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Quality and acceptability of shami kebab incorporated with goat meat and tripe

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Abstract
Goat meat shami kebabs were prepared by replacing goat meat with goat tripe at levels of 25%, 50%, and 75% and their quality characteristics were compared with those of a control prepared using 100% goat meat. Incorporation of goat tripe resulted in a significant increase ($P<0.05$) in pH, diameter shrinkage, drip loss, cooking loss, protein content and fat content compared to the control. In contrast, moisture retention, product yield and moisture content showed a significant ($P<0.05$) decline with increasing levels of tripe incorporation. Sensory evaluation revealed that scores for appearance, color, flavor, tenderness, juiciness, binding and overall acceptability were highest in the 25% tripe-incorporated formulation, with progressive declines observed at the 50% and 75% inclusion levels. The physicochemical and sensory attributes of shami kebabs containing 25% goat tripe were comparable to those of the control, with no significant differences observed between the two treatments. Based on the findings of the present study, it may be concluded that incorporation of goat tripe at a level of 25%, along with 75% goat meat, can be effectively utilized in the preparation of shami kebabs without adversely affecting product quality or consumer acceptability.

Keywords: Goat meat, goat tripe, shami kebab, physico-chemical characteristics, sensory quality, acceptability

Introduction
Food animals are slaughtered primarily for meat production; however, the resulting by-products also represent valuable nutrient-rich resources. Among these, the rumen musculature, commonly referred to as tripe, constitutes a major edible goat by-product and accounts for a considerable proportion of the total slaughter weight. Although goat tripe is rich in proteins and essential minerals, its commercial utilization remains limited due to low consumer preference and the lack of suitable value-addition technologies. Utilization of such edible by-products in processed meat products offers a promising approach to improving meat industry profitability while reducing environmental and economic losses associated with slaughterhouse waste (Anna Anandh *et al.*, 2008) [2]. Shami kebab is a popular traditional meat product prepared from minced meat, Bengal gram dhal (chickpea flour), spices and condiments. The product is widely appreciated for its characteristic flavor, soft texture and convenience (Agnihotri, 2004) [1]. The physicochemical and sensory qualities of shami kebabs are largely influenced by processing conditions and ingredient composition (Pandey *et al.*, 2014) [9]. With increasing market competition, the meat industry is increasingly exploring the utilization of low-cost animal by-products for the development of economical value-added meat products. Therefore, the present study was undertaken to develop and evaluate shami kebabs incorporated with varying levels of goat tripe and to assess their physicochemical characteristics and sensory acceptability.

Materials and Methods
Goat tripe
Fresh goat tripe was procured from local retail outlets. Adhering fat and extraneous materials were manually removed using a knife. The tripe was then thoroughly washed with potable water and pressure-cooked at 15 psi for 20 minutes to soften the connective tissue. After cooking, the tripe was cut into smaller pieces and frozen for 1–2 hours to firm the tissue and facilitate efficient mincing.

Subsequently, the chilled tripe pieces were minced twice using a mechanical meat mincer fitted with a 5 mm plate to obtain a uniform texture.

Goat meat

Fresh goat skeletal meat was procured from local retail outlets. Visible surface fat and excess connective tissue were manually trimmed and removed. The cleaned meat was then cut into small uniform pieces and frozen for 2 hours to firm the muscle tissue and facilitate efficient mincing. Subsequently, the chilled meat pieces were minced twice using a mechanical meat mincer fitted with a 5 mm plate to obtain a uniform texture suitable for kebab preparation.

Formulation of shami kebab

The basic control goat meat shami kebab recipe consisted of 100% goat meat. The goat meat was replaced at 25, 50 and 75% levels with goat tripe in the basic control formulation. Each formulation also contained bengal gram dhal paste (15.0%), condiments mixture (8.0% - onion, garlic and ginger in the ratio of 3:2:1), spice mixture (2.0%), salt (1.8%), whole egg (5.0%) and refined oil (10.0%).

Preparation of shami kebab

Minced goat meat and minced goat tripe were blended according to the respective treatment formulations (control, 25%, 50%, and 75% tripe incorporation levels). Bengal gram dhal was soaked in water overnight, cooked until soft, and ground into a smooth paste to serve as a binding agent. The meat–tripe mixture was then thoroughly mixed with dhal paste, whole egg, refined oil, salt, and spice and condiment blends until a uniform batter was obtained. The prepared mixture was subsequently portioned and manually shaped into uniform circular patties. The circular patties were shallow-fried in refined oil over medium heat until a characteristic golden-brown color developed. Six independent batches were prepared for each treatment to ensure experimental reliability and consistency.

Physico-chemical analysis

To evaluate the quality and composition of the formulated shami kebabs, standard analytical procedures were employed. The pH of the samples was measured using a calibrated digital pH meter. Product yield (%) was calculated as the ratio of cooked product weight to raw product weight multiplied by 100. Physical changes during processing were assessed by measuring diameter shrinkage before and after shallow frying using a digital vernier caliper. Drip loss was determined by recording the weight difference of blotted kebab samples following refrigerated storage. Cooking loss and moisture retention values were calculated using standard equations to evaluate the water-binding capacity of the meat–tripe matrix (El – Magoli *et al.*, 1996) [7]. Proximate composition analysis was carried out according to AOAC (1995) [4].procedures. Moisture content was determined using a hot-air oven method, crude protein content was estimated using a macro-Kjeldahl digestion and distillation assembly, and fat content was analyzed using a Soxhlet ether extraction apparatus.

Sensory evaluation

Sensory evaluation of the shami kebab samples was carried out by a semi-trained panel comprising university faculty members and students. The samples were served warm under standardized laboratory conditions for sensory assessment. Panelists evaluated the sensory attributes, namely appearance and color, flavor, tenderness, juiciness, binding and overall acceptability, using a 9-point hedonic scale, where a score of 1 indicated “extremely undesirable” and a score of 9 indicated “extremely desirable.”

Statistical analysis

To ensure experimental reliability and reproducibility, the entire experiment was conducted in six independent trials. The data obtained were subjected to statistical analysis using analysis of variance (ANOVA) procedures as described by Snedecor and Cochran (1989) [10].

Results and Discussion

Physico-chemical characteristics

Results of physico-chemical parameters of goat tripe incorporated shami kebabs are presented in Table 1. The pH values of shami kebabs increased with increasing levels of goat tripe incorporation. The pH value of 75% goat tripe incorporated shami kebab was significantly ($P<0.05$) higher as compared to other goat tripe incorporated shami kebabs and control goat meat shami kebab. However, no significant difference was observed between control and 25% goat tripe incorporated shami kebab. The increased pH values in goat tripe incorporated shami kebabs might be due to higher connective tissue content and protein concentration of goat tripe (Anna Anandh, 2017) [3]. Tsai *et al.*, (1998) [11] also observed similar pH changes in restructured beef. It might be due to higher protein contents of GT incorporated cooked sausages and protein denaturation during cooking.

Table 1: Physico-chemical characteristics of goat tripe incorporated shami kebab (Mean ± S.E)

Physico – chemical charaterisctics (n = 6)	Control goat meat shami kebab	25% goat tripe incorporated shami kebab	50% goat tripe incorporated shami kebab	75% goat tripe incorporated shami kebab
pH	5.82 ± 0.12^{a}	5.86 ± 0.10a	5.94 ± 0.14^{b}	6.02 ± 0.12^{c}
Product yield (%)	92.48 ± 0.18^{a}	91.62 ± 0.16^{ab}	89.84 ± 0.14^{b}	87.26 ± 0.18^{c}
Diameter shrinkage (%)	8.24 ± 0.16^{a}	8.68 ± 0.14^{ab}	9.12 ± 0.18^{b}	9.84 ± 0.16^{c}
Drip loss (%)	3.18 ± 0.12^{a}	3.42 ± 0.10^{ab}	3.88 ± 0.14^{b}	4.26 ± 0.12^{c}
Cooking loss (%)	7.52 ± 0.18^{c}	8.38 ± 0.16^{bc}	10.16 ± 0.14^{b}	12.74 ± 0.18^{a}
Moisture retention (%)	57.42 ± 0.14^{a}	55.86 ± 0.12^{ab}	53.68 ± 0.16^{b}	51.24 ± 0.14^{c}
Moisture (%)	62.18 ± 0.16^{a}	60.84 ± 0.14^{ab}	58.92 ± 0.18^{b}	56.76 ± 0.16^{c}
Protein (%)	18.24 ± 0.14^{a}	18.86 ± 0.12^{ab}	19.42 ± 0.16^{b}	20.18 ± 0.14^{c}
Fat (%)	10.42 ± 0.12^{a}	10.88 ± 0.10^{ab}	11.34 ± 0.14^{b}	11.92 ± 0.12^{c}

Means bearing same superscripts row-wise do not differ significantly (($P<0.05$).

The mean diameter shrinkage values increased significantly ($P<0.05$) with increasing levels of goat tripe incorporation. Diameter shrinkage values were significantly ($P<0.05$) lower for control and 25% goat tripe incorporated shami kebabs as compared to 50% and 75% goat tripe incorporated shami kebabs. Increased shrinkage in higher goat tripe incorporated treatments might be due to lower extraction of myofibrillar proteins and poor binding properties during frying process. The level of extraction of proteins for binding during the product processing was lower in tripe incorporated shami kebabs sausage which resulted in expulsion of water and higher shrinkage (Hughes *et al.*, 2014) [8].

Drip loss and cooking loss values increased significantly ($P<0.05$) with increase in goat tripe incorporation levels. Tripe decreased the availability of proteins and this might be responsible for increased drip loss value of tripe incorporated shami kebabs as compared to control goat meat shami kebabs. Increased cooking loss in goat tripe incorporated shami kebabs might be due to reduced water holding capacity and lower protein extraction from connective tissue rich tripe (Choi *et al.*, 2025) [5].

Moisture retention and product yield values decreased significantly ($P<0.05$) with increase in goat tripe incorporation levels. Lower moisture retention and product yield observed in higher tripe incorporated shami kebabs might be due to poor emulsifying and binding properties of goat tripe (Anna Anandh et al., 2008) [3]...

Moisture content decreased significantly ($P<0.05$) whereas protein and fat contents increased significantly ($P<0.05$) with increase in goat tripe incorporation levels. The lower moisture content observed in higher tripe incorporated shami kebabs might be due to greater moisture evaporation during frying process. Increased protein and fat contents could be attributed to concentration effect resulting from moisture loss and absorption of oil during frying process (.Pandey *et al.*, 2014) [9].

Sensory characteristics

Results of sensory evaluation scores of goat tripe incorporated shami kebabs are presented in Table 2. Among treatments, the sensory scores for appearance and colour, flavour, tenderness, juiciness, binding and overall acceptability were significantly ($P<0.05$) higher for 25% goat tripe incorporated shami kebabs followed by 50% and 75% goat tripe incorporated shami kebabs. However, no significant difference was observed between control and 25% goat tripe incorporated shami kebabs for all sensory attributes evaluated. The lower appearance and colour scores observed in higher goat tripe incorporated shami kebabs could be attributed to darker colour and lower pigment concentration of goat tripe compared to skeletal muscle meat. Flavour scores decreased significantly ($P<0.05$) with increase in goat tripe incorporation levels. The characteristic flavour of goat tripe might have contributed to lower flavour acceptability in higher incorporation treatments.Tenderness and juiciness scores also decreased significantly ($P<0.05$) with increasing levels of goat tripe incorporation. This might be due to higher connective tissue and collagen content present in goat tripe which adversely affected textural characteristics of the product (Anna Anandh *et al.*, 2008) [2]. Binding scores decreased significantly ($P<0.05$) in higher goat tripe incorporated shami kebabs. This might be due to lower extraction of myofibrillar proteins required for proper binding during product preparation. Overall acceptability scores were significantly ($P<0.05$) higher for control and 25% goat tripe incorporated shami kebabs and the values did not differ significantly between them. However, 50% and 75% goat tripe incorporated shami kebabs recorded significantly lower overall acceptability scores. The results indicated that goat tripe can be effectively utilized up to 25% level in preparation of shami kebabs without adversely affecting product quality and acceptability.

Table 2: Sensory attributes of goat tripe incorporated shami kebab (Mean ± S.E)

Sensory Characteristics** (n= 42)	Control goat meat shami kebab	25% goat tripe incorporated shami kebab	50% goat tripe incorporated shami kebab	75% goat tripe incorporated shami kebab
Appearance and colour	8.4 ± 0.12^{a}	8.3 ± 0.10^{a}	7.8 ± 0.14^{b}	7.2 ± 0.12^{c}
Flavour	8.3 ± 0.10^{a}	8.2 ± 0.12^{a}	7.6 ± 0.16^{b}	6.8 ± 0.14^{c}
Juiciness	8.1 ± 0.14^{a}	8.0 ± 0.12^{a}	7.4 ± 0.10b	6.8 ± 0.14^{c}
Tenderness	8.2 ± 0.12^{a}	8.1 ± 0.10^{a}	7.5 ± 0.14^{b}	6.9 ± 0.12^{c}
Binding	8.0 ± 0.10^{a}	7.9 ± 0.12^{a}	7.2 ± 0.14^{b}	6.6 ± 0.12^{c}
Overall acceptability	8.3 ± 0.12^{a}	8.2 ± 0.10^{a}	7.5 ± 0.14^{b}	6.9 ± 0.12^{c}

Means bearing same superscripts row-wise do not differ significantly ($P<0.05$).

**Sensory attributes were evaluated on a 9 – point descriptive scale (wherein 1 = extremely undesirable; 9 = extremely desirable).

Conclusion

The findings of the present study indicated that goat tripe can be effectively utilized for development of acceptable quality shami kebabs. Incorporation of goat tripe significantly influenced physico-chemical and sensory characteristics of the products. Based on physico-chemical and sensory evaluation results, it can be concluded that 75% goat meat and 25% goat tripe can be successfully used for preparation of shami kebabs without adversely affecting product quality and acceptability. Utilization of goat tripe in value added meat products could improve economic returns and effective utilization of edible slaughter house by-products.

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