THE PIGEON PEA (*Cajanus cajan* (L.) MILLSP), AN ALTERNATIVE ENERGY AND PROTEIN SOURCE FOR POULTRY FEEDING

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ABSTRACT

This paper reviews the potential pigeon pea seed holds as a protein and energy source for poultry. The crop has both annual and perennial varieties occurring throughout the tropical and sub- tropical regions as well as the warmer temperate regions of the world and has adaptability to soils that have low nutrient (fertility) levels. The chemical composition of the pigeon pea seed differs with cultivar, growth condition, soil and geographical location, the manurial treatment they have received and the stage of ripeness at which they are harvested. Crude protein content of the seed ranges from 7.0% in the raw unripe seed, to above 26% in the ripe, dried seeds. Fat levels are between 0.6 to 1.3%, fibre 3.3 to 8.1%, carbohydrate 20.0 to 65.5% and ash 1.3 to 5.5%. The seed also contains antinutritional factors such as trypsin and chymotrypsin inhibitors, cyanogens, haemmaglutinins, tannins, phytic acid, alkaloids and oxalates at comparatively low levels which are destroyed by heat treatment. Reports from different authors state that the processed seeds are well utilized by poultry with comparative advantage in cost of production if not included at levels above 30% in the diet. Therefore, the pigeon peas adaptability to various geographical locations, tolerance to adverse environmental conditions, high yields of seeds with high nutritional value and low levels of antinutritional factors is recommended for inclusion in poultry diets. This will increase the productive base of protein and energy raw materials for poultry feeding.

INTRODUCTION

The pigeon pea also known as the tropical green pea is a perennial member of the family fabaceae. The crop according to Wikipedia free encyclopaedia (2012) has been cultivated for over 3,500 years. Today, the crop is cultivated in the tropical and semi tropical regions of the world (Olomu, 2011). Despite the fact that it is a perennial crop, it has been reported that the seed yield drops considerably after the first two years (Wikipedia, 2012). For this reason, an annual variety more suitable for seed production is the most plausible option for producing grains for animal feeding. In the earlier part of the millennium, Amaefule and Obioha (2001) and Amaefule and Nwabara (2004) reported that the crop is comparatively low in demand in Nigeria as a food crop as it is eaten mostly when there is scarcity of common beans (cowpea) when the price of cowpea is relatively high. The seeds of the crop have no industrial use so far. Thus, the pressure placed on pigeon pea by man for food and the industrial sector for raw material is far less than that of other leguminous crops like soya beans and groundnuts which are used as human food, animal feed ingredients and other industrial purposes. This to a large extent explains why pigeon pea seeds are becoming the most essential ingredient of animal feed in West Africa and specifically Nigeria (Amaefule and Nwabara, 2004; Yisa *et al.*, 2010; Wikipedia, 2012). The reason for developing interest in this crop is not farfetched. The seeds contain high levels of protein (19 – 29%) and essential amino acids such as lysine and tryptophan (Olomu, 2011). The seeds are reported to contain high amounts of vitamin B, carotene and ascorbic acid (Purdue, 2006; Odeny, 2007). The energy value is also high (Odeny, 2007) and what makes the adoption of the use of pigeon pea more interesting is its adaptability to various climatic conditions, tolerance to drought, heat, wilt and stress (Sinclair, 2004; Purdue, 2006). These agronomic characteristics of the crop and the nutritional composition of the seeds is what have made pigeon pea a crop of interest to livestock farmers and nutritionists. This paper reviews past and recent publications on cultivation, nutritive value and utilization of pigeon pea seeds by poultry

The Pigeon Pea Distribution: Pigeon peas occur throughout the tropical and sub- tropical regions as well as the warmer temperate regions. In Africa, *Cajanus kerstingii* grows in the drier belts of Senegal, Ghana, Togo and Nigeria. (Purdue, 2006).

Germplasm

Many cultivars differ in height, habit of growth, colour flower, time of maturity, colour and shape of pods, size and shape of seeds. Perennial types

assume a tree like appearance, yield well the first year and poorer the later years. Annual (weak perennial) types are small plants grown as field crops, mainly cultivated for seed purposes, with very good white seeded and red seeded cultivars (Purdue, 2006). The pigeon pea is reported to exhibit tolerance to disease, laterite, low pH, nematodes, photoperiod, salt, sand, virus, weed, wilt and wind. The crop is however sensitive to frost and water logging, (Duke, 1981; Wrigley, 1981). It is remarkably drought resistant, tolerating dry areas with less than 65cm annual rainfall, even producing seeds profusely under dry conditions, as the crop matures early and the incidence of pest damage is low. Solutes and other compounds in pigeon pea help maintain integrity of cells, preventing protein denaturation in contrast to other legumes (Subbarao *et al.*, 1995; Subbarao *et al.*, 2000). In stress periods, other legumes rapidly close stomata, but pigeon peas allow for stomatal adjustment in response to water stress, allowing for osmotic adjustment until a critical inner water stress occurs (Valenzuela, 2013). Also, Gauchan *et al* (2003) reported the pigeon pea has adaptability to soils that have low nutrient (fertility) levels. In Nepal, the crop is considered a low input (in terms of fertilizer requirement) keystone crop important for National food security

Cultivation

Seeds are sown in pure stands at about 9 – 22kg/ha for rows, but sometimes it is broadcast. Seed germinates in about 2 weeks. In placês like India, the pigeon pea is grown mixed with other crops or grown in alternate rows with sorghum, groundnut, sesame, cotton, pineapples, millets or maize. Valenzuela (2013) stated that the optimum growing temperature for pigeon pea is between 18 – 30oC (64 – 84oF). Fertilizer application of 20 – 100kg/ha phosphoric acid is recommended (Purdue, 2006). Sulphur, with or without phosphorus can significantly increase seed yield and nitrogen fixation. Average dried seed yields per hectare are between 400 – 1,200 kg. (Wrigley, 1981) but may reach 2,500kg/ha in pure stands (Purdue, 2006).

Chemistry and Nutritive Value of Pigeon Pea

The nutrient composition of the pigeon pea seed differs with season, the region in which they are grown, the manurial treatment they have received and the stage of ripeness at which they are harvested (Bolton and Blair, 1986), cultivar, growth condition and soil type (Amaefule and Obioha, 2005; Purdue, 2006). This explains the reason why there are differences in nutrient composition values of the raw seeds by different authors in Tables 1. Other nutrients present in pigeon pea seed are; 161mg Ca, 285mg P, 15mg Fe, 55µg β-carotene equivalent, 0.72mg thiamine, 0.14mg riboflavin and 2.9mg niacin (Purdue, 2006).

Antinutritional factors in pigeon pea.

The pigeon pea, like other leguminous seeds contains metabolic inhibitors, but the level of such inhibitors in the seed is low when compared to other leguminous seeds. (Leaky and Wills, 1977; ICRISAT, 1992). These metabolic inhibitors also known as antinutritional factors, limit the use of the seeds in monogastric animal feeding (Amaefule *et al.*, 2005). Batterham *et al.* (2003) and Purdue (2006) reported the presence of trypsin and chymotrypsin inhibitors in the seeds respectively. Also, the presence of cyanogens (D`Mello, 1995) and tannins (Salunkhe *et al.*, 1985) in the seeds have been reported. Udedibie and Carlini (2002) and Onwuka (2006) reported the presence of hemagglutinins in pigeon pea seeds. Other antinutritional substances that are contained in the seeds according to Onwuka (2006) are alkaloids, and tannins. Onimawo and Akpojovwo (2006) have also reported presence of phytic acid in pigeon pea seeds. These antinutritional factors occur in low concentrations compared to other leguminous seeds and being sensitive to heat treatment, can easily be destroyed (Singh, 1988).

Utilization of differently processed pigeon pea seed by poultry

Pigeon peas have been included at moderated levels in poultry diets without any negative effect on growth performance and egg production. The performance of the birds fed diets containing pigeon pea seed meal compared to the control diets containing soya bean and groundnut seed or cake did not differ significantly at levels below 30% of inclusion. Amaefule *et al.* (2007) assessed the laying performance and egg quality characteristics of pullets by feeding them with 5 separate diets containing 0% (control with soya bean meal) and 30% raw, boiled, toasted and soaked pigeon pea seeds. No significant ($P>0.05$) differences were found among the treatments in all egg production parameters measured. Based on their results, they concluded that raw, boiled or toasted pigeon pea seed meal included at 30% of the diet could be fed to layers that had received 20% pigeon

pea seed meal diet during the grower stage of life without adverse effects on all egg production parameters. This is not far from earlier reports that higher levels of pigeon inclusion in diets of layers (Udedibie and Igwe, 1989) and broilers (Ologhobo, 1992; Bamgbose *et al.*, 2007) above 25% reduce egg production and feed efficiency in both cases respectively. Also, Yisa, *et al.* (2010) fed graded levels (0, 10, 20, 30 and 40%) of inclusion of boiled and dried pigeon pea seed meal diets to dominant black Bovan strain of cockerels and reported no significant differences in live weight gains and carcass yield between dietary treatments containing below 30% pigeon pea and the control. Amaefule (2009) observed that increase in the level of inclusion of pigeon pea seed meal resulted in a significant decrease ($P< 0.05$) in the cost per kg of feed. This is an indication that cost of production of birds can be reduced by including pigeon pea in their diets.

Conclusion

The pigeon pea's adaptability to various climatic conditions, ease of cultivation, low fertilizer requirement, high nutritional value of the seed, low levels of antinutritional factors, ease of processing, absence of requirement for industrial purposes and lower price compared to conventional energy and protein sources makes it a very good alternative ingredient for poultry feeding. Its production will ensure increased availability of ingredients for poultry feeding and a consequent reduction of cost of production of poultry and their products

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Table 1.-Nutrient composition of sundried ripe pigeon pea seeds

Nutrient	a	b	c	d	e	f
Water	10.0	10.1	9.9	-	11.5	9.9
Protein	23.0	19.2	19.5	23.77	26.3	19.5
Fat	1.3	1.5	1.1	1.10	2.1	1.3
Carbohydrate	56.0	57.3	65.5	-	49.7	65.5
Fibre	8.1	8.1	1.3	7.49	5.0	1.3
Ash	3.8	3.8	1.61	-	5.5	3.8

a. Leaky and Wills, (1977) c. Olomu, (1995) e. Amaefule and Obioha, (2005)
b. Purseglove, (1984) d. Aduku, (2004) f. Purdue (2006)