



Effects of Dietary Oregano (*Origanum vulgare* L.) Leaf Powder on Meat Quality of Broiler

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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 dietary oregano leaf powder on meat quality of broiler meat. The diets were supplemented with oregano leaf powder at 15g/kg, 20g/kg, 25g/kg and 0g/kg (control group), represented as T₁, T₂, T₃ and T₄, respectively, dietary oregano leaf powder did not affect muscle pH a* values of broiler meat (P>0.05). However, oregano leaf powder significantly affected b* value, water holding capacity, drip and cooking 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 meat. Further studies on the mode of action of oregano leaf powder using different species of poultry on meat quality may be commercially interesting.

Keywords: dietary supplement, oregano leaf powder, poultry, broiler, meat quality parameters.

Introduction

Poultry meat has many desirable nutritional characteristics, such as low lipid content and relatively high concentrations of polyunsaturated fatty acids that can be further increased by specific dietary strategies. The general consumer rejection of synthetic additives had increased in modern times, interest have arose in recent years for the use of natural additives such as oregano with the intention of improving meat quality,

prevent antibiotics residues accumulation and contamination in their products or the environment. The strong smell of phytogetic compounds may penetrate into muscles and organs, which would improve their flavour, storage and processing values (Gardzielewska *et al.*, 2003).

Oregano (*Origanum vulgare*) is a perennial herb, a flowering plant in mint family with a spicy flavor, the leaves, roots and oil are used in curing a



variety of ailments with bioactive properties including anti-oxidant, anti-microbial, antifungal, anti-inflammatory, and analgesic properties, it is a strong natural foods preservative (Grijalva-Gutierrez *et al.*, 2017).

Lee and Shibamoto (2002) determined that oregano or thyme has a large effect on lipid oxidation. Likewise, (Marcincak *et al.* 2008) revealed that the addition of Oregano in broiler diets was effective in delaying lipid oxidation compared to the control diet, which is a major cause of quality deterioration in meat and meat products and can give rise to rancidity and the formation of undesirable odours and flavours, which affect the functional, sensory and nutritive values of meat products (Gray *et al.* 1996).

Materials and Methods

Study Area

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 $11^{\circ}30' - 13^{\circ}50' \text{ N}$ and longitude $4^{\circ}0' - 6^{\circ}40' \text{ E}$ 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 $35-40^{\circ}\text{C}$ 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 were used, 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 fourteen 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, bone meal from the abattoir was crushed, 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 21 and 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.

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.

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

Note: *Crude protein 18.03 % (min), crude fat 3.15% (min), crude fiber 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%

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, except for drip loss which required inflated bags, samples assigned for muscle pH, water holding capacity, drip loss and cooking loss were vacuum packaged, the samples were stored frozen (−20 °C) until subsequent analysis.

Determination of Meat Quality Characteristics

The characteristics for assessing meat quality were muscle pH values, water holding capacity, drip loss and cooking loss.

Muscle pH

pH of the meat samples was measured at 24h postmortem (ultimate pH) using S220 Seven Compact pH meter (Mettler Toledo™,

Leicester, UK) following the method of Garba *et al.* (2019). 1g of each sample was crushed in liquid nitrogen and homogenized for 30 s in 20ml ice-cold deionized water in the presence of 5mm sodium iodoacetate to inhibit further glycolysis and the production of lactic acid. The pH electrode was placed inside the resultant homogenates to determined pH.

Water holding capacity

The water holding capacity of the meat samples was evaluated by filter paper method, the filter paper wetness test of Kauffman *et al.* (1986) is a more rapid method for determining water-holding capacity. Laboratory grade filter paper is placed on the cut surface of the muscle and scored for wetness.

Drip loss

Measuring drip loss was by means of Honikel's bag method (Honikel, 1998). Thirty gram (30g) of fresh samples were collected, weighed individually, placed within the container on the supporting mesh and sealed. The samples were kept at 4 °C in the chilling room for 24 hours. Upon removal from the packaging, sample was blotted dry using paper towels and weighed. The percentage change in weight over the subsequent aging period was taken as the drip loss.

Cooking loss

Cooking loss evaluation, approximately 30g of thawed samples was vacuum packaged in non-permeable polyethylene bags and was cooked in

a water bath at 85 °C for 10 min resulting in a core temperature of about 75 °C. Following the cooking process, the meat samples were allowed to cool at room temperature for 15 min before being blotted dry, reweighed and recorded, the cooking loss was expressed as a percentage of the difference between the cooked and thawed samples.

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.

Results

Meat Quality Characteristics

pH

Results of this study revealed that supplementation of the diet with Oregano leaf powder did not affect pH values of individual treatments. The ultimate pH ranged from 5.74 to 5.82 (Table 2) which is within the acceptable range (Hedrick, *et al.*, 1994). One of the major postmortem changes occur during the muscle to meat conversion is pH. It affects the quality of the fresh meat and its derivatives (Osório & Osório, 2000).

Table 2. Differences in pH, Water Holding Capacity, Drip Loss and Cooking Loss of Broiler Birds Fed Graded Levels of Oregano Leaf Powder

Parameters	T ₁ (15g)	T ₂ (20g)	T ₃ (25g)	T ₄ (0g)	SEM
pH (unit)	5.79	5.82	5.75	5.77	0.02
Water Holding Capacity	17.43 ^b	31.11 ^b	33.17 ^a	18.16 ^b	4.15
Drip loss (%)	1.98 ^b	1.94 ^b	1.99 ^b	2.94 ^a	0.60
Cooking loss (%)	25.46 ^b	25.78 ^b	25.78 ^b	29.49 ^a	0.24

Note: ^{a,b} Means along rows with different superscripts are significantly different ($P < 0.05$); SEM, Standard error of means (pooled).

The ultimate pH of muscle at 24h postmortem determines various meat parameters, such as water retention capacity, cooking loss, shear

force, as well as sensorial meat properties related with tenderness, succulence, taste, smell, and color (Bressan *et al.*, 2001). Similar findings was

reported by Young *et al.* (2003) where pH 24h was not affected by supplementation with oregano (3%) added to the feed of broiler birds.

Water holding capacity

Water holding capacity of the four treatments in the present study had indicated that T₃ with the highest oregano leaves powder (25g) retained more water compared to other treatments ($P<0.05$) (Table 2). The ability of meat to retain inherent water is defined as water holding capacity (WHC), is an essential quality for both the producer and the consumer (Traore *et al.*, 2012). The technological quality of broiler meat, especially the water-holding capacity during storage, retail display and processing, is substantial for the meat industry due to its economic consequences. Therefore, higher supplementation of oregano leaves powder had improved water holding capacity of broiler meat according to the findings of this study while low (15-20g) supplementation did not impart any effect on the water holding capacity.

The majority of water in muscle is held either within the myofibrils, cell membrane (sarcolemma), between muscle cells and muscle bundles (groups of muscle cells). Once muscle is harvested the amount of water and location of that water in meat can change depending on numerous factors (diet, anatomical location of the muscle, nature of the tissue etc.) and how the product is handled (Honikel, 2004; Honikel & Kim, 1986).

Drip loss

Results of oregano leaves powder supplementation affect drip loss ($P<0.05$) (Table 2). The observed mean values of the drip loss differed significantly among the control (T₄) and the other treatments groups. High drip loss was recorded in 0g (Control) sample of broiler meat compared to the treatments that were supplemented with oregano leaves powder, increased purge over time was due to cyto skeletal protein that constitutes 10% of muscle proteins (Labeit & Kolmerer, 1995) and therefore, water is released continuously during meat storage (Kristensen & Purslow, 2001;

Straadt *et al.*, 2007) because of cyto skeletal structure degradation.

High drip and purge losses can represent a significant loss of weight in carcasses and thus affect the yield and quality of meat, and thereby considered economically important (Wright *et al.*, 2005). Meat with low level of drip loss is preferred especially for meat retailers in comparison with meat that has higher level of drip loss, higher drip loss is undesirable for several reasons, the most imperative one is the weight loss caused by the drip during the storage and retailing (Devi *et al.*, 2019).

Cooking loss

Irrespective of the level of supplementation of oregano leaves powder, meat samples indicated decrease in cooking loss compared to the control treatment (T₄) as shown in Table 2. Cooking loss could be due to muscle structural breakdown as a result of disruption of the channels via which, moisture is lost leading to the formation of a “sponge effect” that traps the water and inhibits it from being released (Farouk *et al.*, 2012; Huff-Lonergan & Lonergan, 2005).

Therefore, all the treatments that were supplemented with oregano leaves powder have lower (25.46-25.78%) cooking loss compared to the control treatment (29.49%). Cooking loss is one of the most important technological quality attributes not only to meat processors but also from a sensory point of view, as a high loss of water implies that the meat is perceived as less juicy (Bertram *et al.*, 2003)

Conclusion

Oregano leaf powder supplementation in broiler chicken with higher (25g) inclusion levels had positive effects on meat quality parameters (pH, water holding capacity, drip loss and cooking loss (aftertaste, flavor, juiciness and tenderness).

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

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.

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