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Impact of flaxseed powder on sensory and microbiological property of dietary Peda

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Abstract
In this investigation, the shelf life of Peda incorporated with flaxseed powder as was carried out to assess the keeping quality. The control sample (T_0) of peda was formulated with cow milk *Peda* (4.0% milk fat) with 30% sugar by weight of khoa and experimental peda (FP1, FP2, FP3) also formulated by using khoa and flaxseed powder in different combination with incorporation of 2.0, 2.5 and 2.5% flaxseed, respectively. From the sensory evaluation experimental peda FP1 was optimized by 9-point hedonic scale. The shelf life study was conducted of experimental FP1peda sample with respected to control T_0 peda sample for every 0, 3, 6, 9, 12 and 15 days at room and refrigeration temperature. From the sensory evaluation which include aroma and taste, colour and appreance and body and texture, it was revealed that all the score was gradually decreased upto 9 days and 15 days at room temperature and refrigeration temperature, respectively. The Microbial studied revealed that SPC was found to be increased whereas there was no coliform was found during the study. The yeast and mold was detected from 9th day at room temperature and refrigeration respectively.

Keywords: Flaxseed powder, sensory, microbiological property, dietary Peda

Introduction
India stands as the world's leading milk-producing nation, boasting a staggering total milk production of 221.1 million tonnes during the year 2021-22, as reported by the Department of Animal Husbandry and Dairying, Government of India in 2022. This impressive achievement is further underscored by a remarkable annual growth rate of 17.79% since 2018-2019. What's particularly fascinating is the remarkable increase in per capita milk availability. In 2013-2014, the daily per capita milk consumption stood at 307 gm/day, and today, it has surged to 444 gm per day, marking an astonishing growth of 44.62% (NDDB for the year 2021-2022). Approximately 55% of the milk produced is utilized into the manufacturing of various dairy products, while the remaining 45% is consumed in its liquid form. Within the 55% earmarked for product manufacturing, a significant portion, roughly 40%, is dedicated to making traditional Indian dairy delicacies like ghee, khoa, burfi, peda, rasogolla, paneer and many more. To provide a highlight of the scale of production, it's worth noting that India produces an outstanding 1.5 million tonnes of khoa annually, a remarkable accomplishment that converts to a substantial economic value, estimated at a minimum of Rs 18,000 crore, as reported by Indiatimes in 2021. The base material for all of these types of *Peda* is khoa and cane sugar in various quantities, with additional ingredients added to meet the needs of flavour, body, and textural features (Amrutha *et al.*, 2012) [3]. *Peda* is a popular khoa based indigenous dairy product, that heat desiccated milk, prepared from cow and buffalo milk or a combination thereof, *Peda* and Burfi are the two major khoa based sweets, which are highly popular in India because of their delicious taste and high nutritional content. It has been investigated that the quantity of *Peda* produced in India far much as any other traditional milk based sweet (Banjare *et al.*, 2015) [5].
The production of *Peda* is fully prohibited to halwais because *Peda* has less moisture so it has a longer shelf life. It's made by combining khoa and sugar in precise amounts. *Peda* has a coarse granular texture and is yellowish yellow in colour. Chemical composition, body, texture, appearance, and microbiological quality are all factors that influence its quality. The incorporation of health-beneficial components results into formation of dietary Peda (Jha *et al.*, 2015) [8].
Flaxseed is considered as a functional food or source of functional ingredients because it contains α-linolenic acid (Aung *et al.*, 2018) [8] lignans and polysaccharides which have

highest omega-3 fatty acid (alpha-linolenic acid) content. Approximately 48% of all of lipids responded as essential fatty acid that should be consumed in a normal diet (other than starch) all of that have positive effects in prevention of disease.

The lowering of cardiovascular diseases with consumption of omega-3 fatty acids reported by Bhadania *et al.* (2004) [6]. This category of fatty acids is said to be abundant in flax seeds and fish. Whole flax seeds are abundant in dietary fibre, including lignin, along with omega-3 fatty acids. Flax seeds comprise roughly 20% protein, 40% lipids, 25% dietary fibre. Nearly half of the lipids found in the seeds contribute to the omega-3 fatty acid.

Sugar contributes to *Peda* a reddish-brown colour, distinctive texture and caramelised flavour. Sugars are used as bulking agents, preservatives, humectants, fermentation substrates, texturisers, stabilisers, flavour carriers, dispersion agents, browning agents and decorative agents in Indian sweets Flaxseeds are emerging as a "super food" as more scientific research points to their health benefits. Flaxseed incorporation into *Peda* in form of powder and oil along with Stevia using as sweetening agents by replacement of sugar to make this product more beneficial than traditional *Peda*. Flaxseed has nutritive as well as medicinal value. Flaxseed contains good amount of omega-3 fats alpha-linolenic acid lignans specifically Secoisolariciresinol di glucoside (SDG). Omega-3 fatty acids have anti-inflammatory, anti-thrombotic and anti-arrhythmic properties.

Flaxseed and Stevia incorporation in *Peda* is an innovative Indian sweet for a cardiovascular disease individual this traditional recipe is modified to reduce the fat and sugar content of the product. This product contains no dietary fat and sugar. Stevioside, rebaudioside used as the main components as it is rich in natural antioxidants and natural sweetener which are effective in reducing the risk of heart disease cancer immune-system decline cataracts and different inflammatory processes. All form of flaxseed Powder and oil have beneficial role in cardio vascular diseases.

Materials and Methods

Preparation of khoa-peda mass

Present investigation was conducted in the laboratory of Department of Dairy Science and Food Technology, Institute of Agriculture Science, Banaras Hindu University, Varanasi, (U.P.) India.

Cow milk was taken from the farm of Dairy Science and Food Technology which was standardized by using cream and skim milk powder. The flaxseed and stevia powder was purchased from local market of Lanka, Varanasi. The Flaxseed powder was grained properly by grinder and roasted it in simmering temperature until it got brown colour.

Fresh cow milk was obtained and condensed in a double jacketed stream kettle while being constantly stirred and scraped. Flaxseed powder was added (2.0% of khoa, 2.5% of *khoa* and 3.0% of *khoa*) at the stage of pat formation of *khoa*. Every mixture is concentrated while being constantly stirred or scraped until the appropriate dough consistency was reached. The concentration was stopped and the contents of kettle were spread on inner wall of kettle for cooling. After cooling the *khoa* was scrapped and collected *khoa* then addition 30% sugar by weight of *khoa* for control sample. Addition of stevia (0.0375% of *khoa* by weight basis). The final product was packed in cardboard boxes and stored at room temperature and refrigeration temperature for further analysis.

Treatment combination for flaxseed and formulated *Peda*

The following treatment were made for the calculation:

T_0 - Cow milk *khoa* (4.0% milk fat) + 30% 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* (weight basis) + 0.0375% Stevia by weight of khoa.

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

Sensory evaluation

The organoleptic quality of *peda* samples were evaluated by ten male and ten female judges from "Department of Dairy Science and Food Technology, BHU, Varanasi," were randomly chosen, which included faculty, research scholars, and postgraduate students. The samples were analyzed for sensory parameters like, colour and appearance, flavour, body and texture and overall acceptability. The judges were given instructions to familiarize themselves with the method prior to the sensory test. Each sample was assigned a degree of like on a scale of 1-9 (1: dislike extremely and 9: like extremely).

Microbiological analysis of *Peda* samples

The microbiological analysis of the product was carried out as per the method described in IS: (SP-18, Part I) (1981).11g of *Peda samples* was transferred aseptically to 99 ml of sterile saline blank aseptically. Thus a 1:10 dilution was obtained which was used for analysis. Further dilution to desirable level was carried out by serially transferring 1 ml of diluted sample to 9 ml sterile saline blank. The appropriate diluted *Peda* sample was pour plated by using Milk Agar (Hi Media) and incubated at 37 °C for 24 to 48hr. At the end of incubation period the plates were taken out from incubator, colonies were counted and expressed as cfu/gm of *khoa* samples. The plating was done in duplicate. The appropriate diluted *Peda* sample was pour plated by using Violet Red Bile Agar (Hi Media) and incubated at 37 °C for 24 hr. At the end of incubation period the plates were taken out from incubator, colonies with dark red colouration were counted and expressed as cfu/gm of *khoa* samples. The plating was done in duplicate. Appropriately diluted *Peda* sample suspension was pour plated by using PDA agar (Hi Media). Before pouring the growth medium to the plate 2-3 drops of 10 percent tartaric acid solution was added to the plates to adjust the pH of the medium to around 3.5. The plates were incubated at 30 °C for 48- 72 hours. At the end of the incubation the colonies were counted and expressed as cfu/g of *Khoa samples*. The plating was done in duplicate.

Statistical analysis

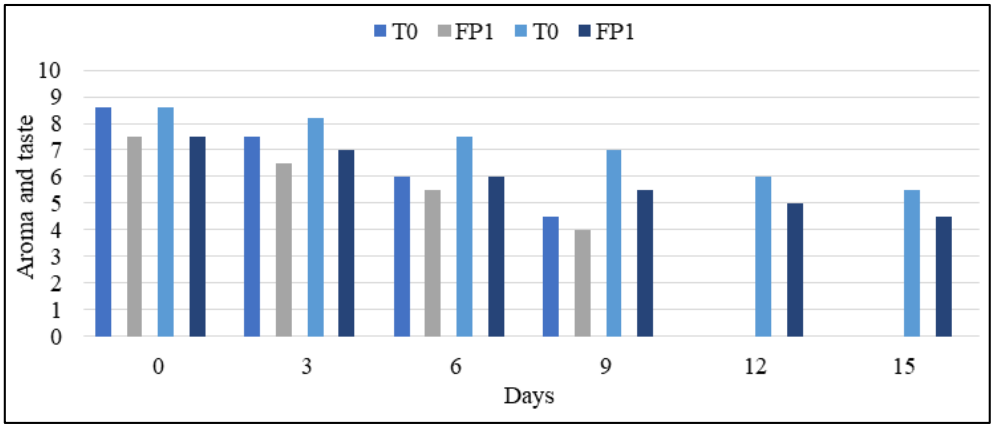
Statistical designs Data WASA analyze during Analysis of Variance (ANOVA) and Critical difference (C.D) in WASP software and excel software.

Results and Discussion

The sample of control (T_0) and optimized product sample of flaxseed powder was stored at room and refrigeration temperature and evaluated by a sensory panel of judges at an interval of 3 days from 0 days up to 15 days. The sensory attributes of stored samples of experimental *Peda* such as flavour, colour and appearance, body and texture as well as

overall acceptability scores are delineated here under.

In the present study trials were undertaken to investigate the physico-chemical changes of *Peda* during its storage under ambient (25 ± 1 °C) and refrigerated condition (7 ± 1 °C). The control and flaxseed powder and oil incorporated *Peda* a sample was vacuumed packed in aluminium polyethylene by vacuum packing machine.

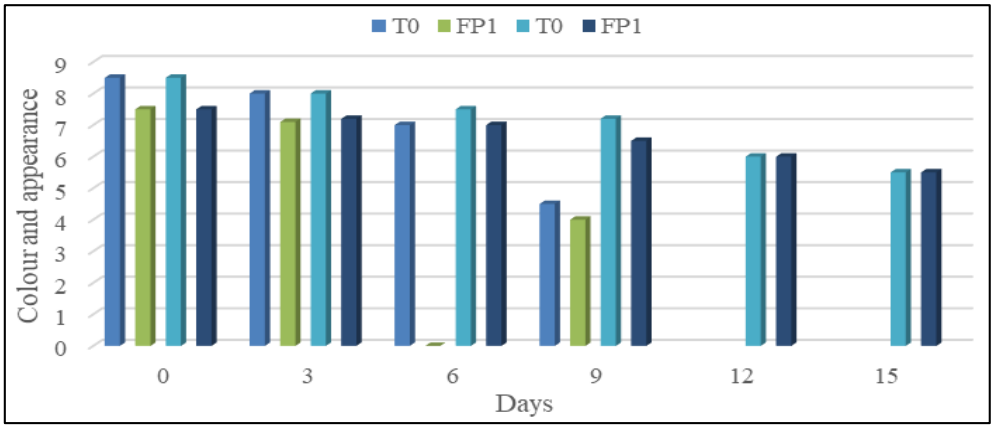


Aroma and taste

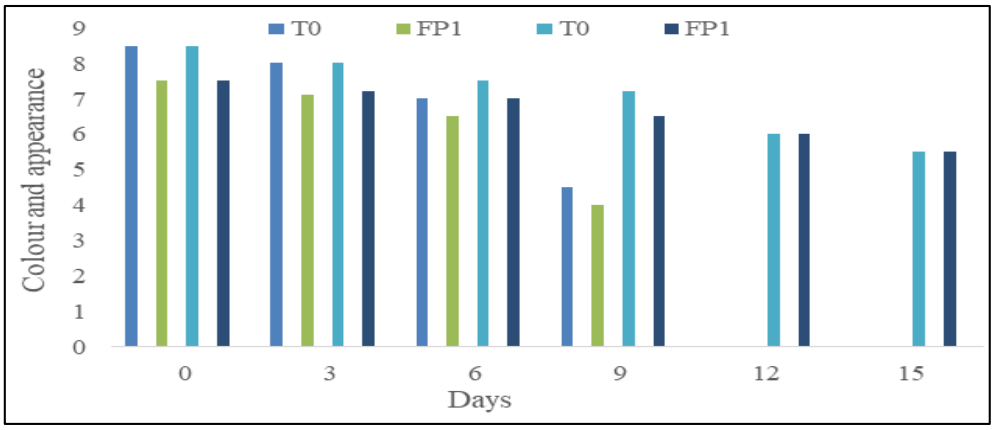
The above table represent the flavour and teste score during storage at room temperature for 9 days decrease significantly 8.6 to 4.5 for control (T_0) and 7.5 to 4 for flaxseed powder optimized *Peda* (FP1). Whereas at refrigeration temperature T_0 and FP1 score decreases from 8.60 to 5.5 and 7.0 to 3.0 in 15th days. It represents the aroma and teste score during storage at room temperature for 9 days decrease significantly 8.6 to 4.5 for control (T_0). It can be concluded that the aroma and taste score decreased rapidly at room temperature as compared to refrigerated temperature during storage

The below table represent the Colour and appearance score during storage at room temperature for 9 days decrease significantly 8.5 to 4.5 for control (T_0) and 7.5 to 4 for flaxseed powder optimized *Peda* (FP1).

It can be observed that the changes in colour and appearance scores decreased rapidly at room temperature than at refrigeration temperature. The decline in scores during storage of *Peda* can be attributed to microbial and chemical changes in the product. This study is correlated with Londhe *et al.*, (2012) [16], Jha *et al.*, (2015) [8], Sharma *et al.*, (2019) [18].



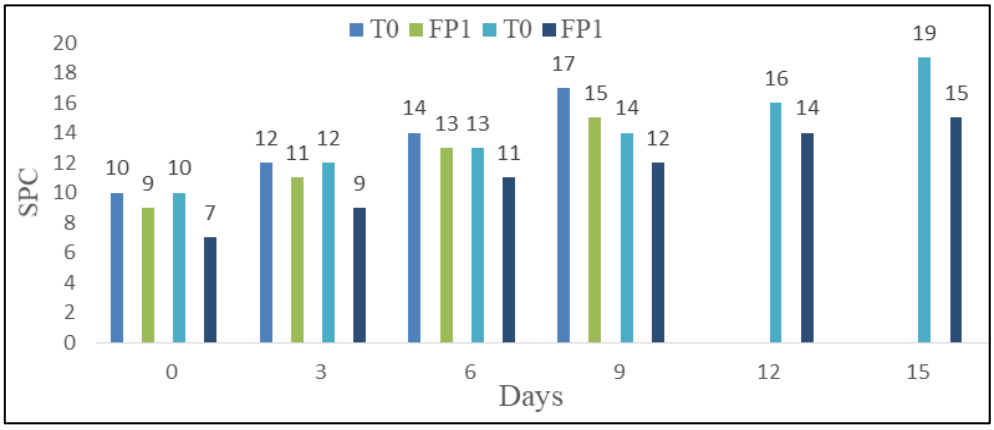
Colour and appearance



Colour and appearance

Microbiological parameter

The below table represent the Standard plate count during storage at room temperature for 9 days increased significantly 10 to 17 for control (T_0) and 6 to 15 for flaxseed powder optimized *Peda* (FP1). Whereas at refrigeration temperature T_0 and FP1 score increased from 10 to 19 and 6 to 19 in 15th days. The standard plate count during storage at room temperature for 9 days increased significantly 10 to 19x10^2 for control (T_0) and 6 to 19 x10^2 for flaxseed oil optimized *Peda* (FP1) was noted, whereas at refrigeration temperature T_0 and FO1 score increased from 10 to 17 x$10^2$and 5 to 14 x10^2 in 15th days. It can be observed that during storage of *Peda* significant increase in SPC in both of the packages up to 9th day was observed thereafter the product was found unacceptable due to visible mould growth. After that observed and thereafter the product was found unacceptable due to visible mould growth similar result was also finding in Amrutha *et al.* (2012) [3] reported an increasing trend in SPC during storage of *Peda* at 37±1 °C at temperature of 30 °C. It can be concluded that increasing the SPC during storage. The highest SPC count was found in control 17x10^3 cfu per gm for 9 day at room temperature and 19 x10^3 cfu per gm for 15 days at refrigeration temperature. In *Peda* enriched with flaxseed powder the SPC found in treatment FP1 15 x10^3 cfu per gm for 9 days at room temperature for 15 days at refrigeration temperature. In *Peda* enriched with flaxseed powder SPC found in treatment FP1 15 x10^3 cfu per gm for 9 days at room temperature and 16 x10^3 cfu per gm for 15 days at refrigeration temperature.



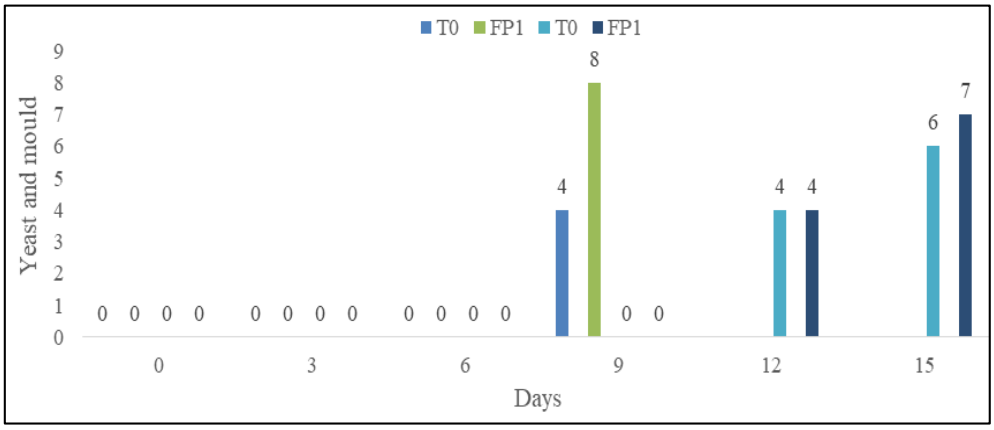
SPC

Colifrom

There was no coliform count detected in thought out shelf life study of flaxseed powder enriched peda it might be due to excess heat treatment and hygiene practices was followed during preparation and packaging of peda. This study was correlated with Sharma *et al*., (2019) [18].

Yeast and Mould count

The below table represent the yeast and mould count during storage at room temperature for 9 days. The control (T_0) and optimized *Peda* had yeast and mould count 5×10^2 cfu/g and 1210^2 cfu/g in 12th days. Whereas at refrigeration temperature T_0 and FP1 had count from 6x10^2 cfu/g and 7x10^2 cfu/g in15th days. This table represent the yeast and mould count during storage at room temperature for 9 days The control (T_0) and optimized *Peda* had yeast and mould count 5×10^2 cfu/g and 6x10^2 cfu/g in 12th days. Whereas, at refrigeration temperature T_0 and FP1 had count from 6x10^2 cfu/g and 8x10^2 cfu/g in15th days.



Yeast and Mould

It can be observed for most of the intermediate moisture Indian dairy foods such as *Peda*, Burfi, Kalakand etc. mould growth tends to be a major problem and often most important single factor limiting their shelf life. During further storage of *Peda* increase in yeast and mould count up to 9th day was observed and thereafter the product was found unacceptable due to visible mould growth it can be seen that the yeast and mould count increased rapidly with storage period at room temperature compared to refrigerated temperature the present study is co-relation with Ahmad *et al*., (2020) [2] reported

increased yeast and mould during storage of *Peda* incorporated with aloe vera juice. Jha *et al*., (2015) [8] observed that gradual loss of moisture during the storage period of 60 days.

Conclusion

From the study it was concluded that flaxseed powder enriched *peda* had shelf life for 7 days and 15 days at room temperature and at refrigeration temperature. Control peda had shelf 6 days at room temperature and 13 days at refrigeration temperature. Sensory analysis which include aroma and taste, color and appreance and body and texture was gradually decreased upto 9 days and 15 days at room temperature and at refrigeration temperature respectively. From microbial analysis during shelf life study it was analysed there was no coliform was detected. The SPC count was detected upto 9 days and 15 days at room temperature and refrigeration respectively. The yeast and mold count was detected on 9th day at room temperture and on 12th and on 15th day at refrigeration temperature. Addition of flaxseed powder developed *peda* (FP1) had got one day or two days' extra shelf life at room temperature and at refrigeration temperature respectively.

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