

## Shelf Life of Smoked Buffalo Tripe Rolls at Refrigeration ( $4\pm 1^{\circ}\text{C}$ ) Temperature

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**Abstract:** A study was carried out to determine the shelf life of smoked buffalo tripe rolls at refrigeration temperature ( $4\pm 1^{\circ}\text{C}$ ) to assess the quality changes while monitoring physico-chemical, microbiological and sensory characteristics under aerobic packaging by using LDPE pouches. Smoked buffalo tripe rolls prepared from a combination of buffalo tripe (75%) and minced buffalo meat (25%) was stored at  $4\pm 1^{\circ}\text{C}$  to assess the quality changes at 0, 7, 14, 21 and 27th day of storage. pH, thiobarbituric acid and tyrosine values were increased and extract release volume was decreased significantly with increasing storage period. Period of storage had no significant effect on moisture content. Throughout the storage period, all microbial counts were within the acceptable limits of cooked meat products. No adverse effects were noticed on sensory scores for appearance, flavour, juiciness, texture and overall acceptability up to 21 days of storage. Therefore, smoked tripe rolls can be prepared and could safely be stored for 21 days at  $4\pm 1^{\circ}\text{C}$  in LDPE pouches under aerobic packaging.

**Key words:** Buffalo tripe, smoked rolls, storage, quality changes, microbial quality, sensory quality

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### INTRODUCTION

India is endowed with the largest buffalo population in the world. About 10.66 million buffaloes are slaughtered annually producing 1.47 million MT of buffalo meat (FAO, 2005). Although, buffaloes are slaughtered mainly for meat, the by products that are available from slaughtered animals are of good value. Tripe, otherwise known as rumen meat is one of the important edible offal of buffaloes and it accounts for 1.3% of the slaughter weight. The yield of buffalo tripe ranges from 4.36-5.45 kg animal<sup>-1</sup>. In India, most of the buffalo tripe is underutilized or thrown as waste.

Tripe from export slaughter establishments are also usually discarded. To overcome this disposal problem and to find means of better utilization, very few attempts have been made to develop value added products exclusively from buffalo tripe (Anna Anandh *et al.*, 2008). Some attempts have also been made to utilize buffalo tripe as partial substitute for lean meat in the preparation of comminuted meat products (Krishnan and Sharma, 1990; Anjaneyulu and Kondaiah, 1990). All these products are highly perishable. Therefore, effort should be made to develop shelf stable products from buffalo tripe. Curing and smoking are important processing techniques used primarily for pork and to some extent for beef (Paleari *et al.*, 2000). Cured and smoked products have been much relished for their unique colour and flavour.

The safety for consumption and shelf stability of smoked products has been proven over the years (Paleari *et al.*, 2003).

To the best of knowledge, no published information on the shelf life of smoked buffalo tripe rolls is available. Hence, a study was conducted to prepare and evaluate the acceptability of smoked buffalo tripe rolls stored at refrigerated temperature ( $4\pm 1^{\circ}\text{C}$ ) in LDPE pouches under aerobic packaging.

### MATERIALS AND METHODS

**Buffalo tripe:** Fresh Buffalo tripe was obtained from local buffalo offals market of Bareilly city and processed at Livestock Products Technology Division, Indian Veterinary Research Institute, Izatnagar, India. Before the tripe was made in to chunks the fat and adhering extraneous materials on the surface were removed by knife. The time lag between the slaughter of the animal and the commencement of the experiment was about 3 h. The buffalo tripe has typical off-odour reminiscent of ingesta. Hence, the material was suitably treated to reduce the off-odour prior to its use.

For deodorization, the tripe was immersed in 5% tri-sodium phosphate solution for 30 min as per standard procedure (Anna Anandh *et al.*, 2004). The deodorized tripe chunks were blade tenderized three times using electrically operated mechanical blade tenderizer (Hobart,

Germany). The blade tenderized buffalo tripe chunks were sectioned in to uniform pieces of about 2-3 cm and were used for the preparation of Smoked buffalo tripe roll.

**Buffalo meat:** Round portion of buffalo skeletal meat was purchased from the local buffalo meat stall of Bareilly city. It was cut into small chunks at Livestock Products Technology Division, Indian Veterinary Research Institute, Izatnagar, India and frozen for 1-2 h to ensure easy mincing. The buffalo meat chunks were minced twice through the meat mincer (Seydelmann, Germany) using 5 mm plate. The minced buffalo meat was used in the preparation of smoked buffalo tripe roll.

**Casings:** Buffalo weasands of average diameter of 10-12 cm were purchased from the local buffalo casings processor of Bareilly city, India. Just before stuffing, weasands were thoroughly cleaned and flushed with tap water and then soaked in 10% salt solution for 1 min and again washed with tap water.

**Product formulation:** The formula for smoked buffalo tripe roll was developed after conducting a series of preliminary trails. The product formulation consisted of 75% buffalo tripe, 25% minced buffalo meat, 2.5% salt, 2.5% cane sugar, 0.5% sodium tri polyphosphate, 0.015% sodium nitrite, 0.15% sodium ascorbate, 2.0% spice mix, 6.0% condiments mix (onion, garlic and ginger 2:1:1) and 10% ice flakes.

**Product preparation:** Smoked buffalo tripe rolls were prepared by mixing weighed quantity of blade tenderized buffalo tripe and minced buffalo meat for 4-6 min in Hobart paddle type mixer (Hobart, Germany) with salt at medium speed (200 rpm) until a white tachy exudate appears on the surface of the meat mix. Then sodium nitrite, sodium tri-polyphosphate, sodium ascorbate and sugar were added and blended for about 1 min. Condiments mix was added to the blend and mixed again for 30 sec followed by spice mix and mixed for 1 min for getting a fine batter. The mix was then stuffed manually in to buffalo weasands. The encased mass was tied with cotton thread. The tripe rolls so prepared were equilibrated for 12 h in the refrigerator at  $4\pm 2^{\circ}\text{C}$ . The rolls were hanged in microprocessor controlled smoke oven (Enviro-Pak, USA) and smoked using 3 stage schedules drying for 30 min, smoking for 5 h at  $45^{\circ}\text{C}$  to attain attractive and desirable brown colour and cooked to an internal temperature of  $85\pm 2^{\circ}\text{C}$  for 30 min to ensure proper cooking. After cooking, the smoked buffalo tripe rolls were allowed to cool down, sliced using meat slicer (Electrolux, Italy) and packaged aerobically in LDPE pouches using a packaging

machine (Roschermatic, Germany). The samples were stored in the refrigerator at  $4\pm 2^{\circ}\text{C}$  over a period of one month to assess the quality changes. The physico-chemical characteristics, microbiological and sensory quality attributes of the product was carried out on 0, 7, 21 and 27th days of storage.

**Physico-chemical characteristics:** The pH was determined using a digital pH meter (Century Instruments Ltd., India). Moisture content of the product was determined as per the procedure of AOAC (1995). For determination of Extract Release Volume (ERV), 15 g of mined stored sample was blended with 60 mL of distilled water in a homogeniser and homogenate was transferred as quickly as possible in to a funnel, equipped with a What man filter paper No. 1. The volume of filtrate collected in first 15 min was recorded as ERV of the respective sample. The procedure of Witte *et al.* (1970) was followed to estimate Thiobarbituric Acid value (TBA). Tri-chloroacetic acid extracts of each sample was used for measuring the absorbance at 532 nm. TBA value was calculated as mg malonaldehyde per kg meat sample by referring to a standard graph prepared using known concentration of malonaldehyde. Thyrosine value of stored samples was determined based on the procedure of Strange *et al.* (1977).

**Microbiological characteristics:** Total plate, psychrotrophic, coliform, yeast and mold and staphylococcal counts of stored samples were determined by the methods described by APHA (1984). Readymade media were (Hi-media Laboratory Pvt. Ltd., Mumbai, India) used for enumeration of microbes. Preparation of samples and serial dilutions were done near the flame in a horizontal laminar flow apparatus which was pre-sterilized by ultraviolet irradiation (Yarco Sales Pvt. Ltd., India) by observing all possible aseptic precautions. About 10 fold dilutions of each sample were prepared aseptically by blending 10 g of sample with 10 mL of 0.1% sterile peptone water with a pre sterilized blender. Plating medium was prepared by dissolving 23.5 g of plate count agar in 1 L of distilled water and pH was adjusted to  $7.0\pm 0.2$ . Media was autoclaved at 15 lb pressure for 15 min before plating. The plates were incubated at  $30\pm 1^{\circ}\text{C}$  for 48 h for Total Plate Count (TPC) and  $4\pm 1^{\circ}\text{C}$  for 14 days for psychrotrophic counts. Coliform count was detected by using Violet Red Bile Agar and plates were incubated at  $37\pm 1^{\circ}\text{C}$  for 48 h. Potato Dextrose Agar was used for enumeration of yeast and mold count and the plates were incubated at  $25\pm 1^{\circ}\text{C}$  for 5 days. Baird Parker Agar was used for enumeration of staphylococcal count. Before plating, the medium was tempered to  $50^{\circ}\text{C}$  and egg yolk telluride emulsion was added to the medium. The

plates were incubated at 37±1°C for 48 h. Following incubation, plates showing 30-300 colonies were counted. The average number of colonies for each species was expressed as log<sub>10</sub> cfu g<sup>-1</sup> sample.

**Sensory evaluation:** Slices of smoked buffalo tripe rolls were served to an experienced panel of scientists and postgraduate students in the discipline of Livestock Products Technology Division, Indian Veterinary Research Institute, Izatnagar, India to determine their sensory characteristics. The sensory attributes like appearance and colour, flavour, juiciness, texture and overall acceptability were evaluated on 8 point descriptive scale as suggested by Keeton (1983). The sensory score of 8 was extremely desirable where as one was extremely undesirable.

**Statistical analysis:** The data generated from four trials were analyzed by following standard procedures (Snedecor and Cochran, 1989) for comparing the means and to determine the effect of storage.

**RESULTS AND DISCUSSION**

**Physico-chemical characteristics:** The mean values for physico-chemical characteristics of smoked buffalo tripe roll during refrigerated storage are shown in Table 1. No significant variation in pH was observed up to 21 days of refrigerated storage but it significantly increased on 27th day of storage. Increased pH of smoked buffalo tripe rolls during refrigerated storage might be due to hydrolysis of the collagen molecules which released amino group in meat system (Webster *et al.*, 1982). Gradual decrease in moisture content was recorded during

storage. However, the decrease was non-significant. These variations in moisture content during storage might be due to some dehydration from permeable film during refrigerated storage. During storage, non significant increase in ERV value was observed up to 14 days of storage. However, significant (p<0.01) increase in ERV value was observed on 21st and 27th day of storage. This might be due to gradual increase in microbial growth during storage (Jay, 1996). The TBA values non significantly increased with increasing storage period up to 14th day of storage and significantly (p<0.01) increased after 21st day of storage. Even though there was a increase in TBA values during storage, they were well with in the threshold limit of 1-2 mg malonaldehyde/kg meat (Watts, 1962).

The lower TBA value in smoked buffalo tripe roll might be due to the combined effect of curing and smoking (Daun, 1979). Increase in TBA during storage of different meat and meat products were also recorded earlier by Tarladgis *et al.* (1960) and Devatkal and Mendiratta (2001). The tyrosine value also non significantly increased with increasing storage period up to 14th day of storage and significantly increased after 21st day of storage. The increased proteolysis resulting in higher tyrosine value was also reported by Naveena *et al.* (2001) in smoked spent hen meat.

**Microbial characteristics:** The mean values for microbial characteristics of smoked buffalo tripe roll during refrigerated storage are shown in Table 2. The mean values for microbial profile of smoked buffalo tripe roll during refrigerated storage are shown in Table 2. Total plate counts increased significantly (p<0.01) with increasing storage period. Similar results of increasing total plate counts with increasing storage period was also

Table 1: Changes in physico-chemical characteristics of smoked buffalo tripe rolls during refrigerator storage at 4±1°C

Parameters	Storage period in days				
	0	7	14	21	27
<b>Physico-chemical characteristics n = 4</b>					
pH	6.42±0.02 <sup>a</sup>	6.35±0.03 <sup>a</sup>	6.39±0.05 <sup>a</sup>	6.48±0.08 <sup>a</sup>	6.67±0.02 <sup>b</sup>
Moisture	69.00±1.36	68.91±0.11	68.66±0.29	68.22±0.20	67.97±0.14
Extract release volume	22.12±0.16 <sup>a</sup>	20.52±1.03 <sup>a</sup>	20.55±0.29 <sup>a</sup>	19.31±0.30 <sup>b</sup>	18.10±0.15 <sup>b</sup>
TBA value	0.50±0.27 <sup>a</sup>	0.53±0.02 <sup>a</sup>	0.70±0.04 <sup>a</sup>	0.77±0.01 <sup>b</sup>	0.83±0.01 <sup>b</sup>
Thyrosine value	0.44±0.01 <sup>a</sup>	0.52±0.04 <sup>a</sup>	0.59±0.02 <sup>a</sup>	0.06±0.01 <sup>b</sup>	0.72±0.05 <sup>b</sup>

n = Number of observations; Means bearing same superscripts row-wise do not differ significantly

Table 2: Changes in microbial profile of smoked buffalo tripe rolls during refrigerator storage at 4±1°C

Parameters	Storage period in days				
	0	7	14	21	27
<b>Microbial profile (log<sub>10</sub> cfu g<sup>-1</sup>) n = 4</b>					
Total plate count	0.22±0.07 <sup>a</sup>	1.53±0.06 <sup>b</sup>	2.00±0.15 <sup>b</sup>	2.69±0.09 <sup>c</sup>	3.51±0.03 <sup>d</sup>
Psychrotrophic count	1.02±0.03 <sup>a</sup>	1.33±0.28 <sup>b</sup>	2.44±0.17 <sup>b</sup>	2.58±0.12 <sup>c</sup>	3.11±0.33 <sup>d</sup>
Coliform count	1.11±0.06 <sup>a</sup>	1.43±0.03 <sup>a</sup>	1.51±0.09 <sup>a</sup>	1.70±0.08 <sup>b</sup>	1.77±0.07 <sup>c</sup>
Yeast and mould count	1.94±0.18 <sup>a</sup>	2.01±0.11 <sup>a</sup>	2.60±0.18 <sup>b</sup>	2.62±0.15 <sup>b</sup>	3.29±0.13 <sup>c</sup>
Staphylococcal count	1.28±0.06 <sup>a</sup>	1.56±0.04 <sup>a</sup>	1.66±0.06 <sup>a</sup>	1.96±0.05 <sup>b</sup>	2.26±0.05 <sup>b</sup>

n = Number of observations; Means bearing same superscripts row-wise do not differ significantly

Table 3: Changes in sensory characteristics of smoked buffalo tripe rolls during refrigerator storage at 4±1°C

Parameters	Storage period in days				
	0	7	14	21	27
<b>Sensory attributes** n = 20</b>					
Appearance and colour	6.7±0.08 <sup>a</sup>	6.2±0.07 <sup>a</sup>	6.0±0.08 <sup>a</sup>	5.9±0.07 <sup>b</sup>	5.8±0.06 <sup>b</sup>
Flavour	5.9±0.67 <sup>a</sup>	5.6±0.09 <sup>a</sup>	5.5±0.08 <sup>a</sup>	5.3±0.09 <sup>a</sup>	5.1±0.20 <sup>b</sup>
Juiciness	6.8±0.07 <sup>a</sup>	6.5±0.07 <sup>a</sup>	6.2±0.08 <sup>a</sup>	5.9±0.12 <sup>b</sup>	5.8±0.24 <sup>b</sup>
Texture	6.4±0.19	6.4±0.17	6.3±0.12	6.2±0.14	6.0±0.18
Over all acceptability	6.8±0.09 <sup>a</sup>	6.5±0.13 <sup>a</sup>	6.3±0.12 <sup>a</sup>	6.0±0.07 <sup>b</sup>	5.9±0.08 <sup>b</sup>

n = Number of observations; Means bearing same superscripts row-wise do not differ significantly; \*\*Sensory attributes of smoked buffalo tripe rolls were evaluated on a 8-point descriptive scale (wherein 1 = extremely undesirable; 8 = extremely desirable)

reported by Devatkal and Mendiratta (2001) in restructured pork rolls and Naveena *et al.* (2001) in smoked spent hen meat. Significant ( $p < 0.01$ ) increase in psychrotrophic count was observed with increasing storage period.

A consistent increase in psychrotrophic counts on all storage days in ground chevon during refrigerated storage was also reported (Verma and Sahoo, 2000). The coliform and yeast and mould counts increased significantly ( $p < 0.01$ ) with increasing storage period. However, from 0-14th day of storage, the increase in coliform and yeast and mould counts were non significant. Non significant increases in staphylococcal counts were also observed between 0-14th day of storage. Afterwards there was a significant increase in Staphylococcal counts. Throughout the storage period, all microbial counts were within the standards stipulated for cooked meat products, even though microbial counts were increased with increasing storage period (Bushway and Jen, 1984; Chen and Jones, 1988).

**Sensory characteristics:** The mean values for sensory attributes of smoked buffalo tripe roll during refrigerated storage are shown in Table 3. The mean values for sensory attributes of smoked buffalo tripe roll during refrigerated storage are shown in Table 3. No significant difference was observed for appearance and colour scores up to 14th day of storage. However, appearance and colour scores decreased significantly ( $p < 0.01$ ) after 21st day of storage. The possible reason for decrease in appearance and colour scores during refrigerated storage might be due to surface drying or lipid oxidation causing non-enzymatic browning.

The flavour scores decreased with increasing storage period and the scores turnout to be significantly ( $p < 0.01$ ) lower only on 27th day of storage. Flavour reduction during storage might be due to microbial growth and lipid oxidation (Tarladgis *et al.*, 1960). The juiciness scores decreased with increasing storage period but the decline was non significant upto 14th day of storage after that decreased significantly ( $p < 0.01$ ) on 21st and 27th day of storage. Dehydration of the product with advancement of refrigerated storage could be the reason for lower

juiciness scores. The texture scores decreased non-significantly with increasing storage period. Overall acceptability scores decreased with increasing storage period. However, there was no significant difference in overall acceptability of the products up to 14th day of storage. A significant ( $p < 0.01$ ) decrease in overall acceptability scores was observed only on 21st day of storage. Decrease in overall acceptability scores with increasing storage period might be due to decrease in appearance and colour, flavour, juiciness and texture scores.

Similar observation of decrease in overall acceptability with increasing storage period was also reported by Devatkal and Mendiratta (2001) and Naveena *et al.* (2001) in smoked pork rolls and smoked spent hen meat, respectively.

## CONCLUSION

Based on the above results, it can be concluded that smoked buffalo tripe rolls had better acceptability up to 21 days of storage at 4±1°C in LDPE pouches.

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