PROCESSING OF BUFFALO MEAT NUGGETS UTILIZING DIFFERENT BINDERS

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Buffalo is a good source of meat and has great economic importance especially due to high export potential. In India, female buffaloes, after their productive period are utilized for meat production. 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. Utilisation of tough 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 (Rajendran Thomas *et al*., 2006). Inclusion of non meat additives as binders or extenders had been documented in production of emulsion based meat products. Among the non meat additives tried as binders were the common bean flour in beef sausages (Dzudie *et al*., 2002) and liquid whey and soy protein in goat meat patties (Gujral *et al*., 2002) and whey protein concentrate in sausages (Serdaroglu and Sapanci –Ozsumer, 2003). The present study was conducted with the objective of preparation of buffalo meat nuggets utilising low value meat and to find the optimum level of inclusion of different binders viz., Maida (refined wheat) flour (MF), Soya flour (SF), Whole Egg (WE) and Liquid Whey (LW) at three levels of inclusion.

The current work was taken up utilizing 80 % of meat (75:25 of skeletal meat: low value meat). Low value meat includes heart and tongue in the ratio of 50:50. Fat is included @ 20% of which 10% is replaced by vegetable oil. Different binders like Maida (refined wheat) flour (MF), Soya flour (SF), Whole Egg (WE) and Liquid Whey (LW) each at 3 different levels were added to the emulsion. The optimum level of inclusion of each binder was estimated by assessing the physico-chemical and sensory characteristics.

Meat from the lean cuts of female buffalo were cut into smaller cubes of 2.5cm thickness, frozen at -18°±1°C and utilized for the product manufacture. Emulsion was prepared utilizing 80% of meat and 20% of fat (10% replaced with refined sunflower oil). Low value meat like head and cheek meat, heart and tongue were included at 25% level of the meat. Frozen meat and fat were minced through a 4.5mm plate of a meat mincer and finely chopped in a bowl chopper. The emulsion was prepared by adding the following ingredients, salt @ 1.8%, sodium tri poly phosphate @ 0.3%, sodium nitrite @ 120 ppm, spice mix @ 1.5% and condiment mix @ 3% as a premix and added to the meat mix. The refined vegetable oil (sunflower) was cooled to 4° C before adding to the mixture. During chopping the temperature of the emulsion was maintained at 10-12°C by the addition of slushed ice. Binders were added in addition to the meat fat mixture at 1, 2 and 3% of WEL, 3, 5 and 7% of MF, SF and LW. Emulsion prepared by utilizing only 80% lean meat and 20% fat was taken as the control sample. The prepared emulsion was packed in stainless steel moulds of dimension 15 x 10 x 4cm, cooked in steam for 30 minutes until the internal temperature reached 72 °C. The moulds were

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cooled under running tap water to room temperature. Nuggets were then cut into uniform sizes of 1"cubes. pork patties. In the first two experiments, pork patties were prepared by using whole egg liquid as a binder at 5, 7 and 10 per cent levels of inclusion and by using skim milk powder as a binder at 1.5, 3 and 5 per cent levels of inclusion. These experiments were replicated 6 times in each levels of inclusion. Then the optimum levels of inclusion of the above two binders were arrived. In the third experiment pork patties were prepared with the optimum levels of whole egg liquid and skim milk powder as binder as per the above findings to find out the better binder among the two. The samples prepared were subjected to analysis of physico-chemical parameters like emulsion pH, product pH, emulsion stability, product yield, and product shrinkage; shear force value and sensory evaluation by panelists to derive the better binder.

Pork was obtained by hot deboning of Large White Yorkshire pigs slaughtered in the Department of Meat Science and Technology, Madras Veterinary College, Chennai. The back fat was collected from the back region. The meat obtained from pig head, cheek, heart and tongue were utilised for the preparation of emulsion. For every 1000g of meat mixture lean meat; low value meat and fat were added at the rate of 500g, 300g and 200g respectively. For every 1000g of meat mixture 17.5g of salt, 120ppm of sodium nitrite, 3g of sodium tripolyphosphate were used as curing agents. Dry cure method was followed. The following spices in percentage w/w were used in this study. Coriander- 20, Aniseed – 14, Black pepper - 12.8, Capsicum – 14, Cumin – 10, Cinnamon – 4, Cloves – 4, Turmeric – 4, Cardamom – 3, Ginger Powder – 10, *Khus khus* - 2.8, Anana Flowers - 0.6, Mace - 0.4, Cassia - 0.2 and Nutmeg - 0.2. The above-mentioned ingredients were ground and sieved. The finely ground powder was stored for subsequent use. For every 1000g of meat mixture 13g of spice mixture was used. Condiments used in the study were onion and garlic in the ratio of 3:1 and were ground to the consistency of fine paste. For every 1000g of meat mixture 30g of condiment mixture was used. Control pork patties were formulated based on the proportions of lean meat @ 50%, low value meat @ 30% (head and cheek meat - 22.6%, heart - 3.8%, tongue meat - 3.6%), and fat @ 20% obtained from back region of pig carcasses. To the above control formulation whole egg liquid at 5, 7 and 10 per cent were added and processed as mentioned below. Skim milk powder at 1.5, 3 and 5 per cent levels of inclusion were added to the control formulation and processed as reported below.

The lean meat, low value meat and fat were chilled to 4°C by keeping in refrigerator for over night. Thawed lean meat and fat were minced separately through a 4mm plate in meat mincer. By using same plate, low value meat was also minced. To the minced meat constituents, salt, sodium tripolyphosphate and sodium nitrite were added along with 30% of slushed ice in bowl chopper and chopped for one minute. Either whole egg liquid or skim milk powder were added as binder and chopped for one minute. Then fat was added with 30% of slushed ice and chopped for one minute. After that condiment mix, spice mix and remaining 40% of slushed ice were added and chopped for one minute. Finally maida was added and chopped for one minute. Patties (70g each) were formed from the emulsions using a mould having inner diameter of 7.3 cm and height of 1.5 cm and placed on the vegetable oil smeared cooking trays.

Patties were cooked in a preheated hot air oven at 180°C for 25 minutes. After first 15 minutes, the patties were turned upside down and cooked for another 10 minutes so as to attain the internal temperature of 73 ?± 2°C.

Samples from each batch were analysed on the same day for the following parameters in order to determine the optimum level of inclusion of these two binders. D. and Yadav, P.L. (1994). Effect of milk co precipitate.

Emulsion pH and product pH were determined using a digital pH meter. The weight of each block was recorded before and after cooking and the yield was calculated and expressed as percentage. The procedure of Kondiah *et al* (1985) was followed to measure the emulsion stability. The shear force value of cooked nuggets were recorded as per the method of Rao *et al*. (1999) and expressed in kg/19 mm diameter. The cooked and shallow pan fried nuggets were served warm to an experienced panel of seven scientists in the discipline of Meat Science and Technology to determine the sensory characteristics. The sensory attributes namely appearance, flavor, juiciness, tenderness and overall acceptability were evaluated using a 9 point hedonic scale (where 9= extremely desirable and 1=extremely undesirable (Keeton, 1983). The experiment was replicated 8 times using different levels of binders and the data were evaluated statistically (Snedecor and Cochran, 1994) by Completely Randomized Design.

Mean ± S.E values of physico-chemical traits and sensory scores of buffalo meat nuggets with different levels of MF, WEL, SF and LW are presented in tables 1-4. Significant difference in emulsion pH was observed for nuggets prepared using MF. Similar significant difference in pH of beef extended with common bean flour was reported by Dzudie *et al*. (2002). A significant difference in the product yield of nuggets prepared using MF and the nuggets prepared with 7% MF had the highest product yield. Significant differences were noticed in the tenderness and overall acceptability scores between the different levels of inclusion of MF in nuggets. Nuggets prepared with 7% MF recorded the highest tenderness and overall acceptability scores. Significant difference in emulsion pH was observed between the control and nuggets prepared by utilising different levels of WE. Significant differences were noticed in emulsion stability, product yield, SFV and sensory evaluation scores between the control and the nuggets prepared by using different levels of WE. Nuggets prepared with 1% WE recorded the highest emulsion stability, product yield, flavour, juiciness, tenderness and overall acceptability scores. Significant differences were noticed in emulsion stability, product yield, SFV and sensory evaluation scores between the control and the nuggets prepared by using different levels of SF. Nuggets prepared with 3% SF recorded the highest emulsion stability, product yield, appearance, flavour, juiciness, tenderness and overall acceptability scores and the lowest SFV. Significant differences were noticed in emulsion stability, product yield, SFV and sensory evaluation scores between the control and the nuggets prepared by using different levels of SF. Sausages prepared with the inclusion of 3% LW had the highest emulsion stability, product yield, SFV, appearance, flavour, juiciness, tenderness and overall acceptability scores. Based on the highest emulsion stability, product yield and sensory scores of the nuggets incorporated with 7% MF, 3% SF, 1% WE and 3% LW were found to be the optimum level of inclusion.

Nuggets prepared using 1% WE and 3 % LW recorded higher emulsion stability compared to other higher levels. This may be attributed to less moisture than other higher inclusion levels. However, highest emulsion stability was noticed in nuggets prepared using 7 % MF; the cause may be attributed to the low moisture level at higher inclusion of MF. Gelation of starch in MF enhances the emulsion binding of proteins (Puolanne and Puusuen, 1983). Addition of polyphosphates may attribute to the increase in ionic strength and cleavage of actomyosin, facilitating protein binding and emulsion stability (Ockerman, 1985). The highest emulsion stability reflected highest product yield. However, nuggets prepared using SF recorded highest emulsion stability and product yield at lower inclusion level i.e. 3 % level.

There was an increase in product pH over emulsion pH for nuggets prepared using different binders. This increase in pH is due to the protein

denaturation, formation of new cross linkages and reduction in acidic groups during cooking in the temperature range of 55-80°C (Ham and Deatherage, 1960).

The Shear force value for nuggets prepared using 7% LW was significantly less compared to other levels. This finding is in congruence with the findings of Gupta *et al* (1993). The increase in shear force value with increase in inclusion level of SF may be due to the reduction of moisture.

Based on the physico-chemical and sensory evaluation studies the desired levels of inclusion of binders was derived to be 3% of SF and LW, 7% MF and 1% of WEL for the production of organoleptically acceptable nuggets which was replaced by 31.25% low value meat.

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Table 1

Mean ± S.E values of Physico-chemical traits and Sensory scores of Buffalo meat nuggets with different levels of Maida (n=8)

Parameter	Control	Maida		
		3%	5%	7%
Emulsion pH	6.39±0.05[b]	6.30±0.10[b]	6.29±0.11[ab]	5.89±0.08[a]
Product pH	6.38±0.10[a]	6.487±0.09[a]	6.43±0.11[a]	6.08±0.13[a]
Emulsion stability (%)	95.89±0.43[a]	94.17±0.93a	94.55±0.99a	96.17±0.14[a]
Product yield (%)	98.02±0.72[b]	94.20±0.78[a]	97.78±0.55[b]	98.22±0.74[b]
Shear force value(kg/19 mm)	0.30±0.01[a]	0.30±0.02[a]	0.30±0.01[a]	0.32±0.01[a]
Sensory evaluation scores				
Appearance	7.54±0.14[a]	7.48±0.18[a]	7.38±0.20[a]	7.53±0.11[a]
Flavour	7.20±0.13[a]	6.43±0.29[a]	6.78±0.18[a]	7.19±0.26[a]
Juiciness	7.25±0.11[a]	7.07±0.19[a]	6.98±0.12[a]	7.35±0.20[a]
Tenderness	7.33±0.13[ab]	6.79±0.20[a]	6.94±0.10[a]	7.63±0.22[b]
Overall acceptability	7.21±0.19[a]	6.98±0.21[a]	7.11±0.09[a]	7.03±0.05[b]

Means bearing the same superscript between rows do not differ significantly ($P \leq 0.01$)

Table 2

Mean ± S.E values of Physico-chemical traits and Sensory scores of Buffalo meat nuggets with different levels of Whole Egg Liquid (n =8)

Parameter	Control	Whole Egg Liquid		
		1%	2%	3%
Emulsion pH	5.95±0.09^{a}	6.27±0.07^{b}	6.29±0.07^{b}	6.29±0.08^{b}
Product pH	6.24±0.12^{a}	6.38±0.06^{a}	6.42±0.06^{a}	6.44±0.06^{a}
Emulsion stability (%)	96.55±0.18^{b}	93.28±1.23^{b}	84.21±2.85^{a}	87.0±1.94^{a}
Product yield (%)	98.51±0.64^{b}	92.58±1.66^{a}	91.28±2.13^{a}	91.59±2.25^{a}
Shear force value(kg/19 mm)	0.30±0.01^{a}	0.70±0.01^{bc}	0.69±0.01^{b}	0.69±0.01^{b}
Sensory evaluation scores				
Appearance	7.57±0.17^{b}	6.60±0.32^{a}	6.68±0.16^{a}	6.23±0.29^{a}
Flavour	7.34±0.19^{c}	6.88±0.26^{bc}	6.61±0.13^{b}	5.83±0.24^{a}
Juiciness	7.36±0.20^{c}	6.82±0.23^{b}	6.55±0.09^{b}	5.63±0.27^{a}
Tenderness	7.77±0.29^{b}	6.89±0.27^{a}	6.82±0.09^{a}	6.86±0.17^{a}
Overall acceptability	7.46±0.16^{b}	6.89±0.26^{b}	6.86±0.13^{b}	5.52±0.31^{a}

Means bearing the same superscript between rows do not differ significantly (P≤0.01)

Table 3

Mean ± S.E values of Physico-chemical traits and Sensory scores of Buffalo meat nuggets with different levels of Soya flour (n=8)

Parameter	Control	Soya flour		
		3%	5%	7%
Emulsion pH	5.99±0.07^{a}	6.04±0.02^{a}	6.03±0.01^{a}	6.07±0.02^{a}
Product pH	6.16±0.03^{a}	6.12±0.01^{a}	6.20±0.01^{a}	6.11±0.13^{a}
Emulsion stability (%)	96.71±0.15^{b}	89.80±1.71^{b}	78.76±3.32^{a}	79.06±3.62^{a}
Product yield (%)	98.02±0.72^{c}	93.27±1.05^{b}	85.76±0.68^{a}	85.08±1.29^{a}
Shear force value(kg/19 mm)	0.30±0.01^{a}	0.40±0.01^{b}	0.41±0.02^{b}	0.51±0.01^{c}
Sensory evaluation scores				
Appearance	7.78±0.12^{b}	7.20±0.16^{b}	5.66±0.15^{a}	4.95±0.27^{a}
Flavour	7.61±0.09^{b}	7.06±0.14^{b}	5.63±0.08^{a}	4.43±0.43^{a}
Juiciness	7.75±0.15^{b}	7.03±0.19^{b}	5.55±0.16^{a}	4.30±0.45^{a}
Tenderness	7.85±0.12^{b}	6.95±0.23^{b}	5.26±0.31^{a}	3.70±0.34^{a}
Overall acceptability	7.79±0.08^{d}	7.05±0.10^{c}	5.59±0.04^{b}	4.08±0.26^{a}

Means bearing the same superscript between rows do not differ significantly (P≤0.01)

Table 4

Mean ± S.E values of Physico-chemical traits and Sensory scores of Buffalo meat nuggets with different levels of Liquid Whey (n=8)

Parameter	Control	Liquid Whey		
		3%	5%	7%
Emulsion pH	6.02±0.10[a]	6.34±0.09[a]	6.24±0.09[a]	6.19±0.11[a]
Product pH	6.11±0.13[a]	6.53±0.16[a]	6.44±0.09[a]	6.42±0.09[a]
Emulsion stability (%)	96.26±0.18[b]	94.95±0.94[b]	90.98±1.38[a]	91.91±0.16[a]
Product yield (%)	98.51±0.66[b]	96.76±1.08[b]	91.37±0.86[a]	90.31±0.62[a]
Shear force value(kg/19 mm)	0.30±0.01[a]	0.64±0.01[c]	0.63±0.01[c]	0.58±0.02[b]
Sensory evaluation scores				
Appearance	7.53±0.04[b]	7.13±0.16[ab]	7.36±0.08[b]	6.87±0.15[a]
Flavour	7.69±0.13[b]	6.94±0.37[a]	6.99±0.28[a]	6.40±0.15[a]
Juiciness	7.41±0.19[b]	6.75±0.39[ab]	6.50±0.34[a]	6.29±0.05[a]
Tenderness	7.99±0.28[b]	6.89±0.34[a]	6.48±0.28[a]	6.31±0.07[a]
Overall acceptability	7.73±0.13[b]	7.09±0.27[a]	6.78±0.35[a]	6.26±0.06[a]

Means bearing the same superscript between rows do not differ significantly ($P \leq 0.01$)