Nigerian Journal of Animal Science and Technology
Nig. J. Anim. Sci. Tech. Vol. 6 (3) 1- 12 (2023)
Available @ www.njast.com.ng

Carcass Yields and Economics of Broiler Chickens Production on Garlic (*Allium Sativum*) and Ginger (*Zingiber Officinale*) Powders Additives

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Abstract

An eight-week study was carried out to assess the effects of garlic and ginger on the carcass yield and economics of broiler production. Ninety-nine (99) day-old Abor acre chicks were allotted in completely randomized design to three treatments comprising T_1 (control), T_2 (1% garlic) and T_3 (1% ginger). Each treatment was replicated thrice with 11 chicks per replicate. Acclimatization to the environment lasted for 1 week. The birds received the experimental diets for 8 weeks, during which the cost of all inputs was recorded. On the last day of the study, a bird per replicate was randomly selected for humane slaughtering and dressing. The data were subjected to analysis of variance and means separated with Duncan's New Multiple Range Test. The results of carcass yield showed that the garlic and ginger treated groups significantly ($p<0.05$) performed better than the control except for the intestine and abdominal fat ($p>0.05$) weights. However, there were no significant differences ($p>0.05$) among the treatments with respect to back, gizzard and neck. The cost of feeding and cost of production of the control were the lowest and differed ($p<0.05$) from the garlic and ginger treated groups. Because of the significantly ($p<0.05$) greater weight gain by the garlic and ginger treated groups and mortality rates in the control group, the return on investment favoured the treated groups significantly ($p<0.05$). It can be concluded that garlic and ginger at inclusion level of 1 % each, enhanced carcass yield and accrued more gain to the farmer.

Keywords: Broiler chickens, Garlic, Ginger, Carcass yield, Economics

Introduction

Broiler chickens are one of the fastest sources of meat growth in the world. Nigeria's climatic conditions are characterized by high temperature and humidity, providing conducive environment for multiplication and transmission of pathogenic organisms/diseases to animals including broiler chickens. Therefore, antibiotics are used to prevent and treat these diseases. Antibiotic growth promoters (AGPs), whose use in consumable animals has been banned in most parts of the world, are frequently used as growth promoters in poultry industry. However, there has been a growing concern about the negative effects of AGP and its residues in meat products as well as its impartation of antibiotic resistance to the consumers.

It is therefore pertinent that farmers start to find alternatives for antibiotics, such as probiotic, acidifier and phytobiotic. These substances do not leave residual traces in meat; hence, healthier as a feed additive (Lillehoj *et al*., 2018; Pertiwi and Dadi, 2020). According to Ogle (2013), antibiotics were mostly used at sub therapeutic doses to promote growth and improve feed efficiency in the intensively managed livestock. However, this resulted to myriads of health issues such as resistance to the drugs and

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resistant strains that became zoonotic. Thus, the emergence of antibiotic resistance pathogenic bacteria led to international restriction on the use of antibiotics in animal production. This necessitated the search for viable alternatives such as herbal products which according to Salihu *et al*. (2020) may serve as environmentally friendly alternative to antibiotic growth promoters (AGPS) in poultry feeds. Phytogenic feed additives (PFA) derived from herbs, spices or aromatic plants are relatively later classes of feed additive that have gained considerable attention in the recent years in the feed industry (Dhama *et al.,* 2014; Abd El-Hack *et al.,* 2016; Alagawany *et al*., 2016). This plant derived products are residue-free unlike synthetic antibiotics and are also generally considered safe to be used as the ingredients in the food industry as well as in animal diet as an ideal growth promoter (Li *et al*., 2016).

Bhardwaj *et al.* (2009), Singh *et al*. (2018) and Tugiyanti and Susanti (2022) had earlier reported that plant additives possess digestion stimulating properties by controlling bacteria as well as improves productive performance and the quality of livestock products. Also, Bedford (2000) reported that herbs reduce some harmful bacteria in the gastro-intestinal tract of broilers which leads to higher efficiency and utilization of feed and consequently higher weight gain. Ginger and garlic supplements in broiler chicken diets have been recognized for their strong stimulating effects on the immune and digestive systems in birds (Al-Shuwaili *et al*., 2015), acting as prebiotic with positive effects on the immune response (Qorbanpour *et al*., 2018). Recent research works on ginger and garlic formulations as feed additives have shown encouraging results with regards to weight gain, feed efficiency, lowered mortality and increased liveability in poultry birds (Shinde *et al*., 2017; Abd El-Hack *et al*., 2020). Different supplemental levels of garlic and ginger have been tried in the diets of birds and the most consistent results were obtained at about 1% level (Puvaca *et al*., 2014; Karangiya *et al*., 2016). This work was, therefore, conceived to assess the carcass yield as well as the economics of using garlic and ginger as feed additives in broiler chicken production.

Materials and Methods

Experimental Site and Ethical Consideration

The experiment was carried out at the Poultry Unit of the student's project site of the Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan, Oyo State, Nigeria. Ibadan is located approximately on longitude 3° 5' to 4° 36' E and latitude 7° 23' to 7° 55' N (Oladele and Oladimeji, 2011). Ibadan has a tropical wet and dry climate, with a lengthy wet season. It has mean total rainfall of 9,233.60 mm, mean maximum and minimum temperatures of 39.82 °C and 22.5 °C respectively (Egbinola and Amobichukwu, 2013) and relative humidity of 74.55%. Ethical conditions governing the conduct of experiments with life animals were strictly observed as stipulated by (Ward and Elsea, 1997). The experimental protocol was approved by the institution's ethical committee for the use of animals for experiment.

Test Ingredients and the Preparation

Ginger and garlic were purchased fresh from Oja-Oba market in Ibadan. Their rinds and husks were peeled off, washed, cut into smaller pieces and sun-dried. They were ground with domestic electric grinding machine (Sonik® Model SB-464) to fine powder and sieved by 1 mm sieve for feed compounding.

Birds, Management and Experimental Design

Ninety-nine (99) day-old unsexed Arbor-acre broiler chicks were purchase from CHIMERO Farm LTD in Ibadan for the study. Prior to the arrival of the birds, the deep litter pens were cleaned and washed with detergent solution. Disinfection of the pen was done using saponated cresol (Lysol®), and the pens were left without stocking for one week and the floor litter laid to 5 cm deep with wood shavings. On arrival of the chicks, anti-stress solution (mixture of water, glucose and vitalyte® vitamins premix) was served as well as control diet and borehole water *ad libitum* for the 7-day acclimatization period. Routine vaccinations (Newcastle disease vaccine (NDV) intra-ocular, Lasota and Infectious bursal disease (IBD)) were administered accordingly. IBD vaccine was repeated on day fourteen. After acclimatization, the birds were allocated to three treatments in a completely randomized design. Each treatment was replicated three times with eleven chicks each. The treatments were identified as T_1 (control, no garlic or ginger), T_2 (1% garlic in the diet) and T_3 (1% ginger in the diet). They were fed with the treatment diets *ad libitum* throughout the experimental duration of 8 weeks under standard environmental conditions (a 12 h/12 h light/dark cycle). A switch from starter to finisher feeds took place after 4 weeks of age. The care and handling of the chickens were in accordance with international accepted guidelines for use of animals (Vogel *et al*., 2002).

Data Collection

Cost of ingredients for feed formulation: The cost of ingredients for feed formulation were recorded to aid cost-benefit analysis.

Feed intake: Daily feed intake was equally recorded using weigh-back mechanism, to ascertain the quantity of feed consumed during the study.

Carcass evaluation: Feeds were withdrawn from the birds at 10 pm on Day 55 but drinking water was provided *ad libitum.* At 7 am on Day 56, three birds ie a bird/replicate, were randomly selected for carcass analysis. They were weighed to obtain the live weights, humanely euthanatized by cervical dislocation, thereafter were bled and scalded with hot water (90 °C) to remove the feathers, and then the plucked weight was measured. The dressing percentage (%) was calculated by dividing carcass weight by final body weight (carcass weight/body weight × 100). The carcass was then eviscerated and the following cuts were made: wing, breast, drumstick, back, neck, shank, gizzard, intestine, liver and abdominal fat. The dressing percentage was recorded as a percentage of the carcass weight. The abdominal fat (%) was calculated by dividing eviscerated weight plus abdominal fat weight with abdominal fat weight [abdominal fat weight/ (eviscerated weight + abdominal fat weight) × 100].

Statistical analysis

All data obtained on carcass yield were subjected to one-way analysis of variance (ANOVA) using a Statistical Package for Social Sciences *(SPSS) version 20.0*. Significantly different means were separated with Duncan's New Multiple Range Test as described by (Obi, 2002).

Results

Carcass yield

Table 3 shows the carcass yield of broiler chickens on feeds compounded with garlic and ginger powders. The results showed that live, plucked and dressed weights of garlic and ginger fed broiler chickens were similar ($p>0.05$) but differed significantly ($p<0.05$) from the control. This trend could be

attributed to the fact that garlic and ginger possibly enhanced appetite, contain factors that increase muscle deposition or even enhanced the gut health which increased absorption of nutrients or that themselves (garlic and ginger) equally contain some nutrients. There is also a probability that their (garlic and ginger) constituents were able to subdue or eliminate some pathogenic microorganisms or parasites that constituted disease burden to the birds. This could have paid off by restricting all nutrients that the ailment could have wasted to muscle growth. In a similar vein, the dressing, wing, drumstick, breast, shank, intestine, liver and abdominal fat percentages showed significant ($p<0.05$) differences across the treatments with exceptions recorded in the back, gizzard and neck percentages ($p>0.05$). The superior dressing percentage of treated groups could be derived from the hitherto points that garlic and ginger could have enhanced deposition of muscles courtesy of their peculiar constituents and possibly the antimicrobial properties that ensured improved health of the chickens. This positive influence was replicated in the major and minor cuts thus T_2 and T_3 performed better. The highest weight recorded in the intestine of the control could be attributed to the likely assault by microbes which possibly resulted to hypertrophy due to inflammatory reaction against invading microorganisms and parasites. This was likely curtailed by garlic and ginger additives in the treated groups. The abdominal fat of the control equally showcased highest level ostensibly due to likely fact that the garlic and ginger contain some factors that reduced adipose tissue deposition in favour of muscle.

Economics of production

Table 4 shows the cost-benefit analysis of broiler chickens on feeds compounded with garlic and ginger powders. The results showed that the cost of feeding and the total cost of producing a bird in T_1 was lower and differed significantly ($p<0.05$) from T_2 and T_3, though T_2 and T_3 were similar ($p>0.05$). This was occasioned by the high market prices of garlic and ginger. The average final body weights, the revenue and accruable gain per bird on garlic and ginger additives were higher and differed significantly ($p<0.05$) from the control. The lowest revenue by the control group was caused by lower body weight gain whereas its lowest return on investment per chicken was due to lower body weight gain and mortality which affected the control group.

Discussion

Carcass yield

Phytobiotic which is produced from the plant's secondary metabolite (either contain nutrition, no nutrition even anti-nutrition) and incorporated to the feed can increase livestock productivity by improving feed characteristics, increasing the health of the digestive tract by controlling bacteria as well as improving production performance and the quality of livestock products (Tugiyanti and Susanti, 2022). Garlic, ginger and turmeric all contain essential oils that act as natural antibiotics. In addition, garlic contains the bioactive substance allicin, while ginger contains oleorosin and gingerol, phenolic compounds and antioxidants (Tugiyanti and Susanti, 2022). Saiyed *et al.* (2015) and Singh *et al*. (2018) reported that dressing percentage was significantly better on supplementation of feed additive and probiotic in the diet of animals which corroborates the present findings. Similarly, Unigwe and Igwe (2022) reported significant weight gain by broiler chickens on diets compounded with garlic and ginger powders. Also in tandem with the present findings, Khaksar *et al*. (2012) reported significant improvements in some carcass traits due to inclusion of thyme essential oils while Kaushal *et al*. (2019) found better carcass and

cut up yields in enzymes and probiotics supplemented groups of broilers. It however, contradicted Abonyi *et al*. (2019) who reported that feed containing 0.5% garlic powder improved feed conversion ratio and body weight gain, but failed to produce positive effect on carcass yield in terms of dressing percentage and relative organ weights of broiler chickens. This contradiction could stem from the lower amount of garlic used by the previous authors. Equally, Okpe and Sule (2022) reported lower carcass characteristic indices of broiler chickens fed varying levels of *Ficus thonningii*. Jiya *et al*. (2014) and Yunana *et al*. (2019) reported significant difference in carcass parameters with super activated charcoal supplementation in broiler chickens diet. The differences in the results might be due to differences in composition of feed additives, probiotics, type of birds used in the experiment, management and environmental factors. The cut parts in the present study that recorded mostly significant increases in the garlic and ginger treated groups are in tandem with Agida *et al*. (2021) who stated that cut-parts (drumstick, thighs and wings) bore a relationship with carcass weight and as well supports the view of Ojewola and Longe (2000) that weights, volumes and dimensions of broiler parts were directly related to the carcass weight and Ojewola and Ewa (2005) who confirmed that heavier birds produced a greater eviscerated yield. The superior breast cut of the treated groups aligns with Reuben *et al*. (2021) who showed that birds on 200 g of both *Mentha piperita* and *Adansonia digitata* had significantly ($p<0.05$) higher breast cut percentages. Contrary to superior weight of intestine of the control group in the present study, El-Hady *et al*. (2020) reported significantly higher weight percentages of intestine and intestine length in broiler chickens on AROMIX® (mixed essential oils of herbs) likewise Khattak *et al*. (2014) who pointed out that the addition of thyme and essential oil of black seed in quail diet increased the weight and the length of the intestine. The strain of bird, the type of additive and possibly the health of the chickens used could have made the difference. That garlic group showed the highest shank percentage weight in the present study could suggest that there was enhanced absorption of minerals particularly calcium possibly supplied by garlic and/or feed. This is corroborated by Dabai *et al*. (2021) who obtained higher weight of shank on birds served 40 mL carrot leaf extract compared to vitalyte and control groups. The higher liver weight in treated groups in this study supports Ayoola *et al*. (2018) who reported increase in liver weight as levels of *Gliricidia sepium* Leaf Meal increased in the diets of broiler chickens and Okpe and Sule (2022) who got improved weight of the liver of broiler chickens fed varying levels of *Ficus thonningii viz-a-viz* the control. Dabai *et al*. (2021) reported that increase in liver could be associated with the fact that liver is known to absorb drugs first before releasing them to entire body cells for use. The lower abdominal fat in the treated groups in this present study is in consonance with Tang *et al*. (2021) who reported that diet supplementation with *Bacillus subtilis* in the diets of broiler chickens decreased the abdominal fat percentage and Reuben *et al*. (2021) who observed lower abdominal fat for broiler chickens fed diets containing *Mentha piperita* at 200 g/100 kg. Abdominal fat is an important index used to measure lipid deposition in broilers (Chao *et al*., 2020; Wan *et al*., 2021). Excessive fat deposition is undesirable, because it degrades meat quality, decreases feed efficiency, and increases production and health costs (Na *et al*., 2018; Zhang *et al*., 2020). The lower abdominal fat in broiler chickens supplemented with garlic and ginger in the present study indicated that garlic and ginger can lead to a higher

economic efficiency since the public tends to favour low-fat-content chicken.

Economics of production

The beneficial effects in respect of economic point of view and cost effectiveness in birds reared with feed additives might be attributed to better growth, feed conversion efficiency, immunity, reduced mortality and improvement of the general health status of broiler birds which ultimately yield more economic profit to the farmers. Results of present investigation contradicts the findings of Narasimha *et al*. (2013) and Kaushal *et al*. (2019) who reported that supplementation of enzymes and probiotics singly or in combination significantly reduced the feeding cost and the cost per kg live weight gain as well as Ayoola *et al*. (2018) who had no significant difference in the cost per kg of animal produced when graded levels of *Gliricidia sepium* Leaf Meal was used in broiler chickens.

Conclusion

It can be concluded that garlic and ginger at inclusion levels of 1 % apiece enhanced better carcass yield and accrued more profit to the farmer.

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Table 1: Ingredients and Proximate Analysis of Starter Diets

Ingredient	T_1 (control)	T_2 (garlic)	T_3 (ginger)
Maize	53.15	52.50	52.50
Fish meal	3.00	3.00	3.00
Soy bean meal	30.00	30.00	30.00
GNC	4.70	4.70	4.70
Wheat offal	5.00	5.00	5.00
Garlic	0.00	1.00	0.00
Ginger	0.00	0.00	1.00
Bone meal	2.00	2.00	2.00
Oyster shell	1.50	1.50	1.50
Lysine	0.10	0.10	0.10
Methionine	0.20	0.20	0.20
Premix	0.25	0.25	0.25
Salt	0.25	0.25	0.25
Total (%)	100	100	100
Proximate analysis			
Dry matter (%)	90.39	90.30	90.40
Moisture (%)	5.50	5.45	5.50
Crude protein (%)	22.25	23.15	22.45
Crude fiber (%)	4.35	4.67	4.71
Ash (%)	10.70	10.45	10.74
Ether extract (%)	8.65	8.75	8.70
NFE (%)	42.70	43.65	43.15
Metabolizable Energy (Kcal/kg)	2845	2825	2820

Table 2: Ingredients and Proximate Analysis of Finisher Diets

Ingredient	T_1 (control)	T_2 (garlic)	T_3 (ginger)
Maize	57.00	56.00	56.00
Fish meal	1.00	1.00	1.00
Soy bean meal	20.00	20.00	20.00
GNC	10.00	10.00	10.00
Wheat offal	8.00	8.00	8.00
Garlic	0.00	1.00	0.00
Ginger	0.00	0.00	1.00
Bone meal	2.00	2.00	2.00
Oyster shell	1.50	1.50	1.50
Lysine	0.10	0.10	0.10
Methionine	0.25	0.25	0.25
Premix	0.25	0.25	0.25
Salt	0.25	0.25	0.25
Total (%)	100	100	100
Proximate analysis			
Dry matter (%)	93.00	94.20	94.40
Moisture (%)	7.00	6.45	6.50
Crude protein (%)	20.20	20.75	20.45
Crude fiber (%)	3.20	3.65	3.74
Ash (%)	6.60	7.40	7.10
Ether extract (%)	5.00	5.70	5.60
NFE (%)	56.20	53.60	54.25
Metabolizable energy (Kcal/kg)	3000.50	2992.50	2962.00

Premix contains:- Vitamin A–8,000 IU, Vitamins D3 –3,000 IU, Vitamins E –8 IU, Vitamin K –2mg, Vitamin B1 – 1 mg, Vitamin B2 – 0.2 mg, Vitamin B12 – 5 mg, Nicotinamide – 10 mg, Selenium – 0.1 mg, Ca Pantothenate – 5 mg, Folic acid – 0.5 mg, Choline Chloride – 150 mg, Iron – 20 mg, Manganese – 80 mg, Copper – 8 mg, Zinc – 50 mg, Cobalt 0.225mg, Iodine –2 mg and Antioxidant – 0.1ppm

Table 3: **Carcass yield of broiler chickens on feeds compounded with garlic and ginger powders**

Parameters	T_1 (Control)	T_2 (1% Garlic)	T_3 (1% Ginger)
Live weight (g)	4061.64±5.73^b	4572.13±2.87^a	4591.76±4.39^a
Plucked weight (g)	3118.43±3.95^b	3641.18±6.93^a	3673.25±8.21^a
Dressed weight (g)	2889.84±12.54^b	3365.61±4.06^a	3319.87±2.23^a
Dressing percentage (%)	71.15±1.54^b	79.64±2.37^a	80.00±4.23^a
Wing (%)	7.45±1.12^b	8.73±2.43^a	8.65±2.06^a
Drumstick (%)	19.58±3.38^b	20.21±3.76^a	20.33±1.81^a
Breast (%)	19.44±1.18^c	20.17±1.27^b	21.23±1.06^a
Back (%)	16.77±2.76	16.28±3.09	15.89±2.35
Gizzard (%)	2.24±0.73	2.18±1.92	2.09±0.65
Neck (%)	6.43±2.87	6.76±2.08	6.80±2.53
Shank (%)	4.65±0.98^b	5.12±1.13^a	4.58±0.82^b
Intestine (%)	4.84±1.97^a	3.87±1.48^b	4.04±0.73^b
Liver (%)	2.07±0.54^b	2.88±1.22^a	2.92±2.17^a
Abdominal fat (%)	2.17±1.76^a	1.38±1.60^b	1.41±1.21^b

^{abc} Means along the same row with different superscripts are significantly different ($p<0.05$)

Table 4: **Cost-benefit analysis of broiler chickens on feeds compounded with garlic and ginger powders**

Parameters	T_1 (Control)	T_2 (1% Garlic)	T_3 (1% Ginger)	±SEM
Feed intake/bird (g) (25 kg = ₦10,250)	9239.26	9356.45	9348.54	1.68
Quantity of garlic powder consumed/bird (g)	-	93.56	-	NA
Quantity of ginger powder consumed/bird (g)	-	-	93.49	NA
Cost of garlic consumed/bird (₦) (100g = ₦1,800)	-	1,684.08	-	NA
Cost of ginger consumed/bird (₦) (100g = ₦1,130)	-	-	1,056.44	NA
Cost of medication (₦)	200	120	120	0.00
Cost of feeding a bird (₦)	3,788.10^b	5,481.86^a	4,851.01^a	13.51
Cost of feeding a bird during acclimatization (₦)	100	100	100	0.00
Cost of day-old-chick (₦)	600	600	600	0.00
Miscellaneous (₦)	1500	1500	1500	0.00
Loss due to mortality(₦) (2 birds lost = ₦16,246.56)	-1,476.93	-	-	NA
Total cost of production/bird (₦)	5,988.10^b	7,032.16^a	6,701.01^a	21.06
Average final body weight/bird (g)	4061.64^b	4572.13^a	4591.76^a	9.58
Revenue/bird (₦) (₦2000/kg)	8,123.28^b	9,144.26^a	9,183.52^a	11.16
Gain (₦)	658.25^b	1,992.10^a	2,362.51^a	18.65

^{abc} Means along the same row with different superscripts are significantly different ($p<0.05$)