MILK PROTEIN HAPLOTYPES AND THEIR ASSOCIATION WITH MILK PRODUCTION TRAITS AND FERTILITY IN HOLSTEIN, HUNGARIAN RED SPOTTED AND CROSSBRED HERDS

J. Vági[1], M. Baranyi[2] and Zs. Bősze[2]

[1]Gödöllő University of Agricultural Sciences. Institute of Animal Husbandry. Department of Applied Animal Genetics. H-2103 Gödöllő

[2]Agricultural Biotechnology Centre. H-2100 Gödöllő. Hungary

SUMMARY

Relationships between milk protein haplotypes and milk production and fertility were investigated in Holstein Friesian. Hungarofries and Hungarian Red Spotted populations using the milk samples taken from four Hungarian herds of altogether 963 cows. Samples were phenotyped for α_{S1}-casein. β-casein. κ-casein and β-lactoglobulin. Milk. fat and protein yields and milk fat and protein percentage and the normal distribution property cow utilization intensity index of fertility parameters were used.

The results obtained shows that among milk protein genotypes both κ-casein and β-lactoglobulin phenotypes have more significant effect than that of α_{S1}-casein and β-casein.

Keywords: Holstein. milk protein polymorphisms. casein haplotypes. milk production. fertility.

INTRODUCTION

Many authors report relationships between milk protein haplotypes and the technological value of milk. milk production. and even fertility. The relationship between cheese production and κ-casein (κ-CN) and β-lactoglobulin (β-LG) genotypes seem the most promising. In both cases the B genotype is more advantageous (Bősze and Dohy. 1993).

The relationship between milk protein haplotypes and milk production is promising. although in some cases the degree of the effect and the measure of its significance may be the problem. The contradictions in the genetic effects are brought into connection with the relationship between the milk protein genes. and with just the same the diversity of relationships between populations is explained (Matti Ojala et. al.. 1997).

MATERIALS AND METHODS

The relationships between milk protein haplotypes and casein genotypes and milk production and reproduction parameters were investigated. The milk protein polymorphisms of milk samples from 578 Holstein (59.3% registered. the others crossbreds with high gene ratio of Holsteins). 195 Hungarian Red Spotted and 190 Hungaro-Friesian cows of four herds were investigated. A total of 963 cow's milk samples were analysed. Samples were phenotyped for α_{S1}-. β-. κ-casein and β-lactoglobulin.

Information about Holstein and Hungarian Red Spotted cows were collected in a registered breeding stock each. and data about Hungaro-Friesian cows were coming from two breeding farms.

Milk production of the cows were evaluated according to their first and second lactation performances (milk yield. fat and protein kg. and fat and protein percentage) reproduction performance were estimated according to the time between first and second calving and according to the utilisation intensity of the cows. One- and multifactor analyses of variance were implied in our evaluation.

Calculating the Index of Cow Utilisation Intensity the actual age of the cow at the time of calving in question is compared to a standard age as follows (Vági. J.. 1990):

$$I_V = \frac{\text{Standard age of cow at calving determined by number of calvings (in days)}}{\text{Actual age of cow at the calving in question (in days)}} \times 100$$

The index is suitable for farm management and population genetics investigations. and is able to express comprehensively the reproduction performance of a herd containing cows of different ages and parities. and compare them to desirable standard values

RESULTS AND DISCUSSION

In the κ–casein locus allele A was dominant in the Hungarian red spotted (HRS) and Holstein (HF) breeds (0.777 and 0.704. respectively) while Hungaro-Friesian (HUF) κ–casein B higher frequency (0.503). In the β-lactoglobulin locus the allele B was more frequent in all three breeds (HRS=0.534. HF=0.624).

Table 1. **Means of different κ–CN and β–LG haplotypes for 305 day milk and protein yields at Holstein, Hungarofriesian and Hungarian Red Spotted breeds**

Geno-types	Holstein	Hu.fries.	H.R.spot.	Milk yield			Protein yield		
	n	n	n	Holstein	Hu.fries.	H.R.spot.	Holstein	Hu.fries.	H.R.spot.
κ–CN									
AA	299	46	89	7534	5030	4706	236.1	165.5	154.8
AB	153	87	51	7751	4798	4293	247.2	163.6	143.9
BB	41	50	7	7310	4658	3709	230.5	165.0	137.6
AE	49	5	2	7748	5043	5073	241.5	174.6	
β–LG									
AA	110	21	28	7486	4986	4481	231.8	160.7	146.6
AB	293	101	94	7665	5197	4495	240.0	167.9	150.5
BB	165	70	40	7592	5070	4668	238.4	163.3	157.6

The κ-casein and β-lactoglobulin haplotypes and milk production linkage characteristics are included in *Table 1.* According to our investigations in the first lactation of Holstein population κ-CN AB and κ-CN AE and κ-CN BE genotype individuals showed up most favourable performance whom got 217 kg, 214 kg and 208 kg ahead of κ-CN AA genotypes, respectively.

In correspondence with the literature the κ-CN genotypes are more desirable due to their better performance. In the investigated Holstein herd, however, it seems to become effective in second lactation only. For Hungarofries and Hungarian spotted herds the performance of the κ-CN AA and κ-CN AE genotypes is more favourable.The β-LG BB genotype among β-lactoglobulin haplotypes get hardly ahead of the other production of β-LG haplotypes (*Table 1*).

Table 2. **Relationship between milk protein haplotypes and fertility of cows in different Hungarian cattle breeds (ICUI=Index of Cow Utilization Intensity)**

Milk protein haplo-types	Holsteins			Hungarofriesian (75% Holstein+25% Jersey)			Hungarian Red Spotted		
	n	Average calvings	ICUI	n	Average calvings	ICUI	n	Average calvings	ICUI
Mean		**3.66 ±0.07**	**90.39 ±0.36**		**5.27 ±0.14**	**90.11 ±0.78**		**3.54 ±0.12**	**94.03 ±0.84**
α_{S1}-casein									
BB	528	-0.02	0.01	167	0.06	-0.15	128	0.05	0.01
BC	38	0.36	-0.08	37	-0.17	1.51	31	-0.45	-0.05
β-casein									
$A_1 A_1$	117	-0.04	-0.53	25	0.23	1.31	19	-0.23	2.30
$A_1 A_2$	264	0.04	0.02	69	-0.05	1.32	58	-0.18	-1.72
A_1 B	27	0.34	1.46	31	-0.31	-2.84	7	0.88	-0.31
$A_2 A_2$	127	-0.25	0.24	42	0.03	-0.26	58	-0.03	0.24
A_2 B	26	0.57	-0.49	35	0.24	-0.25	16	-0.11	1.85
κ-casein									
AA	271	0.06	-0.70	49	0.26	0.28	109	-0.20	-0.73
AB	142	0.19	-0.27	98	-0.10	0.89	49	0.15	1.57
BB	39	-0.06	2.75	52	0.04	-0.24	7	2.74	1.36
AE	45	-0.09	1.93	5	-0.02	3.49			
BE	20	0.04	1.48	-		-			
β-lacto-globulin									
AA	111	0.05	1.49	24	-0.51	-2.05	28	0.03	-1.71
AB	292	0.00	0.19	110	0.25	1.45	94	0.03	0.00
BB	165	0.03	-1.41	74	-0.17	-1.20	40	-0.15	0.43

Table 2 demonstrates the relationship between milk protein haplotypes and fertility in Holstein, Hungarofries and Hungarian Red Spotted herds. In addition to numerous traditional method the *Index of Cow Utilization Intensity (ICUI)* were used (Vági, 1990) which has *anormal distribution* differently from the most parameters used traditionally to characterize

fertility. The classification of the cow utilization intensity parameters according to milk protein haplotypes are shown as the deviations from the averages calculated for the different breeds.

It is practicable to use the Indeces of Cow Utilization Intensity together with average number of calvings of cows and the two parameters together makes the *reprocductive capacity* components.

According to the one-way variance analysis the relationship between milk protein haplotypes and fertility is significant in Holstein-Friesian herds for β-lactoglobulin haplotypes (F-ratio=4.033; $P<0.01$), and near significant at κ-casein haplotypes (F=1.708; $P<0.10$). In Hungarian red spotted herds showed no case of significant relationship between fertility and milk protein haplotypes.

Multifactor analysis of variance was used to the complex evaluation of α_{S1}-CN, β-CN and κ-CN haplotypes and to examine their effect on milk production traits and fertility. According to the results gained, among casein haplotypes singnificant relationship was found in the case of κ-casein, fat content (fat %) and the fat yield (F=3.359; $P<0.01$ and F=2.355; $P<0.05$) and near signicant between the milk production and the intensity of cow utilization (F-ratio=1,774; $P<0.10$ and F=1.792; $P<0.10$) in *Holstein* population.

In *Hungarofriesian* populations only the relationship between κ-casein haplotypes and the fertility was significant (F-ratio=9.116; $P<0.001$) and the milk protein content (%) and the α_{S1}-casein relationship was near significant (F-ratio=2.540; $P<0.10$).

In the *Hungarian Red Spotted* herds significant relationship was observed only in the case of κ-casein haplotypes and milk production, but that holds for several traits, too, such as milk production (F-ratio=6.367; $P<0.001$), milk fat production (F-ratio=4.130; $P<0.01$), as well as the milk protein production (F-ratio=4,189; $P<0.01$) and the milk protein content (F-ratio=4.989; $P<0.01$).

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