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The Impact of Potassium Chloride Salt on the Properties of Caerphilly Cheese as Sodium Chloride Salt Substitute

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ABSTRACT

The association of dietary NaCl with arterial hypertension has led to a reduction in the levels of this salt in food and dairy products. For salting, Kcl has been used as a partial substitute for NaCl, without affecting product acceptability. In this study a sensually adequate saline solution was simultaneously diffused during salting of Caerphilly cheese in brine. Caerphilly cheese was made from mixtures of cow and buffalo milks (1:1) with added liquid rennet and starter (*Lactococcus lactis Sub.sp& Lactococcus lactic Sub.sp cremoris*. *biovar diacetyl lactis* and *leuconostoc pseudomesenteroides*). Dry salt was added at a level of 1% (w: w) of the wet curd. Brine constituting of 25% of only NaCl without salt substitutes as a control, and mixes of NaCl: Kcl (90:10, 80:20and 70; 30, respectively, were examined. Cheese brined by using NaCl: Kcl 70:30 characterized with higher scoring points of 84.8 and 89.2 %, either when fresh or during storage, compared with the control cheese, being treated with 100% NaCl, which gained the lowest scoring points of 70.5-74.4 %. Higher yield of 16.20 % was found in control cheese, compared with either cheese brined with NaCl: Kcl 70:30, which was of the lowest yield of 15.85%. Meanwhile, control treatment contained lower total bacterial counts, lactic acid bacteria and moulds and yeasts, compared with other treatments. Using only NaCl (without added substitutes) in the control treatment had a higher total solid, compared with other treatment. Brining by substituting 10, 20 and 30 % NaCl by Kcl was not markedly different from the traditional cheese salted with sodium chloride.

Keywords: Caerphilly cheese- salting – NaCl salt- Kcl salt

INTRODUCTION

Caerphilly, which originated in Wales, is a crumbly acid cheese. It is made from pasteurized cow milk using calf rennet and a mesophilic starter. The curds are heated to 32-34°C and held at this temperature for about 1 hr. The whey is drawn off and the curds are collected at the bottom of the vat, where rapid acid production occurs. Some dry salt (1%) is added to the curds before molding and pressing overnight. The pressed curds are then brine-salted for 24 hr and packaged. Caerphilly matures rapidly and is ready for sale after 10-14 days.

An alternative proposed by Rapacci (1989) is to substitute some of the NaCl by KCL in the cheese formulation. According to the same author, the substitution of up to 30% of the NaCl by KCL does not produce significant differences in sensorial, physical, and chemical properties ($p>0.05$) from traditional cheese salted with sodium chloride

MATERIALS AND METHODS

Chemical composition of mixed milk:

Cow and buffalo was obtained from the Dairy Department, Faculty of Agriculture, and Mansoura University. Chemical composition of mixed cow and buffalo milks (1:1) is indicated in Table (1)

Table 1. Chemical composition of mixed (cow: buffalo 1:1) milk

Chemical composition of Skim milk				
SNF%	**TP%**	**FAT%**	**Lactose%**	**pH**
7.41	2.79	5.10	4.10	6.57

Starter culture constituted of *Lactococcus lactis subsp lactis, lactococcus lactic subsp cremoris biovar diacetylactis and leuconstoc pseudomesenteroides* was used:

NaCl (kitchen salt) was bought from El-Nasser Company Alexandria, and KCl was obtained from Algomhorieh Company for chemicals at Mansoura city.

Cheese Making:

Milk was heat treated (65^{0}C /20 min), cooled at (30^{0}C), 1.5% starter culture was added, ripening for 45minutes at 32^{0}C. Addition of liquid rennet at 0.03% dilution fivefold with cooled potable water. After 45-60 minutes cutting the curd with vertical and horizontal knives was done after 45-60 minutes to form 6mm cubes, heating at 34^{0}C for 20-30 minutes till the curd get firm, allowing the curd cubes to settle in the vat., followed by draining the whey. Curd is then cut into conical piles at the corners and along the ides of the vat. After 15 minutes, piles are cut and pieces along the sides of the vat. Curd is then replied every 10minutes. Manual or coarse mechanical milling was applied when the pH of the whey reaches 0.20% lactic acid. Added 1% of wet curd by weight, followed by salting the curd, and filling it into 250mm diameter plastic moulds lined with plastic cheesecloth. For 20 littres of milk, two moulds are needed Initial light press was required to maintain the whey drainage .After 20 minutes, mould is removed from the press, cheese replace in mould and repress, this step repeated three times Each time pressure ii increased .Then press overnight at 100KPa.Demold cheese, and transfer to brine 25% salt bath and leave overnight, then removed from the brine, wash, and dry and vacuum pack store at 10^{0}C in the ripening room for two weeks.

Analytical Methods

Total solids, ash, fat, total protein, soluble protein, salt and acidity were determined according to Ling (1963), pH value was measured using laboratory PH meter with glass electrodes pH-meter Jan way 3010 – England ,salt as mentioned by kosikowski(1966) .

Total bacteria were enumerated using the melted media (Difco1971). Moulds and yeasts counts were determined using malt extract agar medium (Pitt1979).

Texture of cheese samples were evaluated using (Texture analyzer by CNS / FARNELLFRA, Borechamwoad, Hertfordsimre, England. Samples of control and experimental cheese were taken while fresh and after 14 days of storage. Cheese sample size was 30 mm of diameter and 20 mm of high. Dimension was 1 mm/ s and 10 mm was the distance of penetration. Samples were allowed to stand at ambient temperature for at least 20 min prior testing. The probe used was TA15-450C perplex cone. Data were collected on computer and the texture profile parameters were calculated from LFRA texture analyzer and computer interface.

The following texture profile parameters were obtained, and calculated as describe by Bourne (1978):

I) The compressive force (g) recorded at maximum compressive during in the first bite as a measure of Hardness
II) The ratio of the positive force area under the curve during the second compression (bite) to that during the first compression (a2/a1) as a measure of cohesiveness.
III) The height (mm) to which the sample recovered during the time that clasped between the end of the first bite the start of the second bite, as a measure of Springiness.
IV) The product of hardness X Cohesiveness (g), as a measure of gumminess.
V) The product of gumminess X springiness (g.mm), as a measure of chewiness.
VI) The modulus (the slope of force, representative of sample rigidity.

Organoleptic properties were evaluated by the score system flavor (40 points), body and texture (30 points) and appearance (30 points) according to Hassan (1996).

RESULTS AND DISCUSSION

Effect of type of salting on the physicochemical properties of cheese

The traditional trend of salting cheese using (NaCl) salt,which exerts harmful effect on hypertension. During the present work, therefore, was carried to attempt applying partial replacing of Na CL (without salt substitutes) with Kcl, by using KCl at10,20and 30 of total salt, compared with control of NaCl. Brining of cheese was carried out in saturated salt lasted for 24 hours .The four examined treatments, (i.e. A,(control made with only salt substitutes), B, 90:10, C,80:20, and D,70:30 NaCL; PCL, in the same order) of cheese were ripened at 10^0 C±2 C for 14 days .

Results indicated in Table (2) show that the acidity of the four cheese treatments gradually increased during the 14 days of storage. By increasing the added KCL concentration, the acidity also increased to 0.75, 0.85, 0.98 and 1.25 % for A, B, C and D treatments, respectively. It could also be found that the KCL is of little effect on the total microbial count, which relatively reflected on the acidity. The pH values took the opposite trend. Substituted Kcl with NaCl the acidity with an increase of the pH values. This present results came in harmony with those gained by El-bakry *et al*. (2010), who observed decrease in the pH of the examined cheese with the decrease of the using salt, however, it was not statistically significant. This effect in the present work might not be due to the types and of substituted salts used for making of cheese. Karagozlu *et al*. (2008) supported that pH of the white pickled cheese was not changed by the fully or partially replacement of sodium chloride with potassium chloride.

Regarding the total solid (TS) content of the tested treatment of cheese, it could be detected that all treatment increased in their contents of TS after 14 days of storage due to the continuous evaporation of moisture. On the other hand, an increase of added KCL resulted in decrease of the TS contents of the examined treatments. This might be due to the nature of potassium, which of less capacity to vivid with moisture:

Table 2. Effect of The Type of Salting on the physicochemical properties of cheese

Treatments	Storage period	A (control)	B (90:10)	C (80:20)	D (70:30)
Acidity	fresh	0.54	0.63	0.69	0.75
	14 days	0.79	0.85	0.98	1.15
pH	fresh	5.40	5.20	4.90	4.70
	14 days	5.10	4.90	4.50	4.10
TS%	fresh	48.50	48.10	47.80	47.10
	14 days	53.10	52.90	51.70	50.25
Fat%	fresh	25.70	25.50	25.20	25.10
	14 days	28.10	27.90	27.50	27.15
Fat/TS	fresh	52.98	53.01	52.71	53.29
	14 days	52.91	52.74	53.19	54.02
TP%	fresh	14.90	14.70	14.50	14.10
	14 days	16.20	15.90	15.50	15.15
TS/TP	fresh	30.70	30.56	30.33	29.90
	14 days	30.50	31.15	29.98	30.01
SP	fresh	0.75	0.80	0.85	0.95
	14 days	1.07	1.25	1.65	1.73
SP/TP	fresh	5.03	5.44	5.86	6.73
	14 days	6.60	7.86	10.64	11.16
Salt	fresh	1.80	1.65	1.55	1.50
	14 days	1.90	1.68	1.60	1.58
ASh	fresh	6.20	6.10	6.15	6.10
	14 days	7.30	7.32	7.35	7.25
Yield	fresh	16.20	16.15	16.08	15.85

Treatments A: Control without salt substitutes, B: 80% NaCL: 20%KCL & C: 70% NaCL: 30%KCL

Fat content of fresh cheese as shown in Table (2) ranged between 25.70 and 25.10%, the highest was detected in control cheese (without salt substitutes), while the lowest in the D treatment (70:30 NaCl: KCl) after 14 days of ripening. Fat content markedly increased, due to the increase in the total solids of cheese, but not as result of the presence of KCl in the brine. These results came in agreement with Al-Otaibi and other's (2006), which supported the results in this study. Replacing NaCl with KCl did not affect the fat content of the examined cheese. The present results also did not show any effect based on changing the type of salt from sodium chloride to potassium chloride. Fat/Ts content of cheese, on the other hand, was taken as a correct parameter, which was (52.98/5.91), (53.01/52.74), (52.71/53.19) and (53.29/54.02 %) for A, B,C and D treatments, in the same order, after 14 days of ripening. Similar results were also obtained by Stephen *et al*., (2000).

As with the soluble protein/total protein (SP/TP) content of the examined cheese, it increased in all variants after 14 days of storage, the apparent increase is owing to the increase in T.S of the tested cheese. SP/TP contents of cheese were were (30.7/30.5),(30.56/31.15),(30,33/29.98) and (29.9/30.07 %) for A,B,C and D treatments, respectively, after 14 days of ripening. No effect of KCl, however, was observed on the protein content of the Caerphilly cheese, which coincided with the results reported by Reddy and Marth's (1993), Katsiari *et al.* (1998) and Ayyash and Shah (2011c).

As with the soluble nitrogen (SN) and SP/TP, results observed in Table (2) show an increase in the SN contents of all of the tested variants of the cheese during 14 days of ripening period, due to the presence of the proteolytic activity of the mesophilic bacteria constituting the added

starter. It could also be cleared that the increase of added KCl led to an increase of SN content of cheese. KCL, on the other hand, little effect on the growth of microorganisms was detected, compared with NaCl. For comparison, SP/TP was taken as good indicator for the ripening index of the cheese .values of SP/TP were (5.03/6.60),(5.44/7.86),(5.80/10.64) and (6.73/11.64%) for A,B,C and D after 14 days of ripening, in the same order. The target is the higher ripening. the use of Kcl is preferable .

Result in Table (2) also show that Values of salt content were (1.80/1.90), (1.65/ 1.68), (1.55/ 1.60) and (1.50/1.55%) in fresh and 14 days old cheese, the same effects were observed in all treatments .

The highest ash content of different cheeses was observed owing to the salt content of cheese, since salt content was detected after cheese salting. As the storage period advanced, the ash content apparently increased .By the end of storage ash content it ranged between 6.20- 7.30%.

Yield of cheese is always the target of cheese producers. Data in Table (2) deals with the yield of fresh cheese. Yields of 16.20,16.11,16.08 and 15.85% were detected for A,B,C and D treatments, respectively The lowest decrease might be due to the concentration of used potassium chloride, the highest yield may also due to the high content of total solids in the admixture milk (cow : buffo 1:1). It is well known that Caerphilly cheese is always made from cow milk.

Results in Table (3) include the evaluation of some rheological properties of the examined cheeses when fresh and after 14 days of ripening.

Table 3. Effect of salting method on the rheological properties of Caerphilly cheese

Treatments	Storage period	A (control)	B (90:10)	C (80:20)	D (70:30)
Hardness	fresh	410	435	455	398
(g)	14 days	1334	1370	1099	1023
Adhesiveness	fresh	31.70	49.17	49.20	38.60
(g.mm)	14 days	173.40	110.76	114.50	85.71
Cohesiveness	fresh	0.46	0.53	0.52	0.50
(ratio)	14 days	0.43	0.46	0.45	0.32
Springiness	fresh	5.60	4.95	4.94	4.66
(mm)	14 days	5.78	4.20	4.25	4.24
Gumminess	fresh	193.64	240.00	245.00	238.80
(N)	14 days	605.00	508.00	365.00	335.00
Chewiness	fresh	1066.30	1136.26	1110.25	1115.20
(N)	14 days	2489.17	2164.55	2167.55	2155.70
Modulus	fresh	24.15	25.32	27.40	21.20
(g/mm)	14 days	78.60	80.29	81.18	69.18

Hardness:

Hardness is a measure of the amount of force required to compress the sample of the cheese and related to the strength of the cheese matrix, also it is defined as a force required attaining a given deformation. Data recorded in Table (3) show that the hardness of the all treated cheeses increased after 14 days of storage, treatments made by using 10 and 20 % Kcl markedly increased the hardness, followed by marked decrease even less than control cheese ,either when fresh or after 14 daysof ripening. The same trend was found in most of hard cheeses.

Adhesiveness:

Adhesiveness is the work required to pull cheese away from a surface (e.g., tongue, teeth, palate (Szczesniak *et al*. (1963) and Bourne (1978). On other word, adhesiveness or stickiness of the cheese defined as the work necessary to overcome attractive force between surface and materials that comes into contact. Results in Table (3) indicate that the adhesiveness increased after 14 days of ripening for all of the examined variants of cheese. Replacing NaCl by KCl increased the adhesiveness up to 20 %, and increasing the ratio between NaCl and KCl to 30 % decreased the adhesiveness. Pastorino *et al*. (2003b) stated that proteins interact with water, which might take place during ripening.

Cohesiveness:

Cohesiveness is the measure of foods internal bonds, on other words, it is the strength of internal bonds making up the body of the product greater the value, the greater the cohesiveness (Szczesniak *et al*. (1963) and Bourne (1978). From the results in Table (3) the ratio of cohesiveness decreased after 14days of storage for all treatments. Substituting 10% NaCl by Kcl increased the ratio, followed by slight decreased up to 30% of KCl. The variations in fat, protein, calcium content and the pH might have contributed to the differences in the cohesiveness of the cheese (Sunder and Upadhyay (1986).

Springiness:

Springiness is the rate at which a deformed material returns to its original shape on removal of the deforming force (Szczesniak *et al*. (1963) and Bourne (1978). Data in the Table (3) show that control cheese made with only salt was of the higher springiness after 14 days of ripening, while the presence of KCl led to decrease of the springiness of cheese. Slight decrease was noticed after 14 days of storage. These results came in agreement with Awed *et al*. (2005). Who observed continuous decrease in the springiness of Cheddar cheese during ripening.

Gumminess:

Gumminess is the energy required to disintegrate a semisolid food for swallowing (Szczesniak *et al*., (1963) and Bourne (1978). Marked increase in gumminess was observed during the ripening of all treatments. Replacing 10 and 20 % KCl instead of NaCl increased the gumminess, while replacing of 30% KCl decreases the gumminess, compared with 10and 20% KCl treatments.

Chewiness:

Chewiness is the energy required to chew a solid food product to a state where it is ready for swallowing (Szczesniak *et al*. (1963) and Bourne (1978). Similar trends of the results of gumminess by using 10 and 20 % KCl increased chewiness, while replacing with 30% KCl decreased the gumminess after 14 days. Gumminess markedly increased up to 20%, followed by decrease when 30 % KCl replaced Nacl in the fresh and 14 days cheese were (1066.30/2489.17),(1136.26/2164.55), (1140.25/ 2167.55) and (1115.70/2155.70) for A,B,C and D treatments, respectively.

Modulus (g/mm):

Modules values increased when 10 and 20 % KCl replaced NaCl, followed by slight decrease by using 30% KCl after 14 days of storage of all treatments, which showed an increase in modulus values.

Data belonging to microbial enumeration are shown in Table (4). Total microbial counts (TMC) markedly increased by replacing Kcl by NaCl in all treatments after 14 days. Total microbial counts considerably increased by replacing NaCl by Kcl. TMC increased after 14 days T.M.C reached 15,17,19and 20 *104 CFU/gm in Caerphilly cheese. It is well known that Kcl had less effect on the microbial growth, compared with sodium chloride. These obtained results came in agreement with *Kamleh et al.* (2012) in Halloumi cheese made with the potassium chloride (Kcl) as a salt replacer had higher total plate counts (TPC) than the sodium chloride (NaCl) salt replacer. Reddy and Marth (1993) also found that Cheddar cheese made with potassium chloride (Kcl) had higher total plate counts (TPC), compared to Cheddar cheese made with sodium chloride (NaCl). It could also be found significant effect of NaCl Kcl NaCl +KCl (El-Shibiny, 2007 and Bidlas & Lambert 2008).

Table 4. Effect of salting type on microbiological properties of Caerphilly cheese during storage.

Microbiological properties	Storage period	A (control)	B (90:10)	C (80:20)	D (70:30)
T.C*104	fresh	4	5	8	11
cfu/mg	14 days	15	17	19	20
L.A.B*104	fresh	5	6	7	9
cfu/mg	14 days	25	27	29	32
M.Y*104	fresh	ND	ND	ND	ND
cfu/mg	14 days	7	8	10	13

Regarding the lactic acid bacteria enumeration on MRS medium, it could be noticed the same trend observed in the results of total microbial count. Relatively higher number is owing to the use of active culture starters. , After14 days of ripening the numbers reached 25, 27,29and 30*104 C.F.U/per gram of cheese.

Fresh cheese was found completely free from the molds and yeasts, due to the applied heat treatment, which destroyed all of moulds and yeasts. After 14 days the number of colonies were 7,8,10 and 13 C..U/ gm of Caerphilly cheese, which might be gained entrance through the recontamination, as the cheese were not rubbed by KCl, which agrees with Bidlas and Lambert 2008 and Kamleh *et al*. 2012),). Furthermore, no colonies of coliform bacteria could be detected in the fresh cheese and after 14 days of ripening.

Organoleptic properties of fresh and matured cheese during 45 days:

Caerphilly cheese reference point out the consumption of cheese started after 14 days of storage and possibly ripening continue to but the desire of different consumers ,for this reason some cheese were left up to 45 days for sensory evaluation, on the other hand, Egyptian people search for old cheeses with sharp flavor.

The samples of cheese were offered to the ten trained judgers as unknown samples, the averages of their opinions were tabulated in Table (5).

As with the appearance, the judgers observed clean rind for all cheese, generally appearance of the four treatments increased as the ripening period advanced up to 30 days, followed by slight decrease for 45 day-old cheese. Increasing the Kcl led to increase of the scoring points of appearance. This might be due to the less evaporation of moisture, as compared with control cheese made with NaCl without salt substitutes. Scoring points ranged between 21 to 26 for fresh cheese and from 20.3 to 25.3, the highest was for 30% Kcl treatment.

Table 5. Effect of salting type on organoleptic properties of fresh and mature Caerphilly cheese during storage.

Organoleptic properties	Storage period	A (control)	B (90:10)	C (80:20)	D (70:30)
Appearance (30)	fresh	21.0	23.0	25.0	26.0
	14 days	22.0	25.0	24.4	25.0
	30days	23.0	23.8	25.7	24.9
	45 days	20.3	24.6	24.0	25.3
Body and texture (30)	fresh	23.0	25.0	25.0	27.0
	14 days	23.0	25.5	26.3	27.0
	30days	23.7	25.9	26.8	27.9
	45 days	24.5	26.0	27.0	28.5
Flavour (40)	fresh	26.0	28.7	30.2	31.8
	14 days	29.5	30.0	32.5	33.4
	30days	28.8	31.0	32.9	34.6
	45 days	29.5	31.4	33.0	35.4
Total (100)	fresh	70.5	76.7	80.2	84.8
	14 days	74.5	80.5	84.5	87.0
	30days	75.5	80.7	84.5	87.4
	45 days	74.3	82.0	84.0	89.2

Body and texture of the four treatments increased as the ripening period advanced, the highest scoring points were for kCl treatments. Higher scoring points were gaind after1 .It seems that Kcl led to improve body and texture of the cheese, which became softer, less hardness (Table 3). KCl led to decrease the hardness of the Caerphilly cheese.

As the ripening period advanced the flavour gained higher scoring points .luckely not bitter flavor was detected even with 30 %Kcl as the percentage of Kcl increased, the scoring points of flavor increased because of the salty taste by Nacl decreased and the flavor of cheese became more pronounced (Table 2). SP/TP increased as the KCl increased to 16 % for control cheese, 10% KCl ,20% KCl and 30% KCl treatments . Scoring points of fresh and 45 days of ripening were (26.0/29.5),(28.7/31.4),(30.2/33.0) and (31.8 and 35.4) out of scoring points . by the end of ripening period total scoring points were (70.5/74.3),(76.7/82.0), (80,2/84,0) and (84.8/89.2) scoring points for fresh and 45 days old cheese, respectively.

CONCLUSION

The highly evaluation of the ten well trained judgers for the 30% Kcl cheese refer to the possibility of replacing 30 %Kcl by NaCl .on the other hand the cheese is more healthy cheese, especially, by decreasing the hypertension. Infants will also accept this type of cheese since most of them dislike salty products. During this work KCl was bought under scientific chemicals, under industry scale possibly, to have low price/ good quality Kcl for food industry

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تأثير ملح كلوريد البوتاسيوم على خصائص الجبن الكيرفيلي كبديل لملح كلوريد الصوديوم

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ادي استخدام كلوريد الصوديوم في صناعة الجبن الي ارتفاع ضغط الدم الشرياني مما ادي الي التفكير في استخدام كلوريد البوتاسيوم كبديل جزئي مع كلوريد الصوديوم عند تمليح الجبن والذي لايمكن استبدالة بالكامل حتي لايؤثر علي جودة الجبن والمنتج النهائي وفي هذه الدراسة تم تصنيع الجبن الكرفيلى من خليط من اللبن الجاموسى والبقرى بنسبة (1:1) واضافة بدادئ يتكون من (*Lactococcus lactis subsp–lactococcus lactic subsp cremoris – biovar diacetyl lactis* and *leuconstoc pseudomesenteroides*) ثم ا اضافة المنفحة وتم تمليح الخثرة بنسبة 1% و تم استخدام محاليل تمليح مختلفة من كلوريد الصوديوم بنسبة 100% و كلوريد الصوديوم وكلوريد البوتاسيوم بنسب 10:90 و20:80 و30:70 ودراسة تاثيرهم علي خواص الجبن الكرفيلي الكيماوية والفيزيائية والريولوجية والميكروبيولوجية والحسية وكانت النتائج للجبن المصنع باستخدام كلوريد الصوديوم وكلوريد البوتاسيوم بنسبة 30:70 أفضل النتائج من حيث التقيم الحسى بنسبة 84,8 -89 % سواء في الجبن الطارج أوبعد 14 يوم مقارنة بالنسب الاخري من التمليح وكانت اقل النتائج في حالة الجبن المصنع باستخدام كلوريد الصوديوم بنسبة 100% وكانت كالتالي 74,2-70,5 % سواء في الجبن الطارج أوبعد 14 يوم .وكان الجبن المملح باستخدام كلوريد الصوديوم 100% أعلي في نسبة التصافي وكانت 16,20 %مقارنة بالجبن الاخري المملح باستخدامكلوريد الصوديوم وكلوريد البوتاسيوم واقلهم من حيث التصافى نسبة 30:70 وكانت التصافي 15,85 %. الجبن المملح باستخدام كلوريد الصوديوم احتوي علي اقل قيم من حيث العدد الكلي للبكتريا وكذلك بكتريا حمض اللاكتيك وكذلك الفطر والخمائر مقارنة بالجبن المملح باستخدام كلوريد الصوديوم وكلوريد البوتاسيوم وكانت أعلي قيم في حالة استخدام كلوريد الصوديوم والبوتاسيوم بنسبة30:70 . الجبن المملح باستخدام كلوريد الصويودم بنسبة 100% حصل علي أعلي النتائج بالنسبة للمواد الصلبة الكلية والدهن والبروتين والرماد ولكن الفروق ليست كبيرة بينها مقارنة بالجبن الاخري المملح باستخدام كلوريد الصوديوم وكلوريد البوتاسيوم .