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Lipid Oxidation And Sensory Attributes Of Broiler Chicken Fed Dietary Oregano (Origanum Vulgare L.) Leaf Powder On Meat Quality

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Abstract
The experiment was carried out in the Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture. Usmanu Danfodiyo University, Sokoto, Nigeria, to determine the effects of lipid oxidation and sensory attributes of broiler chicken fed dietary oregano (Origanum vulgare L.) leaf powder on meat quality. The diets were supplemented with oregano leaf powder at 15g/kg, 20g/kg, 25g/kg and 0g/kg (control group), represented as T_1, T_2, T_3 and T_4, respectively, oregano leaf powder did not affect sensory attributes of broiler meat (P>0.05). However significantly affected oxidative stability losses, higher inclusion level (25g) of oregano leaf powder improves meat quality parameters while supplementation of up to 15g did not affect most of the meat quality parameters. The study recommended 25g inclusion levels of oregano leaf powder due to the positive effects on meat quality parameters of broiler chicken. Further studies on the mode of action of oregano leaf powder using different species of poultry on meat quality may be commercially interesting.
Keywords: *Oregano leaf powder; Broiler chicken.*

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I. Introduction

Meat quality is normally defined by the compositional quality (lean and fat ratio) and the palatability factors such as visual appearance, smell, firmness, texture, juiciness and flavor, which are the most important and perceptible meat features that influence the initial and final quality judgment by consumers before and after meat product purchased (Nasir *et al.*, 2017). Dietary supplementation with herbs and herb extracts is a simple and convenient strategy to introduce a natural additive into chicken meat, phytogenic compounds have been incorporated into the diet to improve animal productivity by enhancing the production performance and the quality of food derived from those animals (Windisch *et al*., 2008). Oregano (Origanum vulgare L.) is an aromatic herb containing abundant active chemical compounds (Falco *et al*., 2013; Park *et al*., 2015), which has been used to replace banned chemical antibiotics in poultry and livestock, oregano have showed high potential from its chemical nature to improve animal health and growth (Ertas *et al*., 2005). The oregano powder derived from oregano leaf is known to possess also antimicrobial, antifungal, and insecticidal activities. Carvacol and thymol are the two main phenols that constitute about 78–82% of the oregano leaf powder compositions and principally responsible for this activity (Marcincak *et al*., 2008).

II. Materials And Methods.

Location Of The Study

The study was carried out at the Poultry Production Unit of the Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture, Usmanu Danfodiyo University. Sokoto, Nigeria. Sokoto is located between latitude $11^0\,30^1$ -$13^0\,50^1$ N and longitude $4^0\,0^1$-$6^0\,40^1$ E semi-arid region in the northern part of Nigeria and lies on altitude of 350m above sea level. It has rainfall of about 760mm per annum and high temperature range of 35-40^{o}C characterized by scanty vegetation, made up of few trees, shrubs and grasses. (Mamman *et al.*, 2000).

Experimental Animals and their Management

Two hundred (200) day-old broiler chicks (Ross 308) were used, purchased from Agrited Hatchery Farm in Ibadan, Oyo state, the birds were transported through the night and arrived Sokoto the following morning hours and rose for seven weeks. A week before the chicks arrived, the house was cleaned, washed and disinfected; wood shavings were spread on the floor as a litter material, on arrival old newspapers were spread on the litter, the chicks were introduced to water first with anti-stress added in their clean drinking water and fed on starter mash

formulated with oregano leaf powder fresh feed and drinking water were offered every morning at 8:00 am and 6:00pm in the evening. At the finisher phase, conical feeders and plastic containers with wire guard drinkers were used for water. Light was provided by electric bulb and charcoal as source of heat. Vaccination against Gumboro at seven days after arrival Lasota at forteen days after arrival and repeated dose of Gumboro at twenty-one days and another repeated dose of Lasota at twenty-seven days, were the only vaccines administered, proper sanitation and hygiene was strictly adhered to.

Sourcing and processing of feeds ingredients

Oregano was obtained at the Sokoto main market, crushed bone meal from the abattoir, groundnut cake were ground separately, industrial soya beans meal were ground to reduce the particles sizes to suit the class of birds for which the feeds were formulated, limestone, lysine, methionine and premix from the supplier, wheat offal, salt and oregano were incorporated into the treatment diets after grading.

Experimental diet formulation

Using computer software, (soft feed App) starter and finisher diets for this experiment targeting 3000 and 2800 Kcal/Kg ME and 21and 19% crude protein (CP) were formulated for the two phases, the broiler starter and finisher with graded inclusion levels of oregano leaf powder is presented in Table 1.

Table 1: Gross and calculated chemical composition of experimental finisher diets with graded levels of oregano leaf powder fed to broiler chickens.

Ingredient	**T_1(15g) Oregano**	**T_2(20g) Oregano**	**T_3(25g) Oregano**	**T_4(0g) control**
Maize	50.5	50.5	50.5	50.5
Soya beans Meal	15	15	15	15
Groundnut Cake	13	13	13	13
Fish meal	0	0	0	0
Wheat offal	12	12	12	12
Limestone	5.4	5.4	5.4	5.4
Bone meal	3	3	3	3
Premix*	0.25	0.25	0.25	0.25
Salt	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				
Energy (Kcal/Kg ME)	2800	2800	2800	2800
Protein (%)	19	19	19	19
Lysine (%)	1.0	1.0	1.0	1.0
Methionine (%)	0.5	0.5	0.5	0.5
Calcium (% Avail)	2.8	2.8	2.8	2.8
Phosphorus (% Avail)	0.7	0.7	0.7	0.7
Fibre (%)	5.5	5.5	5	5.5

*****Crude protein 18.03 % (min), crude fat 3.15% (min), crude fibber 6.4% (max), Total ash 7.4 % (max), Moisture 13% (max). Phosphorus 0.50 % (min), calcium 0.9-1.8%, soya bean meal 44%vitamin premix 0.5%

Experimental design

In a Completely Randomized Design (CRD), two hundred day-old broiler chicks were randomly allocated to four treatments (T_1, T_2, T_3 and T_4) with 5 replicate pen of 10 chicks each, having a total number of 50 chicks per treatment.

Data collection

Data were collected from two sources: primary and secondary sources. Primary data was sourced from the performance records of the experimental chickens managed and their records were taken and analyzed. Secondary data was sourced from books, journal, and conference/workshop proceedings and from academic sources on the internet.

Sample and Sampling procedure

Three birds were sampled from each replicate for meat quality analysis, a total of sixty birds were used for the study, birds sampling were both purposive and random, heavier and the smallest birds were purposively selected while the other one was randomly picked from the flock to give a fair representation of all their body sizes.

The sampled birds were starved of feed but left with only clean drinking water for 8 hours prior to slaughter, the birds were humanely slaughtered according to the halal (prescribed by Muslim law) procedure as outlined by Garba *et al*. (2019) and hoisted for about 10 minutes, then the birds were defeathered and eviscerated for sample collection. Samples of about 20g were removed according to the treatments and packaged in non-permeable polyethylene bags, samples assigned for colour, lipid oxidation and sensory attributes analyses were vacuum packaged, the samples were stored at frozen (−20 °C) until subsequent analysis.

Determination of meat quality characteristics

The characteristics for assessing meat quality were colour, lipid oxidation and sensory attributes.

Colour

Determination of the Laboratory, Inc., Reston, Virginia, USA) Calibration was performed using a white and black plate supplied by the manufacturer. Surface of the sample was measured for lightness (L*), red (a*) and yellow (b*) values based on the International Commission on Illumination (ICI). Samples of about 12mm thick were taken from the fat free area. Meat color values in three spots were recorded and the average value from these three spots was used to determine the color values of the samples (Hunt, 1980). Hunter Lab-values (L* a* b*) with D56 illuminant and 100 standard observer, tristimulus coordinates (X, Y, Z) and reflectance set at specific wavelength (400–700) nm were used for the meat color expression measurement.

Lipid oxidation

Lipid oxidation was measured as 2-thiobarbituric acid reactive substances (TBARS) using Quanti Chrom TM TBARS Assay Kit (DTBA-100, Bio Assay Systems. USA) following the instruction of the manufacturer.

Sensory attributes

Hedonic scale was used to determine the following: After taste, Flavour, Juiciness and Tenderness

Data Analyses

The data were analyzed using the general linear model (GLM) procedure of Statistical Analysis System SAS (2007) package version 9.2 software. SAS Institute Inc., Cary, NC, USA) and statistical significance was set at $P<0.05$. Significant differences between means were detected using LSD.

III. Results And Discussion

Colour

Table 2: Effects of graded levels of oregano leaf powder on colour properties of broiler chicken on meat quality

Colour	15g oregano	20g oregano	25g oregano	0g oregano	SEM
L*	32.85	32.47	32.75	33.27	4.25
a*	13.51	13.08	14.95	12.86	1.69
b*	11.31[b]	12.76[a]	13.24[a]	10.42[b]	2.89

[a,b] Means along rows with different superscripts are significantly different ($P<0.05$)
SEM, Standard error of means (pooled).
L*measures relative lightness, a*relative redness and b*relative yellowness

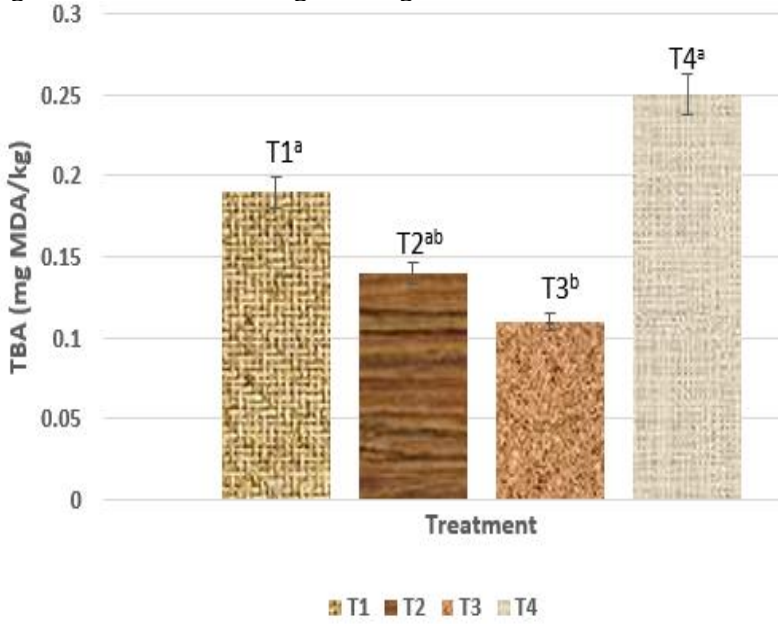
Colour

Results of L*, a*, b* color coordinate values of broiler birds fed different levels of oregano leaves powder are presented in Table 2. Color is among the most significant meat quality attributes and its determined consumer's acceptability and purchasing decisions. Therefore, producers ought to produce carcasses without negatively affecting or compromising the color of the meat. Lack of significant differences in lightness (L*) and redness (a*) values could possibly be explained by similarity in the management of the animals and diet.

Results of the present study have indicated increased b* (yellowness) values in meat colour with increasing levels of oregano leaves powder supplementation. The decrease in (yellowness) b* color coordinate values in the diet containing low oregano leaves powder and the subsequent elevation of the values with the addition of oregano leaves powder concentration might be explained by the increased oregano concentrations in the diet. Dietary treatments can influence the quality of the meat in general (Jaworska *et al*., 2016; Oliveira *et al*., 2015) and the color of the meat in particular (Ivanovic *et al.*, 2016; Oliveira *et al*., 2015; Priolo *et al*., 2001). Finding of this study is consistence with the results of Kirkpinar *et al*. (2014) who reported that broilers with oregano (3%) added to the feed had more yellow (b*) colour than control chickens, which they attributed to the high carotenoid content of oregano. However, they reported that L* (light) and a* (red) values were not affected by supplementation.

Meat lipid oxidation

Figure 1: TBARS values mg MDA/kg meat error bars indicate SEM



In this study, the level of thiobarbituric acid reactive substance at different levels of Oregano leaves powder supplementation differ (P<0.05) among the treatments (Figure 1). Level of supplementation affects the TBARS values detected in T_4 (control) had highest values (0.25 mg MDA/kg) while T_3 with highest level of oregano (25g) supplementation recorded lowest (0.11 mg MDA/kg) TBARS value. This may suggests that very low lipid oxidation occurred in the meat with higher level of oregano leaves powder compared to the control and low-level treatments (T_1 and T_4).

The level of TBARS considered as the threshold for perception and acceptability of oxidation by consumer depends on the species, for example, in beef this threshold ranged from 0.6 to 2mg MDA kg1 meat, while in pork the limit is between 0.5–1mg MDA kg1meat (Campo *et al*., 2006). Wood *et al.* (2008) reported that the TBARS values above 0.5 mg MDA/kg indicate a level of lipid oxidation products which impart a detectable rancid flavor and odour to consumers. Thus, all the treatments in the present study have exhibited an acceptable level of lipid oxidation, however, there was a positive trend as the level of oregano leaves powder increases, TBARS values decreases in the meat samples evaluated.

Lipid oxidation is a major cause of deterioration in the quality of meat, which in turn determines the shelf life and consumer acceptance of meat and meat products (Jacobsen & Bertelsen, 2000). Oxidation in meat depends on the balance between antioxidant and pro-oxidant agents in the muscle (Morrissey *et al.*, 1998) with the oxidative deterioration of the polyunsaturated fatty acids of foods leads through the formation of hydro peroxides to short chain aldehydes, ketones, and other oxygenated compounds, being considered responsible for causing rancidity in stored foods (Imafidon & Spanier, 1994).

Other authors have reported positive effects of other plant extracts on the oxidative stability of chicken meat: rosemary and sage extracts at 500 mg·kg−1 oregano and rosemary essential oils at 150 and 300 mg·kg−1 (Basmacioglu, *et al.*, 2004) or at 100 and 200 mg·kg−1 (Papageorgiou *et al*., 2003). The susceptibility of lipids in tissues to peroxidation depends on the proportion of polyunsaturated fatty acids in lipid bilayers, the amount of reactive oxygen species produced, and the level of antioxidants available through diet or endo- or exogenous sources (Cherian *et al*., 1996; Brenes *et al*., 2008). Therefore, inclusion of oregano leaves powder meal rich in bioactive compounds may prove to be beneficial for the reduction in lipid oxidation products.

Table 3: Effect of graded levels of oregano leaf powder on sensory attributes of broiler chicken meat

Organoleptic construct	**15g**	**20g**	**25g**	**0g**	SEM
After taste	82.20	82.10	82.50	82.60	4.863
Flavour	80.40	80.30	80.50	80.10	5.435
Juiciness	79.60	79.80	78.10	78.40	5.248
Tenderness	68.99	69.05	69.70	70.00	4.781

[a,b] Means along rows with different superscripts are significantly different (P<0.05)
SEM, Standard error of means (pooled).
L*measures relative lightness, a*relative redness and b*relative yellowness

Sensory attributes of broiler chicken fed oregano leaf powder

Table 3 indicated that, there was no significant effect (P>0.05) of oregano leaf powder on the sensory attributes (after taste, flavour, juiciness, and tenderness) of broiler chicken meat evaluated. The finding of this work is in consistent with the findings of Džinić *et al.,* (2009) and Puvača *et al.,* (2013) who reported that; plant phytobiotics did not have effects on eating quality of meat and can be regarded as safe for usage. However, contrary results were obtained by Pavelková *et al.,* (2013) using oregano essential oil in broiler diets, which resulted in improved sensory meat quality, which negated previously published influences of this phytobiotic in altering of taste, juiciness and tenderness of chicken meat. The differences might be attributed to the phytochemical constituents of different forms (leaves and oil) of oregano used in the two separate experiments.

IV. Conclusion

Oregano leaf powder supplementation in broiler chicken with higher inclusion levels (25g) had increased b* (yellowness) values in meat colour and significantly affected oxidative stability losses, but did not affect sensory quality/Attributes (Aftertaste, flavor, juiciness and tenderness) of broiler meat quality.

V. Recommendations

Oregano leaf powder at 25g should be recommended for improvement in meat quality parameter of broiler chickens.

Further studies on the mode of action of oregano leaf powder on meat quality attributes of other poultry species are needed to expand the knowledge on usage of such natural additives in industrial practice

Compliance with ethical standards

Statement of ethical approval.

Human consideration for the well-being of the animals, procedures and conducts involved were considered, there are no alternative to the use of animals possible, number of animals used were minimized and unnecessary duplication was avoided.

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Basmacioglu, H., Tokusoglu, Ö. And Ergül, M. (2004). The Effect Of Oregano And Rosemary Essential Oils Or Alpha-Tocopheryl Acetate On Performance And Lipid Oxidation Of Meat Enriched With N-3 Pufa's In Broilers. South African Journal Of Animal Science, 34: 197-210.

[2] Brenes, A., Viveros,A., Goñi, I., Centeno, C., Sáyago-Ayerdy, S. G.I.Saura-Calixto. F. (2008). Effect Of Grape Pomace Concentrate And Vitamin E On Digestibility Of Polyphenols And Antioxidant Activity In Chickens. Poult. Sci., 87:307–316.

[3] Campo, M. M., Nute, G. R., Hughes, S. I., Enser, M., Wood, J. D., & Richardson, R. I. (2006). Flavour Perception Of Oxidation In Beef. Meat Science, 72, 303–311.

[4] Cherian, G., Wolfe, F. H.And Sim, J. S. (1996). Dietary Oils With Added Tocopherols: Effects On Egg Or Tissue Tocopherols, Fatty Acids And Oxidative Stability. Poult. Sci. 75:423–431.

[5] Džinić, N., Petrović, Lj., Jokanović, M., Tomović, V. And Stanaćev, V. (2009) Effects Of Dietary Garlic Powder On Growth Performances And Quality Of Poultry Meat. Proceedings Of International Feed Symposium, 13: 322-326.

[6] Ertas, O.N., G€Uler, T. C., Iftci, M., Dalkilic, B. And Simsek, €.U.G. (2005). The Effect Of An Essential Oil Mix Derived From Oregano, Clove And Anise On Broiler Performance. Int J Poult Sci., 4:879–884.

[7] Falco, E.D., Mancini, E., Roscigno, G., Mignola, E., Taglialatela-Scafati, O. And Senatore, F. (2013) Chemical Composition And Biological Activity Of Essential Oils Of Origanum Vulgare L. Subsp. Vulgare L. Under Different Growth Conditions. Molecules, 18:14948–14960.

[8] Garba, S., Sazili, A.Q., Mahadzir, M.F., Candyrine, S.C.L., Jahormi, M. F., Ebrahimi, M., Goh, Y.M., Samsudin, A. A., Chen, W. L., Ganesh, S., Ronimus, R., Meutzel, S., And Liang, J. B. (2019) Effects Of Naturally-Produced Lovastatin On Carcass Characteristics Muscle Physico-Chemical Properties And Lipid Oxidation And Cholesterol Content In Goats. Meat Science, 154: 61–68.

[9] Hunt, M. C. (1980). Meat Colour Measurement Meat Conference Of The American Meat Science Association (Pp. 41–46). Lafayette, Indiana, Usa: Purdue University.

[10] Imafidon, G. I., & Spanier, A. M. (1994). Unraveling The Secret Of Meat Flavor. Trends In Food Science & Technology, 5: 315–321.

[11] Ivanovic, S., Pavlovic, I., & Pisinov, B. (2016). The Quality Of Goat Meat And It's Impact Onhuman Health. Biotechnology In Animal Husbandry, 32: 111–122.

[12] Jacobsen, M., & Bertelsen, G. (2000). Color Stability And Lipid Oxidation Of Fresh Beef. Development Of A Response Surface Model For Predicting The Effects Of Temperature, Storage Time, And Modified Atmosphere Composition. Meat Science, 54: 49–57.

[13] Jaworska, D., Czauderna, M., & Rozbicka-Wieczorek, A. J. (2016). Sensory Quality Andchemical Composition Of Meat From Lambs Fed Diets Enriched With Fish And Rapeseedoils, Carnosic Acid And Seleno-Compounds. Meat Science, 119: 185–192.

[14] Kirkpinar, F. I. G. E. N., Ünlü, H. B., Serdaroğlu, M., & Turp, G. Y. (2014). Effects Of Dietary Oregano And Garlic Essential Oils On Carcass Characteristics, Meat Composition, Colour, Ph And Sensory Quality Of Broiler Meat. British Poultry Science, 55(2): 157-166.