

ENHANCING RIPENING OF EGYPTIAN CHEESE VARIETIES: (A REVIEW)

Ahmed, Nawal. S., and M.H., El – Senaity

Department of Dairying, National Research Center, Dokki, Cairo, Egypt.

ABSTRACT

This article was carried out to discuss the previous research about accelerating ripening of the main types of Egyptian cheese varieties, Ras cheese and Domiati cheese. The main methods used were mainly : addition of enzyme preparations; increasing microbial populations and addition of cheese slurry systems.

INTRODUCTION

Cheese ripening is an dynamic biochemical degradation of several components of cheese curd. Attentions have been drawn to the acceleration of such biological changes to reduce the ripening period without altering the quality of the produced cheese. The biochemistry of cheese ripening in an active area of research and aspects of ripening have been reviewed extensively, (Fox (1989); Fox, *et al.* (1990) Fox and Law (1991) ; (1994); (1995);(1996) , Fox and McSweeney , (1996 a, b , 1997) ; Fox and Wallace (1997) ; McSweeney and Sousa (2000) ; Collins , *et al.* 2003 b, (2004) , Curtin and Mc Sweeney (2004) , Mc Sweeney(2004).Mc Sweeney and Fox (2004); Upadhyay, *et al.* (2004)). Cheese ripening is a slow , expensive and a partially uncontrolled process with some what unpredictable results. Consequently , there is an increasing interest in accelerating the Cheese ripening. The economic advantage of rapid development of more cheese flavour in a short periods., would be substantial. Acceleration of Cheese ripening can also be a mean for increasing the production of cheese in developing countries. Rapid production of cheese flavour can also contribute in lowering the price of the resultant cheese. Extensive studies have been directed to the different methods for the acceleration of the main types of cheese produced in Egypt Ras cheese and Domiati cheese. (El –Soda and Saada , (1986); El – Shibiny , *et al.* (1991)and Taleb , *et al.* (1996)].

Ras cheese:

Ras cheese is a local Egyptian hard cheese made from cow's and buflaloe's milk and has the following gross composition form the ripened cheese: Moisture 30 to 36 % ; Fat per dry matter 40 to 53% ; salt 2.5 to 5 % ; Total protein (T.P)24 to 28 % . The ripening period of Ras cheese ranged between 4 to 6 months after which the cheese gained a pungent flavour , (Hofi, *et al.* 1970).

Domiati cheese:

Domiati cheese is the most popular local soft cheese in Egypt as well as in some Mediterranean & Bulkan Countries. Domiati cheese is mainly manufactured from either cow's and buffaloe's milk or mixed . Fresh buffaloe Domiati cheese has the following gross composition for the fresh cheese : Fat / DM. 46. 60 to 49% ; T.N / DM 4.79% ; Salt / water ratio 8.42% ; Salt 5 to 8%

; pH value 6.0 to 6.4 ; Acidity 0.20% , Moisture 60.57 to 61.40 % and Total solids 39.41% .(El –Sissi and Neamat Allah, (1996). The present study aimed to review the different methods for accelerating ripening of main varieties of cheese in Egypt : Ras and Domiati cheese. The acceleration is currently used as follows:

- Addition of enzyme preparations.
- Increasing microbial populations.
- Addition of cheese slurry systems.

A. Ras cheese :

1- Addition of enzyme preparation :

The use of different types of enzyme preparation for acceleration of Ras Cheese ripening has been extensively studied by several investigators, [Ismail *et al*, (1977); Abd El – Salam , *et al*. (1978)], used commercial lipase enzymes to accelerate ripening of Ras Cheese . [Soliman , *et al* .(1980); Law (1981). Law and wigmore ,(1982); Darwish, *et al*. (1989) and Mohamed, *et al*. (1939)] indicated that , addition of either proteolytic or lipolytic enzyme preparations to Ras cheese curd enhancing the ripening process and markedly increase volatile fatty acids and protein degradation. Hefnawy (1986), showed that , Ras cheese treated with pepsin enzyme was accepted for consumption and could be marketed after six weeks of ripening. Recently , El- Soda, *et al*. (1990a) indicated that, addition of proteolytic and lipolytic enzyme preparations to Ras cheese curd showed a significant increase in the rate of cheese ripening. A typical Ras cheese flavour developed after 15 days of ripening when the Rulactine and Piccantase were used. A bitter flavour was pronounced in the maxazyme cheese, while no flavour development was noticed in Palatase treated cheese.

The same authors (1990b), indicated that, development of typical flavour and body in Ras cheese was accelerated by addition of bacterial extract and commercial preparations of proteinase and lipases to the curd. The combination of enzymes and cell free extract led to a cheese with good organoleptic properties free from bitterness. Further more , they also, (1990c) concluded that , addition of commercial enzyme preparations FlavourAge and NaturAge to Ras cheese, ripened at 12 °C for 8 weeks showed a clear preference taste . Hassan , *et al*. (1996), studied ripening Ras cheese slurry with enzymes addition included preparation of lipase and protease from bacteria and its addition to Ras cheese. The microbiological source were screened for abilities to produce proteolytic and lipolytic activities. Three organisms were selected from them for proteolytic and lipolytic activities. Two of them were used to accelerate cheese slurries ripening with concentration of 0.5 ;1.0 and 1.5 ml / 100 g. curd. Slurries were incubated at 37°C for 7 days. The best results were obtained when *Lactobacillus delbrueckii subsp bulgaricus* was used for both protease and lipase.

2- Increasing microbial population :

The effect of trace elements on ripening of cheese may be due to its stimulation of certain microbial groups or to the activation of certain enzymes

responsible for cheese ripening. Preliminary studies on accelerate Ras cheese ripening were reported by Hofi, *et al.* (1973a) .

Ras cheese was manufactured from raw milk , raw milk with starter and from pasteurized milk using two mixtures of trace elements, the first contained (B , Mn , Cu , Zn , Br , Ti , Su or Sn , Co, Si and Ni) and the second contained (Fe , Mn , Cu , Zn and Co). They indicated that , addition of both mixtures of trace elements increased the protein and fat hydrolysis. The effect was more pronounced in pasteurized milk. Cheese made from pasteurized milk with added both mixtures aquired the typical flavour of ripened cheese after 3 months. However, they also indicated that , when both trace element mixtures when added to pasteurized milk at 1 : 5000 and 1 : 10000 dilutions accelerated cheese ripening and the development of typical Ras cheese flavour , Hofi *et al.* (1973b); Hofi, (1978) reported that, addition of trace elements to H₂O₂ treated milk decrease the inhibitory effect of H₂O₂ and led to acceleration in proteolysis and flavour development in Ras cheese. Also, trace elements were used too rapid development of Ras cheese flavour made from recombined milk , (Hagrass , et , al 1983). Also , Darwish, *et al.* (1989) indicated that , when a mixture of KCL+ MnCL was added to Ras Cheese milk and during processing led to acceleration ripening.

El -Soda, *et al.*(1990b), studied acceleration of Ras cheese ripening by addition of bacterial extract and commercial preparation of proteinases and lipases to the curd. The combination of proteinases and lipases with the cell free extract led to a cheese with good organoleptic properties free from bitterness. Addition of proteinases results in most of the cases in better flavour development and with some enzymes to a weak body of the cheese. Law and Wigmore, (1983), suggested that, combination of the cell free extract of selected *streptococcus Lactis Strains* showing a broad specificity in peptidase activity to Neutrase in order to overcome such problems. El - Soda , *et.al* (1981). It can be concluded that , the combination of a gross proteolytic agent to a mixture of exopeptidase. capable of releasing potentially flavourful ,(low molecular weight peptides and amino acids) led to a cheese with good organoleptic properties free of bitterness and will probably give the possibility of reducing the level of proteinases in the enzyme mixture, (El - Soda, *et al.*, 1990c). El - Shibiny , *et al.* (1991), investigated the use of starters and lipase in the acceleration of UF Ras cheese. Cheese was ripened for 3 mouths at 16°C. and monthly analysed. UF Ras cheese showed lower pH and lactose. Lactose disappearance was more rapid than traditional Ras cheese . Soluble Nitrogen (S N) and S N / T N ratio of UF Ras cheese were higher than the traditional cheese all through the ripening period. Law , (1984), noticed that , acceleration of cheese ripening by addition of starter has several advantages which include the case of incorporation of starter cells into cheese curd and retention of a natural enzyme balance in cheese. Addition of starters clearly enhanced the biochemical changes in UF Ras cheese. In all , the UF Ras cheese, lactose disappeared more rapidly than the traditional cheese. Also, the pH of UF Ras cheese was less than the traditional Ras cheese during the ripening period in spite of the higher buffer capacity of UF Ras cheese.

Sutherland and Jameson, (1981), claimed that , protein degradation in UF Ras cheese with added starter was faster than the traditional Ras cheese, this can be showed from the increase in (S N) and SN/TN ratio during ripening. The body and texture of traditional and UF Ras Cheese gave comparable scores all through the ripening period. From these results , it concluded that, addition of thermophillic bacteria to UF Ras Cheese improved cheese ripening and flavour development. Nihal Ezzat and El – Shafei, (1991),investigated that , accelerated ripeining of Ras Cheese using freeze and Heat- shocked *Lactobacillus Heleветicus*. Whole cells of *L. Heleветicus* were freeze and heat – shocked before being added to milk for Ras Cheese manufacture to enhance flavour development and accelerated ripening of Ras Cheese. The pH of the cheese showed no significant difference. The heat- shocked treatment showed the higher soluble Nitrogen (S.N.) and total volatile acidity at the end of ripening. The cheese flavour was enhanced in all experimental cheese , addition of heat treated Lactobacilli also decreased bitter taste.

Grieve, (1982) reported that , the proteinase extracts resulted from *Saccharomyces cerevisiae* increased rate of proteolysis and flavour formation in the treated cheeses. Hagrass, *et al.* (1984) , found that the addition of inactive dry yeast and the dry autolyzed yeast stimulated the proteolysis and increased the total free volatile fatty acids in Ras Cheese. Nadia Zaki, (1988), studied acceleration of Ras Cheese ripening using autlyzed yeast and noticed that, addition of autolyzed yeast during Ras Cheese making increased (SN/ TN)% , and the increasing ran parallel with the ratio of autolyzed yeast. This can be attributed to the high pooteolytic activity of autolyzed yeast. The changes in the volatile fatty acids (VFA) was a clear increasing of treated samples in comparison with control cheese as ripened progress. this could be attributed to the utilization of those acids by certain organisms in the cheese which stimulated Wight addition of autolyzed yeast, Foster, *et al.* (1957); Kosikowski, (1978); El- Shibiny, *et al.* (1978; and Hagrass, *et al.* (1984). Indicated that addition of autolyzed yeast enhanced the production of free amino acids(FAA) where with the progress of ripening the amount of total free amino acids (TFAA) increased. No correlation between the ratio of added autolyzed yeast and the formation of TFAA The control and treated cheese had similar patterns of amino acids. There were qualitative differences observed in cheese protein with addition of antolyzed yeast in compared with control cheese. This could be confirmed by the increased level in SN and FAA available in treated cheeses.

3- Addition of Cheese slurry systems :

Slurry process is supposed to be one of the important and suitable procedures form acceleration of Ras Cheese. It considered as a good source of enzymes; small nitrogenous compounds and free fatty acids. The method developed by Kristoffersen, *et al.* (1967) for accelerating flavour development sin chaddar cheese curd by increasing its moisture content and incubating at 30 °C was successfully applied to Egyptian Ras Cheese. Several

investigators indicated that, cheese slurry with 7 days of storage at 30 °C . developed a flavour similar to that of convential Ras Cheese ripened for 2 months.

Additives such as proteinase; lipase mixtures; trace elements and sodium citrate to fresh cheese slurry enhanced flavour development ;[Dully, (1976) , Sood and Kosikowski, (1979); Abd El – Baky , *et al.* (1982a, b, c); Abd El – Hamid , *et al.* (1991) ; El – Sayed , *et al.* (1993)and Ismail, *et al.* (1996)]. In Egypt , the use of Ras Cheese slurry in acceleration of cow's milk Ras Cheese was attempted by Abd El – Baky, *et al.* (1982); Rabie, *et al.* (1984) .

Hofi, *et al.* (1991) studied the use of cheese slurry in acceleration of Buffaloe milk Ras Cheese. They concluded that, addition of slurry increased the moisture content of the resultant cheese by increasing the water holding capacity of slurry treated cheese. The addition of slurry to cheese milk as well as to the curd particles enhanced the production of Lactic acid and increased the acidity development in the resultant cheese. This means that , slurry promoted the acidity development in cheese and it contains more acidic intermediate compound, dissociated from fat and protein. Added slurry to both milk or curd increased the liberation of soluble Nitrogen (SN) during ripening process. This could be explained by the higher proteolytic action of treated cheese. Also , addition of slurry promoting fat hyrolysis and production of more total volatile fatty acids.(TVFA). Addition of slurry to the curd avoided the loss of soluble compounds, i.e, (SN and FFA) into cheese whey and it became more effective than its addition to cheese milk. There were a gradual development in body, texture and flavour characteristics of treated cheese which may be due to the break down and hydrolysis of protein and fat which gave smooth texture and acceptable organoleptic properties of treated cheese. They concluded that, treated cheese had acceptable properties after 15 days while the control cheese gained these properties after 120 days. A recent study by El – Sissi (2003) , showed that, the manufacture of Ras Cheese from standardized buffaloe milk. Cheese slurry was added to cheese curd during moulding and before pressing. The cheese containing slurry had pronounced higher values of the following parameters than the control: yield; moisture; titratable acidity; repining indices (SN and TVFA) viable count; proteolytic and lipolytic bacterial counts. Recently , Mostafa, *et al.* (2000), studied the use of cheese slurries in the acceleration of UF Ras Cheese. However , the development of acidity was more rapid in treated cheese than the control. Treated cheese also showed the highest ripening indices and development of VFA which is due to the increase of the count of proteolytic and lipolytic bacteria. The development of cheese flavour was accelerated in treated cheeses and there was an improvement cheese body and textures.

Abd El-Hamid , *et al.* (1991), studied the ample productiin condition for Ras Cheese slurry and found that, flavour development in Ras Cheese slurries which were prepared from pasteurized buffaloe's milk using *Stoeptococcus thermophilus* and *Lactobacillus bulgaricus*. (as satrtter) was

affected by age of curd; brine concentration ; incubation temperature and incubation period. More acceptable flavour was achieved when slurry prepared from 24 hrs. old buffaloes Ras Cheese curd ; 4% sterilized NaCl solution and incubated at 37C. for 7 days with daily agitation.

These conditions produced slurries with highest and acceptable values of acidity; Soluble Nitrogen (SN) and volatile fatty acids (VFA) are seemed to be more favourite with sharp acid and full aged flavour at the end of incubation. Potassium sorbate was added before the incubation as an antimycotic substance. Mostafa, *et al.* (2000), studied the utilization of cheese slurries to accelerate the ripening UF Cephalo type" Ras Cheese ". They prepared Ras Cheese slurries from 24 hr. old Ras Cheese curd and from ripened Ras Cheese. Each cheese slurry was added to UF Ras Cheese curd at a ratio of 2%. Traditional and untreated UF Ras Cheese (control) were also manufactured. All cheeses were ripened at 15 C . for 3 months. Addition of slurries had a slight effect on gross chemical composition of UF Ras Cheese compared with control UF Ras Cheese. However, the development of acidity was more rapid in treated cheeses than from the control. Cheeses treated with both cheese slurries showed the highest ripening indices and development of total volatile fatty acids (TVFA). Addition of slurries to cheese curd increased also the count of proteolytic and lipolytic bacteria. The development of cheese Flavour was accelerate in treated cheese and there was an improvement in cheese body and texture.

B – Domiati Cheese :

Domiati Cheese is the most popular soft cheese in Egypt. It is consumed fresh or after pickling in salted whey. The fresh cheese is mild but after the ripening period the cheese has a punget flavour due to the proteolytic and lipolytic activities, [El –Shibiny , *et al.* (1974)]

Several methods of accelerated cheese ripening have been practiced in Domiati Cheese , Ismail ,*et al.* (1978); El- Neshawy , *et al.* ,(1982). Omar and El – Shibiny (1985); Ashour, *et al.* (1986) ; (Abd El- Salam (1987); Omar, *et al.* (1987);.

I- Addition of enzyme preparation:

Addition of either proteases or lipases to Domiati Cheese improved its quality. Abd- El Salam,*et al.* (1981); Ashour, *et al.* (1986). El- Neshawy *et al.* (1982); Omar , *et al.* (1987)] used mainly lipases to enhance flavour development. Recently , Kebary, *et al.* (1996)used a combination of protease (accelerase) and lipase (Lipozyme) to accelerate Domiati Cheese ripening. They concluded that, addition of accelerate and moderate amount of liposine improved the quality of Domiati Cheese and reduced ripening period to its half time. Abdou, *et al.* (2005) used lamb lipase to accelerate the ripening of Domiati Cheese. They indicated that, good quality cheese was obtained by adding lipase to milk at the rates of 10g/100 kg milk before renneting. The cheese was characterized by the flavour; body and texture of fully ripened cheese afte 30 days of storage. Also, cheese made by the combination of lipolysed cream and skimmilk had a good quality, desirable palatiability and

acceptable flavour gained high score after 60 days of storage. Taleb, *et al.* (1996), when using proteolytic enzymes (Milezyme APL 440 ; H.T. proteolytic L.175; Bromelain or papain to accelerate Domiati Cheese pickled in their own whey. They claimed that , utilization of these enzyme caused a marked reduction of ripening period from 90 to 30 days but they induces slight reduction in cheese yield. better organoleptic properties with all utilized enzymes. The best results were obtained with H.T. proteolytic , while the lowest score were obtained with Milezyme APL and Bromelain.

II- The use of slurry preparations:

Cheese slurry has been defined as a solid paste containing about 40% solids and processing the characteristics flavour of a particular cheese used in its preparation (Thakar and Upadhyay, 1992). the mechanism of flavour enhancement in the slurries is not fully understood , but would probably due to the enzyme of lactic acid bacteria and other effective microflora present in the cheese used in their manufacture. Singh and Kristofferson(1971). El – Sayed , *et al.*, (1993) study the improve of the quality of Domiati Cheese made fro ultrafiltered buffalo's milk through enhancing the ripening process using goat's milk slurry. Generally, it could be concluded that , the best level of adding slurry was 50% and the suitable time form storing was two months to produce the highest score cheese (99 points out of 100 points) which has a full ripened flavour and more soft and excellent body.

[El – Sissi , (2002a) , he introduced a newly developed white soft cheese 'Nasr cheese ' for direct consumption using cheese hydrolyzate of the surface flora as an accelerating ripening agent. This work was carried – out to offer another alternative for ripening accelerating agent by utilization of blue cheese slurry. The cheese slurry was prepared immediately before cheese manufacture and its effect on the developed flavour of the resultant cheese at different periods of curd ripening was regarded Nasr cheese was made from buffalo's milk using blue cheese slurry(2%) as a ripening agent form different times of curd ripening at 10–12 C. The resultant cheese was analysed chemically and microbiologically and judged organoleptically, immediately after manufacture and then for three weeks for cheese shelf – life at refrigerator. Period of 12-24 hrs. proved to be the most effective for curd ripening. Nasr cheese gained higher yield; soluble Nitrogen(S.N) coefficient; total viable count and proteolytic & lipolytic bacterial counts than Domiatic Cheese. The cheese also a very desirable old ripened flavour as well as smooth body and compact consistency with cheese shelf – life of 3 weeks at 5 – 7 C. On the other hand [El- Sissi, (2002b), reported that , Domiatic Cheese which was made from standardized pasteurized buffalo's milk with 0.5; 1.2 and 4% blue cheese slurry and 7 % salt. A ripened blue cheese was used to prepare the cheese slurry. Thermolabile microbial rennet was used for renneting (0.03g/kg.milk).

Cheese slurry was prepared immediately before cheese manufacture according to Mostafa, *et al.* (2000), using pasteurized milk instead of sterilized NaCl solution as follows :2 part of ripened blue cheese were ,

blended with 1 part of pasteurized milk at 45 C. plus 0.5% potassium sorbate for 1-2 min. until good homogenous suspension was obtained. The average of gross chemical composition of slurry was as follows : Moisture 68% ; fat / DM 39.8% ; Salt / water ratio 3.46 ; TN/ DM 3.83%; 2.48% SN/ DM; 55.9 TVFA ; 2.48% acidity and pH 5.90 respectively. The resultant cheese was analysed microbiologically and chemically and judged organoleptically at intervals during ripening at room temperature for 8 weeks. Increasing amount of cheese slurry up to 2% caused increase in cheese yield; moisture content ; titratable acidity; ripening indices ; total; viable count ; proteolytic and lipolytic bacterial counts. Ambient temperature up to 25-30C did not cause any abnormal taste during ripening. Addition of 0.5 and 1% slurry delayed the appearance of the desired flavour till 4 and 6 weeks of ripening respectively. Cheese made with 2% slurry ranked the highest organoleptic scores after 3 weeks of ripening. The 2% cheese slurry is recommended to be employed for Domiati Cheese ripening acceleration at room temperature.

III- Other additives:

Addition of whey protein hydrolyzates accelerating Domiati Cheese ripening was first attempted by Khorshid & Rao, (1971). Hofi, *et al.* (1973c) accelerate ripening time of Domiatic Cheese from 3 months to 2 months by treated cheese milk with 0.5% acid casein hydrolyzates. Also, caseins and whey proteins hydrolyzed with trypsin when added to cheese milk lead to reduction in ripening time. Said and Mohran, (1984), showed that, when pancreatic milk hydrolyzate added to cheese milk was more effective than yeast extract or a mixture of both in accelerating ripening of the cheese. El – safty and Ismail, (1982), concluded that addition of free fatty acids : acetic; propionic and valeric to Domiati Cheese milk improved the cheese flavour and shortened the ripening period. They reported that, addition of fatty acids appears to stimulate proteolysis and hydrolysis. Attempts were made to accelerate Domiati Cheese ripening by inoculating the surface of fresh cheese with the yeast *Candida sp*. Rapid protein hydrolysis was observed but flavour defects appear after 60 days of ripening., El – Erian, *et al.* (1979).

REFERENCES

- Abdel – Baky, A-A; El Fak, A.M., Rabie, A.M. and El – Neshawy A.A. (1982a). Cheese slurry in the acceleration of Cephalotype Ras cheese ripening. *J. Food Prot.* 45: 894
- Abdel – Baky, A.; El – Neshawy, A.; Rabie, A., and Farahat S. (1982). Ripening changes in Cephalotype (Ras) cheese slurries. *J. Dairy Res.* 49, 337
- Abdel – Baky, A., El- Fak, A.; Rabie, A. and A. El- Neshawy. (1982b) Cheese slurries in the acceleration of Cephalotype (Ras) cheese ripening. *J. Food prot.* 45, 849
- Abdel – Baky, A., El- Fak, A.; Rabie, A. and El- Neshawy A. (1982c) Utilization of Cheese slurries in the acceleration of Cephalotype (Ras) cheese ripening. *Dairy industries*, 16, 21.

- Abdel – Hamid . L. B. ; Maharan G.A; Abbas , H.M. and Hofi A.A. (1991) . Ample production conditions for Ras cheese slurry. Egypt . J. Dairy Sci., 19: 327
- Abdel – Salam , M, H; El- Shibiny ; El- Bagoury, E.;Ayad E. and N. Fahmi. (1978). Effect of Lipases on the ripening of Egyptian Ras cheese J. Dairy Res. 45:491.
- Abd – El- Salam, M.H; El – Shibiny , S; Ahmed , N.S and Ismail A.A. , (1981). The use of ultrafiltration in manufacture of Domiati cheese from buffalo's milk. Egypt. J. Dairy Sci., 9, 151.
- Abdel- Salam , M.H, (1987). Domaiti and Feta Cheeses. In.P.F.Fox (Ed). Cheese: chemistry, physics and microbiology (2nd ed, vol. 2). London: chapman & Campbell.
- Abdou, S.M.; Dawood , A.H; El – Shibiny, S. and Hassan A.S. , (2005). Acceleration of Domiati cheese ripening by using lipase enzyme. Egypt J. Dairy Sci., 33 : 73 – 83.
- Ashour, M.M ;Abd El –Baky. A.A . and El – Neshawy A.A . , (1986). Improving the quality of Domiati cheese made from recombined milk. Food Chem.. 20: 85.
- Badaway, R.M. (1984) .Studies on the acceleration of Ras cheese ripening .M.Sc. Thesis , Fac. of Agric . Minufiya univ.
- Collins, Y.F; Mc Sweeney, P.L.H. and Wilkinson M.G. , (2003b). lipolysis and free fatty acid catabolism in cheese. A review of current knowledge. Inter. Dairy J. 13, 841 - 866
- Collins , Y.F.; Mc Sweeney, P.L.H. and Wilkinson M.G., (2004). Lipolysis and Catabolism of fatty acids in cheese , In cheese : chemistry , physics and Microbiology , vol. 1 : General Aspects , 3rd, ed n. 373 – 389,.
- Curtin , A. C. and, Mc Sweeney P.L.H (2004) . Catabolism of amino acids in cheese during ripening. In cheese: Chemistry , physics and Microbiology .Vol- 1: s: General Aspects, 3rd edn , pp 435 – 454 ,
- Darwish , S. ; Ezzat, N and Mashaly R. (1989). Accelerated ripening of Ras cheese by using some enzymes and trace elements. Egypt. J. Dairy Sci., 17 :297- 305.
- Dulley , L.R.C. (1976). The utilization of cheese slurries to accelerate the ripening of cheddar cheese. Australian J.Dairy Technol. 31 – 143
- El –Erian, A; Moneib , A; Farag , A. and El –Sissi M-, (1979). Acceleration of Domiati cheese ripening by surface flora. I- chemical studies. Egypt J. Food Sci, 7,7.
- El- Neshawy, A.; Abd El- Baky, A- and Farahat S- (1982). Enhancement of Domiati cheese flavour with animal lipase preparations . Dairy Industries Intr. 47:30.
- El- Safty, S , and Ismail A-. (1982). Addition of free fatty acids to improve the flavour and to accelerate the ripening of Domiati cheese made from reconstituted milk. J. Dairy Res. 49, 671.
- El –Sayed , N.H, Abbas, H.M. and Ahmed N.S .,(1993) . cheese slurry in the acceleration of Domiati cheese ripening. Egypt.J. Dairy Sci. 21:151 - 162.
- El –Shibiny, S.; Abd El- Baky, A.A.; Farahat, S.M; Mahran , G.A. and Hofi A.A.; (1974). Development of free fatty acids in soft cheese during pickling. Milchwissenschaft. 29:666

- El-Shinbiny, S.; Soliman, M.A; Gad, E.E and Abdel – Salam M.H. (1978). Development of volatile fatty acids in Ras cheese. *J.Dairy Res.* 45:497.
- El – Shinbiny, S.; Mahran. G.A;Haggag. H.F; Mahfouz.M.B; and El- sheikh M.M (1991). Accelerated Ripening of UF Ras cheese Egypt *J. Dairy Sci.*, 19:25 – 34.
- El –Sissi, M.G.M and. Neamat Allah A.A, (1996). Effect of salting levels on ripening acceleration of Domiati cheese. *Egypt J. Dairy Sci.* 24:265-275
- El – Sissi , M.G.M.(2002a). Production of an improved Nasr cheese by using blue cheese slurry. *Egypt J. Dairy Sci.*, 30:101-112.
- El – Sissi , M.G.M.(2003). Effect of brining on quality of accelerated ripening Ras cheese made from buffalo's milk. *Egypt . J. Dairy Sci.*, 31:305-317.
- El – Sissi , M.G.M. (2002b). utilization of blue cheese slurry for accelerated ripening of Domiati cheese. *Egypt J. Dairy Sci.*, 30: 83 -99.
- El- Soda, M.; Desmazeaud, M.J., Abou –Donia,S. and Kamal N. (1981). Acceleration of cheese ripening by addition of whole cell of cell free extracts from *Lactobacillus casei* . to the cheese curd. *Milchwissenschaft* , 36:140.
- El –Soda, M and Saada M.. (1986). Accelerated ripening of Egyptian cheese varieties, A. Review. *Egypt j. Dairy Sci.*, 14:115- 126.
- El- Soda , M.; Ezzat. N; Hassanei, S.; El- Abbasy. F. and Wahba A. . (1990a). Acceleration of Ras cheese ripening. I- Addition of commercial enzymes preparation. *Egypt . J. Dairy Sci.*, 18:171-182.
- El- Soda , M.; Ezzat. N; Hassanei, S.; El- Abbasy. F. and Wahba A. . (1990b). Acceleration of Ras cheese ripening. II combination of gross proteolytic agent with the cell free extract of some lactobacillus. *Egypt J. Dairy Sci.*, 18 -188 - 193
- El- Soda , M.; Ezzat. N .; Salam, A.E. and Khamis A. (1990c). acceleration of Ras cheese ripening. III- Evaluation of commercial enzyme mixtures. *Egypt. J. Dairy Sci.* 18- 273- 279.
- Foster, T.M.; Nelson.F.E. Speck , M.L; Doetsch, R.N; and Olson, j. (1957). Pages 345, 368, 369 in *Dairy microbiology*. Prentice- Hall, Englaewood Cliffs, N.J.
- Fox, P.F. (1989). Proteolysis during cheese manufacture and ripening. *J. Dairy Sci.*72, 1379-1400.
- Fox, P.F.; Lucey, J.A and Gogan T.M, (1990). Glycolysis and related reactions during cheese manufacture and ripening. *CRC critical. Reviews in Food Sci. and Nutr.* , 29, 237 – 253.
- Fox, P.F- and Law J. , (1991). *Enzymology of cheese ripening*. Food Biotechnology, 5, 239- 262.
- Fox, P.F.; Singh, T.K.and McSweeney , P.L.H, (1994). Proteolysis in cheese during ripening. In *Biochemistry of milk products.*, PP 1-31Andrews , A.T. and J. Varley, eds. Cambridge: General Aspects , 3rd edn, PP 347- 360.
- Fox, P.F.; Singh, T.K. and McSweeney P.L.H. (1995). Biogenesis of flavour compounds in cheese. In *chemistry of structure- function, Relationship in cheese* , London : Plenum Prees.
- Fox, P.F.; Wallace , T.M; Morgen , S.; Lynch, C.M; Niland, E.J. and Tobin J. , (1996). Acceleration of cheese ripening. *Antonie van Leeuwenhoek* 70, 271-297.

- Fox, P.F.; and McSweeney P.L., (1996a). Chemistry , biochemistry and control of cheese flavour. In Proceedings of the 4th cheese symposium, PP135- 159., Moorpark: Teagase.
- Fox, P.F.and, McSweeney P.L.H, (1996b). Proteolysis in cheese during ripening. Food Reviews International , 12, 457- 509.
- Fox, P.F. and McSweeney P.L.H,(1997). Rennets: their role in milk coagulation and cheese ripening. In Microbiology and Biochemistry of cheese and Fermented milk, 2nd edn. PP 1-49., Law , B.A., ed. London: Chapman & Hall.
- Fox, P.F.; and Wallace J.M, (1997) . Formation of flavour compounds in cheese Advances in Applied Microbiology. 45, 17-85.
- Grieve , P.A., (1982). Use of yeast protease to accelerate cheddar cheese ripening. In XXI International Dairy congress, vol.1 Book 2 Moscow, USSR.
- Hagrass, A.; El – Ghandour, M.; Hammad, Y. and Hofi. A; (1983). Production of Ras cheese from recombined milk. III – Effect of som ripening agents. Egypt . J. Dairy Sci.11, 271.
- Hagrass, A.; Sultan, N. and Hammad Y.. (1984) chemical properties of Ras cheese during ripening as affected by the addition of inactive dry yeast and yeast autolyzate. Egypt. J. Dairy Sci., 12:55.
- Hassan, A.A.; Mahran, GA; Ismail. A.A. and El- Hofi M.A. (1996). Studies on Ras cheese ripening with enzyme addition. I- preparation of lipase and protease from Bacteria and its addition to Ras cheese. Slurry. Egypt. J.Food Sci., 24, No.3 , P.P 373 – 399.
- Hefnawy, S.A (1986)- Accelerated ripening of Ras cheese by using some enzymes. Egypt. J. Dairy Sci. 14, 59.
- Hofi ,A. : Youssef, E. ; Ghoneim, M. and Tawab, G.(1970) Ripening changes in Cephalotype Ras cheese manufactured from raw and pasteurized milk with special reference to flavour .J. Dairy Sci. 53:1207
- Hofi , A.A.; Mahran, F.A; Abdel- Salam , M.H and Rifaat I.D. (1973a). Acceleration of Cephalotype ('Ras cheese) ripened by using trace elements 'I'- Pilot experiments. Egypt J. Dairy sci. 1:33-44
- Hofi , A.A.; Mahran, G, A; Abdel – Salam , M.H and Rifaat I.D (1973b). Acceleration of Cephalotype ('Ras' cheese) ripening by using trace elements. II – Optimum conditions. Egypt. J. Dairy Sci. 1 : 45.
- Hofi, A., Mahran, G., Farahat, S., Ashour , M and Khorshid M. (1973c). The use of casein hydrolyzate in white soft cheese making. Egypt J.Dairy Sci, 1: 159.
- Hofi, M.(1978) studies on the use of hydrogen peroxide catalaste treatment on hard cheese making. M.Sc. Thesis, Ein – Shams University.
- Hofi, A.A; Abdel – Hamid, L.B.; Ahmed , N.S. and Abbas H.M.. (1991). Acceleration of Ras cheese ripening by relevant slurry. Egypt. J.Dairy Sci., 19: 337 – 346.
- Ismail, A.A., El – Sadek , G.M and Rifaat I.D. (1977). The seffect of commercial lipase on the ripening of Ras cheese. Annals Agric. Sci., 22, 15.

- Ismail, A.A., Nassib, T.A. and Abdel – Galil H., (1978). Manufacturing of Domiati cheese from reconstituted milk powder. I- Effect of milk clotting agent and starter on microbiological and chemical qualities. Assiut J. of Agriculture. Sci , 9, (1), 217.
- Ismail, A.A., Hassan , A.A and El- Hofi M.A, (1996). Studies on Ras cheese ripening with Enzymes addition. II – Application of bacterial Proteases and Lipases in accelerating ripening of Ras cheese. Egypt, J. Food Sci., 24 No, 3 , pp 401 , -416.
- Kebary, K.M.K; Kamaly, K.M.;Zedan, A.N. and Zaghlol A.H.. (1996). Acceleration ripening of Domiati cheese by accelase and Lipozyme enzyzmes . Egypt J. Dairy Sci. 24: 75- 90.
- Khorshid, M.and Rao M., (1971). Studies on whey protein hydrolyzates. II – Accelerating the ripening of Domiati cheese , Milchwissenschaft 26 : 472.
- Kosilkowski :, F.V. (1978) Cheese and fermented milk foods. 2nd Ed. Connell univ. Ithaca, Now York. (cited from).
- Kristoffersen, T; Mikdajcik, E.M and. Gould T:A (1967). Cheddar cheese flavour, IV- directed and accelerated ripening process. J. Dairy Sci, 50:292.
- Law, B.A.(1981). Accelerated ripening of cheddar cheese with microbial proteinases. Neth. Milk Dairy J. , 35, 313.
- Law , B. A and Wigmore A. S..(1982). Accelerated cheese ripening with food grade proteinases. J.Dairy Res. 49, 137.
- Law , B.A. and wigmore A.S , (1983). Accelerated ripening of cheddar cheese with a commercial proteinase and intracellular enzymes from starter streptococci. J.Dairy Res. 50:519.
- Law , B.A. (1984). The acceleration ripening of cheese, in advance in the microbiology and biochemistry of cheese and fermented milk. F.L. Davies and B.A Law(ed). El sevier Applied Science
- McSweeney, P.L.H and Sousa M.J, (2000). Biochemical pathways for the production of flavour compounds in cheese during ripening. Le Lait 80, 293- 324.
- McSweeney, P.L.H (2004). Biochemistry of cheese ripening: Introduction and overview. In cheese chemistry , Physics and microbiology, vol.1:
- McSweeney, P.L.H and Fox P.F., (2004).Metabolism of residual lactose and of lactate and citrate. In cheese : chemistry , physics and Microbiology vol. 1 : General Aspects 3rd edn. PP 361 – 372., Fox. P.F., McSweeney, P.L.H; cogan , T.M. and T.P. Guinee, eds. London: Elsevier.
- Mohamed , A.A.; El – Safty , M.S; El- Zayat , A.I. and Abou – El –Nour- A.M, (1989). Accelerated of Ras cheese ripening By using some protelytic enzyme. Egypt – J- Dairy Sci., 17:337-347.
- Mostafa, M.B.M.; El - Abbassy, M.Z and Ismail A.A., (2000). Utilization of cheese slurries to accelerate the ripening of UF Cephalo type "Ras" cheese . Egyptian J. Dairy Sci., 28:231
- Nadia Zaki, (1988). Acceleration of Ras cheese ripening using Autolyzed yeast. Egypt . J.Dairy Sci., 16: 131- 139.
- Nihal Ezzat and El –Shafei H., (1991). Accelerated ripening of Ras cheese using Freeze and Heat – shocked *lactobacillus Heleveticus*. Egypt J. Dairy Sci., 19: 347- 358.

- Omar . M,M and El - Shibiny S , (1985). Composition and microstructure of Domiati cheese as affected by lactose. Egypt J. Dairy sci., 13 :33.
- Omar, M.M ; Abd El – Baky , A. A ; Rabie, M.A and Ashour M.M. (1987). Free fatty acids quality of Domiati cheese made from dried milks as affected by added lipase. Food chem.24 -197.
- Rabie, A.M; Farahat, S.M.; Abdel –Baky, A.Aand Ashour M.M (1984). Ripening changes of Ras cheese made from recombined milk as affected by certain additives. Food chemistry , 15: 191.
- Said , M and Mohran M. , (1984). Acceleration of white soft cheese ripening by using some bacterial growth factors. Egypt. J Dairy Sci., 12, :219-229.
- Singh , S. and Kristoffersen T. , (1971). Accelerated ripening of direct acidified curd. J. Dairy Sci. 54:756.
- Soliman , M.A., EL Shibiny , S.; Mohamed , A.A., and Abdel Salam M.H. , (1980). Effect of added proteolytic and lipolytic enzyme preparations on the development of volatile fatty acids in Ras cheese. Egypt. J . Dairy Sci. 8:40.
- Sood , V. and Kosikowski F- , (1979). Accelerated cheedar cheese ripening by added microbial enzymes. J. Dairy Sci., 62 – 1865.
- Sutherland , B.J. and Jameson G.W., (1981). Composition of hard cheese manufacture by ultrafiltration. Australian J. Dairy Technology, 36:136.
- Taleb. A; El Hefnawy. M.Y; El hami. M.A. and Manal. Naeim A. (1996). Acceleration of Domiati cheese Ripening by new and promising proteolytic Enzymes. Egypt J. food Sci. , 24, No. 2, pp. 183 -198
- Thakar , P. and Upadhyay K. , (1992). Cheese and slurry A review. Cultured Dairy prod. J. 27:9
- Upadhyay , V. K; McSweeney, P.L.H.; Magboul, A.A.A and Fox P.F., (2004). Proteolysis in cheese during ripening. In cheese : chemistry physics and Microbiology, , vol. 1: General Aspects, 3rd edn, pp 391- 434. London : Elsevier.

اسراع التسوية في بعض انواع الجبن المصري (بحث مرجعي).
نوال سيد أحمد أ.د/ محمود حمزة السنيطي
المركز القومي للبحوث قسم الالبان الدقي – القاهرة

تهدف هذه الدراسة الى مناقشة اسراع التسوية في الانواع الرئيسية من بعض انواع الجبن المصري مثل الجبن الراس و الجبن الدمياطي و تشمل علي الطرق الرئيسية المستخدمة في ذلك مثل:

اضافة بعض الانزيمات المساعدة علي التسوية – العوامل التي تؤدي الي زيادة الاعداد الميكروبية في الجبن للاسراع من تسويتها – اضافة (نموذج الجبن المسوي) للثثرة للاسراع من تسويتها (slurry).