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Effect of Age on Physico-Chemical and Sensorial Quality of Buffalo Meat

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Abstract: During the study physical, chemical and sensory properties of *Longissimus dors i*(LD) muscle were determined within age group of = 1.5y (group A),>1.5 to 2y (group B) and >2y (group C). pH of LD muscle among three groups were found to be non significant. Water holding capacity, cooking and drip loss varied between three groups due to age and fat content with significant results (P<0.05). Moisture contents showed significant result. Fat and protein percentage among three groups showed significant difference among them on the basis of their age differences. Ash percentages were found to be non significant(P>0.05). In group A, B and C, sensory scores assigned by the panel of judges for color, flavor, juiciness, tenderness and overall palatability revealed non significant results (P>0.05) although different attributes were influenced by the age of the animals.

Key words: *Longissimus dorsi* · Buffalo Meat · PH · Protein · Fat · Sensory Score

INTRODUCTION

Buffaloes play a pivotal role in overall social development through contribution to milk, meat, hides and draft power for agricultural operations. About 97% of the water buffaloes are primarily found in Asia with Pakistan representing as the third largest country. Kundhi buffalo is the major dairy breed found in Sindh province of Pakistan and constitute approximately 40% of the total buffalo population of the country among is 31.7 million heads [1]. Pakistan is 9th big world meat producer contributing 1,400.00 (1000MT CWE) after India occupying 5th place contributing 3,285.00 (1000 MT CWE) of world meat production [2]. Meat in its widest sense includes all those parts of the animals that are used as food by humans having a very high biological value and is preferred food in Pakistan. The traditional form of meat industry is characterized by unorganized sector in the hands of butchers with very little knowledge of personal hygiene. Most of the meat produced is sold by retail butcher shops to the consumers as fresh unchilled meat.

Animals slaughtered are mostly culled ones or surplus male calves of 1-2 years age group. Meat from young ones is lean, tender, less fatty and palatable as compared to old culled animals and considered a delicacy. The color of the buffalo meat is slightly dark reddish. Buffalo meat contains white fat as the beta carotene (a precursor of vitamin A), which is golden yellow in color, is fully converted into vitamin A, which is colorless. In general the meat is richer in protein with crude protein level of 20.2 %, contains lower saturated fat than beef. Buffalo meat contains 40% less cholesterol, 55% less calories, 11% more protein and 10% more minerals in comparison to bovine meat [3]. The quality and quantity of buffalo meat depend on breed, age, feeding intensity, management system and environmental conditions.

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The buffalo performances for meat production i.e. growth, feed efficiency, conversion ratio, dressing percentage, carcass evaluation and composition and meat quality cuts, are very important in economic terms but the priority focus for expanding the buffalo meat market is meat quality, which means chemical, physical, organoleptic and hygienic characteristics and a good presentation to the consumer.

A study was undertaken on meat quality in buffalo males slaughtered at different ages. Trial covered 30 Friesian male calves and 30 Mediterranean Italian buffaloes reared under identical feeding and environmental conditions and slaughtered at 20, 28 and 36 weeks of age. The water buffalo meat, upon the visual inspection of the judges, was lighter than the bovine meat and a colorimeter confirmed this fact. Cooking losses also decreased with the age of the animal. The meat tenderness was observed using the Warner Bratzler Shear machine. Taste and flavor decreased as the age increased, as did scores by panel of judges, while juiciness scored better after 36 weeks of age [4].

In this study, pH, water holding capacity, cooking loss and drip loss were investigated for physical and moisture, ash, protein and fat contents of buffalo meat were estimated for chemical analysis. Sensory attributes of buffalo meat were judged by scoring for color, odor, juiciness, tenderness and overall palatability.

MATERIALS AND METHODS

Sampling of Buffalo Meat: Buffalo meat samples from muscle of *longissimus dorsi* (LD) were randomly collected from meat market of Tandojam (Hyderabad) and brought to the analytical laboratory of Department of Animal Products Technology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam for achieving the goal of the present study. Samples were categorized into three age groups according to the age at slaughter as per butcher's information i.e. A (= 1.5y, age), B (>1.5 to 2y, age) and C (>2y, age). Samples from each group were analyzed in duplicate for physico-chemical characteristics and sensory attributes.

Physical Analysis: Meat sample of *longissimus dorsi* muscle (10g) homogenized in distilled water (90 ml) was used to measure the pH value using pH meter [5]. The method reported by Wardlaw *et al*. [6] was used to determine the WHC of *longissimus dorsi* muscle. Meat sample (8g) was mixed with 0.6 M NaCl solution (12 ml) in the test tubes and placed into a water bath (5°C) for 15min. These were then centrifuged (4°C) at 10,000 rpm for 15min in a refrigerated centrifuge machine. The supernatant was decanted and measured. WHC was reported as ml of 0.6 M NaCl per 100g of meat. Meat sample (20g) was placed in polyethylene bag and heated in a water bath at internal temperature of 72 °C. Cook-out was drained and the cooked mass was cooled and weighed to determine the weight loss [7].

Drip loss was measured as described by Sen *et al*. [8]. Raw meat sample (50g) was placed at 4°C for 24 h in a refrigerator under polyethylene sealed covers. After 24 h the sample was wiped and dried with filter paper and weighed. Weight of sample is the drip loss of sample.

Chemical Analysis

Moisture Content: The fresh minced meat sample (5g) was transferred in pre-weighed flat bottom aluminum disband transferred to hot air oven at 101 ± 1°C for 3-4 h. Dried sample was then placed in desiccator having silica gel as desiccant. After 1h, the dish was weighed and moisture content was calculated [9].

Protein Content: The sample (2g) was digested using Micro-Kjeldhal digester in the presence of catalyst (0.35g copper sulfate and 7g sodium sulfate / potassium sulfate) where sulfuric acid (20-30 ml) was used as an oxidizing agent and diluted with distilled water (250 ml). The diluted sample (5ml) was distilled with 40% Na OH using Micro-Kjeldhal distillation unit where steam was distilled over 2% boric acid (5ml) containing an indicator bromocresol green for 3 minutes. The ammonia trapped in boric acid was determined by titrating with 0.1N HCl and nitrogen content was determined by the method described in AOAC. [9]. While protein percentage was determined by conversion of nitrogen percentage to protein by using conversion factor (CF), (6.25) assuming that all the nitrogen in meat was presented as protein.

Fat Content: Total fat content was extracted in Soxhlet Extraction Unit as described by AOAC. [9]. Soxhlet Extractor was set with reflux condenser and distillation flask which has been previously dried and weighed. Dried meat sample (2g) was taken in to fat free extraction thimble and placed in extraction apparatus (Soxhlet). Then ether (150ml) was poured in to extraction flask and condenser was joined and placed on electric heater in order to boil

the solvent gently. Extraction was carried out for 6 hours. The solvent was removed from the extraction flask to determine

Ash Content: Ash percentage was determined by Gravimetric method as described by AOAC. [9] using muffle furnace. The fresh minced meat sample (5g) was taken in pre-weighed crucible and transferred to muffle furnace (550°C) for 4-5 h. Ashed sample was transferred to desiccator having silica gel as desiccant. After 1h, the dish was weighed to determine the ash contents of meat sample [9].

Sensory Evaluation: The sensory evaluation of cooked meat (20 min in a boiling water bath with 0.5% salt) samples for color, odor, juiciness, tenderness and overall palatability were performed by a panel consisting of 5 panelists using 5 point hedonic scale i.e. 1= very poor and 5 = excellent [8].

Statistical Analysis: The data obtained was subjected to analysis of variance using the computer programme i.e. Student Edition of Statistics (Sxw), version 8.1 (Copy right 2005, Analytical Software, USA).

RESULTS AND DISCUSSION

Physical Analysis: pH, water holding capacity, cooking loss and drip loss of LD muscle of the buffalo meat was shown in table 1. Higher values of pH were observed in group B than group A and C showing non-significant results (P>0.05), similar results were reported by Morris *et al*. [10]. pH is a result of post mortem biochemical changes which continue during the storage period and are directly related to storage temperature. The pH of the meat depends on the amount of glycogen, rate of glycogen breakdown to lactic acid during anaerobic glycolysis, species of animal and condition of the animal which can be associated when animal is slaughtered quietly after adequate feeding and with the rigor stage of slaughtered animal.

Water holding capacity is the ability of meat tissues to retain free water (not chemically bound) when an external force such as cutting and chopping is applied. Water holding capacity between different age groups showed remarkable difference. Because number of factors could affect these results such as fat contents, pH and time elapsed after slaughtering. Water holding capacity was lower in group C and higher values observed in group A with significant change in the results between three different age groups. Cooking loss is the percentage loss in meat resulting in the release of exudates from meat. There was a significant difference in the amount of cooking loss between three different age groups of buffalo meat samples with higher percentage losses in group A and lower percentage losses in group C because of the more contraction of contractile (myofibrillar) proteins [12]. The results of the present study showed significant difference revealing the significant results (P<0.05) among three different age groups of buffalo meat samples.

Drip loss is the amount of weight loss of meat sample by keeping it in refrigeration at 4°C for 24 h with sealed polyethylene bag. The drip loss increases as the time of storage increases because storage time offers more opportunity for protein degeneration, sarcomere shortening and myosine degeneration. Drip loss of buffalo meat samples between three different age groups revealed significant results (P<0.05).

Proximate Analysis: Results for moisture, protein, fat and ash are depicted in table 2. Moisture content is the presence of amount of water present in the sample of buffalo meat in terms of percentage. Generally fat and moisture in the meat are inversely related. Moisture contents were found to be higher in group A as compared to group C with intermediate value of group B. However, age has a remarkable effect on the moisture percentage of buffalo meat samples. Generally animals of older age have lower percentage of moisture as compared to animals of young age groups [13]. Therefore significant difference was found between the three different age groups of buffalo meat samples showing value of P<0.05.

Higher percentage of protein was in group C and lower percentage of protein was found in group A and intermediate amount was present in group B. A significant difference among age groups of buffalo meat samples was observed at the P<0.05 level of significance. Generally animals of older age have greater amount of protein than the younger ones [7].

In group wise samples based on the age groups, fat percentage was higher in group C and lower in group A although relation between fat and moisture is inverse [14]. A significant change among age groups of buffalo meat samples for fat percentage was observed at the P<0.05 level of significance.

Table 1: Physical quality characteristics of *Longissimus dorsi* muscle of buffalo meat under [1]= 1.5y, age, [2]>1.5 to 2y, age and [3]>2y, age group

	Group			
	A	B	C	[4]LSD
pH	5.70[5]±0.02	5.76±0.02	5.69±0.02	NS
[6]WHC	68.33±0.30	65.68±0.49	64.70±0.37	1.15
[7]CL	64.19± 0.79	59.78± 0.65	56.59± 1.36	2.87
[8]DL	93.84 ± 0.98	96.34 ± 0.43	94.44 ± 0.45	1.95

Table 2: Chemical analysis of *Longissimus dorsi* muscle of buffalo meat of [9]= 1.5y, age, [10]>1.5 to 2y, age and [11]>2y, age group

	Group			
	A	B	C	[12]LSD
Moisture	77.21[13]± 0.18	75.76± 0.12	72.98± 0.30	0.62
Protein	15.97± 0.40	17.06± 0.29	18.59± 0.36	1.03
Fat	2.59± 0.05	3.15± 0.08	3.79± 0.12	0.29
Ash	0.92 ± 0.05	0.95 ± 0.06	0.89 ± 0.06	[14]NS

Table 3: Sensory quality characteristics of *Longissimus dorsi* muscle of buffalo meat of[15] = 1.5y, age, [16]>1.5 to 2y, age and [17]>2y, age group

	Group			
	A	B	C	[18]LSD
Color	3.46 [19]± 0.07	3.44 ± 0.10	3.54 ± 0.10	NS
Flavor	3.64 ± 0.07	3.58 ± 0.10	3.42 ± 0.11	NS
Juiciness	3.60 ± 0.09	3.54 ± 0.09	3.58 ± 0.12	NS
Tenderness	3.56±0.08	3.46±0.09	3.60±0.11	NS
[20]OAP	3.54 ± 0.09	3.68 ± 0.09	3.58 ± 0.10	NS

[1]= 1.5y= Equal or Less than 1.5 years including in group A
[2]>1.5 to 2y = More than 1.5 years & less than 2 years including in group B
[3]>2y= More than 2 years including in group C
[4]LSD= least significant difference (P<0.05)
[5]±= Standard deviation
[6]WHC= Water holding capacity
[7]CL= Cooking loss
[8]DL= Drip loss
[9]= 1.5y= Equal or Less than 1.5 years including in group A
[10]>1.5 to 2y = More than 1.5 years & less than 2 years including in group B
[11]>2y= More than 2 years including in group C
[12]LSD= least significant difference (P<0.05)
[13]±= Standard deviation
[14]NS= Non-significant
[15]= 1.5y= Equal or Less than 1.5 years including in group A
[16]>1.5 to 2y = More than 1.5 years & less than 2 years including in group B
[17]>2y= More than 2 years including in group C
[18]LSD= least significant difference (P<0.05)
[19]±= Standard deviation
[20]OAP= Over all palatability

Higher percentage of ash was observed in group B and lower amount of ash in group C with intermediate ash percentage in group A. It can be due to the advancing slaughtering age of the animal [15]. Results for ash percentage in these three groups were found to be non significant at the level of P>0.05.

Sensory Attributes: One-way ANOVA was carried out on the sensory scores showed no significant differences between samples for all odor, flavor and texture attributes. Sensory score for color in group B were found to be lower and higher sensory scores were observed in group C (Table 3). Likewise high scores were given to group A for flavor likeness. Generally animals of young age do have better flavor than the older ones [15]. Juiciness is the feeling of moisture in the mouth and therefore, cooking loss and water holding capacity are obvious potential attributes to influence the juiciness. Higher juiciness scores were achieved by group A, followed by group C. Higher scores of juiciness were given to group A,

because younger animals do have greater amount of moisture content which aids in higher juiciness of buffalo meat. It can be due to the combination of water, intramuscular fat and saliva production during chewing [15]. Tenderness scores depend upon the muscle fibers and collagen contents of buffalo meat samples assigning high scores to group C for tenderness score. Overall palatability scores were high in group B as compared to group C and group A revealing non significant results.

CONCLUSIONS

It has been concluded that in buffalo meat, pH values were not significantly different (P>0.05) in different age groups. The drip loss was to be higher in group B than the rest of two groups. Cooking loss and water holding capacity was significantly higher in meat of young age group (group A) as compared to old age group (group B and C).Protein and fat contents were lower in meat of young age buffalo (group A) while moisture contents were lower in meat of old age buffaloes group (group C).No any significant difference was seen in ash contents of buffalo meat(P>0.05).Color and tenderness score were higher in meat of group C in contrast to meat of group B and C. Higher scores were given to meat of group A for their flavor and juiciness. Over all palatability scores were higher in meat of group B than rest of other two groups (group A and C).

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