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Brown milk: a value added

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Clotting aptitude

- Enzymatic phase
- Clotting speed
- Curd firmness
- Elasticity
- Permeability
- Coagulum contractility
- Speed and syneresis of curdling



Milk protein and fat affect the cheese yield

Brown and Holstein milk characteristics

Clotting parameters:		
Enzymatic phase (min)	18.62	18.36
Clotting speed (k20) min	6.57 A	10.00 B
Curd firmness at 30 (mm)	31.32 A	24.24 B
Curd firmness at 45 (mm)	46.77 A	37.86 B
Reological characteristics:		
Resistance to compression (g)	32.64 A	23.91 B
Resistance to cut (g)	73.46 A	49.64 B



Summer et al., 2005

Brown and Holstein milk characteristics

Summer et al., 2005

		
Protein (N x 6.38) (g/100g)	3.49 A	3.07 B
Casein (g/100g)	2.71 A	2.37 B
Whey protein (g/100g)	0.61 A	0.54 B
NPN (x 6.38) (g/100g)	0.16 A	0.16 B
casein/total protein (%)	77.53	77.10
Ca total (mg/100g)	120.76 A	113.19 B
Ca colloidal (mg/100g)	83.32 A	74.25 B
Ca soluble (mg/100g)	30.99 A	34.39 B
P total (mg/100g)	97.32 A	88.04 B
P colloidal (mg/100g) P	50.00 A	44.40 B
P colloidal inorganic (mg/100g)	27.04 A	24.06 B
P soluble (mg/100g)	47.60	48.43
(Cl-) (mg/100g)	96.25 A	106.15 B

Ratio between Ca/P and Total protein/casein

			?
Total Ca/total protein	0.035	0.037	- 0.002
Colloidal Ca/total protein	0.024	0.024	0.000
Soluble Ca/total protein	0.011	0.013	- 0.002
Total P/total protein	0.028	0.029	- 0.001
Colloidal P/total protein	0.014	0.014	0.000
Soluble P/total protein	0.016	0.018	- 0.002
Total Ca/casein	0.045	0.048	- 0.003
Colloidal Ca/casein	0.031	0.031	0.000
Soluble Ca/casein	0.014	0.016	- 0.002
Total P/casein	0.036	0.037	- 0.001
Colloidal P/casein	0.018	0.019	- 0.001
Soluble P/casein	0.021	0.023	- 0.002

More plausible hypothesis for justifying the better clotting aptitude of Brown milk may be the different reaction of casein clotting particularly in the firmness phase



Frequencies of different k-casein types in the two breeds in Italy

MILK PROTEIN GENETIC VARIANTS	N	N
	8,766	28,780
AA	16	69
AB	43	27
BB	41	4
B Allele	62	17

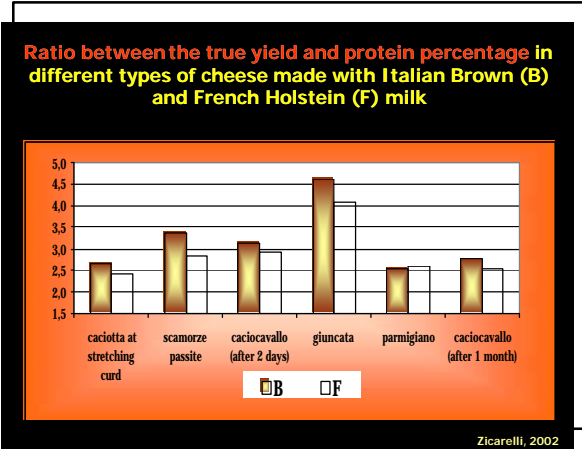
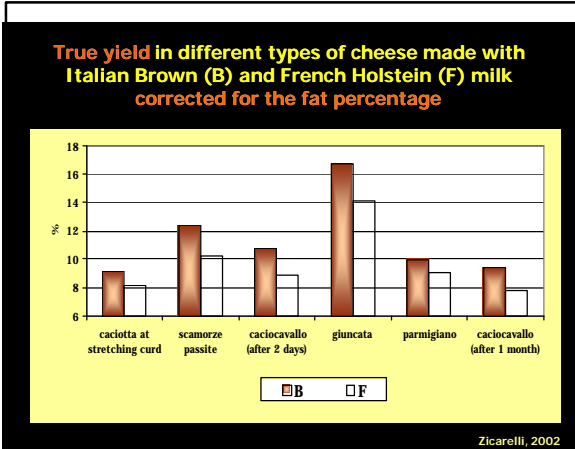
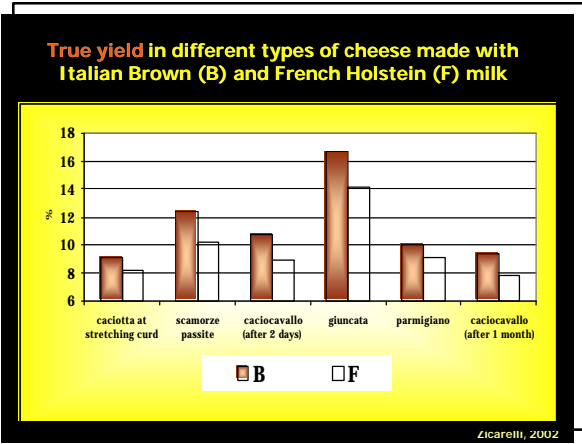
Mariani et al., 2002

- ❖ In many of the oldest dairy cattle breeds there was a high frequency of cows with B allele.
- ❖ For this characteristic the higher milk clotting aptitude made possible the birth of the most famous cheeses when:
 - ✓ chemistry
 - ✓ physical science
 - ✓ microbiology
 - ✓ biotechnology science
 were not born yet.

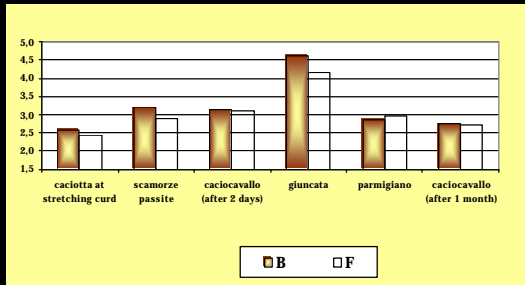
Frequency of B allele in Reggiana, Modenese, Italian Brown and Italian Holstein breeds.

Breeds	Frequency of B allele
Modenese (endangered breed)	50%
Reggiana (endangered breed)	47%
Italian Brown	63%
Italian Holstein	17%

Mariani et al., 2002



Ratio between the true yield and protein percentage in different types of cheese made with Italian Brown (B) and French Holstein (F) milk, corrected for the fat percentage.

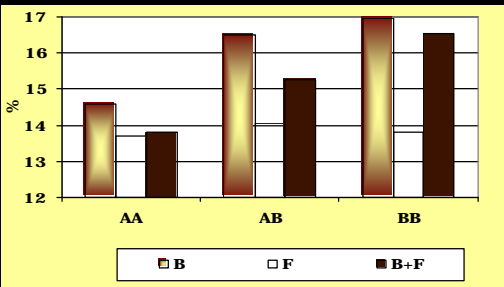


Zicarelli, 2002

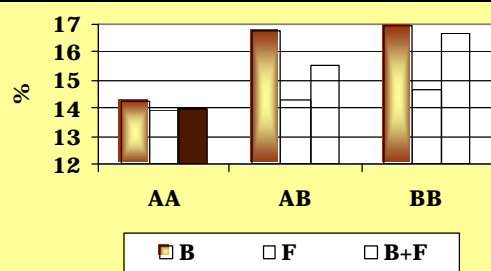
Data from recent studies (Di Palo et al., in press)



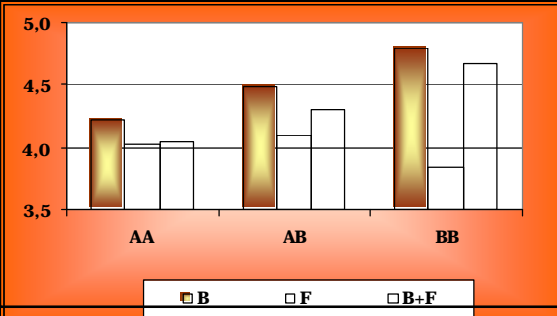
True yield in "giuncata cheese" with Italian Brown (B) and French Holstein (F) milk in relation to the protein genetic variants



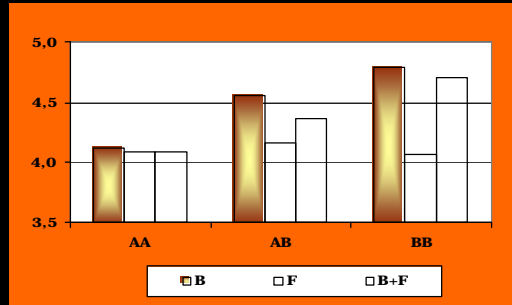
True yield in "giuncata cheese" with Italian Brown (B) and French Holstein (F) milk corrected for the fat percentage in relation to the protein genetic variants



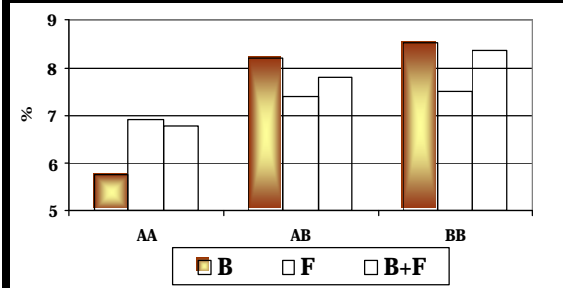
Ratio between the true yield and protein percentage in "giuncata cheese" made with Italian Brown (B) and French Holstein (F) milk in relation to the protein genetic variants



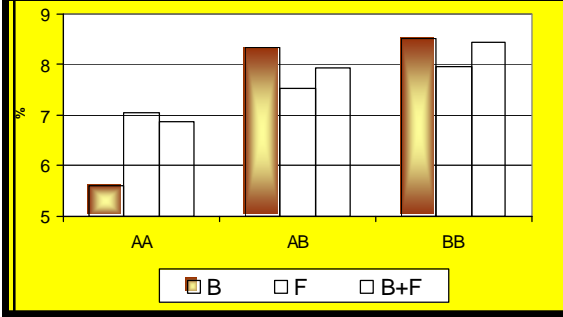
Ratio between the true yield and protein percentage in "giuncata cheese" made with Italian Brown (B) and French Holstein (F) milk corrected for the fat percentage in relation to the protein genetic variants



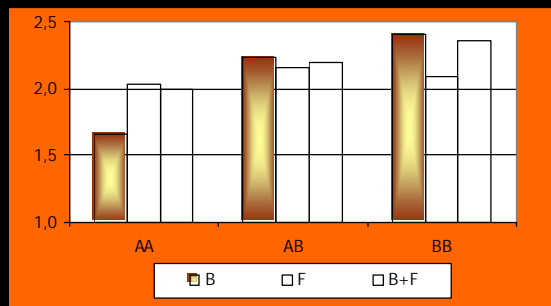
True yield in dry matter achieved in "giuncata cheese" with Italian Brown (B) and French Holstein (F) milk in relation to the protein genetic variants



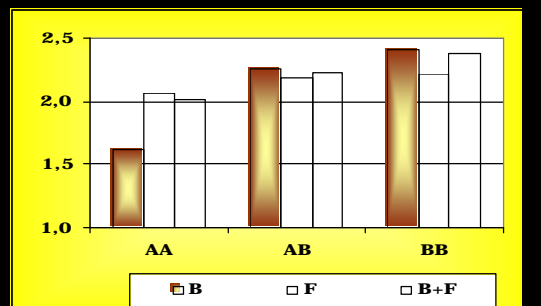
True yield in dry matter in "giuncata cheese" made with Italian Brown (B) and French Holstein (F) milk corrected for the fat percentage in relation to the protein genetic variants



Ratio between the true yield and protein percentage in dry matter achieved in "giuncata cheese" with Italian Brown (B) and French Holstein (F) milk in relation to the protein genetic variants



Ratio between the true yield and protein percentage in dry matter achieved in "giuncata cheese" with Italian Brown (B) and French Holstein (F) milk corrected for the fat percentage in relation to the protein genetic variants



These findings show that the higher milk clotting aptitude of Brown milk, in agreement with Mistry (2002), is affected by many factors.

The economic value of the milk to be sold to cheese factories greatly depends on fat and protein percentages but has never taken into account the breed.

A large number of algorithms using these two elements have been proposed to estimate cheese yield.







The formula developed by Alais (2000), by multiplying protein % and fat % by 3.27 and 0.9 respectively, gives to protein a value that is 3.63 times higher than the value of fat in determining the quantity of cheese that can be produced.



Differences between real yield at 72 hours and estimated yield calculated by Alais's formula within the k-casein variants in Brown and Holstein cows.

Breed	72h cheese yield (A)	Estimated yield (Alais) (B)	Difference B - A
	165.8 A	152.7 B	- 13.1
	138.0 A	146.0 B	+ 8.0
k-casein variants			
AA	141.6	149.2	+ 7.65
AB	152.9 a	149.9 b	- 3.0
BB	153.8 A	148.4 B	- 5.3
Total	149.4	149.2	- 0.2

Differences between real yield at 72 hours and estimated yield by Alais's formula within the k-casein variants in Brown and Holstein cows.

k-casein variants	Breed	72h cheese yield (A)	Estimated yield (Alais) (B)	Difference B - A
AA		145.9	152.3	+ 6.4
		137.2	146.1	+ 8.9
AB		165.1 a	153.8 b	- 11.3
		140.6	145.9	+ 5.3
BB		169.6 A	151.7 B	- 17.9
		138.0	145.2	+ 7.2

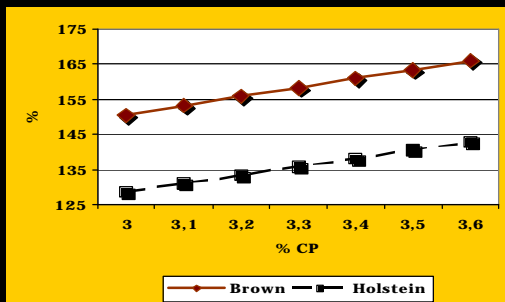


From the above data analysis arises that mass milk sold to cheese factories is paid, using the Alais formula, in relation to estimated yield.

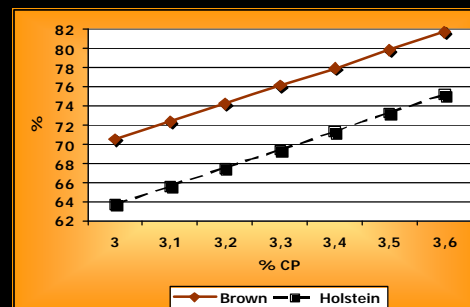
In a paradoxical way the farmer that produces milk with lower yield is rewarded while the farmer that produces milk with higher yield (Brown, Montbeliard et cetera) is damaged.



Estimated yield with in relation to the protein percentage of the Italian Brown and the French Holstein



Estimated yield in dry matter in relation to the protein percentage of the Brown and the French Holstein

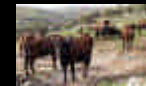


- The above pattern shows that each percentage point of protein must be evaluated in relation to the genetic value of the herd and, therefore, in relation to the percentage of subjects with B allele.



In the introduction of this contribution I have referred that those old breeds producing milk with a good clotting aptitude (from which the majority of the famous cheese was born) are currently endangered because they have been replaced by more productive breeds.

In my opinion, one of the reasons of this phenomenon was the underestimation of the economic value of the milk (milk protein) produced by these breeds.



Therefore, since these breeds were not adequately valorised, they were replaced by others that produce higher quantity of milk that not always has good clotting aptitude.

In the age in which the costs of petrol increase progressively, from the farm to the cheese factory more water and less cheese is always transported.

In my opinion this is not beneficial for both the producer and the transformer.

It is time to adopt a different policy!

A suggestion would be to evaluate milk not only on the basis of traditional characteristics but also taking into account the genetic characteristics.



In the actual zootechnical scenario it shouldn't be difficult to analyze the individual milk once (the genetic characteristics are stable) during the herd life of each cow.

In this way, inserting the data among those registered in the European livestock register, it should not be difficult to update, time by time, the genetic characteristics of the mass milk of each farm.



If this will be achieved, it would be possible to give the proper value to the milk of both Brown and endangered breeds.

