EAAP 2007
58th Annual Meeting of the European Association for Animal Production
Dublin • Ireland • August 26th - 29th • 2007

Association between LGB polymorphism and bovine milk fatty acids composition: preliminary results

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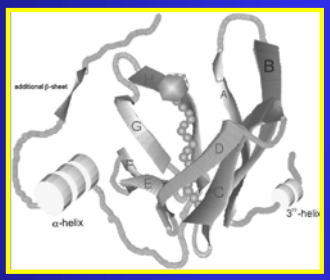
Objective

The aim of this work was to evaluate possible association between Beta-lactoglobulin (LGB) polymorphism and fatty acid composition in milk from Italian Holstein cows.

Introduction

LGB is the most abundant whey protein in ruminant milk. LGB belong to a lipocalin superfamily, which is constituted by proteins with a numbers of functions, mainly related to the transport of metabolites (Pérez and Calvo, 1995). The members of this family show a high similarity, but the major structural motif is a common β-barrel topology (Fig. 1) (Ragona et al., 2000). LGB was proposed as a retinol binding protein in the intestine of newborns and involved in both transport and metabolism of dietary lipids, in order to facilitate the activity of pregastric lipase by sequestering free fatty acids as they are produced. Numerous variants of LGB are identified in cow (A, B, C, D, E, F, G, H, X, Y, Z, Dr), but the A and B ones are the most frequent. LGB A variant differs from B variant in the amino acid sequence at position 64 (AspA→GlyB) and 118 (ValA→AlaB).

Fig.1: A model of lipocalin, showing adequacy of its calyx-originated name (letters A–H indicate b-strands forming b-barrel)

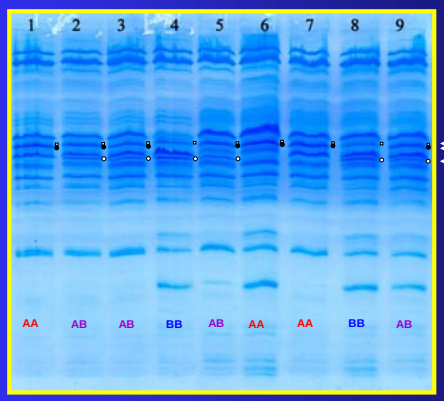


Materials and Methods

- Individual milk samples were taken from 468 lactating Italian Holstein cows at the morning milking
- LBG polymorphism was detected by Isoelectrofocusing (IEF)
- Milk fatty acids composition was determined by Gas-Cromatograph analisys with a high polar 100 m column

Results

Fig.2: IEF polymorphism detection for milk proteins. Black and white dots indicate LGB A and LGB B respectively, while white squares indicate alpha-Lactoalbumin (ALA) B



Tab.1: Bovine LGB frequencies

Genotypes	N° of cows	Frequencies
AA	121	25.85 %
AB	216	46.15 %
BB	131	28.00 %
total	468	100 %

Tab.2: Relationship between LGB polymorphim and milk fatty acids classes

Fatty acid	LGB genotypes			P<F
	AA	AB	BB	
	n= 121	n= 216	n= 131	
MCFA	46.69 ± 0.57 ^{a}	45.35 ± 0.45 ^{b}	45.97 ± 0.54 ^{b}	0.038
LCFA	35.00 ± 0.50	35.65 ± 0.39	35.00 ± 0.47	0.215
BFA	0.98 ± 0.02	0.97 ± 0.02	0.94 ± 0.02	0.371
SFA	54.80 ± 0.58 ^{A}	53.32 ± 0.45 ^{B}	53.42 ± 0.54 ^{B}	0.026
MUFA	23.56 ± 0.38	24.25 ± 0.30	24.09 ± 0.36	0.156
PUFA	3.34 ± 0.06	3.42 ± 0.05	3.46 ± 0.06	0.294
TFA	2.01 ± 0.04	2.04 ± 0.03	2.06 ± 0.04	0.654
C16	27.07 ± 0.35^{A}	26.10 ± 0.28^{B}	26.19 ± 0.33^{B}	0.017

MCFA: Medium Chain Fatty Acids
LCFA: Long Chain Fatty Acids
BFA: Branch Fatty Acids
SFA: Satured fatty Acids
MUFA: Mono-Unsatured Fatty Acids
PUFA: Poly-Unsatured Fatty Acids
TFA: *Trans*-Fatty Acids

Results showed a significant association between AA LGB and palmitic acid (PA) content of milk. Since PA is the major fatty acid (FA) in MCFA and SFA, the association was confirmed also for this FA classes. Previous studies demonstrated that LGB is able to bind PA in its central cavity (Ragona et al., 2000). The results of present work seam to indicate a higher affinity of AA LGB for PA when compared to AB and BB isophorms. Further researches are needed in order to clarify if the association between AA LGB and PA is a consequence of changes in milk LGB content or it is due to structural changes of the same protein.

References

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Ragona L., Fogolari F., Zetta L., Pèrez D.M., Puyol P., De Kruif K., Löhr F., Rüterjans H., Molinari H. (2000): Bovine β-lactoglobulin: interaction studies with palmitic acid. Protein Science 9, 1347-1356.