Original Research Article

Effect of microwave treatment on colour of *danedarkhoa*during storage

Abstract

In-package microwave-treated *danedarkhoa*(a heat-desiccated milk product) was investigated to determine color changes during its storage at different temperatures. An optimized sample of *danedarkhoa*packaged in a nylon pack was stored at 10, 35 and45°Ctemperatures.The changes in L*, a*, and b* value in the in-package microwave-treated and control*danedarkhoa* were investigated during storage. In the control sample, the initial average value of L* was 65.04-67.56. As the temperature increased to 10°C, 35°C, and 45°C, the L* values also increased to 64.53-67.17, 65.45-67.10, and 65.58-67.22 respectively. For a*, the initial value was 5.40-4.19 With the rise in temperature to 10°C, 35°C, and 45°C, the a* values decreased to 5.20-4.01, 5.24-4.10, and 5.24-3.13 respectively. Regarding b*, the value in the control sample was 24.15-29.74 As the temperature was raised to 10°C, 35°C, and 45°C, the b* values further increased to 27.44-31.15, 29.50-30.57, and 27.53-31.91 respectively.

Keywords: Colour value, *Danedarkhoa*,Microwave, Storage

1.0 Introduction

Milk is an excellent source of all vital nutrients in optimal concentrations that promote human development and growth. India produced 221.1 million metric tonnes of milk in 2021–2022 (NDDB, 2023). India has become a producer of traditional milk products since the beginning of time. For religious, social, cultural, nutritional, medical, and economic reasons, these items are crucial. Nearly fifty percent of the milk produced is allocated towards the production of traditional dairy products such as heat-desiccated milk products (*khoa, basundi, rabri, kheer*); *dahi, shrikhand, paneer, chhana*, and *chhana*-based products fall under the category of fermented and coagulated milk products; and clarified products include butter oil, ghee, and others. These items have deep cultural and social roots in Indian society and are rooted in ancient traditions (Ghayal *et al*., 2015).

The most ancient method utilized to process milk and milk products is heat desiccation. Early Buddhist and Jain scriptures contain references to desserts manufactured using heat-desiccated milk, including sihakesara and morandeka. These have been used as desserts at the end of a meal. Lord Buddha authorized his disciples to carry treats as portable sustenance when traversing routes with limited access to food. During the Mauryan Period (268–233 BC), confections were created by combining honey or jaggery with concentrated milk. Additionally, diverse milk delicacies were documented in the literature of the post-Gupta period (750–1200 AD) (Aneja et al., 2002).

Heat-desiccated milk products have thus been traditionally produced in the Indian subcontinent since ancient times. *Khoa,* one of the most important heat-desiccated products, has been utilized as the base material for a large variety of sweet delicacies. According to the Food Safety and Standards Regulations (FSSAI, 2011), *khoa* refers to a product derived by partially removing water from any variant of milk, with or without added milk solids, through heating under controlled conditions. Various *khoa*-based delicacies, including *peda, burfi, kalakand, milk cake, gulabjamun,* etc., are prepared on various occasions in India (Prasad et al., 2015).

Khoa is typically brownish in color and greasy or granular in texture. The high concentration of lactose is the cause for the rich, nutty flavor, mildly cooked taste, and sweet taste. The cow milk *khoa* exhibits a moist surface and a salty flavor with a sticky and sandy texture, which is not useful for the preparation of sweets, and its yield varies from 17 to 19%, which is lower than buffalo milk *khoa* (21-23%) by weight (Aneja et al., 2002).

In an unorganized industry, the marketing of *khoa* often makes chances for adulteration to increase profit because of its high price. The gas chromatography profile of 43% of the *khoa* samples had a fatty acid composition not in conformance with that of milk fat (Amrutha Kala, 2012). In recent reports, synthetic *khoa* made of cheaper oils and lipids is being sold on the market and utilized for the preparation of *khoa*-based sweets, which causes various health hazards (Viji et al., 2023). So it is necessary to examine all parameters of *khoa* during storage.Acomprehensive examination of the instrumental colors that occur during the storage of danedar*khoa* facilitates the acquisition of kinetic information about the reaction rate constant. This, in turn, empowers the dairy industry to regulate and optimize storage conditions, leading to enhanced retention of quality attributes in the product before it reaches consumers. The careful

selection of appropriate packaging and storage conditions plays a crucial role in achieving this objective. Considering the above, the present study sought to investigate the effect of microwave treatment on the color of danedar*khoa* during storage.

1. Materials And Methods

2.1 Materials

Fresh pooled buffalo milk was received from the Experimental Dairy, ICAR-National Dairy Research Institute, Karnal, Haryana, India. Stainless steel cylindrical moulds (3cm × 2.94 cm; Dia × height) were used for moulding the *danedarkhoa* into cylindrical shapes. Moulds give a mass of (22g). Nylon microwavable safe packaging materials pouches (high barrier, easy open, multi-layer coextruded film) were procured from M/s Sealed air packaging materials, Bangalore. A convection microwave oven (make - IFB; model- 30FRC2; power supply - 230V~50Hz; rated microwave output - 900W; operation frequency - 2450MHz; oven capacity – 30 L and cooking uniformity -turntable system) was used for in-package microwave treatment.

2.2 Preparation of *danedarkhoa* sample

*Danedarkhoa*was prepared using the standard batch method of manufacture (Aneja *et al*., 2002). Freshly prepared *danedarkhoa* was molded with the help of stainless steel (SS) cylindrical mouldgivingamass of 22g. It was then packed in a nylon pack under atmospheric conditionsand subjected to in-package microwave treatment (450W microwave power for 30s residence time).

2.3 Storage temperatures and sampling times

The in-package microwave-treated *danedarkhoa* was carefully packed in nylon packaging and stored at three distinct temperatures: 10°C, 35°C, and 45°C. Sampling was conducted at regular intervals of 3 days for the 10°C samples, while daily testing was performed for the samples stored at 35°C and 45°C.

2.4 Colour Measurement

Whole 22 g of *danedarkhoa* (cylindrical form) was shredded with the help of a grater (mesh size of grater) and analyzed for colour measurement. Colour values (L*, a*, b*) of the *Danedarkhoa*samples were determined by using a Colour Measuring System (Labscan, XE, Hunter Lab. Inc., USA). Before colour measurement, the instrument was calibrated with a standard black glass and white glass tiles as specified by the manufactures (Barnwal*et al*., 2014).Data were obtained from software in terms of L* {lightness, range: 0 (black) to 100 (white)}, a* {redness; range: +60 (red) to -60 (green)} and b* {yellowness, range: +60 (yellow) to -60 (blue)}.

2. Result and Discussion

The data pertaining to the effect of microwave treatments on the changes in colour profile in terms of L* of *danedarkhoa* samples and stored at 10, 35 and 45°C are graphically presented in Fig. 1 and 2. The average initial L* value increased from 65.04 to 67.56 (control *danedarkhoa*) and 64.53 to 67.17 (treated *danedarkhoa*) at 10°C storage temperature. At higher temperatures (35 and 45°C), the L* value of *danedarkhoa* increased from 65.45 to 67.10 (at 35°C), and 65.58 to 67.22 (at 45°C) for control sample and 65.16 to 67.98 (at 35°C), and 65.68 to 68.85 (at 45°C) for treated *danedarkhoa.* The L* value was increased by maillard browning reactions in the *danedarkhoa.*

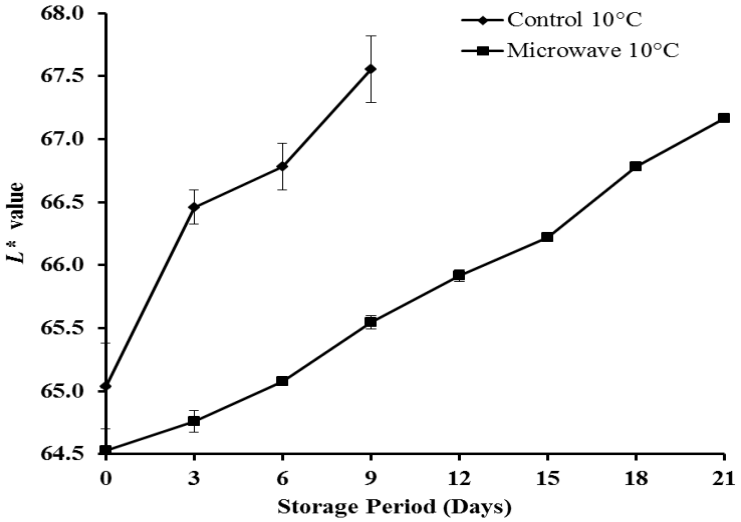

Fig. 1: L* value of control and microwave treated *danedarkhoa* samples during storage at 10°C

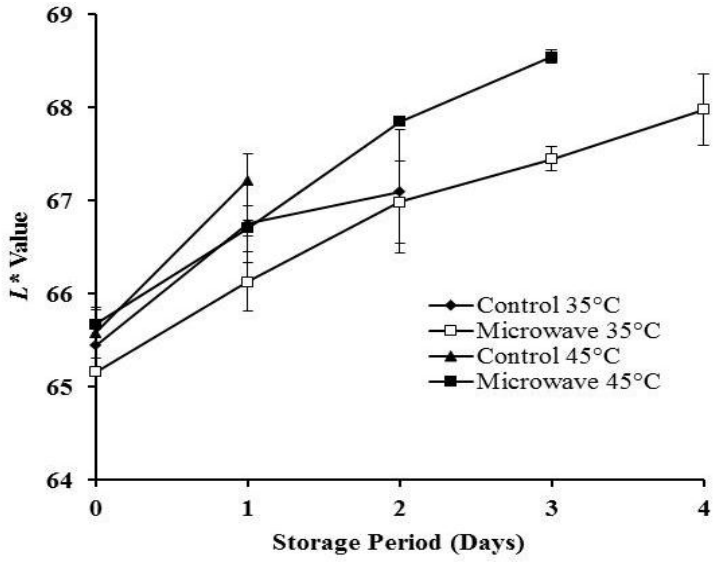

Fig. 2: L* value of control and microwave treated *danedarkhoa* samples during storage at 35 and 45°C

The results are in agreements with the observations of Preeti (2006), who reported that the lightness (L*) decreased during storage (7±1°C).The a* value of both control and treated *danedarkhoa* decreased due to non-enzymatic browning. At 10°C, the a* value decreased from 5.21 to 4.19 up to 9th day of storage for control *danedarkhoa* and 5.20 to 4.01 up to 21th day of storage for treated *danedarkhoa* (Fig. 3). With increase in storage temperature, the initial a* value decreased from 5.54 to 4.07 (at 35°C) and 5.24 to 3.13 (at 45°C) for control danedar*khoa* and 5.24 to 4.10 (at 35°C) and 5.24 to 3.13 (at 45°C) for treated *danedarkhoa* (Fig. 4). The decreased a* value of the *danedarkhoa* could be due to less non-enzymatic browning reaction during storage.

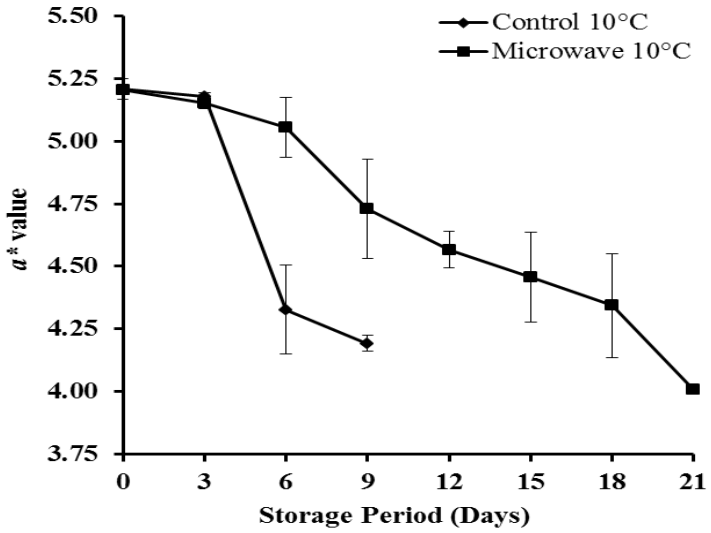

Fig.3: a* value of control and microwave treated *danedarkhoa* samples during storage at 10°C

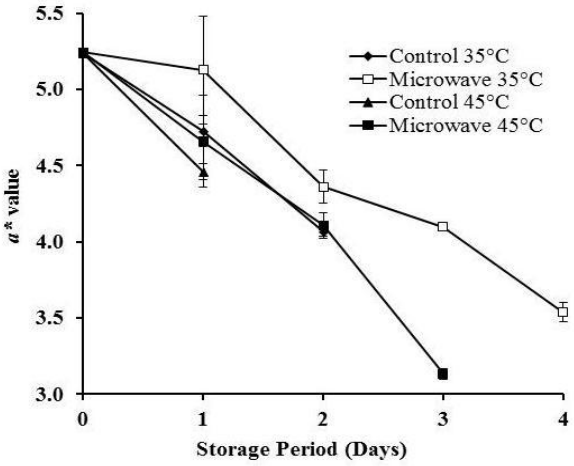

Fig.4: a* value of control and microwave treated *danedarkhoa* samples during storage at 35 and 45°C

The average initial b*value increased from 27.15 to 29.74 (control *danedarkhoa*) and 27.44 to 31.15 (treated *danedarkhoa*) at 10°C storage temperature (Fig. 5). At higher temperatures (35 and 45°C), the b*value increased from 27.18 to 28.16 (at 35°C), and 27.64 to 29.25 (at 45°C) for control *danedarkhoa*sample and 27.50 to 30.57 (at 35°C), and 27.53 to 31.91 (at 45°C) for treated *danedarkhoa*(Fig. 6). Similar observations were reported by Patil and Pal (2005) in shelf life extension of *burfi.*

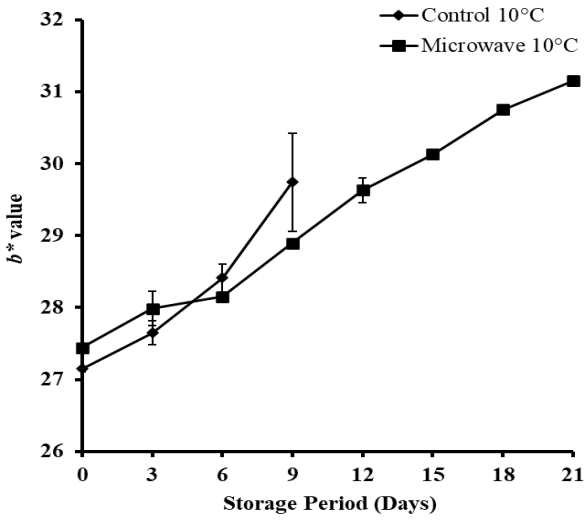

Fig. 5: *b** value of control and microwave treated *danedarkhoa*samples during storage at10°C

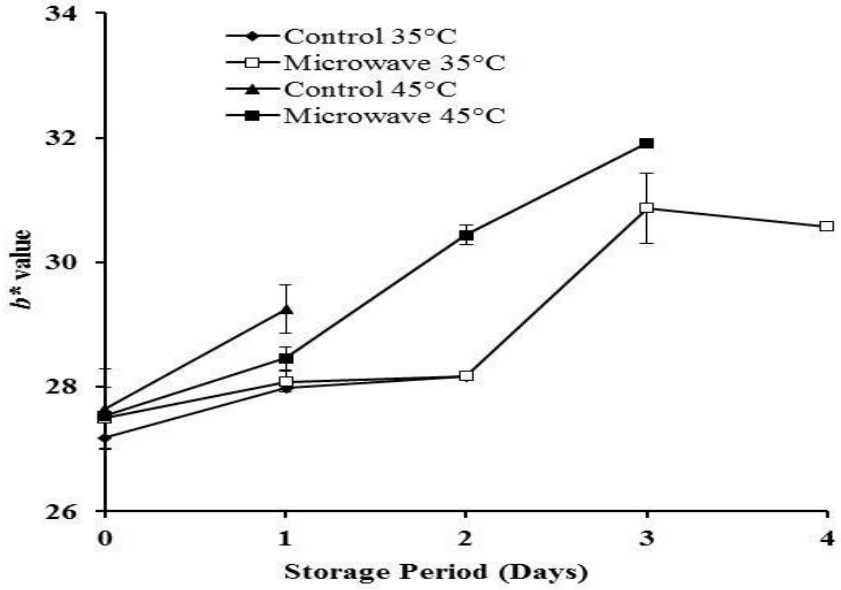

Fig. 6:b*of control and microwave treated *danedarkhoa*samples during storage at 35 and 45°C

CONCLUSION

The product *danedarkhoa* (cylinder shaped) was packed in nylon pack subjected to the microwave treatment at power (450W) and exposed for time (30s) at different storage temperature (10, 35 and 45°C). It was observed that instrumental colour properties such as L* and b* increased in both control and microwave treated sample due to maillard browning reactions in the *danedarkhoa.* The a* value was decreased in bothcontrol and treated sample. The

decreased a* value of the *danedarkhoa* could be due to less non-enzymatic browning reaction during storage. So, it can be concluded that microwave treatment is an effective treatment in maintaining the colour during processing of *danedarkhoa.*

REFRENCES:

Amrutha Kala AL. (2012). A survey of lipid composition of khoa samples in relation to possible adulteration. International Journal of Dairy Technology, 65:444-450.

Aneja RP, Mathur BN, Chandan RC, Banerjee AK (2002). The technology of Indian Milk Products. A Dairy India Publication, Delhi, India

Aneja, R.P., Mathur, B.N., Chandan R.C. and Banerjee, A. K. (2002). Technology of Indian Milk Products. ADairy India publication.

Barnwal P., Mohite A. M., Singh K. K., & Kumar P. (2014). Selected physico-mechanical characteristics of cryogenic and ambient ground turmeric. International Agrophysics, 28(1).

Ghayal G, Jha A, Kumar A, Gautam AK, Rasane P. (2015). Effect of modified atmospheric packaging on chemical and microbial changes in dietetic rabri during storage. Journal of Food Science and Technology. 52:1825–9.

NDDB (2023). Milk Production in India. 2023. Retrieved 3 June 2023, from https://www.nddb.coop/information/stats/

Palit C., & Pal, D. (2005). Studies on mechanized production and shelf-life extension of burfi. Indian journal of dairy science, 58(1), 12-16.

Prasad, R., Beenu, T., & Anirban, D. (2015). Khoa: a heat desiccated indigenous Indian dairy product. Research Journal of Pharmaceutical, Biological and Chemical Sciences, 6(5), 39-48.

Preeti Singh (2006) Studies on the modified atmosphere packaging (MAP) of pizza, Ph.D. Thesis submitted to National Dairy Research Institute, Karnal- 132 001 (Haryana)