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# EFFECT OF *MORINGA OLEIFERA* LEAF POWDER AS SUBSTITUTE FOR LYSINE ON STORAGE QUALITY PROPERTIES OF BROILER BREAST MEAT

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## ABSTRACT

*This experiment explores the effect of Moringa oleifera leaf powder (MOLP) as a natural substitute for synthetic lysine supplementation in broiler diets on storage quality properties of broiler breast meat. The study used 250-day-old Cobb-500 broiler chickens in a completely randomized design, with five treatment groups receiving different proportions of synthetic lysine and MOLP during the starter and finisher phases. The meat quality properties evaluated were pH, water holding capacity, cooking yield, and thawing loss (TL). The results showed that MOLP significantly ($p \leq 0.05$) impacted meat quality properties as values recorded for each quality property followed a specific trend. The minimum values (5.35) recorded for pH were in Month1 and Month 2 at T4 (25% lysine and 75% MOLP) and T3 (50% lysine and 50% MOLP), respectively, while the maximum value (6.82) was recorded at Month 6 in chickens fed T5 (0% lysine and 100% MOLP). The dietary treatment also affected water holding capacity, with Month 1 showing the lowest value (2.46 %) in chickens fed diet T4, while Month 6 revealed the value (6.86 %) in chickens fed diet 2. The effect of dietary treatment on cooking yield and loss did not take a specific/straight trend as the cooking yield was highest at Month 2 (69.27 %) and*

*lowest at Month 5 (42.96) in T2 and T4, respectively. The cooking loss was also recorded at 49.73 % in Month 6 in Diet T1 and 31.05 % in Month 1 in Diet T5. The thawing loss followed a steady trend and increased in value from month 1 to 6, with the lowest value being recorded at Month 1 (1.02 %) in chickens fed diet T3, while the highest value was recorded in Month 6 (8.5 %) in chickens fed diet T1. The effect of MOLP as a substitute for lysine on storage duration impacted all the meat quality properties evaluated.*

**Keywords:** Broiler chickens, Lysine, Meat quality and *Moringa oleifera*,

## INTRODUCTION

Broiler meat, as an affordable and good source of protein, is rich in low amounts of collagen, trace vitamins, mainly thiamin, vitamin B6, and pantothenic acid. It is a good source of iron, zinc, and copper, and has a low-fat content, making it a better decision for consumers (Naji *et al.,* 2013). These nutritional attributes, which are often overlooked, make broiler meat an important component of our meals (Arshad *et al.,* 2016) and, hence, the rising demand for a higher meat yield in the global broiler industry (Rehman *et al.,* 2018).

The poultry industry is an essential sector in Nigeria, contributing significantly to the country's economy and providing a valuable source of animal protein for its population (Heise *et al.,* 2015). Meanwhile, as the demand for poultry products grows in Nigeria and worldwide, it becomes imperative to explore sustainable and eco-friendly practices that can improve productivity while addressing environmental and welfare concerns (Anabaraonye *et al.,* 2021). Poultry scientists are poised to apply organic feed supplements, which may portend therapies to improve the well-being and performance of chickens (Mahfuz *et al.*, 2018a). Therefore, poultry studies are tailored toward finding possible organic feed materials that will be both ecologically adaptive and healthy for human consumption (Pourhossein *et al.,* 2015; Mahfuz *et al.*, 2018b). These make finding alternatives to synthetic additives like lysine using plant sources such as *Moringa* as a natural alternative to synthetic lysine supplementation in broiler diets while considering its potential in addressing environmental and sustainability concerns and as well as improving animal welfare and the nutritional value of the poultry products (Kaderides *et al.,* 2021).

*Moringa oleifera*, a tropical plant renowned for its nutritive and medicinal properties, has gained considerable attention as a potential natural alternative to synthetic lysine supplementation in broiler diets (Mahfuz and Piao, 2019). *Moringa oleifera* leaf is rich in

essential amino acids, vitamins, minerals, and bioactive compounds, making it a promising resource to address the nutrient requirements of broiler chickens (Taufek *et al.,* 2022). Therefore, this experiment was undertaken to study the effect of MOLP as an alternative to lysine on the storage quality properties of broiler breast meat.

## MATERIALS AND METHODS

**Location of the experiment:** The study was carried out at the Department of Animal Production Teaching and Research Farm, FUT Minna, Niger State, Nigeria. The area lies in southern Guinea's savannah belt of Nigeria, with rainfall ranging from 1100 to 1600 mm per annum and an average temperature of 29 °C.

**The Moringa *oleifera* Leaf Powder and its Chemical Evaluation:** The fresh *Moringa oleifera* leaf was air dried in an open-air space under a shade that prevented direct sunlight radiation to avoid losing its green colouration. The dried leaf was pulverised afterwards using a conventional grinding machine. Following the description of AOAC (2020), the *Moringa oleifera* leaf powder was analysed for proximate composition (crude protein, fat, fibre, ash, moisture, and carbohydrate), anti-nutrients (alkaloid, saponin, oxalate, tannins, cyanide and phytates) and phenolics.

**Table 1: Proximate Compositions of *Moringa oleifera* Leaf Powder (MOLP)**

| | |
|---|---|
| Protein (%) | 28.33 |
| Ether Extract (%) | 3.40 |
| Fibre (%) | 16.70 |
| Ash (%) | 4.80 |
| Moisture (%) | 5.00 |
| Nitrogen Free Extract (NFE) (%) | 42.05 |

**Table 2: Phytochemical Composition of *Moringa oleifera* Leaf Powder (MOLP)**

| | |
|---|---|
| Alkaloids (g/100g) | 4.95 |
| Saponins (g/100g) | 6.44 |
| Oxalates (g/100g) | 12.56 |
| Tannins (g/100g) | 8.80 |
| Cyanides (g/100g) | 0.04 |
| Phytates (g/100g) | 2.95 |
| ***Phenolics Composition*** | |
| Phenolic acids (g/100g) | 41.35 |
| Flavonoids (g/100g) | 12.22 |

**Sources of the Experimental Birds and MOLP:** A total of 250-one-day-old Cobb-500 broiler chickens were used for the experiment. They were obtained from Olam Hatchery, Kaduna, Nigeria. *Moringa oleifera* leaf was obtained at villages around the university community.

**Experimental Design and Feeding Management:** The birds (Chickens) were cared for under deep litter and were divided into five (5) diet groups designated as T1, T2, T3, T4, and T5 using a completely randomized design experimental design. Each treatment had five replicates of ten (10) chicks each. The group T1 constituted birds fed 100 % synthetic lysine and 0 % MOLP, T2 constituted birds fed 75 % synthetic lysine and 25 % MOLP, T3 constituted birds fed 50 % synthetic lysine and 50 % MOLP, T4 constituted birds fed 25 % synthetic lysine and 75 % MOLP, while T5 constituted birds administered 0 % synthetic lysine and 100 % MOLP.

While adopting the method of Cargil *et al.* (2007), the birds were orally administered vaccines through drinking water. Lasota vaccine at days seven and twenty-one and Gumboro vaccine at days fourteen and twenty-eight. Experimental starter and finisher diets (Tables 1 and 2) and water were provided *ad libitum.* After the feeding trial, two birds of average weight from each replicate were selected for meat quality analysis. The selected chickens were deprived of feed for twelve hours (6:00 PM to 10:00 AM the following day), after which the chickens' live weight was taken. This was preceded by slaughtering, using a kitchen knife to cut the jugular vein for proper bleeding. The individual slaughter weight was taken, and the slaughtered bird was submerged in warm water (60 seconds) for a few seconds for easy manual feather plucking. The plucked weight was recorded, and evisceration ensued. The dressed weight of

each carcass was recorded. The dressed carcass was cut into parts (breast, thigh, drumstick, wings, back, and neck) and visceral (liver, heart, gizzard, abdominal fat, Intestine, and lungs). The breast meat samples from each replicate were separately packed in a polyethene bag and stored at 5 degrees Celsius for 6 Months. The meat quality properties were assessed at one-month intervals during the six-month storage period.

**Assessment of meat quality characteristics:** The following parameters were measured to evaluate the quality of breast meat. pH, Water Holding Capacity (WHC), Thawing Loss (TL), Cooking yield (CY) and Cooking Loss (CL).

**pH**

The breast muscle samples' pH was measured using a pH meter (pH spear, model 35634-40, Eurotech Instruments, Malaysia). This was done by making an incision with a kitchen knife into the breast meat and placing the probe into the incised point while the displayed value on the pH meter screen was recorded. This was carried out for six (6) months.

**Water Holding Capacity**

While adopting the methodology of Kaufman *et al.* (1992), a 5g sample of breast meat was placed under two filter papers and pressed under a screw jack to get rid of the inherent liquid. WHC was calculated thus;

$$WHC(\%) = \frac{InitialWeight - Finalweight}{Initialweight} \times 100$$

**Thawing Loss**

Fifty grams of the breast (pectoral) muscle sample was packed in a polythene bag and frozen under 4 $^{o}$C for 24 hours. After that, the sample was submerged in a water basin, which was changed twice every 30 minutes. The thawing loss was assessed following the description of Northchut *et al.* (1994) by calculating the differences between initial and final weight and expressing it as the percentage of the initial weight.

**Table 3: Starter Diets of Broiler Chickens Fed Diets Containing *Moringa oleifera*Leaf Powder (MOLP) as Substitute for Synthetic Lysine (SL)**

| Ingredients (kg) | T1 | T2 | T3 | T4 | T5 |
|---|---|---|---|---|---|
| Maize | 50.57 | 50.38 | 49.48 | 47.87 | 46.97 |
| Maize Offal | 11.00 | 11.00 | 11.00 | 11.00 | 11.00 |
| Groundnut Cake | 32.43 | 30.95 | 30.17 | 30.11 | 29.34 |
| Fish meal | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Bone meal | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Salt | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Vitamin Premix | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| SL | 0.25 | 0.19 | 0.13 | 0.06 | 0.00 |
| MOLP | 0.00 | 1.74 | 3.47 | 5.21 | 6.94 |
| Methionine | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| **Total** | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| **Calculated Analyses** | | | | | |
| Crude Protein% | 23.00 | 23.00 | 23.00 | 23.00 | 23.00 |
| Metabolizable Energy (Kcal/kg) | 2855.62 | 2860.50 | 2857.71 | 2847.73 | 2845.06 |

T1: 100% SL, 0% MOLP, T2: 75% SL, 25% MOLP, T3: 50% SL, 50% MOLP, T4: 25% SL, 75% MOLP, T5: 0% SL, 100% MOLP, SL: Synthetic Lysine, MOLP: *Moringa oleifera* leaf powder

**Cooking Yield**

The assessment of cooking yield of the breast meat sample was determined using the method of Bethany *et al.* (2012). A 20 g breast meat sample was taken for boiling. The breast meat sample was placed in a glass container of 20 ml of water and the water bath was preheated for five minutes at 100 degrees Celsius. The glass container was then placed in the water bath and cooking was done at 75 $^{o}$C for thirty minutes. The sample was retrieved from the water bath, allowed to cool to room temperature, and cleaned off of excess liquid. the new weight of the sample was recorded. The cooking yield was calculated thus;

$$Cookingyield(\%) = \frac{Cookedmeatweight(g)}{Initialmeatweight(g)} \times \frac{100}{1}$$

**Table 4: Finisher Diets of Broiler Chickens Fed Diets Containing *Moringa oleifera* Leaf Powder (MOLP) as Substitute for Synthetic Lysine (SL)**

| Ingredients (kg) | T1 | T2 | T3 | T4 | T5 |
|---|---|---|---|---|---|
| Maize | 64.27 | 64.08 | 63.16 | 61.57 | 60.67 |
| Maize Offal | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 |
| Groundnut Cake | 24.73 | 23.25 | 22.49 | 22.41 | 21.64 |
| Fish meal | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Bone meal | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Salt | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Vitamin Premix | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| SL | 0.25 | 0.19 | 0.13 | 0.06 | 0.00 |
| MOLP | 0.00 | 1.74 | 3.47 | 5.21 | 6.94 |
| Methionine | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| **Total** | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| **Calculated Analyses** | | | | | |
| Crude Protein% | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 |
| Metabolizable Energy (Kcal/kg) | 3009.56 | 3014.44 | 3011.44 | 3001.67 | 2999.00 |

T1: 100% SL, 0% MOLP, T2: 75% SL, 25% MOLP, T3: 50% SL, 50% MOLP, T4: 25% SL, 75% MOLP, T5: 0% SL, 100% MOLP, SL: Synthetic Lysine, MOLP: *Moringa oleifera* leaf powder

**Data Analysis**

Using the statistical software SPSS V.23.0.0, a widely accepted tool for data analysis in scientific research, the recorded experimental data were subjected to a one-way analysis of variance (ANOVA). Means were separated at P≤0.05) probability level using Duncan's Multiple Range Test (DMRT).

**RESULTS AND DISCUSSION**

**Effect of *Moringa oleifera*Leaf Powder on pH of Stored Broiler Chickens' Meat**

The effect of MOLP on storage quality significantly influenced the meat pH at various inclusion levels from the second month to the sixth month (Table 5). No significant (P>0.05) differences

in pH within the first month across the Treatment groups of MOLP. These differences in pH from the second to the sixth month did not follow a specific trend, indicating that MOLP inclusion in broiler chicken diets did not affect the pH of broiler chicken meat within the first month of storage. The minimum pH of stored broiler chicken meat recorded is similar to the value reported by Soeparno (2009), whereas the maximum value (6.80) recorded is in variance with that (6.50) reported by Soeparno (2009).

Similarly, the water-holding capacity of broiler chicken meat administered various inclusions of MOLP (Table 6) did not vary across the treatment groups within the first two months of storage of the meat. The result of water holding capacity of broiler chicken meat differed significantly ($P \leq 0.05$) across the MOLP treatment group from the third to the sixth month, even though these differences did not follow any specific pattern, just as observed in the result of the broiler chicken meat pH seen earlier. The findings align with previous research, indicating that the treatment choice can also influence the meat's water retention ability (Cheng and Sun, 2008), as the mean values ranged from 2.46 in the first month in T4 to 6.86 in the 6th Month in T2. This is also similar to the report of Muthukumar *et al.* (2012) that the addition of *Moringa oleifera* leaf extracts increased the WHC of goat meat and raw pork patties, as is now seen in broiler chicken meat, especially from the third to the sixth month in the present study (Table 6).

The result of the cooking yield of broiler chicken meat presented in Table 7 shows significant ($P \leq 0.05$ differences in cooking yield across the treatment group of MOLP from the first month up until the sixth month. The result within the first three months of storage indicated that the cooking yield variation across the MOLP treatment group followed the same trend. While differences in the cooking yield of meat of chickens administered MOLP existed, there was no specific pattern of variation from the fourth to the sixth month across the treatment groups (Table 7). This indicates that treatment can certainly influence the cooking yield of the meat. Comparing these findings with previous studies, it is important to note that there is limited research specifically investigating the effect of *Moringa oleifera* on the storage quality of broiler meat. However, studies have been conducted examining the individual effects of *Moringa oleifera* treatment and storage duration on meat quality parameters. These previous studies investigating *Moringa oleifera* as a treatment for broiler meat quality have reported varying results. Some studies have suggested that *Moringa oleifera* supplementation can positively impact meat quality characteristics, such as tenderness and

juiciness. These effects may be attributed to the bioactive compounds present in *Moringa oleifera*, including antioxidants and anti-inflammatory agents. However, it is worth noting that the specific impacts of *Moringa oleifera* treatment on carcass yield have not been extensively explored in the existing literature. The results of this study, therefore, provide valuable insights into the potential benefits of Moringa oleifera supplementation on the quality of broiler chicken meat.

The result of Thawing Loss presented in Table 8 shows a significant difference between the treatment groups as measured from the first to sixth months. Treatment 2 had the highest Thawing loss in 2nd Month. Generally, the results did not follow a particular pattern. This is also in variance with the findings by Lawrie (1998) that diet does not seem to affect drip loss, and Comale *et al.* (2011) reported that the use of the phytotherapeutic compound in the diets does not globally influence drip and cooking losses. The significant differences in thawing loss across the treatment groups suggest that the inclusion of Moringa oleifera Leaf Powder in broiler chicken diets can influence the thawing loss of the meat, potentially affecting its overall quality and nutritional value.

**Table 5: Effect of *Moringa oleifera* Leaf Powder on pH of Stored Broiler Chickens' Meat**

| TRT | T1 | T2 | T3 | T4 | T5 | SEM | LOS |
|---|---|---|---|---|---|---|---|
| **1ST Month** | 5.40 | 5.40 | 5.40 | 5.35 | 5.35 | 0.01 | NS |
| **2ND Month** | $5.60^{a}$ | $5.50^{ab}$ | $5.35^{b}$ | $5.55^{a}$ | $5.65^{a}$ | 0.03 | * |
| **3RD Month** | $5.80^{ab}$ | $5.75^{b}$ | $5.45^{d}$ | $5.65^{c}$ | $5.85^{a}$ | 0.04 | * |
| **4TH Month** | $6.10^{cd}$ | $6.15^{c}$ | $6.05^{d}$ | $6.25^{b}$ | $6.40^{a}$ | 0.03 | * |
| **5TH Month** | $6.15^{d}$ | $6.40^{c}$ | $6.35^{c}$ | $6.50^{b}$ | $6.65^{a}$ | 0.05 | * |
| **6TH Month** | $6.80^{a}$ | $6.55^{b}$ | $6.55^{b}$ | $6.75^{a}$ | $6.80^{a}$ | 0.03 | * |

**abcd**: Means with varying superscripts and on the same row are significantly (P≤0.05) different. Trt: Treatment, T1: 100% Synthetic lysine, 0% *Moringa oleifera* leaf powder, T2: 75% Synthetic lysine, 25% *Moringa oleifera* leaf powder, T3: 50% Synthetic lysine, 50% *Moringa oleifera* leaf powder, T4: 25% Synthetic lysine, 75% *Moringa oleifera* leaf powder, T5: 0% Synthetic lysine, 100% *Moringa oleifera* leaf powder, SEM: Standard Error of Mean, LOS: Level of significance

**Table 6: Effect of *Moringa oleifera* Leaf Powder on Water Holding Capacity of Stored Broiler Chickens' Meat**

| TRT | T1 | T2 | T3 | T4 | T5 | SEM | LOS |
|---|---|---|---|---|---|---|---|
| **1ST Month** | 2.52 | 2.75 | 2.51 | 2.46 | 2.48 | 0.08 | NS |
| **2ND Month** | 2.70 | 2.89 | 3.08 | 3.11 | 2.68 | 0.07 | NS |
| **3RD Month** | 2.85$^{b}$ | 3.38$^{a}$ | 3.21$^{a}$ | 3.42$^{a}$ | 3.23$^{a}$ | 0.07 | * |
| **4TH Month** | 3.86$^{c}$ | 4.00$^{bc}$ | 3.22$^{d}$ | 4.32$^{a}$ | 4.18$^{ab}$ | 0.10 | * |
| **5TH Month** | 5.05$^{b}$ | 6.33$^{a}$ | 5.11$^{b}$ | 4.72$^{b}$ | 5.36$^{b}$ | 0.16 | * |
| **6TH Month** | 6.02$^{cd}$ | 6.86$^{a}$ | 5.81$^{d}$ | 6.56$^{ab}$ | 6.32b$^{c}$ | 0.11 | * |

**abcd**: Means with varying superscripts and on the same row are significantly (P≤0.05) different. Trt: Treatment, T1: 100% Synthetic lysine, 0% *Moringa oleifera* leaf powder, T2: 75% Synthetic lysine, 25% *Moringa oleifera* leaf powder, T3: 50% Synthetic lysine, 50% *Moringa oleifera* leaf powder, T4: 25% Synthetic lysine, 75% *Moringa oleifera* leaf powder, T5: 0% Synthetic lysine, 100% *Moringa oleifera* leaf powder, SEM: Standard Error of Mean, LOS: Level of significance

**Table 7: Effect of *Moringa oleifera* Leaf Powder on Cooking Yield of Stored Broiler Chickens' Meat**

| TRT | T1 | T2 | T3 | T4 | T5 | SEM | LOS |
|---|---|---|---|---|---|---|---|
| **1ST Month** | 66.72$^{b}$ | 68.23$^{a}$ | 64.26$^{c}$ | 54.17$^{e}$ | 59.48$^{d}$ | 1.38 | * |
| **2ND Month** | 67.85$^{b}$ | 69.27$^{a}$ | 66.40$^{c}$ | 57.61$^{e}$ | 64.21$^{d}$ | 1.10 | * |
| **3RD Month** | 61.13$^{b}$ | 63.23$^{a}$ | 60.66$^{b}$ | 52.52$^{c}$ | 58.02$^{d}$ | 1.01 | * |
| **4TH Month** | 60.06$^{ab}$ | 59.31$^{b}$ | 60.27$^{a}$ | 49.66$^{d}$ | 52.23$^{c}$ | 1.20 | * |
| **5TH Month** | 54.66$^{a}$ | 51.20$^{b}$ | 54.67$^{a}$ | 42.96$^{c}$ | 43.12$^{c}$ | 1.44 | * |
| **6TH Month** | 56.00$^{a}$ | 50.63$^{c}$ | 54.99$^{ab}$ | 45.86$^{d}$ | 54.31$^{b}$ | 1.01 | * |

**abcd**: Means with varying superscripts and on the same row are significantly (P≤0.05) different. Trt: Treatment, T1: 100% Synthetic lysine, 0% *Moringa oleifera* leaf powder, T2: 75% Synthetic lysine, 25% *Moringa oleifera* leaf powder, T3: 50% Synthetic lysine, 50% *Moringa oleifera* leaf powder, T4: 25% Synthetic lysine, 75% *Moringa oleifera* leaf powder, T5: 0% Synthetic lysine, 100% *Moringa oleifera* leaf powder, SEM: Standard Error of Mean, LOS: Level of significance

**Table 8: Effect of *Moringa oleifera* leaf powder on thawing loss of stored broiler chickens' meat**

| TRT | T1 | T2 | T3 | T4 | T5 | SEM | LOS |
|---|---|---|---|---|---|---|---|
| **1ST Month** | 1.30$^{ab}$ | 1.37$^{a}$ | 1.02$^{b}$ | 1.06$^{ab}$ | 1.15$^{ab}$ | 0.05 | * |
| **2ND Month** | 2.00$^{a}$ | 1.86$^{b}$ | 1.33$^{cd}$ | 1.42$^{c}$ | 1.31$^{d}$ | 0.08 | * |
| **3RD Month** | 2.18$^{a}$ | 2.13$^{a}$ | 1.16$^{c}$ | 2.16$^{a}$ | 1.95$^{b}$ | 0.10 | * |
| **4TH Month** | 3.02$^{c}$ | 3.41$^{b}$ | 1.28$^{e}$ | 3.77$^{a}$ | 2.69$^{d}$ | 0.23 | * |
| **5TH Month** | 5.33$^{c}$ | 5.02$^{d}$ | 4.33$^{e}$ | 6.23$^{b}$ | 6.33$^{a}$ | 0.20 | * |
| **6TH Month** | 8.51$^{a}$ | 8.29$^{a}$ | 5.79$^{c}$ | 7.24$^{b}$ | 8.19$^{a}$ | 0.28 | * |

**abcd**: Means with varying superscripts and on the same row are significantly (P≤0.05) different. Trt: Treatment, T1: 100% Synthetic lysine, 0% *Moringa oleifera* leaf powder, T2: 75% Synthetic lysine, 25% *Moringa oleifera* leaf powder, T3: 50% Synthetic lysine, 50% *Moringa oleifera* leaf powder, T4: 25% Synthetic lysine, 75% *Moringa oleifera* leaf powder, T5: 0% Synthetic lysine, 100% *Moringa oleifera* leaf powder, SEM: Standard Error of Mean, LOS: Level of significance

## CONCLUSION

This study indicates that including *Moringa oleifera* leaf powder (MOLP) significantly influenced broiler meat quality. While cooking yield did not show a consistent pattern of increase, other quality properties such as pH, WHC, CL, and TL were notably influenced over the months of storage, providing valuable insights into the effects of MOLP inclusion. It is clear from the study that *Moringa oleifera* treatment and storage duration significantly influenced broiler meat's cooking yield. These findings underscore the need for further investigation into the specific impacts of *Moringa oleifera* treatment on cooking yield, a promising area for future research.

## REFERENCES

Anabaraonye, B., Ewa, B. O., Anukwonke, C. C., Eni, M., and Anthony, P. C. (2021). The role of green entrepreneurship and opportunities in agripreneurship for sustainable economic growth in Nigeria. *Covenant Journal of Entrepreneurship*. *5*(1). Retrieved from https://journals.covenantuniversity.edu.ng/index.php/cjoe/article/view/2661

Arshad, M. S., Anjum, F. M., Khan, M. I., Saeed, F., Imran, A., Sohaib, M., Nadeem, M., and Hussain, S. (2016). Manipulation of natural antioxidants in feed to enhance the oxidative stability and quality of broiler breast meat and nuggets. *Journal of Food Processing and Preservation*, *41*(1), e12849. https://doi.org/10.1111/jfpp.12849

Association of Official Analytical Chemists. (2020). *Official methods of analysis* (18thed.). Washington D.C

Bethany A.S., Juhi R.W., Marybeth D., Juliette C.H., Kristine Y.P., Janet M.R., and Joanne M.H. (2012). USDA Table of Cooking Yields for Meat and Poultry. https://www.ars.usda.gov/ARSUserFiles/80400525/data/retn/usda_cookingyields_meatpoultry.pdf

Cargill, P.W., Joey, J., and Merial Avian Business Unit UK. (2007). Vaccine Administration to Poultry Flocks. Retrieved from http://www.thepoultrysite.com/articles/742/vaccine-administration-to-poultry-flocks/.

Cheng, Q., and Sun, D.W. (2008). Factors Affecting the Water Holding Capacity of Red Meat Products: A Review of Recent Research Advances. *Critical Reviews in Food Science and Nutrition*, *48*(2), 137–159. https://doi.org/10.1080/10408390601177647

Comale, P., Parantola, M., Lussiana, C., Tassone, S., Castellina, C. and Battaglini, L.M., 2011. Effects of ginger (Zingiber officinale) and European Stoneseed (Lithospermum officinale) extracts on performances, meat quality and fatty acid composition of finishing bulls. *Journal of Animal and Veterinary Advances* 10 (9), 1127 – 1132 https://doi.org/10.3923/javaa.2011.1127.1132

Heise, H., Crisan, A., and Theuvsen, L. (2015). The poultry market in Nigeria: Market structures and potential for investment in the market. *International Food and Agribusiness Management Review*, 18(1030-2016-83098), 197-222.

Kaderides, K., Kyriakoudi, A., Mourtzinos, I., and Goula, A. M. (2021). Potential of pomegranate peel extract as a natural additive in foods. *Trends in Food Science and Technology*, *115*, 380–390. https://doi.org/10.1016/j.tifs.2021.06.050

Kauffman, R.G., Cassens, R.G., Scherer, A., and Meeker, D.L. (1992). Variation in Pork Quality; History, Definition, Extent, Resolution. *A National Pork Producers Council Publication Washington D.C. USA.*

Lawrie, R.A. (1998) Lawrie's Meat Science. 6th Edition, Woodhead Publishing Ltd., Cambridge, England, 336 p.

Mahfuz, S. U., Chen, M., Zhou, J. S., Wang, S., Wei, J., Liu, Z., and Song, H. (2018). Evaluation of golden needle mushroom (*Flammulina velutipes*) stem waste on pullet performance and immune response. *South African Journal of Animal Science*, *48*(3), 563. https://doi.org/10.4314/sajas.v48i3.17

Mahfuz, S., and Piao, X. S. (2019). Application of Moringa (Moringa oleifera) as Natural Feed Supplement in Poultry Diets. *Animals,* 9(7), 431. https://doi.org/10.3390/ani9070431

Mahfuz, S., Song, H., Miao, Y., and Liu, Z. (2018). Dietary inclusion of mushroom (Flammulina velutipes) stem waste on growth performance and immune responses in growing layer hens. *Journal of the Science of Food and Agriculture*, *99*(2), 703–710. https://doi.org/10.1002/jsfa.9236

Muthukumar, M., Naveena, B. M., Vaithiyanathan, S., Sen, A. R., and Sureshkumar, K. (2012). Effect of incorporation of Moringa oleifera leaves extract on quality of ground pork patties. *Journal of Food Science and Technology*, *51*(11), 3172–3180. https://doi.org/10.1007/s13197-012-0831-8

Naji, T., Issoufou Amadou, Syed Rizwan Abbas, Zhao, R.Y., Shi, Y., and Guo-wei, L. (2013). *Phytosterol supplementation improves antioxidant enzymes status and broiler meat quality*, *23*(4), 163–171.

Northcutt J.K., Foegeding E.A., and Edens, F.W. (1994). Walter-holding properties of thermally preconditioned chicken breast and leg meat. *Poultry Science (73) 308-316*.

Pourhossein, Z., Qotbi, A. A. A., Seidavi, A., Laudadio, V., Centoducati, G., and Tufarelli, V. (2014). Effect of different levels of dietary sweet orange (Citrus sinensis) peel extract on humoral immune system responses in broiler chickens. *Animal Science Journal*, *86*(1), 105–110. https://doi.org/10.1111/asj.12250

Rehman, H., Zaneb, H., Masood, S., Yousaf, M., Ashraf, S., Khan, I., Shah, M., Khilji, M., and Rehman, H. (2018). Effect of Moringa Oleifera Leaf Powder Supplementation on Pectoral Muscle Quality and Morphometric Characteristics of Tibia Bone in Broiler

Chickens. *Brazilian Journal of Poultry Science*, *20*(4), 817–824. https://doi.org/10.1590/1806-9061-2017-0609

Soeparno, A. (2005) *Meat Science and Technology* (Yogyakarta: Gadjah Mada University Press) Versi 4th.

Taufek, N. M., Zainol Ariffin, S. N., Mohd Arshad, N., and Mazlishah, M. S. (2022). Current status of dietary *Moringa oleifera* and its application in poultry nutrition. *World's Poultry Science Journal*, *78*(2), 397–419. https://doi.org/10.1080/00439339.2022.2016037