Journal of Animal and Veterinary Advances 6 (7): 855-857, 2007
ISSN: 1680-5593

Influence of K-Casein Genetic Variant on Cheese Making Ability

[1]M. Alipanah and [2]L.A. Kalashnikova
[1]Department Animal Science, Zabol University, Zabol, 98516-538, Iran
[2]All-Russian Research Institute of Animal Breeding, Moscow, 141212, Russia

Abstract: There cheese making trials were arranged to investigation the effect of k-casein genotypes on milk renneting properties fresh cheese yield and composition. K-casein BB milk had significantly superior rennet coagulation properties than that of the AA and AB milks. Results showed the k-casein BB in significantly higher fat and protein recoveries into cheese yields, cheese produced from k-casein BB variant milk had higher concentrations of protein and lower fat levels than that produced from the AA variant. This study showed that k-casein BB milk resulted in significantly higher fat and protein recoveries into cheese. K-casein variant had significant effect on proteolysis or on the acceptability score awarded to the cheese.

Key words: K-casein, cheese making, cows, renneting properties, genetic variant

INTRODUCTION

Cheese making ability of milk is association with high contents of protein, casein and fat, high casein number, short rennet coagulation time, high crud firmness and with a high cheese yield.

In Holstein cows K-casein BB is association with a higher protein (Buchberger and Dovc, 2000) and casein content of milk than K-casein. However, in Simmentals and in Brown cattle this association is not so clear. K-casein BB showed in all publications the shortest rennet coagulation time among all K-casein genotypes. From the majority of the published data it may be concluded that milk containing K-casein has significantly shorter rennet coagulation time and higher crud firmness than K-casein AA milk.

In most investigations involving Parmiggiano-Reggiano, cheddar and other cheese varieties higher yields of cheese were found, ranging from 0.3-10%, in favour of K-casein BB compared with K-casein AA (Buchberger and Dovc, 2000).

Early studies on the impact of genetic variants of K-casein on cheese yield indicated as much as a 10% increase in cheese yield with the BB variant of K-casein (Aleandri *et al*., 1990; Marziali and Ng-Kwai-Hang, 1986). Initial reports credited the increase in cheese yield to an increase in protein in the BB milk.

More recent studies have shown only small yield differences between the AA and BB variants (Bremel *et al*., 1998; Stasio *et al*., 2000).

The objective of this study, was to estimate effects of K-casein genotypes on milk renneting properties and yield and composition of fresh cheese.

MATERIALS AND METHODS

Milk was collected from 22 Russian Black-Pied cows. 10 cows had k-casein genotype AA, 10 cows had genotype AB and 3 cows had genotype BB. The cows were kept in the Gorky herd in Moscow state of Russia, respectively.

Cows were same for age, calving date and lactation number. Milk from the k-casein AA, AB and BB cows was separately collected on three times, when the cows were 3, 6 and 8 month in lactation. The bulked milk was stored at 4 c only on day. The each trail the k-casein AA, AB and BB milks were analysed for composition, rennet coagulation time and cheese making characteristics.

Cheeses were made in parallel from bulked k-casein AA, AB and BB milk on three separate samples.

Pasteurized, cooled milks were weighted all whey expressed at whey drainage and during cheese making were returned to the cheese vat, weighted and sampled and analysed within 72 h.

The rennet coagulation properties of vat cheese milk were determined. Cheese milk was analysed for fat, protein and lactose. Bulk cheese whey was analysed for fat and protein. Cheese was analysed for pH, moisture, fat, salt and protein. Cheeses were graded by a trained 10 member in panel. Panelists were selected on their abilities.

The cheeses were presented to the panelists in individual tasting booths. Samples were presented in a random fashion to avoid consistently high scoring for any on sample.

Each panelist was given a sheet of paper on which were the values 0 (reject) and 5 (excellent).

Corresponding Author: M. Alipanah, Department of Animal Science, Zabol University, Zabol, 98516-538, Iran

Experimental data was examined for statistical significance using the two-tailed paired t-test. Statistically significant effects were at the $p<0.05$ level unless other wise stated.

RESULTS AND DISCUSSION

In comparisons with k-casein variant AA milk, k-casein BB milk had shorter rennet coagulation times (68.5 min for AA genotype and 45 min for BB genotype, respectively). The enhanced rennet coagulation properties of the k-casein BB milks, has been consistently reported (Horn and Muir, 1994; Walsh *et al*., 1995, 1998). The shorter coagulation time of the k-casein BB milk probably results from its lower critical levels of k-casein hydrolysis required for the onset of gelation (Horn *et al*., 1996). The slightly higher casein content may also contribute somewhat to the shorter coagulation time (Guinee *et al*., 1997). It might therefore, be of economical interest to breed cows for better milk renneting properties.

The bulk cheese whey from the k-casein AA higher levels of fat and protein than from k-casein AB and BB milks (Table 1). The higher levels of fat in the k-casein AA cheese whey is in agreement with results found for cheddar (Walsh *et al*., 1995) and other cheese varieties such as Gouda (Van den Berg *et al*., 1992) and Mozzarella (Walsh *et al*., 1998). Consistent with these results is the significantly higher levels of fat and protein in k-casein BB ($p\leq0.05$).

The composition of the cheese, analysed are given in Table 1. Cheese from k-casein AB milk had significantly higher levels of fat ($p\leq0.05$); other wise k-casein variant had no significant effect on levels of protein, even though the level protein in the k-casein BB cheese was higher than of the k-casein AA and AB cheeses.

Table 1: Effect of the k-casein variants on the milk and cheese traits

	k-casein genotype		
Trait	AA	AB	BB
Milk composition			
Protein%	3.13±0.01	3.17±0.03	3.17±0.04
Fat%	3.43±0.08	3.37±0.04	3.10±0.48
Lactose%	4.60±0.01	4.60±0.01	4.61±0.09
R(min)	68.5	51.5	45.0
Whey composition			
Fat%	0.70±0.05	0.57±0.04	0.53±0.06
Protein%	0.79±0.02	0.71±0.02	0.71±0.03
Lactose%	3.29±0.52	3.13±0.54	3.30±0.67
Dry matter%	6.36±0.41	7.94±0.52	6.17±0.67
Cheese composition			
Protein%	18.5±0.53	17.38±0.53	19.47±0.85
Fat%	19.23±0.11^{b}	20.31±0.11^{a}	18.53±0.18^{b}
Dry matter%	44.10±0.62	42.82±0.62	42.68±1.01
Cheese yield			
Yield%	11.64±0.48^{a}	13.27±0.34$_{b}$	13.76±0.34^{b}
Recovery in cheese			
Milk fat%	67.03±4.09^{a}	79.45±4.28^{a}	83.54±6.11^{b}
Milk protein%	75.53a±1.94	73.99±4.45^{a}	87.43±1.11^{b}

Results of cheese trials are shown in Table 1. The higher fat and protein recovery with the k-casein BB milk resulted in cheese with higher fat and protein levels

The results of this study, agree with those of Barshinova (2005) and Denisenco (2004), however in other reports no effect of genotypes k-casein BB or AA on the content of fat and protein of cheese has been observed (Walsh *et al*., 1996, 1998).

Grading of cheese by taste panel indicated the cheese from the k-casein AB milk had higher score than from k-casein AA; this may be due to higher level fat, in the cheese from k-casein AB. This trend is attributed from the grater fat percentage ($p\leq0.05$) in cheese from kappa casein BB milk.

The actual yield cheese from the k-casein BB milk was higher than those from the k-casein AA and BB milks ($p\leq0.05$). The higher cheese yields associated with the k-casein BB milks have also been reported for other varieties (from 0.3- 9.8%) (Walsh *et al*., 1995; Horn *et al*., 1996; Barshinova, 2005; Denisenko, 2004). It is seem, that the primary reason for increased cheese yields from BB milk was a higher fat and protein retention in the cheese. In other studies, reported that the primary reason for increased cheese yields from BB milk was a higher fat recovery in the cheese (Bremel *et al*., 1998; Nuyts-Peti *et al*., 1997).

CONCLUSION

For milks with BB or AB genotypes k-casein had remarked influence on the yield of cheese.

The higher fat and protein recovery with the k-casein BB milk resulted in cheese with higher fat and protein levels.

The increases in the yield of cheese solids per kg of milk associated with the k-casein BB variants. Reported in this study and other studies, suggests that selective breeding to increase the proportion of the BB variant may prove advantageous to the dairy industry.

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