PROXIMATE COMPOSITION AND OVERTIME VARIATION IN COLOUR, DRIP LOSS AND pH OF BREAST MEAT FROM BROILERS SUPPLEMENTED WITH *MORINGA OLEIFERA* LEAF MEAL

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Abstract – Proximate composition, shelf life and meat quality of refrigerated breast meat from broiler chicken fed diets supplemented with or without *Moringa oleifera* leaf meal (MOLM) was investigated. No dietary effects were observed on breast meat moisture or ash content; the lipid content was highest in T3 and T1, respectively; and were both lowest in T5 (P <0.05). Breast muscle pH_{45} and pH_{24} were not different between treatments; and no over-time storage effects were observed. Drip loss % was highest on d8 and lowest on d1 (3.75 vs. 0.33). Significant treatment effects (P < 0.05) were observed in the L*, b* and SI values. The b* value was highest on d8 and lowest on d2 (15.3 vs. 13.1); while the L* and a* values were higher on d1 and lower on d8 (55.4 vs. 52.1 and 5.3 vs. 4.6, respectively). Drip loss increased as L* value increased, and a negative correlation and significant difference between L* and pH were observed (-0.268, P = 0.003). In conclusion, additive supplementation of *M. oleifera* leaf meal appeared to improve proximate composition, shelf life attributes and broiler breast meat quality properties.

Key Words: Broiler meat shelf life, *Moringa oleifera* leaf meal; Proximate composition

- INTRODUCTION

Repeated successes in genetic selection for increased breast meat yield have not been transferred to meat quality [1]. On the contrary, it has been associated with induced histological and biochemical modifications of the muscle tissue that result in pale, soft, and exudative (PSE) condition, which may potentially influence the rate of carcass downgrading and meat quality [2]. Consumers are becoming more aware of the food they eat, and evoke certain expectations in relation to sensory characteristics, nutritional value and impact on health [3, 4]. Nowadays, feed additives of plant origin are among different compounds that are perceived as safe and environmentally friendly, thereby satisfying consumer demands for healthier value-added meats [3]. *Moringa oleifera* leaves, due to their specific health and antioxidant properties have received considerable attention as potential natural additives in livestock nutrition [5]. They contain high levels of sulphur-containing amino acids known to enhance the detoxification process by acting as methyl donors in various animal organs [5]. *M. oleifera* leaves possess bioactive compounds with regulatory effect on glucose homeostasis via intestinal micro-flora modulation [6]. Yellowing of beaks, shanks, skin and other non-feather tissues of broilers may indicate bio-availability of pigmenting xanthophylls present in *M. oleifera* leaves. This study was designed to evaluate the effect of additive supplementation of *Moringa oleifera* leaf meal (MOLM) on shelf life attributes and quality of broiler breast meat during overtime storage.

- MATERIALS AND METHODS

A total 2400 day-old Cobb 500 broiler chicks of both sexes were randomly allocated to 5

dietary treatments, each replicated 6 times. Treatment (T) groups were as follows: T_1: positive control, basal diet with 668 g/ton Salinomycin and 500 g/ton Albac; T_2: basal diet with 1% MOLM; T_3: basal diet with 3% MOLM; T_4, basal diet with 5% MOLM; and T_5: a negative control, basal diet with no supplementation. All diets were pelleted. Feed was offered *ad libitum* in starter (0 to 21d), grower (22 to 28 d), and finisher (29 to 35d) basal diets (NRC, 1994). Care and management of birds were in accordance with principles of animal care in experimentation (NRC, 1985) and was approved by the Ethics Committees of the University of Fort Hare.

At 35 days of age, 12 birds were randomly selected per treatment, 2 per replicate and fasted for 6 hours with water offered *ad libitum*. Birds were electrically stunned at 70 volts and sacrificed by cervical dislocation. Each of the 12 left breast muscles was sliced longitudinally, and 24 fillets per treatment group were collected. Proximate analysis of homogenized breast muscle was determined according to the methods of the Association of Official Analytical Chemists (AOAC, 2000) for moisture, crude protein, ash and ether extract; and ME was then calculated.

Fillet weights, pH and drip loss were recorded every morning for 8 consecutive days in triplicates, and average values were calculated. Breast fillets were weighed (W_1) and individually placed on a Styrofoam tray, wrapped and vacuum sealed in transparent oxygen-permeable polyvinyl chloride film then refrigerated at 4^{o}C for shelf-life analysis. After 12 hours the 3 trays were randomly selected from the cooler and fillets were wiped by absorbent paper, and weighed again (W_2). Drip loss % was calculated as [(W1 - W2) ÷ W1 × 100] over 8 days of storage.

Breast meat colour coordinates – lightness (L*), redness (a*) and yellowness (b*) were measured using a portable 45˚/0° BYK-Gardener GmbH colour meter with D65-daylight illuminant and 10^o standard observer at 20mm diameter approximately 24 hours after slaughter (CIE-Lab, 1978). The calorimeter was calibrated with the green standard before measurements were taken. Saturation index (SI) and Hue angle (HA) were calculated as follows: SI index = $[(a^{*2} + b^{*2})^{0.5}]$ and Hue angle = [(tan-1(b*/a*))].

The pH was measured using a portable digital pH meter, equipped with a probe (CRISON pH 25, CRISON Instruments SA, Spain). Breast pH was measured at 45 minutes (pH_{45}) and 24 h (pH_{24}) *post-mortem*. The pH meter was calibrated using pH 4, pH 7 and pH 9 standard solutions before each day's measurement.

Data was subjected to the GLM procedure of SPSS 20 (2011). Interactions were not significant ($P > 0.05$) and were dropped from the model. Duncan's multiple range tests was used to determine the statistical significance among the means (SPSS 20, 2011). Correlation coefficients for colour (L*, a* and b*), pH, drip-loss, saturation index and Hue angle were generated using the Pearson's Correlation Coefficient option of SPSS 20 (2011).

- RESULTS AND DISCUSSION

As shown in Table 1, there were no dietary effects observed on breast meat moisture or ash content; the lipid content was highest in T3 and T1, respectively; and were both lowest in T5 (P <0.05). The protein content was highest ($P < 0.05$) in T1 and lowest in T2 and T5, respectively; while metabolisable energy (ME) levels were highest in T1 and lowest in T5 (437.2 ± 4.92 v. 406.7 ± 3.47). As expected, the low moisture content in breast meat of T1, T3 and T4 resulted in high protein content.

Table 2 shows the effect of diets supplemented with or without MOLM on the pH of broiler

breast meat at 45 minutes (pH_{45}) and 24 hours (pH_{24}) *post-mortem*; as well as the effect of length of storage (4°C) on broiler breast meat pH, colour (L*, a* and b* values), drip loss, saturation index (SI) and Hue angle (HA). Breast muscle pH_{45} and pH_{24} were not different between treatments; and no over-time storage effects were observed on breast pH across treatments. Drip loss % was highest on d8 and lowest on d1 (3.75 vs. 0.33). Significant treatment effects ($P < 0.05$) were observed in the L*, b* and SI values. The b* value was highest ($P < 0.05$) on d8 and lowest on d2 (15.3 vs. 13.1), while the L* and a* values were higher on d1 and lower on d8 ($P > 0.05$). Drip loss increased as L* value increased, and a negative correlation and significant difference between L* and pH were observed (-0.268, $P = 0.003$).

Table 1 Effect of diets supplemented with or without *M. oleifera* leaf meal (MOLM) on proximate composition of broiler breast meat at 35 d of age

Nutrient levels	Dietary treatments					SEM	P-value
	T1	T2	T3	T4	T5		
Moisture (%)	73.6	74.4	73.9	74.2	74.4	0.01	0.093
Ash (%)	1.16	1.14	1.21	1.18	1.15	0.02	0.890
Lipid (%)	2.08[a]	2.11[a]	2.21[a]	2.03[a]	1.47[b]	0.07	0.001
Protein (%)	23.5	22.6	23.2	22.9	22.6	0.13	0.101
ME (kJ/100g)	437.2[a]	424.3[a]	432.5[a]	424.4[a]	406.7[b]	2.20	< 0.001

[a–c] Means within the same row that do not share a common superscript are significantly different (P<0.05).

Table 2 Pearson correlation coefficients (r) for days, pH, Drip Loss %, L*, a*, b*, SI and HA of broiler breast meat over 8 days of refrigeration storage (4°C)

Shelf life attribute	Pearson correlation coefficients (r)					SI	HA
	pH	DL %	L*	a*	b*		
Days	0.220[*]	0.784[**]	-0.226[*]	-0.114[ns]	0.309[**]	0.269[**]	0.226[*]
pH		0.027[ns]	-0.268**	0.076[ns]	-0.006[ns]	0.011[ns]	-0.069[ns]
Drip Loss %			-0.150[ns]	-0.049[ns]	0.221*	0.196*	0.130[ns]
L* (lightness)				-0.413**	-0.239**	-0.337**	0.250**
a* (redness)					-0.002[ns]	0.249[**]	-0.876[**]
b* (yellowness)						0.967[**]	0.464[**]
Saturation Index							0.228[*]

NS: non-significant, *P < 0.05, **P < 0.001. HA = Hue angle.

The low pH in broiler chicken meat may be due to glycogen metabolism in the muscles via the anaerobic glycolytic pathway that result in rapid and greater ATP reduction, hence the mitochondrial-poor white muscle [7]. The L* values in this study were ≥50.0 [8], an indication of paler meat expected of broiler breast meat as a result of genetic selection. Noteworthy, was the degree of expression of the carotenes and xanthophylls present in *M. oleifera* leaves as the b* value increased with the increase in MOLM levels. The colour of the skin, meat and bone are amongst traits of economic importance critical in marketing of fresh whole birds or deboned and skinless raw meat, including evaluation of the cooked product [8]. Lightness in broilers is apparently highly heritable and genetically correlated with pH_u [1]. Darker broiler breast meat is reported to have a shorter shelf-life than lighter breast [9], which may be attributed to differences in mitochondrial concentration [7]. As such, pH was negatively correlated to b*, and its relationship with a* value was negligibly low and insignificant ($P > 0.05$, Table 2).

- CONCLUSION

Physico-chemical meat quality variables improved with the additive supplementation of broilers with *M. oleifera* leaf meal. With the exception of drip loss, which increased with time; meat quality variables such as colour and pH remained constant over time.

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