

IMPROVING OF EDAM-LIKE CHEESE FLAVOUR MADE FROM GOATS MILK BY FEEDING ON SOME MEDICINAL HERBS.

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ABSTRACT

The effect of feeding goats on some medicinal herbs on the quality of edam-like cheese made from its milk in order to hinder goaty off-flavour was investigated. Experimental animals (50 goats) were divided into five similar groups. The first group (R₁) was fed on ration composed of 25% concentrate feed mixture, yellow corn, rice straw and berseem hay on DM basis. This group served as a control. The second group (R₂) was fed on control ration (CR) in addition to Chamomile flowers while the third group (R₃) fed on Thyme leaves; the fourth group (R₄) on Fennel fruits and the fifth group (R₅) was fed on Peppermint leaves and flowering tops. Edam-like cheese was made from the resultant milks of each treatment and stored for 90 days at 10 ± 1 °C and 85 – 90 % relative humidity. The cheese was analysed at 0; 15; 30; 60 and 90 days for moisture, fat contents, titratable acidity, pH, soluble nitrogen, non protein nitrogen, amino acid nitrogen, total nitrogen, total volatile fatty acids, free fatty acids, goaty flavour compounds, total bacterial counts, lactic acid bacteria and coliform groups. The sensory evaluations were also carried out. The resultant cheeses of all treated groups were better than that of the control cheese (R₁). The best treatment was that from milk of animals fed rations containing Chamomile (R₂) followed by animals fed on Peppermint (R₅).

INTRODUCTION

A large number of varieties of cheese made from goats' milk have resulted in great diversity in their nature. The milk from which they were made significantly influenced the finished cheeses. The intensity of the non acceptable goaty flavour was highly correlated to the free fatty acids content (Emara, 1990 and Hassan, 1992), so cheese made from goats' milk are generally characterized by a strong typical flavour.

A great number of goats' milk cheese types are found in many local markets with variety of types at different ages of product. Some goats' milk cheese are made from pasteurized milk (Elias, 1972), while most reports on goats' milk cheese processing did not include pasteurization (Jaouen, 1974). Street (1975) reported that the consumption of an unpasteurized goats' milk cheese had been identified as the cause of epidemics of brucellosis.

Flavour is a major attribute that influences the selection and consumption of cheeses. With the increased consumption and popularity of cheeses made from goats' milk, investigations and resolutions of some of these problems have become economically more important (Attale and Richter, 1996).

Recent studies have demonstrated that goats'milk is excellent in making not only the traditional and modified fresh soft cheese varieties, but also the mould ripened Blue and Camembert cheeses) Davide *et al.*, 1985b). However, the local production of bacteria-ripened cheeses such as the hard Cheddar and the semihard Edam from goats' milk has yet to be tested. These mild flavoured Edam or Queso de Bola and sharp, acid flavoured Cheddar cheese are the most sought-after natural ripened cheeses among philippin, particularly during the Christmas season (Davide *et al.*, 1986).

The therapeutic use of medicinal plants in Africa dates back to the earliest times. Ancient Egyptian writings confirm that herbal medicines have been valued in North Africa for thousands of years (Chevallier, 1996). Spices have been used not only for flavouring food, but also for their preservative properties as antimicrobial and/or antioxidant agents (Abou-Dawood, 1996). More than 350 or 400 species are used in different countries by people with different religion and climate, but 70 spices and herbs are officially recognized by the International Organization for Standardization (ISO) (Nobuji, 1994). Many studies on the effect of extracted effective constituents of medicinal plants can not explain exactly how it works as a whole plant (Chevallier, 1996).

Chamomile, Thyme, Fennel and Peppermint are commonly used in different parts of the world and are considered to have particular health benefits as carminatives, antispasmodics, antifatulent in dyspepsia and anorexia, antiseptics for respiratory and gastrointestinal tracts infections and flavour improving in foods (Blumenthal *et al.*, 2000). The use of medicinal herbs plants in animals nutrition as stimulants for milk and meat production is a very recent approach.

On the other hand, goats'milk products are very rarely accepted by Egyptian consumers due to their non acceptable flavour. Many studies were done using natural herbs and their essential oils in order to improve goaty flavour (Abdel-Kader *et al.*, 2001), but little work had been carried out to establish the effect of animal feeding on herbs on the quality of goats'milk products. Therefore, the purpose of the present study is to study the effect of feeding goats animals on medicinal herbs on the physical, sensory, biochemical, microbiological characteristics of edam-like cheese quality in order to improve or make its gooty off-flavour.

MATERIALS AND METHODS

Materials:-

Milk :

Fresh whole goats'milk (Zaraybe) was obtained from the herd of El-Serow Animal Research Station, Agricultural Research Center, Ministry of Agriculture.

Starter cultures:-

Pure cultures of *Lactococcus lactis subsp. lactis*, *Lactococcus lactis subsp. diacetylactis*, *Lactococcus lactis subsp. cremoris* were obtained from Chr-Hansen's laboratories, Copenhagen, Denmark. These cultures were activated before being used.

Rennet :-

Powder animal rennet (Hala) was obtained from Chr-Hansen's Laboratories, Copenhagen, Denmark. It was diluted with distilled water to the standard rennet solution before using.

Salt :

Clean, food grade, cooking salt (NaCl) was used.

Calcium chloride and Annatto:

Pure calcium chloride and annatto used in cheese making were purchased from El-Gomhoria co., Cairo Egypt.

Coating materials:

A solution mixture of wax composed of white soft paraffin wax, pellet honey and medical Vaslin at a ratio of 1 : 1 : 0.2 respectively was purchased from El-Gomhoria co., Cairo Egypt. were used.

Herbs:-

Air dried Chamomile flowers ; Fennel fruits; leaves and aerial parts of Thyme and leaves and flowering tops of Peppermint were purchased from Royal co- , Cairo . Egypt . These herbs were 100% natural and cultivated according to international laws of organic agriculture without chemicals or pesticides to protect human health and environment.

Experimental animals:-

Fifty Zaraybe goats were chosen randomly . Goats were divided into five similar groups, ten goats/ group. They were kept under similar housing conditions, in five semi-open sheds.

Groups:

Goats in the five groups were fed on:-

Group1(R1): ration composed of 25% concentrate feed mixture (CFM) + 35% Yellow corn (YC) + 17% Rice straw (RS) + 23% Berseem hay (BH), on DM basis. This group served as control ration (CR) which was free from feed additives.

Group2(R2) = CR + 5 gram Chamomile flowers.

Group3(R3) = CR + 5 gram Thyme leaves and aerial parts.

Group4(R4) = CR + 5 gram Fennel fruits.

Group5(R5) = CR + 5gram Peppermint leaves and flowering tops.

Cheese manufacture- :

The procedure of Edam-like cheese manufacture as described by Scott (1981) was used with some modification. Cheese milk was standardized to $4.0 \pm 0.1\%$ fat. The milk was heated to 72°C for 15sec. then cooled to 30°C, annatto solution was added (6ml/100kg milk), inoculated with 1% mixed starter cultures of *Lactococcus lactis subsp. lactis*, *Lactococcus lactis subsp. cremoris* and *Lactococcus lactis subsp. diacetylactis*, and thoroughly mixed with the milk. After that, calcium chloride was added at the rate of 0.02% of cheese milk. When the acidity reached 0.19% rennet was added at the rate of 3gm powder rennet per 100kg cheese milk. As the curd become firm enough, almost within 30 minutes it was cut. Scalding was accomplished by raising the temperature gradually to 37°C in about one hour with continuous stirring. This led the curd to be sufficiently firm and the acidity of whey reached 0.12% the curd was gathered to one end

of the vat and whey was drained off. A slight pressure was applied on the curd to help the whey to run off easily. The curd was put in molds of about 8 cm in depth and about 10cm in diameter with four holes in the bottom for drainage, and have a round cover. After that the molds were covered and pressed for 3 hours with a direct pressure of 150 pounds per square inch. The cheese was turned once every hour during pressing. After complete pressing the cheese was immersed in 20% brine for 24 hours at 5°C. After salting the green cheese was weighed and placed for 2 days in a ripening room for surface drying. The cheese was carefully coated with wax. Resultant cheese treatments were kept in the ripening room at $10 \pm 2^\circ\text{C}$ and 85-90% relative humidity for 90 days.

Chemical analysis of cheese:

The cheese was analyzed for moisture, titratable acidity, fat, T.N., S.N., N.P.N. and A.A.N. contents according to Ling (1963).

The Salt content was determined according to Davies (1932).

The pH value of cheese were measured using a digital pH meter model 201 Orion Research, Japan.

The total volatile fatty acids were determined according to Kosikowski (1978)

Free fatty acids--:

Free fatty acid were isolated from cheese of each treatment as described by Metcalfe and Schmitz (1961) by gas liquid chromatography using Pye unicam series 104.

The conditions of separation were as follows:-

- Column type: polyethelene glycol adipate or succinate.
- Carrier gas : nitrogen
- Flow rate: 50mg/min.
- Column temp: 200°C .
- Loading: 0.1-0.2 μl .
- Detector temp. : $210-220^\circ\text{C}$.
- Coparison against samples of known identity.

Goaty flavour compounds :

Goaty flavour compounds were determined as described by Metcalfe and Schmitz (1961) by gas liquid chromatography using Varian 3700 (4% OV-101 + 6% OV-210). The conditions of separation were as follows:-

- Column type: chromw H P 80 / 100 2 m x 0.35 mm .
- Carrier gas : nitrogen.
- Flow rate: 25 mg/min.
- Column temp: $80-200^\circ\text{C}$.
- Loading: 0.1 – 0.2 μl .
- Detector temp. : 220°C .
- Programing gradient : $8^\circ\text{C} / \text{min}$.

Microbiological analysis of cheese:

Total bacterial count was determined as given by Marth (1978). The Proteolytic bacterial count was determined as described by Chalmer (1962). The Lipolytic bacterial count was determined as given by Sharf (1970). Moulds and Yeasts counts were enumerated as recommended by the

APHA (1992). The Coliform bacterial count was enumerated using the method described in the standard method for the examination of milk and dairy products (1960). Lactic acid bacterial count was determined according to lees *et al* (1974).

Cheese scoring:-

The organoleptic properties of cheese samples were evaluated as mentioned by Abd-El-Fattah (1966).

Statistical analysis:

Statistical evaluation for the results by a split-pilot ANOVA was performed according to the method described by Bulmer (1967).

RESULTS AND DISCUSSION

1-Cheese yield and loss of weight:

Table (1) shows that higher cheese yield in treatments R₂ and R₅ than other treatment i.e. R₁, R₃ and R₄. The loss percentage in cheese weight was increased during ripening in all cheese treatments. This could be attributed to water expulsion and escape of certain amounts of cheese solids which became soluble due to bacterial action. The obtained results agree with that reported by several investigators El-Shafie, (1994) and Ayyad (1997).

Table(1): Effect of different herbs feeding treatments on the yield of Edam-like cheese during ripening .

Properties During ripening (days)	Herbs treatments					
	R ₁	R ₂	R ₃	R ₄	R ₅	
Yield %	0	12.82 ^a	13.64 ^a	12.95 ^a	12.48 ^a	13.42 ^a
	15	12.40 ^b	13.28 ^{ab}	12.43 ^b	12.12 ^b	13.10 ^b
	30	12.03 ^{bc}	12.86 ^{bc}	12.16 ^c	12.03 ^b	12.95 ^{bc}
	60	11.88 ^c	12.60 ^c	11.84 ^d	11.95 ^b	12.84 ^c
	90	11.64 ^c	12.46 ^{ac}	11.65 ^a	11.85 ^b	12.63 ^d
Weight loss %	0					
	15	3.28 ^d	2.64 ^d	4.01 ^d	2.88 ^d	3.38 ^c
	30	6.16 ^c	5.60 ^c	6.10 ^c	3.61 ^c	3.50 ^c
	60	7.33 ^b	6.89 ^b	8.57 ^b	4.25 ^b	4.32 ^b
	90	9.20 ^a	7.18 ^a	9.27 ^a	5.05 ^a	5.89 ^a

R₁ = Control R₂ = Chamomel R₃ = Thyme R₄ = Fennel R₅ = Pepper mint
 a,b,c,d,e means in the same column with different superscription, significantly different (p<0.05)

2 - Gross chemical composition of cheese:

2.1 Moisture content:

Table (2) indicates slight decrease of the moisture content in all groups as cheese treatments as ripening advanced. Decreasing of moisture content in all cheese samples during ripening might be attributed to expulsion of whey as a result of acidity development. These results are in accordance to those reported by El-Shafie (1994).

Table(2): Chemical composition of Edam-like cheese as affected by different herbs feeding treatments.

Chemical composition of cheese treatment		Ripening periods (days)				
		0	15	30	60	90
Moisture %	R ₁	49.78 ^a	46.97 ^b	44.35 ^c	42.93 ^{da}	42.64 ^d
	R ₂	48.71 ^a	45.61 ^b	43.83 ^c	43.43 ^d	42.99 ^a
	R ₃	48.25 ^a	44.73 ^b	42.50 ^c	41.88 ^d	41.41 ^a
	R ₄	49.49 ^a	45.45 ^b	42.12 ^c	41.70 ^c	41.14 ^d
	R ₅	49.39 ^a	44.23 ^b	42.91 ^c	41.61 ^d	41.42 ^d
Acidity %	R ₁	1.220 ^d	1.372 ^a	1.533 ^a	1.890 ^c	2.010 ^c
	R ₂	1.317 ^c	1.666 ^d	1.820 ^a	2.095 ^{abc}	2.214 ^b
	R ₃	1.266 ^b	1.615 ^c	1.972 ^a	2.010 ^{abc}	2.250 ^a
	R ₄	1.028 ^a	1.603 ^b	1.833 ^a	2.025 ^a	2.350 ^a
	R ₅	1.182 ^a	1.582 ^a	1.640 ^a	1.950 ^b	2.145 ^b
pH	R ₁	4.30 ^a	4.13 ^b	3.96 ^a	3.80 ^a	3.61 ^a
	R ₂	4.28 ^a	4.03 ^c	3.87 ^{ab}	3.65 ^b	3.59 ^a
	R ₃	4.19 ^c	4.00 ^c	3.76 ^b	3.36 ^d	3.48 ^{ab}
	R ₄	4.35 ^a	4.00 ^c	3.84 ^{ab}	3.65 ^b	3.42 ^b
	R ₅	4.30 ^b	4.34 ^a	3.75 ^b	3.58 ^c	3.40 ^b
Fat/D.M%	R ₁	49.172 ^d	49.363 ^b	49.675 ^a	49.875 ^a	50.120 ^c
	R ₃	49.087 ^{cd}	48.895 ^b	49.068 ^a	49.130 ^a	49.520 ^c
	R _r	49.451 ^{bc}	48.756 ^b	49.100 ^a	49.350 ^a	49.620 ^b
	R ₄	48.936 ^{ab}	49.175 ^b	49.150 ^a	49.350 ^a	49.560 ^{ab}
	R ₅	48.634 ^a	49.085 ^a	49.205 ^a	49.650 ^a	49.850 ^a
Salt %	R ₁	2.223 ^b	2.235 ^{bc}	2.364 ^{ab}	2.356 ^b	2.385 ^c
	R ₂	2.236 ^b	2.384 ^b	2.356 ^b	2.385 ^a	2.390 ^c
	R ₃	2.310 ^a	2.606 ^a	2.406 ^a	2.385 ^a	2.400 ^b
	R ₄	2.253 ^b	2.443 ^b	2.365 ^{ab}	2.365 ^b	2.450 ^b
	R ₅	2.309 ^a	2.135 ^c	2.336 ^c	2.355 ^b	2.490 ^a
Salt/TS %	R ₁	4.465 ^b	4.758 ^a	4.821 ^c	4.951 ^a	5.018 ^{ba}
	R ₂	4.589 ^{ab}	4.826 ^a	4.942 ^b	5.012 ^d	5.124 ^d
	R ₃	4.787 ^{ab}	4.963 ^c	5.025 ^b	5.254 ^c	5.318 ^c
	R ₄	4.551 ^a	4.875 ^b	5.034 ^a	5.116 ^b	5.251 ^b
	R ₅	4.675 ^c	4.894 ^a	4.958 ^a	5.012 ^a	5.128 ^a

R₁ = Control R₂ = Chamomel R₃ = Thyme . R₄ = Fennel R₅ = Pepper mint
a,b,c,d,e means in the same column with different superscription, significantly different (p<0.05)

2. 2 Fat content:

Table (2) shows the absence of significant changes between all cheese treatments. This could be explained on the basis that goats' milk had small fat globules. This resulted in some loss of milk fat in the whey during cheese making. The general trend of the results is in agreement with that reported by El-Shafie (1994) and Ashmawy (1997).

2. 3 Salt content:

Table (2) shows that different herbs feeding treatments did not remarkably affect the salt contents of the resultant cheese. During ripening a slight and gradual increase in the salt contents of all cheese treatment was observed. However, the variations noticed in salt contents in all treatments are more likely due to the difference in the moisture content of the cheese.

2 . 4 Acidity and pH values:

Titratable acidity increased and pH values decreased gradually with the advance of ripening in all cheese treatments as shown in table (2). These

results are in agreement with that reported by El-Shafie (1994); and Ashmawy (1997).

3 Nitrogen fractions:

3.1 Total nitrogen:

Data of table (3) and figure (1) revealed that cheese made from treated goats' milk (R_2 , R_3 , R_4 and R_5) had slight higher total nitrogen (T.N) than that of treatment R_1 with progress of the ripening period. The slight changes in TN content could be attributed to the changes in moisture content of cheese. These results are in agreement with those reported by El-Shafie (1994) and Ayyad 1997

Table(3):Nitrogen fractions content of Edam-like cheese during ripening as affected by different herbs feeding treatments .

Nitrogen fractions During ripening(days)	Herbs Treatments					
	R_1	R_2	R_3	R_4	R_5	
T.N %	0	3.657 ^a	3.826 ^a	3.650 ^a	3.750 ^a	3.850 ^a
	15	3.790 ^b	3.923 ^a	3.735 ^b	3.842 ^a	3.946 ^a
	30	3.820 ^b	4.070 ^a	3.895 ^b	3.978 ^a	4.095 ^a
	60	3.915 ^b	4.118 ^a	4.010 ^b	4.080 ^b	4.135 ^a
	90	3.950 ^c	4.220 ^a	4.169 ^b	4.140 ^b	4.204 ^a
SN /TN %	0	6.56 ^e	7.13 ^e	6.98 ^e	7.06 ^e	7.03 ^e
	15	10.24 ^d	13.66 ^d	12.22 ^d	12.57 ^d	12.86 ^d
	30	13.14 ^c	19.13 ^c	17.32 ^c	16.85 ^c	19.01 ^c
	60	19.34 ^b	22.92 ^b	21.07 ^b	19.95 ^b	22.45 ^b
	90	22.47 ^a	26.12 ^a	23.97 ^a	23.38 ^a	25.35 ^a
NPN/TN %	0	3.68 ^e	4.57 ^e	3.92 ^e	4.05 ^e	4.12 ^e
	15	4.38 ^d	5.48 ^d	4.85 ^d	4.89 ^d	4.52 ^d
	30	6.15 ^c	7.29 ^c	6.25 ^c	6.10 ^c	6.32 ^c
	60	9.71 ^b	11.12 ^b	10.20 ^b	10.45 ^b	10.86 ^b
	90	10.95 ^a	13.18 ^a	11.73 ^a	11.68 ^a	12.61 ^a
A.A.N/TN %	0	2.34 ^e	2.63 ^e	2.45 ^e	2.34 ^e	2.52 ^e
	15	3.76 ^d	3.98 ^d	3.57 ^d	3.38 ^d	3.87 ^d
	30	4.24 ^c	4.85 ^c	4.32 ^c	4.35 ^c	4.43
	60	7.16 ^b	7.63 ^b	7.45 ^b	7.21 ^b	7.58 ^b
	90	8.68 ^a	9.15 ^a	8.94 ^a	8.73 ^a	8.92 ^a

R_1 = Control R_2 = Chamomel R_3 = Thyme . R_4 = Fennel R_5 = Pepper mint
a,b,c,d,e means in the same column with different superscription, significantly different ($p < 0.05$)

3.2 Soluble nitrogenous compounds :-

Table (3) and figure (2) show gradual increase in the (SN/TN) ratio with the progress of the ripening period with more remarkable increases in treatments R_2 and R_5 than R_3 and R_4 when compared with control R_1 . These results are in agreement with those reported by El-Shafie (1994) and Ayyad 1997.

3.3 Non – protein nitrogen (NPN) :-

Table (3) and figure (3) indicate that the cheeses made from goats' milk by herbs feeding treatments R_2 and R_5 had relatively higher NPN/TN content than that of treatments R_3 and R_4 when compared with

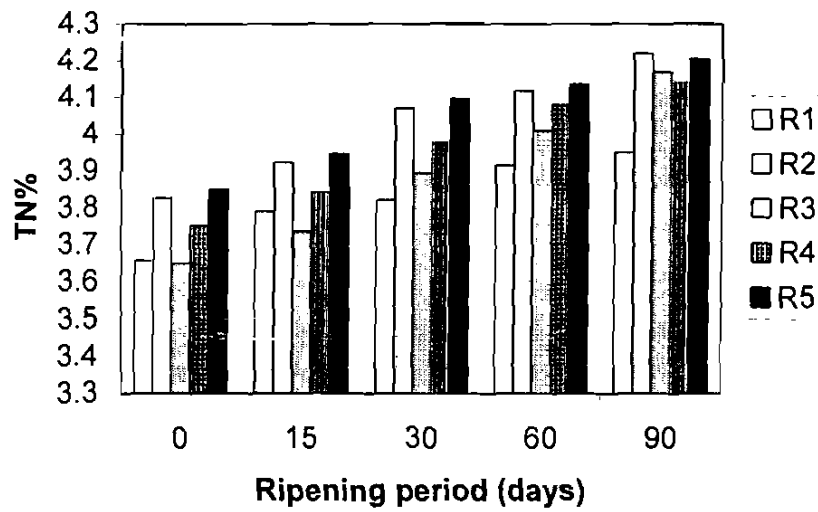


Figure (1): TN% contents of edam-like cheese during ripening as affected by herbs feeding treatments.
 R₁ = Control R₂ = Chamomel R₃ = Thyme . R₄ =Fennel R₅= Pepper mint

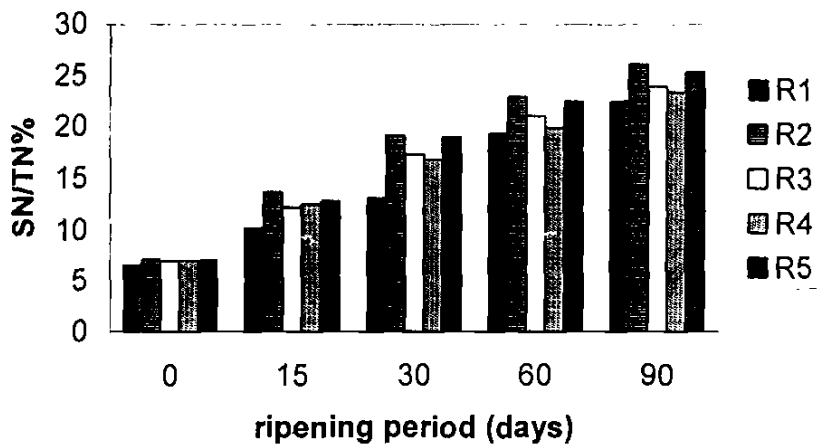


Figure (2): SN/TN% contents of edam-like cheese during ripening as affected by herbs feeding treatments.
 R₁ = Control R₂ = Chamomel R₃ = Thyme . R₄ =Fennel R₅= Pepper mint

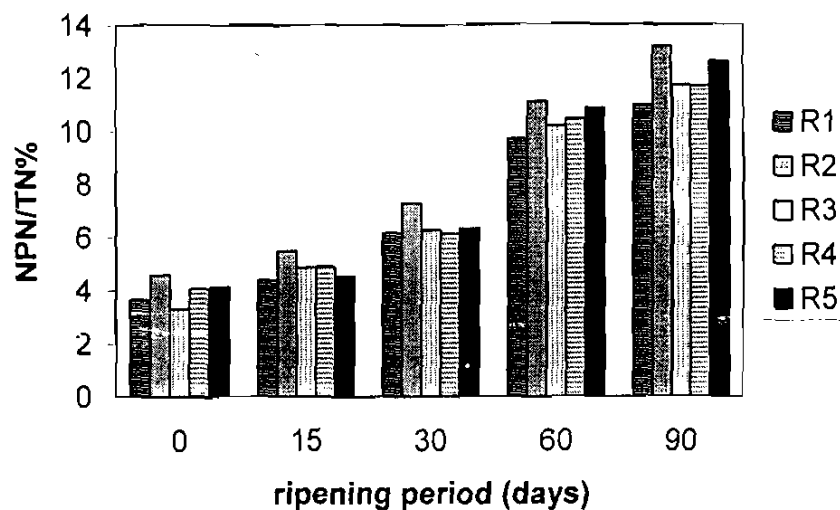


Figure (3): NPN/TN% contents of edam-like cheese during ripening as affected by herbs feeding treatments.
 R₁ = Control R₂ = Chamomel R₃ = Thyme . R₄ = Fennel R₅ = Pepper mint

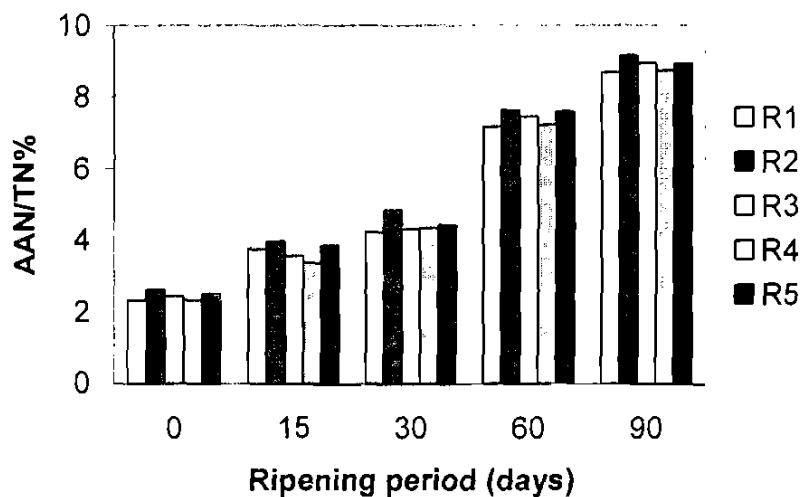


Figure (4): Amino acids nitrogen contents of edam-like cheese during ripening as affected by herbs feeding treatments.
 R₁ = Control R₂ = Chamomel R₃ = Thyme . R₄ = Fennel R₅ = Pepper mint

alower level of the control R₁ . These results are in agreement with those reported by El-Shafie (1994) and Ayyad (1997).

3.4 amino acids nitrogen content (A.A.N):-

Table (3) and figure (4) showe higher A.A.N (as % of T.N) in cheese made from goats'milk of the different feeding treatments (R₂, R₃ R₄ and R₅) than that of control cheese (R₁) . Thus in turn increased the rate of proteolysis during cheese ripening.

4- Total volatile fatty acids (T.V.F.A):

Table (4) shows higher content of total volatile fatty acids for feeding treatments R₂ and R₅ compared with those of R₁, R₃ and R₄ . At the end of ripening, cheese contained high levels of soluble nitrogenous compounds particularly amino acids which are considered to be contribution to the formation of VFA (Nakae and Elliott 1965). The general trend of these results is in agreement with that reported by Ashmawy (1997).

Table (4): Effect of different herbs feeding treatments on the Total Volatile fatty acids of Edam-like cheese during ripening .

Herbs Treatment	Ripening period (days)				
	0	15	30	60	90
R ₁	16.00 ^b	22.8 ^d	28.6 ^c	32.8 ^e	39.0 ^d
R ₂	18.6 ^a	26.4 ^a	34.2 ^a	38.4 ^a	47.6 ^a
R ₃	16.8 ^b	23.6 ^c	30.8 ^b	33.6 ^d	38.4 ^d
R ₄	16.4 ^b	22.8 ^c	31.0 ^b	34.6 ^c	40.3 ^c
R ₅	19.4 ^a	25.8 ^b	33.2 ^a	37.4 ^b	44.2 ^b

R₁ = Control R₂ = Chamomel R₃ = Thyme . R₄ =Fennel R₅= Pepper mint
a,b,c,d,e means in the same column with different superscription, significantly different (p<0.05)

5- Free fatty acids (F F A):-

From tables (5, 6, 7, 8 & 9) all cheese treatments samples contained the same fatty acids such as caprylic (C8), capric (C10) lauric (C12) , myristic (C14), palmitic (C 16), stearic (C18), oleic (C18 9=10), linoleic (C18 9=10, 12=13) and linolenic (C18 9=10 , 12=13 , 15=16) in different quantities

It could be observed that goats'milk cheese had high level of volatile fatty acids (C₂- C₁₀, and the fresh control cheese (R₁) showed the highest level of volatile fatty acids in the resultant cheese . On the other hand , the saturated fatty acid values were 46.066 , 58.200 , 51.052 , 48.617 and 52.262 , as percent of TFA content of the fresh cheese made from different treatments R₁, R₂, R₃, R₄ and R₅ respectively. As well as the values at 3 months old cheese made from goats'milk were 52.078 , 52.433 , 53.287 , 54.798 and 57.016 % respectively. The unsaturated fatty acids were 26.379 , 23.369 , 24.047 , 24.779 and 27.619 % in 3 months old cheese respectively.

These results are in agreement with that reported by Ashmawy (1997) and Ayyad (1997) .

Table (5): Effect of different herbs feeding treatments on free fatty acids content (%) of fresh Edam-like cheese

Fatty acids	Carbon Chain	Cheese treatments				
		R ₁	R ₂	R ₃	R ₄	R ₅
T.V.F.A	4			1.344	2.352	
	6	7.246	1.623	2.227	3.080	2.312
	8	6.320	3.624	3.03	3.519	2.803
	10	15.476	13.814	11.606	12.969	10.849
	12	3.289	3.787	3.428	3.513	2.895
	Total	32.331	22.848	21.635	25.433	18.858
Unsaturated fatty acid	14:1	0.359	0.484	0.374	0.445	0.449
	16:1	0.488	0.754	0.678	0.654	0.628
	18:1	20.756	17.008	25.853	23.715	27.454
	18:2		0.432	0.176	1.136	0.125
	18:3		0.274	0.232		0.214
	Total	21.603	18.952	27.313	25.950	28.880
Saturated fatty acid	14	8.287	10.512	9.265	9.704	8.554
	Iso 14				0.100	0.113
	15		0.699	0.483	0.537	0.550
	Iso16		0.452	0.485	0.574	0.589
	16	25.538	31.815	28.900	28.084	29.106
	17		0.408	0.361	0.392	0.344
	18	12.241	14.314	11.559	9.226	13.006
	Total	46.066	58.200	51.052	48.617	52.262

R₁ = Control R₂ = Chamomel R₃ = Thyme . R₄ =Fennel R₅= Pepper mint

Table (6): Effect of different herbs feeding treatments free fatty acids content (%) of Edam-like cheese at 15 days of ripening.

Fatty acids	Carbon chain	Cheese treatments				
		R ₁	R ₂	R ₃	R ₄	R ₅
T.V.F.A	4	1.943				1.733
	6	2.596	7.253	2.789	2.388	2.268
	8	3.035	6.205	3.153	2.943	2.737
	10	11.073	16.613	12.542	11.138	10.214
	12	3.183	3.649	3.678	3.446	3.010
	Total	21.830	33.72	22.162	19.915	19.962
Unsaturated fatty acid	14:1	0.523	0.463	0.428	0.493	0.516
	16:1	0.570	0.522	0.708	0.451	0.982
	18:1	26.851	20.375	24.884	26.628	25.652
	18:2					
	18:3					
	Total	27.944	21.360	26.020	27.572	27.150
Saturated Fatty acid	14	8.923	8.792	9.505	9.746	8.702
	Iso 14	0.125			0.126	0.121
	15	0.598		0.824	0.626	0.640
	Iso16	0.640			0.772	0.783
	16	27.399	25.413	30.058	28.523	29.335
	17	0.31		0.336	0.784	0.606
	18	12.231	10.715	11.095	11.936	12.701
	Total	50.226	44.920	51.818	52.513	52.888

R₁ = Control R₂ = Chamomel R₃ = Thyme . R₄ =Fennel R₅= Pepper min

Table (7): Effect of different herbs feeding treatments on free fatty acids contents (%) of Edam-like cheese ripened at 30 days of ripening.

Fatty acids	Carbon chain	Cheese treatments				
		R ₁	R ₂	R ₃	R ₄	R ₅
T.V.F.A	4	4.876	1.448		5.974	
	6	3.185	2.190	1.854	3.04	2.653
	8	3.433	2.783	2.404	3.533	2.805
	10	11.739	10.394	9.441	11.918	11.701
	12	3.259	3.393	3.343	3.573	3.546
	Total	26.492	20.208	17.042	28.038	20.705
Unsaturated fatty acid	14:1	0.373	0.497	0.377	0.396	0.530
	16:1	0.881	0.997	0.780	0.955	1.028
	18:1	22.848	25.340	26.984	23.228	24.992
	18:2					
	18:3					
	Total	24.102	26.834	28.141	24.579	26.550
Saturated Fatty acid	14	8.635	9.171	9.517	8.577	8.606
	Iso 14	0.146	0.136	0.099		
	15	0.476	0.612	0.545	0.475	0.711
	Iso16	0.704	0.745	0.624	0.720	1.052
	16	27.336	28.532	30.562	25.870	29.143
	17	0.516	0.597	0.503	0.525	0.612
	18	11.593	13.165	12.967	11.216	12.621
	Total	49.406	52.958	54.817	47.383	52.745

R₁ = Control R₂ = Chamomel R₃ = Thyme . R₄ =Fennel R₅= Pepper mint

Table (8): Effect of different herbs feeding treatments on free fatty acids contents (%) of Edam cheese ripened at 60 days of ripening .

Fatty acids	Carbon chain	Cheese treatments				
		R ₁	R ₂	R ₃	R ₄	R ₅
T.V.F.A	4				1.304	1.268
	6	1.984	1.885	2.317	1.988	1.688
	8	2.497	2.508	3.488	2.519	5.177
	10	9.709	10.061	12.779	9.997	8.578
	12	3.311	3.183	3.998	3.037	2.605
	Total	17.500	17.637	22.582	18.845	16.316
Unsaturated fatty acid	14:1	0.430	0.469	0.458	0.382	0.415
	16:1	0.962	1.002	1.009	0.700	0.783
	18:1	27.674	27.004	24.356	29.182	28.856
	18:2				0.242	
	18:3					
	Total	29.066	28.475	25.823	30.506	30.054
Saturated fatty acid	14	8.881	9.367	10.118	8.947	8.128
	Iso 14	0.131	0.148	0.146	0.059	
	15	0.585	0.585	0.592	0.386	0.542
	Iso16	0.806	0.612	0.676	0.334	0.595
	16	29.405	29.668	27.838	28.076	29.827
	17	0.568	0.553	0.520	0.344	0.455
	18	13.058	12.955	11.705	12.503	14.083
	Total	53.434	53.888	51.595	50.649	53.630

R₁ = Control R₂ = Chamomel R₃ = Thyme . R₄ =Fennel R₅= Pepper mint

Table (9):Effect of different herbs feeding treatments on free fatty acids contents (%) of Edam cheese at 90 days of ripenig..

Fatty acids	Carbon chain	Cheese treatments				
		R ₁	R ₂	R ₃	R ₄	R ₅
T.V.F.A	4	1.536		0.795		
	6	2.293	1.725	0.987	0.759	1.250
	8	2.957	3.457	3.171	2.759	2.139
	10	11.341	14.875	13.804	13.104	9.214
	12	3.416	4.141	3.909	3.801	2.762
	Total	21.543	24.198	22.666	20.423	15.365
Unsaturated fatty acid	14:1	0.380	0.413	0.579	0.696	0.448
	16:1	0.682	0.994	0.982	0.966	1.058
	18:1	25.317	21.962	22.486	23.117	26.113
	18:2					
	18:3					
	Total	26.379	23.369	24.047	24.779	27.619
Saturated fatty acid	14	9.579	11.186	10.647	10.469	8.838
	Iso 14				0.152	0.117
	15	0.496	0.553	0.670	0.806	0.578
	Iso16	0.596		0.636	0.525	0.551
	16	28.760	32.743	29.570	30.088	31.912
	17	0.436	0.655	0.587	0.575	0.586
	18	12.211	7.296	11.177	12.183	14.434
	Total	52.078	52.433	53.287	54.798	57.016

R₁ = Control R₂ = Chamomel R₃ = Thyme . R₄ =Fennel R₅= Pepper mint

6- Goaty flavour compounds:

From table (10) it could be noticed that the different herbs ratios were more effective in reducing the percentages of 4-methyloctanoic and 4-ethyloctanoic acids in both fresh and ripened cheese when compared with the control. On the other hand, it could be noticed that the levels of goaty flavour compounds in fresh cheese were decreased after ripening for 90 days in cheese treatment R₂, followed by R₅ then R₃ and lastly R₄.

These results could be explained by the effect of the higher heat treatment on removing some of these volatile fatty acids especially cheese milk was heated to 72°C/15sec. which was higher than the boiling point of the volatile fatty acids (C₂ – C₈). Also some of these branched chain fatty acids may inter in specific metabolic pathways of cheese microflora, thus reducing its concentration during ripening.

Table (10): Goaty flavour compounds (as % of T.V.F.A) in Edam-like cheese made from goats milk as affected by different herbs feeding treatments when fresh and after 90days

Goaty flavour compounds	Cheese Treatments									
	R ₁		R ₂		R ₃		R ₄		R ₅	
	Fresh	90	Fresh	90	Fresh	90	Fresh	90	Fresh	90
Hexanoic acid	6.210	11.312	14.363	9.129	17.582	14.211	16.021	13.509	12.254	13.841
4-methyl octanoic acid	2.103	0.580	1.292	0.413	1.711	0.531	1.794	0.552	1.398	0.453
4-ethyl octanoic acid	1.912	0.461	1.163	0.292	1.323	0.381	1.389	0.410	1.297	0.366
Nonanoic acid	1.410	0.230	1.020	0.00	1.312	0.160	1.351	0.183	1.121	0.00
Decanoic acid	46.714	52.744	47.861	58.091	60.00	60.824	54.120	63.181	52.131	59.970

R₁ = Control R₂ = Chamomel R₃ = Thyme . R₄ =Fennel R₅= Pepper mint

It is well known that volatile fatty acids including normal chain, branched chain and other minor fatty acids hydrolysed from milk fat by

lipases or present in milk as metabolic conjugates provide characteristic flavour for many foods especially cheese. It was also postulated that typical goaty flavour originates from branched chain fatty acids having 8 – 10 carbon atoms. Fatty acids exhibiting branching at the 4-position were found to have goaty-mutony-sheepy aroma notes and among them 4-ethyloctanoic acid exhibited an intense goat like aroma with the lowest threshold (1.8-6 pp b) for any fatty acids (Quere et al., 1996).

7- Microbiological analysis:

From table (11) the results show that the total bacterial counts and Lactic acid bacteria in all cheese treatments gradually decreased during the ripening period reaching to the lowest count at the end of ripening. These results are in agreement with that reported by Godinho and Fox (1981). As regards to different herbs feeding treatments, the Mould & Yeast counts of cheese made from different herbs feeding treatments, no colonies had been appeared in the fresh cheeses but after the first month of ripening few colonies had been observed. The results in Table (12) show that the proteolytic and Lipolytic bacterial counts in all treatments gradually decreased during the ripening period reached to the lowest count at the end of ripening. On the other hand, in coliform groups, no colonies had been appeared in the fresh cheeses and after the first and second months of ripening, but after this period few colonies had been appeared in all treatments except R₂. These results could be attributed to less soluble nitrogenous compounds in such cheese which could affect the growth and activity of cheese micro flora.

Table(11): Effect of different herbs feeding treatments on the Total bacterial count, lactic acid bacteria and Mould & Yeast content of goats milk Edam-like cheese during ripening.

Cheese treatments	Total bacterial count x 10 ⁶					Lactic acid bacteria x 10 ⁸					Mould & Yeast x 10 ²				
	Ripening period (days)														
	0	15	30	60	90	0	15	30	60	90	0	15	30	60	90
R ₁	195 ^a	165 ^{a,b}	120 ^a	86 ^a	51 ^a	173 ^a	140 ^a	95 ^a	67 ^a	43 ^a	--	--	1 ^c	2 ^b	4 ^a
R ₂	213 ^a	180 ^a	115 ^a	93 ^a	56 ^a	186 ^a	152 ^a	98 ^a	73 ^a	50 ^a	--	--	--	--	1 ^c
R ₃	180 ^a	156 ^{a,b}	135 ^a	85 ^a	46 ^a	162 ^a	124 ^a	87 ^a	61 ^a	40 ^a	--	--	--	--	2 ^b
R ₄	198 ^a	173 ^{a,b}	124 ^a	90 ^a	52 ^a	181 ^a	147 ^a	94 ^a	65 ^a	42 ^a	--	--	1 ^c	2 ^b	5 ^a
R ₅	196 ^a	150 ^b	112 ^a	78 ^a	44 ^a	168 ^a	141 ^a	73 ^a	58 ^a	38 ^a	--	--	2 ^b	4 ^a	5 ^a

R₁ = Control R₂ = Chamomel R₃ = Thyme R₄ = Fennel R₅ = Pepper mint
 a,b,c,d,e means in the same column with different superscription, significantly different (p<0.05)

Table (12): Effect of different herbs feeding treatments on the contents of Lipolytic bacteria, Proteolytic bacteria and Coliform groups of goats milk Edam-like cheese during ripening.

Cheese treatments	Lipolytic bacteria x 10 ⁴					Proteolytic bacteria x 10 ⁴					Coliform groups x 10				
	ripening period (days)														
	0	15	30	60	90	0	15	30	60	90	0	15	30	60	90
R ₁	56 ^a	42 ^a	33 ^a	25 ^a	15 ^a	67 ^a	54 ^{bc}	30 ^a	25 ^a	12 ^b	--	--	--	--	--
R ₂	68 ^a	53 ^a	40 ^a	23 ^a	16 ^a	74 ^a	62 ^{ab}	37 ^a	29 ^a	16 ^{ab}	--	--	--	--	--
R ₃	80 ^a	43 ^a	35 ^a	20 ^a	12 ^a	73 ^a	65 ^a	35 ^a	22 ^a	13 ^b	--	--	--	1 ^a	1 ^a
R ₄	55 ^a	46 ^a	37 ^a	27 ^a	15 ^a	68 ^a	50 ^{bc}	34 ^a	25 ^a	20 ^a	--	--	1 ^a	2 ^a	2 ^a
R ₅	63 ^a	44 ^a	32 ^a	24 ^a	14 ^a	56 ^a	43 ^a	31 ^a	23 ^a	16 ^{ab}	--	--	--	1 ^a	2 ^a

R₁ = Control R₂ = Chamomel R₃ = Thyme R₄ = Fennel R₅ = Pepper mint
 a,b,c,d,e means in the same column with different superscription, significantly different (p<0.05)

8- Organoleptic properties:

Table (13) indicates the organoleptic evaluation of Edam-like cheese made from some herbs feeding treatments. Treatment R2 gained higher score points for flavour as well as for body characteristics and total score points at different stages of ripening. The best treatments which had associated with the highest evaluation were R₂ and R₅ having strong, sharp flavour and good taste than other treatments. The general trend of these results was in agreement with that reported by Ashmawy (1997) and Ayyad (1997).

Table (13): Organoleptic properties of Edam-like cheese as affected by different herbs feeding treatments during ripening.

Cheese treatments	Fresh				2weeks storage				1st month storage				2nd month storage				3 rd month storage			
	A	Bt	F	T	A	BT	F	T	A	BT	F	T	A	BT	F	T	A	BT	F	T
R1	15	35	50	100	15	35	50	100	15	35	50	100	15	35	50	100	15	35	50	100
R2	13	30	35	78 ^b	14	31	37	82 ^b	14	32	40	86 ^b	14	33	42	89 ^b	14	33	45	92 ^a
R3	14	32	38	84 ^a	14	33	42	89 ^a	14	33	45	92 ^a	14	34	47	95 ^a	14	34	48	96 ^a
R4	13	31	35	79 ^b	14	32	39	85 ^b	14	32	43	89 ^b	14	33	45	92 ^b	14	34	47	95 ^a
R5	13	30	35	78 ^b	14	31	37	82 ^b	14	32	41	87 ^a	14	33	43	90 ^a	14	33	46	93 ^a
R5	13	31	36	80 ^b	14	32	38	84 ^b	14	32	43	89 ^b	14	33	45	92 ^b	14	34	47	95 ^a

A = appearance & colour. BT = body & texture. F = Flavor T = Total score point.

R₁ = Control R₂ = Chamomel R₃ = Thyme. R₄ = Fennel R₅ = Pepper mint

a,b,c,d,e means in the same column with different superscription, significantly different (p<0.05)

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تحسين نكهة الجبن الشبيه بالأيلام و المصنع من لبن الماعز بالتغذية على بعض الأعشاب الطبية .

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اهتم البحث بدراسة تأثير تغذية الماعز ببعض الأعشاب الطبية (أزهار الكاموميل و الزعتر و الشمر و النعناع الفلفلي) على خواص وجودة جبن الأيلام المصنع من هذا اللبن بهدف التغلب على نكهة الماعز غير المرغوبة حيث تم اختيار عدد ٥٠ من الماعز الزريبي عمرها من ٣ الى ٥ سنوات ومتوسط الوزن ٥٠ كجم وقسمت الى ٥ مجموعات غذيت على العلائق الآتية:

- أ- المجموعة الأولى: (المقارنة) غذيت على عليقة قياسية تحتوي المركبات الغذائية والبرسيم وقش الأرز كمادة مالئة.
- ب- المجموعة الثانية: غذيت على عليقة المقارنة بالإضافة الى أزهار الكاموميل.
- ج- المجموعة الثالثة: غذيت على عليقة المقارنة بالإضافة الى أوراق الزعتر وأجزائه الطبية.
- د- المجموعة الرابعة: غذيت على عليقة المقارنة بالإضافة الى ثمار المشمش.
- هـ- المجموعة الخامسة: غذيت على عليقة المقارنة بالإضافة الى أوراق النعناع الفلفلي والقمم الزهرية.

ويمكن تلخيص أهم النتائج التي تم الحصول عليها فيما يلي:-

١. محتوى جبن المعاملات المختلفة من الرطوبة والدهن والبروتين الكلي متقاربة الى حد ما فى جميع المعاملات .
 ٢. وجدت تغييرات واضحة فى نسبة النتروجين الذائب والنتروجين الغير بروتينى و نتراتروجين الأحماض الأمينية والأحماض الدهنية الكلية الطيارة والأحماض الدهنية الحرة فى جميع المعاملات المختلفة عن جبن مجموعة المقارنة.
 ٣. لوحظ أن محتوى المركبات المسنولة عن نكهة لبن الماعز فى الجبن الشبيه بالأيلام (٤-حمض ميثيل أوكتانويك و ٤- حمض إيثيل أوكتانويك) قليلة فى كل من الجبن الطازج والمسوى لمدة ٩٠ يوم للمجموعة الثانية يليها المجموعة الخامسة ثم الثالثة وأخيرا الرابعة مقارنة بالقيم العالية للمجموعة الأولى (المقارنة). وأكدت تلك النتائج التقدير الحسى للمجموعات المختلفة.
- لذلك يمكن التوصية بإضافة الأعشاب الطبية مثل البابونج ، الشمر ، الزعتر ، النعناع الى عليقة الماعز و بالتالى معالجة نكهة الماعز غير المرغوبة فى الجبن الشبيه بالأيلام .