J. Agric. Sci. Mansoura Univ., 28 (2): 1213 - 1227, 2003

EFFECT OF PROBIOTIES ON THE QUALITY AND RIPENING CHANGES OF EDAM -LIKE CHEESE MADE FROM GOATS ' MILK .

El-Shafie,Nemah M.[1];A.A.Abd El Baky[1]; M.M. Nasr[2] and A.A. El Zawahry[2]

1. Food Science Department, Faculty of Agriculture Zagazig University
2. Animal Production Research Institute – Agriculture Research Center. Cairo –Egypt

ABSTRACT

An attempt has been made to improve the quality of Edam-like cheese made from goats' milk . Traditional culture (containing *Lactococcus lactis subsp. lactis* , *Lactococcus lactis subsp cremoris* , *Lactococcus lactis subsp diacetylactis* and *Leuconostoc mesentroides subsp cremoris*)was replaced by a probiotic culture containing *Lactobacillus acidophilus* La-5, *Bifidobacterium bifidum* Bb-12 and *streptococcus thermophilus* St-20 probiotic(ABT) at levels of 25 , 50 , 75 and 100 % . This treatment slightly increased moisture content particularly at the higher rates of replacement. This was associated with somewhat high yield and low in weight loss. Total nitrogen, fat and salt contents were not affected considerably with this treatment. Glycolytic changes as indicated by titratable acidity and pH development took place in cheese with added probiotic (ABT) culture at a slight high rate compared with conventional cheese. Protein breakdown, fat hydrolysis and accumulation of volatile fatty acids increased in cheese containing probiotic culture. This was more intensive in cheese made using probiotic(ABT) culture (100%).The use of probiotic(ABT) culture did not considerably affect the percentages of the main components responsible for goaty flavour namely 4- methyloctanoic and 4-ethyloctanoic acids in fresh cheese .However the percentages of these branched chain fatty acids decreased with the progress of ripening . The organoleptic properties of cheese made using probiotic(ABT) culture at a rate of 100% gained the highest scores and were more preferable than other treatments whereas goaty flavour could not be detected in this treatment .The use of probiotic culture in the manufacture of Edam-like cheese with improved quality from goats' milk could be recommended .

INTRODUCTION

World wide application for goats' milk in cheese making has been growing recently. The easy adaptation of goats to poor and dry pastures encourages this aspect . Goats' milk and dairy products derived from it often face the problem of goaty flavour . Gomes and Malcata (1998) suggested that caprine milk and its dairy products might be improved by the addition of probiotic cultures.

Probiotic organisms such as lactobacillus and bifidobacterium spp. are described as living microorganisms which upon ingestion in certain numbers exert health benefits. Rasic and Kurmann, (1983) have shown that such organisms have several health benefits for human e,g anticarcinogenic effect, increased immino competence and antimicrobial activity. Meanwhile Blanchette *et al.* (1996) showed that dairy products containing bifidobacteria may be tolerated by individuals who are suffering from lactose intolerance.

The most popular food delivery systems for these cultures have been freshly fermented dairy foods such as yoghurts and fermented milks as well as unfermented milks with cultures added (Alm 1991 and Sanders et al

1996). To expand the probiotic product use, attention has been given to manufacture cheese which sustain a high viable count of probiotic cultures. Dinaker and Mistry (1994) used freeze, dried concentrate of *bifidobacteria infantes* to produce cultured Cottage cheese. Gomes *et al.* (1995) have used bifidobacteria spp. together with *Lactobacillus acidophilus* in the production of Gouda cheese. Gobbetti *et al.* (1997) produced Crescenza cheese (soft rindless Italian cheese) by incorporation of bifidobacteria. The authers showed that the presence of bifidobacteria did not influence the aerobic microflora, the growth of *Streptococcus thermophilus* used as a starter or the gross composition of the cheese. No differences were found in the primary proteolysis with respect to the conventional cheese but higher levels of S.N and more remarkable activites of amino peptidase, imino peptidase, dipeptidase and tripeptidase were detected in all cheeses with added bifidobacteria. Also cheese with added bifidobacteria showed concentration of lactic and acetic acids higher than those in the conventional cheese.
Stanton *et al.* (1996) evaluated the suitability of Cheddar cheese as a probiotic food, they showed that this trend depends on the particular probiotic strain used during manufacture . They added that the probiotic cheese can be manufactured without alteration of the cheese making technology. In addition these data suggested that some probiotic cultures remain highly viable during the ripening period and that cheese is as yoghurt for delivery of these strains at the GIT.

(Nasr 2001) showed that UF-Ras cheese with good quality could be produced when modified starter (heat-shocked yoghurt culture + bifidobacteria) was used in cheese making . The cheese contained sufficient bifidobacteria to be beneficial as dietary adjuncts. The processing time and ripening period decreased by 48 and 50 % respectively compared with traditional cheese. Meanwhile, the resultant cheese showed the highest organoleptic scoring.

The work in the present investigation was carried out to evaluate the effect of using a probiotic mixed culture on the quality and ripening changes of Edam-like cheese made from goats' milk.

MATERIALS AND METHODS

Materials:

Milk: Fresh goats' milk containing about 4% fat (zaraibi) was obtained from the herds of El-Serow Animal Research Station, Agricultural Research Center, Ministry of Agriculture.

Starter cultures:

A multiple mixed strain culture containing *Lactococus lactis subsp lactis.,L. lactis subsp cremoris., L. lactis subsp. diacetylactis* and *Leuconostoc mesenteroides subsp. cremoris* (LD-culture CH-N11) and multible mixed strain culture probiotic(ABT) containing *Lactobacillus acidophilus* La-5, *Bifidobacterium bifidum* Bb-12 and *Streptococcus thermophilus* St-20 was obtained from Chr-Hansen's laboratories, Copenhagen, Denmark.

Rennet:

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

Salt:

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

Calcium chloride:

Pure calcium chloride used in cheese making was obtained from Laboratory of Dairying of the Animal Production Research Institute, Dokki, Giza which was purchased from El-Gomhoria co., Cairo Egypt.

Annatto:

Solution of annatto used for cheese making was obtained 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.

Cheese making:

Goats' milk was standardized to 4 ± 0.1% of fat content then heated to 92°C/15s,then $CaCl_2$ was added at a level of 0.02%. Two types of starter cultures were used in cheese making. The frist type (A) was a mixed strain culture containing *Lactococcus lactis* subsp *lactis*, *Lactococcus lactis* subsp *crèmoris*, *lactococcus, lactis*. subsp. *diacetylactis* and *Leuconostoc mesenteroides* subsp *cremoris*. The second type probiotic(ABT) was a mixed strain culture containing *Lactobacillus acidophilus La-5 Bifidobacterum bifidum, Bb-12* and *Streptococcus thermophilus. St-20.*

Five treatments of Edam-like cheese were made using the above mentioned cultures as follows:

Treatment 1: Traditional cheese was made using starter culture (A) 100%.

Treatment 2: Starter culture (A) was replaced by probiotic(ABT) culture at a rate of 25%

Treatment 3: Starter culture (A) was replaced by probiotic(ABT) culture at a rate of 50%

Treatment 4: Starter culture (A) was replaced by probiotic(ABT) culture at a rate of 75%

Treatment 5: cheese was made using probiotic(ABT) starter culture 100%.

The starter cultures in all treatments were added to cheese milk at a level of 1 %.

The cheese making process was completed as described by Scott (1981). Resultant cheeses were ripened at 10±2°c and a relative humidity of 85-90%. Cheese samples were taken from the several treatments for analysis when fresh and after 30,60 and 90 days of ripening..

Chemical analysis of cheese milk :

Cheese milk was analyzed for total solids, fat, protein and acidity as described by Ling (1963)

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).

Salt content was estimated according to Davies (1932).The pH value of cheese were measured using a digital pH meter model 201 Orion Research, Japan.

Cheese fat acidity was determined according to Abdel-Kader (1971) and Woodman (1941),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) and determined 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 : helium or nitrogen
-Flow rate: 50mg/min.
-Column temp: 200°C
-Loading: 0.1-0.2µl
-Detector temp. : 210-220°C
-Comparison : against samples of known identify.

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 : helium or nitrogen
-Flow rate: 25 mg/min.
-Column temp: 80-200°C
-Loading: 0.1-0.2µl
-Detector temp. : 220°C
-Programming gradient:8 °C /min.

Microbiological analysis of cheese:

Total bacterial count was determined by Marth (1978) . Proteolytic bacterial count was determined as described by Chalmer (1962) . Lipolytic bacterial count of cheese samples was determined as given by Sharf (1970). Moulds and yeast counts were enumerated as recommended by the APHA (1978).

Cheese hardness:

Cheese hardness expressed as m.m penetration was measused as described by Ahmed(1997). A penetrometer supplied by Koehler Instrument Company Inc. 1595 Sgcomore Avenue, Bohemio, New York 11716, USA. was used.

Organoleptic properties:

Fresh and ripened cheese were organoleptically examined after 0 , 30 , 60 and 90 days of ripening with maximum score points of 50 , 40 ,and 10 for flavour , body characteristics and appearance(Abd-El-Fattah 1966).

Statistical analysis:

Results were statistically evaluated by a split- pilot ANOVA to determine the effects of replacing traditional culture with ABT culture on the different properties of cheese (Bulmer, 1967).

RESULTS AND DISCUSSION

Cheese yield, loss of weight and gross chemical composition:-

Data presented in table (1 and 2) show the effect of replacing rate of traditional starter culture by probiotic(ABT) culture at different levels on yield, loss of weight and gross chemical composition of Edam-like cheese made from goats' milk. Cheese yield slightly increased and loss of weight slightly decreased by this treatment particularly at the high replacing rates. This was associated by somewhat high moisture contents. These results could be attributed to the differences in the type of curd syneresis and the rate of pH decrease in the curd which was due to the differences in the properties of traditional and probiotic cultures. Gomes *et al* (1995) showed that the types of curd syneresis and rate of pH development in the curd were affected in Gouda cheese with added probiotic cultures and those were associated with the presence of some visible crakes in the resultant cheese.

Table (1): Effect of replacing rate of traditional starter culture by probiotic (ABT) culture on yield and weight loss of Edam-like cheese made from goats' milk through ripening period.

Properties	Ripening period (days)	Control	Replacing rate of traditional starter culture by ABT culture			
			%25	%50	%75	%100
Yield %	0	15.41^{a}	15.22^{b}	15.44^{a}	15.44^{a}	15.44^{a}
	30	14.22^{a}	14.19^{a}	14.31^{a}	14.56^{a}	14.50^{a}
	60	13.88^{b}	13.85^{b}	14.11^{a}	14.29^{a}	14.28^{a}
	90	13.68^{ab}	13.59^{b}	13.81^{a}	13.85^{a}	13.89^{a}
Weight Loss %	0	-	-	-	-	-
	30	7.72^{a}	6.13^{b}	7.27^{a}	5.61^{b}	6.05^{b}
	60	9.96^{a}	8.36^{c}	8.54^{b}	7.45^{d}	7.49^{d}
	90	11.28^{a}	10.10^{d}	10.55^{b}	10.30^{c}	10.02^{d}

Control : Cheese made by traditional starter culture.

A,b,c,d: Means with same letter among the treatments in the same period are not significantly different.

Control cheese and cheese with added probiotic(ABT) cultures at different levels showed comparable levels of total N., salt and fat. Glycolytic changes as indicated by titratable acidity and development of pH took place in cheese with added probiotic(ABT) culture at relatively high rate compared with cheese made by traditional culture. This was more observable at the higher rate of replacing traditional culture by probiotic (ABT) culture.

Table(2):Effect of replacing rate of traditional starter culture by probiotic (ABT) culture on chemical composition of Edam–like cheese made from goats' milk through ripening period .

Chemical composition	Ripening period (days)	control	Replacing rate of traditional starter culture by ABT culture			
			%25	%50	%75	%100
Moisture %	0	51.26^{a}	51.26^{a}	51.33^{a}	51.52^{a}	51.72^{a}
	30	45.56^{c}	45.54^{c}	46.41^{b}	46.78^{a}	46.83^{a}
	60	44.51^{b}	44.50^{b}	45.82^{a}	45.85^{a}	45.93^{a}
	90	43.50^{b}	43.46^{b}	44.50^{a}	44.60^{a}	44.75^{a}
Fat/ D.M %	0	48.89^{a}	48.99^{a}	48.70^{a}	48.61^{a}	48.81^{a}
	30	49.78^{a}	49.83^{a}	49.88^{a}	49.65^{a}	50.00^{a}
	60	51.42^{ab}	51.16^{b}	51.80^{a}	51.79^{a}	51.90^{a}
	90	51.87^{a}	52.00^{a}	52.37^{a}	52.39^{a}	52.37^{a}
T.N/D.M%	0	7.28^{a}	7.29^{a}	7.29^{a}	7.30^{a}	7.30^{a}
	30	6.94^{d}	6.94^{d}	7.00^{b}	6.95^{a}	6.97^{c}
	60	6.84^{b}	6.84^{b}	6.94^{a}	6.91^{a}	6.85^{b}
	90	6.81^{b}	6.86^{a}	6.84^{ab}	6.83^{b}	6.81^{b}
Salt%	0	2.70^{a}	2.69^{a}	2.70^{a}	2.71^{a}	2.72^{a}
	30	3.40^{b}	3.39^{b}	3.46^{a}	3.49^{a}	3.49^{a}
	60	3.88^{b}	3.89^{b}	3.98^{a}	3.99^{a}	4.00^{a}
	90	4.13^{b}	4.13^{b}	4.23^{a}	4.24^{a}	4.25^{a}
Acidity	0	0.90^{b}	0.92^{ab}	0.92^{ab}	0.93^{a}	0.93^{a}
	30	1.20^{c}	1.23^{bc}	1.25^{abc}	1.28^{ab}	1.30^{a}
	60	1.25^{c}	1.28^{ab}	1.30^{abc}	1.33^{ab}	1.36^{a}
	90	1.32^{c}	1.35^{bc}	1.38^{bc}	1.41^{ab}	1.45^{a}
PH	0	4.50^{a}	4.48^{ab}	4.47^{ab}	4.46^{b}	4.45^{b}
	30	4.28^{a}	4.24^{a}	4.19^{b}	4.14^{c}	4.10^{c}
	60	4.20^{a}	4.15^{b}	4.10^{c}	4.07^{c}	4.05^{c}
	90	4.13^{a}	4.06^{b}	4.03^{b}	4.01^{c}	4.01^{c}

Control : Cheese made by traditional starter culture.

A,b,c,d : Means with same letter among the treatments in the same period are not

significantly different.

Desjardins *et al.* (1990) showed that all strains of bifidobacteria possessed α and β galactosidase activities and this in turn enhanced the conversion of lactose to lactic acid. Meanwhile, Gobbetti *et al* (1997) showed that cheese with added bifidobacteria contained traces of lactose and had concentrations of both lactic and acetic acids slightly higher than the conventional cheese. In addition the presence of bifidobacterium and *lactobacillus acidophilus* in the probiotic (ABT) culture might contribute to the higher rate of acidity in cheese with added probiotic(ABT) culture. Gomes *et al.* (1995) noticed a synergistic effect seems to be exist between *bifidobacterium sp* and *L.acidophilus* strains and they found that the acid production of mixed culture was greater than the same rate of acid production when the two strains were employed independently with the same inoculum rate in cultured milk . The general trend for these results are in agreement with that reported by Gomes *et al.* 1995, Blanchette *et al.* 1996; Gomes and Malcata 1998; Gobbetti *et al.* 1998 and El-Zayat and Osman, 2001.

Rate of ripening :

Proteolysis:

Protein degradation was assessed by the determination of soluble nitrogen (S.N), non protein nitrogen (N.P.N) and amino acid nitrogen (A.A.N) (Table 3). The use of probiotic (ABT) culture significantly affected the rate of proteolysis. This was more remarkable with increasing the level of ABT culture. Cheese made using probiotic (ABT) starter culture showed higher S.N./T.N, N.P.N/T.N and A.A.N/T.N contents than those of control cheese made using the traditional starter culture along the ripening period. The highest level of nitrogen fractions was found to be in cheese made using probiotic (ABT) culture at level of 100%. These results could be explained on the basis that bifidobacterium had more pronounced aminopeptidase activity specially, imino-, di- and tripeptidase activities. Minagawa *et al.* (1985) described the exopeptidase system of several bifidobacterium strains and demonstrated the presence of amino peptidase, iminopeptidase and carboxy peptidase activities. Meanwhile, El-Soda *et al.* (1992) showed that bifidobactereium spp. had casein hydrolytic activity .

The presence of *L.acidophilus* as a component of probiotic (ABT) culture might contribute to the more rate of proteolysis observed in cheese with added ABT culture . Gomes *et al* (1995) showed that Gouda cheese with added probiotics showed higher degree of proteolysis than that in the conventional cheese. They attributed their conclusion to the strong proteobtic activity *of L.acidophilus*.

Lipolysis:

Lipolysis was evaluated by the determination of cheese fat acidity , total volatile fatty acids and .free fatty acids

Fat acidity:

Table (3) shows the changes in cheese fat acidity expressed as percent of oleic acid and T.V.F.A of Edam-like cheese made from goats' milk

as affected by using ABT culture. These data show that ABT starter culture remarkably affected the fat acidity of the resultant cheese whereas fat acidity of resultant cheese increased by increasing the level of added probiotic (ABT) starter culture. Fresh cheese fat acidity were 0.833 , 0.825, 0.821, 0.823 and 0.830 and increased to 1.184, 1.195, 1.209, 1.226 and 1.266 at the end of ripening period for control cheese made by using traditional starter culture, cheese made from probiotic (ABT) culture at levels of 25, 50, 75 and 100%, respectively. The general trend of these results is in agreement with that reported by Gomes and Malcata (1998).

Table (3): Effect of replacing rate of traditional starter culture by probiotic (ABT) culture on ripening indices of Edam - like cheese made from goats' milk through ripening period.

Ripening indeces	Ripening period (days)	control	Replacing rate of traditional starter culture by ABT culture			
			25	50	75	100
S.N./T.N (%)	0	892^{c}	873^{d}	908^{b}	925^{a}	936^{a}
	30	1363^{d}	1336^{e}	1466^{c}	1563^{b}	1629^{a}
	60	1750^{d}	1701^{e}	1831^{c}	1950^{b}	2005^{a}
	90	2025^{b}	1985^{e}	2063^{c}	2108^{b}	2150^{a}
N.P.N./T.N.	0	481^{a}	481^{a}	484^{a}	486^{a}	490^{a}
	30	847^{d}	851^{d}	878^{c}	911^{b}	941^{a}
	60	1063^{d}	1050^{e}	1108^{c}	1123^{b}	1138^{a}
	90	1309^{c}	1333^{c}	1360^{b}	1370^{b}	1391^{a}
A.N./T.N.	0	235^{a}	236^{a}	236^{a}	239^{a}	239^{a}
	30	470^{b}	473^{b}	483^{b}	496^{a}	504^{a}
	60	801^{d}	818^{d}	845^{c}	877^{b}	901^{a}
	90	969^{e}	984^{d}	1023^{c}	1040^{b}	1058^{a}
Fat acidity	0	0833^{a}	0825^{ab}	0821^{b}	0823^{ab}	0830^{ab}
	30	1042^{c}	1046^{c}	1064^{b}	1072^{b}	1086^{a}
	60	1116^{d}	1120^{d}	1143^{c}	1157^{b}	1184^{a}
	90	1184^{a}	1195^{d}	1209^{c}	1226^{b}	1266^{a}
T.V.F.A ml Na OH N/10.	0	1564^{b}	1567^{b}	1580^{ab}	1586^{ab}	1597^{a}
	30	3227^{d}	3260^{c}	3283^{b}	3357^{a}	3373^{a}
	60	3943^{e}	3980^{d}	4003^{c}	4023^{b}	4062^{a}
	90	4517^{d}	4533^{d}	4550^{c}	4573^{b}	4596^{a}

Control : Cheese made by traditional starter culture.

A,b,c,d : Means with same letter among the treatments in the same period are not significantly different.

Total volatile fatty acids and free fatty acids :

From the data in Table (3), it could be seen that the replacing rate of traditional starter culture by probiotic (ABT) culture remarkable affected the T.V.F.A of the resultant cheese. Whereas, T.V.F.A of resultant cheese increased by increasing the replacing rate of traditional starter culture by probiotic(ABT)culture. It could be noticed that the cheese made from probiotic (ABT) starter culture at rate 100% had the highest levels of T.V.F.A. Gobbetti *et al* (1997) showed that there were marked esterase activities on C4, C6 and C8 B-naphthyl derivalies .Esterase activity as chain length of the fatty acids derivatives increased .The general trend for these results are in agreement with that reported by Gomes and Malcata (1998).

Table (4) shows the pattern of free fatty acids (F.F.A) as % of total of

Table (4): Effect of replacing rate of traditional starter culture by probiotic (ABT) culture on F.F.A as % of total of Edam- like cheese made from goats' milk after 90 days of ripening

Fatty acids	C:	Control	Replacing rate of traditional starter culture by ABT culture			
			%25	%50	%75	%100
Volatile fatty acids	6+4	1.294	1.353	2.173	1.386	1.898
	8	1.697	1.777	2.266	1.825	2.188
	10	7.721	8.336	8.999	9.163	9.952
	total	10.712	11.466	13.438	12.374	14.038
Non-volatile fatty acids	12	2.771	3.007	2.285	2.967	2.849
	14	9.126	8.719	6.849	8.745	8.475
	14:1	0.958	0.730	0.252	0.315	0.265
	15	0.493	1.645	1.369	0.796	0.274
	Iso-16		0.917		0.293	0.347
	16	31.779	29.567	28.024	33.448	32.501
	16:1	1.347	1.346		0.596	0.641
	17	1.667	0.835	0.475	0.244	0.253
	18	7.825	10.238	19.859	12.731	9.982
	18:1	33.936	30.454	27.291	27.492	30.376
	18:2	0.088	0.433	0.105		
	18:3		0.643	0.051		
	Total	89.288	88.534	86.560	87.627	85.963

Control : Cheese made by traditional starter culture.

Edam-like cheese made from goats' milk as affected by using probiotic (ABT) culture. Results showed that the pattern of free fatty acids isolated from all treatments was found to be the same. The obtained results indicated that introducing probiotic (ABT) culture in cheese making increased the levels of volatile fatty acids at the end of ripening. This increase was more remarkable when cheese was made using probiotic (ABT) culture (100%). Total volatile

fatty acids constituted 10.712, 11.466, 13.438, 12.374 and 14.038 % of total free fatty acids at the end of ripening for control cheese made by using traditional starter culture and cheese made from probiotic (ABT) starter culture at rates 25, 50, 75 and 100% respectively in the same order. The high levels of free fatty acids could be attributed to the high from one side and the more accumulation of soluble nitrogenous compounds from the other side. Soluble nitrogenous compounds particularly free amino acids play an important role as precursors for the formation of volatile fatty acids through specific metabolic pathways (Nakae and Elliott, 1965). The general trend of these results is in agreement with that reported by Gomes *et al* (1995); Gomes and Malcata (1998) and Gobbetti *et al.* (1998).

Goaty flavour:

Table (5) shows the major branched chain fatty acids which are considered to be responsible for goaty flavour. From these results it could be observed that introducing probiotic (ABT) culture in cheese making did not have a considerable effect on the percentages of both 4-methyloctanoic and

Table (5): Effect of replacing rate of traditional starter culture by probiotic culture on goaty flavour compounds (as % of T.V.F.A) of Edam –like cheese made from goats' milk when fresh and after 90 days of ripening .

Goaty flavour compounds	Control		Replacing rate of traditional starter culture by ABT culture							
			$\%_{025}$		$\%_{050}$		$\%_{075}$		$\%_{0100}$	
	Fresh	90	Fresh	90	Fresh	90	Fresh	90	Fresh	90
Hexanoic acid	12.62	8.83	16.94	9.21	4.26	9.87	4.21	8.64	10.53	9.17
4methyloc-tanoic acid	1.20	0.86	1.32	1.10	1.70	1.40	1.02	1.00	1.42	1.13
4 ethyloctanoic acid	0.82	0.48	0.81	0.67	0.72	0.53	0.76	0.71	1.21	0.92
Nonanoic acid	2.19	2.63	2.32	3.26	3.20	3.60	4.12	3.73	4.38	3.51
Decanoic acid	63.51	74.16	56.86	59.48	61.00	58.25	69.57	65.95	60.12	64.74

Control : Cheese made by traditional starter culture.

4-ethyloctanoic acids in the cheese of different treatments, but the percentages of these components decreased with progress of ripening.Thus 4-methyloctanoic acid constituted 1.2, 1.32, 1.7, 1.02 and 1.42 % of total volatile fatty acids. The corresponding values for 4-ethyloctanoic acid were 0.82, 0.81, 0.72, 0.76 and 1.21 % of T.V.F.A for control cheese made using traditional starter culture and cheese made using probiotic (ABT) starter culture at levels of 25, 50, 75 and 100% respectively. On the other hand, the percentages of 4-ethyloctanoic acid were 0.82, 0.81, 0.72, 0.76 and 1.21 % of T.V.F.A. for fresh cheese and these values decreased to 0.48, 0.67, 0.53, 0.71 and 0.92 % of T.V.F.A for 90 days old cheese in control cheese made from traditional starter culture and cheese made from probiotic (ABT) starter

culture at rates 25, 50, 75 and 100%, respectively. The above mentioned observation might be assimilated by the enzyme system of probiotics (Gomes *et al* 1995 and Blanchette *et al* 1996)

Microbiological properties:

Table (6) showed that the changes in total, proteolytic and lipolytic bacterial counts as well as yeast and moulds in Edam-like cheese made from goat's milk as affected by type of starter culture during ripening. Results showed that the total, proteolytic and lipolytic bacterial counts in all treatments gradually decreased during the ripening period reaching the least count at the end of ripening. Total bacterial and Proteolytic bacterial counts were higher in cheese made from probiotic (ABT) culture at rate 100% . On the other hand, yeast and moulds counts in all cheeses gradually increased with the advance of ripening. The obtained results also indicated that yeast and moulds count decreased by increasing the rate of probiotic (ABT) culture indicating that bifidobacteria gave unfavourable condition for the growth of yeast and moulds (Rasic and Kurmann, 1983). Similar results were reported by Gobbetti *et al.* (1998).

Table (6): Effect of replacing rate of traditional starter culture by probiotics (ABT) culture on microbiological properties of Edam –like cheese made from goats' milk through ripening period .

Microbiological	Ripening period (days)	control	Replacing rate of traditional starter culture by ABT culture			
			%25	%50	%75	%100
Total bacterial count (X^{8} 10 C F.U/ g)	0	154^{b}	155^{b}	164^{ab}	$161^{a,b}$	166^{a}
	30	126^{a}	125^{a}	127^{a}	129^{a}	131^{a}
	60	71^{a}	65^{ab}	51^{c}	53^{bc}	72^{a}
	90	33^{a}	31^{ab}	24^{b}	28^{ab}	35^{a}
Proteolytic bacterial count (x 10^{4} C.F.U /g)	0	41^{ab}	44^{a}	38^{bc}	35^{c}	43^{ab}
	30	30^{ab}	31^{ab}	30^{ab}	27^{b}	32^{a}
	60	24^{a}	26^{a}	23^{a}	20^{b}	25^{a}
	90	16^{a}	16^{a}	15^{a}	14^{a}	18^{a}
Lipolytic bacterial count (X103 C.F.U /g)	0	42^{c}	45^{abc}	43^{bc}	46^{ab}	48^{a}
	30	25^{c}	28^{bc}	30^{b}	32^{ab}	35^{a}
	60	19^{b}	21^{ab}	22^{ab}	22^{ab}	26^{a}
	90	14^{b}	16^{b}	17^{ab}	18^{ab}	21^{a}
Yeast and moulds count (X10 C.F.U /g)	0	-	-	-	-	-
	30	8.0^{a}	7.0^{ab}	6.3^{ab}	5.7^{ab}	4.3^{b}
	60	12.3^{a}	10.0^{ab}	9.7^{ab}	8.0^{b}	7.0^{b}
	90	15.0^{a}	12.0^{b}	11.3^{b}	10.3^{b}	9.3^{b}

Control : Cheese made by traditional starter culture.

A ,b ,c ,d : Means with same letter among the treatments In the same period are not significantly different

Hardness of cheese:

Hardness was expressed as millimeters penetration by penetrometer in Edam-like cheese made from goat's milk using probiotic (ABT) cultures

(Table 7). From the obtained results it could be noticed that ABT cultures have some decreasing effect on hardness. The effect of probiotic (ABT) cultures on hardness could be explained by the high moisture content and the more proteolysis observed in cheese containing bifidobacteria. It is known that water can acts as lubricant in cheese and an increase in moisture content would increase the hydration of protein and enhance freedom of movement, thereby increasing the deformability of cheese and consequently decrease hardness. Meanwhile the increase in proteolysis result in less intact protein network that decrease hardness . The general trend of these results is in agreement with that reported by Gomes and Malcata (1998).

Table (7): Effect of replacing rate of traditional starter culture by probiotics (ABT) culture on hardness of Edam- like cheese made from goats' milk through ripening period.

Ripening period (days)	control	Replacing rate of traditional starter culture by ABT culture			
		%25	%50	%75	%100
0	13.83[a]	13.56[a]	13.82[a]	13.85[a]	14.05[a]
30	11.80[a]	11.50[a]	11.58[a]	11.80[a]	12.02[a]
60	10.20[a]	9.86[a]	10.09[a]	10.25[a]	10.50[a]
90	9.80[a]	9.28[a]	9.56[a]	9.59[a]	9.83[a]

Control : Cheese made by traditional starter culture.
A ,b ,c ,d : Means with same letter among the treatments in the same period are not significantly different

Organoleptic properties:

Table (8) shows that, the average scores given for appearance, flavour and body characteristics of Edam-like cheese made from goats' milk as affected by type of starter culture. These data clearly showed that the type of starter culture significantly affected the organoleptic properties of the resultant cheese. It could be noticed that using probiotic (ABT) culture in cheese making greatly improved the overall organoleptic properties of the ripened cheese. The highest scoring was observed in 60-90 days ripened cheese when probiotic (ABT) culture was used alone (100%) or in combination with traditional starter culture at a level of 75 % whereas goaty flavour was never detected in the cheese of such treatments . The decrease in the percentages of branched chain fatty acids with the progress of ripening seems to have positive effect on the overall quality of ripened cheese as this enabled to restrict the goaty flavour. Brennand *et al* (1989) showed that fatty acids exhibiting branching at the 4-position were found to have goaty-mutton-sheepy aroma notes and among them 4-ethyloctanoic acid exhibited an intense goat like aroma with the very low concentration. In addition, the higher level of volatile fatty acids observed in ripened cheese with added probiotic (ABT) culture might mask the goaty flavour of the residual branched chain fatty acids

Table (8): Effect of replacing rate of traditional starter culture by probiotics (ABT) culture on organoleptic properties of Edam- like cheese made from goats' milk through ripening period .

Ripening period (days)	Scoring		control	Replacing rate of traditional starter culture by ABT culture			
				25	50	75	100
0	Appearance	10	800	800	800	800	800
	Body & texture	40	3300	3200	3300	3300	3400
	Flavour	50	4200	4200	4200	4250	4250
	Total score	100	8300^{b}	8200^{c}	8300^{b}	8350^{b}	8450^{a}
30	Appearance	10	900	800	900	900	900
	Body & texture	40	3600	6500	3550	3500	3650
	Flavour	50	4450	4400	4450	4400	4500
	Total score	100	8950^{a}	8700^{c}	8900^{a}	8800^{a}	9050^{a}
60	Appearance	10	900	800	900	900	900
	Body & texture	40	3650	3600	3600	3600	3750
	Flavour	50	4750	4600	4750	4700	3850
	Total score	100	9300^{b}	9000^{d}	9250^{bc}	9200^{c}	9500^{a}
90	appearance	10	900	800	900	900	950
	Body & texture	40	3700	3700	3750	3700	3800
	Flavour	50	4800	4700	4750	4700	4850
	Total score	100	9400^{b}	9200^{d}	9400^{b}	9300^{c}	9600^{a}

Control : Cheese made by traditional starter culture.
A ,b ,c ,d : Means with same letter among the treatments in the same period are not significantly different

REFERENCES

Abd El-Fattah, E. A (1966) Studies on butter milk and its utilization In the manufacture of Baby Edam cheese . M. Sci. Thesis , Ain -Shams Univ . Egypt.

Abdel-Kader, A. M. E. (1971) Studies on improvement of Domiati cheese made from dried milk. M.Sci. Thesis , Ain Shams Univ. Egypt.

Ahmed, A.G (1997) Chemical and microbiological studies on processed cheese. M. Sci. Thesis, Faculty of Agric. Univ.of Ain .Shams .Egypt

Alm , L. (1991) The therapeutic effects of various cultures – an overview . In Therapeutic Properties of Fermented Milks. Ed.R.K. Robinson. Elsevier . New York PP. 45-64 .

5-APHA (1978)Standard Methods for the examination of dairy products (American Public Health Association) Inc 12th ed. New York.

Blanchette-L; D. Roy; G. Belanger; S.F. Gauthier (1996). Production of Cottage cheese using dressing cream fermented by bifidobacteria. Journal-of-Dairy-Science., 79 (1): 8-15.

Brennand , C.B.; J.K. Ha; and C. Lindasy (1989) Volatile fatty acids occurring in milk fat and meat lipids. J. of Sensory Studies, 4- 105 .

Bulmer, M.G (1967)Principles of statistics .2 nd. Ed .Oliver and Boyed , Edinburg and London.

Chalmer , C.H.(1962) Bacteria in Relation to the milk Supply. 4 th Ed .London pub .Edward Arnold .

Davies,W.L(1932) Determin-ation of sodium chloride in milk Analyst (57):81

Desjardins, M. L.; Roy, D.; Toupin, C. and Goulet, J.(1990) Uncoupling of growth and acid production in Bifidobacterium spp. J. Dairy Sci. 73 :; 1478 : 1484 .

Dinakar,P. and Mistry,V.V. (1994) Growth and viability of Bifidobacterium bifidum in Cheddar cheese J.Dairy Sci. 77: 2854- 2864 .

El-Soda,M.; Macedo,A. and Olson,N.F.(1992) The peptide hydrolase system of Bifidoba-cterium species. Michwis-senchaft 47 : 87-90

El-Zayat-A.I and Osman, M.M (2001) The use of probiotics in Taliag cheese, Egyptian-Journal of Dairy-Science 29 (1): 99 - 106 .

Gobbetti, M; Corsetti, A ; Smacchi, E ; Zocchetti, A ; Angelis, M-de De–Angelis, M. (1998) Production of Crescenza cheese by incorpo-ration of bifidobacteria . Journal of Dairy-Science. 1998, 81: 1, 37-47.

Gobbetti, M.; Corsetti, A. ; Smacchi, E.; De Angelis, M. And Rossi, J. (1997) Microbiology and biochemistry of Pecorino Umbro cheese during ripening. Ital. Food Sci. 2: 111-126 .

Gomes ,A.M.P.and Malcata, F.X (1998) Development of probiotic cheese manufactured from goat milk : response surface analysis via technological manipulation. Journal of Dairy Science 81 (6) 1492-1507.

Gomes ,A.M.P; F.X. Malcata; F.A.M. Klaver and H.J Grande (1995). Incorporation and survival of Bifidobacterium sp. strain Bo and Lactobacillus acidophilus strain Ki in a cheese product .Netherlands-Milk-and-Dairy-Journal, 95-71, 2-3: 49.

Kosikowski, F.V (1978). Cheese and Fermented Milk Foods. Published by the Auther.Carnell, Univ. Ithaca, New York , USA.

Ling, E.R (1963) A text book of dairy chemistry. Vol. 2 Practical 3 rd Ed , Chapman and Hall, Ltd Londen ,UK.

Marth, E.H (1978) Standard Methods for the Examination of Dairy Products. 14 th Ed. Am. Public. Assoc. Washington D.C.

Metcalfe, D.K.and Schmitz, A.A.(1961) Anal. chem. 33, 363. C.F.E gonstall. Thin layer Chromatography, P.146

Minagawa, E.; S. Kaminogawa; F.Tsukaski; H. Motoshima and K. Yamaushi (1985) Exopeptidas profiles of bifidobacteria. J.Nutr.Sci. Vitaminol 31: 599 – 606.

Modler , H.W.; R.C. Mckellar and M.Yoguchi (1990). Bifidobacteria and bifidogenic factors , Can..Inst. Food Sci . Technol .J., 23 – 29.

Nakae, T. and J.A. Elliott (1965). Production of volatile fatty acids by some lactic acid bacteria II- Selective formation of volatile fatty acids by degradation of amino acids. J. Dairy Sci., 48 : 293 .

Nasr, W.I.A (2001) Studies on accelerating manufacture steps of hard cheese . M.Sci . Thesis , Faculty of Agriculture – Moshtohor, Zagazig university (Benha Branch).

31: 599 – 606.

Modler , H.W.; R.C. Mckellar and M.Yoguchi (1990). Bifidobacteria and bifidogenic factors , Can .Inst. Food Sci . Technol .J., 23 – 29.

Nakae, T. and J.A. Elliott (1965). Production of volatile fatty acids by some lactic acid bacteria II- Selective formation of volatile fatty acids by degradation of amino acids. J. Dairy Sci., 48 : 293 .

Nasr, W.I.A (2001) Studies on accelerating manufacture steps of hard cheese . M.Sci . Thesis , Faculty of Agriculture – Moshtohor, Zagazig university (Benha Branch).

Rasic , L. J. and J.A Kurmann (1983). Bifidobacteria and their Role. Birkhauser Verlag , Bern , Switzerland .

28-Sanders, M.E.; D.c. Walker; K.M. Walker; K. Aoyama and T.R. Klaenhammer (1996). Performance of commercial cultures in fluid milk applications . Journal of Dairy Science, 79: 943 – 955

29-Scott, R. (1981) cheese making practice . Applied Science publ. Ltd London .

30-Sharf, J.M. (1970) Recom-mended methods for the Microbiological Examination of Food. .2nd Ed .Am public Health Assoc .Inc. New york N.Y.10019

31-Stanton. C; G Gardiner; P.B.Lynch; J.K.Collins; Fitzgerald-G; Ross (1996) Probiotic cheese International Dairy Journal; 8 (5/6):491-496.

Woodman, A.G. (1941). International Chemical Series Food Analysis 4 th McGraw - Hill . Book Co.Inc. N. Y. and London

تأثير استخدام البكتيريا الحيوية على جودة وتسوية الجبن الشبيه بـــالا يـــدام المصنع من لبن الماعز

نعمه محمد الشافعي* – عطية عبد المعطى عبد الباقى** محمد ماهر أحمد نصر* – أحمد عبد الرحمن الظواهرى**

* قسم علوم الأغذية – كلية الزراعة – جامعة الزقازيق

** معهد بحوث الإنتاج الحيوانى – مركز البحوث الزراعية

أجريت محاولة لتحسين جودة الجبن المصنع من لبن الماعز حيث تم تصنيع جبن أيـــدام من لبن الماعز باستخدام البادئ التقليدي المكون من

Lactococcus lactis subsp lactis , Lactococcus lactis subsp cremoris, Lactococcus lactis subsp diacetylactis and Leuconostoc mesentroides subsp cremoris.

معاملة (١) . ثم استبدال البادئ التقليدي بالبكتريا الحيوية المكون من

Lactobacillus acidophilus La-5, *Bifidobacterium bifidum* Bb-12 and *streptococcus thermophilus* St-20 (ABT)

بنسب ٢٥ % معاملة (٢) و٥٠% معاملة (٣) و ٧٥% معاملة (٤) و١٠٠% معاملـــة (٥) حيث وجد أن استبدال البادئ التقليدي بالبكتريا الحيوية أدى الى زيادة تصافى الجبن الناتج مـــع انخفاض فى نسبة الفقد فى وزن الجبن أثناء التسوية وكان ذلك مرتبطا مع زيادة في نسبة الرطوبة وقد ازداد معدل تحلل البروتين وتكوين الأحماض الدهنية وحموضة دهن الجبن في المعاملات التى استخدم فيها البكتريا الحيوية ولم تتأثر المركبات المسئولة عن نكهة المـــاعز بإضافـــة البكتريـــا الحيوية ولكن انخفضت نسبة هذه المركبات مع تقدم التسوية . وقد حصلت الجبن المصنع باستخدام