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The Use of an Infrared Oven in Drying Probiotic Yoghurt and Studying the Chemical, Microbial, and Sensory Properties of Dried Yoghurt During Storage Periods

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Abstract

The present study aims to produce dried probiotic yoghurt using an infrared oven. A therapeutic starter consisting of three species: *Lactobacillus acidophilus*, *Bifidobacterium bifidum*, and *Streptococcus thermophilus* was used. The product was then dried at 50°C, and the physicochemical, microbial, and sensory properties of the dried yoghurt were studied during refrigerated storage. The results demonstrated the possibility of preserving probiotic yogurt dried in an infrared oven at 50 °C at refrigerator temperature, while, the moisture, protein, fat, carbohydrate, ash, total solids, pH levels and total acidity of probiotic yoghurt (5.91%, 31.92%, 1.45%, 51.51%, 8.21%, 94.09%, 4.34, and 0.98%, respectively) after 1 day of storage time. The log number of starter bacteria was 8.30, 6.73, 6.62, and 6.30 CFU/g for *Lactobacillus acidophilus*, *Streptococcus thermophilus*, *Lactobacillus acidophilus*, and *Bifidobacterium bifidum*, respectively. The sensory evaluation results of the infrared oven-dried yoghurt samples on the first and last days of storage at refrigerator temperature were similar to the results of the air oven-dried yoghurt samples. Finally, drying the probiotic yoghurt in an infrared oven at 50°C yielded a dried product containing a high number of probiotic bacteria and exhibited good physicochemical properties after 3 months.

Key words: Dried product, probiotic bacteria, Infrared oven.

Introduction

Yoghurt is a fermented food resulting from a synergistic action between milk and lactic acid bacteria *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophilus*, these bacteria produce lactic acid, which ferments the lactose sugar in milk. Yoghurt is one of the most common fermented foods in the world and is widely accepted by consumers due to its taste and health benefits (1).

Recent studies have tended to integrate different nutrients into food products to enhance their functional properties (2). An example of this is probiotic yogurt, as foods that offer additional benefits beyond their nutritional value, including positive effects on the body's physiological functions and reduced disease risk, are included within the category of functional foods (3). Consumer interests have shifted significantly in recent years towards functional foods, including functional fermented dairy products such as therapeutic yoghurt, as they contain nutrients, biologically active compounds, and probiotic bacteria, especially *Bifidobacterium* and *Lactobacillus* spp., which provide many therapeutic benefits that improve the health of the consumer, such as reducing blood cholesterol levels, lowering blood sugar levels, and their ability to strengthen the immune system and aid digestion (4). Probiotic yoghurt is a functional food containing a sufficient number of viable microorganisms (at least 10^9 CFU/g) that positively affect host health by altering the gastrointestinal microbiota (5). Probiotic yoghurt is one of the most popular functional foods in the world. Adequate amounts of probiotics are important as they play a vital role in determining the health-promoting properties of yoghurt (6). Many studies have shown that adding bifidobacteria and other probiotics to dairy products, such as organic yogurt, can increase their nutritional content, which is essential for consumer health. Additionally, it supports gastrointestinal health (7).

The reason for using drying techniques in yoghurt production is that, in addition to preserving the organoleptic and nutritional properties of the product, they are mainly to extend its shelf life (8). Drying significantly reduces the costs associated with packaging, transportation, and storage. Dried products can also be stored at room temperature, unlike fresh products transportation and storage costs (9). Several drying techniques are employed, including foaming, freeze drying, electric oven drying, and vacuum drying, to extend the shelf life of yoghurt and investigate the ability of lactic acid bacteria (LAB) to withstand drying conditions.

Most changes in yoghurt powder properties are related to fluctuations in free moisture content, which in turn is affected by fluctuations in headspace relative humidity and temperature. Hygroscopicity can lead to numerous undesirable changes, including lactose crystallization, color change (Maillard browning), lipid oxidation, protein conformational changes, alterations in surface composition, and modifications in particle morphology (10).

Infrared drying technology (IR) is used to dry high-moisture food materials. Compared to traditional drying technologies, this method offers several advantages, including high energy efficiency, short drying times, uniform heating of materials, easy control of material temperature, high-quality finished products, and reduced energy costs (11).

The present research aims to convert probiotic yoghurt into dried probiotic yoghurt and maintain adequate numbers of viable bacteria in the dried probiotic yoghurt product during storage periods by drying it in an infrared oven at different temperatures, with the optimal temperatures being determined by calculating the number of viable bacteria. , leading to reduced costs associated with packaging, processing, and transportation.

Materials and Methods

Raw Materials: The milk used in this research was commercial skimmed milk powder bought from a local supermarket. The composition of skimmed milk powder was 5% water, 53% carbohydrates (lactose), 32% protein, and 9% ash. Every probiotic starter culture originates from the Danish laboratory Chr. Hansen A/S. It was a combination of *Lactobacillus acidophilus* (La-5), *Bifidobacterium bifidum* (Bb-12), and *Streptococcus thermophilus* (ST) (1:1:1). MRS-sorbitol (de Man, Rogosa and Sharpe basal medium without glucose) was prepared by mixing 10 ml of a membrane-filtered sterile solution containing 10% D-sorbitol with 90 ml of basal medium to obtain a final concentration of 1% sorbitol. Filter-sterilized MRS-NNLP (stock solutions of the NNPL components, namely neomycin sulfate at a concentration of 100 mg/l, paromomycin at 200 mg/l, nalidixic acid at 15 mg/l, and LiCl at 3 g/l) is commercially available from Sigma-Aldrich in Germany. Additionally, MRS agar and M17 culture media were used to activate the starter culture and enumerate the bacterial population during yoghurt production and the subsequent storage periods.

Probiotic-Yoghurt Production: A total volume of 150 g of skimmed milk powder was mixed with 1000 ml of distilled water for the yoghurt production process. The sample was subjected to thermal treatment at 95°C for 15 minutes. After reducing the temperature to 40°C, a 5% concentration of an activated starter culture containing 10⁹ CFU/g of lactic acid bacteria (LAB) was introduced. The mixture was then incubated at 40°C until it reached a pH level of 4.6. Subsequently, the sample was refrigerated at 6-8°C for 24 hours, during which the following tests were conducted (12).

Probiotic-Yoghurt Drying

Probiotic-Yoghurt Infrared drying: A 50 g of yoghurt was spread evenly on a glass plate with dimensions of 50 cm in width and 10 cm in height. The thickness of the fat layer was 0.5 cm at 50°C until the required wetness percentage of 5% was reached. Compared to a control sample that was oven dried under the same conditions (13). The dried yoghurt

samples were stored in vacuum bags and placed in the refrigerator at $6 \pm 2^{\circ}\text{C}$ for a period of 1, 30, 60, and 90 days.

Yoghurt Analysis

Chemical Composition: Tests were carried out to analyze the chemical composition of fresh probiotic yoghurt samples after storage for 1 day. The moisture content of fresh and dried yogurt samples was determined according to the method adopted by (14), by exposing them to an oven at a temperature of $105^{\circ}\text{C} \pm 2$. The total protein ($\text{N} \times 6.38$) of the samples was estimated using the Micro-Kjeldahl method (15). The ash content of the yogurt samples was determined according to the method by (16) using a muffle furnace at 621°C for 16-20 hours. The percentage of carbohydrates was estimated using the following equation: $\text{total carbohydrates \%} = 100 - (\text{moisture \%} + \text{protein \%} + \text{fat \%} + \text{ash \%})$.

Physiochemical Test: Physicochemical tests were performed on fresh probiotic yoghurt samples after storage for 1 day. for the total titratable acidity and pH of the probiotic-yoghurt samples determined according to the method reported by (14).

Number of starter bacteria count: The number of viable starter bacteria remaining per individual can be ascertained using the pour plate technique. ST is grown on M17 media at 42°C for 48 h under aerobic conditions, while *La-5* and *Bb-12*. require anaerobic conditions for growth. *La-5* is grown on MRS-sorbitol, while *Bb-12* is grown on MRS-NNLP. Both are incubated at 37°C for 48 to 72 h (17).

Bacterial tests: Bacterial tests of fresh and dried Probiotic Yoghurt samples are subject to microbial contamination. The Spore-forming Bacteria should be cultured on nutrient agar media, such as Nutrient Agar. *coli* should be cultured on MacConkey agar, while Staphylococci should be cultured on Mannitol Salt agar. Both should be incubated at 37°C for 48 hours (18).

Reconstitution of dried yoghurt: Dried yogurt powder was dissolved in warm water (50°C) at a ratio of 1:6 (powder to water). After mixing, the mixture was cooled to 35°C and left for 5 minutes. The mixture was then poured into a cup and left to cool in the refrigerator until the yoghurt was reconstituted (19).

Sensory evaluation: A panel of 30 untrained, non-smoking, adult consumers (12 males and 18 females), aged 18-60 years, was recruited to evaluate samples of probiotic yoghurt dried in an infrared oven and an air oven at 50°C . For the sensory evaluation, 1 gram of each sample was placed in a transparent plastic cup and assigned a random number. The consumer was to rinse their mouth with water after each sample. The consumer was then asked to rate six sensory attributes (appearance, colour, texture, flavor, and overall acceptability) on a 9-point hedonic scale, ranging from 1 (strong dislike) to 9 (strong desire) .

Statistical Analysis: The experiment was designed and the data were analyzed using Completely Randomized Design (C.R.D) and statistically analyzed using the ready-made statistical program Special Program for Statistical System (SPSS 30). The studied factors were tested using the least significant difference (LSD) test at a 5% probability level.

Results

Probiotic-Yoghurt Properties

Table 1 and Figure 1 show the chemical, physical, and microbiological properties of probiotic yoghurt after 24 hours of production. The measured chemical properties of probiotic yoghurt before drying included protein, carbohydrate, ash, moisture, and fat content. The averages of moisture, protein, carbohydrate, ash, and fat contents were 87.93, 5.40, 5.03, 0.22, and 1.42, respectively. The logarithm numbers of starter bacteria were 9.70, 8.83, 8.72, and 8.66 log CFU/g for LAB, ST, La-5, and Bb-12, respectively.

Chemical and physical properties of dried probiotic-yoghurt.

Table 2 presents the chemical compositions and physical properties of probiotic yoghurt subjected to drying at 50 °C using an infrared oven and an air oven during storage periods of 1, 30, 60, and 90 days. The effect of the drying process on the samples' moisture content was observed, with results indicating a significant decrease in moisture content. This was accompanied by an increase in the percentage of other components, including protein, carbohydrates, ash, and fat, resulting from the heat treatment and storage conditions. The protein and ash content values of probiotic-yoghurt dried by an Infrared oven after one day of drying ranged between 31.3% and 32.5%, and between 7.41% and 8.2%, respectively.

Table 1. Physiochemical properties of fresh probiotic-yoghurt

Physiochemical test	Result The averages
Moisture %	87.93±1.92
Protein (N × 6.38) %	5.40±0.45
Carbohydrates (lactose)%	5.03±0.61
Fat %	0.22±0.01
Ash %	1.42±0.09
Total Solids %	12.07±1.02
Total solids nonfat %	11.85±0.95
pH	4.35±0.21
	1.11±0.06

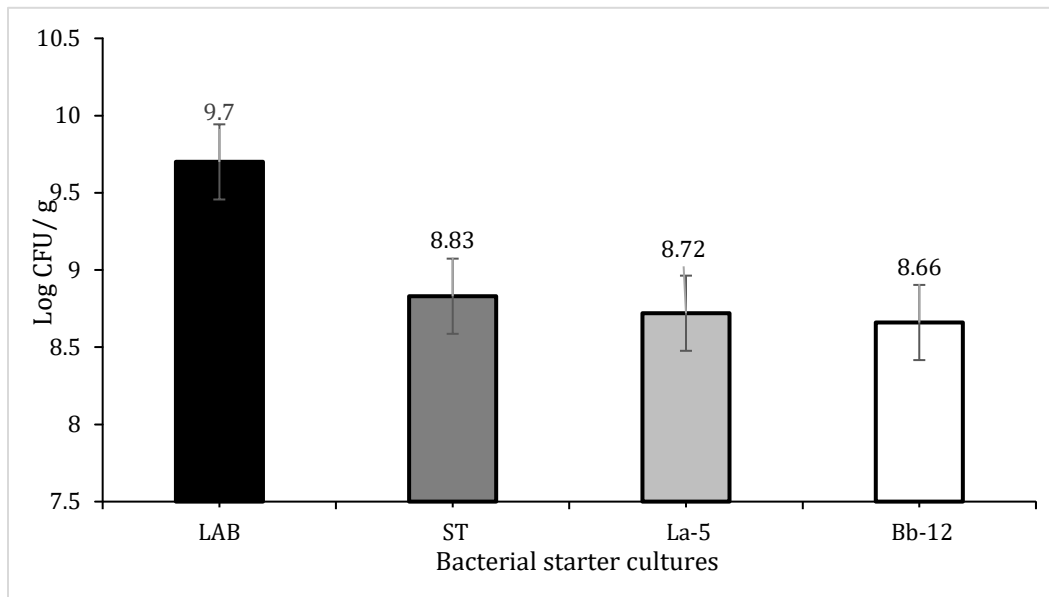


Figure 1. Log. Number of viable starter bacteria

Starter bacteria count of dried probiotic-yoghurt.

The numbers of lactic acid bacteria, *La. acidophilus*, *St. thermophilus*, and *B. bifidum*, were determined in dried yogurt samples after drying in an infrared oven at 50°C, and during storage periods (1, 30, 60, and 90) days, as shown in figure (2). Bacterial counts were estimated after one day of storage at 50°C, with the total counts of *Lactobacillus acidophilus*, *Lactobacillus thermophilus*, *Lactobacillus acidophilus*, and *Bifidobacterium bifidum* being 8.30, 6.73, 6.62, and 6.30 log, respectively. CFU/g, respectively. After 30 days of storage, the log numbers of starter bacteria were 7.24, 6.64, 6.60, and 6.24 CFU/g, respectively. At the end of storage time (90 days), the total counts of lactic acid bacteria, *St. thermophilus*, *L. acidophilus*, and *B. bifidum* were 6.45, 5.85, 5.90, and 5.09 log CFU/g, respectively. The logarithm of starter bacterial counts in air oven-dried yoghurt samples was higher throughout the storage period. The bacterial count continued to decline steadily over storage but remained within acceptable limits, consistent with previous studies.

Results indicated that *Staphylococcus* spp., *E. coli*, and spore-forming bacteria did not grow in samples of dried probiotic yoghurt containing probiotics, which were dried in an infrared oven at 50 °C over a storage period of three months (90 days) (Table 3).

Table 2. Physiochemical properties of dried probiotic-yoghurt at 50°C

Chemical Ingredients	Oven type	Storage Periods (day)			
		1	30	60	90
Protein %	Infrared	32.92 ^a ±1.02	31.42 ^a ±0.95	31.31 ^a ±0.96	31.88 ^a ±3.73
(N × 6.38)	Air	31.92 ^a ±1.00	31.12 ^a ±1.02	31.25 ^a ±1.05	31.85 ^a ±2.92
Carbohydrates	Infrared	51.51 ^a ±0.92	53.31 ^a ±2.65	55.06 ^a ±2.71	51.05 ^a ±4.33
(lactose) %	Air	52.51 ^a ±1.11	53.42 ^a ±1.99	55.32 ^a ±1.86	51.07 ^a ±5.01
Ash (%)	Infrared	8.21 ^a ±0.02	8.05 ^a ±0.67	7.53 ^a ±0.22	7.4 ^{1a} ±0.42
	Air	8.22 ^a ±0.09	7.96 ^a ±0.88	7.52 ^a ±0.91	7.51 ^a ±0.35
Moisture (%)	Infrared	5.91 ^a ±0.90	5.85 ^a ±1.94	4.59 ^a ±0.53	8.21 ^a ±1.06
	Air	5.89 ^a ±0.62	6.01 ^a ±1.81	4.48 ^a ±0.71	8.08 ^a ±1.00
Fat (%)	Infrared	1.45 ^a ±0.01	1.41 ^a ±0.11	1.51 ^a ±0.04	1.45 ^a ±0.57
	Air	1.46 ^a ±0.00	1.45 ^a ±0.06	1.43 ^a ±0.01	1.43 ^a ±0.02
Total solids (%)	Infrared	94.09 ^a ±3.66	94.19 ^a ±5.91	95.41 ^a ±6.66	91.79 ^a ±4.98
	Air	94.11 ^a ±4.16	93.99 ^a ±5.51	95.52 ^a ±7.01	91.92 ^a ±5.21
Total solid nonfat (%)	Infrared	92.64 ^a ±5.42	92.78 ^a ±3.41	93.90 ^a ±5.23	90.34 ^a ±6.19
	Air	92.65 ^a ±3.68	92.54 ^a ±4.12	94.09 ^a ±4.98	90.49 ^a ±5.53
Ph	Infrared	4.34 ^a ±0.42	4.14 ^a ±0.02	4.09 ^a ±0.07	4.00 ^a ±0.11
	Air	4.30 ^a ±0.22	4.16 ^a ±0.09	4.11 ^a ±0.01	4.04 ^a ±0.09
Total acidity (%)	Infrared	0.98 ^a ±0.13	1.08 ^a ±0.12	1.15 ^a ±0.00	1.22 ^a ±0.02
	Air	0.97 ^a ±0.14	1.10 ^a ±0.11	1.19 ^a ±0.06	1.31 ^a ±0.09

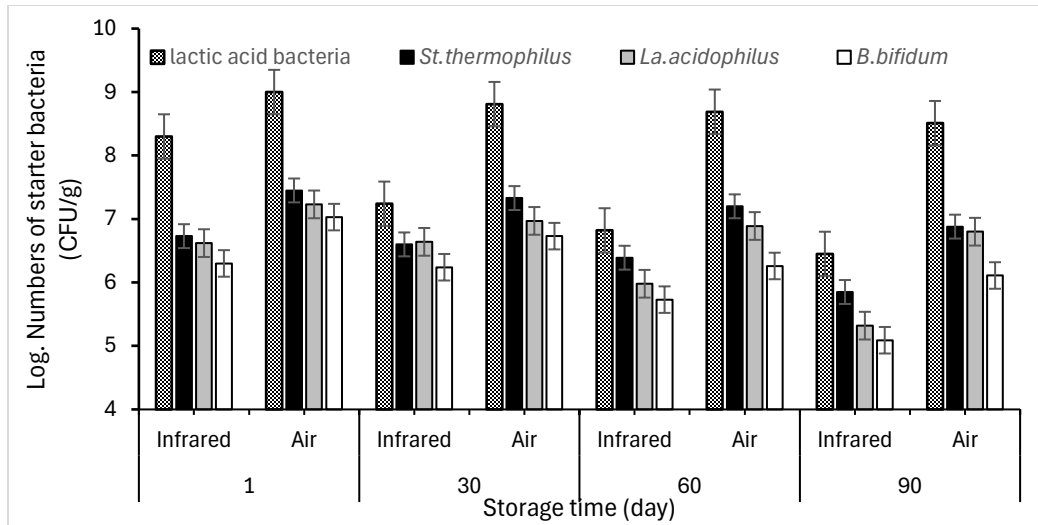


Figure 2. Number of starter bacteria cultures (log. CFU/g) of dried probiotic-yoghurt at 50°C.

Table 3. Spoilage bacteria numbers of dried probiotic yoghurt

Bacteria numbers (CFU/g)	Oven type	Storage Periods (day)			
		1	30	60	90
<i>Staphylococcus</i> spp.	Infrared	Nil	Nil	Nil	Nil
	Air	Nil	Nil	Nil	Nil
<i>Escherichia. coli</i>	Infrared	Nil	Nil	Nil	Nil
	Air	Nil	Nil	Nil	Nil
Endo spore-forming bacteria	Infrared	Nil	Nil	Nil	Nil
	Air	Nil	Nil	Nil	Nil

Sensory Properties of dried probiotic -yoghurt

The figure (3A) illustrates the sensory properties of dried yoghurt samples by infrared oven and air oven after 1 day of storage time. A 9-point hedonic test assessed sensory acceptability, with scores ranging from 1 (strongly dislike) to 9 (strongly like). The appearance scores ranged from 8.60 to 8.80, the colour scores were 6.97 to 7.10, the texture scores were 8.65 to 8.80, and the flavour scores were 8.1 to 8.5. Moreover, the overall acceptability scores were 8.36 and 8.40, respectively. After 90 days of refrigerated storage,

the sensory properties of dried yoghurt samples, estimated by 30 consumers using an infrared oven and an air oven, were assessed. The mean values for appearance, color, texture, flavor, and overall acceptability of dried yoghurt samples prepared by an infrared oven were 7.25, 5.88, 7.44, 8.76, and 7.53, respectively. The sensory properties of the dried yoghurt samples, as measured by the air oven, were 7.45, 6.60, 8.00, 8.20, and 7.84, respectively (Figure 3B).

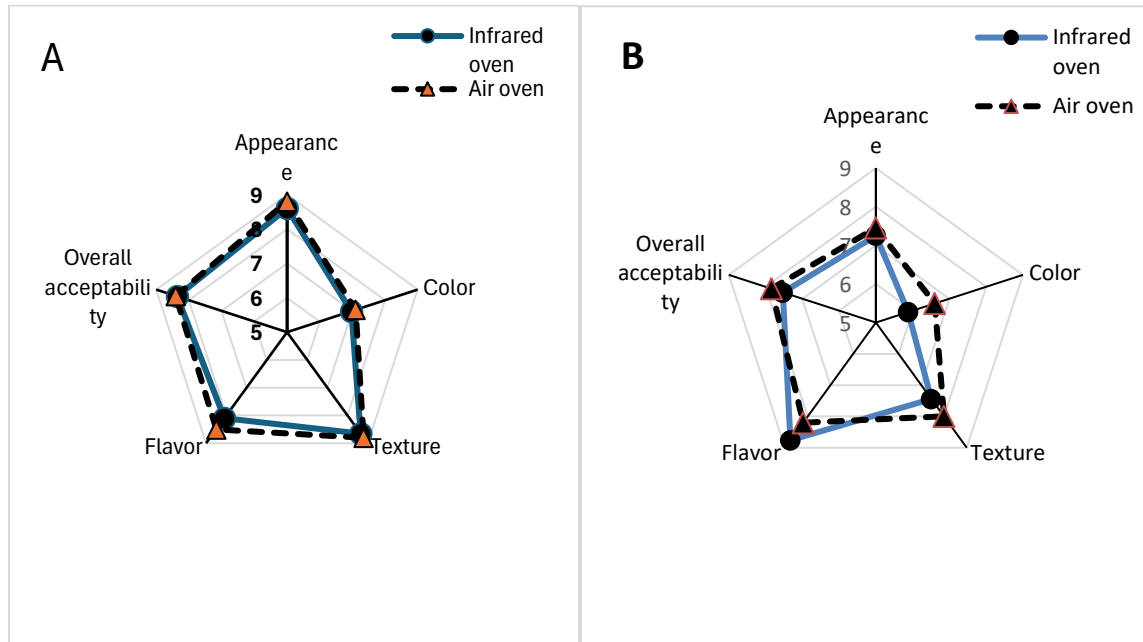


Figure 5. The sensory scores of dried probiotic yoghurt samples prepared using an infrared oven and an air oven during storage. (A) after 1 day of storage time, (B) after 90 days of storage time.

Discussion

Probiotic-Yoghurt Properties

The percentages of protein, carbohydrates, ash, moisture, and fat were found to be consistent with the required standards for producing probiotics. Table 1 shows that the percentages of protein, carbohydrates, ash, moisture, and fat were consistent with the required standards for producing probiotics. The percentages of protein, carbohydrates, ash, moisture, and fat were found to be consistent with the required standards for producing probiotics (Table 1). The averages of moisture, protein, carbohydrate, ash, and fat contents were 87.93, 5.40, 5.03, 0.22, and 1.42, respectively. These ratios were consistent with the required standards for producing probiotic yoghurt. The pH value decreased to 4.35, while the total acidity value increased to 1.11%. The change in pH and total acidity values can

be attributed to the presence of starter bacteria that enzymatically convert lactose into organic acids, such as lactic acid, acetic acid, and formic acid, as well as some short-chain fatty acids. The majority of *St. thermophilus* numbers (Figure 1) could be attributed to the availability of its growth requirements, as provided by the incubation temperature of the probiotic yoghurt. The results of this study are consistent with previous studies that indicate the development of a gelatinous network within yoghurt during the cooling process, as also indicated by the decrease in pH levels and the increase in total acidity resulting from lactic acid bacteria utilizing lactose and converting it to organic acids (6,21).

Chemical and physical properties of dried probiotic-yoghurt.

The results of the present study demonstrated an enhancement in protein content and a reduction in ash content Table 2, in contrast to the outcomes of earlier studies conducted by (22). These values were in alignment with those reported by (23). The present study demonstrated that dried probiotic-yoghurt produced from skim milk powder exhibited a protein content ranging from 31.3% to 32.92%. The carbohydrate values represented by lactose ranged from 51.02% to 55.48% Table 2. The variation in lactose content during storage can be attributed to the activity of live lactic acid bacteria present in dried probiotic-yoghurt, which continue to ferment this sugar, as reported by (24). The fat value, meanwhile, ranged from 1.42% to 1.45%. The disparity in fat content between dried yoghurt and skim milk powder can be attributed to the reduced moisture content inherent in the former.

Starter bacteria count of dried probiotic-yoghurt.

The decline in viable *B. bifidum* bacteria, compared to the levels of *L. acidophilus* and *S. thermophilus* bacteria, can be attributed to the impact of the temperatures used during the drying process. This discrepancy may be attributable to the differential resilience of *La acidophilus* and *St. thermophilus* to these conditions in comparison with *B. bifidum*. The logarithm of starter bacterial counts in air oven-dried yoghurt samples was higher in comparison to the logarithm of starter bacterial counts in infrared oven-dried yoghurt samples throughout the storage period figure (2), this may be because infrared drying uses a range of radiation in addition to heat, which has a synergistic effect, causing a decrease in starter bacterial counts. The number of viable bacteria remaining depends on several factors, such as drying temperatures, the initial bacterial count in the product before drying, and the duration of heat exposure (25, 26). The ability of yoghurt starter cultures to maintain a high bacterial count after drying is attributed to the presence of a protective membrane layer composed of solids surrounding the bacterial cells (27). This protective layer mitigates the damaging effects of drying on the bacterial cell membrane while enabling an encapsulation process that effectively maintains bacterial viability (28). The use of prebiotics or heat-tolerant yoghurt strains in the production of dried yoghurt is an

effective approach to maintaining bacterial viability and activity during drying processes at temperatures above 50°C. Prebiotics bind to proteins and form a network that protects the lactic acid bacteria present in the yoghurt from the effects of the drying process (29).

The findings of the study demonstrated *Staphylococcus* spp., *E. coli*, and spore-forming bacteria did not grow in samples of dried probiotic yoghurt containing probiotics Table 3, this may be due to the low water activity of the dried product and the inability of bacteria to grow under these conditions, in addition to the refrigerated storage conditions that limit bacterial growth activity.

Sensory Properties of dried probiotic -yoghurt

The Sensory evaluation results (Figure 3A) suggest that consumers discerned discrepancies in appearance, color, texture, and flavor, which collectively influenced their overall acceptance. The mean overall acceptability was found to be proportional to the appearance and texture of the samples. The color of the samples was found to be temperature-dependent, exhibiting a shift from a slightly yellowish white to a light brown hue. The highest mean overall acceptability scores were observed in dried yoghurt samples prepared by the air oven method, which also had the highest mean colour score. This finding aligns with the conclusions of a study by (30), which reported that consumer acceptance of food samples is influenced by factors such as appearance and texture (20).

The flavor and taste of fermented products depend on the metabolic products of the starter cultures used in production (31). The use of mixed starters and probiotic bacteria may increase the resulting flavor compounds and improve the taste, especially in the presence of *Streptococcus thermophilus* (32). Infrared and air oven drying methods did not significantly affect the sensory evaluation results during storage periods that lasted up to 90 days (Figure 3B).

Conclusions

The use of different drying methods helps in identifying and selecting the optimal method for drying yoghurt produced using probiotic starters. The use of an infrared oven yielded acceptable results, as determined by sensory evaluation of the dried product throughout the storage period. The number of probiotic bacteria was within the required levels and did not decrease despite the drying method and the long storage period. In addition, no growth of spoilage bacteria was observed. The results of the chemical content of dried yoghurt using the infrared oven were close to those of dried yoghurt in an air oven. Therefore, the infrared drying method for fermented dairy can be adopted as a promising and new method.

Conflicts of interest

The authors declare that there is no conflict of interest.

Ethical Clearance

This work is approved by The Research Ethical Committee.

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استخدام فرن الأشعة تحت الحمراء في تجفيف اللبن الرائب حيوي ودراسة الخواص الكيميائية والميكروبية والحسية للبن الرائب المجفف خلال فترات التخزين

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الخلاصة

تهدف هذه الدراسة إلى إنتاج لبن رائب حيوي و مجفف باستخدام فرن الأشعة تحت الحمراء. استُخدم بادئ علاجي مكون من ثلاثة أنواع من البكتيريا: *Lactobacillus acidophilus*، *Bifidobacterium bifidum*، و *Streptococcus thermophilus*. جُفّف المنتج بعد ذلك عند درجة حرارة 50 درجة مئوية ودُرست خصائصه الفيزيائية والكيميائية والميكروبية والحسية خلال تخزينه في الخزن المبرد. أظهرت النتائج إمكانية حفظ اللبن الرائب الحيوي المجفف في فرن الأشعة تحت الحمراء عند درجة حرارة 50 درجة مئوية وفي درجة حرارة التلاجة، بينما بلغت نسب الرطوبة والبروتين والدهون والكربوهيدرات والرماد والمواد الصلبة الكلية ودرجة الحموضة والحموضة الكلية للبن الرائب العلاجي 5.91%، 31.92%، 1.45%، 51.51%، 8.21%، 94.09%، 4.34%، و 0.98%، على التوالي بعد يوم واحد من التخزين المبرد. بلغ عدد لوغار يتم بكتيريا البادئ لبكتيريا حامض اللاكتيك و *Streptococcus thermophilus* و *Lactobacillus acidophilus* و *Bifidobacterium bifidum* 8.30، و 6.73، و 6.62، و 6.30 وحدة تشكيل مستعمرة/غرام على التوالي. وكانت نتائج التقييم الحسي لعينات اللبن الرائب المجففة بالأشعة تحت الحمراء في اليومين الأول والأخير من التخزين في درجة حرارة التلاجة مماثلة لنتائج عينات الزبادي المجففة بالهواء. وأخيراً، نتج عن تجفيف اللبن الرائب الحيوي في فرن الأشعة تحت الحمراء عند درجة حرارة 50 درجة مئوية منتجاً مجففاً يحتوي على عدد كبير من بكتيريا المعززات الحيوية وتمتع بخصائص فيزيائية وكيميائية جيدة حتى بعد 3 أشهر من الخزن.

الكلمات المفتاحية: منتج مجفف، بكتيريا المعززات الحيوية، فرن الأشعة تحت الحمراء.