



Impact of Paprika (*Capsicum annum*) Addition on Quality of Value-Added Goat Meat Spread

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Abstract

Natural colorants seem to be an acceptable alternative to replace nitrite in improving the color of processed meat products. Value added processed meat products are prepared according to the demands of health-conscious consumers by using natural, organic, preservative free and easily available non meat ingredients in the marketplace. The present study was undertaken to evaluate the instrumental color, physico-chemical properties and sensory qualities of spent goat meat spread incorporated with different levels of paprika powder viz., control, 0.5%, 1.0% and 1.5%. Addition of paprika significantly increased the values of instrumental colour in value added goat meat spread. Instrumental color values of paprika incorporated value-added goat meat spread showed higher red coloration as compared to control. Incorporation of paprika in value added goat meat spread was ranked significantly higher for color and overall acceptability of product. Further, the values of pH, cooking yield and spreadability of paprika incorporated value-added goat meat spread were effect non-significant. Instrumental color, physico-chemical and sensory quality of value-added goat meat spread were enhanced by the addition of paprika.

Keywords: Goat Meat, Instrumental Colour, Paprika, Spread, Sensory Quality

Introduction

Practical use of spent goat meat for value addition in foods may modernize meat industry by standardize appropriate and economic technology for processing such underutilized meat into value-added meat products that are palatable and economically viable (Jin *et al.*, 2007). Spread is a form of food material that is smeared over bread, chapatti like basal foods to add extra taste, flavor, texture and delicacy. Though it is an essential part of the dish, it should be distinguished from the food itself along which it is consumed. The specific consistency, colour and texture of spread has made it into one of the convenient foods. Common worldwide spread available in market include dairy spreads (e.g., cheeses, creams, and butters), plant spreads (e.g., jams, jellies), margarines, yeast spreads (e.g., vegemite and marmite) and meat spreads (e.g., pate, fleisch butter, cretons). Use of meat in spread-like food preparation is not very much familiar in Indian subcontinent, though various meat spread like food products are available in Indian market and are well accepted by the consumers, but they are not nutritionally sound for health point of view due to its low-quality protein content as compared to meat spread (Talukder *et al.*, 2017).

Utilization of nitrites in meat products have positive and negative effects. Nitrate curing salts added to meat products is the formation of a stable red color; a key role is the strong antioxidant function of nitrite in cured meat, retarding the development of rancidity and off-odors and flavors during storage (Sebranek and Bacus, 2007 and Andree *et al.*, 2010). Nitrate curing salt have negative effects are related to health issues such as nitrosamine formation. The stronger association between nitrate with cancer risk for processed meats than for red meat suggests that the underlying mechanism relates to addition of nitrites (Demeyer *et al.*, 2008). Nitrite can react under certain circumstances (low pH and high temperature) with amines to form nitrosamines, a compound associated with certain types of cancer (Honikel, 2008).

Acceptable alternative to replace nitrite to improve or maintain the color of processed meat products by natural colorants, since they have consumer acceptance, antioxidant activity and acceptable sensorial characteristics of color and flavor; in addition, they do not require certification to be employed (Bazan-Lugo, 2008 and Totosaus, 2009). In this respect, previous studies proposed the use of betanin (Bloukas *et al.*, 1999) tomato paste (Deda *et al.*, 2007) or Chinese red broken rice (*Monascus purpureus*) powder (Rojsuntornkitti, *et al.*, 2010), color compensation for nitrite-reduced meat products.

Genus *Capsicum* is widely used for extraction of paprika and consumed as a vegetable, spice, or food colorant. The species *Capsicum annuum L.* is used to manufacture a paprika extract for food coloration. Carotenoids, such as capsanthin and capsorubin, are the main compounds responsible for the red color. Use of paprika or pepper extracts as seasoning with has a long tradition in many countries worldwide, such as Spain, Hungary, and Mexico (Roncales, 2007). The stability of paprika oleoresin strongly depends on light and the type of solvent used for its extraction (Cantrill, 2008). Paprika extracts are also suitable for coloring boiled and cooked sausages; however, such sausages frequently develop undesired orange stripes. Some varieties of *Capsicum annuum L.* also contain capsaicinoids, which add a hot-spicy taste to the product (Roncales, 2007). Because the colorful carotenoids in paprika extracts are also powerful antioxidants, the addition of paprika or pepper powders is also used to enhance the oxidative stability of lipids and proteins in meat patties (Duthie *et al.*, 2013). Now-a-day's consumers are much more health conscious and convenience are coupled to many divergent issues as pricing, availability, choice, safety and health (Desmond and Troy, 1998). Hence, this study was undertaken to processing of value-added goat meat spread added with paprika.

Material and Methods

Spent goat meat required for the experiments were procured from local market at Vepery, Chennai. Meat was deboned after 24 hr. of chilling at $4 \pm 1^\circ\text{C}$. All the visible fat, fascia and connective tissue, were trimmed off and meat was minced twice through a 4.5 mm sieve in a meat mincer. The mincemeat after packaging in colorless low-density polyethylene (LDPE) bag was conditioned for about 24 h at $4 \pm 1^\circ\text{C}$ in a refrigerator and then maintained at $-18 \pm 1^\circ\text{C}$. Before product preparation, the meat was thawed at $4 \pm 1^\circ\text{C}$ for 12 h. The condiment pastes of onion, garlic and ginger in the ratio of 3:2:1 was used. Spice ingredients, procured from the local market were dried at $50 \pm 1^\circ\text{C}$ for 4 hr. in a hot air oven. The ingredients were finely ground, sieved and added in fixed proportions as shown in Table 1.

Table 1: Composition of spice mix for meat spread

Sr. No.	Ingredients	% in the mix
1	Coriander powder (Dhania)	25
2	Cumin seeds (Zeera)	12
3	Dried ginger (Sont)	10
4	Aniseed (Soanf)	10
5	Black pepper (Kali mirch)	10
6	Caraway seed (Ajowan)	5
7	Turmeric (Haldi)	5
8	Capsicum (Mirch powder)	8
9	Cardamom (Badi elaichi)	5
10	Cinnamon (Dal chini)	5
11	Cloves (Laung)	3
12	Nutmeg (Jaiphal)	1
13	Mace (Jaipatri)	1
14	Total	100

Processing of Meat Spread

The present study was carried out in steps to formulate and the incorporation of paprika was standardized as Control, 0.5%, 1.0% and 1.5%. The mix was cooked by applying braising process (Ashish *et al.*, 2015). Developed value added goat meat spread analyzed on the basis of instrumental color, physico-chemical properties and sensory evaluation (Table 2 and Figure 1).

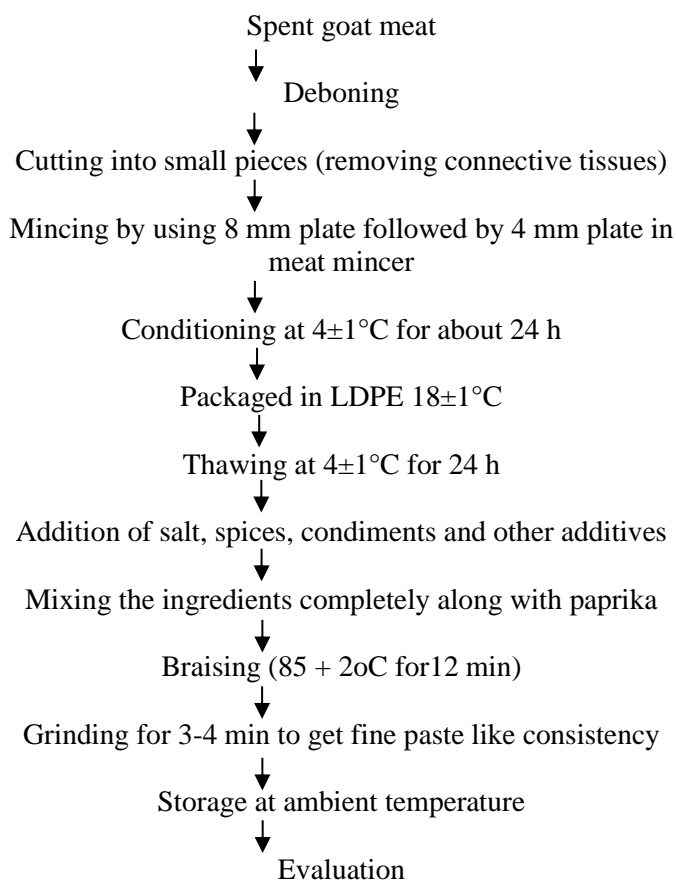
**Figure 1:** Processing protocol for the development of meat spread.

Table 2: Formulation for the processing of value-added goat meat spread

Ingredients %	C	PT1	PT2	PT3
Spent goat meat	48.3	48.3	48.3	48.3
Salt	2.23	2.23	2.23	2.23
Spice mix	1.47	1.47	1.47	1.47
Skimmed milk powder	1.86	1.86	1.86	1.86
Condiments	5.95	5.95	5.95	5.95
Corn starch	2.97	2.97	2.97	2.97
Paprika	0	0.5	1	1.5
Water	37.17	36.67	36.17	35.67
Total	100	100	100	100

C-Control, PT1- 0.5% Paprika, PT2-1.0% Paprika, PT3-1.5% Paprika

Products Analysis

Instrumental Color Analysis

Colour was measured in triplicates for each sample using Hunter lab Mini scan XE plus Spectro- colorimeter having a illuminant of D65/10° (Model No. 45/O-L, Reston Virginia, USA) (Bindu *et al.*, 2007). The absorbance was expressed as L* (brightness), a*(redness) and b* (yellowness). The hue (relative position of colour between redness and yellowness) and chroma (colour intensity) was calculated as follows.

$$\text{Hue} = \tan^{-1} (b^*/a^*)$$

$$\text{Chroma} = \sqrt{(a^*)^2 + (b^*)^2}$$

Determination of Cooking Yield

Product yield was determined by the method outlined by Verma *et al.* (2012). The emulsion weight and the product weight were recorded and the product yield was calculated by using the equation.

$$\text{Cooking yield\%} = \frac{\text{Weight of product after cooking}}{\text{Weight of product before cooking}} \times 100$$

pH

The product pH was estimated by immersing product slurry respectively in a pre-calibrated digital pH meter (Cyberscan pH 510, Merck). The slurry was prepared by homogenizing 5g of sample with 45 ml of distilled water in a laboratory blender for one minute following the procedure of Trout *et al.* (1992).

Spreadability

The spreadability of the gel was determined (Bachhav and Patravale, 2009) using the following technique: 0.5 g gel was placed within a circle of 1 cm diameter premarked on a glass plate over which a second glass plate was placed. A weight of 500 g was allowed to rest on the upper glass plate for 5 min. The increase in the diameter due to spreading of the gels was noted.

Sensory Evaluation

Sensory evaluation of spread was done by using a nine-point descriptive scale (Keeton, 1983) with slight modifications, where 9 = excellent and 1= extremely poor. The sensory panelists consist of Professors and Postgraduate students of the Livestock Products Technology Division (Meat Science) of Madras Veterinary College. Fresh spread was served to the panelists. The panelists evaluated the samples for attributes such as general appearance, flavor, spreadability, texture, after taste, adhesive ability, and overall acceptability.

Statistical Analysis

All the experiments were replicated six times, and the data generated were analyzed by statistical methods one way ANOVA, mean \pm S.D using SPSS software package developed as per the procedure of Snedecor and Cochran, 1995 and means were compared by using Duncan's multiple range test, 1995.

Results and Discussion

Instrumental Color Parameters

Paprika incorporated goat meat spread at different concentrations affect the colour of product significantly ($p < 0.05$). Incorporation of different levels of paprika to compensate colour resulted in darker ($p < 0.05$) meat spread than control. Paprika enriched meat spreads presented significantly ($p < 0.05$) higher values for redness and yellowness than the control (without paprika). The lightness of spread decreased significantly ($p < 0.05$) with increasing incorporation levels of paprika in products. In meat spread the changes in red colour corresponded to a linear increase in redness caused by the presence of more red pigments in paprika. Paprika has a high carotenoid content (Levy *et al.*, 1995; Reeves, 1987). The *ketocarotenoids capsanthin* and *capsorubin* (red xanthophylls), are the main red compounds principally responsible for increased redness value (a^*) in the meat spread containing paprika (Farrel, 1990; Locey and Guzinski, 2000). In contrast to the yellowness color values increases significantly ($p < 0.05$), when increasing the incorporation levels of paprika in meat spread. The increasing in yellowness of meat spread increases the appearance of meat spread. The changes in yellow color values which were evident (Mielnik and Slinde, 1983). *Carotenoids* and *xanthophylls* components might be responsible for increased red and yellow colour in meat products (Mercadante, 2010 and Radzevicius *et al.*, 2008). The chroma or colour strength was non significantly ($p > 0.05$) lower in control spread than in those treated with paprika. Goat meat spread prepared with 1.0% incorporated paprika showed higher value for chroma. Control sample presented higher hue value where compared to different levels of paprika treated goat meat spread (Table 3). Hue angle play an important role in determining the colour stability of meat and meat products (Luciano *et al.*, 2009). Where higher hue angle scores of product indicate lower redness (Little, 1975 and Dzudie *et al.*, 2002) and a less stable red colour (Farouk *et al.*, 1997). The pigments *Capsanthin* and *Capsorubin* contained in paprika are responsible for these colour differences like higher chroma and lower hue in goat meat spread.

Table 3: Mean test for instrumental colour analysis for goat meat spread incorporated with different levels of paprika

Hunter colour analysis	Paprika levels %				Over all mean treatment
	Control	0.5	1	1.5	
Lightness (L^*)	64.57 \pm 0.57 ^a	62.02 \pm 3.20 ^a	52.48 \pm 0.72 ^b	51.35 \pm 0.54 ^b	57.60 \pm 6.20
Redness (a^*)	06.81 \pm 1.62 ^c	11.27 \pm 0.87 ^b	14.73 \pm 0.63 ^a	16.45 \pm 0.11 ^a	12.31 \pm 3.94
Yellowness (b^*)	32.15 \pm 1.13 ^c	35.69 \pm 0.23 ^b	37.68 \pm 0.01 ^a	38.91 \pm 1.02 ^a	36.11 \pm 2.74
Hue	1.00 \pm 0.00	0.99 \pm 0.00	0.99 \pm 0.00	0.90 \pm 0.12	0.97 \pm 0.06
Chroma	32.89 \pm 1.35	37.43 \pm 0.43	40.46 \pm 0.24	35.92 \pm 11.09	36.67 \pm 5.55

Means bearing different superscripts between columns differ highly significantly ($p < 0.05$)

Physico-Chemical Quality

pH

During the study pH of paprika incorporated goat meat spread was also assessed to determine if the incorporation of paprika affected the effectiveness of colour as well as influencing the pH of the meat spread. It was assessed that pH of paprika incorporated goat meat spread were not affected significantly ($p > 0.05$). The use of different levels of paprika slightly reduced the pH of meat spread but this did not have any significant effect on the final products, (Yusop *et al.*, 2012). It might be due to higher levels of acids present in paprika, (Carle and Schweiggert, 2016).

Cooking Yield

Processing variables on the cooking yield of goat meat spread was illustrated in Table 4. Paprika was the variable which had a slight effect on cooking yield of goat meat spread. It was reported that the incorporation of different

levels of paprika did not have significant ($p > 0.05$) effect on yield of meat spread. Yield in meat and meat products is associated with fat and water retention (Aleson-Carbonell *et al.*, 2005). The differences in the cooking yield of the meat spread could be related to water absorption degrees of the non-meat ingredients used (Mendiratta *et al.*, 2013).

Spreadability

The prepared goat meat spread should have good spreadability to meet ideal quality. It is reported that the spreadability of goat meat spread was decreasing non significantly ($p > 0.05$). Incorporation of different paprika levels in goat meat spread reduces the spreadability of products but it was not affecting the actual qualities of products. The spreadability has an important character in uniform application of the products to the bread.

Table 4: Mean test for physico-chemical quality of goat meat spread incorporated with different levels of paprika

Parameters	Paprika levels (%)				Over all mean treatment
	Control ^{NS}	0.5 ^{NS}	1.0 ^{NS}	1.5 ^{NS}	
pH	6.18 ± 0.05	6.13 ± 0.04	6.09 ± 0.07	6.07 ± 0.07	6.11 ± 0.06
Cooking yield (%)	85.85 ± 0.27	86.05 ± 0.28	86.16 ± 0.28	86.30 ± 0.30	86.09 ± 0.29
Spreadability (cm)	3.50 ± 0.10	3.30 ± 0.20	3.30 ± 0.20	3.20 ± 0.10	3.32 ± 0.17

Sensory Quality

Goat meat spread incorporated with paprika were ranked in order of sensory performance (1-9) by the trained panel of judges. 1% paprika treated spread obtained a higher rank differing significantly ($p < 0.05$) for appearance, flavor, after taste and over all acceptability than control. The concentration of paprika resulted on more intense coloration in products. These results seem to be correlated with instrumental colour where the redness (a^*) values were higher than the control. The application of paprika has been associated by consumers with characteristic fresh sausage colour (Martinez *et al.*, 2006) and a certain preference of consumers/judges for chorizo with paprika with high carotenoid pigments has been reported (Gomez *et al.*, 2008). Sensory scores for flavor increased significantly ($p < 0.05$) upto 1.0% of incorporation of paprika and thereafter, the score declined significantly ($p < 0.05$). It may be due to strong spicy flavor of paprika (Carle and Schweizzert, 2008). Sensory score for spreadability, texture and adhesive ability of goat meat spread were reducing slightly and it was noticed non-significant after increasing the levels of paprika concentration from 0.5 -1.5% which does not have any effect on actual quality of goat meat spread. Overall acceptability score were significantly ($p < 0.05$) higher for 1.0% paprika incorporated goat meat spread as compared to control, 0.5% and 1.5%.

Table 5: Mean test for sensory quality of goat meat spread incorporated with different levels of paprika

Sensory quality	Paprika levels				Over all mean treatment
	Control	0.5	1	1.5	
Appearance	4.58 ± 0.99 ^c	6.50 ± 0.79 ^{ab}	7.00 ± 0.95 ^a	5.83 ± 0.83 ^b	5.98 ± 1.26
Flavour	4.42 ± 1.08 ^c	6.08 ± 1.16 ^b	7.25 ± 0.86 ^a	5.33 ± 0.88 ^b	5.77 ± 1.43
Spreadability	6.25 ± 0.75	6.17 ± 0.83	6.00 ± 0.85	5.83 ± 0.83	6.06 ± 0.81
Texture	6.08 ± 0.66	6.00 ± 0.73	6.00 ± 0.73	5.92 ± 0.79	6.00 ± 0.71
After Taste	6.50 ± 0.79 ^{ab}	6.83 ± 0.93 ^a	7.00 ± 0.85 ^a	6.00 ± 0.73 ^b	6.58 ± 0.89
Adhesive Ability	6.08 ± 0.79	5.92 ± 0.66	5.83 ± 0.71	5.67 ± 0.65	5.88 ± 0.70
Overall Acceptability	6.17 ± 0.71 ^{bc}	6.58 ± 0.66 ^{ab}	7.08 ± 0.66 ^a	5.83 ± 0.71 ^c	6.42 ± 0.82

Means bearing different superscripts between columns differ highly significantly ($p < 0.05$)

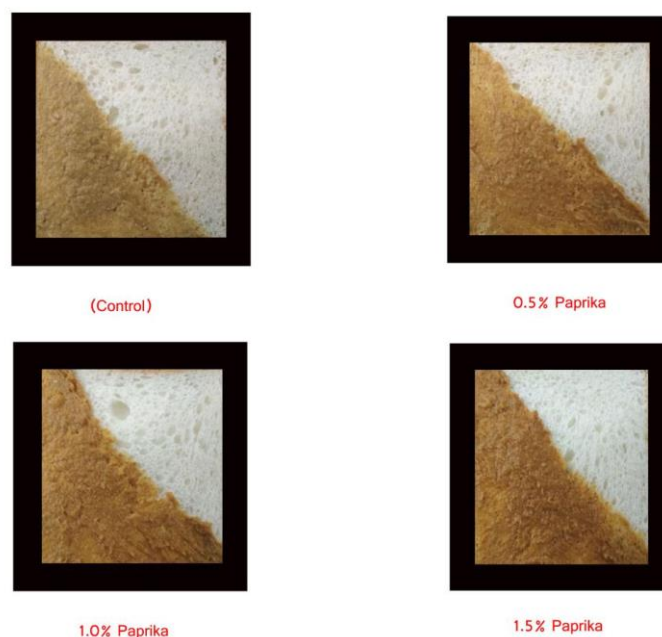


Figure 2: Different levels of paprika

Conclusion

The results of this research indicated that goat meat spread made with added paprika are characterized by having dominant sensory attributes such as colour, flavor and overall acceptability along with colour profile. Hedonic data indicated that consumers preferred goat meat spread incorporated with 1% paprika. The authors recommend that incorporation of 1% paprika could be a better alternative for nitrate and nitrite in value added goat meat spread.

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Conflict of Interests

There is no conflict of interest.

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