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Quality and Acceptability of Restructured Buffalo Meat Rolls in Refrigerated Storage

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Abstract: Restructured buffalo meat rolls prepared from minced buffalo meat was stored at 4 ± 1°C to assess the quality changes at 0, 5, 10, 15 and 20 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 15 days of storage. Therefore, restructured buffalo meat rolls can be prepared and could safely be stored for 15 days at 4 ± 1°C in LDPE pouches under aerobic packaging.

Key words: Buffalo Meat · Restructuring · Rolls · Quality · Storage Stability

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. Buffalo meat is abundantly available in India and has enormous potential for development in to valuable and highly palatable processed meat products. Meat processing improves preservation by inhibiting or deterring microbial decomposition / spoilage and results in flavourful and nutritious products. Buffalo meat is widely used in the production of a variety of buffalo meat products, such as sausages, loaves, burgers, patties, salted and cured meat and buffalo corned beef.

Restructuring technology can be used to produce value added products from low quality raw materials of meat industry, which are good sources of protein but are often underutilized. Restructured meat using flaking and forming or chunking and forming to produce low cost steaks has provided new steak products to consuming public [1]. Products that undergone desinewing and particle size reduction such as sectioning, chunking, slicing, blade tenderization, flaking, chopping followed by forming into steaks, roasts or patties are called restructured meats [2]. Value enhancement of raw materials, portion control, uniform quality and consumer convenience are advantages of restructured meat products. The objective of the present study was to prepare and evaluate the quality and acceptability of restructured buffalo meat rolls in refrigerated storage (4 ± 1°C).

MATERIALS AND METHODS

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 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 buffalo meat roll.

Weasands: Buffalo weasands of average diameter of 10-12 cm were purchased from the local buffalo casings processor. 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.

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Product Processing: The formula for buffalo meat roll was developed after conducting a series of preliminary trails. The product formulation consisted of 100% 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.

Weighed quantity of minced buffalo meat samples were mixed in meat mixer (Hobart, Germany) at a speed of 200 rpm for 2 min with salt (2.7%), sodium tri polyphosphate (0.5%) and minced buffalo meat (25%). Thereafter, sodium nitrite (0.015%), sodium ascorbate (0.15%), spice mix (2.0%) condiments mix (6.0%) and ice flakes (10%) were added to mixer and mixing was further continued for 3 min so as to obtain the homogenous mixture. Then about 500 g of meat mix was stuffed manually in to a weasand. The raw rolls were cooked in pre heated water up to an internal temperature of 82 ± 1°C and maintained at this temperature for about 10 min. The internal temperature was recorded using probe thermometer (Oakton, China). After cooking, the cooked meat rolls were allowed to cool down, packaged in low density polyethylene pouches (LDPE) and chilled in refrigerator. After 12 h of chilling, the rolls were sliced using meat slicer (Electrolux, Italy) and packaged aerobically in LDPE pouches using a packaging machine (Roschermatic, Germany). The samples were kept at 4 ± 1°C and examined at intervals of 5 days up to 20 days.

Physico - Chemical Analysis: 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 [3]. 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*. [4] 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*. [5].

Microbial Analysis: Total plate, psychrotrophic, coliform, yeast and mold and staphylococcal counts of stored samples were determined as per the methods described in the APHA [6]. Readymade media were (Hi-media Laboratory Pvt. Ltd., Mumbai, India) used for enumeration of microbes.

Sensory Evaluation: Slices of buffalo meat rolls were served to an experienced panel of scientists and postgraduate students in the discipline of Livestock Products Technology 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, [7]. 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 [8] for comparing the means and to determine the effect of storage.

RESULTS AND DISCUSSION

Changes in Physico - Chemical Characteristics: The mean values for physico- chemical characteristics of restructured buffalo meat roll during refrigerated storage are presented in Table 1. Stored restructured buffalo meat roll pH decreased significantly ($P < 0.01$) with increasing storage period. However, no significant variation in pH up to 5 days of refrigerated storage, but it significantly decreased on day 10 of storage. A further significant ($P < 0.01$) decrease in pH was observed on day 15 of storage and the value did not different from day 20 of storage. Significant decrease in pH of restructured pork rolls during refrigerated storage also reported [9]. Increased pH of buffalo meat rolls during refrigerated storage might be due to hydrolysis of the collagen molecules which released amino group in meat system [10]. 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 decrease in ERV value was observed up to 10 days of storage. However, significant ($P < 0.01$) decrease in ERV value was observed on day 15 of storage and the value did not different from day 20 of storage.

This might be due to gradual increase in microbial growth during storage [11]. The TBA values non significantly increased with increasing storage period up to day 5 of storage and significantly ($p< 0.01$) increased after on day 10 of storage. Increased TBA value between day 15 to 20 of refrigerated storage did not differ significantly between them. 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 [12]. Increase in TBA values might be due to increase in lipid oxidation and production of volatile metabolites in aerobic packaging. Increase in TBA during storage of different meat and meat products were also recorded earlier by Tarladgis *et al*. [13] and Devatkal and Mendiratta [9]. The tyrosine value also significantly increased with increasing storage period up to day 15 of storage and significantly decreased after day 20 of storage.

Changes in Microbial Quality: The mean values for microbial profile of restructured buffalo meat roll during refrigerated storage are presented in Table 2. Total plate counts increased significantly ($P < 0.01$) with increasing storage period. However, from day 15 to 20 of storage, the increase in total plate counts were non significant. Similar results of increasing total plate counts with increasing storage period were also reported by Devatkal and Mendiratta [9] in restructured pork rolls. 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 [14]. The coliform counts were increased significantly ($P < 0.01$) with increasing storage period. However, between day 5 to 10 and day 15 to 20 of storage, the increase in coliform counts were non significant. The yeast and mould counts also increased significantly ($P < 0.01$) with increasing storage period. However, between day 0 to 5 and day 10 to 20 of storage, the increase in yeast and mould counts were non significant. Non significant increases in staphylococcal counts were also observed between day 0 to 5 and 10 to 15 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 [11]. No visible slim and off odour appeared up to day 15 of storage in restructured buffalo meat roll. However, on day 20 of storage, the stored product revealed marginally spoiled stage with appearance of surface slim and slight off odour.

Table 1: Changes in physico-chemical characteristics of restructured buffalo meat rolls during refrigerator storage (4±1°C)

	Storage period in days				
Parameters	0	5	10	15	20
Physico-chemical characteristics n = 4					
pH	6.36±0.01^a	6.29±0.02^a	6.14±0.02^b	6.06±0.01^c	6.01±0.01^c
Moisture	72.12±0.82	71.81±0.86	71.30±0.48	70.02±0.42	69.24±0.57
Extract release volume	21.06±0.58^a	21.02±0.42^a	20.35±0.32^a	19.04±0.24^b	18.46±0.39^b
TBA value	0.51±0.04^a	0.59±0.08^a	0.70±0.02^b	0.84±0.04^c	0.85±0.08^c
Thyrosine value	0.46±0.02^a	0.54±0.01^b	0.63±0.01^c	0.69±0.01^c	0.53±0.01^b

n=Number of observations

Means bearing same superscripts row - wise do not differ significantly

Table 2: Changes in microbial profile of restructured buffalo meat rolls during refrigerator storage (4±1°C)

	Storage period in days				
Parameters	0	5	10	15	20
Microbial profile (log 10 cfu/g) n = 4					
Total plate count	2.30±0.08^a	3.55±0.10^b	4.56±0.10^c	5.23±0.12^d	5.89±0.10^d
Psychrotrophic count	ND	2.67±0.06^a	3.42±0.18^b	4.31±0.10^c	4.96±0.10^c
Coliform count	ND	2.18±0.10^a	2.28±0.18^a	2.67±0.10^b	2.82±0.11^b
Yeast and mould count	2.26±0.08^a	2.52±0.08^a	3.21±0.06^b	3.57±0.02^b	3.62±0.10^b
Staphylococcal count	1.26±0.04^a	1.63±0.04^a	1.81±0.05^b	2.26±0.03^b	2.62±0.05^c

n=Number of observations

Means bearing same superscripts row - wise do not differ significantly

Table 3: Changes in sensory characteristics of restructured buffalo meat rolls during refrigerator storage (4±1°C)

	Storage period in days				
Parameters	0	5	10	15	20
Sensory attributes** n = 20					
Appearance and colour	7.01±0.10[a]	7.0±0.02[a]	6.9±0.02[a]	6.7±0.04[b]	5.6±0.04[c]
Flavour	6.9±0.08[a]	6.8±0.10[a]	6.6±0.08[b]	6.6±0.29[b]	5.5±0.04[c]
Juiciness	6.8±0.06[a]	6.6±0.08[a]	6.5±0.06[a]	6.3±0.10[b]	5.2±6.06[c]
Texture	6.9±0.10[a]	6.7±0.04[b]	6.4±0.10[b]	6.4±0.08[b]	6.0±0.04[c]
Over all acceptability	7.0±0.06[a]	6.9±0.10[a]	6.6±0.08[b]	6.5±0.10[b]	5.4±0.04[c]

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)

Changes in Sensory Attributes: The mean values for sensory attributes of restructured buffalo meat roll during refrigerated storage are presented in Table 3. No significant difference was observed for appearance and colour scores up to day 10 of storage. However, appearance and colour scores decreased significantly ($P < 0.01$) after day 15 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. However, between day 0 to 5 and day 10 to 15 of storage, the decrease in flavour scores were non significant. Flavour scores significantly decreased on day 20 of storage. Flavour reduction during storage might be due to microbial growth and lipid oxidation [13]. The juiciness scores decreased with increasing storage period, but the decline was non significant up to on day 10 of storage after that decreased significantly ($P < 0.01$) on day 20 of storage. Dehydration and moisture reduction of the product with advancement of refrigerated storage could be the reason for lower juiciness scores. The texture scores decreased significantly ($P< 0.01$) with increasing storage period and there was in significant decrease in texture scores were observed between on day 5 to 20 of storage. Overall acceptability scores decreased with increasing storage period. However, there was no significant difference in overall acceptability of the products up to day 5 of storage. A significant ($P< 0.01$) decrease in overall acceptability scores was observed only on day 10 of storage. Reduction in over all acceptability scores between day 10 to 15 did not significantly between them but it significantly decreased on day 20 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 [9] in pork rolls.

CONCLUSION

Based on the above results, it can be concluded that restructured buffalo meat rolls had better acceptability up to 15 days of storage at 4 ± 1°C in LDPE pouches.

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