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Evaluation of Growth Performance, Carcass, Organ Characteristics and Digestibility Coefficient of Finisher Broiler Chicken-fed Varying Levels of Fennel Seed Powder

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Abstract

A 28-day trial was conducted to evaluate the impact of different levels of fennel seed powder as a feed additive on the growth performance, carcass yield, internal organ characteristics, and nutrient digestibility of finisher broiler chickens. The study involved 200 finisher broiler chickens divided into four groups of 50 birds each. Four experimental diets were formulated with fennel seed powder at 0g, 150g, 300g, and 450g per 100kg of feed, labeled as T_1, T_2, T_3, and T_4, respectively. The treatment groups were further sub-divided into five replicates with 10 birds in each group. Collected data were subjected to analysis of variance. The results indicated significant differences ($p<0.05$) in final weight gain (FWG), daily weight gain (DWG), and feed conversion ratio (FCR) among the groups. Birds in T_4 group showed the highest FWG and DWG values ($p<0.05$). Additionally, T_4 had the lowest FCR values ($p<0.05$), significant differences in feed intake ($p<0.05$) were similarly observed. Significant differences ($p<0.05$) were recorded in dressed weight, live weight, dressing percentage, and various cut-parts for the birds, birds in T_4 recorded superior values for all carcass traits. The internal organs were not affected by the feed ($p>0.05$). However, the diet significantly influenced abdominal fat, with T_4 showing the lowest values ($p<0.05$). The nutrient digestibility coefficients were significantly affected by the diet, with T_4 showing the highest values in all proximate composition parameters analyzed ($p<0.05$). It was concluded that adding fennel seed powder at 450g per 100kg of feed can enhance the growth performance, carcass quality, internal organ traits, and nutrient digestibility of broiler chickens.

Key words: Performance, carcass, internal organs, digestibility, broiler chickens, proximate composition.

1.0 Introduction

Poultry products (meat and eggs) have been quick and valuable sources of high-quality animal protein. The Consumption of these products has become a perfect avenue to enhance human health because of their high nutritive value (Alphonsus *et al*., 2012; Sam *et al*., 2019; Akpa *et al.*, 2010). All round availability of these products depends on employing vital

production strategies such as provision of high-quality feed, use of feed additive, prevention of diseases and observing sound management practices (Essien and Udoh 2021).

Feed is known to contribute 60 – 70% of the entire cost of intensively reared poultry (Lawrence *et al.,* 2008; Essien *et al*., 2022a, Christopher *et al.,* 2023). Feed additive such as antibiotics growth promoter has been added to poultry diet to improve performance and also prevent diseases. Unfortunately, the massive and abusive use of these antibiotics' growth promoter has been implicated with negative report on human health which has led to its being banned by the European Union in 2006 (Eu-Wide 2005).

Recently, spices and their product are beneficial to man and animal due to their nutritional and medicinal properties (Czarra, 2009). Several research have shown the gainful impacts of spices and herbal products in livestock production and feeding (Okon *et al*., 2022; Solomon *et al*., 2022; Essien *et al*., 2022b; Essien 2021; Okon *et al*., 2023). Plants have been reported to contain antinutritional substances such trpsin inhibitors, saponins, alkaloids, tannin, phytate, oxalate, polyphenol, flavonoid etc (Udedibie *et al* 2005; Essien and Udedibie, 2007). The physiological evaluation of herbs, spices and their essential oil in poultry feeding has revealed strong effect as substitute for natural growth stimulant (Al-Wendawi and Gharb, 2021; Rahman *et al.,* 2020; Essien, 2021).

Spices and herbal products are available in different forms: rhizomes, bulb, nut, seeds leaves and fruit. They contained numerous bio-active compounds which are responsible for their various nutritional and pharmacological properties. Spice and herbs have been reported to enhance feed taste by their strong aroma, increase production of digestive enzymes, improve utilization of digestive products through enhance liver function, improve immune system response (Iqbal *et al.,* 2001; Hermandes *et al.,* 2004, Ramakrishna *et al.,* 2003) thus could be regarded as effective growth alleviating agents.

Fennel (*Foeniculum Vulgae*) is a plant from Apiaceae family. It is a medicinal plant with a distinctive aroma, which is used in traditional medicine as a spice. The fruits, seeds and leaves of fennel plant contained some health promoting essential oil such as fenchone, anehole myrene limonene, chaviicol, cinole, anisic, aldelyde and pinene (El-Deek *et al.,* 2003). Fennel seed is rich in amino acid, flavonoid, fatty acid (linoleic and stearic) and some phenolic compounds (El-Deek *et al.,* 2003). Bio-active compound, presence in fennel seeds is responsible for its numerous pharmacological activities which include antioxidant, antimicrobial, antispasmodic, anti-inflammatory, hepato protective and apopiotic functions. Some researchers have reported the beneficial effect of fennel seeds in the diet of poultry, which include, enhance performance in broiler chickens' diet, and improved egg quality in laying hens (Mohammed and Abbas, 2009). The objective of this study was to evaluate the influence of supplementing fennel seeds in broilers diet on performance, carcass characteristics, integral organ weights and digestibility coeffient of broiler chickens.

2.0 Materials and Methods

2.1 Experimental Site

The study was conducted at the Teaching and Research Farm, Department of Animal Science, Faculty of Agriculture, Akwa Ibom State University, Obio Akpa Campus. Obio Akpa is situated between latitudes 4°30'N and 5°00'N and longitudes 7°30'E and 8°00'E. The area experiences annual rainfall ranging from 3500 to 5000 mm, an average monthly temperature of 25°C, and relative humidity between 60% and 90% (AKSG, 2024).

2.2 Source and Processing of Experimental Material

Fennel seeds for this research were purchased from Itam Market, located in Itu Local Government Area of Akwa Ibom State. The fennel seeds were milled to powder through the use of hand blender (Corona 1016, Landersy Y. CIA South Africa).

2.3 Proximate and Phytochemical Analysis of Fennel Seed Powder

A 10g sub-sample of fennel seed powder was taken to the laboratory for proximate analysis to determine crude protein, lipid, crude fiber, and ash, following the guidelines provided by AOAC (1995). Phytochemical analyses for saponin, alkaloid, flavonoid, polyphenols, and tannin were conducted using the methods described by Harborne (1993) and (1998).

2.4 Experimental Diets

Total of 4 experimental diets for broiler finishers were compounded and labeled T_1, T_2, T_3, and T4. Treatment one (T_1) designated as the control, contained no fennel seed powder, while T_2, T_3, and T_4 included 150g, 300g, and 450g of fennel seed powder per 100kg of feed, respectively. Nutrient composition of the experimental diets is presented in Table 1.

2.5 Management of Experimental Animals

Two hundred unsexed Arbor Acre one day old broiler chicks were bought from a recognized poultry vendor in Itam, Itu LGA. Chicks were brooded together for two weeks and fed a diet free of fennel seed powder until the 27th day. On the 28th day, the birds were weighed and divided into four groups of fifty birds each, each group given one of the treatment diets in a Completely Randomized Design. Each group was further subdivided into five replicates of 10 birds. The birds were housed in pens measuring 2m by 2m, with wood shavings used as litter material. Feed and water were given ad libitum in suitable drinkers and feeders. Strict sanitation practices were maintained daily, and all vaccines were given accordingly. The feeding trial lasted for 28 days.

2.6 Data Collection

Body weight of birds was measured weekly using a 20kg capacity weighing scale (Hana Spring – Platform Scale). Feed intake was obtained by using the leftover feed from quantity provided the previous day. The feed conversion ratio (FCR) was calculated based on daily weight gain.

2.7 Carcass and Organ Weight Evaluations

Two birds from each replicate were randomly selected after the experiment. The selection was done to ensure equal weight basis and the selected birds were starved of feed overnight. Weights of the birds were recorded, birds were killed by cutting the jugular vein, and allowed to bleed. Then scalded in hot water (70-75°C) for one minute, and feathers were removed manually. The carcasses were eviscerated and weighed to determine carcass yield. Primal cut-parts (thigh, drumstick, shank, back, wing, and breast) were weighed, recorded, and expressed as a percentage of dressed weight. The weights of the organs (gizzard, liver,

kidney, and heart) and abdominal fat were recorded and expressed as a percentage of live weight.

2.8 Apparent Nutrient Digestibility Study

When the feeding trial ended, two birds per replicate were placed in individual metabolic cages equipped for feeding, drinking, and droppings collection. The birds were given five days to adjust to the new environment before the digestibility trial began. An amount of feed was provided to the birds. Droppings were collected and oven-dried at 60°C for 24 hours over five days. The bulked droppings were ground and samples taken to the laboratory for proximate analysis of dry matter, crude protein, crude fiber, ether extract, ash, and nitrogen-free extract. Apparent nutrient digestibility was calculated using the formula:

$$Apparent\ Nutrient\ Digestibility\ =\ \frac{Nutrient\ in\ Feed\ -\ Nutrient\ in\ Faecese\ x\ 100}{Nutrient\ in\ Feed}$$

Equation 2.1

2.9 Data Analysis

Data generated from this study were analyzed with ANOVA using SAS (2002), and significant means were separated using Duncan's Multiple Range Test (Duncan, 1955).

Table 2.1: Ingredients and Nutrient Composition of Broiler Finisher Diet

Ingredients	T_1(0gFsP)	T_2(150gFsP)	T_3(300gFsP)	T_4(450gFsP)
Yellow maize	55.00	55.00	55.00	55.00
Soyabean meal	26.00	26.00	26.00	26.00
Fish meal	3.00	3.00	3.00	3.00
Wheat offal	6.00	6.00	6.00	6.00
Palm kernel cake	5.00	5.00	5.00	5.00
Bone meal	4.00	4.00	4.00	4.00
Common salt	0.25	0.25	0.25	0.25
Vitamin/mineral premix	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**
Calculated Chemical Composition (%Dm)				
Crude Protein	21.13	21.13	21.13	21.13
Ether extract	4.32	4.32	4.32	4.32
Crude fiber	3.96	3.96	3.96	3.96
Ash	5.25	5.25	5.25	5.25
N-free extract	65.34	65.34	65.34	65.34
ME (Mcal/kg)	2911.02	2911.02	2911.02	2911.02

*FSP – Fennel Seed Powder, N-Nitrogen

3.0 Results and Discussion

3.1 Proximate and Phytochemical Composition of Fennel Seed

The results of the proximate composition of fennel seed are presented in Table 3.1. The result showed that fennel seed contained crude protein (7.73%), ash (8.03%), crude fibre (9.04%), ether extract (7.21%), nitrogen free extract (49.78%) and moisture (23.89%). The value for ash 8.03% revealed that fennel seed is rich in minerals. Minerals are known to play crucial roles in the body. They form parts of the skeletal structure, connective tissues, blood cells, fluid and all biological oxidation systems (Aduku, 2004). Their deficiency or absence in the body may result in structural and physiological abnormalities (Banerjee, 2018). The value for crude protein 7.73% was lower than the values obtained by Aamir-Shehzad (2014), ether extract 7.21% obtained in this research is lower than (9.76%) reported by Hina *et al.,* 2014. These variations in values reported by these authors could arise from varied environmental conditions, geographical locations and analytical methods employed (Ekpo *et al.*, 2022; Ekpo and Okon, 2022). Phytochemical composition of fennel seed revealed that it contains alkaloid (2.42%), flavonoid (3.51%), saponin (1.43%), tannin (1.36%) and phenol (3.44%). These are a group of plant bioactive compounds that provide health benefits in animals and humans. Tannin has been reported to inactivate microbial adhesin enzymes, stimulate phagocytic cells (Haslam, 1995). Saponin possesses anti-microbial ability, anti-carcinogenic, and decreases cholesterol and triglyceride levels in the blood (Mohan *et al.*, 2016). Alkaloids show anti-inflammatory, antimicrobial and antifungal effects and occur in organic compounds which contain nitrogen atoms. Phenols and flavonoid help to lower the triglyceride and cholesterol in the body. They act as antioxidants.

Table 3.1: Proximate Composition of Fennel Seed

Parameters	Composition (% Dm)
Moisture	23.89
Ether extract	7.21
Ash	8.03
Crude fibre	9.04
Crude protein	7.73
Dry matter	81.79
NFE	49.78
Anti-nutrient	
Phenol	3.44
Tannin	1.36
Saponiin	1.43
Flavonoid	3.51
Alkaloid	2.42

3.2 Performance of Birds Fed Varying Level of Fennel Seed Powder at the Finisher Phase

The result of the performance of finisher broiler chickens is shown in Table 3.2. Significant effect was observed in the final body weight and weight gain. The birds on T_4 recorded the highest significant final weight and weight gain values followed by those on T_3 which were significantly higher than T_2 and T_1. The value for T_2 was higher than T_1 but did not differ statistically. The higher value obtained in T_4 could be attributed to the beneficial effect of fennel seed powder as spice. Spices can stimulate the secretion of digestive enzymes and facilitate effective absorption of nutrients thus resulting in rapid growth (Wenk, 2003). However, this result agrees with the report of Mohammed and Abbas (2009) who recorded a

significant increase in final weight values of broiler chicken fed fennel seed powder. Also, Abou- Elkhair and Hussein (2018) reported higher body weight gain of laying hens fed a diet supplemented with fennel and black cumin seed at 300g/100kg. The values obtained in this study for final body weight is in consonance with the reports of Sam and Okon (2022) who reported similar final body weight in Arbor Arce strain of broiler chicken.

Significant effect was observed in the feed intake of birds fed 450g, 300g and 150g fennel seed powder. The feed intake of birds fed diet supplemented with fennel seed powder were significantly higher than the control. This could suggest that the diets were palatable and fennel seed could contain compounds or substances that stimulate feed intake (Gende *et al.,* 2009).

The feed conversion ratio of the birds was significantly affected by the diets. Birds fed 450g of fennel seed powder had the best feed conversion ratio followed by birds in a 300g group. The results in this study are in line with (Lee *et al.*, 2004) who opined that spices are known to improve performance in poultry through their impact on gut function resulting in a more stabilized intestinal health. Also, Wenk (2003) reported that spices stimulate the secretion of digestive enzymes and increase or improve the absorption of digestive nutrients.

Table 3.2: Growth performance of finisher Broiler Chickens fed Diet Containing Fennel Seed Powder (Foeniculum Vulgare)

Ingredients	T_1(0gFsP)	T_2(150gFsP)	T_3(300gFsP)	T_4(450gFsP)	SEM
Initial Weight (g)	840.00^{d}	840.06^{c}	840.03^{b}	840.07^{a}	0.01
Final Weight (g)	2001.33^{c}	2064.66^{c}	2124.00^{b}	2288.66^{a}	1.31
Weight gain (g)	1167.33^{c}	1224.60^{c}	1283.96^{b}	1448.60^{a}	1.48
Daily Weight gain (g)	41.68^{c}	43.74^{c}	45.85^{b}	51.73^{a}	1.55
Total feed intake (g)	3028.00^{c}	3127.32^{c}	3141.33^{b}	3187.33^{a}	0.0
Daily feed intake(g/d)	108.13^{c}	111.68^{c}	112.18^{b}	113.83^{a}	0.01
Feed conversion ratio	2.59^{C}	2.55^{c}	2.44^{b}	2.20^{a}	0.10

abc - means on the same row with different superscript are significantly different ($p<0.05$)
FSP – Fennel Seed Powder, SEM – Standard Error of Mean

3.3 Carcass Characteristics of broiler birds fed varying level of fennel Seed Powder at Finisher Phase

The result of the carcass and internal organs of finisher broiler chickens fed diets containing varying levels of fennel seed powder is presented in Table 3.3. The live weight, dressed weight and dressing percentage of the birds were significantly influenced by the diet with birds fed 450g of fennel seed powder recording the highest value for the three parameters. This result could be linked to the synergetic effect reflecting in the values of final body weight and daily weight again of the birds, where birds fed 450g of FSP had the highest final weight and daily weight gain values. The result of this research is in consonant, with the result of El-Hack *et al.,* (2015) who recorded better live weight values of broiler chicken, fed fennel seed powder over the control. Also, Hujaz *et al.* (2015) recorded higher significant values ($p<0.05$) in dressed weight of broiler chickens fed fennel seed powder at 2.5g/kg of feed compared to the control. However, this result showed a positive effect of fennel seed powder on carcass weight. Similar effect was observed in the dressing out percentages of the birds. Bird fed 300g fennel seed powder in this study recorded the highest dressing out percentages than the rest of the groups. However, the values obtained across treatment fell within the recommended range 60.30 – 74.65% for broiler chickens (Onibi *et al.,* 2009). The

result is in tandem with Tariq *et al.,* (2015) report who recorded a significant increase in dressing percentage of broiler chickens fed fennel seed powder compared to birds in the control.

The primal cut-parts were significantly influenced ($p<0.05$) by the diet with broiler chickens fed 450g fennel seed powder recorded the highest values for wing, breast, thigh and drumstick. This result could reflect a link between final weight and dressed weight as the heaviest group of birds produced better cut-parts weights.

Mansoub (2011) observed that herbal plants enhance carcass quality through effective nutrient utilization, higher and efficient absorption of amino acids which enhances protein metabolism and muscle deposition in birds. Doleyi *et al.* (2014); Tariq *et al.* (2015) reported significant increase in thigh and breast weights of birds fed fennel seed powder at 450g/100kg.

The internal organs of the birds (heart, liver, kidney and gizzard) were not significantly affected by the diets. There were no observable abnormalities on the internal organs of the experimental chickens. Liver and kidney function in the elimination of toxins and metabolic waste in the body. The heart is involved in the circulation of blood to all parts of the body while the gizzard helps in the grinding of feed particles. Higher gizzard weight may be as a result of coarseness of feed and presence of hull and fibre in feed. The result of the internal organs of the experimental chickens as in this research showed that the birds were able to perform their biotransformation functions.

Abdominal fat of the experimental chicken was significantly ($p<0.05$) affected by the diet. Birds fed 450g of fennel seed powder recorded significant reduction in abdominal fat values compared to the rest of the treatment. The highest value was obtained in control. This result could suggest antioxidant properties and activity in fennel seed powder because of the presence of flavonoid. Flavonoid is known to inhibit lipid peroxidation thereby reducing the formation of free fatty acid in the body.

Table 3.3: Carcass and Internal Organ Characteristics of Broiler Finisher Chickens fed Diet Containing Fennel Seed Powder (*Foeniculum vulgare*)

Ingredients	T_1(0GFSP)	T_2(150GFSP)	T_3(300GFSP)	T_4(450GFSP)	SEM
Live weight (g)	2007.33^c	2024.66^c	2124.00^b	2288.66^a	0.62
Dress weight (g)	1533.66^c	1552.43^c	1676.42^b	1845.23^a	1.16
Dressing %	76.40^c	76.68^c	78.92^b	80.64^a	1.34
Primal cut-parts (% dressed weight)					
Breast	24.36^c	24.57^c	27.41^b	30.36^a	1.41
Back	11.30^c	11.36^c	13.59^b	15.96^a	0.10
Thigh	10.43^c	11.01^c	13.03^b	15.71^a	0.34
Drumstick	11.53^c	12.03^c	14.51^b	17.01^a	0.46
Wing	9.10^c	9.35^c	11.03^b	14.41^a	0.33
Internal Organs (% Live Weight)					
Liver	0.23	2.41	2.30	2.44	0.02
Kidney	0.09	0.11	0.14	0.14	0.01
Gizzard	2.41	2.39	2.37	2.44	0.03
Heart	0.31	0.41	0.38	0.42	0.01
Abdominal fat	2.36^a	2.13^b	1.46^c	0.63^d	0.21

abc - means on the same row with different alphabets are significantly different ($p<0.05$)
FSP – Fennel Seed Powder, SEM – Standard Error of Mean

3.4 Nutrient Digestibility Coefficient of Broiler Chicken Fed Varying Level of Fennel Seed Powder

The result of the nutrient digestibility coefficient is presented in Table 3.4. Significant differences ($p<0.05$) were observed with birds fed diet supplemented with fennel seed powder at 450g and 300g levels. Birds fed 450g of fennel seed powder recorded highest nutrient digestibility coefficient values for crude protein, ether extract, ash and crude fibre followed by birds fed 300g of fennel seed powder. Higher values were recorded with birds fed 300g of fennel seed powder over 0g (control) group but they were statistically similar. This result indicated a better nutrient utilization by birds fed diet supplemented by fennel seed powder. Herbs, spices and their essential oil are known to improve digestion and enhance the utilization of digestive products (Zhang *et al.*, 2009; Greathead, 2003).

Table 3.4: Nutrient digestibility coefficient of the broiler finisher chickens fed fennel seed powder

Parameter (%)	T_1(0GFSP)	T_2(150GFSP)	T_3(300GFSP)	T_4(450GFSP)	SEM
Dry matter	88.35^{d}	88.41^{c}	90.41^{b}	92.43^{a}	1.23
Crude Protein	78.56^{d}	79.35^{c}	84.34^{b}	86.51^{a}	3.14
Ash	78.91^{d}	78.63^{c}	84.53^{b}	88.01^{a}	2.31
Crude Fibre	78.65^{d}	79.11^{c}	81.41^{b}	82.37^{a}	1.04
Nitrogen free extract	82.14^{d}	81.57^{c}	83.32^{b}	85.51^{a}	0.15
Ether extract	78.21^{d}	80.51^{c}	85.43^{b}	89.63^{a}	1.35

abc - means on the same row with different superscript are significantly different ($p<0.05$), FSP – Fennel Seed Powder, SEM – Standard Error of Mean

4.0 Conclusion

The research indicated that fennel seed powder could be used as alternative feed additive in poultry nutrition at 450g/kg feed to enhance performance, carcass yield, internal organs characteristics and nutrient digestibility coefficient of finisher broiler chickens.

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