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Evaluation of Ready to Use Flavoured Drink Prepared with Camel Milk Powder

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ABSTRACT

Experiment was conducted from June, 2023 to December, 2024 for PhD research work at ICAR-National research Centre on Camel, Bikaner, Rajasthan, India to prepare a healthy drink with freeze-dried camel milk powder. The Flavoured drink was prepared with the help of freeze-dried camel milk powder and cardamom powder with powdered sugar at different levels. Camel milk was procured from NRCC, and freeze-dried with the help of freeze-drier. The chemical composition of raw camel milk was as Fat-3%, SNF-6.23%, Acidity-0.129, Protein-2.5%, Lactose-3.65%, and total solid was found 7.75%. The freeze-dried camel milk powder was dissolved in water with different levels of cardamom powder. The three levels of cardamom powder i.e. 0.2%, 0.5% and 1% were incorporated and 0.5% cardamom powder and 6% sugar was optimized based of sensory evaluation and physio-chemical parameters. Thus 0.5% level was chosen based of sensory attributes. The following observation were noted as Moisture-0.5%, Fat-15.08±0.60%, Protein-20.03±0.57%, Ash-6.28±0.09%, Loose bulk density-0.29±0.01, tapped bulk density-0.90±0.07. Particle size of camel milk powder were D [3, 2] 2.19 µm D [4, 3] 4.15 µmDv (10) 1.05 µmDv (50) 2.97 µmDv (90)7.92 µmand instant flavoured drink powder is D [3, 2] 2.21 µm D [4, 3] 4.34 µmDv (10) 1.05 µmDv (50) 3.01 µmDv (90) 8.18 µm. Total plate counts (TPC)and yeast and mold counts (YMC) increased significantly (p<0.05) from day o to 180 days of storage in FDCMP and as well as IFDP. A significant (p<0.05) effect of addition of cardamom powder and sugar powder showed significantly (p<0.05) lower TPC and YMC during entire period of storage.

KEYWORDS: Camel milk powder, freeze dried, cardamom, bulk density

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Data Availability Statement: Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

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1. INTRODUCTION

In the world, the camel population is estimated to be more than 35 million (Faye, 2020). In India the camel population is about 2.5 lacs with 9 registered breeds of it viz. Bikaneri, Jaisalmeri, Jalori, Kharai, Kacchhii, Malvi, Marwari, Mewari, Mewati. In Rajasthan the camel population is 2.13 lacs that is 85.2% of the country's total camel population (Anonymous, 2024). Even after high adaptive nature of camel in the desert of Rajasthan, its contribution in total livestock population of Rajasthan (567.75 lac) is only 0.375%. Year by year camel population of India is decreasing, as it has decreased from 10.3 lacs (1992) to 2.5 lacs (2022) in 29 years. Recently, camel milk has become popular due to its antidiabetic, anti-cancerous, and anti-autism property (Deshwal et al., 2020). Furthermore, bioactives such as lactoferrin, peptides, zinc, and monounsaturated and polyunsaturated fatty acids present in camel milk help combat or reduce the risk of various diseases, such as gastrointestinal diseases, tuberculosis, autism, jaundice, and asthma (Swelum et al., 2021). Camel milk contains higher numbers of large micelles than bovine milk (Muthukumaran et al., 2022; Seifu, 2022). The unique arrangement of omega-3 fatty acids in camel milk facilitates its ability to endure freezing and thawing procedures while retaining its texture and avoiding curdling, which is a common issue associated with bovine milk (Siddiqui et al., 2024). Interestingly, camel milk was found to be a safer and healthier option for lactose-intolerant patients (Ho et al., 2022). The key features of camel milk are the higher amount of minerals (Ca, Fe, Mg, Cu, and Zn), vitamins (A, B_2, E, and C), and antimicrobial components (immunoglobulins, lacto-ferrin, and lysozyme), and lower amount of fat and cholesterol (Almasri et al., 2024) rather than in comparison to bovine milk. Camel milk owes high nutritional value as its milk contains a high proportion of antibacterial substances and a thirty times higher concentration of vitamin C in comparison to cow milk. (Jacob and Vadodaria, 2024) Camel milk is the most valuable product and it is known as 'white gold of the desert' (Wernery, 2006 and Davati et al., 2015).

Therefore, by virtue of its immense nutritive value, camel milk is gaining popularity across the world, however, small scale production, seasonality, handling and transportation problems necessitate its conversion to more shelf stable form (Pal et al., 2024). The food industry often processes liquid products into powder for facilitating easier transportation, preservation, and storage (Nnaedozie et al., 2019).

Camel milk is produced only in areas where camels are raised. Thus, it is essential to develop appropriate technology or products of camel milk so that it can be easily distributed globally. (Habtegebriel et al., 2018; Ho et al., 2019). Milk and its derivatives are inherently susceptible to numerous microbiological, physical and biochemical degradations, so with the help of drying technique, there is extending shelf life of product and as well as reducing the transportation cost (Fathi et al., 2022). Freeze-drying is regarded as a highly efficacious dehydration technique for thermally sensitive substances(Jangam et al., 2016). It facilitates the retention of vitamins and macroelements in reconstituted camel milk. (Tastemirova et al., 2022)

Cardamom powder was found best its characteristic aroma, flavor, and bioactive components (Winarsi et al., 2016). Owing to its fragrance, cardamom is an esteemed aromatic spice that is commonly utilized in the culinary traditions of Scandinavian, Arab, and Eastern cultures. Cardamom (*Elettaria cardamomum*) is a widely flavoured culinary spice and flavouring agent (Hamdy et al., 2024). This present study evaluates to determine the physico-chemical properties of instant flavoured drink powder from camel milk powder and to determine the shelf life of freeze dried camel milk powder and instant flavoured drink powder.

2. MATERIALS AND METHODS

The experiment was conducted from June, 2023 to December, 2024 at ICAR-National Research Centre on Camel, Bikaner, Rajasthan, India (26°54'45"N, 75°47'14"E).

2.1. Chemical reagents

All the chemicals were analytical grade and were obtained from standard firms (Hi Media, Sigma, Qualigens, CDH etc.)

2.2. Preparation of freeze-dried camel milk powder (FDCMP)

The camel milk was procured from camel dairy maintained at ICAR-NRC on Camel, Bikaner. The physico-chemical properties were analysed. The milk was pasteurized and dried in the freeze-drier model (INOFD-200S), (Company Qingdao Innova Bio- MedTech Co., Ltd.) for 24 hours at temperature of -40°C. samples were ground in the mixer and packed in the aluminium zipper pouch.

2.3. Preparation of instant flavoured ready to serve drink (IFDP)

Instant flavoured drink was prepared by mixing freeze-dried camel milk powder with powdered sugar and cardamom powder with pinch of artificial green colour (FSSAI grade). Cardamom powder was prepared by mixing the cardamom in kitchen blender in order to obtain a fine powder of cardamom.The mixer was packed in aluminium standee zip pouches and stored at room temperature for further analysis (Table 1).

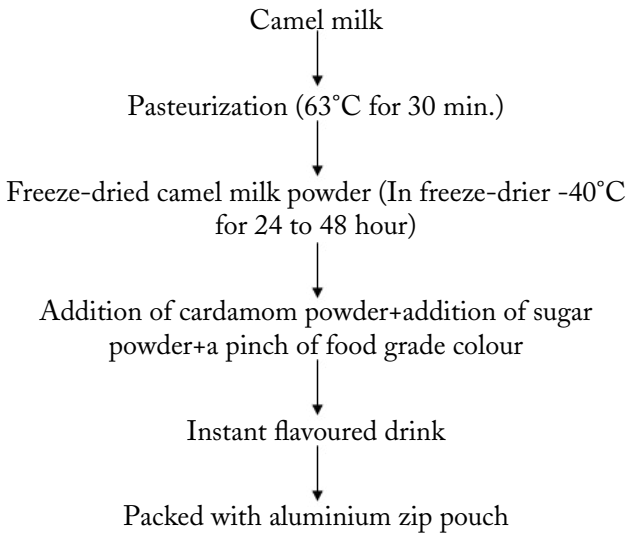

Table 1: Formulation of instant flavoured drink (IFDP)

Ingredients	Control	T_1	T_2	T_3
Milk powder (g)	10 g	10 g	10 g	10 g
Water(40° C) (millilitre)	90 ml water	90 ml water	90 ml water	90 ml water
Powdered sugar (g)	6 g	6 g	6 g	6 g
Cardamom powder (g)	-	0.2 g	0.5 g	1 g
Food grade colour (g)	-	0.1 g	0.1 g	0.1 g

2.4. Proximate analysis of FDCMP and IFDP

Moisture content was analysed by oven-dried method (Annonyms, 2005). The protein was determined by the Kjeldahl method that estimate of total nitrogen in the sample with AOAC method. Muffle furnace was used in the determination of Ash content at 550°C for overnight. Fat was estimated with Soxhlet apparatus method. Carbohydrate was determined from the difference. All the proximate analysis was performed in triplicate.

2.5. Physical properties of FDCMP and IFDP

2.5.1. Bulk density

Bulk density was estimated as the method explained by Pandey et al. (2020). Ten grams of BFMS was taken into measuring cylinder (100 ml) and the volume of the powder was noted.

Bulk density=Mass of powder/Volume of powder

2.5.2. Tapped density

The Tapped density of the BFMS was calculated by the method defined by Deshwal et al. (2020). Ten g of the sample placed in a 100 ml mixing cylinder, and the volume was noted after the sample was tapped 20 times on rubber pad from a height of 15 cm.

Tapped density=Mass of powder/Tapped volume

2.5.3. Particle size

Particle size of camel milk powder was determined by laser light-scattering using a Malvern Zetasizer Nano Series Ver 6.30 (Malvern Instruments Ltd., UK), revealed particle size distribution (d10, d50 and d90).

2.6. Sensory evaluation of IFDP

Sensory evaluation of IFDP was carried out in terms of colour, odour, taste, after taste, consistency and overall acceptability using 8-point descriptive scale. Seven members of semi-trained sensory evaluation panellists from the NRCC, Bikaner and performed the sensory evaluation. Each panellist offered independent observation on randomized samples of IFDP.

2.7. Total plate count

The aggregate mass of total plate count agar, amounting to 23.5 grams (Hi-Media Laboratories Pvt. Ltd., Mumbai), was solubilized in 1000 ml of distilled water. Subsequently, the solution was subjected to boiling to ensure complete dissolution, and then autoclaved under a pressure of 15 lbs. (121°C) for a duration of 15 minutes. The final pH was meticulously calibrated to 7.0 at a temperature of 25°C. The total plate counts in pre -treated camel milk powder was enumerated according to the method provided by Annonymous (1991).

Duplicate sets of sterilized petri-plates were inoculated aseptically with 1 ml of aliquots derived from the appropriate dilution. Approximately 10–15 ml of sterilized plate count agar were carefully dispensed into the petri-plates, and to ensure thorough mixing of the media, the disc was rotated gently in both clockwise and counter clockwise directions. Subsequently, the plates were incubated at a temperature of 35±2°C for a duration of 24 hours within the incubator. The incubation plates exhibiting 30-300 colonies were preferentially enumerated and recorded as log10 cfu g^{-1} of the sample.

2.8. Yeast and mold count

A total of 39 grams of Potato Dextrose Agar, sourced from Hi-Media Laboratories Pvt. Ltd., Mumbai (code No. M096), was dissolved in one litre of distilled water, subjected to boiling to ensure the complete dissolution of the medium, and subsequently sterilised through autoclaving at a pressure of 25 lb (121°C) for a duration of 15 minutes. The pH was adjusted to 3.5 at a temperature of 25°C. The inoculation of the designated sample dilution was performed utilizing a pour plate with overlay technique, and the plates were subsequently incubated at 35°C for a period of 5 days. Upon completion of the colony counting, the outcomes were articulated as $\log_{10}$ cfu g^{-1} of the samples.

3. RESULTS AND DISCUSSION

All analyses were performed in duplicates and their values were expressed as mean±standard deviation (SD). For sensory analysis the results were analysed statistically for analysis of variance and least significant difference test using the software of statistical package for social sciences (IBM SPSS Statistic 20) and as per Snedecor and Cochran (1980). The statistically analysed result was tabulated and interpreted.

3.1. Sensory analysis of IFDP

The IFDP was prepared by blending FDCMP and sugar powder with different levels of cardamom powder (0.2, 0.5 and 1%) and 0.1% of food grade green colour. The sensory scores pertaining to the flavoured drink from different level of cardamom powder are presented in Table 2.

The drink prepared with 0.5 % of cardamom powder was having highest score for overall acceptability. Kandel et al. (2023) observed the effect of cardamom powder in paneer made with cow and buffalo milk and found that 0.20% of cardamom powder in treatment was having a desirable sensory score. Singh et al. (2019) for cardamom flavoured milk as he reported that score for colour and appearance increased with increasing cardamom levels in Pinni.

Table 2: Sensory analysis of instant flavoured drink

	Control	T_1 (1%)	T_2 (0.5%)	T_3 (1.5%)
Color	6.90±0.04^{a}	7.21±0.06^{b}	7.40±0.06^{c}	7.59±0.05^{d}
Odour	7.05±0.06^{a}	7.25±0.05^{b}	7.42±0.05^{b}	7.33±0.05^{b}
Taste	7.03±0.04^{a}	7.21±0.07^{b}	7.38±0.05^{b}	7.27±0.05^{b}
After taste	6.89±0.04^{a}	7.01±0.05^{a}	7.25±0.05^{b}	7.10±0.03^{b}
Consistency	7.15±0.05^{a}	7.23±0.04^{ab}	7.33±0.05^{b}	7.27±0.05^{ab}
Overall acceptability	7.30±0.05^{a}	7.42±0.05^{b}	7.61±0.02^{c}	7.50±0.03^{bc}

Mean±SE* with different superscripts in a row wise (lower case alphabet) differ significantly (p<0.05); n=21 for each treatment

3.2. Proximate analysis of IFDP

Composition of the instant flavoured drink powder shown in table 3. Powders is an important property, which affects their shelf life and also flow properties. The moisture content of the IFDP was 2.49%, on the lower side of the range, viz. 2–4% reported for whole milk powder (Kumar et al., 20022). The fat content was 15.08%, that was lower than freeze-dried camel milk powder. Protein content of the IFDP powder was less than that reported for FDCMP, viz., 20.03% and the ash content was 6.28% appreciably lower than FDCMP that has been reported by Kumar et al. (2022). Total carbohydrates in the IFDP were higher as compared with FDCMP on account of the added sugar (Pandey et al., 2020). Zhou et al. (2025) also observed the similar finding for freeze-dried camel milk powder as shown in table 3 for FDCMP (Figure 1).

Table 3: Physico-chemical parameters

Parameter	FDCMP	IFDPP
Moisture (%)	3.42±0.14	2.49±0.08
Protein (%)	26.05±0.33	20.03±0.57
Fat (%)	24.38±0.49	15.08±0.60
Ash (%)	9.79±0.11	6.28±0.09
Lactose (%)	36.37±0.48	56.08±0.78
Loose bulk density (g cm^{-3})	0.26±0.01	0.29±0.01
Tapped bulk density (g cm^{-3})	0.34±0.008	0.90±0.07

3.3. Bulk density and tapped density

Tapped and untapped density is an important parameter for the powder because it indicates the area cover by the powder, which is vital for packing industry. Tapped and untapped density resultsare presented in Table 3, where the untapped density known as bulk density and tapped density were found to be 0.295 and 0.90 g cm^{-3} respectively that is higher from FDCMP. The addition of sugar decreased cohesiveness and increased bulk and tapped densities (Pandey et al., 2020).

3.4. Particle size distribution analysis

The D_{10}, D_{50} and D_{90} values was found 1.09 µm, 2.97 µm and 7.69 µm respectively for camel milk powder.The D_{10}, D_{50} and D_{90} values was found 1.05 µm, 3.01 µm and 8.18 µm for instant flavoured milk powder. The results were observed in accordance with O'Donoghue et al. (2019) (Figure 2).

3.5. Microbial parameters of FDCMP and IFDP

The mean values for total plate count (TPC) of FDCMP and IFDP, days of storage are illustrated in table 4. Total plate counts increased significantly (p<0.05) from day 0 to 180 days of storage in FDCMP and as well as IFDP. A significant (p<0.05) effect of the addition of cardamom powder was observed as the IFDP containing cardamom powder and sugar powder showed significantly (p<0.05) lower TPC during entire period of storage.

The mean values for yeast and mold counts of FDCMP and IFDP, days of storage are illustrated in table 4. The yeast and mold counts were not detected on day 0 in IFDP. A significant (p<0.05) effect of the addition of cardamom powder was observed as the IFDP containing cardamom powder and sugar powder showed significantly (p<0.05) lower YMC during entire period of storage. The yeast and mold counts of IFDP were significantly (p<0.05) lower than FDCMP on all days of storage. The similar results were in accordance with Singh et al. (2020). Cardamom powder exhibits antibacterial properties primarily due to its rich composition of bioactive compounds, particularly essential oils like 1,8-cineole. These compounds disrupt bacterial cell membranes, leading to cell lysis and death (Sobhy et al., 2023) (Figure 3).

Table 4: Microbial study of FDCMP and IFDP at different storage days

Days	Total plate count		Yeast and mold count	
	FDCMP	IFDP	FDCMP	IFDP
0	2.28±.006[a]	2.23±.012[a]	0.14±0.005[a]	0.00[a]
45	2.47±.007[b]	2.3±.016[b]	0.36±0.05[b]	0.1498±0.03[b]
90	2.68±.009[c]	2.44±.177[c]	0.678±0.07[c]	0.3477±.002[c]
135	2.9±.009[d]	2.62±.022[d]	0.838±0.11[d]	0.583±0.262[d]
180	3.2±.052[e]	2.83±.012[e]	1.135±0.32[e]	0.733±0..008[e]

Mean±SE* with different superscripts in a column (lower case alphabet) in a subgroup differ significantly (p<0.05), n=6 for each treatment; FDCMP-Freeze-dried camel milk powder; IFDP-Instant flavoured drink powder

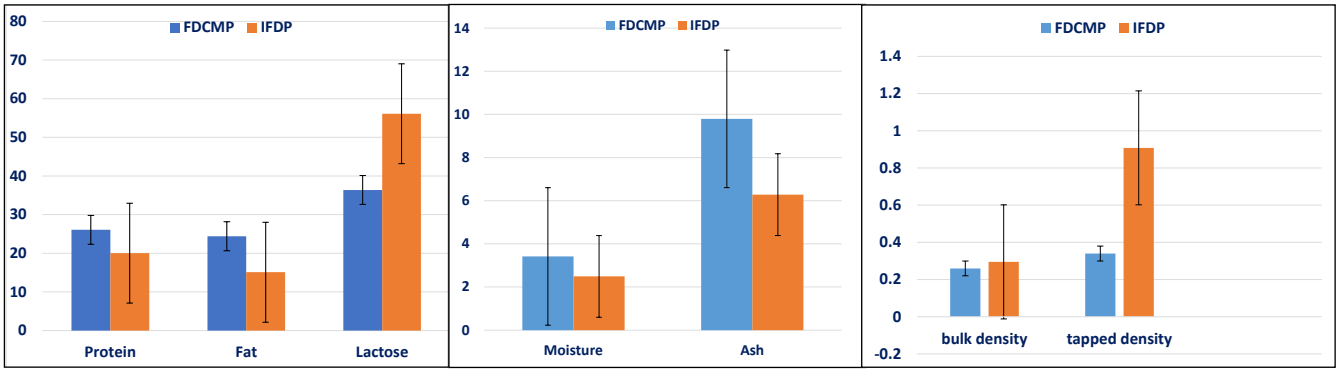

Figure 1: Proximate parameters and densities of freeze-dried camel milk powder and instant flavoured drink powder

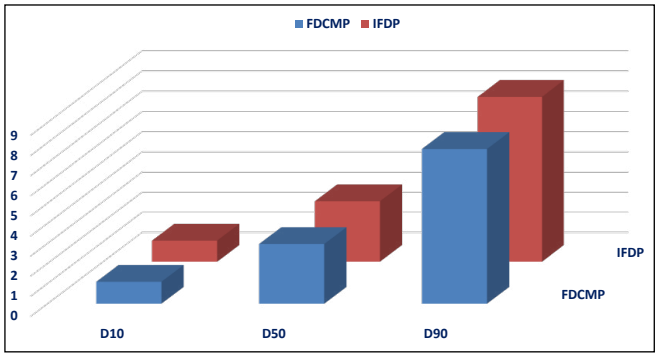

Figure 2: Particle size analysis of freeze-dried camel milk powder and instant flavoured drink powder

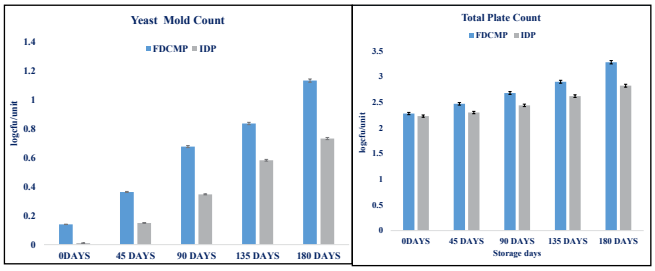

Figure 3: Microbiological studies of FDCMP and IFDP at different storage days

4. CONCLUSION

The camel milk powder was prepared instantly with the freeze-drying technique. Instant flavoured drink was prepared from camel milk powder and cardamom powder and sugar powder was used. The optimization of cardamom powder in instant flavoured drink was done and with the help of sensory evaluation the 0.5% cardamom powder containing instant flavoured powder was selected as best. Further this IFDP and FDCMP was evaluated for physico-chemical properties.

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