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THE CHEMICAL COMPOSITION AND TECHNOLOGICAL PROPERTIES OF COW MILK FROM THE MORNING AND EVENING MILKING IN THE SUMMER MONTHS

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Abstract

The composition of milk is changed during lactation but also during a day. Some authors reported changes about $\pm 1,1$ kg in milk yield during a day, about $\pm 0,75$ % in milk fat content during a day and about $\pm 0,20$ % in protein content during a day in the stable breeding conditions. The aim of our experiment was evaluated the changes in milk yield (kg), composition of milk and technological properties of milk from the morning and evening milking. The interval between morning and evening milking was $12 \text{ h} \pm 15 \text{ min}$. The object of experiment were 12 cows of Holstein cattle on the first lactation from the 100-day of lactation to 200-day of lactation. The samples of milk were collected in June, July and August, once a month from the morning and evening milking. The production parameters (milk yield - kg, milk protein production - kg, milk fat production - kg), milk composition (milk protein content - %, milk fat content - %) and technological properties of milk (titratable acidity - SH, rennet coagulation time - s, quality of curd - class) were determinate. There were found high significant differences ($P < 0.01$) between morning milk yield (14.4 kg) and evening milk yield (12.6 kg) and between morning milk protein production (0.46 kg) and evening milk protein production (0.40 kg). No significant differences were found between morning and evening values of the rest parameters.

Keywords: composition of milk, milking, Holstein Friesian, summer period

Introduction

Milk production varies during lactation, producing what is termed a lactation curve (*Landete-Castillejos and Gallego, 2000*). *Zizlavsky and Miksik (1988)* recorded, that there are changes in milk production during a day too. *Teply et al. (1979)* published daily variation $\pm 1,10$ kg in milk yield, $\pm 0,75$ % in milk fat content and $\pm 0,20$ % in milk protein content.

Milk yield of cows can be expressed in many different ways; for instance, in kilograms per lactation or in kilograms per day. In practise, milk yields are realised per milking. A true lactation yield is the summation of all yields during the lactation (*Ouweltjes, 1998*). Milk yield in dairy cows is regulated by numerous factors, such as genetics, environment, hormonal status, nutritional state and milking frequency (*Lollivier and Marnet, 2005*).



Teply et al. (1979) reported that milking is realised twice a day with milking interval 12 h today. Milking interval was defined as the time from the start of one milking to the start of the next (*Lee et al.*, 1995).

Cows tend to have higher milk yield at the morning milking even when the interval between milkings is equal (*Palmer et al.*, 1994). Greater milk yields are associated with longer milkings intervals, and morning milk yield may be greater when milking intervals are equal (*Hargrove*, 1994).

Protein and fat content are the most important components that dictate the purchase price of milk. They are influenced by various genetic as well as environmental factors, such as nutrition, stage of lactation, age of the animal, season, climatic effects, milking system, milking time, udder health, etc (*Klopcic et al.*, 2003). *Zizlavsky and Miksik* (1988) reported that many authors published in their studies the least protein content in milk from morning milking and higher in milk from evening milking. Fat content is the most variable component of milk and besides the factor listed above, also depends on completeness of milking, sampling procedure and milking interval (*Klopcic et al.*, 2003). Fat percentages in the morning milking were lower even when milking intervals were nearly equal (*Hargrove*, 1994).

There were no much information about differences in technological properties of milk between morning and evening milking. We compared our results only with *Brauner and Hanus* (1984).

Materials and methods

The object of experiment were 12 cows of *Holstein cattle* on the first lactation from the 100-day of lactation to 200-day of lactation. The samples of milk were collected in June, July and August, once a month from the morning and evening milking. The production parameters (milk yield - kg, milk protein production - kg, milk fat production - kg; *Figure 1-3*), milk composition (milk protein content - %, milk fat content - %; *Figure 4*) and technological properties of milk (titratable acidity - SH, rennet coagulation times, quality of curd – class; *Figure 5-7*) were determined. The milk yield was recorded in the parlour during the sampling. The milk components (milk protein and milk fat) were determined in the Research Institut of Cattle Breeding in Rapotin by MilcoScan 133 B, technological properties of milk were determined in the laboratory of applied lactology in the Department of Animal Breeding of Mendel university. Titratable acidity was determined by ČSN 570530, part 58, rennet coagulation time by nephelo-turbidimetric sensor for milk coagulation, tenet of this sensor were described in *Cejna and Chladek* (2005) quality of curd were evaluated by 5-class scale, where class 1 was the best and class 5 the worst. This scale is described in *Gajdusek* (1999).



Results and discussion

Milk yield from the morning milking was 14.4 kg and milk yield from the evening milking was 12.6 kg. There was high significant differences ($P < 0.01$) between these two values (*Figure 1*).

Milking interval between morning and evening milking was 12 h \pm 15 min and the time from the evening to morning milking was higher. This fact, when the longer interval produces more total milk than the shorter interval is in agreement with many authors (*Everett and Wadell, 1970; Hargrove, 1994*).

Table 1. The average (x), their standard deviations (Sx) and their variation coefficient (Vx, %) of monitored parameters

Parameter	Morning			Evening			P
	x	Sx	Vx (%)	x	Sx	Vx (%)	
Milk yield (kg)	14.4	2.3	15.6	12.6	2.8	22.3	**
Milk protein production (kg)	0.46	0.08	17.40	0.40	0.09	23.19	**
Milk fat production (kg)	0.55	0.10	18.69	0.51	0.12	23.69	NS
Milk protein content (%)	3.15	0.18	5.57	3.16	0.20	6.34	NS
Milk fat content (%)	3.86	0.62	16.15	4.13	0.61	14.67	NS
Titrateable acidity (SH)	7.16	0.77	10.68	7.42	1.05	14.12	NS
Rennet coagulation time (s)	274	126	46	271	97	36	NS
Quality of curd (class)	1.81	0.70	38.77	1.97	0.87	43.89	NS

** $P < 0.01$; NS – non-significant

Milk protein production of milk from the morning milking was 0.46 kg and 0.40 kg from the evening milking. There was high significant differences ($P < 0.01$) between these two values. We can suppose that the milk yield had effect on milk protein production (*Figure 2*). *Klopčič et al. (2003)* reported equal values of morning and evening milk protein production.

Milk fat production was higher in milk from morning milking (0.55 kg) than from the evening milking (0.51 kg). No significant differences were found (*Figure 3*). This is in agreement with *Lee and Wardrop (1984)*.

The values of milk protein content from the morning and evening milking were nearly equal (*Figure 4*). 3.15 % for morning milking and 3.16 % for evening milking. Slightly higher milk protein content in morning milking were published by *Zizlavský and Mikšik (1988)*. *Hargrove (1994)* found that protein percentage in morning and evening interval was nearly equal too.



Milk fat content was 3.86 % from the morning milking and 4.13 % from the evening milking. There were no significant differences between these two values. Higher values of evening milk fat content were reported by *Sedlakova* (1969) and *Miksik* (1980) too.

Titrateable acidity of milk from morning milking was no significant lower from the morning milking (7.16 SH) than milk from the evening milking (7.42 SH) (*Figure 5*). *Brauner and Hanus* (1984) found high significant value in milk from morning milking.

The values of rennet coagulation time from the morning and evening milking were nearly equal (*Figure 6*). The value of rennet coagulation time from morning milking was 274 s and the value from evening was 271 s. *Brauner and Hanus* (1984) reported high significant values from the morning milking.

Quality of curd was no significant better in samples of milk from the morning milking (class 1.81) than the samples of milk from the evening milking (class 1.97) (*Figure 7*). We reported only our results because there were no information about this parameter between morning and evening milking in the literature.

Figure 1. The variation of milk yield (kg) between morning and evening milking in separate months

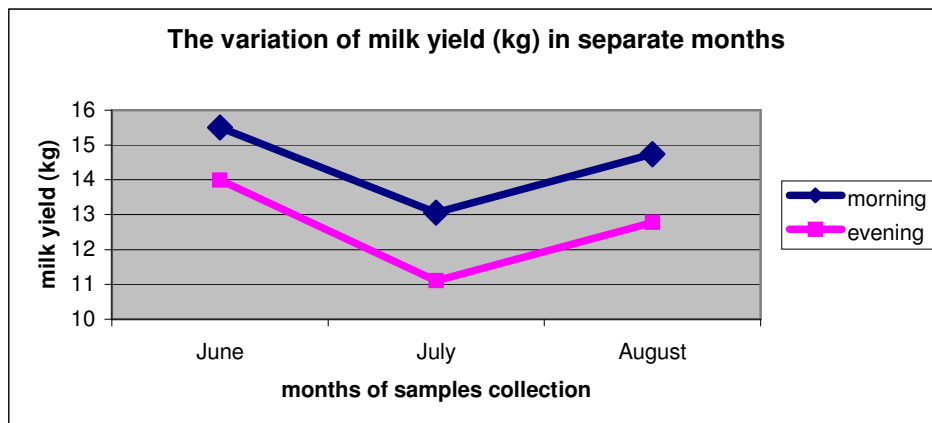




Figure 2. The variation of milk protein production (kg) between morning and evening milking in separate months

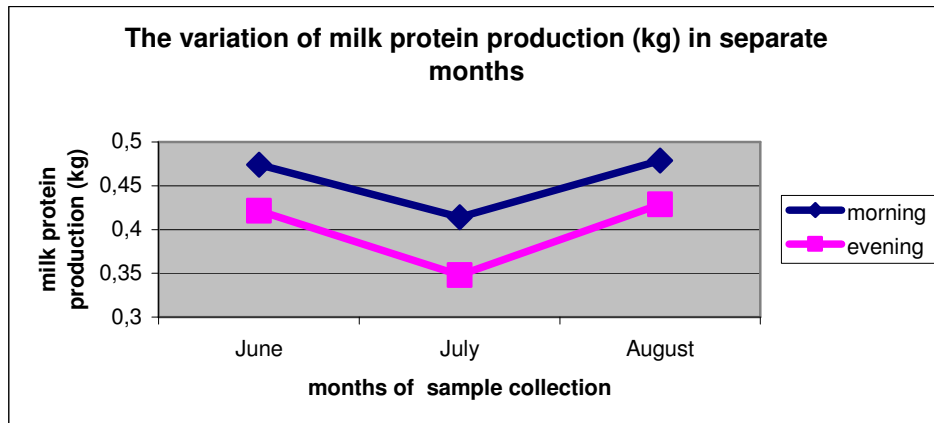


Figure 3. The variation of milk fat production (kg) between morning and evening milking in separate months

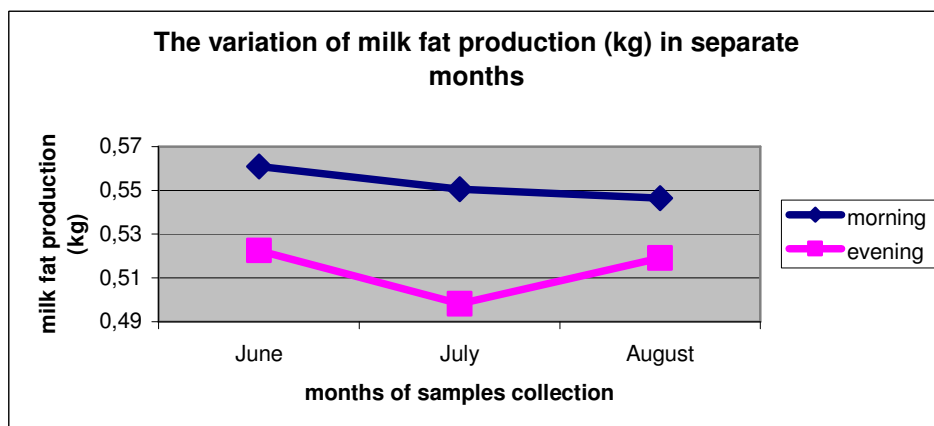


Figure 4. The variation of milk protein content (%) between morning and evening milking in separate months

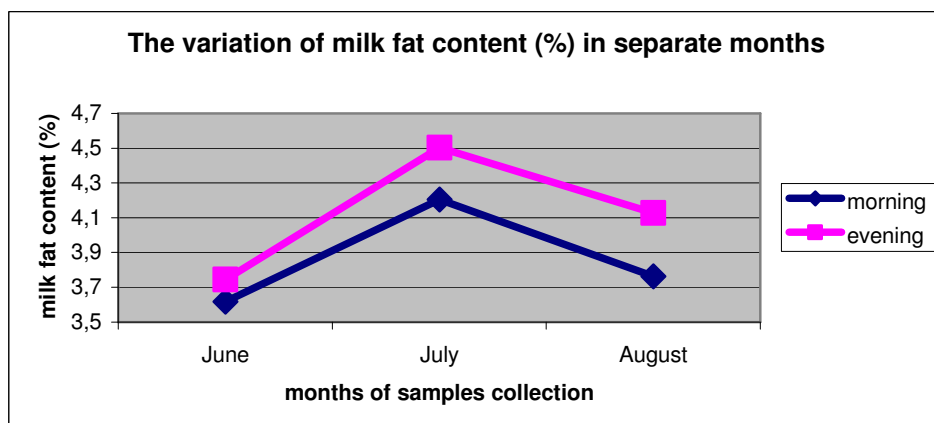




Figure 5. The variation of titratable acidity (SH) between morning and evening milking in separate months

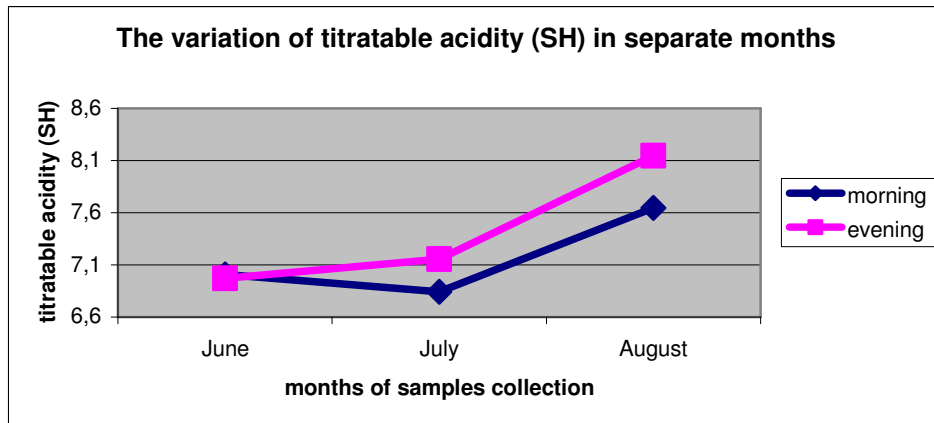


Figure 6. The variation of rennet coagulation time (s) between morning and evening milking in separate months

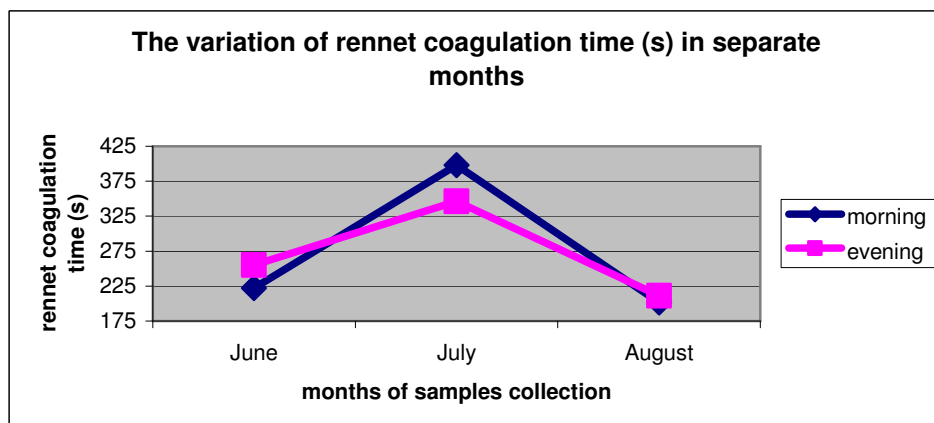
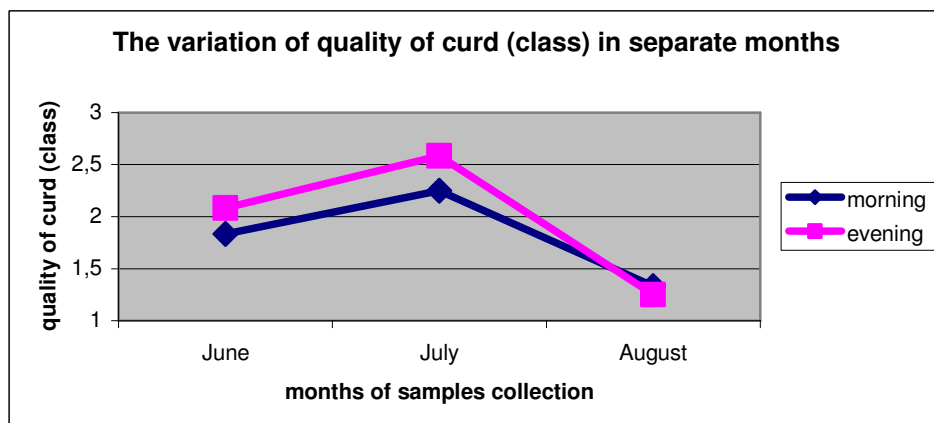


Figure 7. The variation of quality of curd (class) between morning and evening milking in separate months





Conclusion

There were evaluated samples of milk from the morning and evening milking. The production parameters (milk yield - kg, milk protein production - kg, milk fat production - kg), milk composition (milk protein content - %, milk fat content - %) and technological properties of milk (titratable acidity - SH, rennet coagulation times, quality of curd - class) were determined. There were found high significant differences ($P < 0.01$) between morning milk yield (14.4 kg) and evening milk yield (12.6 kg) and between morning milk protein production (0.46 kg) and evening milk protein production (0.40 kg). No significant differences were found between morning and evening values of the rest parameters.

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