

INFLUENCE OF SALTING METHOD ON THE QUALITY OF EDAM CHEESE

M.A. El-Batawy^{*}; Wedad A. Metry^{*}; M.A. Zedan^{**} and H.S.M. El-Tawel^{**}

** Dairy Science Department, Faculty of Agriculture at Fayoum, Cairo University, Egypt. ** Food Technology Research Institute, Agricultural Research Center, Giza, Egypt.*

SUMMARY

Pasteurized cows' milk was used for manufacturing of Edam cheese. Four treatments of salting were applied as follows: Fresh cheese was salted by immersion in a NaCl solution 20 – 25 % at 10 -12 ° C for 48 hr (control). Three treatments were carried out by adding dry salt to the wet curd by the ratio of 2 , 3 and 4 % (w/w) respectively. Resultant cheese was ripened at 10 - 12 ° C and 85 -90 % relative humidity for three months. Yield, biogenic amines (histamine, cadaverine, tryptamine, tyramine and putrescine), maturation indices , rheological , chemical and organoleptic properties were investigated during ripening

Edam cheese salted by adding 2 % dry salt showed higher yield (%), moisture (%) and titratable acidity (TA %) than other treatments either in fresh or during the ripening , cheese pH showed an opposite trend of T.A . In control cheese (brined) fat, total nitrogen and salt contents were higher than in the other treatments but it contained the lowest values of biogenic amines content at 90 days of ripening . Water soluble nitrogen, non protein nitrogen and total volatile fatty acids were high in cheese salted by adding 2 % dry salt followed by that of 3 %, 4 % and control one at all ages of cheese ripening. On the other hand, adding dry salt to the wet Edam cheese curd led to decrease of hardness and springiness along the gumminess and chewiness, while cohesiveness increased . It could be recommended that good quality Edam cheese could be obtained by adding dry salt in the curd (at the rate of 3% w/w) followed by that salted by 4% dry salt .

Key words : Edam cheese, biogenic amines, yield gumminess, chewiness, springiness and hardness.

Proc. The 9th Egyptian Conf. for Dairy Sci. & Tech. "Milk and Dairy Products for a Healthy Future", Dokki, 9-11 October (2004), Cairo, Egypt

INTRODUCTION

In cheese making salting process is considered one of the main steps that determines the quality of the product . Besides controlling the biological activities and subsequently , cheese ripening , salt imparts to the cheese of specific taste boasting its palatability to the consumer .In general , proteins are the main structural component in cheeses and the rheological properties of the protein matrix depend on the presence of free water , fat particles and salt (Innocente *et al.*,2002).

Protein hydrolysis is a fundamental process in cheese during ripening , it is of great importance to the development of the characteristic flavour and texture (Visser, 1993) .

Investigations have shown that salt has a major influence on cheese proteolysis (Thomas and Pearce , 1981 ; Kristiansen *et al.*,1999 and Sihufe *et al.*,2003) .Varying the salt contents in the cheese influences the bacterial activity , ionic strength and may results conformational change not only in the enzymes but also in the casein especially hydrolysis of B- casein (Kristiansen *et al.*,1999). The traditional method used for salting Edam cheese is by immersing fresh cheese (after it pressed overnight) in brine solution (22 – 25 % strength and pH 5.75-5.85) at 10 – 12 ° C for 2 – 3 days . Anywise this method takes long time , further more , absorption of salt decreased with increasing size and surface area of cheese depending upon the shape of cheese , its diameter and weight (Vujicic 1962) .On the other hand,El- Batawy *et al .*(1992) reported that Ras cheese salted by wet – curd salting obtained the highest score , while the brined cheese had the lowest scoring points .The effect of salting method on Edam cheese until now , still without any attempt to research , in spite of the chief role of NaCl in cheese ripening .

Therefore , the aim of this work is to study the effects of using wet curd salting method at different rates of salt on the quality of cheese compared with that of traditional salting method (brine) of Edam cheese .

MATERIALS AND METHODS

Materials

Raw milk:

Fresh raw cows' milk was obtained from the herd of a private farms at El – Fayoum district.

Influence of salting method on Edam cheese

Starter culture:

Starter culture was obtained from Hansen Laboratories (Denmark). This starter consists of lyophilized cultures of *Lactococcus lactis* subsp. *cremoris*, *Lactococcus lactis* subsp. *Lactis* and *Lactococcus lactis* subsp. *Diacetylactis*.

Rennet:

Calf rennet powder (HALA) was obtained from CHR – Hansen's Lab, Denmark.

Sodium chloride:

Commercial edible grade sodium chloride was obtained from El – Nasr company for salt, Alexandria, Egypt.

Methods

Cheese making procedure:

Edam cheese was made from cows' milk adjusted to 0.7 casein / fat ratio by the traditional method of Scott (1998). Fresh cheese was salted by the brining method (control). The other three treatments were salted by adding dry salt to the wet curd at the rate of 2%, 3% and 4% in treatments A, B and C respectively. Resultant cheese of the 4 trials were coated with plastic coat and cured at 10 – 12 °C and 85 – 90 % relative humidity for three months. The chemical, rheological and organoleptic characteristics were estimated at different intervals during ripening. Biogenic amines content were determined at 90 days of ripening period. All experiments were reported in triplicates.

Compositional analysis:

Fat (%), moisture (%), salt (%), total nitrogen (TN%), water soluble nitrogen (WSN%) and non protein nitrogen (NPN%) were estimated in cheese samples according to the method described by Ling (1963). pH was measured using a digital pH meter model SA720 (Orion U.S.A.). Total volatile fatty acids (TVFA) were determined by the distillation method as described by Kosikowski (1966).

Biogenic amines:

Cadaverine, histamine, putrescine, tyramine and tryptamine were extracted and determined according to Ayesh *et al.* (1995) and Naguib *et al.* (1995).

Textural properties:

Textural properties such as cohesiveness, gumminess, hardness, chewiness and springiness of cheese were measured with an Instron Universal machine (model 1195, Instron Corporation, Canton, M.A., U.S.A.) by the method of Yang and Toranto (1983).

Cheese scoring :

Samples from fresh and ripened Edam cheese (30 , 60 and 90 days) were scored for organoleptic properties according to scoring sheet suggested by El-Kenawy (1977) . The evaluation was carried out by staff members at Department of Dairy Science , Faculty of Agriculture at Fayoum , Cairo University .

RESULTS AND DISCUSSION

Cheese yield and chemical composition :

The changes in yield (%), moisture (%), salt (%), titratable acidity (TA%) and pH of Edam cheese during ripening as affected by the methods of salting are presented in Table (1) . The yield and moisture content of cheese resulted from different treatments were in the following order : 2% dry salt > 3% dry salt > 4% salt > control .The yield and moisture content of all treatments decreased gradually with the increase of ripening period up to 90 days. These results are in agreement with those obtained by Duzrec and Zall (1982)El-Demerdash (1996) and El-Sisey (2002) .

The same Table showed that both salt % , salt/moisture % and TA % increased upon progressive ripening. Similar data were recorded by El-Shibiny *et al.*, (1998), El-Sheikh *et al.*, (1999) and El-Sisey (2002). It can be seen that control Edam cheese contained higher salt % than other treatments at different ages of cheese, followed by that salted by 4%, while the lowest salt % and salt/moisture % was observed in 2% dry salt one at all ripening periods.

The titratable acidity of the 4 treatments showed the following order: 2% > 3% > 4% dry salt added > control (brined cheese) at the all ripening intervals . This may be due to moisture content that showed the same order . In all treatments, the cheese TA increased with extending storage and the rate of increase was being slightly greater in early stages of ripening.

Also, the data revealed that there was general drop in the pH of all trials during the first month then gradually increased during the ripening period . Such decrease in pH of a premature cheese is mainly due to the developed lactic acid from lactose fermentation, however, the gradual increase observed during ripening could be attributed to a further breakdown of lactic acid forming other organic acids such as acetic, propionic and formic acids that producing organic salts when associated with the bases as well as to increase of amino bases through protein degradation upon advanced ripening (Hefnawy, 1977 and El -Batawy 1979).

Influence of salting method on Edam cheese

Edam cheese salted by adding 3% dry salt showed similar pH values of that obtained with the control cheese. Similar trend of TA and pH values in semi-hard cheese reported by Kristiansen *et al.*, (1999).

Data shown in Table (2) cleared that fat %, dry matter %, fat/dry matter % and total volatile fatty acids progressively increased with the advancement of ripening. The rate of increasing seemed proportional to the moisture decreasing. Fat % calculated on dry matter basis, indicate that there were no remarkable differences between the different treatments throughout the ripening period. Similar results of fat and fat/Dry matter of Edam cheese were recorded by Nasr *et al.*, (1992); El-Shibiny *et al.*, (1998) and El-Sisey (2002).

The total volatile fatty acids content of all treatments increased gradually throughout the ripening period (Table 2). These findings were in agreement with those reported by Zaki and Salem (1992); El-Shibiny *et al.*, (1998) and El-Sisey (2002).

It was clear that the treatments with 2 and 3 % dry salting showed higher values for TVFA than the control and 4 % dry salt treatments .

Nitrogen content and proteolytic activity :

The total nitrogen (TN%), water soluble nitrogen (WSN%) and non protein nitrogen (NPN%) contents of Edam cheese made by different salting methods are tabulated in Table (3). The TN% of Edam cheese produced from different treatments markedly increased during the progressive cheese ripening. However the TN % showed an opposite trend of moisture . Similar trend of TN in Edam cheese was reported by El-Sheikh *et al.*, (1999) and El-Sisey (2002).

As shown in the same table WSN % and NPN % of Edam cheese was affected by using different salting methods . Cheese made from cows' milk and salted with 2% dry salt in the curd showed the highest WSN% followed by that salted with 3 and 4% dry salt , while control Edam cheese showed the lowest WSN % and NPN % at any interval of ripening period. This indicate that WSN% and NPN% took the same trend of moisture content . The increasing of cheese moisture usually decreasing salt and salt in cheese moisture (in vis-vera) and consequently the water activity will be lower and proteolytic enzyme activities were limited with lower moisture and higher salt content (Geurts *et al.*, 1980) .

The degree of ripening expressed as WSN/TN and NPN/TN as shown in Table (3) indicated that WSN/TN and NPN/TN ratios showed similar trend of WSN and NPN . The ratios of WSN/TN and NPN/TN increased markedly during the first 60 days, followed by slight increase between 60 and 90 days. These data insure that the use of dry salt in the curd at the low rate (2%) showed higher WSN/TN and NPN/TN which meaning that more acceleration of cheese ripening than the traditional salting method.

Biogenic amines content

Table (4) show the biogenic amines content (tryptamine, histamine, putrescine, cadaverine and tyramine) of Edam cheese made by different salting methods at 90 days of ripening. Results indicated that added dry salt to Edam cheese curd at the rate of 2% had the highest content of total biogenic amines at 90 days of ripening, followed by that of 3%, while that salted by brining method (control) had the lowest content of biogenic amines. It can be seen that the increase of biogenic amines content related to the higher moisture and the lower salt of cheese that effect on the rate of protein hydrolysis .

Tryptamine was absent in control cheese and found in traces in the other treatments. The highest histamine content was found in the cheese salted by 2% in the curd, while the lowest was in control cheese. Furthermore cadaverine showed the highest level of biogenic amines in all treatments either when fresh or during the ripening period , while tryptamine level was the lowest . Similar trends of biogenic amines content in Ras cheese by Mehanna *et al.*, (1989) and Tawfik *et al.*, (1992).When compared the obtained data with the limits of biogenic amines permissible in foods human consumption it could be noticed that Edam cheese made by different salting methods recorded values less than the permissible limits.

Textural properties

Textural quality of cheese can be determined by measuring the quantifiable rheological properties of cheese in terms of hardness, cohesiveness, springiness, gumminess and chewiness .Table (5) reveal the changes in the textural properties of Edam cheese made by different salting methods. It is clear that all the textural properties gradually increased until the 60 days of ripening then decreased at the 90 days. This could be mainly due to proteolysis of casein to compounds that are very soluble in water and that do not contribute to the protein network responsible for the cheese rigidity.For this reason, the cheese softens during maturation . Similar results in semi-hard cheese (Tybo Argentino cheese) was reported by Norac *et al.*, (1992) and in Cheddar cheese by Kanawjia and Singh (1996). For all treatments , there are an opposite trend between hardness and moisture content. Therefor control cheese had the lowest moisture content and the highest hardness & springness during all stages of ripening , while the treatment (A) showed the lowest values . Similar results were obtained by Bhaskaracharya and Shah (1999). Edward *et al.*, (1984) who reported that there is a close relationship between the hardness of full-matured Edam cheese and the decrease in moisture content during ripening .

The differences observed in springiness and cohesiveness values may be attributed to amount of protein matrix present and its strength. The later being dependent on factors such as moisture, salt, fat and in particular the mineral content of the cheese (Lawrence *et al.*, 1983 and Innocente *et al.*, 2002).

Influence of salting method on Edam cheese

Fredrick and Dulley (1984) have reported that the decrease in springiness of Cheddar cheese related with increase in proteolysis during ripening.

The progressive significant increase in gumminess (a product of hardness and cohesiveness) and chewiness (a product of hardness and springiness) until 60 days could be attributed to progressive increase in the hardness, cohesiveness and springiness, then decreased at 90 days of ripening in both of gumminess and chewiness. This may be due to direct relation between textural profiles like hardness, springiness and chewiness to ripening period (Fredrick and Dulley, 1984 and Kanawjia and Sing, 1996)

Organoleptic properties

The organoleptic properties of Edam cheese from different treatments and corresponding score are presented in Table (6). It is clear that the score of colour, appearance, body & texture and flavour increased gradually during ripening period. Furthermore, the treatment C (3% dry salting) showed the highest scoring values, while the treatment B (2% dry salting) has the lowest values. Both the control cheese and treatment E (4% dry salting) showed nearly the same values of scoring.

From the previous results, it was concluded that addition of 3% dry salt to the wet curd gave the best results of Edam cheese quality followed by that made with adding 4% dry salt one.

REFERENCES

- Ayesh, A.M.; Amra, H.A.; Abou-Arab, A.A. and Khayria, Nagiub (1995). Detection and determination of eight biogenic amines in frozen Mackerel (*Scombrororous sp.*) and Sardine (*Sardinella sp.*) using HPLC. J. Egypt. Ger. Soc. Zool., Vol. 17 (A) : 121-135.
- Bhaskaracharya, P.K. and Shah, N.P. (1999). Textural evaluation of commercial Mozzarella cheese. J. Dairy Sci. 79-185.
- Duzrec, D.S. and Zall, R.R. (1982). Effect of on-farm heating and storage of milk on Cottage cheese yield. J. Dairy Sci., 65 : 2296.
- Edward, W.; Janusz Budny, Kazimierz, W. Hoppe, Alicja Gryzowska and Janusz Turowski (1984). Effect of water content on the hardness of Edam cheese. J. of Food Eng. 3 (1984) : 295-305.
- El-Batawy, M.A. (1979). Studies on some enzyme extracts used in coagulating milk. Ph.D. Thesis, Cairo Univ., Egypt.

- El-Batawy, M.A.; El-Abd, M.M.; Younes, N.A. and El-Tawel, H.S. (1992). Effect of salting method on the ripening of Ras cheese made from mixed goats' and cows' milk. *Egypt. J. Dairy Sci.*, 20 : 341-350.
- El-Demerdash, M.S. (1996). Studies on Gouda cheese. M.Sc. Thesis, Zagazig Univ., Egypt.
- El-Kenawy, M. (1977). Studies on the use of hydrogenated vegetable oil in substituting milk fat for making filled soft cheese. M.Sc. Thesis, Fac. of Agric., Cairo Univ., Egypt.
- El-Sheikh, M.M.; Farrag, A.F.; Al-Khamy, A.F. and El-Shibiny, S. (1999). Edam cheese from whey protein milk retentate. *Egypt. J. Dairy Sci.*, 27 : 317-329.
- El-Shibiny, S.; Al-Khamy, A.F.; Shahein, N.M. and El-Sheikh, M.M. (1998). Effect of sodium caseinate addition on yield and quality of Edam cheese made by ultrafiltration. *Egypt. J. Dairy Sci.*, 26 (1) : 117-130.
- El-Sisey, S.A. (2002). Studies on semi-hard cheese. Ph.D. Thesis, Menofiya Univ., Egypt.
- Fredrick, L.A. and Dulley, J.R. (1984). The effect of elevated storage temperature on the rheology of Cheddar cheese. *N.Z.J. Dairy Sci. & Technol.*, 68 (suppl. 1).
- Geurts, T.J.; Walstra, P.; Mulder, H. (1980). Transport of salt and water during salting of cheese 2 : Quantities of salt taken up and of moisture lost. *Neth. Milk & Dairy J.* 34, 229-254.
- Hefnawy, S.H.A. (1977). Studies on the effect of some factors on the ripening and quality of Ras cheese. M.Sc. Thesis, Cairo Univ., Egypt.
- Innocente, N.; Pittia, p.; Stefanuto, O. and Corradini, C. (2002). Correlation among instrumental texture, chemical composition and presence of characteristic holes in a semi-hard Italian cheese. *Milchwissenschaft*, 57 (4) : 204-208.
- Kanawjia, S.K. and Sing, S. (1996). Textural profile of Buffalo milk Cheddar cheese ripening. *Indian J. Dairy Sci.*, 49 : 2.
- Kosikowski, F.V. (1966). Cheese and Fermented Milk Foods. Edwards Brothers, Inc. Ann. Arbor, Mich.
- Kristiansen, A.S.; Decling, D.F.; Jensen, Y.; Arido and Quist, K.B. (1999). Influence of salt content on ripening of semi-hard round-eyed cheese of Danbo-type. *Milchwissenschaft* 54 (1) : 19-23.

Influence of salting method on Edam cheese

- Kristiansen, A.S.; Decling, D.F.; Jensen, Y.; Arido and Quist, K.B. (1999). Influence of salt content on ripening of semi-hard round-eyed cheese of Danbo type. *Milchwissenschaft* 54 (1) : 19-23.
- Lawrence, R.C.; Gilles, J. and Greamer, L.K. (1983). The relationship between cheese texture and flavour.
- NZ. J. Dairy Sci. & Technol. 18 : 175. (C.F. Abbas, Kh.A. (2003) Studies on Mozzarella cheese. M.Sc. Thesis, Cairo Univ., Egypt).
- Ling, E.R. (1963). A Text Book of Dairy Chemistry. Vol. II 3rd Chapman & Hall Ltd., London.
- Mehanna, N.M.; Antila, P. and Pahkala, E. (1989). High performance liquid chromatographic analysis of biogenic amines in Egyptian cheeses. *Egypt. J. Dairy Sci.*, 17 : 19-26.
- Naguib, K.; Ayesh, A.M. and Shalaby, A.R. (1995). Studies on the determination of biogenic amines in foods. 1. Development of a TLC method for the determination of eight biogenic amines in fish. *J. Agric. Food Chem.* 13 : 134-139.
- Nasr, M.M.; Youssef, L.M. and Kandeal, A.A. (1992). Accelerated Edam cheese ripening with flavour AGECP enzyme preparation added to cheese curd. *Egyptian J. Food Sci.*, 20 : 285-293.
- Norac, B.; Alicia E. bevilacqua; and Noemi, E. Zarotzky (1992). Proteolytic and rheological evaluation of maturation of Tybo-Argentino-cheese. *J. Dairy Sci.*, 75 (12).
- Scott, R. (1998). Cheese making practice. Third edition. Applied Science Publ. LTD London.
- Sihufe, G.A.; Zorrilla, S.E. and Rubiolo, A.C. (2003). Casein degradation of Fynbo cheese salted with NaCl / KCl brine and ripened at various temperatures. *J. Food Sci.*, 68 : 117-123.
- Tawfik, N.F.; Shalaby, A.R. and Effat, B.A. (1992). Biogenic amines of Ras cheese and incidence of their bacterial producers. *Egypt. J. Dairy Sci.*, 20 : 219-225.
- Teodorovic, V.; Buncie, S. and Smiljanic, D. (1994). A study of factors influencing histamine production in meat.
- Fleisch Wirtsch, 74 : 170-172. (C.F. Ragb, W.A. (2003). Nutritional, chemical and toxicological studies on Mish cheese. Ph.D. Thesis, Minufiya Univ., Egypt).
- Thomas, T.D. and Pearce, K.N. (1981). Influence of salt on lactose fermentation and proteolysis in Cheddar cheese. *NZ. J. Dairy Sci. & Technol.* 16 : 253-259.

El-Batawy, et al.

- Tunick, M.H.; Mackey, K.L.; Smith, P.W. and Holisinger, V.H. (1991). Effect of composition and storage on the texture of Mozzarella cheese. *Neth. Milk & dairy J.* 45, 117-125.
- Visser, S. (1993). Proteolytic enzymes and their relation to cheeses ripening and flavor. *J. Dairy Sci.*, 76 : 329-350 (1993).
- Vujicic, I.F. (1962). Intensity of salt diffusion in Kachkaval cheese. *Novon Sadu (6) .C.F.Dairy Sci. Abstr.* 25 : 2114 (1963).
- Yang, C.S.T. and Toranto, M.W. (1983). Textural properties of Mozzarella cheese analogous manufactured from soybeans. *J. Food Sci.*, 47 : 906-910.
- Zaki, N. and Salem, S.A. (1992). Effect of proteolytic enzymes or accelerated ripening of Edam cheese. *Indian J. Dairy Sci.*, 45, 6.

Table (1) : Effect of salting methods on the yield and some chemical composition of Edam cheese during ripening period .

Parameters	Ripening Period (days)	Salting methods			
		Brine solution (control)	Dry salting		
			2 %	3 %	4 %
Yield (%)	Fresh	11.25	12.00	11.88	11.65
	15	10.77	11.44	11.33	11.13
	30	10.48	11.10	11.02	10.93
	60	10.27	10.85	10.78	10.65
	90	10.07	10.72	10.60	10.61
Moisture (%)	Fresh	44.70	47.90	46.92	45.00
	15	42.80	45.68	44.73	43.01
	30	41.66	44.31	43.52	42.21
	60	40.82	43.29	42.58	41.13
	90	40.00	42.80	41.86	40.98
Salt (%)	Fresh	2.51	1.31	1.76	2.42
	15	3.11	1.65	2.01	2.78
	30	3.38	1.86	2.25	3.01
	60	3.48	2.24	2.65	3.26
	90	3.72	2.51	2.99	3.54
Salt/ Moisture (%)	Fresh	5.62	2.73	3.75	5.38
	15	7.27	3.61	4.49	6.46
	30	8.11	4.20	5.17	7.13
	60	8.53	5.17	6.22	7.93
	90	9.30	5.86	7.14	8.64
Titratable Acidity (%)	Fresh	0.98	1.01	0.98	0.96
	15	1.31	1.39	1.40	1.30
	30	1.42	1.62	1.60	1.46
	60	1.72	1.98	1.94	1.79
	90	1.88	2.01	1.99	1.95
pH	Fresh	5.28	5.05	5.28	5.36
	15	5.11	5.06	5.00	5.09
	30	4.95	4.49	4.65	4.90
	60	5.25	5.02	5.05	5.15
	90	5.35	5.15	5.20	5.25

Influence of salting method on Edam cheese

Table (2) : Fat content , fat/ dry matter and total volatile fatty acids (TVFA)* during ripening of Edam cheese as affected by salting methods.

Parameters	Ripening period (days)	Salting methods			
		Brine solution (control)	Dry salting		
			2%	3%	4%
Fat (%)	Fresh	23.92	22.28	22.64	23.55
	15	25.44	24.41	24.48	24.80
	30	26.18	25.23	25.33	25.65
	60	27.27	25.86	25.81	26.65
	90	28.01	26.32	26.46	27.21
Dry matter (%)	Fresh	55.30	52.10	53.08	55.00
	15	57.20	54.32	55.27	56.99
	30	58.34	55.69	56.48	57.79
	60	59.18	56.71	57.42	58.87
	90	60.00	57.20	58.14	59.02
Fat/DM (%)	Fresh	43.25	42.76	42.65	42.83
	15	44.48	44.94	44.29	43.52
	30	44.87	45.30	44.85	44.38
	60	46.08	45.60	44.94	45.27
	90	46.65	45.98	45.51	46.10
TVFA	Fresh	9	11	11	9
	15	12	14	13	12
	30	22	25	24	23
	60	29	32	31	30
	90	34	38	37	36

*TVFA as ml 0.1N NaOH / 100 g cheese.

Table (3) : Effect of salting method on the nitrogen distribution in Edam cheese, during ripening .

Parameters	Ripening period (days)	Salting methods			
		Brine solution (control)	Dry salting		
			2%	3%	4%
T.N (%)	Fresh	3.29	3.11	3.20	3.27
	15	3.39	3.30	3.35	3.39
	30	3.43	3.38	3.50	3.41
	60	3.76	3.54	3.62	3.60
	90	4.05	3.58	3.98	4.01
WSN (%)	Fresh	0.203	0.236	0.228	0.215
	15	0.246	0.389	0.296	0.258
	30	0.377	0.423	0.411	0.388
	60	0.438	0.509	0.478	0.450
	90	0.526	0.611	0.565	0.532
NPN (%)	Fresh	0.065	0.078	0.076	0.071
	15	0.131	0.134	0.130	0.132
	30	0.162	0.182	0.178	0.168
	60	0.192	0.206	0.202	0.196
	90	0.285	0.301	0.298	0.291
WSN/TN	Fresh	6.17	7.59	7.13	6.68
	15	7.26	11.79	8.84	7.61
	30	9.83	12.51	11.74	11.38
	60	11.93	14.38	13.20	12.47
	90	12.98	17.07	14.20	13.27
NPN/TN	Fresh	1.98	2.51	2.38	2.20
	15	3.96	4.06	3.88	3.89
	30	4.72	5.34	5.09	4.93
	60	5.23	5.82	5.56	5.43
	90	7.04	8.41	7.49	7.26

Influence of salting method on Edam cheese

Table (4) : Biogenic amines content (mg / Kg) of Edam cheese at 90 days of ripening as affected by different salting methods

Salting methods	Biogenic amines (mg / Kg)				
	Tryptamine	Histamine	Putrescine	Cadaverine	Tyramine
Brine solution	-----	10.82	11.68	20.86	3.20
Dry salting 2 %	0.58	57.60	39.20	37.50	7.90
Dry salting 3 %	0.39	43.80	31.60	23.30	5.30
Dry salting 4 %	0.26	33.10	24.90	17.40	4.60

Table (5) : Some textural properties of Edam cheese during ripening as affected by Salting method.

Parameters	Ripening Period (days)	Salting methods			
		Brine solution (control)	Dry salting		
			2 %	3 %	4 %
Hardness (N)	Fresh	2.47	2.15	2.25	2.37
	30	2.63	2.31	2.38	2.55
	60	2.83	2.41	2.53	2.70
	90	2.345	1.89	2.15	2.25
Springiness (m.m)	Fresh	6.20	5.00	5.75	5.80
	30	6.32	5.25	5.82	5.90
	60	6.43	5.38	5.95	6.12
	90	5.40	4.80	5.16	5.25
Cohesiveness	Fresh	0.59	0.64	0.62	0.60
	30	0.61	0.68	0.64	0.62
	60	0.63	0.72	0.67	0.64
	90	0.60	0.66	0.64	0.62
Gumminess (N)	Fresh	1.46	1.38	1.40	1.42
	30	1.60	1.52	1.57	1.58
	60	1.78	1.72	1.75	1.76
	90	1.41	1.25	1.38	1.40
Chewiness N.m.m	Fresh	9.05	6.90	8.05	8.24
	30	10.11	7.98	9.14	9.32
	60	11.45	9.25	10.41	10.77
	90	7.61	6.00	7.12	7.35

N = Newton ; m.m = millimeter ; N. m.m = Newton millimeter.

