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Quality and Acceptability of Restructured Goat Tripe Nuggets with added Goat Meat Emulsion

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ABSTRACT

Restructured goat tripe nuggets from goat rumen meat with 15, 25 and 35 % of added goat meat emulsion were prepared and quality evaluated. Restructured goat tripe nuggets prepared with 100% goat rumen meat were used as control. Significantly ($p<0.05$) increased values were observed for product yield, moisture and protein contents in goat meat emulsion incorporated restructured goat tripe nuggets than control. However, significantly ($p < 0.05$) decreased values were observed for pH, product shrinkage, drip loss and fat content. Sensory evaluation scores for flavor, juiciness, binding and overall acceptability were highest for 25% goat meat emulsion incorporated restructured goat tripe nuggets followed by 35, 15% goat meat emulsion incorporated restructured goat tripe nuggets and control restructured goat tripe nuggets. However, scores for appearance and colour and tenderness were highest for 35% goat meat emulsion incorporated restructured goat tripe nuggets followed by 25, 15% goat meat emulsion incorporated restructured goat tripe nuggets and control restructured goat tripe nuggets. The appearance and colour, flavor, juiciness and tenderness scores between 35 and 25% goat meat emulsion incorporated restructured goat tripe nuggets did not differ significantly. Thus, it can be concluded that 75% goat rumen meat and 25% goat meat emulsion can be used for preparation of restructured goat tripe nuggets without affecting quality and acceptability.

Keywords: Goat, Rumen, Tripe, Emulsion, Nuggets, Quality

Products that undergone desinewing and particle size reduction techniques such as sectioning, chunking, slicing, blade tenderization, chopping followed by forming into roasts, patties or rolls are restructured meat products (Hedrick *et al.,* 1994). Value enhancement of raw materials, portion control, uniform quality and consumer convenience are some of the advantages of restructured meat products. Restructured meats can be bounded together through the formation of gel that is thermally set (hot-set) (Boles and Shand, 1999). Restructured meat products are generally prepared by extracting muscle proteins using salt and sodium tri-polyphosphate, which forms a heat set gel upon subsequent cooking. Conventional restructured meat products using salt and phosphates depend on the thermal binding of myofibrillar proteins that are extracted from meat (Mandigo, 1986). Fine chopped meat contains high levels of extracted myofibrillar proteins that will act as effective binder for water, fat and meat particles in restructured meat products. Meat homogenate or fine chopped meat is prepared by mixing or chopping with salt and phosphate. Increasing the amount of fine chopped meat (12-18% level) decreased the tensile strength of the product. Hence, it may be postulated that only a certain amount of extracted myofibrillar protein is needed to produce a cohesive bond between meat pieces and any additional extracted proteins had no additional effect (Trout and Schmidt, 1984). Anna Anandh *et al.* (2008) found that the amount of minced skeletal meat needed in cooked buffalo tripe rolls to produce a satisfactory bind was 25%, while Terlizzi *et al*. (1980) found that 15-20% homogenate gave maximum binding strength in a restructured ham rolls. It appears that when muscle fibres and extracted proteins form an intermediate continuum between adjacent meat surfaces, maximum binding occurs

(Trout and Schmidt, 1984). The works of Huffman (1980) and Terlizzi *et al*. (1980) support this concept. They found that thin slices of muscle added to restructured meat products combined with the extracted meat proteins to form a strong cohesive bound.

Food animals are slaughtered mainly for meat, the byproducts that emanate from slaughtered animals are also of good value. Rumen musculature otherwise known as 'tripe' and colloquially called as *'butt' or 'potti'*, is one of the important edible offal of goats and accounts for 1.3% of slaughter weight and yield of rumen meat was reported to be ranging from 0.28 to 0.77 with mean value of 0.53 kg in goats (Anna Anandh, 2017 a). Goat tripe is one of the high protein by product obtained from slaughter house. In India most of goat tripe is utilized for preparation of meat curry (Anna Anandh, 2017 b). To find means of better utilization, very few attempts have been made to develop value added products exclusively from goat tripe (Anna Anandh, 2017a). In this perspective, it is necessary to evolve appropriate technology to convert the tough, less palatable and highly perishable goat tripe into convenient, attractive and more acceptable novel products. Hence, a study was undertaken to develop and evaluate the acceptability of restructured goat tripe nuggets from goat rumen meat with different levels of goat meat emulsion.

MATERIALS AND METHODS

Goat rumen meat

Fresh goat rumen meat was obtained from local goat meat stall. Before goat rumen meat was made in to pieces, the fat and adhering extraneous materials on the surface were removed by knife. The goat rumen meat had typical off-odour reminiscent of ingesta. For deodorization, the goat rumen meat was immersed in 5% tri-sodium phosphate solution for 30 min as per Anna Anandh *et al.* (2008). The deodorized goat rumen meat chunks were sectioned into uniform pieces of 2-3 cm and frozen for 1-2 h to ensure easy mincing. The goat rumen meat chunks were minced through the meat mincer (Mado, Germany) using 20 mm plate. The minced goat rumen meat was used in the preparation of restructured goat tripe nuggets.

Goat skeletal meat

Fresh goat skeletal meat was purchased from local goat meat stalls. It was cut into small chunks and frozen for 1-2 hr to ensure easy mincing. The goat meat chunks were minced twice through the meat mincer (Mado, Germany) using 5 mm plate. The minced goat meat was used in the preparation goat meat emulsion.

Preparation of meat emulsion

For emulsion preparation salt and sodium tri-polyphosphate was added to the minced goat skeletal meat. The materials were chopped for about 2 min with a Bowl chopper (Scharffen, Germany). After addition of ice flakes it was chopped again for 1-2 min. Refined vegetable oil was added slowly and chopping was continued till the oil was completely dispersed in the batter and chopping continued for 2 min to give a fine viscous emulsion.

Product formulation and treatments

The basic control recipe consisted of 100% goat rumen meat (tripe). Goat meat emulsion replaced at 15, 25 and 35% of the goat rumen meat in the basic control formulation.

Product preparation

Restructured goat tripe nuggets were prepared by mixing of weighed quantity of minced goat rumen meat and goat meat emulsion for 4 - 6 min in paddle type mixer with salt at medium speed (200 rpm) until a white tachy exudate appeared on the surface of meat mix. Then, sodium tri-polyphosphate was added and blended for about 1 min. Refined vegetable oil was added slowly and chopping was continued till the oil was completely dispersed in the batter. After addition of cooked mashed potato it was chopped again for 1–2 min. Condiments mix was added to the blend and mixed again for 30 sec followed by spice mix and mixed for 1 min for getting a fine mix. The meat mix of 500 g was placed into rectangular aluminum moulds and were packed compactly and covered. The moulds were then clipped and tied and the tripe blocks were cooked in a pressure cooker without pressure for 30 min to reach the internal temperature of the cooked goat tripe blocks to 80±2° C. The internal temperature was recorded using digital probe thermometer. The cooked goat tripe blocks were cooled to room temperature, chilled overnight at 4 ± 2 °C and cut into slices of 15 mm thickness using a meat slicer. The slices were manually cut into nuggets

of 15 mm^3 size. The nuggets were aerobically packed in low density polyethylene (LDPE) bags and were used for analysis of various physico – chemical characteristics and sensory parameters.

Analytical procedures

pH was determined by using a digital pH meter (Century Instruments Ltd., Mumbai, India). The weight of each goat tripe block was recorded before and after cooking, the product yield was calculated (product yield = weight of cooked mould /weight of raw mould × 100) and expressed as percentage. The diameters of tripe block were measured before and after cooking with a digital vernier caliper at 3 random locations. Reduction in diameter shrinkage was expressed in percentage. Drip loss was determined by reweighing blotted slices of goat tripe nuggets after one week of storage at 4 ± 2°C (drip loss = weight loss/ initial weight × 100). Moisture (Oven drying), protein (Kjeldahal) and fat (Soxhlet ether extract) contents of the products were determined as per AOAC (1995).

Sensory evaluation

Restructured goat tripe nuggets were served to a five member experienced panel. The sensory attributes appearance and colour, flavour, juiciness, tenderness, binding and overall acceptability was evaluated on eight point descriptive scale as suggested by Keeton (1983). The sensory score of 8 was extremely desirable, whereas a score of 1 was extremely undesirable.

Statistical analysis

The data generated from four trials for each experiment was analyzed following standard procedures (Snedecor and Cochran, 1989) for comparing the means and to determine the effect of treatments ($p < 0.05$).

RESULTS AND DISCUSSION

Physico – chemical characteristics

Results of physico–chemical parameters of different level of added goat meat emulsion on restructured goat tripe nuggets are presented in Table 1. The mean pH value of restructured goat tripe nuggets were 6.8 ± 0.02, 6.6 ± 0.04, 6.4 ± 0.04 and 6.3 ± 0.02 for control, 15%, 25% and 35% goat emulsion incorporated restructured goat tripe nuggets. The pH values of restructured goat tripe nuggets decreased with increasing levels of goat meat emulsion. The pH value of 35% goat meat emulsion incorporated restructured goat tripe nuggets was significantly ($p<0.05$) lower as compared to other goat meat emulsion incorporated restructured goat tripe nuggets and control restructured goat tripe nuggets. However, no significant difference was observed between control, 15 and 25% goat meat emulsion incorporated restructured goat tripe nuggets. Higher pH of incorporated restructured goat tripe nuggets might be due to higher initial raw pH values of goat rumen as compared to skeletal meat (Anna Anandh *et al*., 2008). Tsai *et al.* (1998) also observed similar pH changes in restructured beef. It might be due to protein denaturation during cooking. The present results are in agreement with reports of Sofos *et al*. (1979) and Buchanan (1986). The mean product yield were 59.71 ± 0.14, 68.45 ± 0.12, 78.80 ± 0.11 and 76.22 ± 0.14 % for control, 15%, 25% and 35% goat emulsion incorporated restructured goat tripe nuggets. The mean

Table 1: Formulation for goat tripe nuggets

Ingredients	Levels of ingredients (%)			
	Control	Treatment -I	Treatment – II	Treatment -III
Goat rumen meat	100	85	75	65
Goat meat emulsion	—	15	25	35
Salt	2.5	2.5	2.5	2.5
Sodium tri poly phosphate	0.5	0.5	0.5	0.5
Refined Vegetable oil	5.0	5.0	5.0	5.0
Condiments mix (Onion, garlic and ginger :3:2:1)	6.0	6.0	6.0	6.0
Spice mix	3.5	3.5	3.5	3.5
Cooked mashed potato	35.0	35.0	35.0	35.0
Refined wheat flour	4.0	4.0	4.0	4.0

product yield of restructured goat tripe nuggets increased with increasing levels of goat meat emulsion. The product yield was significantly ($p<0.05$) higher for 35% goat meat emulsion incorporated restructured goat tripe nuggets, but the value did not differ significantly from 25% goat meat emulsion incorporated restructured goat tripe nuggets. The product yield of control and 15% goat meat emulsion incorporated restructured goat tripe nuggets also did not differ significantly between them. Low product yield of control restructured goat tripe nuggets might be due to higher particle size and low levels of extraction of proteins. Minced meat increased protein availability which results in greater solubilization of muscle proteins during restructuring process and thus leads to increased product yield in goat meat emulsion incorporated restructured goat tripe nuggets as compared to control (Anna Anandh, 2017c; Xargayo and Lagares, 1992). Lin and Keeton (1994) also reported increased product yield in precooked meat product by use of finely chopped meat.

The mean product shrinkage value were 22.34 ± 0.10, 18.42 ± 0.14, 13.82 ± 0.12 and 11.18 ± 0.12% for control, 15%, 25% and 35% goat emulsion incorporated restructured goat tripe nuggets. The mean product shrinkage values were significantly ($p< 0.05$) higher for control as compared to goat meat emulsion incorporated restructured goat tripe nuggets. Product shrinkage of goat meat emulsion incorporated restructured goat tripe nuggets differ significantly ($p< 0.05$) between them. Coagulation of muscle proteins resulted in shrinkage including thermal shrinkage of collagen fibres in the connective tissue which subsequently expressed water from the muscle tissue (Schock *et al.,* 1970; Aragnosa *et al.,* 1989). Addition of goat meat emulsion in restructured goat tripe nuggets significantly reduced the product shrinkage. The level of extraction of myofibrillar proteins for binding during the restructuring process was lower in control restructured goat tripe nuggets which results in expulsion of water and higher shrinkage. The results observed in our present study are comparable with those reported by Chen and Trout (1991). The mean drip loss value were 4.12 ± 0.14, 3.41 ± 0.12, 3.28 ± 0.10 and 2.10 ± 0.18 % for control, 15%, 25% and 35% goat emulsion incorporated restructured goat tripe nuggets. Drip loss decreased with increasing levels of goat meat emulsion in restructured goat tripe nuggets. The drip loss value was significantly ($p<0.01$) lower in goat meat emulsion incorporated restructured goat tripe nuggets as compared to control.

Among restructured goat tripe nuggets, drip loss value was significantly ($p<0.05$) lower in 35% goat meat emulsion incorporated restructured goat tripe nuggets and the value differ significantly from 15 and 25% goat meat emulsion incorporated restructured goat tripe nuggets. Increased drip loss values were primarily due to moisture loss. The steaks prepared from small pieces generally have higher drip loss as compared to those steaks from relatively larger meat pieces. This might be due to more cellular disruption in the smaller meat pieces and consequently more cytoplasmic fluid loss (Anna Anandh *et al.,* 2008).

The moisture and protein contents increased whereas, fat content decreased with increasing levels of goat meat emulsion. The moisture content of 35% goat meat emulsion incorporated restructured goat tripe nuggets was significantly ($p<0.05$) higher as compared to other goat meat emulsion incorporated restructured goat tripe nuggets

Table 2: Effect of added goat meat emulsion on physico-chemical parameters of restructured goat tripe nuggets

Physico-chemical parameters*	Levels of goat meat emulsion (%)			
	0	15	25	35
pH	6.8 ± 0.02[a]	6.6 ± 0.04[a]	6.4 ± 0.04[a]	6.3 ± 0.02[b]
Product yield (%)	59.71± 0.14[a]	68.45± 0.12[b]	74.80±± 0.11[c]	76.22± 0.14[c]
Product Shrinkage (%)	22.34 ± 0.10[a]	18.42 ± 0.14[b]	13.82 ± 0.12 [c]	11.18 ± 0.12 [d]
Drip loss (%)	4.12 ± 0.14[a]	3.41 ± 0.12[b]	3.28 ± 0.10[b]	2.10 ± 0.18 [c]
Moisture (%)	65.40 ± 0.18 [a]	66.25 ± 0.14 [a]	69.62 ±_0.12 [b]	75.5 ±0.14 [b]
Protein (%)	13.80 ± 0.12	15.15 ± 0.12	16.18 ± 0.10	17.88 ± 0.10
Fat (%)	4.20 ± 0.10	3.52 ± 0.10	3.25 ± 0.12	3.15 ± 0.14

*Number of observations = 4; Means bearing same superscripts (lowercase letters) row-wise do not differ significantly ($p < 0.05$).

and control restructured goat tripe nuggets. However, no significant difference was observed between control, 15 and 25% goat meat emulsion incorporated restructured goat tripe nuggets. The lower moisture content of restructured goat tripe nuggets might be due to higher drip loss. However, protein and fat contents between control and goat meat emulsion incorporated restructured goat tripe nuggets did not differ significantly between them.

Sensory characteristics

Table 3: Effect of added goat meat emulsion on sensory attributes of restructured goat tripe nuggets

Sensory attributes**	Levels of goat meat emulsion (%)			
	0	15	25	35
Appearance and colour	5.4 ± 0.14^{a}	5.9 ± 0.12^{a}	6.8 ± 0.14^{b}	6.9 ± 0.11^{b}
Flavour	5.6 ± 0.12^{a}	5.8 ± 0.14^{a}	6.4 ± 0.14^{b}	6.3 ± 0.12^{b}
Juiciness	6.7 ± 0.14^{a}	6.8 ± 0.12^{a}	7.2 ± 0.14^{b}	6.8 ±0.13^{a}
Tenderness	6.2 ± 0.12^{a}	6.6 ± 0.14^{a}	7.0 ± 0.11^{b}	7.2 ± 0.12^{b}
Binding	5.8 ± 0.12^{a}	6.5 ± 0.12^{b}	7.4 ± 0.12^{c}	6.6 ± 0.12^{b}
Overall acceptability	5.9 ± 0.12^{a}	6.4 ±0.12^{b}	7.0 ± 0.13^{c}	6.7 ± 0.12^{b}

**Number of observations = 20; Sensory attributes of restructured goat tripe nuggets were evaluated on an 8-point descriptive scale (wherein, 1 = extremely undesirable; 8 = extremely desirable); Means bearing same superscripts (lowercase letters) row-wise do not differ significantly ($p < 0.05$).

Results of sensory evaluation of goat emulsion added restructured goat tripe nuggets are presented in Table 2. The sensory scores for appearance and colour was significantly ($p< 0.05$) higher for 35% goat meat emulsion incorporated restructured tripe nuggets followed by 25, 15% goat meat emulsion incorporated restructured goat tripe nuggets and control restructured goat tripe nuggets. The higher appearance and colour scores for goat meat emulsion incorporated restructured goat tripe nuggets could be attributed to the attractive colour of goat meat emulsion. The flavour and tenderness scores were slightly higher for 35% goat meat emulsion incorporated restructured goat tripe nuggets followed by 25, 15% goat meat emulsion incorporated restructured goat tripe nuggets and control restructured goat tripe nuggets. However, the flavour and tenderness scores between 35 and 25% goat meat emulsion incorporated restructured goat tripe nuggets did not differ significantly. The sensory scores for juiciness, binding and overall acceptability were significantly ($p<0.05$) higher for 25% goat meat emulsion incorporated restructured goat tripe nuggets followed by 35, 15% goat meat emulsion incorporated restructured goat tripe nuggets and control restructured goat tripe nuggets. These results are in agreement with the findings of Trout and Schmidt (1984) and Liu *et al*. (1990). They reported that increasing the amount of chopped skeletal meat, decreased the binding, juiciness and acceptability of the comminuted meat products. The sensory scores for overall acceptability was significantly ($p< 0.05$) higher for 25% goat meat emulsion incorporated restructured tripe nuggets followed by 35%, 15% goat meat emulsion incorporated restructured goat tripe nuggets and control restructured goat tripe nuggets. The overall acceptability scores of control and 15% goat meat emulsion incorporated restructured goat tripe nuggets also did not differ significantly between them but differ significantly from 35% goat meat emulsion incorporated restructured tripe nuggets.

Based on the results of sensory attributes, restructured goat tripe nuggets prepared with 25% goat meat emulsion was rated better for all sensory attributes except tenderness. Tenderness scores were higher for 35% goat meat emulsion incorporated restructured goat tripe nuggets. However, the other sensory scores were lower than 25% goat meat emulsion incorporated treatment.

CONCLUSION

The goat rumen meat can be effectively converted into value added restructured goat tripe nuggets of acceptable quality by using 75% goat rumen meat with 25% goat meat emulsion. Addition of goat meat emulsion in the restructured goat tripe nuggets formulation improves physicochemical and sensory qualities of restructured goat tripe nuggets. Therefore, preparation of restructured goat tripe nuggets from goat rumen meat with goat meat emulsion will enhance the utilization of goat tripe.

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