



Technological and Chemical studies on Edam cheese

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SUMMARY AND CONCLUSION

Edam cheese is one of the semi-hard cheese varieties that originated in Netherlands and spread to the rest of the world due to its mild flavour and smooth texture which differ from other hard and semi-hard varieties by its shorter ripening time. Its consumption has increased in Egypt and the local factories started producing Edam cheese in a commercial scale. Edam is a cheese variety that requires high quality milk, the use of certain starters, and following hygienic conditions in all manufacturing procedures to avoid flavour, texture and microbiological defects in the resulting cheese. Therefore, big efforts must be made to emulate the traditional manufacturing method and adapt the available conditions to produce Edam cheese with high quality.

Therefore, the current investigation was aimed to:

- I:** Proteolysis, lipolysis and volatile compounds in Edam Cheese Made from Raw, Thermized, and Pasteurized Milk.
- II:** Evaluate of the influence of natural whey cultures utilized as starters on the physicochemical, textural, microbiological and sensorial properties of pasteurized Edam cheese during the ripening period.
- III:** Evaluate of black cumin oil addition on the quality of Edam cheese during the ripening period.

The present study was carried out under the following parts:

Part I: Proteolysis, lipolysis and volatile compounds in Edam Cheese Made from Raw, Thermized, and Pasteurized Milks

Edam cheese was produced in three different treatments using thermized milk (65°C/15 sec), pasteurized milk (72°C/15 sec) and raw milk. Cheeses were ripened for 45 days and analyzed at 1, 15, 30 and 45 days intervals. The results showed that the highest moisture content 48.87% was determined in Edam cheese produced from pasteurized milk, while the lowest (45.55%) was observed in Edam cheese made with raw milk at the first stage of ripening. Edam cheeses produced either from pasteurized or thermized milk was characterized by lower fat and protein contents. The acidity of raw milk Edam cheese was the highest among all Edam cheese samples during the ripening period. In addition, ripening indices including WSN/TN % (15.41, 13.20 and 14.58 %) and NPN/TN% (6.31, 5.78 and 6.17%) were determined and were comparable between raw, thermized and pasteurized milk Edam cheese, respectively at the end of ripening. Moreover, Edam cheeses from pasteurized or thermized milk characterized with lower hardness values than raw milk Edam cheese. The applied heating of Edam cheese milk affected the microflora of Edam cheese samples and the level of proteolysis, lipolysis and subsequent liberation of free fatty acids and volatile compounds when compared to Edam cheese made with raw milk. All Edam cheeses had the higher sensorial scores particularly at the end of ripening period.

Part II: Evaluate of the influence of natural whey cultures utilized as starters on the physicochemical, textural, microbiological and sensorial properties of pasteurized Edam cheese during the ripening period

The natural whey culture (NWC) was used in three different levels (2, 3 and 4%) in the production of Edam cheese from pasteurized milk. In addition, Edam cheese was produced from pasteurized milk inoculated with commercial starter culture and produced from raw milk for comparisons. The physicochemical, free amino acids, organic acids, textural, microbial and sensorial properties of Edam cheese samples were evaluated at 1,

15, 30 and 45 days of ripening. Obtained results showed that the titratable acidity, moisture, ash, WSN/TN and NPN/TN % were significantly higher ($P \leq 0.05$) while protein and fat contents were lower in all experimental cheeses with NWC than in traditional Edam cheese. The free amino acids, Tyr, Pro, Glu, Lys, Leu and Phe were the main free amino acids in all Edam cheese batches, representing around 65% of the total free amino acids content. Levels of all individual amino acids were higher in experimental Edam cheeses with 3 or 4% NWC than in the traditional or Edam cheese samples made with pasteurized milk. The concentrations of acetic, propionic, lactic and butyric acids were a much higher levels in experimental Edam cheeses with NWC than the other cheese treatments. Edam cheeses with NWC have markedly higher values of textural evaluation than the values for the other cheese samples. During the ripening period, the highest LAB counts occurred in the Edam cheese made with pasteurized milk with NWC, followed by the Edam cheese with made with pasteurized milk with starter culture and the lowest counts were determined in the traditional Edam cheese. In sensory terms, the cheeses manufactured with NWC were significantly higher scored than the control cheese. Overall, Edam cheese made with 4% NWC was higher in quality characteristics than that made with starter culture and was similar to control cheese made with raw milk.

Part III: Evaluate of black cumin oil addition on the quality of Edam cheese during the ripening period.

Edam cheese samples were prepared with different concentrations of black cumin oil (0.2, 0.4 and 0.6 % v/w). Cheeses ripened for 60 days and analyzed at 0, 15, 30, 45 and 60 days intervals for their chemical, ripening indices, fatty acid profile, microbiological and sensory properties. The results showed that significant differences in chemical composition and ripening indices among treated cheese sample (0.6% oil) and control was observed in all examined parameters. The added black cumin oil increased the acidity from 0.79% in control to 1.13% in cheese with 0.6% oil at fresh time; with continuously increased in all cheese samples during ripening. WSN/TN reached 15.91 % in cheese with higher level of black cumin oil at the end of ripening. In addition, free amino acids recorded 1.21 g leucine/g cheese in Edam cheese with 0.6 % oil at end of ripening periods. Free fatty acids increased with increasing level of oil in Edam cheese

samples. Moreover, incorporation of black cumin oil in Edam cheese reduced the total viable counts (5.97 log cfu/g), Yeast & Molds (1.00 log cfu/g) at the end of ripening and inhibited the growth of coliform groups. Proteolytic bacteria recorded higher counts (3.19 log cfu/g), while lipolytic bacteria recorded lower counts (2.59 log cfu/g) in Edam cheese with 0.6 % oil comparing to other cheese samples at 60 days of ripening period. Panelists accepted the taste of cheese with higher concentration of black cumin oil (0.6%) with no complains on appearance and smell, while they favored the texture of Edam cheese with higher percentage of oil, then overall acceptability went to 0.6 % oil treated cheese.

It could be concluded that:

- 1- Thermization and pasteurization affected the volatile compounds, fatty acid profile and compositional profile of Edam cheese with comparable results obtained between Edam cheese made with thermized milk and raw milk.
- 2- Natural whey culture could be used successfully in the inoculation of Edam cheese milk for the production of acceptable Edam cheese with high quality characteristics.
- 3- Black cumin oil could be used as natural preservative in Edam cheese manufacture with good quality properties.