



Development and quality characterization of cream cottage cheese spread fortified with extra virgin olive oil (*Olea europaea* L.) based on consumer preferences

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Abstract: Cheese considered as a well-known dairy related product which is manufactured in many varieties according to its texture and flavors. Cream cottage cheese is formed by coagulation of casein and having high protein contents. Due to increase awareness of modern consumers' fortification of dairy foods including fresh cheese are in demand. Extra virgin olive oil attained by olive fruit is used for this purpose due to the presence of minerals, fatty acids and polyphenols. Required materials were procured from local market and cream cottage cheese was coagulated with lemon juice as it is a high source of citric acid under controlled conditions by short set method and enriched with three different concentration of extra virgin olive oil (2% 4% and 6%). Proximate analysis (moisture, protein, fat contents, ash, total solids, solid not fat) physicochemical analysis, sensory analysis and rheological analysis was performed. Physicochemical analysis showed that as the EVOO concentration in cheese was increased it shows non-significant results on pH, moisture, fat, proteins, total solids, total nitrogen while in case of phenolic compounds, and free fatty acids are significantly affected by quantity of EVOO. Rheological analysis exposed that quantity EVOO had a significant effect on the texture of curd. Flavor, body and texture, overall acceptance are significantly affected days and concentration. Sample with minimum EVOO concentration show more significant results and overall acceptability as compared to other treated samples. This study was done in order to access influence of three various quantities of EVOO on different properties of cream cottage cheese and to evaluate consumer preference. [Ayesha Khaliq, Hafsa Zahid, Qura-tul-Ain, Sadia Ansar, Ammara Zeeshan, Mahnoor Yaqub, Sonia Rabani, Qamar Sajjad. **Development and quality characterization of cream cottage cheese spread fortified with extra virgin olive oil (*Olea europaea* L.) based on consumer preferences.** *Life Sci J* 2021;18(3):42-48]. ISSN 1097-8135 (print); ISSN 2372-613X (online). <http://www.lifesciencesite.com>. 9. doi: [10.7537/marlsj180321.09](https://doi.org/10.7537/marlsj180321.09).

Key words: Extra virgin olive oil, Cream cottage cheese, EVOO fortification. Quality attributes consumer preference.

1. Introduction

Cheese a distinguished dairy item is a combination of fats and proteins which is consumed worldwide according to consumer choice. There are more than 400 different cheese varieties Fox *et al.*, (2017). Among all types fresh acid based cheese are high in demand as these are easy to prepare in short time and easy to consumed (Repajic *et al.*, 2019). Cheese is an Asian food obtained by whey elimination from cheese curd by the mean of any suitable coagulant. Fresh cheese has less shelf life as compared to processed cheese which also decline during storage (Asensio *et al.*, 2015). The physicochemical and biological changing occurring during assembly of acid curd chesses are far less complex than those changes which occurred during ripening of cheese with less moisture content such as hard cheese and semi hard cheese (Del *et al.*, 2018).

Cheese is an historical dairy item even cheese making and processing is mentioned in Bible. Aristotle and Homers studies shows that in old times cheese is a simple way of milk preservation which is prepared by the milk of different animals (Rana *et al.*, 2017). Cheese considered as fresh with a mild acidic flavor and consumed immediately after ripening due to high chances of off flavor as it consist of high moisture content and by the coagulation of casein (Rinaldoni *et al.*, 2014).

Dairy based perishable products like cream cheese are usually developed over time by using different food techniques rather than invented (Marx, 2012). In modern era cheese also reflected source of nourishment as it's a source of lipids, calcium and protein. Cream cottage cheese is one of those chesses which are coagulated by using different types of acids. Acidification of such cheese done at pH of 4.6

and an isoelectric point causes casein to coagulation (Fox *et al.*, 2017). Cottage cheese falls in the categories of such a cheese with high moisture mature which tend to reduce its shelf life and restricted it to only 10 days even at 4°C. Due to less storage life the overall marketing of product effected. Under ideal standards of cream cottage cheese it must fresh, having warm acidic flavor containing diacetyl contents and no sensations of after flavors (Makhal *et al.*, 2015; Shahid *et al.*, 2021).

Keeping in view the health benefits of plant related extracts extra virgin olive oil grained from olive fruit is considered quite useful in maintaining the human health status because it consist of minerals, fatty acids, polyphenols, fibers, and triterpenic acid compounds in its composition. Fortification of such an extract in cheese not only enhanced the sensory status but also influence the physicochemical properties of product. Olive oil is a great source of polyphenols having free radical activity which in turn increase the anti-oxidative status and increase health position of consumer. Extra virgin olive oil (EVOO) either gained by direct pressing of olives or by the mean of centrifugation process contains a large number of major compounds such as glycerides which is 98% of total oil mass and miner compounds imparting 2%. Moreover there are 230 different compounds makes the EVOO composition (Rallo *et al.*, 2018; Raza *et al.*, 2021).

Olive oils are categorized into 3 divergent groups further virgin olive oil is divided into 3 types; EVOO having oleic acid 0.8g/100g. Other type is virgin olive oil which covers oleic acid about 2g/100g. Third type is ordinary olive oil which holds 3.3g/100g of oleic acid. Unstable compounds presence in olive did not affect the odor and taste of oil (Nocella *et al.*, 2018; Rallo *et al.*, 2018). As related to other sort of olive oil EVOO is high in quality (Roselli *et al.*, 2018). Range in concentration of 0.02-600 mg/kg almost 36 phenolic compounds is present in EVOO. Storing life of EVOO in proper packaging is 12 to 18 months (Leghari *et al.*, 2021). Although a limited numbers of fatty acid are the part of olive oil composition but it influences the nutritional status of oil positively. Oil comparing mono saturated fatty acids is prefer over oil having more saturated fatty acids in it (Al-Bachir and Sahlou, 2017). With the salt addition of 3% and fat choice of 16-18% whole cream is usually used for cream cheese dressing. Sometimes dressing of cheese is prepared of low fat milk, salts and light cream.

To preserve of perishable product and to renovate the milk into usable item which is easy to consumption less in bulk and convenient cheese manufacturing is most easy way by using different techniques. With suitable time temperature

combination cheese is prepared from cow, camel, goat and buffalo milk. Likeness of consumer based on oil freshness which is related to safety standards. EVOO oxidation is governed by few factors such as olive storage prior to processing. The time, during which oil is exposed to oxygen, packing process and oil extraction temperature (Li and Wang, 2018). The main objective of this research is the development of cream cottage cheese supplemented with EVOO and to define quality attributes and acceptance of cream cottage cheese.

2. Materials and methods

Skim milk, light cream, lemon extracted juice and black pepper was procured from local store of Faisalabad, EVOO of Alba brand particularly of Spanish origin was purchased from chase up mall Faisalabad. Refined salt and chemical regents were taken from dairy laboratory; NIFSAT was obtained from local market.

2.1. Proximate analysis of milk

Legesse *et al.* (2017) and Shekhar *et al.* (2015) methods were used to determine milk pH. Using the respective method of Frau *et al.* (2015) ash matters were calculated. Fats in milk sample were calculated through Gerber method followed by Shekhar *et al.* (2015) and Kleynet *et al.* (2001).SNF and acidity were determine by Gakkhar *et al.* (2015) Protein contents of skim milk were estimated by using Kjeldahl's method as used by Margolies *et al.* (2018).

2.2. Product development

Cream cottage cheese was manufactured according to the procedure used by (Fox *et al.*, 2017) and Phadungath (2005) with slight reforms. About 3.5% fats in skimmed milk were used consistent in preparation of cheese and then homogenized at 12-14 MPa at suitable temperature of 50-55°C. Milk was Pasteurized at 60-68°C for half an hour under control conditions. Then chilled at 42°C and subjected to short set incubation. Lemon juice was added before development and the process of acidification starts. Acidification was done at pH 4.4 to 4.9. Cooking could be done at 42°C to 70°C for 30 to 45 minutes. During cooking of curd the temperature was gradually increase to 42°C. Now drain the whey. Salt was added about (0.5-1%). Now the cheese curd and cream having olive oil 2%, 4% and 6% was homogenized at 1200rpm for 10 minutes until a smooth spread was formed. Cream added was low in fat contents completely homogenized. Addition of spices helps to modify the taste of finishing product.

2.3. Physicochemical analysis of cream cottage cheese

pH was determined by Shekhar *et al.* (2015) method was used for this purpose by dipping the electrode of electronic digital pH meter into sample

of cheese. Volatile fatty acids of cottage cheese were calculated by the manner Abbas *et al.* (2015). The phenolic compounds in sample were calculated by the method of Repajic *et al.* (2019) and Han *et al.* (2011). In this method Folin Ciocalteu reagent was used keeping the gallic acid as a standard. Moisture contents of cheese sample were measured by the following method of Bradley (2010). Protein content was estimated by Kjeldahl's technique as used by Margolies *et al.* (2018). Total solids were calculated by Thabet *et al.*, (2014) by weighing total amount of solids in a known volume of cheese sample). By using the method of nitrogen content of cream cheese was determined Margolies *et al.* (2018). Gerber method was used in order to calculate fat contents present in cheese sample according to the method used by Abbas *et al.* (2015).

2.4. Rheological analysis

Texture profile was analyzed by the mean of TAXT₂ texture analyzer with attach load cell of 25 grams and by using a compression plate probe by the respective method of Shekhar *et al.* (2015). This probe was forced to the depth of about 20.0cm in product at storage temperature of 5°C. The insertion of probe into cream cheese sample should be smooth.

2.5. Sensory evaluation

9 points hedonic scale followed by the method of Felfoul *et al.* (2015) was used for the determination of sensual properties of product. This includes color of final product, taste and flavor, body and texture and over all acceptability.

2.6. Statistical analysis

The data gathered after accomplishment of different parameters was statistically evaluated according to Montgomery (2017) via two way ANOVA and factorial design. Data is analyzed by using statistix 8.1 software and factorial is applied on each parameter.

3. Results and discussion

3.1. Proximate composition of fluid skim milk

Fluid skimmed milk comprises of 86.4% of total moisture contents and fat traces of 0.3% as only bit of fat remained in milk the resulting product had less quantity of fat with a progressive health benefits. The ash matter was 0.9%. Examination exhibit that total solids was 10.0 percent only. pH of milk having vital role in producing the consistency of finish item for consumption was 6.9.

Table: 1. Proximate composition of fluid skim milk

Component	Quantity (%)
Moisture	86.4
Ash	0.9
pH	6.9
Fats	0.35
Total solids	10.0
Acidity	0.19

3.2. Physicochemical analysis of cream cottage cheese fortified with EVOO

Fortification of EVOO in cream cottage cheese displays significant decreasing trend in case of days due to high acidity. The results were in accordance with Abbas *et al.* (2015) and Shekhar *et al.* (2015). The increase in TVFFAs with days is due to the breakage of protein which enhanced the flavor of end product the results were in accordance with the Abbas *et al.* (2015) and Shekhar *et al.* (2015). Total phenols are an important constitute of EVOO results showed that more the oil fortification in sample more will be the phenolic compounds in ending product. Total volatile fatty acids of prepared cheese produce differed significantly by difference among EVOO concentrations, days as well as interaction between these two variables. The results was related to Shekhar *et al.* (2015) it was due to replacement of moisture content and more whey protein discharge from cream cottage cheese matrix. Reduced in

moisture content directed to increase in protein and fat contents while lactose still shows declining range. Moisture seems to be significantly affected by the whey drainage making cheese spread firm. A study was conducted by Gab, (2018) on soft category cheese fortify with olive oil and sun flower oil wax represents indifferent relation in the level of moisture in product during storing. Decreased in moisture content led to increase in protein and fat contents while lactose still shows decreasing range. Moisture seems to be significantly affected by the whey drainage making cheese spread from proteins obtained from milk are essential part of diet (Rasheed *et al.*, 2016).

The proteins content do not varied significantly by modify in extra virgin olive oil absorption The results was according to Abbas *et al.* (2015). The total solids of cream cottage cheese did not affect significantly by change in EVOO. Results present an decline trend with days as moisture

released and solid matter increased in cheese the results was in accordance with (Abbas *et al.*, 2015). The total nitrogen matter of cream cottage cheese did not vary significantly by variance in EVOO concentration while influence of days is significant throughout storage time. The results were related to Abbas *et al.* (2015) and Felfoul *et al.* (2015). Milk contains about 0.5 to 1 % of nitrogen content which

is directly related with proteins. The total fat matter of cream cottage cheese do not vary significantly by difference in EVOO concentration and interaction between these two variables while effect of days is significant. Fat contents were increasing till first week of storage then start to decline results were agreement with the study Felfoul *et al.* (2015). Results are shown in table 2.

Table: 2. Physicochemical changes in cream cottage cheese fortified with EVOO

Parameter	Treatment	Storage days			
		0	7	14	21
pH	T ₀	4.39	4.24	4.19	4.16
	T ₁	4.37	4.24	4.10	4.07
	T ₂	3.37	4.21	3.74	3.62
	T ₃	4.34	3.94	3.79	3.36
TVFA(%)	T ₀	8.38d	8.39cd	8.43cd	8.44bc
	T ₁	8.82cd	8.85cd	8.91cd	9.83ab
	T ₂	8.83cd	8.87cd	8.92cd	9.86ab
	T ₃	8.85cd	8.89cd	8.94cd	10.09a
TPC(mg GAE/10g)	T ₀	3.40	3.39	3.15	3.18
	T ₁	30.42	30.68	31.35	33.40
	T ₂	30.48	34.74	32.60	32.69
	T ₃	30.51	35.74	34.85	36.49
Moisture(%)	T ₀	70.82	70.19	69.89	69.82
	T ₁	70.80	69.86	69.81	69.44
	T ₂	70.79	69.83	69.45	69.24
	T ₃	70.74	69.60	69.20	69.14
Protein(%)	T ₀	14.55	15.87	15.80	15.03
	T ₁	15.05	16.76	16.01	15.14
	T ₂	15.04	15.74	14.79	11.07
	T ₃	15.02	15.37	11.41	11.14
T.S(%)	T ₀	24.71	24.73	24.75	24.80
	T ₁	24.72	24.75	24.77	24.84
	T ₂	24.70	25.00	25.15	25.47
	T ₃	24.60	24.73	24.89	24.95
T.N(%)	T ₀	0.58	0.73	0.95	0.92
	T ₁	0.56	0.70	0.89	0.71
	T ₂	0.56	0.68	0.98	0.87
	T ₃	0.52	0.66	0.99	0.91
Fat(%)	T ₀	21.40	22.67	22.06	20.71
	T ₁	21.37	22.82	24.58	23.09
	T ₂	21.52	22.31	24.59	23.14

3.3. Rheological analysis

The results obtained from variance of analysis for rheological analysis of cream cottage cheese curd changes significantly by difference in EVOO

concentration, days as well as interaction between these two variables shows a continues declining trend as the addition of olive increase with the passing storage time the real texture of curd becomes greasy

and oily and freshness reduced hence effecting the overall texture of product. The results were in accordance to Shekhar *et al.* (2015) and Fosberg and Joyner (2018) which are shown in table 3. Stickiness of product increased as storage time as well as

addition of oil in product was increased control group and the sample with least oil supplementation shows less stickiness same results were shown by Shekhar *et al.* (2015).

Table 3. Rheological analysis of cream cottage cheese fortified with EVOO

Parameter	Treatment	Storage days			
		0	7	14	21
Texture (mm)	T ₀	9.91ab	9.16ab	8.95ab	7.45abc
	T ₁	8.81bc	8.73ab	7.49cd	7.45abc
	T ₂	8.71ef	7.51fg	6.82bc	6.72abc
	T ₃	8.23g	7.29de	6.71ef	7.06def
Stickiness	T ₀	-5.57a	-5.61ab	-5.81ab	-5.90b
	T ₁	-5.56a	-5.62a	-5.83ab	-5.92b
	T ₂	-3.71a	-3.83a	-3.95b	-4.20b
	T ₃	-3.69a	-3.79ab	-3.98a	-4.30ab

3.4. Sensory evaluation

Sensory evaluation was done by using 9 point hedonic scale results shows that sample with least amount of fortified oil and less storage time was more preferred while sample which had more oil become oily, greasy, gave a strong aroma and bitter flavor hence T₁ scored more in term of flavor, taste

color body and texture as presented in table 4. Regularity in referenced standards by consumers influence the validity of product. Based on difference in preference criteria's every individual response obtained from whole palpation have no effect on actual situation (Bayarri *et al.*, 2011).

Table 4. Sensory evaluation of cream cottage cheese fortified with EVOO

Parameter	Treatment	Storage days			
		0	7	14	21
Flavor	T ₀	46.26abc	43.13ab	42.01cde	39.92ef
	T ₁	47.58a	46.26ab	45.11abc	43.50bcde
	T ₂	46.43ab	45.02abc	41.53de	41.43cde
	T ₃	42.59cde	44.97abcde	43.18bcde	37.63f
Color	T ₀	12.40	12.48	12.34	11.48
	T ₁	12.47	12.29	12.20	11.43
	T ₂	12.47	12.20	12.20	11.18
	T ₃	12.51	12.18	12.11	11.09
Body and texture	T ₀	38.37a	34.51ab	29.70ab	29.09ab
	T ₁	35.18ab	34.13ab	29.65b	28.92b
	T ₂	32.05ab	30.66ab	30.89ab	28.01b
	T ₃	29.07b	27.55b	27.60b	27.34b
Overall acceptability	T ₀	89.51ab	83.20abc	70.04bcd	74.30cde
	T ₁	89.76a	84.36abc	78.54abcd	72.10ef
	T ₂	88.16ab	82.76ab	75.86cde	78.91ef
	T ₃	84.13abc	81.80ab	75.43def	66.91f

4. Conclusion

In this study physicochemical analysis showed that pH, Total solids and moisture content in cheese was decreased with increase in the storage time. The protein contents fat content and nitrogen contents increases up to 7 days during storage and then tend to decreased. Total volatile free fatty acids and phenolic compounds tend to increase as quantity of EVOO raised. Rheological analysis exposed that EVOO had a significant effect on the texture of curd. Control group had higher texture profile and viscosity owing to more melting fats range. Sensory parameters had impact on the feature of product. With high percentage of acetyl contents cheese was usually demanded by consumers. Final result indicates that T₀ had less sensory properties as compared to other treated samples. The sample with less volume of fortified oil had supplementary essences which show a declining tendency as storing time increase. Color shows a decreasing trend with increasing storage time. T₀ and T₁ scored high by the judges as its smoothness and body consistency were seem to be improved.

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