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RESPONSE OF BROILER FINISHER FED SUPPLIMENTRY LEVELS OF OKRA (*Abelmoschus esculentus*) WASTE MEAL

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Abstract: **The study was conducted to evaluate the response of finisher broiler chickens fed supplementary levels of okra waste meals. Total of 84; Abore acre strains of broilers, aged 28 days with an average weight of 0.83kg ± 0.05kg were used for the study. The Birds were randomly assigned to four treatment groups in a completely randomized design involving dietary inclusion of four levels (0%, 5%, 10% and 15%) of okra waste meal. Each treatment group was replicated trice to obtain a total of 12 replicates of 7 birds each. The chickens were randomly assigned to experimental pens of 1m x 1m each 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. Significant (P<0.05) differences among treatments groups in growth performance, carcass characteristics and lipid profile were observed. For the growth performance, Average final weight, Average daily weight gain and feed conversion ratio of the experimental birds had no significant differences (P > 0.05) when the values recorded for the control were compared with B and C. However, D was significantly decreased (P < 0.05) for the final weight and daily weight gain with higher feed conversion ratio value. Furthermore, the carcass characteristics showed that D had the least significant values (P > 0.05) among all the parameters observed except for the wing, head and neck which had similar values when compared to the control values. For the cost analysis, C had the least production cost. The study suggests that supplementing broiler diets with 15% inclusion of okra waste meal enhances growth. However, the observed benefit can be achieved without compromising production cost of broiler chicken only with the incorporation of 10%inclusion of okra waste meal. The findings of this study are evidence that the use of okra waste fruits will make okra fruits to be ideal for healthier broiler production.**

Keywords: **Okra; response; Broiler; waste; supplementary**

1. AN OVERVIEW OF *ABELMOSCHUS ESCULENTUS* (OKRA)

Okra (*Abelmoschus esculentus* L.) is a well-known and widely used *Malvaceae* species and an economically important vegetable crop growing in tropical and sub-tropical regions of the world (Okocha and Chinatu, 2008). Okra is a good source of some critical minerals and vitamins that are needed for the body's metabolic processes that use carbohydrates, proteins, and lipids. The immature fruits are used in soups and stews and can be eaten fresh or cooked by boiling or frying (Oyelade, *et al*., 2003). Okra is a common household vegetable that provides a significant amount of energy, minerals, and vitamins to the human body (Anwar, *et al*., 2011). It is farmed specifically for its green leaves and immature pods, which are eaten as a green vegetable. Magnesium, salt, calcium, iron, potassium and other bio-elements present in okra are typically low in human diets in underdeveloped nations (Naveed *et al*., 2009). In human diets, it supplies proteins, dietary fiber, carbohydrate, vital minerals, and iodine.

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Proximate composition of okra waste (*Abelmoschus esculentus*) is presented in Table A.

Table A: Proximate composition of okra fruits (*Abelmoschus esculentus*)

Parameter	Quantity/g
Moisture	89.6
Protein	1.9
Fibre	1.2
Fat	0.2
Ash	0.7
Calories	35
Carbohydrate	6.4

Gopalan *et al* (2007)

Table B presents mineral composition of okra fruits.

Table B: Mineral composition of okra waste (*Abelmoschus esculentus*)

Parameter	Quantity/mg
Calcium	66
Sodium	6.9
Magnesium	53.0
Phosphorus	56.0
Potassium	103

Gopalan *et al.* (2007)

Okra pod contains seeds which are small in size. The seed coats are succulent when young and hard when mature. The seeds contain a high level of crude fibre. The nutritional quality of the ripe seed is believed to be excellent. Okra seed, for example, is known to be a high-quality protein source, especially when compared to other plant protein sources in terms of essential amino acids. According to Arapitsas (2008), Okra Seeds are high in phenolic chemicals, including catechin oligomers and hydroxycinnamic derivatives. The nutrition content of okra seed revealed that it comprises 21 percent protein, 14 percent fats, and 5% ash. The seed hulls were removed by grinding and sifting, yielding a meal containing 35% protein, 25% fats, and 6% ash. Savello *et al.* (1980) reported that the analysis of chemical composition of okra seed flour revealed a predominance of moisture (69.6%), total carbohydrates (30.81%), protein (22.14%), oil (14.01%) and crude fiber (27.30%). Potassium, Sodium, Magnesium and Calcium were found to be the major elements, while Iron, Zink, Manganese and Nickel are also present (Al-Wandawi, 1983; Moyin-Jesu, 2007). The seeds from two varieties of okra namely, Sabz Pari, Punjab-8 (*Hibiscus esculentus*), grown under similar environment, exhibited moisture content of 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). Oil concentration of okra seeds from Greece was determined to be 15.9 to 20.7 percent, depending on the extraction process, according to Andras *et al*. (2005). Linoleic acid (up to 47.4%) and tocopherol isomers were discovered to be abundant in the oil. In average, the oil content of okra seeds ranges from 20 to 40%. Except for oil palm and soybean, the production of okra seed oil is comparable to that of most other oil seed crops. Okra seed oil may also have a hypocholesterolemic impact. The potential for widespread okra growing for edible oil and cake is enormous. When the oil from the full seed is expended, the cake retains all of the crude fiber. Dehulled seeds seem to be the better form to employ for oil extraction because a high quantity of crude fiber in the diet may interfere with the use of several nutrients. Cereal flour could potentially be fortified with okra seed flour. Supplementing maize pap with okra meal, for example, boosts protein, ash, oil, and fiber levels. Okra seed flour has long been used to supplement corn flour in the production of higher-quality dough in nations such as Egypt. Mineral and vitamin content of okra seed flour has been reported. Its addition to foods with a high carbohydrate content is likely to enrich them and improve their nutritional value (Otunola, *et al.*, 2007; Sanjeet *et al.*, 2010 and. Sorapong, 2012.). Proteins' importance in human nutrition cannot be overstated. Okra seed is a well-known high-quality protein source, particularly in terms of necessary amino acid levels when compared to other plant protein sources. As a result, it is an important part of the human diet. The biological value of a protein is determined by its amino acid composition, quantities, and human digestion. The amino acid composition of okra seed protein is comparable to that of soybean, the PER is higher than soybean, and the amino acid pattern of okra seed protein makes it an adequate supplement to legume in cereal-based diets, according to Ndangui *et al*. (2010) and Adetuyi, (2012), who compared the amino acids of some legume crops with okra seed.

2. MATERIALS AND METHOD

Experimental Materials

okra wastes were gathered at Eke market, Afikpo, Ebonyi state and were cut into sizes, sundried in 7 consecutive sunny days and milled with milling machine (harmer mill) after which they were analyzed for their proximate composition at shalom Laboratory, Nsukka. The materials were then included at 0, 5 ,10 and 15% in the experimental diets.

Experimental Diets

The experimental birds were fed compounded starter and finisher diets. The diets' components are shown in Tables 1 and 2. It is noteworthy that the starter diet did not contain the experimental materials (okra meal).

Table 1: Percentage Composition of the Starter Diet

Ingredient (%)	Maize	Wheat offal	PKC	GNC	Soya bean meal	Fish meal	Bone meal	salt	Methionine	lysine	premix	Total
Quantity (kg)	45.57	5.06	4.51	18.05	20.30	2.26	3	0.5	0.25	0.25	0.25	100

Calculated analysis:		
Crude Protein		23%
Crude Fibre		5.00%
Energy Kcal/kg	3200	

Table 2: Percentage Composition of the Experimental Diets

Feedstuff	T1	T2	T3	T4
Okra waste meal	0.00	2.00	3.99	5.27
Maize	48.97	49.14	49.33	45.54
Wheat offal	5.44	5.46	5.48	5.42
PKC	4.03	2.01	0.00	2.03
GNC	16.14	16.06	15.98	16.22
Soya bean meal	20.17	20.08	19.97	20.27
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	5.00	5.00	5.00	5.00

** To provide the following per kilogram of feed; vit A 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;

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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

GNC =ground nut cake. PKC=Palm Kernel Cake. CP=crude Protein.CF=Crude Fibre.T1= control diet 0% okra meal. T2= 5% okra waste. T3= 10%okra waste and T4= 15% okra waste.

Experimental Birds and Management

Total of 84; Abore acre strains of broilers, aged 28 days with an average weight of 0.83kg ± 0.05kg were used for the study. The Birds were randomly assigned to four treatment groups in a completely randomized design involving dietary inclusion of four levels (0%, 5%, 10% and 15%) of okra waste meal. Each treatment group was replicated trice to obtain a total of 12 replicates of 7 birds each. The chickens were randomly assigned to experimental pens of 1m x 1m each 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.

Measurements and Data collection

Data were collected on the initial body weight, final body weight, average daily weight gain, average feed intake, feed conversion ratio and mortality rate for the growth performance; Live body weight, de-feathered weight, eviscerated weight, thigh weight, wing weight, breast weight, back weight, shank weight, head and neck weight, for the carcass characteristics and total cost of feed/kg weight, total cost of feed consumed/bird, total cost of production/bird, cost of sales/bird, profit made/bird for the cost implication of using the dietary levels of okra waste meal 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 in 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 kilogram of weight gain over the same period.

Determination of the carcass weights was done by starving all the birds over night at day 28 of the experiment, after which twelve birds were randomly selected from all the treatments, one per replicate, they were tagged for identification, weighed, slaughtered by cutting of their throat with sharp knife and were bled. They were de-feathered and weighed again to determine the dressed weight. Eviscerated weight was determined by weighing the left over part after the intestines had been removed. Economic analysis was determined as follows: Total cost of feed ingredient used to formulate 100kg feed = cost of each ingredient x the quantity of the ingredient used in the formulation of 100kg of feed

Total cost of feed/kg = summation of the cost of feed ingredient used to formulate 100kg feed over 100

Total cost of feed consumed = total feed intake per bird × cost of 1 kg diet

3. RESULTS

Proximate composition of experimental diets

Table 3 presents the proximate compositions of the experimental diets.

Table 3: 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	21.00	5.23	5.00	3.90	54.15
T2	13.20	21.00	6.74	5.24	2.72	51.10
T3	14.01	20.98	6.92	6.26	2.11	49.72
T4	11.52	20.98	6.70	6.70	2.41	51.69

T1= control diet 0% okra waste. T2= 5% okra waste. T3= 10% okra waste. T4= 15% okra waste.

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From Table 3, results of the proximate compositions of the diets showed that the crude fibre were 5.00, 5.24, 6.26 and 6.70 for T1, T2, T3 and T4 respectively, all the values obtained were comparable to the recommended 7% for finisher broiler (NRC, 1994) also similar to the values recorded for mature and immature okra meals as reported by Ajayi *et al* 2022. Meanwhile, the crude proteins (%) of 21.00, 21.00, 20.98 and 20.98 for T1, T2, T3 and T4 respectively were in same manner comparable to the (NRC, 1994) crude protein requirements for finisher broilers.

Proximate composition of experimental materials

Table 4 presents the proximate compositions of the experimental material.

Table 4: Proximate composition of okra waste (dry weight bases)

Accessions	Moisture (g/100 g)	Crude protein (g/100 g)	ash (g/100 g)	Crude fiber (g/100 g)	Crude fat (g/100 g)	Carbohydrate. (g/100 g)
Okra waste meal	12.11	15.85	6.36	33.71	1.53	47.80

The results of the proximate compositions of okra waste meal

Table 4 shows that okra waste meal is rich in nutrients such as, crude protein; 15.85, fibre; 33.71 and carbohydrate; 47.80 which are higher than the findings observed for garden egg waste (Ajayi *et al*., 2022). Moreover, the moisture contents, ash and fat 12.11, 6.36 and 1.53 respectively were lower than the values recorded for garden egg waste as reported by Ajayi, *et al* 2022.

Feed Cost per kg and 100kg

The feed cost per kg and 100kg are presented in Table 5

Table 5: Feed cost per kg and 100kg

Ingredient/ cost price/#	Cost price/ #/kg	T1#/kg	T2#/kg	T3#/kg	T4#/kg
Okra waste meal	0.00	0.00	0.00	0.00	0.00
Maize	120	5876.4	5896.8	5919.6	5464.8
Wheat offal	70	380.8	382.2	383.6	379.4
PKC	80	322.40	160.8	0.00	162.4
GNC	135	2178.9	2168.1	2157.3	2189.7
Soya bean meal	180	3630.6	3614.4	3594.6	3648.6
Bone meal	100	400	400	400	400
Salt	100	50	50	50	50
Methionine	3750	937.5	937.5	937.5	937.5
Lysine	1800	450	450	450	450
Premix	1800	450	450	450	450
Total/100kg/#		14676.6	14509.8	14324.6	14150.4
Total/kg/#		146.766	145.10	143.25	141.50

GNC =ground nut cake. PKC=Palm Kernel Cake. T1= control diet 0% okra waste. T2= 5% okra waste. T3= 10% okra waste and T4= 15%okra waste. # = Naira.

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

Data on growth performance of broiler chickens fed varying dietary levels of okra waste meals is presented in Table 6.

Table 6: Growth performance values of finisher broiler chickens fed varying dietary levels of okra waste meals.

Parameter	T1	T2	T3	T4
Initial weight kg	0.90± 0.1	0.89± 0.0	0.90± 0.1	0.90 ± 0.1
Average Final live weight/kg	2.44± 0.2^{a}	2.43 0.1^{a}	2.29± 0.3^{ab}	2.14± 0.2^{b}
Average daily weight gain/kg	0.038± 0.0^{a}	0.038± 0.0^{a}	0.035± 0.0^{ab}	0.031 ± 0.0^{b}
Daily feed intake/kg/bird	0.16± 0.0	0.15±0.0	0.14± 0.0	0.16 ± 0.0
Feed conversion ratio	0.60± 0.0^{a}	0.59±0.2^{a}	0.62± 0.5^{a}	0.73 ± 0.3^{b}
Mortality	0.00± 0.0	0.00±0.0	0.00± 0.0	0.00 ± 0.0

^{a,b,} Different superscripts within each row indicate significant differences ($p < 0.05$) (n =10).

T1= control diet 0% okra waste. T2= 5% okra waste. T3= 10% okra waste. T4= 15% okra waste.

The average final weight and average daily weight gain of the experimental birds had significant lower values ($P < 0.05$) when the mean values recorded for the treatment 4 was compared with the control. However T2 and T3 had similar values with the control. For the daily feed intake and mortality; there were no significance differences ($P > 0.05$) among all the treatments. However, the feed conversion ratio of treatment 4 had higher significant ($P < 0.05$) value than all other treatments.

Carcass characteristics of broiler chickens fed varying dietary levels of okra waste.

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

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

Parameter	T1	T2	T3	T4
Final Body Weight(kg)	2.35±0.1^{ab}	2.05±0.2^{ab}	1.85±0.1^{abc}	1.55±0.2^{c}
Dressed Weight(kg)	2.05±0.1^{a}	1.85±0.2^{ab}	1.65±0.1^{abc}	1.30±0.1^{c}
Eviscerated Weight(kg)	1.55±0.1^{a}	1.38±0.1^{ab}	1.30±0.1^{ab}	0.88±.02^{b}
Breast Weight(kg)	0.40±0.1^{b}	0.45±0.1^{b}	0.30±0.1^{c}	0.25±0.1^{d}
Thigh weight(kg)	0.45±0.1^{ab}	0.45±0.1^{ab}	0.35±0.1^{bc}	0.25±0.1^{c}
Back weight(kg)	0.25^{+}0.1^{bc}	0.20±0.0^{c}	0.25±0.1^{bc}	0.20±0.1^{c}
Head and Neck(kg)	0.20±0.1	0.13±0.1	0.20±0.1	0.06±0.1
Wing(kg)	0.25±0.1	0.15±0.1	0.20±0.0	0.13±0.1

^{a,b,c} Means with different superscripts within each row indicate significant differences ($P < 0.05$) (n =10). Without superscript = not significant. T1= control diet 0% okra waste. T2= 5% okra waste. T3= 10% okra waste. T4= 5% okra waste. T5= 10% okra waste,

For the final body weight, dressed weight, eviscerated weight, breast weight and backweight; no significant difference ($P > 0.05$) was observed when the T2 and T3 were compared with the control values. However, T4 had the least significant values ($P < 0.05$) on these parameters. For the back weight; wing, head and neck; no significant differences were observed among all the treatments ($P > 0.05$).

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

Effect of waste okra meal on economic analysis of finisher broiler chickens is presented in table 8.

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

Parameter	T1	T12	T3	T4
Cost of day old chicks/#	450	450	450	450
Cost of feed/kg/#	146.77	145.10	143.25	141.50
Average final weight/kg	1.54^{a}	1.54^{a}	1.39^{b}	1.24^{b}
Feed intake cost(#/bird)	657.50^{a}	609.42^{a}	561.54^{b}	633.92^{b}
Feed cost/kg weight gain(#)	394.5^{a}	359.56^{b}	348.16^{b}	462.16^{ab}
Cost of production(#/bird)	1057.53^{a}	1003.76^{ab}	933.94^{b}	1023.08^{a}

^{a,b,cd,e} Different superscripts within each row indicate significant differences ($p < 0.05$) . Without superscript = not significant. T1= control diet 0% okra waste. T2= 5% okra waste. T3= 10% okra waste. T4= 15% okra waste.

No significant differences ($p > 0.05$) were observed when the costs of diets containing okra waste at all inclusion levels when compared to the cost of the control feeds. However, the costs of feed intake and average final weight of treatments 3 and 4 were significantly decreased when compared to the control values. For the cost of feed/kg weight gain; treatments 2 and 3 were significantly lower ($p < 0.05$) than the control value. However, the total cost of production/bird for the treatment 3 had a significant lower value ($p < 0.05$) than other treatments.

4. DISCUSSION

Performance of broiler chickens fed varying dietary level of okra waste meal

As shown in tables 6, there were significant differences among dietary treatments on growth performance of the experimental birds (p<0.05

For the Average final weight and Average daily weight gain, the values recorded for the birds on 15% okra waste meal were significantly (p<0.05) decreased when compared to the control. This is an indication that the experimental diet was not maximally utilized at this inclusion level by the chickens in this study, the poor performance of the chickens could be attributed to high level of fibre and anti-nutritional factors such as tannin presence in the diets. This result is in line with the report of Aletor, 1993 that, tannin in the biological system has the ability to chelate protein thereby impeding digestion. For the average Daily feed intake and mortality, no significant difference (P>0.05) was observed when the control values when compared with all the treatments. This is an indication that the finishing broiler chickens accepted the experimental diets at all the inclusion levels. The maximum acceptability of the diet at these inclusion levels could be attributed to the fine texture of the experimental materials which made it unnoticeable in the diets.

For the feed conversion ratio, the birds on 15% inclusion of okra waste meal had higher significant mean value than other treatments. This is an indication that finisher broilers can only convert up to 10% inclusion of okra waste when fed into high quality meat. The good performance of all the experimental materials in this study might be attributed to the processing method of the experimental materials; the methods of milling (fine meal) may also have contributed to the high degree of absorption which facilitated the degree of conversion of the nutrients into muscles. These agree with the report of Okorie, 2006 who argued that the method of milling may have aided the buildup of the muscular and structural tissues of the experimental broilers.

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

As shown in table7, the Live body weight, dressed weight, eviscerated, breast weight and back weight had no significant difference (p>0.05) when the birds on 5% and 10% okra waste were compared with the control birds. The similar values recorded for the control, T2 and T3 is evidence that the experimental diets were well utilized by the finisher broilers. The optimum conversion of the diet to meat at these inclusion levels could be attributed to the facilitation of the dietary nutrient balanced in the experimental diets.

Cost analysis of broiler chickens fed varying dietary level of okra waste meal

As shown in table 8, there were significant differences among dietary treatments.

No significant difference was observed when all the inclusion levels of okra waste meal were compared to the control for the cost of feed/kg. This is an indication that okra waste meal was used to formulate comparable cheap diets with the control up to 15% inclusion. The favorable comparism between these treatments was as the result of the fact that the proximate composition of okra waste varied from that of other ingredients such as maize, palm kannel cake and groundnut cake which highly influenced the composition of the experimental diets

For the cost of feed intake final weight gain; The values recorded for the control were significantly higher than what was observed for treatments 3 and 4. The increase could be attributed to the high inclusion levels of the conventional feeding stuff such as maize, GNC and PKC in these diets to ensure balanced diets for the birds. This agrees with (Damron and Sloan, 1998). Who argued that An ideal broiler diet is one that will maximize production at the least cost. However, 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.

For the cost of feed/kg weight gain; treatments 2 and 3 were significantly lower ($p < 0.05$) than the control value. However, the total cost of production/bird for the treatment 3 had a significant lower value ($p < 0.05$) than other treatments. For feed cost/kg weight, the values observed for T2 and T3 were significantly lower than the control value. Furthermore, the total cost of production/bird for the treatment 3 had a significant lower value ($p < 0.05$) than other treatments. This is an indication that the birds on 10% inclusion of okra waste were raised with the least cost without compromising growth performance. The significant lower value recorded for birds on 10% inclusion level could be attributed to the fact okra wastes were picked without any cost for this study.

5. CONCLUSION AND RECOMMENDATION

The results of the present study showed that okra waste meal can be incorporated up to 10% in feeding of finisher broiler without compromising their growth. The results demonstrate that the observed benefits can be achieved without compromising economic profits only with the incorporation of 5% and 10% okra meals. The findings of this study are evidence that the use of okra waste at 5% and 10% inclusion level will make okra waste to be ideal for broiler production. The utilization of okra waste will also be an efficient means of averting the environmental hazard and danger likely to be posed by the increasing generation of the okra waste in the market places and communities where they are grown. The resultant effect will lead to attainment of food security.

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