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Milk Separation According to Coagulation Properties

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Question:

1. What is considered "good" milk?

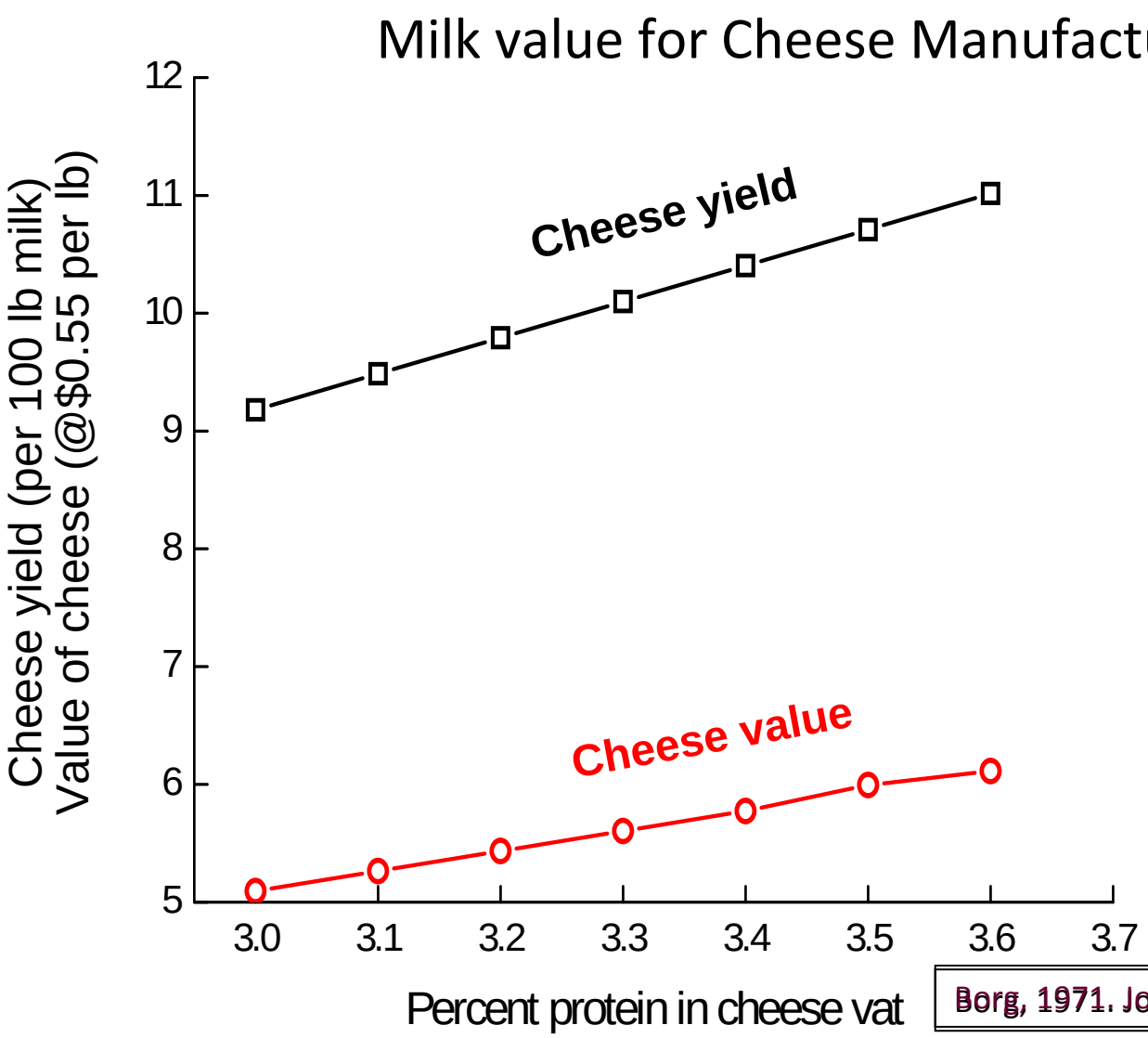
2. Are there different "good" milks?

1. More complicated than a simple answer

2. For the farmer - Animals/gland level

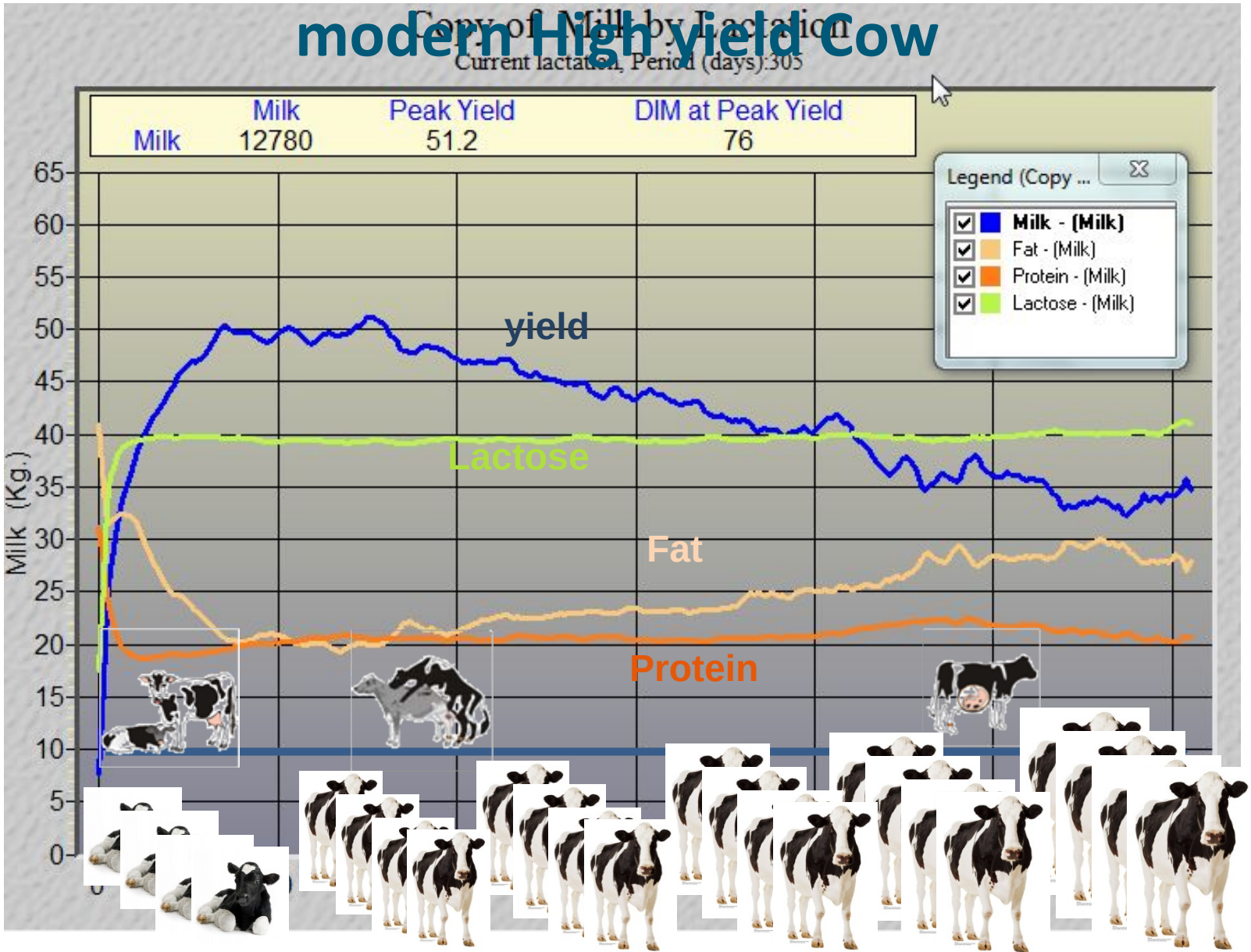
For the Dairy industry - Bulk Milk

Milk value - The value of the milk depends on quality and composition



Borg, 1971. Journal of Dairy Science, *54:1134-1136*

Milk yield and composition presents the status of the modern High yield Cow



- To produce milk, the modern cows require three times more energy then it needs survive.

- Every deviation from balance energy equilibrium has great impact on milk quality and composition.

Diet
Genetics
Stage of lactation
Parity
Health
Environment

Quality milk varies between cows, between milking sessions and during the milking process itself.

Equal milk parameters (fat, casein, SCC, bacterial count…)

Results in different cheese yield

Leitner, G., N. Silanikove, S. Jacobi, L. Weisblit, S. Bernstein and U. Merin. (2007). The influence of milk storage time on the farm and in dairy silos on its quality for cheese production . *Int. Dairy J.*, 18:109-113.

Milk Products

butter

(high % of fat)

Churning

(controlled % of fat)

fermentation

Whole or Low fat milk

cheese

coagulation

(high coagulation property)

soap

yoghurt

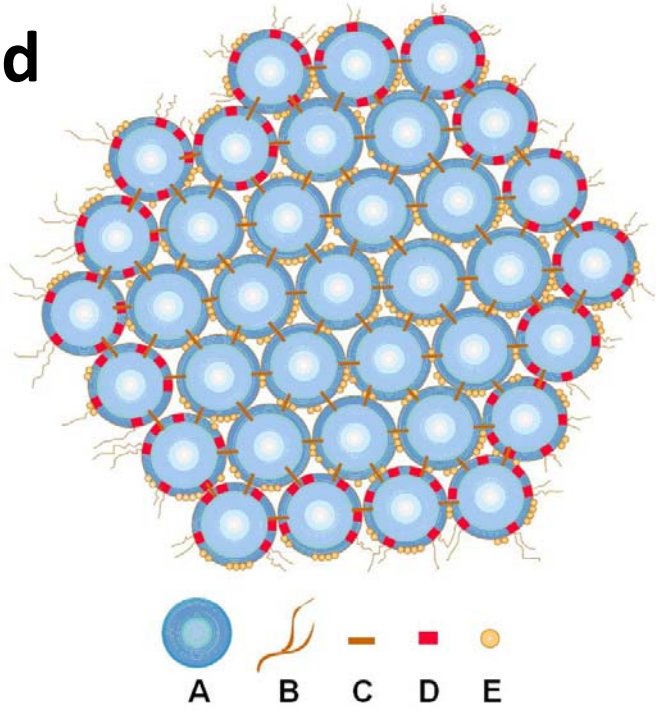
(controlled % of proteins)

Cheese Coagulation

Cheese formation is the product of casein micelles aggregation to a form of a "cage".

Hydrophobic inside and hydrophilic outside.

This formation traps the solids and looses the water and whey.

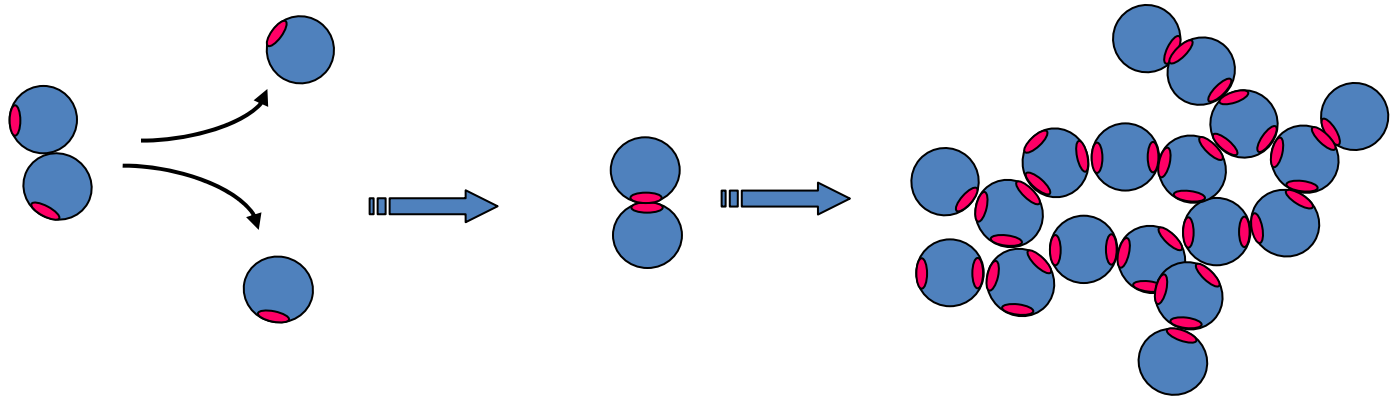


1.Proteolysis

2.Aggregation

3.Gelation

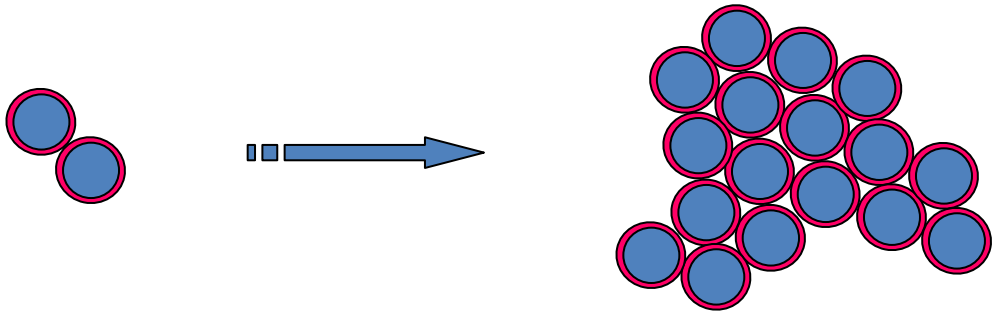
The billiard balls model of aggregation



Non-reactive collision

Reactive collision

Loose curd formation

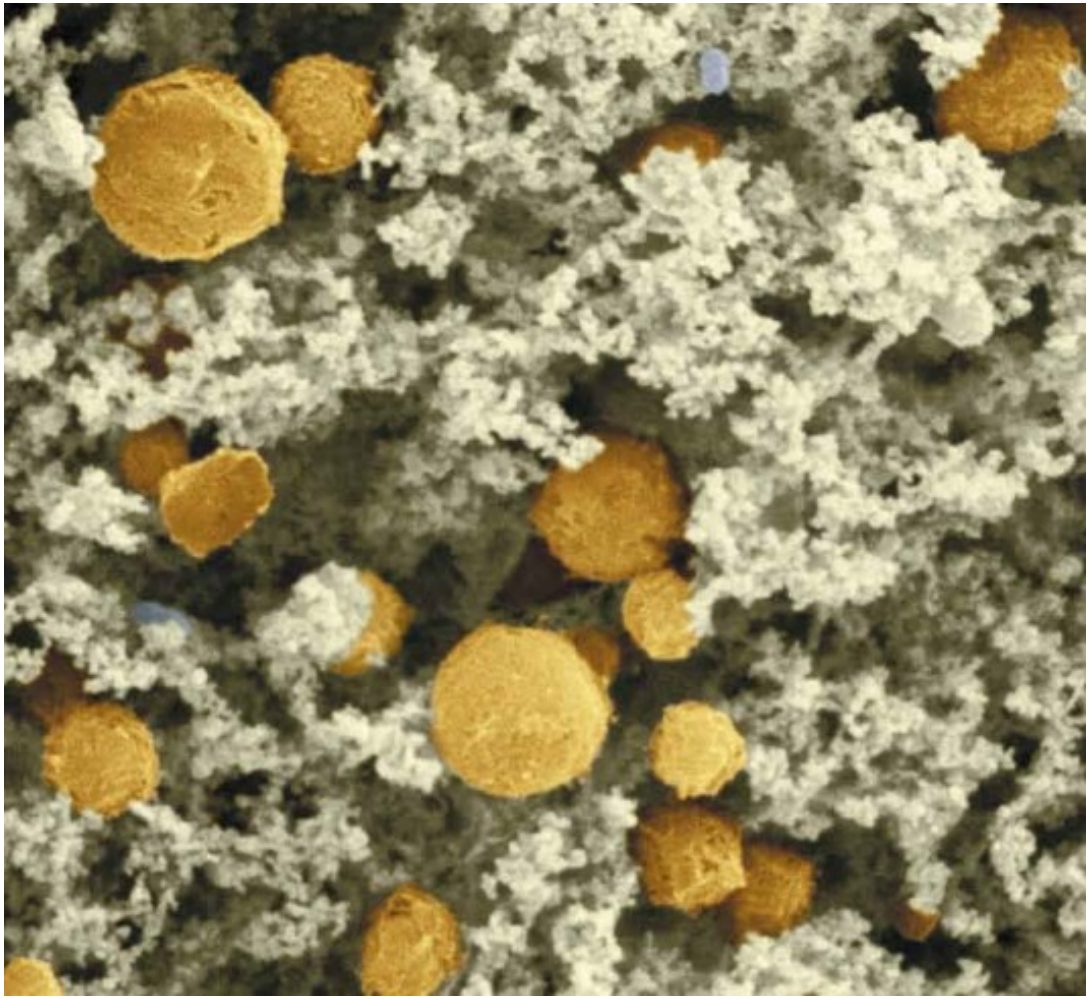


Full reactive surface

Solid curd formation

Yield and quality of cheese production depends not only on quantity of caseins but also on the sticking probability of casein collision manifested in “protein efficiency”

Electronic Microscopy Milk Aggregating

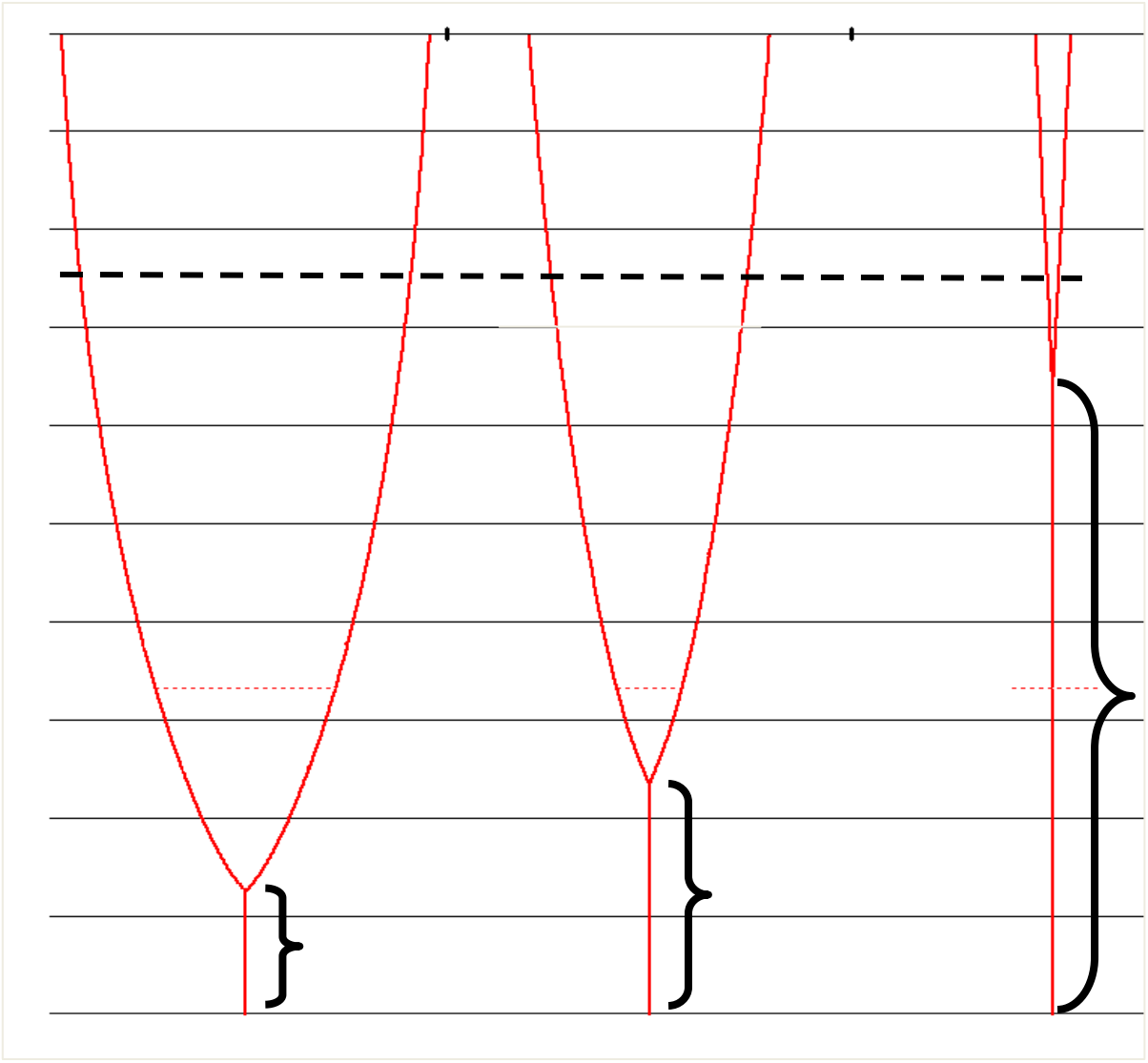


Aggregation of milk: Casein matrix(white) holding the fat globules(yellow). Two strep. type bacteria (in light blue)

M. Kalab

Two parameters are tested using the Optigraph© (Alliance Instruments) to define milk quality for cheese

Clotting time (in seconds)
Curd firmness (volts) 30 min after addition of coagulating enzyme



Curd firmness (volts)

Clotting time (sec)

AfiLab – Optical Milk Analyzer

On-line real-time analysis milk of constituents at every stall

- Fat
- Protein
- Lactose
- Coagulation

Property

Enables real-time routing of milk per its properties

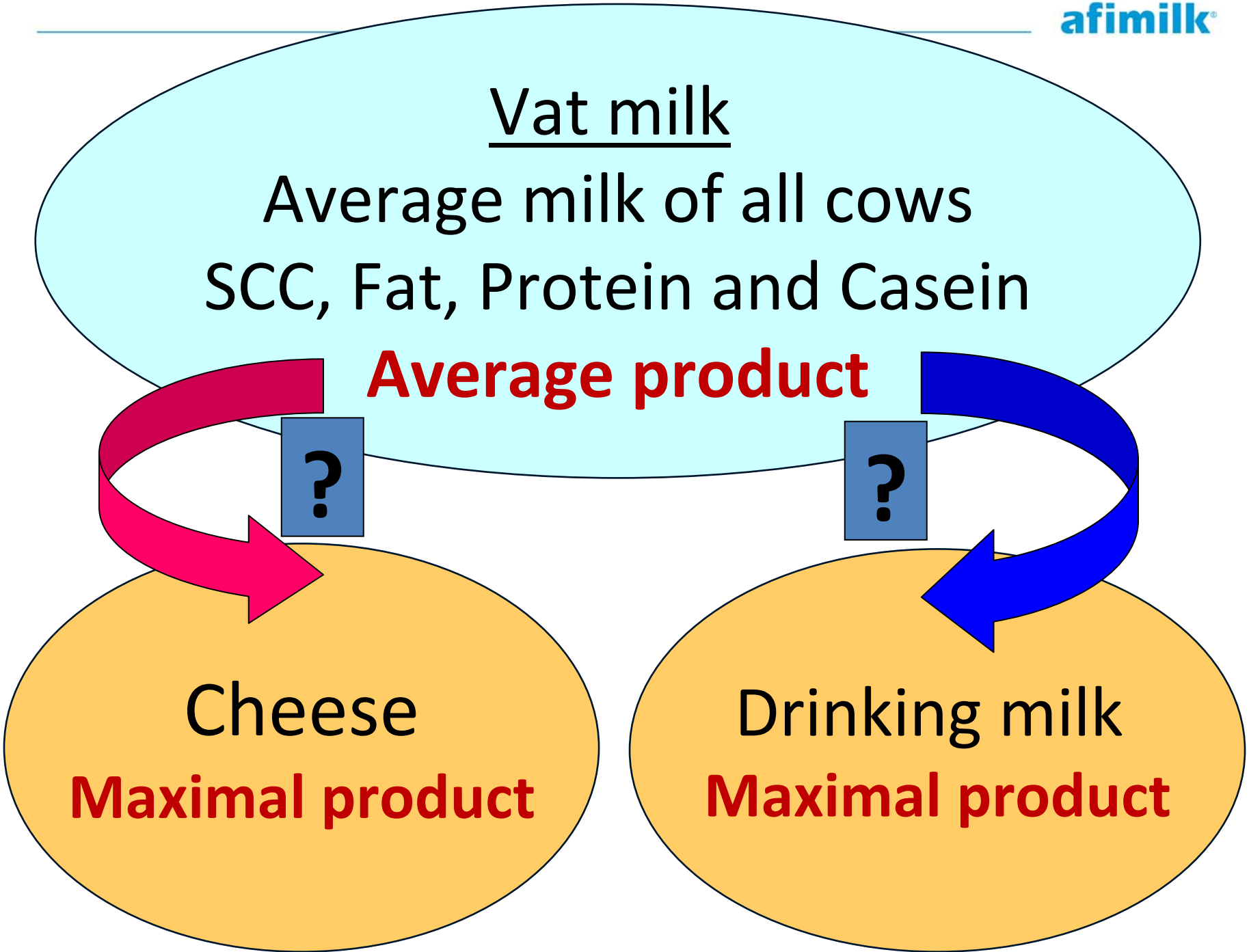
Can milk coagulation properties be used for on-line sensing and separation of milk according to the manufacturer need?

Vat milk

Average milk of all cows

SCC, Fat, Protein and Casein

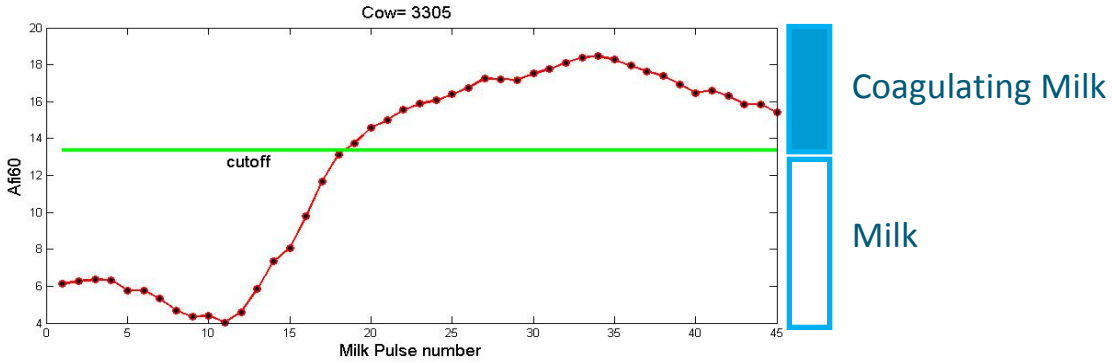
Average product


Vat milk
Average milk of all cows
SCC, Fat, Protein and Casein
Average product
?
?
Cheese
Maximal product
Drinking milk
Maximal product

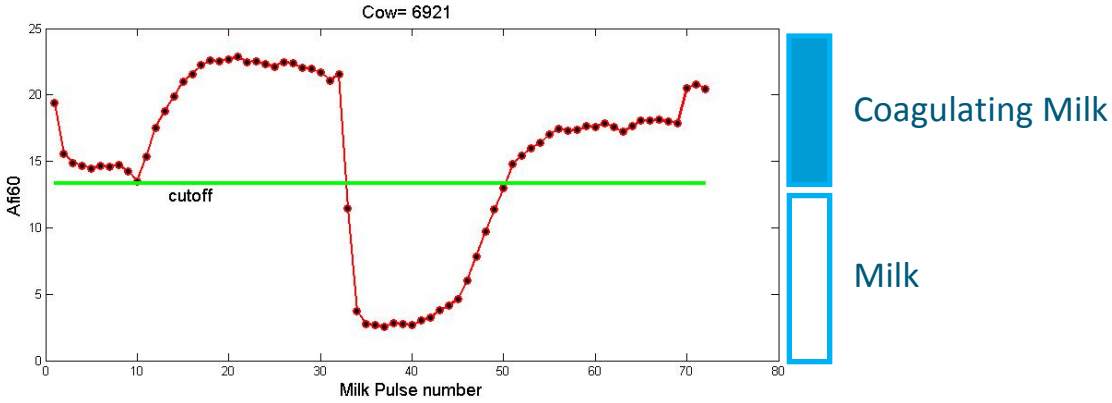
Milk Routing During Milking

Milk Properties Change During Milking Cycle

Cow-1



Cow-2

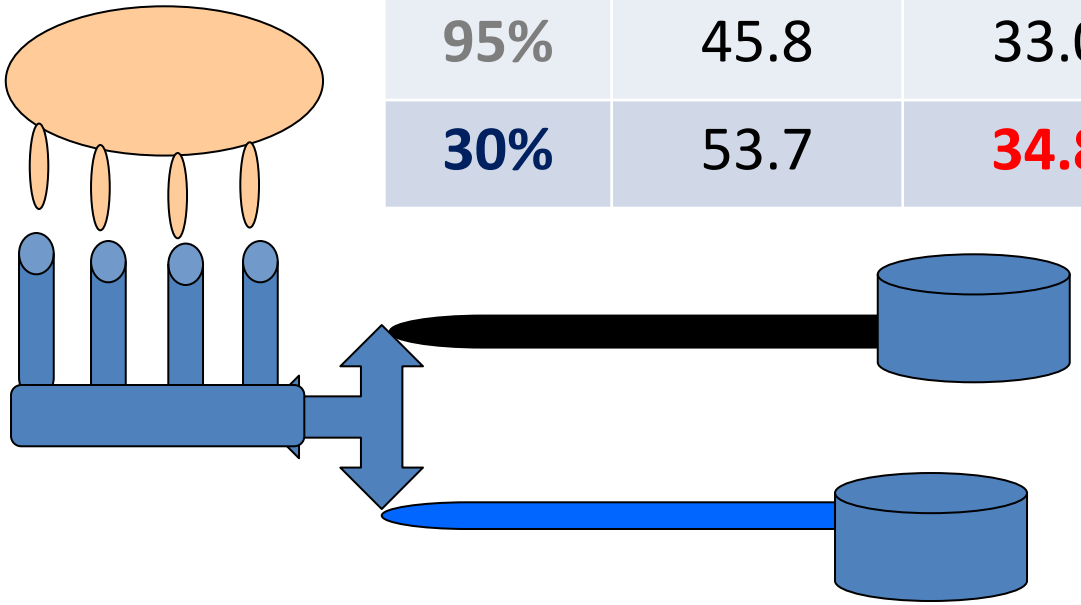


330 cows

Separations: 100%; 5 & 95%; 30 & 70%

Target or Target separation

	Fat (kg/L)	Protein (kg/L)	Lactose (kg/L)	SCC (x1000)
100%	45.4	32.3	49.6	213
95%	45.8	33.0	49.7	215
30%	53.7	34.8	49.8	230



Leitner G., U. Merin, L. Lemberskiy-Kuzin, D. Bezman, G. Katz (2012). Real time visual/near -infrared analysis of milk clotting parameters for industrial applications. *Animal* (in press).

132 L

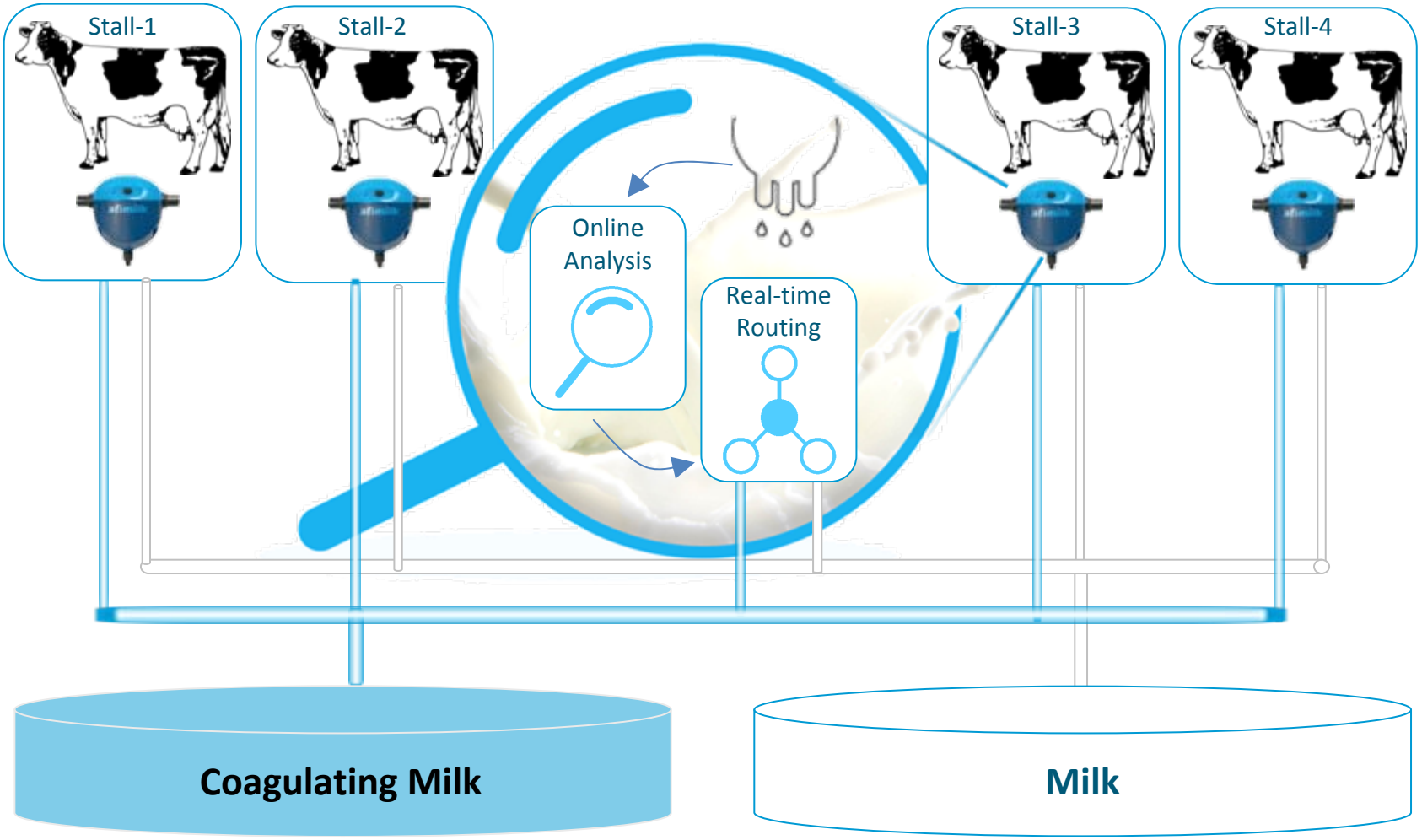
100%	95%	30%
14.1 kg	14.6 kg	17.2 kg
L/kg	9.4	9.0	7.7

Case Study: Jacobs, Israel

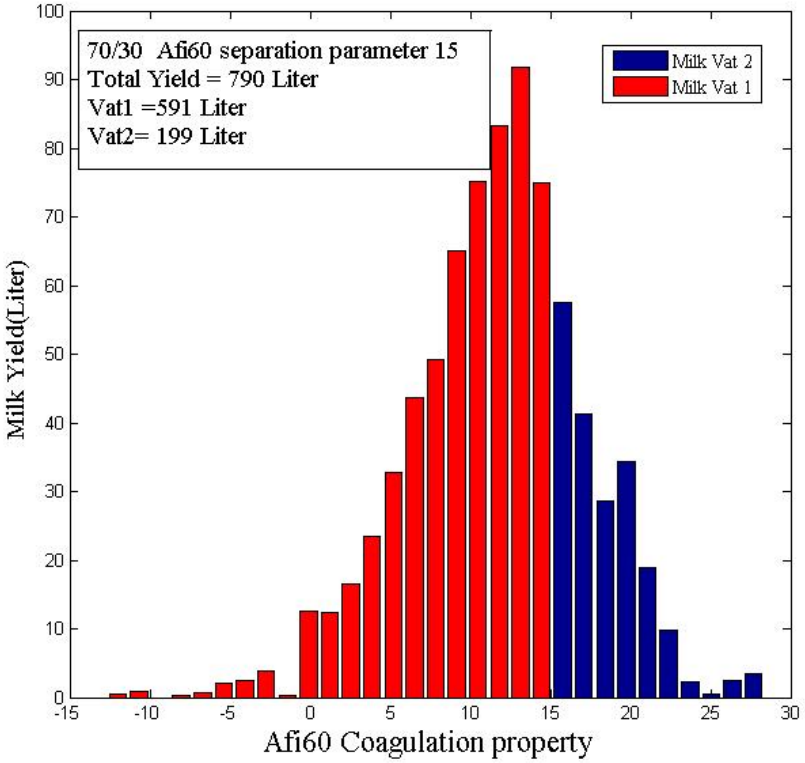
Phase 0 - Small Scale Test

- Jacobs – a small dairy
  - Hard and semi-hard cheeses
  - Rest of the milk is used for Yogurts
- A single dedicated farm
  - 120 cows, 18 stalls
- Test period – 9 months in 2012
- Producing 4000 Lit daily

How does it Work?



MSS Alpha initial results: 8/11/11

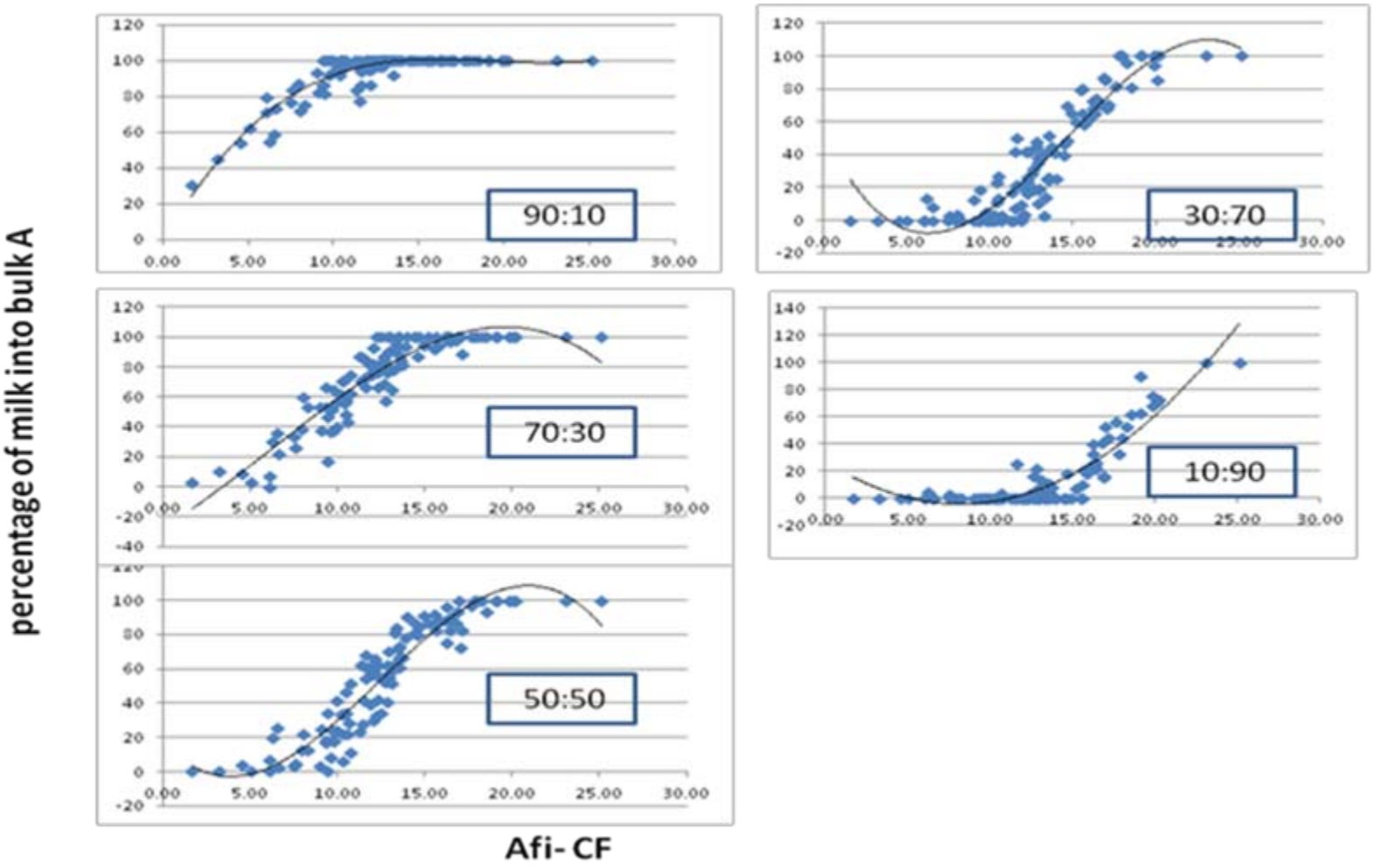


Yield	log(SCC)	Lactose	Protein	Fat	
591.42	2.50	4.73	2.90	3.68	Vat 1
199.32	2.73	4.69	3.20	5.15	Vat 2
790.74	2.59	4.75	3.05	4.30	Total

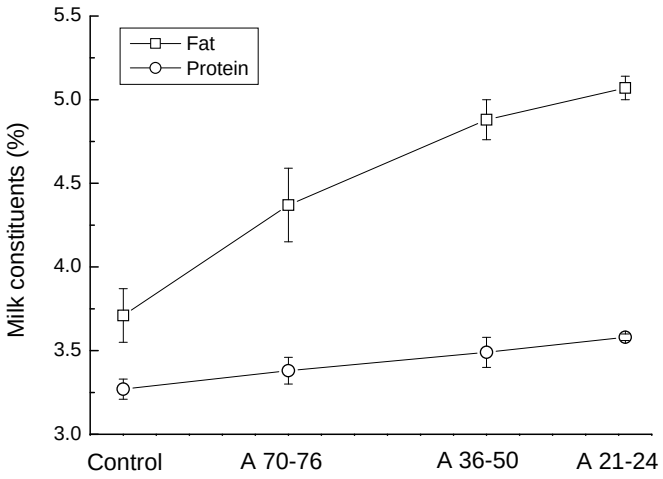
MSS Alpha Preliminary Results : Performance by Cow

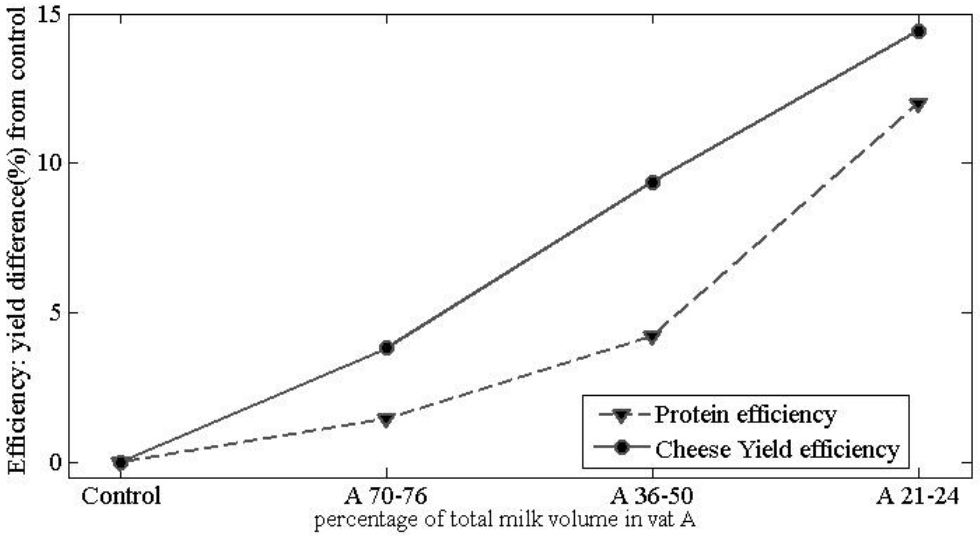
protein V2	protein V1	total protein	fat V2	fat V1	total fat	V2 yield	V1 Yield	total yield	Cow
3.04	2.73	2.74	4.49	3.54	3.57	0.22	8.88	9.10	100
3.18	3.04	3.05	3.71	2.69	2.76	0.44	6.31	6.75	179
3.03	2.90	2.98	4.90	3.97	4.59	6.53	3.28	9.81	209
0	2.83	2.83	0	5.21	5.21	0.00	11.79	11.79	213
0	2.87	2.87	0	3.84	3.84	0.00	9.65	9.65	248
3.55	0	3.55	4.98	0	4.98	5.23	0.00	5.23	290
3.44	3.37	3.40	4.93	3.61	4.32	4.94	4.17	9.11	302
2.89	2.53	2.60	5.03	3.45	3.77	2.63	11.86	14.49	309

Single cow performance at different cutoffs



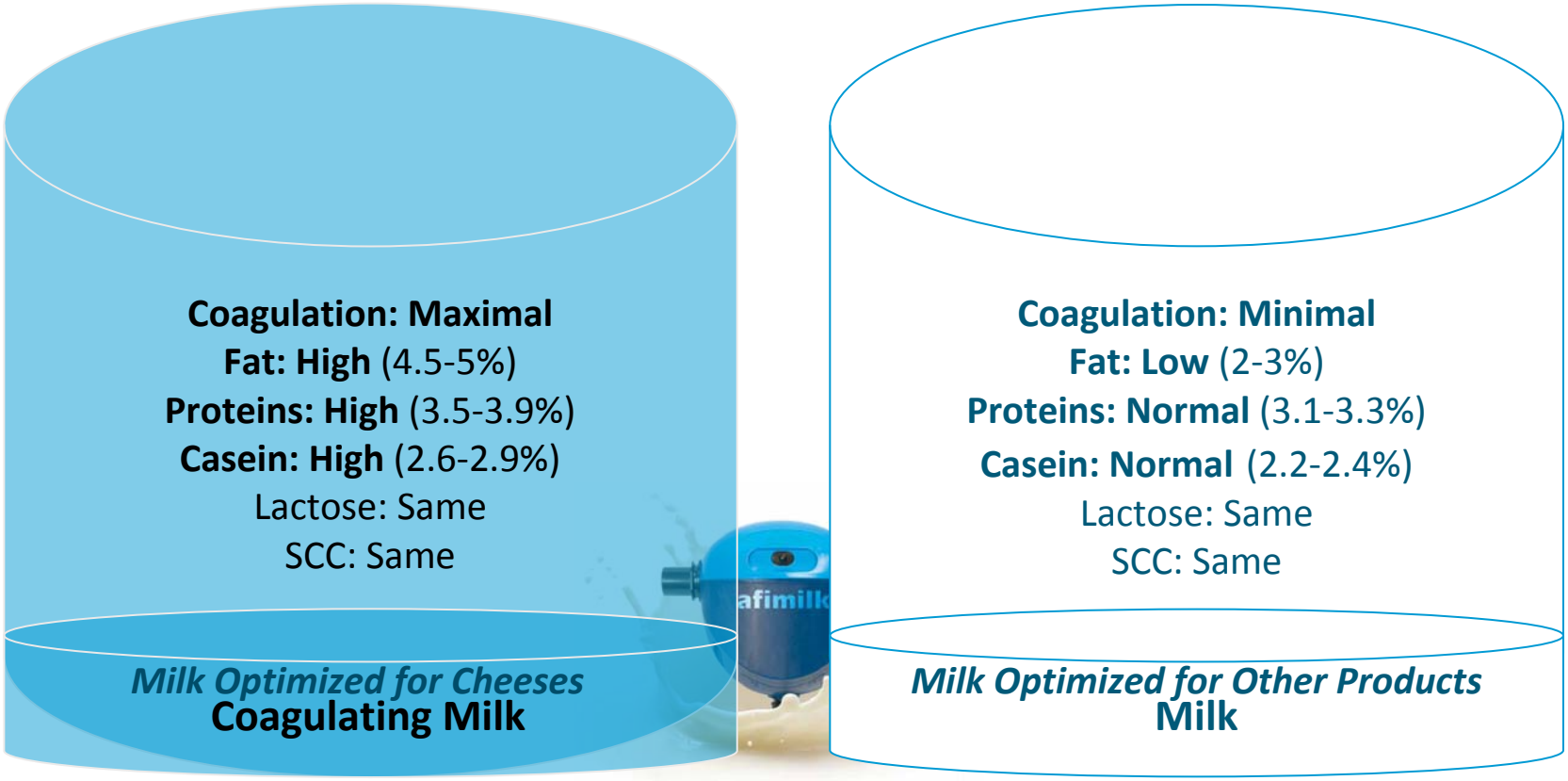
MSS pilot results milk processing into Gouda



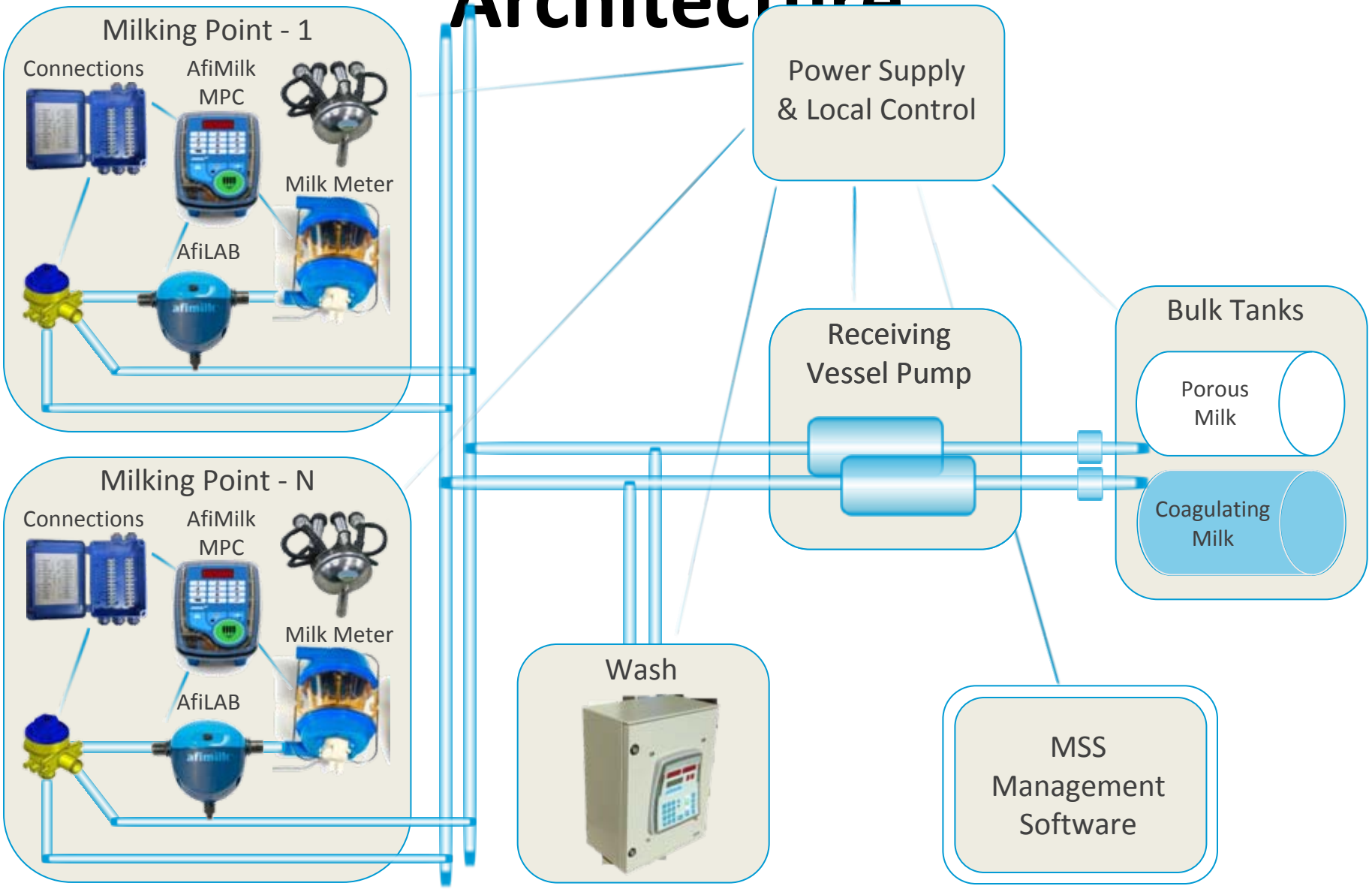


Milk type	Cheese yield (kg/100 L)	Cheese Yield efficiency (%)	Van Slyke yield (kg/100 L) (42% moisture)	Protein efficiency (%)
Control	10.47	0	10.53	0.0
A 70-76%	10.87	3.8	10.98	1.4
A 39-50%	11.45	9.3	11.91	4.9
A 21-24%	11.98	14.4	11.11	10.4

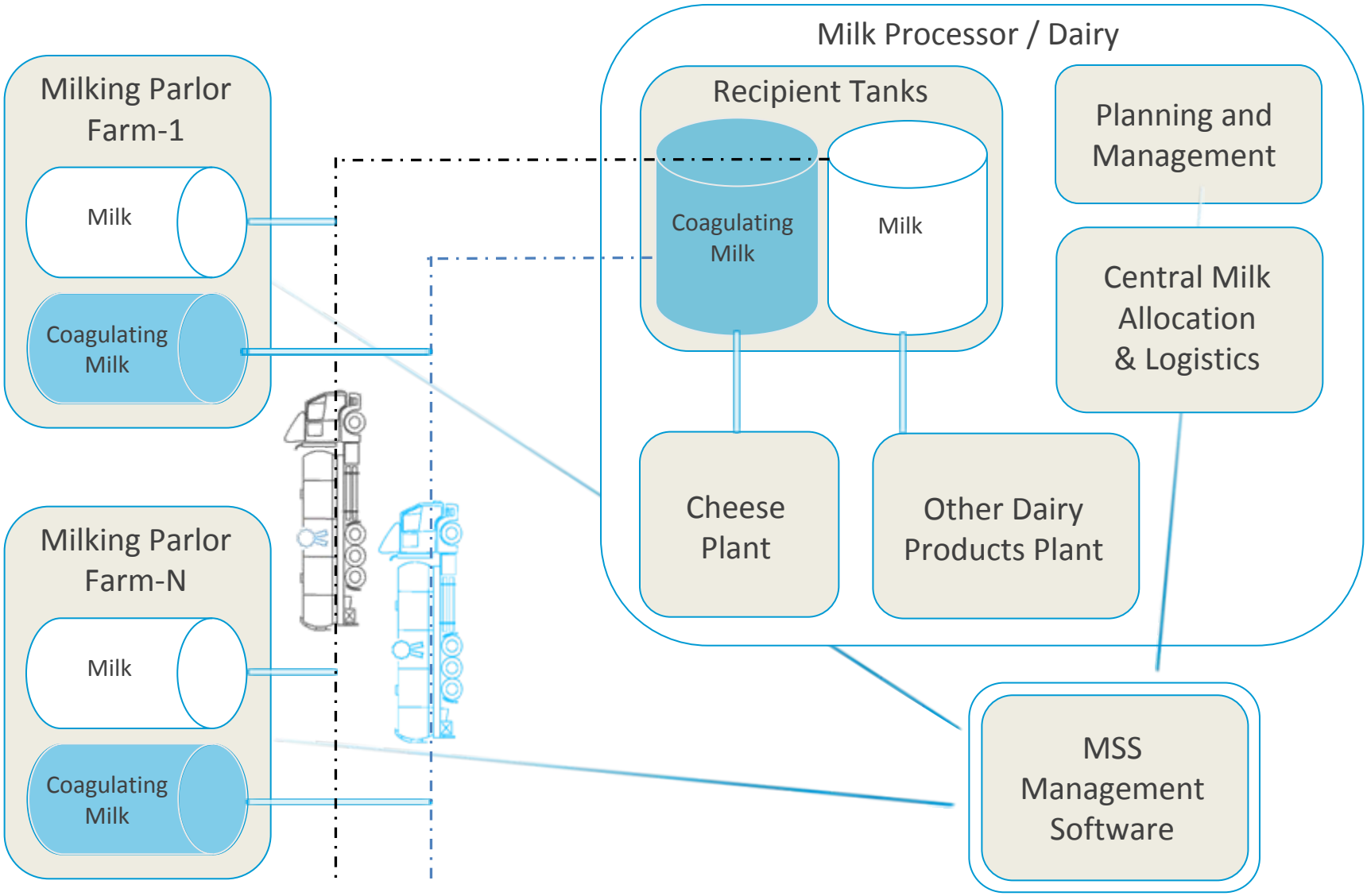
Expected Composition of Segregated Milk

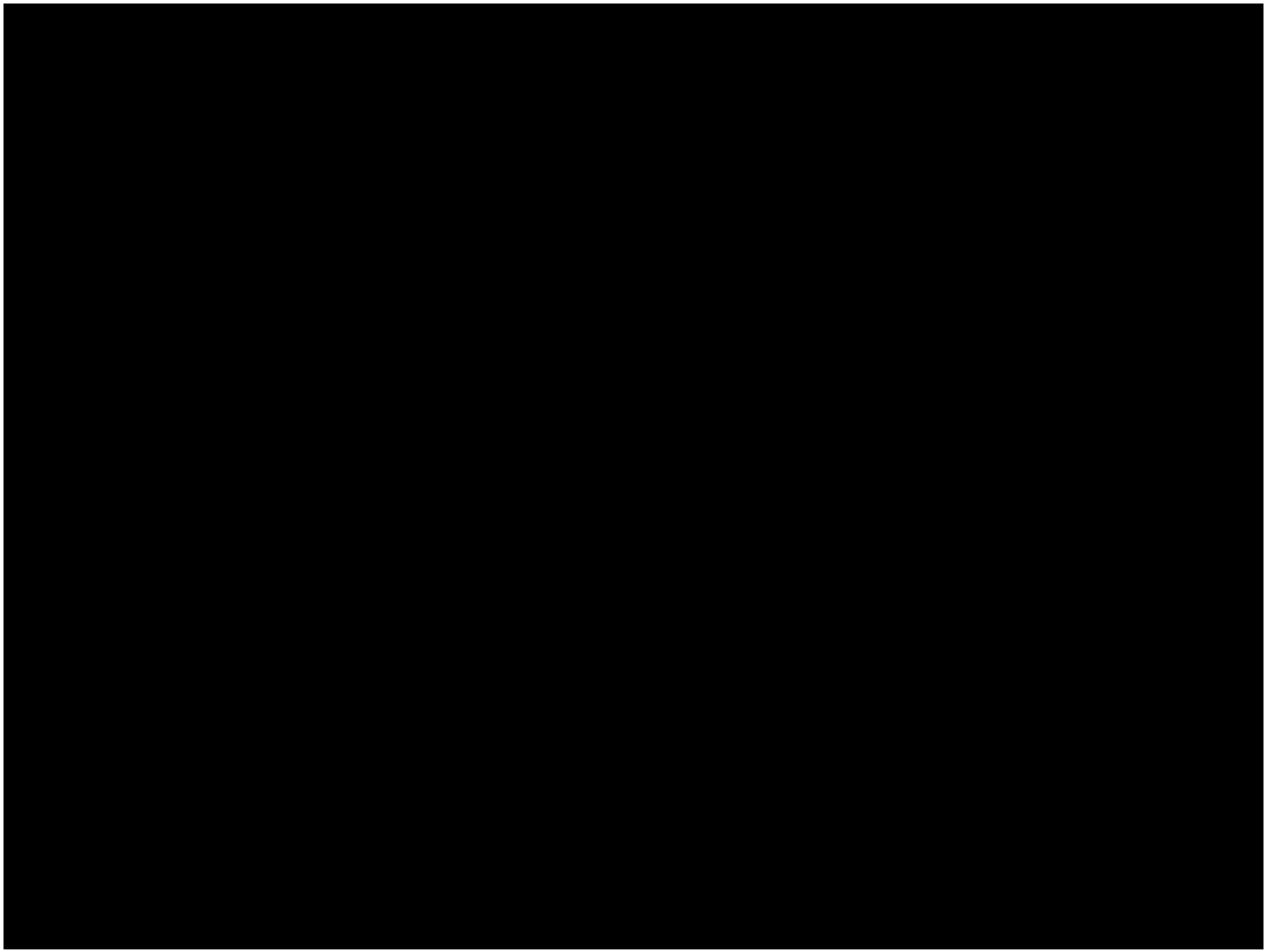


MSS - Milking Parlor System Architecture



MSS – Milk Flow Architecture





Summary

Focus on the milk going into the vat

Present

Future

Management by exceptions performed applied to manage the contents of the milk vat

Thank you!

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Vital know-how in every drop