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Chemical composition, hygiene characteristics and coagulation aptitude of milk for Parmigiano Reggiano cheese from herds yielding different milk levels

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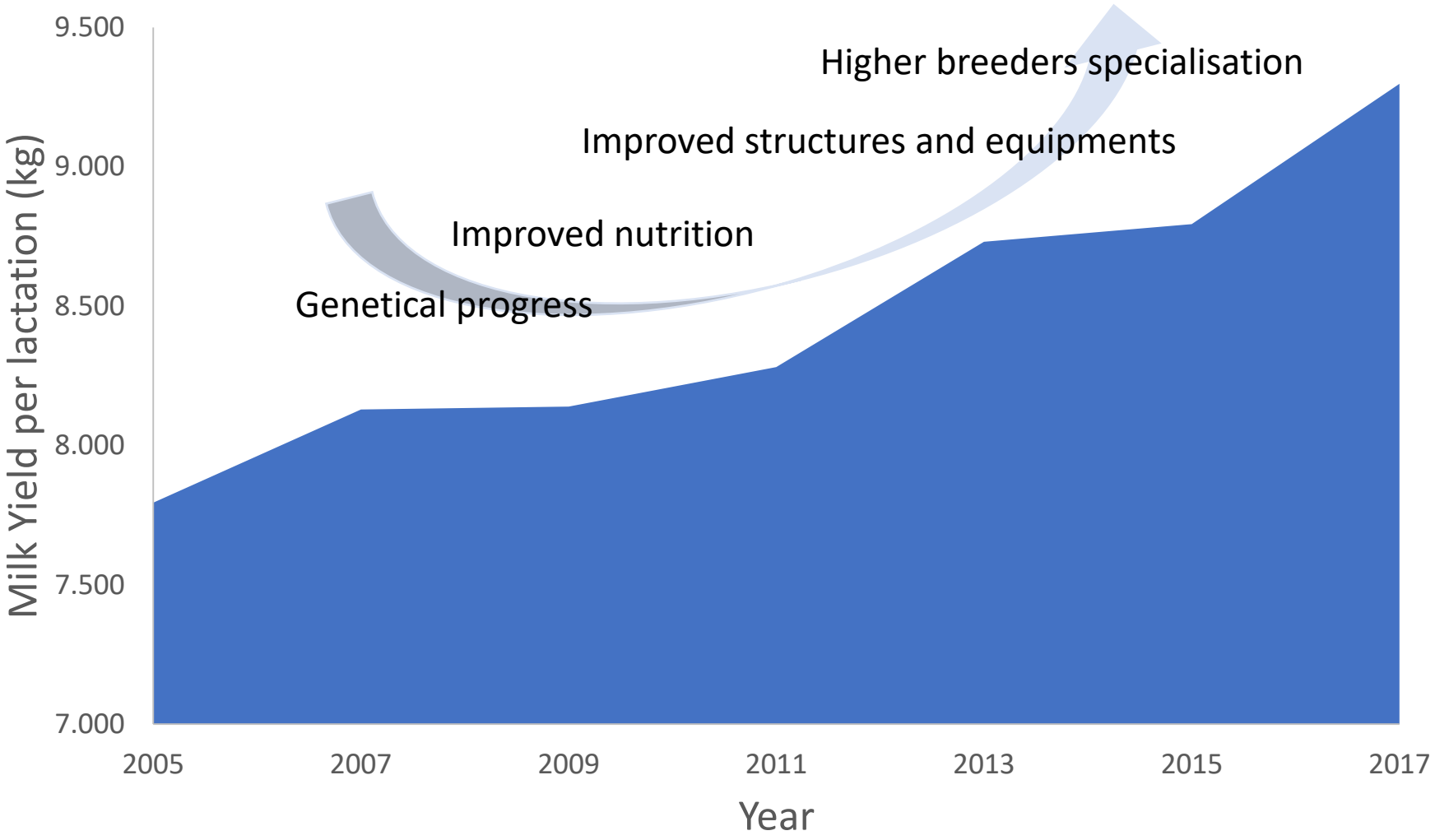
Milk Yield trend



Data retrived from **http://bollettino.aia.it**

Holstein Fresian in Modena, Reggio Emilia and Parma provences

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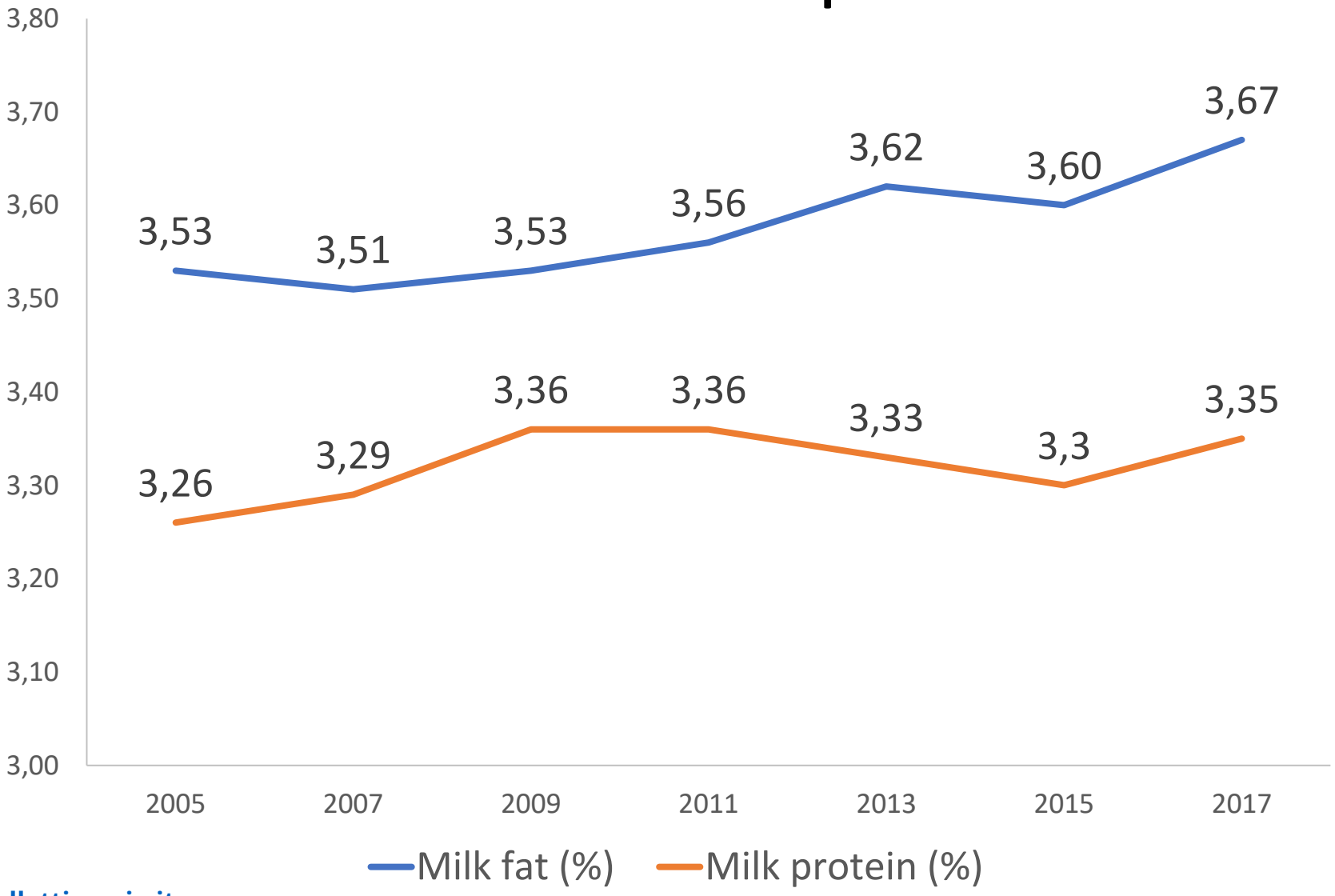
Milk fat and protein



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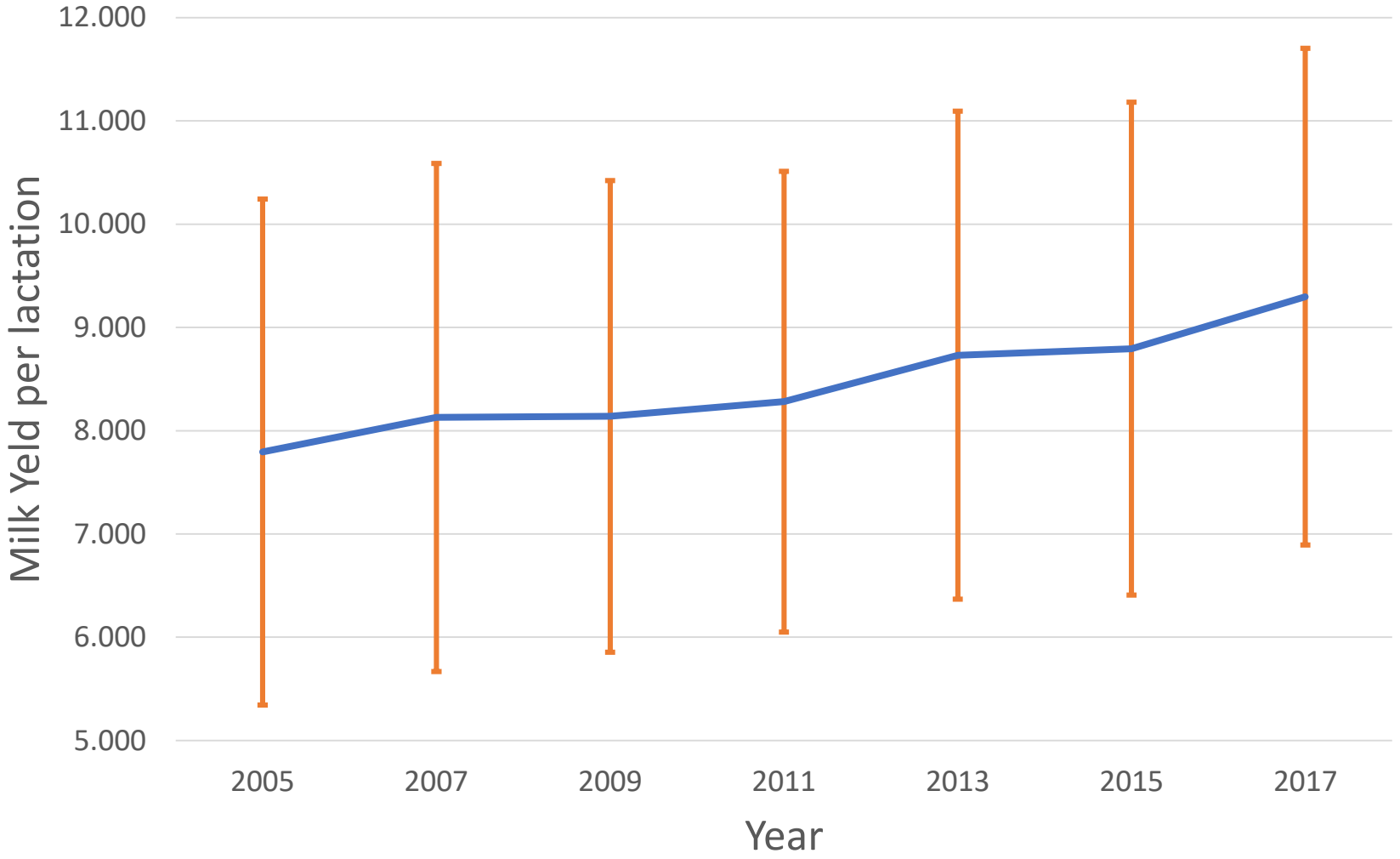
Milk Yield trend



Effect on milk quality and milk technological traits

Data retrived from **http://bollettino.aia.it**

Holstein Fresian in Modena, Reggio Emilia and Parma provences

The aim of the research was to compare milk quality parameters among herd characterized by different levels of milk production

Effect of leaving the tradition?

- **1080 bulk milk samples** - 30 dairy herds producing milk for Parmigiano Reggiano cheese - Padana Plain, Reggio Emilia Provence, North Italy.

- Herds: **3 classes** (10 herds per class) according to their production level (kg/cow/lactation):
  (L) from 6000 to 7999 kg
  (M) from 8000 to 9999 kg
  (H) from 10000 to 12000 kg.

- Average **herd size** were 64, 69 and 64 in the L, M and H, respectively.

- Samples were **collected monthly** in each herd during **3 years period**

- **Parameters** assessed: fat and crude protein (CP), titratable acidity (TA), total bacterial count (TBC), somatic cells count (SCC), coliforms bacteria (CB) and *Clostridia* spores.

- Least mean values were obtained by **ANOVA univariate** using the herd class (L, M or H) as fixed factor.

RESULTS AND DISCUSSION: CHEMICAL COMPOSITION

Table 1. Chemical composition, physico-chemical properties and microbiological characteristics of the milk produced in herd with different production level.

		L-group[1]		M-group[1]		H-group[1]		SE[3]	P[4]
		n[2]=360		n[2]=360		n[2]=360			
Fat	**g/100g**	**3.60**	**b**	**3.28**	**a**	**3.30**	**a**	**0.01**	***
Protein	**g/100g**	**3.26**	**a**	**3.41**	**b**	**3.38**	**b**	**0.01**	***
Titratable acidity	**°SH/50mL**	**3.22**	**a**	**3.25**	**b**	**3.23**	**a**	**0.01**	**
Somatic cell count	10^3cells/mL	382	c	253	b	209	a	7	***
Total bacterial count	10^3CFU/mL	95	c	53	b	45	a	4	***
Coliform bacteria	CFU/mL	2294	c	1664	b	1342	a	118	***
Clostridia spores	spores/L	71		71		63		3	NS

Fat was higher in L milk than in the M and H ones.

CP resulted lower in L milk compared to M and H milks.

The TA was higher in M milk and lower in L and H ones.

These differences, although statistically significant, probably were not significant from a cheese-making perspective.

[1] Cow milk production classes: L-group, 6000÷7999; M-group, 8000÷9999 and H-group 10000÷12000 kg/cow/lactation.

[2] Number of samples collected.

[3] Standard error.

[4] Significance of differences: a, b, c are different for P≤ 0.05; NS, P>0.05; ***P≤0.001.

RESULTS AND DISCUSSION: HYIGIENE CHARACTERISTICS

Table 2 Results of chi-square test for somatic cell (SCC), total bacterial count (TBC), coliforms, *Clostridial* spores and lactodynamographic (LDG) classes of bulk tank milk samples collected from free-stall herds and collected from tie-stall herds

		L-group[1]		M-group[1]		H-group[1]		SE[3]	P[4]
		n[2]=360		n[2]=360		n[2]=360			
Fat	g/100g	3.60	b	3.28	a	3.30	a	0.01	***
Protein	g/100g	3.26	a	3.41	b	3.38	b	0.01	***
Titratable acidity	°SH/50mL	3.22	a	3.25	b	3.23	a	0.01	**
Somatic cell count	**10^3cells/mL**	**382**	**c**	**253**	**b**	**209**	**a**	**7**	***
Total bacterial count	**10^3FCU/mL**	**95**	**c**	**53**	**b**	**45**	**a**	**4**	***
Coliform bacteria	**FCU/mL**	**2294**	**c**	**1664**	**b**	**1342**	**a**	**118**	***
Clostridia spores	**spores/L**	**71**		**71**		**63**		**3**	**NS**

- The parameters of SCC, TBC and CB resulted higher in L milk and lower in H milk.
- Milk produced in H herds showed a better microbial quality, with less SCC, TBC and CB values.
- No differences were observed for *Clostridia* spores in the 3 types of milks. Generally low levels (<100 spores/L) 5000-10000 Spores/L out of the area

[1] Cow milk production classes: L-group, 6000÷7999; M-group, 8000÷9999 and H-group 10000÷12000 kg/cow/lactation.

[2] Number of samples collected (for SCC = 340 and for CBT = 350)

[3] Significance of differences: a, b, c are different for P≤0.05; NS, P>0.05; **P≤0.01; ***P≤0.001.

[4] SCC = Rolling geometric average values calculated on 3 months

[5] TBC = Rolling geometric average values calculated on 2 months

RESULTS AND DISCUSSION: COAGULATION APTITUDE

Table 2 Results of chi-square test for somatic cell (SCC), total bacterial count (TBC), coliforms, *Clostridial* spores and lactodynamographic (LDG) classes of bulk tank milk samples collected from free-stall herds and collected from tie-stall herds

		L-group[1]			M-group[1]			H-group[1]			P[3]
		n^2=360			n^2=360			n^2=360			
	Class	n.	%		n.	%		n.	%		
SCC [4]	>400 x 10^3 cells/mL	130	**38.2**	c	35	10.3	b	5	1.5	a	***
TBC [5]	>100 x 10^3 CFU/mL	106	30.3	c	21	6.0	b	12	3.4	a	***
Coliforms	Up to 1,000 CFU/mL	243	67.5	a	287	79.7	b	329	91.4	c	***
	1,001 to 5,000 CFU/mL	88	24.4	c	60	16.7	b	21	5.8	a	**
	Over 5,000 CFU/L	29	8.1	b	13	3.6	a	10	2.8	a	**
Clostridial	Up to30 spores/L	59	**16.4**		**51**	**14.2**		**57**	**16.9**		NS
spores	31¸100 spores/L	245	**68.1**		**246**	**68.3**		**261**	**72.5**		NS
	Over 100 spores/L	56	**15.6**		**63**	**17.5**		**38**	**10.6**		NS
LDG	Optimal	190	52.8	a	223	61.9	b	212	58.9	b	**
	Sub-optimal	95	26.4		100	27.8		94	26.1		NS
	Poor	75	20.8	b	37	10.3	a	54	15.0	a	**

Almost 40% in L group not conform (CE Regulation 853/2004) + hidden losses of milk and cheese 50 Euro/vat

Milk preservation>18°C instead of 8°C of other POD or 4-6°C of industrial milk.
>100.000 not conformity process: 1/3 in L group (CE 853/2004)

[1] Cow milk production classes: L-group, 6000÷7999; M-group, 8000÷9999 and H-group 10000÷12000 kg/cow/lactation.

[2] Number of samples collected (for SCC = 340 and for CBT = 350)

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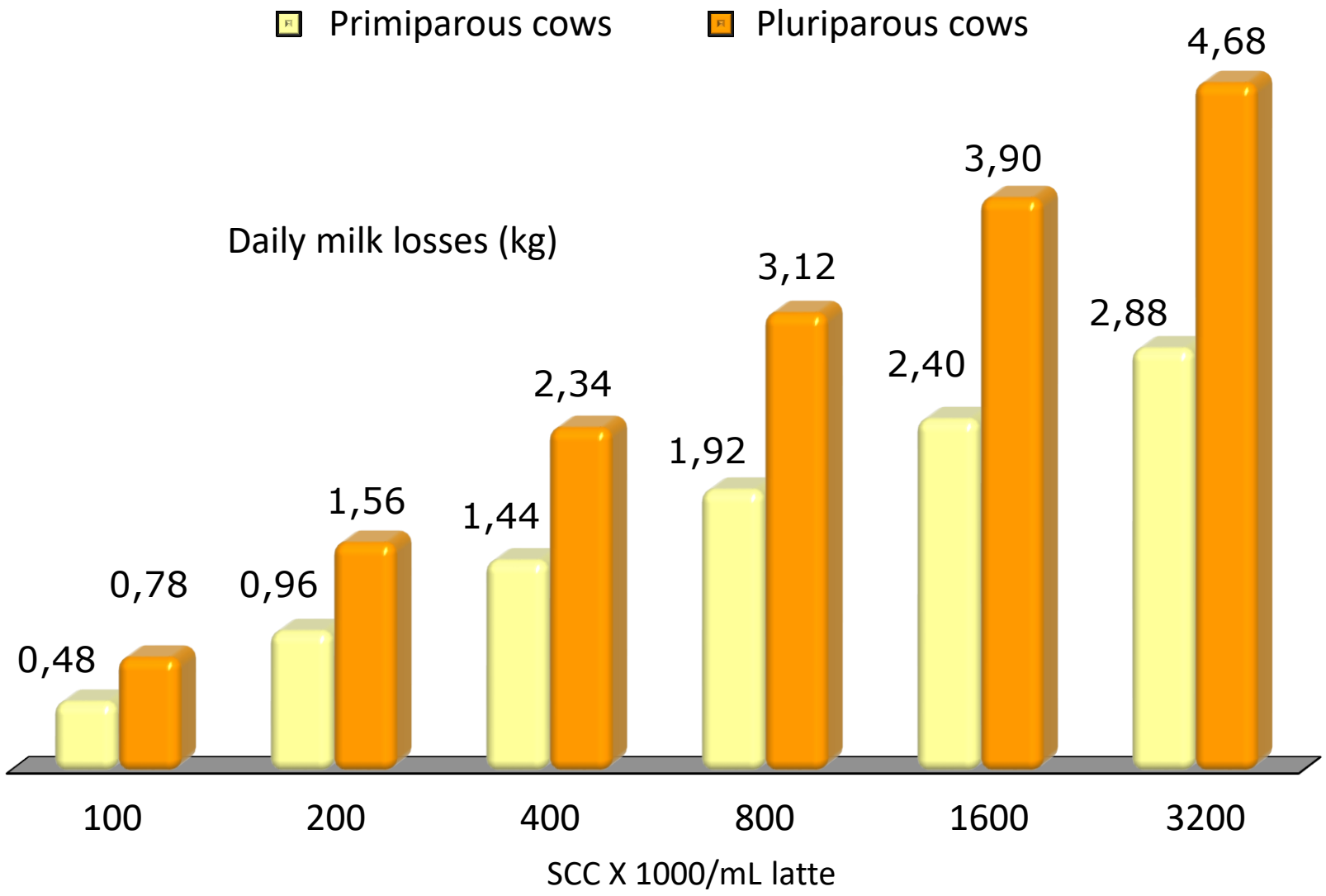
Somatic Cell Count (SCC) and milk production losses



SCC> 400000 = Lower Quality

Reduce:

Casein
Casein index
Phosphorus
Titratable acidity

Increase:

pH
Clorides (Cl^-)

Reduce the cheese yield:

at 24 hours
at 24 months

<u>Economic losses</u>

Increase in somatic cell count and cheese production

1000 kg of milk
≤400 SCC/1000 ml

1000 kg of milk
>400 <1000 SCC/1000 ml

~ 50 €/vat/d

(Summer et al., personal communication)

CONCLUSIONS

- Despite a lower level of mik fat, **the increase of milk productivity is associated**

to a general **increase in milk hygiene characteristics**

to a general **improvement of milk coagulation properties**

- **Low quality** in low herds: **Hidden losses** (opportunity losses) at farm and cheese factory levels that push them out of the market

- HIGH PRESSURE FOR **IMPROVEMENTS** AND **FARM UPGRADE!!**

THANK YOU !

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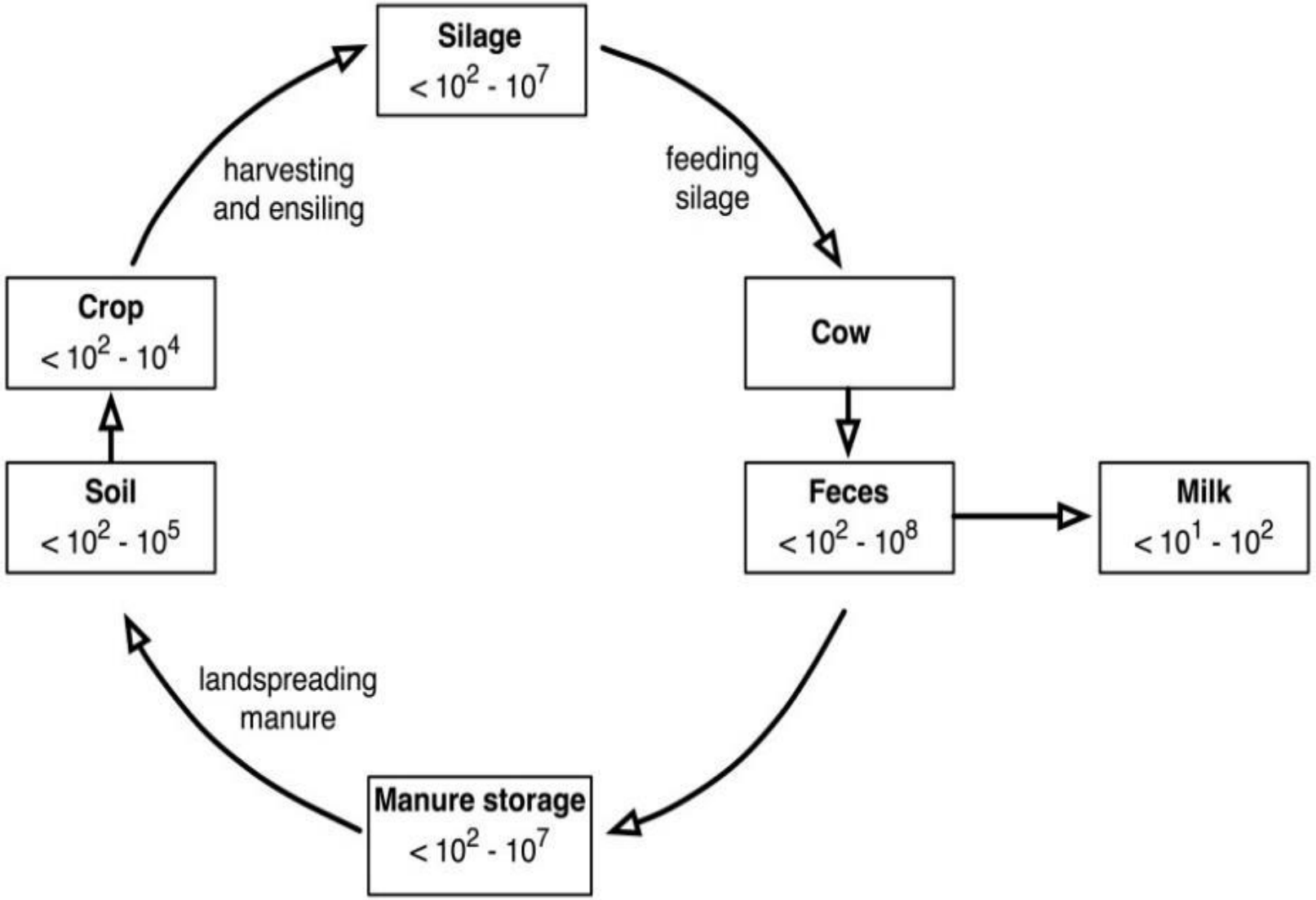
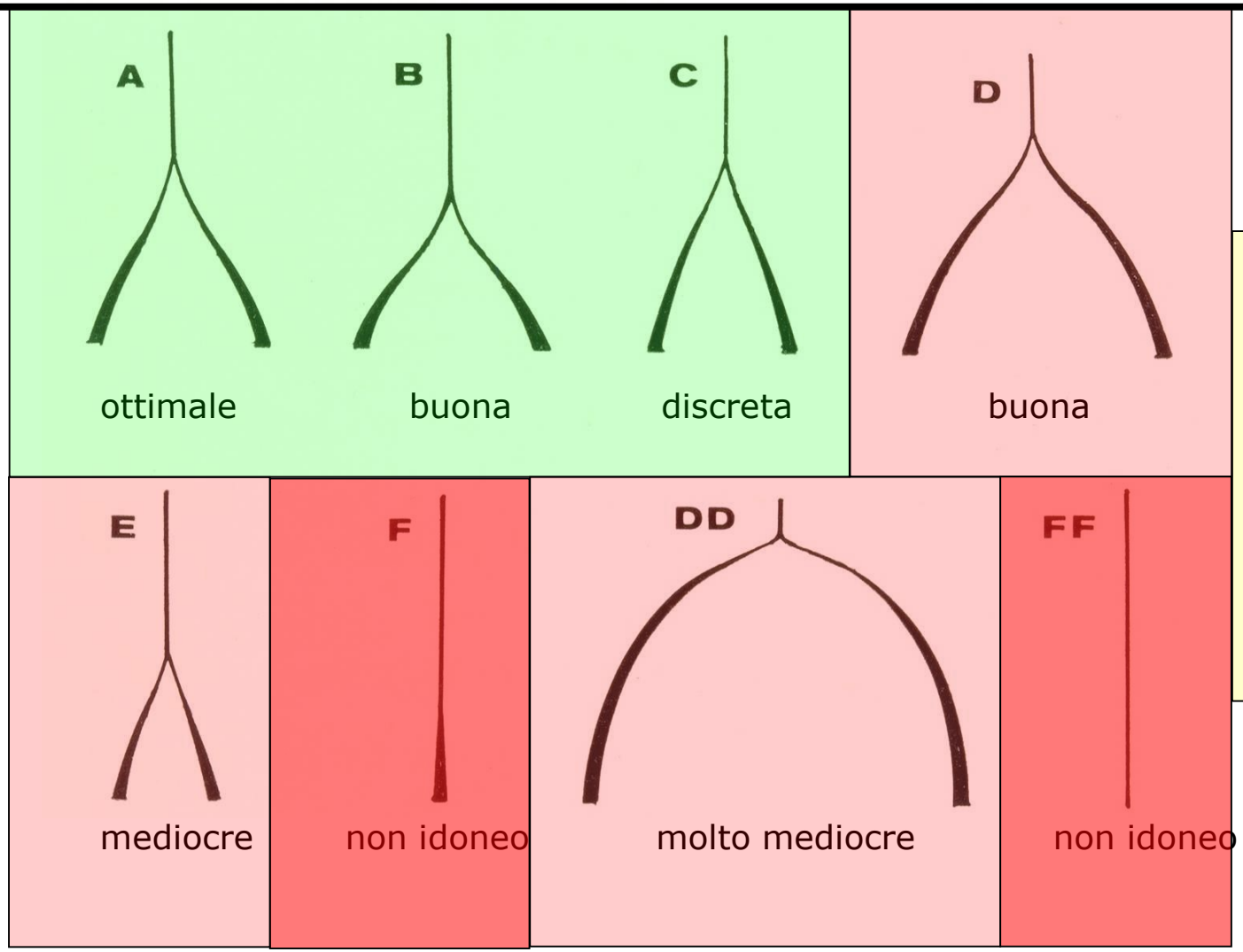
THANK YOU !

“Ciclo” inquinante delle spore



Lattodinamogrammi dei tipi identificati



Tipi intermedi:

Tipo AE
tipo A con tempi lunghi tendenti al tipo E

Tipo EA
tipo E con consistenza del coagulo vicina a quella del tipo A

A, B, C	ottimali
AE, EA	discreti
D, E, DD	mediocri
F, FF	anomali