

Under-Utilized Legumes as Potential Poultry Feed Ingredients: A Mini- Review



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Abstract

Legumes are very important sources of protein in human nutrition. That remarkable quality as a protein source, make them to be also highly attracted by the poultry industry for the same purpose. This raised the issue of investigating other sources of protein for the poultry in other to balance the competitive situation between humans and the chicks. A review of a relatively recent literature reveals that there are several species and varieties of under-utilized legumes with relatively considerable amount of protein as compared to the commonly consumed legumes by humans. However, their experimentation as animal feed suffers a bit in term of documentation. Therefore, it might be wise to intensify research in that line for this is going to be source of cheap input and better economic benefit for the poultry industry.

Keywords: Under-utilized legumes; Poultry feeds; Poultry nutrition; Animal nutrition; Food-feed competition

Introduction

The animal protein is increasing being solicited in many developing countries especially the ones from poultry products [1]. One of the most important concerns of poultry keeping is to get good quality rations of energy, protein, amino acids, minerals, and vitamins to ensure suitably high productivity of their animals [2]. Generally, soybean meal is often used as good feed ingredient, due to its high contents of amino acids and energy supplied to the livestock and poultry rations. However, soybean is an industrialized crop with varied utilization ranging from oil production, milk to utilization of by products as biofuel. The Global production of soybean is about 366 million tons in 2016 [3]. After oil is extracted from soybeans, the residuals are expressed as a soybean meal, and it is mainly used in poultry production systems and for other livestock animals as ingredients in their diet [2]. Despite the utilization of soybean in the form of by-product to feed poultry, it still pose a challenge of high cost of feed and accessibility of such meals for smallholder poultry keepers. One of the best ways to tackle such challenges is to investigate alternative sources of proteins such as under-utilized legumes as a replacement to soybean.

Legumes (family: Fabaceae) have very important nutritional value for both humans and animals. It is reported that they represent the second most valuable plant source for human and animal nutrition [4]. They are also known as the 3rd largest family among flowering plants, comprising about 650 genera

and 20000 species. Some of the most commonly domesticated, grown and commercialized legumes such as soybeans, cowpeas, common beans and others are available on the markets, however, their production rate remain unsatisfying as compared with their consumption rate. Therefore, there is a need to look for alternatives.

Crop species with little attention or completely ignored by agricultural researchers, plant breeders, and policymakers which are wild or semi-domesticated varieties and non-timber forest species adapted to particular local environments are defined as neglected and underutilized species [5]. Legume crops of such label could represent a huge potential alternative as a replacement to the source of protein in poultry feed to mitigate the cost of feed ingredient. This mini-review summarizes information about some potential under-utilized legumes which could be used as a source of protein in poultry feeds based on their nutritional constituents.

Brief Description of Under-Utilized Legumes with Potentials to Serve as Poultry Feed Ingredient

It is generally known that maize and soya beans are two widely consumed crops for both humans and animals. These crops are highly cultivated and solicited globally, especially for food and feed formulations making them a subject of competition between humans and animals. Maize (corn) represents the most commonly used energy source, and soybean meal is a common plant protein source for the poultry industry for example. This raises the issue

of whether it is necessary to first produce crops for animal feed before thinking of man or is it necessary to feed the animals with the same types of crops used by humans. However, many other legumes exist which may have similar nutritional potential but faces relatively low utilization due to some reasons.

African yambean

(*Sphenostylis stenocarpa* Hochst. ex A. Rich.; Leguminosae) is an under-utilized legume with a wide distribution in various parts of Africa for its nutritious seeds and tubers. The plant is highly adaptable and can thrive in acidic and highly leached sandy soil in the humid lowlands of the tropics [4]. Nutrition wise, the seeds are known to possess high crude protein (21% to 29%) and approximately 50% carbohydrate and among the amino acids lysine (9.28g/16gN) and methionine levels (1.16g/16gN) are either comparable or even better than those of soybean [4].

Jack bean

(*Canavalia ensiformis*) is one of the under exploited tropical dry beans. It is fairly distributed and cultivated in Africa, Asia, the West Indies, Latin America and India. The jack bean can be grown in marginal soils and arid to semi arid regions not suitable for common legumes such as *Phaseolus* and *Vigna* species. The seed of jack bean, the highly produced large seeded tropical legume, contains about 30% crude proteins and 60% carbohydrates [6]. *Canavalia ensiformis* is also ranked among the underutilized legumes that could ameliorate protein deficiency in human nutrition, particularly in developing countries.

Bambara groundnut

(*Vigna subterranea* (L.) Verdc) is documented to originate in West Africa with a considerable genetic diversity [7]. It is an important food legume grown widely in semi-arid Africa which is closely related to cowpea (*Vigna unguiculata*) with which it shares much of its area of cultivation and origins of genetic diversity [8]. In many parts of Africa, it represents the third most important legume after groundnut (*Arachis hypogaea*) and cowpea [8]. However, it is also considered as an under-utilized crop. Nutrition wise, it is rich in carbohydrate and protein content, making it an important benefit to the diets of people who cannot afford expensive animal protein [9]. Therefore, it could be wise to also think of converting its protein content to animal protein.

Creole bean

(*Vigna reflexo-pilosa* var. *glabra* = *Vigna glabrescens*) is the only tetraploid species in genus *Vigna* and the little-known cultivated species of the subgenus *Ceratotropis* [10]. It was first found used as a forage crop in West Bengal, Mauritius, and Tanzania, while it was used as a pulse in the same ways as mung bean in Vietnam and Philippines [11]. The crop is considered to have been domesticated in Southeast Asia from its possible wild ancestor, *Vigna reflexo-pilosa* var. *reflexo-pilosa* [12].

Minni payaru

(*Vigna stipulacea*) is a newly recognized as a domesticated Indian *Vigna* species and therefore has very limited published information [10].

Moth bean

(*Vigna aconitifolia* (Jacq.) Marechal) is a minor legume crop and considered to be the most drought and heat tolerant cultigen among Asian *Vigna* [13]. It is widely grown in India and the Far East and has been qualified as a possibly more significant food source for the future [14]. It is considered to have been domesticated in India, Pakistan, Myanmar or Ceylon [15]. Its nutritional content is also well appreciable for human consumption as it possesses very important nutrients, vitamins, and minerals in very good proportions. The nutritional content is 24.3% protein, 68.0% carbohydrates, 3.9% lipids, 3.8% ash, 133(mg/100g) calcium, 356(mg/100g) phosphorus, 183(mg/100g) magnesium, 11(mg/100g) iron, 0.50(mg/100g) thiamine, 0.10(mg/100g) riboflavin and 1.7(mg/100g) niacin. The National Bureau of Plant Genetic Resources (India), keeps and preserve a collection of more than 1000 accessions of which cultivars such as RMO-40 and RMO-225 are mostly cultivated in India. The wild ancestral form and cultivated form have not been distinguished taxonomically. However, the existence of a putative wild ancestral form during Tamil has been recognized [16]. Researchers have found that there is a substantial genetic variation between moth bean germplasms which could be used in crop improvement [17]. Few accessions of moth beans kept at the NIAS genebank, Japan is shown in Fig. 1H. Further research on these accessions is needed to shed more light on their genetic potential in legume improve.

Rice bean

(*Vigna umbellata* (Thunb.) Ohwi & Ohashi) is a multipurpose legume as well as a neglected and under-utilized legume [18]. Compared with cowpea (*Vigna unguiculata*), adzuki bean (*Vigna angularis*) and mung bean (*Vigna radiata*), it is a less important crop. However, it represents a locally important contributor to human nutrition in parts of India and South-East Asia [13,18]. All parts of the plant are edible and used in culinary preparations [19]. It is also used as an important fodder and a green manure [11].

Tuber cowpea

(*Vigna vexillata*) is another recently recognized as domesticated *Vigna* species as it was found cultivated in Bali and Timor, Indonesia [20]. That domesticated form was discovered with some important agronomic characteristics such as prominent seed size increase, loss of pod shattering and loss of seed dormancy [13]. It is cultivated for its tuber but the seeds are also used as human food. Its root protein content is 15% which is about 2.5 times higher than that of yam (6%), 3 times higher than that of potato (5%) and sweet potato (5%) and 5 times higher than that of cassava (3%) [13].

Velvet bean

(*Mucuna pruriens* (L.) DC. var. *utilis* (Wall. ex Wight) Baker ex Burck), an under-utilized food legume collected from South India, was found to contain appreciable levels of crude protein (273.2g/kg DM), lipid (60.61g/kg DM), neutral detergent fiber (84.3g/kg DM), and ash content (56.04g/kg DM) [21].

Under-Utilized Legumes Tested as Poultry Feed Ingredients

The effect of replacement of soybean meal by under-utilized legumes meal as an alternative protein ingredient on the growth performance of chickens is very scanty or almost not well documented. However, velvet bean meal as an alternative protein ingredient on the growth performance of broiler chickens was investigated [21]. It was found that processed velvet beans replaced in an adequate proportion exhibited better growth performance of broiler birds without any adverse effects.

Conclusion

Despite the existence of several under-utilized legumes with considerable protein content as compared with competed legumes, very few studies attempt to experiment under-utilized legumes as replacement to soybeans in poultry feed formulations.

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