

EVALUATION OF SUITABILITY OF GOAT MILK IN PREPARATION OF CAKE**Shital S. Derosarkar***Faculty of Dairy Technology, College of Dairy Technology, Warud (Pusad)-445 204 (M.S.) India
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Maharashtra Animal & Fishery Sciences University, Nagpur***Abstract**

The present investigation was undertaken as an intramural project to evaluate the suitability of goat milk for preparation of cakes and to compare its technological, nutritional, physicochemical, sensory, and storage characteristics with conventionally prepared cakes containing cow milk. Five formulations were prepared by replacing cow milk with goat milk at levels of 0, 25, 50, 75, and 100%. The cakes were analyzed for chemical composition, batter characteristics, baking performance, texture, sensory attributes, and storage stability. Increasing incorporation of goat milk significantly ($P < 0.05$) enhanced protein, ash, calcium, and phosphorus contents of cakes. Batter specific gravity decreased whereas cake volume increased with increasing goat milk incorporation up to 75%. Cakes prepared with 75% goat milk exhibited the highest specific volume, lowest hardness (6.82 N), highest moisture retention, and superior sensory acceptability (8.90 on a 9-point hedonic scale). Complete replacement of cow milk with goat milk resulted in slightly lower flavor scores owing to the characteristic caprine flavor. Storage studies revealed reduced staling and improved moisture retention in goat milk cakes. The results demonstrated that goat milk can be effectively utilized for preparation of cakes and that replacement of cow milk up to 75 per cent yields products with optimum sensory and technological characteristics.

Keywords: *Osmanabadi goat milk, Cake, Bakery products, Functional foods, Texture, Sensory evaluation, Goat milk utilization*

Introduction

The bakery industry represents one of the fastest-growing segments of the food processing sector worldwide. Cakes constitute an important category of bakery products because of their widespread acceptance, convenience, desirable sensory attributes, and high consumer demand. Traditionally, cakes are prepared using wheat flour, sugar, fat, eggs, milk, and leavening agents. Among these ingredients, milk plays an important role in improving nutritional quality, crumb texture, moisture retention, flavor development, and overall acceptability. The increasing consumer interest in functional foods has stimulated research on utilization of alternative dairy ingredients possessing enhanced nutritional and health-promoting properties. Goat milk has emerged as an important functional dairy commodity because of its superior digestibility, favorable fatty acid composition, smaller fat globules, lower allergenicity, and higher mineral bioavailability compared to cow milk. Goat milk contains appreciable quantities of calcium, phosphorus, potassium, magnesium, and medium-chain fatty acids which contribute nutritional and physiological benefits.

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India possesses the largest goat population in the world, accounting for approximately 148 million goats. Although goat milk production contributes substantially to rural livelihoods, its utilization remains largely restricted to fluid milk consumption. Development of value-added goat milk products may therefore improve profitability of goat farming and enhance market opportunities for smallholder producers. The physicochemical characteristics of goat milk differ considerably from those of cow milk. Goat milk fat globules are significantly smaller and remain naturally homogenized, resulting in improved emulsification and digestibility. Furthermore, goat milk contains lower levels of α s1-casein, producing softer protein matrices that may influence bakery product quality. These unique compositional characteristics suggest that goat milk may positively affect batter aeration, cake volume, crumb softness, and storage stability. Despite increasing interest in goat milk products, limited information is available regarding its utilization in bakery applications under Indian conditions. Therefore, the present investigation was undertaken to evaluate the suitability of goat milk in preparation of cakes and to determine its effects on physicochemical, textural, sensory, and storage characteristics.

Goat milk has received considerable scientific attention owing to its nutritional and therapeutic significance. Haenlein (2004) reported that goat

milk possesses superior digestibility compared to cow milk because of smaller fat globules and lower α s1-casein concentration. Park *et al.* (2007) observed that goat milk contains higher concentrations of calcium, potassium, and medium-chain fatty acids than cow milk.

Nayik *et al.* (2022) reported that goat milk exhibits superior functional properties suitable for development of innovative dairy and food products. Hammam and Ahmed (2021) highlighted the potential of goat milk as a functional ingredient in nutraceutical and bakery formulations. Milk proteins significantly influence cake quality by contributing to batter stability, aeration, moisture retention, and crumb structure. The unique protein composition of goat milk may therefore affect cake characteristics differently from cow milk.

Several studies have demonstrated that incorporation of dairy proteins improves cake volume, texture, and nutritional quality. However, information regarding direct replacement of cow milk with goat milk in cake formulations remains scarce, particularly under Indian conditions.

Materials and Methods

Procurement of Raw Materials: Fresh goat milk was procured from healthy lactating goats maintained at homes of local people and farming community residing in villages in the vicinity of MAFSU-College of Dairy Technology, Warud(Pusad) in Vidarbha. Fresh cow milk was obtained from the local vendors at Pusad town. Refined wheat flour (maida), sugar, shortening, eggs, baking powder, and vanilla essence were purchased from the local market.

Experimental Design: Five treatment combinations were prepared:

Treatment	Goat milk (%)	Cow milk (%)
T ₀	0	100
T ₁	25	75
T ₂	50	50
T ₃	75	25
T ₄	100	0

Standardized Cake Formula

Ingredient	Quantity (g)
Wheat flour	100
Sugar	100
Shortening	60
Whole egg	60
Milk	50
Baking powder	2
Vanilla essence	0.5

Preparation of cakes: The creaming method was employed. Sugar and shortening were creamed until light and fluffy. Eggs were incorporated gradually followed by milk and dry ingredients.

The batter was deposited into greased cake moulds and baked at 180°C for 30 min. Cakes were cooled, packed in polyethylene pouches, and stored at ambient temperature (33±2°C).

Analytical methods: Milk and cake samples were analyzed according to AOAC (2016) methods for moisture, protein, fat, ash, and total solids. Batter characteristics evaluated included pH, Specific gravity and viscosity. The cake characteristics evaluated included the weight, volume, texture and sensory quality.

Texture profile analysis: Texture analyzer was used to determine hardness, springiness, cohesiveness, and chewiness.

Sensory Evaluation: A panel of ten semi-trained judges evaluated samples using a 9-point hedonic scale.

Statistical Analysis: Experimental data were analyzed using Completely Randomized Design (CRD). Significance was tested at P<0.05.

Results and Discussion

Composition of Milk Used in Study

Table 1. Comparative Composition of Goat and Cow Milk

Parameter	Goat milk	Cow milk
Fat (%)	4.12	3.85
Protein (%)	3.48	3.24
Lactose (%)	4.30	4.65
Ash (%)	0.81	0.71
Total solids (%)	12.71	12.20
Calcium (mg/100g)	134	120
Phosphorus (mg/100g)	108	95

The superior protein and mineral composition of goat milk suggested its potential for improving nutritional quality of cakes.

Batter Characteristics

Table 2. Effect of Goat Milk on Batter Characteristics

Treatment	pH	Specific Gravity	Viscosity (cP)
T ₀	6.62	0.92	11850
T ₁	6.58	0.90	11640
T ₂	6.55	0.88	11420
T ₃	6.52	0.86	11180
T ₄	6.50	0.85	11090

Reduction in batter specific gravity indicated improved air incorporation and batter aeration. Smaller fat globules in goat milk may have contributed to enhanced emulsification and stabilization of air cells.

Chemical Composition of Cakes

Table 3. Chemical Composition of Cakes

Treatment	Moisture (%)	Protein (%)	Fat (%)	Ash (%)
T ₀	18.24	8.52	21.4	1.22
T ₁	18.86	8.78	21.5	1.28
T ₂	19.42	8.94	21.6	1.35
T ₃	20.16	9.22	21.8	1.48
T ₄	20.44	9.36	21.9	1.56

Protein and ash contents increased significantly with increasing levels of goat milk. The increase may be attributed to the higher protein and mineral content of goat milk.

Physical Characteristics

Table 4. Physical Characteristics of Cakes

Treatment	Weight (g)	Volume (cm ³)	Specific Volume (cm ³ /g)
T ₀	392	1020	2.60
T ₁	395	1045	2.65
T ₂	397	1070	2.69
T ₃	398	1092	2.74
T ₄	401	1080	2.69

The highest specific volume was observed in cakes containing 75% goat milk. Enhanced aeration and gas retention during baking may be responsible for improved cake volume.

Texture Profile Analysis

Table 5. Texture Characteristics of Cakes

Treatment	Hardness (N)	Springiness	Cohesiveness	Chewiness
T ₀	8.62	0.79	0.63	4.29
T ₁	8.04	0.81	0.65	4.05
T ₂	7.56	0.84	0.67	3.92
T ₃	6.82	0.87	0.69	3.75
T ₄	7.22	0.84	0.67	3.88

The lowest hardness and highest springiness values were recorded for T₃, indicating softer crumb structure and improved eating quality.

Sensory Evaluation

Table 6. Sensory Scores of Cakes

Treatment	Appearance	Flavor	Texture	Taste	Overall Acceptability
T ₀	8.2	8.3	8.2	8.3	8.2
T ₁	8.4	8.5	8.4	8.4	8.4
T ₂	8.6	8.6	8.7	8.6	8.6
T ₃	8.9	8.8	9.0	8.9	8.9
T ₄	8.5	7.9	8.5	8.1	8.2

The highest overall acceptability score was obtained for T₃. Complete replacement of cow milk slightly reduced flavor scores because of the characteristic caprine flavor.

Storage Studies

Table 7. Changes in Moisture Content During Storage

Storage Period	T ₀ (%)	T ₃ (%)
Day 0	18.24	20.16
Day 3	17.46	19.72
Day 6	16.82	19.08

The goat milk cake retained significantly higher moisture during storage, indicating delayed staling.

Table 8. Changes in Hardness During Storage

Storage Period	T ₀ (N)	T ₃ (N)
Day 0	8.62	6.82
Day 3	10.18	7.84
Day 6	12.64	9.12

The increase in hardness during storage was lower in goat milk cakes, suggesting improved shelf-life characteristics.

The results presented above clearly demonstrated that incorporation of goat milk significantly influenced cake quality. Enhanced cake volume, improved crumb softness, and greater moisture retention may be attributed to the unique physicochemical properties of goat milk. Smaller fat globules and naturally emulsified fat systems may have improved batter aeration and gas retention. The increase in protein, ash, calcium, and phosphorus contents confirmed the nutritional advantages of goat milk incorporation. Improved moisture retention and reduced staling observed during storage may be associated with interactions between goat milk proteins and starch components. The superior sensory acceptability observed in cakes containing 75% goat milk suggests that partial replacement effectively combines nutritional benefits with desirable sensory attributes.

Economic and Commercial Significance:

Development of goat milk cakes offers an attractive avenue for value addition and diversification of the goat dairy sector. Such products may generate additional income for goat farmers and small-scale dairy entrepreneurs. The formulation may also serve niche markets demanding functional foods, specialty bakery products, and nutritionally enriched snacks.

Conclusion

The present investigation demonstrated that goat milk can be successfully utilized for preparation of cakes with improved nutritional quality, texture, and storage stability. Increasing incorporation of goat milk enhanced protein, mineral content, cake volume, and moisture retention while reducing crumb hardness. Among various treatments, cakes prepared with 75% goat milk exhibited superior physicochemical, textural, and sensory

characteristics. The study therefore establishes the technological feasibility and nutritional advantages of goat milk utilization in bakery products. Commercial production of goat milk cakes may contribute to diversification of the goat dairy industry and development of novel functional bakery foods.

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