ANOTHER LOOK AT SENSORY ATTRIBUTES OF BROILER CHICKENS FED WITH NON-FERMENTED AND FERMENTED DIETS

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Abstract

This study aimed to assess the sensory attributes and general acceptability of steamed meat of broiler chickens fed with non-fermented (control) and fermented diets. The study used water, water + coco vinegar, and water + RPL8+AKE probiotic as fermenting causal agents. A total of thirty (30) breast carcass (steamed at 100oC for 10-15 minutes) samples per treatment at five grams (5g) per sample were utilized for evaluation. A group of thirty trained taste panelists composed of Food Technology students assessed the sensory attributes using the quality score and Hedonic scale sheets. Descriptive statistics were used in the sensory evaluation, and analysis of variance (ANOVA), and multiple comparison test using Tukey's honestly significant difference (HSD) test was used to compare the treatment means of the sensory attributes of the steamed meat samples in terms of skin color, flesh color, aroma, texture, taste, and general acceptability. The rating scores on skin colors (p-value=0.050), and texture (p-value=0.013) of steamed meat of broiler chickens fed with non-fermented and fermented diets were significantly different at a 5% level. Results revealed that the fermented diets have improved the broilers' skin colors (yellowish cream) and improved the texture quality of meat (moderately firm). Based on ANOVA, there is no significant difference observed in the descriptive scores in relation to flesh color (p-value=0.171), aroma (p-value=0.621), taste (p-value=0.723) and general acceptability (p-value=0.491). However, the steamed carcass of broiler-fed fermented diets (coco vinegar and probiotic) is slightly preferred based on ranks. Hence, fermented diets can modify the meat quality of broilers to meet consumers' expectations.

Keywords: Fermented diet, steamed carcass, sensory attributes, coco vinegar, probiotic

Introduction

One of the meat-type commercial hybrid chickens is a broiler that is prepared as a dish in a variety of ways depending on the region and culture in different countries (Pellattiero et al., 2020). The muscle parts such as breast, drumstick, thighs, wings, and legs, and giblets such as liver, heart, and gizzard are prepared and cooked for food. It can be processed in many ways like sausages, in salads, grilled or roasted, baked, breaded and deep-fried, and used in various dishes. To date, broiler meat is commonly deep-fried in fast-food restaurants as fried chicken, chicken nuggets, or buffalo wings and buttered chicken feet and neck. Presently, the demand for broiler meat products is expected to increase, along with population and income growth. In that case, quality and healthy broiler chicken must be served to avoid risks from diseases. In the study of Mir, Rafiq, Kumar, Singh, and Shukla (2017), it is very crucial to investigate the quality of broiler meat and its influencing factors. Additionally, Manning, Baines, and Chadd (2006) stated that ascertaining the food safety and health aspect of the meat of broiler chicken is one of the vital issues of the meat business industry. Food safety is very essential to protect the health of consumers from any form of human disease (Nauta et al., 2008; Wahyono & Utami, 2018; Thames & Theradiyil Sukumaran, 2020). Seemingly, according to Hugas and Tsigarida (2008), investigating and evaluating the pros and cons of carcass contamination will result in an improved food safety procedure in any meat industry.

Aside from food safety, it is also important to study the sensory attributes of broiler meat to understand its characteristics and improve its marketability. To date, most consumers are concerned with the sensory attributes that are characterized by intrinsic and extrinsic

qualities obtained from production (Pellattiero et al., 2020). One of the ways of improving the sensory attributes of broiler meat is the use of fermentation diets during the production period. According to some studies, Fermentation can improve the flavor, aroma, texture, appearance, and palatability of broiler meat (Pelicano et al., 2003). Chemical parameters of broiler meat such as protein, fat, moisture, and pH, and sensory attributes like color and tenderness of drumstick meat were improved with the use of probiotics (Al-Owaimer, Suliman, Alyemni & Abudabos, 2014). Moreover, the use of probiotics and other natural fermenting agents is identified as a potential alternative source of friendly microorganisms for the fermentation process (Bernardeau, Vernoux & Gueguen, 2002). However, information on the effect of fermenting causal agents such as plain water, coco vinegar, and probiotics on the sensory attributes of broiler meat is limited and fragmented. Moreover, it is crucial to continually investigate the use of a variety of food diets to improve the sensory qualities and meat attributes of chickens (Shaviklo, Alizadeh-Ghamsari & Hosseini, 2021). Hence, this study is considered to be conducted.

In general, this current study was conducted to assess the sensory qualities and general acceptability of steamed meat of broiler chickens fed with fermented diets. The assessment included important sensory attributes (flesh and skin colors, aroma, texture, and taste) and the general acceptability of steamed breast of broilers. This current study aims to determine the effect of fermented diets on the sensory qualities of broiler meat as opposed to non-fermented diets. Results of this study might suggest a substitute diet for broiler in improving sensory qualities and marketability. In addition, the study may serve as a benchmark for future animal science research that deals with the production of broilers and other birds. Furthermore, this study also may contribute scientific knowledge to the body of literature.

Materials and Methods

Broiler Chickens

The broiler chickens used in this study were the produced broilers in the study of Rivera and Casinillo (2021) which is fed by non-fermented ration (control) and fermented diets (treatments) such as water, water+15 ml coco vinegar, and water+15 ml RPL8+AKE probiotic as fermenting causal agents. Coco vinegar is abundant in amino acids and rich in nutrients (Othaman, Sharifudin, Mansor, Kahar, & Long, 2014). Additionally, it is commercially available and its pH level is almost neutral, unlike other kinds of vinegar that are very acidic. Moreover, probiotics (live microorganism) provides health benefits that can improve the wellness of broilers and their consumers (Wang et al., 2017). In this study, the process of fermentation lasted for about 72 hours inside the covered container placed at room temperature. In the conduct of this current study, the broiler chickens are 45 days old following the health feeding program by Lambio (2010).

Slaughter and Fabrication

After the feeding trial, three broilers from each treatment were harvested and slaughtered through Cosher Method. After bleeding, the following process was accomplished: scalding with 50oC-60oC for a few seconds, plucking, singeing or passing the carcass over a moderate flame to remove filoplumes, evisceration or withdrawal of the visceral organs out from the body cavity, separation of the giblets (includes the heart, liver, and gizzard). Finally, the carcasses were washed using clean and potable water and were dripped for 20 minutes before getting the breast part for carcass quality evaluation.

Preparation of Carcass Samples

The dressed chicken was fabricated by cutting into various standard cuts. Only the

breast part was taken and separated for carcass evaluation. The breast was reserved and prepared, and each carcass sample was placed in properly coded sealable plastic and stored inside the refrigerator, ready for cooking.

Experimental Treatments and Sensory Evaluation Procedure

The sensory quality assessment was done at the Department of Food Science and Technology, Visayas State University, Baybay City, Leyte, Philippines. A total of thirty (30) breast carcass samples per treatment at five grams (5g) per sample was utilized for evaluation. Each sample was cooked in a steamer at 100°C for 10 – 15 minutes. The carcass was placed and arranged in a steamer with a code to avoid mixing of samples. After cooking, the carcass was arranged in pre-coded plastic trays. Three (3) chicken breasts per replicate were selected at random from each of the different treatment diets as shown in Table 1.

Table 1. Experimental Layout.

	Treatments	Replicates
T_0	Control (Non-fermented ration)	R_1 R_2 R_3
T_1	Fermented ration using plain water	R_1 R_2 R_3
T_2	Fermented ration using water +15ml Coco Vinegar	R_1 R_2 R_3
T_3	Fermented ration using water +15ml RPL8+AKE Probiotic	R_1 R_2 R_3

A group of thirty (30) trained taste panelists composed of Master of Science, Junior, and Senior Food Technology students in Visayas State University assessed the sensory attributes using quality score sheets. Sensory attributes of steamed broiler meat were evaluated through a modified meat quality sensory evaluation by Lyon and Lyon (2000). Table 1 shows a summary of sensory attributes of steamed broiler meat which follows a 4-point rating scale.

Table 2. Sensory attributes of steamed broiler meat.

Perception Score	Skin Color	Flesh Color	Aroma	Texture	Taste
1.00 – 1.75	Yellow	Pale white	No distinct sour aroma	Very soft	Bland
1.76 – 2.50	Yellowish cream	Pinkish white	Slightly sour aroma	Soft/Chewy	Slightly sour
2.50 – 3.25	Creamy white with a tinge of pale yellow	Creamy white	Moderately sour aroma	Moderately Firm	Moderately sour
3.26 – 4.00	Creamy white	White	Extremely sour aroma	hard/tough	Extremely sour

For the acceptability and general acceptability of the sensory attributes of the steamed broiler meat, a Hedonic scale was used which is based on the paper of Peryam and Pilgrim

(1957). The acceptability rating uses a 9-point rating scale with 1 being the lowest score and 9 being the highest score. Table 3 shows the 9-point rating scale and its corresponding description.

Table 3. Range of mean perception score and its description.

Perception Score	Description
1.00 – 1.89	Dislike extremely
1.90 – 2.78	Dislike very much
2.79 – 3.67	Dislike slightly
3.68 – 4.56	Dislike
4.57 – 5.45	Neither like nor dislike
5.46 – 6.34	Like slightly
6.35 – 7.23	Like moderately
7.24 – 8.12	Like very much
8.13 – 9.00	Like extremely

Data Analysis

In the papers of Carifio and Perla (2008), and Norman (2010), it is concluded that parametric statistical methods are safe to be used with Likert scale data with no different outcome as opposed to non-parametric methods. Hence, descriptive measures such as mean average and standard deviation (a measure of dispersion) were used in summarizing the sensory evaluation. In addition, an analysis of variance (one-way ANOVA) was used to compare the treatment means of the sensory attributes of the steamed meat samples in terms of skin color, flesh color, aroma, texture, taste, and general acceptability. Furthermore, Tukey's Honestly Significant Difference (HSD) was employed to aid the multiple comparison test for treatment means at a 5% significance level. The sensory data were analyzed and calculated using a statistical software called Statistical Package for Social Science (SPSS) version 20.0.

Results and Discussion

Skin Color

It is revealed by ANOVA that the skin color rating of broiler meat (F_c=2.606, p-value=0.05) was significant at a 5% level. This implies that at least two treatment means differ significantly in terms of skin color. By Tukey's HSD, it shows that T3 (Fermented ration using water +15ml RPL8+AKE Probiotic) has a lower rating compared to the other treatments which fall into the category of yellowish cream (Table 4). The result is not consistent with the findings of Inovich et al. (2012) that the sensory attributes like skin color of broiler meat were improved with the use of probiotics. On the other hand, T1 (Fermented ration using plain water) and T2 (Fermented ration using water +15ml Coco Vinegar) fall to the category of Creamy white with a tinge of pale yellow in which the two treatments are the same as the control T0 (Table 4). It goes to infer that the two treatments (T1 and T2) can be substituted to the usual feeding of broilers in maintaining the skin color high rating.

Table 4. Skin color rating on the steamed carcass of broiler chicken.

Treatment	Mean*±Standard deviation	Description[c]
T_0	2.79^a±0.67	Creamy white with a tinge of pale yellow
T_1	2.58^a±0.77	Creamy white with a tinge of pale yellow
T_2	2.55^a±0.87	Creamy white with a tinge of pale yellow
T_3	2.48^b±0.88	Yellowish cream

Note: *–significant at 5% level; the same assigned letter means that it is not significant; c – See Table 2.

For the skin color acceptability rating, the ANOVA reveals that (F_c=0.780, p-value=0.506) the four treatments (T0, T1, T2, and T3) are not significantly different. Table 5 shows that the four treatments are rated as "Like moderately" (See Table 3 for details). However, there is a slight advantage in acceptability rating for the skin color under the three treatments (T1, T2, and T3) compared to the control T0. In that case, the use of fermented diets in the production is more likely accepted in regards to its skin color. This result is consonant with the findings of Pelicano et al. (2003) that the skin color of broilers under a fermented diet is slightly preferable.

Table 5. Skin color acceptability rating on the steamed carcass of broiler chicken.

Treatment	Mean^{ns}±Standard deviation	Description^{d}
T_0	6.54±0.89	Like moderately
T_1	6.70±1.16	Like moderately
T_2	6.77±1.33	Like moderately
T_3	6.75±1.23	Like moderately

Note: ns –not significant; d – See Table 3.

Flesh color

Table 6 reveals no significant difference (F_c=1.677, p-value=0.171) on flesh color among the fermented treatments (T1, T2, and T3) and control group (T0) using one-way ANOVA. This means that the flesh color of broilers with fermented diets and the control group are more likely the same, that is, creamy white. However, the broilers under fermented diets are slightly different (closer to a pinkish-white category, Table 2) from the control group based on Table 6. This indicates that fermented diets have a slight effect on the carcass of broilers which is very helpful in consumer preference (Castaneda et al., 2005). According to Bunnell and Bauernfeind (1962), the color of broilers' carcass plays an important role and it is highly correlated with food preferences depending on regional consumers throughout the world.

Table 6. Flesh color rating on the steamed carcass of broiler chicken.

Treatment	Mean^{ns}±Standard deviation	Description^{c}
T_0	3.00±0.76	Creamy white
T_1	2.84±1.07	Creamy white
T_2	2.73±0.96	Creamy white
T_3	2.71±1.06	Creamy white

Note: ns –not significant; c – See Table 2.

In regards to the flesh color acceptability, the four treatments namely T0, T1, T2, and T3 are not significantly different (F_c=0.591, p-value=0.621) based on one-way ANOVA (Table 7). Despite the insignificant result for acceptability rating between treatments, a slightly more acceptable flesh color was noticed on steamed meat of broilers fed non-fermented and water+coco vinegar fermented diets. In that case, water+coco vinegar fermented diet can be a substitute for the usual feeding of broilers to maintain a more acceptable flesh color. This result is parallel with the studies that deal with improving the meat quality of chicken broilers (Pelicano et al., 2003; Mir et al., 2017).

Table 7. Flesh color acceptability rating on the steamed carcass of broiler chicken.

Treatment	Mean[ns]±Standard deviation	Description[d]
T_0	7.17±0.93	Like moderately
T_1	7.10±1.31	Like moderately
T_2	7.17±1.09	Like moderately
T_3	6.98±1.22	Like moderately

Note: ns –not significant; d – See Table 3.

Aroma

As shown in Table 8, aroma perception scores were not significantly different (F_c=0.591, p-value=0.621) among treatments (T0, T1, T2, and T3) based on one-way ANOVA. However, it is noticed that broilers fed with RPL8+AKE probiotic fermented diets obtained the highest aroma perception score. This indicates that the aroma of the steamed carcass of broiler is slightly improved by fermented food diets. This result is somehow parallel to the findings of Onibi et al. (2009) that deal with the meat quality of broiler chickens fed with supplementary diets.

Table 8. Aroma rating on the steamed carcass of broiler chicken.

Treatment	Mean[ns]±Standard deviation	Description[c]
T_0	2.18±0.81	Slightly sour aroma
T_1	2.08±0.97	Slightly sour aroma
T_2	2.11±0.96	Slightly sour aroma
T_3	2.29±0.99	Slightly sour aroma

Note: ns –not significant; c – See Table 2.

Table 9 shows that the four treatments (T0, T1, T2, and T3) are not significantly different (F_c=0.957, p-value=0.413) in regards to aroma acceptability rating. However, it was observed that aroma was slightly more preferable on steamed meat of broilers fed fermented diet using water + coco vinegar as fermenting agent (Table 9). The study of Castaneda et al. (2005) is consistent with its report on the improvement of broiler meat aroma under fermented diets. According to Chavez et al. (2004), it is important to modify the aroma and eliminate the nuisance odor of broiler meat to increase its marketability and acceptability.

Table 9. Aroma acceptability rating on the steamed carcass of broiler chicken.

Treatment	Mean[ns]±Standard deviation	Description[d]
T_0	7.24±0.98	Like very much
T_1	6.99±1.50	Like moderately
T_2	7.26±1.16	Like very much
T_3	7.21±1.25	Like moderately

Note: ns –not significant; d – See Table 3.

Texture

The texture score of steamed meat of broiler chickens fed with non-fermented and fermented diets showed a significant (F_c=3.612, p-value=0.013) difference among treatments (Table 10). This implies that results revealed better texture (moderately firm) on fermented diets than non-fermented diets (by Tukey's HSD). In that case, a broiler under fermented diets results in a moderately firm texture carcass which is ideal meat quality. In the meat production of poultry, features like firmness and tenderness are influential in judging the meat quality by consumers (Mir et al., 2017). Additionally, proper firmness is mostly reflected in consumption characteristics such as juiciness and flavor of broiler carcass. Hence, fermented diets help

improve the firmness quality of broiler meat. The study of Pelicano et al. (2003) is consistent with its report on the improvement of meat texture under fermented diets.

Table 10. Texture rating on the steamed carcass of broiler chicken.

Treatment	Mean*±Standard deviation	Description[c]
T_0	3.26^{b}±0.76	hard/tough
T_1	2.67^{a}±1.03	Moderately Firm
T_2	2.79^{a}±0.98	Moderately Firm
T_3	2.60^{a}±0.85	Moderately Firm

Note: *–significant at 5% level; the same assigned letter means that it is not significant; c - See Table 2.

For texture acceptability rating, the fermented diets (T1, T2, and T3) and non-fermented diets (T0) do not differ (F_c=0.471, p-value=0.702) based on the ANOVA result. However, fermented diets are more likely preferred compared to non-fermented diets (Table 11). In that case, the hard steamed carcass of broiler is less likely preferred by consumers. Hence, a meat quality that is preferable for consumers is achieved by broilers that are fed by fermented diets. This result is parallel to the findings of Khan et al. (2018) that deals with feed supplements for birds that targeted the development of meat products to meet the great interest and higher demand.

Table 11. Texture acceptability rating on the steamed carcass of broiler chicken.

Treatment	Mean[ns]±Standard deviation	Description[d]
T_0	6.97±1.01	Like moderately
T_1	7.10±1.35	Like moderately
T_2	7.08±1.37	Like moderately
T_3	7.19±1.27	Like moderately

Note: ns –not significant; d – See Table 3.

Taste

In terms of the taste rating score, results revealed no significant difference (F_c=0.442, p-value=0.723) among treatments (Table 12). The sensory panelists describe all treatments as slightly sour. However, fermented diets have lowered the sourness of steamed carcass of broiler a little bit based on the mean scores. This observation suggested that fermented diets can amend broiler meat flavor and taste. This result is inconsonant to the findings of Wang et al. (2017) that deals with fermented diets to improve chicken meat flavor. Likewise, the result is consistent with the study of Fujiwara et al. (2008) which deals with fermented foods to improve the production and quality of birds' meat.

Table 12. Taste rating on the steamed carcass of broiler chicken.

Treatment	Mean[ns]±Standard deviation	Description[c]
T_0	1.97±0.68	Slightly sour
T_1	1.84±1.02	Slightly sour
T_2	1.90±0.96	Slightly sour
T_3	1.85±0.85	Slightly sour

Note: ns –not significant; c – See Table 2.

The taste acceptability description by the panelists was "like moderately" on both fermented (T1, T2, and T3) and non-fermented diets (T0) (F_c=0.445, p-value=0.721) (Table 13). The ANOVA reveals that F_c=0.445 with a p-value of 0.721 which suggests that there is no significant difference between the treatments. Although the fermented diets have a lesser sourness in the steamed carcass of broilers, still the steamed carcass under the non-fermented

diets was preferred based on Table 13. This result suggested that consumers are more likely to prefer a slightly sour steamed carcass of broilers. Additionally, it implies that fermented diets do not influence the taste acceptability of steamed carcasses of broilers. This result is not consistent with the study of Joshi and Kumar (2015) that deals with improving meat products to have an appealing taste to consumers.

Table 13. Taste acceptability rating on the steamed carcass of broiler chicken.

Treatment	Mean^{ns}±Standard deviation	Description^{d}
T_0	6.93±0.95	Like moderately
T_1	6.75±1.40	Like moderately
T_2	6.90±1.44	Like moderately
T_3	6.81±1.29	Like moderately

Note: ns –not significant; d – See Table 3.

General Acceptability

Just like the acceptability rating of each specific sensory attribute, the overall general acceptability rating of steamed meat of broilers which ranges from 7.06 to 7.25 is not significant (F_c=0.806, p-value=0.491) influenced by the dietary (fermented diets) treatments (Table 14). The overall general acceptability description rating falls in the "like moderately" of the 9-point Hedonic scale. Although not significant, the general acceptability rating of steamed meat of broilers fed with a fermented diet using water + coco vinegar (x □=7.25) was slightly more acceptable. Followed by broiler chickens fed with a fermented diet using probiotics (x □=7.09). This suggests that broiler chickens fed with a fermented diet have slightly improved their meat quality. In that case, results suggested that fermented diets can amend the sensory attributes of meat to meet the consumers' preferences in the chicken meat market. This is due to the microorganism, amino acids, nutrients, and other health benefits from a fermented diet that is incorporated into the meat of broilers. Hence, it can boost the nutritional value and modify its sensory attributes that attract consumers. Aside from the health effect, it can also soften the meat of broilers into the desired texture that is preferable to consumers. And this finding is consistent with the studies available on literature that deals with improving the meat quality of broilers (Pelicano et al., 2003; Onibi et al., 2009; Mir et al., 2017; Pellattiero et al., 2020).

Table 14. General acceptability rating of the steamed carcass of broiler chicken.

Treatment	Mean^{ns}±Standard deviation	Description^{d}
T_0	7.07±0.74	Like moderately
T_1	7.06±1.06	Like moderately
T_2	7.25±0.98	Like very much
T_3	7.09±0.99	Like moderately

Note: ns –not significant; d – See Table 3.

Conclusions

In conclusion, results showed that a fermented diet has significantly improved the skin color and texture of steamed meat of broilers. Specifically, the water+15 ml RPL8+AKE probiotic as a fermenting causal agent has modified the skin color of steamed meat of broilers to yellowish cream which makes it attractive to the consumers. Additionally, the three fermenting agents in this study have also improved the texture as moderately firm which makes the steamed meat of broilers appealing to the consumers. Furthermore, the steamed meat of broilers under fermenting agents (water + 15 ml coco vinegar and water + 15 ml RPL8+AKE probiotic) is more likely preferred by consumers based on general acceptability rating. Hence, it

implies that fermented diets can significantly improve the sensory attributes' quality of broiler meat which is a very important factor in increasing its marketability. For future studies, one may consider reevaluating the performance of broiler chickens with the same fermenting causal agents at a higher level to attain the best level of step-up. Moreover, it is recommended to conduct laboratory analytic investigation on the fermenting causal agents concerning the microbial population and its differential count to throw out the possibility of the existence of harmful contaminants. It is also suggested to include other potential and naturally available fermenting agents, and the assessment of the Physico-chemical characteristics of the raw carcass.

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