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RESEARCH ARTICLE

COWPEA (*vigna unguiculata)* MEAL SUBSTITUTE FOR SOYBEAN MEAL IN DIET OF COBB 500 BROILER CHICKENS

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ABSTRACT

The high price of commercial feeds in the poultry production industry causes production costs to increase in the broiler production business. Research was conducted at the Zambia College of Agriculture Field Station, Department of Animal Science, Muchinga Province, Zambia. The research aimed to evaluate the use of cowpea (*Vigna unguiculata*) as a complete substitute for soybean meal in a two-phase feeding system on the performance of Cobb 500 broiler chicks. The diets had broiler requirements of 20% crude protein (starter feed) and 19% (finisher feed) formulated according to standards. A total of 90-day-old chicks were allocated to three treatment groups: the first treatment, VU0%, had soybeans (no cowpea) included in the starter and finisher diet; the second treatment, VU75%, had cowpea meal included at 75% in the starter and finisher feed; and the third treatment, VU100%, had cowpea meal included at 100% in the starter and finisher feed. Each treatment had 3 replications, with 10 chickens per replication. The results showed no significant difference (p> 0.05) in feed intake, weight gain, or feed conversion ratio in UV0%, UV75%, and UV100%. The conclusion is that cowpea (*Vigna unguiculata*) can be a complete substitute for soybean meal in broiler starter and finisher feed diets when included at 100% in starter and finisher diets.

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INTRODUCTION

In many rural and urban areas of African countries, chicken production provides jobs, income, food security, and protein to resource-constrained communities (Kabir et al., 2015). Chicken production depend on commercial feed formulated using soybeans due to their high crude protein content, the protein component in animal feed formulations is necessary because it actively participates in the metabolism of essential substances such as hormones, enzymes, antibodies, and the creation of body tissue (Beski et al., 2015). Soybeans are an important source of plant protein used in the composition of commercial animal feed as well as for human nutrition(Ali et al., 2020).Soybeans are in great demand due to rising use by humans and animals. As a result, their price has increased and livestock production costs have gone up (Chakam et al., 2010).The strong demand for soybeans drives up their price on the global market, for this reason poultry's traditional source of protein has become prohibitively expensive, especially in low-income African nations. Production of chickens is hampered mostly by the continuous feeding expenditures, which make about 70–85% (Sanni and Ogundipe, 2005).

According to (Samboko et al., 2018), feed expenses for raising broilers account for almost 70% of overall production costs in Zambia. Despite this, the majority of farmers, including small-scale and commercial farms, rely on costly commercial feed to raise broilers. In order to replace soybeans in feed formulation, it is necessary to investigate plant protein legumes like cowpea (*Vigna unguiculata*). In animal nutrition, cowpeas can be a great source of nutritional protein, particularly in situations where animal proteins are expensive and in limited supply (Harouna et al., 2018). The utilization of alternative protein sources in feed formulation will reduce production costs for the majority of small-scale farmers in resource-constrained populations in many rural and urban parts of African countries. Cowpeas and soy beans have comparable amounts of nutrients and calories. Due to their comparable amino acid profiles, cowpeas (*Vigna unguiculata*) can be used in place of soy beans (Wiryawan et al., 2017). Cowpeas share a similar chemical makeup with other non-traditional legumes. According to (Akande and Fabiyi, 2010), it has between 25% and 27% crude proteins. Cowpeas vary greatly in terms of protein content, but they are high in the amino acids tryptophan and lysine.

There is, however, a lack of the sulphur, amino acids, cysteine and methionine (Chakam et al., 2010). Nevertheless, this cannot always be an issue because animals' livers are capable of metabolizing cysteine and methionine (Waldroup et al., 2002). However, the anti-nutritive elements present in the seed reduce this good nutritional content (Thakur et al., 2019).Tannin and trypsin inhibitors are two common anti-nutritional components of cowpeas. These inhibitors hinder digestion and lead to a decrease in the amount of feed fed to animals. A variety of processing techniques, including boiling or heat treatment, can be used to reduce the anti-nutritional factors.(Emiola and Ologhobo, 2006), Small-scale farmers frequently employ these techniques because they are inexpensive and simple to implement (Ragab et al., 2010). Additionally, studies by (Belal et al., 2011) showed that the decorticating method reduced raw cowpea's 1.68 (Tu/mg/protein) trypsin and 0.76% tannin to 1.65 (Tu/mg/protein) trypsin and 0.02% tannin, respectively, and decorticating-roasting reduced it to 0.74 (Tu/mg/protein) trypsin and 0.004% tannin. In terms of agronomy and economics, cowpeas are a crop that can withstand heat and drought (Narayana and Angamuthu, 2021), cowpeas have a low input cost, and are well-suited to South Africa's desert agronomic regions (Mohammed, 2020).

Various research on the performance of chickens have looked into cowpeas; broilers were given varying amounts of cooked cowpea seeds at 0%, 15%, 20%, 25%, and 30% by (Chakam et al., 2010). The results showed that there was no significant difference in the broilers' performance, and that performance rose with an increased degree of inclusion. Furthermore, the findings by (Defang et al., 2008) demonstrated that broilers fed cowpea had a larger production of carcasses. Most notably, it has been reported that 75% of the soybean meal in broilers has been successfully substituted by sun-dried cowpeas (Lon-Wo and Cino, 2000). However, there is no research on how well cowpeas replace soybeans at 100%, even if they promote weight gain at higher inclusion levels and show promising effects at 75%. Therefore, the purpose of this study was to assess how the growth performance of Cobb 500 broiler chicks would be affected if cowpea (*Vigna unguiculata*) was used at 100% in place of soybean meal after being cooked.

MATERIALS AND METHOD

Location of Study: The study was carried out in the Muchinga Province of Zambia at the Zambia College of Agriculture, Mpika Field Station, and Department of Animal Science.

Cowpea (*Vigna unguiculata*) meal preparation: Dry cowpea seeds were collected from the field demonstration plots at Zambia College of Agriculture. The dry cowpea seeds were boiled in water for 15 minutes at 60 ^{0}C for treatment against anti-nutritional factors and later dried for 7 days prior to grinding. The dried cowpeas were ground using a hammer mill to pass through a 3 mm sieve.

Proximate analysis: As indicated in table 1 below, the proximate analysis values for the cowpea sample utilized in feed formulation came from a laboratory analysis carried out in accordance with AOAC (1998) at the University of Zambia, Animal Nutrition Laboratory at the Animal Science Department (Mwale, 2013).

Table 1. Proximate analysis values for cowpeas

Chemical component	Content
Dry Matter (%)	90.64
Crude protein (%)	22.66
Ash (%)	7.06
Ether extract (%)	1.42
Calcium (%)	0.70
Phosphorus (%)	0.25
Gross energy (Kcal/kg)	2 748.49

University of Zambia, Animal Nutrition Laboratory at the Animal Science Department (Mwale, 2013)

Feed formulation: Starter diets had 20% Cp and finisher diets had 19% Cp, according to the normal standards for broiler feed formulations. Sunflower seed cake contributed 9.98%, fish meal contributed 5.57%, and soybeans contributed 17% of the diet's total protein. All treatments maintained the same amounts of fish meal and sunflower cake in their basal diets with other additives. The three treatment diets (Table 2, below) substituted cowpeas for soybeans at varying percentages of inclusion (0%, 75%, and 100%).

Table 2. Diet Composition for standard broiler starter and finisher feeds

INGREDIETS (%)	UV0%		UV75%		UV100%	
	Starter	Finisher	Starter	Finisher	Stater	Finisher
Maize meal	46.80	46.30	46.80	46.30	46.80	46.30
Maize brain high quality	17.00	20.00	17.00	20.00	17.00	20.00
Soybean meal	15.60	13.60	3.90	3.40	0	0
Cowpea meal	0	0	11.70	10.20	15.60	13.60
Fish meal	7.88	5.59	7.88	5.59	7.88	5.59
Sunflower seed cake	9.98	12.00	9.98	12.00	9.98	12.00
Methionine	0.18	0.12	0.18	0.12	0.18	0.12
Di-Calcium Phosphate (DCP)	0.94	0.47	0.94	0.47	0.94	0.47
Limestone	1.07	1.34	1.07	1.34	1.07	1.34
Lysine	0.25	0.19	0.25	0.19	0.25	0.19
Salt	0.08	0.14	0.08	0.14	0.08	0.14
Broiler premix	2.5	0.25	2.5	0.25	2.5	0.25
Total (%)	100	100	100	100	100	100

Table 3. The calculated nutritional value of diets

Nutrients	Starter feed	Finisher feed
ME (Kcal/kg)	2752.8	2752.8
Crude Protein(g/kg)	194.4	180.3
Digestible lysine(g/kg)	10.3	8.7
Digestible Methionine(g/kg)	5.2	4.3
Digestible Methionine + Cystine(g/kg)	7.6	6.6
Ca(g/kg)	12	10.5
P(g/kg)	8.5	6.8
Crude Fat(g/kg)	55.6	57.2
Crude Fibre(g/kg)	50.1	54.8

(g/kg) grams per kilogram of dry matter
(Kcal/kg) kilo calories per kilogram of dry matter

Experimental design and treatment: A total of 90-day-old Cobb 500 broiler chicks were allocated to three treatment groups using a completely randomized design (CRD), with each group consisting of three replications and 10 chicks per replication placed in a deep litter system. The chickens were fed using the two-phase system of starter and finisher feed. The birds were offered *ad libitum* feed and fresh water throughout the experimental period of six weeks.

Data collection: The collection of data was done by recording feed consumption, weight gain, and feed conversion ratio throughout the raising period. The amount of feed offered and refused was recorded daily to calculate the feed consumption, and the total feed consumption per bird was calculated and recorded at the end of the 6-week raising period. Birds were weighed weekly for treatments and per replication, and weight gain per chicken was calculated. Total body weight gain (BW) change was calculated as the difference between the final and initial body weight after 6 weeks. The feed conversion ratio (FCR) was computed as the ratio of total feed intake to total weight gain.

Data analysis: The experimental design used in the investigation was a completely randomized design (CRD). After obtaining the data, a post hoc Tukey's multiple range test was performed on the variables that showed significant ($p<0.05$) results from the analysis of variance (ANOVA). The IBM SPSS Statistics version 25 program was used to process the data.

RESULTS AND DISCUSSION

The performance of the broilers observed during the study, including average feed intake, weight gain, and feed conversion ratio (FCR), is presented in Table 3.

Table 3. Mean values for total feed intake, weight gain, and food conversion ratio per chicken

Treatment	UV0%	UV75%	UV100%
Feed intake (Kg)	3.87^{a}	3.81^{a}	3.76^{a}
Weight gain (Kg)	2.25^{b}	2.29^{b}	2.30^{b}
Feed Conversion ratio (FCR)	1.72^{c}	1.67^{c}	1.63^{c}

abc Means in the same row with common letter are not different at p>0.05

There was no significant difference ($p>0.05$) in feed intake, weight gain, or feed conversion ratio when cowpea was added to diets at 0%, 75%, or 100%. The study's findings led to the production of broiler chickens with weights that were comparable to those of the diet containing soybeans without cowpea. The findings of this study are consistent with those of (Lon-Wo and Cino, 2000) who reported that sun-dried cowpeas were a good substitute for 75% of soybean meal in broiler chickens. Furthermore, broilers fed cowpea had a higher carcass yield, according to (Defang et al., 2008). Cowpea meal was also added by (Eljack et al., 2010) at several percentages: 0%, 10%, 20%, and 30%, as the levels of inclusion rose, the broiler performance was found to significantly improve in terms of weight gain, dressing percentage, and carcass cuts. Similarly, when cowpea meal was added to broiler diets at 16% and 15%, (Trompiz et al., 2002)and (Abdelgani et al., 2018) respectively, the studies indicated no significant difference on growth performance of broiler chickens. It follows that adding cowpeas at all stages, from lower to higher levels, can promote growth performance. However, Chakam et al., (2010) showed that residual amounts of ant-nutritional components caused a quick linear decline in weight gain when the inclusion level of cowpeas climbed over 20%. It is crucial to realize that in order for cowpea to yield better results, the right treatment approach needs to be used; in order to effectively deactivate the anti-nutritional components and lessen their aftereffects, a longer boiling time may be the best option. Dehulling and boiling together improved the performance of chickens fed on variously processed cowpea seeds at a 20% level (Akanji et al., 2015). Additionally, the pressure-cooking method of treating cowpeas is superior since it allows for greater temperature control, which may enhance the grain's nutritional content (Chakam et al., 2010). Because the cowpeas in this study were cooked for 15 minutes at 60 degrees Celsius, it's possible that the anti-nutritional effects were eliminated, which explains why the performance of the hens fed 75% and 100% cowpea increased. The treatments UV0%, UV75%, and UV 100%, showed no significant difference in feed consumption. Although there was no statistical difference in the treatments, the broiler chickens on the diet consisting only of soybeans (UV0%) ate slightly more in total than the cowpea treatments; this could be because soybeans were more palatable than cowpea. Broiler chicks fed soaked cowpea at 0%, 5%, 10%, and 15% did not significantly differ in their feed intake (Balaiel, 2009). The feed conversion ratio did not exhibit a statistically significant difference, and the obtained results are consistent with those published by (Balaiel, 2009)for chickens fed at levels of 0%, 5%, 10%, and 15% on soaked cowpeas. This means that both in the diet containing cowpeas and the control diet, the broiler chickens ate the same amount of grain and transformed it into meat at the same ratio.

CONCLUSION

According to the study findings, cowpeas can totally replace soybeans as a source of protein in broiler diets. There would be an increase in the amount of animal protein available for use in broiler feeds if cowpea seeds were substituted for soybeans in the rations for the chickens.

RECOMMENDATION

I strongly recommend that research be done on Cobb 500 broiler chickens to access blood parameters and carcass characteristics for the chickens fed on 100% cowpea to replace soybeans.

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