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SUMMARY AND CONCLUSION

This study has been carried out on the Friesian cows herd at Sakha, Animal Production Research Station, Ministry of Agriculture. The following investigations were undertaken.

PART I - Effect of stage of lactation of Friesian cows on milk yield and its properties as well as the properties of Domiati cheese and Samna.

This part dealt with the effect of stage of lactation of Friesian cows on milk yield and its properties as well as the properties of Domiati cheese and Samna. The obtained results can be summarized in the following sections.

Section A: Milk yield and its properties:

1) Milk yield: The daily milk yield during the lactation period ranged from 5.25 kg in the 10th month to 11.40 kg in the 3rd month of lactation with an average of  $9.06 \pm 0.70$  kg. The first five months of lactation were characterized by higher milk yield (over the average) than the remainder of lactation period.

## II. Chemical properties

1) The average of fat, SNF and protein contents reached the minimum values of 3.70, 8.30 and 2.78% respectively in the 2nd month of lactation, and the maximum values of 4.60, 8.55 and 3.20% respectively at the end of lactation period. The ash content and its alkalinity reached the minimum of 0.64% and 6.4 ml/1 N HCl in the 3rd month of lactation period, after which they gradually increased reaching the maximum values of 0.74% and 8 ml / N HCl at the end of lactation period. The maximum value of 4.76% was obtained for lactose content in the first month of lactation while the minimum value of 4.44% occurred in the 10th month of lactation period.

The average of fat, SNF, protein, lactose and ash contents and its alkalinity during the whole lactation period was 4.1, 8.43, 2.971, 4.59 and 0.69% respectively. The average of ash alkalinity was 7.1 ml /N HCl.

2) Nitrogen fractions: The average of total nitrogen as well as the nitrogen of casein, lactalbumin, lactoglobulin, proteose peptone and non protein contents reached the minimum of 0.4602, 0.3470, 0.0280, 0.0220, 0.0080 and 0.0220% in the 2nd, 3rd, 1st, 2nd, 4th and 5th month of lactation, respectively, The corresponding maximum values of these fractions

were 0.5269, 0.3929, 0.0360, 0.0290, 0.0240 and 0.0260% in the 10th, 10th, 3rd, 10th, 10th and 1st month of lactation, respectively. The average of these fractions during the whole lactation period was 0.4894, 0.3704, 0.0314, 0.0256, 0.0146 and 0.0237% respectively.

3) Milk salts: The chloride, calcium, magnesium, phosphorus and citrate contents had the minimum values of 0.108% 100.30, 10.82, 80 and 144 mg/100 ml milk in the 2nd, 2nd, 2nd, 3rd and 10th month of lactation period, respectively, while their maximum values were 0.139%, 130.20, 12.10, 96 and 186 mg/100 ml milk in the 10th, 10th, 6th, 10th and 1st month of lactation period in the same order. The average of chloride, calcium, magnesium, phosphorus and citrate contents during the whole lactation period was 0.1215%, 116.05, 11.60, 87.60 and 168 mg/100 ml milk, respectively.

The salt balance (Ca + Mg/cit. + phos.) reached the minimum of 0.42 in the 2nd month of lactation, then increased with advancing lactation period to reach the maximum of 0.59 at the end of lactation period. The average of salt balance of Friesian cow's milk during the whole lactation period was 0.50.

4) The chloride/lactose number: It gradually increased from the minimum of 2.298 in the 2nd month to reach the

maximum of 3.13 at the end of lactation period with an average of 2.66 during the whole lactation period.

5) Phospholipids and unsaponifiable matter contents:

The minimum values of phospholipids and unsaponifiable matter were 21.25 and 12.025 mg/100 ml milk respectively. On the fat basis, their corresponding values were 0.5743 and 0.3250% in the 2nd month of lactation, after which they gradually increased to reach the maximum of 31.50 and 30.82 as mg/100 ml milk and 0.6848 and 0.670 as percentage of fat content, at the end of lactation period, respectively. The average of phospholipids and unsaponifiable matter contents was 26.17 and 19.135 mg/100 ml milk, and 0.6312 and 0.460% of fat in the same order, during the whole lactation period.

III. Physical and physico-chemical properties:

1) The fat globules attained their largest size of 3.24  $\mu$  in the 2nd month of lactation where the minimum number of 1.2 billion globules/ml milk were obtained. As the lactation period advanced, the average size of fat globules gradually decreased to reach the minimum of 2.57  $\mu$  in the 10th month of lactation, while the maximum number of 2.5 billion fat globules/ml milk was obtained at the end of lactation period. The average of size and number of fat globules during the whole lactation period was 2.879  $\mu$  and 1.641 billion/ml milk, respectively.



The relatively large size of fat globules (6 to 8 u) being 13, 7, and 5% were noticed at early, mid and late lactation periods, respectively. The relatively small globules (1 to 2 u) represented 42, 51 and 59% at early, mid and late lactation periods, respectively.

2) The minimum values of specific gravity, refractive index, acidity and pH which were 1.0276, 1.3430, 0.15% and 6.40 in cow's milk, were observed in the 3rd, 5th, 10th and 1st month of lactation, respectively. Their maximum values of 1.0315, 1.3445, 0.185% and 6.75, were obtained in the 10th month of lactation, except acidity which was observed in the 1st month of lactation. The average values during the whole lactation period were 1.0298 for sp. gravity, 1.3439 for refractive index, 0.169% for acidity and 6.60 for pH.

Section B - The properties of Domiati cheese and Samna

1) Domiati cheese:

1) Coagulation time and curd tension: in early lactation period, the rennet coagulation time (RCT) was shorter, being 90 sec. and the resultant coagulum was firmes (highest curd tension of 15.66g) in the first months of lactation. As the lactation advanced, RCT increased to reach the maximum of

180 sec. and the coagulum became more softer (the curd tension was the lowest, 12.50 g) in the 10th and 8th month of lactation, respectively.

The average of RCT and curd tension of Friesian cow's milk during the whole lactation period was 144 sec. and 14.20 gram, respectively.

The correlation and regression coefficients between RCT and curd tension were negative and highly significant. Also negative and highly significant correlation and regression coefficients were obtained for the relation between RCT and acidity of milk. On the other hand, positive and highly significant correlation and regression coefficients existed between RCT and pH of milk.

2) Cheese yield: The minimum yield of fresh Domiati cheese was 19.50 kg/100 kg milk in the second month of lactation, while the maximum of 24.50 kg/100 kg milk was obtained in the 10th month of lactation. The average of the yield during the whole lactation period was 21.35 kg/100 kg milk.

Positive and highly significant correlation and regression coefficients were obtained for the relation between

casein plus fat % of milk and cheese yield %. Also, positive and significant correlation and regression coefficients existed for the relation between water in cheese/casein in milk and cheese yield.

3) Moisture content: The maximum moisture content of fresh Domiati cheese produced during the second month of lactation was 59.66%, while the minimum of 57.20% was obtained at the end of lactation period. The average of moisture of moisture content of fresh Domiati cheese was 58.36% during the whole lactation period.

Positive and highly significant correlation and regression coefficients existed between casein in 100 kg milk and water in cheese produced from 100 kg milk. Also, positive and significant correlation and regression coefficients were obtained for the relation between casein/fat ratio in milk and moisture content of the resultant Domiati cheese.

4) Fat/dry matter ratio: Its minimum value of 40.90% was noticed in the cheese produced during the second month of lactation, while its maximum value of 46.73% was reported for the cheese made during the 10th month of lactation period. The average of fat/dry matter in fresh Domiati cheese was 44.98% throughout the whole lactation period.

Negative and significant correlation and regression coefficients were obtained for the relation between casein/fat ratio in milk and fat/dry matter in cheese.

## II. Samna

1) The minimum of iodine value, saponification number and refractive index were 27.19, 214.58 and 1.4540 respectively and attained in the 2nd, 10th and 1st month of lactation in the same order. However, the maximum of 35.80, 230.06 and 1.4560 were obtained in the 10th, 1st and 10th month of lactation, respectively. The average of iodine value, saponification number and refractive index during the whole lactation period was 32.10, 223.97 and 1.4549 respectively.

2) The stability of Samna against oxidative, rancidity as measured by thiobarbituric acid (TBA) and peroxide value (P.V.) was more obvious at the end of storage period of 40 weeks whereas, the Samna obtained during the early months of lactation (1st and 2nd) was more resistant to oxidation than those obtained in the mid or late lactation periods. Samna of low stability was obtained during the late lactation period (9th and 10th month). The TBA value of Samna of the first and second month of lactation was 0.35-0.37, while the samna of 9th and 10th month of lactation period had TBA value of

0.61-0.62, at the end of storage period. The corresponding values for P.V. were 4.2-4.7 for the 1st and 2nd month of lactation and 6.4-6.6 for the 9th and 10th month of lactation period.

PART II - Effect of seasonal variation of Friesian cows on milk yield and its properties as well as the properties of Domiati cheese and Samna.

The milk yield of Friesian cows and its properties as well as the properties of the resultant Domiati cheese and Samna as affected by seasonal variation were investigated in this part. The obtained results can be summarized in the following sections.

Section A - Milk yield and its properties:

1) Milk yield: The maximum daily milk yield was 12.50 kg in June, then gradually decreased to reach the minimum of 8.90 kg in November, with an average of 10.52 kg throughout the whole year. The marked increase in milk yield from March to reach the maximum value in June may be attributed to the green and dry feeding mixture in the late of May and beginning of June, and to the highest calving occurred in March and April, giving their maximum yield in the 2nd and 3rd month after calving (May and June).

## II. Chemical properties

1) The fat, SNF, protein and ash content gradually increased from the maximum of 3.6, 8.46, 2.775 and 0.65%, respectively at the beginning of stall feeding in May and June to reach the maximum of 4.3, 8.72, 3.205 and 0.73% in December, February, January and January in the same order. The drop occurred in these values was more pronounced in the beginning of stall feeding (May and June), which may be due to the effect of stage of lactation, whereas the milk production attained maximum during this period.

The averages of fat, SNF, protein, lactose and ash contents during the whole year were 3.90, 8.58, 2.994, 4.59 and 0.69% respectively. The alkalinity of milk ash varied from 6.2 ml/ N HCl in March to 8 ml/ N HCl in December with an average of 7.17 ml/ N HCl during the whole year.

2) Nitrogen fractions: The minimum value of 0.4615% was obtained for total nitrogen in June and 0.3470% for casein nitrogen in June, 0.0280% for lactalbumin nitrogen in October, 0.0220% for lactoglobulin nitrogen in June, and 0.0095% for proteose peptone nitrogen in May. The maximum values for these fractions were 0.5254, 0.3922, 0.0360, 0.0292 and 0.0220% respectively at the beginning of green feeding in January. However, the minimum value of non-

protein nitrogen of 0.0225% was obtained in December at the late of stall feeding and beginning of green feeding, and the maximum of 0.0270% in July during the stall feeding. The average values of these nitrogenous fractions were 0.4938% for the total nitrogen, 0.3707% for casein nitrogen, 0.0316% for lactalbumin nitrogen, 0.0255% for lactoglobulin nitrogen, 0.0169% for proteose peptone nitrogen and 0.0246% for non-protein nitrogen.

3) Milk salts: The chloride content reached the maximum of 0.138% in October and decreased to the minimum of 0.102% in January. The maximum values of calcium, magnesium, phosphorus and citrate contents were 134.4, 12.4, 96 and 190 mg/100 ml milk in December, March, December and March respectively during the green feeding, while their minimum values were 120, 9.9, 84 and 152 mg/100 ml milk in May, May, March and December in the same order. The average of chloride, calcium magnesium, phosphorus and citrate contents was 0.117%, 125.90, 11.60, 88.17 and 173.08 mg/100 ml milk, during the whole year respectively. It can be noticed that the higher values of chloride and citrate contents were obtained at the stall feeding period, while highest values of calcium, magnesium and phosphorus contents occurred during the green feeding period.

The minimum value of the salt balance (Ca + Mg/Citr. + phos.) was 0.470 at the beginning of stall feeding in June and its maximum was 0.59 in December. The average of salt balance of Friesian cow's milk was 0.527 throughout the year.

4) The chloride/lactose number reached the maximum value of 3.067 in October then decreased to reach the minimum of 2.242 in February. The average of chloride/lactose number of Friesian cow's milk was 2.545 during the whole year.

5) Phospholipids content decreased to reach the minimum of 23.90 mg/100 ml milk and 0.6459% of fat in April, then gradually increased to reach the maximum of 32.90 mg/100 ml milk and 0.7651% of fat in December. However, the unsaponifiable matter content reached the minimum of 12.96 mg/100 ml milk and 0.360% of fat in June and the maximum of 22.36 mg/100 ml milk and 0.520% of fat in December.

The average of phospholipids content was 28.23 mg/100 ml milk and 0.7225% of fat, while the average of unsaponifiable matter content was 17.008 mg/100 ml milk and 0.434% of fat. The foregoing results indicate that the relatively higher levels of phospholipid contents in milk of late summer and fall seasons were accompanied with the late lactation period



for most of lactating cows, and the higher unsaponifiable matter contents of winter milk than summer milk may be due to the fact that the green feeding in winter contains higher quantities of unsaponifiable matter than dry fodder in summer.

### III. Physical and physico-chemical properties of milk:

1) The average size of fat globules was relatively bigger during the green feeding period, whereas the maximum size of 3.16  $\mu$  was observed in May at the late of green feeding and the smallest size of 2.59  $\mu$  occurred in December at the late of dry feeding. The opposite trend was observed for the number of fat globules, where the minimum number of 1.2 billion/ml milk was obtained in May. The maximum number of 2.65 billion/ml milk in December. The average size and number of fat globules was 2.897  $\mu$  and 1.194 billion/ml milk, respectively throughout the whole year.

The milk obtained during the green feeding season (January to May) had relatively larger fat globules (6-8  $\mu$ ) as compared with that of dry feeding season (August to Dec.) On the other hand, about 56% of the fat globules in the milk of dry feeding season were smaller in size (1-2  $\mu$ ), while these small of fat globules represented about 46% in the milk of green feeding season.

2) Specific gravity of the Friesian's milk reached the minimum value of 1.0270 in June, then slightly increased to reach the maximum of 1.0320 in February, with an average of 1.0297 throughout the whole year.

3) Refractive index of Friesian cow's milk was relatively constant and did not appreciably changes during the whole year. The minimum value was 1.3430 in March and April and the maximum of 1.3445 occurred in December, and January. The average of refractive index was 1.3436 during the whole year.

4) The titratable acidity and pH values of Friesian cow's milk oppositely behaved throughout the year. The minimum values were 0.150% for titratable acidity in December, and 6.45 for pH in January. The maximum values of titratable acidity and pH were 0.190% and 6.75 in January and November, respectively. The average of titratable acidity and pH was 0.168% and 6.60 throughout the whole year.

Section B - The properties of resultant Domiati cheese and Samma.

I. Domiati cheese:

1) Coagulation time and curd tension: The rennet coagulation time was longer (240 sec.) at the beginning of dry feeding in June, then gradually shortened to reach the

minimum of 90 sec. in January at the beginning of green feeding. However, the curd tension exhibited the opposite trend of the coagulation time throughout the year, whereas the curd tension reached the minimum of 12.50 g in June (soft) and the maximum of 16.30 g in January (firm). The average of coagulation time and curd tension was 168 sec. and 14.27 gram, respectively during the whole year.

2) Cheese yield: The yield of fresh Domiati cheese increased to reach the maximum of 24% at the late of fall season in November, while the minimum of 20.50% was obtained at the late of green feeding in May. The average of fresh Domiati cheese yield was 22.33% throughout the year. The increase in the yield of fresh Domiati cheese was accompanied with increasing in milk constituents, particularly, the fat plus casein content.

3) Moisture content: The moisture content of fresh Domiati cheese decreased to reach the minimum of 57.25% in August, then increased to reach the maximum of 60.44% in March with an average of 59.23% during the whole year. Also, the moisture content of Domiati cheese was affected by the casein contents of milk and the casein/fat ratio in milk, whereas these relations were positive and significant with the moisture content of fresh Domiati cheese.

4) Fat/dry matter ratio: The minimum value was 40.70% in May, after which it gradually increased to reach the maximum of 46.44% in November. The average of fat/dry matter ratio of fresh Domiati cheese was 43.88% throughout the year. The fat/dry matter ratio of cheese followed the same trend for fat, protein and SNF content in the milk manufactured into cheese throughout the year, while a reverse relation between the casein/fat ratio in milk and the fat/dry matter ratio in cheese was obtained.

## II. Samna:

1) Iodine value gradually increased from the minimum of 26.62 in January to reach the maximum of 33.50 in September with an average of 30.06 during the whole year. The Samna obtained during the dry feeding period (June-November) had higher iodine value than that of green feeding period (Jan.-May).

2) Saponification number was 226.5 in March and remained almost the same in April and May, then tended to decrease to 209.4 in October after that, it gradually increased to the maximum of 230.3 in January. The average of saponification number was 219.15 throughout the whole year.

Samna obtained during the green feeding season was characterized by relatively higher saponification number as

compared with that of dry feeding season.

3) Refractive index of Samna slightly increased from the minimum of 1.4540 in March to reach the maximum of 1.4560 in August and September. The average value was 1.4550 throughout the whole year. The refractive index followed the same pattern of the iodine value during the year.

4) The stability of Friesian cow's Samna prepared along the months of the year as measured by TBA and P.V. during the storage period of 40 weeks at room temperature markedly varied from month to another, whereas the effect became more noticeable at the end of storage period. The maximum values of TBA and P.V. were 0.620 and 6.7 respectively for the Samna prepared from the milk of July. The samples produced during the dry feeding season (in summer) were less stable against oxidation, which was characterized by low levels of unsaponifiable matter and relatively higher iodine value and refractive index. While, the minimum values of TBA and P.V. being 0.340 and 4.4 respectively, were reported for the samples prepared from the milk of December at the beginning of green feeding in winter, whereas these samples were more stable against oxidation as compared by those obtained during dry feeding season in summer.

Part III - Effect of feeding system of Friesian cows on milk yield and its properties as well as the properties of Domiati cheese and Samna.

This part was devoted to study the effect of feeding system of Friesian cows on milk yield and its properties. Also, the properties of the resultant Domiati cheese and Samna were investigated.

Twelve of Friesian cows, calved in March and April 1977 were divided into groups (control and treatment groups), each of six cows. Their lactation period was divided into 3 intervals, each of 3 months. The first period was called preparatory period, during which the animals were fed on similar ration. In the second period (Experimental period) the treatment group were fed on the same control ration in addition to 10 kg/day of Elephant grass as green fodder, then the cows of the two groups were fed again on the same ration during the third period which was known as the post-experimental period. The obtained results can be summarized in the following sections:

Section A - Milk yield and its properties:

1) Fat corrected milk yield (FCM): The daily average of 4% FCM yield of the control and treatment groups during

the preparatory period was nearly the same, being 15.64 and 15.42 kg, then significantly increased ( $P < 0.01$ ) during the experimental and post-experimental periods for the treatment group. The values of the treatment group were 13.55 and 10.52 kg during the experimental and post-experimental periods respectively, while the values of control group during these periods were 11.04 and 7.87 kg in the same order.

## II. Chemical properties:

1) The differences between the averages of fat, T.S, protein contents were insignificant for the two groups during the preparatory period, and significantly increased ( $P \leq 0.05$ ) during the experimental and post experimental periods for the treatment group over the control animals. However, the lactose and ash contents of the two groups were not affected by improving the feeding system whereas, the average of lactose and ash contents of milk of both control and treatment groups was the same during the periods of investigation.

2) Nitrogen fractions - Total nitrogen, casein nitrogen, lactalbumin nitrogen, lactoglobulin nitrogen, proteose peptone nitrogen and non protein nitrogen content of the milk of the treatment group significantly ( $P \leq 0.05$ ) increased over the control group during the experimental and post-

experimental periods. However, these values were nearly the same during the preparatory period for the two groups.

3) Milk salts - The averages of chloride, calcium and magnesium contents of the milk of the control and treatment groups were nearly the same during the preparatory period. However, the corresponding values of the treatment group were significantly increased over the control group during the experimental and post-experimental periods.

### III. Physical and physico-chemical properties:

The averages of specific gravity, refractive index, titratable acidity and pH of Friesian cow's milk were not affected by improving the feeding system, whereas the differences between the values of the control and treatment groups were statistically insignificant during the preparatory, experimental and post experimental periods.

#### Section B - The properties of Domiati cheese and Samna

##### I. Domiati cheese

1) Coagulation time - The average of rennet coagulation time of Friesian cow's milk from the treatment and control groups were nearly the same, during the preparatory period. The corresponding values were significantly increased for the



control group over the treatment group during the experimental and post-experimental period.

2) The average of fresh Domiati cheese yield obtained from milk of the treatment cows was significantly higher ( $P = 0.05$ ) than that obtained from the milk of the control group during the experimental and post-experimental periods. The same trend was obtained for the moisture and fat/dry matter content of Domiati cheese made from the milk of the treatment group, whereas the values were significantly ( $P = 0.05$ ) higher than the control group during the experimental and post-experimental periods.

## II. Samna

The averages of iodine value and saponification number of Samna obtained from both milk of the control and treatment cows during the periods of investigation were nearly the same, whereas the differences were statistically insignificant and these values were not affected by the improving feeding system.

Part IV - Relationship between milk yield and its composition as well as amongst milk constituents.

The data obtained throughout this study were statistically analyzed to find out the relations between milk yield and its composition as well as amongst milk constituents. The relations obtained can be summarized as follows:

- Negative and highly significant correlation and regression coefficients were found for the relations between milk yield and its fat, protein and SNF contents.

- Positive and highly significant correlation and regression coefficients were obtained for the relations existing between fat and protein content, fat and SNF content and between protein and SNF content.

- Positive and highly significant correlation and regression coefficients were recorded for the relation between total nitrogen and casein nitrogen contents.

- Negative and non-significant correlation and regression coefficients were obtained for the relations between casein nitrogen and lactalbumin nitrogen contents and between casein nitrogens and non-protein nitrogen contents.

- Negative and highly significant correlation and regression coefficients were obtained for the relations between chloride and lactose contents.

- Positive and highly significant correlation and regression coefficients were obtained for the relations between chloride and calcium contents, magnesium and calcium contents as well as calcium and phosphate contents.

- The relation between chloride and citrate contents had negative and highly significant correlation and regression coefficients, whereas, the relation between magnesium and citrate contents was insignificant. However, similar relation was obtained for citrate and calcium contents. On the other hand, negative and significant correlation and regression coefficients were recorded for the relation between phosphate and citrate contents.

- Positive and highly significant correlation and regression coefficients were obtained for the relation between fat content and its phospholipids, unsaponifiable matter contents and number of fat globules/ml. milk.

- Negative and highly significant correlation and regression coefficients were obtained for the relations between fat content and size of fat globules and between size and number of

fat globules, as well as between size of fat globules and phospholipids content.

- Positive and highly significant correlation and regression coefficients were reported for the relation between unsaponifiable matter and phospholipids contents.