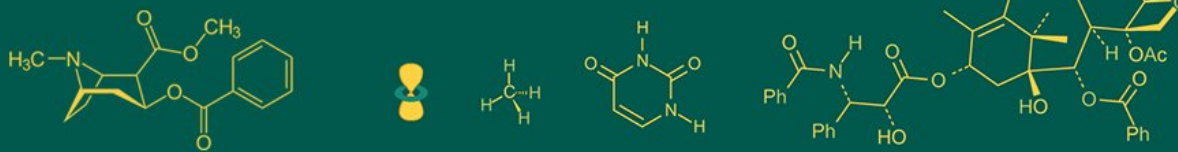


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Ankur Trivedi
 Ph.D. Scholar, Dairy
 Technology Division, ICAR-
 National Dairy Research
 Institute, Karnal, Haryana,
 India

Tarun Verma
 Assistant Professor,
 Department of Dairy Science
 and Food Technology,
 Institute of Agriculture
 Science, Banaras Hindu
 University, Varanasi, Uttar
 Pradesh, India

Deshmukh RR
 Ph.D. Scholar, Dairy
 Microbiology Division, ICAR-
 National Dairy Research
 Institute, Karnal, Haryana,
 India

Somveer
 Ph.D. Scholar, Dairy
 Engineering Division, ICAR-
 National Dairy Research
 Institute, Karnal, Haryana,
 India

Ankur Aggarwal
 Ph.D. Scholar, Department of
 Dairy Science and Food
 Technology, Institute of
 Agriculture Science, Banaras
 Hindu University, Varanasi,
 Uttar Pradesh, India

Corresponding Author:
Ankur Trivedi
 Ph.D. Scholar, Dairy
 Technology Division, ICAR-
 National Dairy Research
 Institute, Karnal, Haryana,
 India

Flaxseed enriched dietary Peda: A nutritious delight with flaxseed powder

Ankur Trivedi, Tarun Verma, Deshmukh RR, Somveer and Ankur Aggarwal

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Abstract

India is the world's largest milk producer, with a record production of 209.96 million tons of milk per annum in 2020. Milk production in India has been increasing at an average annual growth rate of 6.3 percent over the past six years. The traditional dairy sector plays a significant role in India, accounting for over 90 percent of all dairy products consumed in the country. Khoa, a partially dehydrated whole milk product, is the main ingredient in various traditional Indian sweets like Peda and Burfi. Peda is a popular khoa-based indigenous dairy product, while Burfi is another khoa-based sweet. Flaxseeds, which are rich in omega-3 fatty acids, and Stevia, a natural sweetener, have been incorporated into Peda to make it more beneficial in terms of nutrition and health. This modified Peda recipe reduces the fat and sugar content, making it a healthier option, particularly for individuals with cardiovascular diseases. Flaxseeds contain omega-3 fats and lignans, which have anti-inflammatory and anti-thrombotic properties. Stevia, on the other hand, is a natural sweetener that provides sweetness without adding calories or affecting blood sugar levels.

Keywords: Flaxseed enriched dietary Peda, flaxseed powder, healthier option

Introduction

India has established itself as the world's foremost milk producer, boasting a record-breaking annual output of 209.96 million tons, surpassing the 2019-2020 production of 198.4 million tons (Food and Agriculture Organization Corporate Statistical Database - FAOSTAT). This impressive growth, averaging 6.3 percent annually over a six-year period, has been duly recognized by the Union Ministry for Fisheries, Animal Husbandry, and Dairying, which honoured the sector with the Gopal Ratan Award. Notably, khoa, accounting for 5.5 percent of total milk production, holds a special place in the production of sweets like Peda, burfi, kalakand, and gulabjamun (Banjare *et al.*, 2015) ^[1]. Khoa, a heat-desiccated dairy product, has been an integral part of Indian sweets for centuries. Varieties such as Pindi, Danedar, Dhap, Mawa, or Kawa are all based on khoa, characterized by a minimum milk fat content of 30 percent on a dry matter basis, without added starch, sugar, or colouring matter (PFA, 2005, FSSAI, 2011) ^[14, 15]. Peda, a beloved Indian sweet, is primarily crafted from khoa. Peda's appeal lies in its nutrition, texture, and flavor, derived from a carefully balanced mixture of khoa, sugar, and natural or artificial color and flavours. Peda and Burfi, two popular khoa-based sweets, enjoy immense popularity in India due to their delectable taste and nutritional richness (Dharam, 2000) ^[16]. While khoa-based products offer high profit margins, their production has remained predominantly small-scale, limiting their reach to local markets because of their relatively short shelf life. Peda, in particular, is favoured for its extended shelf life, making it an ideal offering at Hindu temples and religious events (Karthikeyan & Pandiyan, 2013) ^[17]. Due to consumer demand for foods with superior health advantages, Flaxseed now has fresh chances as a functional food. It has become a popular addition in diets personalized for specific purpose (Gul *et al.*, 2016) ^[18]. Nutritionists and medical researchers are increasingly interested in flaxseed because of the possible health benefits related with its biologically active components-ALA lignin Secoisolariciresinol di glycoside (SDG) and dietary fibre. (Kajla *et al.* 2015) ^[6]. Mahato *et al.*, (2021) ^[8] reported that using stevia to reduce the calorie content of flavoured milk is an alternative. It is vital to maintain customer approval of the product while lowering the sugar level.

Methods and Materials

The research “Development dietary Peda prepared from flaxseed powder” was conducted in the laboratory of Department of Dairy Science and Food Technology, Institute of Agriculture Science, Banaras Hindu University, Varanasi, (U.P.) India.

Procurement of raw milk and analysis of milk

The procurement of raw milk for the preparation of Peda from a dairy farm is a crucial aspect of our study. The method we employed involved a systematic approach to ensure the quality and safety of the raw milk. Firstly, we procure a raw milk from dairy farm, Department of Dairy Science and Food Technology, Institute of Agriculture Science, Banaras Hindu University, Varanasi known for its high-quality milk production. We conducted regular visits to the farm to observe the milking process, ensuring that it adhered to proper hygiene and sanitation standards. Raw milk analysis is done by different method by AOAC, (2003) which is moisture, protein, fat, and ash content of raw milk for quality of milk for Peda preparation.

Collection of raw ingredients for Peda preparation

The researchers obtained several key ingredients from the local market in Varanasi for their research. They acquired flaxseed powder, known for its high omega-3 fatty acid content and importance in health-related investigations, from a trusted local source. Sugar, a crucial element in various food-related investigations, was also obtained from the market. It plays a vital role in the development of palatable products and the study of sugar's impact on

physiological parameters. Additionally, they procured powdered stevia, a natural sweetener, from a reliable local vendor. Stevia was used to explore its potential as a sugar substitute in certain applications.

Milk standardization

Standardizing cow milk for Peda preparation is a vital process in the dairy industry. It involves adjusting the milk's fat and solids-not-fat (SNF) content to achieve specific attributes required for high-quality Peda. Cream is added to increase the fat percentage, while Skimmed Milk Powder (SMP) enhances SNF content. Accurate measurement of these components ensures consistent flavor and texture in Peda batches, meeting consumer expectations.

Treatment combination for flaxseed and formulated Peda

T0: Cow milk *khoa* (4.0% milk fat) + 30 percent sugar by weight of *khoa*.

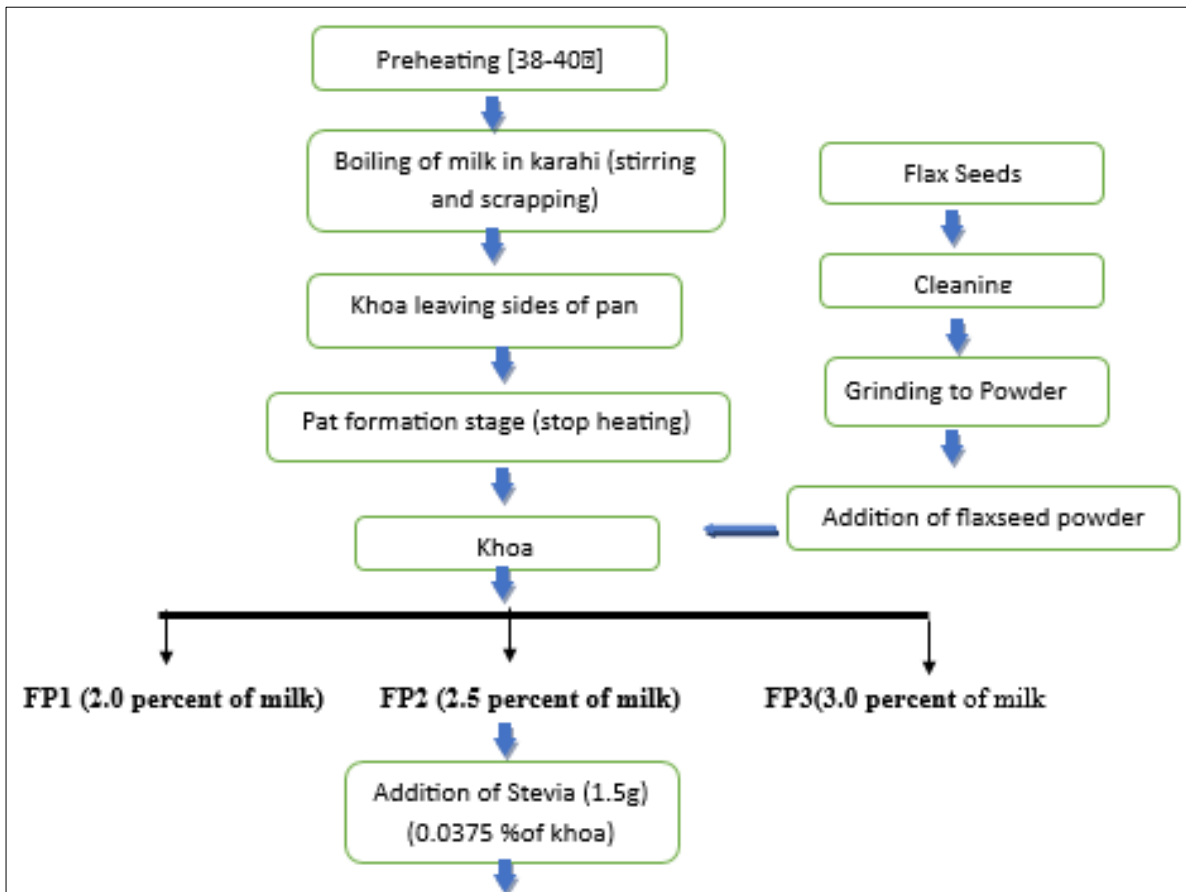
FP1: Cow milk *Khoa* + Flaxseed Powder @ 2.0% of *Khoa* (weight basis) + 0.0375% Stevia by weight of *khoa*.

FP2: Cow milk *Khoa* + Flaxseed Powder @ 2.5% of *Khoa* by weight basis + 0.0375% Stevia by weight of *khoa*.

FP3: Cow milk *Khoa* + Flaxseed Powder @ 3.0% of *Khoa* by weight basis + 0.0375% Stevia by weight of *khoa*.

| Treatment | Cow milk <i>Khao</i> | Flaxseed powder | Sweetener |
|-----------|----------------------|-----------------|-----------|
| T0 | 100 | 0 | 30 gm |
| FP1 | 100 | 2 | 0.0375 gm |
| FP2 | 100 | 2.5 | 0.0375 gm |
| FP3 | 100 | 3 | 0.0375 gm |

Preparation of flaxseed powder incorporated Peda



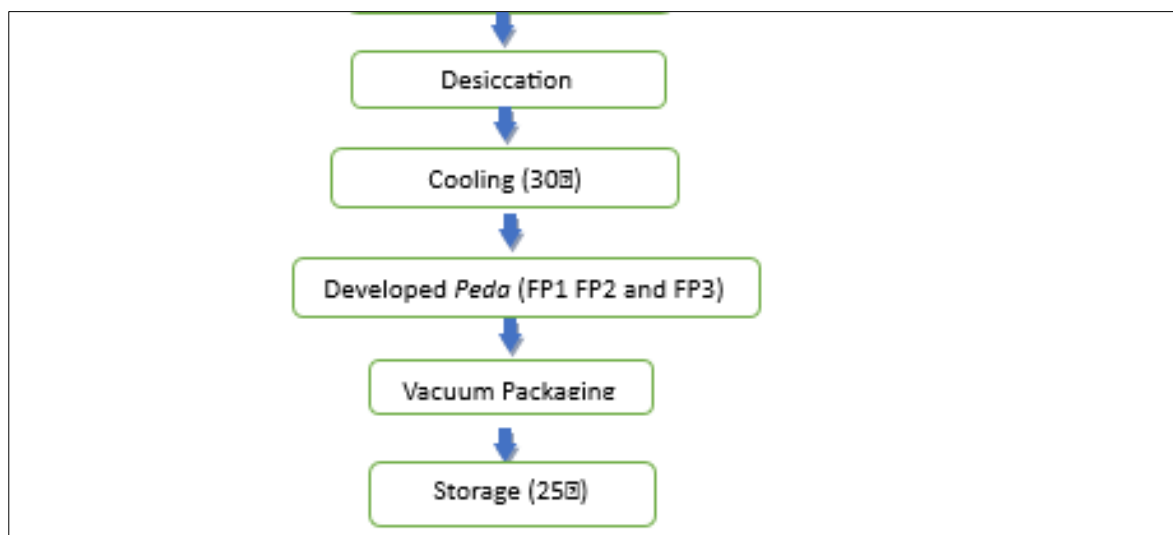


Fig 1: Preparation flow chart of flaxseed powder incorporated Peda

Physico-chemical analysis

The chemical composition of flaxseed enriched Peda was analyzed for various constituents including moisture, protein, fat, and ash content. The analysis was performed following the procedures outlined by the AOAC (Association of Official Analytical Chemists) in 2003. Additionally, the dietary fiber content of the Peda sample was determined using the method described by AOAC in 1975. The total solids content of the Peda sample was measured using the procedure outlined in IS (Indian Standards) 147-9 (Part-II) 1961. In order to determine the total sugar content of the Peda, the volumetric (Lane-Eynon) method as described in ISI (Indian Standards Institute) 1981 was employed. This comprehensive physico-chemical analysis provides valuable information regarding the composition of the flaxseed enriched Peda, enabling a better understanding of its nutritional profile.

Sensory evaluation

A sensory evaluation was conducted to assess the quality of Peda samples. The evaluation involved a panel of ten male and ten female judges randomly selected from the "Department of Dairy Science and Food Technology, BHU, Varanasi". The panel consisted of faculty members, research scholars, and postgraduate students. The sensory evaluation focused on various parameters, including colour and appearance, flavour, body and texture, and overall acceptability of the khoa samples and khoa-based sweets. To ensure accurate assessments, the judges were provided with instructions to familiarize themselves with the evaluation method before the test. During the evaluation, each sample was rated on a scale of 1 to 9, with 1 representing extreme dislike and 9 indicating extreme liking. This approach allowed the judges to provide an objective assessment of their preference for each Peda sample.

Statistical analysis

The statistical design data in the study were analyzed using Analysis of Variance (ANOVA) and Critical Difference (C.D) methods. The analysis was performed using both the WSP software and Excel software.

Results

Analysis of raw milk

The outcomes of the chemical analysis of milk samples collected from animal farms presented in Table 1. Cow's

milk exhibited higher fat (4.2%), total protein (3.4%), ash (0.65%), and total solids (11.80%). On the other hand, cow's milk had a greater lactose content (4.82%). Similar results are obtained in this research conducted by (Sharma *et al.*, 2019)^[13].

Table 1: Chemical composition (%) of cow's milk samples from different animal farms

| Milk ingredient | Cow's milk (Mean ± SD) |
|-----------------|------------------------|
| Acidity | 0.15 ± 0.08 |
| pH value | 6.73 ± 0.24 |
| Fat | 3.7 ± 0.75 |
| T.P | 3.4 ± 0.12 |
| Ash | 0.65 ± 0.05 |
| T.S | 11.80 ± 0.19 |
| Lactose | 4.82 ± 0.45 |

Standardize milk

The outcomes of the chemical analysis of standardize milk samples for Peda in Table 1. Cow's milk exhibited higher fat (4.2%), total protein (3.4%), ash (0.65%), and total solids (11.80%). On the other hand, cow's milk had a greater lactose content (4.82%).

Table 2: Chemical composition (%) of standardize milk samples

| Milk ingredient | Standardize milk |
|-----------------|------------------|
| Acidity | 0.15 |
| pH value | 6.7 |
| Fat | 4.0 |
| Protein | 3.9 |
| Ash | 0.75 |
| T.S | 13 |
| Lactose | 5.3 |

Chemical evaluation of flaxseed incorporated Peda

A study was conducted to assess the chemical composition of Peda incorporating flaxseed and sesame seeds. The experiment involved using honey as a substitute for sugar, and three different levels of flaxseed (2%, 2.5%, and 3%) were incorporated into the Peda. The samples were analyzed for moisture, fat, protein, ash, fiber, and antioxidant content. The results of the analysis can be found in Table 2. Similar study were conducted and reported in (Jha *et al.*, 2014; Modha *et al.*, 2015; Sharma *et al.*, 2019)^[5, 9, 13].

Table 3: Chemical evaluation of flaxseed enriched Peda (Mean)

| Chemical Parameters | Samples | | | | | |
|---------------------|---------|-------|-------|-------|----------|----------|
| | T0 | FP1 | FP2 | FP3 | S.Ed (±) | CD at 5% |
| Fat (%) | 16.55 | 17.78 | 18.49 | 18.86 | 0.52 | 0.125 |
| Moisture (%) | 19.56 | 18.82 | 18.29 | 17.7 | 0.18 | 0.211 |
| Protein (%) | 15.93 | 16.13 | 16.69 | 17.12 | 0.27 | 0.199 |
| Fiber (%) | 0 | 0.88 | 2.26 | 3.12 | 0.12 | 0.101 |
| Ash (%) | 2.80 | 3.05 | 3.24 | 3.76 | 0.4 | 0.138 |
| Reducing sugar | 31.11 | 30.43 | 30.19 | 29.95 | 0.56 | 0.13 |
| Non-Reducing Sugar | 0.54 | 0.49 | 0.5 | 0.5 | 0.12 | 0.148 |
| Total Solid | 80.43 | 81.13 | 81.69 | 82.37 | 1.1 | 0.369 |

Sensory evaluation of flaxseed incorporated Peda

A study evaluated the sensory attributes of different Peda variations with varying levels of flaxseed content (2%, 2.5%, and 3%). The sensory evaluation included color and appearance, body and texture, flavor and taste, and overall acceptability. The results showed that the control Peda, which did not contain any flaxseed, received the highest scores in all sensory categories. Specifically, it received a score of 7.6 for color and appearance, 7.4 for body and texture, 7.5 for flavor and taste, and 7.8 for overall acceptability. These findings suggest that the control Peda was preferred in terms of sensory attributes compared to the Peda variants with flaxseed incorporation.

Table 4: Sensory evaluation of flaxseed incorporated Peda (Mean)

| Sensory Analysis Parameters | Samples | | | | | |
|-----------------------------|---------|-----|------|------|-----------|----------|
| | T0 | FP1 | FP2 | FP3 | S. Ed (±) | CD at 5% |
| Colour and Appearance | 8.6 | 7.6 | 6.8 | 5.6 | 0.22 | 0.855 |
| Body and Texture | 8.4 | 7.4 | 6.1 | 4.8 | 0.18 | 0.727 |
| Flavour and Taste | 8.5 | 7.5 | 6.6 | 5.3 | 0.2 | 0.893 |
| Sweetness | 8.6 | 6.2 | 5.4 | 3.9 | 0.12 | 0.668 |
| Overall Acceptability | 8.48 | 7.8 | 6.62 | 5.48 | 0.25 | 0.535 |

Conclusion

Based on the findings of the study, it can be concluded that the inclusion of flaxseed in khoa for the preparation of nutritionally enhanced Peda by completely replacing sugar leads to positive sensory evaluation results. Peda made with flaxseed in treatment FP1 achieved the highest scores in sensory evaluation, particularly in terms of color and appearance, body and texture, flavor and taste, as well as overall acceptability. Therefore, incorporating flaxseed and in khoa can be considered as an effective strategy to produce Peda with superior sensory attributes.

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