Quality of Restructured Buffalo Meat Fillets extended with Hydrated Barley

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ABSTRACT

The study was aimed at optimizing level of hydrated barley flour in restructured buffalo meat fillets. The hydrated barley flour at three levels viz. 8, 10, and 12 percent was used as extender replacing lean meat in the formulation of control restructured buffalo meat fillets. The extended fillets were evaluated for various physico-chemical and sensory properties and compared with the control. The cooking yield increased with barley flour extension and at 12 percent level, it was significantly higher ($P<0.05$) than control. Moisture percent was significantly higher ($P<0.05$) and fat percent significantly lower ($P<0.05$) at 10 and 12 percent levels when compared with control. Overall acceptability scores for all the treatment products were comparable to control. Various physico-chemical parameters including cooking yield as well as sensory scores indicated that restructured buffalo meat fillets containing hydrated barley flour up to 12 percent level were highly acceptable. The production cost of restructured buffalo meat fillets was reduced by 10.31 percent with barley flour extension. Thus, 12% level of extension of hydrated barley flour in the formulation of restructured buffalo meat fillets was selected to economize the processing technology for the production of restructured buffalo meat fillets.

Key words : *barley flour, fillets, hydrated, production cost, restructured, sensory scores*

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INTRODUCTION

Buffalo meat is the cheapest and abundantly available alternative to beef to feed the world community with healthy protein source. The total buffalo population of India is 112.9 million which constitutes more than 58 per cent of the world's total buffalo population (FAO, 2011). We produce around 1.50 MT of buffalo meat which accounts around 33% of total meat production of the country (FAO, 2011). Despite this, the production of processed buffalo meat is minimal at present as only 2% of the meat is processed in India.

Modern consumers are no longer satisfied with the traditional meat products. Rapid urbanization and change in life style have increased the demand for more nutritious and ready to eat meat products (Deogade et al. 2008). Processed meat products provide taste, convenience and designer foods to the meat consuming population. However, high cost of these products makes it difficult for an average consumer to use these products regularly in their diet. Therefore, development of technology for production of low-cost meat products is need of the hour. Hence, the cost of production has to be brought down in order to make these products more affordable and popular among general public. Restructured meat products have the advantages of convenience in preparation, resemblance in taste with hot processed meats and economy in the production. It enables the use of less valuable meat components to produce high quality meat products at reduced cost. Development of restructured buffalo meat meat fillets (cuts or slices of boneless meat) can be a viable option for utilization of low cost meat cuts. Dietary fibre sources have been used as potential fat substitutes in meat products due to technological reasons and health benefits to humans (Vendrell-Pascuas et al. 2000). The dietary fibre content of barley is around 15.6 percent (Biswas et al. 2011), which is very desirable for improving the functional properties of meat products. So, the study was undertaken to extend the restructured buffalo meat fillets with barley flour and reducing the cost without compromising the sensory acceptability.

MATERIALS AND METHODS

Deboned chunks of buffalo meat of adult female buffalo carcass (>10 yr of age), free from external fat was obtained from the local market of Bareilly within 5-6 hrs after slaughter. All visible fascia and external fat was trimmed off and meat portions were made into cuts of approximately 0.5kg. The cuts were then packaged separately in low density polyethylene (LDPE) pouches (200 gauges) and kept in refrigerator (4±1oC) for conditioning for about 24 hours. Thereafter, the samples were shifted to deep freezer (Blue Star, FS345, Denmark) for storage at -18±2°C until further use (used within 15 days). Condiments

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were prepared by making a fine paste of onion and garlic in the ration of 2:1 in a mixer-grinder. The spice ingredients were purchased from local market, freed from extraneous matter and dried in hot air oven at 50°C for 4 hr. The ingredients were ground and sieved through a fine mesh. The powders were mixed in suitable proportion to obtain spice mixture. The spices mixture was stored in plastic container for subsequent use. The ingredients used for the preparation of curing solution were dissolved, mixed well and then filtered (composition is shown in Table 1).

Preparation of restructured buffalo meat fillets:

Frozen meat was thawed (approx. 12 h at 4±1°C, reaching between -3 and -5°C). The partially thawed meat was carefully trimmed free off adhering visible loose connective tissue and fascia and then sliced across the grain into 1cm thick slices. The sliced buffalo meat was then cut along and across to chunks of nearly 1 cm3. Temperature of the meat chunks was maintained below 2°C by keeping it immediately in a refrigerator at 0°C after chunking, so as to ensure temperature of meat chunks below 10°C throughout the processing. Meat chunks (77% of formulation) in semi-frozen state were placed in paddle mixture (HOBART, Model: N50G) and massaged initially at low speed with simultaneous addition of curing solution (15% of formulation), which facilitated the extraction of muscle proteins from meat and formed a tacky exudate to bind meat pieces. After the initial 8 minutes of mixing at low speed, the refined wheat flour (3%), spices (2%), condiments (3%) and hydrated barley flour (1:1, w/w) were added in order and concurrently mixed/blended for additional 4 minutes at medium speed for uniform mixing.

Four batters (750 g each) were prepared by replacing the lean meat with hydrated barley flour at 0, 8, 10 and 12% level. Once each mixing time was achieved, the meat batter was unloaded from the mixer, weighed and stuffed into stainless steel moulds (17.5cm×11.5cm×4.5cm). Moulds were squeezed with wooden press to remove air pockets, closed tightly and placed in pressure cooker filled with 1/3 boiling hot water and then cooked for 40 minutes by steam without pressure. Slow heating rate was ensured by adjusting the flame regulating knob (Code: 637470, Regalia, Sun flame) to low, so that the required internal temperature of 85°C of the product was achieved. The cooked meat block was cooled to room temperature, sliced into fillets, packaged into low density polyethylene (LDPE) bags (200 gauges) and analysed for different parameters including sensory evaluation. The formulation of prestandardized control restructured buffalo meat fillets is shown in Table 1.

Analytical procedures:

The pH of the cooked steak was determined by blending 10 g sample with 50 ml distilled water using pestle and mortar. The pH of the homogenate was recorded by immersing combined glass electrodes of digital pH meter (Elico India L1 127). Moisture, protein, fat and ash contents of restructured buffalo meat fillets were determined using AOAC (1995) methods. Shear force value was determined as per the method described by Berry and Stiffler (1981). It is measured as force required for shearing 1 cm square block on Warner-Bratzler Shear Press (81031307 GR Elec. MFG. Co. USA) and expressed in kg/cm2.

Sensory evaluation:

Experienced panellists consisting of scientists and post graduate students of the division of Livestock Products Technology were involved in conducting the sensory evaluation of the product. The organoleptic attributes namely general appearance, flavour, binding, texture, saltiness, juiciness and overall acceptability were evaluated using an 8 point descriptive scale, where 8=extremely desirable and 1 = extremely undesirable for any attribute (Keeton, 1983).

Statistical analysis:

The data generated from various trials under each experiment were pooled, processed and analyzed by statistical method of one way-ANOVA and Mean±S.E. using SPSS software package developed as per the procedure of Snedecor and Cochran (1995) and means were compared by using Dunkan's multiple range test (Dunkan, 1955).

RESULTS AND DISCUSSION

Physico-chemical properties of restructured buffalo meat fillets:

The results obtained for different physico-chemical parameters are shown in Table 2. There was improvement in the cooking yield with progressive increase in the level of barley flour and at 12 percent level, cooking yield was significantly higher ($P<0.05$) than control. This could due to great ability of barley flour to absorb water (Keeton, 1994). Titov et al. (1994) also observed significant ($P<0.05$) increase in cooking yield of poultry sausages with hydrated (1:3) barley flour. Marginal increase in pH with increased extension could be attributed to neutral nature of barley flour and was in agreement with findings of Kumar and Sharma (2006) who also found an increase in pH of chicken patties extended with hydrated barley flour. The moisture percentage increased with increasing barley flour level and was significantly higher ($P<0.05$) at 10 and 12 percent levels than control and 8 percent level. It might be due to higher moisture retention and water

binding by barley flour starch. Shand (2000) also reported better water holding capacity in bologna sausages incorporated with 4 percent hull-less barley. Protein percentage at all three levels of barley flour extension were significantly lower ($P<0.05$) than control. Fat percentage at 10 and 12% extension were significantly lower ($P<0.05$) than control, but at 8% level it was comparable to all the treatments. Declining trend in protein and fat percentage was expected due to replacement of lean meat with barley flour which incorporated carbohydrates in the product at the expense of protein and fat. Moisture to protein ratios of product with 10 and 12% levels were significantly higher ($P<0.05$) than control and 8 percent level. The increasing trend with increase in level of extender depended on moisture and protein percentages of the respective products. Shear force values recorded gradual decrease with increase in level of extender and at all three levels, it was significantly lower ($P<0.05$) than control, which might be due to softening effect caused by increased moisture content. Manish and Sharma (2004) also observed similar trend for different physico-chemical parameters in low-fat pork patties extended with barley flour.

Sensory attributes of restructured buffalo meat fillets:

The scores obtained for various sensory attributes are shown in Table 3. Mean sensory scores for general appearance showed a declining trend with increase in the level of extender. A gradual decrease in appearance scores might be attributed to decrease in intensity of meat colour with increase in the level of extension. Decrease in general appearance score with the increased levels of barley flour was also reported by Khate (2007) in low salt, low fat designer pork sausages. Flavor scores also decreased marginally with increasing level of extension but were comparable with control at all levels. Declining trend in flavour scores might be due to dilution of meaty flavour with increasing amount of barley flour, which had a bland taste. Flavour and texture scores followed a declining trend with increase in barley flour in the formulation in low-fat pork patties (Manish and Sharma, 2004). Lower binding scores with increasing barley flour extension might be due to higher retention of moisture. Mean texture score for control was 7.29, significantly higher ($P<0.05$) than those for 10 percent and 12 percent treatments having values of 7.01 and 6.98, respectively. Juiciness scores did not differ significantly among all the levels. The juiciness scores at 8 and 10 percent levels were significantly lower ($P<0.05$) than control but no significant difference was observed between12 percent level and control. The marginal increase in juiciness score at higher levels of barley flour extension might be due to extra mastication associated with profuse salivation. Similar trend for sensory attributes was observed by Manish and Sharma (2004) and Malav et al. (2012) for low-fat pork patties extended with barley flour and restructured chicken meat blocks extended with hydrated water chestnut flour, respectively. Overall acceptability scores for all the treatments were comparable to control and no deteriorating effect on quality attributes was observed in restructured buffalo meat fillets extended with hydrated barley flour even at 12 percent level.

Production cost of restructured buffalo meat fillets:

Economics is a very important criterion along with nutritive value and sensory acceptability to determine the marketability of any product. Therefore, production cost of restructured buffalo meat fillets extended with 12 percent hydrated barley flour (1:1, w/w) was determined and compared with control (Table 4). The major determinant of product cost is raw materials, which mainly determine the profit earned by producer. Raw materials used in the processing of restructured buffalo meat fillets are lean meat, condiments, spices, curing solution, refined wheat flour (maida) and barley flour. The cost of raw materials along with other expenditures like the depreciation cost of machineries (@ 10 percent per annum), packaging cost, labour cost, cost of electricity, cost of water, rent and maintenance have been mentioned in Table 4. The production cost of restructured buffalo meat fillets incorporated with barley flour reduced by more than Rs. 14 per kg (10.31 percent) when compared with control. Thus, extension with barley flour appreciably reduced the cost of the final product and hence added value to the product from producer point of view.

RESULTS AND DISCUSSION

The study showed that restructured buffalo meat fillets can be extended with hydrated barley flour and at 12% level of extension, the product was highly acceptable to sensory panelists. Various physico-chemical parameters, sensory evaluation and production cost also confirmed the viability of the product. Dietary fibre content of restructured buffalo meat fillet is expected to increase owing to the high fibre content of barley, which is important for improving the functionality of product. Hence, it can be concluded that the product can be commercially exploited without compromising with various quality attributes when extended with hydrated barley.

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Table 1: Formulation of curing solution and prestandardised control restructured buffalo meat fillet

Formulation of curing solution	
Ingredients	***Quantity***
Sodium chloride	120 g
Cane sugar	60.0 g
Sodium tripolyphosphate	25.0 g
Monosodium glutamate (MSG)	0.50 g
Sodium nitrite	0.75 g
Water	1000.0 ml
Formulation of prestandardised control restructured buffalo meat fillet	
Ingredients	***Quantity***
eat(g)	77.0
Curing solution(ml)	15.0
Maida(g)	3.0
Spices (g)	2.0
Condiments (g)	3.0

Table 2: Effect of different levels of hydrated barley flour (1:1, w/w) on the physico- chemical properties of restructured buffalo meat fillets (Mean ±SE)*

Physico-chemical properties**	Control (0%)	Treatment (hydrated barley flour, 1:1 w/w)		
		8%	10%	12%
Cooking yield (%)	91.58b±0.63	92.71ab±0.34	93.17ab±0.60	94.33a±0.54
pH	6.19±0.02	6.21±0.02	6.22±0.03	6.24±0.02
Moisture (%)	70.63b±0.33	70.99b±0.35	72.21a±0.42	72.23a±0.39
Protein (%)	19.99a±0.26	18.03b±0.33	16.54c±0.28	16.27c±0.15
Moisture: Protein	3.54c ±0.05	3.94b ±0.08	4.37a ±0.07	4.44a ±0.05
Fat (%)	2.38a±0.09	2.15ab±0.10	2.07b±0.07	1.98b±0.10
Ash (%)	2.95±0.12	2.99±0.09	3.02±0.13	2.95±0.05
Shear force value (kg/cm2) #	0.80a±0.04	0.69b±0.03	0.65b±0.03	0.60b±0.04

*Mean±SE bearing different superscripts in a row differ significantly (P<0.05)
**n=6 and #n=30 for each treatment

Table 3: Effect of different levels of hydrated barley flour (1:1, w/w) on sensory attributes of restructured buffalo meat fillets (Mean±SE)*

Sensory attributes	Treatment (hydrated barley flour, 1:1 w/w)			
	Control (0%)	8%	10%	12%
General appearance	7.29±0.07	7.20±0.06	7.14±0.06	7.06±0.09
Flavour	7.19±0.06	7.14±0.06	7.06±0.05	7.04±0.07
Binding	7.21±0.06	7.14±0.06	7.06±0.07	7.00±0.09
Texture	7.29a±0.09	7.12ab±0.08	7.01b±0.08	6.98b±0.10
Saltiness	7.19±0.06	7.17±0.06	7.02±0.03	7.04±0.09
Juiciness	7.20a±0.06	7.00b±0.09	7.04b±0.09	7.09ab±0.07
Overall Acceptability	7.25±0.07	7.07±0.09	7.04±0.07	7.02±0.08

*Mean values are scores on 8-point descriptive scale where 1: extremely undesirable and 8: extremely desirable.
Mean±SE bearing different superscripts in a row differ significantly (P<0.05)
n=21 for each treatment

Table 4: Cost of production of restructured buffalo meat fillets (RBMF)

S. No.	Particulars	Cost (Rs.) of 100 kg formulation of RBMF/day			
		Control		12 % Barley Flour	
		Quantity (Kg)	Cost (Rs)	Quantity (Kg)	Cost (Rs)
I	**Raw material cost**				
	1 Deboned lean buffalo meat	77	10780	65	9100
	2 Hydrated barley flour (1:1, w/w)	-	-	12	252
	3 Curing solution	15	150	15	150
	4 Refined wheat flour (maida)	3	36	3	36
	5 Spice mix	2	400	2	400
	6 Condiments	3	120	3	120
II	**Cost of machineries**				
	(depreciation cost)	-	168	-	168
III	Packaging cost	-	180	-	180
IV	Labour cost	-	950	-	950
V	Cost of electricity	-	394	-	394
VI	Cost of water	-	22	-	22
VII	Rent	-	400	-	400
VIII	Maintenance	-	250	-	250
	Total expenditure (Rs.)	**100**	**13850**	**100**	**12422**
	Cost (Rs) per Kg		**138.50**		**124.22**

*Mean values are scores on 8-point descriptive scale where 1: extremely undesirable and 8: extremely desirable.
Mean±SE bearing different superscripts in a row differ significantly (P<0.05)
n=21 for each treatment