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REVIEW ARTICLE

Alternative Plant Protein Sources *Trichantera Gigantea* (Ketum Ayam) for Poultry Feed: A Review

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ABSTRACT - The agriculture of animals faces the difficulty of meeting the food demands of a growing global population while having limited natural resources. In recent decades, the chicken industry has made significant progress in order to meet new difficulties and changing consumer demands. The demand for an animal protein production system that considers the social, economic, and environmental dimensions of sustainability has grown. The shift away from the use of antibiotic growth promoters in animal feed has presented difficulties in preserving gut health and therefore, the performance of birds. Feed technology covers the alteration of components and the development of animal feeds, playing a crucial role in a sustainable animal production system to ensure the provision of top-notch, high-protein feed. *Trichantera Gigantea* (Ketum Ayam) which is high in protein content, provides ecological advantages such as soil enhancement, erosion prevention and nitrogen fixation, which can enhance crop productivity. In addition to these agricultural advantages, *Trichantera Gigantea* can be used as alternative plant protein sources which can reduce national's dependency in imported protein sources thus, secured our nationals food security issues and maintains poultry health and welfare.

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1. INTRODUCTION

1.1 Protein Consumption

Poultry meat is often regarded as a nutritious diet due to its provision of high-quality protein and other essential nutrients [1]. Additionally, poultry meat is often lower in fat compared to meat products derived from other animal sources. Poultry meat that came from broiler chicken is both economically viable and easily obtainable, resulting in a significant global consumption rate [1]. Furthermore, broiler chickens are the primary source of poultry products that are consumed by humans [2]. Providing the dietary requirements of the growing global population while facing limitations on natural resources poses a significant problem for the agriculture sector [2]. Projections indicate that the world's population will surpass 9.2 billion by 2050, while the overall global food requirement is projected to increase by 35 to 56% from 2010 to 2050 [2]. Therefore, it is critical to enhance the performance of protein production in a sustained manner. The utilization of genetic selection has significantly enhanced productivity and efficiency, leading to the production of superior, cost-effective animal protein for human consumption [3]. This trend is projected to continue in order to meet the rising demand for the cheapest protein. Due to the high cost of protein and the country's dependency on imported feed ingredients, our country now faces a major problem of insufficient supply of raw basic materials [4]. Although, the process of genetic selection for increased productivity has resulted in various issues related to metabolic health, as well as the quality of meat and eggshells [5]. There is an imperative to continuously developing precision poultry farming technology in order to create the main part of a total imaging system that can assess chicken productivity and welfare [2]. While various challenges in terms of performance have been successfully addressed through strategies such as nutrition, management, and selective breeding based on genetic and genomic data, there are still new and emerging issues that need to be addressed to ensure food safety.

1.2 Protein Consumption in Malaysia

South East Asia countries including Malaysia currently experiencing a nutrition transition, which involves a change from plant proteins to animal proteins in diet [6]. Across all countries, there was an increasing trend between higher levels of education, income, and protein consumption. The frequency counts from study conducted by A. Drewnowski et al [7] revealed that plant proteins were present in 50% of the analyzed items, whereas meat accounted for 19%, fish for 12%, eggs for 12%, and dairy for 7%. The chicken was the most common source of meat, accounting for 16% of the total, while pig and beef each accounted for only 1.5% [7]. However, an increase in the consumption of animal protein was linked to the dietary preferences of the younger generation. The dietary requirements involving meat in some religions

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followed in Malaysia are have a significant impact on the country's food sources, which are influenced by socio-cultural and economic considerations [6]. The Chinese ethnic group, for instance, exhibited comparatively greater levels of money and education in comparison to other ethnic groups, and this was correlated with increased consumption of animal protein [7]. The reason why chicken is popular among Malaysians is because it is a protein-rich food that is liked by everyone. Malays, being adherents of Islam, are prohibited from consuming pork, while Hindu Indians are prohibited from consuming beef due to religious restrictions [7]. In a newspaper article authored by Mohammad Khairil Ashraf Mohd Khalid, Malaysia's Food Security Minister, Datuk Seri Mohammad Sabu, said that survey that was conducted by Veterinary Services Department (DVS) for four months throughout the peninsular shown that the prices and supplies are stable in 2024 [8]. He also said that governments policy changes will consider all factors, especially current supply trends to avoid dumping while restricting the import of chicken [8].

2. FEED FORMULATION

The significance of feed formulation and production technologies is increasing due to several upcoming worldwide possibilities, challenges, and risks [9]. The global demand for animal produced food is projected to rise by 70% in 2050 compared to the year 2000. This increase can be attributed to the growth of the world population, higher income levels, and urbanization [9]. The global demand for animal feed is projected to reach 1500 Metric tonnes by 2050, with the primary expansion anticipated in Asia and Africa. Furthermore, the feed business is confronted with significant issues such as animal welfare, minimizing environmental contamination, incorporating novel ingredients, and utilizing materials that are unsafe for human consumption in order to improve production efficiency [9]. The current feed formulation prioritizes cost minimization rather than profit maximization. Sophisticated models that describe the growth and reproduction of birds based on genetic, dietary, and other environmental factors are now being created, but their implementation has been laborious [10]. The focus of profit maximizing models will shift towards the production functions of broilers and layers. The production functions represent the correlation between the value of products, specifically meat and eggs, and the expenses associated with feed [10]. The cost of feed accounts for 60-75% of the entire production cost in chicken. The quality of feeds is determined by the crude protein content and the expense associated with providing animals with nutrition [11]. A good feed should not only have high nutrient contents but can increase feed intake by the animals [12]. Plant proteins are widely and readily accessible in the environment. The *Trichantera Gigantea* is a possible source and may become significant in research due to its high crude protein content [11]. It can be provided to animals either in its fresh form or as leaf meal and can be used as an element in the composition of animal diets.

3. ALTERNATIVE PLANT PROTEIN SOURCES

The utilization of growth-promoting materials in animal farming is now acknowledged and has become an integral component of the poultry sector to accelerate the growth of poultry [13]. Awareness among farmers regarding the manufacture of organic and cost-effective animal products using locally sourced feed ingredients is increasing. Consequently, researchers are examining the effectiveness and economics of including local and indigenous herbs, shrubs, enzymes, and probiotics into the diets of farm animals [14]. Increasing the sustainability of livestock production is widely recognized as essential for achieving the goals of sustainable development. A crucial aspect of this is segregating the production of livestock feed from the use of agricultural land as much as feasible [15]. The competition between food and feed for land has been a longstanding topic. Currently, to feed the world's population about 50% of the land that is suitable for crop production has been utilised. Furthermore, for producing livestock feed about one-third of this land is specifically used [15]. The ongoing transformation of carbon-rich and biodiverse land, such as forests and wetlands, into pasture and crops for animal feed is clearly unsustainable. Just like with human food, there are various options available for providing protein to animals as feed.

Alternatives protein sources are crucial in poultry diets, particularly for broiler. Protein is expected to be the primary constraining element, along with vitamins and minerals [16]. Studies is required to examine the potential of using plant-based protein sources that are readily accessible in the local area. Multipurpose tree leaves can decrease the consumption of costly conventional protein-rich concentrate meals, hence boosting the profitability of broiler farmers [16]. Farmers in tropical climates commonly utilize modest quantities of green feed as a preventive measure against potential vitamin deficits and unknown growth factors.

3.1 Trichantera Gigantea (Ketum Ayam)

Plant proteins are widely and readily accessible in the environment. Figure 1 shows *Trichantera Gigantea* or *Madre de Agua* is a potential source that contains high proteins contents 13% to 22% in dry matter form [17]. These proteins are authentic and include high-quality amino acids that can be readily absorbed by the animal body. The *Trichantera Gigantea* leaves contain 2.8% crude fat, 4.4% crude fiber, 19.7% ash, and 37.0% NFE (nitrogen-free extract) [13].The *Trichantera Gigantea* tree, also known as Madre de Agua, has a high crude protein content in its foliage, especially in the leaves and thin stems. *Trichantera Gigantea* thrives in the lush tropical environment. Several studies have shown that *Trichantera Gigantea* has the potential to be used as alternative protein sources for animal feed in Table 1.

Animals consume these parts of the tree, which provide a significant amount of true protein with a balanced amino acid profile [16]. The leaves are quite palatable and easily broken down in the digestive system [18]. *Trichantera Gigantea*

does not include any anti-nutritional components or harmful chemicals, also thrives in well-drained loamy to clayey soils that are both porous and have a high moisture retention capacity. Optimal growth of this plant can be achieved in acidic soil conditions, and it is advisable to provide fertilizer in order to maximize foliage production [18]. Several studies have shown that *Trichantera Gigantea* has the potential to be used as an alternative protein source in animal feed.

Figure 1. Trichantera Gigantea

Table 1. Several studies have shown that Trichantera Gigantea has the potential to be used as an alternative protein source in animal feed

Animal Model	Percentage of *Trichantera Gigantea* in feed	Remarks
Mallard Duck	10% to 20%	Partial replacement of *Trichantera Gigantea* in the duck layer feed can be done [16].
Philippine Native Chicken	0% to 15%	10% or higher content of *Trichantera Gigantea* in animal feed can be adopted for chicken feed in term of voluntary feed intake [19].
Quail	15% to 25%	15% of *Trichantera Gigantea* in feed shown an optimum level that can provide increases in growth and egg production [11].
Broiler	0% to 15%	10% and 15% inclusion of *Trichantera Gigantea* in feed were economically viable in broiler production and 15% inclusion of *Trichantera Gigantea* shown a highest return of cost [13].
Nile Tilapia	0% to 100%	All samples fed with *Trichantera Gigantea* pellets length and weight are significant at $p < 0.05$ [20].

Table 1 shows that several experiments has been conducted to evaluate the effectiveness of *Trichantera Gigantea* as a source of alternative protein in animal feeds. Quails feed with 15% of *Trichantera Gigantea* had a significant high egg production at 44.16 and 50.05 compared to the quails feed with 25% of *Trichantera Gigantea* at 36.82 and 43.66 for the first and second months of egg production [11]. This shown that optimum percentage of *Trichantera Gigantea* in animal feed could had an effect on the animal growth and egg production. Broilers feds with 15% of *Trichantera Gigantea* obtained a best return of investement around 110.23 ₱ (RM8.85) compared to the broilers fed with 0% of *Trichantera Gigantea* at 70.25 ₱ (RM5.65) [13]. This shown that the presence of *Trichantera Gigantea* have a postive effect on broilers body weight gain thus increasing the return of cost. All these projects shown that *Trichantera Gigantea* has a potential as an alternative plant protein that can be substitutes conventional protein in animal feed that are expensive.

4. IMPACTS: TRADE-OFFS (LAND-BASED LIVESTOCK FEED)

Livestock feeds can utilize a wide variety of protein sources, including insects, plants, and other viable alternatives [15]. Insects are often abundant in protein and can serve as a substantial reservoir of vitamins and minerals and have been recognized as prospective candidates for utilization in feed products inside the European Union countries such as black soldier fly, yellow mealworm, and common housefly [15]. Possess antibacterial characteristics and could potentially serve as a substitute for antibiotics in livestock industries are one of the uniqueness of the black soldier fly larvae [21]. The nutritional composition of insect meals is influenced by factors such as the specific species, the method of rearing, and the substrate utilized for their cultivation [22]. The utilization of insects in livestock diets is significantly hindered by legal obstacles [23]. In higher-income nations, insect-based feeds are prohibited for ruminants due to disease-related

concerns but are employed for monogastric animals. However, experiments have shown that ruminant fermentation and nutrient digestibility remain unaffected by these feeds[24].

Additional sources with significant potential as animal feed include high-protein plants like paper mulberry [25], drumstick tree (*Moringa oleifera*) [26] and also *Trichantera Gigantea* [13]. High-protein plants can undergo processing to improve their taste, consumption, and capacity to be digested. This processing can also help preserve the nutrients in the plants, remove any harmful substances that may affect nutrition, or increase the concentration of beneficial elements [14]. The aim is to achieve this without reducing the nutritional content of the diet. This type of protein can be said as preferable for feeds to come from a crop that is part of an environmentally sustainable farming system. This system should maximize biomass yield, minimize the use of agro-chemicals, and preserve or improve soil fertility [14]. [27] have suggested diversifying livestock production with alternative protein sources that have lower environmental implications as one of the steps to transition towards a more sustainable operating area for livestock. Novel and new protein sources are significantly important in this transition. Further evaluation is required to assess the nutritional, environmental, and technical implications of these factors on a large scale [15].

5. FUTURE DEVELOPMENT FOR ALTERNATIVE PROTEIN

On a global scale, the livestock industry is expected to undergo significant and rapid changes in the decades. These changes will be driven by the increasing demand for livestock products in lower-income countries, as well as the ongoing trend of urbanization and a shift towards more processed foods [15]. Additionally, there will be a growing focus on reducing the livestock sector's impact on global warming, and the development of alternative protein sources for both animal feed and human consumption. The impact of these characteristics in different countries will mostly rely on the socioeconomic level of each country [15]. In higher-income countries, the efficiency of livestock production will keep improving, leading to a decrease in demand for conventional animal-based foods. This trend is driven by increasing concerns about sustainability and ethics surrounding the production of such food in highly intensive landless systems [15]. The population of cattle in Europe and Oceania is already decreasing, and this trend may continue due to the shrinkage and concentration of the industry, as well as stricter regulations for environmental and animal welfare. As previously said, it is crucial to replace farmed meat with protein alternatives to achieve substantial environmental benefits [15]. Ingredient sourcing for industrial production is anticipated to be unconstrained due to the potential for enhancing crops to optimize their protein content, quality, and function in plant-based meats [28].

Countries with middle-income levels, like Brazil, India, and China, have the potential to enhance their animal production efficiencies. They can also benefit from exporting to countries with lower health, safety, and quality standards or where the transition to healthier diets is hindered by ongoing poverty and malnutrition [15]. The growth of the alternative protein sector will rely on sustainable inputs and production methods that can be scaled up, in addition to public-private financing to accelerate progress in food and feed innovation [29]. Enhanced technical production can incorporate many alternative protein sources such as high-protein plant and insects. This integration can help decrease greenhouse gas (GHG) emissions by making use of waste and other carbon sources [15]. In order to achieve future positive effects in the development of the livestock sector, a wide range of factors will be necessary. In wealthier nations, the decline of the livestock industry has significant economic and social consequences for existing livestock farmers, which must be dealt with in appropriate ways. For the future development of the livestock sector in lower-income nations, it will be necessary to address challenges related to social acceptance, solid financial support, and robust regulatory frameworks in order to ensure fairness and equality [15].

6. CONCLUSION

Due to the growing demand for meat and other animal products, as well as the rising interest in organic products, alternative plant proteins sources offer a promising solution for producing feed that is high in protein for monogastric animals. This method is more sustainable and reduces the reliance on importing soybean and soybean meal from other countries. Sustainability will become highest consideration in finding ways to produce affordable and high-quality protein animal feed while preserving animal welfare and minimized the environmental impact. Nutritionists need to continue to overcome the industry challenges in utilizing available ingredients while, meets the nutritional content needed for the animal and reducing production costs.

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AUTHOR CONTRIBUTIONS

Muhammad Amirul Syafiq Nasarudin: Study Conception and Design, Writing – Original Draft Preparation, Reviewing and Editing.

Abdul Syukor Abd Razak, Suryati Sulaiman, Mohd Rashid Ab Hamid, Noraini Samat.: Supervision.

Ali Zainal-Abidin Mohamad Termizi: Data Collection, Writing – Reviewing.

Nurul Farah Anisa Hairolnizam, Farah Amalina: Writing- Reviewing.

DATA AVAILABILITY STATEMENT

The data used to support the findings of this study are included within the article.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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