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ORIGINAL ARTICLE

Storage stability of smoked buffalo rumen meat product treated with ginger extract

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Abstract Smoked buffalo rumen meat products were prepared from 3 times blade tenderized buffalo tripe with 5.0% ginger extract and were subjected to various physico-chemical parameters, microbial profile and sensory quality at 25±1 °C under aerobic packaging. All physico-chemical parameters, microbial counts and sensory evaluation score of ginger extract treated buffalo rumen meat product were higher compared to control. pH, moisture content, thiobarbituric acid, tyrosine values, total plate, yeast and mould and staphylococcal counts were increased and extract release volume were decreased significantly with increasing storage period. Throughout the storage period, all microbial counts and sensory evaluation score were within the acceptable limits up to storage period of 15 days at 25±1 °C in LDPE pouches under aerobic packaging.

Keywords Buffalo · Rumen meat · Tripe · Blade tenderization · Ginger extract · Curing · Smoked product · Quality changes

Introduction

Rumen meat, otherwise known as *tripe*, is one of the important underutilized high proteinacious by product of buffaloes. The yield of buffalo rumen meat ranges from 4.36 kg to 5.45 kg per animal and it accounts for about 1.3% of the slaughter weight. In India, most of the buffalo tripe is underutilized or thrown as waste because of socio-cultural factors and lack of technology. Tripe from export slaughter establishments are also usually discarded. More availability, tougher texture due to high collagen content, off odors, poor functional properties and highly perishable nature or poor shelf life of buffalo tripe make its effective utilization is a difficult task. The material offers good scope for processing in the products, subject to successfully overcoming these limitations. To overcome 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). Development of suitable technologies is considered as a potential solution to the problem of utilizing rumen meat in to processed convenience food products. Cured smoked products like ham, bacon and other processed meat products are popular throughout the word. Curing and smoking are important processing techniques used primarily for pork and, to some extent also for beef or poultry (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 such products has been proven over the years. Ginger extract is widely used as a condiment in household cooking. Many reports claimed that ginger extract greatly enhanced the tenderness of meat steaks which was a problem with other proteolytic enzymes. Naveena et al. (2001) reported that ginger extract can be effectively utilized to improve the qualities of tough meat and to produce convenience, attractive and highly palatable smoked product from spent hen meat with improved shelf life. Extension of shelf life by use of ginger has also been reported by Syed Ziauddin et al. (1995). Hence, a study was under taken for to study the storage stability of smoked buffalo rumen meat products prepared

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from use of ginger extract in conjunction with mechanical blade tenderization at room temperature (25±1 °C) in LDPE pouches under aerobic packaging.

Materials and methods

Buffalo rumen meat Fresh buffalo rumen meat was obtained from local buffalo offals market of Bareilly city. To reduce sampling error, the buffalo rumen meat for each trial was collected from single animal, packaged in polyethylene bag and brought to the laboratory. Before the meat was made in to chunks, the fat and adhering extraneous materials were removed by using knife. The time lag between slaughter of animal and commencement of analysis was about 3 h.

Ginger extract Fresh ginger was purchased from local market. The ginger was peeled, sliced, ground in a morter with pestle and squeezed through two layer of cheese cloth to produce a crude ginger extract. The yield of crude extract was approximately 50% of the peeled ginger.

Product preparation Buffalo rumen meat was cut in to small chunks of 2.5×2.5 cm size and deodorized by immersion in 5% trisodium phosphate solution for 30 min (Anna Anandh et al. 2008). The deodorized buffalo rumen meat chunks were subjected to blade tenderization three times using blade type mechanical blade tenderizer (Hobart, Germany) to open up the structure of meat and facilitate uniform penetration of curing solution in to the buffalo rumen meat chunks. For each experiment, 250 g of buffalo rumen meat chunks were used. The three times blade tenderized buffalo rumen meat chunks were immersed in curing solution consisting of 5% sodium chloride, 2.0% cane sugar, 0.5% sodium tripolyphosphate, 0.01% sodium ascorbate, 0.05% sodium nitrite and incorporated with 5.0% ginger extract. For control (no treatment), buffalo rumen meat chunks were immersed in above standard curing solution without 5.0% ginger extract and blade tenderization. All buffalo rumen meat chunks were immersed in curing solution in non-corrosive stainless steel containers for 12 h at 4±1 °C to facilitate equilibration. The buffalo rumen meat chunks thoroughly mixed once in the curing solution by using a stainless steel striver after 6 h of chilling. After equilibration, the buffalo rumen meat chunks were drained off the curing solution and were smoked using 3 stage schedules in a automatic microprocessor smoke oven (Enviro- Pak,USA) : drying for 30 min, smoking for 5 h at 45 C to attain attractive and desirable brown colour and cooked to an internal temperature of 85±1 °C for 30 min to ensure proper cooking. After cooking, the smoked buffalo rumen meat products 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 at 25±1 °C in room temperature and were evaluated the quality changes. The physico – chemical characteristics, microbial profile and sensory quality attributes of the product was carried out on day 0, 5, 10 and 15 of storage.

Analytical procedures

Physico – chemical analysis The pH of the smoked buffalo rumen meat products were determined by homogenizing 10 g of sample with 50 ml distilled water with help at ultraturex tissue homogenizer (Jenke and Kenkel, IKA labor Technic, Germany) for 1 min. The pH of the suspension was recorded by immersing the combined glass electrode of digital pH meter (Century Instruments Ltd, India). Moisture content of the product was determined by standard methods using Hot air oven 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 homogenizer 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. Tyrosine value of stored samples was determined based on the procedure of Strange et al. (1977).

Microbiological evaluation Total plate, 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. 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 lit of distilled water and pH was adjusted to 7.0±0.2. Media was autoclaved at 15 1b pressure for 15 min before plating. The plates were incubated at 30±1 °C for 48 h for total plate count (TPC) counts. Potato Dextrose Agar was used for

enumeration of yeast and mold count and the plates were incubated at 25±1 °C for 5 days. Baird Parker Agar was used for enumeration of staphylococcal count. Before plating, the medium was tempered to 50 °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 $\log_{10}$ cfu/g sample.

Sensory evaluation Experienced sensory panel evaluated the smoked buffalo rumen meat products for appearance, flavour, juiciness, tenderness and overall palatability on a 8-point descriptive scale (where in 1 is extremely undesirable and 8 is extremely desirable).

Statistical analysis Four trails were conducted and the data generated from each trial were analyzed by following standard procedure described by Snedecor and Cochran (1989) for comparing the means and to determine the effect of treatments.

Results and discussion

Changes in physico – chemical characteristics Significantly ($P>0.01$) higher over all pH was observed in ginger extract treated smoked buffalo rumen meat product as compared to control product (Table 1). Over all days means of pH decreased significantly ($P<0.01$) with increasing storage period. However, no significant variation in pH between day 5 to 10 of storage, but it significantly decreased on day 15 of storage. Higher pH values of ginger extract treated products might be due to higher pH of ginger extract. Similar results were also reported in smoked spent hen meat by Naveena and Mendiratta (2004). The mean pH values of smoked products of our present study were in agreement with report of Sofos et al. (1979) and Buchananan (1986) wherein they reported pH values of above 6.0 in cured and smoked products. Gradual decrease in moisture content was recorded during storage. However, the decrease was non significant between day 0 to 10 of storage. These variations in moisture content during storage might be due to some dehydration from permeable film during refrigerated storage. Naveena et al. (2001) have also reported a decrease in moisture values with increasing storage period in smoked spent hen meat. Overall mean ERV values were slightly higher in treated product as compared to control. No significant difference was observed between control and ginger extract treated smoked buffalo rumen meat products. There was a significant ($P<0.01$) decrease in ERV values with increasing storage period. During storage, non significant increase in ERV values was observed on day 5 to 10 of storage. However, significant ($P<0.01$) decrease in ERV value was observed on day 15 of storage. This might be due to gradual increase in microbial growth during storage (Jay 1996). Overall mean TBA value of control and ginger extract treated smoked buffalo rumen meat product differ significantly ($P<0.01$) between them. The mean TBA values significantly ($P<0.01$) increased with increasing storage period. Even though there was a significant increase in TBA values during storage, they were well with in the threshold limit of 1–2 mg malonaldehyde/kg meat (Watts 1962). Increase in TBA values might be due to increase in lipid oxidation and production of volatile metabolites in aerobic packaging. A slightly lower TBA value in ginger extract treated products as compared to control is an indicative of antioxidant effect of ginger extract (Lee et al. 1986). Overall mean tyrosine value differed significantly ($P<0.01$) between control and ginger extract treated smoked buffalo rumen meat products. The mean tyrosine value significantly ($P<0.01$) increased with increasing storage period. Increase in proteolysis resulting in higher tyrosine value in the meat stored at ambient temperature was also reported by Syed Ziauddin et al. (1993).

Changes in microbial quality Overall days mean for total plate counts were increased significantly ($P<0.01$) with increasing storage period (Table 2). However, the overall treatment means of total plate count count indicated that the counts were higher for control and lower for ginger extract treated smoked buffalo rumen meat product, although the differences between treatments were non- significant. Similar results of increasing total plate count with increasing storage period was also reported by Naveena et al. (2001) for smoked spent hen meat treated with ginger extract. Yeast and mold counts were increased with increasing period of storage. However, increase in yeast and mould counts on day 5 to 15 of storage were non significant. The overall treatment means indicated slightly higher yeast and mould count in control product and lower in ginger extract treated buffalo rumen meat product. However, no significant difference was observed between control and ginger extract treated buffalo rumen meat product. Overall days means for staphylococcal counts were significantly ($P<0.01$) increased with increasing storage period. However, non significant increases in staphylococcal counts were observed on day 5 to 10 and 10 to 15 of storage. Overall treatment means for staphylococcal counts were higher in control product and lower ginger extract treated buffalo rumen meat product and the counts were non significant. The microbial were comparatively lower in ginger extract treated meat products than control as also reported by Naveena et al. (2001) and Kim and Lee (1995). Preservative quality of ginger was attributed to the presence of some active antimicrobial principles contained in ginger. Throughout the storage period, all microbial counts were within the standard stipulated for cooked meat products, even though microbial counts were increased with increasing storage period. No visible slim and off odour appeared

Table 1 Changes in physico – chemical parameters of smoked buffalo rumen meat product during storage at ambient temperature (25±1 °C)

Treatments	Period (days)				Treatment
	0	5	10	15	Means±SE
pH					
Control	6.5±0.01	6.3±0.04	6.2±0.02	6.0±0.01	6.2±0.02[1]
Treated	7.9±0.09	7.2±0.01	7.1±0.04	6.8±0.04	7.2±0.04[2]
Days means±SE	7.2±0.05[a]	6.7±0.02[b]	6.7±0.03[b]	6.4±0.02[c]	
Moisture (%)					
Control	64.3±1.1	64.2±1.1	63.9±1.5	62.2±1.1	63.6±1.2[1]
Treated	63.9±0.67	62.9±0.12	61.6±0.22	59.0±0.24	61.8±0.31[2]
Days means±SE	64.1±0.86[a]	63.5±0.61[a]	62.7±0.77[a]	60.6±0.68[b]	
ERV (ml)					
Control	22.2±0.04	18.1±0.12	15.6±0.28	10.4±0.08	16.6±0.26
Treated	22.7±0.20	19.5±0.09	17.3±0.22	12.0±0.24	17.9±0.18
Days means±SE	22.5±0.12[a]	18.8±0.10[b]	16.4±0.25[b]	11.2±0.52[c]	
TBA (mg malonaldehyde/kg)					
Control	0.41±0.12	0.62±0.18	0.69±0.40	0.72±0.22	0.61±0.46[1]
Treated	0.42±0.21	0.51±0.10	0.55±0.92	0.68±0.42	0.54±0.21[2]
Days means±SE	0.41±0.16[a]	0.56±0.14[b]	0.62±0.66[c]	0.70±0.32[d]	
Tyrosine (mg tyrosine/100 g)					
Control	1.6±0.02	3.5±0.12	6.1±0.42	6.5±0.08	4.4±0.16
Treated	1.6±0.04	2.1±0.16	3.3±0.55	5.4±0.16	3.1±0.28
Days means±SE	1.6±0.03[a]	2.8±0.14[b]	4.7±0.48[c]	6.0±0.12[d]	

Number of observations: 4

Mean with common superscripts in a row (alphabets) and in a column (numerical) did not differ significantly ($P<0.01$)

up to on day 15 of storage in ginger extract treated buffalo rumen meat product and control.

Changes in sensory attributes Appearance & colour scores decreased significantly ($P<0.01$) with increasing storage period (Table 3). No significant difference was observed for appearance upto on day 0 to 5 of storage. However, appearance and colour scores decreased significantly ($P<0.01$) on day 10 of storage. Appearance and colour scores on day 10 and 15 of storage did not differ significantly between them. The possible reason for decrease in appearance and colour during storage might be due to surface drying or lipid oxidation causing non – enzymatic browning. Overall treatment mean showed that ginger extract treated smoked buffalo rumen meat product rated significantly ($P<0.01$) better in appearance and colour as compared to control. Improvements in colour or appearance and juiciness of smoked rumen meat products with ginger extract treatment are in agreement with Syed Ziauddin

Table 2 Changes in microbial quality of smoked buffalo rumen meat product during storage at ambient temperature (25±1 °C)

Treatments	Period (days)				Treatment
	0	5	10	15	Means±SE
Total plate count (log_{10} cfu/g)					
Control	1.6±0.02	3.5±0.12	6.1±0.42	6.5±0.08	4.4±0.16
Treated	1.6±0.04	2.1±0.16	3.3±0.55	5.4±0.16[c]	3.1±0.28
Days means±SE	1.6±0.03[a]	2.8±0.14[b]	4.7±0.48[c]	6.0±0.12[d]	
Yeast and mould count (log_{10} cfu/g)					
Control	1.9+0.02	3.6±0.10	4.0±0.16	4.2±0.12	3.4±0.10
Treated	1.7±0.12	2.4±0.14	2.6±0.16[b]	3.7±0.18	2.6±0.15
Days means±SE	1.8±0.14[a]	3.0±0.12[b]	3.3±0.16[b]	4.0±0.15[b,c]	
Staphylococoal count (log_{10} cfu/g)					
Control	2.1±0.02	3.8±0.12	4.4±0.18	4.6±0.10	3.7±0.11
Treated	1.5±0.08	2.5±0.02	3.2±0.16	3.7±0.18	2.7±0.26
Days means±SE	1.8±0.05[a]	3.1±0.07[b]	3.8±0.17[b]	4.2±0.14[bc]	

Number of observations: 4

Mean with common superscripts in a row (alphabets) and in a column (numerical) did not differ significantly, ($P<0.01$)

Table 3 Changes in sensory quality of smoked buffalo rumen meat product during storage at ambient temperature (25±1 °C)

Treatments	Period (days)				Treatment
	0	5	10	15	Means±SE
Appearance and colour					
Control	5.1±0.01	4.6±0.02	4.4±0.01	4.1±0.02	4.6±0.02[1]
Treated	6.9±0.02	6.2±0.01	5.1±0.02	5.0±0.02	5.8±0.02[2]
Days means±SE	6.0±0.01 [a]	5.4±0.02 [a]	4.7±0.01[b]	4.5±0.02[b]	
Flavour					
Control	5.0±0.01	4.8±0.01	4.5±0.01	4.4±0.02	4.7±0.01[1]
Treated	6.8±0.01	5.7±0.01	4.9±0.02	4.8±0.01	5.5±0.01[2]
Days means±SE	5.9±0.01 [a]	5.2±0.01 [a]	4.7±0.01[b]	4.6±0.01[b]	
Juiciness					
Control	5.0±0.01	4.9±0.02	4.5±0.02	4.1±0.02	4.6±0.02[1]
Treated	6.6±0.02	6.2±0.02	5.2±0.01	4.8±0.01	5.7±0.01[2]
Days means±SE	5.8±0.01 [a]	5.5±0.02 [a]	4.8±0.01 [b]	4.5±0.01[b]	
Tenderness					
Control	4.5±0.01	4.5±0.01	4.4±0.02	4.4±0.02	4.4±0.01[1]
Treated	6.5±0.01	6.4±0.01	5.9±0.02	5.7±0.02	6.1±0.01[2]
Days means±SE	5.5±0.01	5.4±0.01	5.1±0.02	4.8±0.02	
Overall Acceptability					
Control	5.0±0.01	4.7±0.01	4.5±0.01	4.0±0.02	4.5±0.01[1]
Treated	6.4±0.01	5.9±0.01	5.4±0.02	5.1±0.02	5.7±0.01[2]
Days means±SE	5.7±0.01 [a]	5.3±0.01 [a]	4.7±0.01 [b]	4.5±0.02[b]	

Number observations: 20

Means with common superscripts in a row (alphabets) and in a column (numerical) did not differ significantly ($P<0.01$)

et al. (1995) who reported improvement in colour and appearance of ginger extracted treated buffalo meat. Overall treatment mean flavour scores for ginger extracted treated smoked buffalo rumen meat product was significantly ($P<0.01$) higher as compared to control. The flavour scores were decreased with increasing storage period and the scores turnout to be significantly ($P<0.01$) lower only on day 10 of storage. Flavour scores on day 10 and 15 of storage did not differ significantly between them. Flavour reduction during storage might be due to microbial growth and lipid oxidation (Tarladgis et al. 1960). Labell (1987) reported an increase in the flavour of poultry meat treated with 2% ginger powder. He attributed that the increase in flavour of ginger extract treated samples might be due to flavour producing reaction which occurred during cooking. Overall days mean for juiciness scores decreased significantly ($P<0.01$) with increasing storage period, but the decline was non significant utpo on day10 of storage. However juiciness scores were decreased significantly ($P<0.01$) on day 10 of storage and scores did not differ significantly from 15 day of storage. Dehydration of the product with advancement of higher temperature storage could be the reason for lower juiciness scores. The overall treatment mean juiciness scores indicated significantly ($P<0.01$) lower scores for control and higher for ginger extract treated smoked buffalo rumen meat product. Overall days mean for tenderness scores were decreased non significantly with increasing storage period. Overall treatments mean for tenderness scores significantly ($P<0.01$) higher for control product as compared to ginger extract treated smoked buffalo rumen meat product. Overall treatment means for overall acceptability scores were significantly ($P<0.01$) higher for ginger extract treated smoked buffalo rumen meat product and lower for control. Overall acceptability scores were decreased with increasing storage period. However, there was no significant difference in overall acceptability of the products on day 0 to 5 of storage. A significant ($P<0.01$) decrease in overall acceptability scores was observed only on day 10 of storage. Overall acceptability scores on day 10 and 15 of storage did not differ significantly between them. Decrease in overall acceptability scores with increasing storage period might be due to decrease in appearance and colour, flavour, juiciness and tenderness. Similar observation of decrease in overall acceptability with increasing storage period was also reported by Naveena et al. (2001) in smoked spent hen meat.

Conclusion

Ginger extract treated smoked buffalo rumen meat product did show significantly increased in changes in physico – chemical, microbial and sensory characteristics during storage upto

15 days. Throughout the storage period, microbial counts were within the standard stipulated for cooked meat products. Therefore, buffalo rumen can be successfully used for value addition into preparation of smoked product. Ginger extract treated smoked buffalo rumen meat product was better for acceptability upto storage of 15 days at 25±1 °C under aerobic packaging.

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