American Journal of Food Technology

ISSN 1557-4571

Academic Journals Inc.

www.academicjournals.com

American Journal of Food Technology 10 (2): 58-67, 2015
ISSN 1557-4571 / DOI: 10.3923/ajft.2015.58.67

Prolonged Shelf Life of Sour Cream by Adding *Moringa oleifera* Leaves Extract (MOLE) or *Moringa oleifera* Oil (MOO)

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ABSTRACT

Sour cream is a widely popular acidified dairy product. It has a limited shelf life and strict hygiene and safety of the product. The objective of this study was to improve the quality of sour cream and prolonged the shelf life. *Moringa oleifera* Leaves Extract (MOLE) or *Moringa oleifera* Oil (MOO) were added to sour cream at concentrations 600, 800 and 1000 ppm. Subsequently, the chemical, microbiological and organoleptic properties of sour cream dairy storage 4 week at 5±1°C were determined. The results indicated that addition of MOLE and MOO at all levels has remarkable effect on TS, fat, total protein and lactose. The acidity content increased with increasing the level of MOLE while it decreased with increasing level of MOO. Acidity increased gradually in all treatments during storage period. Peroxide Value (PV) in sour cream samples as affected by addition of MOLE and MOO at different levels. Sour cream fortified with MOO exhibited lowest PV than sour cream fortified with MOLE. The results indicated that TC decreased with advanced storage period in all treatments of sour cream fortified with MOLE and MOO than control. Lipolytic and proteolytic bacteria, yeast and mould were not detected in sour cream fortified with MOLE and MOO. All sour cream made with MOLE and MOO had acceptable flavor, body and texture and appearance during storage period. It can be concluded that, the use MOLE and MOO as a sour cream preservative leads to improve microbial stability had no negative effect on all the parameters evaluated hence, higher sensory acceptability as well as improve shelf life of sour cream.

Key words: Sour cream, *Moringa oleifera* leaves extract, *Moringa oleifera* oil, shelf life, peroxide value

INTRODUCTION

Protection of food from microbial or chemical deterioration has traditionally been an important concern in the food industry. Chemical synthesized preservation has been classically used to decrease both microbial spoilage and oxidative deterioration of food.

In recent years consumers refer natural foods without of this situation. Consumers are demanding partial or complete substitution of synthesized preservatives due to their adverse health effects. This fact has led to an increasing interest in developing more natural alternatives in order to enhance shelf life and safety of food (Bukar *et al*., 2010; Arora *et al*., 2013). Methods of natural protection began to popular in food attribution and new preservation methods focused on the use of eco-friendly and bio-friendly plants which have been antioxidant and antimicrobial effects in

order to enhance shelf-life and safety of food. Studies have been demonstrated that diet rich in phenolic antioxidants have many health benefits and confer longer life expectancy. Phenolic antioxidants are mainly present in leaves and seeds of some plants have been implicated in preventing the food from free radical mechanism. *Moringa oleifera* leaves and seeds are good source of antioxidants and oil which is highly resistant to oxidation (Anwar *et al*., 2007b).

Moringa oleifera is an important food commodity which had enormous attention as the natural nutrition of the tropics (Anwar *et al*., 2007a). Furthermore, *Moringa oleifera* has been found to be a potential new source of oil. *Moringa* oil is composed of highly unsaturated fatty acids containing 80.4% polyunsaturates, mainly Oleic acids 67.9% (Ogbunugafor *et al*., 2011). In addition, the low acid value of *Moringa* oil indicated a possible low free fatty acid composition which suggest lesser susceptible to rancidity. Moreover, oil of low acidity has been considered to acceptable for edible application. Previous studies have suggested that the high oleic acid content of *Moringa* oil coupled with its highly unsaturated nature and low peroxide value may qualify the *Moringa* oil for use in industries (Manzoor *et al*., 2007; Ogbunugafor *et al*., 2011).

Moringa oleifera oil (MOO) is edible and closely resembles to olive oil in fatty acid composition. Vegetable oils rich in monounsaturated fatty acids are generally more stable to oxidative rancidity and are healthier (Long *et al*., 1997). It can be concluded that MOO can be added by interesterification process up to 50% in butter oil to formulate a healthier and stable fat with acceptable physico-chemical properties (Nadeem *et al*., 2012). *Moringa oleifera* gave high oil yield which has good antioxidant capacity with potential for industrial, nutrition and health application (Ogbunugafor *et al*., 2011).

In addition aqueous extract of *Moringa oleifera* showed strong and superior antibacterial activity against all bacteria strains especially with regard to gram positive bacteria. These findings supported the traditional use of the plant in the treatments of different infections (Saadabi and Abu Zaid, 2011).

Nadeem *et al*. (2013a) concluded that *Moringa oleifera* leave extract at 600 ppm may be used for enhanced of oxidative stability of butter oil. In addition, they suggested that leaf extract of *Moringa oleifera* at 600 ppm may be used for reasonable storage stability of butter at refrigeration temperature with acceptable sensory characteristics (Nadeem *et al*., 2013b).

Cultured (sour) cream is an extremely viscous product and has been used for years in many countries. The flavour and aroma similar to cultured butter milk. The product is utilized warm or cold in many dishes, such as sauces, soups and dressings. The product has a bright appearance and uniform texture. Its taste is rather mild and slightly acid with pH of ~4.5. Cultured cream has a limited shelf life <10°C and strict hygiene is required during production to ensure good quality and safety of the product. However, yeast and moulds can grow on the surface of the product in package that is not airtight. In the event of extended storage, the enzymes of lactic acid bacteria can hydrolyze the β-lactoglobulin and cause bitterness in the product (Tamime, 2006).

Fat dairy products containing higher content of unsaturated fatty acid are susceptible to auto oxidation and reduce shelf stability of foods. No work has been done to investigate the effect of *Moringa oleifera* Leaves Extract (MOLE) or *Moringa oleifera* oil (MOO) for stabilization of sour cream at refrigeration temperature for the reason this research work was planned to improve quality of sour cream and prolonged the shelf life.

MATERIALS AND METHODS

Materials: Buffalo milk (6.2% fat) was obtained from Faculty of Agriculture, Cairo University, Egypt. *Moringa oleifera* either leaves or oil was obtained from breadbasket of Egypt association,

Dokki. Cream starter culture consisting of *L. lactis* sub spp. Lactis and L. lactis sub. spp. *Leuconostoc* were obtained from Chr. Hansens Lab A/S Copenhagen Denmark.

Preparation of leaves extract from *Moringa oleifera*: Twenty to thirty gram of fresh leaves were boiled with 200 mL of water for 1 h the extract was filtered using Whitman filter Paper no. 1 and then concentrated in Vacuum at 40-50°C using a rotary evaporator. Evaporation of soluble components evaporator affords a crude extract of the soluble components.

Preparation of sour cream: Fresh cream (20-22% fat, 9.5-10% SNF) was mechanically separated from fresh buffalo milk. Cream was heat treated at 85°C in a thermostatically controlled water bath for 10 min, cooled immediately to 21°C. The stock was divided into seven portions, the first portion was served as control and the other six portions were fortified with 600, 800 and 1000 ppm either *Moringa oleifera* leaves extract (MOLE) or *Moringa oleifera* oil (MOO) for T_1,T_2,T_3,T_4,T_5 and T_6, respectively. Each portion was inoculated with 2% starter of *L. lactis* spp. *Lactis* and *L. lactis* spp. *Leuconostoc* and incubated at 21°C for 16 h. The resultant cream products were transferred to the refrigerator and analyzed weekly up to 4 week. All these treatments were performed in triplicate.

Method of analysis: Total Solid (TS), Fat, ash and total protein contents were determined according to AOAC (2007). Lactose content in the resultant cream was determined as described by Lawrence (1968). Titratable acidity of cream was determined according to Richardson (1986). The pH values were measured using a digital laboratory pH meter (HI931400, Hannq instruments with glass electrode. Peroxide value of cream was determined according to method described by AOAC (2000) as follows.

Five gram fat sample dissolved in 30 mL of glacial acetic acid and chloroform (3:2, v/v) after that 0.5 mL of saturated potassium iodine (KI) was added. Iodine (I_2) is liberated by reaction with peroxides then titrated with standardized sodium thiosulfate using a starch indicator. Peroxide Value was calculated from the following equation:

$$\text{meq peroxide / kg fat} = \frac{S - B \times N \times}{\text{Sample weight (g)}}$$

Where:
S = Sample titration
B = Blank titration
N = Normality of the $Na_2S_2O_3$ solution

Microbiological examination: Total bacterial count of sour cream was enumerated after incubation at 32°C 2 days using plat count agar according to Marshall (1992). Yeasts and moulds, Lipolytic bacteria and proteolytic bacteria of sour cream were determined according to APHA (1994).

Sensory evaluation: Samples of resultant sour cream were judged by a panel of 10 judges selected on the basis of their consistency in scoring. The samples were scored for flavour (out of 45 point), texture and body (out of 30 point), acidity (out of 10 point) and appearance (out of 15 point) as suggested by Keating and White (1991). All data were analyzed by the General Linear Models procedure of SAS Institute (1990). Least significant difference test was performed to determine differences in means at $p \leq 0.05$.

RESULTS AND DISCUSSION

Chemical composition of different treatments of sour cream made with addition of MOLE and MOO presented in Table 1. The results indicated that addition of MOLE and MOO at all levels has remarkable effect on TS, fat, total protein and lactose. While slight decrease in ash content was observed. Moreover, the addition of MOLE and MOO to sour cream in all treatments did not pose any problem of standard of identity of sour cream.

The reason for non variation in the composition of different treatments and control was due to the addition level of MOLE and MOO was quite low to affect changes in the composition of sour cream. In Connecticut, sour cream must contain at least 18% milk fat (Hankin *et al*., 1981).

Acidity and pH value: Data in Fig. 1 show changes in total acidity and pH values of different sour cream treatments during storage period. One of the most important parameter to determine

Table 1: Chemical composition of fresh sour cream (%) fortified with either different levels *of Moringa oleifera* leaves extract (MOLE) or *Moringa oleifera* oil (MOO)

		Treatments*					
Properties	Control	T_1	T_2	T_3	T_4	T_5	T_6
TS	29.89	29.88	29.86	29.85	29.90	29.93	29.94
Fat	21.20	21.18	21.18	21.16	21.20	21.23	21.25
Protein	3.39	3.38	3.37	3.37	3.39	3.38	3.35
Lactose	4.38	4.30	4.30	4.28	4.30	4.25	4.25
Ash	0.79	0.78	0.78	0.77	0.79	0.78	0.78

*T1, T2, T3: Sour cream with 600, 800 and 1000 ppm of *Moringa oleifera* leaves extract, respectively. T4, T5, T6: Sour cream with 600, 800 and 1000 ppm of *Moringa oleifera* oil, respectively, TS: Total solid

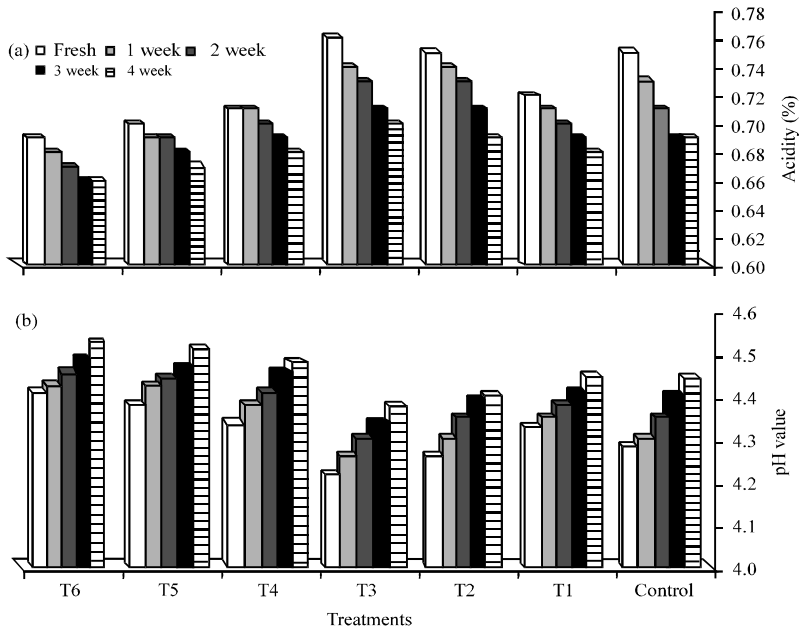

Fig. 1(a-b): (a) Titratable acidity (%) and (b) pH values of sour cream fortified with either different levels of *Moringa oleifera* leaves extract (MOLE) of *Moringa oleifera* oil (MOO) during storage period

the quality and shelf-life of dairy products is acidity and pH. The acidity will influence which microorganisms will survive and grow in a food. The present data indicated that total acidity increased in all treatments during storage period.

Generally, the acidity content ranged from 0.66-0.70% in fresh sour cream and increased during storage to be 0.69-0.76%. Furthermore, the acidity content increased with increasing the level of MOLE while it decreased with increasing level of MOO. These results are in line in accordance with Salem *et al.* (2013) and Salama *et al.* (2014) who reported that the addition of dry leaves of *Moringa oleifera* (DLMO) increased acidity of Labneh and innovative beverage compared to control in fresh and during storage period. In addition, the lowest score for acidity was noted for sour cream made with MOO. The acidity of sour cream of all treatments within the acidity of commercial soured product. The acidity of all soured products must not be less than 0.5 expressed as lactic acid (Hankin *et al.*, 1981). Changes in pH values of all treatments were in opposite trend to that of acidity.

Peroxide value: Peroxide Value (PV) indicator the primary stages of auto oxidation and important parameter for storage stability of fat dairy products. Higher level of peroxide value is associated with poor keeping quality. The results in Table 2, indicated that PV in sour cream samples as affected by addition of MOLE and MOO at different levels. In addition, PV developed at a considerably higher rate in control sour cream than that of either sour cream fortified with MOLE and MOO. Peroxide value of sour cream samples and the control sample increased throughout the storage period. At the end of storage period (4 week), control sample exhibited the highest PV of 1.12 (meq oxygen/kg fat) as compared to sour cream fortified with either MOLE and MOO which recorded that 0.81, 0.75, 0.61, 0.53, 0.46 and 0.35 (meq oxygen/kg fat) for treatments T1, T2, T3, T4, T5 and T6, respectively. Furthermore, sour cream fortified with MOO exhibited lowest PV than sour cream fortified with MOLE. These results are close with (Manzoor *et al.*, 2007; Ogbunugafor *et al.*, 2011) who reported that the lower peroxide value of *Moringa oleifera* oil compared to that of palm oil indicated that the oil may be stable to oxidative degradation. The stabilization of sour cream containing MOO and MOLE may be due to the presence of higher concentration of phenolic, antioxidants which inhibited the formation of oxidation products. Moreover, *Moringa oleifera* leaves act as a good source of natural antioxidants due to the presence of various type of antioxidant compounds such as ascorbic acid, flavonoids, phenolics and carotenoids (Fahey, 2005; Ashfaq *et al.*, 2012). Also, the hydrocarbons found in the essential oil in of *Moringa oleifera* could have also antioxidant activity (Marrufo *et al.*, 2013). Phenolic compounds are a class of antioxidant agents which act as free radical terminators and also involved in retardation of oxidative degradation of lipids (Pourmorad *et al.*, 2006).

Table 2: Peroxide values (meq oxygen/kg fat) of sour cream fortified with either different levels of *Moringa oleifera* leaves extract (MOLE) or *Moringa oleifera* oil (MOO) during storage period

		Treatments*					
Storage period	Control	T_1	T_2	T_3	T_4	T_5	T_6
Fresh (week)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.53	0.41	0.40	0.31	0.28	0.25	0.22
4	1.12	0.81	0.75	0.61	0.53	0.46	0.35

In this study the reason for the low peroxide value of treatments containing MOO and MOLE stored at 5±1°C could be attributed to the antioxidant activity of the leaf extract of *Moringa oleifera*. These results are agreement with Sreelatha and Padma (2009) and Ashfaq *et al.* (2012). They reported that the extract *Moringa oleifera* both nature and tender leaves have potent antioxidant activity against free radicals, prevent oxidative damage. Also, Nadeem *et al.* (2012) reported that oxidative stability of blends of butter oil significantly increased with increasing a level of *Moringa oleifera* oil in the blend. Furthermore, the stabilization of butter oil containing up to 600 ppm MOE at ambient temperature was due to the presence of higher concentration of phenolic antioxidant MOE which inhibited the formation of oxidation products (Nadeem *et al.*, 2013a).

Microbiological analysis: The second important quality criterion that the determines the acceptability and shelf life of dairy products is microbiological analysis. These tests can be used to evaluate both food quality and food safety. Tests may be done to estimate changes in the number and type of spoilage organism (yeasts, moulds or bacteria) occurring over time.

The results in Table 3 showed the changes in Total Count (TC) of different treatments of sour cream during storage period at refrigerator temperature 5±1°C. The results indicated that TC

Table 3: Microbiological quality (log CFU mL^{-1}) of sour cream fortified with either different levels *of Moringa oleifera* leaves extract (MOLE) or *Moringa oleifera* oil (MOO) during storage period

		Treatments*					
Properties and storage period (week)	Control	T_1	T_2	T_3	T_4	T_5	T_6
Total count bacteria							
Zero	4.073	4.208	4.294	4.312	4.128	4.145	4.192
1	4.210	3.800	3.715	3.694	3.700	3.699	3.670
2	4.440	3.606	3.49	3.531	3.515	3.462	3.419
3	4.632	3.429	13.385	3.395	3.419	3.322	3.312
4	4.807	3.208	3.201	3.189	3.199	3.199	3.125
Proteolytic bacteria							
Zero	ND**	ND	ND	ND	ND	ND	ND
1	ND	ND	ND	ND	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	ND
3	1.251	ND	ND	ND	ND	ND	ND
4	2.477	ND	ND	ND	ND	ND	ND
Lipolytic bacteria							
Zero	ND	ND	ND	ND	ND	ND	ND
1	ND	ND	ND	ND	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	ND
3	1.289	ND	ND	ND	ND	ND	ND
4	2.382	ND	ND	ND	ND	ND	ND
Mold and yeast							
Zero	ND	ND	ND	ND	ND	ND	ND
1	ND	ND	ND	ND	ND	ND	ND
2	ND	ND	ND	ND	ND	ND	ND
3	1.253	ND	ND	ND	ND	ND	ND
4	1.865	ND	ND	ND	ND	ND	ND

**Not detected

decreased with advanced storage period in all treatments sour cream fortified with MOLE and MOO than control. In case of use MOO or MOLE were higher than control when fresh. But during storage TC were lower than control. This may be due to antibacterial effect of *Moringa oleifera* leaves. These results are in line with reported with (Saadabi and Abu Zaid, 2011; Onsare *et al*., 2013; Vinoth *et al*., 2012). It was reported that the biological active compounds isolated from both leaves and seeds of the plant exhibited antimicrobial activity (against gram positive bacteria). *Moringa* contains a range of fairly unique phytochemicals containing the simple sugar, hexose and its rich in a fairly unique group of compounds called glucosinolates and isothiocyanates (Ashfaq *et al*., 2012). In addition the phytochemical screening indicated the presence of phenolics, flavonoids, tannins, glycosides, volatile oil and terpenoids in the extracts. Thus suggested that this phytochemical have posses antibacterial activity (Vinoth *et al*., 2012). It was reported that the biological active compounds isolated from both leaves and seeds of *Moringa stenopetala* exhibited antibacterial activity against *S. aureus*, *S. typhi*, *Shigella* and *Candida albicans* (Arora *et al*., 2013). It was found that different extracts of *Moringa oleifera* leaves are active against bacteria such as *E. coli*, *S. aureus*, *P. aeruginosa* and as these organisms range from pathogenic and toxigenic organism liable to cause food borne illnesses and food spoilage due to bacteria presence (Ali, 2014). Furthermore, Badoms *et al*. (2014) indicated that *Moringa* leaf ethanol had the highest inhibitory potential against bacteria population. They concluded that the use of ethanol extract of *Moringa* leaf as a cheese preservative leads to improve microbial stability and nutritional quality as well as higher sensory acceptability. The lipolytic and proteolytic counts were affected with addition of MOLE and MOO. These counts were not detected in all treatments when fresh and through storage period. Nevertheless, it appeared in samples of control after 15 days.

In addition to quality deterioration, yeast and moulds counts have been used as indices for the end of shelf-life of dairy products. From results, moulds and yeast were not detected in all treatments when fresh and through storage period (4 week). Ali (2014) reported that aqueous extract of *Moringa oleifera* leaves posses significant antimicrobial activity against gram positive and negative fungal species. These results are in line with those reported by Salem *et al*. (2013). However, moulds and yeasts appeared in samples of control after 3 weeks.

Organoleptic properties: The third important parameter to determine the quality and shelf-life of dairy products is the sensoric properties. Sensory evaluation assesses a food's smell, appearance, flavor and texture. It can be used to monitor and record obvious changes that occur over time and is therefore, useful when determining the shelf-life of foods. The food should be assessed under the conditions at which it is designed to be stored and consumed. As can be seen from Table 4 the results of organoleptic properties revealed that addition of MOLE, MOO had significant effect on flavor, body texture and total score. The addition of MOLE and MOO to sour cream improved flavor without adversely effects on quality. These results are in line with Kaylegian and Lindsay (1995). They reported that fats should have a peroxide value of less than 1 meq oxygen/kg oil to be considered fresh. At this level, no off flavor can be perceived in milk fat. According to the International Dairy Federation the standard value for milk fat is 0.2 meq oxygen/kg fat. The sour cream with MOLE gained the highest score either when fresh or through at the intervals storage periods. Moreover, all sour cream made with MOLE and MOO had acceptable flavor, body and texture and appearance. These results are agreement with Badoms *et al*. (2014). They reported that

Table 4: Sensory evolution of sour cream fortified with either different levels of *Moringa oleifera* leaves extract (MOLE) or *Moringa oleifera* oil (MOO) during storage period

		Treatments*					
Storage period and properties	Control	T_1	T_2	T_3	T_4	T_5	T_6
Zero							
Flavor (45)	43	43	44	43	40	41	40
Body and texture (30)	28	28	28	27	26	26	25
Acidity (10)	9	8	9	8	8	7	7
Appearance (15)	15	15	15	15	15	15	15
Total (100)	95^{Aa}	94^{Aa}	96^{Aa}	93^{ABa}	89^{Ba}	89^{Ba}	87^{Ca}
1 week							
Flavor (45)	43	43	44	43	40	41	40
Body and texture (30)	28	28	28	27	26	26	25
Acidity (10)	9	8	9	7	8	7	7
Appearance (15)	15	14	15	14	14	14	14
Total (100)							
3 week	91^{Aab}	91^{Aa}	92^{Aa}	89^{Aa}	86^{ABab}	85^{ABab}	83^{Bab}
Flavor (45)	40	40	41	40	37	37	36
Body and texture (30)	26	26	26	25	24	24	23
Acidity (10)	7	7	7	6	7	6	6
Appearance (15)	13	13	13	13	13	13	12
Total (100)	86^{Ab}	86^{Aab}	87^{Aab}	84^{ABab}	81^{Bb}	80^{Bb}	77^{Cb}
4 week							
Flavor (45)	39	39	39	37	36	35	35
Body and texture (30)	24	24	25	23	24	26	22
Acidity (10)	6	6	6	5	6	6	5
Appearance (15)	13	13	13	12	13	13	12
Total (100)	82^{Ac}	82^{Ac}	83^{Ab}	77^{Bc}	79^{Bc}	80^{Ab}	74^{Cc}

^{A,B,C}Means with the same letter among treatments are not significantly different ($p \leq 0.05$), ^{a,b,c}Means with the same letter during storage period are not significantly different ($p \leq 0.05$)

cheese samples preserved with ethanol extracts of *Moringa* leaves had most acceptable to consumers. The use of *Moringa oleifera* oil as preservative of soft cheese will improve the overall acceptability and improve flavor and texture which could be the accounted for the nice aroma of *Moringa oleifera* oil as well as improve the nutritional, therapeutic and shelf life of cheese (Belewu *et al*., 2012).

CONCLUSION

The use MOLE and MOO as a sour cream preservative leads to retarded microbial growth (yeast and mould and proteolytic and lipolytic bacteria) and decreased peroxide value and effectively preserved sour cream without adversely affecting quality. In addition, they had no negative effect on all the parameters evaluated hence, higher sensory acceptability as well as improve shelf life of sour cream. Fat dairy products are susceptible to auto oxidation and reduce shelf stability of foods. Thus, it is recommended that the addition of effect of MOLE or MOO for stabilization of sour cream at refrigeration temperature to improve quality of sour cream and prolonged the shelf life.

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