Coagulation Properties and Composition of Milk of Crossbred Cows Compared with Holstein Cows

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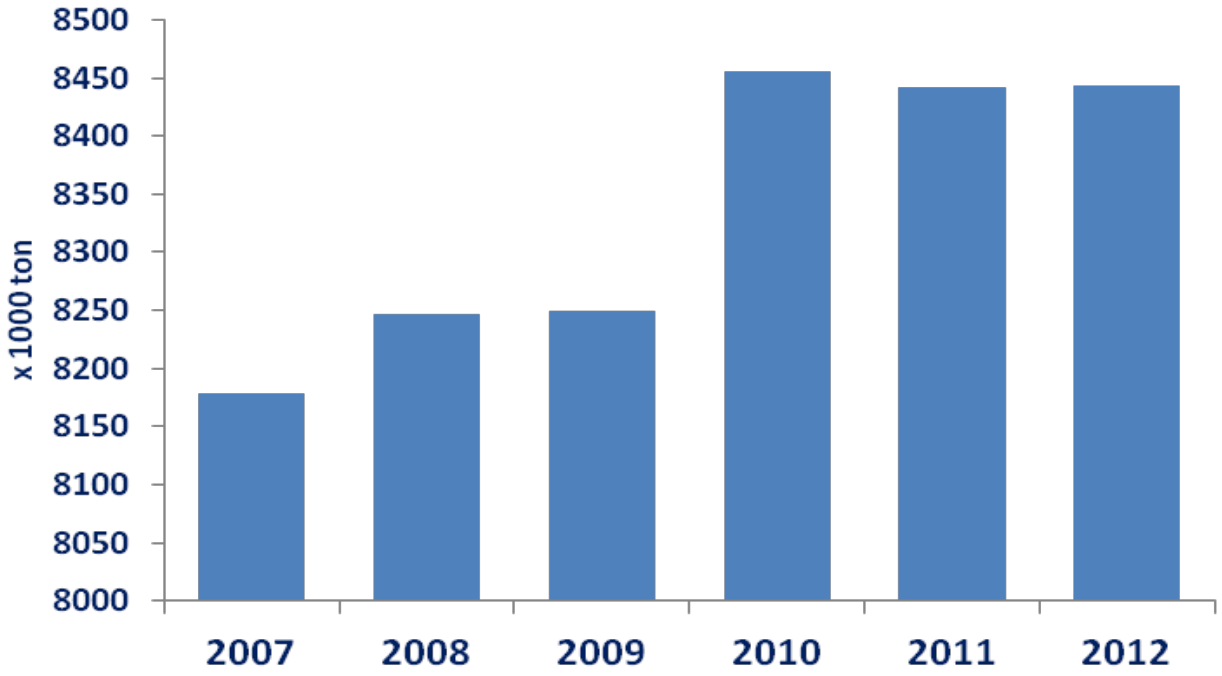
Milk production and milk quality studies Crossbred *vs*. Holstein cows

-  Milk production
-  Protein and fat content
-  Protein and fat yield
-  Somatic Cell Score

⇨ **COAGULATION PROPERTIES OF MILK?**

- The amount of milk used for cheese making is growing worldwide
- ≈ 8.500.000 ton of cheese produced in Europe



To determine the effect of breed composition on milk quality and milk coagulation properties

Sampling

506 cows

3 HERDS

Po Valley

Sampling

Purebreds

159 HO

1° Generation Crossbreds

140

SR x HO

42

MO x HO

16

BS x HO

2° Generation Crossbreds

103

MO x(SR x HO)

20

SR x(MO x HO)

26

MO x (BS x HO)

Milk composition

MilkoScan FT2 (Foss)

Fat, %

Protein, %

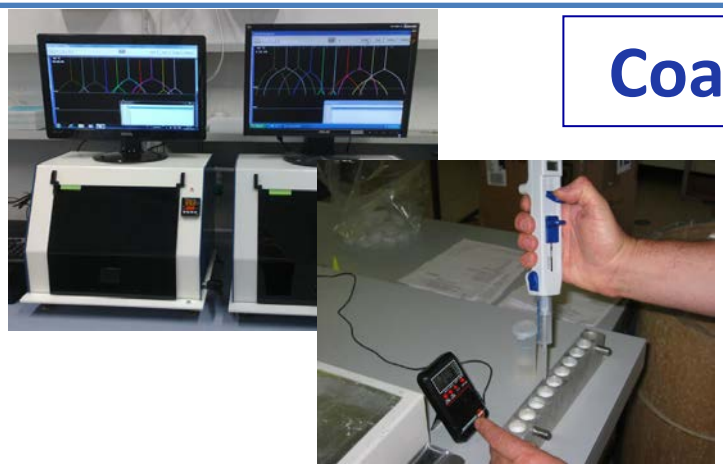
Casein, %

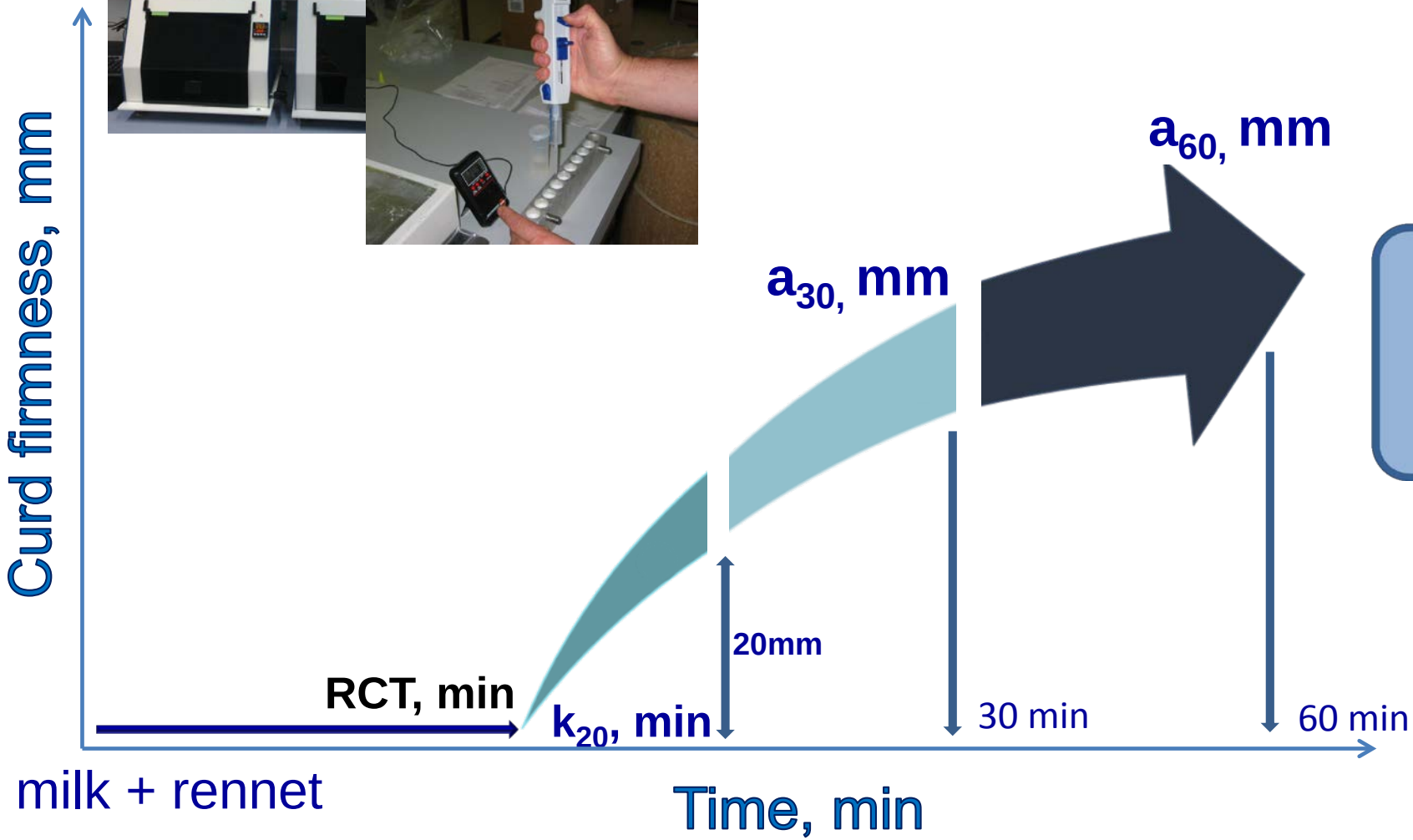
Lactose, %

Fossomatic

Somatic cell score

Coagulation properties - MCP





⇨ MODELING RENNET COAGULATION TIME

$$CF_t = CF_p \times (1 - \exp^{-k_{CF} \times (t - RCT_{eq})})$$

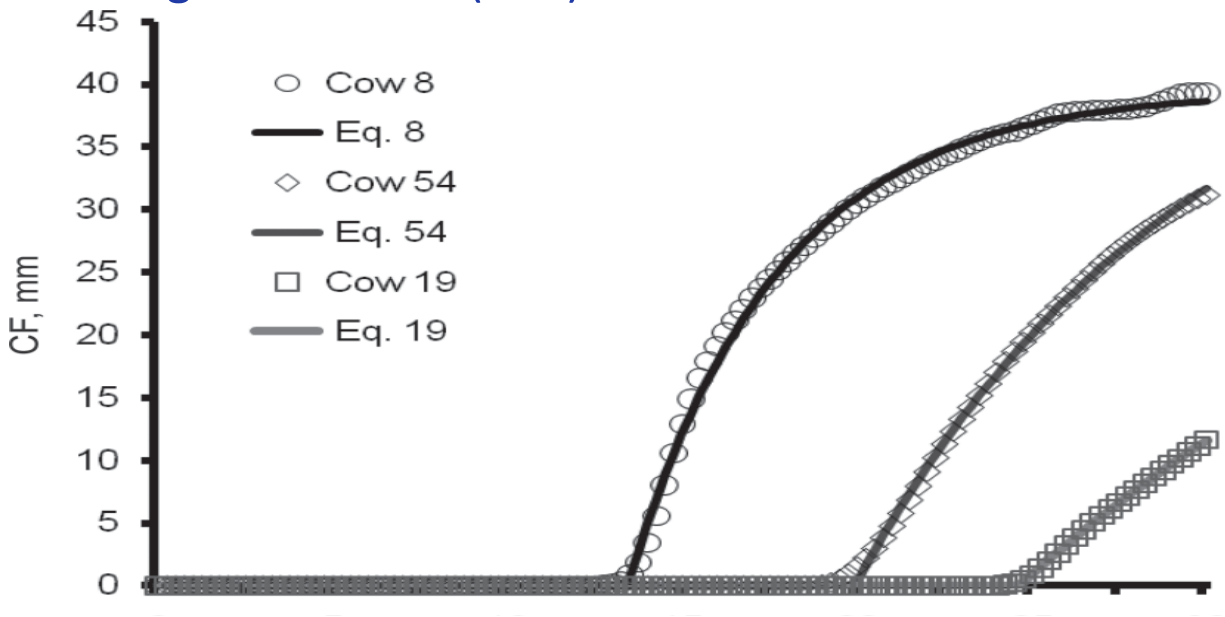
CF_t : curd firmness at time t (mm)

Bittante, JDS 2011

CF_p : asymptotical potential value of curd firmness at an infinite time (mm)

k_{CF} : curd-firming rate constant (min^{-1})

RCT_{eq} : Rennet coagulation time (min)



⇨NLIN PROCEDURE (SAS)

MILK and MILK COMPOSITION ⇨ GLM PROCEDURE (SAS)

FIXED EFFECTS (classes)
Herd Test day (7)
Days in milk (5)
Parity (3)
Breed composition (7)

RANDOM EFFECTS
Residual

COAGULATION PROPERTIES ⇨ MIXED PROCEDURE (SAS)

FIXED EFFECTS(classes)
Herd Test day (7)
Class of days in milk (5)
Parity (3)
Breed composition (7)
Pendula (20)

RANDOM EFFECTS
Cow
Residual

Contrast

Purebreds

HO

VS

1° Generation Crossbreds

SR x HO

MO x HO

BS x HO

2° Generation Crossbreds

SR x(MO x HO)

MO x(SR x HO)

MO x (BS x HO)

Contrast

Purebreds

HO

1° Generation Crossbreds

SR x HO

MO x HO

BS x HO

VS

2° Generation Crossbreds

SR x(MO x HO)

MO x(SR x HO)

MO x (BS x HO)

Purebreds

HO

Contrast

1° Generation Crossbreds

SR x HO

VS

MO x HO

BS x HO

2° Generation Crossbreds

SR x(MO x HO)

VS

MO x(SR x HO)

MO x (BS x HO)

Purebreds

HO

Contrast

1° Generation Crossbreds

SR x HO

MO x HO

VS

BS x HO

2° Generation Crossbreds

SR x(MO x HO)

MO x(SR x HO)

VS

MO x (BS x HO)

Effect of Breed Composition – Milk Yield and Milk Quality

	Milk yield	Milk quality traits					
		Fat	Protein	Casein	Lactose	SCS	pH
	P<0.001	**P<0.01**	**P<0.05**	%	**P<0.01**		
HO	33.02	3.96	3.69	2.69	5.03	2.88	6.47
SR x HO	29.89	4.34	3.79	2.77	4.91	2.35	6.47
MO x HO	32.29	4.24	3.76	2.77	5.01	2.90	6.47
BS x HO	28.49	4.17	3.74	2.73	4.91	2.88	6.44
SR x (MO x HO)	31.26	4.30	3.76	2.74	4.96	2.66	6.48
MO x (SR x HO)	29.24	3.95	3.76	2.74	4.97	2.74	6.50
MO x (BS x HO)	28.90	4.34	3.70	2.68	4.99	2.96	6.49

HO - Holstein, BS – Brown Swiss, SR – Swedish Red, MO – Montbèliarde

Effect of Breed Composition – Milk Yield and Milk Quality

	Milk yield kg×d^{-1}	Milk quality traits					
		Fat %	Protein %	Casein %	Lactose %	SCS	pH
HO	33.02	3.96	3.69	2.69	5.03	2.88	6.47
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P<0.05

P<0.05

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Effect of Breed Composition – Milk coagulation properties

	Milk coagulation traits			Curd firmness model		
	RCT	k_{20}	a_{30}	RCT_{eq}	CF_P	K_{CF}
	min	**P<0.05**	**P<0.001**	**P<0.05**	**P<0.05**	**P<0.05**
HO	21.4	5.3	30.4	22.4	49.6	12.1
SR x HO	22.3	5.2	33.4	22.4	50.7	11.9
MO x HO	19.7	3.9	38.6	19.2	50.9	13.6
BS x HO	20.1	5.3	35.9	21.3	51.1	12.0
SR x (MO x HO)	19.5	4.2	41.3	19.2	53.6	15.6
MO x (SR x HO)	22.2	5.0	33.4	21.6	49.8	12.6
MO x (BS x HO)	20.9	4.8	32.9	20.8	49.6	13.3

HO - Holstein, BS – Brown Swiss, SR – Swedish Red, MO – Montbèliarde

Effect of Breed Composition – Milk coagulation properties

	Milk coagulation traits			Curd firmness model		
	RCT min	k_{20} min	a_{30} min	RCT_{eq} min	CF_P mm	K_{CF} %×min^{-1}
HO	21.4	5.3	30.4	22.4	49.6	12.1
SR x HO	22.3	5.2	33.4	22.4	50.7	11.9
MO x HO	19.7	5.9	38.6	19.2	50.9	13.6
BS x HO	20.1	5.3	35.9	21.3	51.1	12.0
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P<0.05

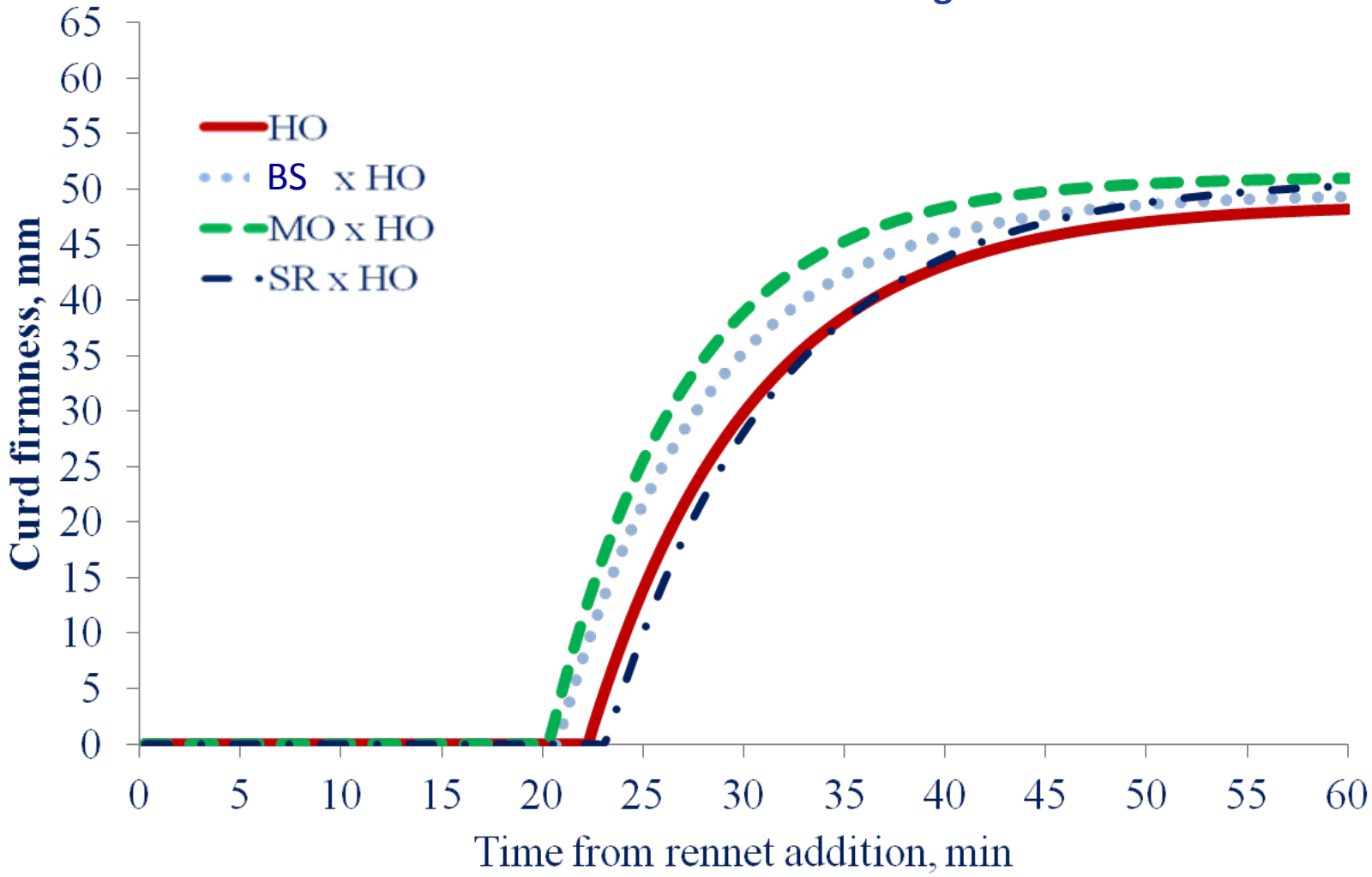
P<0.05

P<0.05

P<0.05

HO - Holstein, BS – Brown Swiss, SR – Swedish Red, MO – Montbèliarde

Holstein versus Crossbred Cows – Modelling of curd firmness



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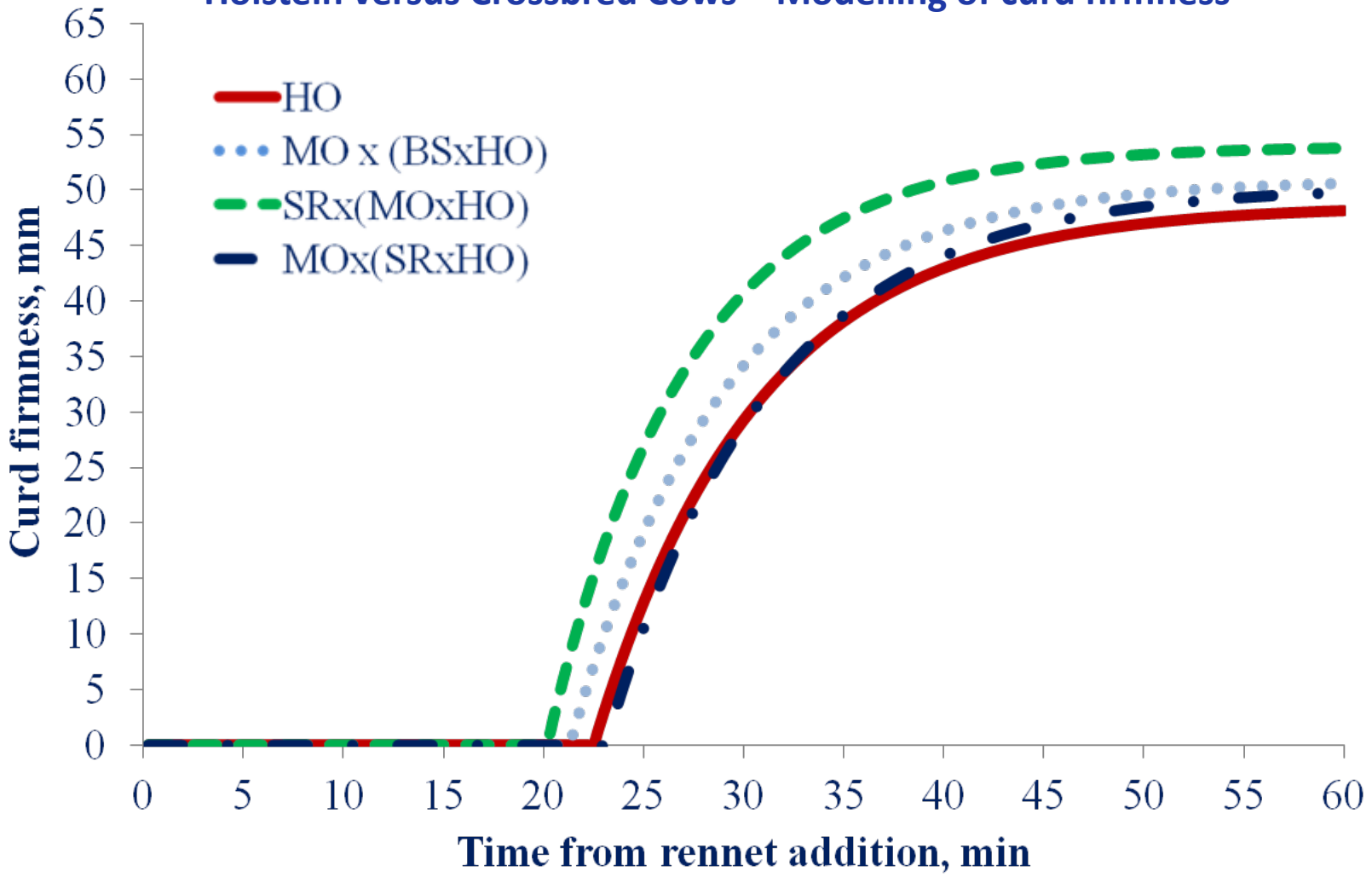
Holstein versus Crossbred Cows – Modelling of curd firmness



HO - Holstein, BS – Brown Swiss, SR – Swedish Red, MO – Montbèliarde

CONCLUSION – MILK QUALITY

- Crossbred cows produced less milk with lower lactose content, but higher fat and protein content
- No differences between crossbred cows for most of the traits

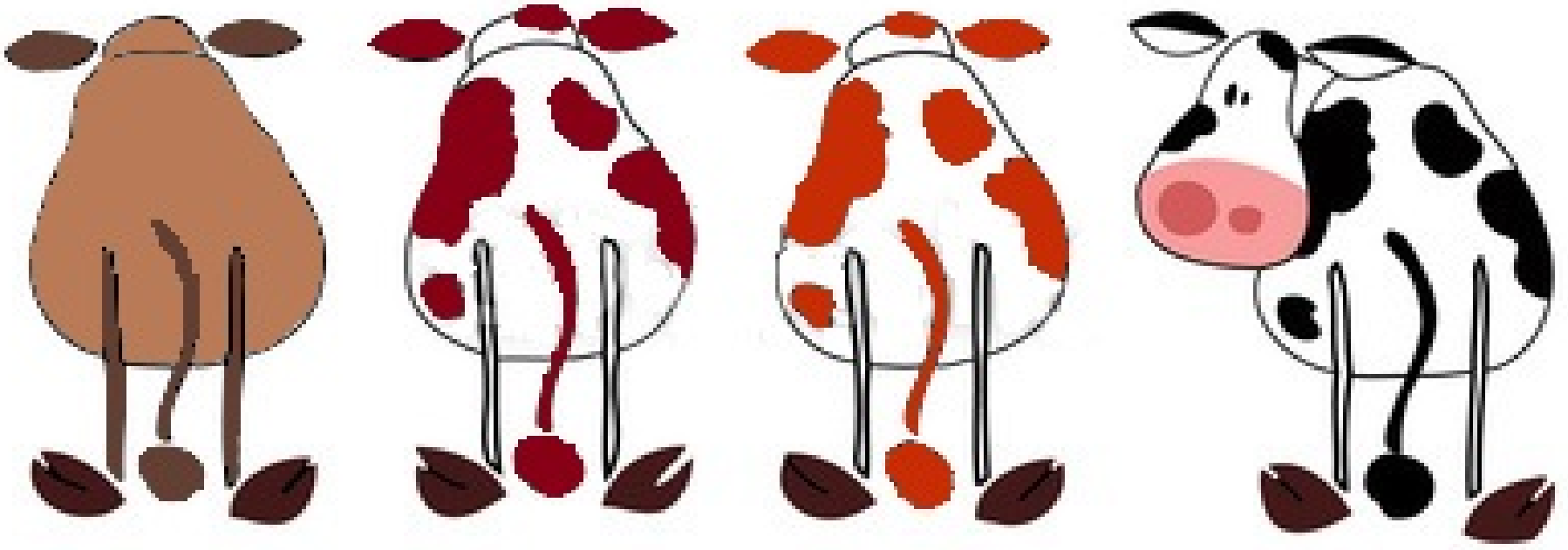
CONCLUSION – COAGULATION PROPERTIES

- Crossbred cows showed better milk coagulation properties parameters than pure HO
- Difference between crossbred cows for milk coagulation properties were observed

FUTURE WORK

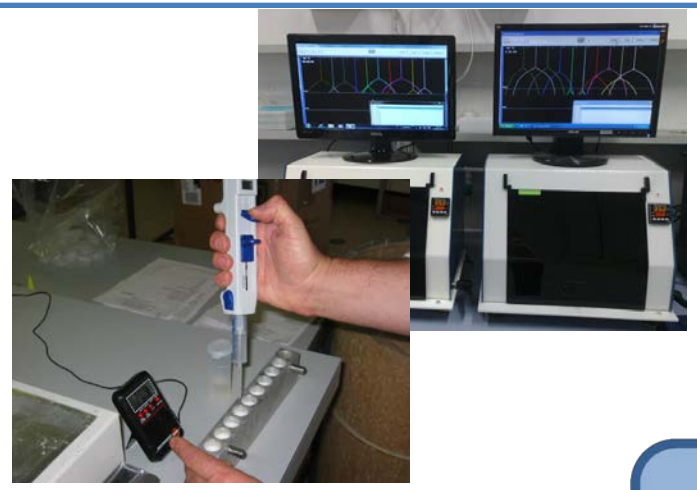
Analyze protein profile

Individual cheese yield/whey losses



Thanks for your attention

Coagulation properties - MCP



- Milk sub-samples (10 mL)
- Heated to 35°C
- 200 µL rennet solution (Hansen Standard 160, with 80±5% chymosin and 20±5% pepsin; Pacovis Amrein AG, Bern, Switzerland) diluted to 1.6% (wt/v) in distilled water (to yield 0.051 IMCU×mL^{-1})

Holstein versus Crossbred Cows – Production Traits and SCS

Trait	Breed [1]						
	HO	BSxHO	MOxHO	SRxHO	MOx(BSxHO)	SRx(MOxHO)	MOx(SRxHO)
Fat, %	**3.99**	4.23	4.25	4.35***	4.34	4.29	3.95
Protein, %	**3.69**	3.74	3.76	3.79***	3.70	3.76	3.76*
Casein, %	**2.69**	2.72	2.77	2.77**	2.68	2.74	2.74
Lactose, %	**5.03**	4.86*	5.01	4.92***	4.94	4.95	4.95*
Somatic cell score	**2.88**	2.93	2.90	2.35*	2.96	2.66	2.72

[1] HO - Holstein (reference breed), BS – Brown Swiss, SR – Swedish Red, MO – Montbeliarde

*** P<0.05, ** P<0.01, *** P<0.0001**

Holstein versus Crossbred Cows – Milk coagulation properties

Trait	Breed [1]						
	HO	BSxHO	MOxHO	SRxHO	MOx(BSxHO)	SRx(MOxHO)	MOx(SRxHO)
RCT, min	22.20	20.10	20.34	22.80	20.61	21.29	22724
k_{20}, mm	5.40	5.20	3.86***	5.17	4.81	4.27	5.03
a_{30}, mm	28.28	31.93	35.47*	28.82	31.34	36.06*	27.98
CF_P, min	48.65	49.56	51.07	51.00**	50.92	53.92**	50.35
RCT, mm	22.26	20.76	20.32	23.11	21.33	20.18	23.11
K_{CF} mm	0.12	0.13	0.15**	0.11	0.13	0.14	0.12

[1] HO - Holstein, BS – Brown Swiss, SR – Swedish Red, MO – Montbèliarde

*** P<0.05, ** P<0.01, *** P<0.0001**