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Studies on the Development of Processed Products from Buffalo Veal

FATIMA AL-HASSAWI, MANJIT S. GOSAL[1], POONAM AGGARWAL[1] AND JIWAN S. SIDHU*

Department of Food Science and Nutrition, College of Life Sciences, Kuwait University, P. O. Box 5969, Safat-13060, Kuwait
**(e-mail : jiwan.sidhu2001@yahoo.com; jiwan.sidhu@ku.edu.kw; Mobile : +1 240 441 7542; WhatsApp number: +1 240 242 7715)*

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ABSTRACT

A few processed products (sausages, meat balls and patties) have been prepared from the young buffalo meat. The fresh meat from young buffalo calf (veal) had a moisture, protein, fat and ash contents ranging from 72 to 75, 18 to 19, 3.1 to 4.6 and 1.1 to 1.12%, respectively. The higher amount of moisture was lost when sausages were cooked in oil (40.92%) than in water (63.86%). The highest cooking loss (34.75%) was observed in sausages fried in oil than in all other cooked products. The sausages, meat balls and patties had excellent sensory quality and consumer acceptability. The sausages fried in oil were the most preferred meat item with the consumers and were highly appreciated for their excellent flavour and overall quality. The results of this study suggested a strong possibility of producing acceptable processed veal products for improving the economic returns for the farmers from the neglected male buffalo calves.

Key words : Buffalo veal, meat balls, meat patties, sausages, sensory quality, proximate composition

INTRODUCTION

During the present day civilization, the consumption of meat products is directly related to the standard of living of a society, but recently the nutritionists and health professionals have questioned this belief and have suggested consuming more of foods of plant origin. Deriving fewer proteins from animal sources has been reported to achieve higher values for healthy eating index scores (Masako *et al.,* 2021). They have reported that taking reasonable amounts of plant proteins with enough of animal proteins reduced the C-Reactive proteins in diabetic patients. Compared with western countries, the consumption of meat is extremely low in India. Consumption of adequate amounts of animal proteins is also necessary to reduce the incidences of various non-communicable diseases among humans. But the higher intake of high-quality proteins in children has been reported to result in the increased incidences of obesity and other non-communicable diseases (NCDs) later in life. Interestingly, the consumption of buffalo meat has been suggested as a suitable alternative to red meat from beef cattle, even for persons having cerebrovascular and cardiovascular diseases (Tamburrano *et al.,* 2019). They have reviewed the nutritional benefits of consuming buffalo meat as it is rich in proteins, excellent quality unsaturated fat, but low in cholesterol, rich in essential amino acids like lysine, many vitamins and minerals. However, consumption of low quality proteins from cereals in the developing countries has been reported to lead to under nutrition and the increased risk of many NCDs (Benziger *et al.*, 2016; Miller *et al.*, 2020). Food technologists have even attempted to substitute meat with some plant proteins-derived alternatives to offer these food products with acceptable taste and texture profile (Cordelle *et al.,* 2022).

Nisar *et al.* (2010) studied the effect of cooking methods on the chemical composition, microbial and sensory quality of buffalo meat patties among the local consumers. The buffalo meat proteins possess exceptionally good functional properties, thus can be processed into various comminuted meat products, such as burgers, patties, kababs and sausages. The fat in buffalo is located under the skin as subcutaneous fat, with a very little

[1]Department of Food Science & Technology, Punjab Agricultural University, Ludhiana-141 004 (Punjab), India.

intramuscular marbling and was affected by the type of corn silage fed to the buffaloes (Masucci *et al.*, 2016). Compared with bovine beef, the total fat in buffalo meat cuts is reported to be 1.36 to 2.40% and is also low in cholesterol content of 48.8 to 53.7 mg/100 g, having higher MUFA (37.3%) and PUFA contents (24.3%). Interestingly, consumption of buffalo meat has been reported to be beneficial to reduce the cardiovascular risks (Giuffrida-Mendoza *et al.*, 2015). They have reported buffalo meat to show lower values for atherogenic index because of lower cholesterol content, thus offering desirable health benefits. Buffalo meat, like any other meat products, is susceptible to quality deterioration, mainly due to lipid peroxidation. Although, food industry has been using a number of synthetic antioxidants, such as, butylated hydroxy toluene (BHT), butylated hydroxyanisole (BHA) and many others, but the consumers now-a-days are looking for natural antioxidants coming from plant sources. Pomegranate peel extract (PPE) is known to be rich in many bioactive compounds having strong antioxidant properties (Kharchoufi *et al.*, 2018). PPE not only has ant oxidative but also antibacterial properties, and has been reported to be useful in extending the shelf life of ground buffalo meat up to 20 days under refrigerated conditions (Ghemire *et al.*, 2022).

In the State of Punjab, the female buffaloes are used for milk production, but the male buffalo calves are not valued very much, therefore, are usually left uncared. Moreover, traditionally buffalo meat is not as popular as meat from other animals or poultry birds. If these male calves are exploited for their potential for the production of excellent quality veal products, it can tremendously add to the income of farmers and the economy of the country. Extensive information on the preparation of beef products is available in the literature, but the information on the processing of buffalo veal is extremely scanty. Keeping this in view, this investigation was initiated to develop standardized recipes for a few processed food products from buffalo veal (meat from 3-4 months old males), including their sensory quality.

MATERIALS AND METHODS

Young male buffalo calves of 3-4 months of age, after giving proper rest and ante mortem examination were slaughtered in the abattoir of Animal Sciences Department of the Punjab Agricultural University, Ludhiana, India. Similarly, the slaughter was carried out on three different days to collect more samples of veal for processing. After the post mortem examination, the carcass was deboned manually and the meat was collected from the fore- and hind quarters only, which was frozen at -18°C till further use. Every time a required portion of this frozen veal was taken out for thawing at 4-5°C for 10-12 h for later on processing into various products in the laboratory. All the other ingredients required for processed veal products were procured from the local market.

Veal sausages : The thigh portion veal was cut into smaller pieces manually and then coarsely minced using locally made electric meat grinder (Gardener Make, Delhi, India), first using a 6 mm plate. It was then passed through 3 mm plate, and was used for the preparation of meat balls and meat patties. However, for making sausages, the coarsely minced veal along with other ingredients, was further chopped into a fine emulsion using a silent cutter (Japanese make). The emulsion was then stuffed into a 1½ cm diameter sheep intestine casing with the help of a manually operated sausage filling machine (Gardener make, Delhi). The stuffed sausages were manually turned into 3 to 4 inch long links. The prepared sausages were stored in a refrigerator at about 2-4°C till required for further chemical analysis and sensory evaluation. The recipes for sausages, meat balls and meat patties were standardized after a number of preliminary trials to arrive at the standardized formulations (Table 1).

Veal balls : The coarsely minced meat was mixed with the ingredients listed in Table 1 to obtain a homogenous mass. The veal was then manually shaped into balls of about 50 g, placed on pre-oiled stainless steel tray and broiled in an electric oven (Toshniwal make, Delhi) at 130°C for 1¼ h and used for further chemical analysis, cooking losses and sensory evaluation.

Veal patties : The coarsely minced meat was mixed thoroughly with the above ingredients listed in Table 1 to obtain a homogeneous

Table 1. Standardized recipes for processed buffalo veal products

Type of ingredients	Processed veal products (Amount of additives in g)		
	Veal sausage	Veal balls	Veal patties
Minced veal	1000	1000	1000
Table salt	10	10	10
Hydrogenated vegetable oil	100	-	-
Sodium nitrate	0.3	-	-
Sodium nitrite	0.1	-	-
Spice mix	20	-	-
Wheat flour	30	50	50
Wheat semolina	20	-	-
Finely minced garlic	-	5	-
Chopped onion	-	120	125
Tomato paste	-	50	75
Chopped green chilli	-	-	15

mass. It was then manually shaped into patties of about 100 g, in a 80 mm mold, with a height of 16 mm, placed on a pre-oiled stainless steel tray, then broiled in an electric oven (Toshniwal make, Delhi) 130°C for 75 min, and then used for further chemical analysis, cooking losses and sensory evaluation.

Proximate analysis : The fresh minced meat as well as raw and cooked meat balls, patties and sausages were analyzed for moisture, crude fat, ash and crude protein contents by standard AOAC methods as reported by Alkandari *et al.* (2021). All determinations were carried out in quadruplicates. All the reagents used in this study were of analytical grade (AR). The crude protein, crude fat and ash contents were calculated.

Cooking loss determination : Four patties or meat balls were weighed before and after cooking these in the hot air oven (Toshniwal make, Delhi) at 130°C for 75 min. The loss in weight during the cooking procedure was calculated as described below :

Cooking loss = 100 [(Initial weight – Weight after cooking) / (Initial weight)]

The sausages were fried in cooking oil maintained at 115±5°C to obtain a light brown colour and desirable doneness. Alternately, these sausages were also cooked in boiling water for 15 min. In both these methods, the cooking losses were calculated as :

Cooking loss = 100 [(Initial weight – Weight after frying/boiling) / (Initial weight)

These cooking studies were repeated four times and the average cooking losses were calculated.

Sensory analysis : The samples of meat balls and meat patties which were cooked in an oven at 130°C for 75 min as well as sausage cooked in boiling water for 15 min or fried in cooking oil for 7 min, were served to 10 semi-trained panelists for sensory analysis for appearance, flavour, juiciness, tenderness and overall acceptability on a 9-point hedonic scale, with 9 for liked extremely to 1 for disliked extremely (Aldughpassi *et al.*, 2021). Room temperature tap water was provided to rinse their palate in between the samples. The average score of these panelists was calculated.

The data were statistically analyzed using standard method of statistical analysis to know the level of significance (Aldughpassi *et al.*, 2021), using one-way analysis of variance and the Duncan's multiple range test was employed to examine the statistical significance among the mean values of quadruplicate samples at P = 0.05. These statistical techniques were particularly used for comparing the quality characteristics of the finished products.

RESULTS AND DISCUSSION

The young buffalo calves of about three months of age were slaughtered and boneless meat was obtained from the fore and hind legs. This veal was used for the preparation of processed meat products like fresh sausage, meat balls and patties. The fresh veal and the optimized formulations of these products were analyzed for proximate composition, microbiological as well as sensory quality. The optimized recipe for fresh sausages was evaluated for sensory quality and consumer acceptance. Prepared sausages were boiled in water for 25 min and were also fried in oil for about 7 min before they were taken for chemical and sensory analysis (Table 2). The fresh buffalo veal had moisture content of 74%, but on dry basis, the protein, fat and ash contents were 76.39, 12.35 and 4.32%, respectively. The freshly prepared sausages had moisture, protein, fat and ash contents of 72.52, 66.26, 25.46 and 6.06%, respectively.

The sausages upon cooking lost a significant amount of moisture during the frying in oil but the loss was much less when sausages were

Table 2. Chemical analysis of buffalo meat sausages

S. No.	Sample	Moisture (%)	Protein (%)*	Fat (%)*	Ash (%)*
1.	Raw buffalo veal	74.79	76.39	12.35	4.32
2.	Sausage (fresh)	72.52	66.26	25.45	6.06
3.	Sausage (cooked in water)	63.86	63.39	25.53	3.48
4.	Sausage (fried in oil)	49.92	62.91	30.03	6.02
C. D. (P=0.05)		2.38	3.03	0.43	0.29

*On dry basis.

cooked in water. The moisture content of sausages cooked in oil was significantly lower (49.92%) than the sausages cooked in water (63.86%). Nisar *et al.* (2010) also reported a lower loss of weight for buffalo meat sausages when pressure cooked in water than the sausages cooked in microwave oven. However, they observed slightly lower moisture content of 59.36% in these sausages. Non-significant difference in the loss of protein content of sausages between cooking in water and frying in oil was observed. The sausages cooked in oil rather picked up a significant amount of fat during the frying operation. A significant decrease in ash content was observed in the sausages cooked in water. This probably happened due to the leaching of salts into the cooking water. The degradation of collagen during pressure cooking of bovine meat was much higher than the boiling water cooking, thus leading to softer texture, better sensory quality and lower cooking loss (Latorre and Velazquez, 2021).

The fresh buffalo veal was minced coarsely through electrically operated meat mincer. Preliminary studies were carried out by varying the spices, condiments, broiling time and temperature for the preparation of meat balls before arriving at a standardized recipe. The cooked meat balls were analyzed for chemical analysis and sensory quality for the standardization purpose. Then the raw meat, uncooked and cooked meat balls were analyzed for moisture, protein, fat and ash contents (Table 3). There was a significant reduction (16.6%) in the moisture content of meat balls after broiling in oven at 130°C for 75 min. No significant difference in protein content was observed during broiling of meat balls. Cooked meat balls had slightly higher protein content (68.36%) as compared to raw meat (67.39%). The slight increase in protein contents could be due to the extensive loss of moisture during boiling of meat balls. However, upon cooking, the meat balls had higher protein content (68.36%) than the uncooked meat balls (59.69%).

After boiling at 130°C for 75 min, there was a significant reduction in the original fat content (15.86%) of uncooked meat balls, to the cooked meat balls (15.25%) because a good amount of fat oozed out of the meat balls into container during cooking. The ash content also differed significantly between uncooked (7.86%) and cooked (7.18%) meat balls. A good amount of mineral matter might have leached out during cooking, resulting in lower ash content of cooked meat balls. The higher ash content of meat ball as compared with raw meat (3.63%) is mainly because of addition of common salt in the recipe during their preparation. The moisture, protein, fat and ash contents of cooked meat balls had finally reached to 52.58, 68.36, 15.25 and 7.18%, respectively. Purslow (2018) reviewed the role of intramuscular connective tissues (IMCT) affecting the texture of meat tissues. Accordingly, the IMCT were reported to be the most important contributors

Table 3. Chemical analysis of buffalo meat balls

S. No.	Sample	Moisture (%)	Protein (%)*	Fat (%)*	Ash (%)*
1.	Raw meat	74.68	67.39	18.53	3.63
2.	Meat ball (uncooked)	69.16	59.69	15.86	7.86
3.	Meat ball (cooked)	52.55	68.36	15.25	7.18
C. D. (P=0.05)		9.28	0.03	1.05	0.34

*On dry basis.

to cooked meat toughness, and the collagen degradation was affected mainly by the cooking method employed, which led to varying cooking losses.

After coarsely grinding the fresh meat in a meat grinder, meat patties were prepared using the standardized recipe. For the standardization of recipe for the preparation of patties, variations were carried out in spicing, condiments and boiling time and temperature combinations. These cooked patties were evaluated for sensory quality before arriving at the standardized recipe, as listed in Table 1. The fresh meat, uncooked and cooked patties were analyzed for chemical composition (Table 4). The raw meat, uncooked and cooked patties had 74.69, 70.51 and 51.28% moisture; 17.06, 68.22 and 33.12% protein; 4.69, 4.83 and 6.69% fat; 0.92, 2.33 and 4.17% ash, respectively. No significant difference was observed in protein content of raw meat (67.39%) and cooked patties (68.04%). However, there was a significant difference in protein content between uncooked and cooked patties. A significant loss of fat was also observed in raw meat patties (16.31%) after cooking (13.72%). Obviously, good amount of fat oozed out of the meat patties during boiling at 230°C for 75 min. The ash content increased significantly in case of uncooked patties (7.90%) and cooked patties (8.41%) in comparison with that of fresh buffalo meat (3.62%). Higher ash content was mainly due to the added salt into the recipe. However, no significant difference in ash content of raw patties and cooked patties was observed.

The prepared sausages which were cooked in boiling water (100°C) for 15 min and also fried in oil at 115±5°C for 7 min as well as the meat balls and patties after broiling at 130°C for 75 min were studied for cooking losses (Table 5). The sausages fried in oil had significantly higher cooking loss than those of cooked in water. The cooking losses for sausages cooked in water and oil were 25.53 and 34.75%, respectively. The meat balls and patties showed a cooking loss of 27.43 and 29.51%, respectively. The highest cooking loss was observed in the case of sausage fried in oil. Loss of these nutrients generally depended upon the methods of cutting the meat as well as the cooking methods employed. Ismail *et al.* (2021) reported that cutting and chopping machine significantly affected the cooking loss in buffalo meat patties. However, the colour and textural characteristics of cooked buffalo meat patties did not differ significantly between the bowl cutter and universal mixer. Hossain *et al.* (2017) developed a Tetraplex PCR method using a portion of DNA regions to determine the presence of buffalo meat in beef burger products and found that even 1% of buffalo meat mixed in the burgers was enough to get reliable results. They found the cooking methods, such as, autoclaving, boiling and microwave cooking had no effect on the stability of DNA.

A significant difference in the cooking loss was observed between meat balls and patties, when cooked using the same temperature and time combinations. The higher cooking loss of meat patties can be explained because of the larger surface area exposed in comparison with meat

Table 4. Chemical analysis of buffalo meat patties

S. No.	Sample	Moisture (%)	Protein (%)*	Fat (%)*	Ash (%)*
1.	Raw meat	74.69	67.39	18.29	3.62
2.	Meat patties (uncooked)	70.51	61.77	16.31	7.90
3.	Meat patties (cooked)	51.28	68.04	13.72	8.41
C. D. (P=0.05)		0.285	2.938	0.512	0.226

*On dry basis.

Table 5. Cooking loss of sausages, meat balls and meat patties

S. No.	Sample	Cooking temp. (°C)	Cooking time (min.)	Cooking loss (%)
1.	Sausage (cooked in water)	100	25	25.54
2.	Sausage (fried in oil)	115±5	7	34.75
3.	Meat ball	130	75	27.43
4.	Meat patties	130	75	29.51
C. D. (P=0.05) for treatments : 1.12				

Table 6. Average scores of different products prepared from buffalo meat

S. No.	Sample	Appearance	Juiciness	Tenderness	Flavour	Overall acceptance
1.	Sausage (boiled in water)	7.1	6.3	7.7	6.8	7.3
2.	Sausage (fried in oil)	7.7	7.0	7.0	7.9	8.5
3.	Meat balls (cooked)	6.9	6.4	6.9	6.9	6.0
4.	Meat patties (cooked)	7.9	6.6	6.8	6.5	7.2
C. D. (P=0.05)		0.82	-	-	0.72	0.078

balls. The original fat content of patties had a significant effect on the cooking loss. Nisar *et al.* (2010) reported that buffalo meat patty with lower fat content (5% added fat than 15% added fat) in the formulation showed lower loss in microwave cooked patties. They found higher moisture and fat contents in buffalo patties cooked in microwave than other methods.

The cooked sausage, meat balls and patties prepared by the standardized recipes (Table 1) were evaluated for various sensory attributes viz., appearance, juiciness, tenderness, flavour and overall acceptability by a semi-trained panel on a 9-point hedonic scale and the average scores are presented in Table 6. The meat patties had the highest score (7.9) of appearance among all the products, whereas meat balls had the lowest average score (6.9). Anne *et al.* (2022) reported that cooking modified the meat muscle structure and chemical composition which affected the sensory quality and nutritional properties. Most of these changes depended on the meat structure (marbling) and cooking methods employed. Naveena and Kiran (2014) recently reviewed the buffalo meat composition, nutritional quality and processing characteristics when compared with cattle beef and reported that buffalo meat possessed superior processing and nutritional qualities. Sensory qualities of the processed buffalo meat products were affected by the method of cooking. The buffalo meat patties cooked in hot air oven were found to possess better colour, appearance and flavour scores than the microwave cooked samples (Nisar *et al.,* 2010).

CONCLUSION AND RECOMMENDATIONS

The moisture, protein, fat and ash contents of the buffalo meat balls, patties and sausages varied depending upon the method of cooking employed. The cooked samples were found to be acceptable to the panelists. The results of this study offered an opportunity to produce acceptable quality balls, patties and sausages from meat obtained from young buffalo males of 3 to 4 months of age. As there is no bias against consumption of buffalo meat in northern India, the processing of buffalo veal into processed products offers a good possibility for improving the nutritional status of the population as well as profitable opportunity for improving foreign exchange earnings for the country.

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