Journal of Food and Nutrition Research, 2015, Vol. 3, No. 3, 191-195
Available online at http://pubs.sciepub.com/jfnr/3/3/10

DOI:10.12691/jfnr-3-3-10

Nutritional and Functional Properties of Fruited Cream Cheese Spread as Influenced by Hydrocolloids

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Received December 25, 2014; Revised February 23, 2015; Accepted March 23, 2015

Abstract Cream cheese is used as an ingredient in many foods. The objective of the study was to develop cream cheese spread with improved texture using apple puree (10%) and different hydrocolloids @ 2%. Seven fruited cream cheese spread samples were prepared. Cream cheese spread with no hydrocolloid was kept as control (CS). Three cheese spread samples were prepared by using pectin (CSP), gelatin (CSG) and carrageenan (CSC) alone and other three using different hydrocolloid in combination such as gelatin: carrageenan (CSGC), gelatin: pectin (CSGP) and pectin: carrageenan (CSPC). Results demonstrated that (CSGC) showed better textural properties such as hardness (321.45 g) and viscosity (189.33cP). Sensory scores regarding compactness were also highest in CSGC as compared to others due to the combination of gelatin and carrageenan. Maximum water activity (0.76) was found in the CS while lowest water activity (0.72) was observed in the CSGC and CSPC. Sensory analysis indicated that graininess, sour taste, butter flavor and compactness were increased with storage of 60 days.

Keywords: *cream cheese, dairy spread, hydrocolloids, gelatin, pectin, carrageenan*

Cite This Article: Nabila Gulzar, Aysha Sameen, Muhammad Issa Khan, Nuzhat Huma, MianAnjum Murtaza, and Saima Rafiq, "Nutritional and Functional Properties of Fruited Cream Cheese Spread as Influenced by Hydrocolloids." *Journal of Food and Nutrition Research*, vol. 3, no. 3 (2015): 191-195. doi: 10.12691/jfnr-3-3-10.

1. Introduction

Cream cheese is an un-ripened cheese has soft, rich, di-acetyl flavor with creamy white color and a smooth consistency. It is highly nutritious being rich in fat and milk proteins (casein and whey). Proteins form network which includes fat droplets [1]. Traditionally, cream cheese made from cream or from a mixture of cream and milk or skim milk. According to United States, the Food and Drug Administration (FDA) regulations cream cheese must have at least 33% fat but the moisture contents should not be more than 55% [2].

There are two main kinds of cream cheese based on fat contents in the initial and final composition. One is single cream cheese and other is double cream cheese. Double-cream cheese having at least 9-11% fat content in the initial mix, while single-cream cheese having 4.5-5% fat content in the initial mix [3]. One type of cream cheese is triple cream cheese that has 75% fat in dry matter contents [4].

Cream cheese is also categorized on the basis of packing type. One is cold pack cream cheese and other is hot pack cream cheese. It is used as a spread on bagels, as a salad dressing, and it can also be used as an ingredient for making many types of desserts, such as cheese cake. Fresh cheeses are used in different types of dishes like sweet and savory dishes. It can also be used in different types of sauces [3].

Average daily intake of spread contribute about one-fifth of total fat intake. Dairy fat spread started to become popular due to its unique flavor therefore the cream cheese can be further processed to make cream cheese spread to meet the daily requirement [5]. Hydrocolloids are substances that are used to bind water and act as gelling agent. Pectin and carrageenan are hydrocolloides which are anionic in nature, extensively used to gel and harden dairy products. Hydrocolloids are adsorbed on the surface of newly formed droplets and show surface-active properties and aggregation is prevented by electrostatic forces during homogenization [6,7,8,9]. Gelatin is the only protein which possess unique hydrophilic character therefore act as hydrocolloid. Gelatin also having some emulsifying ability, but their major role is as a gelling agent and colloid stabilizer. K-Carrageenan form gel on cooling through a disordered-ordered transition forming intermolecular double helices and subsequent aggregation and gelatin under specific circumstances [10].

Dairy based spreads contain about 40-80% of fat contents. When these spreads stored at refrigerating temperature their spread-ability decreases and some other textural defects also arises. In order to minimize these problems more readily spreadable products including low fat blends has been developed. Keeping in view the problem of low spread-ability and textural defects in dairy fat based spread, the present study was planned in which fruited cream cheese spread was made by using hydrocolloids to improve the structure and texture of cream cheese spread. Different hydrocolloids (Pectin, Gelatin and Carrageenan) alone and in combination were used for this purpose.

2. Materials and Methods

Milk was procured from the dairy farm of University of Agriculture Faisalabad for the manufacturing of cream cheese. Freeze dried mesophillic culture (Chr. Hansen's) was used for cheese acidification. Chymosin of 50000 u/G strength of Pharm Chemical Co., Ltd. China was used as coagulant in cream cheese manufacturing. The hydrocolloids (Carrageenan, gelatin and pectin) used as gelling agent in fruited cream cheese spread.

2.1. Manufacturing of Cream Cheese (CC) and Fruited Cream Cheese Spread (FCS)

Cream cheese was prepared by following the procedure given by Sanchez et al [4] with slight modification. The spread was prepared by following the recipe of Reddy et al [11] with some modification. Apple cutting without peeling and coring was carried out. The material was cooked by adding water and apple cider to get apple puree. It was further cooked with the addition of sugar and other ingredients. Fruited cream cheese spread was prepared by blending of apple puree, cream cheese, vanilla extract and stabilizers. Seven fruited cream cheese spread samples: CS as control cream cheese spread with no hydrocolloid, three cream cheese spread samples were made with different hydrocolloids(pectin, gelatin and carrageenan) @ 2% pectin (CSP), gelatin (CSG), carrageenan (CSC) alone and other three cheese spread samples were prepared in combination of gelatin: carrageenan (CSGC), gelatin: pectin (CSGP) and pectin: carrageenan (CSPC) @ 1:1%.

2.2. Quality Evaluation of Cheese Spread

Physico-chemical analysis of cream cheese and fruited cheese spread was carried out by using prescribed method. The pH was determined by using pH meter following the protocol given by Ong et al [12]. The moisture content, acidity and crude protein was analyzed by following the methods given in AOAC [13]. The fat content was determined using Gerber method according to method given by Marshal [14].Water activity of spread was determined at different storage intervals by following the method of Piga et al [15]. Hardness, viscosity and oil separation of each sample was determined according to methods detailed by Reddy et al [11].

2.3. Sensory Analysis

The spread was evaluated for its sensory characteristics by a panel of assessors drawn from faculty members using method given by Wendin et al [16]. Spread was evaluated for its butter flavor, graininess, sour taste, fatty after taste and compactness.

3. Results and Discussion

3.1. Physico-chemical Analysis of Fresh Cream Cheeseand Fruited Cream Cheese Spread

Table 1 indicates the results of the fresh cream cheese analysis, which revealed that cream cheese is rich in fat. The mean value shows that it possesses 35.36% fat. Fat plays important role for flavor release in cream cheese [16]. It also contains protein in the range of 8-9% which has the ability to retain a large amount of water. The results indicated that moisture contents in cream cheese was 46.55%, high moisture is due to presence of high protein [17]. pH plays an important role in giving the texture to the product, the mean value for pH and acidity is 4.51 and 1.34% respectively. These results are in line with the findings of [18].

Table 1. Mean values of fresh cream cheese analysis

	pH	**Moisture (%)**	**Acidity (%)**	**Protein (%)**	**Fat (%)**
Cream cheese	4.51±0.17	46.55±1.89	1.34±0.05	8.73±0.15	35.36±1.30

Table 2. Physico-chemical composition of cheese spread as influenced by hydrocoloids

Treatments		Moisture (%)	pH	Acidity (%)	Protein (%)	Fat (%)
CS		60.69±3.74	4.71±0.21	1.57±0.16	5.45±0.6	25.88±1.6
CSP		57.23±3.50	4.74±0.23	1.54±0.06	5.46±0.94	28.00±1.93
CSG		59.79±3.26	4.70±0.21	1.59±0.11	7.65±0.94	27.55±1.58
CSC		59.13±3.77	4.69±0.16	1.61±0.06	4.37±1.89	28.44±1.13
CSGC		55.57±1.73	4.70±0.21	1.58±0.14	6.56±1.89	29.00±1.93
CSGP		56.65±2.63	4.70±0.13	1.58±0.08	6.18±1.46	29.22±1.09
CSPC		59.80±3.72	4.70±0.16	1.59±0.11	4.74±1.93	27.88±1.53
Total	Mean	58.40±4.06	4.43±0.23	1.60±0.19	5.77±1.77	27.99±1.90

a) CS (control cream cheese spread) b) CSP, CSG and CSC (Cream cheese spread with pectin, gelatin and carrageenan), c) CSGC, CSGP and CSPC (Cream cheese spread in combination of gelatin: carrageenan, gelatin: pectin and pectin: carrageenan

Table 2 describes the effects of different treatments on the physicochemical analysis of fruited cream cheese spread. Moisture content of spread was in the range of 55 to 60%. Maximum moisture was observed in the CS while (CSGC, CSGP) showed lowest moisture content due to binding of moisture content with hydrocolloids. The same observation was encountered in the previous study in which typical stabilizer blends involve the use of primary colloidal stabilizers in combination with the secondary stabilizers such as carrageenan used in ice cream and other frozen dairy desserts. In these blends, carrageenan serves the purpose of preventing serum separation of ice cream mix caused by the use of the primary stabilizers [19]. The pH and acidity of treated samples did not differ significantly with the change of hydrocolloids, while pH decreases and acidity increases with storage (Table 3). Razig and Babikar has showed similar results and found that pH of the soft cheeses decreased at the end of the storage period [20]. Protein and fat in all spread samples ranges from 4-6% and 25-29% respectively. The samples CSP, CSGC and CSGP have more protein contents due to presence of gelatin.

Table 3. Physico-chemical composition of cheese spread as influenced by storage

Storage	Moisture (%)	pH	Acidity (%)	Protein (%)	Fat (%)
0	57.46±3.5	4.65±0.16	1.48±0.20	7.34±0.98	26.04±2.08
15	54.59±2.59	4.40±0.18	1.63±0.17	6.93±1.01	29.19±1.50
30	52.32±2.08	4.23±0.15	1.69±0.16	5.04±1.43	30.76±2.14
Total	54.78±4.06	4.42±0.23	1.60±0.19	6.43±1.77	28.66±1.90

3.2. Structural Analysis

3.2.1. Water Activity

The effect of storage and treatments on water activity of spread was highly significant while the effect of interaction of storage and treatments was non-significant. Figure 1 indicated that maximum water activity 0.76 was found in CS which contains no hydrocolloids and lowest water activity (0.72) was found in the CSGC and CSPC.

Some reports illustrated that using hydrocolloids thickens aqueous phase which may improve the spread-ability and reduce the loss of moisture normally caused by the large amounts of water of these products [21]. In this study, hydrocolloids showed different thickening power of aqueous phase and water activity in spite of their same concentration. The combination of gelatin and carrageenan (CSGC) and pectin and carrageenan (CSPC) revealed greater thickening power thereby has less water activity as compared to pectin and gelatin (CSGP) combination (Figure 1). The water activity of FCS decreases as the storage period increases. Pajonk observed similar results that the viscosity decreased as the storage increased due to moisture loss from the surface of the product which reduces water activity of spread [22].

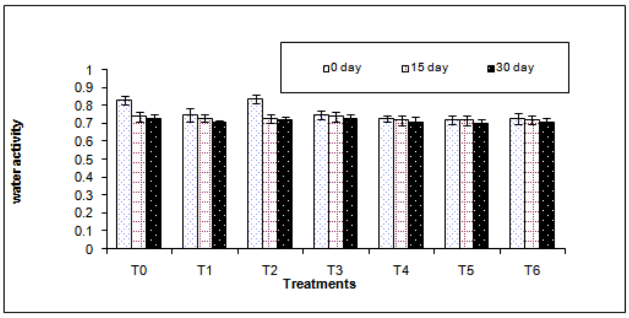

Figure 1. Water activity of cheese spread at different storage intervals

3.2.2. Texture

The results regarding texture of FCS depicted that storage, treatments and interaction of storage and treatments showed significant effects on the texture. Figure 2 demonstrated that maximum textural force was observed in the CSGC that was 321.45 g while lowest textural force was monitored in the CS that was 116.64 g. With storage the force increased, at 0 day it is 121.62 g while at 30 days of storage it became 248.88 g.

It was found that textural force increases by using hydrocolloid as well as hydrocolloid combinations are more affective to increase gel strength as compared to alone. Greater force 321.45 g was observed in CSGC while CSGP and CSPC have 151.54 g and 242.61 g force respectively. This significant difference of force was due to the hydrocolloids. Hydrocolloids increased the gel hardness and strength in the processed cheese spread [23]. With storage the force increased, at 0 day it is 121.62 g while at 30 days of storage it became 248.88 g. Previous studies also showed that with storage hardness increase in spread which increases textural force [24].

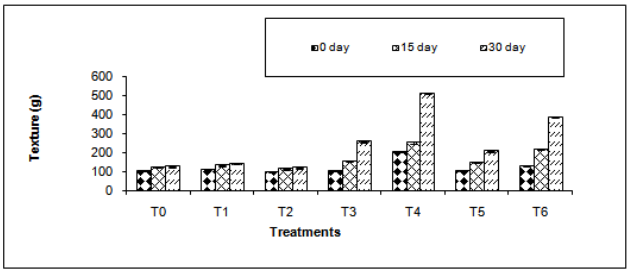

Figure 2. Texture of cheese spread at different storage intervals

3.2.3. Viscosity

The results for viscosity of FCS illustrated that viscosity differed significantly with storage and treatments while not differed significantly with interaction of storage and treatments. Mean values from the Figure 3 indicated that maximum viscosity 189.33cP was found in the CSGC and lowest viscosity 120.61cP was observed in the CS. Hydrocolloids increase gel strength with different levels and combinations. The mean values for CSGC indicated that at 0 day viscosity is 181.67cP and it gradually increased and it became 195.67cP at 30 days of storage period.

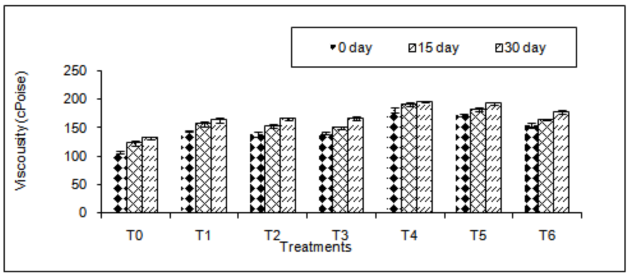

Figure 3. Viscosity of spread at different storage

The combination of carrageenan with gelatin presented greater viscosity. Increasing k-carrageenan concentration in spreads significantly increased the viscosity of the aqueous phase resulting in gelation of the aqueous phase on cooling [24]. The viscosity gradually increases with storage. Sherwood and smallfield have reported similar results that with storage viscosity increase [25]. Storage time indicating a more plastic behaviour of the spreads and gives a large viscous constituent in the system [26].

3.3. Sensory Analysis

Results regarding sensory (Figure 4, Figure 5 and Figure 6) showed highly significant variation with storage, treatments and interaction of storage and treatments on butter flavor of FCS. Maximum butter flavor (4.1 score) was found CSGP and lowest sensory score 1.9 was found in CSP. Butter flavor increased as storage period increased. The effect of storage, treatment and combination of storage and treatment was also significant on the Graininess of the FCS. Maximum score 3.86 and 3.83 for graininess was given to CSP and CSG respectively, while lowest sensory score 1.86 and 1.83 is for CSGC, CSGP respectively. Mean values of the graininess at storage intervals showed that graininess increased with storage. Sensory results about sour taste illustrated that storage has significant effect on sour taste of the FCS. The means for sour taste during different storage interval indicated that the score for sour taste increased with storage. The sour taste increased due to increase the acidity of the product. Acidity increased due to biochemical reactions in the product during storage. Sensory scores demonstrated that the effect of storage, treatments and their interaction on fatty after taste attribute is non-significant. The mean values indicated that the storage period has no significant effect on the sensory characteristic fatty after taste. The fatty after taste sensory attribute remain same as storage time increased. Compactness differed significantly with storage, treatments and interaction of storage and treatment while not differed with interaction of storage and treatments. Mean values indicated that maximum compactness i.e. 3.9 sensory score was found in CSGC which has gelatin and carrageenan in combination and lowest was found in the CS that is 1.03 sensory scores in which no hydrocolloids was added. The means of compactness at different storage interval indicated that compactness increased with storage.

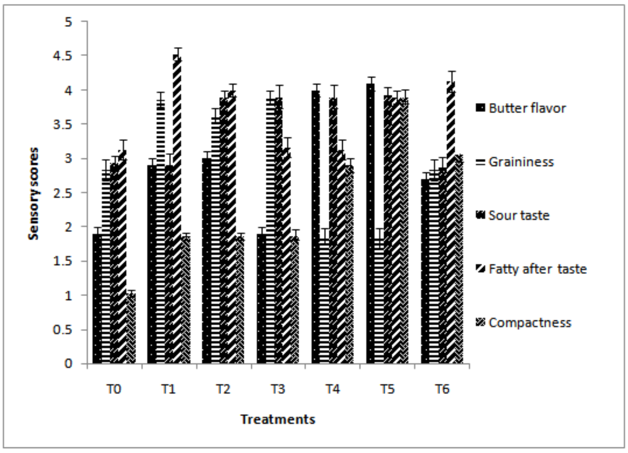

Figure 4. Sensory scores of cheese spread at 0 day of storage

Although butter flavor retention in cream cheese is greatly influenced by the fat, salt and homogenization levels [16]. But, it was clear from the present study that hydrocolloids also affect the flavor retention of the spread. Maximum butter flavor retention was found CSGP and lowest retention 1.9 was found in CSP.

Previous work on cream cheese sensory characteristics observed graininess during storage that a textural defect [27]. In this study, although graininess increases with storage but the treatment CSP and CSG showed graininess at 0 day of preparation also. It was clear from the results that gelatin and pectin alone is not suitable for the preparation of spread. Their combination with carrageenan is suitable for attractive spread appearance.

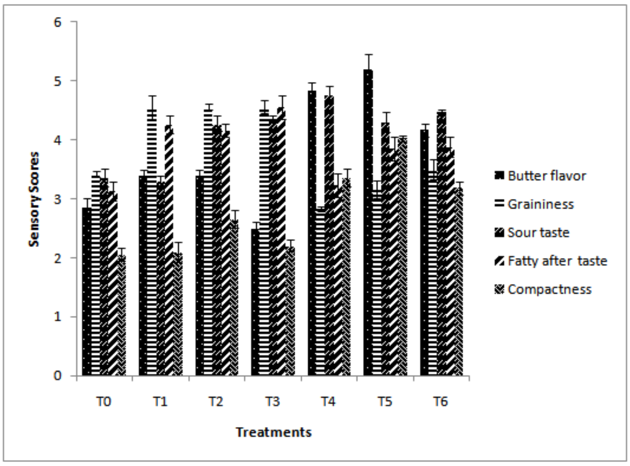

Figure 5. Sensory scores of cheese spread at 15 days of storage

Acidity increases with storage due to lactic acid production which increases sourness in all treatments of spread (Figure 4, Figure 5 and Figure 6). During storage various biochemical changes like conversion of lactose to lactate and proteolysis results acidic taste of cheese [12]. In early stages of ripening the lactose was converted to lactate which was a precursor of many biochemical reactions. These reactions resulted in the increase in acidity of the product. These biochemical reactions also responsible for the flavor release in the product.

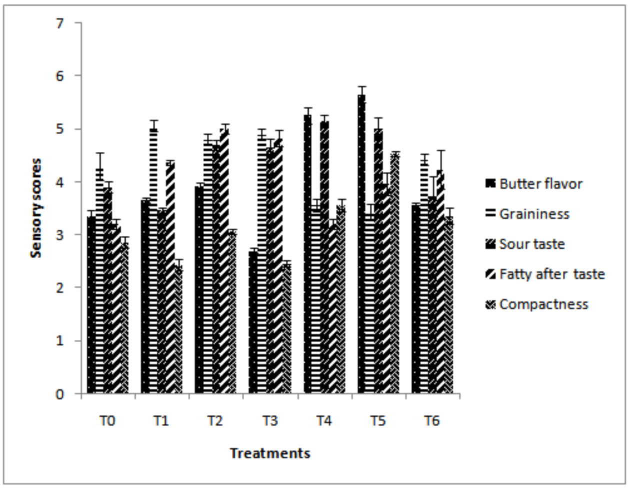

Figure 6. Sensory scores of cheese spread at 30 days of storage

Hydrocolloids have no effect on fatty taste of spread as the fatty after taste is closely related to the fat level in cream cheese (Figure 4, Figure 5 and Figure 6). Sensory attributes like appearance, butter flavor, and compactness is affected by the fat level of the cream cheese [28].

Addition of pectin increases Ca reactivity to the dairy desserts resulted in increased gel strength, critical strain, adhesiveness and chewing time and reduced syneresis and fracture point [29]. In this study, even though pectin increases gel strength but more gel strength was observed when gelatin and carrageenan was used in combination (Figure 4, Figure 5 and Figure 6).

4. Conclusion

Consumption of spread increases day by day as daily intake of spread is about one fifth of total fat intake. Dairy fat spread has more demand due to its unique flavor and health benefits. Cream cheese and its products like spread are not manufactured in Pakistan hence; it is imported on expense of heavy foreign exchange. From the present research, the overall acceptability of CSGC sample is more with respect to its appearance, texture and sensory. It was concluded that the product made was much more cost effective as compared to the imported product therefore it is recommended that it should be manufactured locally on small as well as large scales.

Acknowledgements

The authors acknowledge National Institute of Food Science and Technology, University of Agriculture, Faisalabad for research assistance.

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