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Interrelationships of Biochemical Parameters in Milks from Machine Milking

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The aim of this research is to investigate the relationships between biochemical components in milks from machine milking. The data was obtained from DIMES Company. The milk component levels in this study are consistent with normal values for cows. There was positive correlation between solids and total fat ($r = 0.59$; $p < 0.01$) and between solids and milk acidity (sH) ($r = 0.75$; $p < 0.01$). But, no relationship was found between solids and pH. There was no correlation between pH and sH levels in machine milking. The fat has a higher correlation with sH ($r = 0.64$; $p < 0.01$). This should be useful in calculating the quantity of fat in milk for cheese-making. Relationships between biochemical parameters are also useful in studying the physiology of milk production. Further researches are needed to confirm the findings obtained from machine milking cows in this study.

Key Words: Interrelationships, Biochemical parameters, Milks, Machine milking.

INTRODUCTION

Relationships between milk components is a subject of interest for last years[1-3]. Chemical studies reflect a need for data to support investigations of a nutritional, breeding or processing nature. Early investigations of milk composition are useful in establishing its nutritional value. Recently, authorities are interested in the variability of milk constituents and their heritability, *e.g.*, the current problem of breeding for increased solids-not-fat content. However, the studies on the use of machine milking in dairy farm conditions are limited[4,5]. Component chemistry and relationships between them are also useful in studying the physiology of milk production. For example, the fat is the most variable parameter among the major milk components and its synthesis (Fig. 1) is affected by many factors-especially dietary and environmental factors such as milking.

Most coefficients of Pearson's correlations among the various milk biochemical parameters were reflected metabolic adaptations in lactation. Little is known about factors affecting milk components in machine milking. However, any correlations

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among milk biochemical parameters in machine milking are still unknown. Therefore, the correlations among milk constituents by using the Pearson correlation coefficients have been obtained in this study.

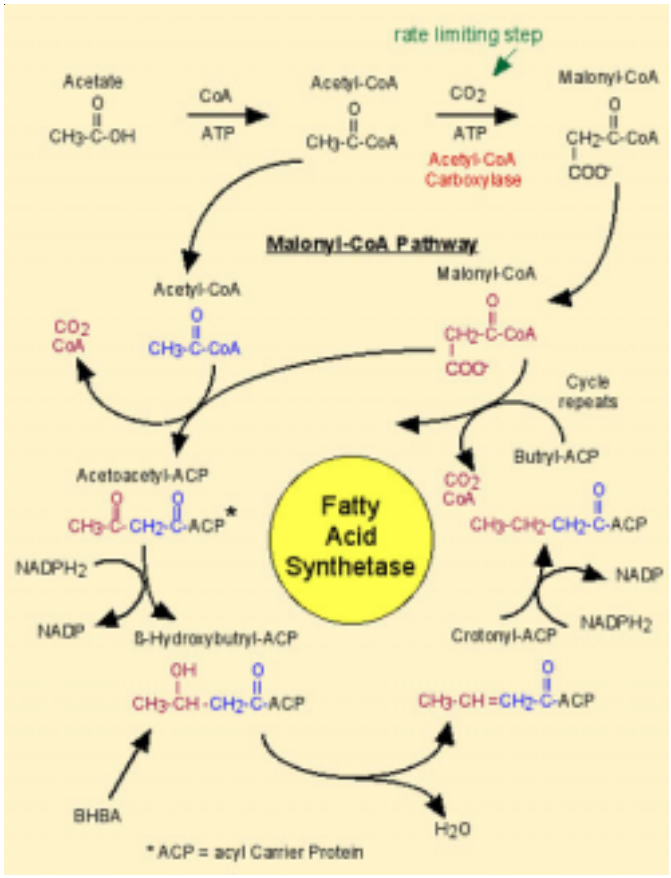

Fig. 1. Synthesis of fatty acids of milk

EXPERIMENTAL

The data was obtained from DIMES Company for all months of year 2006. Cow's milk samples were collected directly from homogenized bulk milk at determined local points and put in to the 200 mL sterile plastic container stored at 4 ºC and immediately transported in freezer to the laboratory and analyzed. The milk fat was determined by Roese-Gottlieb Method[6]. Milk acidity was determined using a Xerolyt electrode (model HA 405; Ingold Electrode, Wilmington, MA). Total solids were determined by drying a known mass of milk at 102 ± 1 °C. All of the data are indicated as mean ± SEM. Correlations among parameters were calculated using the Pearson correlation coefficients.

RESULTS AND DISCUSSION

Acidity (pH and sH): As shown in Table-1, milk acidity levels in this study are consistent with normal values for cows announced by Koneko and Cornelius[7]. The pH of milks ranged from 4 to 7. It is found 5.9 ± 0.14 level of sH of milk from bulk. The extra acidity value in milk is not desirable. It has been explained in The Turkish Food Regulation that the acidity of cows' milk is not more than 8 sH (0.18 %). It can be seen from Table-1 that is the normal value for Turkish standards. Turkish dairy milk acidity values have changed between 4.20 sH (0.09 %) and 12 sH (0.27 %)[8]. There was no correlation between pH and sH levels (Table-2) in machine milking.

TABLE-1
DESCRIPTIVE STATISTICS

Parameters	Mean	Standard deviation
sH	5.9	0.14
pH	6.7	0.04
Solid	9.7	0.29
Fat	3.3	0.20

TABLE-2
CORRELATION COEFFICIENTS BETWEEN EXPERIMENTAL DATA

		Solid	Fat	sH	pH
Solid	Pearson correlation	1	.598(**)	.750(**)	.043
	Significant	.	.000	.000	.733
Fat	Pearson correlation	.598(**)	1	.642(**)	.154
	Significant	.000	.	.000	.216
sH	Pearson correlation	.750(**)	.642(**)	1	.118
	Significant	.000	.000	.	.347
pH	Pearson correlation	.043	.154	.118	1
	Significant	.733	.216	.347	.

**Correlation is significant at the 0.01 level.

Solids and Fat: The milk solids and total fat in this study are consistent with normal values for cows announced by Koneko and Cornelius[7]. Total fat and solid levels are normal values for standards. There was positive correlation between solids and total fat ($r = 0.59$; $p < 0.01$) and between solids and sH ($r = 0.75$; $p < 0.01$). But, no relationship was found between solids and pH.

If the dairy farmers want to increase level of fat, they should observed that total solid level during lactation in machine milking treatment. It is known that fat is the most variable parameter among the major milk components and its synthesis is affected by many factors-especially dietary and environmental factors such as milking. Depending upon feed costs and changes in milk fat value, economics favour increased production of milk fat in some circumstances and decreased production in others.

The authors found a positive correlation between total fat and acidity (sH) in machine milking treatment. It can be explained that milk fat contains high concentrations of short- and intermediate-chain fatty acids and have a large effect on total acidity. Fatty acids are frequently represented by a notation such as C18:2 which indicate that the fatty acid consists of an 18-carbon chain and 2 double bonds. Although this could refer to any of several possible fatty acid isomers with this chemical composition, it implies the naturally-occurring fatty acid with these characteristics, *i.e.*, linoleic acid. Double bonds are said to be 'conjugated' when they are separated from each other by one single bond, *e.g.*, (-CH=CH-CH=CH-). The term 'conjugated linoleic acid' refers to several C18:2 linoleic acid variants such as 9,11-conjugated linoleic acid and 10,12-conjugated linoleic acid which correspond to 9,11-octadecadienoic acid and 10,12-octadecadienoic acid. The principal dietary isomer of conjugated linoleic acid is *cis*-9,*trans*-11-conjugated linoleic acid, also known as rumenic acid. Conjugated linoleic acid is found naturally in cheese, milk and yogurt; $CH_3(CH_2)_5CH=CH-CH=CH(CH_2)_7COOH$ 9,11-conjugated linoleic acid.

The correlation coefficients (Table-2) show that most individual constituents (fat and sH) of milk change positively and highly significantly with changes in total solids. As might be expected, the individual components increase or decrease as the total solids increase or decrease, but not to the same extent. The milk pH, however, show no significant correlation to changes in total solids of milk. The relationships of the fat to total solids and solids-not-fat have been the subject of research for many investigators[9-11]. Since the present values are similar to those reported in the literature, these relationships are not discussed further here. Less numerous data are available on the relationships between the fat and other constituents. It is apparent from Table-2 that fat has a higher correlation with total solids and sH. This should be useful in calculating the quantity of fat in milk for cheese-making. Thus, it is important to deduct the fat before expressing the relationship between fat and total solids or between fat and sH.

Relationships between components are also useful in studying the physiology of milk production. Processing difficulties are often attributed to changes in composition[12]. Further researches are needed to confirm the findings obtained from machine milking cows in this study.

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