STUDIES ON BUFFALO MILK AND SOME OF ITS PRODUCTS

BY

WEDAD AZAB METRY AZAB

B.Sc. Agric. (Agric. Industries)

Faculty of Agriculture, Fayoum, Cairo University

1984

M.Sc. (Dairying)

Faculty of Agriculture, Fayoum, Cairo University

1990

THESIS

Submitted in Partial Fulfillment of the Requirements for the degree of

DOCTOR OF PHILOSOPHY

IN

Dairying

Dairying Department

Faculty of Agriculture

Cairo University

Fayoum

1995

SUMMARY AND CONCLUSION

Part I: Influence of months of the year on the gross composition and some physical properties of buffalo milk

Fresh buffalo milk samples were monthly obtained and analyzed for :pH ,rennet coagulation time ,fat content, diameter of fat globules, curd tension ,solids not fat content , nitrogen distribution ,soluble and miceller casein, urea, syneresis, calcium and phosphate distribution.

The results obtained can be summarized as follows:

1- The pH and fat of buffalo milk reached the highest value in Aug. and Sept. and decreased afterwards to reach their lowest values in Jan. and Feb..

2- Rennet coagulation time (RCT) of buffalo milk showed to be pH-dependent and was longer in June-July than in Dec.-Feb.

3- In contrast of fat content, the percentage of solids not fat reached its minimum value in Aug. then increased gradually during Sept.- Feb. and reached to maximum value in Jan. then decreased throughout March-Aug.

4- During the period from Nov. to April, buffalo milk exhibited to have fat globule of larger diameters than during May to Oct..

5- Total nitrogen (T.N.), non-casein nitrogen (N.C.N.) and whey nitrogen (W.N.)contents, were lower in Aug., July and July when compared with their levels in Dec., Nov. and Dec. respectively.

6- Casein nitrogen (miceller and soluble casein) during Sept.-Feb was higher than in March-Aug.. On the other hand size of casein particles showed an opposite trend.

7- Urea and non protein nitrogen (NPN) contents displayed an adverse trend to T.N., N.C.N. and W.N. contents.

8- Curd tension of buffalo milk tended to be higher in Dec. - Feb. than June-July .There were a negative correlation between curd tension and syneresis.

9-Buffalo milk samples contained higher calcium and phosphate (total, soluble and colloidal) contents in Dec.- Feb. than in June - Aug.

Statistical analysis of the data obtained revealed that, there were significant differences ($P<0.05$) between the 2 herds in diameter of fat globules, RCT, SNF, TN, NCN, urea, NPN, soluble casein, miceller casein, size of casein particles, curd tension, syneresis, calcium and phosphate distribution. But the herd was not significant effect on the pH and fat content.

Part II : Modified buffalo milk for Ras cheese making

Fresh buffalo milk was standardized (C/F ratio 0.70.), heated, divided into 6 portions (17.00 kg each treatment) ,treated and made into Ras cheese as following :

Treatments included reducing the pH of the milk to 6 (A),reducing the pH of the milk to 6 and addition of 0.20% sodium citrate (B),replacing of buffalo milk with sodium caseinate 10 or 20 %(C&D),pre-rennetted and aging of buffalo milk (E).Cheeses were ripened for 4 months at 13 ± 1°C and 80-85% RH.

Samples were analyzed for moisture ,pH ,titratable acidity, fat ,free fatty acids ,total volatile fatty acids, total nitrogen ,soluble nitrogen non protein nitrogen, free

The results showed that:

1- The yield of Ras cheese made from buffalo milk mixed with 20% sodium caseinate preparation was significantly higher and that made from cow milk (control I) was significantly less than the rest of cheeses made from buffalo milk (control II) or modified buffalo milk.

2- Ras cheese produced from control I contained moisture significantly higher than that produced from control II. Mixing buffalo milk with 20% sodium caseinate preparation produced cheese of significantly higher moisture than the other ones.

3- Titratable acidity (T.A.) of cheeses increased significantly with the progress of the ripening, but did not differ significantly in fresh cheese made from cow or buffalo milk. Cheese made from buffalo milk mixed with 20% sodium caseinate had the highest T.A. and the cheese made from the pre-rennetted and aged buffalo milk (treatment E) had the lowest T.A.

4- Ras cheese obtained from control I exhibited significantly lower pH than those produced from control II and that made from buffalo milk with reduced of the milk pH to 6 (treatment A). Cheeses produced from buffalo milk mixed with 10 or 20% sodium caseinate (treatment C and D) showed significantly lower pH than control I cheese.

5- In all trials, salt content increased by advancing ripening period (4 months), with an opposite trend of cheese moisture. Significant differences ($P< 0.05$) were found between cheeses produced from control I and II. Ras cheese obtained from treatment E showed the highest values of salt and salt/water (%), while cheese produced from treatment D showed the lowest ones.

6- With the exception of cheeses produced from treatment D and E, Ras cheese obtained from control II contained fat significantly higher than control I. Cheeses obtained from treatments A, B, C and D had

significantly lower fat content than control II cheese. The lowest fat content was recorded in treatment E cheese. On the other hand, the results indicated that, there was significant differences ($P< 0.05$) in the fat content between fresh and ripened cheeses made from cow, buffalo or modified buffalo milk.

7- Ras cheese made from buffalo milk had significantly higher levels of total nitrogen (T.N.) than those made from cow milk. Cheese obtained from treatment E contained the highest percentage of T.N, while that produced from treatment D had the lowest level of T.N%. .

8- Soluble nitrogen (S.N) was significantly higher in fresh cheese produced from control II than control I. During ripening, an opposite trend was found, where control I cheese showed significantly higher S.N than that of control II. Cheese obtained from treatment D exhibited the highest values of S.N, followed by C, B and A cheeses respectively. Ras cheese obtained from treatment E showed the lowest percentage of S.N

9- Non-protein nitrogen (NPN) and free amino groups (FAG) increased significantly with prolonged maturation of cheeses made from cow, buffalo and modified buffalo milk. The differences throughout ripening were significant. Cheese obtained from treatments C and D had significantly higher NPN content as compared to the other treatments, but cheese obtained from treatment E showed the lowest values of NPN or FAG when fresh and during ripening.

10-Short chain free fatty acids (F.F.A) were not detected in all fresh cheeses. Fresh cheese obtained from treatment D had the highest percentage of saturated F.F.A/T.F.A%, while the lowest level was found in cheese obtained from treatment E. Compared with Ras cheese made from cow milk, cheese made from buffalo milk exhibited higher lipolysis, with the exception of treatment E.

11-Total volatile fatty acids (T.V.F.A) increased with the progress of ripening process. The differences during ripening process were significant. Cheese obtained from control I contained T.V.F.A more than control II. Ripened cheeses produced from treatment A, B, C, and D had significantly higher in the T.V.F.A than control I cheese. The T.V.F.A content was lower in cheese obtained from treatment E than that of the other cheeses.

12-Ras cheeses made from buffalo, modified buffalo or cow milk were characterized by their rubbery texture and flat taste up to day 30, therefore gained lowest scores for flavour, body and texture. During progress of ripening process, the quality of all cheeses improved and reached the highest score points at day 120. Ras cheese produced from control II characterized by its hard body and crumbly texture as well as lack of flavour when compared with control I, treatment A and B cheese. Ras cheese obtained from treatment D had very sharp flavour, taste of the processed cheese with high acidity and pasty body, while cheese produced from treatment E characterized by its very hard body with flat flavour and slightly bitter taste. On the other hand, the cheese produced from treatment C exhibited clean flavour with slight acidity and smooth body, therefore gained significantly higher scores for flavour, body, texture and appearance than the rest of cheeses.

From the previous results, it could be concluded that Ras cheese could be successfully made from buffalo milk mixed with 10% sodium caseinate preparation before cheese making.

Part III: Use of buffalo milk in making plain and flavoured acidophilus milk

Acidophilus milk was prepared from a standardized fresh buffalo milk (3% fat) or cow milk (1.5% fat). Strawberry juice concentrate (10%) or apple juice concentrate (15%) and sugar (10%) was added (before and after incubation) to the standardized milk. Resultant acidophilus milk was stored at 5 ± 1°C up to 15 days. Samples were subjected to chemical and microbiological analysis and assessed for their organoleptic characteristics at 3 days intervals.

The results obtained showed that:

1- Acidophilus milk made from buffalo milk, plain or flavoured, coagulated in shorter time than cow ones. Addition of fruit juice concentrates to the milk before incubation led to further shorter time of coagulation especially when strawberry juice concentrate was used.

2- No significant changes occurred in the fat and total solids (T.S) contents of acidophilus milk made from buffalo or cow milk (plain or flavoured) during storage period (15 days). Addition of fruit juice concentrates to the milk led to significant differences in the T.S content. Acidophilus milk containing strawberry contained lower total solids than that of apple ones.

3- Titratable acidity (T.A) of acidophilus milk made from buffalo milk with or without fruits was significantly higher than corresponding cow ones at zero time and during storage. The samples containing strawberry or apple juice concentrates had significantly ($P< 0.05$) higher titratable acidity than those of plain acidophilus milk made from buffalo or cow milk. The increase in the T.A. was pronounced when apple juice concentrate was used than that of strawberry juice

concentrate. The results indicated that the pH of plain or flavoured acidophilus milk exhibited an opposite trend for titratable acidity.

4- Viability of *Lactobacillus acidophilus* in acidophilus milk made from buffalo milk (plain or flavoured) was significantly higher than in cow ones (plain or flavoured) . Plain fresh acidophilus milk showed the highest viability of *L. acidophilus*, which significantly decreased on the storage period. Addition of fruit juice concentrates before incubation of acidophilus milk resulted in significantly higher viability of *L. acidophilus* in the product at zero time than the addition after incubation and coagulation. During storage an adverse trend was observed.

5- No yeast and mould (Y & M) were detected in fresh acidophilus milk samples made from buffalo or cow milk (plain or flavoured). But were detected in flavoured acidophilus milk samples, on the day 6 and day 9 of storage when apple and strawberry juice concentrate was used respectively, either in acidophilus milk samples made from buffalo or cow milk.

6- Aidophilus milk samples were free from coliforms and staphylococci groups at zero time and throughout storage.

7- Plain or flavoured acidophilus milk made from buffalo milk, when fresh or during storage was superior in the quality and gained higher scoring points than corresponding acidophilus milk made from cow milk. Addition of fruit juice concentrate and sugar improved the acceptability and increased total sensory evaluation score, either in fresh or stored samples. Furthermore, the samples contained apple juice concentrate gained higher scores than those containing strawberry juice concentrate. Blending fruit juice concentrates and sugar with the plain acidophilus milk after fermentation yielded a product of superior

organoleptic properties to that obtained by addition of such ingredients before fermentation.

The shelf life of plain and flavoured acidophilus milk was extended up to 15 days at 5 ± 1°C. Buffalo milk can be successfully used in making high quality acidophilus milk with the preference of adding apple juice concentrate before fermentation.