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Effecs of Okra Waste (*Abelmoschusesculentus*) Supplimentation in the Feeding Of Broiler Finisher

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Abstract
The study was conducted to evaluate the nutritional composition of okra waste, growth performance, carcass yield, organ weights and cost benefits of finisher broiler chickens fed dietary levels of okra waste .one hundred and forty four pieces of unsexed four weeks old Ross 308 broiler chickens with the average weight of 0.85kg were used for the study that lasted for four weeks. Significant (P<0.05) differences among treatment groups in weight gain, average daily feed intake, feed conversion ratio, mortality, organ such as the liver, gizzard, heart,carcass weights and cost analysis were observed. The study suggests that supplementing broiler diets with up to 10% okra waste isideal in feeding finisher broiler as it brings about a drastic reduction in the feeding cost without compromising the performance, organ and carcass weight of the experimental birds

Keywords*: waste; okra; broiler; supplementing; finisher*

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I. Introduction

High cost of feeds is one of the challenges facing Poultry farmers in developing countries. This is due to high competition between man and industries over the stuff they are made of, for instance, energy sources are required in large quantity in poultry feeds, followed by protein source which is costlier. However, efforts have be geared towards solving the problem of high cost of feed by exploiting agricultural by- products as alternative to certain ingredients but little has this helped as some of these by products are still being used for other things. In view of this,of supplementation of okra waste in the feeding of finisher broilers is considered. It is expected that the result of this study will bring about reduction in feed cost, value addition to okra waste and reduce or totally eradicate environmental pollution caused by these wastes during harvest.

Okra (*Abelmoschusesculentus* L.) is one of the most widely known and utilized species of the family Malvaceae and an economically important vegetable crop grown in tropical and sub-tropical parts of the world. Okra contains moderate levels of some essential mineral and vitamin which are important for body metabolic processes that utilize carbohydrates, proteins and fats. The immature fruits are eaten in soup either fresh or prepared by boiling or frying and used in soup and stews [Oyelade, *et al* 2003]. Okra is a popular home vegetable and a vital source of energy for human body. It is mostly grown for its green leaves and young pods which are consumed as green vegetable. Lack of stable power supply and refrigeration facilities in some rural areas where this crop is produced seriously affect the preservation of this crop such that much of the product is lost. As okra fruit matures, it becomes lignified. The market prefers okra when immature. However, the absence of efficient utilization of the excessive unsold okra fruits during harvest increases the huge quantity of waste generated which will become a great threat to the communities and market places where they are grown and sold if not checked, thereby causing a nuisance. More effective means of incorporating these waste products has become necessary in view of the environmental hazards they constitute in major producing areas and markets all over the country where they are distributed during the season, some of which are in urban areas (WHO, 1991).The chief bio-elements are found in okra are magnesium, calcium, sodium, potassium and iron etc., which are often deficient in the diet of developing countries. It contains vitamins and is a good source of essential nutrients. It provides proteins, dietary fiber, carbohydrates, minerals and iodine. One hundred grams of edible okra contain moisture 89.6 g, minerals 0.7g, protein 1.9g, carbohydrates 6.4g, fat 0.2g, calcium 66 mg, fiber 1.2g, calories 35, potassium 103 mg, phosphorus 56 mg, magnesium 53.0 mg and sodium 6.9 mg [Gopalan*et al* 2007]. Okra seeds are small in size and the seed coat is very hard containing a high level of crude fiber. The mature seed is known to have superior nutritional quality. Okra seed is known to be rich in high quality protein especially with regard to its essential amino acids relative to other plant protein sources. Arapitsas, 2008 reported that Okra Seeds are rich in phenolic compounds with derivatives, catechin oligomers and hydroxycinnamic derivatives. The nutrients content of okra seed showed that okra seed contains 21% protein, 14% lipids and 5% ash. Removal of the seed hulls by grinding and sifting produced a meal with 35% protein, 25% lipids and 6% ash]. Savello, *et al* 1980 reported that chemical composition of okra seeds flour revealed a predominance of moisture (6.96%), total carbohydrates (30.81%), protein (22.14%),oil (14.01%) and crude fiber (27.30%). K, Na, Mg and Ca were found to be the principal elements, with Fe, Zn, Mn and Ni to be also present [Al-Wandawi,1983.,Moyin-Jesu, E.I., 2007]. The seeds from two varieties namely SabzPari, Punjab-8 of Okra (Hibiscus esculentus), grown under similar environment, exhibited moisture content 7.26, 8.35%; ash 5.18, 6.23%; oil 11.72, 13.42%, protein 20.00, 23.68% and crude fiber 29.60, 27.41%, respectively [Anwar, et al 2011]. According to Andras*et al*. [2005] oil concentration of okra seeds from Greece was found to be 15.9 to 20.7%, depending on the extraction method. The oil was found to contain a high level of linoleic acid (up to 47.4%) and tocopherols isomers. Okra seeds contain about 20 to 40% oil. Okra seed oil yield is comparable to most oil seed crops except oil palm and soybean. Moreover, okra seed oil has potential hypocholesterolemic effect. The potential for wide cultivation of okra for edible oil as well as for cake is very high. All of the crude fiber is retained in the cake when oil is expelled from the whole seed. Since a high level of crude fiber in the diet may interface with the utilization of many nutrients the dehulled seeds seem to be the better form to use. Okra seed flour could also be used to fortify cereal flour. For example, supplementing maize pap with okra meal increases protein, ash, oil and fiber content. Okra seed flour has been used to supplement corn flour for a very long time in countries like Egypt to make better quality dough. Okra seed flour has been reported to be rich in minerals and vitamins. Its addition to predominantly high carbohydrate foods might be expected to enrich such foods and improve their nutritional status [. Otunola, *et al* 2007, Sanjeet, *et al* 2010 and. Sorapong, 2012.]. Proteins play a particularly important role in human nutrition. Okra seed is known to be rich in high quality protein especially with regards to its content of essential amino acids relative to other plant protein sources. Hence, it plays a vital role in the human diet. The amino acid contents proportions and their digestibility by humans characterize a protein’s biological value. The amino acid composition of okra seed protein is comparable to that of soybean, the PER is higher than that of soybean and the amino acid pattern of the protein renders it an adequate supplement to legume or cereal based diets [Ndangui*et al* 2010, Adetuyi,2012].

II. Materials And Method

Experimental materials

Okra wastes were gathered at Eke market, Afikpo, Ebonyi state, Nigeria. The fruits were cut into pieces, sundried and milled with milling machine after which they were analyzed for their proximate composition,and then included at 0%, 10%, 20% and 30% in the experimental diets.The finisher diet was formulated and fed to the experimental birds.

Experimental diet

The composition of the diet is presented in Table 1.

Table 1. Percentage composition of the experimental diets

Ingredient	T1(0%)(kg)	T2(10%)(kg)	T3(20%)(kg)	T41(30%)(kg)
okra waste	0.00	4.89	9.79	14.69
Maize	48.97	44.07	39.18	34.28
Wheat offal	5.44	5.54	5.62	5.26
PKC	4.03	4.03	4.02	4.05
GNC	16.14	16.09	16.06	16.21
Soya bean meal	20.17	20.13	20.08	20.26
Bone meal	4.00	4.00	4.00	4.00
Salt	0.5	0.5	0.5	0.5
Methionine	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated analysis				
Crude Protein (%)	21	21	21	21
Crude Fibre (%)	4.94	4.99	5.15	5.17
Crude fat (%)	4.82	4.48	4.15	3.81
Energy Kcal/kg	2994	2897	2800	2900

** To provide the following per kilogram of feed; vitA 10,000IU; vit. D3 1,500 IU; vit. E 2 mg; riboflavin 3 mg; pantothenic acid 10 mg; nicotinic acid, 2.5 mg; choline 3.5 mg; folic acid 1mg; magnesium 56 mg; lysine 1mg; iron 20 mg; zinc 50 mg; cobalt 1.25 mg.*The metabolizable energy of the test ingredient was calculated using prediction equation as reported by Pauzenga, 1985 with the formula M.E = 37 X %CP + 81.8 X %EE + 35.5 X%NFE
Note: GNC =ground nut cake. PKC=Palm Kernel Cake. CP=crude Protein.CF=Crude Fibre.T1= control diet 0% ,okra fruits and , mature okra fruits. T2= 10% okra fruits. T3= 20% okra fruits. T4= 30% okra fruits.

Experimental birds and management

A total of one hundred and forty four (144) Ross 308 strains of broilers of 28 days of age with an average weight of 0.85kg were used for the experiment. The broilers were randomly assigned to 4 treatment groups in a completely randomized design involving dietary inclusion of four levels (0%, 10%, 20% and 30%) of okra waste. Each treatment group was replicated trice to obtain a total of 12 groups of 12 birds each. The chickens were randomly assigned to an experimental unit of 1.5m by 1.5m each partitioning and raised in a deep liter system of management. Feed and water were given *ad-libitum* and proper routine management practices and medications strictly adopted. The feeding trial lasted for 28 days.

Data collection and measurements

Data were collected on the growth performance, carcass and organ characteristics and the cost implication of using the dietary levels of okra waste in the broiler production. The day old chicks were brooded together and were weighed at the beginning of the experiment and on weekly basis thereafter. To determine the weight gain of the birds; Feed intake was recorded daily and was determined by the weigh back technique which involved obtaining the difference between quantity of feed offered and the left over the following morning. Feed conversion ratio (FCR) was calculated from the data on feed intake and weight gain as the quantity of feed taken per kilogramof weight gain over the same period. At day 28 of the experiment, two birds were randomly selected from each replicate of the treatments. Determination of the carcass characteristics was done by slaughtering the selected birds (decapitation of the neck). They were dressed and weighed to determine the dressing weight. Data collected were analyzed in a completely randomized design ANOVA. Differences among means were determined with Duncan's multiple-range test with 5% level of significance as described by Steel and Torrie (1980). The data were computed with IBM SPSS statistical 16 of 2013 software. Feed samples were assayed for their proximate composition by the method of AOAC (1990).

III. Results

Proximate composition of experimental materials

The proximate compositions of the experimental materials and experimental diets are presented in table 3 and 4 respectively.

Table 3: proximate composition of the experimental material (dry weight bases)

Parameter	Quantity/g
Moisture	12.11
Protein	15.86
Fibre	16.86
Fat	1.53
Ash	6.40
Calories	47.79
Carbohydrate	6.4

Table4. The proximate compositions of the experimental diets

Treatment	Moisture content (g/100 g)	Crude protein (g/100g)	Total ash (g/100g)	Crude fiber (g/100g)	Crude fat (g/100 g)	Carbohydrate (g/100 g)
T1	10.72	22.20	5.19	5.19	3.70	53.00
T2	13.20	22.00	6.64	5.24	2.72	50.20
T3	14.01	21.80	6.82	5.26	2.11	50.00
T4	11.52	21.06	6.60	5.25	2.41	53.16

T1= control diet 0% okrawaste T2= 10% okra waste. T3= 20% okra waste. T4= 30% okra waste.

The results of the proximate compositions of the experimental diets reveals in table 4 that the moisture content, crude fibre and ash content of the experimental diets increased as the inclusion level of okra waste increased up to 20% inclusion and declined at 30%.However, the crude protein and crude fatdecreased as the inclusion level of okra waste increased in the diets. Furthermore, the carbohydrate content of the experimental diets decreased up to 20%inclusion of okra but rose to the control level at 30% inclusion ofokra waste in the diets.

Growth performance of broiler chickens fed varying dietary levels of okra waste

Data on performance of finisher broiler chickens fed varying dietary levels of okra wasteis presented in table 5.

Table5. Performance of finisher broiler chickens fed varying dietary level of okra waste

Parameter	T1	T2	T3	T4
Average initial weight	0.87±0.0	0.97± 0.1	0.87± 0.0	0.85± 0.1
final live weight (kg/bird)	2.60± 0.1 ^{a}	2.09± 0.2^{abc}	1.77± 0.1^{cd}	1.56± 0.2^{d}
Daily weight gain	0.04± 0.0^{ab}	0.04± 0.0^{ab}	0.04± 0.0^{abc}	0.04± 0.0^{bc}
Daily feed intake	0.14± 0.0^{ab}	0.13± 0.0^{ab}	0.12±0.0^{b}	0.12± 0.0^{b}
Feed conversion ratio	3.15± 0.0	3.14± 0.0	3.24±0.2	3.44± 0.5
Mortality	0.00± 0.0	0.00± 0.0	0.00±0.0	0.00± 0.0

a,b,c,d Different superscripts within each row indicate significant differences ($p < 0.05$) (n =15). Without superscript = not significant.

T1= control diet 0% okra waste. T2= 10% okra waste. T3= 20% okra waste. T4= 30% okra waste.

The results of the growth performance of the experimental diets reveals in table 5 that thevalues recorded for the birds on 20% and 30% on average final weight of the experimental birds were significantly ($P > 0.05$) lower when compared with the value recorded for the control. However, no significantly difference ($P > 0.05$) was observed when the birds on 10%,20% and 30% inclusion of okra waste were compared with the control for the daily weight gain, , daily feed intake, feed conversion ratio and mortality;

Carcass yield of finisher broiler chickens fed varying dietary level of okra waste

Data on Carcass yield of finisher broiler chickens fed varying dietary level of and okra waste are presented in table 6.

Table 6: Carcass weight of finisher broiler chickens fed varying dietary level of okra waste

Parameter	**T1**	**T2**	**T3**	**T4**
Final body weight(kg)	2.45±0.3^{ab}	2.35±0.1^{abc}	2.05±0.2^{abc}	1.55±0.2 ^{c}
Dressed weight(kg)	2.25±0.3^{a}	2.05±0.1^{a}	1.85±0.2^{ab}	1.30±0.1^{b}
Eviscerated weight(kg)	1.80±0.2^{a}	1.55±0.1^{a}	1.38±0.1^{ab}	0.88±.02^{b}
Breast weight(kg)	0.60±0.1^{a}	0.40±0.1^{b}	0.45±0.1^{b}	0.25±0.1^{c}
Thigh weight(kg)	0.45±0.1^{a}	0.45±0.1^{a}	0.45±0.1^{a}	0.25±0.1^{b}
Residual weight(kg)	0.45±0.1^{a}	0.25±0.1^{bc}	0.20±0.0^{c}	0.20±0.1^{c}
Head and neck(kg)	0.15±0.1	0.20±0.1	0.13±0.1	0.06±0.1
Wing(kg)	0.20±0.0	0.25±0.1	0.15±0.1	0.13±0.1

[a,bc] Different superscripts within each row indicate significant differences ($P < 0.05$) (n =6). Without superscript = not significant.T1= control diet 0% and okra waste. T2= 10% okra waste. T3= 20% okra waste. T4= 30% okra waste.

The results of the carcass weight of the experimental diets reveals in table 6 that the values observed for the birds on 30% inclusion levels of okra waste were significantly($P < 0.05$) lower when all the treatments were compared with the control for the final body weight, dressed weight, eviscerated weight, breast weight, thigh weight and Residual weight. However,the wing, head and neck had similar values with the control.

Organ characteristics of broiler chickens fed varying dietary levels of Okra waste.

Data on Organ characteristics of broiler chickens fed varying dietary levels of okra waste is presented in Table 7.

Table 7: Organ characteristics values of finisher broiler chickens fed varying dietary levels of Okra waste.

ORGAN	T1	T2	T3	T4
LIVER/g	42.7±.0.0^{abc}	42.0±0.1^{bc}	42.2±0.0^{abc}	43.5±0.1^{c}
HEART/g	8.2±0.0^{b}	8.2 ±0.0^{b}	8.2 ±0.1^{b}	8.4 ±0.3^{ab}
GIZZARD/g	38.7 ±0.4^{a}	40.6 ±0.4^{b}	42.5 ±0.0^{c}	44.3 ±0.4^{d}

[abcd] Means of different superscripts within each row indicate significant differences ($p < 0.05$) (n =6).

T1= control diet 0% okra waste T2= 10% okra waste. T3= 20% okra waste. T4= 30%okra waste.

The results of the organ weight of the experimental birds reveals in table 7 that the liver and heart had no significant differences when the values recorded for all the treatments were compared with the control.

However, the gizzard of the birds on 30% inclusion level of okra waste had a significant ($p < 0.05$) higher value than the control. A linear increase was observed as the inclusion level of okra increased in the diets.

Effect of okra waste diets on economic analysis of finisher broiler chickens

Effect of okra diets on the economic analysis of finisher broiler chickens is presented in table 8.

Table 8: Effect of okra diets on economic analysis of finisher broiler chickens

Parameter	T1	T2	T3	T4
DOC cost/#	350	350	350	350
Cost of feed/kg/#	144.59^{a}	138.01^{b}	132.16^{c}	125.5^{d}
Feed intake cost(#/bird)	560.72^{a}	520.86^{b}	500.14^{b}	480.64^{c}
Feed cost/kg weight gain(#)	506.07^{a}	485.33^{b}	470.48^{c}	456.62^{d}
Cost of production(#/bird)	1665.78^{a}	1364.35^{b}	1182.75^{b}	1062.33^{c}
Average sales price/kg(#)	1200	1200	1200	1200
Average sales price/bird(#)	3120^{a}	2508^{ab}	2124^{b}	1872^{c}
Profit(#)	1454.22^{a}	1143.65^{ab}	941.25^{b}	809.97^{c}

^{a,b,cd} Different superscripts within each row indicate significant differences ($p < 0.05$) (n =2).
Without superscript = not significant.T1= control diet 0% okra waste. T2= 10% okra waste. T3= 20% okra waste. T4= 30% okra waste.DOC=day old chicks.

The results of the cost analysis of the experimental diets reveals in table 8 that the values observed for the control were higher than other treatments except for the average sale/ bird and profit in which the values observed for test ingredient 2 were comparable to the control values. A linear decrease was observed as the level of inclusion of okra waste increased in the diet for the cost of feeds, feed intake cost, and feed cost/kg weight, total cost of production and average sale price/bird.

IV. Discussion

The results of the proximate compositions of okra waste

The results of the proximate compositions of okra waste in table 3 shows that okra waste is rich in nutrients like, ash; 6.40and crude carbohydrate;47.79. These figures are within the range of 10.00- 10.60 and 40.00- 49.8 recorded for ripe and unripe okra (Ajayi, *et al*., 2020) but lower than the values recorded for some selected vegetables grown in Nigeria (Adegbenro*et al;* 2012) .moisture;12.11 and fibre; 15.86 were higher than 8.38% and 8.00% recorded for *Sesbibiasesban* seed (ogunbode*et al*;2013). Furthermore, the value recorded for the crude protein; 15.86ishigher than the estimated average composition of 10 – 13% crude protein reported for ripe and unripe okra. (Ajayi, *et al*., 2020)

The results of the proximate compositions of the experimental diets

The results of the proximate compositions of the experimental diets reveals in table 4 that the crude fibre (%)5.19,5.24,5.26 and 5.25 of all the test ingredients are all within the recommended 5- 7% for finisher broiler (NRC,2006). Furthermore, the crude proteins(%) 22.20,22.00,21.80 and 21.06 recorded for all the test ingredients are within the estimated recommendation of 21-23% crude protein requirements for finisher broilers (NRC,2006).

Growth performance of broiler chickens fed varying dietary level of okra waste

The results of the Growth performance of broiler chickens fed varying dietary level of okra waste as shown in table 5 reveals that the birds on 20% and 30% inclusion of okra waste for the average final weight of the experimental birds had a significantly ($P > 0.05$) lower values when compared with the value recorded for the control. The declined values for these treatments on final weight could be attributed to higher anti nutritional factor and fibre level at these levels of inclusion. The non-statistically increased values observed for the feed conversion ratio at these levels of inclusion is an evidence of negative effect of high anti nutritional factors and fibre in the feed. This supports the view of Aletor, 1993 who claimed that tannin in the biological system has the ability to chelate protein thereby impeding digestion. Even though, no significant difference ($P > 0.05$) was observed when the birds on 10%,20% and 30% inclusion of okra waste were compared with the control for the daily weight gain, , daily feed intake, feed conversion ratio and mortality.

Carcass characteristics and Organ weight of broiler chickens fed varying dietary level of okra waste

As shown in table 6 and 7, the control values were significantly higher than the values of all the test ingredients observed for the final body weight, dressed weight, eviscerated weight, breast weight, thigh weight and residual weight. The similar values recorded for the control and the named parameters at 10% and 20% inclusion of okra waste is an indication that the experimental birds maximally utilized the experimental diets up to 20% inclusion level of okra. This agrees with Ajayi, *et al.,* 2022 who argued that the optimum conversion of diet to meat in broilers could be attributed to the facilitation of the dietary nutrient balanced in the experimental diets.For the organ of the experimental birds; the liver and heart of all the treatments observed hadsimilar values when compared with the control. thisobservation suggests that the liver and heart were not negatively affected at up to 30% levels of inclusion of the experimental diets.However, the gizzard of the birds on 30% inclusion level of okra waste was drastically increased above the control value. A linear increase was observed as the inclusion level of okra increased in the diets.The linear increase observed could be attributed to the high fibre content of the experimental feeds. This agrees with Hamed and Olorede, (2003) who argued in their work that fibre in monogastric diets specifically has a mechanical effect on gizzard and cause the gizzard to increase.

Cost analysis of broiler chickens fed varying dietary levels of okra waste

The results of the cost analysis of the experimental diets reveals in table 8 that the values observed for the control were higher than the birds on 10%, 20% and 30% inclusion level of okra waste for all the parameters observed except for the average sales/ bird and profit in which the values observed for the birds on 10% inclusion level of okra were comparable to the control values. A linear decrease was observed as the level of inclusion of okra waste increased in the diet for the cost of feeds, feed intake cost, and feed cost/kg weight, total cost of production and average sale price/bird. These decreased values could be attributed to a fact that okra waste was not bought with money and replaced some costly ingredients which are also a component of the experimental diets. This is in line with ajayi*et al* 2020 who reported in their work that most agricultural by-products such as okra waste are considered waste, therefore a cheap source of feeding animals. Furthermore, the values observed for the sale price/bird and the profit confirms the report of Damron and Sloan, 1998 postulated that an ideal broiler diet is the one that will maximize production at the least cost. Although a costly diet may produce phenomenal gains in live-stock, the cost per unit of production may make the diet economically infeasible. Likewise, the cheapest diets will not always be the best since it may not allow for maximum production.

V. Conclusion and Recommendation

The results of the present study showed that okra waste can be incorporated up to 10% in feeding of finisher broiler without compromising the growth performance. Hence, the use of okra waste will make condemned okra fruits to be usable in formulating broiler diet. The utilization of condemned okra fruits will as well reduce the cost of broiler production and become an efficient means of solving the problem of environmental hazard and danger likely to be posed by the increasing generation of the okra fruits/ waste during harvest.

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