DIETS SUPPLEMENTED WITH A MIXTURE OF POMEGRANATE, GINGER AND GARLIC IMPROVES HEALTH AND MEAT QUALITY OF BROILER CHICKENS

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Abstract: Some indices of health and meat quality of broiler chickens fed diets supplemented with a mixture of ginger, garlic and pomegranate were investigated. Dried and pulverized spices, ginger, garlic and pomegranate were mixed in ratio 2:2:1, respectively. The mixed-spices were combined with Starter and Finisher to formulate four (4) diets; 1 and 2 were 0% mixed-spices supplemented Starter and 2% mixed-spices supplemented Starter respectively. Diets 3 and 4 were respectively 0% mixed-spices supplemented Finisher and 2% mixed-spices supplemented Finisher. In the first phase of the experiment, 150 chicks were divided into groups A and B of 75 birds each, and respectively assigned to diets 1 and 2 for three (3) weeks. In the second (Finisher) phase, group A was sub-divided into groups C and D while group B was subdivided into groups E and F and fed *ad libitum* for additional 3 weeks. Group C was placed on diet 1 and then diet 3, D was on diet 1 and then on diet 4, E was on diet 2 and then on diet 3 and F was on diet 2 and then on diet 4. The breast and thigh ultimate pH values were found to be significantly decreased ($p<0.5$) in the groups maintained on mixed spices supplemented diets when compared with values in the group C (Control). All the test groups had significantly lower ($p<0.05$) serum ALT activities in comparison with the control. We therefore conclude that diets supplemented with the mixed spices improve meat quality of broiler chickens.

Keywords: Broiler, meat quality, health indices, feed supplementation

Introduction

Poultry meat is an important source of animal protein and other invaluable nutrients in human diets. It contains not just high quality protein, but moderate energy content, unsaturated lipids, fat-soluble and B-complex vitamins as well as minerals (Mustafa and Orkide, 2017; Runjun, 2013). As perceptions of consumers about meat change, and as they become more health conscious, nutritional strategies are being geared towards producing meat more as a functional food; meat fortified with special constituents that possess advantageous physiological effects (Stanton *et al*., 2005) in addition to its traditional nutritional contents.

Functional foods according to Danik and Jaishree (2015) are natural or processed foods that contain known or unknown biologically-active compounds; which, in defined, effective non-toxic amounts, provide a clinically proven and documented health benefit for the prevention, management, or treatment of chronic disease.

Bioactive substances in meat include linoleic acid, creatine, L-carnitine, anserine and glutathione, and studies have shown that modifying animal feed can increase the content of these bioactive compounds in the meat (Krajcovicova-Kudlackova *et al*., 2000; Mir *et al*., 2004) thereby making it a functional food.

The availability of bioactive compounds in meat can be regulated through the practices employed in animal production. The practices include incorporation of antioxidants in the animal feed which not only improve their health, lead to production of healthier meat (Jime´nez-Colmenero *et al*., 2001). Antioxidants are substances that prevent oxidation of other compounds such as lipids and oils, or neutralize free radicals. Addition of antioxidants to food, could control rancidity development, retard the formation of toxic oxidation products, maintain nutritional quality, and extend the shelf-life of products (Alexander *et al*., 2017). Consumption of foods rich in antioxidants is a good defence against many diseases and oxidative stress related conditions (Hipkiss and Brownson, 2000). Nutritional approaches are thought to be more effective than direct addition of the additive to meat since the compound is preferably deposited where it is most needed (Govaris *et al*., 2004; Dhama *et al*., 2015).

Spices and herbs are rich sources of antioxidants which consist of flavonoids, phenolic compounds, sulfur-containing compounds, tannins, alkaloids, phenolic diterpenes, and vitamins (Yesiloglu *et al*., 2013; Choi and Cha, 2014).

The rate and extent of pH decline after slaughter are major determinants of meat quality and are largely determined by the amount of lactic acid produced from glycogen during anaerobic glycolysis (Lawrie & Ledward, 2006). The evaluation of blood parameters such as transaminase activities allow for estimation of the health and nutritional status of organisms. This research was carried out to investigate the combined effects of mixed spices in improving the health of broiler chickens and quality of their meat.

Materials and Methods

Common commercial pelletized Starter's and Finisher`s mash were purchased from dealers in Vital Feeds in Dutsin-Ma Local Government of Katsina State. A total of 150 broiler chicks at a day-old were purchased from Chi Farms Limited Ibadan, Nigeria. Garlic and pomegranate powder were both purchased from Al-Halal Islamic store in Katsina, Katsina State. Dried ginger was bought from Dutsin-ma Central market, screened thoroughly for unwanted particles and stones, milled to flour using a mechanical grinder to pass a 0.5-mm mesh sieve and stored inside a clean vessel. The pomegranate, ginger and garlic were respectively combined in the ratio of 1:2:2 and thoroughly mixed to achieve homogeneity. The mixed-spices were mixed with the Starter and Finisher`s feeds to formulate four (4) experimental diets

Feed formulation

The mixed spices and Starter were mixed in a ratio of 2:98 receptively to formulate 2% mixed-spices supplemented Starter. Also, 2% mixed-spices supplemented Finisher was formulated using the same method (Idoko *et al*., 2019).

The following feeds were then formulated for the experiment;

1. 0% mixed-spices supplemented Starter
2. 2% mixed-spices supplemented Starter
3. 0% mixed-spices supplemented Finisher
4. 2% mixed-spices supplemented Finisher

Experimental design and animal management

Starter phase: In this phase of the experiment, the 150 chicks were divided into groups A and B of 75 birds each and randomly assigned to diets 1 and 2, respectively.

Finisher phase: In the second (Finisher) phase of the experiment, group A in the first phase was sub-divided into groups C and D while group B in the first phase was subdivided into groups E and F as follows;

Group C was maintained on 0% mixed spices - supplemented Starter and then 0% mixed-spices -supplemented Finisher feeds (Control).

Group D was maintained on 0% mixed spices-supplemented Starter and then 2% mixed spices-supplemented Finisher feeds.

Group E was maintained on 2% mixed spices -supplemented Starter and 0% mixed spices-supplemented Finisher feeds.

Group F was maintained on 2% mixed spices-supplemented Starter and then 2% mixed spices-supplemented Finisher feeds.

The broilers were kept in accordance with the method of Idoko *et al.* (2019). In this method, the birds were put in a warm (35 – 38°C), appropriately ventilated and disinfected environment. After seven days of acclimatization to the experimental environment, the birds were maintained *ad libitum* on their respective experimental Starter feeds for three (3) weeks and Finisher feeds for another three (3) weeks. The birds received gumboro disease vaccines on the 10th and 24th days. Newcastle disease vaccine (Lasota strain) was administered on the 17th and 31st days.

Animal sacrifice and preparation of specimen

At the end of the feeding trial, 5 birds with the least standard deviation among them were selected from each group and starved for 12 hours, weighed after the fasting and sacrificed by severing the jugular vein. Blood was collected into untreated sample tubes. The sacrificed birds were scalded and plucked.

Determination of ultimate pH (pHu)

Ultimate pH (pHu) of the breast and thigh meat was measured at 24 h with pH meter after homogenization of 10 g meat in 100 ml distilled water (Wardlaw *et al*., 1973).

Determination of transaminase activities

Serum was separated from the blood in plain tubes by allowing the blood to clot for 3 hours. The clotted blood was spun in a bench top centrifuge at 1500 rpm for 15 minutes to obtain serum. The serum samples were thereafter separated into another set of plain sample tubes and kept in the refrigerator. The serum activities of transaminases (aspartate aminotransaminase and alanine aminotransaminase) were determined using aspartate –aminotransferase and alanine-aminotransferase Randox assay Kits based on the method of Reitman and Frankel (1957) modified by Schmidt and Schmidt (1963).

Statistical analysis

Results were expressed as means ± SEM. Data generated during the starter phase were subjected to t-test but to oneway ANOVA during the Finisher phase. The statistical package program used for the analysis was SPSS (16.0 version) and $p < 0.05$ was considered significant.

Result and Discussion

Table 1 displayed the ultimate meat pH of broiler chickens fed with or without spices-supplemented diets. The ultimate pH values were significantly decreased ($p<0.5$) in the groups maintained on mixed spices supplemented diets when compared with values in the group maintained on 0% mixed spices - supplemented Starter and then 0% mixed-spices - supplemented Finisher feeds (Control). The lower pH of the meat from the birds fed mixed spices supplemented diet could be due to higher level of stored glycogen in those birds. The post-mortem pH of meat is determined by the amount of lactic acid produced from glycogen during anaerobic glycolysis (Lawrie and Ledward, 2006). The higher the amount of stored glycogen, the more the amount of lactic acid produced via anaerobic glycolysis and the lower the pH. Therefore, glycolytic potential, as measure of substrate concentration for post-mortem glycolysis, is a major determinant of pHu. The increased glycogen-storing and pH-lowering effect of the mixed spices is advantageous. The low pH resulting from meat having high level of glycogen at slaughter prevents total conversion of glycogen to lactic acid. There will be left residual glycogen. The residual glycogen improves meat quality by allowing for improved keeping qualities since the microbial population utilises glycogen as a fuel rather than protein. Utilisation of protein by bacteria results in the production of ammonia which gives offensive odour. A low pH also slows bacterial growth and so helps to guard against spoilage (Newton and Gill, 1981). Furthermore, glycogen is a very hydrophilic (water loving) molecule and tend to maintain the moisture content of meat. The finding is in agreement Alexander *et al*. (2017) who reported that when added to food, antioxidants control rancidity development, retard the formation of toxic oxidation products, maintain nutritional quality, and extend the shelf-life of products. In a research by Džinić *et al*. (2013), the addition of 2% of garlic powder in feed led to excellent meat quality regarding the juiciness and tenderness of breast meat. Deterioration in meat quality is also caused by lipid peroxidation (Ana *et al*., 2018) and this could be prevented by antioxidants in the spices.

Table 1: Ultimate meat pH of broiler chickens fed with or without spices-supplemented diets

Parameter	C	D	E	F
BpH	5.74±0.07^a	5.39±0.08^b	5.03±0.12^c	4.81±0.01^c
TpH	6.45±0.07^a	5.09±0.12^b	5.08±0.08^b	4.92±0.03^b

BpH- Breast ultimate pH
TpH- Thigh ultimate pH

Table 2: Serum transaminase activities (U/L) in broiler chickens fed with or without spices-supplemented diets

Enzyme	C	D	E	F
ALT	42.7±2.96^a	11.00±0.00^b	21.67±1.33^c	24.33±0.88^c
AST	12.67±0.33^a	8.00±0.58^b	10.33±0.33^a	12.66±1.20^a

ALT- Alanine-aminotransferase
AST-Aspartate-aminotransaminase

All the test groups had significantly lower ($p<0.05$) serum ALT activities in comparison with the control. However, only the group maintained on 0% mixed spices-supplemented Starter and then 2% mixed spices-supplemented Finisher feeds had significantly lower ($p<0.05$) AST activity (Table 2). The evaluations of blood parameters such as transaminase activities allow an informed estimation of the health and nutritional status of the birds. Extrusion of marker enzymes such as ALT and AST into the blood occurs when the integrity of the hepatocellular membrane, muscles and cardiac muscle fibers are compromised (Oche *et al*., 2014). The highest amount of ALT is found in the liver and is used as an index of degree of orderliness of the cell membrane. This is why in acute liver failure, the enzyme is released into the serum immediately after a hepatocellular damage (Orlewick and Vovchuk, 2012). Although not specific for liver disease, ALT and AST could be used in combination with other enzymes to monitor the course and progression of various liver disorders (Xing-Jiu *et al*., 2006). The significantly lower serum ALT in the group maintained on the mixed spices supplemented diets could therefore be due to a more ordered hepatocellular membrane layer in particular in those birds. AST is less specific than ALT and from the result obtained, AST was significantly lower only in the group maintained on 0% mixed spices-supplemented Starter and then 2% mixed spices-supplemented Finisher feeds. From the foregoing, inclusion of the mixed spices only during the finisher phase could offer more protection against the distortion of the cell membrane.

Conclusion

In conclusion, diets supplemented with a mixture of pomegranate, ginger and garlic improve health and meat quality of broiler chickens. Therefore, supplementation of broiler feed with a mixture of the spices is recommended.

Conflict of Interest

Authors have declared that there is no conflict of interest reported in this work.

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