

**EFFECT OF AGE ON MEAT QUALITY CHARACTERISTICS OF SWAMP BUFFALOES**Z. RAHMAN\*, M. HAZARIKA<sup>1</sup>, A. DAS<sup>1</sup>, A.G. BARUAH<sup>2</sup>, B.K. SARKAR<sup>3</sup>, S. UPADHYAY<sup>1</sup>, P. GOGOI<sup>1</sup>, S. CHOUDHURY<sup>1</sup>, N. JEBIN<sup>4</sup>, D.M. CHAVHAN<sup>5</sup> and D. DEURI<sup>1</sup>

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**ABSTRACT**

The work was undertaken to study the effect of age, viz., young (2-4 years) and adult (above 4 years) of either sexes on quality characteristics of meat from swamp buffaloes of Assam. The longissimus dorsi muscle was collected from these animals and the physico-chemical characteristics, viz., pH, Water Holding Capacity (WHC), colour analysis, muscle fibre diameter, myofibrillar fragmentation index and proximate composition of two different age groups were studied. The results obtained in this study indicated that the meat of adult buffalo had higher pH and lower water holding capacity with increasing age, muscle fibre diameter were found more in male than female and also increased as age advanced, Lightness (L\*), yellowness (b\*), moisture content decreased significantly ( $P < 0.01$ ) with increasing age. Based on the quality, it was concluded that meat from young animals (2-4 years) had superior quality than the adult (above 4 years) animals.

**Keywords:** Age, Longissimus dorsi, Muscle fibre diameter, Meat quality, Swamp buffalo

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Quality of meat is mostly dependent on age, sex of the animal and nutritional composition of meat. Meat is an excellent source of good quality animal protein which provides all the essential amino acids and various micronutrients in proper proportion to human being. It is also a valuable source of B-complex vitamins including E, riboflavin, niacin, biotin, pyridoxine, pantothenic acid and cyanocobalamin and minerals like iron, zinc, selenium and phosphorus (Pereira and Vicente, 2013). Consumers are now more focused on the quality and nutritional characteristics of foods including meat and meat products and they are increasingly focusing on their eating habits and nutrient intake as well as food safety. Buffalo is the only potential animal that can boost meat industry in India. Buffalo meat is the healthiest meat among red meats known for human consumption since it is low in calories and cholesterol. Buffalo meat is comparable to beef in many of its physicochemical, nutritional and functional properties and sensory attributes (Kandeepan *et al.*, 2009). Assam has the largest livestock population amongst all the North Eastern states. The swamp buffalo are distributed in West Bengal, Orissa, Assam and some other parts of North East region. Very scanty information is available about the physico-chemical and proximate composition of meat of swamp buffaloes slaughtered in service type slaughter

houses. Hence, the attempt has been made in this study to assess the effect of age on the physico-chemical and proximate composition of swamp buffalo meat so as to determine the optimum age for slaughter.

**MATERIALS AND METHODS****Experimental design**

A total number of twenty swamp buffaloes of two different age groups, viz., young (2-4 years) and adult (above 4 years) were selected based on the dentition and ring of the horn and subsequently, meat from these animals were collected from the service type of slaughter houses for this study. The ante-mortem inspection of animals was carried out before slaughter. Each age group consisted of 5 male and 5 female animals.

**Meat samples**

Samples were taken from the longissimus dorsi muscle at the level of 12-13<sup>th</sup> rib (Alonso *et al.*, 2009). The collected meat samples were packed in clean polyethylene bags and placed in the thermocol box with ice and immediately transported to the laboratory of Department of Livestock Products Technology, C.V.Sc, A.A.U., Khanapara, Guwahati.

**Analytical procedures**

The pH was measured by using a digital pH meter

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(Make: Metrohm, Switzerland, Model-780) and the water holding capacity was assessed with certain modifications, adopting the filter paper press method (Hofmann *et al.* (1982). The colour of the raw meat was determined by using CIEL\* a\* b\* system in Cary 100 UV visible Spectrophotometer (Honikel, 1998). Muscle fibre diameter was measured according to the method outlined by Tuma *et al.* (1962). Myofibrillar fragmentation index (MFI) was determined by “Virtishomogeniser 45” (Virtis Company, Gardiner, New York, USA) with slight modifications (Davis *et al.*, 1980). Proximate composition, viz., moisture, protein, ether extract and total ash content of meat samples were analysed by following the standard procedure A.O.A.C. (2003).

### Statistical analysis

The data obtained in the present study on young and adult age groups of swamp buffalo meat of either sex were analysed by the method described by Snedecor and Cochran (1994) by using SAS software.

## RESULTS AND DISCUSSION

### Meat quality characteristics

The meat quality studies of the fresh meat revealed no significant differences ( $P < 0.01$ ) in the overall mean values of pH and WHC with increasing age of both the sexes of buffaloes (Table 1). WHC and pH are directly proportional to each other. There was non significant increase in WHC (sq cm) with increased age of both the sexes of buffaloes, this might be due to higher accumulation of fat within the muscles of old age animals comparing to young ones which were obtained by Kandeepan (2013) and Abdolghafour and Ahmad (2014) in young and spent buffalo meat. Similarly, there was non significant increase in the mean pH values with the increase in the age of both the sexes of buffaloes. Females had slightly higher pH values compared to males. The result of the present study was in agreement with Ilavarasan *et al.* (2016) in buffalo meat, which might be due to increased myoglobin content. Aberle *et al.* (2001) suggested that changes in pH of the cattle meat were highly significantly affected by intrinsic factors such as species, muscle type, individual animals, and by extrinsic factors such as the handling of cattle before and after slaughter apart from influence of glycogen content.

The overall mean values of muscle fibre diameter increased significantly ( $P < 0.01$ ) with the increase in the age of both the sexes of buffaloes (Table 1). Age has significant ( $P < 0.01$ ) effect on the muscle fibre diameter ( $\mu$ ) as higher age group of buffaloes recorded larger muscle fibre diameter in both the sexes of buffaloes (Kandeepan *et al.*, 2013). The muscle fibre diameter of male buffaloes

**Table 1**  
**Physico-chemical properties of young (2-4 years) and adult (above 4 years) age groups of swamp buffalo meat (Mean $\pm$ SE)**

| Parameters                      | 2-4 years age                 |                                | Above 4 years age               |                                |
|---------------------------------|-------------------------------|--------------------------------|---------------------------------|--------------------------------|
|                                 | Male                          | Female                         | Male                            | Female                         |
| pH                              | 5.99 $\pm$ 0.12               | 6.03 $\pm$ 0.13                | 6.06 $\pm$ 0.11                 | 6.12 $\pm$ 0.16                |
| WHC(sq cm)                      | 3.09 $\pm$ 0.53               | 2.91 $\pm$ 0.67                | 2.86 $\pm$ 0.55                 | 2.63 $\pm$ 0.74                |
| Muscle fibre diameter ( $\mu$ ) | 36.71 <sup>a</sup> $\pm$ 0.65 | 31.78 <sup>b</sup> $\pm$ 0.14  | 44.82 <sup>c</sup> $\pm$ 0.43   | 39.27 <sup>cd</sup> $\pm$ 0.31 |
| MFI (%)                         | 85.17 <sup>a</sup> $\pm$ 5.85 | 82.83 <sup>ab</sup> $\pm$ 6.03 | 74.49 <sup>abc</sup> $\pm$ 6.29 | 64.84 <sup>cd</sup> $\pm$ 4.92 |

Mean having different superscript in the row (small letter) differ significantly ( $P < 0.01$ ). SE = Standard Error, n = 5

**Table 2**

**Proximate composition (%) of young (2-4 years) and adult (above 4 years) age groups of swamp buffalo meat (Mean $\pm$ SE)**

| Parameters        | Proximate Composition         |                                |                                 |                                 |
|-------------------|-------------------------------|--------------------------------|---------------------------------|---------------------------------|
|                   | 2-4 years age                 |                                | Above 4 years age               |                                 |
|                   | Male                          | Female                         | Male                            | Female                          |
| Moisture (%)      | 73.54 <sup>a</sup> $\pm$ 0.05 | 73.42 <sup>ab</sup> $\pm$ 0.07 | 72.42 <sup>abc</sup> $\pm$ 0.06 | 71.07 <sup>abc</sup> $\pm$ 0.03 |
| Protein (%)       | 20.32 <sup>b</sup> $\pm$ 0.04 | 19.06 <sup>a</sup> $\pm$ 0.05  | 20.39 <sup>bcd</sup> $\pm$ 0.03 | 20.33 <sup>bc</sup> $\pm$ 0.05  |
| Ether Extract (%) | 1.78 <sup>a</sup> $\pm$ 0.16  | 2.01 <sup>ab</sup> $\pm$ 0.13  | 2.40 <sup>bc</sup> $\pm$ 0.11   | 2.51 <sup>cd</sup> $\pm$ 0.18   |
| Total Ash (%)     | 0.92 <sup>a</sup> $\pm$ 0.06  | 0.96 <sup>ab</sup> $\pm$ 0.03  | 0.95 <sup>abc</sup> $\pm$ 0.08  | 0.98 <sup>abc</sup> $\pm$ 0.05  |

Mean having different superscript in the row (small letter) differ significantly ( $P < 0.05$ ), ( $P < 0.01$ ); SE = Standard Error, n = 5

**Table 3**

**Effect of age and sex on Lightness (L\*), Redness (a\*) and Yellowness (b\*) at refrigerated storage temperature (4  $\pm$  1°C) (Mean  $\pm$  S.E.)**

| Parameters      | 2-4 years age                 |                                | Above 4 years age              |                                |
|-----------------|-------------------------------|--------------------------------|--------------------------------|--------------------------------|
|                 | Male                          | Female                         | Male                           | Female                         |
| Lightness (L*)  | 35.94 <sup>a</sup> $\pm$ 0.41 | 35.09 <sup>ab</sup> $\pm$ 0.47 | 34.83 <sup>bc</sup> $\pm$ 0.37 | 34.13 <sup>cd</sup> $\pm$ 0.56 |
| Redness (a*)    | 10.93 <sup>a</sup> $\pm$ 0.43 | 13.92 <sup>b</sup> $\pm$ 0.59  | 14.71 <sup>bc</sup> $\pm$ 0.61 | 15.06 <sup>cd</sup> $\pm$ 0.52 |
| Yellowness (b*) | 10.93 <sup>a</sup> $\pm$ 0.51 | 9.89 <sup>b</sup> $\pm$ 0.44   | 9.61 <sup>bc</sup> $\pm$ 0.31  | 9.32 <sup>bcd</sup> $\pm$ 0.47 |

Mean having different superscript in the row (small letter) differ significantly ( $P < 0.05$ ), ( $P < 0.01$ ); SE = Standard Error, n = 5

was markedly higher as compared to female buffaloes and this phenomenon was irrespective of the age. This might be due to larger body conformation, muscle growth and development due to more body activities and exercise implicated in male buffaloes.

A significant difference ( $P < 0.01$ ) was also noticed in the myofibrillar fragmentation index between the age groups of both the sexes of buffaloes (Table 1) and this might be due to increase collagen content inside the muscle fibre as age advanced.

Significantly ( $P < 0.01$ ) lower moisture and higher protein, ether extract and total ash ( $P < 0.05$ ) content were

found in adult than young buffalo meat (Table 2). The moisture content of buffalo meat decreased with increase in the age of the animal, which was probably associated with an increase in fat content (Lawrie, 1998) and the fat was the last tissue to mature in the older animals tending to be fatter (Warriss, 2000). The fat content of meat was highly variable and was influenced by factors such as age, sex, nutrition, body weight, growth rate, physiological condition and physical activity of animal (Owen *et al.*, 1978; Kirton, 1988). The moisture and protein content were found to be slightly higher in male than female buffaloes which might be due to more physical activity of male animal.

A significant ( $P < 0.05$ ) decrease in the overall mean values of lightness ( $L^*$ ) was observed with the increase in age of both the sexes of buffaloes (Table 3). Redness ( $a^*$ ) values were recorded to increase significantly ( $P < 0.01$ ) with increasing age of both the sexes of buffaloes. Also, there was significant ( $P < 0.01$ ) decrease in the overall mean values of yellowness ( $b^*$ ) as the age advanced of both the sexes of buffaloes (Table 3).

### CONCLUSION

Based on the meat quality characters and nutritional composition, it was observed that swamp buffalo slaughtered at 2-4 years of age had better meat quality as well as balanced nutritional composition as compared to animals slaughtered at above 4 years of age.

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