EFFECTS OF DIFFERENT HEAT-TREATMENTS ON QUALITY OF WHITE PICKLED CHEESE[1]

BEYAZ PEYNİR ÜRETİMİNDE FAKLI PASTÖRİZASYON DÜZEYLERİNİN PEYNİR NİTELİKLERİNE OLAN ETKİSİ

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ÖZET: Bu araştırmada farklı pastörizasyon normları uyglanmış sütten üretilen beyaz peynirlerin bazı özellikerinde ısıl işleme bağlı olarak meydana gelen değişimler incelenmiştir. Bu amaçla peynire işlenecek çiğ süt dört kısıma ayrılmış ve; K örneği Kontrol (Çiğ süt) olmak üzere, A örneğine 68°C/10 d, B örneğine 75°C/5 d ve C örneğine 85°C/5 d süreyle pastörizasyon işlemi uygulanmıştır. K, A, B ve C örnekleri için sırasıyla 75, 73, 72 ve 70 l süt kulanılmıştır. Beyaz peynire işlenecek bütün pastörize sütlere % 0,02 oranında kalsiyum klorür ($CaCl_2$) ile % 1 oranında R-703 ticari kodlu D.V.S. (Dri-Vet-Set) starter kültür ilave edilmiştir.

Bu örneklerde depolamanın 0., 15., 30., 60. ve 90. günlerinde toplam kurumadde, yağ, tuz, titrasyon asitliği, pH, toplam azot, protein olmayan azot, uçucu yağ asitleri, penetrometre değeri ve toplam bakteri, maya-küf ve koliform organizma sayısı belirlenmiştir.

Ayrıca peynirlerin duyusal değerlendirmesi de yapılmıştır. Bu analiz sonuçlarından uyglanan farklı ısıl işlemlerin peynirlerin toplam kurumadde, yağ, tuz, titrasyon asitliği, pH, toplam azot, protein olmayan azot, uçucu yağ asitleri ve penetrometre değerleri üzerine etkisi, istatistiksel olarak önemli bulunmuştur.

SUMMARY: In the study effect of different heat-treatments of milk on some properties of White Pickled Cheese was investigated. Raw milk was divided into four parts as follows: Control (Raw milk) beyond this, A pasteurized 68°C/10 min, B pasteurized 75°C/5 min, C pasteurized 85°C/5 min. 75, 73, 72 and 70 l milk used for K, A, B and C respectively. Addition of 0.02 % $CaCl_2$ and inoculation of 1 % starter culture coded as R-703, al pasteurized milks processed to White Pickled Cheese.

In cheese samples total solid, fat, salt titratable acidity, pH, total nitrogen, non-protein nitrogen, volatile faty acids, penetrometer value and counts of yeast-mould, total bacteria and coliform group microorganisms were determined at 0.,15., 30., 60., 90 days of storage.

Furthermore organoleptic properties of cheeses were also evaluated From the results of those anlyses the effect of using different heat-treatments were found to be statistically significant on the total solids, fat, salt, titrable acidity, pH, total nitrogen, non-protein nitrogen, volatile fatty acids, penetrometer values.

INTRODUCTION

In white pickled cheese process pasteurization of milk is necessary because of hygientiy. Cheese produced from raw milk can be poisonous for human. It can also cause many diseases (WALKER at al., 1960; MARTH, 1969; TATINI at al.,1971). Not only pathogenic microorganisms but also great deal of microorganisms which cause unacceptable taste and flovour are destroyed by pasteurization. Thus, suitable medium for starter microorganisms, an increase in yield and uniformity of cheese can be obtained (PRICE, 1944; FOX, 1987).

When the pasteurization temperature is decreased to below 68°C, some spoilage microorganisms can be alive. When the pasteurization temperature is increased to above 74°C, the curd tension can decrease because of the denaturation of ß-lactoglobuline and interaction of ß-lactoglobuline K-casein (PLANCKH, 1971; HOOFI 1979). Taste and flavour defect can be also seen because of heat-treatment intensity (FRANKLIN and SHARPE, 1963; MELACHOURIS and TUCKEY, 1966).

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When cheese milk pasteurized between 60-85°C, the loss of proteins especially because of whey proteins denaturation,but yield increase (IKANOMOV et al., 1956; PENEV and PRODANSKI, 1962; MARTH, 1969; RAMOS, 1978; RAMAZANOV et al., 1979; GORELOVA et al., 1980; BIKASH and SINGH, 1990; LAU et al., 1990).

In some studies it is mentioned that intensive heat-treatment causes an increase in fat recovery (THEESE, 1971; VIOREL and GHINEA, 1982) but in some other studies there are opposite ideas (BIKASH and SINGH, 1990; LAU at al., 1990). Heat-treatment gives hydrophilic peculiarity to the cheese. Therefore moisture content of cheese is increased (GRIGOROV, 1970; TEESE, 1971; NAGUIB et al., 1974; GAMAL-EL-DIN and BALTADZHIEVA, 1976; GORELOVA et al., 1980; YOUSSEF et al., 1982; BIKASH and SINGH, 1990). Generally high temperature pasteurization causes some interactions between whey proteins moisture content and the crumbling peculiarity of cheeses increase (MELACHOURIS and TUCKEY, 1966; DAVIES et al., 1978).

During the ripening period, reological properties such as elasticity and strength of curd are affected by high pasteurization temperatures. Also the heat-treatment above 80°C increases this negative effect (DOLEZALEK et al., 1978; MARSHALL et al., 1978; PALUCH et al., 1990). But low pasteurization temperatures have no remarkable effect on these properties. In a study on Mozzarella cheese production, milk is pasteurized at 63°C and 71°C for 30 min. Raw milk is used as control. Cheeses produced from pasteurized milk have better flavour, than the control but their structure and texture are similar (BIKASH and SINGH, 1990). In an another study on Hrudka cheeses which are made from raw and pasteurized milk at 63-65°C/30 min., 72°C/20 sec. have beter flavour than the cheese which is pasteurized at 85°C/flash (KRCAL and PREKOPPOVA, 1987).

HOFI et al. (1969) studied on Ras cheese which is produced from raw milk and pasteurized milk at 82,2°C for 1 min. It is expressed that pasteurization slows down the lypolisis and decreases volatile fatty acids content of cheeses. The soluble protein content and sensory marks of the cheese which are produced from pasteurized milk are lower than the cheese which is produced from raw milk. Similar results are also found in other researches (PRICE and CALL, 1969): HOFI et al., 1975; LEILA et al., 1977; GAYA et al., 1990).

Shelf life of Hrudka cheese is inreased with the 72°C/flash pasteurization than chees made with raw milk and pasteurized at 63-65°C for 30 min. (PAPAJOVA, 1978). PERI and PAGLIARINI (1988) expressed that 75°C/20 sec. pasteurization increased shelf life of cheese. In addition to this it is observed that heat-treatment at 75°C is more suitable than the heat-treatment at 68°C and 78°C for the reological properties of Mozzarella (CAVALIERA et al. 1990).

MATERIAL and METHOD

Material

Cow milk was used as raw material in this white pickled cheese experiment.

Starter cluture which contained mesophilic homofermantative lactic acid bacteria (belong to the firm named Chr. HANSEN'S whose comercial code is R-703) was inoculated in order to develop the acidity and accelarate the ripening. After then coagulant (chymosine+pepsin) which was having 1/10000 power was added into the milk.

Calcium chloride ($CaCl_2$, Merck) was added to pasteurized milk in order to improve the coagulation capacity.

Method

Cheese production method

Some required treatments were applied to the milk and then raw material, was divided into four parts. The first part of milk was Control sample. The pasteurization wasn't applied to control samples. Second, third and forth parts of milk were pasteurized at 68°C/10 min., 75°C/5 min., 85°C/5 min. respectively.

After all parts of milk were cooled to 30±1°C, 1 % of starter culture and 0.02 % of calcium chloride ($CaCl_2$) were added to 2nd, 3rd and 4th parts. Fruthermore all parts were exposed to prematuration up to 8±1°SH. The amount of coagulant (chymosine+pepsin) was according to 1.5 hours coagulation.

After the coagulation of milk was completed, curd was cut into 1 cm^3 pieces. Filtering, pressure and portioning (dimensions of fresh cheese colud be 9x8.5x7 cm) were applied to curd respectively. Furthermore fresh cheese was kept in brine which was containing 14 % NaCl and 0.02 % $CaCl_2$ and had 13-15°C temperature. Thus pickled cheese put into tin boxes and then brine which had 12 % NaCl content was added.

Cheeses were ripened at 6±2°C. On the 1st, 15th 30th and 90th days of ripening period analyses were made.

Analysis methods

Dry matter, salt and titratable acidity of cheeses were determined according to Anonymous (1989); milk fat content was determined according to Gerber method (ANONYMOUS, 1978); also pH values were determined with pH-meter (Orion 420).

Total nitrogen (TN), water sluble nitrogen (WSN) and non-protein nitrogen (NPN) contents of cheese samples were determined according to GRIPON et al. (1975).

Volatile fatty acids were determined according to KOSIKOWSKI (1978).

Penetrometer values were determined by penetrometer Stanhope-Seta. In order to decrease the standard deviation 10 measurements were taken from top and bottom sides of the cheeses. It was measured as the depth of headgear which had 45° angle and penetrated for 5 second.

The amount of total bacteria, coliform organisms and yeast-mould was determined according to Harrigan and Mc Cance (1966).

Sonsory properties of cheese samples were appraised by 7 experts according to the rulers in Anonymous (1989).

Statistical Appraisement

The results we got,appraised according to simple variance analysis. In order to determine the different groups Duncan test was used (DÜZGÜNEŞ et al., 1987).

CONCLUSION and CONSULTATION

Some properties of white pickled cheeses which were produced from raw milk as control and pasteurized mik (at 68°C for 10 min. (A), 75°C for 5 min. (B), and 85°C for 5 min. (C) resp.) are present in Table 1. These measurements are taken from the 1st and 90th days of ripening period.

According to Table 1, heat-treatment at 68°C and at 75°C cause an increase in dry matter of cheeses. This increase is due to the whey protein denaturation, the interaction between whey proteins and casein decrease in loss of milk fat and protein with whey. Heat-treatment at 85°C for 5 min. (C) causes an increase in dimension of casein micelles and in water binding, capacity. As a result a decrease is noticed in A and B samples on the 90th day of ripening period. Effects of ripening and heat-treatment on dry matter are important from the statistical point of view ($p<0.01$).

Difference in fat contens of cheeses during 90th days of ripening is similar to the total dry matter contents (Table 1). Effects of heat-treatment and ripening on fat contents are also important from the statistical pint of view ($p<0.01$). The effect on fat in dry matter is also important at a level of $p<0.05$ statistically.

Pasteurization has destructive effect on microbiological content of cheeses. It has also an effect on salt/water ratio. Because of this, development is noticed when it is compared with control sample. Effects of heat-treatment and ripening on titratable acidity are important from the statistical point of view ($p<0.01$). On the 90th day of ripening, titratable acidity of all samples are different from each other at a level of $p<0.01$.

When we look at pH values during ripening period, sample C shows higher value than the others. Higher salt contents of C prevent excessive decrease of pH. As a result of statistical analyses, common effects of heat-treatment and ripening on pH-values are important at a level of $p<0.05$. HOFI et al. (1969) and NAGUIB et al. obtained similar results.

Total nitroen, water soluble nitrogen, non-protein nitrogen and ripening coefficient values are given at Fig. 1, 2, 3 and 4.

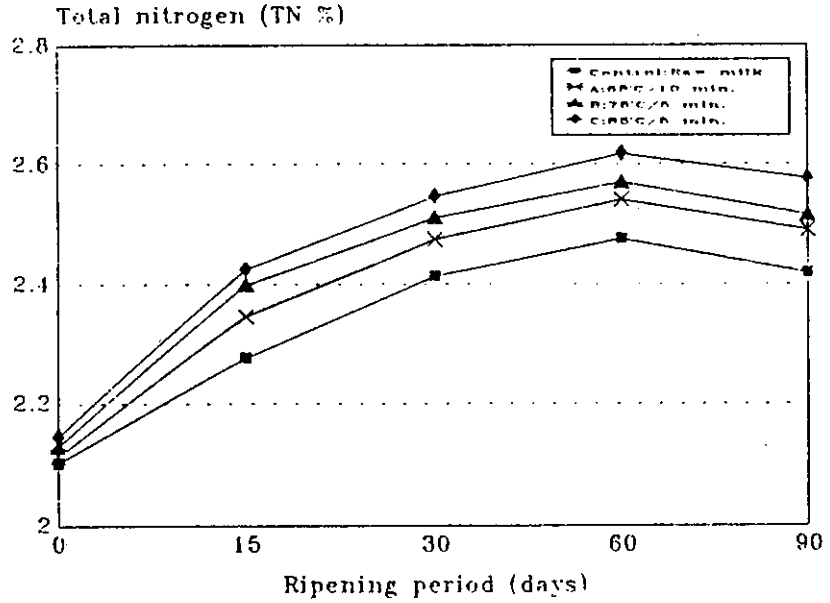

Fig. 1. Total nitrogen contents of the samples

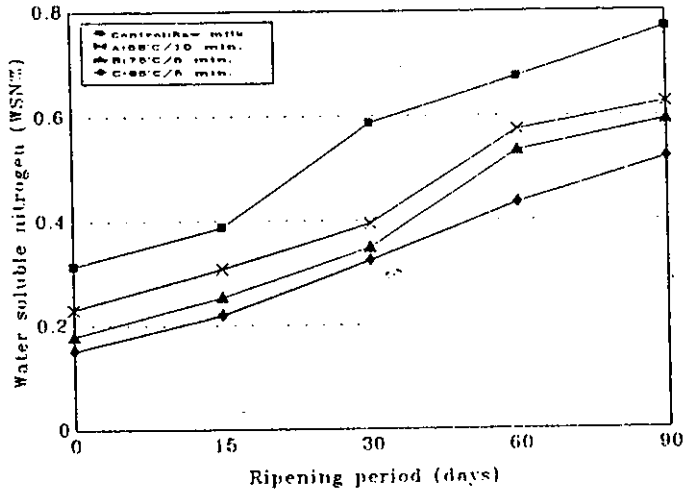

Fig. 2. Water-soluble nitrogen content of the samples

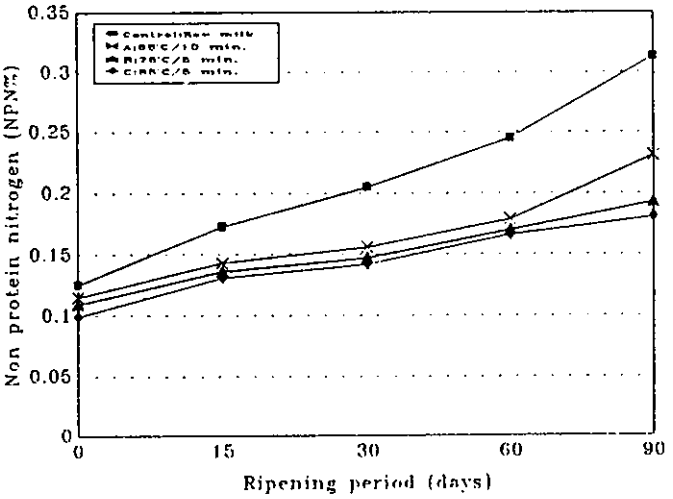

Fig. 3. Non-protein nitrogen contents of the samples

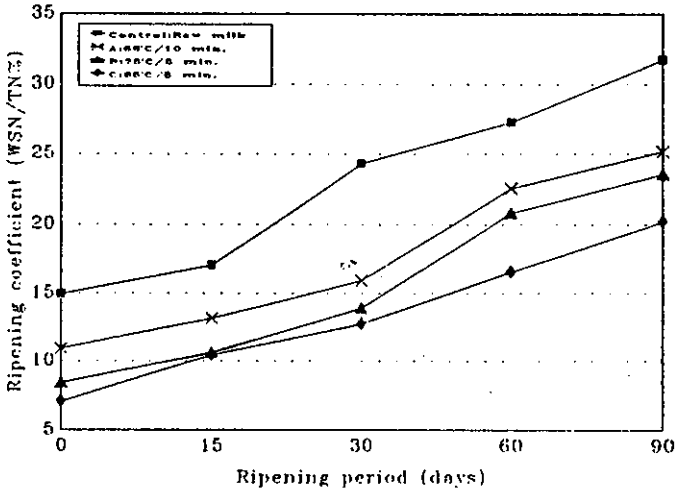

Fig. 4. Ripening coefficient values of the samples

When we look at Fig. 1. an increase in total nitrogen is noticed till the 60th day. After then decrease canbesen. This is due to the some nitrogenous substances which transport from cheese to brine. If we look at pasteurization temperatures during ripening period Control sample shows lowest TN content, C shows highest TN content. Similar results were obtained by HIFI et al. (1969), ABDOU and DAWOOD (1977) and LAU et al. (1990). It is expressed that total nitrogen content of C sample is due the amount of albumin and globulin recovery (PRICE, 1944; KINEZ, 1950). Effects of heat-treatment and ripening on TN ratio are important statistically ($p<0.01$).

As it is seen in Fig. 2, during storage there is a remarkable increase in WSN ratio which is accepted as asign of proteolysis. Rapid proteolysis rate is determined in control sample. On the other hand this proteolysis rate is very slow in sample C (85°C/5 min.) during storage. This situation can be explained by the effect of pasteurization on the moisture and salt content of the cheese. Also it is explained by the inhibition effect of pasteurization on Str. lactic and Str. diacetillactis (RASIC, 1962). In addition to this, effects of these two factors (pasteurization, storage) on WSN ratio are also important ($p<0.01$).

Table 1. Some properties of cheese samples ($n^{(1)}=2$)

Qualities	Ripening	Samples[2]			
		Control	A	B	C
Total dry matter (%)	1st day	39.31	42.25	41.32	38.94
	90th day	42.49	46.65	47.68	44.97
Milk fat (%)	1st day	16.50	17.75	17.00	16.25
	90th day	19.75	22.50	23.25	21.00
Milk fat/dry matter (%)	1st day	41.97	42.01	41.14	41.73
	90th day	49.48	48.25	48.76	46.69
Titratable acidity Lactic acid (%)	1st day	1.12	1.07	1.05	1.05
	90th day	1.59	1.54	1.48	1.45
pH values	1st day	4.65	4.70	4.68	4.72
	90th day	4.18	4.21	4.25	4.26
Salt content (%)	1st day	4.45	4.62	4.78	5.26
	90th day	5.68	6.66	6.86	7.40

(1) Repetition number

(2) Samples: Control: Raw milk, A: 68°C/10 minb, B: 75^{d}C/5 min., C: 85°C/5 min.

The variation of NPN contents of Control, A, B and C samples are shown in Fig. 3, during ripening, Control has highest value of NPN, there isn't an important difference between A, B and C samples statistically. Common effect of heat-treatment are the decrease of ripening coefficient and the increase of pasteurization temperature. These effects are important at a level of $p<0.01$.

When we look at Fig. 5, it is clear that heat-treatment has reducing effect on development of volatile fatty acids like nitrogenous fractions.

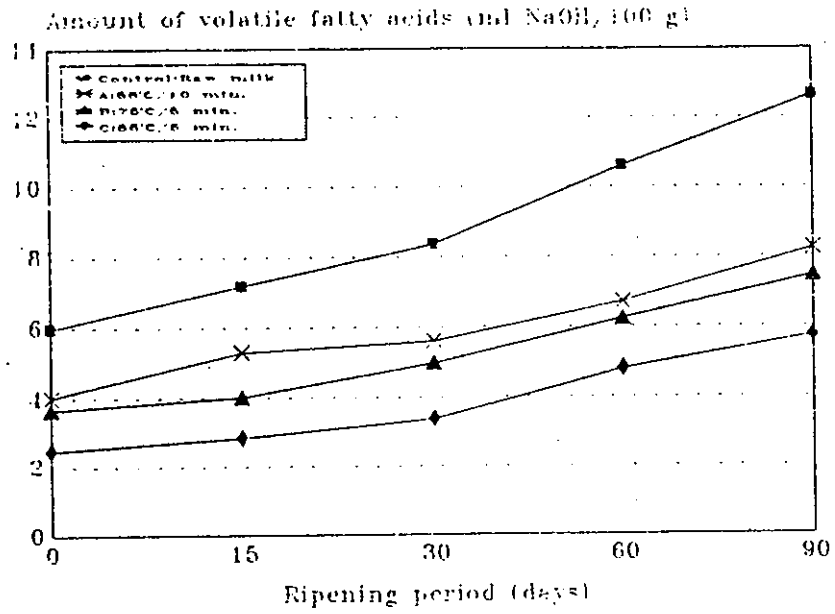

Fig. 5. Volatile fatty acid values ofthe samples

Control samples has the highest value whereas C has the lowest value. In another study which is similar to this one, continuous but a little increment is determined in volatile fatty acids known as an indicator of fat hydrolysis depends on pasteurization (LEILA et al., 1977). Effect of heat-treatment and ripening on volatile fatty acids are important statistically ($p<0.01$).

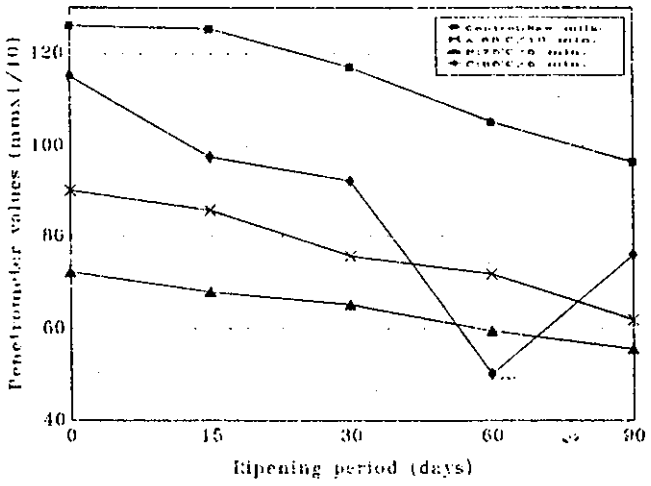

Fig. 6. Penetrometer values of the samples

Penetrometer values of samples which are indicator of texture and ripening time are shown in Fig. 6. Penetrometer values of all samples decrease during storage. In other words an increase in strength of cheeses is noticed. At the beginning and at the end of storage, B (75°C/5 min.) shows hardest structure. Sample B is followed by A.C and Control samples respectivelly. A rapid decrease in C on the 60th day and an increment was determined on the 90th day of storage. This situation is related to the effect on intensive heat-treatment over 80°C on water binding capacity of curd. It causes disorder structure. Also Marshall et al. (1978) explained that higher temperature caused a decrease in tightness of curd. Heat-treatment and ripening affect penetrometer values as a level of $p<0.05$.

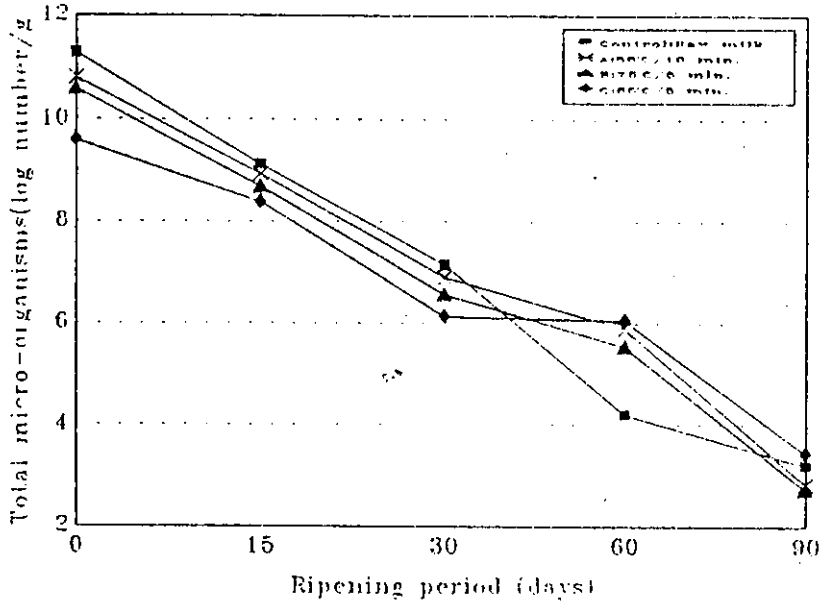

Fig. 7. Total microorganism contents of the samples

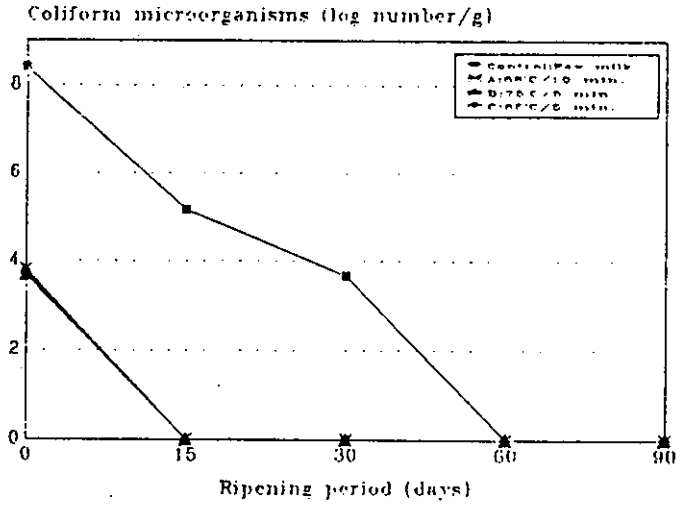

Fig. 8. Coliform microorganism contents of the samples

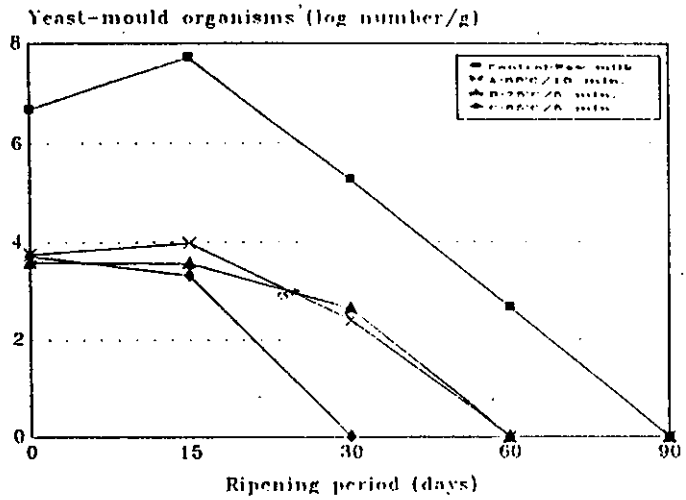

Fig. 9. Yeast-mould organism contents of the samples

Microbiological properties of all samples are shown in Fig. 7, 8 and 9. As it is seen in Fig. 7 total bacteria content of Control sample is higher than the content of heat-treated samples on the 30th day of ripening. On the 60th day of ripening a decrease in total bacteria content is noticed because of the tree months ripening neither coliform bacteria nor yeast and mould are determinated in cheese samples. Existence of coliform bacteria and yeast-mould at the beginning of the storage is due to the contamination during cheese manufacture.

Sensory properties of cheeses which were produced from raw milk (Control) and three different heat-treated milk (A, B, C) were started to be determined on the 30th day of the ripening (Table 2). According to table, sensory points belong to all samples are low. Control sample got the lowest point. All sensory ponits decreased during the storage. Structure, smell, taste and total point of A (68°C/10 min.) are the highest on the 30th day of ripening. B (75°C/5 min.) has the highest point on the 60th and 90th dayys of ripening.

The results of sensory properties are similar to the other studies. For example LEILA et al. (1977) determined that the body and textural properties of Baby Edam cheeses which were produced from pasteurized milk (at 77°C) had the best body and textural properties. Cavaliera et al. (1990) expressed that organoleptic properties of Mozzarella cheeses which were pasteurized at 75°C had the better organoleptic properties than the cheeses which were pasteurized 68°C and 78°C on the 0, 15th, 30th, 60th and 90th days of storage but sensory properties were begun to be determined on the 30th day of the storage.

It was found that the effects of heat-treatment on dry-matter, fat, titratable acidity, pH, salt, total nitrogen, water soluble nitrogen, non-protein nitrogen, volatile fatty acids and penetrometer values were (tightness of curd) important statistically.

It was determined that heat-treatment reduced proteolysis and typolisis.

Sample B (75°C/5 min.) got the highest sensory point on the 60th and 90th days of ripening. When we examine all these pasteurization norms we can say that 75°C/5 min. pasteurization is advisable for white pickled cheese manufacture.

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