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Research Article

DEVELOPMENT OF BUFFALO MEAT ROLLS INCORPORATED WITH ALOE VERA GEL AND ARJUN TREE BARK EXTRACT

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ABSTRACT

The objective of the present study was to develop buffalo meat rolls by incorporating extracts from natural medicinal plants viz *Terminalia arjuna* and aloe vera at 2, 4 and 6% level (each) for selecting optimum level of incorporation and their effect on the texture profile of the developed products. Aloe vera gel (at 4% level) in meat rolls resulted in slightly higher scores for juiciness and tenderness than arjun tree bark extract (at 2% level) but no significant difference in both these samples for overall sensory scores were observed and were comparable to controls. On the basis of sensory scores, 4% level of aloe vera gel and 2% level of arjun tree bark extract were found suitable for incorporation and selected for further studies. The hardness, springiness and cohesiveness of the developed products were comparable to control samples. The buffalo male calf meat rolls with good sensory and textural properties can be developed by incorporating 4% aloe vera and 2% arjun tree bark extracts.

Key words: Aloe vera, buffalo male calf, *Terminalia arjuna*, texture profile

India is the world's largest exporter of spent buffalo meat and has 58% of world's buffalo population contributing about 30% of India's meat production (FICCI, 2000) and registered 27% growth in export during the financial year 2012-13 (APEDA, 2015). On the other hand, the country suffers huge loss in terms of high mortality rate (80 to 84.69%) in male buffalo calves due to poor calf rearing practices (Tiwari *et al*., 2007). Buffalo meat is dark, coarse and tough in texture (Naveena *et al*., 2011). Common processing and curing of red meat and meat products pose a health hazard due to high amount to added salt and fat. Health foods, also known as designer foods are described as one tailored to certain specific concentration and proportion of nutrients/compounds that are necessary/helpful for healthy living. This can be achieved either by modifying the composition of food, limiting the concentration of potentially harmful components or by incorporating certain desirable ingredients present in specific foods (Jimenez-Colomenero *et al*., 2001). Incorporation of extracts of medicinal plants into meat products would certainly enhance the acceptability and consumption of meat products.

Aloe vera gel/juice by regulating blood pressure, improving circulation of the blood, lowering cholesterol, and making blood less sticky, may help lower the risk of heart diseases (Lawless and Allen, 2000). Its ingredients are active against bacteria and help to treat fungal and viral infections. It also contains vitamin B_{12} including many other vitamins (Surjushe *et al*., 2008). *Terminalia arjuna* Roxb, commonly known as arjun tree is traditionally used for several medicinal purposes in India. The arjun bark is known to contain a crystalline compound, arjunine, a lactone, arjunetin, essential oil, reducing sugar and other calcium salts and has several health benefits. Hence, the study was undertaken to standardize the incorporation levels of aloe vera gel and arjun tree bark extracts for development of buffalo meat rolls.

MATERIALS AND METHODS

Male buffalo calves (10-12 months old) meat was procured from local market. Carcasses were washed thoroughly with warm water spray and deboned manually after trimming of fat and connective tissue. Deboned meat was frozen for 24 h and then minced in an electrical meat mincer (Mado Primus, MEW 613) and used for preparation of buffalo male calf meat rolls.

Preparation of Arjun Tree Bark Extract (ATBE): Arjun tree bark was collected from the University campus and was shade dried for 7 days followed by drying in a hot air oven at 50^0C for 12 h. The bark was ground to a fine powder in an electric mixer and used to make alcoholic extract as per methods of Sinha *et al.* (2008) with slight modification. 10 g of bark powder was dissolved in 90 ml of 80% ethyl alcohol and kept in

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a flask on the orbital shaker for 3 hrs followed by incubated at 37^{0}C for 72 h. The extract was filtered through Whatman filter paper No. 1 and filtrate was dried in hot air oven drier for 12-14 h till a final pasty consistency with 50±2% yield was obtained.

Preparation of Crude Aloe Vera gel (AVG): Fresh aloe vera (*Aloe barbadensis* Miller) leaves were washed and cleaned with muslin cloth properly. Crude gel was taken out by scrapping with plastic spatula after opening the leaves with the stainless steel knife. The gel was kept under refrigeration.

Preparation of Meat Rolls: Control rolls contained sodium chloride (2.5%), sodium tripolyphosphate (0.5%), sodium nitrite (150 ppm), spice mix (2%), condiments paste (3%) and sunflower oil (3%). Treatments consisted of arjun bark extract and aloe vera gel at 2%, 4% and 6% levels (each) in addition to ingredients used for preparing control rolls, thoroughly mixed in an electric mixer for 4-5 min to prepare emulsion. Emulsion was stuffed in autoclavable beakers manually and steam cooked for 40 min, cooled to room temperature, packaged in polythene bags and stored at refrigerated (4±2^{0}C) temperature for further studies. The products were selected on the basis of sensory evaluation using 8-point descriptive scale (Keeton 1983), where 8=excellent and 1=extremely poor with the help of 6 semi trained sensory panelists.

Texture Profile Analysis: The control and the products were subjected to texture profile analysis (TPA). The TPA was conducted using a Texture Analyzer (TMS-PRO, Food Technology Corporation, USA). Sample size of 1cm ×1cm ×1cm was subjected to pretest speed (30 mm/sec), post test speed (100 mm/sec) and test speed (100 mm/sec) to a double compression cycle with a load cell of 2500 N. A compression platform of 25 mm was used as a probe. TPA was performed as per the procedure outlined by Bourne (1978). Parameters like hardness, springiness, stringiness, cohesiveness, chewiness, gumminess and resilience were calculated automatically by the preloaded Texture Pro software in the equipment from the force-time plot.

The experiment was repeated thrice in duplicate and the results were analyzed using completely randomized design (Snedecor and Cochran, 1989).

RESULTS AND DISCUSSION

Standardization of Buffalo Meat Rolls on the Basis of Sensory Evaluation: Colour scores decreased with an increase in AVG incorporation in meat rolls which was due to reduction in intensity of red colour on addition of aloe vera (Table 1). However, the colour scores of AVG at 4% level were comparable to control. Soltanizadeh and Ghiasi-Esfahani (2015) also developed a good quality low fat meat beef burgers by addition of AVG up to 5% level properties. The sensory scores for colour of meat rolls incorporated with ATBE decreased as the level of ATBE increased. The meat rolls with 2% ATBE were comparable to control for their colour scores and a significant ($p \leq 0.05$) decline as compared to control was recorded at 4 and 6% levels. Sharma *et al*. (2012) also reported good results on incorporating ATBE and suggested its inclusion only up to 5% level. At higher level of ATBE incorporation, the meat rolls were dark in colour and it might be due to the blackish colour of ATBE (Desai and Chanda, 2014).

The lower flavour scores of AVG incorporated meat rolls as compared to control were due to dilution of meaty flavour due to replacement of meat with aloe vera gel. However, up to 4% level, this gel showed the flavour scores well comparable with control and only 6% showed a significantly ($p \leq 0.05$) lower flavour scores. These findings are in accordance with the reports of Andres *et al.* (2006). The meat rolls with 2% ATBE were comparable to control for their flavour scores and a significant ($p \leq 0.05$) decline as compared to control was recorded at 4 and 6% levels. These results are in accordance with the findings of Sharma *et al.* (2012).

The AVG added meat rolls were perceived as juicy by panelists. The scores for juiciness maintained probably due to the gel formation by AVG in the products. Similar findings were also reported by Caceres *et al.* (2004). Though, the sensory scores for juiciness were significantly ($p \leq 0.05$) lower than control at all the incorporation levels of ATBE but the scores were within the acceptable range (>6) at 2% level. Perhaps, the meat rolls with lower moisture level were perceived as less juicy by panelists. Garcia *et al.* (2006) explained that the level of water physically entrapped in the product might influence the perception of juiciness.

The tenderness score of AVG added meat rolls was comparable to control even up to 6% level. The softening of products on incorporation of AVG maintained the tenderness score. Caceres *et al*. (2004) reported a similar trend in tenderness scores on addition of inulin and fructo-oligosaccharides in low fat cooked sausages. The sensory scores for tenderness were significantly ($p \leq 0.05$) lower than control at all the incorporation levels of ATBE but the scores were within the acceptable range (>6) at 2% levels. These results are

Table 1

Standardization of buffalo male calf meat rolls incorporated with aloe vera gel and arjun tree bark extract on the basis of sensory evaluation

Treatments	Sensory parameters					
	Colour	Flavour	Texture	Juiciness	Tenderness	Overall
Control	7.50^{a}±0.51	7.41^{a}±0.51	7.50^{a}±0.45	7.33^{a}±0.49	7.41^{a}±0.49	7.41^{a}±0.51
AVG (2 %)	7.16^{a}±0.54	7.33^{a}±0.40	7.41^{a}±0.54	7.41^{a}±0.00	7.50^{a}±0.55	7.41^{a}±0.41
AVG (4 %)	7.00^{ab}±0.00	7.16^{a}±0.51	7.16^{a}±0.52	7.33^{a}±0.54	7.33^{a}±0.52	7.16^{ab}±0.51
AVG (6 %)	6.50^{bc}±0.40	6.66^{bc}±0.41	6.50^{b}±0.54	6.66^{bc}±0.51	7.00^{ab}±0.75	6.66^{b}±0.40
ATBE (2 %)	7.33^{a}±0.54	7.00^{ab}±0.51	7.00^{a}±0.41	6.83^{b}±0.51	6.83^{b}±0.54	7.00^{ab}±0.51
ATBE (4 %)	6.33^{cd}±0.51	6.00^{c}±0.63	6.16^{b}±0.41	6.16^{c}±0.40	6.00^{c}±0.63	6.16^{c}±0.63
ATBE (6 %)	6.00^{d}±0.40	5.16^{d}±0.41	5.33^{c}±0.98	5.00^{d}±0.63	5.16^{d}±0.75	5.33^{d}±0.54

Means±SD with different superscripts (small letters) column wise differ significantly ($p \leq 0.05$)
AVG=Aloe vera gel; ATBE=Arjuna tree bark extract

in accordance with findings of Garcia *et al.* (2006).

The scores for overall acceptability showed a decreasing trend on increasing level of AVG inclusion. Significantly ($p \leq 0.05$) lower overall acceptability scores were obtained at 6% levels as compared to control, but at 4 % level the scores were comparable with control and hence selected. Kashyap *et al.* (2012) recommended that chicken meat patties could be prepared after incorporation of AVG (3%) with acceptable quality. Overall acceptability scores of ATBE incorporated meat rolls at 2% level were statistically ($p \leq 0.05$) similar to control samples. Significantly ($p \leq 0.05$) lower overall acceptability scores as compared to control were obtained at 4 and 6% levels of ATBE in meat rolls. Hence 2% level of ATBE was selected. So, on the basis of sensory scores, 4% level of AVG and 2% level of ATBE were found suitable for incorporation and selected for further studies.

Texture Profile Analysis: The modification in the texture is one of the important functional properties of plant additives in designer foods. Addition of AVG in meat rolls resulted in lowering hardness value as compared to control due to its higher soluble contents (Table 2). More moisture content in gel further lowered shear press value in gel treated meat rolls. Kashyap *et al.* (2012) reported that the lower hardness of aloe vera added chicken meat patties as compared to control might be due to their lower lean meat content resulting in the weaker protein binding and gelation in denatured protein matrix. Similar reports have also been presented by Caceres *et al*. (2004) and Andres *et al.* (2006) in cooked and chicken sausages added with fructo-oligosaccharides and hydrocolloids, respectively. The higher value of hardness of meat rolls added with 2% ATBE as compared to control could be due lower moisture content in ATBE and incorporation of bark particles in protein matrix might have strengthened the binding during cooking. These findings are in agreement with Viuda-Martos *et al*. (2009) and Choi *et al*. (2010) .

Springiness values are directly related to elastic properties of meat product (Saricoban *et al*., 2009). Rolls prepared with 4% AVG had significantly ($p \leq 0.05$) higher springiness value in comparison to the product prepared with 2% ATBE. This could be due to an increase in emulsion viscosity leading to greater elasticity of products added with aloe vera gel. Highest cohesiveness value was recorded in the control meat rolls. However, the values for cohesiveness of meat rolls prepared with 4% AVG were statistically ($p \leq 0.05$) similar to that of control. The value for cohesiveness was significantly ($p \leq 0.05$) lower in rolls containing 2% ATBE as compared to control and AVG treated meat rolls. A decrease in cohesiveness value due to incorporation of plants parts in meat has also been reported by Lin and Lin (2004) and Saricoban *et al.* (2009) in meat balls and beef patties, respectively. Gumminess value is a derived value that depends upon hardness and cohesiveness of the samples. The gumminess value was significantly ($p \leq 0.05$) lower in rolls containing 4% AVG as compared to ATBE incorporated and control meat rolls. Similar results have also been reported by Yang *et al*. (2007). Highest value of gumminess was recorded in ATBE incorporated meat rolls than that of control sample. These results are in accordance with the reports of Huang *et al*. (2011) in emulsified pork meat balls added

Table 2

Texture profile analysis of developed buffalo male calf meat rolls

Parameters	Control	Aloe vera gel (4 %)	Arjun tree bark extract (2 %)
Hardness (N/cm^2)	6.86^{ab}±0.31	4.26^{a}±0.27	9.06^{b}±0.48
Springiness (cm)	2.83^{ab}±0.01	2.87^{b}±0.02	2.80^{a}±0.03
Cohesiveness (ratio)	0.51^{b}±0.008	0.48^{b}±0.01	0.40^{a}±0.009
Gumminess N/cm^2	8.56^{c}±0.52	7.86^{a}±0.49	9.33^{b}±0.44
Chewiness N/cm	14.71^{b}±0.76	12.39^{a}±0.87	16.09^{c}±0.79

Means±SD with different small letters superscripts row wise differ significantly ($p \leq 0.05$)

with rice bran.

Chewiness is calculated using hardness as a factor, which suggests resistance to compression force. As AVG addition resulted in decreased hardness and softening of product, this led to decrease in value of chewiness. Kerr *et al*. (2005) also suggested that presence of texture modifying extenders may reduce the binding among proteins. A significant ($p \leq 0.05$) increase in chewiness value as compared to control was observed in rolls containing ATBE and the higher hardness value due to lower moisture content of bark treated rolls contributed for it. Our findings are similar to dose reported by Huang *et al*. (2011) and Lee *et al.* (2008).

It is concluded that designer buffalo meat rolls can be prepared with addition of 4% aloe vera gel and 2% arjun tree bark extract, individually without compromising the sensory and textural quality of the product. The developed buffalo male calf meat rolls has commercial significance as designer healthy product for better marketability.

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