VARIABILITY OF α_{S2} CASEIN PHENOTYPES IN A NEW ZEALAND WHITE RABBIT BREEDING STOCK IN HUNGARY

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Abstract - High level of variability of α_{S2}-caseins was detected in NZW rabbit milk. Eight α_{S2}-casein patterns were observed 5 being present in more than 10 % of analysed milk samples. The α_{S2}-casein phenotypes could have a weak relationship with specific performance traits of rabbit does.

INTRODUCTION

Milk protein types and their effects on growth, reproduction, milk production and milk composition as well as their potential use as a selection aid for genetic improvement in cattle have been reviewed (LIN et al., 1992).
Intensive research has recently been started on rabbit milk proteins and their respective genes in the hope that rabbits could be used as a model animal in research towards the transgenic modification of milk composition in dairy cattle. Two unknown proteins of rabbit milk have been sequenced (BARANYI et al, 1995) and were found to be the putative product of two different α_{S2} casein transcripts from rabbit mammary gland tissue sequenced by DAWSON et al, 1993.
However the rabbit is also kept as a meat animal and the lactation performance of rabbit does is important because the doe milk is the only food source available for pups until 21 days of age. It is thus the main factor conditioning the health of sucklings Results from investigations related to this field have not been reported yet.
In the present study we investigated the level of phenotypic variability and the frequency of different phenotypes in a NZW rabbit breeding stock in Hungary. Furthermore, we evaluated the possible association between α_{S2}-casein phenotypes and economically important traits of rabbit does because of the potential use of milk protein types as an aid to genetic selection.

MATERIALS AND METHODS

Animals

Milk samples were obtained from 55 randomly chosen NZW does of the breeding stock (total of 360 does) at the Institute for Small Animal Research, Gödöllő.
Data for performance traits of does and their consecutive litters recorded regularly in the herd book were used for calculations. Extensive reproduction cycle performed at the farm and random sampling of the does having different number of litters in a period covering more than 12 months excluded specific seasonal effects. Distribution of litters according to the parity order and milk protein pattern are shown in table 1. Litter traits were averaged at 1-12 litters per doe, a total of 213 litters were evaluated. Data were subjected to single factor analysis of variance.

Separation of α_{S2} caseins

Milk samples were preserved with sodium azide (final concentration, 0.004 %), skimmed by centrifugation and diluted 20-fold with a sample buffer containing 8 M urea, 5% glycerol and 5% 2-ME. 124 x 258 x 0.25 mm IEF gels were prepared. The polymerization solution consisted of 9.4 ml gel stock solution [4.85% (wt/vol) acrylamide, 0.15% (wt/vol) NN'-methylene-bisacrylamide, 8 M urea, 15% glycerol] and the following carrier

ampholyte mixture: 100 l pH 2.5-4.5, 80 l pH 4.2-4.9, 70 l pH 4.5-5.0, 70 l pH 5.0-5.5, 150 l pH 5-6, 150 l pH 5-8. Sample loading: 15 ml/cm. Isoelectric focusing was performed at 12-15 °C, on an LKB Multiphor II electrophoresis unit (LKB Pharmacia). Prefocusing lasted 25 min at 4 W (maximum 2000 V and 15 mA), sample focusing 60 min at 4W (maximum 2000 V and 15 mA), and focusing for 120 min at 5 mA (maximum 2500 V and 20 W). The gels were stained with Coomassie Brilliant Blue G-250.

Table 1 : Number of litters at subsequent parities within groups according to the protein pattern

Protein	Parity order												
pattern	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	4	3	3	3	2	2							17
2	1	1	1	1	1	1	1						7
3	6	6	5	4	3	2	1						27
4	15	12	10	8	5	4	4	3	2	2	1	1	67
5	3	2	1										6
6	7	5	5	5	4	4	2	1	1	1	1		36
7	12	6	2	2	2	2	2	2	2	1			33
8	7	5	4	1	1	1	1						20
Total	55	41	32	25	19	18	15	8	5	4	3	1	213

Micella size

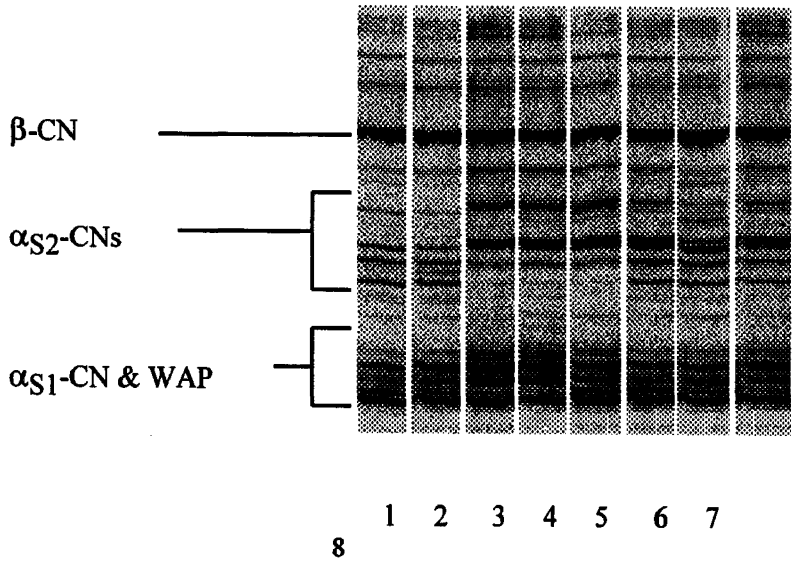
Skimmed, sodium-azide-preserved rabbit milk samples were diluted with distilled water, and the micella size was determined (nm) with a Coulter® model N4 sub-micron particle analyser, using single angle light-scattering spectroscopy.

RESULTS

Eight different patterns with a total of ten different bands were identified.

The rabbit milk samples showing eight different α_{S2}-casein patterns on IEF gels are presented on figure 1. Each of the different pattern includes 4 to 7 bands.

Figure 1 : α_{S2}-casein patterns on IEF gels



Frequency of different patterns and averages of performance traits by several litters of rabbit does which have been grouped according to their α_{S2} casein pattern are summarized in table 2. 5 of the 8 different patterns were observed in more than 10 % of the cases studied. Significant differences were found in litter traits such as litter size at weaning, body and litter weight at weaning according to the protein pattern of milk. Furthermore, growth and micella sizes seem to be different in rabbit does showing different patterns.

Table 2 : Effect of α_{s2}-casein pattern on production traits of does and their

		Groups of does defined by α_{s2}				
	Total	1	2	3	4	5
No. of does	55	4	1	6	15	3
Frequency %		7.27	1.82	10.91	27.27	5.45
No. of litters	213	17	7	27	67	6
Inseminations/kindling	1.33 ± 0.31	1.33 ± 0.29	1.40	1.26 ± 0.39	1.32 ± 0.28	1.06 ± 0.
Litter size at birth	7.75 ± 0.97	7.79 ± 0.93	8.17	8.63 ± 1.35	7.72 ± 1.19	7.40 ± 1.
Litter size at weaning	5.22 ± 1	4.95 ± 0.87	6.50b	5.38 ± 0.81	5.63b ± 0.86	4.06a ± 1
Body weight at weaning§	111.65 ± 13.16	104.93 ± 9.45	107.6	106.60 ± 14.45	105.10 ± 9.17	111.47 ± 4
Litter weight at weaning§	560.48 ± 91.72	521.65 ± 114.38	699.4	571.6b ± 94.34	596.63b ± 93.89	450.77 ± 13
Micella size	223.1 ± 13.18	223	221	222.67 ± 16.44	232.67d ± 13.15	237
Doe weight§ at 6 weeks age	105.85 ± 14.07	100.75 ± 14.36		108.8 ± 21.67	95.8a ± 18.54	113.3b ± 1
Doe weight§ at 10 weeks age	208.88 ± 12.65	203.75 ± 21.25		210 ± 19.34	194.79c ± 14.40	209 ± 4.9
Doe daily gain§§ 6–10 weeks	36.79 ± 3.38	36.77 ± 4.84		36.14 ± 3.07	35.36 ± 2.96	34.17 ± 2

Letters a and b in the same rows denote significant differences at P<0.1 between means marked with different letter
Letters c and d in the same rows denote significant differences at P<0.05 between means marked with different letter
§ dkgs
§§ grams

DISCUSSION

Compared to the results of BARANYI et al, 1995, who have reported differences between casein patterns of individual animals, in this study we have found more phenotypic variations. The frequencies of 5 different α_{s2}-casein patterns were considerably high, however 3 of the patterns had a frequency lower than 10 %. Heredity of the detected patterns was not defined because of the random sampling.
The differences between the casein phenotypes were statistically significant, moreover differences were found between the averages of economically important traits at groups formed according to the protein patterns. Consequently after detecting the heritability pattern of the 10 bands causing the 8 different casein phenotypes, it could be used as a selection aid if further experiments confirm the association between α_{s2}-casein phenotypes and other traits.

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