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ASSESSMENT OF DOMIATI CHEESE MADE USING FREE AND IMMOBILIZED MICROBIAL RENNETS

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ABSTRACT

Domiati cheese was made from heated or unheated standardized Buffalo's milk (٦٪ fat) using (free and immobilized microbial rennets. The cheese was stored at room temperature (٢٠-٢٥°C) for ١٥, ٣٠, ٤٥, and ٦٠day. All cheese samples showed a gradual loss of yield, moisture, and salt in moisture during ripening, while, protein and fat increased with both immobilized or free microbial rennets. All cheese samples showed gradual increase in SN/TN; Tyrosine & Tryptophan and TVFFA content during ripening (up to ٦٠ days).The cheese made using free microbial rennet had higher values of SN/TN; tyrosine and tryptophan and TVFFA compared with that made using immobilized microbial rennet. Also, cheese made from free enzyme had high score in both fresh cheese and cheese stored for ٣٠ days, while cheese made using immobilized microbial rennet stored for ٤٥days had higher scores values. Cheese made using immobilized rennet had a softer body and texture than that made with free rennet.

This study demonstrated the beneficial effect of using the immobilization for cheese making to reduce the high cost of rennet ., Heating milk at ٧٠°C/٥ min before immobilization produced cheeses with better quality in terms of cheese flavour and yield.

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Immobilized microbial rennet in Damitati cheese making

INTRODUCTION

Coagulation of casein micelles in milk can be achieved by acidification of milk or cream to pH ٤.٦ or by combination of acid and heat or by many proteolytic enzymes from animal, microbial or plant origins. The vast majority of cheese varieties are produced by rennet coagulation while acid coagulated cheese represents about ٢٣٪ of the total cheese production. Rennet extract from the abomasa of young suckled calves is the most widely used coagulant for cheese making; buffalo, lamb, and kid rennets are also used in several countries (Addis *et al*., ٢٠٠٥). Rennin is the predominant and principal milk clotting enzyme in the fourth stomach of the calf (٨٨-٩٤٪ chymosin and ٦-١٢٪ pepsin); the proportions in commercial rennets usually ٧٠٪ chymosin and ٣٠٪ pepsin. Owing to the increase in world production of cheese and reduction of calf vells supply (due to decrease calf numbers and tendency to slaughter calves at an older age), the supply of calf rennet has been inadequate for many years. This has led to, an increase in the price of veal rennet and , therefore, a search for rennet substitutes became receronly . Despite the availability for numerous potentially useful milk coagulants, only six rennet substitutes have been found to be more or less acceptable for cheese production (Fox et al .٢٠٠٠) .

The advantages of immobilized enzymes are well known from both academic and practical points of view (Zaborsky ,١٩٧٣ and Chibata ,١٩٧٨) Therefore, this study was to examine the perrihctties of using microbial rennet (free and immobilized enzymes) in Domiati cheese making designed.

MATERIALS AND METHODS

Materials:

Milk supply:

Fresh morning milking Buffalo's milk samples were obtained from animal production department, Faculty of Agriculture, Al-Azhar University (Assiut). Milk samples were defatted by centrifugation at ٣٠٠٠ g for ٢٠ min at ٤٠°C, using Janetzki. T٢٣ centrifuge.

Microbial rennets:

Microbial rennet in powder form were obtained from DSM (France) with a commercial name (Fromase R ٢٢٠٠). Mucor miehei rennet solution (١N) was prepared by dissolving ٣ gm of powder rennet in ١٠٠ ml distilled water and used at a rate of ١.٠ ml / ١ liter milk (٠.٠٣ gm / ١ liter of milk).

Salt: Commercial sodium chloride was obtained from El-Nasr Company, for salt (Alexandria, Egypt).

Agar: Agar Agar was obtained from Nice Chemicals Pvt. Ltd. India.

Analytical methods:

Titratable acidity, total solids, fat and total nitrogen content of cheese: were determined according to the methods described by Ling (١٩٦٣).

Domiati cheese making using free microbial rennet:

Domiati cheese was made according to the method adopted by Metwalli *et al*. (١٩٨٢).

Buffalo's milk ٦٪ fat, was heated to ٧٠°C for ٥ min in thermostatically controlled water bath, and cooled to about ٤٠°C. The milk was salted at a level of about ٨٪ using commercial salt, renneted and held at ٣٠°C for complete curding. The curd was transferred into ٤٠ cm^3 wooden moulds lined with cheese-cloth, allowed to drain, wrapped in cheese-cloth, and then covered with abard. A weight of about ٥٠٪ of the curd weight was placed on top and left overnight for complete drainage. The curd was cut into cubes, weighed, and then pickled.

Pickling was conducted by canning about ٢٥٠ gm, of cheese in cans of ٥٠٠ gm capacity, filled with its own drained whey after adjusting to about ١٠٪ salt, sealed by hand-seaming then stored at room temperature (٢٠-٢٥°C). Samples were taken fresh and after ١٥, ٣٠, ٤٥ and ٦٠ day for analysis. In this experiment cheese was also made from unheated but falos milk Domiati cheese making using immobilized microbial rennet Buffalo’s milk was divided into two parts . the first part was used as acontrol (un heated) . the second part was heated to ٧٠ °C for ٥ min hen , cooled to ٤٠ °C .Immobilization was carried out according to the method described by Zayed and Hunter (١٩٩١) with some modification : A potion ٠.٠٣ gm of Mucor

miehei rennet was added to ٥ ml distilled water mixed with ٧٠ – ٨٠ ml agar solution at ٤٥ – ٤٧ °C and cooled to ٧ °C for ١٢ hour . Immobilization was carried out by using support put in milk.

Cheese analysis :

Salt was determined according to Simov (١٩٨٠). Proteolysis in cheese was carried out by the determination of: (١) Water soluble nitrogen (WSN); (٢) Tyrosine and Tryptophan contents. Watert-soluble nitrogen (WSN) content in cheese was determined according to Kuchroo and Fox (١٩٨٢). Tyrosine and Tryptophan content in cheese was determined according to Vakaleris and Price (١٩٥٩).

Lipolysis in cheese during ripening was followed by determining the changes in the total volatile free fatty acids (TVFFA) as ml ٠.١ N NaoH/١٠٠ gm cheese using the method described by Kosikowski (١٩٨٢).

Organoleptic properties:

Cheese samples were evaluated according to the method of Pappas *et al*. (١٩٩٦) when fresh and after ١٥, ٣٠, ٤٥, and ٦٠ days at room temperature. An overall score out of (١٠٠ points) was given for flavour (٥٠ points), body & texture (٤٠ points) and appearance (١٠ points) by a panel consisted of twelve. Persons, mainly staff members.

RESULTS AND DISCUSSION

Yield and Moisture contents:

The obtained data revealed that, all cheese samples made from unheated or heated milk showed a gradual loss of yield during the ripening period either that made with free microbial rennet (Table ١) or that made with immobilized rennet (Table ٢).Cheese made using free microbial rennet (unheated milk), the percentage of yield was ٢٨.١٣ in fresh cheese decreased to ١٨.٨٢٪ after ٦٠ days of storage, while in cheese made from heated milk min, the starting yield was ٢٩.٢١ and decrease to ٢٣.١٠٪ after ٦٠ days of storage. The percentage of fresh yield for cheese made from immobilized enzyme (unheated milk) was ٢٧.٠٠, and decreased to ١٩.١٠٪ after ٦٠ days of storage, while in cheese made from heated milk, the starting yield was ٢٩.٠٠

and decrease to ٢٣.٤٥٪ after ٦٠ days of storage.

The data revealed that all cheese samples showed a gradual loss of moisture throughout the ripening period either using free or immobilized microbial rennets, this might be due to the leakage of whey at the cheese surface and evaporation. The loss of moisture at the end of ripening period amounted to about ١١.٦٪ in cheese made from unheated milk using free microbial rennet (fresh cheese), while this value was ١١.٠٤٪ in cheese made from heated milk. Moreover, the loss of moisture was ١٠.٤٩ in cheese made from unheated milk and ٩.١٥٪ in cheese made from heated milk when immobilized enzyme was used ..

Table ١: Changes in the chemical composition of Domiati cheese made by using free microbial rennet during ripening periods.

Treatments	Ripening period	Compositional parameters (%)					
		Yield	M	P	Fat	Salt/ M	A
Cheese made from unheated milk	Fresh	٢٨.١٣	٦٢.٩٥	١٣.٧٢	١٩.٥	٦.٨١	٠.١٩
	١٥ days	٢٧.٨٢	٦٠.٨٠	١٤.٣٦	٢١.٧	٦.٠٨	٠.٦٢
	٣٠ days	٢٣.١٤	٥٨.٠٩	١٤.٨٠	٢٢.٥	٥.٨٢	٠.٩٨
	٤٥ days	٢٠.١٠	٥٤.٧٤	١٥.٦٣	٢٣.٠	٥.٢٤	١.٧٠
	٦٠ days	١٨.٨٢	٥١.٣٥	١٥.٩٥	٢٦.٣	٥.٢٠	١.٩٠
Cheese made from Heated milk at ٧٠°c/٥ min	Fresh	٢٩.٢١	٦١.٣١	١٤.٣٦	١٩.٨	٦.٩٢	٠.٢٠
	١٥ days	٢٨.٧٥	٦٠.٢٠	١٤.٦١	٢٢.٠	٦.١١	٠.٦٥
	٣٠ days	٢٥.٧٨	٥٣.٦٥	١٥.٩٥	٢٢.٨	٥.٤٣	٠.٩٥
	٤٥ days	٢٣.٦٠	٥٠.٥٤	١٦.٢٠	٢٣.٥	٥.٣٢	١.٧٥
	٦٠ days	٢٣.١٠	٥٠.٢٧	١٦.٥٩	٢٧.١	٥.١١	١.٨٢

M: Moisture
P: Protein
A: Acidity

Table ٢: Changes in the chemical composition of Domiati cheese made by using immobilized microbial rennet during ripening periods

Treatments	Ripening period	Compositional parameters (%)					
		Yield	M	P	Fat	Salt/ M	A
Cheese made from unheated milk	Fresh	٢٧.٠٠	٦٤.٥٩	١٣.٩٧	٢٠.٠	٥.٩٠	٠.٢٠
	١٥ days	٢٥.٦٠	٦١.٤٣	١٤.٦٧	٢٢.٥	٥.٤٠	٠.٦٥
	٣٠ days	٢١.٣٠	٥٨.٤١	١٤.٨٦	٢٣.٠	٥.٠٠	٠.٨٨
	٤٥ days	١٩.٤٠	٥٥.٢٢	١٥.٣٨	٢٥.٠	٤.٩٧	١.٤١
	٦٠ days	١٩.١٠	٥٤.١٠	١٥.٧٦	٢٧.٥	٤.٩١	١.٦٢
Cheese made from Heated milk at ٧٠°c/٥ min	Fresh	٢٩.٠٠	٦٤.٣٠	١٤.٣٦	١٩.٠	٥.٧٠	٠.٢٠
	١٥ days	٢٧.٨١	٦٢.٢٢	١٤.٧٤	٢١.٧	٥.٥٠	٠.٦٣
	٣٠ days	٢٦.٣٢	٥٨.٢٣	١٥.٦٣	٢٤.٥	٥.٣٠	٠.٩٠
	٤٥ days	٢٤.٦٧	٥٧.١٠	١٥.٨٢	٢٥.٣	٥.١٠	١.٣١
	٦٠ days	٢٣.٤٥	٥٥.١٥	١٦.٣٣	٢٦.٠	٥.٠٠	١.٦٠

Generally, the data showed that the yield of cheese increased by heat treatment of milk. Similar results observed by Richard and Marshall (١٩٨٦), who concluded that the yield of cheese increased significantly by heat treatment of milk.

Protein and Fat contents:

The data demonstrated that, protein content increased during the ripening periods; this is possibly due to the loss of water. This increase in protein content was found in cheese made from unheated or heated milk using either free or immobilized microbial rennets. Fat content, increased along the storage period in cheese made from either unheated or heated milk using free or immobilized microbial rennets during the ripening periods. These results are in agreement with the results obtained by Moatsou *et al*. (٢٠٠٤) for feta cheese made with calf rennet or traditional artisanal liquid rennet from Lamb's and Kid's.

Salt/Moisture ratio and Acidity:

The data in Tables ١ and ٢ showed that, salt in moisture decreased with increasing ripening period. The decrease of salt in moisture after storage for ٦٠ days was about ١.٦١% in cheese made from unheated milk using free microbial rennet (fresh cheese), while this value was ١.٨١٪ in cheese made from heated milk . On the other hand , the loss of salt in moisture ,cheese made using immobilized microbial rennet was ٠,٩٩٪ in cheese made from unheated milk and ٠.٧٪ in cheese made from heated milk .

A gradual increase in acidity during ripening was observed. This could be mainly due to the development of organic acids and the formation of lactic acid during ripening. The increase of acidity after storage for ٦٠ days was ١.٩٠% in cheese made from unheated milk using free microbial rennet , while was ١.٨٢٪ in cheese made from heated milk.. The ; increase of acidity in the case of using immobilized microbial rennet was ١.٦٢٪ in cheese made from unheated milk and ١.٦٠٪ in heated milk was used . In addition, the data demonstrated that, cheese made with free microbial rennet had higher acidity compared to that made with immobilized microbial rennet after ٦٠ days of storage in cheese made from unheated or heated milk.

Proteolysis:

Proteolysis in cheese was assessed by the determination of water soluble nitrogen (WSN) and Tyrosine & Tryptophan contents.

The proportion of total soluble nitrogen (SN) traditionally has been regarded as a ripening index for cheese as it reflects the extent of proteolysis, in that it is an indicator of casein hydrolysis brought about by the action of the rennet and milk proteases present at the start of ripening (Visser, ١٩٧٧).

Table ٣ show the mean analytical results for TN, SN and SN/TN of Domiati cheese samples made by using free or immobilized microbial rennets during the ripening process, which was extended up to two months. The data revealed that, the amount of SN and TN increased gradually in cheese made from unheated or heated milk throughout the ripening period either using free or immobilized microbial rennets.

Table ٣: Changes in total and soluble nitrogen of Domiati cheese made with free and immobilized microbial rennets during ripening of cheeses.

Treatments	Ripening period	%Nitrogen		**SN/TN
		SN	TN	
Cheese made from unheated milk (free microbial rennet)	Fresh	٠.٢٢٧	٢.١٥	١٠.٥٦
	١٥ days	٠.٣٥٠	٢.٢٥	١٥.٥٦
	٣٠ days	٠.٤١٠	٢.٣٢	١٧.٦٧
	٤٥ days	٠.٤٨٠	٢.٤٥	١٩.٥٩
	٦٠ days	٠.٥٠١	٢.٥٠	٢٠.٠٤
Cheese made from *heated milk (free microbial rennet)	Fresh	٠.٢٢٠	٢.٢٥	٩.٧٨
	١٥ days	٠.٣٣٠	٢.٢٩	١٤.٤١
	٣٠ days	٠.٣٩٣	٢.٥٠	١٥.٧٢
	٤٥ days	٠.٤٧٠	٢.٦٠	١٨.٠٨
	٦٠ days	٠.٥٢٠	٢.٦٠	٢٠.٠٠
Cheese made from unheated milk (immobilized microbial rennet)	Fresh	٠.٢٢٠	٢.١٩	١٠.٠٤
	١٥ days	٠.٢٤١	٢.٣٠	١٠.٤٨
	٣٠ days	٠.٣١٠	٢.٣٣	١٣.٣٠
	٤٥ days	٠.٣٣٦	٢.٤١	١٤.٠٤
	٦٠ days	٠.٤٠٦	٢.٤٧	١٦.٤٣
Cheese made from heated milk (immobilized microbial rennet)	Fresh	٠.٢١٥	٢.٢٥	٩.٥٦
	١٥ days	٠.٢٥٠	٢.٣١	١٠.٨٢
	٣٠ days	٠.٣٣٠	٢.٤٥	١٣.٤٧
	٤٥ days	٠.٤٠٢	٢.٤٨	١٦.٢١
	٦٠ days	٠.٤٧٠	٢.٥٦	١٨.٣٦

*Heat treatment at ٧٠°C/٥ min **SN / TN = SN ÷ TN × ١٠٠

The data showed that, after two months of ripening, the values of SN/TN increased from ١٠.٥٦ to ٢٠.٠٤ in cheese made from unheated milk using free microbial rennet, wherse these values increased from ٩.٧٨ to ٢٠.٠٠ in cheese made from heated milk. On the other hand, the values of SN/TN increased from ١٠.٠٤ to ١٦.٤٣ after storage in

cheese made from unheated milk using immobilized microbial rennet, while this value increased from ٩.٥٦ in fresh cheese to ١٨.٣٦ after storage in cheese made from heated milk. These results are similar to the findings published by other researchers, (Abd El-Rahman, ١٩٩٠ and Darwish *et al*., ١٩٩٢).

The increases of SN could be attributed to the enzyme activity . This is in agreement with the results obtained by Moatsou *et al*. (٢٠٠٤), who found that the main proteolytic agent responsible for the primary proteolysis in Feta cheese is the residual rennet because of the low pH, which is not favourable for plasmin action. In addition, they found that primary proteolysis was estimated from the residual α_s-casein percentage and the percentage of SN/TN during the first days of ripening. The changes of α_s-casein were due to rennet action on $\alpha_{,s١}$-casein which is the preferable substrate for chymosin action during cheese ripening (Sousa *et al*., ٢٠٠١).

The comparison of SN/TN in cheese made with free and immobilized microbial rennets (either unheated or heat treated milk), it can be seen that SN/TN for cheese made with immobilized microbial rennet was lower than that for cheese made with free microbial rennet.

Table ٤ show, the content of tyrosine and tryptophan in Domiati cheese made by using free or immobilized microbial rennets during the ripening process, which was extended up to two months. The data show that, the amount of soluble tyrosine and tryptophan increased gradually in cheese made from unheated or heated milk throughout the ripening period either using free or immobilized microbial rennets until the end of the storage period. Moreover, the cheese made using free microbial rennet had higher values of tyrosine or tryptophan compared with cheese made using immobilized microbial rennet,.

Table ٤: Tyrosine and Tryptophan contents in cheese made with free and immobilized microbial rennets during ripening of cheeses.

Treatments	Ripening period	Amino acid content (mg/١٠٠ gm)	
		Tyrosine	Tryptophan
Cheese made from unheated milk (free microbial rennet)	Fresh	٧.١٠	١٧.١٠
	١٥ days	١٠.٩٤	٢٠.٣٣
	٣٠ days	١٧.٦٠	٢٤.١٣
	٤٥ days	٢٧.١٠	٣٠.١٤
	٦٠ days	٤٠.٧١	٣٦.٠٠
Cheese made from heated milk (free microbial rennet)	Fresh	٧.٢٠	١٧.٥٨
	١٥ days	١٠.٨٦	١٨.٧٠
	٣٠ days	١٦.٠٣	٢٣.٧٤
	٤٥ days	٢٧.٨٢	٢٩.٧٠
	٦٠ days	٣٩.١٠	٣٥.١٠
Cheese made from unheated milk (immobilized microbial rennet)	Fresh	٥.٨٣	١٥.٣٠
	١٥ days	٩.٧١	١٩.١٠
	٣٠ days	١٦.١١	٢١.٢٠
	٤٥ days	٢٣.٩٥	٢٧.٧٨
	٦٠ days	٢٦.١٤	٣٠.١١
Cheese made from heated milk (immobilized microbial rennet)	Fresh	٥.٩٠	١٣.٧٠
	١٥ days	٨.٢٠	١٦.٣١
	٣٠ days	١٣.١٥	٢٠.٥٠
	٤٥ days	٢٢.٣٣	٢٦.٣٣
	٦٠ days	٢٤.١٠	٢٨.١٧

Higher values of tyrosine and tryptophan content in Domiati cheese either made with animal or microbial rennet were reported by Hofi *et al*., (١٩٧٦), who found that the content of tyrosine and tryptophan in fresh cheese made from the mixture of buffalo and cow milk (١:١) by using animal rennet were ٢٥.٣ and ٤١.٦ mg/١٠٠ gm,

respectively. While the content of tyrosine and tryptophan in cheese made with microbial rennet were ٢٥.٣ and ٥١.٨ mg/١٠٠ gm, respectively.

Lipolysis:

Data in Table ٥ show the changes in TVFFA of Domiati cheese made by using free or immobilized microbial rennets during the ripening process, The amount of TVFFA increased gradually in cheese made from unheated or heated milk throughout the ripening period either using free or immobilized microbial rennets until the end of the storage period. On the other hand, the cheese made using free microbial rennet had higher values of TVFFA compared with cheese made using immobilized microbial rennet, either in the fresh cheese or at the end of storage period ripening this trend was also found when heated or unheated milk was used .

Table ٥: The Changes in total volatile free fatty acids (TVFFA) content in cheese made with free and immobilized microbial rennets during ripening period.

Treatment	Age of cheese (days)				
	Fresh	١٥	٣٠	٤٥	٦٠
Cheese made from unheated milk (free microbial rennet)	TVFFA				
	٧.٠	١٢.٥	١٩.٥	٢٢.٠	٢٩.٥
Cheese made from heated milk (free microbial rennet)	٦.٥	١٠.٦	١٧.٨	٢٠.٥	٢٨.٥
Cheese made from unheated milk (immobilized microbial rennet)	٥.٩	٩.٨	١٦.٥	١٧.٠	٢١.٥
Cheese made from heated milk (immobilized microbial rennet)	٥.٣	٨.٧	١٤.٨	١٦.٥	٢٠.٣

The TVFFA content in fresh cheese using either unheated or heated milk were between ٦.٥-٧.٠ (ml ٠.١ N NaoH/١٠٠ gm cheeses) and ٥.٣-٥.٩ with free and immobilized microbial rennet, respectively. These values increased between ٢٨.٥-٢٩.٥ and ٢٠.٣-٢١.٥ at the end of the ripening period with free and immobilized microbial rennet, respectively. Also, the data cleared that, the TVFFA were slightly higher in cheese made with unheated milk by using free microbial rennet than the other treatments, similar results were obtained by Hofi *et al*. (١٩٧٦) and Abd EL-Salam *et al*. (١٩٨١). Ibrahim *et al*. (١٩٩٩), who showed that, the slight decrease in TVFFA of the heated samples might be related to the inactivation of heat on the lipolytic activities in cheese milk.

Sensory evaluation:

Sensory evaluation of Domiati cheese is a valuable criterion for determining cheese quality and acceptability. The body, texture and fla vour are affected considerably by many factors such as type of milk, pretreatment of the milk, season of milk production, addition of starter to milk, type of coagulant used, percentage of salt in both the cheese curd and the pickling medium, microflora of the cheese milk, additives to the cheese milk to accelerate the cheese ripening and type of storage temperature during ripening (Pappas *et al*., ١٩٩٦).

Data in Table ٦ show the panel test of Domiati cheese made from heated milk (٧٠°C/٥ min) by using free or immobilized microbial rennets during the ripening process. . Higher flavour score points were obtained from cheese made with free microbial rennet after ١٥ or ٣٠ days of the ripening than that of the other cheese samples,, . In addition, the data revealed that the cheese made with free microbial rennet gained higher score for body and texture after ٣٠ days of the ripening than that of the other cheese samples, while these values were obtained after ٤٥ days of the ripening period in cheese made from immobilized microbial rennet. In fact, there were no high differences in appearance scores points of the two cheeses (either made with free or immobilized microbial rennet)

Table ٦: The panel test of Domiati cheese mad from heated milk (٧٠°C/٥ min) made with free and immobilized microbial rennets during ripening of cheeses.

Component (%)	Free Microbial rennet					Immobilized Microbial rennet				
	Age of cheese(day)					Age of cheese(day)				
	fresh	١٥	٣٠	٤٥	٦٠	fresh	١٥	٣٠	٤٥	٦٠
Flavor (٥٠)	٣٧	٣٩	٣٩	٣٤	٣٢	٣٤	٣٥	٣٣	٣٦	٣٧
Body & Texture (٤٠)	٣٢	٣١	٣٦	٣٥	٣٥	٣٠	٣٠	٢٧	٣٦	٣٢
Appearance (١٠)	٨	٧	٨	٨	٧	٨	٨	٧	٨	٨
Total (١٠٠)	٧٧	٧٧	٨٣	٧٧	٧٤	٧٢	٧٣	٦٧	٨٠	٧٧

From Table ٦, it can be seen that cheese made with immobilized rennet tend to be soft in body and texture than that from cheese made with free rennet. These results are in agreement with those obtained by Garg and Johri (١٩٩٤) for Cheddar cheese. Moreover, the cheese made with free enzyme gained higher score than that using immobilized microbial rennet in fresh cheese and cheese stored up to ٣٠ days, while the cheese made using immobilized microbial rennet stored at ٤٥ and ٦٠ days had higher values of scores than that using free enzyme.

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تقييم الجبن الدمياطى المصنع بإستعمال الإنزيمات الميكروبيه الحره والمحملة أثناء التسوية

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تم صناعة الجبن الدمياطي بمعاملة اللبن الجاموسي المعدل (٦% دهن) الخام والمعامل حراريا على درجة حرارة ٧٠°م لمدة ٥ دقائق ثم التبريد الى ٤٠°م قبل وضع الإنزيمات الميكروبية المثبتة باللبن ، وقد تم تخزين الجبن الناتج على درجة ٢٠-٢٥°م لمدة شهرين .

وكانت النتائج المتحصل عليها كالاتي :

- جدث نقص لكل من الرطوبة والتصافي وكذلك نسبة الملح خلال فترة التسوية بينما لوحظ زيادة في كل من الحموضة ونسبة البروتين والدهن في الجبن الناتج مع زيادة فترة التخزين.
- كانت النسبة المئوية للتصافي ونسبة البروتين أعلي بقليل في الجبن الناتج من اللبن المعامل حراريا عنه في الناتج من اللبن الخام بينما لاتوجد اختلافات في نسبة التصافي ونسبة البروتين بين الجبن المصنع بالانزيمات الحرة والانزيمات المثبتة وكان الجبن المصنع بالانزيمات المثبتة ذو خثرة أطري عن المصنعة بالمنفحة الحرة
- أوضحت النتائج أن كلا من النتروجين الذائب الي النتروجين الكلي والتيروسين والتربتوفان وكذلك الاحماض الدهنية الحرة كانت أعلي في الجبن الناتج من الانزيمات الحرة عنها من الانزيمات المثبتة .
- أوضحت نتائج التقييم الحسي أن الجبن المصنعة من الانزيمات الحرة حصلت علي أعلي درجات التحكيم في الجبن الطازج والمخزنة حتي ٣٠ يوم بينما الجبن المصنعة من الانزيمات المثبتة فقد كانت اعلي الدرجات بعد التخزين حتي ٤٥ يوم وكانت الجبن المصنع بالانزيمات المثبتة ذات قوام متماسك وناعم من ذلك المصنع بالانزيمات الحرة .
- وعموما يمكن القول بأن طريقة تثبيت الانزيمات ادت الي الخفض من كمية الانزيمات المستعملة أثناء عملية التصنيع وكان الجبن الناتج لايختلف كثيرا عن الجبن المصنع بالطريقة العادية كما أن طريقة التثبيت للانزيمات تحتاج لمزيد من الدراسة ويتوقع لهذه الطريقة أن تكون محط اهتمام لصناع الجبن في السنوات القادمة.