

Technology Development to incorporate Onion (*Allium cepa L*) oil as a functional ingredient in Cheese spread

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Abstract. The incorporation of functional ingredients in cheese is a new technology application in the food industry. Onion oil is considered a functional oil which is obtained by cold pressing of onion. These oils were incorporated as a functional ingredient in a percentage of 0.3 ml/Kg, 0.35 ml/Kg, 0.40 ml/Kg, and 0.45 ml/Kg and named T1 to T4 respectively and T0 as a control sample with pure water while maintaining the standard process. Prepared samples were poured into 175 ml glass bottles and kept for sensory, chemical, and microbiological analyses at room temperature and then chilled. The sensory attributes were examined using the 5-point hedonic test. Except for taste and appearance, no significant differences in qualitative attributes were identified in all samples. To assess the shelf life microbiological characteristics such as total plate count, yeast and mould, and coliforms, as well as chemical data such as pH, moisture content, and titratable acidity were tested. The onion oil sample T4 showed good sensory and chemical attributes for cheese and therefore, it can be concluded that the functional onion oil incorporation technology is useful for producing a better cheese spread for the market.

1 Introduction

Milk is a complex meal composed of individual components that may or may not be good for your health. A feeding schedule has the power to change the content of milk. The purportedly harmful health consequences of milk and milk products might help to explain this tendency in part.

The reason for this criticism is that milk fat comprises a high percentage of saturated fatty acids, which are thought to be linked to heart disease, weight gain, and obesity [1]. Lipids, proteins, amino acids, vitamins, and minerals may all be found in cow's milk. It includes nucleotides, peptides, polyamines, growth factors, cytokines, immunoglobulins, enzymes, and other bioactive peptides [2-3].

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The demand for healthy cheese in the dairy sector has grown despite the paucity of studies on the fortification of dairy products with by-products from fruits and vegetables, and their derivatives such as oils of spices and fruits. Natural cheese such as ripened and unripened cheese are heated and combined with the proper emulsifiers to create processed cheese. Nowadays, the production of processed cheese is promoted since it tastes better and has a unique flavour [4-5].

The most popular natural cheeses utilized in the production of processed cheese worldwide are cheddar, mozzarella, and Swiss. Different types of processed cheese are produced by starting with natural cheese, which usually has different flavours and levels of cheese maturation. There are two types of processed cheese available: cheese spreads, which are flavorful, soft, high in moisture content, and low in acidity, and cheese blocks, which are solid, highly acidic, and have a relatively low moisture level [6-7].

The second-most significant horticultural crop in the world is onions (*Allium cepa L.*). Onions are eaten as young green plants or as bulbs, both raw and cooked. They are prized for their unique flavour and pungency, which enhance the flavour of other meals. In practically every household, either green or bulbs are used daily and are a vital component [8-10]. The onion quality depends on the irrigation methods [11] and the well-supplied nutrients will play a major role in the composition.

Onions contain twenty-five active ingredients. The most valuable ingredient is sulfur, which has anti-inflammatory and thrombotic properties. Other active ingredients include thiosulfates and superoxide-dismutase (SOD), which also has antioxidant properties. The lower epidermis of the onion scale contains minor amounts of arabinose, xylose, fructose, and galactose, whereas the onion's cell wall is mostly composed of glucose and uric acid [12-13].

In order to offer a detailed study of the effects of varying the proportion of onion oils on the target components' shelf life in storage, this research was carried out to test the suitability of onion oil in spread cheese.

2 Methods

The study's goal was to define spread cheese by evaluating the chemical makeup of cheese spread made with varied amounts of onion as functional components to assess the feasibility of presenting it to the market. It is obvious that onion oil acts as a functional oil and sometimes as an essential oil in humans owing to its composition and molecular structure, in particular its bioactivities, including antioxidant and antibacterial characteristics, have an influence on spread cheese [14].

Initially, fresh cream is obtained by the cream separation procedure in the laboratory using a cream separator. The fat percentage was calculated using a lactoscan fat analyzer in the laboratory and then normalized using skimmed milk with a fat percentage of 0.1 using the Pearson square technique. Onion oil was produced in the laboratory using the cold-pressing oil extraction method and maintained in a cool environment to prevent oxidative rancidity and oil-related spoilage [15].

Onion oil is a useful oil made by cold pressing the onion [16]. These oils were integrated as functional components in a proportion of 0.3 ml/Kg, 0.35 ml/Kg, 0.40 ml/Kg, and 0.45 ml/Kg and called T1 to T4, respectively, and T0 as a control sample with clean water, following the normal procedure outlined in Table 1.

Table 1. Different treatments of onion-incorporated spread cheese.

Ingredients (g)	T0	T1	T2	T3	T4
Ripened swiss cheese	1000	1000	1000	1000	1000
Unripened swiss cheese	1360	1360	1360	1360	1360
Fresh cream	2480	2480	2480	2480	2480
Vegetable fat	810	810	810	810	810
Water	111.8	110	109.7	109.4	109.1
Salt	78	78	78	78	78
Sodium citrate	76	76	76	76	76
Palsgard (Emulsifier)	55	55	55	55	55
Citric acid	14	14	14	14	14
Potassium sorbate	8	8	8	8	8
Trisodium phosphate	7.2	7.2	7.2	7.2	7.2
Onion oil	00	1.8	2.1	2.4	2.7
Total weight	6000	6000	6000	6000	6000

Subsequently, the components were added to a steam-jacketed kettle and heated to 92°C for three minutes. Samples of prepared cheese spread were placed into sterilised glass bottles intended for culinary use. As previously mentioned, five treatments were created and maintained at room temperature as well as in a refrigerator (4°C). All five of the treatments that were created throughout the experiment underwent chemical analysis; the findings are tabulated for presentation in a comprehensive format. The samples were compared to both local (GOST) and international (ISO) standards. Samples were prepared and put into glass bottles with the labels T0 to T4 for sensory, chemical, and microbiological analysis at room temperature before being cooled. The sensory qualities were assessed using the 5-point hedonic test including spreadability as an additional factor to check which is a main factor for spread cheese samples and the microbiological analysis was conducted as explained in the previous research articles [17].

3 Results and Discussion

To determine the likelihood of producing this functioning cheese and having it spread both locally and globally, every treatment developed during the inquiry fit both national and international standards. The samples' chemical composition, which includes their fat content, moisture content, total solid content, pH, and titratable acidity, was examined using the methodology described in other studies [18] and is displayed in Table 2.

Table 2. The chemical composition of the onion oil incorporated spread cheese.

Characteristic	T0	T1	T2	T3	T4
Fat (Dry Matter %)	36.60	36.90	37.12	37.30	37.58
Protein(Dry Matter %)	23.34	23.49	23.47	23.39	23.30
Moisture %	56.39	55.15	55.06	54.93	54.85
Total solid%	43.61	44.85	44.94	45.07	45.15
pH	6.28	6.25	6.23	6.24	6.23
Titratable acidity	0.76	0.76	0.77	0.78	0.78

As suggested, onion oil was used in this investigation. It was found to have a wide range of effects on the prepared spread cheeses' appearance, spreadability, texture, and flavour, with little effect on colour. This was caused by the experiment's low level of onion oil incorporation, which was necessary because there is a research gap regarding the appropriate percentage of onion oil in the cheese sample. The research outcome will

provide a suitable solution for this. The body of the cheese had a smooth, glossy, and soft texture when the acidity strength was low, and a very hard body when the acidity strength was high [3,17,19]. The addition of onion oils to the cheese produced a smooth texture and soft spreadability due to their strength and emulsion ability.

3.1 Sensory evaluation

The chemical makeup of the spread cheese samples is displayed in Table 2. The samples were made using the suggested formula, which is displayed in Table 1, except for the 6 kg of cheese sample, for which the water and functional onion oil was simply changed to the minimum required for boiling the kettle. For four hours, the samples were maintained at a temperature between 40 and 42°C in an incubator. Figure 1 depicts the spread cheese samples' organoleptic appearance, which is detailed in other study studies [3, 15-16]. Thirty novice panellists conducted the test. Based on the tasting panel's conclusions, Figure 1 displays the predicted hedonic medians and ranks for each quality attribute. These numbers provide some insight into the notable variations in the organoleptic characteristics of the cheese's various percentages of incorporated onion oils between treatments.

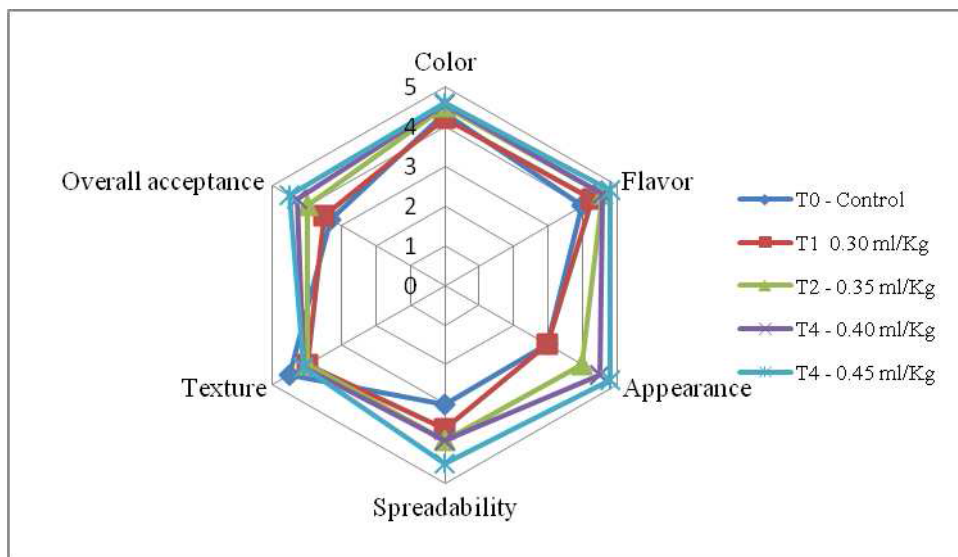


Fig. 1. Organoleptic test results of Onion oil added samples.

The probability values of the quality parameters show that there are significant changes between the treatments where the incorporation percentage of onion oil is rising. This demonstrates that sample T4 had greater probability values for spreadability, flavour, general acceptability, and appearance than any other sample, with no discernible differences in sample colour. This implies that there was no discernible change in the samples' colour or appearance. Although onion oil may have a functional influence on the texture of the sample, the spreadability, flavour, and appearance of the samples revealed a substantial difference.

According to the conducted studies, none of the samples displayed a liquid mass as a result of syneresis, and sample T4 demonstrated the anticipated result in which the product benefited from the integration of onion oil. T4 was a uniform mass possessing the same viscosity. They can be transformed into commercially viable products with consistent flavours and high shelf life. The only drawback of processed cheese is that it usually lacks

the flavour of well-ripened real cheese. Other benefits of processed cheese include ease of merchandising, consistent quality, low waste ring cost, good keeping quality, and reliability as a pasteurized product. The manufacturing of processed cheese spread is quite similar to that of processed cheese food or processed cheese, with the main distinction being the high moisture level of the finished product. High moisture content is tolerated to provide the desired spreadability. Cooking at temperatures over 88°C and maintaining a low pH (<5.2) helps prevent bacterial deterioration.

The spreadability of the processed spread is critical as a primary textural characteristic. Increasing the availability of moisture improves spreadability, while optional additives like gums and stabilizers help to retain moisture without separating. The main gums used in spreads are gelatin, karaganin, and xanthan gum.

3.2 The shelf life of the cheese samples

To determine the product's estimated two-month shelf life, a weekly chemical and microbiological assessment of the selected treatment was conducted. Together with chemical data, microbiological measures such as pH, titratable acidity, mold count, and total plate count were routinely assessed. The whole plate count, yeast and mold counts, and coliform counts were measured during the evaluation period, which lasted up to two months. Table 3 and Figure 2 show that after 4 weeks of storage at room temperature, the cheese spread did not chemically degrade. After four weeks of storage, it was discovered that the samples that had been stored at room temperature had certain unpleasant odours and were not fit to be maintained there.

Table 3. pH value of the onion oil added spread cheese samples.

Weeks	T0	T1	T2	T3	T4
1	6.37	6.24	6.23	6.22	6.21
2	6.36	6.23	6.22	6.15	6.19
3	6.35	6.22	5.98	6.04	6.15
4	6.33	6.21	5.97	6.01	6.09
5	6.30	6.18	5.91	6.00	6.00
6	6.29	6.17	5.81	5.99	5.99
7	6.19	6.07	5.75	5.89	5.89
8	6.06	6.00	5.74	5.88	5.88

After two months of observation, the estimated shelf life was tested, and the results showed that all samples had reduced pH levels during storage, indicating some minor chemical changes in the product during storage. The pH and the titratable acidity during the eight weeks are shown in Table 3 and Figure 2, respectively. The results indicate that the proportion of onion oil added to the spread cheese samples has a chemical impact since there was a significant variation in pH between the control sample and the T4 sample and no significant difference between the other samples [20-21].

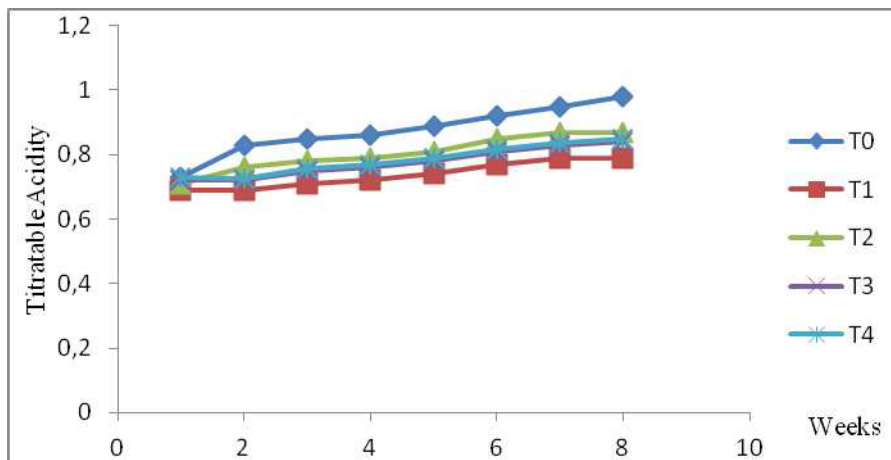


Fig. 2 Titratable acidity of the onion oil added cheese spread samples.

Over 8 weeks of storage, there was a little increase in titratable acidity and a tiny decrease in moisture content and pH values. Based on the predicted value for the chemical changes, it is possible to infer that the product is safe to use for at least 8 weeks.

The storage life is governed by the aqueous phase's composition, physical structure, and stability. The composition of the aqueous phase becomes more crucial in achieving acceptable microbiological stability and contamination throughout consumer usage. These directly impact the shelf life of spreads. Dairy spreads sometimes require chilled storage to provide a safe and healthy product, particularly for consumer consumption. Spreads typically have a shelf life of three to six months.

Microbiological analysis, such as total plate count, yeast and mold counts, are displayed in Tables 4 and 5, respectively, which were archived. Referegrations were analyzed using the methodology described in earlier works [3, 13, 20-22]. After 4 weeks of storage at room temperature, the samples were discarded due to the presence of too many yeast, mold, and total plate count colonies, as well as an unpleasant odour. Refrigerated samples were subjected to continual microbiological analysis throughout 8 weeks. The coliforms were missing in the product, which obeys the domestic standard GOST and International (ISO) requirements while having a mild increase in the total plate counts of the samples until 2 months,

Table 4. Total plate count of the onion oil incorporated cheese spread.

Week	Total plate count				
	T0	T1	T2	T3	T4
1	2.21 *10 ²	2.16 *10 ²	2.14 *10 ²	2.13*10 ²	2.01*10 ²
2	2.27 *10 ²	2.28 *10 ²	2.26 *10 ²	2.22 *10 ²	2.19 *10 ²
3	3.29 *10 ²	3.35 *10 ²	3.32 *10 ²	3.21 *10 ²	3.02 *10 ²
4	4.89 *10 ²	4.73 *10 ²	4.70 *10 ²	4.68 *10 ²	3.94 *10 ²
5	5.61 *10 ²	5.46 *10 ²	5.36 *10 ²	5.26 *10 ²	4.89 *10 ²
6	6.32 *10 ²	6.13 *10 ²	6.31 *10 ²	6.30 *10 ²	6.02 *10 ²
7	7.51 *10 ²	7.05 *10 ²	7.01 *10 ²	6.89 *10 ²	6.59 *10 ²
8	7.98 *10 ²	7.75 *10 ²	7.51 *10 ²	6.49 *10 ²	6.99 *10 ²

This is smaller than the threshold, therefore it might be utilized for a further two weeks by watching the predicted value of microbial counts [19]. The total plate counts of the samples show a slight increase in microorganisms, which is typical during food processing and storage. However, the T4 sample showed a significant reduction in yeast and mold,

demonstrating the inhibitory effects of functional onion oils which increase with the percentage of incorporation but the flavour of onion will be a limitation factor for incorporating this oil in a huge percentage as depicted in Tables 4 and 5.

Table 5. Yeast and Mold of the onion oil incorporated cheese spread.

Week	Yeast and mold count					Coliforms				
	T0	T1	T2	T3	T4	T0	T1	T2	T3	T4
1	14	14	14	11	11	Absent	Absent	Absent	Absent	Absent
2	16	16	16	13	12	Absent	Absent	Absent	Absent	Absent
3	16	16	16	13	12	Absent	Absent	Absent	Absent	Absent
4	18	18	17	14	14	Absent	Absent	Absent	Absent	Absent
5	19	19	18	15	14	Absent	Absent	Absent	Absent	Absent
6	22	22	21	18	17	Absent	Absent	Absent	Absent	Absent
7	24	24	23	19	18	Absent	Absent	Absent	Absent	Absent
8	25	25	24	20	19	Absent	Absent	Absent	Absent	Absent

In a refrigerated condition, the total plate count increased somewhat during 8 weeks, and the yeast and mold counts followed suit. Microbial ranges, on the other hand, are compliant with national laws GOST and international (ISO) standards, implying that they may be manufactured industrially and utilized for market research. The microbiological examination, as well as the treatments adopted, adhere to national and ISO standards.

According to Tables 4 and 5, neither the control nor experimental samples contained any dangerous bacteria or microorganisms from the *Escherichia coli* group for the course of the 60-day storage period, In contrast to all other samples, the control sample exhibited a much higher amount of yeast than any other sample. [17, 21, 23-24].

4 Conclusion

T4 was approved as the best sample, and more improvement is required to go for a higher percentage, but the flavour changes are the factor to be taken into consideration. When compared to conventional cheese spread available in the market, the cheese spread has the same sensory attributes with mild changes in appearance, flavour, and texture due to the addition of functional onion oils. Shelf life research shows that, like a regular product, a manufactured product should be stored for around three months without suffering from any major quality problems. Comparing it to other products available in the neighbourhood market and those already in use, the cost analysis shows that it is rather affordable.

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