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Meat Quality and Physicochemical Properties of Broiler Chicken Fed Lab

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Abstract:

The aim of this study is to evaluate the meat quality and physicochemical properties of broiler chicken fed LAB. Deep litter was used for the feeding of the birds for the period of eight (8) weeks. Broiler chickens was completely randomized into five treatment groups; Treatment 1 birds were given LAB 1, Treatment 2 were given LAB 2 while Treatment 3 were given the combination of LAB 1 and 2. Treatment 4 and 5 are control group. Treatment 4 is the positive control group (this group was given antibiotics) and Treatment 5 is the negative control group (this group are not given any antibiotics or LAB). A total of twenty-four (25), five dressed carcasses from each treatment were randomly selected from the five treatment groups. The breast cuts were generally trimmed of bones, overlaying skin and visible subcutaneous fats, then subjected for meat quality evaluations. Data were analysed using ANOVA at α 0.05. There was no significant difference in cooking loss in breast meat, drumstick meat, thigh meat. Chilling loss and drip loss. Both the raw and cooked meat pH was significantly higher in broiler chickens fed without LAB/Antibiotics (negative control) 6.13 and 6.45 respectively with least pH values obtained in broiler chicken fed the synergy of LAB 1 and 2 (5.85 and 6.15) respectively. Broiler chickens fed without LAB/Antibiotics (negative control) had the least extract released volume and while extract released volume for treated broiler chickens and water holding capacity are the same statistically. Oxidative rancidity was significantly higher in meat from broiler chicken fed antibiotics (3.22mg/g). Meat from broiler chickens fed LAB 1 had the highest score for aroma, flavor, juiciness, tenderness and overall acceptability with meat from broiler chicken fed no LAB and antibiotics had the least score for aroma while LAB 2 had the least score for colour, flavor juiciness and overall acceptability. LAB 1 could be added to the diet of broiler chickens due to its improvement quality on both the meat quality and eating characteristics which show no advert effect.

Keywords:

LAB, Water Holding Capacity, pH, Oxidative Rancidity and Sensory Evaluation

1. Introduction

Due to the rise in population growth, the need to increase the protein requirement is of necessity. Poultry production has become an important part of economic activity in many countries [1]. Poultry meat is a rich source of high quality protein, minerals and vitamins and poultry production, especially broiler chickens remains one of the veritable ways of attaining sustainable and rapid production of high quality protein to meet the increasing demand of the Nigeria teeming populace [2]. In large scale intensive production, poultry production is exposed to many stressful conditions and diseases that result in serious economic losses [3].

Currently, prevention measures using antimicrobial agents have been questioned due to the evolution of antimicrobial resistance among pathogenic bacteria. It is imperative that today's poultry industries be proactive in improving animal health and growth, and the safety of poultry products in a sustainable way. Probiotics, prebiotics, and synbiotics are proposed as natural and safe alternatives to antibiotic growth promoters in order to solve the intestinal problems of birds through the modulation of the composition and function of the intestinal microbiota, therefore improving health and performance of birds [4,5].

Accordingly, probiotics are being considered as the best option to fill the gap and already used by some farmers in preference to antibiotics [6] and [7]. In addition, the probiotic application has been reported in the poultry industry with an emphasis on their influence on the growth performance of chickens and their carcass compositions [8] and [9]. Besides, probiotics supplements in chicken also improve pH, colour, water-holding capacity, fatty acid profile and oxidative stability in fresh meat [10] and [11].

Regarding the effect of synbiotics (delivered in ovo or in feed) on growth performance and meat quality different are the studies yielding sometimes contradictory results. Some studies [12,13,14,15], using different kind of synbiotics supplemented in feed, reported beneficial effects on growth performance, feed efficiency, carcass, and some meat quality traits. Differently, other authors found minimal [13] or none [16,17] effect of synbiotics, delivered in ovo or in feed, on growth performance and on meat quality traits.

Therefore, the study seek to evaluate the meat quality and physicochemical properties of broiler chicken fed LAB.

2. Materials and Methods

Experimental site

The research is carried out in the MEDICOM laboratory Jos, Jos Plateau State, Nigeria.

Experiment materials

The bacterial (LAB 1 and 2)isolates used in this research study were isolated from three different sources viz Vegetable market dump site Faringada,Corn mill waste dumpsite Tudun Wada, Cereal production waste site at Grand cereal all in Jos and environment.

Housing and feeding management

Deep litter was used for the feeding of the birds for the period of eight (8) weeks. A commercial feed was used for both starter and finisher phase. The chicks were properly housed under standard management practices and vaccination schedule followed appropriately as recommended. There are five treatment groups; Treatment 1 birds were given LAB 1, Treatment 2 were given LAB 2 while Treatment 3 were given the combination of LAB 1 and 2. Treatment 4 and 5 are control group. Treatment 4 is the positive control group (this group was given antibiotics) and Treatment 5 is the negative control group (this group are not given any antibiotics or LAB).

Meat quality parameters

A total of twenty-four (25), five dressed carcasses from each treatment were randomly selected from the five treatment groups. The meat was conventionally prepared and the weight of each chicken recorded before and after processing and used to determine percentage loss and product yield of each sample. Meat was cut from the breast portions of the carcass and used for the meat quality. The breast cuts were generally trimmed of bones, overlaying skin and visible subcutaneous fats, then subjected for meat quality evaluations.

Cooking yield

The weight of meat was recorded before and after cooking and the yield was expressed as percentage

$$\text{Cooking yield} = \frac{\text{Weight of cooked meat}}{\text{Weight of raw meat}} \times 100$$

pH

The pH value of raw and cooked meat samples will be determined by weighing 10 grams of sample into a blender with 90ml of distilled water and homogenised until smooth slurry was formed. The digital pH meter was placed in a buffer solution in order to allow equilibrium for two minute before placing= it into prepared slurry. An average of three readings taken gave the pH value according to method described by [18].

Determination of Extract Release volume (ERV)

The technique was first described in [19] has been shown to be a value in determining incipient spoilage in meat as well as in predicting refrigerator shelf life.

Principle: The technique is based on the volume of aqueous extract released by homogenate of meat when allow to pass through the filter paper for a given period of time, by this meat of good organoleptic and microbial quality release large volume of extract, whereas meat of poor quality releases smaller volume or none.

Requirements: Beaker, distilled water, Whatman No. 1 filter paper, pestle and mortal, graduated cylinder.

Procedure

a) Take 25 g meat sample in 100 ml distilled water

b) Bend it with in pestle and mortal

c) Filter through Whatman No. 1 filter paper, folded thrice so as to make eight sections.

d) Allow the homogenate to seep between the folds

e) Collect the extract in 100 ml graduated cylinder for 15 min.

f) Record extract release volume and interpret results

Interpretation:

ERV (ml) Meat quality

> 25 ml Good quality

> 20 ml Incipient spoilage

< 20 ml Spoiled meat

Chilling loss

The weight of meat was recorded before chilling and after chilling for 24 hours, the yield was expressed as percentage

$$\text{Chilling loss} = \frac{\text{Weight after chilling meat}}{\text{Weight before chilling}} \times 100$$

Drip Loss

This was measured by the method of [20] with some modifications. Each breast was weighed immediately after ageing, hung in a laminate bag, closed loosely with string and allowed to thaw. After thawing for 24 h at 4°C, the meat samples were taken out, mopped and re-weighed and the drip loss calculated.

Water holding capacity

Water Holding Capacity (WHC) was determined according to [21]. Minced meat (20 g) was placed in a centrifuge tube containing 30 ml of 0.6 M NaCl and was stirred with glass rod for 1 min. The tube was then kept at 4 ± 1 °C for 15 min, stirred again and centrifuged at 3000g (R-24, Remi Instruments, India) for 25 min. The supernatant was measured and WHC was expressed in percentage.

Analysis of oxidative rancidity

Thiobarbituric acid value (TBA) was estimated by modified methods of [22]. Three mls each of glacial acid and 1% TBA solution were added to test tubes appropriately labelled blank and tests. 0.6ml of distilled water was added to the blank, while 0.6ml of the homogenised sample was added to each of the tests tubes. These were thoroughly mixed, incubated in a boiling water bath for 15 minutes, then allowed to cool, after which they were centrifuged and their supernatants collected. The supernatant from the blank was used to zero the spectrophotometer (preset at 532nm) before reading the absorbance of the supernatant from the test solutions.

The amount of TBARS was expressed as milligrams of malondialdehyde per gram of sample.

$$\text{TBA} = \frac{\text{O.D} \times V \times 1000}{A \times v \times I \times Y}$$

Where:

O.D = Absorbance of test at 532nm.

V= Total volume of the reaction mixture = 6.6mL

A= Molar extinction coefficient of the product, and according [22] is equal to $1.56x10^5$

I= Length of light path =1cm.

Y= mg of tissue in the volume of the sample used.

v= volume of tissue extract used =0.6ml

Sensory evaluation

A total of 20 trained individuals aged between 20 and 40 years were used to assess two replicate of the prepared sausage. The samples wereevaluated using a 9-point hedonic scale for flavor,colour, juiciness, tenderness, and overall acceptability The scale had a maximum score of 9 while the lowest score of 1 was assigned to the poorest condition [23].

Experimental design

Completely randomized design was used for this study.

Statistical analysis

In this research, data was statistically analyzed with the SPSS program for windows (SPSS VERSION 25, SPSS Inc., Chicago, IL, USA). Duncan's multiple range test is been used to compare the differences between means.

3. Results and Discussion

3.1. Results

Physicochemical properties and meat quality of broiler chicken fed with LAB and without LAB are shown on Table 1 and Table 2. There was no significant difference in cooking loss in breast meat, drumstick meat, thigh meat. Chilling loss and drip loss. Both the raw and cooked meat pH was significantly higher in broiler chickens fed without LAB/Antibiotics (negative control) 6.13 and 6.45 respectively with least pH values obtained in broiler chicken fed the synergy of LAB 1 and 2 (5.85 and 6.15) respectively. Broiler chickens fed without LAB/Antibiotics (negative control) had the least extract released volume and while extract released volume for treated broiler chickens and water holding capacity are the same statistically. Oxidative rancidity was significantly higher in meat from broiler chicken fed antibiotics (3.22mg/g).

Table 1. *Physicochemical properties of broiler chicken fed with LAB and without LAB.*

Parameters	LAB 1	LAB 2	LAB 1 +LAB 2	Antibiotics (positive control)	Without LAB/Antibiotics (negative control)	SEM
Beast cooking loss (%)	26.7	31.13	30.67	29	25.65	0.83
Drumstick cooking loss (%)	27.32	27.52	25.62	23.88	32.15	1.21
Thigh cooking loss (%)	25.76	24.36	27.42	26.08	27.13	0.71
Raw Meat pH	5.65^{c}	5.85^{b}	5.85^{b}	5.75^{bc}	6.13^{a}	0.04
Cooking Meat pH	6.15^{b}	6.20^{ab}	6.15^{b}	6.20^{ab}	6.45^{a}	0.04

abcd means with different superscripts on the same row differ significantly (P< 0.05)

SEM = Standard error of mean

Table 2. *Meat quality of broiler chicken fed with LAB and without LAB.*

Parameters	LAB 1	LAB 2	LAB 1 +LAB 2	Antibiotics (positive control)	Without LAB/Antibiotics (negative control)	SEM
Extract Released volume (%)	28.25[a]	22.25[a]	22.75[a]	28.00[a]	12.50[b]	1.64
Chilling loss (%)	0.26	0.43	0.63	1.74	0.23	0.23
Drip loss (%)	1.86	1.60	1.74	1.46	2.17	0.11
Water holding capacity (%)	61.67[a]	63.33[a]	45.00[ab]	48.33[ab]	36.67[b]	3.55
Oxidative rancidity (mg/g)	1.57[b]	1.21[b]	1.59[b]	3.22[a]	1.39[b]	0.39

abcd means with different superscripts on the same row differ significantly (P< 0.05)

SEM = Standard error of mean

Figure 1 shows the sensory evaluation of broiler chickens fed with LAB and without LAB. Meat from broiler chickens fed LAB 1 had the highest score for aroma, flavor, juiciness, tenderness and overall acceptability with meat from broiler chicken fed no LAB and antibiotics had the least score for aroma while LAB 2 had the least score for colour, flavor juiciness and overall acceptability.

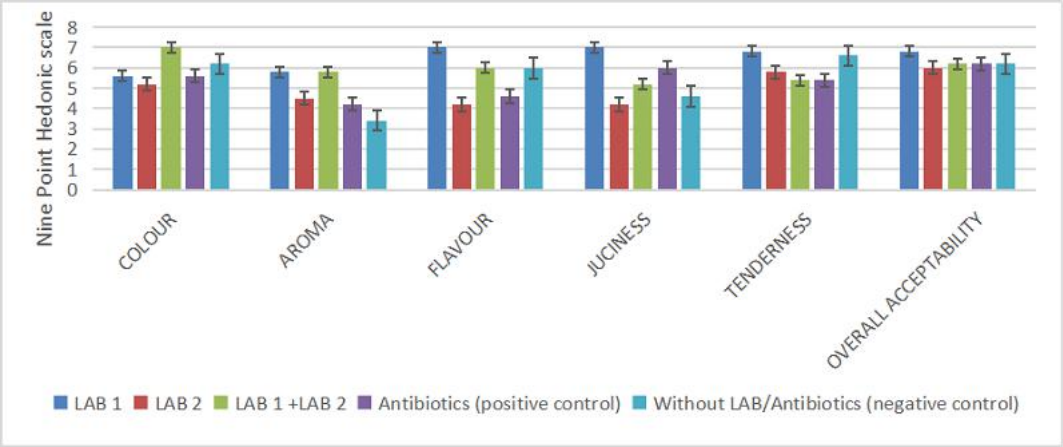

Figure 1. *Sensory evaluation of broiler chickens fed with LAB and without LAB.*

3.2. Discussion

Drip and cooking losses serve as useful indicators for the water holding capacity (WHC) of meat. WHC influences meat appearance prior cooking, meat cooking characteristics and as well as juiciness. Among the additives, the higher WHC observed in birds fed sole probiotics (Diet C) supported the findings of [24] who reported reduction in drip loss in breast muscle of Guangxi yellow chicken birds fed Bacillus coagulan. Regardless of the treatment, drip loss increased across the ageing period. This could be due to the disruption of the collagen and other myofibrillar protein matrix during the process of ageing which makes the myofibrillar proteins lose their ability to hold water. In addition, [25] reported that water could be forced out of myofibrils due to contraction during rigor mortis and enters into channels formed between the muscle fibre and the cell membrane because of the loss of intracellular matrix by action of calpain; such water could flow to the exterior as weep or drip. Cooking loss in breast meat was not influenced by dietary treatments at 24 h post-mortem. However, differences in cooking loss were observed on 7 d post-mortem. [26] reported similar findings where birds fed probiotics had lower drip loss

than the control birds from 0 to 8 d post-mortem. In contrast, [27] reported that probiotic supplementation had no effect on cooking loss in broiler breast meat. Among the additives, birds fed sole probiotics (Diet C) had lower cooking loss than other treatments. The profound influence of various additive on cooking and drip losses could be an advantage in enhancing the juiciness of the breast meat since higher juiciness is mostly derived from meat that exhibits lower drip and cooking losses. In addition, lower drip loss observed in birds fed additives could guard against loss of water soluble nutrients associated with drip loss.

The meat pH values observed in this study agree with literature results [28,29]. The pH and its variations can influence cooking loss and water holding capacity, which are extremely important for the acceptance of meat by the consumer [29]. In this study, pH was relatively lowered by the addition of both LAB 1 and 2. While the water holding capacity was increased with the inclusion of the probiotic. This result was in agreement with the findings of [30]. In agreement with the current results [31] showed that there is no connection between the physical properties of broiler breast meat (pH and water holding capacity) with the addition of enzymes ($P > 0.05$). Similar results were made by [32] who claimed that commercial enzymes, such as xylanase and phytase, have no impact on meat composition or quality parameters. The result obtained from the WHC could be due to the ability of the LAB to retain water within the muscle fibres which is in agreement with the findings of [10] and Saleh [33] who state that probiotics supplements in chicken also improve pH, colour, water-holding capacity, fatty acid profile and oxidative stability in fresh meat.

The extract released volume (ERV) is a measurement of meat quality and spoilage. When the ERV value obtained is higher, its shows that the meat is of good quality but when the values obtained is low, it shows that meat is of poor quality. In this study the Both LAB 1 and 2 with is combination promote good meat quality compared to meat from broiler chicken fed no LAB and antibiotics.

Meat from broiler chickens fed LAB 1 had the highest score for aroma, flavor, juiciness, tenderness and overall acceptability with meat from broiler chicken fed no LAB and antibiotics had the least score for aroma while LAB 2 had the least score for colour, flavor juiciness and overall acceptability. This findings in this study was in line with the result obtained by [34]. [35] stated in their study that the scores for the sensory attributes of the meat balls; appearance, texture, juiciness and overall acceptability were significantly higher and those for flavour were lower in the probiotic (Lacto-Sacc) fed group.

However, the present results differ from [36] who observed that neither probiotic nor antibiotic affected sensory characteristics (intensity of aroma, strange aroma, flavour, strange flavour, tenderness, juiciness, acceptability, characteristic colour and overall aspects) of breast and leg meats.

4. Conclusions

LAB 1 could be added to the diet of broiler chickens due to its improvement quality on both the meat quality and eating characteristics which show no advert effect.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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