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# QUALITY ENHANCEMENT OF RAS CHEESE WITH SODIUM CHLORIDE AND / OR POTASSIUM CHLORIDE

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**ABSTRACT:** *Ras cheese was made by the traditional method from a mixture of buffalo's and cow 's milk. The resultant cheese was chemically, microbiologically and sensory evaluated during ripening (90 d.). The results indicated that moisture, fat, fat in dry matter, soluble nitrogen, soluble nitrogen coefficient, total volatile fatty acids, soluble tyrosine and soluble tryptophane of fresh Ras cheese decreased significantly with the decrease of fat levels in cheese milk. However, acidity, salt, salt in serum, total nitrogen and total protein increased significantly in fresh Ras cheese with the decrease of fat levels in cheese milk. By prolonging the ripening period, moisture content decreased significantly. In contrast, acidity, salt, salt in serum, fat, fat in dry matter, total nitrogen, total protein, soluble nitrogen, soluble nitrogen coefficient, soluble tyrosine, soluble tryptophane and total volatile fatty acids increased significantly for all treatments. It is obvious that the use of different fat levels in cheese milk had no observable effect on the numbers of total bacterial count, lactic acid bacteria, as well as the psychrotrophic, proteolytic bacteria and yeasts & molds which found in the resultant fresh Ras cheese. On the other hand, population of these microorganisms increased during the ripening period up to fourth week then decreased up to the end of ripening period. In general, no tested samples of the resultant cheese were rejected by the consumers.*

**KEYWORDS:** Ras Cheese, Quality Enhancement, Sodium Chloride, Potassium Chloride

## INTRODUCTION

Ras cheese (Cephalotery type) is considered the most popular hard cheese in Egypt, which has a great acceptance by the Egyptian and Arabian consumers. This cheese made from cow's milk or a mixture of cow's and buffalo's milk. Ras cheese is normally consumed after a ripening period of 4 months. This period gives a fully ripened product (El-Sayed *et al.*, 1993). Sodium chloride is widely used as a preservative and flavoring agent in food and dairy products, particularly in cheese. High sodium intake has been claimed to be a major contributor to development of hypertension and cardiovascular diseases (Abernathy, 1979). The total daily intake of salt by North American consumer was estimated to range from 10 to 12 g. It has been recommended that to minimize the risk of hypertension, the daily intake of salt should be reduced to 8 g per day ( Institute of Food Technologists, I F T, 1980).

Any substitute for NaCl used in food products must satisfy the criteria that it is functional, at least in part, and does not sacrifice product safety. Finding a substitute for NaCl is difficult because of its unique pure salty taste and flavor enhancing property. Various salts have been evaluated as substitutes for sodium chloride. These include potassium chloride, magnesium chloride, calcium chloride, ammonium chloride and lithium chloride; each of these has its drawbacks. In spite of its inherent bitter taste, KCl has been the most widely and successfully used partial replacement for sodium chloride. It has been reported that use of herbs, spices,



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and organic acid may reduce or eliminate the need for salt in some processed foods (Reddy and Marth, 1991). The balance between potassium and sodium in the body is very important for proper physiological functions. Therefore, the ratio of potassium to sodium should be considered when evaluating the rate of Na in diet. Some studies had supported a theory that increased intake of KCl can reduce the blood pressure of hypertensive patients even in the presence of excess NaCl (Gooda et al., 2000). Hence, the present study was undertaken to determine and characterize how far cheese made with sodium chloride and / or potassium chloride was acceptable by consumers.

## MATERIALS AND METHODS

### Cheese Milk.

A mixture of cow's (Jersey) and buffalo's milk was used to manufacture Ras cheese. Milk was obtained from the herd of the Faculty of Agriculture, Assiut University.

### Rennet.

Local commercial liquid calf rennet obtained from local market, was added to cheese milk in an amount required to coagulate unsalted milk within 40- 45 minutes at 35 °C .

### Salt.

Clean good grade of cooking salt was used to manufacture Domiati cheese.

### Starter.

Pure cultures of *Streptococcus thermophilus* 14486, L*actobacillus delbrueckii sub.sp.bulgaricus* 11842 and *Lactobacillus casei sub. sp. casei* 393 were used.These cultures were supplied by the American Type Culture Collection (ATCC).

### Wax .

Commercial fine grade paraffin and bee wax were obtained from the local market in Assiut, Egypt.

### Calcium Chloride .

Fresh solution of 40% calcium chloride was prepared and 1 ml was added to each 2 kilograms of heated milk to give a final concentration of 0.02 percent .

### Ras Cheese Manufacture.

Ras cheese was made from cow's milk. The milk was heated momentarily to 72 ° C and the procedure suggested by Abdel Tawab (1963 ) for Ras cheese making was followed.

The following treatements were used

1- Control ( 4%fat and 2% salt NaCl ).



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2- 4 % fat and 2 % salt (NaCl + KCl 1:1 in molar basis ).

3- 4 % fat and 2 % salt (NaCl + KCl 2:1 in molar basis ).

4- 4 % fat and 2 % salt ( KCl ).

The experimental cheese was soaked in potassium sorbate solution (0.66% w/ v) for one minute in an attempt to prevent surface growth of molds according to Bohme et al. (1996).

**Cheese Analysis:**

Titratable acidity, moisture, soluble nitrogen were determined according to A.O.A.C. (1990). Salt content of cheese was estimated as described by Pearson (1975). The fat content of cheese samples was estimated as described by Agarawella and Sharma (1961). The total nitrogen content of cheese samples was measured by Kjeldahl method adopted by Rowland (1938). Total volatile fatty acids were determined by the distillation method described by Kosikowski (1966). All values are expressed as ml. 0.1 N NaOH /100 g. cheese. Soluble tyrosine and tryptophane content of cheese were determind spectrophotometrically according to the method of Vakaleris and Price (1959)

Total bacterial count was determined using plate count agar as described by the Manual of Microbiological Methods (1957). The colonies of proteolytic bacteria were enumerated on skim milk agar media. The respective colonies exhibiting clear zones on skim-milk agar were identified as described by Ewings et al. (1984). Yeasts and molds in cheese samples were counted on potato dextrose agar medium at pH 3.5 with adding an antibiotic (Deibel and Lindquist, 1981). Lactic acid bacteria in cheese samples were counted using MRS (DeMan, Rogosa, Sharpe) medium according to Marshall (1992). Psychrotrophic bacteria in cheese samples were carried out as described for the standard plate count except incubation of plates were at 7 $\pm$ 1 for 10 days (Vedamuthu et al., 1978 ).After plate counts were obtained, averages were calculated, and results are given as the $\log_{10}$ of such values. Sodium and potassium were measured in the cheese extract by the Flame-photometry method according to Jackson (1967).

Statistical analysis for the obtained data was carried out using the Statistical Analysis System (SAS, 1988).

Organoleptic properties of variantly examined cheese samples were checked by five different dairy technologists as well as by more than 10 normal consumers, using the 100 mark-system (El-Gazzar, 1979 & 1983).

## RESULTS AND DISCUSSION

### Cheese Moisture

Results in table (1) indicate that the moisture content of treatment 3 (cheese milk 2%fat and 2% salt (NaCl: KCl 1:2) was the highest, compared with the other treatments, followed by those of treatment 1, treatment 2 then treatment 4. From the obtained results, it could be observed that the moisture content of all cheeses decreased significantly ($P < 0.01$) as the ripening period progressed. These results are in agreement with those Reddy and Marth (1993 a, b and c), (1994) and (1995 a).



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**Cheese Acidity**

The titratable acidity of fresh Ras cheese made with substitution of sodium chloride by potassium chloride are given in table (1). It was noticed that samples of the treatment 2 had the highest acidity at the beginning and during ripening, followed by treatment 3, and 1 (control). It could be also observed that the acidity increased significantly ($P < 0.01$) throughout the ripening period for all treatments. This could be due to the growth of starter bacteria throughout the ripening period. These results are in agreement with those of Salem and Abeid (1997) and Gooda et al. (2000).

**Fat Content**

Fat determinations of cheese made with substitution of sodium chloride by potassium chloride are given in table (1). The samples of treatment 2 had the highest fat content in the fresh cheese and along its ripening period, compared with the other treatments, followed by those of treatment 4, 3 then treatment 1 (control). From the obtained results, it could be observed that the fat content increased significantly ($P < 0.01$) for all the treatments. These results are in agreement with those of Fitzgerald and Buckley (1985),

Data in table (33) and figure (29) show that substitution of sodium chloride by potassium chloride had no effect on the fat content in dry matter. From the obtained results, it could also be noted that the fat content in dry matter was not affected throughout the ripening period. These results are in harmony with those Reddy and Marth (1993 a, b and c), (1994) and (1995 a).

**Salt Content in Cheese and Serum**

Data in table (1) indicate that salt content of fresh Ras cheese decreased with the decrease of the substitution rate of sodium chloride by potassium chloride. From the obtained results, it could be also observed that the samples of treatment 1 had the highest salt (NaCl) content in the fresh cheese and along its ripening period, compared with the other treatments, followed by those of treatment 2 then treatment 3. From the obtained results, it could be also observed that the samples of treatment 4 had the highest salt (KCl) content in the fresh cheese and along its ripening period, compared with the other treatments, followed by those of treatment 3 then treatment 2. It could be also observed that the salt content increased throughout the ripening period for all the treatments. These results are in agreement with those of Fitzgerald and Buckley (1985) and Salem and Abeid (1997).

Table (1) show that the salt content in serum of fresh Ras cheese made with the substitution of sodium chloride by potassium chloride decreased significantly ($P < 0.01$) with the decrease of the substitution level of sodium chloride by potassium chloride. The samples of treatment 1 had the highest salt content in serum in the fresh cheese and along its ripening period, compared with the other treatments, followed by those of treatment 4, 3 then treatment 2. From the obtained results, it could be also observed that the salt content in serum increased significantly ($P < 0.01$) throughout the ripening period for all the treatments. These results are in agreement with those of Reddy and Marth (1993 a, b and c), (1994) and (1995 a and b).

**Total Volatile Fatty Acids**

Total volatile fatty acids (TVFA) content of cheese made with substitution of sodium chloride by potassium chloride are presented in table (1). It is evident that the total volatile



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fatty acids (TVFA) content of cheese decreased significantly ($P < 0.01$) with the decrease of substitution level of sodium chloride by potassium chloride. From the obtained results, it could be also observed that the samples of treatment 1 had the highest total volatile fatty acids (TVFA) content in the fresh cheese and along its ripening period, compared with the other treatments, followed by those of treatment 3, 2 then treatment 4. During ripening period the total volatile fatty acids (TVFA) content increased significantly ($P < 0.01$) for all the treatments. These results are in harmony with those of Salem and Abeid (1997).

**Nitrogen Content**

Table (2) indicate that the total nitrogen of Ras cheese made with substitution of sodium chloride by potassium chloride. It was noticed that samples of the treatment 3 had the highest total nitrogen at the beginning and during ripening, followed by treatment 2, 4 and treatment 1 (control). During ripening period the total nitrogen content increased significantly ($P < 0.01$) for all treatments. These results are in agreement with those of Aly (1995) and Salem and Abeid (1997).

Table (2) show that the protein content of cheese made with the substitution of sodium chloride by potassium chloride. It is evident that samples of the treatment 3 had the highest total protein at the beginning and during ripening followed by treatment 2, 4 and treatment1 (control). From the obtained results, it could be also observed that total protein content increased significantly ($P < 0.01$) for all the treatments. These results are in harmony with those of Fitzgerald and Buckley (1985).

**Soluble Nitrogen and Soluble Nitrogen Coefficient**

The soluble nitrogen content (SN) is taken as an index for cheese protein proteolysis during ripening. It is commonly calculated as per cent of total nitrogen (SN/TN%).It is obvious from table (2) that the samples of treatment 1 had the highest soluble nitrogen content (SN) in the fresh cheese and along its ripening period, compared with the other treatments, followed by those of treatment 4, 3 then treatment 2 . It could be also noted that the soluble nitrogen increased significantly ($P < 0.01$) throughout the ripening period for all the treatments. These results are in harmony with those of Gooda et al. (2000).

Data in table (2) show that samples of treatment 1 had the highest soluble nitrogen coefficient (SN / TN %) in the fresh cheese and along its ripening period, compared with the other treatments, followed by those of treatment 4, 2 then treatment 3 . From the obtained results, it could be also observed that the soluble nitrogen coefficient increased significantly ($P < 0.01$) for all the treatments. Confirmatory to these results were also obtained by Aly (1995) and Salem and Abeid (1997).

**Soluble Tyrosine and Soluble Tryptophane**

Data in table (2) show that the samples of treatment 4 had the highest soluble tyrosine in the fresh cheese and along its ripening period, compared with the other treatments, followed by those of treatment 2, 3 then treatment. On the other hand, the soluble tyrosine increased significantly ($P < 0.01$) for all the treatments. Confirmatory to these results were also obtained by Ramadan (1995). Results in table (2) show that the samples of treatment 1(control)) had the highest soluble tryptophane in the fresh cheese and along its ripening period, compared with the other treatments, followed by those of treatment 4, 2 then treatment 3. From the obtained results, it could be also observed that the tryptophane



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increased significantly (P < 0.01) for all the treatments. These results are in agreement with those of by Ramadan (1995).

**Sodium and Potassium Content**

Data in table (3) show that the sodium content of fresh Ras cheese decreased significantly (P < 0.01) with the increase of the substitution rate of sodium chloride by potassium chloride. The samples of treatment 1 had the highest sodium content in the fresh cheese and along its ripening period, compared with the other treatments, followed by those of treatment 2, 3 then treatment 4. On the other hand, the sodium content increased significantly (P < 0.01) for all the treatments. Confirmatory to these results were also obtained by Reddy and Marth (1993 a) and (1994).

Table (3.) indicates that potassium content of fresh Ras cheese increased significantly (P < 0.01) with the increased substitution of sodium chloride by potassium chloride. The samples of treatment 4 had the highest potassium content in the fresh Ras cheese and along its ripening period, compared with the other treatments, followed by those of treatment 3, 2 then treatment 1. From the obtained results, it could be also observed that the potassium content increased significantly (P < 0.05) throughout the ripening period for all the treatments. These results are in agreement with those of Reddy and Marth (1993 a) and (1994).

Data in table (3) show that sodium / potassium (Na / K) content of fresh Ras cheese decreased significantly (P < 0.01) with the increased substitution rate of sodium chloride by potassium chloride. The samples of treatment 1 had the highest sodium content in the fresh cheese and along its ripening period, compared with the other treatments, followed by those of treatment 2, 3 then treatment 4. Furthermore, it could be also observed that the sodium / potassium (Na / K) content increased significantly (P < 0.05) for all the treatments. Confirmatory to these results were also obtained by Fitzgerald and Buckley (1985)

**Table 1. Composition of low salt Ras cheese made with sodium chloride and / or potassium chloride during ripening period.**

| Treatments | Ripening Period (wk) | Moisture % | Acidity % | Salt % | Salt in Serium % | Fat % | Fat / D.M % | TVFA |
|---|---|---|---|---|---|---|---|---|
| 1-Cheese milk 4% fat and 2% salt (control) | Fresh | 39.51 | 0.72 | 4.15 | | 32.33 | 53.50 | 15.50 |
| | 2 | 38.00 | 0.81 | 4.35 | | 33.00 | 53.26 | 24.83 |
| | 4 | 37.10 | 1.05 | 4.75 | | 33.50 | 53.29 | 53.17 |
| | 8 | 36.25 | 1.22 | 4.77 | | 34.17 | 53.61 | 68.83 |
| | 12 | 34.82 | 1.29 | | | 35.00 | 53.71 | 82.83 |
| 2-Cheese milk 4%fat and 2% salt (NaCl : KCl 1:1) | Fresh | 38.23 | 1.17 | | | 32.67 | 52.89 | 15.83 |
| | 2 | 37.24 | 1.26 | | | 33.67 | 53.65 | 27.50 |
| | 4 | 36.63 | 1.33 | | | 34.83 | 54.97 | 41.83 |
| | 8 | 35.72 | 1.38 | | | 35.17 | 54.71 | 62.17 |
| | 12 | 34.55 | 1.68 | | | 36.00 | 55.00 | 70.17 |
| 3-Cheese milk 2%fat and 2% salt (NaCl: KCl | Fresh | 39.34 | 1.23 | | | 32.33 | 53.31 | 16.83 |
| | 2 | 38.56 | 1.34 | | | 33.33 | 54.26 | 26.17 |
| | 4 | 37.48 | 1.56 | | | 33.83 | 54.12 | 42.83 |
| | 8 | 36.42 | 1.71 | | | 34.33 | 54.01 | 63.17 |



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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1:2 ) | 12 | 35.40 | 1.86 | | | 35.17 | 54.44 | 81.17 |
| 4-Cheese milk 4%fat and 2% salt (KCl) | Fresh | 37.85 | 1.23 | | | 32.67 | 52.57 | 16.17 |
| | 2 | 36.81 | 1.29 | | | 33.67 | 53.28 | 23.83 |
| | 4 | 35.99 | 1.44 | | | 34.33 | 53.64 | 41.51 |
| | 8 | 35.22 | 1.62 | | | 35.17 | 54.28 | 61.50 |
| | 12 | 34.02 | 1.84 | | | 36.00 | 54.56 | 69.17 |

**Table 2. Protein content of low salt Ras cheese made with sodium chloride and / or potassium chloride during ripening period.**

| Treatments | Ripening Period (wk) | T.N% | T.P % | S.N % | S.N / T.N % | Soluble Tyrosine | Soluble Tryptophane |
|---|---|---|---|---|---|---|---|
| 1-Cheese milk 4% fat and 2% salt (control) | Fresh | 2.23 | 14.80 | 0.42 | 18.13 | 18.26 | 16.21 |
| | 2 | 2.65 | 16.89 | 0.49 | 18.35 | 45.48 | 25.29 |
| | 4 | 2.94 | 18.76 | 0.56 | 19.05 | 70.67 | 47.38 |
| | 8 | 2.94 | 18.69 | 0.66 | 22.60 | 95.55 | 64.22 |
| | 12 | 3.20 | 20.42 | 0.80 | 24.89 | 141.44 | 84.34 |
| 2-Cheese milk 4%fat and 2% salt (NaCl : KCl 1:1) | Fresh | 2.32 | 14.80 | 0.33 | 14.09 | 19.93 | 16.90 |
| | 2 | 2.78 | 17.72 | 0.43 | 15.38 | 46.31 | 23.34 |
| | 4 | 2.94 | 18.76 | 0.52 | 17.63 | 75.01 | 46.26 |
| | 8 | 3.07 | 19.59 | 0.64 | 20.79 | 98.01 | 63.35 |
| | 12 | 3.20 | 20.44 | 0.74 | 23.11 | 140.05 | 78.57 |
| 3-Cheese milk 2%fat and 2% salt (NaCl: KCl 1:2 ) | Fresh | 2.32 | 14.80 | 0.32 | 13.67 | 22.85 | 18.28 |
| | 2 | 2.84 | 18.10 | 0.42 | 14.83 | 47.31 | 25.00 |
| | 4 | 2.98 | 19.03 | 0.51 | 17.24 | 65.00 | 45.18 |
| | 8 | 3.11 | 19.86 | 0.65 | 21.03 | 103.65 | 62.38 |
| | 12 | 3.25 | 20.74 | 0.75 | 23.00 | 139.47 | 77.26 |
| 4-Cheese milk 4%fat and 2% salt (KCl) | Fresh | 2.32 | 14.80 | 0.33 | 14.19 | 19.46 | 19.38 |
| | 2 | 2.66 | 16.95 | 0.45 | 16.90 | 45.26 | 25.05 |
| | 4 | 2.90 | 18.48 | 0.57 | 19.83 | 70.20 | 48.27 |
| | 8 | 3.07 | 19.59 | 0.68 | 22.16 | 99.92 | 63.88 |
| | 12 | 3.25 | 20.74 | 0.76 | 23.27 | 147.06 | 80.59 |


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**Table 3. Sodium and Potassium Content of low salt Ras cheese made with sodium chloride and / or potassium chloride during ripening period.**

| Treatments | Ripening Period (wk) | Sodium | Potassium | Sodium /Potassium |
|---|---|---|---|---|
| 1-Cheese milk 4% fat and 2% salt (control) | Fresh | 6.46 | 0.26 | 25.07 |
| | 2 | 5.91 | 0.24 | 24.64 |
| | 4 | 5.85 | 0.23 | 25.47 |
| | 8 | 5.64 | 0.22 | 25.68 |
| | 12 | 5.48 | 0.20 | 27.44 |
| 2-Cheese milk 4%fat and 2% salt (NaCl : KCl 1:1) | Fresh | 4.15 | 1.37 | 3.03 |
| | 2 | 3.82 | 1.34 | 2.85 |
| | 4 | 3.79 | 1.32 | 2.87 |
| | 8 | 3.78 | 1.27 | 2.98 |
| | 12 | 3.69 | 1.17 | 3.16 |
| 3-Cheese milk 2%fat and 2% salt (NaCl: KCl 1:2 ) | Fresh | 3.82 | 1.80 | 2.12 |
| | 2 | 3.65 | 1.77 | 2.06 |
| | 4 | 3.59 | 1.74 | 2.07 |
| | 8 | 3.52 | 1.69 | 2.08 |
| | 12 | 3.45 | 1.67 | 2.06 |
| 4-Cheese milk 4%fat and 2% salt (KCl) | Fresh | 2.15 | 4.26 | 0.47 |
| | 2 | 1.77 | 4.16 | 0.43 |
| | 4 | 1.62 | 3.11 | 0.52 |
| | 8 | 1.49 | 3.04 | 0.49 |
| | 12 | 1.42 | 2.89 | 0.49 |

**Microbial Content**

The results presented in table (4) show that the total microbial count in the fresh Ras cheese salted with sodium chloride and/ or potassium chloride for all the treatments was nearly similar. During the ripening period, total bacterial count of all cheese treatments increased gradually up to the second week of ripening period, then decreased slightly up to the end of the ripening period. This decrease was 1.89 order of magnitude at the end of the ripening period (12 weeks) for treatment one. Values for treatments two, three and four were 1.64, 1.88 and 2.25, respectively. These results are in harmony with those of Reddy and Marth (1993 c) and Aly (1995).

Table (4) shows also that the count of lactic acid bacteria for all treatments in the fresh Ras cheese was somewhat similar. It could be seen from these results that the substitution did not affect the lactic acid bacterial count of fresh Ras cheese. As ripening period extended, the lactic acid bacterial count increased gradually up to the second week of ripening period, then decreased slightly up to the end of ripening period. This decrease was 2.06 order of magnitude at the end of the ripening period for treatment one. Values for treatments two,



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three and four were 1.94, 1.83 and 2.24, respectively. These results are similar to those of Reddy and Marth (1993 c) and (1995 a)

From the obtained results, it could be also observed that psychrotrophic bacterial count of Ras cheese salted with sodium chloride and/ or potassium chloride was nearly similar for all the treatments. Treatment 1 (Cheese milk 4%fat and 2% salt) had the highest psychrotrophic bacterial count followed by treatment 2 (Cheese milk 4%fat and 2% salt (NaCl: KCl 1:1), treatment 3(Cheese milk 2%fat and 2% salt (NaCl: KCl 1:2*)*, then treatment 4(Cheese milk 4%fat and 2% salt (KCl)). However, psychrotrophic bacterial count of all cheese treatments increased gradually up to the fourth week of ripening period, then decreased slightly up to the end of ripening period. This decrease was 0.57 order of magnitude at the end of the ripening period for treatment one. Values for treatments two, three and four were 0.65, 0.89 and 0.78, respectively.

Results in table (4) show that the proteolytic bacterial count of Ras cheese salted with sodium chloride and/ or potassium chloride was nearly similar. Treatment 2 (Cheese milk 4%fat and 2% salt (NaCl: KCl 1:1) had the highest Proteolytic bacterial count, followed by treatment 1 (Cheese milk 4%fat and 2% salt), treatment 3(Cheese milk 2%fat and 2% salt (NaCl: KCl 1:2*)*, then treatment 4(Cheese milk 4%fat and 2% salt (KCl)). However, proteolytic bacterial count increased gradually up to the fourth week of ripening period, then decreased slightly up to the end of ripening period. This decrease was 1.43 orders of magnitude at the end of the ripening period for treatment one. Values for treatments two, three and four were 1.22, 0.78 and 1.15, respectively.

Furthermore, it could be also observed that the count of molds and yeasts of fresh Ras cheese salted with sodium chloride and/ or potassium chloride detected after the second weeks of ripening. During the ripening period yeasts and molds increased in all the investigated treatments. These results are similar to those of Aly (1995) and Reddy and Marth (1995 a).

**Organoleptic Properties.**

Data presented in table (5) show that the organoleptic properties of Ras cheese when fresh and after 1, 2, and 3 months old. Cheese made with 2% salt (NaCl) was the best, either when fresh cheese or ripened. In contrast, cheese made with 2% salt (KCl) had the lowest scores among the investigated treatments. However, cheese made with 2% salt (NaCl + KCl 1:1 in molar basis) and 2% salt (NaCl + KCl 2:1 in molar basis) was nearly similar. By prolonging the ripening period, the total grades of treatments one, two, three and four were 91, 87, 84 and 75, respectively. In general, no tested samples of the resultant cheese were rejected by the consumers.


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**Table 4. Microbial content of low salt Ras cheese made with sodium chloride and / or potassium chloride during ripening period.**

| Treatments | Ripening period in weeks | Microbial count C.F.U / g of cheese (log $_{10}$ ) | | | | |
|---|---|---|---|---|---|---|
| | | Total bacterial count | Lactic acid bacteria | Psychrotrophic bacteria | Proteolytic bacteria | Yeasts and Molds |
| 1-Cheese milk 4% fat and 2% salt (control) | Fresh | 7.54 | 7.17 | 4.74 | 6.77 | ( - ) |
| | 2 wk. | 7.65 | 7.24 | 5.34 | 7.21 | ( - ) |
| | 4 wk. | 6.69 | 6.54 | 5.57 | 6.17 | 1.31 |
| | 8 wk. | 6.47 | 6.39 | 4.23 | 5.91 | 2.84 |
| | 12 wk. | 5.65 | 5.11 | 4.17 | 5.34 | 4.07 |
| 2-Cheese milk 4%fat and 2% salt (NaCl : KCl 1:1) | Fresh | 7.55 | 7.39 | 4.34 | 6.91 | ( - ) |
| | 2 wk. | 7.74 | 7.59 | 5.23 | 7.44 | ( - ) |
| | 4 wk. | 6.87 | 6.69 | 5.53 | 6.69 | 1.95 |
| | 8 wk. | 6.74 | 6.65 | 4.34 | 6.31 | 3.17 |
| | 12 wk. | 5.91 | 5.47 | 3.69 | 5.69 | 4.34 |
| 3-Cheese milk 2%fat and 2% salt (NaCl: KCl 1:2 ) | Fresh | 7.95 | 7.74 | 4.23 | 6.69 | ( - ) |
| | 2 wk. | 7.72 | 7.38 | 5.39 | 7.11 | ( - ) |
| | 4 wk. | 6.95 | 6.69 | 5.44 | 6.31 | 1.47 |
| | 8 wk. | 6.74 | 6.34 | 4.17 | 6.17 | 3.32 |
| | 12 wk. | 6.07 | 5.91 | 3.34 | 5.91 | 3.69 |
| 4-Cheese milk 4%fat and 2% salt (KCl) | Fresh | 7.72 | 7.49 | 4.17 | 6.47 | ( - ) |
| | 2 wk. | 7.92 | 7.74 | 5.57 | 7.34 | ( - ) |
| | 4 wk. | 6.84 | 6.74 | 5.66 | 6.74 | 1.91 |
| | 8 wk. | 6.65 | 6.34 | 4.23 | 6.25 | 3.34 |
| | 12 wk. | 5.47 | 5.25 | 3.39 | 5.32 | 4.17 |


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**Table 5. Organoleptic properties of low salt Ras made with sodium chloride and / or potassium chloride during ripening period.**

| Treatments | **Ripening period in weeks** | **Flavor (50)** | **Body & texture (40)** | **Appearance (10)** | **Total (100)** |
|---|---|---|---|---|---|
| 1-Cheese milk 4% fat and 2% salt (control) | **4** | **41** | **34** | **8** | **83** |
| | **8** | **43** | **36** | **8** | **87** |
| | **12** | **45** | **37** | **9** | **91** |
| 2-Cheese milk 4% fat and 2% salt (NaCl : KCl 1:1) | **4** | **40** | **32** | **8** | **80** |
| | **8** | **42** | **34** | **8** | **84** |
| | **12** | **43** | **36** | **8** | **87** |
| 3-Cheese milk 2% fat and 2% salt (NaCl: KCl 1:2 ) | **4** | **36** | **32** | **8** | **76** |
| | **8** | **38** | **33** | **9** | **80** |
| | **12** | **41** | **34** | **9** | **84** |
| 4-Cheese milk 4% fat and 2% salt (KCl) | **4** | **34** | **32** | **8** | **74** |
| | **8** | **35** | **32** | **8** | **75** |
| | **12** | **36** | **31** | **8** | **75** |

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**تحسين جودة جبن الراس منخفض الدهن**

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**تم تصنيع جبن راس بالطريقة التقليدية من خليط من لبن جاموسي ولبن بقري . وقد تم تقييم الجبن الناتج كيميائياً وميكروبيولوجياً و حسيا لكل من الجبن الطازج والمخزن لمدة 90 يوم. و أظهرت النتائج أنخفاض الرطوبة ، الدهن , الدهن في المادة الجافة ، النيتروجين الذائب ، معامل النيتروجين الذائب ، الاحماض الدهنية الطيارة ، التيروسين الذائب والتربتوفان الذائب انخفاضا معنويا في حين زادت الحموضة ، الملح ، الملح في السيرم ، النيتروجين الكلي والبروتين الكلي للجبن الراس الطازج زيادة معنوية بانخفاض نسبة الدهن في لبن الصناعة. كما لوحظ من النتائج أنه بتقدم فترة التسوية انخفض المحتوي الرطوبي للجبن انخفاضاً معنوياً في حين زادت الحموضة ، نسبة الملح ، نسبة الملح في السيرم ، نسبة الدهن ، النيتروجين الكلي ، النيتروجين الذائب ، معامل النيتروجين الذائب ، الاحماض الدهنية الطيارة ، التيروسين الذائب و التربتوفان الذائب زيادة معنوية. و أظهرت النتائج أن اختلاف نسبه الدهن في لبن الصناعة ليس له تأثير ملحوظ علي كل من العدد الكلى للبكتيريا , بكتريا حامض اللاكتيك ، البكتيريا التي تنمو علي درجة حرارة الثلاجة , البكتيريا المحللة للبروتين و الخمائر و الفطريات في الجبن الراس الطازج وكذلك زادت أعداد هذه الميكروبات بزيادة فترة التسوية حتي الاسبوع الرابع ثم انخفضت واستمر ذلك حتي نهاية فترة التسوية. وعموماً لم يتم رفض أي من عينات الجبن الناتجة والمختبرة بواسطة المستهلكين.**



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