Asian Journal of Research in Animal and Veterinary Sciences

6(4): 12-17, 2020; Article no.AJRAVS.60743

Synergistic Effect of Probiotic and Enzyme on Physical Evaluation and Consumers Preference of Broiler Chickens

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Authors' contributions

This work was carried out in collaboration among all authors. Authors TA, PEE, DOO and NMS designed the study. Authors JJM, ACN, HH, SBP and AKA performed the analysis. Authors DOO and ACN wrote the first draft of the manuscript. Authors NMS, DOO and PEE supervised the study and analysed the data. All the authors managed the literature search writing of the final manuscript. All authors read and approved the final manuscript.

Article Information

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Complete Peer review History: http://www.sdiarticle4.com/review-history/60743

Original Research Article

Received 10 July 2020
Accepted 16 September 2020
Published 23 October 2020

ABSTRACT

The objective of the study was to determine physicochemical activities and consumer's preference of broiler chickens fed probiotic and enzyme-based diet. A total of Twenty (20) refrigerated (4 ± 1°C) whole carcass broiler chickens were used for this study. 5 broiler chickens from 4 dietary treatments were used to perform the comparison of physicochemical and sensory analyses in a Completely Randomized Design. T1- Control treatment (without Enzyme nor Probiotics); T2- Probiotic based diet; T3- Enzyme based diet and T4- Probiotic + Enzyme based diet. The broiler chickens were obtained from an experimental site at the Poultry Division of the National Veterinary Research Institute, Vom. Chicken samples were acquired then slaughtered and taken to the laboratory

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properly packed in cool boxes with ice. Breast samples were used for physical and sensory analyses. Data were analyzed using descriptive statistics and ANOVA at $\alpha_{=0.05.}$ There were no significant differences in both the pH of raw and cooked meat. The cooking loss of breast meat showed no difference in all the dietary treatment. The same trend was observed for the cooking loss for drumstick meat. Cooking loss in thigh meat had a significant difference with T1 having the highest cooking loss. The product yield was significantly higher in meat from T3 and had the least in T1. It was also observed that meat from T2 had higher thermal shortening with less shortening obtained in T3. For boiled chicken meat, no difference was observed in colour, flavor, and juiciness while no difference was also observed in colour, aroma, flavor, juiciness and overall acceptability of grilled chicken meat. For boiled chicken, tenderness was higher in meat from broiler chicken fed T1 and T4 with less tenderness obtained in T3 while the grilled chicken meat tenderness was significantly higher in meat from broiler chicken fed T3. In conclusion, since there was no significant difference in most of the parameters measured, it shows adding probiotic and enzyme in the diet of broiler chickens does not have significant effect on the meat quality measures but shows significant effect on consumers' preference when compared with meat from broiler chickens fed a control diet without probiotic and enzyme with chickens fed probiotics and enzyme. There is no need adding probiotic and enzyme in the diet of broiler chickens except in breaking high fibre diet and promoting wellness of the chickens.

Keywords: Probiotic; enzyme; physicochemical properties; consumer's preference and broiler chicken.

1. INTRODUCTION

Poultry production has become an important part of economic activity in many countries. In large-scale intensive production, poultry production is exposed to many stressful conditions and diseases that result in serious economic losses [1] Currently, prevention measures using antimicrobial agents have been questioned due to the evolution of antimicrobial resistance among pathogenic bacteria. Accordingly, probiotics are being considered as the best option to fill the gap and already used by some farmers in preference to antibiotics [2,3]. 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 [4,5]. Besides, probiotics supplements in chicken also improve pH, colour, water-holding capacity, fatty acid profile and oxidative stability in fresh meat [6,7].

Besides the use of probiotics, digestive enzymes have been introduced into poultry production. Digestive enzymes have proved to improve feed efficiency and hypertrophy of the gastrointestinal tract has also been observed in chickens [8]. Exogenous enzymes increase nutrient digestibility by breaking down the fiber in plant cell walls or by hydrolyzing proteins resistant to these endogenous enzymes. This response has been observed with the addition of exogenous enzymes to diets that are of high viscosity [9] as well as to corn- and soy-based diets, considered to be of low viscosity diets [10]. The addition of enzymes to diets can help to eliminate the effects of anti-nutritional factors and improve the utilization of dietary energy and amino acids, resulting in improved performance of chickens [11].

The combination effect of probiotic and enzyme on meat quality has not been fully documented. So far, little research has been conducted to investigate the effect of probiotic and enzyme on the meat quality of broilers. This study seeks to investigate the synergistic effect of probiotic and enzyme on physical evaluation and consumers' preference of broiler chickens.

2. MATERIALS AND METHODS

2.1 Experimental Site

The research was carried out at the Poultry Division of National Veterinary Research Institute Vom, Jos South Local Government Area, Plateau State which lies on Latitude 09°44°N and Longitude 08°45°E, with a physical features of rocky granites of old volcanoes.

2.1.1 Meat samples

Twenty (20) refrigerated (4 ± 1°C) whole carcass broiler chickens, 5 broiler chickens each from 4 dietary treatments were used to perform the

comparison of physicochemical and sensory analyses. Treatment 1- Control (without enzyme nor probiotics); Treatment 2- Probiotic based diet, Treatment 3- Enzyme based diet and Treatment 4- Probiotic + Enzyme based diet. The broiler chickens were obtained from an experimental site at the Poultry Division of National Veterinary Research Institute. Chicken samples were acquired then slaughtered and taken to the laboratory properly packed in cool boxes with ice. The breast samples were used for physical and sensory analyses.

2.1.2 Cooking method

Boiling and grilling methods were used in this study.

2.1.3 Boiling method

Meat was wrapped in a nylon and carefully tighten and placed in a pre-boiled water at 100°C till an internal temperature of 72°C was reached.

2.1.4 Grilling method

Meat were placed in an electric griller at 200°C till an internal temperature 72°C was reached.

2.1.5 pH

The pH value of raw and cooked meat samples were determined by weighing 10 grams of sample into a blender with 90 ml of distilled water and homogenized 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 the prepared slurry. An average of three readings taken gave the pH value according to method described by [12].

2.2 Cooking Yield

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

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

2.2.1 Product yield

$$\text{Product yield \%} = \frac{\text{Cooked products}}{\text{Raw products}} \times 100$$

2.2.2 Thermal shortening

Thermal shortening % = Length before cooking – length after cooking/ Length before cooking X 100.

2.3 Sensory Evaluation

A total of 20 trained taste panelists aged between 20 - 40 years were used to assess two replicate of the prepared sausage. The samples were evaluated 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 [13].

2.4 Experimental Design

A Completely Randomized Design was used for this study.

2.5 Data Analysis

Data obtained was subjected to analyses of variance using SPSS Statistical Package Version 25. Significant differences between treatment means were separated using Duncan's Multiple Range Test.

3. RESULTS

The pH of raw and cooked meat as affected by Probiotics and Enzyme-based diet fed broiler chickens is showed in Table 1 with no significant differences in both the pH of raw and cooked meat of broiler chicken.

Table 2 shows the Cooking loss of meat as affected by Probiotics and Enzyme-based diet fed broiler chickens. The cooking loss of the breast and drumstick meat showed no differences in all the dietary treatment whereas Cooking loss in thigh meat has significant differences with T1 having the highest loss.

Fig. 1. shows the products yields and thermal shortening of meat from broiler chickens fed Probiotics and Enzyme based diet. The products yield was significantly higher in meat from Enzyme-based diet with least products yield in meat from Control diet. Although meat from Probiotic-based diet is higher in thermal shortening with less shortening obtained in Enzyme-based diet.

Table 3 shows the Sensory evaluation of boiled and grilled chicken meat as affected by

Probiotics and Enzyme-based diet fed broiler chickens. For boiled chicken meat, no difference was observed in colour, flavor, and juiciness while no different was also observed in colour, aroma, flavor, juiciness, overall acceptability of grilled chicken meat. For boiled chicken, tenderness was higher in meat from broiler chicken fed T1 and T4 with less tenderness obtained in T3 while for the grilled chicken meat tenderness was significantly higher in meat from broiler chicken fed T3.

4. DISCUSSION

pH is the acidity and alkalinity of any substance. The pH of meat is a significant index of its quality and together with colour should be used in the evaluation of meat [14]. pH is closely related to other important characteristics such as water holding capacity [15]. pH is the acidity and alkalinity of any substance. Studies on the Probiotic administration in poultry showed that pH might be influenced, but the results depend on the type of microorganisms and also on the specifics of the experimental design. [16] studied the effect of two probiotics supplied in a different amount to the diet of broiler chickens and found significant changes in the pH measured 24 hours post mortem in breast and thigh meat, which differed between the microorganisms used. Receiving 0.05% Streptococcus faecium cernelle 68 in the feed significantly decreased pH; while 0.01% of Bacillus cereus IP 5832 increased pH in both meat cuts [17]. Based on the results obtained in this study, there are no significant differences in all the pH obtained in the dietary treatment and between raw and cooked meat. Cooking loss in this study was in line with the one obtained by [18] who stated that Water holding capacity (WHC) and cooking loss (CL) 5 hours after slaughter were not different among different Probiotics or between them and the control group. The product yield was higher in meat from both Probiotic and Enzyme based diet compared to other dietary treatments. The result obtained in this study could be due to the ability of both the probiotic and enzyme based diet to bind or increase the water holding capacity of the meat. The thermal shortening showed no significant difference. According to [19] the three major sensory properties that interfere with meat quality evaluation are general aspect, texture and flavor; whereas [20] considered that general aspect is the most important, since it influences the consumers decision on buying the product or not the product. The consumers' preferences result obtained in this study was in agreement with the one obtained by [18].

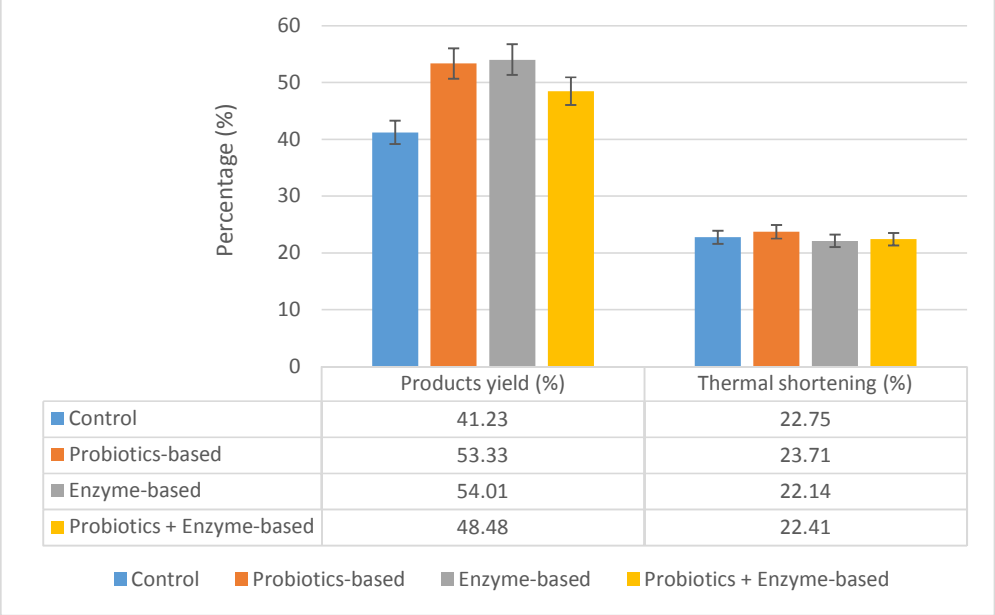

Fig. 1. Products yield of grilled chicken meat and thermal shortening of chicken meat as affected by probiotics and enzyme-based diet fed broiler chickens

Table 1. The pH of raw and cooked meat as affected by Probiotics and Enzyme-based diet fed broiler chickens

Parameters	T1	T2	T3	T4	SEM
Raw meat pH	6.23	6.27	6.42	6.38	0.03
Cooked meat pH	6.45	6.60	6.45	6.65	0.06

T1=Control, T2=Probiotics based diet, T3=Enzyme based diet, T4=Probiotics + Enzyme based diet; SEM=Significant Error of the Mean

Table 2. Cooking loss as affected by probiotics and enzyme-based diet fed broiler chickens

Parameters	T1	T2	T3	T4	SEM
Cooking loss Breast meat (%)	26.53	22.50	23.11	22.90	0.87
Cooking loss Drumstick (%)	21.17	20.44	22.68	23.49	0.72
Cooking loss Thigh (%)	30.75^{a}	23.57^{b}	29.88^{a}	23.33^{b}	1.16

[a, b] Means in the same row not sharing superscript are significantly different at P<0.05; T1=Control, T2=Probiotics based diet, T3=Enzyme based diet, T4=Probiotics + Enzyme based diet; SEM=Significant Error of the Mean

Table 3. Sensory evaluation of boiled and grilled chicken meat as affected by probiotics and enzyme-based diet fed broiler chickens

Parameters	T1	T2	T3	T4	SEM
Boiling method					
Colour	6.40	5.80	5.90	7.10	0.23
Aroma	5.10^{a}	3.70^{b}	3.10^{b}	3.20^{b}	0.28
Flavour	4.80	4.00	4.30	4.60	0.20’
Juiciness	6.00	5.40	4.90	5.70	0.21
Tenderness	6.50^{a}	4.80^{b}	5.80^{ab}	6.30^{a}	0.25
Overall acceptability	6.60^{a}	5.20^{b}	5.10^{b}	5.50^{ab}	0.24
Grilling method					
Colour	4.60	4.40	5.70	5.70	0.24
Aroma	5.40	4.80	4.20	5.30	0.22
Flavour	6.20	5.70	5.40	5.90	0.20
Juiciness	4.20	3.90	4.90	5.00	0.21
Tenderness	4.90^{b}	4.60^{b}	6.90^{a}	4.60^{b}	0.31
Overall acceptability	6.70	6.40	5.90	6.60	0.20

[a, b] Means in the same row not sharing superscript are significantly different at P<0.05; T1=Control, T2=Probiotics based diet, T3=Enzyme based diet, T4=Probiotics + Enzyme based diet; SEM=Significant Error of the Mean

5. CONCLUSION

In conclusion, since there was no significant difference in most of the parameters measured, it shows that adding probiotic and enzyme in the diet of broiler chickens does not have significant effect on the meat quality measured but shows significant effect on consumers’ preference when compared with meat from broiler chickens fed a control diet without probiotic and enzyme with chickens fed probiotics and enzyme. There may be no need adding probiotic and enzyme in diet of broiler chickens except in breaking high fibre diet and promoting wellness of the chickens.

ACKNOWLEDGEMENTS

We acknowledge the staff of Poultry Division of National Veterinary Research Institute, Plateau State (NVRI) and laboratory crew of Animal Products and Processing laboratory, Department of Animal Production, University of Jos, Jos for their effort and support during the research work.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
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