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Development of chevon popcorn coated with millet flour

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Abstract
The study was conducted to develop chevon popcorn coated with millet flour. The chevon popcorn mixture was made by mixing and grinding deboned chevon meat, salt, oil, onion garlic paste, dry spices, pepper powder, chilli powder and maida. The mixture was divided into portions of 3-5 g each and it has been subjected to cooking by placing in water at 80^{O}C for 30 minutes. The popcorn coating was prepared using maida, cornflour, salt, white pepper powder, garlic powder, onion powder, baking soda. In control only maida and cornflour was used in equal proportion with the other ingredients. In treatments T1, T2 and T3 ratio of maida and cornflour was replaced at the rate of 10, 20 and 30 % millet flour mix (Sorghum flour, Kodo millet flour, Pearl millet flour in 1:1:1), respectively. The sensory scores revealed that appearance, flavour, texture, crust crispiness and overall acceptability were very desirable for all the products. There is no significant difference in the sensory scores of the control and treatments. Hence, millet flour could be used as the coating mixture with added health benefit in the chevon popcorn.

Keywords: Chevon, popcorn, sorghum flour, kodo millet flour, pearl millet flour

Introduction
Chevon (goat meat) is a protein rich, low-fat red meat and thus may be an excellent source of lean in the preparation of low-fat meat products (James and Berry, 1997). [6] Its health promoting chemical composition like lower total fat, saturated fatty acid and cholesterol content, fulfils the expectations of consumers' demand for healthful foods and thus explaining its growing popularity and increased demand (Mazhangara *et al*., 2019). [10] But it has low fiber content. Lack of dietary fibre content in meat could be pointed as one of the major reasons for the negative impact on consumption of meat products (Vasanthi *et al*., 2024). [16] Incorporating non-meat ingredient sources rich in dietary fibre into meat enhances the functional quality of meat products and addressing the health needs of the consumers (Verma *et al*., 2012) [18]. Millets are a family of widely different small-seeded grasses commonly cultivated as cereal crops or grains for human food across the globe. It is considered as high-energy yielding nourishing foods which help in addressing malnutrition. Grains of millets are widely consumed as a source of traditional medicines and important food to preserve health (Nithiyanantham *et al*., 2019). [11] Millets are the "Nutri cereals" which have a low - glycaemic index and therefore it can be used as an alternative food for weight control and to reduce the risk of chronic diseases, such as diabetes (Martin *et al*., 2018). [9] Sorghum (*Sorghum bicolor*) millets are rich in vitamins and minerals. It's also an excellent source of fiber, protein, phenolic compounds, phenolic acids, flavonoids and tannins (Dykes and Rooney, 2006). [4] Kodo millets (*Paspalum scrobiculatum*) are rich in B vitamins (especially niacin, B6 and folic acid) and minerals (calcium, iron, potassium, magnesium and zinc). Pearl millet (*Pennisetum glaucum*) grains have a high potential as food for humans because they are gluten-free, higher in dietary fiber and essential amino acids like leucine, isoleucine and lysine (Venkatachalapathy *et al*., 2019) [17].

Enrobing/coating is the process of making "further processed products" by applying edible coating to the products. It includes two distinct steps, i.e., breading and battering. It brings several advantages to meat products such as value addition, versatility to consumers and improvement of nutritive value and microbial qualities of the products (Richardson, 1989). [12] It can also significantly enhance the sensory qualities of meat products and could be an effective method of value addition with better consumer acceptability (Ahamed *et al*., 2007). [1] Salt, pepper, red chilli flakes, parsley, corn flour and bread crumbs were used commonly for dipping and coating enrobed products (Dayakar et al 2022) [2]. Nowadays there is a rising demand for the healthy and tasty ready to eat meat products among the consumers. To meet the demand of healthy and nutritious meat food item, the incorporation of millet grains and its byproducts play a key role (Talukder and Sharma, 2015). [15] Hence, the present study was planned to develop chevon popcorn coated with millet flour to have added health benefits.

Materials and Methods
Procurement of raw materials
Deboned was purchased from local market, Puducherry and used for popcorn preparation in the Department of Livestock Products Technology, Rajiv Gandhi Institute of Veterinary Education and Research (RIVER), Puducherry. The fat and connective tissues were removed from the meat and cut into small cubes of about 4–5 cm then packed in LDPE bags and stored in freezer (Blue star) (-18^{0}C) till

further use. The other ingredients required for the popcorn preparation was purchased from local market, Puducherry.

Preparation of millet flour mix

The Sorghum, Kodo millet and pearl millet used in the study were cleaned and dried in hot air oven at 37^0C for 3 hours, then it has been ground into fine powder using home mixer grinder, separately. The millet flour mix (Fig 1) was prepared by mixing Sorghum flour, Kodo millet flour and Pearl millet flour in equal proportion (1:1:1).

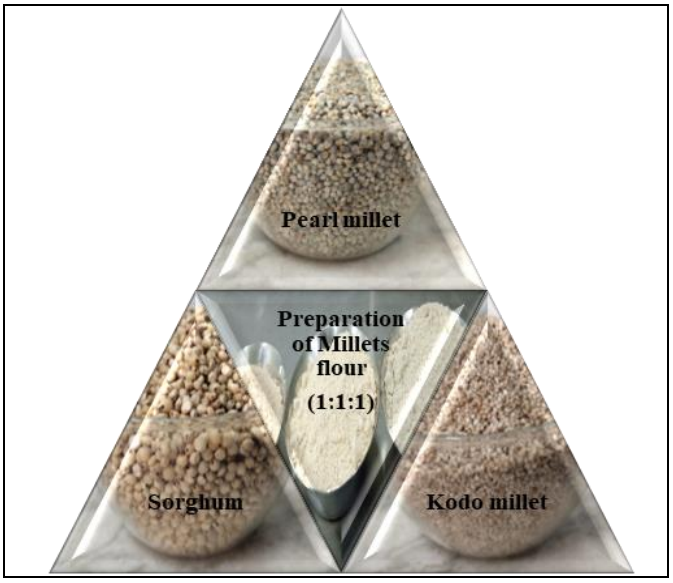

Fig 1: Millet flour mix

Preparation of chevon popcorn coating mix with millets millet flour

The chevon popcorn coating mix incorporated with different levels of millet flour were presented in table 1. The basic coating mix consists of refined wheat flour (50%) and corn flour (50%). In treatment 1,2 and 3 basic coating mix were replaced with millet flour mix at the rate of 10, 20 and 30%, respectively. Other ingredients like salt, onion powder, garlic powder, chilli powder and white pepper powder were mixed with the flour mix in the required quantity (included over the level of flour). All the ingredients should be mixed properly to obtain the chevon popcorn coating mix with millets millet flour.

Table 1: Chevon popcorn coating mix incorporated with different levels of millet flour

Ingredients	Control	Treatment 1 (T1)	Treatment 2 (T2)	Treatment 3 (T3)
Basic coating mix (Refined wheat flour and corn flour 1:1)	100%	90%	80%	70%
Millet flour mix	Nil	10%	20%	30%
Salt	4 %	4 %	4 %	4 %
Onion powder	2%	2%	2%	2%
Garlic powder	2%	2%	2%	2%
Chilli powder	2%	2%	2%	2%
White pepper powder	2%	2%	2%	2%

Preparation of chevon popcorn

The standardized recipe of chevon popcorn contains deboned chevon meat and other ingredients like salt, oil, onion garlic paste, dry spices, pepper powder, chilli powder and maida on the basis of meat weight (table 2). The frozen deboned chevon meat was thawed, minced by passing through 8mm plate in a meat mincer (Mado shop Mincer Junior, Germany). The chevon popcorn mixture was prepared using food processor by mixing minced meat, salt and chilled water for 3 minutes, then vegetable oil was added and mixed for 2 minutes. Then onion garlic paste, dry spices, pepper powder, chilli powder and refined wheat flour were mixed for 2 min to get the chevon popcorn mixture. The chevon popcorn mixture was divided into small portions of 3-4 g each and subjected for cooking by placing in hot water at 80° C for 30 minutes to get the chevon popcorn balls. Then each cooked ball was dipped in corn flour slurry and coated with the chevon popcorn flour mix and deep fat fried in oil to obtain tasty chevon popcorn (Fig 2).

Table 2: Standardized recipe of chevon popcorn

Ingredients	Percentage
Deboned chevon meat	100
Salt	1
Oil	5
Onion garlic paste	2
Dry spices	0.5
Chilli powder	0.25
Pepper powder	0.25
Refined wheat flour	3
Chilled water	8

1. Deboned meat

2. Ingredients

3. Chevon popcorn mixture

4. Cooked meat portions

5. Chevon popcorn

Fig 2: Steps involved in preparation of chevon popcorn

Sensory evaluation

The chevon popcorn coated with millet flour was judged by the semi-trained panelists consisting of faculty and post-graduate students of RIVER, Puducherry, for appearance, flavour, texture, crispiness and overall acceptability using 8-point descriptive scale (Keeton, 1983) [8].

Statistical analysis

The experiment was replicated thrice. The data were analyzed using SPSS version 16.0 MSI (SPSS, Chicago, U.S.A). One-way analysis of variance (ANOVA) was used for sensory analysis. The level of significant effects was tested using the least significant difference (LSD) test (Snedecor and Cochran, 1995). [14]

Result and Discussion

The sensory score (table 3) of chevon popcorn coated with millet flour for appearance were 7.23, 7.16, 7.10, 7.06 for control, T1, T2 and T3 respectively. The flavour score of chevon popcorn coated with different level millet flour were ranged from 7.10 to 7.16. The texture score of chevon popcorn was 7.26, 7.20, 7.13 and 7.10 for control, T1, T2 and T3, respectively. The crispiness scores for control (7.16) and for the treatments ranged between (7.03 to 7.10). The acceptability scores for the control and treatments were in the range of 7.33 to 7.50. Sensory scores revealed that appearance, flavour, texture, crispiness and overall acceptability were very desirable for control and treatments. There is no significant difference in the sensory scores of the control and treatments for any of the sensory attributes which denotes the high level of acceptability of the chevon popcorn coated with different level of millet flour. Coating has invariably increased the acceptability of the chevon popcorn with added health benefits. Similarly, Gauri *et al*., (2014) [5] reported that sensory quality parameters like colour, flavour, juiciness, crispiness and overall acceptability were significantly ($P<0.05$) higher in enrobed goat meat bites than the non-enrobed goat meat bites. Jen *et al*., (2007) [7] observed that juiciness scores of the cooked ground beef patties extended with different level of sorghum flour (2, 4 and 6%) were not affected and also found that tenderness of cooked patties increased as the level of sorghum flour increased. Vasanthi *et al*., (2024) [16] prepared 7% Kodo millet flour incorporated chicken nuggets and witnessed the following sensory scores for appearance (6.54), flavour (7.30), juiciness (7.37), texture (7.37) and overall acceptability (7.61). In low fat chicken meat balls fortified with 7% pearl millet flour had the sensory scores of 7.50, 7.17, 6.75, 6.58, 7.08, 7.17 for appearance, flavour, juiciness, texture, tenderness and overall acceptability, respectively and all the scores were above 'very acceptable' level (Santhi *et al*., 2023) [13]. Sorghum flour could be effectively incorporated at the level of 5% in the preparation of gluten free chicken nuggets without affecting the sensory qualities. There is no significant difference between the control and 5 % sorghum flour incorporated product the scores were 6.85, 7.00, 7.17 and 7.17 for colour, flavour, juiciness and texture (Devatkal *et al*., 2011). [3]

Table 3: Effect on the sensory quality of chevon popcorn coated with millet flour (Mean±SE)

Parameter	Control	Treatment 1	Treatment 2	Treatment 3
Appearance	7.23±0.078	7.16±0.069	7.10±0.055	7.06±0.046
Flavour	7.20±0.088	7.16±0.069	7.10±0.073	7.13±0.063
Texture	7.26±0.082	7.20±0.074	7.13±0.079	7.10±0.055
Crispiness	7.16±0.069	7.10±0.055	7.03±0.033	7.03±0.058
Acceptability	7.50±0.104	7.46±0.092	7.33±0.099	7.36±0.101

Conclusion

Highly acceptable chevon popcorn preparation process was optimized and Millet flour (Sorghum flour, Kodo millet flour, Pearl millet flour) could be used in the coating mixture up to 30% by replacing the basic coating material of corn and refined wheat flour with added health benefit.

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