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THE EFFECT OF CHOSEN MILK TECHNOLOGICAL PROPERTIES ON THE RENNET COAGULATION TIME OF COW MILK

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Abstract

Milk coagulation properties are an important aspect in cheese-making production, especially in those countries where dairy industry is based on traditional products and is market-oriented. Milk coagulation properties are influenced by several factors such as age of animals, stage of lactation, composition of ration, season, and breed. The aim of our experiment was evaluated the effect of chosen technological properties (active acidity – pH, titratable acidity – SH, quality of curd – class, milk protein content - %, milk urea content – mg/100 ml) on the rennet coagulation time. The object of experiment were milk from cows of Holstein cattle on the first lactation. The samples of milk were divided according to the rennet coagulation time into two groups: group I (better rennet coagulation time; to 200 s; n = 40) and group II (worse rennet coagulation time; above 200s; n = 40). There were found high significant differences ($P < 0.01$) between group I and II in rennet coagulation time (164 s; 244 s), active acidity (pH 6,68; pH 6,78), titratable acidity (7,12 SH; 6,86 SH), quality of curd (1,80 class; 2,48 class). No significant differences were found between group I (better rennet coagulation time) and group II (worse rennet coagulation time) values of the rest parameters.

Keywords: rennet coagulation time, technological properties,



Introduction

In many milk-producing countries, a large proportion of milk production is destined for cheese production (Joudu et al, 2008). The first step in cheesemaking involves the coagulation of milk; for the majority of cheeses, this is achieved by the addition of a low level of a milk-clotting enzyme (rennet) to the milk (Zobrist et al, 2005).

Rennet coagulation of milk may be divided into primary (enzymic hydrolysis) and secondary (aggregation) stages, although these stages normally overlap to some extent during cheese making (Lucey, 2002). The expulsion of whey from coagulum (syneresis) is caused by the contraction of the curd due to the rearrangement of bonds between protein aggregates. Syneresis is a complex process involved in many of the steps in cheese making (Grundelius et al, 2000).

However, the milk clotting properties are variable, and factors influencing these properties include the concentrations of total CN and calcium, pH, genetic polymorphism of milk proteins, stage of lactation, season, feeding (Wedholm et al, 2006), age of animals, breed (Joudu et al, 2008).

Cheese yield is influenced by coagulation properties of milk, which can vary greatly from cow to cow, with 30 to 40% of this variation explained by genetic differences (De Marchi et al, 2009).

Materials and methods

The object of our experiment was milk from Holstein cows on the first lactation keeping in the school farm in Zabcice. The cows were kept in the same conditions and feeding with the same rations. The samples of milk were collected by equipment for milk recording. We determined rennet coagulation time (RCT; s), quality of curd (class), active acidity (pH), titratable acidity (SH), milk protein content (%), milk urea content (mg/100 ml). The samples of milk were divided according to the rennet coagulation time (RCT) into: group I (better RCT; to 200 s; n = 40) and group II (worse RCT; above 200 s; n = 40). Titratable acidity were determined by ČSN 570530, part 58, active acidity by pH-meter CyberScan PC 510 (Eutech Instruments), rennet coagulation time by nephelo-turbidimetric sensor for milk coagulation, tenet of this sensor were described in Cejna and Chladek (2005); Pribyla a Cejna (2006) 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); Kuchtik et al (2008), milk urea content by UREAKVANT 2 in the laboratory for milk analysis in Brno-Chrlice, milk protein content in the Research Institut of Cattle Breeding in Rapotin by MilcoScan 133 B.



Results and discussion

The average (\bar{x}), their standard deviations (s_x) and their variations (V_x , %) of monitored parameters between group I and group II are presented in *Table 1*.

Table 1. The average (\bar{x}), their standard deviations (s_x) and their variations (V_x , %) of monitored parameters between group I and group II

Parameter	group I			group II			SP
	x	s_x	V_x (%)	x	s_x	V_x (%)	
RCT (s)	164	20,51	12,48	244	28,94	11,86	**
Active acidity (pH)	6,68	0,07	1,04	6,78	0,07	1,09	**
Titratable acidity (SH)	7,12	0,35	4,95	6,86	0,42	6,14	**
Quality of curd (class)	1,80	0,90	50,00	2,48	0,63	25,53	**
Milk protein (%)	3,45	0,52	15,13	3,36	0,41	12,23	NS
Milk urea (mg/100 ml)	42,1	7,21	17,14	44,2	12,42	28,11	NS

** $P < 0.01$; NS – no significant

As we can see in the *Table 1* and *Figure 1*, the mean value of rennet coagulation time (RCT) was high significant ($P < 0.01$) better in group I (164 s) than in group II (244 s). There were found high significant ($P < 0.01$) differences in other parameters as active acidity (pH), titratable acidity (SH) and quality of curd (class).

Rennet coagulation time showed better results with lower pH, when active acidity in group I was pH = 6,68 and pH = 6,78 in group II (*Figure 2*). The difference between these two groups was high significant ($P < 0.01$). Our results are in agreement with many authors as *Najera et al* (2003), *Esteves et al* (2003), *Lucey* (2002), *Okigbo et al* (1985).

The same case is in titratable acidity, when the high significant ($P < 0.01$) higher value (7.12 SH) was found in group I (*Figure 3*). Higher titratable acidity is associated with lower (better) rennet coagulation time. Similar results takes *Gajdusek* (2000) in his work.

Quality of curd was better in group I where was determined high significant ($P < 0.01$) lower value (1,80 class) than in group II, where the value was 2,48 class (*Figure 4*). As in the two parameters above, lower (better) quality of curd is associated with lower (better) rennet coagulation time too. These results are in agreement with *Okigbo et al* (1985), *Joudu et al* (2008).



Milk protein content was 3,45 % in group I and 3,36 % in group II. There were no significant differences between group I and group II (Figure 5). This is in agreement with Joudu et al (2008). Hanus et al (2004) found similar conclusion too but they state, that this fact not needn't be rule.

No significant difference was found between group I and group II in milk urea content. Milk urea content was 42,1 mg /100 ml in group I and 44,2 mg/100 ml in group II (Figure 6). The fact, when higher milk urea content is associated with worse rennet coagulation time take Chladek a Cejna (2005) too.

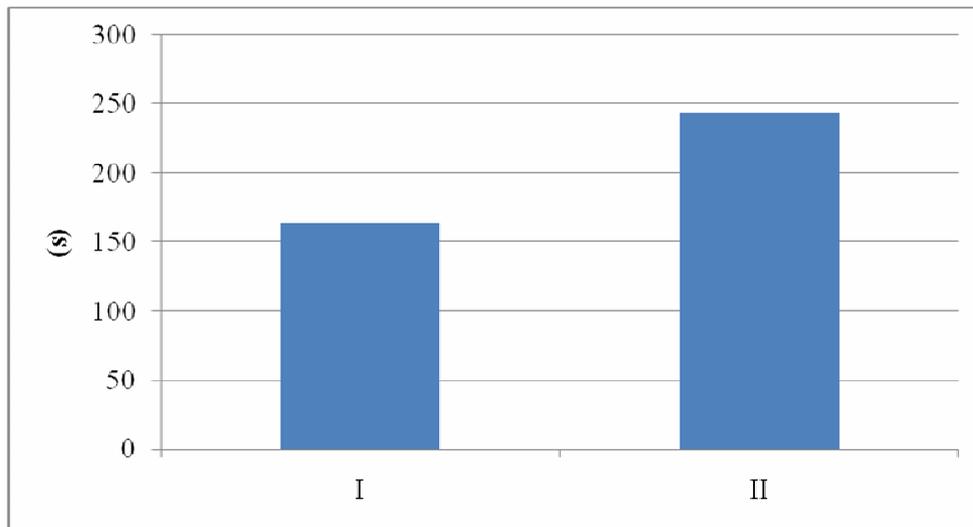


Figure 1. The mean value of rennet coagulation time between group I and group II

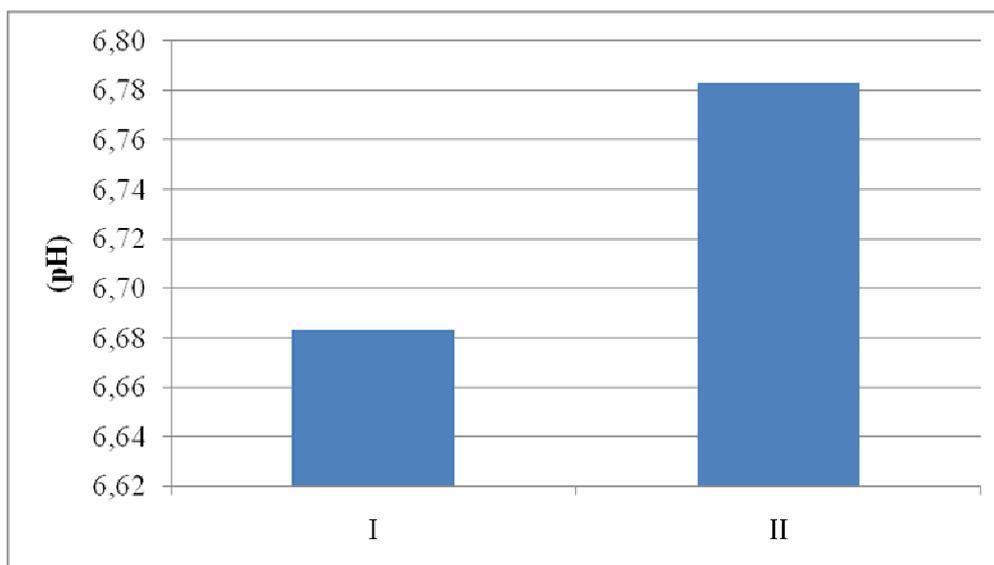


Figure 2. The mean value of active acidity (pH) between group I and group II

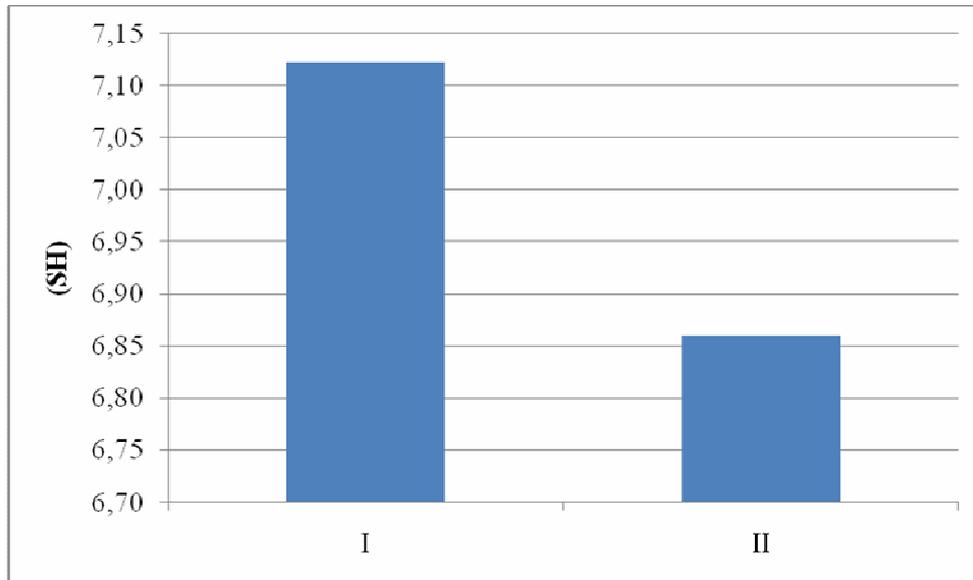


Figure 3. The mean value of titratable acidity (SH) between group I and group II

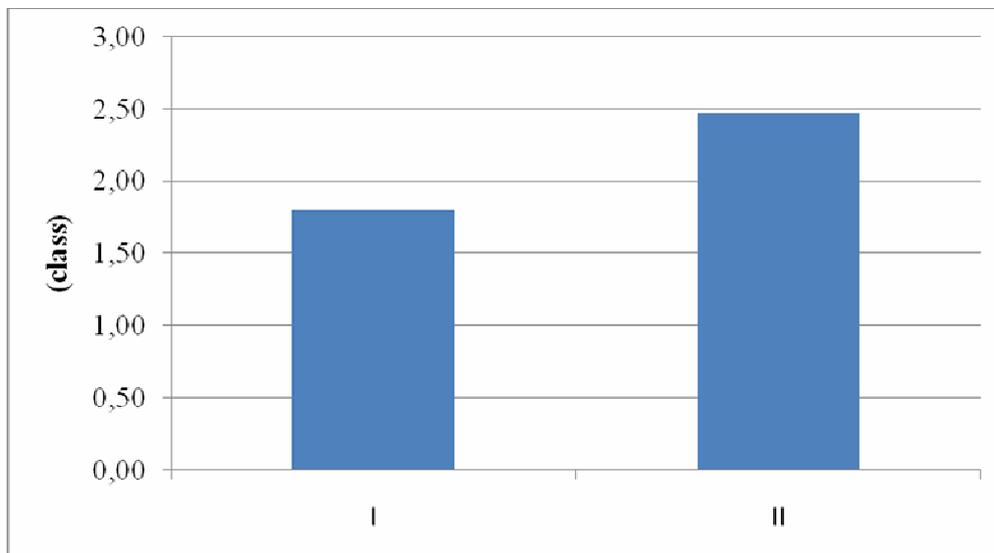


Figure 4. The mean value of quality of curd (class) between group I and group II

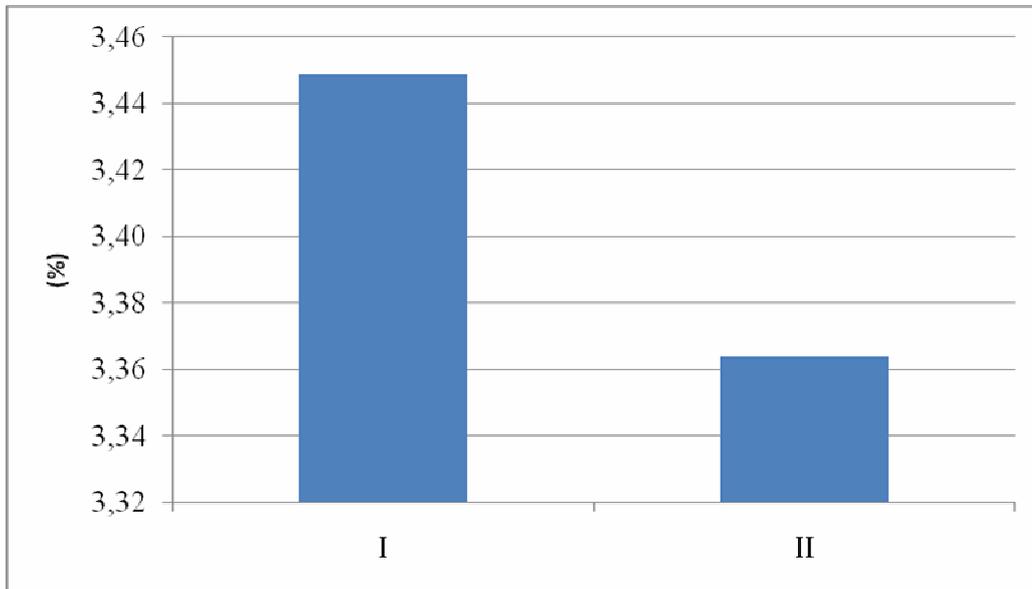


Figure 5. The mean value of milk protein content (%) between group I and group II

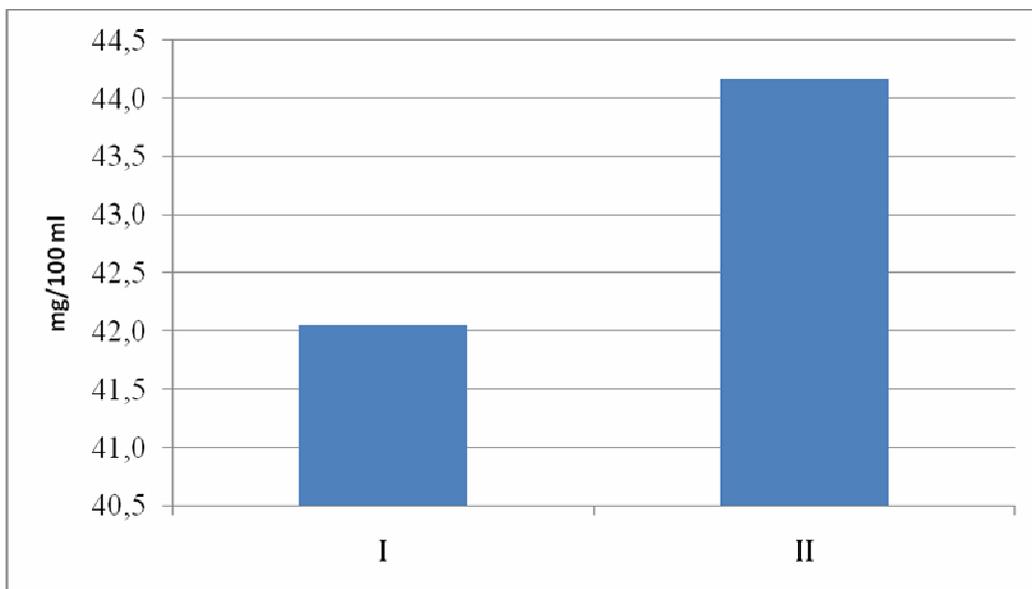


Figure 6. The mean value of milk urea content (mg/100 ml) between group I and group II



Conclusion

We found high significant ($P < 0.01$) differences in active acidity ($\text{pH} = 6,68$; $\text{pH} = 6,78$), titratable acidity (7,12 SH; 6,86 SH) and quality of curd (1,80 class; 2,48 class) between group I (better rennet coagulation time) and group II (worse rennet coagulation time) in our experiment. No significant differences were found in milk protein (3,45 %; 3,36 %) content and milk urea content (42,1 mg/100 ml; 44,2 mg/100 ml).

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