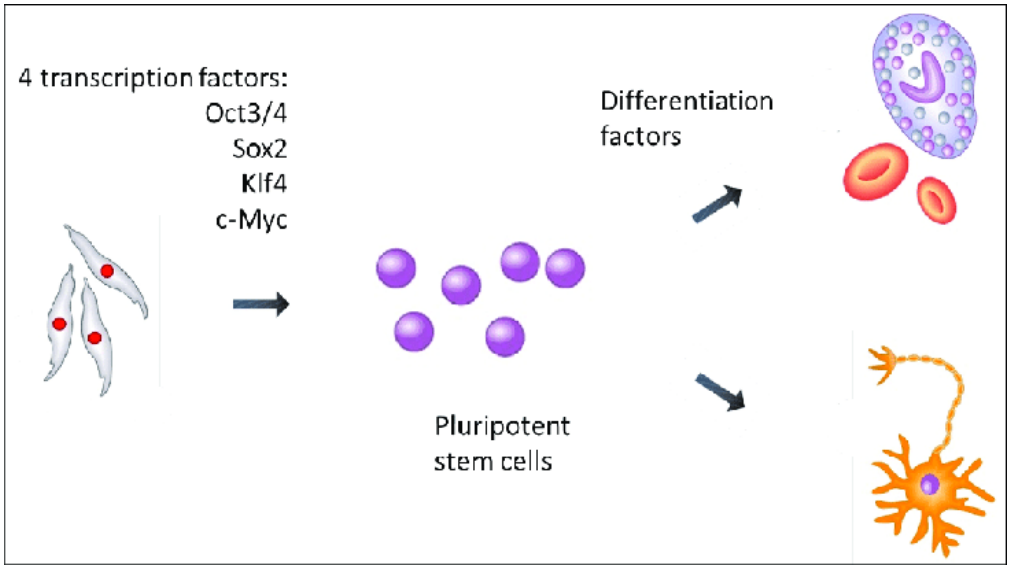

Figure 3: The overview of the induced pluripotent stem cell activities.

(Credit photo: Pepper, Gouveia & Nőthling Slabbert, 2015)

The technology of embryo development; why?

Basically, the first option is using the natural gamete, but the successful rate might be low. Based on history in captivity the natural breeding is not so promising (Saragusty et al., 2016). Therefore, the scientists opt for assisted reproductive technology for conserving the endangered species. In January 2019, the scientists have successfully created three sets of embryos from the eggs of living northern white rhino with the

spermatozoa that were preserved from the deceased northern white rhinos. The embryos are being cryopreserved in liquid nitrogen, with later in coming future the conservationists planning to implant them in a southern white rhino surrogate (Gilliland, 2019). Therefore, it is good if we try to do the same thing to the other endangered species in Malaysia such as Malayan tiger, Malayan Gaur etc.

In addition, the system concerning embryo banking is not well established in Malaysia. The banking system, especially for endangered species, could benefit our country in the field of ART. Therefore, knowledge on the embryo development and cryopreservation techniques for endangered species are very crucial to be initiated. Do animal farming activities need a cell banking system too in Malaysia?

By having the protocol of developing the viable embryo, the country can start to embark on cellular technologies in solving the extinction of endangered species. Recently the derivation of cell lines and the development of IPSCs from the tissue of Northern White Rhinos, which only left two in the entire world, have been undertaken at the frozen zoo of San Diego, California US. Therefore, we should be on track with other external researchers in dealing with global issues. We could do similar approaches to our precious endangered species.

Thus, the country will start collaborating with foreign researchers or expertise since we also have our own experts in this field, which could provide less expenses and budgets. Soon our nation will stand together tall with other countries to assist our precious endangered species.

The product of this study would be the resources of our country. This will enhance the tourism activities from local or international tourists. In addition, it also could help the society to generate more income. Then, the intellectual properties concerning the protocol and the end products could generate more revenue. The application of the technologies towards animal farming should be encouraged to ensure the sustainability of our animal farm products.

This project also will enhance the transfer of knowledge program. IIUM is not only the one that would have this technology. The collaborators such as Borneo Rhino Alliance (BORA), Department of Wildlife and National Parks Peninsular Malaysia (PERHILITAN) and Department of Veterinary Services Malaysia had been thought capable of conducting the protocol as well. The community, especially farmers will benefit with these technologies.

Conclusion

The key activities in project completion are gathering the findings of this study for providing the best protocols for conducting the ART on the endangered species which require our attention. It will be a model for conserving endangered species especially in our country. In which, the protocol developed from this could be vastly used to the various species from the endangered species but with slight modification. Animal farming?

By having the viable embryo development protocol, the country can start to embark on cellular technologies in solving the extinction of endangered species. In IIUM, we already started by having IIUM Frozen Zoo facility at Kuantan Campus.

The technologies could potentially provide benefits to animal farming which eventually assist in solving food security issues faced by all of us lately. The SCNT and iPSC approaches will allow the farmers to freeze the potential animal cells for next generation breeding even without any present gamete collecting process. In which, this study will be serving the government and society by producing the viable embryo for the cloning activities in the future.

Acknowledgement

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COMPARISON OF ESTRUS RESPONSE RATE AND ELECTRICAL RESISTANCE OF VAGINAL MUCUS FOR TWO PRID-DELTA ESTROUS SYCHRONIZATION PROTOCOLS IN BEEF COWS

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Introduction

Timed artificial insemination (TAI) protocols facilitate AI to be performed without investing time and labour required for estrus detection. Five-day Cosynch (5DCOS) and seven-day Cosynch (7DCOS) are popular estrous synchronization protocols utilized for reproductive management of dairy and beef cattle. Comparative studies between the two protocols have been previously studied but they were based on the use of CIDR® (Controlled Internal Drug Release). Progesterone usage in timed AI procedures increases ovulation synchronization (Bisinotto et al., 2015). A new progesterone device PRID-Delta® has become available in Malaysia and there is a lack of literature on its reproductive fertility in Malaysian cattle. This study aimed to compare the efficacy of two estrous synchronization protocols (5DCOS and 7DOCS) utilizing PRID-Delta® as a progesterone device in terms of estrus response rate (ERR) and electrical resistance of vaginal mucus (ERVM).

Keywords: Estrus response, electrical resistance of vaginal mucus, timed artificial insemination, PRID-Delta, beef cattle

Materials and Methods

Eighteen Brangus cows were recruited into this study. The age, body condition score, parity and days postpartum ranged from 3-9 years, 3-5 (9-point scale), 1-5 parity, and 86-830 days, respectively. Cows were randomly divided into two groups to received either one of two treatment protocols. Group 1 (5DCOS) involved a five-day Cosynch + PRID-Delta received GnRH (2mL of Cystorelin®, Ceva Santé Animale, Libourne, France) and intra-vaginal PRID-Delta (Santé Animale, Libourne, France) on D0. On D5, PRID was removed and 2 doses of 25mg Enzaprost®T (Ceva Santé Animale, Libourne, France) 8 hours apart (Initial dose at PRID removal). Group 2 (7DCOS) involved a seven-day Cosynch + PRID-Delta® received the same treatment on D0, except the group received a single dose of Enzaprost®T. Timed artificial insemination was scheduled at 58 and 72 hours after PRID-removal in 5DCOS and 7DCOS groups respectively when second GnRH was administered. Estrus observed visually twice daily along with electrical resistance measurement of vaginal mucus using Draminski estrous detector (Draminski, Olsztyn Poland) from the time of PRID-Delta® removal until the scheduled AI day. Data was analyzed using IBM SPSS version 27.0.

Results and Discussion

The proportion of ERR is presented in **Figure 1**. In postpartum cows, ERR was 80% and 25% for 5DCOS and 7DCOS, respectively. The increased proportion of ERR observed in the 7DCOS group may be attributed to the longer treatment duration (10 days) compared to the 5DCOS group (7 days). The extended duration might have allowed cows to develop larger follicles, leading to increased estrogen production and a higher number of cows exhibiting estrus in the 7DCOS group (Whittier et al., 2013). Electrical resistance of vaginal mucus (ERVM) during the scheduled AI day is presented in **Table 1**. Significant difference was observed between cows that expressed estrus and those that did not (p < 0.001). This indicates that ERVM could be effectively used as an estrus detection tool to optimize the AI timing in cows.

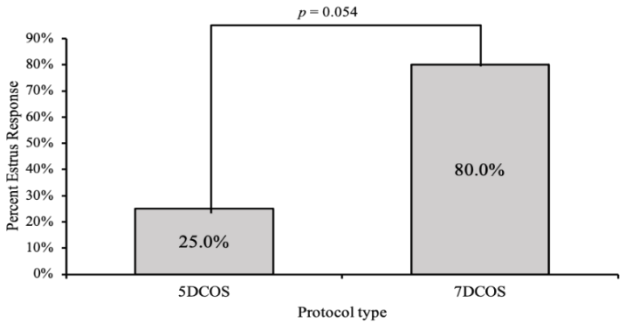

Figure 1. Proportion of estrus response rates for 5DCOS and 7DCOS protocols

Table 1. Electrical resistance of vaginal mucus measured in Ohms during scheduled AI day based of estrus status.

Estrus Expression	N	Means (Ω)	SD	*p*-value
Yes	10	224.30	42.76	< 0.001
No	8	311.88	25.67	

Conclusion

In conclusion, the 7DCOS + PRID-Delta® showed greater tendency of estrus response rate than 5DCOS + PRID-Delta® in postpartum cows. ERVM values during the scheduled AI differed significantly between cows that expressed estrus and those that did not express estrus indicating potential use of ERVM in detecting estrus in a TAI program. However, due to the low sample size in this study, further study with larger sample size is required to increase the statistical power and provide reliable results.

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COMPARISON OF DIFFERENT CONCENTRATION OF HONEY AND STINGLESS BEE HONEY EXTENDERS ON SEMEN QUALITY OF BOER GOAT AT 5˚C

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Introduction

During cold storage, cryoprotectants are often added to help protect the sperm cells from damage and extend their viability. Honey can be a useful semen extender component for preserving semen during cold storage. High levels of sugar contents such as glucose and fructose can help to protect cells by acting as a natural cryoprotectant (Zakiya et al., 2020) and proven to be effective with less detrimental effects compared to other extenders (Kasimanickam et al., 2011). Superior antioxidants properties in stingless bee honey such as polyphenols and flavonoids, may contribute to reduce oxidative stress and protect cells from damage (Wongsa et al., 2023). However, more research is needed to fully understand the antioxidant properties of stingless bee honey and how they compare to those of traditional honey. The purpose of this study is to evaluate the efficacy of honey and stingless bee honey TRIS semen extenders for preservation of Boer goat semen at 5˚C up to 48h.

Keywords: goat, semen, honey, stingless bee honey, chilling

Materials and Methods

Semen samples were collected from three Boer bucks using artificial vagina, pooled and supplemented with TRIS as control (C), 4% honey + TRIS (TH1), 5% honey + TRIS (TH2), 4% stingless bee honey + TRIS (TS1) and 5% stingless bee honey + TRIS (TS2) and replicated three times. The processed semen was cooled in the refrigerator (5˚C) and evaluated at 0, 2, 4, 6, 8, 10, 24 and 48h. The chilled samples were assessed for viability, sperm individual progressive motility (IPM), morphology and mortality. Two-way analyses of variance (SAS software version 9.4) and Least Significant Difference (LSD) test were used to compare the differences between mean values. Statistical significance for the means was considered at $P<0.05$. The results were then presented as mean ± standard deviation (SD).

Results and Discussion

Viability of the sperm was significantly higher in TH2, TS1 and TS2 at 4h (Figure 1). However, in 10h onwards only TH2 showed a higher percentage in viability ($P<0.05$) than those treated with stingless bee honey (TS1 and TS2). Even though stingless bee honey contains higher antioxidants than regular honey to support the semen preservation, low

sugar content of stingless bee honey may explain the reduced mean percentage of viable sperm (Rao et al.,2016).

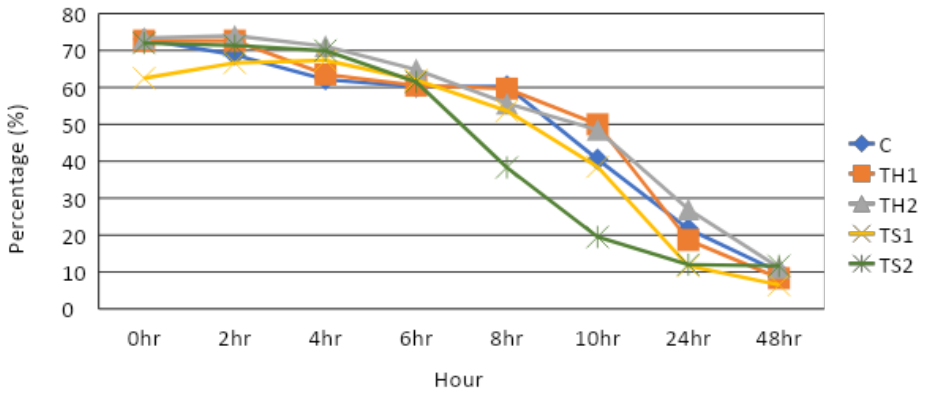

Figure 1. Sperm viability with different concentrations of honey (TH) and stingless bee honey (TS) across 48 hours intervals. *C (Control=100% TRIS); TH1 (TRIS + 4% honey); TH2 (TRIS + 5% Honey); TS1 (TRIS + 4% stingless bee honey); TS2 (TRIS + 5% stingless bee honey).

IPM of TS1 and TS2 were significantly lowest at 2h, 4h and 6h ($p<0.05$) as compared to C, TH1 and TH2. The use of honey in semen extenders resulted in an increasing percentage of IPM in TH1 and TH2 at 10h, 24, and 48h($p<0.05$). Stingless bee honey reportedly contains less sugar and more minerals and antioxidants than honey produced by honey which contributed to this.

Conclusion

The result of this study indicates that TRIS supplemented with 5% of honey improved the sperm quality after chilling.

Acknowledgement

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QUANTIFICATION OF RUMEN MICROBIAL POPULATION IN RESPONSE TO *A. PANICULATA* AND *O. STAMINEUS* SUPPLEMENTATION USING QUANTITATIVE RT-PCR

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Introduction

The ruminal microorganism population and composition can be examined in order to determine the degree of digestion by ruminant, since microbial react to the nutrients left after the digestion of feed had been completed by the host (Mcanally, 1944). In order to quantify the ruminal species, techniques of molecular microbial ecology were introduced with great sensitivity and precision, besides several studies have reported a sense of which species are most abundant in the rumen under particular feeding conditions (Kobayashi, 2006). Additionally, there are many studies have proven *Andrographis paniculata* and *Orthosiphon stamineus* to be successful in enhancing the nutritional importance of livestock animals as it is rich in antioxidant properties (Chao & Lin, 2010). Thus, the present study was conducted to determine the rumen microbial population in response to *A. paniculata* and *O. stamineus* supplementation using quantitative RT-PCR analysis in the rumen of goats.

Keywords: *Andrographis paniculata*, *Orthosiphon stamenius*, rice straw, goats, real-time pcr.

Materials and Methods

Four fistulated Boer cross-bred (±25 kg of body weight) were used in 4 different periods (4 x 4 Latin square design), where each period was for a duration of 22 days; 10 days of adaptation period, 5 days of sampling and 7 days of change-over. The animals were fed once daily at 0800 (3% body weight) with 60% of urea-treated rice straw and 40 % of one of four concentrate diets: basal diet + 1% *A. paniculata* (AP), basal diet + 1% *O. stamineus* (OS), basal diet + 0.5% of *A. paniculata* and 0.5% *O. stamineus* (AO) and a basal diet without supplementation of herbs (BD). Clean water was provided *ad libitum* and the animals were individually penned. The rumen microbial populations in the ruminal contents were quantified using real-time PCR analysis.

Results and Discussion

Table 1: Quantification of total bacteria, total protozoa, methanogens and fibre-degrading bacteria (Log10 copy number per gram)

Item	Diet				SE
	AP	OS	AO	BD	
Total bacteria	8.87	8.6	8.91	8.97	0.22
Protozoa	5.8[a]	5.79[a]	5.55[a]	6.15[b]	0.07
Methanogens	6.71[ab]	6.93[bc]	6.56[a]	7.18[c]	0.07
F. succinogens	5.21[a]	5.37[b]	5.31[ab]	5.73[c]	0.02
R. albus	7.07[ab]	7.25[b]	6.85[a]	7.26[b]	0.06
R. flavefaciens	4.01	3.89	4.05	4.06	0.22

Significantly different at 5% ($P<0.05$)
a, b and c: Means with different letter within a row differed significantly.

The main factors affecting the population and the abundance of the microbial community, especially fibre-degrading bacteria in the rumen were heavily influenced by the dietary conditions (Samsudin et al., 2014). This theory is supported by Cardozo et al. (2004), where in a study conducted previously showed herbs supplementation may affect the microorganism population in the rumen, and also effective in enhancing beneficial bacteria or reducing pathogenic bacteria. In the present study, reduction of protozoa, methanogens, *F. succinogens* and *R. albus* number were observed when *A. paniculata* and *O. stamineus* were introduced to the goats compared to control group. Varel et al. (1991) has stated that this situation could have been due to the presence of secondary metabolite compound in the herbs. These secondary metabolites in both of the herbs are believed to be toxic to protozoa and have been identified as possible defaunating agents (Newbold et al., 1997). Moreover, the secondary metabolites in the supplemented herbs may be also having the ability to reduce methane production and the growth of fibre-degrading bacteria, thus inhibited the attachment of the fibrolytic bacteria to fibre particles, reducing the number of *F. succinogens* and *R. albus* in the present study.

Conclusion

The supplementation of *A. paniculata* and *O. stamineus* in urea-treated rice straw based-diets neither improves nor causes adverse effect on the goat rumen microbial population. Further study could be done by increasing the supplementation of herbs in order to observe more effective results.

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EVALUATION OF COPPER CONCENTRATION IN GOAT FEED MATERIALS IN JOHOR

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Introduction

Copper (Cu) is a metal that occurs naturally in the environment and is an essential nutrient for all living organisms. Cu is mainly sored in the liver and is an essential part for several enzyme mechanisms. It plays an important role in tissue respiration. While deficiency of Cu could result in a wide range of clinical signs, one of the early enzymes to be affected due to Cu toxicity is tyrosinase which is critical for melanin synthesis (Underwood and Suttle, 1999). Cu poisoning occurs primarily in sheep; however, goats are also at risk. Goats require more Cu than sheep, which is the reason why Cu is commonly added to goat feed. The purpose of this study was to evaluate the Cu levels in raw materials for goat feed used by dairy goat farmers in Johor.

Keywords: copper, dairy goat

Materials and methods

Sampling activity was carried out from 24 June to 17 August 2020. A total of eighteen dairy goat farms in Johor were involved in this study, in the districts of Kluang (n=7), Batu Pahat (n=6), Kulai (n=2), Johor Bahru (n=2) and Pontian (n=1). A total of forty feed samples were collected and analysed. The types of feed samples collected consist of dairy cattle pellets (n=8), goat pellets (n=3), soybean waste (n=14), oil palm by-product (n=3), and Napier grass (n=12). A wet ashing method has been used to digest these samples. The quantitative determination of Cu was made using an atomic absorption spectrophotometer method with a flame burner fed with an air-acetylene mixture in a Perkin Elmer analyser in conjunction with AA WinLab software. The calibration curve of absorbance against concentration was obtained using standard solutions (Perkin Elmer), at three points: 1, 2, and 4 mg/kg. The wavelength used for the determination of copper was 324.7 nm. The results of copper concentration are presented in mg/kg dry matter. All data were analysed using Microsoft Excel 2010 (Microsoft, Redmond, WA, USA).

Results and Discussion

The average, lowest, and highest concentrations of Cu in dairy goat feed samples are presented in Table 1. The results show that all the samples contained Cu in detectable amounts.

Table 1: Average, lowest and highest copper concentrations in dairy goat feed samples

			Range	
Samples	**n**	**Mean ± SD (mg/kg)**	**Low**	**High**
Dairy cattle pellet	8	12.2 ± 3.4	8.4	19.4
Goat pellet	3	13.7 ± 3.3	10.0	15.9
Soybean waste	14	7.1 ± 7.2	3.0	32.5
Palm oil by-product	3	21.3 ± 8.7	15.1	31.2
Napier grass	12	4.4 ± 1.8	1.7	6.8

The Cu requirement proposed by the National Research Council (2007) is 15 mg/kg, while the Malaysian Standard (2011) recommends that the Cu concentration for dairy goat feed should contain between 12.00 mg/kg to 20.00 mg/kg. The average Cu concentration obtained from the dairy cattle pellet and goat pellet analysed in this study are 12.2 mg/kg and 13.7 mg/kg respectively, are still within the range recommended by the Malaysia Standard. The average concentration of Cu in the oil palm by-product was found to be the highest (21.3 mg/kg) compared to Napier grass which is the lowest (4.4 mg/kg). Meanwhile, as for soybeans waste, the average Cu concentration is quite low at 7.1 mg/kg but has the highest range value at 32.5 mg/kg.

Since both deficiency and excess of Cu in raw feeding materials are capable to affect the health of livestock, animal farmers need to be aware and careful in formulating their own animal feed.

Conclusion

The variable copper concentrations found in this study support the need for on-going monitoring of copper levels in raw feed to ensure animal feed is safe and that the dietary needs of dairy goats are met, as recommended by the National Research Council and Malaysian Standard.

Acknowledgement

The authors are grateful to the Director General of Department of Veterinary Services and Director of Malaysian Veterinary Institute for permission to participate and to present this study in the 42nd MSAP Annual Conference.

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LEVAMISOLE RESISTANCE IN GOAT FARMS IN KELANTAN: IS IT DEVELOPING?

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Introduction

Gastrointestinal nematode infection is one of the major problems in the goat industry worldwide but its control is limited by the widespread anthelmintic resistance. This problem emerged in Malaysia since 1990s with detection of resistance on benzimidazoles and macrocyclic lactones. About 10 years ago, levamisole was the only anthelmintic found to be effective against gastrointestinal nematodes in goat farms (n=8) in Kelantan (Basripuzi et al., 2012). However, the current status of levamisole in Kelantan is still unknown. Hence, this study aimed to determine the prevalence of gastrointestinal nematode infection and investigate the latest status of levamisole resistance in selected goat farms (n=3) in Kelantan.

Keywords: levamisole, anthelmintic resistance, goats, Kelantan

Materials and Methods

Faecal samples that were collected from a total of 73 goats in three farms located in Bachok and Kota Bharu, Kelantan were subjected to McMaster method, faecal culture and genus identification of infective stage larvae, L3. The prevalence was determined based on the number of identified L3 genus divided by the total number of observed L3. The samples were screened for the criteria of Faecal Egg Count Reduction Test (FECRT). Then, the goats in each farm were divided into control and treatment groups with approximately similar means of faecal egg count (FEC). The goats in the treatment group were administered with levamisole according to the manufacturer's recommended dosage. The faecal samples were collected 7 days post-treatment and also subjected to McMaster method, faecal culture and L3 identification. The Faecal Egg Count Reduction Percentage (FECR%) was calculated according to the formula provided by Coles et al. (1992). Levamisole resistance was determined if FECR% value was less than 95% and the lower confidence level of 95% was less than 90%.

Results and Discussion

Haemonchus sp. was identified as the most prevalent nematode genus in Farm B (91%) and Farm C (100%). *Trichostrongylus* sp. and *Oesophagostomum* sp. were detected in Farm B with low prevalence (<10%) (Figure 1). No L3 was observed in Farm A. The findings were expected as a previous study (Basripuzi et al., 2012) showed high prevalence of *Haemonchus* sp. in comparison to the other nematode genus.

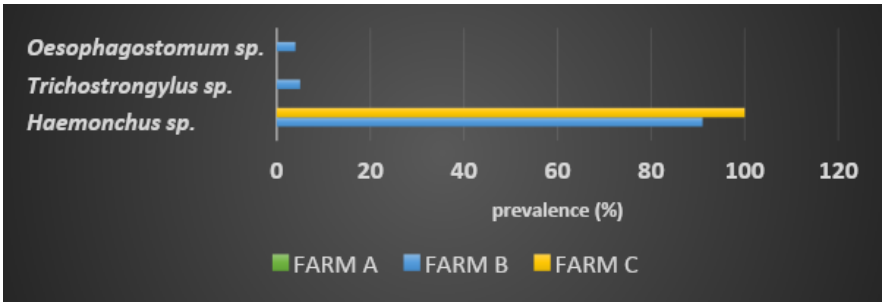

Figure 1: Prevalence of nematode in selected goat farms in Kelantan

Levamisole resistance was detected in Farm B that met the criteria for FECR% of 88% and 95% lower confidence level of less than 90% (Table 1). However, resistance was not suspected in Farm C based on low mean FEC in both treatment and control groups. Farm A was excluded from the FECRT due to the absence of nematode eggs.

Table 1. Levamisole resistance status in the selected goat farms in Kelantan

			Post-treatment mean FEC[2]		FECR[3](%)	95% CI[4]	
Farm	N[1]	Status	Levamisole	Control		Lower	Upper
Farm B	20	Resistant	245	2041	88	1	99
Farm C	10	Low count	0	70	100	70	100

[1]No. of animals; [2]Faecal egg counts; [3]Faecal egg count reduction; [4]CI = confidence interval

Conclusion

Consistent with the previous study, *Haemonchus* sp. was still identified as the predominant nematode infecting goats in Kelantan. In contrast to the previous study that showed negligible resistance to levamisole, the current study revealed that levamisole resistance has been developed in at least one goat farm in Kelantan. Nonetheless, more farms must be included in the study to confirm levamisole resistance status among goat farms in this state.

Acknowledgement

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THE EFFECT OF ABIOTIC FACTORS ON FLY ABUNDANCE IN EARTHEN AND CONCRETED MANURE SETTLING FLOORS IN BROILER CHICKEN FARM

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Introduction

Open house poultry farms in Malaysia typically adopted earthen or concreted manure settling floors. Earthen manure settling floors are strongly contingent on soil type and the nature of soil water permeability. Basically, the manure-settling floors will have an even surface, yet in earthen floor nature, this is considerably difficult to achieve as soil is subjected to gradual erosion during manure removal and routine cleaning. While the concreted manure settling floor type has a firm concrete basement, it is free from the effects of soil type, and most importantly, it is easier to clean in order to maintain a good sanitary level in farms. Modern poultry farming systems, which are large operations with high densities of animals, have given rise to environmental concerns at the national level. Accumulated poultry manure can be highly suitable for house fly breeding, especially where general sanitation is poor and there is excessive moisture. Houseflies prefer manure as a breeding source but have been found breeding in moist, spilled feeds and other moist, warm decaying organic matter (Ralph 2010). Apart from manure moisture content and volatile by-products from manure degradation, there are several other factors that affect fly population growth in these two farming systems, namely, temperature, humidity, ammonia vapour and wind speed, which influence housefly breeding. Hence, this study was conducted to determine the effect of abiotic and biotic factors on housefly abundance in both earthen and concreted manure settling floors.

Materials and Methods

Fly abundance was enumerated using Scudder grill (Scudder, 1947). Fly index was taken weekly in the morning from 0900 to 1100 as standard time when housefly is found active (Bong and Zairi, 2009). Husbandry data consisting of age of birds in the sampling houses was recorded. Breeding area air temperature, ammonia (NH_3) and hydrogen sulfide (H_2S) were sampled using a TG-501 probe of GreyWolf Sensing Solution at nine locations (three at the north, three at the south and 3 at the center portion) of the house in a total of 3 houses per farm. Wind speed measurements were taken using anemometer starting from north wall in 3 locations across the width of the house in a total of 3 houses per farm. All data were analyzed using independent samples T-test (IBM SPSS analysis version 27) and subjected to a Pearson correlation test (IBM SPSS analysis version 27). The tests were performed using a significance level of $p= 0.05$.

Results and Discussion

Fly abundance in means housefly index showed lower abundance in concreted manure settling floor as compared to earthen manure settling floor type in this current study. However, housefly index was also homogenous between earthen and concreted manure settling floor type when compared with the age of birds. This is consistent with Annuar et al. (2002), where he claimed that the fly index in poultry farm had no correlation with the age of chicken. In this current study, earthen manure settling floor recorded lower breeding ground temperature (29.14 ± 1.76 °C) compared to concreted manure settling floor (29.59 ± 1.81 °C). This could be best explained by the nature of heat transmissibility of the manure settling floor type material. It is apparent that the type of manure flooring has an effect on ammonia gas concentration, where earthen flooring recorded lower concentration of ammonia (0.85 ± 1.18 ppm) as compared to concreted flooring (0.98 ± 1.03 ppm). Furthermore, correlation between ammonia gas concentration and manure settling floor type in the present study indicates ammonia production is affected by the type of manure settling floor type. It is also apparent that manure settling floor has an effect on hydrogen sulfide gas concentration; where earthen flooring recorded a lower concentration of hydrogen sulfide (0.04 ± 0.06 ppm) as compared to concreted manure settling floor type (0.05 ± 0.09 ppm). Though many have documented that maximum flight speed that can be achieved by an adult housefly is approximately 2 m/s (Dahlem, 2009), present study revealed maximum average wind speed of 0.98 ± 0.50 m/s in poultry farm with earthen manure settling floor type.

Conclusion

In conclusion, broiler chicken farms with earthen manure settling floor had larger fly abundance as compared to the concreted manure settling floors. Breeding ground temperature, ammonia gas and hydrogen sulfide gas concentrations were found to cause significant effect on the housefly index. Hence, houseflies can be effectively controlled by adhering to Good Animal Husbandry Practises (GAHP), along with the maintenance of good sanitation and cultural control practises in broiler chicken farms.

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RESISTANCE STATUS OF POULTRY STRAIN *Musca domestica* LARVAE TOWARDS PYRETHROIDS AND ORGANOPHOSPHATE INSECTICIDES

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Introduction

The house fly, *Musca domestica* is well known as a pest which mechanically transmits both medical and veterinary important diseases (Abbas et al., 2015; Ma et al., 2017). Prolonged and improper use of insecticides to control houseflies has resulted in the development of resistance in field populations (Sawiki, 1987). This study aims to determine the resistance status of poultry strain *M. domestica* larvae towards pyrethroids insecticides namely permethrin, deltamethrin and organophosphate insecticide namely malathion and temephos.

Keywords: *Musca domestica*, resistance, insecticide, pyrethroid, organophosphate

Materials and Methods

Third instar larvae strain of *M. domestica* were collected from two poultry farms in Sungai Lembu, Penang and Tapah Road, Perak, whereas one susceptible strain provided by IMR. These were subjected to topical bioassay of insecticide concentrations ranging from 0.0005 mg/L to 2000.0 mg/L. By dividing the LC_{50} value of the field strain by the LC_{50} value of the susceptible strain, the resistance ratio (RR) was obtained (WHO, 1980).

Results and Discussions

By sstatistical probit analysis using the SPSS software Version 28, the sub-lethal dosage (LC_{50}) of permethrin, malathion, deltamethrin and temephos against *Musca domestica* larvae were obtained at 934.81 mg/L, 451.77 mg/L, 485.00 mg/L, and 254.52 mg/L respectively for Sungai Lembu strain, 943.32 mg/L, 976.96 mg/L, 440.67 mg/L and 901.66 mg/L. In this study, both poultry farm strains were resistant with resistance ratio values ranging from 13.78 to 48.82 fold. Thus, rotational application of various modes of action of insecticide is suggested to overcome the resistance as target pests tend to develop resistance due to the continuous use of the same mode of action of insecticides.

Table 1: Toxicity of insecticides to adult house flies of poultry field strain compared to the susceptible population

Insecticides	Strains	LC_{50} (mg/L)	Slope ± SE	X^2	RR
Permethrin	**SL**	934.81	2.07	2.90	36.37

	TR	943.32	2.52	0.89	36.71
	IMR (susceptible)	25.70	0.583	3.53	-
Malathion	**SL**	485.00	1.33	1.65	30.81
	TR	440.67	1.43	4.15	28.00
	IMR (susceptible)	15.74	0.72	8.94	-
Deltamethrin	**SL**	451.77	1.40	4.44	21.45
	TR	979.96	1.12	21.46	46.53
	IMR (susceptible)	21.06	0.80	8.457	-
Temephos	**SL**	254.52	0.93	1.68	13.78
	TR	901.66	4.37	0.34	48.82
	IMR (susceptible)	18.47	0.48	7.13	-

LC_{50}: Lethal concentration that causes 50% mortality; SE: Standard error; X^2:Chi-square value; RR: Resistance ratio. SL: Sungai Lembu strain; TR: Tapah Road strain: IMR: Institute of Medical Research Strain

Conclusion

In conclusion, cultural approaches such as proper sanitation, waste management, and sticky baits are recommended primarily for a more sustainable environment and to prevent the development of pesticide resistance.

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ESTIMATING THE COST OF ASIAN SEABASS (*Lates Calcarifer*, Bloch 1790) ON MARINE CAGE CULTURE USING STOCHASTIC MODEL

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Introduction

Asian seabass (*Lates calcarifer*) is a widely farmed fish species in Malaysia due to its wide acceptance as a food fish. This species has many suitable characteristics for aquaculture including its euryhaline ability but can be prone to vibriosis in drastic environmental change leading to high mortality and economic losses to the farmers. The total cost of producing a tail of Asian seabass in the east coast marine cage farm was calculated to be RM13.34 per kg comprising RM11.66 in variable costs, RM0.11in fixed costs and RM1.57 in provisional costs due to mortality. The economic loss due to vibriosis was estimated at RM0.97 per tail per kg, which represents 7.27% of the total production cost of Asian seabass per kg. An increase in vibriosis case fatality rate and the prevalence of clinical vibriosis at a maximum rate of 100% and 42%, respectively could increase the costs of grow-out by RM1.45 and RM1.44 per tail of fish from its default value, thereby increasing the costs of production by 12% (Mohd Yazid, 2021). This study aims to estimate the grow- out cost of Asian seabass in marine cage culture farming scenario through the use of a stochastic bioeconomic model that includes the economic benefit of Vibriosis vaccination.

Keywords: Asian seabass, aquaculture, animal health economics, vibriosis, vaccine

Materials and Methods

The animal level model was built in Microsoft Excel® (Microsoft Corp., Redmond, WA, USA) using @Risk (Palisade Corp., Ithaca, NY, USA) add-on. The model was simulated with 2,000 iterations representing the stocking number of fish per cage and assuming subsidized vibriosis vaccine to smallholder marine cage farms. Output from the stochastic bioeconomic model was analyzed descriptively using @StatTools add-on (Palisade Corp. Ithaca, NY, USA) where cost of grow-out fish from the first day of stocking until the bodyweight reached 1kg was calculated and includes costs of feeding, and costs of mortality. The model comprised of biological parameters such as prevalence of vibriosis, mortality and body weight variations. We simulated the impact of the vaccine on Vibrio spp prevalence and bodyweight using field data of an oral vaccine trial. *Vibrio* spp. were identified from fish intestines through metagenomics approaches with the presence of potential biomarkers and the percentage difference were added in the bioeconomic model. Other model inputs were based on previous literature, information from farmers on the farm and expert opinions.

Results and Discussion

The simulated model demonstrated the mortality rate of vaccinated Asian seabass reduced to 23%, specifically, caused by vibriosis was decreased to 10% and caused by other reasons increased to 13%, respectively, the cycle period shortened by 44 days and the costs of mortality due to vibriosis lowered by 69% after vaccination.

Table 1: Average cost per tail to produce a marketable cage-cultured of non-vaccinated and vaccinated Asian seabass starting from 20g to 1,135g (5%-95% percentiles: 1,100g-1,170g) in a period of 210 days after stocking for non-vaccinated group and from 20g to 1,145g (5%-95% percentiles: 1085g-1,195g) in a period of 166 days after stocking for vaccinated group through stochastic bioeconomic model.

Type of costs	**Output (5%–95%percentiles) (RM)**	
	Non-vaccinated	**Vaccinated**
Variable		
Fry	1.50	1.50
Feed	9.62 (8.51-11.03)	9.76 (8.55-11.26)
Labor	0.20 (0.20-0.20)	0.17 (0.16-0.19)
Subtotal	11.32	11.43
Fixed		
Maintenance	0.37 (0.37-0.37)	0.29 (0.27-0.32)
Provision		
Mortality due to vibriosis	0.65	0.07
Mortality due to other reasons	0.35	0.24
Subtotal	1.00	0.31
Costs	12.69	12.03
Type of profit	**Profit (RM)**	
Revenue	20.21 (19.57-20.83)	20.40 (19.35-21.28)
Gross margin	8.89 (7.46-10.03)	8.97 (7.46-10.28)

Conclusion

Our study showed the costs of mortality (provision) due to vibriosis was lowered by 69% after vaccination.

Acknowledgement

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QUANTITATIVE DETERMINATION OF AFLATOXIN B1 TOWARDS DIFFERENT STORAGE CONDITIONS IN NON-TREATED GRAIN CORN

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Introduction

In the feed chain, storage environments such as poor aeration and high humidity, are among factors which triggers and accelerate the growth of fungi which consequently lead to mycotoxins production. Aflatoxin B1 (AFB1) produced by *Aspergillus* spp. is regarded as a potent mycotoxin that poses concerns to human health and livestock. In farm animals, aflatoxicosis can affect the liver and interrupt the digestive system. This in turn has a negative impact on livestock production with a reduction in body weight and feed conversion rate. Aflatoxins can contaminate a variety of livestock feeds and cause enormous economic losses, estimated billions of dollars annually for the U.S. corn industry alone (Jiang et al., 2021). Hitherto, instrumentation methods such as high-performance liquid chromatography (HPLC), liquid chromatography–mass spectrometry (LC-MS) and gas spectrometry (GC) are widely used for AFB1 determination. Commercial ELISA kits also are widely available in the market for mycotoxins detection. However, both chromatography and ELISA methods are time-consuming besides requiring bulky instruments to give accurate quantitative reading. To address the need of having on-site rapid detection, an immuno-based electrochemical biosensor for the quantitative detection of AFB1 has been developed. In this study, the application of the biosensor system attached with a portable reader as point-of-care is being employed for determination of AFB1 in grain corn stored at two different conditions.

Keywords: aflatoxin B1, biosensor, grain corn, storage

Materials and Methods

A miniaturized biosensor system with modified screen-printed carbon electrodes (SPCEs) and an integrated portable device is described in this study. The biosensor development employs in-house polyclonal antibody (Animal Ethics Committee of MARDI approval number 20190215/R/MAEC00045). Modified SPCEs were prepared as described by Jusoh et al. (2022). The strips are then attached on an Android-based handheld portable device for mycotoxin analysis and results read-out. For the storage study, 10 kg of non-treated harvested grain corns were packed in woven bags and kept in two different temperatures i.e. room temperature (23-28ºC, ± 60-70% relative humidity) and cold room (8ºC, ± 85% relative humidity) for six months. A three replicate was used for each

treatment, totalling 36 samples. AFB1 analysis was taken every month, recorded and compared. For validation study of the results obtained from the biosensor method, 11 samples were sent to Veterinary Public Health Laboratory, Salak Tinggi and SGS Lab, Shah Alam using UPLC-FLR and UPLC-FLD respectively.

Results and Discussion

The results for AFB1 determination for the 6 months in different temperatures is presented in Table 1 below. At room temperature, AFB1 started to contaminate the non-treated grain corn as early as the first month and remained persistent monthly. Meanwhile, at cold room, AFB1 contamination can be contained for the first 3 months. However, taking into the average of all the replicates, total AFB1 for all treatments are still below the MRLs set for AFB1 in grain corn (5 ppb).

Table 1. AFB1 determination in grain corn stored at different temperatures

Storage/Months	AFB1 concentrations (ppb)					
	1	2	3	4	5	6
8ºC						
Replicate 1	[a,b]n.d.	n.d.	[b]n.d.	5.57	4.61	1.62n.d.
Replicate 2	[b]n.d.	[b]n.d.	[b]n.d.	1.78	n.d.	7.59
Replicate 3	0.84	1.73	[b]n.d.	5.98	5.08	
Room temperature						2.88
Replicate 1	[b]3.31	[b]n.d.	0.54	3.32	2.17	4.30
Replicate 2	[b]n.d.	[b]2.64	n.d.	7.38	1.18	3.47
Replicate 3	2.81	[b]2.11	2.42	1.43	5.92	

[a]n.d.=not detected
[b]=as determined and validated by instrumentation method (MKAV/SGS Lab)

Conclusion

Non-treated grain corn stored in woven bags kept in cold conditions has the least AFB1 occurrence for the first 3 months.

Acknowledgement

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ECONOMETRIC ANALYSIS OF THE EX-FARM BROILER PRICE IN MALAYSIA USING STRUCTURAL TIME SERIES APPROACH

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Introduction

Due to high cost of imported animal feeds from producer country, the production costs of broiler chicken have increased considerably. It is worth to note that most of the international trade between Malaysia and producer country is using the US Dollar or greenbacks. Hence, Malaysia is at a disadvantage side against the competitive producer countries such as Argentina. The depreciating of Malaysian Ringgit against US Dollar resulting to low purchasing power, making the cost of importing thus increasing the production costs. This condition has reduced the profit margin for domestic farmers and eventually making their businesses unable to sustain. Previous studies have shown fluctuations in broiler feeds price is the main factor to the final product price in the market (Sharifuddin et al. 2013). This problem is a long-standing challenge to the government, feed millers, integrators, farmers, distributors, retailers and eventually consumers who had to purchase the final products at a higher price. A potential solution to this difficult problem could involve an econometric study considering the dynamic changes in animal feeds price is an essential economic risk factor affecting affection the volume of broiler production. The most recent work in this area is from (Arikan et al. 2022) using boosting regression method shows there is a high correlation between broiler chicken consumer price and variable factors such as broiler feeds, corn, soybean meal, wheat prices, the dollar exchange rate and producer price index in Turkey. However, the work is limited to investigate the factors that affect broiler price in the Turkey market framework. Considering the issue of higher production costs of broiler in Malaysia, this study attempted to evaluate holistically the factors affecting chicken meat prices. Accurate forecasting with an appropriate model is important for making decisions or making judgments in this issue. First, the aim of this research is to reveal the correlation of factors on the ex-farm broiler price in Malaysia from 2018 to 2022. Second, to model and predict the ex-farm broiler and macroeconomic variables prices using structural time series approach.

Keywords: poultry, broiler, animal feeds, structural time series, forecasting

Materials and Methods

The time series data were collected from Datastream database. There are six monthly time series data collected which are ex-farm broiler price (MYR/kg), corn price (USD/tonne), soybean meal price (USD/tonne), wheat price (USD/tonne), exchange rate (MYR/USD), and crude oil price (USD/barrel). Next, these data were analyzed using descriptive statistics, time series plot, and structural time series model estimation.

Results and Discussion

There are three stages involved in the model estimation procedure. First, the best fitted structural time series model was determined. Second, the factors affecting the ex-farm broiler price was investigated. Finally, the forecasting performance were evaluated based on the performance metrics. The development of structural time series model begins with stepwise procedure. The best fitted structural time series models were determined based on the lowest Akaike Information Criterion considering all the residual assumptions satisfied. The best fitted models analyzed were tabulated in Table 1.

Table 1. Estimation of structural time series model.

Variables	Variance disturbance				Model
	Level	Slope	Seasonal	Irregular	
Ex Farm Broiler	5.3×10^{-4}	0.0001	0.0005	0.001	BSM
Corn	3.2×10^{-3}	-	-	0.005	LLM
Soybean meal	0.0008	0.0002	0.0001	0.0003	BSM
Wheat	0.0026	0.0037	0.0008	0.0075	BSM
Exchange rate	2.6×10^{-5}	-	-	0.0002	LLM
Crude oil	0.0001	0.0006	-	0.0004	LLTM

*LLM = Local level model, LLTM = Local linear trend model, BSM = Basic structural model

Conclusion

The findings of this study have shown that the dynamic changes in animal feeds prices have significant effect in the cost of production in Malaysia. Besides, the disruption in supply chain also led to the asymmetric price transmission. This study suggests that policy makers should consider different approach to reduce the dependency on foreign resources and protecting the poultry industry in Malaysia.

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A DEEP LEARNING MODEL TO PREDICT THE HEALTH OF CHICKEN MANURE

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Introduction

Chicken manure can provide valuable insights into the health and well-being of your chickens (Zhou et al., 2023). Currently, inspectors rely on observing the colour and characteristics of chicken faeces on the manure belt in stacked chicken coops as a means of making an initial assessment of the chickens' health. Nevertheless, this approach to monitoring is prone to subjectivity and can cause disturbance to the chickens (Zhu and Zhou., 2021). In this research, we introduce a method to automatically identify the health of chicken manure images using deep learning. From 7505 chicken manure images, we managed to obtain 99% accuracy in distinguishing healthy chicken manure from three different diseases.

Keywords: chicken manure, computer vision, deep learning, AlexNet

Materials and Methods

There are three main steps in building a function to automatically identify the health of chicken manure images using deep learning. The first step is data preparation such as collecting chicken manure images and label it accordingly as either healthy or affected by Salmonella, Newcastle Disease or Coccidiosis. The second step is to build a deep learning model from that dataset. The third step is to compute the performance of a deep learning model in identifying the status of unseen chicken manure images. Figure 1 illustrates those steps in order.

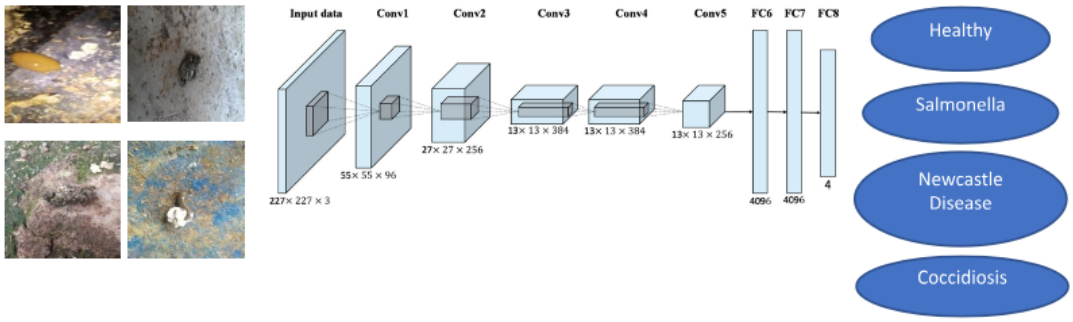

Figure 1: Steps in building a deep learning model to distinguish healthy and unhealthy chicken manure.

Results and Discussion

Figure 2 illustrates our model performance in classifying the status of chicken manure.

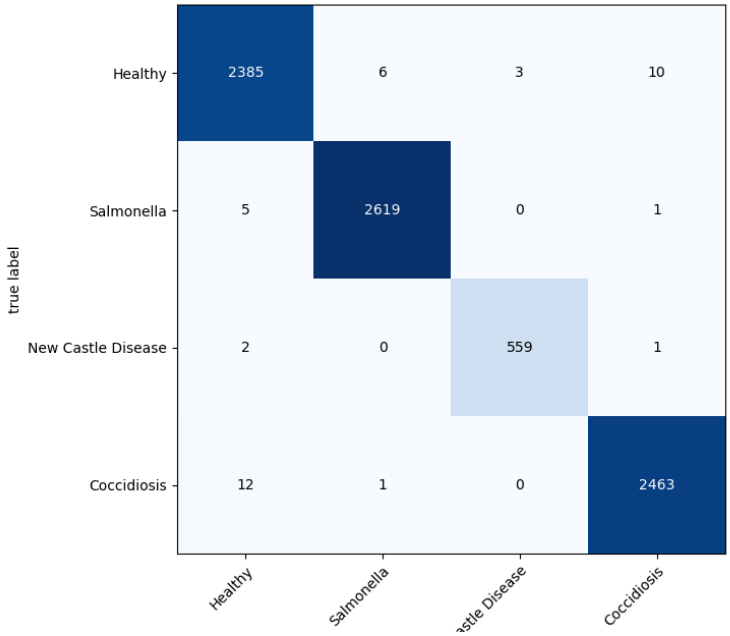

Figure 2. Confusion matrix in predicting chicken manure status, such as healthy, Salmonella, Newcastle Disease and Coccidiosis.

Figure 2 shows the confusion matrix in predicting the status of the chicken manure. It is divided into a 4-by-4 matrix to show the correctness of the prediction and the actual data.

From the total of 8067 data rows, we managed to get 8026 corrects.

To find the accuracy, the formula used as below:

$$Accuracy = \frac{TP+TN}{TP+FP+FN+TN} \times 100\%$$

Where TP = True Positive, TN = True Negative, FP = False Positive and FN = False Negative. Accuracy achieved from the experiment is 99.9%.

The precision for can be calculated by using the formula below:

$$Precision_i = \frac{TP_i}{TP_i+FP_i} \times 100\%$$

Where i denotes a particular disease.

The precision achieved for healthy, Salmonella, Newcastle Disease and Coccidiosis were 99.2%, 99.8%, 99.5% and 99.5% respectively.

Conclusion

From the experiment, it can be seen that using deep learning in predicting disease from the image of the chicken manure is possible. It is proven when the accuracy is able to achieve almost 100% in our study. This can be a stepping stone to develop an application for farmers, breeders and veterinarians to identify the types of disease just from the faeces image recognition. By using this application, the rate of dying can be reduced as early detection is made possible and thus increase the sustainability of chicken production and food security.

Acknowledgement

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EFFECT OF ALTERNATIVE FEED PROTEINS ON INTESTINAL HISTOMORPHOLOGY OF BROILERS

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Introduction

Defatted black soldier fly larvae (BSFL), microalgae and duckweed are some of the alternative protein sources that can partially supersede the conventional protein sources in broiler diets. It is important to determine the impact of incorporating alternative protein feeds on the intestinal health of broilers, as poor intestinal health can elicit health conditions, resulting in poor growth performance. The objective of the study was to examine the effect of partial inclusion of defatted BSFL, microalgae, and duckweed on intestinal histomorphology in broilers.

Keywords: defatted black soldier fly larvae, microalgae, duckweed, histomorphology

Materials and Methods

A total of 336 male day-old Cobb500 chicks were weighed and randomly assigned into seven treatment groups consisting of six replications per treatment. The birds were fed with seven treatments including basal diet (control), 3% and 6% defatted BSFL, 3% and 6% *chlorella*, and 3% and 6% duckweed. The experimental diets were formulated to be isonitrogenous and isocaloric across treatments. The birds were raised in a closed house provided with *ad libitum* water and feed.

At 21 and 35 days of age, the birds were slaughtered, and 5cm of intestinal segment samples (duodenum, jejunum, and ileum) were excised and flushed with distilled water to remove the digesta content. Samples were kept in 10% buffered formalin solution for histomorphology analysis. The samples were processed and examined under the light microscope. Villi height (VH) and crypt depth (CD) were measured (10 villi and 10 crypts per section) and the data from VH and CD was used to obtain the ratio of VH and CD (VH:CD).

Results and Discussion

Improvement in growth performance and feed conversion efficiency relies on healthy intestinal morphology, which might be related to a balance of the entire intestinal microflora, resulting in a better intestinal environment. The microscopic structure of villi and crypt are indicators of intestinal development, health, and functionality of the gut

(Biasato et al., 2018). Long villi and shallow crypts are indicators of an ideal gut morphological asset. Greater VH:CD value indicates better digestion and absorption in the intestine, and *vice versa*.

In the starter phase, the alternative proteins had no effect on VH, CD and VH:CD for duodenum, jejunum, and ileum ($P>0.05$, respectively).

In the finisher phase, the alternative diets had higher jejunal VH compared to the control ($P<0.05$). In contrast, Dabbou et al. (2018) reported shorter jejunal VH were observed in broilers fed 15% BSFL meal as a substitution of soybean meal. This could mean that a high inclusion rate of 15% BSFL may reduce VH. However, the alternatives had lower duodenal and ileal VH compared to the control ($P<0.05$, respectively). In contrast, Kang et al. (2017) reported that ileal VH increased with the inclusion level of 2 to 7.5% of *Chlorella* by-product in the broiler diet.

Deeper CD indicates rapid tissue metabolism to renew the intestinal villi. This occurs in response to the host's intestinal mechanism, which compensates for villi atrophy due to inflammation (Kang et al., 2017). *Chlorella*, duckweed and 3% defatted BSFL had shallower duodenal CD than the control ($P<0.05$). 6% *chlorella* and duckweed had shallower ileal CD than the control ($P<0.05$). However, deeper jejunal CD was observed in the alternative diets compared to the control ($P<0.05$).

3% *chlorella* and duckweed had higher duodenal VH:CD compared to the control ($P<0.05$). 6% *chlorella* and duckweed had higher ileal VH:CD compared to the control. Jejunal VH:CD was not affected by dietary treatments ($P>0.05$).

Conclusion

Defatted BSFL improved jejunal and ileal VH but there was no improvement on intestinal CD and VH:CD. *Chlorella* improved jejunal VH, intestinal CD and VH:CD. Similarly, duckweed improved jejunal VH, intestinal CD and VH:CD. Overall, alternative diets showed some improvement on intestinal histomorphology with minimal adverse effects.

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PERFORMANCE OF FOOD SAFETY MONITORING PROGRAM AND OTHER SAMPLES FROM SOUTHERN ZONE OF PENINSULAR MALAYSIA IN YEAR 2022

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Introduction

Department of Veterinary Services (DVS) Malaysia has established a national food safety monitoring program in which animal-based food from abattoirs and processing plants with DVS's certifications such as Veterinary Health Mark (VHM) and Good Veterinary Hygiene Practice (GVHP), will be checked. Samples outside the program such as imported meat, raw milk from local farmers, downstream food products, and the hygiene level of abattoirs were also monitored. This study reports findings from the food safety monitoring program and samples outside the program in the southern zone of Peninsular Malaysia for the year 2022.

Keywords: food safety, hygiene, animal-based food, abattoirs

Materials and Methods

About 313 cases consisting of 1423 samples and 6226 food microbiology tests had been conducted (DVS, 2016). Half of the samples (56%) were meat-based, followed by milk-based (23%), edible bird's nests (EBN)-based (15%), swabs from abattoirs environment (4%), and eggs (1%).

Results and Discussion

About 16% of raw chicken meat from VHM-certified abattoirs had *Salmonella* spp. compared to 7% for pork from DVS's abattoirs, whereas 11% of the former had *E. coli* load exceeding the limit (DVS, 2011) as compared to 8% of the latter. Around 3% to 4% of both samples were exceeding the coliforms' limit, but negative of *Yersinia enterocolitica*. For VHM-certified processing plants, 13% of the raw materials (meat) had *Salmonella* spp., compared to only 0.6% in processed food. 8% of raw materials were exceeding *E. coli* and coliforms' limits but in processed food, 8% of the samples exceeded the limits for total plate count (TPC) for *S. aureus*. Around 10% to 14% of EBN samples from VHM and GVHP-certified processing plants exceeded limits of yeast and mould, *S. aureus* (4% to 8%), *and TPC* (2% to 8%), but were negative for avian influenza and Newcastle disease. Raw and pasteurised egg samples were negative for *Salmonella* spp. and not exceeding the limits for the microbial load.

Only 2% to 3% of swab samples from licensed abattoirs were exceeding the limits of coliforms and TPC load, whereas most of the meat samples from the abattoirs were in good hygiene level. Few downstream food product samples from small-scale local producers were analysed and most had microbiological loads exceeding the limit and *Salmonella* spp. About 7% of imported meat samples exceeded the *E. coli* limit and 5% had *Salmonella* spp. but were negative for *E. coli* O157 and sarcocysts. Almost half of the raw milk samples from local farmers exceeded the TPC limit whereas only 14% of samples were good-grade milk with high total dissolved solids content. Overall, 5% of all samples were detected with *Salmonella* spp., the majority were from chicken meat-based samples. Among the *Salmonella* serovars identified were Enteritidis, Brancaster, Typhimurium, Albany, Senftenberg, and others.

Conclusion

All samples, specifically from the food safety monitoring program under DVS's supervision were in satisfactory hygiene level and less contaminated with pathogens. However, the detection of *Salmonella* spp. might indicate possible contamination during production despite adhering to rigorous food safety system protocols. These findings could assist DVS in evaluating the effectiveness of its programs in ensuring the supply of safe and quality food.

Acknowledgment

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LUMPY SKIN DISEASE: AN OUTLOOK ON 2021 OUTBREAK IN PENINSULAR MALAYSIA

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Introduction

Lumpy skin disease (LSD) is caused by LSD virus (LSDV), classified in the genus Capripoxvirus, family Poxviridae which generally affects large ruminants, especially cattle and domestic water buffalo (Ratyotha et al., 2022). It is a vector-borne disease of cattle and Asian water buffalo that is included in the OIE list of notifiable diseases (Roche et al., 2020). In the last few years, the disease has emerged as a threat to large, domesticated ruminants in Asia including Malaysia, where this disease started spreading in the year 2021. This paper will focus on general information about the LSD outbreak in Malaysia, including the summary of cases, the disease's geographical distribution, and the eradication strategy implemented by DVS.

Keywords: Lumpy Skin Disease, LSD, poxvirus, livestock, DVS

Materials and Methods

Data used in this study was based on the compilation of LSD cases diagnosed in VRI in the year 2021 that contains information on infected animals, owner information as well as diagnosis outcome. Microsoft Excel (2013) was used for the descriptive analysis and data arrangement, while ArcGIS V10.8.2 software was used to create the distribution map after incorporating the necessary data.

Results and Discussion

The total number of LSD cases received for laboratory testing was 539 cases with 1,527 samples in 2021 (Table 1). The work category stated was based on the sender's information. The Real-Time RT-PCR was used to examine the skin scraping, nasal swab, blood, and pool organ samples. Positive results were observed in 850 samples (290 cases).

Table 1. Total cases and samples tested for LSD for the year 2021 iVRI

Category	Positive cases / total cases (Positive sample / Total Samples)								
	May	**June**	**July**	**Ogos**	**Sept**	**Okt**	**Nov**	**Dec**	**Grand Total**
Diagnostic	8/13 (40/49)	66/136 (130/292)	61 (72/136)	34 (131/152)	17/23 (32/52)	5/8 (0/20)	0/4 (0/13)	4 (0/14)	283 (417/728)
Import	-	-	-	-	1/1 (1/1)	-	-	-	1/1 (1/1)
Monitoring	0/1 (0/2)	2 (0/2)	2 (0/9)	9 (28/34)	-	-	0/1 (0/1)	1 (0/6)	16 (28/54)
R&D	-	3/15 (4/43)	13 (11/81)	18 (4/66)	-	-	-	-	46 (19/190)
Reference	4/5 (29/30)	55/91 (174/263)	8/76 (144/211)	-	-	-	-	-	172 (347/504)
Surveillance	-	14 (20/32)	2 (9/9)	-	-	1/1 (0/4)	0/1 (2/2)		18 (35/47)
Vaccine	-	-	-	1 (1/1)	1/1 (1/1)	1/1 (1/1)	-	-	3 (3/3)
Grand Total	12/19 (69/81)	258 (328/632)	154 (236/446)	62 (164/253)	19/25 (34/54)	7/10 (17/25)	1/6 (2/16)	5 (0/20)	539 (1,527)

In Malaysia, the first LSD outbreak was noted in May 2021 in Ipoh, Perak. Results showed that LSD swiftly expanded from the northern region along the Thailand borders to the south and east coast between the months of June and July. The accelerated spread of LSD was most likely associated with significant cross-border animal movement activities and the spread of insect vectors. Perak was the state with the most positive cases, accounting for 52.41% of all positive cases reported in Malaysia in the year 2021. The infections started to decline in August, three months after the first incident and continued to do so until December.

Conclusion

Various approaches have been taken by DVS including vaccination of cattle and buffaloes with homologous attenuated vaccines, clinical surveillance activities, revision of import protocols from the infected countries, control of illegal animal movement at the international borders, and awareness campaigns through social media. All the efforts implemented proved to be effective when cases of LSD infection were reduced by the end of 2021. However, biosecurity prevention and control must continue in order to contain and prevent the spread of this outbreak.

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DETECTION OF AFRICAN SWINE FEVER VIRUS IN JOHOR FROM 2019 TO 2022

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Introduction

African swine fever (ASF) is a haemorrhagic disease affecting domestic pigs and wild boar with devastating consequences to the global swine industry and food security. For these reasons, ASF has been characterized as an emerging and notifiable disease by the World Organization for Animal Health (WOAH). ASF is caused by the African swine fever virus (ASFV), which belongs to the family *Asfarviridae*, genus *Asfivirus* (Ki-Hyun Cho et al.,2022). First case of ASF in Malaysia was reported in the state of Sabah in February 2021 (Khoo et al.,2021). Since 2019 until 2022, A total of 1167 organ samples were sent to the Veterinary Laboratory Southern Zone. This study aims to report the prevalence status of ASF disease in the southern zone.

Keywords: African Swine Fever, Wild Boar, Veterinary Laboratory Southern Zone.

Materials and Methods

From 2019 until 2022, A total of 1167 organ samples from swine were sent to Veterinary Laboratory Southern Zone for ASFV detection. The samples (bone marrow, liver, kidney, spleen, lung, intestine, heart and brain) were from wild boars.

Results and Discussion

In total, 15 out of 1167 samples were found to be positive for African Swine Fever Virus (ASFV) using Taqman real time PCR as shown in Table 1.

Table 1. C_T values generated using qPCR assays

Year	Number of samples (n)	Taqman real time PCR		
		Ct value Mean	Positive	%
2019	40	Unidentified	0/42	0
2020	324	Unidentified	0/324	0
2021	267	Unidentified	0/267	0
2022	534	30.4	15/534	2.81
Total	**1167**	**30.4**	**15/1167**	**2.81**

Conclusion

This report indicates that wild boars are actively infected with ASF. Therefore, numerous pig farms located in areas with active ASFV circulation in wild boars are at a higher risk of ASF infection. Control measures need to be effectively implemented for both swine and wild boar populations through close and coordinated efforts by the relevant government bodies for the successful control of ASF disease in Johor.

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GEOGRAPHICAL DISTRIBUTION OF HAEMORRHAGHIC SEPTICEMIA (HS) IN PENINSULAR MALAYSIA

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Introduction

The population of cattle and buffaloes in Malaysia was 701,117 heads and 63,587 heads in 2021. (Livestock Statistics by Department of Veterinary Services). Haemorrhagic Septicemia (HS) caused by *Pasteurella multocida* serotypes B: 2 and E:2 is a fatal, life threatening disease of cattle and buffaloes causing high mortality and morbidity (De Alwis, 1992; Rafidah et al., 2012, OIE, 2021).). HS was first reported in Malaysia as early as the 1880s (FAO, 1991). Vaccination of animals is the most common and effective measure against HS. The current work aims to study geographical distribution of HS among buffaloes, cattle, sheep, and goats in Peninsular Malaysia from 2017 to 2021.

Keywords: Hemorrhagic Septicemia, *Pasteurella multocida*, cattle, buffaloes

Materials and Methods

Data on HS outbreaks, and animal mortality, including year, animal species, breed, states, district, and farm management were obtained from Disease Control and Veterinary Biosecurity Division, Department of Veterinary Services Malaysia, Putrajaya.

Results and Discussion

Table 1 showed the mortality number of animals due to HS in cattle and buffaloes from 2017 to 2021. A total of 199 deaths due to HS were recorded in cattle and buffaloes from 2017 to 2021. The highest mortality was in 2017 at 146 heads and the lowest in 2021 with 3 deaths caused by HS. Out of 17 cases reported, only one (1) death was in Selangor while 198 deaths were in Terengganu.

Table 1. Mortality due to HS between 2017-2021 in Malaysia

Type of Livestock/Mortality	2017	2018	2019	2020	2021
Buffalo	49	0	0	44	0
Cattle	96	6	0	0	3
Mix	1	0	0	0	0
Total	146	6	0	44	3
Source: Disease Control and Veterinary Biosecurity Division, DVS					

About 52.7% mortalities involved cattle of Kedah-Kelantan (KK) and KK cross breed, 46.7% mortalities in buffaloes, and 0.5% mortalities in mix cases of cattle and buffaloes.

The HS in Terengganu recorded 81 deaths in Kuala Terengganu, 60 in Marang, 42 in Dungun district, 8 in Hulu Terengganu, and 5 in Kemaman for the period of 2017 to 2021.

For the past 5 years, the geographical distribution of HS has been localized into Terengganu state in Peninsular Malaysia. (OIE, 2023). Total loss due to HS in Terengganu from 2017 to 2021 was estimated at RM 1.6 million with 198 heads animal mortality. Records of the HS vaccine provided by VRI showed that Terengganu has obtained about 96,375 doses of vaccines from 2017 to 2021. Since the economic impact of the disease is quite significant on the ruminant industry, an efficient strategy should be taken aggressively especially in Terengganu to prevent outbreaks in the future.

Conclusion

There was a decrease in cases and death of HS in Terengganu until 2021. Further work should be conducted to investigate efficacy of vaccine delivery in the field and to create awareness about the importance of vaccination.

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EVALUATION OF PROTEIN CONTENT IN RAW COW MILK IN PERAK

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Introduction

Milk contains several groups of nutrients and one of them is milk proteins. Milk proteins comprise of casein (about 80%) and whey proteins (about 20%) (Zhang et al., 2016). Milk protein is an important component of milk, especially from a nutritional point of view. In Malaysia, the quality of milk produced by dairy farms is monitored under a quality programme. Milk Collection Centre (MCC) will send the milk samples to Veterinary Research Institute (VRI) for composition analysis. Milk protein content is a major composition to be evaluated for determination of the quality of milk. Therefore, it is important to evaluate the protein content of milk produced by the farmers. Hence, the objective of this study is to evaluate the protein content of raw cow milk samples program from four MCC in Perak.

Keywords: milk protein, Milk Collection Centre, raw cow milk

Materials and Methods

A total of 5801 raw cow milk samples received from four Milk Collection Centre (MCC) in Perak from 2019 to 2022 were included in the study. The milk was analysed for composition by the Fourier Transform Infrared (FTIR) MilkoScan Mars 6006 (Foss Electric, Hillerd Denmark) at Biochemistry Section, VRI. All the raw milk samples were analysed in duplicate and average data was taken. Data were then analysed using IBM SPSS statistic Ver 23.0 for descriptive and one-way ANOVA was performed to compare the mean different percent of protein content for MCCs and years. Dunnett's T3 test was selected for multiple comparison analysis.

Results and Discussion

Overall, the mean of protein content for 5801 milk samples was 3.28±0.29 g/100g. The mean of protein content was comparably higher than a study in Thailand which reported 3.13±0.16 g/100g (Kittivachra et al., 2006) but lower than a study in Indonesia with mean of 3.48 ± 0.0504 g/100g (Fardianshah, 2017). Table 1 shows protein content detected in raw cow milk samples based on year and MCC in Perak. These findings showed a gradual decrease for percentage of mean protein content in raw milk samples from 2019 to 2022. Additionally, milk samples from MCC B had the highest mean protein content followed by MCC A and samples from MCC D recorded the lowest protein content. Protein content in milk is highly related to several factors such as breed, feed intake, milk yield, lactation and bodyweight. This study revealed that the protein content of the raw milk from Perak is comparable with guidelines from FAO which the protein content reference is 3.3 g/100g (range 3.2-3.4 g/100g).

Table 1. Percentage of protein content detected in raw cow milk samples based on year and MCC in Perak.

Variables	Number of samples	Mean ± SD*	Minimum	Maximum
Year				
2019	1966	3.35±0.24[a]	2.48	4.30
2020	1625	3.31±0.29[b]	2.29	4.59
2021	1201	3.24±0.27[c]	2.05	4.69
2022	1009	3.18±0.33[d]	1.54	5.31
MCC				
A	1242	3.35±0.23[a]	2.48	4.69
B	2129	3.36±0.33[a]	1.54	4.59
C	199	3.29±0.39[a]	2.29	5.31
D	2231	3.17±0.22[b]	2.31	4.50
Total	5801	3.28±0.29	1.54	5.31

*Mean values in the same column with different alphabets superscript ([a,b,c,d]) are significantly different at $p<0.05$ (ANOVA, Dunnett's T3).

Conclusion

In conclusion, the protein content of raw milk collected in Perak is of good quality. However, the decreasing pattern of the protein content within the study period is an indication of requirement for special attention and close monitoring for further improvements.

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COMPARATIVE HISTOPATHOLOGY OF H120, 4/91, 1/96, and MH5365/95 SEROTYPES OF INFECTIOUS BRONCHITIS VIRUS INFECTION IN MINIMUM DISEASE FREE CHICKENS

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Introduction

Infectious bronchitis virus (IBV) has been dubbed the coronavirus of domestic poultry (Cavanagh, 2007). IBV is an acute and highly contagious viral disease which causing severe economic losses in the chicken industry. Besides that, airsacculitis brought on by co-infection with Mycoplasma or *E. coli* causes a significant proportion of carcasses to be rejected in slaughterhouses, this disease causes significant negative economic impact to the poultry sector (Cavanagh and Gelb, 2008). Thus the objective of this study was to experimentally compare the tissue distribution of commercial vaccine compared with the Veterinary Research Institute (VRI) research vaccine.

Keywords: Infectious bronchitis virus, histopathology, vaccine

Materials and Methods

Experimental design
Fifty one-day old Minimum Disease Free (MDF) chickens were received from MDF Section of VRI. They were divided into four groups (Mass H120, 4/91, 1/96 and MH5365/95; n=10 per group) and one control group (n=10). Chickens were vaccinated once with the respective virus vaccine via the intranasal route.

Histopathological examination
At day 7 and 28 days post vaccination, chickens were humanely euthanized to examine the affected organ/tissue (trachea, lung and kidney) in this study. Those tissues were collected and fixed in 10% formalin and stained by the standard H & E method for histopathology slide preparation. According to Nakamura et al. (1991) scores were used to define the histopathological severity levels as follows; (1) for no lesions, (2) for minor lesions, (3) for moderate lesions, or (4) for severe or widespread lesions.

Results and Discussion

No unfavorable clinical symptoms of IBV infection were seen in any of the vaccinated or control chickens. Following vaccination with the IBV virus vaccine at 7 to 28 dpv, no severe gross and histopathological lesions were seen in the trachea, lungs and liver (Table 1). No lesions were observed in the control group. The proventriculus lesions found were non-specific in nature and found in the control birds as well (Benyeda et al., 2010).

Table 1. Histopathological scores of MDF chicken after inoculation with different IBV vaccines at different days post inoculation.

Time	Groups	Histopathological lesion scores in different types of tissue		
		Trachea	Lung	Liver
7 dpv	Mass H120	3	3	3
	4/91	3	3	3
	1/96	3	3	3
	MH5365/95	3	3	3
	Control	1	1	1
28 dpv	Mass H120	2	2	2
	4/91	1	2	2
	1/96	2	2	2
	MH5365/95	2	2	2
	Control	1	1	1

Conclusion

The present study showed that the 4 types of IBV studied gave almost the same result for histopathology. All vaccines showed moderate lesion scoring at the 7 dpv and mild lesion scoring for 28 dpv except 4/91(no lesion). It showed that MH5365/95 tissue distribution was the same as the commercial vaccine.

Acknowledgement

The authors would like to extend their gratitude to the Director General of the Malaysian Department of Veterinary Services, the Director of the Veterinary Research Division, and the Director VRI for the permission to publish this study and also thank you to the VRI staff for supporting this study.

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RABIES VIRUS ISOLATION FROM SALIVARY GLANDS OF DOGS DURING OUTBREAK IN SARAWAK USING RAPID TISSUE CULTURE INFECTIONS (RTCIT)

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Introduction

Rabies is an infectious disease which defects the brain. It is caused by a virus known as lyssavirus belonging to the family *Rhabdoviridae*. It can be transmitted by all homoeothermic animals and the virus is secreted in the saliva of an infected animal (Bano et al., 2016). Jimenez et al. (2019) successfully isolated the virus from salivary gland tissues from confirmed rabid carnivores, comprising striped skunks and other wild and domestic carnivores from 2013 to 2015 in northern Colorado. Other studies showed that Hoary foxes' (*Pseudoalopex vetulus*) salivary glands (SG) that were tested using fluorescent antibody test (FAT) and mouse inoculation test (MIT) were found to be positive rabies (Silva et al., 2009). To our knowledge, virus isolation from SG of suspected rabid dogs in Malaysia has never been described before.

The aim of this study was to isolate rabies virus from the SG of suspected rabid dogs of Sarawak Outbreak samples using RTCIT techniques.

Keywords: rabies, RTCIT, virus isolation, rapid test

Materials and Methods

Veterinary Research Institute received 39 SG samples of suspected rabid dogs during Sarawak Rabies Outbreak from 2017 to 2018. The RTCIT were performed in four-well Lab-Tek tissue culture chamber slides (Nalgene Nunc International, Lab-Tek® II). Wells of chamber slides were seeded with $5x10^5$ viable BHK-21 cells per ml. The 10% diluted SG suspension was added to the wells and incubated for 1 hour at 37°C with 5% CO_2. Then the suspension was removed and replaced with fresh growth medium. The slide chamber was incubated for 5 days at 37°C with 5% CO_2. The medium was removed after 5 days, air dried and fixed with 80% cold acetone for 30 minutes. The FAT was performed, and the slide chamber was observed under 20X and 40X magnification using fluorescence microscope to detect the present of apple green fluorescence foci of rabies.

Result and Discussion

The Rabies virus was successfully isolated from 22 samples (56.41%) whereas 17 (43.59%) samples were negative. Charey and McLean (1983) suggested that the rabies infected animals have higher titers of rabies virus in their salivary glands than in their brain. The transmission of this disease requires entrance of virus through the saliva of

infected animal due to biting, wounds or unwrap cuts in fur or mucous membranes (Langley, 2009). Thus, rabies can be prevented by avoiding direct contact with rabid animals as well as their mucous membranes and wounds. Furthermore, proper training to wildlife workers, veterinarians, animal handlers and laboratory workers is necessary for prevention of the disease (Bano et al., 2016).

Conclusion

The result of this study indicates that with sufficient care and experience, RTCIT can be used to determine the presence of rabies virus in the SG of suspected rabid dogs.

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DETECTION OF AFLATOXIN M1 IN RAW COW MILK IN PERAK DISTRICT

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Introduction

Dairy products, especially milk, are an essential component of the human diet, particularly for infants and young children (Rahimi, 2010). Therefore, there should not be any form of contamination to the milk to ensure the quality of the milk. Aflatoxin M1 (AFM1) is one of the contaminants that often occur in milk Aflatoxin contamination in milk and its products can occur via two ways; either the toxin is passed to the milk of animals when consume feed contaminated with aflatoxin B1 which , through a metaolic process , turned into AFM1 or the milk and milk products are contaminated with fungi (Akeberegn, 2019). This study aimed to detect the concentration of AFM1 in raw cow milk samples by ELISA method from four Milk Collection Centre (MCC) in Perak.

Keywords: detection, aflatoxin M1, milk, Perak

Materials and Methods

A total of 46 raw cow milk samples were received in the Biochemistry Section of Veterinary Research Institute (VRI) for diagnostic purposes from four MCC in Perak (A, B, C, D). The study was conducted in The Biochemistry Section using the ELISA method and each milk sample represents one animal. Sample selection is based on a simple random sampling method and was analyzed by descriptive and non-parametric test using SPSS. Analysis of the mean value of AFM1 is based on significant difference at $p<0.05$.

Results and Discussion

Thirteen percent (13.0%) of the samples tested were found to exceed the maximum limit of European Commission (EC) for AFM1 contamination which is 0.05µg/kg, with 25.0% and 21.1% of samples tested coming from MCC B and D respectively. Statistical analysis showed that there was a significant difference in the concentration of AFM1 mean value between the four MCC at $p<0.05$ (Table 1). Among all these MCC groups, MCC A-B, as well as MCC A-D showed that there was a significant difference in the concentration of AFM1 mean value at $p<0.0125$, while other groups of MCC were not significantly different (Table 2). However, all the AFM1 concentration values in this study were below the maximum limit set by Malaysian Food Regulation (1985) at 0.5µg/kg. The low concentration of AFM1 value detected in the raw cow milk samples in this study was considered a positive sign that the products are safe to consume. Although the concentration level of AFM1 in this study was less than the limit set, the possibility of

AFM1 contamination occurring is high since Malaysia has a high relative humidity and warm climate which are favorable for fungal growth.

MCC	**N**	**Mean±Sd** (ng/ml)	**Min** (ng/ml)	**Max** (ng/ml)	**Mean Rank**	**Chi-Square**	**df**	***p-value****
A	8	6.01±6.41	0.0344	18.95	11.06	9.165	3	**0.027**
B	12	33.61±25.83	0.0015	75.41	28.71			
C	7	17.56±8.31	23.56	26.80	23.00			
D	19	43.70±86.75	1.363	389.74	25.63			
Total	46	30.53±58.29	0.0015	389.74	-	-	-	-

Table 1. Number of samples tested, average min/max, mean rank and Kruskal-Wallis* test among the MCC

Table 2. Mann Whitney-Benferroni corrected test between MCC

MCC	A-B	A-C	A-D	B-C	B-D	C-D
p-value	**0.0121***	0.0206	**0.0125***	0.1508	0.5980	0.7071

*significant difference p<0.0125

Conclusion

In conclusion, low concentration of AFM1 was detected in all samples received from the four MCCs in this study. Thus, by improving the handling and storage as well as consistently checking for the presence of aflatoxin in dairy and livestock products will ensure a reduction in the risk of aflatoxin toxicity to consumers.

Acknowledgement

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PREVALENCE OF FOOT AND MOUTH DISEASE IN PERAK, MALAYSIA IN 2022

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Introduction

Foot and Mouth disease (FMD) is a highly contagious viral disease that affects cloven-hoofed animals such as cattle, pigs, goats, and sheep (Jamaliah, 2012). In Malaysia, FMD outbreaks have been reported since the 1930s, and despite efforts to control the disease, it is still widespread in the country. According to the records from the Department of Veterinary Services (DVS) Malaysia, there were 26 outbreaks involving 157 animals in 2021, where 23 of these outbreaks reported in cattle involving 151 animals - in six different states (WOAH, 2022). The FMD prevention activities include periodical surveillance as well as strict quarantine measures to prevent the spread of the disease. All findings and results in this work were based on samples received by the Veterinary Research Institute (VRI), Ipoh, Perak, and do not reflect overall cases reported to the Perak state DVS or DVS Malaysia.

Keywords: Foot and Mouth Disease, Surveillance, Livestock, Perak, DVS

Materials and Methods

The data reported was based on FMD serum samples submitted to VRI under the National Animal Disease Surveillance Programme in Perak, Malaysia in 2022. Data were obtained from the Laboratory Information and Management System (LIMS) at VRI and analyzed using Microsoft Excel, while the distribution map was created using ArcGIS V10.8.2 software after the relevant data was integrated. Surveillance samples and tests were calculated using random sampling and epitools (DVS, 2022). The serum samples were tested for non-structural protein (NSP) using the ELISA method (ID Screen FMD NSP Competition ELISA kit) provided by the Disease Control and Veterinary Biosecurity Division, Putrajaya.

Results and Discussion

Fifty-eight farms were sampled for the National Surveillance Programme for FMD in Perak, involving 12 districts with an average of 10 samples collected per farm. FMD cases was observed across the states during the year, with the majority of cases (61%,108/176) from cattle samples being positive, 25% (19/75) from sheep, 21% (25/117) for goat, and no positive samples from pig (0/208) as shown in Table 1. The disease's spatial distribution was found to occur in the area adjacent to the border and along the major route headed from the Hulu Perak district to Kuala Kangsar at the central part of Perak.

This may be due to the illegal movement routes involved and the uncontrolled movement of infected animals from neighboring countries and states (Ramanoon, 2016). Direct contact with infected and susceptible animals is thought to be the most prevalent route of infection. In Peninsular Malaysia, cattle were the species of animal most affected by FMD compared to other livestock (WOAH, 2022). Sheep and goats are typically owned by smallholders and managed on a free-range basis; therefore, mixing with other animals at nearby areas during watering or grazing is common. Pigs, on the other hand, are kept in close house production systems in highly commercialized operations (Ghan, 1994). Cattle are also more susceptible to airborne transmission compared to pigs which are less susceptible to airborne transmission and require higher doses (Carolina et.al, 2016).

Table 1. Number of cases and samples tested for FMD surveillance.

District of Perak	Positive Cases / Total Cases				Total Positive cases/ Total cases	Total Positive Samples/ Total samples
	Pig	Sheep	Goat	Cattle		
Bagan Datuk	0/1	1/1	0/1	-	1/3	1/24
Batang Padang	0/4	-	2/2	1/1	3/7	14/71
Hilir Perak	0/2	1/1	1/1	4/4	6/8	36/73
Kampar	0/3	-	-	1/1	1/4	9/42
Kerian	0/3	-	1/1	1/1	2/5	13/70
Kinta	0/2	-	0/1	-	0/3	0/30
Kuala Kangsar	0/2	2/3	1/1	3/3	6/9	46/88
Larut Matang	-	-	1/2	3/4	4/6	21/60
Manjung	0/3	1/1	0/1	2/3	3/8	7/73
Pengkalan Hulu	0/0	-	1/1	-	1/1	3/10
Perak Tengah	0/0	0/2	1/1	1/1	2/4	2/35
Grand Total	**0/20**	**5/8**	**8/12**	**16/18**	**29/58**	**152/576**

Conclusion

FMD cases were detected in all districts of the state of Perak except Kinta. The prevalence rate was relatively higher in ruminants and no case was diagnosed in pigs. This study has provided some information on the current status of FMD across the state of Perak .in 2022. Additionally, the spatial distribution identified in this study may should also be considered in controlling the disease. To prevent the spread of the disease in the region, effective preventive measures and surveillance systems must be improved. Proper livestock management practices, Good Animal Husbandry Practices (GAHP), public awareness campaigns, and active collaboration between the veterinary services and livestock stakeholders should play a critical role in reducing the prevalence and spread of FMD in Perak.

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THE CURRENT STATE OF BEEF CATTLE FARMING PRACTICES IN PENINSULAR MALAYSIA

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Introduction

The current Malaysia's beef cattle number was estimated at 721,344 heads in 2022, worth over RM1.6 million (Department of Veterinary Services, 2022). However, these figures only accounted for 36,800 metric tonnes (mt) of meat production or 23% of the estimated 197,000 mt of total national beef consumption. Although the livestock census is conducted regularly across Malaysia, but data on breed, age and weight were not collected. All these data are essential to understand the current scenario of cattle farming in this country and for the future development of Malaysia's livestock industry. The objective of the study is to determine the actual distribution and composition, as well as other associated fractions of beef cattle farming practices in Malaysia.

Keywords: beef cattle, farming practices, KK crossbred, beef production

Materials and Methods

A field survey was conducted at randomly selected farms (n=75) based on the logical proportion livestock per state. Qualitative and quantitative data collection including production systems, animal numbers and physiological characterization on animal breed, age, sex, animal weight based on phase (born, milking, grower, mature, etc.) and manure management. Data analysis is conducted using descriptive analysis following scientific research requirements.

Results and Discussion

The survey has shown that the Malaysian beef cattle population was dominated by the Kedah-Kelantan (KK) crossbred. It is one of the local indigenous breeds usually found in the northern and eastern regions of Peninsular Malaysia. Over 75% of beef cattle are KK crossbreds (Table 1). The farmers commonly rear these breeds of cattle in their farms as they are easy to manage, adapt well with the environment, disease resilience, and are highly marketable to consumers. KK crossbred remains the major cattle breed reared (75.3 %) and mostly reared via integration in palm oil plantations. The census data obtained showed that the estimated KK crossbred's live weight was between 200-400 kg for cattle aged 2 years old and above and is marketable for religious activities. Yet, under intensive farming, the KK elite breed was found to achieve 430–460 kg of weight at 3–4 years of age (Shaari M.R, et al., 2021). Thus, to gain maximum profit, higher body weight

among KK crossbreds is targeted under an intensive farming production system. The cattle sex fraction was found to be 50.1% dominated by female cattle, as well as higher born ratio for female cattle with 53.7%. The census also showed an extensive production system is the largest farming approach either integration on palm oil estate or orchard (55.7%), followed by intensive (32.9%) and semi-intensive (11.4%). Generally, an intensive production system produced higher live weight gains (fattening) and carcass ratio. These practices, however, call for higher capital because the animal feed will account for a larger portion of the production costs. Thus, many farmers continued with their traditional backyard farming. According to our data, 68% of the farmers run the cattle beef farm on a part-time basis usually via backyard farming, and this explains why 70.7% of cattle farming activity is still self-owned without SSM registration, with the rest being Enterprise (24.0%) and Sdn. Bhd. (5.3%). In addition to cattle rearing, over half of the farmers also raised other animal species in their farm, such as goats, sheep, chickens, and others in their backyard. While on cattle manure management, despite the fact that most intensive cattle farmers choose liquid manure over solid management, there was a lack of proper manure management. This is demonstrated by 49.1% of farmers who direct animal waste to holding ponds/lagoons without proper utilization or processing, as well as 27.9% of farms that did not recycle solid animal waste as organic fertilizer.

Table 1. The current outlook on beef cattle production activities in Peninsular Malaysia (n farms = 75)

Farming Own ship scope	**Percentage (%)**	**Type of Production system**		**Percentage (%)**
Own	70.7	Intensive		32.9
Enterprise	24.0	Semi-intensive		11.4
Sdn. Bhd.	5.3	Extensive		55.7
Breeds	**Percentage (%)**	**Sex ratio**	**Live animal (%)**	**Birth ratio (%)**
KK and crosses	75.3	Male	49.9	46.3
LID and crosses	10.1	Female	50.1	53.7
Charolais and crosses	2.7			
Brahman and crosses	8.5			
Limousine and crosses	0.5			
KK Cross cattle age		**Weight range (kg)**		**Mean weight (kg)**
Male	< 1 year old	20-120		63.3
	1-2 years old	120-220		147.9
	> 3 years old	200-400		369.8
Female	< 1 year old	20-120		67.2
	1-2 years old	120-180		136.5
	> 3 years old	200-250		242.0
Breeding (mating) programme	**Percentage (%)**	**Manure management**		**Percentage (%)**
Structured breeding specific bull	61.9	Solid	Unmanage solid	27.9
Artificial Insemination (AI)*[1]	(14.2)		Manage solid as organic fertilizer	23.0
Random mating	23.8	Liquid	Liquid unmanage (lagoon / pond /etc)	49.1
None*[2]	14.2		Total	100.0
Total	100.0			

*[1]AI practices is within farmer with structured breeding program
*[2]Farmer practising feedlotting on male cattle, no breeding program involved.

Conclusion

The beef cattle farming in Malaysia is dominated by KK crossbred and mostly focused on small-scale farming, but it is expanding and shifting towards a more sustainable agriculture.

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CAN AGRICULTURE RESIDUE AS BIO-COVER INHIBIT METHANE EMISSION FROM STORED SLURRY?

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Introduction

Emissions from slurry storages can be mitigated in several ways, the most common of which involve decreasing the slurry's open surface area by the addition of rooftops or a simple covering approach. Cover can be either both fixed or free floating made of various materials and made to resist the effects of atmospheric agents. The objective of the study is to overview agriculture waste residue and by-products as a physical barrier to minimize the amount of methane (CH_4) emitted from the slurry surface.

Keywords: agriculture residue, methane emission, slurry cover, slurry storage, greenhouse gas.

Materials and Methods

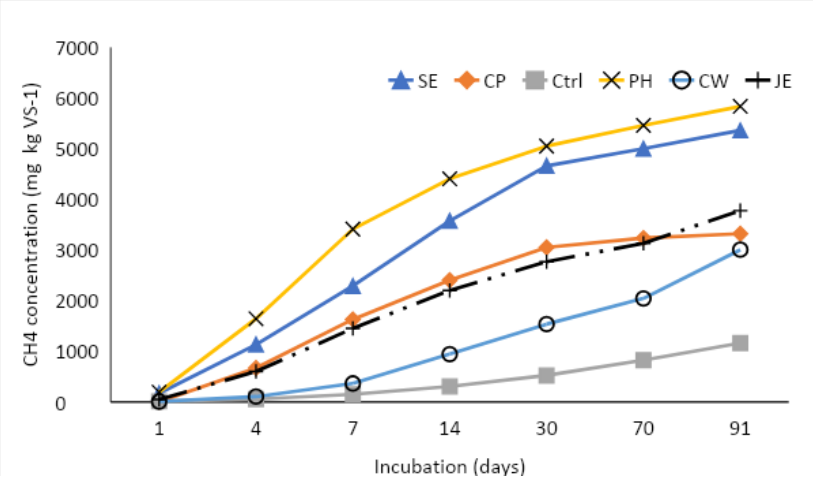
Fresh cattle slurry from a local farm was transferred into 130 L high-density polyethylene (HDPE), such that each pail received 40 kg cattle slurry with and without agriculture residue by-products as biological cover (30 cm thickness). There were 5 types of agriculture residue by-products used known as chipped wood (CW), paddy husk (SE), rice straw (JE), cocopeat (CP), unfilled grains (PH) and control (Ctrl). 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 (Cardenas et al., 2010).

Results and Discussion

The study revealed (Figure 1) that none of the covered slurries showed reduced CH_4 emissions. Those agricultural wastes did not act as a physical bio-cover to inhibit but did stimulate microbial activities through organic degrades thus resulting in higher cumulative CH_4 emission during storage observation. This was similar to a study reported by Berg et al., 2006 when the slurries were stored at 25°C. During the study, it was observed that the agriculture waste used as cover partially sank into the slurries. The sink of this residue acted as an organic addition to slurries. As a consequence, the use of PH, SE, JE, CP, and WC contributed more CH_4 emission rather than reduction. The highest in CH_4 emission was from PH, with 401% followed by SE, JE, CP and WC with 361%, 225%, 186%, and 158% respectively as compared to Ctrl. The highest emission from PH is

probably due to its proportional containing some fermentable carbohydrates. The findings in this study were contradicted the previous experiment which showed a reduction between 28 to 47 % and an additional reduction in ammonia emission (Pelletier et al., 2005; Guarino et al., 2006; VanderZaag et al., 2009; Misselbrook et al., 2005). Thus, other possible approaches shall be considered to reduce CH_4 emission from a stored slurry.

Figure 1. Cumulative methane emission during slurry storage with agriculture residue bio-cover



Conclusion

This study indicated that agricultural by-product covering strategies increased CH_4 emissions. This technique is unfeasible and raises atmospheric carbon because organic agricultural waste sinks into the slurry and emits more GHGs.

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DIAGNOSIS OF ANIMALS MYCOPLASMOSIS IN MALAYSIA (2021-2022)

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Introduction

Mycoplasma sp. is a bacteria which lacks a peptidoglycan cell wall that can cause infection and pathology lesions in the respiratory, reproductive and musculoskeletal systems. According to the Federation of Asian Veterinary Association data Surveillance 2019-2021, the most commonly encountered bacteria in the field which caused a significant economic loss as well as the most difficult to treat in the Asia Pacific region is *Mycoplasma gallisepticum* in poultry. The World Organization for Animal Health (WOAH) listed contagious bovine pleuropneumonia (CBPP), contagious caprine pleuropneumonia (CCPP) and infectious agalactia as economically important diseases caused by mycoplasma species in ruminants. While hemotropic *Mycoplasma ovis* is currently recognized as an emerging zoonotic pathogen. Therefore, the diagnosis data of mycoplasmosis in Malaysia is required to ascertain the current status for a better disease control measure.

Keyword: *Mycoplasma*, economic loss, respiratory disease, zoonotic

Material and Methods

The diagnostic data of 230 cases received from various animal species around Malaysia for mycoplasmosis diagnosis in the year 2021-2022 were analyzed descriptively. Isolation and identification of *Mycoplasma* spp. were conducted according to standard procedure and PCR using publish primers (Akemi K, et al., 1997)

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Result and Discussion

From 230 cases received, 61% (n=141) were found to be positive. Mycoplasmosis in avian showed the highest prevalence which was 36% (n=36), followed by bovine at 22% (n=31), caprine at 15% (n=21), and ovine at 9% (n=12). Swab was the most frequent type of sample received (36%), followed by the specimens of lungs (33%), trachea (19%), head (8%) and the hock joint (5%). Kedah was reported as the state with the highest number of mycoplasmosis cases (29%, n=41/141), followed by Perak (24%,n=34), Penang (22%,n=31), Selangor (9%,n=12) and Perlis (5%,n=7). From the data obtained, *Mycoplasma* cases increased by 82% from 2021 (50 cases) to 2022 (98 cases). Unstrict biosecurity and routine sanitation were the main causes of the spread of *Mycoplasma* infection. A large number of poultry farms within a small geographical area increase the probability of exposure and spread of disease. Ineffective treatment of mycoplasmosis might be due to antimicrobial resistance (Mugunthan, et al., 2023).

Table 1 shows that 73% of *Mycoplasma* species were unable to be identified. This could be due to the limitations of primers for identification using PCR and also a large number of new strains of *Mycoplasma* (Sawicka-Durkalec, et al., 2021). For diagnostic improvement, the development of new or improved primers can be explored to identify new strains of *Mycoplasma* spp.

Table 1. Identification of *Mycoplasma* spin various species of hosts

Group of animals	Species	Total
Bovine	*Mycoplasma. sp*	24
	M. bovirhinis	1
	M. bovis	10
	M. dispar	1
Avian	*Mycoplasma. sp*	40
	M. gallicepticum	12
	M. synoviea	4
	M. columbinasale	2
Caprine	*Mycoplasma. sp*	19
	M. arginini	1
	M. agalactiae	2
Ovine	*Mycoplasma. sp*	10
	M. arginini	1
Laprine	*Mycoplasma. sp*	4
Cervine	*Mycoplasma. sp*	3
Canine	*Mycoplasma. sp*	5
	M. spumans	3
	M. canis	3
Feline	*Mycoplasma. sp*	7
	M. felis	1
	M. gateae	2
Equine	*Mycoplasma. sp*	1
Primate	*Mycoplasma. sp*	1

Conclusion

Avian and bovine showed the highest incidence of mycoplasmosis in Malaysia. However, there is still a limitation in identifying mycoplasma species. Hence the establishment of current PCR for better identification of *Mycoplasma* spp. is needed to strengthen diagnostic capacity and capability in VRI.

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BIOCHEMICAL PARAMETER CHANGES IN CATTLE INFECTED WITH BOVINE VIRAL DIARRHEA – A PRELIMINARY STUDY

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Introduction

Bovine viral diarrhea (BVD) is a viral disease that is widespread among cattle populations globally, resulting in significant economic losses in the livestock industry. The disease is caused by the bovine viral diarrhea virus (BVDV) which is a member of the *Flaviviridae* family. BVDV infection can lead to a variety of clinical symptoms, ranging from mild to severe, such as respiratory and gastrointestinal issues, immune suppression, and reproductive disorders. BVD can cause various forms of diseases in cattle, including subclinical benign diarrhea, peracute highly fatal diarrhea, hemorrhagic and thrombocytopenic disease, reproductive failure, abortions, and fetal malformations (Bulut et al. 2013). However, the association between BVDV infections and biochemical changes remains to be elucidated. Therefore, the aim of this study was to evaluate the biochemical parameter changes in cattle infected with bovine viral diarrhea in Malaysia.

Keywords: Bovine viral diarrhea, BVD, bovine, biochemical parameter, disease

Materials and methods

Sixteen serum samples from the Mammalian Virology Section, Veterinary Research Institute (VRI), Ipoh, Perak that were tested positive for BVD using Serum Neutralization Test (SNT) were used in this study. For biochemistry analysis, serum was processed in an automated chemistry analyzer (VetTest Chemistry Analyzer 8008). The parameters analyzed were calcium, creatinine, glucose, cholesterol, total protein (TP), alanine aminotransferase (ALT), aspartate aminotransferase (AST), albumin (ALB), and lactate dehydrogenase (LDH). tThe serum samples were divided into two groups: namely low antibody titer (1/20 and 1/40) and high antibody titer (1/80 and 1/160). Data analysis was performed using the SPSS (IBM Corporation, USA). The differences between the study groups were evaluated using independent sample t-tests and $p<0.05$ was considered to represent statistically significant differences.

Results and Discussion

Differences were observed between the two groups, where the high titer group exhibited higher levels of AST, calcium, ALT, albumin, cholesterol, and LDH compared to the low titer group. In contrast, the low titer group showed higher levels of creatinine, glucose, and total protein. However, there were no significant differences observed between the two groups, except for glucose that was significantly higher in low titer group than the high titer group ($p<0.05$).

Our analysis has shown that clinical chemistry parameter changes in BVD-infected animals included increases in ALT, creatinine, and LDH when compared to the normal value. Increasing values of ALT and creatinine may indicate kidney and liver problems.

Table 1: Different biochemical parameters values in sera of low and high titer of BVD-infected animals

	Group Titer	N	Mean	Std. Deviation	Sig. (2-tailed)
ALT	Low	6	14.5150	5.74437	.373
	High	10	17.2540	5.77295	.377
Albumin	Low	6	27.1667	3.06050	.540
	High	10	28.1000	2.76687	.555
AST	Low	6	40.2500	16.13540	.093
	High	10	59.0700	22.20506	.072
Calcium	Low	6	2.3933	.15475	.524
	High	10	2.4430	.14268	.537
Cholestrol	Low	6	1.7200	.42643	.073
	High	10	2.8460	1.36423	.033
Creatinine	Low	6	158.6667	41.15661	.575
	High	10	146.6000	40.47551	.580
Glucose	Low	6	2.4233	.43962	.028
	High	10	1.7750	.54702	.022
LDH	Low	6	1146.0000	152.97712	.804
	High	10	1180.6000	309.68558	.770
Total Protein	Low	6	74.0000	4.38178	.672
	High	10	72.4000	8.31598	.623

Conclusion

BVD infected animals showed increases in elevated liver and kidney biochemical parameters indicating that the BVDV may cause affecting the functions of both organs. Therefore Nevertheless, a more comprehensive study with a larger sample size is recommended for further evaluation of these parameters among infected cattle in the future.

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ARE WE READY FOR BLOCKCHAIN IN THE LIVESTOCK INDUSTRY?

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Introduction

The traditional complex networks supply chain nowadays faces many challenges. Blockchain has therefore become the latest technology capable of improving the traceability of products and services, particularly relevant to supply chains in the agro-food industry. Blockchain is an innovation in data management that enables successive records in relation to a digital enterprise to be linked and stored in a common, decentralized, distributed and unchanged data structure. The most recent advancement in blockchain technology enables agricultural practitioners and farming communities to readily get up-to-date information, allowing them to make better decisions in their day-to-day farming operations (Kaddu and Haumba, 2016). Furthermore, using a blockchain solution greatly minimizes the chances of an object being changed, as the information in the blockchain cannot be manipulated. This article reviews research on the application of blockchain technology in agricultural and food supply chain systems and the food industry, focusing on the preparations and challenges faced by local governments when implementing blockchain and applying blockchain to livestock products.

Keywords: blockchain, livestock, traceability, agriculture

Materials and Methods

Literature-based analyses along the supply chain of livestock-based products to understand the prospect of applying blockchain technology and followed by an exploratory study by interviewing possible service providers that can be the backbone of this technology. Finally, all the information was combined to discuss the predominant applications, current open issues, and best practices.

Results and Discussion

Numerous studies such as from Patil et al. (2017), Lin et al. (2017) and Lin et al. (2018) have proposed the use of blockchain and IoT based smart agriculture framework for general use especially in smart greenhouse farms. For the agriculture industry to boost production and sustainability, the utilisation of data and information is becoming increasingly important. Hence, the advancement in information and communication technology significantly improves the efficacy and efficiency of data collection, storage, analysis, and use in agriculture (Walter et al., 2017). It is worth noting that the same improvement can be achieved in the livestock industry with the implementation of

blockchain technology. Xiong et al. (2020) also mentioned that smart agriculture using blockchain does not lessen, if anything, the technological barrier to participation for farmers. Based on our findings positive feedback from government authorities and industry to improvise the current information system with Blockchain. While it will receive some challenges to implement this technology at the farmer level and Ecosystem Enablers level as shown in Table 1.

Table 1. Challenges and Key Initiative Ecosystem Enablers

Enabler	
Challenges	1. High initial cost of investment 2. Lack of reliable & scalable connectivity infrastructure 3. Low awareness of government incentives and facilities 4. Potential high cost of investment for certain use cases
Key initiatives	1. Reliable and accessible internet connectivity 2. Acceleration financial facilities 3. Change management

(Source: National Blockchain Roadmap 2021-2025)

Conclusion

It was found that while blockchain technology is potentially sustainable and worthy of applications, there remain various limitations and complications toward adoption, such as the low awareness among stakeholders, the weak sector-wide coordination, and the lack of capacity in primary suppliers. Potential benefits and implications of blockchain technology for the livestock industry have yet to be widely understood, especially in Malaysia.

Acknowledgement

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DETECTION OF MYCOBACTERIUM TUBERCULOSIS COMPLEX (MtbC) BY REAL TIME PCR IN VETERINARY RESEARCH INSTITUTE (VRI)

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Introduction

Tuberculosis (TB) is a chronic bacterial disease of animals and humans caused by members of the *Mycobacterium tuberculosis Complex* (MtbC). Zoonotic tuberculosis resulting from transmission to humans constitutes a public health concern. According to Mayer et al. (2017), tuberculosis is a zoonosis and globally distributed causing public health implication and economic losses. This study aimed to report diagnostic outcomes of real time PCR alongside traditional isolation of mycobacteria on selected culture media.

Keywords: *Mycobacterium tuberculosis Complex* (MtbC), isolation, PCR, bovine

Materials and Methods

The study was performed on 69 tissue samples from cattle with clinical history and postmortem findings indicative of tuberculosis infection. Decontamination process was applied to all samples and cultured on Lowenstein Jensen medium and subjected to real time PCR.

Results and Discussion

Nine samples (9/69) were found MtbC positive by real time PCR while four (4/69) samples were positive for non-tuberculous mycobacteria (NTM). However, none of the samples (0/69) tested were positive for isolation of mycobacteria. Most of the culture was contaminated while no growth was observed until 4 weeks of incubation on certain samples. Successful culture depends on multiple factors including proper collection of appropriate samples, transportation of the samples to laboratory and decontamination step of the samples. Ten samples (10/13) tested positive for real time PCR show no visible lesion, while three samples (3/13) show visible lesions. Presence and absence of lesions might affect the number of bacteria in the samples. This may be due the infected animal may have low bacterial loads because of the early stage of infection.

Table 1. Comparison between real time PCR and isolation.

Results	Diagnostic methods	
	Real time PCR	Isolation
Positive	13	0
Negative	56	69

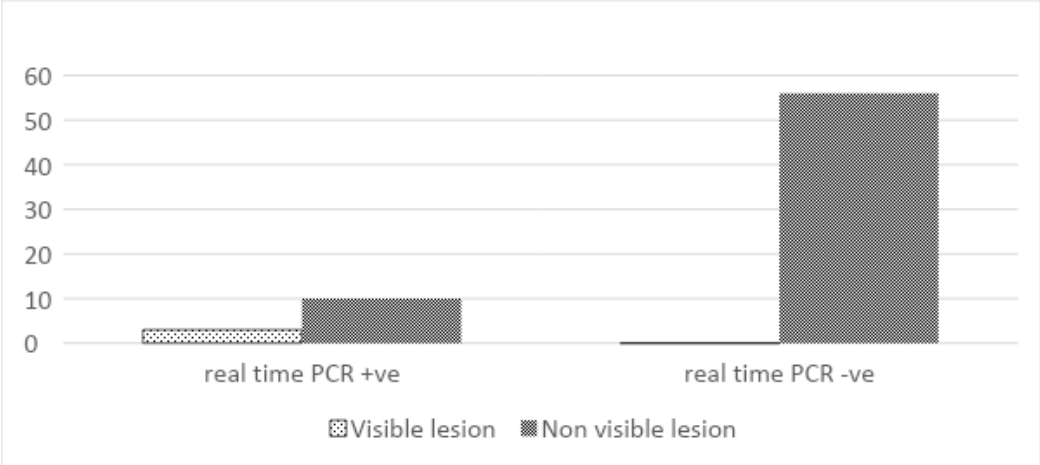

Figure 1. Comparison between real time PCR result and the presence or absence of anatomic lesions

Conclusion

Although the culture was contaminated, real time PCR positive samples should be considered as MtbC positives. Therefore, real time PCR can be used as an alternative test method in diagnosis of tuberculosis.

Acknowledgement

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PRELIMINARY STUDY ON NUTRITIVE VALUE OF MADRE DE AGUA (*Trichantera gigantea*)

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Introduction:

Madre de Agua (*Trichantera gigantea*) is a fodder tree also known as ketum ayam among livestock farmers in Malaysia (MyMetro, 2021). The leaves of Madre de Agua are good sources of protein with varying levels from 13 to 22% in dry matter form. Most of the protein content is considered a true protein and contains good amino acid balance (Abuan 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. Likewise, the time gap between the two cuttings also greatly affects the productivity and quality of green fodder. The cutting interval that is too short or too long may reduce the productivity of the following harvest. A short cutting interval causes plants to not be able to accumulate enough nutrients for later regeneration, while a long cutting interval will push back the following harvest until after the dry season, causing the decrease of yield. Meanwhile, the long cutting interval will increase the proportion of mature foliage, leading to a reduction of crude protein and an increase of fibre contents in leaves, thus reducing the quality of feed (Kien et al., 2020). Therefore, it is important to determine an appropriate cutting interval in the development of green fodder production. Therefore, this study was designed to evaluate cutting age on nutritive values in terms of the percentage of dry matter (DM), crude protein (CP), crude fibre (CF), Total Digestible Nutrient (TDN) and metabolizable energy (ME) of Madre de Agua. This information is needed to select the best cutting age in optimizing the nutritive value of Madre de Aqua.

Keywords: Madre de Agua, cutting age, nutritive values

Materials and methods

The experiment was conducted with 3 treatments representing 3 different cutting intervals of 6, 7 and 8 weeks. Each treatment was represented by three randomly selected plants in the same plot and sampling area. Replications were carried out up to 3 times. Fresh materials (leaves and young branches) were manually cut early in the morning at approximately 1 meter height from the ground surface. Certain affecting factors such as plant spacing, cutting height and the amount of fertilizer used were similar and acted as control factors between each treatment (0.2 kg/tree of NPK compound chemical fertilizer and 1.5 kg/tree of compost fertilizer applied every 3 months). Fresh materials were harvested, weighed, and sent to the laboratory for proximate analysis. The data were analysed using Statistical Analysis System (SAS) followed by a t-Test post-hoc test. Means values of less than 0.05 ($p<0.05$) are considered statistically significant. The result

was analysed with an analysis of variance followed by Duncan's new multiple range test (DMRT).

Results and Discussion

Table 1: Nutrient quality of *Trichantera gigantea* for 3 different ages of harvesting.

Parameters (%)	**Treatment**		
	6th week	**7th week**	**8th week**
Dry Matter (DM)	14.2b	14.8a	15.3a
Crude Protein (CP)	21.0a	20.0a	19.0a
Crude Fibre (CF)	16.6b	17.9a	18.3a
Total Digestible Nutrient (TDN)	66.7a	64.0a	63.9a
Metabolism Energy (ME) (MJ/Kg)	10.2a	9.2b	9.0b

*Means within the same row with different superscripts are significantly different at ($p<0.05$) level as determined by Duncan's Multiple Range.

As shown in Table 1, when cutting intervals increased from the 6th to 7th week, the rate of DM and CF significantly increased. While there was no significant difference between DM and CF from the 7th to 8th week. As for CP, even though the rate did not significantly decrease from the 6th to the 8th week, the CP yield in the 8th week was still lower than the 6th week. There was also no significant difference from week 6 to week 8 for TDN value. However, the ME significantly decreased from week 6 to the 7th week and was not significantly different from the 7th week to the 8th week. The 6 week cutting interval had the lowest fibre and it had significantly lower DM, so it should not be selected. Seventh and 8th week cutting intervals had a significantly higher rate of fibre and DM than shorter cutting intervals. These results allow us to exclude the 6th week cutting interval. The cutting intervals of the 7th and 8th weeks were the most appropriate to consider for harvest, and this is consistent with the results observed by Kien et al. (2020).

Conclusion

Trichantera gigantea contains high nutritive value, especially the CP rate. This fodder may fulfil the livestock requirement but further studies should be conducted to get the maximum benefit from this fodder.

Acknowledgement

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OCCURRENCE OF CAMPYLOBACTER POULTRY MEAT SAMPLES IN NORTHERN REGION OF MALAYSIA (2017-2021)

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Introduction

Campylobacter is widely recognized as one of the most frequent causes of acute bacterial gastroenteritis in humans worldwide. Its route of transmission to humans is most commonly through ingestion of raw or undercooked poultry meat. The four species most commonly regarded as being involved in *Campylobacter* gastroenteritis are *Campylobacter jejuni*, *Campylobacter coli*, *Campylobacter lari,* and *Campylobacter upsaliensis*. Among the various contamination testing procedures, isolation and identification of *Campylobacter* via enrichment onto selective medium and biochemical test are the most common techniques that are applied in Malaysia (Saleha, 2002). The understanding of the identification of *Campylobacter* over the year and species are the basis for quality assurance of control strategies to prevent *Campylobacter* contamination.

Keywords: *Campylobacter*, year, poultry meat, MVZU

Materials and Methods

Isolation and identification of *Campylobacter* sp. were carried out as outlined by ISO 10272-1 (ISO, 2006). Approximately 25g of meat samples were added to 225 ml of enriched Campylobacter selective enrichment medium [Bolton broth (Oxoid, Cambridge, UK)] with 5% lysed horse blood. It was then incubated under the microaerobic condition at 42°C for 48 hours. Inoculated the suspension with a sterile loop onto the surface of selective Campylobacter agar [Karmali agar (Oxoid)] with selective supplements. Suspected colonies were further confirmed by gram staining, hanging drop motility test, and biochemical test (catalase and oxidase).

Results and Discussion

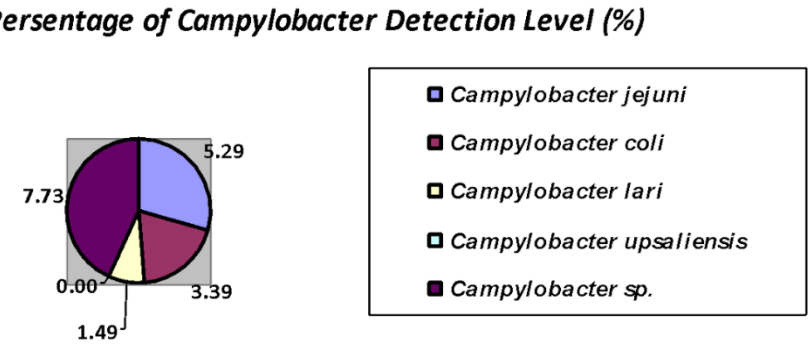
A total of 737 poultry meat samples were documented with 132 poultry meat samples (17.91%) tested positive for *Campylobacter* in MVZU. The year-specific rate for *Campylobacter* was the highest at 23.48% in 2018 (Table 1). The lowest specific rate of year for *Campylobacter* was in 2017 with 14.73%. In this study, the year 2018 showed a higher number of positive samples, and it gradually declined throughout the year. The percentage of *Campylobacter* Detection Level for poultry meat samples for *Campylobacter jejuni* is 5.29% (Pie Chart 1). It was followed by *Campylobacter coli* with a 3.39% of *Campylobacter* Detection Level. *Campylobacter jejuni* is the most common cause of gastroenteritis in humans. Therefore, the risk is greater if consuming poultry meat samples that are contaminated with *Campylobacter jejuni.* Besides that,

Campylobacter jejuni can survive high and low temperatures, low pH, and dry conditions compared to other *Campylobacter* species (Moore, 2005). Regular monitoring of *Campylobacter* is necessary for the successful control of human Campylobacteriosis in connection with meat production (Nur-Aziera-Aina, 2020).

Table 1: Yearly occurrence of *Campylobacter* sp. poultry meat samples received in Makmal Veterinar Zon Utara (MVZU), Pulau Pinang, Malaysia (2017-2021).

Years	Testing samples	Positive *Campylobacter*	Negative *Campylobacter*	Year-specific rate (%)
2017	129	19	110	14.73
2018	132	31	101	23.48
2019	150	27	123	18.00
2020	163	26	137	15.95
2021	163	29	134	17.79
Total	**737**	**132**	**755**	**17.91**

Pie Chart 1: Percentage of *Campylobacter* Detection Level for poultry meat samples received in Makmal Veterinar Zon Utara (MVZU), Pulau Pinang, Malaysia (2017-2021) based on the *Campylobacter* species.



Conclusion

This study indicates that *Campylobacter* sp. contamination in poultry meat samples has the highest rate in the year 2018. *Campylobacter jejuni* is the most isolated and identified compared to other species. Although the conventional and biochemical test method is a prominent technique to detect Campylobacter yet suggested the use of PCR assay using specific primers in order to obtain specific and sensitive output *Campylobacter* detection as a rapid diagnostic tool.

Acknowledgment

This work is done by using the data collection of MVZU, and the Department of Veterinary Services (DVS) Malaysia. The author would like to thank all for their valuable contribution to this study.

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FATTY ACID CONTENT IN CHICKEN MEAT FED WITH FLAXSEED-BASED DIET AT DIFFERENT FEEDING DURATIONS

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Introduction

Consuming food containing omega fatty acids (FA)have been reported to minimize the risk of cardiovascular disease (e.g. heart attack or stroke), Omega-3 (n-3) FAs are found mostly in animal and plant sources, whereas alpha linolenic acid (ALA; the precursor for n-3) is more abundantly found in seeds and seeds oil, such as nuts and flaxseed (Rymer & Givens, 2005). However, some people do not consume these seeds/oil due to their dietary preferences or health reasons. As a result, this has sparked the interest of researchers in enriching chicken meat with omega fatty acids.. According to the Department of Veterinary Services (DVS 2022), Malaysians consumed 1.68 million mt of poultry meat in 2021. MARDI has introduced a new ayam kampung breed, known as Ayam Saga to meet local demand. Although a lot of research has been carried out to study the enrichment of chicken meat with omega FA (Bostami *et al*. 2017, Konieczka *et al*. 2017), very little work has been undertaken to investigate the absorption and accumulation of ALA in free-range or village chicken meat. An experiment was conducted to determine the deposition of ALA in chicken meat fed with omega-based feed at different feeding duration.

Keywords: Alpha Lipoic Acid, Ayam Saga, Omega-3 content, Flaxseed

Materials and methods

A total of 120 Ayam Saga (7-week-old) were allotted to four different treatments, with 5 replications and 6 birds per replication. Birds from Group A were fed corn-soy-palm oil-based diet (control), while group B, C and D were fed with 5% corn-soy-flaxseed based diet at 5, 3 and 1 week before slaughter, respectively. At the age of 12 weeks, five birds from each treatment from each replication were slaughtered for carcass analyses. Cleaned chicken breast and thigh parts were deboned and collected for lipid and fatty acid analysis. Lipid analysis was conducted according to chloroform:methanol extraction method as described by Wang *et al*. (2000). Fatty acid methyl esters (FAME) were then prepared from the lipid samples and injected into gas chromatography (Clarus® 500 Gas Chromatograph (GC); PerkinElmer). The condition of the GC was as described by Tang *et al.* (2015). All data were statistically analysed using one way analysis of variance of SAS. Then, Duncan's Multiple Range Test (DMRT) was used to compare the significant differences between treatments (P<0.05).

Results and discussion

Mean carcass weight and percentages of ALA data are presented in Table 1. Results showed that there were no significant differences in weight of the carcasses and percentage of lipid between treatments. This indicated that the addition of flaxseed in chicken diet, as well as consuming diet containing flaxseed oil at different feeding duration did not affect the proportion of lipid and weight of carcasses. The results are in-line with Bostami et al., (2017) who reported that carcass weight was not affected by different fat sources. However, the flaxseed diet did have significant impact on the composition of the omega fatty acids in the carcasses. There was an increase in ALA in the meat from birds fed omega-3 diet compared to palm oil-based diet (P<0.0020). This result supports the results by Konieczka *et al*. (2017). On average, the content of ALA increased with feeding duration. These results were also similar to that reported by Konieczka *et al*. (2017), where ALA increased with a prolonged intake.

Table 1. Carcass weight and percentage of lipid and alpha linolenic acid (ALA, g/mg lipid) (Mean ± SE) of range chickens at the age of week 12 fed diet containing 0 and 5% flaxseed

Treatment	A	B	C	D	Pr>F
Dressing weight, g	1065.2±8.00	1155.6±9.20	1164.9±7.05	1131.6±6.38	0.2337
Breast, g	84.7±3.84	91.8±3.96	95.5±2.70	84.5±2.37	0.4200
Thigh, g	59.7±0.80	63.4±0.93	64.5±0.95	59.2±1.71	0.8048
Breast lipid, %	0.17±0.03	0.20±0.04	0.17±0.02	0.11±0.10	0.2020
Thigh lipid, %	0.47±0.06	0.43±0.08	0.59±0.06	0.44±0.06	0.1474
ALA (breast), g/mg	0.00^{c}±0.00	0.005^{a}±0.001	0.003^{ab}±0.000	0.002^{b}±0.000	0.0020
ALA (thigh), g/mg	0.00^{c}±0.00	0.012^{a}±0.003	0.012^{a}±0.002	0.005^{ab}±0.000	0.0018

[a,b,c] Means with different superscripts within the same row differ significantly at P<0.05. A – 2% palm oil (Control); B - 5% flaxseed (5 weeks before slaughter); C - 5% flaxseed (3 weeks before slaughter); D - 5% flaxseed (1 week before slaughter)

Conclusion

Omega enriched diet can alter the composition of fatty acids in range chicken meat, especially when chicken was fed with an omega source diet, 5 weeks before slaughtering. This functional meat can be one of the omega sources for human consumption.

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THE LAYING PERFORMANCE OF VILLAGE HENS FED ON A DIET HIGH IN OMEGA-3

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Introduction

Functional eggs have gained significant attention in recent years, as consumers seek healthier food options. Modifying the diet of laying hens to enhance the nutritional content of eggs has become an area of interest for many researchers. Supplementing omega-3 fatty acids into the hens' diet has shown potential health benefits for both hens and consumers (Berenjian et al., 2021). However, there have been limited studies investigating the benefits of feeding village hens with omega-3 diets with regards to their laying performance. Thus, this study aims to evaluate the effect of a diet high in omega-3 on the laying performance of village hens.

Keywords: Omega-3, village hens, laying performance

Materials and methods

Village hens of the Ayam Saga breed, aged 21 weeks, were housed in a deep litter system (open house) with a cage occupancy of 7 hens per cage. The environmental conditions in the housing had temperatures ranging from 24 to 35°C and humidity levels ranging from 48 to 83%. A total of 56 birds were randomly divided into 2 treatments in a randomized complete block design (RCBD). Each treatment is composed of 4 replications with 7 birds per replication. The hens were fed with corn-soy diet (0% omega-3) (T1) and a corn-soy diet with 0.47% omega-3 (T2). About 110g of feed was given to the birds daily. The egg production was recorded daily. Eggs weights were taken after four (4) weeks of feeding the birds with the experimental diet. The hen-day egg production (HDEP), egg mass and feed conversion ratio (FCR) were obtained with the equation as shown below:

Hen-day egg production (%/hen) = Number of eggs laid in 1 week/ number of hen /7 days x 100
Egg mass (g/hen) = Hen-day egg production (%) x egg weight (g)/ 100
Feed conversion ratio (g feed/ g egg) = Feed intake (g/hen)/ egg mass (g/hen)

Results and Discussion

The study showed that there were no significant differences observed among the groups in HDEP, egg mass, egg weight and FCR. This was aligned with several studies that have reported similar findings (Mazali et al. 2004); Silke et al., 2008). Mazali et al. (2004) found that no significant differences in HDEP, egg weight, egg mass and FCR in commercial

laying hens (Hy-Line) fed with a high omega-3 diet to hens on a standard diet over 20 weeks. However, some studies reported a decrease in egg weight with the supplementation of omega-3 diets (Ahmad et al., 2012).

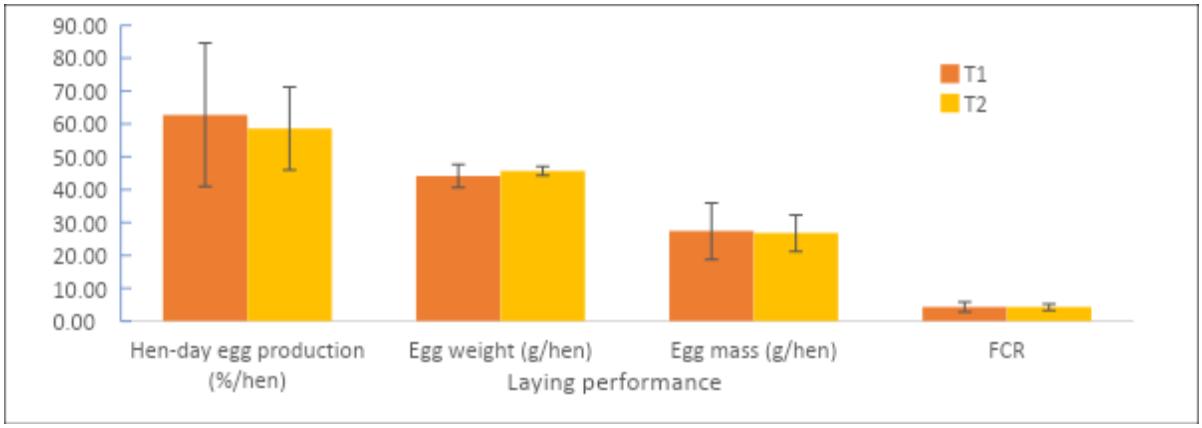

Figure 1. Data represent means ± standard deviation. Means within a row with different letters were significantly different (P < 0.05). T1: hens fed with a corn-soy diet (0% omega-3) and T2: hens fed with a corn-soy diet with 0.47% omega-3.

Conclusion

In conclusion, the study showed that the inclusion of omega-3 fatty acids in the study did not affect the laying performance of village hens.

Acknowledgement

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IMPACTS OF DIFFERENT METABOLISABLE ENERGY (ME) LEVELS ON ELITE KEDAH-KELANTAN GROWER CATTLE'S EMISSION INTENSITY

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Introduction

Methane (CH_4) is one of the greenhouse gases that contributes to climate change. Ruminant livestock industry is among one of agriculture sub-sector contributing to CH_4 emission through the enteric fermentation process. To reduce CH_4 emission, a proper mitigation strategy is needed. The emission intensity (EI) value can be used to gauge the effectiveness of a mitigation strategy (Wang et al., 2019). Whilst a better cattle breed with lower emission can be developed, the breed also needs to be climate friendly with lower emission per unit of production (meat, milk etc). This can be achieved through an improved growth performance while maintaining or only at a slight increase of CH_4 emission. The Kedah Kelantan (KK) Elite beef cattle breed is an improved version of the indigenous KK which has been introduced by MARDI in 2018 (Rosly et al., 2021). Since then, several feed formulations with different nutritional contents have been developed for different growth stages to improve its growth performance. Among the formulation includes one that is specific for the cattle grower (finisher) stage as this type is the one that will be utilised for beef production, and important in achieving national mitigation target particularly from the beef sector. One of the formulations includes manipulation of metabolisable energy (ME) levels in the diet. Therefore, the objective of this research is to evaluate different levels of ME inclusion in the grower cattle feed formulation towards the cattle EI through calculation using average daily gain (ADG) and emission factor (EF) acquired from the study. IPCC tier-2 methodology (IPCC, 2006) will be used for the calculation of EF and EI.

Keywords: metabolisable energy, Kedah-Kelantan, cattle, grower, emission intensity

Materials and Methods

Different levels of ME inclusion in the Elite KK grower cattle diet are utilised, namely base (as control), 5% and 10% labelled as treatment A, B and C, respectively. Using ADG results acquired from inclusion of different energy levels in the cattle feed, as well as the breed parameters reported previously by Rosly et al. (2021), the enteric methane emission factor (EF) for grower (finisher) type cattle has been developed and further used

in calculating the emission intensity (EI) level using IPCC tier-2 methodology (IPCC, 2006).

Results and Discussion

Table 1. Average ADG and EI between treatments for Elite KK grower cattle

Treatment	ADG means (kg/d)	CH_4 EI means (kg CH_4/kg LW increment)
A	0.43±0.05[a]	0.44±0.03[c]
B	0.50±0.05[ab]	0.38±0.03[cd]
C	0.60±0.05[b]	0.33±0.03[d]

Means with similar superscripts are not significantly different (p-value >0.05) (ANOVA, GLM procedure)

The ADG for Elite KK grower cattle fed with 10% ME (treatment C) is higher than both grower cattle groups receiving 5% and base ME (treatment A and B). However, the increment is only significant comparing to grower cattle receiving base level ME (treatment A) (p-value <0.05) but does not show any significant difference between grower cattle receiving 5% ME (treatment B) (p-value >0.05) (Table 1). CH_4 emission intensity of grower cattle fed with a base level ME (treatment A) on the other hand is higher than both grower cattle groups receiving 5% and 10% ME (treatment B and C). Nevertheless, the increment is only significant comparing to grower cattle receiving 10% ME (treatment C) but does not show any significant difference between grower cattle receiving 5% ME (treatment B) (Table 1).

Conclusion

It can be concluded that the additional 10% ME (treatment C) in the dietary formulation for the grower cattle group is the best to increase ADG while still maintaining the cattle enteric CH_4 emission at a low EI. This shows a promising future in the utilisation of KK Elite grower cattle as a climate-friendly beef cattle to improve the country's beef production with the suggested dietary formulation.

Acknowledgement

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PREVALENCE OF ASPERGILLOSIS IN AVIAN SPECIES IN NORTHERN REGION OF MALAYSIA ISOLATED FROM NORTHERN ZONE VETERINARY LABORATORY FROM 2019 TO 2022.

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Introduction

The most common fungal respiratory diseases in poultry are aspergillosis and candidiasis (Orosz, 2000). Aspergillosis is caused by a fungal species genus *Aspergillus*, such as *A. fumigatus*, *A. flavus*, *A. niger*, *A. nidulans* and *A. terreus* with *A. fumigates* considered to be the most pathogenic and frequently isolated from pathologic lesions (Richard *et al.,* 1984, ArchanaKannoju*et al.,* 2021). The spores of the fungus are saprophytic and ubiquitous in nature (Bandres *et al*., 2022; Ulloa-Avellán *et al*., 2022). Aspergillosis primarily affects the respiratory systems of chickens, turkeys, ducklings, and goslings and less frequently in other avian species (Shoukat *et al*., 2018; Al-Azawy & Al-Ajeeli, 2019). The disease develops through inhalation of small-sized conidia or spores through a contaminated environment, litter, and feed (Chung *et al*., 2020). The present study was carried out to reveal the prevalence of Aspergillosis in Avian species submitted to the Northern Zone Veterinary Laboratory (Bukit Tengah) from 2019 to 2022. Aspergillosis is known to be implicated with pulmonary or Complex Chronic Respiratory Disease (CCRD) (Arné *et al.,* 2011; Munir *et al.,* 2017; Zarif *et al.,* 2021) and thus may lead to significant economic losses, particularly in poultry production and commercial birds (De Oca *et al.,* 2017; Cheng Z *et al*., 2020). Therefore, the current number of positive cases of aspergillosis was carried out to delineate the patterns of Aspergillosis infections in the northern region of Malaysia.

Materials and Methods

Data were analysed from cases submitted to the Northern Zone Veterinary Laboratory over a period of four years:2019, 2020, 2021 and 2022. Suspected lesions, normally from lungs, air sacs and eggs of infected poultry were cultured on Sabouraud dextrose agar (Oxoid). Plates were then incubated aerobically at 35 - 35℃ for 3-5 days. Macroscopic and microscopic examinations of the colonies were carried out to determine the type of fungal responsible for the infections.

Results and Discussions

Data from diagnostic and monitoring cases were tabulated from the Bacteriology Section and analysed. Out of 226 cases suspected of fungal infections, only 65 cases (29%)

revealed positive results for aspergillosis. For the period of four years, *Aspergillus niger* contributed to 60% of the positive aspergillosis followed by *Aspergillus fumigatus* and *Aspergillus flavus* which made up 22% and 18% of positive aspergillosis cases respectively.

Table 1. Percentage of positive cases of aspergillosis in avian species in the Northern Region of Malaysia from 2019 to 2022.

Year	Percentage of positive cases by year (%)		
	A. fumigatus	***A. niger***	***A. flavus***
2019	7.1	75.0	17.9
2020	7.7	76.9	15.4
2021	53.3	26.7	20.0
2022	33.3	44.4	22.2

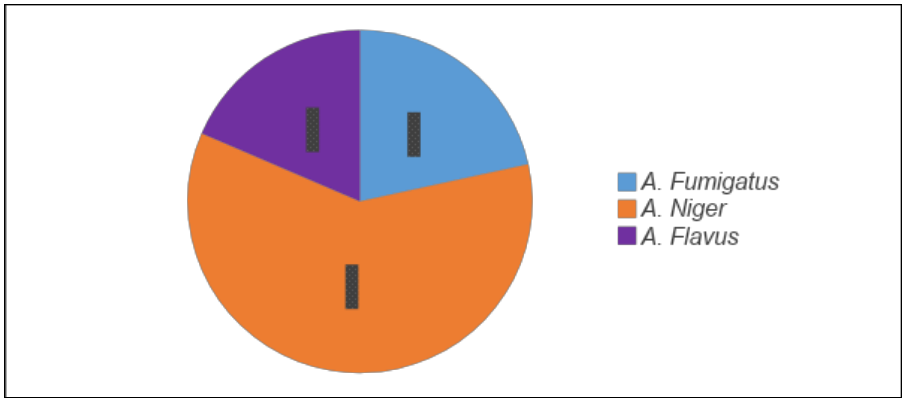

Figure 1: Percentage of *Aspergillus* species responsible for aspergillosis from 2019 to 2022.

Conclusions

Although the patterns of aspergillosis were inconsistent by year, with respect to the data when there was a sudden increase in the percentage of *A. fumigatus* cases received in 2021, it is suggested that *A. fumigatus* cases in the north zone must be controlled and prevented with proper farm sanitation, hygienic environment, and more stringent feed control. The predominating *Aspergillus* species in the Northern Area for the period of four years is *A. niger*. This study reflects the importance of monitoring the prevalence of *Aspergillus* species in avian especially in the Northern Zone of Malaysia. Whilst information regarding aspergillosis is limited, results from this study highlight the importance of accurate diagnosis, thus contributing to the necessary prevention and good management of the disease by the farmers.

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MILK PRODUCTION PERFORMANCE OF SELECTED DAIRY CATTLE FARMS IN JOHOR, MALAYSIA

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Introduction

In 2020, it was estimated that more than 77% of dairy cattle farmers in Malaysia practised small-scale farming systems, resulting in a lack of milk production in the country. The self-sufficiency level (SSL) of milk recorded in 2019 was 63.03% throughout Malaysia (DVS, 2020). Almost all dairy cattle breeds in Malaysia, particularly on commercial farms are imported and have difficulty acclimating to the local climate. Hot temperatures will negatively affect the quantity and quality of milk (Saadiah et al., 2019). In this regard, systematic farm management that enables minimising the stress level of the livestock is essential to ensure the optimum production of milk. To improve the country's milk production, it is important to assess the performance of dairy cattle farming. Therefore, this study was performed to evaluate the current performance of selected dairy cattle farms in Johor which was determined by average milk production and the significance of the type of farming system on milk production and lactation length.

Keywords: dairy cows, lactation length, intensive system, semi-intensive system

Materials and Methods

A set of survey forms was constructed for the purpose of data collection. In June 2022, an actual survey was conducted on four commercial-scale dairy cattle farms located in Kluang, Mersing, and Johor Bahru. There were two types of farming systems involved in this study, namely, intensive and semi-intensive systems. Raw data on farm production and other relevant information were acquired primarily through face-to-face interviews using a pre-tested survey form. Meanwhile, secondary data was acquired from the existing publications. The data collected were organised and analysed quantitatively and qualitatively using IBM SPSS version 26.0. The comparisons between the types of farming systems with respect to milk production and lactation length per cow were analysed using a t-test with a significant level of $p<0.05$.

Results and Discussion

Table 1: Average milk production and lactation length according to farm

Farm	N[a]	Breed	Farming system	Milk production (litre/cow/day)	Lactation length (day)	Cowshed temperature (°C)
Farm A	152	Friesian-Jersey	Intensive	10.00	285	29.6
Farm B	70	Brown Swiss / Friesian / Jersey	Intensive	11.50	225	30.3
Farm C	92	Friesian / Jersey	Semi-intensive	8.00	280	28.6
Farm D	80	Friesian-Jersey	Semi-intensive	11.25	290	33.3

[a]Number of cows from each farm

Table 2: Effect of farming system on milk production and lactation length

Measures	Intensive	Semi-intensive
Milk production (litres/cow/day)	$10.75^{a} \pm 1.06$	$9.63^{a} \pm 2.30$
Lactation length (days/cow)	$255^{a} \pm 42.43$	$285^{a} \pm 7.07$

[ab]Mean values with different superscripts are significantly different ($p<0.05$)

Conclusion

Each farm produced between 8.0 and 11.6 litres of milk per cow per day, which indicated a moderate level of productivity. There was no significant difference in mean milk production per cow in both intensive and semi-intensive farming systems. All farms recorded cowshed temperatures above 25°C, where the occurrence of heat stress tends to increase. Therefore, to meet future demand for dairy products, the application of modern technology should be encouraged and widely used. A farm building that can provide a suitable environment for the cattle should be designed particularly for the imported breed. Climate control barns can be designed and used to improve milk production and the reproductive performance of cows. Extension services need to be strengthened to educate and encourage farmers on the importance of recording data comprehensively as the findings of any research can be used to help farmers in developing the dairy industry.

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OCCURRENCE OF VETERINARY DRUGS AND HORMONE IN ANIMAL FEED MONITORING FROM PENINSULAR MALAYSIA FROM 2020-2022

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Introduction

The Malaysian authorities has recently banned seven (7) antibiotics, colistin, erythromycin, enrofloxacin, tetracycline, ceftiofur, tylosin and fosfomycin from usage in animal feed and feed additives for food-producing animals. These drugs were included in the recent amendment in the Feed Act 2009 regulations, Feed (Prohibited Antibiotics, Hormones and Other Chemicals) (Amendment of Schedule) Regulations 2023. Colistin was banned in January 2019, for usage in feed and feed additive for the purpose of treatment, growth promoters and prophylaxis for food-producing animals; followed by the banning of erythromycin, enrofloxacin, tetracycline, ceftiofur, tylosin and fosfomycin starting 21 May 2021, for the purpose of growth promoters and prophylaxis for food-producing animals (Feed Regulations, 2023). Aside from these banned antibiotics, monitoring was also enforced on other veterinary drugs and hormones of significance to food-producing animals (Food Act, 1983). In concurrent with increased number of antibiotics included in the Feed Act regulation, the National Veterinary Public Health Laboratory (MKAVK) has been tasked to monitor the usage of these drugs in animal feed. The objectives of this study were to monitor the usage of veterinary drugs and hormones in animal feed, premix and drinking water received at the laboratory, categorizing the type of drugs used according to species and observed the trends of drugs usage from 2020 to 2022 since implementation of the Feed Act 2009 regulations.

Keywords: Feed Act 2009, veterinary drugs, hormones, animal feed

Materials and Methods

A total of 441 animal feed, premix and drinking water (2020; n=172, 2021;n=200 and 2022;n=69) samples were received and analyzed at the National Veterinary Public Health Laboratory (MKAVK), from 2020 to 2022. Analysis was conducted on all samples for eight groups of drugs and one hormone, amphenicol, nitrofuran, sulfonamide, tetracycline, nitroimidazoles, macrolide, fluoroquinolones, colistin and beta-agonist. Samples were

screened using enzyme-linked immunosorbent assay (ELISA) methods and multidrugs analysis using ultra-performance liquid chromatography-tandem mass spectrometer (UPLC-MS/MS). Suspected samples were further analysed using a single group method with UPLC-MS/MS instrumentation to quantitatively confirm the concentration in mg/kg.

Results and Discussion

None of the banned antibiotics in Feed Act 2009, chloramphenicol, nitrofurans group, nitroimidazoles group and beta-agonist group were observed in the samples. Compounds from amphenicol, sulfonamide, tetracycline, macrolide, fluoroquinolones, and beta-agonist groups were detected in animal feed (n=288) and premix samples (n=33), but not in drinking water (n=120). The list of compounds detected were as shown in Table 1.

Table 1. Groups of veterinary drugs and hormones and its compounds detected in the monitoring of animal feed and premix of poultry, porcine and ruminants from year 2020 to 2022.

Veterinary Drugs/ Hormone Groups	**Compounds**
Amphenicol	Florfenicol, Thiamphenicol
Sulfonamide	Sulfamethazine, Sulfamethoxazole, Sulfadimethoxine, Sulfadiazine, Sulfathiazole.
Tetracycline	Chlortetracycline, Tetracycline*, Oxytetracycline, Doxycycline
Macrolide	Tylosin*, Tiamulin, Lincomycin, Tilmicosin
Fluoroquinolones	Enrofloxacin*
Beta-agonists	Ractopamine

* Recently banned drugs in Feed Act 2009, Feed (Prohibited Antibiotics, Hormones and Other Chemicals) (Amendment of Schedule) Regulations 2023.

Amphenicols, tetracycline, macrolide, and beta-agonist were detected in poultry and porcine samples, while sulfonamide was exclusively found in porcine feed and premix, as well as fluoroquinolone which was only used in poultry. Usage of beta-agonist (ractopamine) was detected in porcine and ruminant feed. Samples may contain one or more groups of veterinary drugs and hormones, and one or more compounds of a group. Trends showed decreased usage of antibiotics in animal feed, from 41.8% in 2020, to 24.5% in 2021 and 11.6% in 2022, after ban for animal growth promoter (AGP) and prophylaxis were enforced as shown in Figure 1.

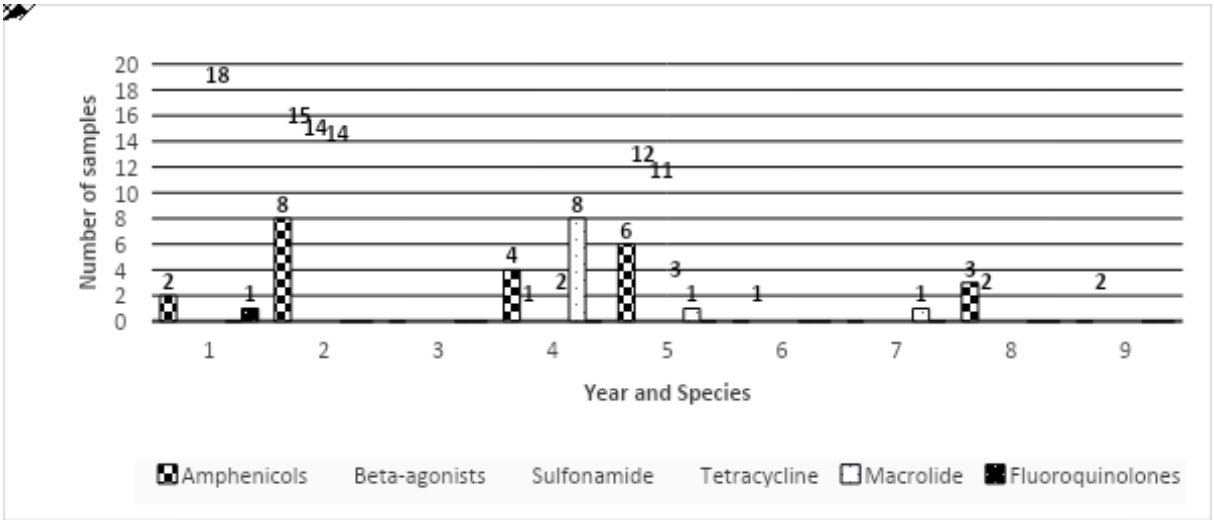

Figure 1. Trends of Veterinary Drugs and Hormone Usage in Animal Feed and Premix Samples from 2020 to 2022

Conclusion

The usage of veterinary drugs and hormones in the local industry complied with the regulations set by the authorities. Trends observed showed that farmers and animal-based food producers were aware of and adhered to the new regulations gazetted in Feed Act 2009. The monitoring program for animal feed, premix and drinking water should be continuously implemented to ensure the enforcement of Feed Act 2009 in line with food safety concern and antimicrobial resistance (AMR), for the local market as well as in the trade industry.

Acknowledgement

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COMPARISON OF ROSE BENGAL PLATE TEST (IN HOUSE AND COMMERCIAL) AND COMPLEMENT FIXATION TEST FOR BRUCELLOSIS SEROLOGICAL DETECTION IN CATTLE IN MALAYSIA

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Introduction

Brucellosis is a notifiable disease in Malaysia and many other countries. Serological tests for Brucellosis have strict requirements to ensure it is reliable and accepted for domestic and international trade purposes. Starting from 2018, the Malaysian Veterinary Protocol (PVM) has outlined that ruminant livestock should be screened for Brucellosis using the Rose Bengal Plate Test (RBPT). Livestock that are tested positive will be confirmed with the Complement Fixation Test (CFT) or ELISA at the laboratory level. RBPT is a fast, non-laborious and inexpensive test, making it very suitable for use in the field. At present, veterinary authorities are using commercial RBPT kits for Brucellosis screening in the field. There are various types of commercial RBPT kits available in the market with various performances. Therefore, this study aimed to evaluate the in house RBPT kit, commercial RBPT kits and the CFT based on agreement between tests as well as its diagnostic performance.

Keywords: Rose Bengal, RBPT, Brucellosis, Cohen's kappa

Materials and Methods

Seventy cattle serum samples were tested against in house RBPT (V-RBPT) and CFT according to DVS Manual for Serology Laboratory. Commercial RBPT (C1-RBPT and C2-RBPT) were carried out according to manufacturer recommendations. The antigen used in all assays is *Brucella abortus* S99. Specificity and sensitivity of each RBPT test were evaluated against CFT as a gold standard. On top of that, Cohen-Kappa analysis was used to estimate the agreement between tests.

Results and Discussion

The specificity and sensitivity for V-RBPT, C1-RBPT and C2-RBPT were evaluated using CFT as a gold standard. As a result, the specificities were 97.4% (95% CI;90.0-100.0), 97.4% (95% CI;90.0-100.0), and 79.0% (95% CI:73.0-85.0), while the sensitivities were 96.8% (95% CI:88.9-99.9), 93.1% (95% CI:86.0-100.0) and 75.0% (95% CI:68.8-81.2) respectively. This indicates that the V-RBPT had better sensitivity and specificity compared to earlier studies by Getachew et al. (2016). Meanwhile, the C1-RBPT had similar specificity with V-RBPT but lower sensitivity. Besides, C2-RBPT showed the least specificity and sensitivity among the three kits. The results for the second analysis which is the Cohen's kappa were summarized in Table 1 below.

Table 1. The degree of agreement between in house RBPT (V-RBPT), commercial RBPT (C1-RBPT & C2-RBPT) and CFT tests.

Test	Kappa (%)	κ value	Degree of Agreement
1. V-RBPT and C1-RBPT	100.0%	1.00	Perfect agreement
2. V-RBPT and C2-RBPT	85.4%	0.68	Substantial agreement
3. V-RBPT and CFT	94.4%	0.89	Perfect agreement
4. CFT and C2-RBPT	83.8%	0.66	Substantial agreement

Based on the analysis, V-RBPT was found to have strong percentage agreement and k-value was close to 1.0 with C-RBPT and CFT. This can provide an estimate that the results of these three tests are conforming to each other.

Conclusion

Due to its good diagnostic performance compared to the CFT and in agreement with C1-RBPT and CFT, V-RBPT could be considered as an alternative screening test to replace the usage of C1-RBPT and C2-RBPT in the future. Further work can be initiated to produce the V-RBPT kit on a large scale to meet the domestic demand.

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MEAT QUALITY OF KEDAH-KELANTAN BEEF CATTLE FED WITH OIL PALM BY-PRODUCTS BASED FEED PELLET

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Introduction

Many of the components of oil palm biomass has great potential to be utilized as constituents in compound feeds especially for ruminants. Feed intake and performance of animals uptaking feed with the inclusion of oil palm biomass can be improved through optimal formulation and processing (Karimizadeh et al., 2017). Diet is among several factors that have a high impact on meat quality such as colour and tenderness, which subsequently influences customers' acceptance and satisfaction with the end product. The objective of the study was to evaluate the effects of formulated feed pellets with the inclusion of oil palm by-products on meat quality of Kedah-Kelantan beef cattle.

Keywords: Beef cattle feed pellet, oil palm by-products, meat quality

Materials and Methods

A total of 42 beef cattle were assigned to two treatment groups of oil palm based (MPOB) and commercial (COM) and subjected to 90-days feeding trial. At the end of the feeding trial, the beef cattle were randomly selected for slaughtering and the meat samples were collected for meat quality analysis which includes meat colour, natural drip loss, cooking loss and meat texture. All analyses were repeated in triplicates and data obtained were analyzed using T-Test of SAS Statistical package 9.1 (SAS Inst. 2013) to compare means at $P<0.05$ for significant differences.

Results and Discussion

Meat quality of beef cattle fed with different feed pellets is shown in Table 1. There were no significant differences ($P>0.05$) in all parameters except for meat colour where the a* and b* values were significantly higher ($P<0.05$) in the MPOB sample as compared to the COM sample. This finding was in line with Rodrigues et al. (2021) who observed that feeding oil palm products to cattle had significantly increased ($P<0.05$) the yellowness of the meat when compared to control diet. Meanwhile, Santana Filho et al. (2016) reported that substitution of oil palm by-products for soybean meal in the diet of bulls did not affect the water holding capacity and meat texture parameters.

Table 1. Meat quality of beef cattle fed with different feed pellets

Parameters	Treatment		P value
	MPOB	COM	
Meat colour			
L*	36.04 ± 1.39	38.72 ± 0.87	0.18
a*	18.14^{a} ± 0.60	12.25^{b} ± 1.30	0.01
b*	7.67^{a} ± 0.18	4.19^{b} ± 0.90	0.02
Drip loss, %	0.09 ± 0.05	0.07 ± 0.05	0.81
Cooking loss, %	3.20 ± 0.31	3.67 ± 0.77	0.60
Meat texture, N	22.58 ± 1.96	21.27 ± 1.54	0.63

Note: Data show mean ± SE. MPOB:oil palm-based feed pellet; COM:commercial pellet; L*:luminosity; a*:redness; b*:yellowness; N:Newton. ^{a,b}Means in the same row with different superscripts differ significantly at $P<0.05$.

Conclusion

In summary, oil palm-based feed pellets provide similar effects on the meat quality of the beef cattle with better meat colour appearance.

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QUANTITATIVE DETERMINATION OF AFLATOXIN B1 TOWARDS DIFFERENT STORAGE CONDITIONS IN NON-TREATED GRAIN CORN

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Introduction

In the feed chain, storage environments such as poor aeration and high humidity, are among factors which triggers and accelerate the growth of fungi which consequently lead to mycotoxins production. Aflatoxin B1 (AFB1) produced by *Aspergillus* spp. is regarded as a potent mycotoxin that poses concerns to human health and livestock. In farm animals, aflatoxicosis can affect the liver and interrupt the digestive system. This in turn has a negative impact on livestock production with a reduction in body weight and feed conversion rate. Aflatoxins can contaminate a variety of livestock feeds and cause enormous economic losses, estimated billions of dollars annually for the U.S. corn industry alone (Jiang et al., 2021). Hitherto, instrumentation methods such as high-performance liquid chromatography (HPLC), liquid chromatography–mass spectrometry (LC-MS) and gas spectrometry (GC) are widely used for AFB1 determination. Commercial ELISA kits also are widely available in the market for mycotoxins detection. However, both chromatography and ELISA methods are time-consuming besides requiring bulky instruments to give accurate quantitative reading. To address the need of having on-site rapid detection, an immuno-based electrochemical biosensor for the quantitative detection of AFB1 has been developed. In this study, the application of the biosensor system attached with a portable reader as point-of-care is being employed for determination of AFB1 in grain corn stored at two different conditions.

Keywords: aflatoxin B1, biosensor, grain corn, storage

Materials and Methods

A miniaturized biosensor system with modified screen-printed carbon electrodes (SPCEs) and an integrated portable device is described in this study. The biosensor development employs in-house polyclonal antibody (Animal Ethics Committee of MARDI approval number 20190215/R/MAEC00045). Modified SPCEs were prepared as described by Jusoh et al. (2022). The strips are then attached on an Android-based handheld portable device for mycotoxin analysis and results read-out. For the storage study, 10 kg of non-treated harvested grain corns were packed in woven bags and kept in two different temperatures i.e. room temperature (23-28ºC, ± 60-70% relative humidity) and cold room (8ºC, ± 85% relative humidity) for six months. A three replicate was used for each

treatment, totalling 36 samples. AFB1 analysis was taken every month, recorded and compared. For validation study of the results obtained from the biosensor method, 11 samples were sent to Veterinary Public Health Laboratory, Salak Tinggi and SGS Lab, Shah Alam using UPLC-FLR and UPLC-FLD respectively.

Results and Discussion

The results for AFB1 determination for the 6 months in different temperatures is presented in Table 1 below. At room temperature, AFB1 started to contaminate the non-treated grain corn as early as the first month and remained persistent monthly. Meanwhile, at cold room, AFB1 contamination can be contained for the first 3 months. However, taking into the average of all the replicates, total AFB1 for all treatments are still below the MRLs set for AFB1 in grain corn (5 ppb).

Table 1. AFB1 determination in grain corn stored at different temperatures

Storage/Months	AFB1 concentrations (ppb)					
	1	2	3	4	5	6
8ºC						
Replicate 1	[a,b]n.d.	n.d.	[b]n.d.	5.57	4.61	1.62n.d.
Replicate 2	[b]n.d.	[b]n.d.	[b]n.d.	1.78	n.d.	7.59
Replicate 3	0.84	1.73	[b]n.d.	5.98	5.08	
Room temperature						2.88
Replicate 1	[b]3.31	[b]n.d.	0.54	3.32	2.17	4.30
Replicate 2	[b]n.d.	[b]2.64	n.d.	7.38	1.18	3.47
Replicate 3	2.81	[b]2.11	2.42	1.43	5.92	

[a]n.d.=not detected
[b]=as determined and validated by instrumentation method (MKAV/SGS Lab)

Conclusion

Non-treated grain corn stored in woven bags kept in cold conditions has the least AFB1 occurrence for the first 3 months.

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THE USE OF UAS-BASED IMAGING AND VEGETATION INDEX FOR EARLY STRESS DETECTION OF NAPIER GRASS

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Introduction

The use of Unmanned Aerial System (UAS) orthophoto has been known for its effectiveness in overviewing crop health and condition in response to agriculture inputs and environmental changes. Normalized Different Vegetation Index (NDVI) is the most widely used vegetation index. It is calculated by taking the difference between the reflectance of the near-infrared (NIR) and red bands of the electromagnetic spectrum and dividing it by their sum. This study aims to evaluate the use of vegetation index (NDVI) for an early detection of crop stress response obtained from an UAS-based imagery.

Keywords: UAS, vegetation index, pasture, land-cover, orthophoto.

Materials and Methods

The study site is located at TKPM Redong, Labis, Johor. DJI Phantom 4 Pro V2 drone was used to collect digital images. The flight altitude was selected to be at a 60 m, and minimum of 70% side lap and 75% front lap for imaging an area of 30 acres planted with Napier grass. A total number of 4 GCPs were used for the georeferencing and accuracy assessment. Orthophoto were generated from 478 images captured at 12 cm/pixel resolution. The focused plant age group used for this study is 50-day Napier grass.

Results and Discussion

Results show that different color bands can determine different properties of land cover conditions including live vegetation, bare soil, water bodies and man-made features. Multiple differences of crop canopy densities and color bands are closely related to stress response from environmental changes and abiotic effects were detected up to 41.43% throughout the study plot. This may include the possible effect of waterlogged, drought, pests and diseases. Further scrutiny should be done through ground truthing and crop sample analysis must be done to affirm the effect of stress towards overall yield and nutrient quality.

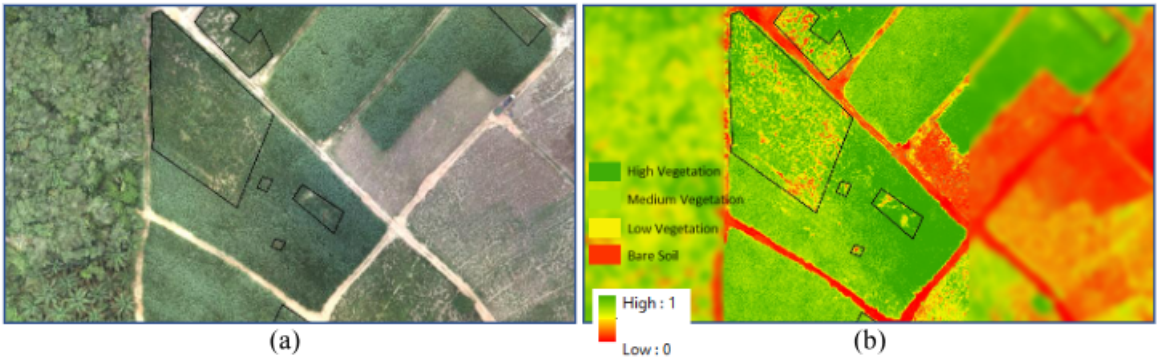

Figure 1. Real-time detection of possible in-field stress zone for Napier grass based on RGB orthophoto (a) and highlighted vegetation index (NDVI) classification (b)

Conclusion

As a conclusion, the use of UAS based imaging for monitoring can be beneficial for an early detection of pasture stress through analysis of vegetation index such as NDVI. This may assist farm managers and decision makers as part of their decision support system (DSS) mechanism for an early intervention plan in assuring an optimal and sustain pasture quality growth.

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GREEN PRACTICES IN FEEDLOT MANAGEMENT SYSTEMS FOR FUTURE SUSTAINABLE LIVESTOCK FARMING

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Introduction

In 2021, the Ministry of Agriculture and Food Security launched National Agrofood Policy 2021-2030 (DAN 2.0) which targets local beef production to reach 111.000.0 metric tonnes and SSL capacity at 50% by 2025 (MAFI, 2021). To support the DAN2.0 vision, the Department of Veterinary Services has come out with strategies and actions in The National Beef Industry Development Strategic Plan (BIF PLAN) 2021-2025 and among the strategies are to increase the cattle population and farm transformation programs from traditional farms to semi-commercial and commercial scale entrepreneurs (DVS, 2021). The Ministry of Agriculture and Food Security aspires to redevelop feedlot mega-farms to enhance local feedlot farming as the main focus to increase food production capacity in 2023 (Pejabat Menteri KPKM, 2023).

Increasing the cattle population with mega farms will negatively impact the environment such as land degradation, water pollution, and greenhouse gases. The cattle (beef and dairy) industry is the main world GHG contributor compared to other livestock industries which contribute estimated 5.0 gigatonnes of CO2-eq yearly and represent 62% of the GHG emission (FAO, n.d.). DVS' BIF PLAN 2021-2025 also highlights the importance of research in green practice in ruminant housing under Strategy 7 (Strengthen the research and R&D development): Activity 3: Sub-activity 2. Hence, this study is to look at readily available green technologies to be adapted into feedlot farming.

Keywords: feedlot, sustainable farming, agriculture technology

Discussion

The feedlot management system is an intensive production system where the cattle are kept full-time in the barn to rapidly grow and fatten in a certain period. Feedlot systems will increase the concentration of water and land pollution due to the centralisation of a huge number of cattle in an enclosed area. However, on the other side, feedlot systems enable the farmer to manage the livestock efficiently.

Department Of Veterinary Services published Feedlot Farming Manual as a guideline for future farmers or investors who wish to venture into the industry which has guidelines for infrastructure for feedlot farms such as the preferable location for farms and barn structures that take into account the farm's waste management to reduce pollution. For future environmental sustainability, the livestock industry has to use more green practices and technologies.

Rainwater harvesting: Cattle rearing uses a huge amount of water for cleaning and cattle drinking. A beef cattle weighing around 200-400 kg needs drinking water up to 40 L/day (DVS, 2001). A 250-head feedlot farm will need around 10,000 litres of water a day. Up to 90 % of the water usage is for drinking, the rest is for washing, cleaning, and feed processing if applicable Considering Malaysia has an abundance of rain, the installation of rainwater harvesting system as alternative or supplementary water source in farm to be use around farm such as for cleaning the pen and machinery.

Solar energy system: Electricity or energy use in feedlot is maybe not as much as water consumption and mainly used to operate machines or equipment. However, integration of solar energy system in feedlot can still benefit the farm by reducing the electric cost and contribute to reducing emission. A feedlot farm can install photovoltaic panel on their roof and using the generated energy to power for farm's use and the excess generated electricity can be trade to national electric grid.

Biogas system: A 450kg feedlot cattle can produce 378 litre wastewater per day that mixed with manure, food waste and urine (DVS, 2019). Biogas system processing organic matter (animal waste) inside a digester tank in anaerobic condition. This process produced methane and carbon dioxide and can be trapped to be as biogas for fire or to generate electricity. The solid and overflow water at the end of the process can be use as fertilizer or reuse in the farm. Therefore, biogas system is one way to get benefit from animal waste by efficiently manage animal waste to produce biogas, electric and fertilizer.

Precision livestock farming: Precision livestock farming (PLF) is a concept that integrated automation and big data to achieve optimum production via better decision and livestock management. To monitor animal behavior, various sensors are use such as animal sensing systems, 3D-camera technology and thermal imaging, feed and water intake recording, and automated weighing system. All the data recorded by these sensors and monitoring devices are then link to an integrated system to be analysed by the farmer. PLF also can act as a tool to reduce pollution by monitoring the exact amount of feed needed by the livestock to reduce feed waste.

Conclusion

The technologies are revolving to the benefit of human and we have to make use of these technologies to create better and sustainable environment including in farming practice. Support from government and law enforcement are needed to change the livestock farming practice towards greener practices. Based on current priority on mega feedlot farms redevelopment and commercial-scale farms, integration green technology should be one of the requirements especially for new farms establishment.

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