The Pharma Innovation Journal 2023; SP-12(9): 896-898

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; SP-12(9): 896-898

www.thepharmajournal.com
Received: 21-07-2023
Accepted: 27-08-2023

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Effect of packaging materials on sensory characteristics of Chhana poda under refrigerated storage conditions

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Abstract
Chhana and chhana-based products have been considered as a good source of nutrition to human health and well accepted by all consumers. In eastern part of India particularly Orissa and West Bengal, Chana podo (baked sweet cottage cheese) is a very famous Indian delicacy. The Chhana poda packed under control and experimental samples i.e., active composite film was studied for its sensory characteristics during the storage. The active composite film consists of gallic acid and grapefruit seed extract helped to enhance the quality of the product. Sensory evaluation of Chhana poda packed under these packaging conditions showed a significant difference (p<0.05) between the samples and days. The present study concluded that an enhancement was observed in sensory characteristics of Chhana poda packed under active composite film, which can be further applicable for other dairy products.

Keywords: Chhana poda, active packaging, biodegradability, sensory, shelf-life, refrigerated storage conditions

Introduction
Sensory evaluation is interconnected between research and development. It is mainly related to technical aspects of food, consumer, and marketing research, with a focus on consumers' behaviour and psychology (Dijksterhuis, 1995) [1]. As per the world scenario, India is the leading producer of milk with a production of 221.1 million tonnes in 2021-22, with a per capita availability of 444 gms / day (DAHDF, 2021) [2]. Chhana, heat coagulated milk product has a high food and nutritional value because it contains most of the protein, minerals and vitamins found in milk. In terms of production and consumption, chhana, a milk product, is getting more popular, used to manufacture a variety of popular Indian sweets and culinary dishes.(Rai *et al.,* 2020) [3]. Chhana poda prepared with ingredients like chhana, sugar, and refined wheat flour (suji)/(maida). As a garnishing agent Nuts, cloves, and cardamoms are often used for preparation this sweet. It is available in a variety of flavours and ingredients depends upon area locality, having light brown outer surface, sweet taste, caramelized flavour, and a spongy texture. due to its fat content and sugar. The body and textural qualities of this product is due to semolina (Kumar, 2008) [4]. Despite progress in quality and mechanisation, there is a critical need for the development of appropriate and cost-effective packaging due to its limited shelf life (Kumar, 2005) [5]. The active packaging concept helps to enhance the shelf life of the product rather than being added at high levels directly to the food to protect foods against microbial or chemical deterioration (Almasi *et al.,* 2021) [6]. Here, the film is prepared with Polycaprolactone (PCL) (Woodruff & Hutmacher, 2010) [7]. Tapioca starch (Kowalczyk *et al.,* 2015) [8]. Gallic acid (GA) (3,4,5-trihydroxybenzoic acid), Grapefruit Seed Extract and Glycerol as a plasticizer. Here Gallic acid (GA) possessing strong antioxidant, anti-inflammatory, anti-cancer activities (Badhani *et al.,* 2015) [9] and Grapefruit Seed Extract's antibacterial properties have been utilised to combat the microbiological deterioration of food (Lyu *et al.,* 2019) [10]. So, the current study was undertaken to determine influence of various packing materials on sensory properties of Chhana poda during refrigerated storage.

Materials and Methods
Standardized milk, citric acid was procured from Experimental Dairy plant of this college and other ingredients like suji, and sugar procured from Ludhiana market were used for the production of Chhana poda**.** For preparation of film, Polycaprolactone, gallic acid, Tapioca starch, Grapefruit seed extract used in the study was purchased from reputed firm.

The preparation of Chhana poda was undertaken as per the procedure mentioned by Pal *et al.* (2019) [11] with the slight modifications for incorporation of non-dairy ingredients (5% suji and 25% sugar).The majority of ingredients was Chhana. The control film was prepared by solvent casting method using ingredients using Polycaprolactone, tapioca starch and then added with glycerol. For the preparation of active composite films gallic acid (antioxidant) and grapefruit extract (antimicrobial) were added along with above mentioned ingredients. After this, developed films were manually applied over the product and then packed in LDPE as a secondary packaging material for further storage studies with the interval of 3 days. The sensory parameters of Chhana poda with and without active film during storage study were analysed by applying two-way analysis of variance (ANOVA) by employing IBM SPSS Statistics 26. (n=6).

Results and Discussion

Colour and appearance

The colour and appearance scores for control and experimental samples decreased significantly during the storage period (fig 1a). There was a significant difference observed between the samples and the days of storage. Makhecha (2012) [12] noticed that decrease in colour and appearance scores of *Thabdi* (heat desiccated dairy product) when stored at 7±2°C using different packages. Colour and appearance of the product became light and dull due to dry appearance, as a result of loss of moisture from the upper surface of the control sample. The loss of moisture is less in experimental sample might be due to active composite film wrapped over the product then packed in LDPE.

Body and Texture

Changes in scores of body and texture were depicted in the fig. 1b. Body and texture score of 8.20 was noted in both the samples initially and at the end of the storage study both the samples scores were reduced. Control product became dry, hard, sandy, and brittle which might be due to the loss of moisture. Due to this reason, the body and texture scores were less in control sample as compared to experimental samples. There was a significant (p<0.05) difference between the samples and days were observed.

Flavour

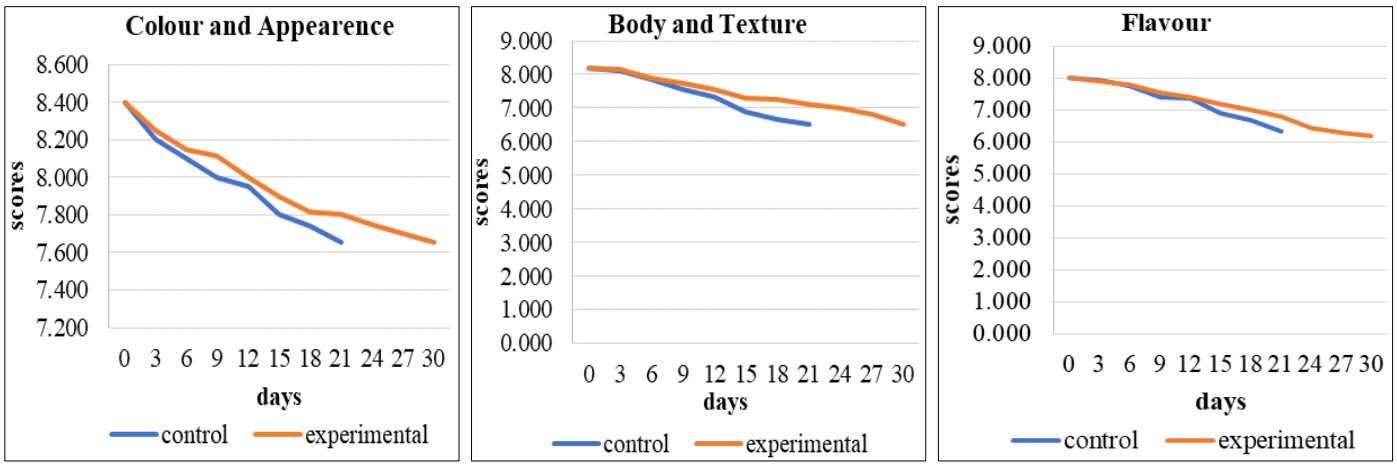
The changes in flavour score of both the samples over a storage period is represented in fig 1c. Flavour of control samples varied in the range of 8 to 6.35 during the storage period of 21 days, whereas experimental sample exhibited slightly less score in the range of 8 to 6.20 at the end of 30th day due to slight bitterness was noticed in the product. The reason for reduction in flavour scores might be due to the reduced moisture and increased HMF, FFA content on storage.

Sweetness

Control sample exhibited sweetness score in the range of 8 to 7.033 at the end of 21st day and experimental scores was observed to be in the range of 8 to 6.50 during 30 days of storage. It is represented in fig. 1d. This decrease was attributed to slight bitterness in experimental samples.

Overall acceptability

Overall acceptability (fig 1e), scores of sensory parameters which further depends on several factors like proteolysis, lipolysis, and flavour changes during storage. It was observed that the overall acceptability score of both samples declined sharply during the storage period. The overall acceptability score of control sample varied in the range of 8 to 6.50 during 21 days of storage, whereas the experimental sample varied in the range of 8 to 6.4 days of storage (30 days). This decrease in scores was due to changes in flavour and body and texture attributes. During storage of *Burfi* at 37±2 ºC and 7±2 ºC, a decrease in overall acceptability score was observed by Tiwari (2013) [13]. Here, the results of sensory parameters were correlated with microbiological analysis of the product.



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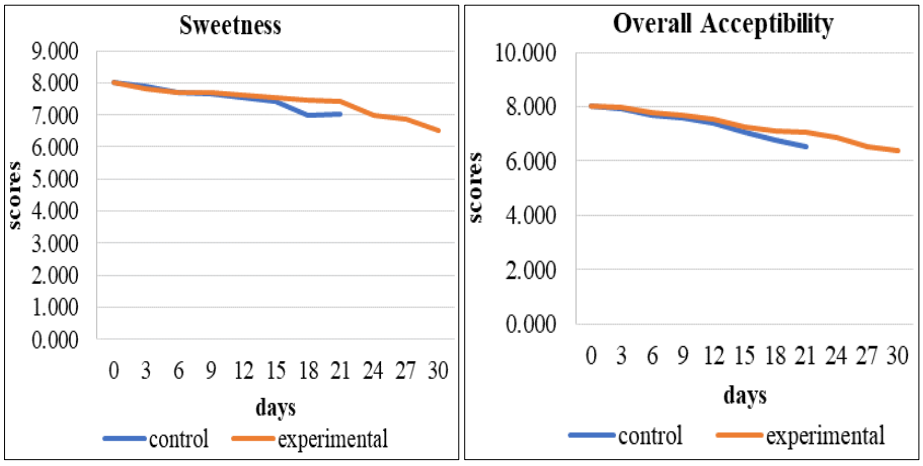

D E

Fig 1 (A-E): Changes in sensory scores of samples packed under different packaging conditions at refrigerated storage

Conclusion

Changes in sensory parameters of control and experimental samples were analysed to determine the extended shelf life of sample. Sensory scores revealed the control product sample was acceptable up to 21 days, whereas the experimental product was acceptable up to 30 days. The developed product having good acceptability and can be taken as an option to start the entrepreneurship for better economic returns.

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