Properties of Edam Cheese Fortified by Dietary Zinc Salts.

Nabil Sami Abd-Rabou, Ahmed Hassan Zaghloul, Faten Lotfi Seleet* and Mahmoud Abdala El -Hofi

Dairy Science Department, National Research Center, Dokki, Giza, Egypt.
*faten.seleet@gmail.com

Abstract: Edam cheese is a type of semi hard cheese having a wide distribution among consumers in Egypt. Zinc has a very important and effective role in human nutrition and body metabolism. The objective of this study was to elucidate the effect of fortification of cheese curd with zinc on the properties of the Edam cheese. Edam cheese was fortified by different sources of dietary zinc such as zinc acetate, zinc chloride and zinc sulphate at a level of 150 mg zinc / kg cheese curd. The resultant cheese was analyzed fresh and during storage at 5°±1 at refrigerator each 2 weeks until 12 weeks. Results showed that Edam cheese fortified with zinc was higher in acidity, acid value and protein fractions during storage period than control. On the other hand, Edam cheese fortified with zinc acetate recorded the highest organoleptical scores, which more pronounced and preferable compared to control and other treatments. Fortified Edam cheese with zinc could be recommended as a good source to promote human dietary zinc intake. [Journal of American Science 2010;6(10):441-446]. (ISSN: 1545-1003).

Key words: Edam cheese, Zinc fortification, properties of Edam cheese.

1. Introduction:

Cheese is a rich source of essential nutrients; in particular, proteins, bioactive peptides, amino acids, fat, fatty acids, vitamins and minerals (Barbara Walther et al., 2008).

Edam cheese originated in Holland in the village of Edam .It is a type of semi hard cheese having a wide distribution among consumers in Egypt. Milk or other dairy products are poor sources of various trace elements or their levels are not sufficient for human dairy requirements and do not present a healthy body (Jayasekarel et al., 1992). Therefore, consumers need to obtain their requirements of the trace elements from other products rather than milks or fortified by it.

Among all various trace elements; zinc has a very important, effective role in human nutrition and body metabolisms. It has structural and regulatory roles in many enzymes e.g. alkaline phosphatase, nucleic acid polymerases and others. It participates in mechanisms of major metabolic pathways and heme synthesis. Also, it is involved in tissue synthesis, gene expression and embryogensis (Fayed and Abou-Zikri, 1997). Regarding this shortage of milk zinc content; daily produced dairy intake do not sufficient for the dietary requirements and its mean value is markedly lower than those (8 mg/day) for adults and adolescence (Institute of Medicine, Food and Nutrition Board, 2001). Some investigations have been dealt with fortification and enrichment of milk, cheese or beverages with zinc (Hermanson et al., 1995; Degheidi & Abd-Rabou 1998 and Abd-Rabou 2002). The aim of this work was to study the effect of zinc salts on some properties of Edam cheese which has manufactured from fortified curd with different sources of food grade zinc salts.

2-Materials and methods:

2.1-Materials:

Zinc chloride, zinc acetate and zinc sulphate, food grade were obtained from CID, Company for Drugs, Cairo, Egypt. Fresh cow's milk (11.78%TS, 3.38%TP and 3.2%Fat) was obtained from the farm of Faculty of Agriculture, Cairo University, Egypt.

2.2-Cheese making:

Edam cheese was manufactured as described by (Fox, 1987). Four treatments of Edam cheese were carried out using 20 kg of milk for each one. The first treatment (T1) was made by adding zinc chloride, the second treatment (T2) was made by zinc acetate, while the third treatment (T3) was made by zinc sulphate. In all treatments zinc was added at level of 150 mg zinc/kg cheese curd. The forth treatment was a control sample (C) made without zinc salt addition. All cheese treatments were ripened for 12 weeks. Three replicates were made from each treatment.

2.3-Chemical analysis of cheese:

The cheeses were analyzed for moisture, titratable acidity, acid value, total nitrogen (TN), and soluble nitrogen (SN) contents according to the methods described by A.O.A.C. (2000). The minerals content was determined in ash by using Atomic Absorption Spectrophotometer (IL-S-12) according to the method described by Jackson (1958). Thiobarbituric acid value (TBA) was carried out spectrophotometrically at 580 nm as described by

Keeny (1971). Peroxide value (PV) was colorimetric estimated according to IDF (1974) using spekol colorimetri 11 (Carlzeiss Jena at 500 nm).

2.4-Sensory evaluation:

The sensory properties of cheese samples were assessed by a panel test after 6, 8, 10, and 12 weeks of ripening .It was carried out by twenty member whose selected among the staff of Dairy Science Department, National Research Center, Cairo, Egypt. The panelists were asked to score the cheese for: taste and flavour intensity (out of 60 points) taste30, flavour 10, saltiness 10, acidity 10; Body (15 points); Texture (15 points); Colour and appearance (10 points) according to Larmond (1987).

3-Results and discussion:

3.1. Zinc content in fortified Edam cheese:

Results showed that cheese fortified with zinc acetate shows highest zinc recovery (72.13%) than other treatments (table 1), whereas cheese fortified with zinc chloride had gained (70.93%). On the other hand cheese fortified with zinc sulphate showed lowest recovery (69.0%) than other treatments. This may be due to difference of zinc sources. This results was in agreement with those obtained by Abd-Rabou (2002).

Table 1: zinc content in fresh curd cheese.

Cheese treatments	Total zinc in cheese (mg/kg)	Zinc recovered in cheese %
Control	4.39	-
T1	106.4	70.93
T2	108.2	72.13
T3	103.5	69.00

T1: Cheese with zinc chloride. T2: Cheese with zinc acetate. T3: Cheese with zinc sulphate.

3.2. Element contents in fortified Edam cheese:

Concentration of the major elements, Ca, P., K and Mg% were illustrated in Table 2. The concentrations of these elements in fresh cheeses were not the same. Cheese fortified with zinc acetate was the highest in Ca, and P % (0.89 and 0.69% respectively), while cheese fortified with zinc chloride was the highest in Mg (1.86%) than other treatments. Control cheese recorded the highest K content being 0.683%. In the other side, the content of trace elements in cheeses (Mn, Cd, Cr and Cu) in µg/kg was not the same in both fortified cheeses or in control. Cheese fortified with zinc sulphate showed the highest content of Mn 5.6 and Cu 2.8 µg/kg, while cheese fortified with zinc chloride was the highest in Cr content (1.8 µg/ kg).

3.3. Titratable acidity of cheese:

Table 3 shows that, the titratable acidity of cheese fortified with zinc was higher (in all treatments) than in control cheese along the ripening period. A gradual increase in the acidity of cheeses was observed during the first stage of ripening in all cheese samples. The acidity of cheese fortified with zinc acetate (T2) was slightly higher than other treatments during ripening period and reached 1.28%, while it was1.25 % and 1.20% in cheese with zinc sulphate and zinc chloride respectively. Acidity in control cheese had the lowest value 1.16%. The increase of acidity in fortified cheese might be attributed to proteolysis and increase in nitrogen fractions during ripening as a result of the stimulating effect of trace elements on acid producing bacteriaAmer *et al*., (1977) and Degheidi and Abd-Rabou (1998).

3.4. Acid value of cheese fat:

Fat acidity of cheese fat (Table 3), were the same in all fresh cheese samples, then they gradually increased with different levels till the end of ripening period (12 weeks). Cheeses fortified with zinc salts recorded high values of fat acidity, zinc acetate was the highest than the control and other treatments; this is probably due to the effect of zinc salt. These results are in agreement with previous studies by Abd El Salam *et al* (1973) and Degheidi and Abd-Rabou (1998) who reported that the addition of trace elements to Ras cheese had increased the rate of production of fatty acids such as acetic, propionic and butyric during ripening period.

Table 2: Some minerals content in fresh curd cheese.

Cheese treatments	Ca %	P %	K %	Mg %	Mn (µg/kg)	Cd (µg/kg)	Cr (µg/kg)	Cu (µg/kg)
Control	0.78	0.66	0.683	1.65	2.9	0.606	1.6	1.51
T1	0.79	0.62	0.618	1.86	3.9	0.317	1.8	2.17
T2	0.89	0.69	0.517	1.75	4.4	0.223	1.6	2.51
T3	0.77	0.58	0.645	1.58	5.6	0.256	1.5	2.80

T1: Cheese with zinc chloride. T2: Cheese with zinc acetate. T3: Cheese with zinc sulphate.

Table 3: Effect of zinc fortification on the moisture, titratable acidity and acid value content of Edam cheeese during ripening.

Cheese treatments	Repining period (weeks)						
	Fresh	2	4	6	8	10	12
			Moisture %				
Control	42.9	39.2	38.5	38.1	37.6	37.5	37.2
T1	42.9	39.4	38.7	38.3	37.7	37.5	37.4
T2	42.7	39.5	38.9	38.2	37.9	37.7	37.5
T3	42.4	39.4	38.7	38.2	37.8	37.6	37.3
			Acidity %				
Control	0.42	0.50	0.61	0.73	0.85	1.02	1.16
T1	0.42	0.53	0.67	0.82	0.88	1.08	1.20
T2	0.43	0.58	0.73	0.87	0.93	1.16	1.28
T3	0.41	0.54	0.71	0.85	0.91	1.13	1.25
			Acid value %				
Control	0.96	1.62	2.16	2.37	2.60	3.00	3.10
T1	0.96	1.79	2.48	2.61	2.80	3.27	3.71
T2	0.98	2.10	2.57	2.80	3.10	3.68	3.90
T3	0.96	2.03	2.52	2.78	2.98	3.56	3.86

T1: Cheese with zinc chloride T2: Cheese with zinc acetate T3: Cheese with zinc sulphate

3.5. Total and soluble nitrogen contents:

Changes of soluble nitrogen of Edam cheese as affected by zinc fortification are illustrated in figure (1). Data showed that nitrogen content in cheese samples gradually increased as a result of progress of ripening period. Negligible differences existed between different treatments until the end of ripening period. These changes in soluble nitrogen could be attributed to the changes in the moisture content during cheese ripening. S.N/T.N % in cheese samples were not the same (Figure2). Their Levels in all treatment cheeses were higher than in control cheese during ripening periods. This was more remarked in cheese treated with zinc acetate (18.88%) at the end of ripening period, while they were18.68% and 17.20% in cheeses treated with zinc sulphate and zinc chloride respectively. With control cheese S.N/T.N%, reached 16.50% at the end of ripening period (12 weeks). The increase in S.N/T.N% in Edam cheese fortified with zinc during ripening could be attributed to the effect of zinc salts as a stimulating agent for proteolytic activity and more rapid protein breakdown occurred along cheese ripening then accelerate its ripening process. Similar results were reported for Ras cheese Degheidi and Abd-Rabou (1998) and for Domiati cheese Abd-Rabou (2002).

3.6. Changes in thiobarbituric acid values (TBA) of Edam cheese as affected by zinc fortification:

Figure (3) showed the changes in the thiobarbituric acid values (TBA) as affected by zinc fortification of Edam cheese. The average of TBA values as optical density (O.D.) was gradually increased along the ripening period. These values were higher in treated cheeses than in control one. The TBA value of cheese fortified with zinc chloride was higher than other treatments, which reached 0.085 as O.D at the end of ripening period (12 weeks), but they were 0.047 and 0.035 for treatments with zinc acetate and zinc sulphate respectively. While it was 0.023 in control cheese.

3.7. Changes of peroxide value (PV) of Edam cheese as affected by zinc fortification.

Figure (4) Showed that the average of peroxide values (as ml. equiv. /kg) was increased gradually with different levels up to 6 weeks of ripening period, then the values began to decrease up to the end of ripening period (12 weeks). Cheese treated with zinc chloride (T1) showed higher PV value, than other cheeses along the ripening period. PV value reached 0.051, 0.032 and 0.017 ml equiv. /kg for treatments T1 & T2 and T3 respectively, while the lowest PV value was recorded in control cheese (0.013 ml equiv/kg). This indicated that fortification of Edam cheese with different zinc salts had an increasing effect on PV values along the ripening period. These results are in agreement with Degheidi and Abd-Rabou (1998).

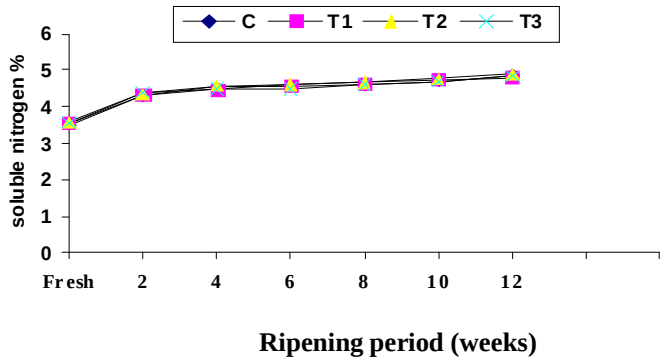

Figure 1: Changes in soluble nitrogen % of Edam cheese fortified with zinc during ripening. C: Control cheese. T1: Cheese with zinc chloride. T2: Cheese with zinc acetate. T3: Cheese with zinc sulphate.

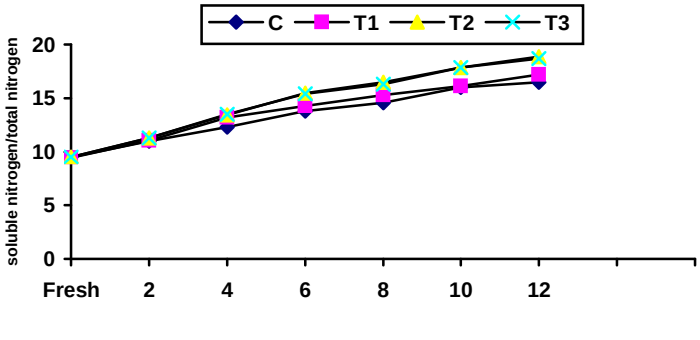

Figure 2: Changes in soluble nitrogen/total nitrogen of Edam cheese fortified with zinc during ripening C: Control cheese. T1: Cheese with zinc chloride. T2: Cheese with zinc acetate. T3: Cheese with zinc sulphate.

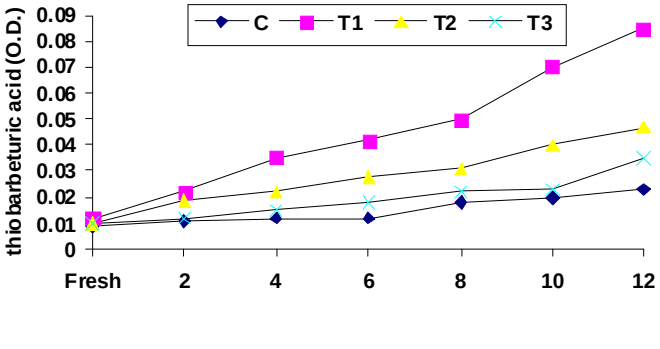

Figure 3: Changes in thiobarbeturic acid (TBA) value of Edam cheese fortified with zinc salts during ripening period. C: Control cheese. T1: Cheese with zinc chloride. T2: Cheese with zinc acetate. T3: Cheese with zinc sulphate

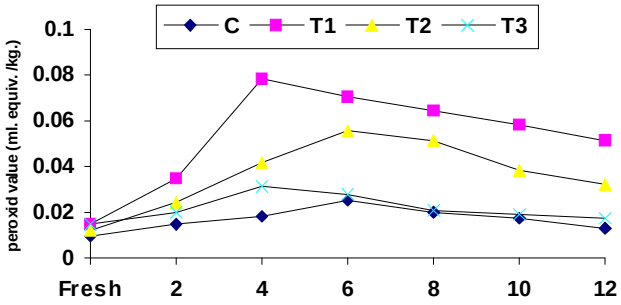

Figure 4: Changes in peroxide value (PV) of Edam cheese fortified with zinc during ripening period. C: Control cheese.T1: Cheese with zinc chloride. T2: Cheese with zinc acetate T3: Cheese with zinc sulphate.

Table 4: Sensory scores of Edam cheese fortified with zinc during ripening.

Sensory properties	Age of cheese (weeks) 6				8				10				12			
	C	T1	T2	T3	C	T1	T2	T3	C	T1	T2	T3	C	T1	T2	T3
Taste and Flavour (60 point)																
Taste 30	22.1	22.5	23.4	22.8	23.3	23.8	24.0	23.7	25.1	26.8	28.8	27.5	25.5	28.1	29.2	28.3
Flavour 10	8.1	8.2	8.3	8.3	8.2	8.3	8.6	8.5	8.4	8.7	8.9	8.7	8.5	8.8	9.1	8.8
Saltness 10	8.1	8.4	8.4	8.5	8.4	8.6	8.7	8.8	8.8	9.3	9.8	9.5	9.0	9.5	9.6	9.6
Acidity 10	7.3	7.3	7.5	7.5	7.5	7.6	7.7	7.8	8.0	8.1	8.2	8.3	8.1	8.3	8.5	8.7
Body & texture (30)																
Body 15	11.8	12.1	12.2	12.2	12.2	12.3	12.4	12.5	12.2	12.6	13.1	12.6	12.5	12.8	12.2	12.9
Texture 15	11.6	11.8	12.0	11.8	12.1	12.3	12.6	12.3	12.5	12.7	13.5	13.2	12.6	13.2	12.7	13.1
Colour&appearance 10	7.6	7.7	7.8	7.8	7.7	7.9	8.2	8.2	8.0	8.1	8.5	8.3	8.5	8.5	9.0	8.7
Total scores (100)	76.6	78.0	79.6	78.9	79.4	80.8	82.2	81.8	83.0	86.3	90.8	88.1	84.7	89.2	90.3	90.1

C: Control cheese. T1: Cheese with zinc chloride. T2: Cheese with zinc acetate. T3: Cheese with zinc sulphat

3.8. Sensory properties of Edam cheese:

Results of the sensory panel's assessment of cheese quality during ripening for 6, 8, 10 and 12 weeks were given in Table (4). All score's properties of Edam cheese samples were increased generally during ripening period. It seems that, high remarked scores for fortified cheeses with zinc salts was it's to be perceived properties more tasty, flavour intensity, body and texture, colour and appearance.

Edam cheese fortified with zinc acetate had better properties along the ripening period and reached the highest scores earlier than the other treated cheeses or control, except for body and texture properties which were decreased in the last week. The present results are in accordance with that reported by Salama and Nadia (2002) and Omar et. al, (2008).

4. Conclusion:

On the light of the above mentioned results, it could be concluded that addition of zinc acetate or zinc chloride was more effective for improving the organoleptic properties of Edam cheese and accelerate its ripening process. For zinc recoveries, fortified Edam cheese with different zinc salts used could be recommended as a good source to promote human dietary intake.

Correspondence author:
Dr. Faten L. Seleet,
Dairy Science Department,
National Research Centre,
Dokki, Cairo, Egypt;
e-mail:faten.seleet@gmail.com

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7/7/2010