DJAS
Damietta Journal Agricultural Sciences
مجلة دمياط للعلوم الزراعية

Damietta Journal Agricultural Sciences

Damietta Journal Agricultural Sciences Damietta Journal Agricultural Scien

Volume 2, Issue II, 2023

DJAS

Damietta Journal of Agricultural Sciences
http://publication.du.edu.eg/journal/ojs302design/index.php/agr/index
ISSN: 2812-5347(Print)- 2812-5355 (Online)

Development a method for making Ras cheese from pasteurized milk

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Keywords:

Ras cheese
Starters
Lactobacillus
Streptococcus
Romy cheese.

Abstract:

In this research, an attempt was made to use a number of starters in order to reach similar sensory characteristics with Ras cheese. The differences between the treatments in the chemical composition were slight, with the superiority of treatment 4 in the percentage of fat on a dry weight basis at the end of ripening, reaching 50.13% followed by control cheese 49.24% after 180 days of ripening. The ripening period had a clear effect on the formation of non-protein nitrogen (NPN) and soluble nitrogen (SN), as their percentage increased with the increase in the ripening period. The non-protein nitrogen after 180 days of ripening ranged from 0.405 in T2 to 0.681 in T3. while the highest soluble nitrogen (SN) content 0.778 was recorded in T4 at the end of ripening. The results showed convergence of coefficients 3 and 4 for the sensory characteristics of the control cheese. T1, T2, and T3 showed the convergent results in texture profile analysis, while T4 recorded the highest value of Cohesiveness, Gumminess and Chewiness index (0.52, 4013 and 2930, respectively) Cheese made from pasteurized milk without a stater had the lowest sensory characteristics.

INTRODUCTION:

Ras cheese is the only hard cheese that is produced in Egypt (**Hofi *et al.,* 1970)**. It has Greek origins and is called Ras in Egypt and Cephalotyre in Italy, which means “head” in the language of the two countries **(Phelan *et al.,* 1993**). Ras also known as “Romy” cheese in Egypt **(Hammam *et al.*, 2018)**. Ras cheese was prepared from raw unpasteurized milk. As a result of the moderate thermal conditions in Egypt, it is considered an opportunity for high microbial activity, which gives this cheese unique characteristics, such as taste, aroma, and texture. The presence of starter microbes not only improves the properties of cheese but also prevents the growth of undesirable microbes **(El-Fadaly *et al.*, 2015).** It is mainly manufactured from milk during the winter. Several attempts have been made to produce Ras cheese from pasteurized milk using microbial starters. Egyptian standard specifications stipulate that dairy products must be manufactured from pasteurized milk **(Abd-Elmonem *et al.*, 2022)**. Ras cheese is the only exception to this rule, because it is difficult to produce it from pasteurized milk while preserving its sensory characteristics. Despite this, a large number of species of microorganisms were recorded in Ras cheese, some of which were pathogenic or undesirable, and the results differed greatly based on the microbial load of raw milk as well as manufacturing parameters, storage temperature, salting percentage, salting method, and storage period **(Hamad *et al.*, 2020)**. Two types of microbes were used in the cheese industry. The first is the microbial starter, responsible for the main characteristics of cheese, which can provide satisfactory results in manufacturing. The second type is co-starter or adjunct culture, which often has a limited goal in the industry **(Awad *et al.*, 2007).** It may enhance the taste, activate the main starter, or produce flavors, and often the role of the co-starter ends within a limited period of time compared to the main starter. Therefore, the aim of the study was to produce Ras cheese from pasteurized milk while preserving the original qualities of traditional Ras cheese.

Material and Methods:

Material:

Milk

Row whole mixed cow and buffalo milk (80:20) was obtained from Serw Research Station.

Bacterial strains

Bacterial strains were obtained from Christian Hansen's Laboratory, Denmark. Two mixed cultures were used as Ras cheese starters. These strains were ***Streptococcus thermophilus* & *Lactobacillus bulgaricus*** for **treatment (3)** and ***Streptococcus thermophilus* & *Lactobacillus helvaticus*** for **treatment (4).**

Rennet

Calf animal rennet brought from local market had 0.5 normality strength was used during this study. 3 ml of rennet was applied for 1 L of milk.

Chemicals and media

A food grade of salt and calcium chloride purchased from El. Nasr Pharmaceutical Chemical Co., Egypt. Three media used in this work (Nutrient agar, MRS and M17) and it were purchased from Oxiod, UK.

Methods:

Cheese making procedure

Traditional Ras cheese making (treatment 1) shewed in (Table 1), the procedure reported by **Abdel-Tawab (1966)** was adopted for making Ras cheese with some modification. Standardized milk (4% fat) was heated to 32 °C and sufficient rennet was added (2%) to complete coagulation within 30 – 40 min. The coagulum was cut into small pieces of 2cm*2cm and then carefully stirred. The temperature of the vat was then raised to 43 °C over a period of approximately 45 min, and gentle stirring was maintained throughout the process. Moulds lined with cheesecloth were filled with sufficient curd to produce one mould cheese. Light mechanical pressure was applied over the next four hours at which point the cheese was reversed in the press, left under pressure for over (approximately 18 h), and left for four days. Cheese was salted in a saturated solution for 24 h. The outer layers were then washed with a thin layer of sodium benzoate and sodium sorbate solution 0.1% and left to dry. After 15 d, the cheese was storage at 15-20 °C. While **treatments (2,3** and **4)** were produced from pasteurized milk (heated at 65°C for 30 min, then cooled to 32°C). The starter was added to milk at 32°C before rennet addition and left to work by monitoring the change in acidity to prevent acid coagulation. The remaining manufacturing steps were performed as previously described.

Table 1. The starter used for the manufacturing of Ras cheese

Treatment	Milk	Starter
T 1	Raw	The natural milk microflora
T 2	Pasteurized	Without starter
T 3	Pasteurized	*Streptococcus thermophilus* and *Lactobacillus bulgaricus*
T 4	Pasteurized	*Streptococcus thermophilus* and *Lactobacillus helvaticus*

Chemical analysis

The moisture, total protein, fat, non-protein nitrogen (NPN), soluble nitrogen (SN) and salt content was determined as described by **AOAC (2005).**

Microbiological Analysis

Cheese samples were examined for total bacterial count (TBC) on Nutrient agar medium, Lactobacilli count on MRS medium and Streptococci count on M17 medium as described by **Atlas (2010).**

Texture profile

Texture properties of cheese were determined (Brookfield CT3 texture analyzer) using prop with (50mm diameter) and operated at a crosshead speed of 1 mm/s and deformation distance of 10 mm. The following texture profile parameters were obtained and calculated as describe by **Awad (2011).**

Sensory evaluation

A group of 10 panelists assessed the prepared Ras cheese samples according to sensory criteria such as Flavor, Body and Texture, Appearance, and color. The mean ratings for the assessments were determined. All sensory studies were carried out under the guidance of the Food-Technology Department at Damietta University, Egypt. **(Scott, 1981)**.

Statistical analysis

The results were presented as means of triplicates except Sensory evaluation 10 replicates. A tow-way analysis of variance (ANOVA) was performed using SAS software (Ver. 9.4) to test for significance variations between sample means at $p < 0.05$. (**Steel *et al.*, 1997**).

Results and Discussions

Chemical analysis

Table (2) shows the chemical composition of Ras cheese during ripening. It is clear from the data that the moisture content decreased gradually throughout the ripening period for all treatments. This may be due to water evaporation during ripening **(Conner, 1980)**. During ripening, the outer layers of Ras cheese lose moisture at a greater rate than the inner layers, creating a hard covering **(Hammam *et al.*, 2018).** Most of the moisture loss occurred during the first storage period, and the rate of moisture loss decreased thereafter.

The highest moisture content (43.15 %) was recorded in treatment 4 in fresh cheese, and the lowest content (30.02 %) was recorded at 180 days of ripening in treatments 4. This results agreement with (**Hofi *et al.* 1970 and EL-Neshawy *et al.*, 1984**).

The percentage of protein decreased with the progression of the ripening period. This decrease was mainly due to the effect of enzymes present in the added rennet, resulting from microbial activity, or naturally present in milk. As a result, the values of non-protein nitrogen substances and soluble nitrogen increased, which led to an improvement in the sensory properties of cheese. The highest protein content was 36.90% (dry weight), in treatment 3 in fresh cheese, and the lowest content in dry weight 27.41% was recorded at 180 days of ripening in treatment 4. While, the highest protein content was 22.47% in treatment 3 (wet weight) at 60 days of ripening. This results agreement with (**EL-Essawi *et al.*, 2013).**

The highest fat content in fresh cheese and after 180 days of ripening was recorded in treatment 3 then treatment 4 (56.88 and 56.40%, respectively). while the lowest was recoded 45.66% in dry weight and 31.02% in wet weight in treatment 2 after 180 days of ripening. Similar results in the same range were reported by **(Hofi *et al.*, 1970).** The salt content increased gradually with moisture content decrease and ranged from 1.46% treatment 2 at fresh cheese to 3.82% in treatment 2 after 180 ripening time. These results are agreement with (**Awad, 2011** and **EL-Essawi *et al.*, 2013).**

Table 2. Chemical composition of Ras cheese during ripening time

Treats	Ripening time	Moisture %	Protein %		Fat %		NPN %	SN %	Salt %
			Wet weight	Dry weight	Wet weight	Dry weight			
T 1	Fresh	40.91^{c}	20.02^{fg}	33.89^{bc}	31.10^{g}	52.63^{bc}	0.245^{h}	0.299^{f}	1.58^{h}
	60 days	37.38^{d}	20.37^{cdef}	32.54^{cd}	31.28^{fg}	49.97^{def}	0.340^{f}	0.476^{de}	2.12^{f}
	120 days	30.21^{f}	21.44^{b}	30.73^{ef}	34.56^{ab}	49.52^{def}	0.366^{e}	0.460^{de}	2.31^{ef}
	180 days	30.19^{f}	21.30^{bc}	30.53^{ef}	34.37^{ab}	49.24^{def}	0.408^{d}	0.599^{bc}	3.53^{a}
T 2	Fresh	41.31^{bc}	20.24^{ef}	34.50^{b}	31.25^{fg}	53.26^{b}	0.207^{i}	0.203^{fg}	1.46^{h}
	60 days	33.37^{e}	21.25^{bcd}	31.91^{de}	33.00^{c}	49.55^{def}	0.319^{f}	0.262^{fg}	3.4^{ab}
	120 days	32.90^{e}	20.30^{def}	30.26^{efg}	31.43^{efg}	46.86^{gh}	0.398^{d}	0.528^{cd}	3.82^{a}
	180 days	32.05^{e}	19.68^{fg}	28.97^{fgh}	31.02^{g}	45.66^{h}	0.405^{d}	0.660^{b}	3.55^{a}
T 3	Fresh	42.84^{ab}	21.06^{bcde}	36.90^{a}	32.43^{cd}	56.88^{a}	0.280^{g}	0.211^{fg}	1.67^{gh}
	60 days	36.68^{d}	22.47^{a}	35.49^{ab}	32.08^{def}	50.67^{cde}	0.470^{c}	0.293^{fg}	3.77^{a}
	120 days	33.57^{e}	20.08^{efg}	30.23^{efg}	32.17^{de}	48.44^{efg}	0.518^{b}	0.405^{e}	3.14^{bc}
	180 days	33.13^{e}	19.41^{fg}	29.03^{fgh}	31.99^{def}	47.85^{fg}	0.681^{a}	0.544^{cd}	3.70^{a}
T 4	Fresh	43.15^{a}	18.15^{h}	31.94^{de}	32.05^{def}	56.40^{a}	0.193^{i}	0.192^{g}	1.65^{gh}
	60 days	33.21^{e}	20.23^{ef}	30.30^{efg}	34.13^{b}	51.12^{cd}	0.249^{h}	0.235^{fg}	2.61^{de}
	120 days	33.28^{e}	19.14^{g}	28.70^{gh}	34.17^{b}	51.22^{bcd}	0.466^{c}	0.299^{f}	2.80^{cd}
	180 days	30.02^{f}	19.18^{g}	27.41^{h}	35.07^{a}	50.13^{de}	0.481^{c}	0.778^{a}	3.63^{a}
LSD at 0.05		1.719	0.903	1.574	0.785	1.979	0.023	0.091	0.396

Table 3. Microbiological analysis of Ras cheese during 180 days ripening

Treats	Storage time	TBC Log cfu/g	Lactobacilli count Log cfu/g	Streptococci count Log cfu/g
T 1	Fresh	4.70^{h}	3.81^{g}	4.08^{i}
	60 days	5.85^{cd}	4.51^{e}	5.35^{bc}
	120 days	6.93^{a}	5.04^{b}	5.06^{ef}
	180 days	5.98^{c}	4.51^{e}	4.96^{f}
T 2	Fresh	4.18^{j}	3.27^{i}	3.17^{k}
	60 days	5.35^{f}	4.10^{f}	4.94^{f}
	120 days	6.45^{b}	4.91^{c}	5.18^{de}
	180 days	5.19^{g}	4.21^{f}	3.86^{j}
T 3	Fresh	4.48^{i}	3.54^{h}	3.87^{j}
	60 days	5.66^{e}	4.77^{d}	5.25^{cd}
	120 days	5.90^{c}	5.05^{b}	5.46^{b}
	180 days	5.85^{cd}	4.73^{d}	4.64^{g}
T 4	Fresh	4.42^{i}	4.22^{f}	4.25^{h}
	60 days	5.43^{f}	5.15^{b}	5.22^{cd}
	120 days	5.71^{de}	5.94^{a}	5.81^{a}
	180 days	4.83^{h}	4.78^{d}	4.95^{f}
LSD at 0.05		0.150	0.127	0.130

-Means in a column that are not followed by the same letter are significantly different ($p < 0.05$).

Microbiological Analysis

Table (3) shows the total bacterial count (TBC) of Ras cheese during ripening. It is clear from the data that the TBC increased gradually and reached a maximum at 120 days of ripening, followed by a slight decrease at 180 days. T1 had the highest total bacterial counts (6.93 log cfu/g) followed by T2 (6.45 log cfu/g), T3 (5.90 log cfu/g), then T 4 (5.71 log cfu/g). Despite this, the results of lactobacilli counting were higher in T4 (5.94 log cfu/g), followed by T3 (5.05 log cfu/g), T 1 (5.04 log cfu/g), then T2 (4.91 log cfu/g). Similarly in Streptococci counting, T4 (5.81 log cfu/g) had the highest Streptococci count followed by T3 (5.46 log cfu/g), T1 (5.35 log cfu/g) then T2 (5.18 log cfu/g). In general, the growth of bacteria recorded in cheese samples were in the same trend as those recorded by **(Abd-Elmonem *et al.*, 2002)**, who reported that the total bacterial count, Lactobacilli count and streptococci count increased gradually in all treatments, followed by a gradual decrease thereafter.

Texture Profile

Data presented in Table 4 showed the texture profile of Ras cheese at the end of ripening. T4 had the highest value of Cohesiveness, Gumminess, Chewiness, and Chewiness index followed by T1 (control). Springiness referred to the degree to which the sample returned to the original shape after partial compression between the tongue and hard palate **(Gwartney *et al.*, 2004),** the highest value recorded in T2 followed by T3 then T1 and T4. Chewiness and Chewiness index referred to a measure of the work needed to masticate a solid food to a state ready for swallowing **(Tunick, 2000)**, which, can mean the number of chews that are required before the sample is ready for swallowing **(Zheng *et al.*, 2016).**

Table 4. Texture profile of Ras cheese at 180 days of ripening

Treats	Cohesiveness	Springiness (cm)	Gumminess (g)	Chewiness (J)	Chewiness index (g)
T 1	0.43	0.28	1800	0.05	1296
T 2	0.33	0.35	1250	0.04	1137
T 3	0.35	0.29	1440	0.04	1066
T 4	0.52	0.15	4013	0.06	2930

Sensory evaluation

Table 5 showed the organoleptic properties of Ras cheese at different period of ripening. T1 represented the original sensory characteristics, and showed superiority in all sensory characteristics over the rest of the treatments. The pantalets acceptance of the cheese samples increased with the ripening of the cheese. T3 was the closest to the control in sensory traits, followed by T4, while cheese made from pasteurized milk without starters T2 was poor in its sensory traits. Some results are in the same trend was recorded by **(EL-Neshawy *et al.*, 1984)**, who mentioned that the Ras cheese made from pasteurized milk without starters are very poor in the organoleptic characteristics.

Table 5. Organoleptic properties of Ras cheese at ripening

Treats	Storage time	Flavor (45)	Body and Texture (40)	Appearance (10)	Color (5)	Total (100)
T 1	Fresh	43.0^{ab}	38.66^{ab}	9.56^{a}	5.0^{a}	96.33^{ab}
	60 days	44.0^{a}	39.61^{a}	9.23^{ab}	5.0^{a}	98.00^{a}
	120 days	44.0^{a}	39.60^{a}	9.66^{a}	5.0^{a}	98.33^{a}
	180 days	44.6^{a}	39.66^{a}	9.66^{a}	5.0^{a}	99.00^{a}
T 2	Fresh	30.3^{g}	29.00^{d}	9.30^{ab}	4.6^{ab}	73.33^{h}
	60 days	33.3^{f}	29.33^{d}	9.30^{ab}	4.6^{ab}	76.66^{g}
	120 days	35.0^{ef}	30.66^{d}	9.56^{a}	5.0^{a}	80.33^{f}
	180 days	36.6^{de}	33.66^{c}	9.56^{a}	4.6^{ab}	84.66^{e}
T 3	Fresh	40.0^{c}	30.33^{d}	9.00^{ab}	5.0^{a}	84.33^{e}
	60 days	40.0^{c}	33.66^{c}	9.33^{ab}	4.6^{ab}	87.66^{cde}
	120 days	41.3^{bc}	38.00^{ab}	9.33^{ab}	4.3^{abc}	93.00^{b}
	180 days	41.6^{bc}	37.66^{ab}	9.66^{a}	4.6^{ab}	93.66^{b}
T 4	Fresh	37.6^{d}	36.66^{b}	8.00^{bc}	4.0^{bc}	86.33^{cde}
	60 days	37.33^{d}	37.33^{ab}	9.00^{ab}	4.6^{ab}	88.33^{cd}
	120 days	37.0^{d}	36.33^{b}	7.66^{c}	4.6^{ab}	85.66^{de}
	180 days	40.6^{c}	37.66^{ab}	7.66^{c}	3.6^{c}	89.66^{c}
LSD at 0.05		1.764	2.106	1.200	0.720	3.202

Means in a column that are not followed by the same letter are significantly different ($p < 0.05$).

Conclusions

The results showed that there were no statistically significant differences between treatment 1 and 3 in the sensory characteristics of interest to the consumer, which indicates the possibility of producing Ras cheese from pasteurized milk, which is similar in its sensory characteristics to Ras cheese made in the traditional way from raw, unpasteurized milk.

FUNDING:

This research did not receive any funding

CONFLICT OF INTEREST:

The authors declare that they have no conflict of interest.

AUTHORS CONTRIBUTION

The authors confirm contribution to the paper as follows: study conception and design: Mohamed Nour-Eldin Farid Hamad, Sherif Mohamed El-Kadi and Shymaa Al Esawy Ibrahim Esawy; data collection: Mohamed Nour-Eldin Farid Hamad, Sherif Mohamed El-Kadi and Shymaa Al Esawy Ibrahim Esawy; analysis and interpretation of results Mohamed Nour-Eldin Farid Hamad, Sherif Mohamed El-Kadi and Shymaa Al Esawy Ibrahim Esawy ; draft manuscript preparation: Mohamed Nour-Eldin Farid Hamad, Sherif Mohamed El-Kadi and Shymaa Al Esawy Ibrahim Esawy. All authors reviewed the results and approved the final version of the manuscript.

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تطوير طريقة لصنع جبن الراس من الحليب المبستر

الملخص العربي:

في هذا البحث، جرت محاولة لاستخدام عدد من البادئات لتصنيع جبن راس له خصائص حسية مماثلة للجبن الراس التقليدي. كانت الفروق بين المعاملات في التركيب الكيميائي طفيفة، مع تفوق المعاملة 4 في نسبة الدهون على أساس الوزن الجاف في نهاية فترة التسوية، حيث بلغت 50.13٪ تليها عينة الجبن الكنترول 49.24٪ بعد 180 يوم من التسوية. كان لفترة التسوية تأثير واضح على تكوين النيتروجين غير البروتيني (NPN) والنيتروجين القابل للذوبان (SN)، حيث زادت نسبتهما مع بزيادة فترة التسوية. وتراوح النيتروجين غير البروتيني بعد 180 يومًا من النضج من 0.405 في T2 إلى 0.681 في T3. بينما تم تسجيل أعلى محتوى نيتروجين قابل للذوبان 0.778 (SN) في T4 في نهاية النضج. أظهرت النتائج تقارب المعاملتين 3 و4 في الخصائص الحسية مع الجبن الكنترول. أظهرت T1 وT 2 و T3 نتائج متقاربة في تحليل تقدير صفات القوام، بينما سجلت T4 أعلى قيمة لمؤشر التماسك والصمغية والقابلية للمضغ (0.52 و 4013 و 2930 على التوالي). كان الجبن المصنوع من الحليب المبستر بدون بادئات أقل الخصائص الحسية.

الكلمات المفتاحية: الجبن الراس- البادئات- لاكتوباسلس – استربتوكوكس – الجبن الرومى.