SUMMARY AND CONCLUSION

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UTILIZATION OF UF AND RO-CONCENTRATED MILK IN MANUFACTURING OF SOME DAIRY PRODUCTS

The use of UF and RO techniques to separate and concentrate milk constituents is widely recognized and can be applied to manufacture various dairy products. Ultrafiltration has become an increasingly common processing step in the manufacture of some cheeses from which is Mozzarella cheese.

Mozzarella cheese made from UF-concentrated milk has impaired stretching and melting properties **(Covaccvich and Kosikowski, 1978).** It has been reported that the severity of the problem worseus as the concentration of the milk increases. Whey protein denaturation and precipitation, disturbance of the calcium balance and increasing buffering capacity argued the cheese made from UF-milk will produce curd having a caurser protein network than that of traditional cheese; this affects the melting property.

On the other hand, ingredients used in ice cream production affected greatly its quality and properties. Retentates from UF-and RO-techniques can be used in replacement of MSNF in the frozen desserts. Ultrafiltration reduces the lactose and increases the protein content in the retentate but RO-did not change the proportion of milk components.

The objective of this study was to evaluate and improve the quality of using these concentrates in making Mozzarella cheese and Ice cream

Therefore, this study was carried out in three parts.

PART I

Using ultrafiltration (UF) Retentate in Mozzarella cheese making.

In this part some trials were conducted during the manufacture of the UF-cheese to lower the calcium content in the retentate with the object of reducing the firmness of the curd such as diafiltration or direct acidification processes. The prepared retentates (either from cows' or from buffaloes' milk) were divided into three portions (each of them). The first part served as control; The second part was used for making Mozzarella cheese by direct acidification. The third part was splited to two parts and diafiltered either with water or salt solution (1 %).

There were ten treatments employmed in this part:

T1- Cows' milk (control).

T2- UF-Cows' retentate (control–UF).

T3- UF- Cows' retentate with direct acidification (DAC).

T4- Diafiltration of Cows' retentate with water (DFCW).

T5- Diafiltration of Cows' retentate with 1 % salt solution (DFCS).

T6- Standaredized Buffaloes' milk , 3 % fat (control).

T7- UF- Buffaloes' retentate (control–UF).

T8- UF- Buffaloes' retentate with direct acidification (DAB).

T9- Diafiltration of Buffaloes' retentate with water (DFBW).

T10- Diafiltration of Buffaloes' retentate with 1 % salt solution, (DFBS).

The cheeses were analyzed when fresh and after one month of refrigeration at $\simeq$ 5 °C for chemical, physical, rheological and organoleptical properties. Yield percent as well as recovery of milk constituents and their losses in whey and stretch water were calculated.

The results obtained in this part could be summarize as follows-:

1- Ultrafiltration alters the relative percentage of milk constituents in the milk retentate, as they increased in retentate except lactose.

2- Permeate contained 0.049 % and 0.077 % total nitrogen (TN in cows' and buffaloes'), begin of the same magnitude as NPN content of milk, indicating the milk proteins were almost complete impermeable. This means that proteins are almost retained in retentate, and TN of permeate was nearly made up of NPN of milk. The permeate was found to be free from fat, which was retained in the retentate during UF process. Lactose content was found to be nearly similar to that in whole cows and buffaloes' milk, since lactose easily pass through the membrane. Calcium content of permeate was almost one third the total calcium of milk.

3- Mozzarella cheese made from cows' milk treatments had higher moisture and MFFB content than buffaloes' treatments. Mozzarella cheese made from either cows' or buffaloes' concentrated milk had moisture and MFFB content lower than the control treatment. The moisture content of all treatments is within the Federal Standards for low moisture Mozzarella cheese (> 45 - < 52 %)

4- Mozzarella cheese made from cows' milk treatments had higher fat and F/DM when fresh and during storage period than other treatments. The differences in fat content between treatments were very low.

5- Mozzarella cheese made from standardized buffaloes' milk treatments had TP content higher than those made from cows'. UF-Mozzarella cheese had TP content higher than that of control, indicating that the milk proteins were almost completely impermeable. This means that proteins are almost retained in the produced Mozzarella cheese. TP content increased in all treatments after storage period. Diafiltration treatment increased the total protein content.

6- Mozzarella cheese made from buffaloes' milk contained higher ash than those made from cows' milk, which increased during storage. UF-Mozzarella cheese contained higher ash compared to traditional cheese treatment. Diafiltration process increased

the ash content in the cheese; while acidification decreased the ash content. But S/M percentage of buffaloes' Mozzarella cheese treatments were higher than those of cows' treatments.

7- Mozzarella cheese made from buffaloes' milk contained the highest lactose content, which decreased after the storage period. Diafiltration process decreased the lactose content.

8- Acidity development of traditional Mozzarella cheese made from cows' or buffaloes' milk was higher than those made from UF- retentates. Diafiltration decreased the acidity of the cheese, while acidification increased the acidity of resultant cheese.

9- Mozzarella cheese made from cows' milk had higher SN % and SN/TN % than those made from buffaloes' milk. UF-Mozzarella cheese had lower SN and SN/TN % than that traditional one. SN and SN/TN % increased in all treatments after storage period.

10- Mozzarella cheese made from buffaloes' milk had Ca^{++}, Ca/DM %, P^{++} and P/DM % higher than those made from cows' milk and increased after the storage period. Acidification and diafiltration processes decreased the calcium and phosphorus contents in the cheese.

11- Higher TVFA, tyrosine and tryptophan content were observed in cheese made from cows' milk than those of buffaloes' milk. UF-Mozzarella cheese had lower TVFA, tyrosine and tryptophan content than the traditional one. Acidification and diafiltration

decreased the TVFA, tyrosine and tryptophan contents; while they were increased in all treatments after storage period.

12-Mozzarella cheese made from cows' milk had higher meltability either measured by disc or tube method than those made from buffaloes' milk. UF-Mozzarella cheese had lower meltability than that of traditional one. Meltability increased in all treatments after the storage period. The lowest meltability was for direct acidification treatments. Diafiltration slightly affected the meltability

13-UF-Mozzarella cheese had low oiling off, Mozzarella cheese made from cows' milk had higher values of oiling off than those made from standardized buffaloes' milk. Oiling off of Mozzarella cheese increased in all treatments after storage period. Acidification and diafiltration slightly affected the oiling off property.

14- The flavour, body & texture, and appearance in cows' Mozzarella cheese treatments were higher than buffaloes' cheeses. Generally the different treatments affected the sensory scores of cheese.

In the conclusion, the foregoing results clearly indicate that, manufacture of Mozzarella cheese from UF- cows' retentate gave cheese of close composition and somewhat, quality to the traditional Mozzarella cheese. It gave a reasonable increase in cheese yield

(from 19.27 to 21.99 % and from 18.41 to 24.78 %) for Mozzarella cheese made from cows' and buffaloes' milk. But, Mozzarella cheese made from buffaloes' milk had some defects *e.g.*, decrease in their meltability.

PART II

Improvement of properties of Mozzarella cheese made from UF-retentate.

Earlier part of this study indicated that, Mozzarella cheese can be made either from cows' or buffaloes' milks and their UF-concentrated milk (retentate), but the results indicated that, there were some cheese texture defects; *i.e.* decreased meltability rate which affect the quality of Mozzarella cheese that made from buffaloes' milk and its concentrate by ultrafiltration (UF) technique.

To overcome texture and meltability defects and to enhance the flavour, this part has been planned to reduce the calcium content to a level near to the normal in the curd by using brine solution as a stretching water; increasing the stretching time and to develop flavour by incorporting bacteria (*Bifidobacteria Bb-12*) to produce Mozzarella cheese with good quality.

The processing of Mozzarella cheese from standardized buffaloes' milk (~ 3 % fat); its UF-retentate and UF-cows' retentate, were carried out in six treatments:

T1-Control Mozzarella cheese was made by traditional procedure from pasteurized standardized buffaloes' milk (~ 3% fat) using

activated yoghurt culture containing *Streptococcus salivarius* sub spp *thermophilus* and *Lactobacillus delbruickii* sub spp *bulgaricus* at a rate of 1.5 %.

T2-Mozzarella cheese made from UF cows' retentate.

T3-Mozzarella cheese made from UF buffaloes' retentate.

T4-As treatment T3 with using 1% brine solution as a stretching water.

T5-As treatment T3 with using 2% brine solution as a stretching water.

T6-As treatment T3 with using 3% brine solution as a stretching water.

All cheese treatments except T1 were made using 1.5 % activated yoghurt starter culture + *Bifidobacteria Bb-12* at a rate of 0.75 %. The resultant cheese was analyzed when fresh and after one month of storage at $\simeq$ 5 °C for chemical, rheological and organoleptic quality.

The results can be summarize as follows:-

1- The resultant Mozzarella cheese with brine solution as stretching water had higher moisture and MFFB content than traditional one. On the other hand, Mozzarella cheese made from UF retentate without using brine solution as stretching water had lower moisture and MFFB contents than the control treatment. Moisture and MFFB content decreased during storage period.

2- Traditional Mozzarella cheese had the highest fat which increased after storage period in all treatments, due to the moisture loss.

3- UF-Mozzarella buffaloes' cheese had TP content higher than those of cows' treatments. Slight variations in TP content of buffaloes' cheese were observed. SN and SN/TN increased in all treatments after storage period. Significant differences were recorded in SN for various treatments.

4- UF-Mozzarella cheese had higher ash, Ca^{++} and P^{++} content than traditional which increased during storage in all treatments. Stretching the curd in brine and using *bifidobacteria* lowered the calcium and phosphorus contents in the resultant cheese.

5- Acidity development of UF-cows' Mozzarella cheese was higher than all other Mozzarella cheese treatments. Variations due to the treatments in UF-buffaloe's cheese were slight. Acidity increased during storage period in all treatments. The pH values decreased during storage period in all treatments.

6- Mozzarella cheese made from UF-cows' milk and standardized buffaloes' milk contained the highest lactose content, which decreased after the storage period.

7- UF-Mozzarella cheese had higher TVFA, tyrosine and tryptophan content which, increased in all treatments after

storage period. Stretching the curd with brine increased these values.

8- Using brine solution as stretching water and adding *Bifidobacteria* during making Mozzarella cheese made from UF-buffaloes' milk developed the meltability of the resultant cheese, and it was observed that the cheese with 2 % brine solution as stretching water had the highest meltability measured by either disc or tube method.

9- UF-Mozzarella cheese had higher oiling off; Mozzarella cheese made from cows' milk had higher values of oiling off than those made from buffaloes' milk. Oiling off of Mozzarella cheese increased in all treatments after storage period. UF-Mozzarella cheese made from cows' milk had the lowest oiling off compared with all other treatments than the control.

10- The sensory evaluation of the produced cheese indicated that the flavour, body & texture, and appearance of Mozzarella cheese treatments made using brine solution as stretching water had higher scores.

In conclusion, the results reflect that, manufacture of Mozzarella cheese from UF- buffaloes' milk gave cheese of near composition and somewhat quality to traditional Mozzarella cheese. It gave a reasonable increase in cheese yield (from 0.7 in UF-cows' Mozzarella cheese to 19.0 % in UF-buffaloes' Mozzarella cheese).

The meltability of Mozzarella cheese developed with using brine solution as stretching water and also the flavour was enhanced with using *Bifidobacteria*. The best one was that stretched in 2 % brine solution.

PART III

Utilization of UFR or ROR in Ice Cream Making

The 3rd part of this study was to produce Ice cream using some effective techniques mainly the ultrafiltration (UF) and reverse osmosis (RO) to incorporate the obtained milk concentrate as a substituting ingredient of MSNF and the resultant ice cream was evaluated.

The following treatments were conducted:

T1- Control Ice Cream using SMP.

T2- Ice Cream with 50 % MSNF from UFSMR.

T3- Ice Cream with 75 % MSNF from UFSMR.

T4- Ice Cream with 100 % MSNF from UFSMR.

T5- Ice Cream with 50 % MSNF from ROSMR.

T6- Ice Cream with 75 % MSNF from ROSMR.

T7- Ice Cream with 100 % MSNF from ROSMR.

The ice cream mix was determined for chemical and physical properties and the resultant ice cream was tested when fresh for physical and organoleptic properties. The overrun was also estimated.

The obtained results in this part could be summarize as follows:-

1- Utilizing concentrated milk either by UF or RO technique did not affect significantly the total solids (TS) and fat content in ice cream mixes. On the other hand, total protein content of ice cream mixes increased with replacement of MSNF by UFSMR than that of control and ROSMR.

2- Lactose content decreased in the mixes with increasing replecement of MSNF of both concentrated milk either by UF or RO.

3- Ash content increased in the mixes with increasing replecement of MSNF for both concentrated milk either by UF or RO.

4- Acidity of all ice cream mixes increased with increasing of replecement MSNF for both concentrated milks either by UF or RO, while pH value of all ice cream treatments continuously decreased with increasing replecement of MSNF of both concentrated milk either by UF or RO.

5- Specific gravity, melting resistance and overrun of resultant ice cream increased with increasing of replecement MSNF of both concentrated milk UF or RO.

6- Sensory evaluation of resultant ice cream showed that all treatments were accptable for flavour, body & texture and melting quality. On the other hand, ice cream with 100 %

replecement of MSNF by RO concentrated milk had slight sandness and it was more sweet than others.

In a conclusion, of this part from the sensory assessment and physical properties, the best treatment was that made from 100 % replecement of UFSMR, then the 75 % of ROSMR.

From such a study, with reference to manufacture Mozzarella cheese it could be conclude that Mozzarella cheese with good quality can be made from UF cows'. Also, it can be made from buffaloes' retentate using brine solution (2 %) as a stretching water. On the other hand, diafiltration techniques either by water or brine solution did not improve the quality of Mozzarella cheese especially that made from UF-full retentate. Mozzarella cheese made by direct acidification had lower quality than that of traditional and UF-Mozzarella cheeses.

Looking at the resultant ice cream made with 100 % in replecement of UFSMR and 75 % of ROSMR gave the best sensory quality and melting resistance.

CONCLUSIONS

It could be recommend of using UF -retentate making Mozzarella cheese successfully from cows' milk when compared with buffaloes' milk; cows' and buffaloes' concentrated milks by ultrafiltration (UF) at 20 % TS showed the best quality properties. To improve Mozzarella cheese from buffaloes' milk; cows' and buffaloes' retentates we suggest the use of 2 % brine solution as a

stretching water with the addition of 0.75 % *Bifidobacteria* as an adjunct starter and storing the resultant cheese at 5 ± 1 °C for one month, as its quality was improved during storage.

On the other hand, ice cream could be successfully made using UF or RO-retentates rich-in-protein as a source of MSNF with any percent up to 100 % UFR and 75 % of ROR of MSNF replacement with exception only MSNF supplementation 100 % of ROR.