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Effect of Processing Method of Kidney Beans (*Phaseolus Vulgaris*) on Carcass Quality, Organ Weight and Organoleptic Properties of Broiler

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Abstract— *Effect of processing method of kidney beans (phaseolus vulgaris) on carcass quality, organ weight and organoleptic properties of broiler was studied using one hundred and twenty day-old chicks (Arbo acre strain). Raw, dehulled and boiled KB were used for treatment 2, 3 and 4, respectively. Prior to grinding of KB, 50kg was boiled at 100 ^{0}C for 1 hour, 10kg was dehulled by immersing in cool water for 20 hours, and seed coat removed. The work was carried out using completely randomized design, with four treatments and three replicates of 10 birds per replicate. Data collected were analyzed using SPSS version 22. The relative weight of liver, spleen and heart had no significant effect ($p>0.05$) within the dietary treatment. The weight of the liver was smaller in birds fed raw kidney beans meal and the liver was characterized by marked coagulative necrosis. The weight of the gizzard was significantly ($p<0.05$) higher in birds fed control diet. Furthermore there were no significant differences ($p>0.05$) in birds fed boiled, dehulled and control diets on the breast weight but significantly smaller in those fed raw diet meal. There were also no significant differences on the drumstick, thigh, neck and head size. Tenderness was not significantly affected by the dietary treatments. Juiciness, taste, and flavour intensity showed significant differences within the dietary treatment while overall acceptability showed a significant increase with the boiled kidney bean meal. Consequently, birds fed with BKD performed better in the organoleptic properties, while those on dehulled kidney beans meal gave better result for organ weight and carcass yield. In conclusion, sensory characteristics, organ weight, and carcass yield is an indication that kidney beans especially the boiled and dehulled one can serve as a feed ingredient in broiler ration would have no adverse effect.*

Keywords— dehulled kidney beans, organoleptic properties, sensory characteristics.

I. INTRODUCTION

According to Dipeolu *et al.* (2004) poultry industry has been described as the fastest means of ameliorating the animal protein deficiency in third world countries particularly in Nigeria, due to the high turnover rate associated with poultry production and consequent economic efficiency. Feed, which accounts for 60-80% of the total cost of production of most livestock species, is by far the major factor limiting the growth and expansion of the livestock industry (Ogundipe, 1992; Ikani *et al*., 2001). Currently, the convectional protein ingredient for monogastric animal feed production such as soyabean and groundnut cakes are often scarce and expensive due to the high demand for them for human consumption. Consequently, animal nutritionists in developing countries such as Nigeria have resorted to exploring other potential and hitherto neglected feed resources in order for the monogastric animal feed industry to have a wider range of alternatives to choose from. The availability of alternative sources of nutrient will encourage a shift to the sources for which there is less competition. Efforts have been made to use the vegetable protein sources such as pigeon pea (Amaefule and Obioha, 2001; Lorgyer *et al*., 2009; Lorgyer, 2010), *Mucuna pruriens* seeds (Emenalom and Udedibie, 1998; Tuleun *et al*., 2011) and Jack beans (Esonu *et al.*, 1998) in monogastric diets with encouraging results. There are however, many other legumes whose seeds can be explored

for their nutritional value for monogastric animals (Bawa, 2003); one of such legumes is the kidney beans (*Phaseolus vulgaris*).

Kidney beans (*Phaseolus vulgaris*) also referred to as common bean belong to the genus phaseolus in the legume family Fabaceae and is botanically classified as dicotlydeons (Uebersax, 2006). Kidney bean is a potential feed source for pigs and poultry because of its high content of protein, energy. The amino acid profile is similar to that of soyabean, expect for lower level of methionine (Laurena *et al*., 1991).

However, like other grain legumes, the usefulness of kidney beans as a feed factor ingredient for monogastric animal may be limited due to the presence of some anti-nutritional factors which include trypsin inhibitor, hydrocyanic acid, tannin, phytic acid, oxalate and lectin (Olomu, 2011). It has been established that heat treatment and other processing methods exert beneficial effects on the nutritional quality of the seed of grain legumes by destroying the anti-nutritional factors inherent in them (Balogun *et al.*, 2001). Some of the anti-nutritional factors are, however thermostable. Thus different processing method should be applied either alone or in combination with heat treatment. This is needful because some researchers have reported that the effectiveness of heat treatment in detoxifying tannin, phytate and oxalate in kidney beans is low (Emiola *et al.*, 2007).

Thus, emphasis has been placed on the various ways of inactivating the anti-nutritional factors in the kidney bean and improvement of its nutritive value. However, little attention has been given to the evaluation of the effect of sun drying, or dehulling or aqueous heating of kidney beans (*Phaseolus vulgaris*) prior to inclusion in poultry feed. Consequently, we aimed at evaluating the effect of feeding sun dried, dehullied and aqueous heated kidney beans on the carcass quality, organ weight and organoleptic properties on broiler chicken. Specifically, the study determines:

- The weight of the heart, gizzard, liver, spleen and intestine of broiler fed raw, dehulled and aqueous heated *Phaseolus vulgaris* seed based meals.
- The carcass quality via drumstick, thigh, neck, head, breast, shank, wing of broiler fed raw, dehulled and boiled *Phaseolus vulgaris* based diet.
- The juiciness, tenderness, taste, flavour intensity and overall acceptability of broiler fed raw, dehulled and boiled *Phaseolus vulgaris* based diet.

II. MATERIALS AND METHODS

The research was undertaken at the Poultry unit of the Department of Animal Science and Technology, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria. Awka is the Capital of Anambra State and it is in the tropical rainfall zone of Nigeria. The mean annual temperature, rainfall and humidity are 27.0 ^{O}C, 1828 mm and 80 %, respectively. The driest month is December with a rainfall of 7mm and the highest is September having an average of 306mm. Rainy season last for six months, occurring from April to July and September and October. It is locate within the latitude of 6^{o}12’25”N and longitude, 7^{o}04’04”E.

The Kidney bean (*Phaseolus vulgaris*) used in the study was procured from Eke Awka Market in Awka, Anambra State. They were divided into three equal parts for the respective processing method before inclusion in the diet. For the boiled, the dry seeds were cleaned from dust and dirty materials, weighed and then poured into a cooking pot with water boiling at 100 ^{o}C and left for a period of an hour after which it was sundried for 4 days using empty rice bag before milling. For the dehulled, the dry beans was cleaned from dust and dirt materials and soaked in cool water for between 18-24 hours after which the seeds were removed using grinding machine; then the seed coats were separated from the beans. The beans were then rinsed and sundried using empty rice bag until they were sufficiently dried. The raw kidney bean together with the aqueous heated kidney beans were them grinded using a grinder.

One hundred and twenty day old broiler chicks of the breed Arbo Acre were procured from Fidan hatchery, Ibadan, Oyo State for the experiment. The birds were reared in a deep litter system, and acclimatized for one week and fed with commercial broiler starter (vital feed) bought from Eke Awka market for one week. On the 8th day, the chicks were weighed individually and distributed into the four treatment group and replicates. The treatments were: T1- Control diet; T2- Birds fed

raw kidney bean meal diet; T3 – Birds fed dehulled kidney bean meal diet; T4 – Birds fed aqueous kidney bean meal diet. So, the experimental design was a one way classification in a completely randomized design (CRD) with the following model.

$$X_{ij} = \mu + \alpha_i + \varepsilon_{ij} \quad (1)$$

Where X_{ij} is the observed value of each of the response variables (carcass characteristics, organ weight and organoleptic quality characteristics) arising as a result of:

μ = the overall population mean

α_i = observed effect of the dietary treatment

ε_{ij} = random or residual error due to the experimentation

Brooding was done with the chicks in the four treatment group and adequate heat provided. Light was set out at night for enhanced growth. Each treatment was separated into three replica with 10 birds in each replica and the birds were fed their respective experimental diet daily. By the end of the starter phase at 4 weeks, the finisher experimental diet was given to the birds as in the starter phase. The chicks were given an anti-stress formulation in their drinking water (Milk and sugar) on the first day to relieved transportation stress. They were given Lasota vaccine on the first day of arrival. Feed and water were provided *ad libtum*. The chicks were vaccinated against Gumboro and Newcastle disease at 2 and 3 weeks of age, respectively. Prophaltytic doses of cocidiostat, (Ancoban), vitamin and antibiotic were regularly provided in their drinking water at a dose of 1ml liter of water. Litters were being changed weekly.

The feeding trial was carried out in two phases; the starter and the finishes phase. 100kg starter diet were formulated for the four treatment. Diet 1 (treatment 1) with no inclusion of *Phaseolus vulgaris*, Diet 2 (treatment 2) with the inclusion of 10% raw *Phaseolus vulgaris*, Diet 3 (treatment 3) with the inclusion of 10%. dehulled *Phaseolus vulgaris* and Diet 4 (treatment) with the inclusion of 10% boiled *Phaseolus vulgaris.* The finisher diet was adjusted to suit the required broiler finisher phase of lesser protein and higher carbohydrate. Thus a 500kg finisher was formulated.

Iso nitrogenous and iso calorific diets were compounded using zero percent (T1), 10 % raw (T2), dehulled (T3) and aqueous (T4) kidney bean meal.

At the end of the metabolism trial, 12 birds from each replicate of different treatments were starved over night to empty their gut contents, weighed and slaughtered. They were left to bleed completely then scalded in hot water and defeatered; their weight after defeathering and evisceration were taken. The cut up parts which include thighs, drumstick, shank, wing, neck, breast, and head were weighted and expressed as percentage of the eviscerated weight. The organ such as heart liver, spleen and gizzard were also weighed using a sensitive electronic scale.

Samples were collected from the breast of the experimental bird and cut into small size and cooked for approximately 20minutes with 5g of salt. Thereafter, they were presented in dishes under bright light to an untrained panel of 15 tasters. The panellists Include student of Unizik and staff of Ezi Awka Community Secondary School. A structural questionnaire was designed to solicit responses about juiciness, tenderness, tenderness, taste flour intensity and overall acceptability of the meat (see appendix I) using 5 point hedonic scale as described by Barylko-Pikielna (1975) with one being the least favourable of each parameter and 6 being its best condition. The scale was thoroughly explained to the panellists prior to the tasting session. Warm water was provided with which panellists rinsed their mouth between samples tasted.

Data collected were subjected to analysis of variance (ANOVA) using SPSS-22 release 7.2 statistical software. The differences between treatment means were separated using the least significant different (LSD) test.

III. RESULTS

Table 1 presents the effect of raw, dehullled and boiled kidney beans based meal on the organoleptic properties of broiler chickens.

TABLE 1

THE EFFECT OF RAW, DEHULLLED AND BOILED KIDNEY BEANS BASED MEAL ON THE ORGANOLEPTIC PROPERTIES OF BROILER CHICKENS

	Treatment diets			
Parameters	**T1(control)**	**T2(RKB)**	**T3(DKB)**	**T4(BKB)**
Juiciness	3.53^{b}	3.82^{ab}	3.69^{ab}	3.95^{a}
Tenderness	3.36^{a}	3.76^{a}	3.69^{a}	3.86^{a}
Taste	3.36^{b}	3.33^{b}	3.51^{b}	4.08^{a}
Flavor intensity	3.15^{b}	3.18^{b}	3.27^{ab}	3.96^{a}
Acceptability	3.42^{b}	3.56^{b}	3.30^{b}	4.20^{a}

Means bearing different superscripts along the same row were significantly different at p<0.05.

According to the Table there were no significant differences (p>0.05) in the juiciness of the birds fed T2, T3 and T4. There were also no significant differences in the juiciness of birds fed T2, T3, and T1. However, there was a significant difference (p<0.05) in the juiciness of birds fed T1 and T4. The result showed no significant differences (p>0.05) in the tenderness and taste of the chicken fed the different treatments, except in taste of birds fed T4 and T2 (p<0.05). Flavour intensity of birds fed T1, T2 and T3 were similar (p>0.05), while significance difference was observed between the birds fed T3 and T4 diets. But no significant differences (p>0.05) were recorded in the overall acceptability of birds, except for T4.

Table 2 presents the carcass yield of broilers fed raw, dehulled and boiled kidney bean seed meal based diet

TABLE 2

THE CARCASS YIELD OF BROILERS FED RAW, DEHULLED AND BOILED KIDNEY BEAN SEED MEAL BASED DIET

	Treatment diets			
Parameters	**T1(control)**	**T2(RKB)**	**T3(DKB)**	**T4(BKB)**
Breast	210.67a	129.00^{b}	195.00^{a}	189.00^{ab}
Drumstick	214.00^{a}	191.00^{b}	215.00^{a}	205.67^{a}
Thigh	160.33^{b}	171.00^{ab}	198.33^{a}	197.33^{a}
Wings	173.33^{ab}	166.00^{b}	181.00^{a}	166.00^{b}
Neck	94.67^{b}	95.67^{ab}	100.67^{a}	103.00^{a}
Head	57.67^{a}	50.00^{b}	54.00^{a}	53.00^{a}
Shank	91.67^{a}	80.33^{ab}	71.33^{b}	94.67^{a}

Means bearing different superscripts along the same row were significantly different at p<0.05.

No significant differences (p>0.05) were recorded in the breast weight and drumstick of all the birds, except for bird fed RKB. Birds fed RKB were similar to all the groups (p>0.05), whereas birds in control group were significantly different (p<0.05) from those in DKB and BKB. Wing size was significantly higher (p<0.05) in DKB than other treatment groups except for control; similarly, the size of the neck was smaller in control group than other groups except for those fed RKB. Except for birds fed RKB, the size of the head was uniform (p>0.05) in all the groups. There were no significant differences (p>0.05) in shank weight between birds fed control diet, BKB and RKB. There is also no significant difference in the shank weight of birds fed RKB and DKB.

Table 3 presents the organ weight of broilers fed raw, dehulled and boiled kidney bean seed meal based diet

TABLE 3

THE ORGAN WEIGHT OF BROILERS FED RAW, DEHULLED AND BOILED KIDNEY BEAN SEED MEAL BASED DIET

	Treatments			
Parameters	**T1(control)**	**T2(RKB)**	**T3(DKB)**	**T4(BKB)**
Heart	11.00 ± 1.73^{a}	10.33 ± 0.58^{a}	12.67 ± 2.08^{a}	12.00 ± 1.57^{a}
Gizzard	89.677 ± 2.08^{a}	64.67 ± 10.79^{b}	77.00 ± 21.38^{ab}	67.00 ± 2.65^{ab}
Liver	50.67 ± 6.66^{a}	45.67 ± 8.50^{b}	52.33 ± 4.51^{a}	52.33 ± 11.68^{a}
Spleen	2.00 ± 0.00^{a}	2.00 ± 0.00^{a}	3.00 ± 1.00^{a}	2.33 ± 0.57^{a}
Intestine	19.33 ± 4.04^{a}	18.67 ± 3.22^{a}	19.67 ± 3.51^{a}	18.67 ± 2.04^{a}
Live weight	2008.33 ± 95.7^{a}	1877.33 ± 107.83^{a}	2061.67 ± 229.44^{a}	2000.00 ± 52.51^{a}
Plucked weight	1887.33 ± 163.5^{ab}	1678.00 ± 23.26^{b}	1901.00 ± 157.87^{ab}	1993.00 ± 173.85^{a}

Means bearing different superscripts along the same row were significantly different at p<0.05.

The study observed similar ($p>0.05$) heart, spleen, intestine and live weight across all the treatment groups. Smaller liver, gizzard, and plucked weight were recorded in birds fed raw kidney beans ($p<0.05$), however, the gizzard and spleen of birds fed raw kidney beans did not vary with those fed DKB.

IV. DISCUSSION

There were no significant differences on the weight of the heart, liver, spleen and intestine indicating that the three methods used in processing of KB had no deleterious effect on the internal organs of the broilers. Wafar *et al*. (2017) reported a similar result on the organs (liver and gizzard) while working with pumpkin seed based meal on the performance and carcass characteristics of broiler chickens. They maintained that the increasing level of the pumpkin seed in the diet did not affect the internal organs. Again, Soultan (2009) observed that 5% inclusion of palm kernel cake in broiler diet had no significantly effect on spleen and live weight. However, Fasuyi (2007) and Tamburawa *et al.* (2016) reported increase in weight of heart and liver while feeding some supplements.

Yakubu (2017) also gave similar result that *Jatropha curcass* seed meal increased heart weight which according to him might have be caused by increased metabolic requirement. There is also a significant difference in the weight of the gizzard across the dietary treatment. This could be as a result of extra muscular activity in breaking down ingesta which have high fiber. Richard (2012) reported a similar result and attributed a higher gizzard weight obtained to increase in frequency of contraction of this organ to reduce fiber particles. There is a significant difference between bird fed treatment diet two and other treatments. This could be as result of toxic substance. The result is in line with the report of Emiola *et al*. (2007) who equally observed that the liver was characterized by marked coagulative necrosis and degeneration of the hepatocytes of bird when fed raw and dehulled seed meal. Ortiz *et al.* (1994) also observed a degeneration of the hepatocytes in the liver which he said was due to the high tannin content of the diet.

No significant differences in the breast weight of birds fed boiled, dehulled and control diet implies that either processing method is ideal as long as breast weight is concern. Thus the treatments did not exhibit any detrimental effect on breast weight. The difference observed on the breast weight of birds fed raw kidney bean with others indicate insufficient nutrient for tissues synthesis in the group. This result correlates with that of Tuleun *et al*. (2011) who in their study reported a decreased in the breast weight of bird fed fermented Mucuna seed meal. He claimed that the nutrients required for tissues synthesis was not sufficient and this could be attributed to poor utilization of protein due to the presence of ant nutritional factors possibly tannin. Muhammad (2017) reported a high breast weight and better feed utilization when fed 20% pigeon pea boiled with potash diet in birds because of the improved palatability with inclusion of boiled pigeon pea seed in diet.

The drumstick, thigh, neck and head of the different dietary treatments were not significantly similar. This may be that the carcass was not influenced by the treatment. This result concurs observation of Aletor (1992) who reported from his study on the effect of different processed soybeans on the performance, organ weight, carcass yield on the economic producing broiler that the carcass were not significantly influenced by the dietary treatments. The differences observed in the shank weight and this result is in agreement with Aletor (1992).

There were no significant difference on the juiciness, tenderness and flavor intensity of the broiler fed the different dietary treatment. This may be due to the age of the bird at slaughter, adequate water in the meat and similar fat level in the meat. This result agrees with Teye *et al.* (2011). The juiciness in meat arises from the moisture relaxed by the meat during chewing (Howard, 1976; Christens *et al*, 2000). According to Lowrie (1976) and Ledward (2006) fat in meat improves the appearance, juiciness and other sensory qualities of meat. The taste and overall acceptability of the dietary treatment four were significantly higher than other treatment groups. Boiled kidney bean was observed to be most preferred in terms of taste, overall acceptability, flavor intensity in addition juiciness and tenderness.

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