

Effects of basil leaf (*ocimum basilicum*) marination on sensory attributes of spent layer meat

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Abstract

This research was conducted at agric physical lab, Department of Animal science, Faculty of Agriculture to determine the effects of marinating spent layer meat with basil leaf paste on drip loss and sensory attributes under different post mortem conditions. In the light of this, the poultry industry is obliged to continuously grow for a steady supply of quality poultry meat. Marinating the spent layer hen's meat with fresh basil leaves (*Ocimum basilicum*) in addition to subjecting the meat to 0, 6, 12, and at 24 hours post mortem aging before cooking increased its organoleptic attributes which was readily acceptable to consumers. Marination of meat with herbs or spices like basil leaves paste had enhanced consumer's preference for taste, texture aroma, colour and overall acceptance. Marination improved consumer acceptance of spent layer meat irrespective of parts and post mortem aging. However, the majority of the respondents preferred meat marinated and subjected to 12 hours of post mortem aging. It is recommended that more quantity of marinade should be added further studies should in order to determine more effect of fresh basil leaves rough paste. And more hours of postmortem aging should be increased in order to determine more effect of fresh basil leaves rough paste marinate.

Keywords: Meat, Leaf Paste, Marinating spent layer, *Ocimum basilicum*

1. Introduction

Globally, there are 2.6 billion spent hens that are used in the pet industry and not much for human consumption (Navid, Shcikhlar, & Kavch, 2011). Meat from spent layer hens tends to be tough, non-juicy and low in fat. Because of these, the use of spent chicken meat has long been a problem for the poultry industry. Tenderness is considered to be the most important organoleptic characteristics of meat (Lawrie, 1991). The toughness associated with spent chicken meat is primarily due to increased cross linking in the connective tissue of older animals (Archile-conrteras & Purslow, 2011). Culled hens which were being used for meat purpose are going to be discarded by the quality conscious consumers due to inherent quality differences especially tenderness and juiciness of spent layer hen meat. Therefore, the farmers are facing a problem in disposing their old-unproductive layers at minimum price. Chloride, phosphates have been reported to be used for tenderizing agent and tough meat (Sachdev & Verma, 1990).

Poultry meat is the most widely consumed meat in the world. A recent survey (FAO, 2013) reported that the total poultry meat consumption has increased from 66.4 million tonnes in 2000 to 91 million tones in 2009. In the light of this, the poultry industry is obliged to continuously grow for a steady supply of quality poultry meat. However, during slaughter, processing, storage and market display the quality attributes of poultry carcasses and meat deteriorate due to lipid oxidation and microbial proliferation and this affects the sensory attributes (Kinsella, 2011). Lipid oxidation is responsible for reduction in the nutritional quality as well as changes in the flavor, colour and other sensory attributes of meat (Aguirrezabal, Mateo, Domínguez, & Zumalacárregui, 2000) while microbial

contamination can cause a major consumers health hazards and economic loss to the meat retailers in terms of food poisoning and meat spoilage respectively.

Marination has been a traditional means of improving the qualities of meat in terms of flavour, tenderness, and extending shelf life of meat and meat products (Alvarado & McKee, 2007). One important benefit of marination is the increase in yield of raw meat, which can be of great benefits to the producers and the consumers as well (Xargayó, Lagares, Fernandez, Ruiz, & Borrell, 2001). Beneficial effects of marination on meat texture include juicier texture and above all reduction in water loss (Woelfel & Sams, 2001). Several studies have shown that marination can retard the growth of micro-organisms in meat (Carroll, 2005; Shelef & Yang, 1991). Marinating chicken meat has been reported to reduce the rate of microbial proliferation like *Campylobacter* counts and slows down the rate of lipid oxidation process in meat (Perko-Mäkelä, Koljonen, Miettinen, & Hänninen, 2000). Murali et al. (2012) found that marinating chicken meat with a combination of green tea, lemon and turmeric were most effective against *C. jejuni* and *S. enteritidis* killing all the bacteria within 12 hours of incubation. Further, combinations of both lemon and green tea and lemon and turmeric killed all *C. jejuni* isolates but not *S. enteritidis*, within 24 hours of incubation. *O. basilicum* has been reported to reduce of microbial loads in raw shrimps during washing and storage at 4°C (Kalembek & Kunicka 2003; Faleiro, There is no reference, 2003). Therefore, the purpose of this study is to determine the effects of marinating spent layer meat with basil leaf paste on drip loss and sensory attributes under different post mortem conditions. The main objectives of this research are to determine the effects of *O. basilicum* leaf paste marination on sensory attributes of spent layer meat as well as the effects of *O. basilicum* leaf paste marination on water holding capacity of spent layer meat.

2. Material and Methods

2.1. Location of the study

The study was conducted at agric physical lab, Department of Animal science, Faculty of Agriculture. Sokoto is located in the savannah agro-ecological zone (Latitude 13° 00'27.0''N and Longitude 5° 15'05.6''E). Usmanu Danfodiyo University is located on 13° 07'38.9''N and 5° 12'19.0''E, about 350m above the sea level. The rainfall establishes between mid -May to early June and reaches the peak in August. The climate is dry sub-humid with annual rainfall ranging from 550mm-700mm. Dry season starts in mid-October and ends in late April, (SERC, 2012).

2.2. Experimental Animal and Procedure

Five spent layers of 120 weeks old were purchased from labana farm alero in kebbi state, the birds were slaughtered and dressed and then dissected. The breast, drumstick and thigh muscles were removed and each of the cut was the subjected to immersion marination method.

Treatment 1 served as control was not marinated, treatment 2 was marinated in 127 ml of water and treatment 3 was marinated in 127 g of *O. basilicum* leaves (basil) rough paste, each treatment was replicated 3 times. After marination all treatments were subjected to post mortem aging hours of 0, 6, 12 and 24 at 4 °C in a chiller in-order to allow for the penetration of marinate and biochemical processes of conversion of muscle to meat. Before marination the weight of the muscles were taken and recorded and subsequently after each post mortem aging hour. After determining the water holding capacity in terms of drip loss, the muscle and meat samples were tested for sensory attributes using consumer type sensory evaluation method.

2.3. Sensory evaluation

The muscle and meat samples from breast, thigh and drumstick that were aged 0, 6, 12 and 24 hours postmortem were assigned for sensory evaluation. The evaluation was a consumer type sensory evaluation panel (n= 126 consumers) of different ethnicity across six geopolitical zones North Central (NC), North East (NE), North West (NW), South East (SE), South South (SS) and South West (SW) of the country were randomly selected twenty individual from each geopolitical zone contributed in the evaluation. Meat samples were removed from the 20°C freezer and thawed in a chiller at 4°C for 24 h. The breast muscle and meat samples were then cooked in a water bath at 80°C until the internal temperature had reached 78°C which were monitored with a needle thermometer.

The samples were allowed to cool and cut in a rectangular shape with cross sectional area of (2 x1x1.27 cm²) and then wrapped in coded aluminium foil and stored in an incubator at 60°C until evaluation. During evaluation, samples were put in coded plates and randomly allocated in individual booths under natural day lighting to mask the differences in meat colour under controlled conditions in the laboratory in the Department of Animal Science, Faculty of Agriculture, Usmanu Danfodiyo University Sokoto. The participants were given instructions on how to complete the score sheet, and samples were presented in a different order to each of the consumer. From each of the plate, the consumer evaluated nine samples only once, corresponding to the four aging periods (0, 6, 12 and 24 hours) from each of the treatments. All evaluations (Colour, aroma/flavour, texture/tenderness, juiciness and overall acceptability) used the nine-point hedonic scales as recommended by Peryam and Pilgrim (1957). A score of 1 stood for extremely dislike, 2 stood for dislike very much, 3 stood for dislike moderately, 4 stood for dislike slightly, 5 stood for neither like nor dislike, 6 stood for like slightly, 7 stood for like moderately, 8 stood for like very much and 9 stood for extremely like. The consumers/respondents rinsed their mouths with water before and between samples tasted (Bosman, There is no reference, 1997).

3. Statistical analysis

The data generated were checked for normality using Proc Univariate of the SAS ver. 9.1. Data generated related to water holding capacity (drip loss) were subjected to multivariate analysis using the GLM procedure of SAS ver. 9.1 (SAS Institute Inc., Cary, N.C., USA) statistical analysis software. Interaction effect using GLM multivariate analysis and nonparametric test K independence and 2 independence sample was used to compare means related to sensory evaluation and kruskal wallis test used to rank mean responses. Means were separated using Tukey’s HSD (P<0.05).

4. Results and Discussion

Table 1. shows the weights of different parts of the birds before marinating. The initial weights of different parts were not significantly different between treatments, post mortem, parts and as baseline; there were no interaction between treatment, post mortem and parts. (P>0.05).

Table 1. Initial Weight (g) of different part of the carcass

Parts	P.M (hr.)	Treatments			P-Value				
		T1	T2	T3	SE M	Trt	P.M	Parts	TrtxPMxParts
B	0	15	15	15	0.00	n.s	n.s	n.s	n.s
	6	15	15	15	0	n.s	n.s	n.s	n.s
	12	15	15	15					
	24	15	15	15					
T	0	15	15	15					
	6	15	15	15					
	12	15	15	15					
	24	15	15	15					
D	0	15	15	15					
	6	15	15	15					
	12	15	15	15					
	24	15	15	15					

T1 – Control, T2- water marination, T3- herbal marination
 Mean values are significant at P-value less than 0.05 % =(P<0.05)
 Mean values are not significant at P-value higher than 0.05 % =(P>0.05)
 P.M (hr.)- Hours of post mortem aging.
 B-Breast, T-Thigh, D-Drumstick.

Results on table 4: 2 shows that there were significant differences between treatments and hours of postmortem aging (P<0.05). However, result of interaction did not show significant differences between treatments, post mortem and parts (P>0.05). These results are in accordance to other workers finding (Kulmyrzaev & Mc Clement, 2000), who also reported that the percentage of weight loss of grilled chicken marinated with honey, determined to be 35.2%, was significantly lower than those of other samples that are not marinated.

Table 2. Final Weights (g) of different parts of the carcass after marination

Parts	P.M (hr.)	Treatments			SE M	P-Value			
		T1	T2	T3		Trt	PM	Parts	TrtxPMxParts
B	0	10.3	12.16	13.3	0.05	0.00	0.04	0.81	0.995
	6	10.3	12.26	13.2	4	0	5	6	
	12	10.4	12.44	13.2					
	24	10.3	12.48	13.3					
T	0	10.5	12.28	13.0					
	6	10.3	12.37	13.0					
	12	10.3	12.47	13.9					
	24	0.43	12.52	13.3					
D	0	10.5	12.22	12.9					
	6	10.4	12.34	13.0					
	12	10.4	12.41	13.0					
	24	10.5	12.43	13.3					

T1 – Control, T2- water marination, T3- herbal marination
 Mean values are significant at P-value less than 0.05 % =(P<0.05)
 Mean values are not significant at P-value higher than 0.05 % =(P>0.05)
 P.M (hr.)- Hours of post mortem aging.
 B-Breast, T-Thigh, D-Drum stick.

There were significant differences (P<0.05) between treatments and hours of post mortem aging (Table 4:3). Although, results of different parts and the interaction between treatments, post mortem and parts showed that there were no significant differences (P>0.05). These results are in accordance close to those reported by other workers (Hudspeth and may, 1969) who reported that the water holding capacity of spent layer whole carcass meat was higher (p<0.05) than that of spent layer meat with gizzards and livers that are not marinated.

Table 3. Drip loss of meat and muscle (ml) of birds subjected to hours of post mortem aging

Parts	P.M (hr.)	Treatments			P-Value				
		T1	T2	T3	SE M	Trt	PM	Parts	TrtxPMxParts
B	0	4.61	2.84	1.68	0.05	0.00	0.04	0.81	0.995
	6	4.64	2.74	1.79	4	0	5	6	
	12	4.53	2.58	1.72					
	24	4.64	2.52	1.60					
T	0	4.49	2.72	1.97					
	6	4.66	2.62	1.95					
	12	4.62	2.52	1.90					
	24	5.59	2.48	1.63					
D	0	4.44	2.78	2.10					
	6	4.50	2.66	1.99					
	12	4.50	2.59	1.92					
	24	4.60	2.57	1.62					

T1 – Control, T2- water marination, T3- herbal marination
 Mean values are significant at P-value less than 0.05 % =(P<0.05)
 Mean values are not significant at P-value higher than 0.05 % =(P>0.05)
 P.M (hr.)- Hours of post mortem aging.
 B-Breast, T-Thigh, D-Drum stick.

Table 4. Shows results on the differences in mean responses and ranking taste of muscles and meat of spent layers. The respondents like moderately to like slightly most of the meats marinated with basil leaf (T 3) irrespective of parts and hours of post mortem aging. The results also showed that treatment 3 ranked higher in taste as was shown to be mostly preferred by the respondents .These result agree with the findings of other workers (Solyakov & Skog, 2002) who reported that the presence of different types of sugar in the marinated chicken breast samples created taste.

Table 4. Differences in mean responses and ranking of scores of taste of meat and muscles of spent layers

Parts	P. M (hr.)	Treatments			Kruskal Wallis Mean Ranking		
		T1	T2	T3	T1	T2	T3
B	0	6.	6.	7.	211.3	229.4	370.8
	13	73	57	5	8	7	
	6	4.	5.	7.			
	94	07	31				
	12	6.	4.	7.			
	07	93	20				
	24	4.	4.	6.			
	87	80	00				
	0	6.	4.	7.			
	00	53	60				

T	6	4.	6.	6.
		88	20	67
	12	4.	5.	7.
		50	80	53
	24	4.	4.	7.
		33	67	40
D	0	4.	4.	7.
		88	47	27
	6	4.	4.	7.
		21	60	00
	12	4.	4.	6.
		27	00	87
	24	5.	6.	7.
		00	07	00
SE		0.1	0.1	0.1
		99	99	99

T1 – Control, T2- water marination, T3- herbal marination
P.M (hr.)- Hours of post mortem aging.
B-Breast, T-Thigh, D-Drum stick.

Table 5. Shows results on the differences in mean responses and ranking aroma of muscles and meat of spent layers. The respondents like moderately to like slightly most of the meats marinated with basil leaf (T 3) irrespective of parts and hours of post mortem aging. The results also showed that treatment 3 ranked higher in taste as was shown to be mostly preferred by the respondents. These results agree with the findings of (Solyakov & Skog, 2002) who reported that the presence of different types of sugar in the marinated chicken breast samples created flavour/Aroma giving it an attractive appearance. Sofos (1983), also reported that flavor/Aroma and of frankfurters formulated with 2.5 % salt were high and remain in the acceptable range through long periods of storage. Products with 1.5% or 1% had lower acceptability in comparison to those with 2.5% salt.

Table 5. Differences in mean responses and ranking of scores of aroma of meat and muscles of spent layers

Parts	P.M (hr.)	Treatments			Kruskal Ranking	Wallis	Mean
		T1	T2	T3			
B	0	5.	5.	5.	206.	248.	356.
		33	80	64	74	68	70
	6	5.	5.	7.			
		25	40	13			
	12	5.	4.	6.			
		07	87	87			
	24	4.	5.	6.			
		33	13	27			
T	0	5.	6.	5.			
		00	00	87			
	6	4.	5.	7.			
		75	80	00			
	12	4.	5.	7.			
		86	80	07			
	24	4.	4.	6.			
		73	27	33			

	0	5.	5.	6.
		19	33	93
D	6	4.	5.	6.
		64	67	87
	12	4.	4.	7.
		20	87	40
	24	4.	4.	7.
		80	80	40
SE		0.1	0.1	0.1
		93	93	93

T1 – Control, T2- water marination, T3- herbal marination

P.M (hr.)- Hours of post mortem aging.

B-Breast, T-Thigh, D-Drum stick.

The result in Table 6. Showed the differences in mean responses and ranking texture of muscles and meat of spent layers. The respondents like moderately to like slightly most of the meats marinated with basil leaf (T 3) irrespective of parts and hours of post mortem aging. The results also showed that treatment 3 ranked higher in taste as was shown to be mostly preferred by the respondents. This result is also similar to finding of other worker, (Sheard et al) who reported that brines contain different ingredients and / or additives including phosphates to poultry meat improve the textural characteristics of meat products such as juiciness and tenderness by reducing losses during cooking.

Table 6. Differences in mean responses and ranking of scores of Texture of meat and muscles of spent layers

Parts	P.M (hr.)	Treatments			Kruskal Wallis Mean Ranking		
		T1	T2	T3	T1	T2	T3
	0	4.87	5.13	6.50	215.0	228.2	368.18
B	6	5.75	5.47	7.25	8	5	
	12	4.93	5.40	6.53			
	24	5.47	5.20	6.80			
T	0	4.80	4.87	7.33			
	6	4.88	5.27	6.60			
	12	6.00	5.40	7.20			
	24	4.60	4.47	6.87			
D	0	3.38	4.87	6.53			
	6	4.86	5.27	7.20			
	12	5.47	5.40	7.27			
	24	4.93	4.47	6.27			
SE		0.182	0.182	0.182			

T1 – Control, T2- water marination, T3 herbal marination

P.M (hr.)- Hours of post mortem aging.

B-Breast, T-Thigh, D-Drum stick.

The result in Table 7. Showed the differences in mean responses and ranking colour of muscles and meat of spent layers. The respondents like moderately to like slightly most of the meats marinated with basil leaf (T 3) irrespective of parts and hours of post mortem aging. The results also showed that treatment 3 ranked higher in taste

as was shown to be mostly preferred by the respondents. These result agree with the findings of (Solyakov & Skog, 2002) who reported that the presence of different types of sugar in the marinated chicken breast samples created flavour and brown colour, giving it an attractive appearance and taste. Luciano, There is no reference (2009) also reported that the post mortem aging period increased lightness in lamb meat.

Table 7. Differences in mean responses and ranking of scores of Colour of meat and muscles of spent layers

Parts	P.M (hr.)	Treatments			Kruskal Wallis Mean Ranking		
		T1	T2	T3	T1	T2	T3
B	0	5. 13	5.33	6.79	220. 25	230.9 8	360.27
	6	5. 44	3.87	6.00			
	12	5. 00	5.67	6.80			
	24	4. 73	5.87	7.20			
T	0	4. 20	5.27	6.40			
	6	5. 06	6.07	7.13			
	12	5. 64	5.00	6.73			
	24	4. 13	5.00	6.67			
D	0	5. 00	4.60	6.67			
	6	4. 50	5.00	6.80			
	12	5. 20	4.67	6.87			
	24	4. 07	3.60	6.87			
SE		0.2 02	0.202	0.202			

T1 – Control, T2- water marination, T3- herbal marination

P.M (hr.)- Hours of post mortem aging.

B-Breast, T-Thigh, D-Drum stick.

The result in Table 8. Showed the differences in mean responses and ranking overall acceptance of muscles and meat of spent layers. The respondents like moderately to like slightly most of the meats marinated with basil leaf (T 3) irrespective of parts and hours of post mortem aging. The results also showed that treatment 3 ranked higher in taste as was shown to be mostly preferred by the respondents. Sofos (1983), also reported that overall acceptability of frankfurters formulated with 2.5 % salt were high and remain in the acceptable range through long periods of storage. Products with 1.5% or 1% had lower acceptability in comparison to those with 2.5% salt.

Table 8. Differences in overall acceptance of meat and muscles of spent layers

Parts	P.M (hr.)	Treatments			Kruskal Wallis Mean Ranking		
		T1	T2	T3	T1	T2	T3

Parts					T1	T2	T3
B	0	5.1	6.	7.	195.	248.63	387.35
	3		67	36	52		
	6	5.2	6.	7.			
	5		13	88			
	12	5.0	6.	7.			
T	7		33	60			
	24	5.6	5.	7.			
	7		73	53			
	0	5.2	5.	6.			
	7		73	67			
D	6	5.4	5.	6.			
	4		27	87			
	12	5.0	5.	6.			
	0		40	93			
	24	4.4	6.	7.			
D	0		20	13			
	0	4.2	5.	7.			
	5		33	40			
	6	5.2	5.	7.			
	1		93	13			
D	12	5.6	5.	7.			
	7		67	60			
	24	5.7	4.	6.			
	3		53	87			
	SE	0.18	0.18	0.18			
	2	2	2				

T1 – Control, T2- water marination, T3- herbal marination

P.M (hr.)- Hours of post mortem aging.

B-Breast, T-Thigh, D-Drum stick.

5. Conclusion

Marinating the spent layer hen's meat with fresh basil leaves (*Ocimum basilicum*) in addition to subjecting the meat to 0, 6, 12, and at 24 hours post mortem aging before cooking increased its organoleptic attributes which was readily acceptable to consumers. Marination of meat with herbs or spices like basil leaves paste had enhanced consumer's preference for taste, texture aroma, colour and overall acceptance. Marination improved consumer acceptance of spent layer meat irrespective of parts and post mortem aging. However, the majority of the respondents preferred meat marinated and subjected to 12 hours of post mortem aging.

Recommendation

1. It is recommended that more quantity of marinate should be added further studies should in order to determine more effect of fresh basil leaves rough paste.
2. It is also recommended that more hours of postmortem aging should be increased in order to determine more effect of fresh basil leaves rough paste marinate.

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