EFFECTS OF GINGER (*Zingiber officinale*) AND GARLIC(*Allium sativum*) OIL EXTRACT ON THE FATTY ACID COMPOSITION IN MEAT OF BROILER CHICKENS

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ABSTRACT

The objective of this study was to determine the effect of dietary inclusion of ginger (Zingiber officinale) and garlic (Allium sativum) oil (GICLM) on the fatty acid composition of broiler chicken. A total of 150 1-day-old broiler chicks (Ross 308) of mixed sex were randomly divided into five treatments with three replicates consisting of 10 birds each in a completely randomized design. Birds in treatment 1 (T1) were fed basal diet with 0 % GICLM while T2, T3, T4 and T5 were given GICLM at 0.1, 0.2, 0.3, and 0.4 % respectively. The experiment lasted for 8 weeks; food and water were provided ad libitum and all other management practices were strictly observed. The results showed that significant (P<0.05) differences were observed in saturated fatty acid (SFA), polyunsaturated fatty acid (PUFA) and omega-6/omega -3 ratio (n-6: n-3) values obtained. Birds fed diet containing 0.4 % GICLM had the highest PUFA value (52.21 %), followed by T4 (44.76 %), T3 (36.30 %), T2 (30.99 %) and T1 (19.70 %) respectively. Similarly (n-6: n-3) values were significantly influenced (P<0.05) among the treatments. Saturated fatty acid was highest in T1 (40.65 %), intermediate in T2 (29.66 %), T3 (25.13 %) and lowest in T4 (22.17 %), T5 (21.10 %) (P < 0.05). Antheriogenic index reduced significantly (P<0.05) as the dietary inclusion of GICLM increases. It can be concluded that supplementation of GICLM at 0.4 % highly influenced the composition of fatty acid in broiler meat. Ginger and garlic oil increased the level of unsaturated fatty acids in broiler meat which when consumed by humans reduces the risk of cardiovascular diseases.

Keywords: Broiler chicks, Fatty acids, Garlic, Ginger, Phytochemicals.

INTRODUCTION

The huge increase in poultry production to meet growing demand in the world has led to the rise in antibiotic use, leading to a worrying increase in cases of antibiotic resistance diagnosed in animal and humans (Olafadehan *et al*., 2020). Poultry meat is an excellent source of protein, essential vitamins, minerals and fatty acid especially polyunsaturated fatty acids (Akintayo and Alagbe, 2020; Mohammad *et al*., 2015). Consumption of antibiotics contaminated animal products is injurious to health while multiplications of antibiotic resistance pose a great threat and danger to the livestock industry, particularly poultry (Oluwafemi *et al*., 2021; Shittu and Alagbe, 2020). It thus becomes imperative to find cheap, readily available alternatives to antibiotics feed additives in poultry diets. Among the potential alternative is the use of essential oils (EO). Scientific studies have shown that EO exhibit antimicrobial, hepatoprotective, anti-inflammatory, antioxidant, hypolipidemic, antimalarial, antidiabetic, antipasmodic and lipoxygenase inhibitory activities due to the presence of phytochemicals (Musa *et al*., 2020). The concentrations of phytochemicals are influenced by differences in geographical location, plant species, age and part of plants used as well as extraction methods (Oluwfemi *et al*., 2021).

Therefore this experiment was carried out to determine the effect of dietary inclusion of garlic (*Allium sativum*) and ginger ((*Zingiber Officinale*) oil on the fatty acid composition of broiler chicken.

MATERIALS AND METHODS

Experimental Site

This experiment was carried out at the Poultry unit of the University of Abuja Teaching and Research farm which is located along airport road, Gwagwalada FCT-Abuja. Gwagwalada falls within latitude 08°51 and 09°37N, longitude of 007°20 and 007°51E, and the land mass cover 6,550 km (6,500 hectares) and with annual rainfall approximately between 1100 mm to 1650mm (NPC, 2001).

Source and extraction of oil

Fresh samples of ginger and garlic rhizomes were purchase from a local market in Gwagwalada Abuja, Nigeria. The samples were sorted out from the bad ones, then washed and peeled manually using a kitchen knife to remove the outer covering of the rhizomes. Extraction of the oil was carried out using cold press machine (Model XX-078A, Hamburg Germany). The extracted oil was mixed in ratio 1: 1 to obtain ginger and garlic oil mixture (GICLM) and stored in a well labeled plastic container.

Management of experimental animals and diet formulation

One hundred and fifty one day old (Ross 308) broiler chicks of mixed sex were used for the experiment. The birds were purchased from a commercial hatchery in Ibadan, Oyo State, Nigeria and weighed on arrival on the farm to obtain their initial body weight and thereafter weekly weights were taken. A deep litter housing system was used, it was fumigated two weeks prior to the commencement of the study, and the surrounding environment was also cleaned daily to ensure proper hygiene. Birds were divided to five treatments with 3 replicates of ten birds in a completely randomized design. Vaccines were administered according to the prevailing disease condition in the environment and all other management practices were strictly adhered to throughout the experiment which lasted for 56 days. Two basal diets were formulated at different stages of production to meet the nutrient requirements of the birds according to NRC (1994) as presented in Table 1. Broiler starter mash (1-28 days) and finishers mash (29-56 days) diets were formulated. Birds in Treatment 1 (T1) were fed diet without inclusion of ginger and garlic oil (GICLM), while T2, T3, T4 and T5 were fed diets containing the test ingredient at 0.1, 0.2, 0.3 and 0.4 % respectively.

Fatty acid analysis

At the end of the experiment, five birds were randomly selected from each treatment for fatty acid analysis (FA). Meat lipids (Thigh) from freeze dried; grounded samples will be extracted with chloroform-methanol. After extraction, FAs in the residual fat was esterified, using acid and base catalyzed, fatty acid methyl esters (FAMEs) analysis was performed by gas chromatography mass spectrometry (GC–MS; Mussek-QM- 2010 plus, China) equipped with electron impact (EI) detector. The determination was carried out according to the procedures described by Olafadehan *et al*. (2021).

RESULTS AND DISCUSSION

Fatty acid composition in meat of broiler chickens fed diets supplemented with oil extract from ginger and garlic oil is presented in Table 4.3. C12:0 (Lauric acid), C14:0 (myristic acid), C16:0 (palmitic acid), C18:0 (stearic acid), C20:0 (arachidic acid) and C22:0 (behenic acid) ,C22:1 (myristoleic acid), C14:1c (palmitoleic acid), C16:1c (linoleic acid), C18:1c (oleic acid), C18:1n9t (elaidic acid), C18:1n9c (linolelaidic acid), C:22:1 (erucic acid), C20:5n3 (eicosapentenoic acid), C18:3n3 (α – linolenic acid), C20:4n6 (arachidonic acid), C20:3n6 (dihomogammalinolenic acid) and C22:6n3 (docosahexenoic acid) ranged between 1.28 – 2.77 %, 1.60 – 3.10 %, 12.63 – 20.90 %, 3.96 – 9.63 %, 1.33 – 3.87 %, 0.23 – 0.38 %, 1.96 – 3.60 %, 2.00 – 3.59 %, 10.30 – 15.10 %, 1.20 – 1.62 %, 0.11 – 0.42 %, 0.12 – 0.88 %, 10.22 – 23.88 %, 0.56 – 1.72 %, 5.20 – 12.4 %, 2.66 – 7.17 %, 0.62 – 4.01 % and 0.44 – 3.03 % respectively. Total saturated fatty acid (TSFA) values were highest in T1, intermediate in T2, T3 and lowest in T4 and T5 ($P<0.05$). Unsaturated fatty acids (USFA) and antheriogenicity index were significantly different ($P<0.05$) among the treatments. The results obtained agree with the findings of Olafadehan *et al*. (2021). Bourre (2005) reported that meats from chickens are low in lipids or fats, but high in PUFA. Antheriogenic index (A.I) is an index used to determine the safety of meat. This value significantly ($P<0.05$) reduced as the dietary supplementation of GLCLM increased in the diets. According to Olafadehan *et al.* (2020), artheriogenic index is regarded to be safe if its value does not exceed 1.0. However, the results revealed that dietary supplementation of GLCLM reduced cholesterol level in meat (hypolidemic), thus it could possibly lower the risk of cardiovascular infection conditions in humans.

CONCLUSION

It was concluded that GLCLM could be included in broiler diet up to 0.4 % without causing any deleterious effect on the performance of birds while improving the safety of the meat for human consumption.

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Table 1 Composition of the experimental diets

Ingredients	Starter phase (%)	Finisher phase (%)
Maize	46.00	50.00
Soya bean meal	18.50	12.00
Groundnut cake	15.00	11.00
Fishmeal	2.00	2.00
Wheat offal	12.45	19.05
Bone meal	2.00	2.00
Oyster shell	3.00	3.00
Salt	0.25	0.25
*Premix	0.25	0.25
Methionine	0.30	0.25
Lysine	0.25	0.20
Total	**100.00**	**100.00**
Calculated analysis (% DM)		
Crude protein (%)	23.05	20.91
ME (MJ/Kg)	11.73	11.71
Ether extract (%)	3.93	3.89
Crude fiber (%)	3.67	3.79
Calcium (%)	1.75	1.74
Phosphorus (%)	0.43	0.41

***Premix supplied per kg diet: - vit A, 13,000 I.U; vit E, 5mg; vit D3, 3000I.U, vit K, 3mg; vit B2, 5.5mg; Niacin, 25mg; vit B12, 16mg; choline chloride, 120mg; Mn, 5.2mg; Zn, 25mg; Cu, 2.6g; folic acid, 2mg; Fe, 5g; pantothenic acid, 10mg; biotin, 30.5g; antioxidant, 56mg.

Table 4.3: Fatty acid composition in meat of broiler chickens fed diets supplemented with oil extract from ginger and garlic

Treatments	T1	T2	T3	T4	T5	SEM
C12:0	2.77[a]	1.77[a]	1.67[b]	1.51[b]	1.28[c]	0.06
C14:0	3.10[a]	2.45[b]	2.26[b]	1.92[c]	1.60[c]	0.02
C16:0	20.90[a]	16.33[b]	14.07[b]	13.10[c]	12.63[c]	1.46
C18:0	9.63[a]	6.06[a]	5.13[b]	4.08[b]	3.96[b]	0.62
C20:0	3.87[a]	2.81[b]	1.77[c]	1.40[c]	1.33[c]	0.12
C22:0	0.38[a]	0.24[b]	0.23[b]	0.26[b]	0.30[a]	0.10
C14:1c	1.96[b]	3.01[a]	3.38[a]	3.56[a]	3.60[a]	0.20
C16:1c	2.00[b]	2.26[b]	3.25[a]	3.36[a]	3.59[a]	0.15
C18:1c	10.3[c]	13.0[b]	13.8[b]	14.2[a]	15.1[a]	1.55
C18:1n9 t	1.20[c]	1.35[b]	1.51[a]	1.58[a]	1.62[a]	0.62
C18:1n9C	0.11[c]	0.28[b]	0.33[a]	0.39[a]	0.42[a]	0.12
C:22:1	0.12[c]	0.55[b]	0.76[a]	0.81[a]	0.88[a]	0.10
C18:2n 6	10.22[c]	16.42[b]	18.28[b]	22.40[a]	23.88[a]	0.15
C20:5n3	0.56[b]	1.20[a]	1.42[a]	1.55[a]	1.72[a]	0.04
C18:3n3	5.20[c]	6.29[b]	7.33[b]	9.09[b]	12.4[a]	0.25
C20:4n6	2.66[c]	3.70[c]	4.90[b]	5.96[b]	7.17[a]	1.56
C20:3n 6	0.62[c]	1.42[b]	2.33[b]	3.05[a]	4.01[a]	0.20
C22:6n3	0.44[c]	1.96[c]	2.04[b]	2.71[b]	3.03[a]	0.15
[1]TSFA	40.65[a]	29.66[b]	25.13[b]	22.27[c]	21.10[c]	6.05
[2]USFA	25.09[c]	38.44[b]	45.53[a]	54.46[a]	62.32[a]	3.72
[3]MUFA	5.39[c]	7.45[c]	9.23[b]	9.70[b]	10.11[a]	2.07
[4]PUFA	19.70[c]	30.99[b]	36.30[b]	44.76[a]	52.21[a]	3.28
n:3:n-6	5.97[a]	3.89[b]	2.07[b]	1.88[c]	1.28[c]	0.21
Atherogenecity	0.90[a]	0.62[b]	0.55[b]	0.38[c]	0.27[c]	0.18

[1]Total saturated fatty acid= C12:0 + C14:0 + C16:0 + C18:0 + C20:0 +C22:0

[2]Unsaturated fatty acid = (3 + 4)

[3]Mono unsaturated fatty acid= C14:1C + $C16:1_C$ + $C18:1_C$ + C18:1n9t + C18:1n9c + C22:1

[4]Polyunsaturated fatty acid = C18:2 n6 + C20:5 n3 + C18:3n3 + C20:4n6 + C20:3n6 + C: 22:6n3

[5]n-6: n-3 = (C18:2 n6 + C20:4n 6 + C20:3n 6 / (C20:5n 3 + C18:3n 3 + C: 22 6n 3), [6]Antherogenic index = (C12:0+ 4×C14:0+ C16)/ε̧ of UFA; SEM: Standard error of mean