VALUE ADDED BUFFALO MEAT SAUSAGE WITH POTATO FLOUR AS BINDER

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ABSTRACT

A study to determine the optimum level of inclusion of three different levels of potato flour (3, 5 and 7 percent) in buffalo meat sausage incorporated with 30 percent low-value meat was carried out. The optimum level of potato flour was determined by assessing the physico-chemical (emulsion pH, product pH, emulsion stability, cooking yield and shear force value) and sensory characteristics. A highly significant ($P<0.01$) increase in emulsion and product pH was observed with increase in level of inclusion. Similarly, 7 percent flour recorded better emulsion stability and cooking yield compared to other levels. Sensory evaluation revealed that sausages prepared with 5 percent potato flour had superior scores ($P < 0.01$) compared to 3 and 7 percent. Sausages with 5 percent level had higher scores for appearance, texture, flavour and overall palatability except for juiciness. Sausages prepared with a 5% level of PF were packed and stored under refrigeration ($4\pm1^{o}C$) for 30 days. The product was subjected to storage stability studies based on evaluation of pH, shear force, TBARS and tyrosine value. The results revealed that during storage there was a highly significant ($P<0.01$) decrease in pH and shear force value, and significant increases in TBARS and TV value. Sausages prepared with 5 percent PF were acceptable up to 21 days of refrigerated storage

Keywords: buffalo sausage, potato flour, emulsion, sensory evaluation

INTRODUCTION

India ranks first in the world buffalo population (96.9 million) and possess about 58 percent of world population (FAO, 2003). In India, the production of buffalo meat is 142 million tonnes (FAO, 2003), and this accounts for 35.7 percent of the total meat production in the country contributing significantly for human nutrition and gross domestic product. Although buffalo meat is rated superior to beef (Keshava Rao and Kowale, 1986), the meat from aged buffalo is not preferred because of its toughness.

Utilization of tough meat like head meat and other offal meat in the production of value added comminuted meat products will promote the meat industry. Buffalo meat has been used for processing of products like sausages (Sachindra *et al.,* 2005), loaves (Suresh *et al.,* 2004) burgers (Modi *et al.,* 2003), patties (Suman and Sharma, 2003) and nuggets (Thomas *et al.,* 2006). These offal meat and low value cuts are low in emulsifying and water

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binding capacities (Whiting, 1989 and Hendrick *et al.,* 1994). Binders, especially those of plant origin, can be used in the product formulations to compensate low functionality of such meat and offals (Bawa *et al.,* 1998). Potato has long been used by meat processors and can be processed into starches and flour which can be used in sausages as a binder or extender to increase water binding and improve cooking yield (Berry, 1997 and Hughes *et al.,* 1998). Hence this study was designed to evaluate the optimum level of inclusion of potato flour as a binder in improving the stability of buffalo meat sausage.

MATERIALS AND METHODS

Fresh buffalo lean meat, head meat, heart, tongue and fat were obtained from the buffaloes slaughtered at the Chennai Corporation slaughter house, Perambur. Meat from the head and cheek was isolated and separable fat was removed. The heart was cut open along its longitudinal axis and clotted blood was removed. The epithelial layer of tongue was scraped off, and then the tongue was cut into small pieces. The lean meat, head meat, tongue, fat, and heart were packed in polyethylene bags separately and frozen at -20°C. Potato flour was prepared by scalding fresh potatoes at 80°C for 10 minutes and then peeling off the skin. Scalded potatoes were cut into small pieces and dried in an oven at 60°C overnight. The dried potatoes were ground into a fine powder using a Cyclotec of 1 mm sieve.

Preparation of Sausage: Sausages were prepared by using 50 percent lean meat, 30 percent low-value meat (LVM- head, heart and tongue), 20 percent fat and with 3, 5 and 7 percent levels of potato flour individually (Table 1). Frozen meat, LVM and fat were tempered at 4°C and were cut into small pieces

Table 1. Formulation for preparation of buffalo meat sausage.

Ingredients	Percentage
Lean Meat	50
Low value meat *(head, heart and tongue meat in the ratio of 70:15:15)*	30
Buffalo fat Vegetable oil (sunflower)	10 10 100
Sodium Tripolyphosphate	0.3
Salt	2.0
Added water (Ice)	10.0
Spice mix	1.5
Green condiments	4.0
Sodium nitrite	0.012
Binder (Potato Flour)	3 or 5 or 7 percent

and minced using 4.5 mm plate in Electrolux mincer (Omas, Model-16789). LVM was minced twice. Additives (sodium tripolyphosphate -0.3 percent, salt-2 percent and sodium nitrite-120 ppm), spice mix-1.5 percent, green condiments, chilled water(Ice)-10 percent were added and chopped along with meat and fat in a meat chopper. At the final step, potato flour was added and chopped for 1.5 minutes. During chopping, care was taken to maintain the emulsion temperature between 10-13^{o}C. From this emulsion, samples were taken for pH and emulsion stability. Sausage emulsion was stuffed in sheep casing of 19 mm diameter, using a manual sausage stuffer and linked manually. Stuffed sausages were kept in a refrigerator (4$\pm$1^{o}C) for 1 h to ensure proper setting. Sausages were then cooked in a water bath at 80^{o}C for 15 minutes until a core temperature of 72$\pm$3^{o}C was reached. Sausages prepared were subjected to physicochemical and sensory evaluation.

Analysis: The pH was measured using a digital pH meter (Cyberscan pH 510, Merck). Emulsion stability was estimated as per the method outlined by Baliga and Madaiah (1971). The cooking yield was calculated as the difference in the weight of the sausage before and after cooking. The shear force values of cooked sausages were assessed using Warner Bratzler Shear Press (Model No. 04347, The G.R. MFG. Co., Manhattan, U.S.A.) and the results were recorded as per method of Rao *et al.* (1999). Thio-barbituric acid reactive substance (TBARS) number and tyrosine value (TV) were determined using method of Tarladgis *et al.* (1960) and Strange *et al.* (1977), respectively. Organoleptic quality was evaluated by a semi-trained panel using a nine-point hedonic scale (where nine was extremely desirable and one was extremely undesirable).

Statistical Analysis: Data were analyzed by the statistical method of one way ANOVA using a SPSS@ software package developed as per the procedure of Snedecor and Cochran (1994) and means were compared by using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The mean values on physicochemical and sensory characteristics of buffalo meat sausages with different levels of inclusion of potato flour are presented in Tables 2 and 3.

The pH of both the emulsion and the product showed a highly significant ($P<0.01$) increase with increase in the levels of potato flour. The pH of the emulsion increased irrespective of the level of inclusion upon cooking; this might be attributed to the fact that in the cooking range of 55-80^{o}C, new cross linkages are formed along with loss of free acidic groups from meat protein (Reddy and Vijayalakshmi, 1998). A highly significant ($P<0.01$) enhancement in emulsion stability was observed in sausages incorporated with 5 and 7 percent levels of potato flour. This might be attributed to high starch content of PF and binding of greater amounts of water favoring stable emulsion formation (Berry and Wergin, 1993). Incorporation of increasing levels of potato flour had a positive effect ($P<0.01$) on cooking yield, which is a reflection of increased emulsion stability (Hachmeister and Herald, 1998). A highly significant ($P<0.01$) increase was observed in shear force with increase in levels of potato flour. Bushway *et al.* (1982) observed an increase in shear value in potato flour + potato starch incorporated frankfurters than frankfurters with potato starch alone. Similarly, Carballo *et al*. (1996) established a direct relationship between starch content and hardness of frankfurters. Addition of starch generally caused an increase in penetration force (Hughes *et*

Table 2. Mean ± S.E. values of physico-chemical characteristics of buffalo meat sausage with different levels of potato flour.

PARAMETERS	LEVELS OF POTATO FLOUR		
	3%	5%	7%
Emulsion pH	5.75±0.01[a]	5.83±0.01[b]	5.88±0.01[c]
Product pH	5.80±0.012[a]	5.88±0.010[b]	5.93±0.010[c]
Emulsion stability (%)	92.79±0.23[a]	94.71±0.17[b]	95.98±0.24[b]
Cooking Yield (%)	91.64±0.17[a]	94.31±0.26[b]	95.58±0.22[c]
Shear Force (Kg/ 19 mm dia)	0.54±0.01[a]	0.63±0.019[b]	0.68±0.01[c]

Means bearing different superscripts (a, b, c) between rows differ significantly (P<0.01 or P<0.05).

Table 3. Mean ± S.E. values of Sensory characteristics of buffalo meat sausage with different levels Potato flour.

PARAMETERS	n	LEVELS OF POTATO FLOUR		
		3%	5%	7%
Appearance	6	7.40±0.17[a]	7.32±0.18[a]	6.84±0.11[b]
Flavour	6	6.69±0.05[a]	7.48±0.07[b]	6.65±0.012[c]
Texture	6	6.8±0.04[a]	7.43±0.05[b]	6.09±0.18[c]
Juiciness	6	6.79±0.07[a]	7.43±0.05[b]	6.24±0.27[c]
Overall acceptability	6	6.69±0.04[a]	7.6±0.07[b]	6.24±0.15[c]

Means bearing different superscripts (a, b, c) between rows differ significantly (P<0.01 or P<0.05).

Table 4. Mean ± S.E for physico-chemical characteristics of buffalo meat sausage with 5 percent potato flour at refrigerated storage (4±1°C).

Parameter	Storage Days					Mean ± S.E
	0	7	14	21	30	
pH	5.88 ± 0.01[a]	5.91 ± 0.01[a]	6.07 ± 0.01[b]	6.01 ± 0.01[b]	5.94 ± 0.008[a]	5.96 ± 0.01 **
Shear Force Value	0.57 ± 0.01[a]	0.67 ± 0.01[b]	0.77 ± 0.006[c]	0.85 ± 0.01[d]	0.99 ± 0.007[e]	0.77 ± 0.01 **
TBARS (mg of malanoldehyde/Kg)	0.35 ± 0.004[a]	0.65 ± 0.008[b]	0.75 ± 0.007[c]	0.85 ± 0.008[d]	0.97 ± 0.005[e]	0.71± 0.01**
Tyrosine Value (mg/100g of sample)	1.89 ± 0.05 [a]	4.35 ± 0.2 [b]	5.04 ± 0.08 [c]	7.2 ± 0.21 [d]	9.44 ± 0.06 [e]	5.58 ± 0.13 [**]

Means bearing same superscripts (a,b,c,d,e) between rows do not differ significantly (P<0.01 or P<0.05).
** Highly Significant (P<0.01).

al., 1998). This may be due to the fact that starch in flour favours formation of strong heat induced structure through swelling of starch granules embedded in a protein matrix (Berry and Wergin, 1993).

A highly significant difference was observed with respect to appearance of sausage, with lower scores for sausage incorporated with the 7 percent level followed by the 5 and 3 percent levels. The 5 percent level recorded better flavor scores compared to the other levels. An enhancement of flavour release during mastication may be due to the slow release of bound water during physical breakdown allowing more effective flavour release (Trout *et al.,* 1992).

A highly significant ($p<0.01$) difference in texture scores was evident between the different treatments of potato flour. Upon sensory evaluation, sausages showing the highest texture score were those with the 5 percent level for potato flour. This result was in accordance with Bushway *et al.* (1982) who found an improvement in texture of frankfurters with inclusion of potato starch. Sausages containing 3 percent level had higher scores for juiciness than other levels; this can be attributed to higher water binding properties of potato starch making moisture unavailable for early juice release during mastication (Berry and Wergin, 1993). The results revealed that, sausages with the 7 percent inclusion level recorded better emulsion stability and cooking yield followed by the 5 and 3 percent levels. The sensory scores revealed sausages with 5 percent level had higher scores than 7 and 3 percent except for juiciness. Hence potato flour at 5 percent level was considered optimum in preparation of buffalo meat sausage with 70 percent lean meat and 30 percent low-value meat.

The mean values on physicochemical characteristics of sausages with optimum level (5 percent) of PF under refrigerated storage ($4\pm1^{o}C$) are presented in Tables 4.

A highly significant ($P<0.01$) increase in pH values was observed from 0 day to 20 days of storage and a slight decrease at 30 days of storage. This is in congruence with Reddy and Rao (1997) who observed increase in pH with increase in storage period in patties. They thought that this increase might be due to the liberation of metabolites resulting from bacterial activity. On the contrary, a significant decrease in pH during refrigerated storage was observed by Choi and Chin (2003) and Devatkal *et al.* (2004). Shear force values showed a highly significant ($P<0.01$) increase during the storage period. Similar findings were observed by Thompson (1984) and Sahoo and Anjaneyulu (1997) who suggested that increase in firmness could have been caused by dehydration of cooked sausages. There was a progressive increase ($P<0.01$) in TBARS number during storage, which is in concurrence with Drerup *et al.* (1981) and Bentley *et al.* (1987) and is a reflection of the advance in oxidative changes in buffalo meat sausage during storage. The tyrosine value showed a linear and highly significant ($P<0.01$) increase with the increase in storage days from an initial value and was in accordance with findings of Bentley *et al.* (1987).

Sausages prepared with 5 percent inclusion of potato flour were acceptable till 21 days of storage at refrigerated temperature and their stability were based on the rancidity and protein degradation.

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