APVA-002

NATURAL ANTIOXIDANTS DIETARY SUPPLEMENTATION ON BROILER CHICKEN'S MEAT: IMPACT ON FATTY ACID PROFILES

[1]*Ishola, H., [1]Aremu, J. O. and [2]Imam, R. O.

[1]Department of Animal Production, Faculty of Agriculture, Kwara State University, Malete. Kwara Sate, Nigeria
[2]Department of Dairy Science, Faculty of Agriculture, University of Abuja
Corresponding Author: abdulhakeemadisa5@gmail.com, 08033740086

ABSTRACT
There are several studies on effect of dietary natural antioxidants on meat quality in broiler chickens. However, the findings are variable and inconsistent. Therefore, the need for additional studies to evaluate the effect of natural antioxidant on fatty acid profiles of broiler chicken's meat. A total of 300, one day-old Abor acres broiler chicks were assigned to 5 treatments and 3 replicates each in a completely randomised design. The feeding trial was for 8 weeks period. The birds were fed starter diets (23% CP and 2879Kcal/kg ME) and finisher diets (20% CP and 3000Kcal/kg ME) for 4 weeks each. The experimental feeding trial were T1 (Butylated hydroxy anisole BHA + control), T2 (ordinary water OW as – control) and T3 (Sweet orange peel extract (SOPE), T4 Shaddock peel extract (SHPE), and T5 Lemon peel extract (LMPE), all at inclusion level of 0.02 % per litre of water. Fat from the meat samples were extracted and characterized to ascertain their fatty acid profiles. Caproic, capric, enanthic and propionic acids were significantly higher ($P<0.05$) in bird's meat on OW compared to other treatments. Supplementation with BHA resulted in an increased precipitation level of valeric and butyric acids. Caproleic, palmitoleic, myristoleic and oleic acids were significantly higher ($P<0.05$) in bird's meat on SOPE, LMPE with other treatments. Linoleic, eicosapentaenoic and arachidonic acid in bird's meat on LMPE and SHPE were significantly higher ($P<0.05$) compared to other treatments. The dietary supplementation with antioxidants had significant effects on the fatty acid profiles of broiler chicken's meat.

Keywords: Supplementation, Fatty acid profile, Antioxidants, Meat

INTRODUCTION
Natural antioxidants are substances derived from natural sources, such as plants, that can prevent or slow down cell damage caused by unstable molecules called free radicals. In poultry nutrition, they play a crucial role in protecting the health of the bird's and improving the quality and shelf life of poultry products (Hakeem *et al*., 2020). Antioxidants help to prevent lipid peroxidation (the breakdown of fats) in meat, which can lead to rancidity and off-flavors and its shelf-life (Barden and Decker, 2016).

The poultry industry is increasingly focused on enhancing the quality and shelf-life of meat products. Dietary supplementation with natural antioxidants has emerged as a promising strategy to improve the oxidative stability of broiler chicken meat. This approach involves incorporating antioxidants, such as vitamin E, vitamin C and various plant extracts into chickens' feed. These antioxidants combat the formation of free radicals, thereby preserving the fatty acid profiles, lipid stability and protein integrity of the meat (Botsoglou *et al*., 2002). The use of synthetic antioxidants like Butylated hydroxy anisole (BHA) and Butylated hydroxy toluene (BHT) in the preservation of meat products has long been proven to be effective in optimizing oxidative stability and maintaining the quality of meat (Srinvasan *et al.*, 2008).

However, the concern over the side effects of synthetic preservatives on human health, particularly, their toxicity, coronary heart disease and carcinogenic effect has resulted in shifting research focus on preservatives that are safe and of natural origin (Dwyer-Nield *et al*., 2010). This study is intended to highlights the benefits of natural antioxidant supplementation in broiler diets and its implications for meat quality and consumer health.

MATERIALS AND METHODS
The feeding trial conducted at Kwara state University teaching and research farm, Malete and the laboratory evaluation of both qualitative and quantitative analysis of phytochemical compounds in SOPE, SHPE and LMPE described by Hakeem *et al*.(2024).

Extraction of oil and characterization of fatty acids

Lipids were extracted from the meat samples as described by (Carlos *et al*., 2023). Five grams of the meat samples were placed in an Erlenmeyer flask in a mixture of 25 ml chloroform, 50 ml methanol and 20 ml of deionized water in a ratio 1:2:0.8, v/v/v and shaken for 10 min. The mixture was filtered through filter paper and poured in a glass separating funnel to allow the organic and aqueous layers to be separated. The rotary evaporator was used to evaporate the chloroform layer from the extracted lipids and weighed. The gas chromatograph analysis of the extracted SPSO using a Shimadzu QP2010 quadrupole (GC-MS) instrument equipped with a carbowax (30 m × 0.25 mm ID; 0.25ìm film thickness) capillary column (intercut DB5MS. Japan). One microliter of the sample was injected into the capillary column and Helium was use as a carrier gas. The column temperature was programmed initially at 50°C for 1min and increased at a rate of 5°C per min till obtain a final temperature of 280°C. Fatty acid characteristics was based on mass spectral comparisons with the National Institute of Standards and Technology (NIST) Library 2008 (De Souza *et al*., 2013).

Statistical Analysis: Data were analysed for normality using the PROC UNIVARIATE SAS (2014) package Tukey HSD test at P< 0.05 significant level was used to separate the means.

RESULTS AND DISCUSSION

The results of the fatty acid profile of the broiler chicken fed dietary antioxidants shown in Table 1 revealed that all the fatty (Saturated, mono and poly unsaturated) acids were influenced (P<0.05) by the treatments and (Wood *et al.,* 2004) in his study observed a high success outcome in single- stomached birds. For the saturated fatty acids, valeric and butyric acids of bird's meat were significantly higher (P<0.05) in BHA treatment as compared with other treatments. Caproic, capric, enanthic and propionic acids were predominantly higher (P<0.05) in bird's meat of OW treatment in comparison with other treatments. This may be as a result of absence of phytochemicals in the dietary treatment which may either inhibit or aid in the oxidation of the lipids to either being metabolised or precipitated in the tissue. The results in this study is consistent with the report of the study conducted by (Kim *et al.,* 2009) in which dietary supplementation with different levels of garlic bulb and garlic husk affected the fatty acid composition of the meat compared to the control treatment.

Table 1: The Effect of Dietary Butylated hydroxyanisole, Water, Sweet orange, Shaddock and Lemon Peel Extracts on Meat Quality (Fatty Acid Profile) of Broiler Chickens

Parameters	Treatments						
	BHA	OW	SOPE	SHPE	LMPE	SEM	P value
Saturated Fatty Acids							
Caproic acid (C6:O)	1.72^{d}	7.71^{a}	2.41^{c}	6.94^{b}	0.00^{e}	0.0007	<0.0001
Capric acid(C10:O)	25.28^{c}	39.66^{a}	12.10^{e}	30.99^{b}	20.19^{d}	0.027	<0.0001
Palmitic acid(C16:O)	0.79^{b}	0.00^{c}	0.00^{c}	4.25^{a}	0.00^{c}	0.0006	<0.0001
Valeric acid(C5:O)	2.96^{a}	0.00^{b}	0.00^{b}	0.00^{b}	0.00^{b}	0.0005	<0.0001
Caprylic acid(C8:O)	12.71^{c}	5.72^{e}	15.96^{a}	12.33^{d}	15.50^{b}	0.001	<0.0001
Lauric acid(C12:O)	0.00^{b}	0.00^{b}	0.00^{b}	2.00^{a}	0.00^{b}	0.0005	<0.0001
Butyric acid(C4:O)	4.18^{a}	0.00^{b}	0.00^{b}	0.00^{b}	0.00^{b}	0.0003	<0.0001
Enanthic acid(C7:O)	0.00^{e}	29.48^{a}	1.14^{d}	1.61^{c}	1.90^{b}	0.026	<0.0001
Myristic acid(C14:O)	1.01^{c}	1.48^{b}	0.00^{d}	0.00^{d}	3.07^{a}	0.007	<0.0001
Propionic acid(C3:O)	0.00^{b}	3.90^{a}	0.00^{b}	0.00^{b}	0.00^{b}	0.026	<0.0001
Monounsaturated Fatty Acids							
Caproleic acid (C10:1Λ9)	1.07^{e}	1.23^{d}	9.17^{a}	2.01^{c}	4.86^{b}	0.001	<0.0001
Palmitoleic acid (C16:1Λ9c)	0.00^{d}	1.69^{b}	1.29^{c}	0.00^{d}	3.50^{a}	0.004	<0.0001
Myristoleic acid (C14:1Λ9c)	1.84^{a}	0.00^{b}	0.00^{b}	0.00^{b}	0.00^{b}	0.0005	<0.0001
Oleic acid (C18:1Λ9c)	1.07^{c}	0.00^{d}	0.00^{d}	6.00^{a}	2.07^{b}	0.009	<0.0001
Poly Unsaturated Fatty Acids							
Linoleic acid (C18:4(n-6))	7.98^{c}	3.58^{d}	9.08^{b}	0.00^{e}	14.62^{a}	0.0005	<0.0001
DHA(C22:(6n-3))	0.00^{b}	0.84^{a}	0.00^{b}	0.00^{b}	0.00^{b}	0.0005	<0.0001
Acetic acid	0.93^{b}	1.47^{a}	0.00^{c}	0.00^{c}	0.00^{c}	0.0006	<0.0001
ECA	0.00^{b}	0.00^{b}	0.00^{b}	5.55^{a}	0.00^{b}	0.0005	<0.0001
Arachidonic acid(C20:4(n-6))	0.00^{b}	0.00^{b}	0.00^{b}	2.13^{a}	0.00^{b}	0.0005	<0.0001

[a, b, c] means having different superscripts along the same row are significantly different ($p < 0.05$). BHA – butylated hydroxyanisole, OW – ordinary water, SOPE – sweet orange peel extracts, SHPE – shaddock peel extracts, LMPE – lemon peel extracts, DHA- Docosahexaenoic acids, ECA- Eicosapentaenoic acid

For monounsaturated fatty acid; myristoleic acid of bird's meat was higher ($P<0.05$) in BHA when compared with other treatments. However, bird's meat on SOPE treatment had higher ($P<0.05$) caproleic acid compared with BHA treatment. Oleic acid of bird's meat on SHPE treatment was significantly higher ($P<0.05$) as compared with OW and SOPE treatments. Finally, palmitoleic acid of bird's meat on LMPE was significantly higher ($P<0.05$) as compared with BHA and SHPE treatments. For the polyunsaturated fatty acids (PUFA), notable changes were observed in the PUFA profile. The DHA and acetic acid of bird's meat on OW treatment was significantly higher ($P<0.05$) while BHA, SOPE, SHPE and LMPE treatments significantly reduced the DHA and acetic acid values. Interestingly, the ECA and arachidonic acid values of bird's meat on SHPE treatment were significantly higher ($P<0.05$) as compared with BHA, OW, SOPE and LMPE treatments. Finally, linoleic acid value of bird's meat on treatment LMPE was significantly higher ($P<0.05$) compared with other treatments. The result observed in this study agrees with result obtained in the research conducted by Ayerza *et al.* (2002), who confirmed the influence of antioxidant on fatty acid composition of broiler chicken meat fed dietary supplemented antioxidants. Dietary supplemented antioxidants have shown to increase long-chain n-3 fatty acid such as ECA and DHA in the broiler thigh meat (Saleh *et al*., 2017). However, the high levels of DHA (0.84) and Acetic (1.47) acids observed in the negative control OW contradicts the results obtained by Jung *et al*. (2010), in which DHA levels in the breast meat of broilers fed dietary mixture of gallic acid and linoleic acid were increased.

CONCLUSION

The dietary supplementation with natural antioxidants offers a viable approach to enhance the quality and shelf-life of broiler chicken meat. By preserving fatty acid profiles, improving lipid stability and protecting protein integrity, these antioxidants contribute to meat products that are both more nutritious and sensorily appealing.

REFERENCES

Ayerza, R., Coates, W. and Lauria, M. (2002). Chia seed (*Salvia hispanica* L.) as an omega-3 fatty acid source for broilers: influence on fatty acid composition, cholesterol and fat content of white and dark meats, growth performance, and sensory characteristics. *Poultry Science Journals*, 81:826–837.

Barden, L. and Decker, E. A. (2016). Lipid oxidation in low-moisture food: a review. Critical Reviews in Food Science and Nutrition. *Taylor and Francis* 56(15), 2467-2482

Botsoglou, E., Govaris, A. & Papageorgiou, V. (2002). The effect of dietary oregano essential oil on lipid oxidation in raw and cooked chicken meat. *Meat Science* 62(2), 247-255

Carlos, B.F., Junior, M.F., Cristiano, R.M., Alexandre, J.C., Roger, W., Paulo, C.B.C & Jose, M.L. (2023). Sample preparation methods for fatty acid analysis in different raw meat products by GC-FID. *Springer Nature* 16, 749-758

De Souza, A. H. P., A. K. Gohara, Â. C. Rodrigues, N. E. De Souza, J. V. and Visentainer, M. M. (2013). Sacha inchi as potential source of essential fatty acids and tocopherols: multivariate study of nut and shell. *Acta Scientiarum. Technology* 35(4):757-763 https://doi:10.4025/ACTASCITECHNOL.V35I4.19193

Dwyer-Nield, L.D, McQuillan, J., Hill-Baskin, A. and Radcliffe, R.A. (2010). Epistatic interactions govern chemically- induced lung tumor susceptibility and kras mutation site in murine C57BL/6J-ChrA/J chromosome substitution strains. *International Journal of Cancer* 2010 January, 1;126(1):125-32

Hakeem, I., Elisha, Z. J., John, Y. A and Olushola, J. A. (2020). Effects of natural antioxidant extract supplementation on the growth performance and meat quality of broiler chickens. *Journal of Agricultural Sciences* (Belgrade), 65(4): 405-417

Hakeem, I., Elisha, Z. J., John, Y. A and Olushola, J. A. (2020). Effects of natural antioxidant extract supplementation on the growth performance and meat quality of broiler chickens. *Journal of Agricultural Sciences* (Belgrade), 65(4): 405-417

Hakeem Ishola, E.Z. Jiya, J.Y. Adama and O.J. Alabi (2024). Evaluation of the antioxidant potentials of fruit peels extract. *Technoscience Journal for Community Development in Africa* 3(2024): 8-17

Jung, S., Choe, J.H., Kim, B., Yun, H., Kruk, Z.A. and Jo, C. (2010). Effect of dietary mixture of gallic acid and linoleic acid on antioxidative potential and quality of breast meat from broilers. *Meat Science Journals*, 86:520–526.

Kim, Y.J., Jin, S.K. and Yang, H.S. (2009). Effect of dietary garlic and husk on the physicochemical properties of chicken meat. *Poultry Science Journal*, 88:398-405.

Saleh, H., Golian, A., Kermanshahi, H. and Mirakzehi (2017). Effects of dietary α-tocopherol acetate, pomegranate peel and pomegranate peel extraction phenolic content, fatty acid composition and meat quality of broiler chickens. *Journal of Applied Animal Research*, 45:629–636.

Srinvasan, D., Parkin, K. L.and Fennema, O. R. (2008). *Fennema's food chemistry* **(**4th ed.). Boca Raton: CRC Press.

Wood, J.D., Nute, G.R., Richardson, R.I., Whittington, F.M., Southwood, O., Plastow, G., Mansbridge, R., da Costa, N. and Chang, K.C. (2004). Effects of breed, diet and muscle on fat deposition and eating quality in pigs. *Meat Science Journals*, 67, 651–667.