# STANDARDIZATION OF A METHOD FOR PREPARATION OF ORANGE PULP FORTIFIED *SHRIKHAND* FROM *OSMANIBADI* GOAT MILK

**Shital S. Derosarkar**
*Faculty of Dairy Technology, College of Dairy Technology, Warud (Pusad)-445 204 (M.S.) India*
*Maharashtra Animal & Fishery Sciences University, Nagpur*

**C.D. Khedkar**
*Faculty of Dairy Technology, College of Dairy Technology, Warud (Pusad)-445 204 (M.S.) India*
*Maharashtra Animal & Fishery Sciences University, Nagpur*

**Abstract**
*The present investigation was undertaken to standardize a method for preparation of orange pulp fortified goat milk Shrikhand and evaluate its physicochemical, microbiological, sensory, nutritional, antioxidant, and storage characteristics. Osmanabadi goat milk was utilized for preparation of chakka, which was subsequently blended with orange pulp at different levels. The treatments consisted of control Shrikhand prepared without orange pulp and experimental products containing 5, 10, 15, and 20% orange pulp. The products were evaluated for compositional attributes, acidity, pH, vitamin C content, antioxidant activity, sensory quality, and storage stability under refrigerated conditions. Incorporation of orange pulp significantly enhanced vitamin C content, antioxidant activity, flavor, and consumer acceptability of the product. Among the treatments, Shrikhand containing 15% orange pulp exhibited the highest overall acceptability score (8.86 on a 9-point hedonic scale). Antioxidant activity increased from 11.4% in control to 42.8% in optimized orange Shrikhand. The product maintained satisfactory microbiological quality and sensory characteristics for up to 14 days under refrigerated storage. The study demonstrated that goat milk can be successfully utilized for manufacture of value-added functional Shrikhand enriched with orange bioactive compounds.*

***Keywords:*** *Goat milk, Orange Shrikhand, Functional dairy food, Antioxidants, Vitamin C*

## Introduction

India is the world's largest milk-producing nation and possesses a rich heritage of fermented dairy products. Among traditional fermented milk products, Shrikhand occupies a unique position owing to its pleasant flavor, creamy texture, high nutritional value, and widespread consumer acceptance. Traditionally, Shrikhand is prepared from chakka obtained by draining whey from dahi followed by incorporation of sugar and flavoring agents. Growing consumer awareness regarding the role of diet in health promotion has stimulated development of functional dairy products enriched with bioactive compounds. Fruits constitute an important source of antioxidants, vitamins, minerals, flavonoids, carotenoids, and dietary fiber. Incorporation of fruit-derived bioactive compounds into dairy foods not only improves nutritional quality but also enhances consumer appeal.Goat milk has attracted considerable scientific attention because of its superior digestibility, smaller fat globules, lower allergenicity, and favorable nutritional profile. Goat milk contains highly digestible proteins and medium-chain fatty acids that contribute to improved nutrient utilization. Moreover, the unique physicochemical characteristics of goat milk make it suitable for development of novel fermented dairy products.

Orange (*Citrus sinensis*) is one of the most widely consumed citrus fruits and is recognized for its high vitamin C content, antioxidant activity, flavonoids, carotenoids, and health-promoting phytochemicals. Citrus bioactives have been associated with protection against oxidative stress and improvement of immune function. Incorporation of orange pulp into goat milk Shrikhand may therefore provide an opportunity to develop a functional dairy product with enhanced nutritional and sensory attributes.Although extensive research has been conducted on fruit-flavored fermented dairy products, information regarding goat milk orange Shrikhand remains limited. Therefore, the present investigation was undertaken to standardize a method for preparation of goat milk orange Shrikhand and evaluate its quality characteristics.

## Objectives

The study was conducted with the following objectives:

- To standardize a method for preparation of goat milk orange Shrikhand.
- To optimize the level of orange pulp incorporation.
- To evaluate physicochemical and sensory characteristics of the product.
- To determine antioxidant activity and vitamin C content and
- To study storage stability under refrigerated conditions.

## Materials and Methods

**Procurement of Raw Materials:**Fresh goat milk was procured from healthy lactating goats maintained at the university dairy farm. Fully ripe sweet oranges were obtained from local markets. Commercial starter cultures consisting of *Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus* were used for fermentation.

**Preparation of Orange Pulp:**Fresh oranges were washed, peeled, and segmented. Seeds were removed manually. The pulp was homogenized and pasteurized at 80°C for 5 min followed by cooling to room temperature.

**Preparation of Chakka:** Goat milk was standardized to 4.5 per cent fat and heated to 85°C for 30 min. The milk was cooled to 42°C and inoculated with 2 per cent starter culture. After incubation for 8–10 h, coagulated curd was transferred to muslin cloth and allowed to drain whey for 12 h under refrigerated conditions to obtain chakka.

**Preparation of Orange Shrikhand:** The chakka was mixed with sugar at 40 per cent of chakka weight. Orange pulp was incorporated according to the treatment schedule.

**Treatment Details**

| Treatment | Orange Pulp (%) |
|---|---|
| $T_0$ | 0 |
| $T_1$ | 5 |
| $T_2$ | 10 |
| $T_3$ | 15 |
| $T_4$ | 20 |

The mixture was homogenized and packed in polypropylene cups before storage at 5±1°C.

**Analytical Methods:** The samples were analyzed for, total solids, fat, protein, ash, titratable acidity, pH, Vitamin C, Total phenolic content and Antioxidant activity (DPPH assay). The procedure given by AOAC (2016) were followed.

**Sensory Evaluation: t**he products were evaluated by a panel of ten semi-trained judges using a nine-point hedonic scale for color and appearance, flavor, body and texture, sweetness, and overall acceptability.

**Statistical analysis of the data:**The experiment was conducted using Completely Randomized Design (CRD). Data were analyzed statistically and significance was tested at $P<0.05$.

## Results and Discussion

### Composition of Goat Milk

**Table 1. Composition of Goat Milk Used for Shrikhand Manufacture**

| Parameter | Value |
|---|---|
| Fat (%) | 4.25 |
| Protein (%) | 3.48 |
| Lactose (%) | 4.32 |
| Ash (%) | 0.82 |
| Total solids (%) | 12.87 |
| Acidity (% LA) | 0.17 |

The composition was within the normal range reported for goat milk and was considered suitable for preparation of fermented dairy products.

### Physicochemical Characteristics of Goat Milk Orange Shrikhand

**Table 2. Physicochemical Characteristics of Shrikhand**

| Treatment | Total Solids (%) | Fat (%) | Protein (%) | Acidity (%) | pH |
|---|---|---|---|---|---|
| $T_0$ | 59.2 | 8.8 | 8.4 | 1.06 | 4.42 |
| $T_1$ | 58.8 | 8.7 | 8.3 | 1.08 | 4.38 |
| $T_2$ | 58.2 | 8.6 | 8.2 | 1.10 | 4.34 |
| $T_3$ | 57.6 | 8.5 | 8.1 | 1.12 | 4.30 |
| $T_4$ | 56.8 | 8.4 | 8.0 | 1.15 | 4.26 |

A slight decrease in total solids and pH was observed with increasing levels of orange pulp due to dilution and presence of organic acids.

### Vitamin C Content

**Table 3. Vitamin C Content of Goat Milk Orange Shrikhand**

| Treatment | Vitamin C (mg/100g) |
|---|---|
| $T_0$ | 1.8 |
| $T_1$ | 9.6 |
| $T_2$ | 15.8 |
| $T_3$ | 21.6 |
| $T_4$ | 27.4 |

Vitamin C content increased significantly with increasing levels of orange pulp incorporation.

### Antioxidant Activity

**Table 4. Antioxidant Activity of Goat Milk Orange Shrikhand**

| Treatment | DPPH Scavenging Activity (%) |
|---|---|
| $T_0$ | 11.4 |
| $T_1$ | 22.8 |
| $T_2$ | 31.6 |
| $T_3$ | 42.8 |
| $T_4$ | 47.5 |

The increase in antioxidant activity may be attributed to citrus flavonoids, vitamin C, and phenolic compounds present in orange pulp.

**Sensory Evaluation**

**Table 5. Sensory Scores of Goat Milk Orange Shrikhand**

| Treatment | Flavor | Body & Texture | Color & Appearance | Overall Acceptability |
|---|---|---|---|---|
| $T_0$ | 8.12 | 8.18 | 8.10 | 8.13 |
| $T_1$ | 8.34 | 8.30 | 8.42 | 8.35 |
| $T_2$ | 8.60 | 8.52 | 8.68 | 8.60 |
| $T_3$ | 8.88 | 8.82 | 8.90 | 8.86 |
| $T_4$ | 8.32 | 8.18 | 8.74 | 8.38 |

Shrikhand containing 15 per cent orange pulp received the highest sensory scores. Higher levels resulted in slight reduction in flavor acceptability because of increased citrus acidity.

**Storage Studies**

**Table 6. Changes in Overall Acceptability During Storage**

| Storage Period (Days) | $T_0$ | $T_3$ |
|---|---|---|
| 0 | 8.13 | 8.86 |
| 7 | 7.94 | 8.54 |
| 14 | 7.62 | 8.18 |

The optimized product maintained acceptable sensory quality throughout refrigerated storage.

The results demonstrated that orange pulp can be effectively incorporated into goat milk Shrikhand to improve nutritional and functional attributes. The increase in antioxidant activity and vitamin C content confirmed successful enrichment with citrus bioactives. The superior sensory acceptability observed in $T_3$ suggested that incorporation of 15 per cent orange pulp provided optimum balance between sweetness, acidity, and citrus flavor. Goat milk contributed desirable body and texture characteristics owing to its fine fat globules and highly digestible protein matrix. The product represents a promising example of functionalization of traditional Indian dairy foods using natural fruit ingredients.

**Industrial Significance**

The developed product offers several advantages including value addition of goat milk, diversification of traditional dairy products, enhancement of nutritional quality, utilization of citrus fruits, and development of functional dairy foods for health-conscious consumers. The technology may be adopted by dairy cooperatives, small-scale entrepreneurs, and artisanal dairy processors.

**Conclusion**

The study demonstrated successful standardization of a method for preparation of goat milk orange Shrikhand. Incorporation of orange pulp significantly improved antioxidant activity, vitamin C content, and sensory quality. Among the treatments, Shrikhand containing 15 per cent orange pulp exhibited the highest overall acceptability and desirable physicochemical characteristics. The developed product possesses considerable potential as a functional dairy food and provides an innovative avenue for value addition of goat milk.

**References**

1. AOAC (2016). Official Methods of Analysis. Association of Official Analytical Chemists, Washington DC, USA.
2. Haenlein GFW (2004). Goat milk in human nutrition. Small Ruminant Research 51: 155–163.
3. Park YW, Juarez M, Ramos M and Haenlein GFW (2007). Physicochemical characteristics of goat milk. Small Ruminant Research 68: 88–113.
4. Nayik GA, Dar BN and Nanda V (2022). Goat milk: Nutritional profile, processing and product development. Dairy 3: 418–437.
5. Giampieri F, Alvarez-Suarez JM and Battino M (2017). Citrus and fruit bioactives in functional foods. Nutrition Reviews 75: 27–41.
6. Granato D, Barba FJ, Kovačević DB, Lorenzo JM, Cruz AG and Putnik P (2020). Functional dairy products and consumer health. Food Research International 129: 108118.
7. Walstra P, Wouters JTM and Geurts TJ (2006). Dairy Science and Technology. CRC Press, Boca Raton, USA.