Detection of ketosis in dairy cattle by determining infrared milk ketone bodies in milk

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Ketosis : definition

- Deviation of carbohydrate and lipid metabolism associated with significant energy deficit between supply and need:
  Intense mobilization of body fat
  Incomplete utilization of long chain fatty acids
  Accumulation of ketones in the blood, urine and milk
- Syndrome observed in early lactation (1st, 2nd or 3rd month of lactation)
- Gradual symptoms: animal healthy, subclinical ketosis, clinical ketosis

Ketosis: 3 Types

Three types of ketosis are described according to the origin of the causes favoring the development of this disease:

Type I: insufficient energy intake. Not suitable feeding techniques may limit the energie concentration, inappetence due to several causes (lameness, mastitis, milk fever) resulting in an inability swallowed up.

Type II: fat cow syndrome. Mismanagement of food during the dry period.

Type III: ketogenic ration. Butyric acid is a precursor of ketone bodies. This acid is found in high concentrations in silage of poor quality.

Ketosis: Implications

- Clinical symptoms
  - Loss of appetite
  - Preferred forage to concentrates
  - acetone odor in the mouth, urine
- Drop in production
- Changing milk composition (increased fat / protein ratio)
- Disturbance of reproduction
- Increases the frequency of intercurrent diseases (mastitis, displaced abomasum, metritis …)

Ketosis: fréquency

- Metabolic disease underdiagnosed in breeding
- Clinical ketosis: 3-4% of cows
- Subclinical ketosis between 7 and 14% of animals (Achard T. 2005, PhD ENVN)
- Current indicator: Ratio Fat / Proteine> 1.5
  - Sensitivity: 58%
  - Specificity: 69% (Duffield et al. 2000)

Ratio Fat/proteine is not enough specific ↔ need an accurate indicator

New Indicateur based on wich molecules? Bibliography

- Which ketone body?
  Acetone - Beta-hydroxybutyrate - Aceto-acetate (unstable)

- Concentration in the blood is a good indicator of ketosis

- Correlation ketones blood / milk is medium (Enjalbert 2011: 0.66 for the BHB)

- Correlation Infrared Milk ketones - Chemical reference average milk: 0.79 (Ross 2007)

- Subclinical ketosis level in milk (chemistry reference method): BHB 0.1 mmol / l - Acetone 0.15 mmol / l

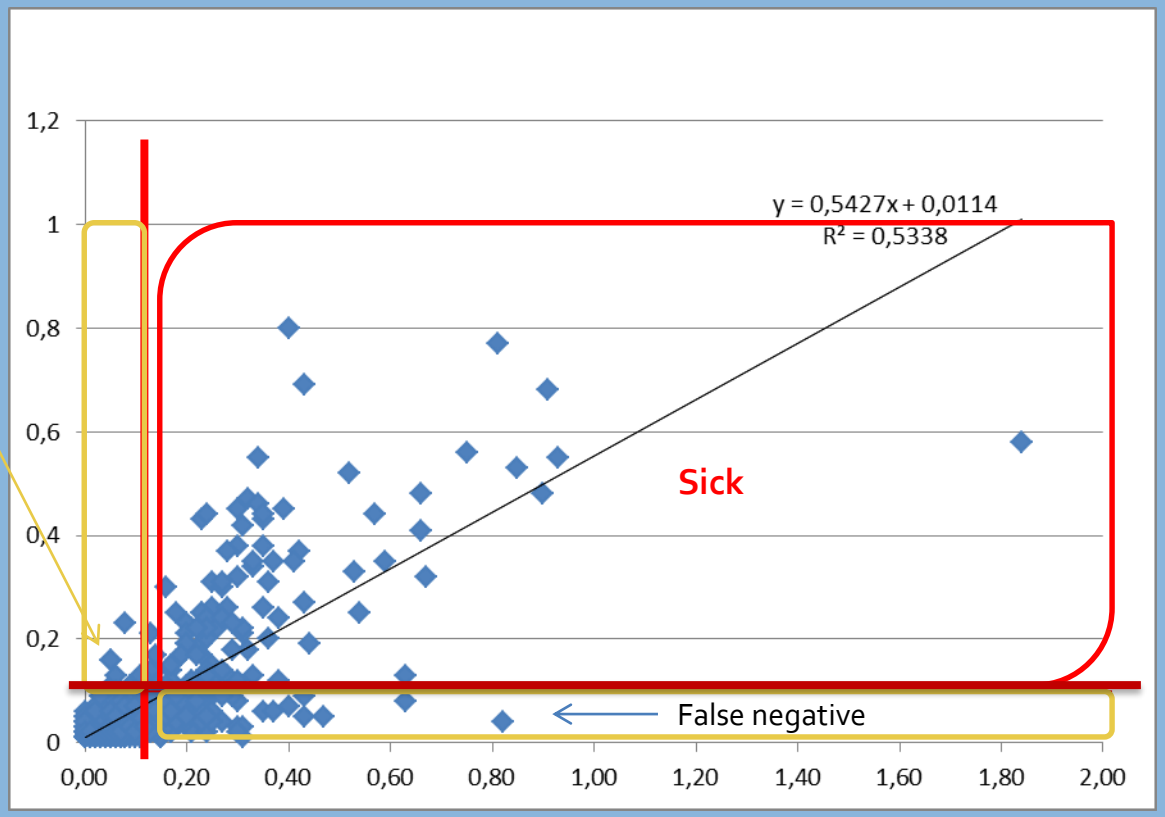
Material

- Providing of 2.1 Foss calibration
- Ability to fill in the milk two ketone bodies used like ketosis markers:
  The Beta-Hydroxybutyrate (BHB) and Acetone (Ac)
- 492 reference samples (92 in January to 400 in June 2011)

Relations Reference/Infrared methods

BHB

Infrared



Unit: mmol/l

False positive

Reference method

Results

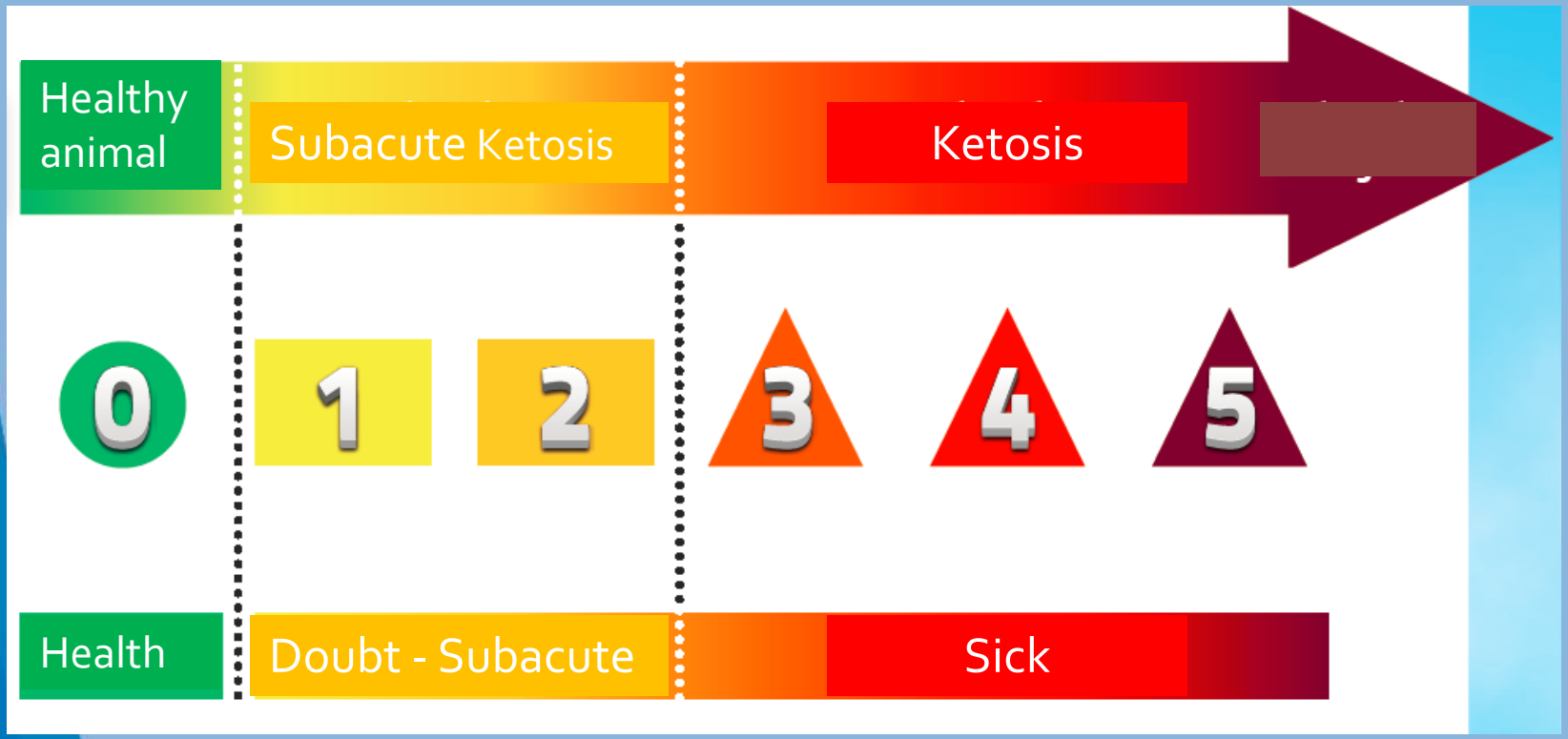
		Reference		
		Sick	Health	
Diagnoses	sick	98	9	Positive predictive value : 92%*
	Health	10	67	Négative predictive value : 87%*
	Total	108	76	
		Sensibility : 91%	Specificity : 88%	

*For information on these frequence sick/health

More than 9 on 10 sick cows are detected by the model (sensitivity)
When the model says that a cow is sick, it is true more than 9 times out of 10 (VPP)

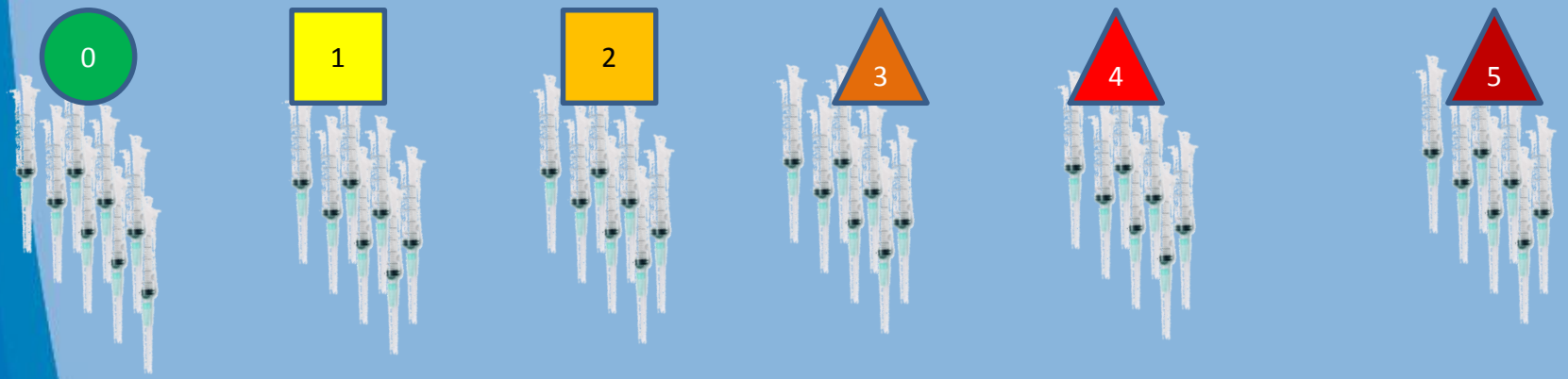
The evaluation grid

KETODECTECT®



What about blood

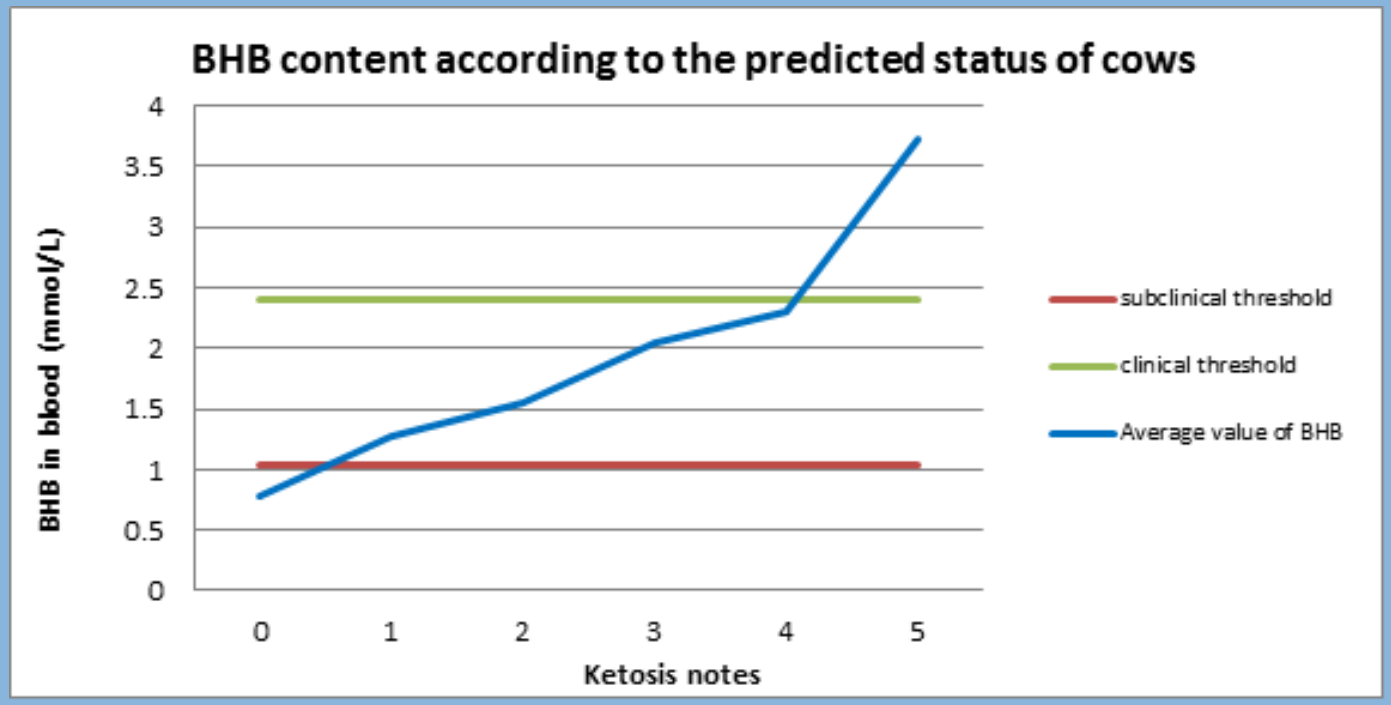
Validation data: 10 blood samples in each class:



Blood profile on:

- BHB
- glucose
- Hepatic enzymes (Asat - Gamma GT)
- urea
- triglycerides
- albumin

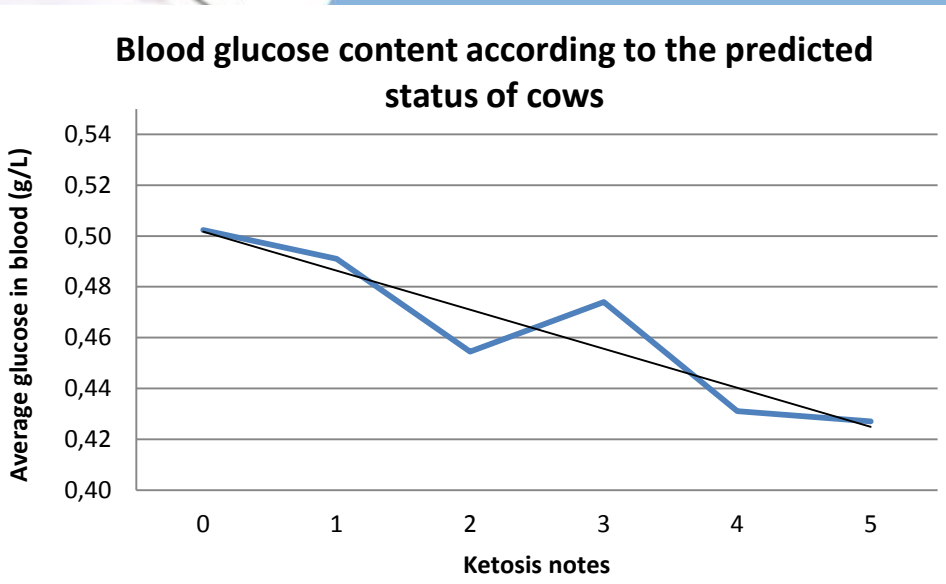
The proofs in the blood



Linear evolution of blood BHB concentration according to the ketosis note

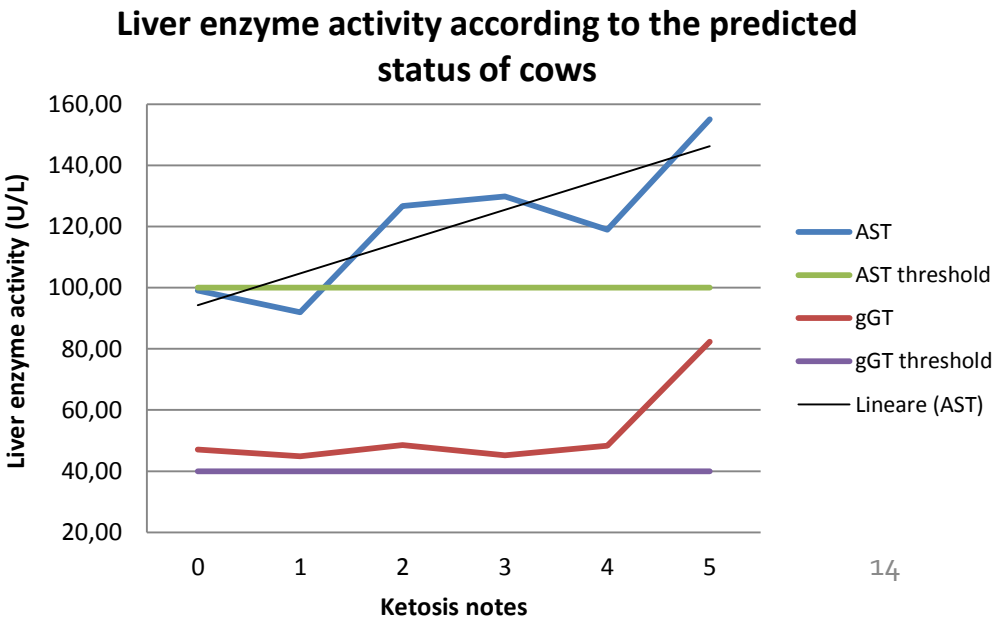
Note 3: sub-clinical or clinical?

The proofs in the blood



With increasing Ketosis note:
- Decrease proportional blood glucose
- Increased liver enzymes indicative of suffering

Non-significant relationship between this sample and note CETODETECT Urea - Triglycerides - Albumin

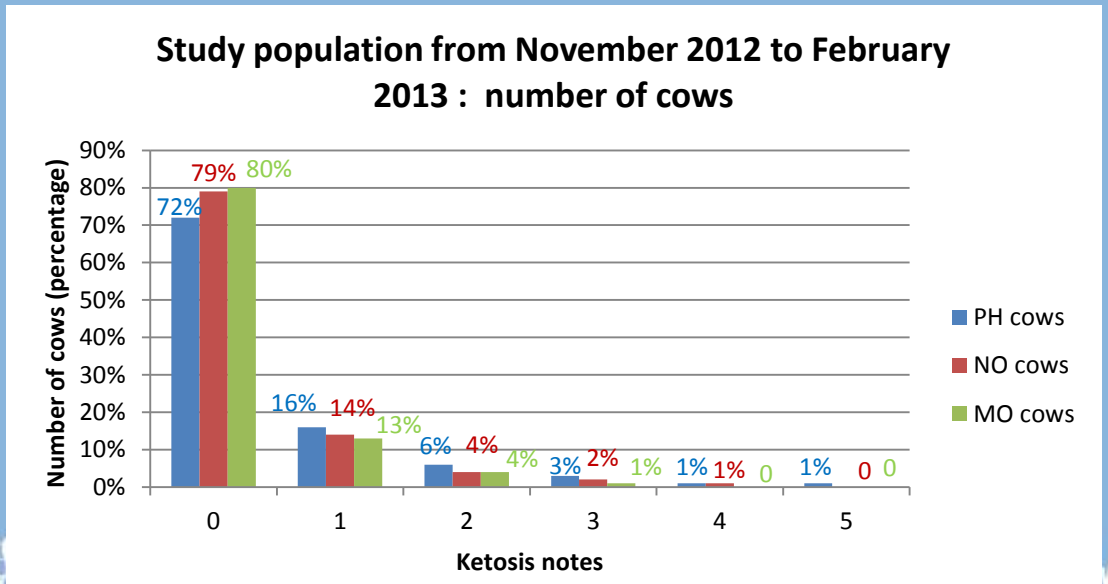


What about Population projection ?

➢ **The frequency of clinical and subclinical ketosis (note KETODETECT® from 1 to 5) changes according to seasons and diets :**
15% summer 2012 ; 12% sept/oct. 2012 ; 25% winter 12/13 ; 14% winter 13/14

Study population from November 2012 to February 2013 – 162,742 data – 3 breeds: PH (Prim'Holstein) (115,960 data), NO (Normande) (39,532 data), MO (Montbeliarde) (7,250 data)

	CetoDetect®					
	0	1	2	3	4	5
Number of data	122 030	25 867	9 309	3 076	1 885	1 340
Percentage	74.63	15.82	5.69	1.88	1.15	0.82

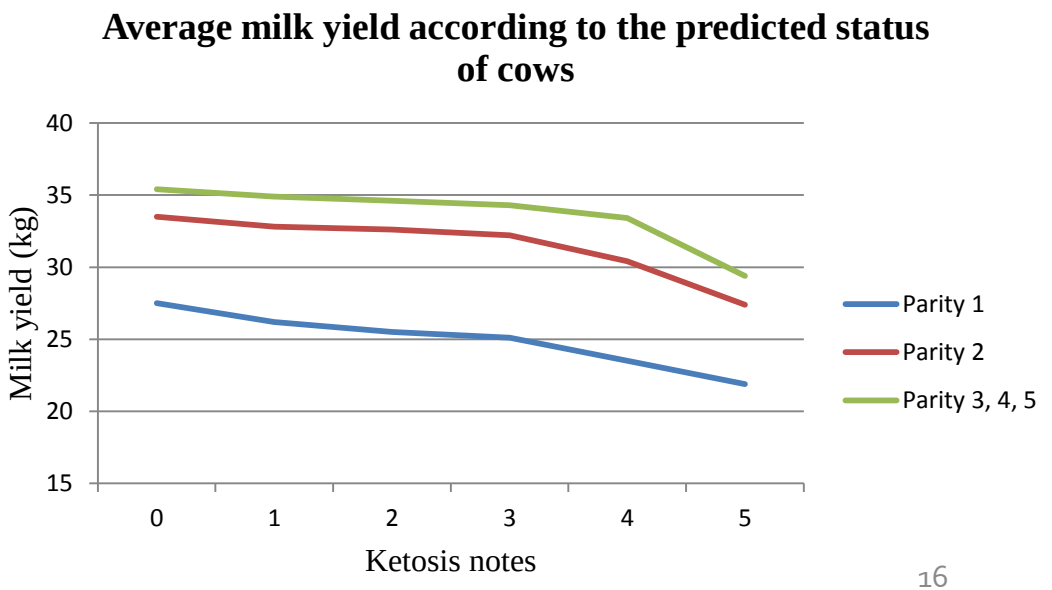


What about milk production ?

Milk production based on ratings KETODETECT® and lactation rank
Analyse on 115960 P'H

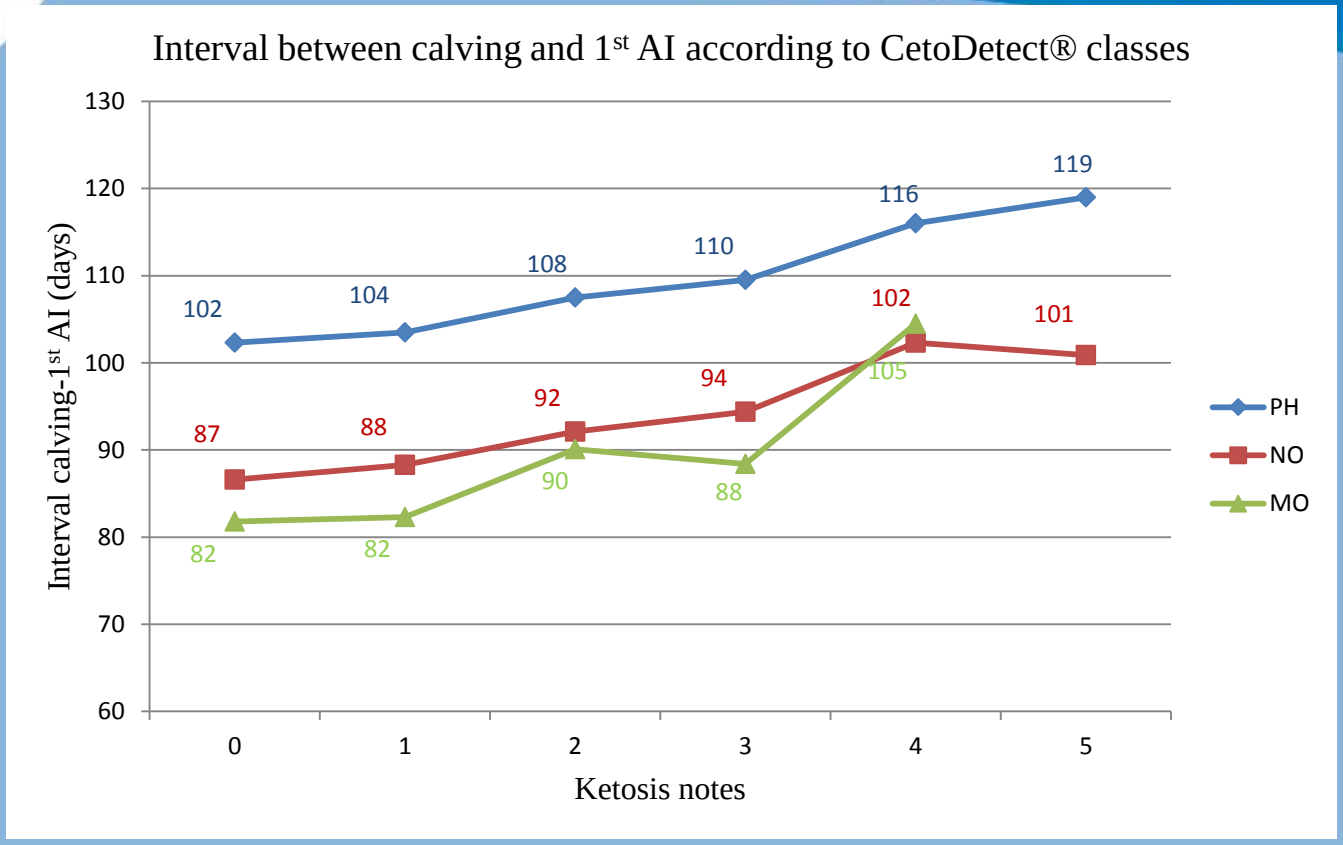
	CetoDetect®					
Average milk yield (kg)	0	1	2	3	4	5
1st lactation	27.5	26.2	25.5	25.1	23.5	21.9
dairy accumulated losses		***-1.3***	***-2***	***-2.4***	***-4***	***-5.6***
2nd lactation	33.5	32.8	32.6	32.2	30.4	27.4
dairy accumulated losses		***-0.7***	***-0.9***	***-1.4***	***-3.1***	***-6.1***
3rd lactation	35.4	34.9	34.6	34.3	33.4	29.4
dairy accumulated losses		***-0.6***	***-0.8***	***-1.1***	***-2.1***	***-6.1***

A significant decrease in milk production in case of problems, up to 6 kg of milk on average.



Clasel data

What about reproduction ?

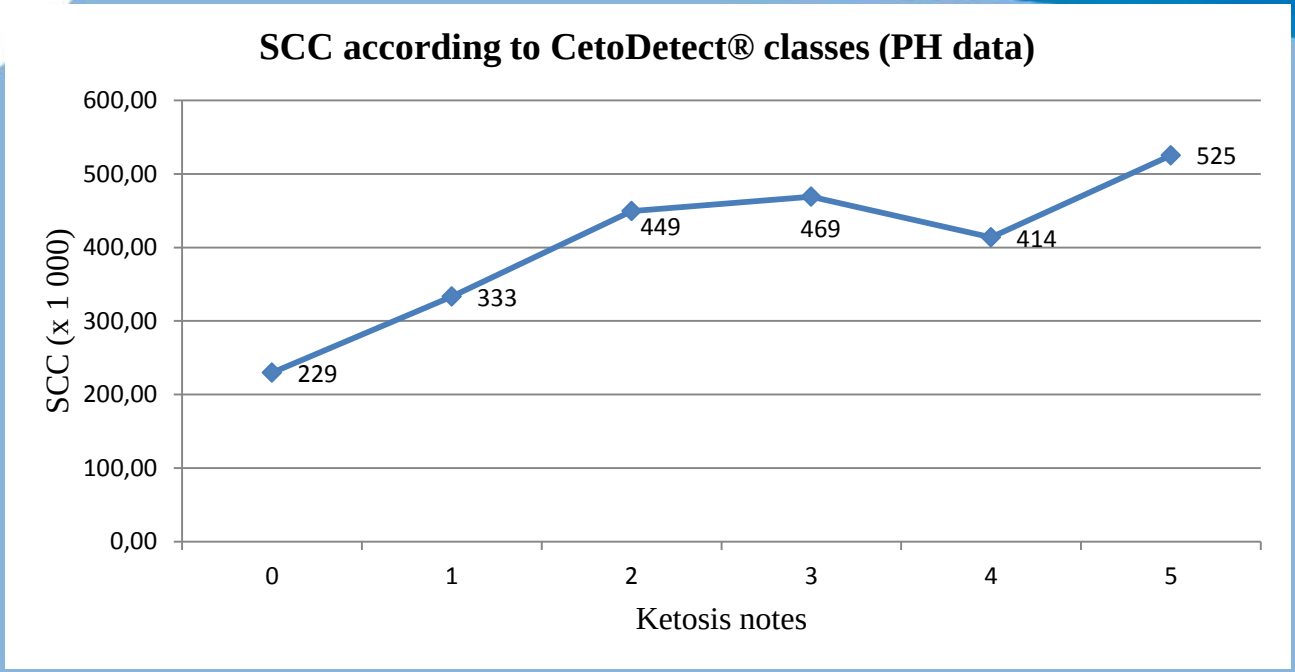


Strong impact of ketosis on the time-breeding dairy cows (until ovarian cycle whether 22 days)

Bibliographic source (JDS) : Success rate in the first IA divided by 2!
Metritis number multiplied by 3.

Journal of Dairy Science june 07. Walsh – Duffield - Leblanc

What about cells ?



Turning abomasum : increased by 4 to 8 times frequency!

Lameness

Reforms: higher probability 1.4 and 2 times more to be reformed during or at the end of lactation

The offer

annual engagement

Price: 3 € / cow / year

Simulation for a herd of 50 cows

	Economic losses
milk losses	
300 liter x 330€/1000L milk x 50 cows x15%	750 €
increase of pathologies	
2 mastitis x 150€	300 €
3 metritis x 50€	150 €
lameness/displaced abomasum/other	300 €
	1 500 €

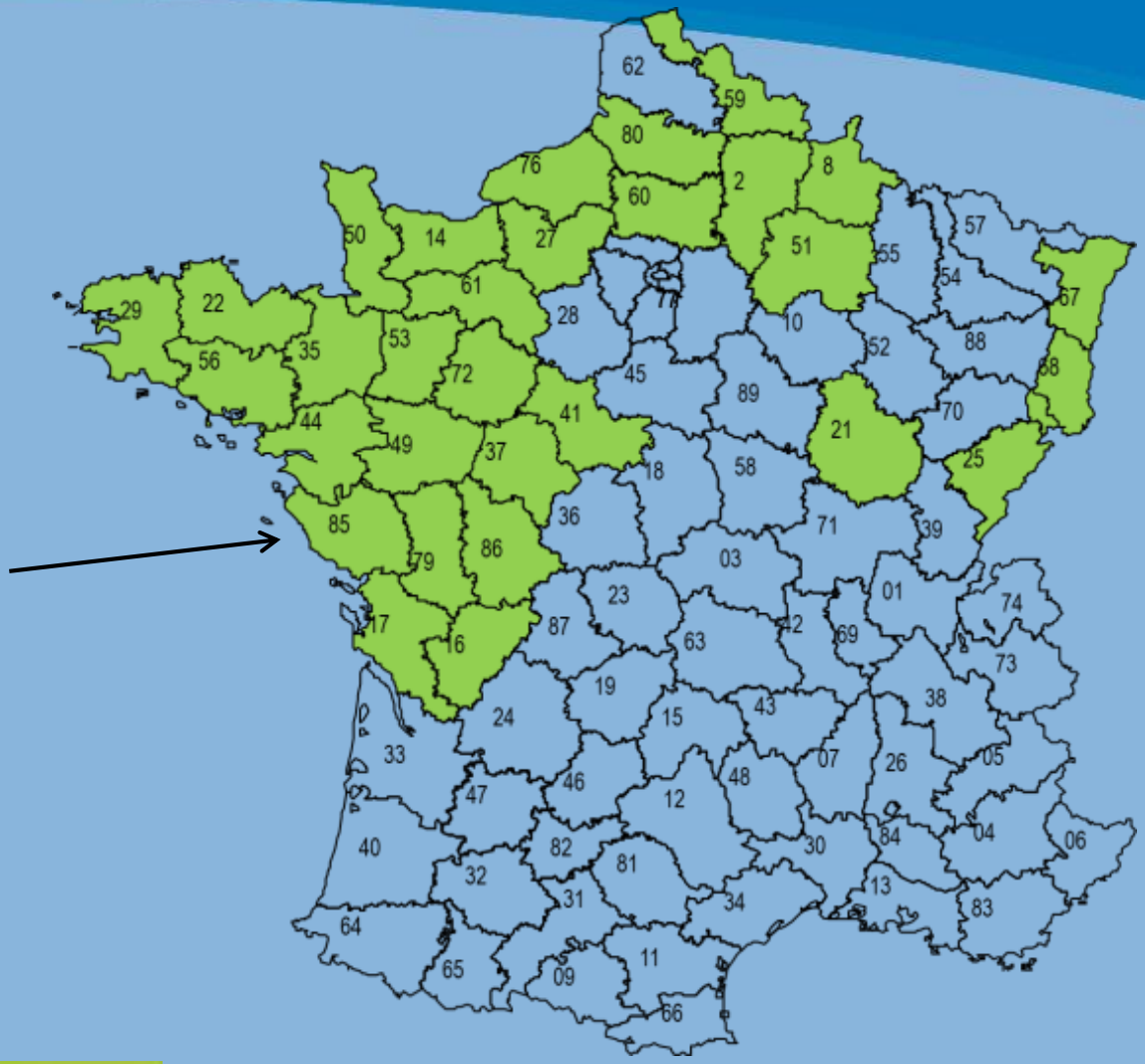
New indicateur: 3 €/VL * 50 VL = 150 €

Simulation for a herd of 50 VL the best knowledge of the status of the animal adjusts 2/3 of the problems: 1500 € * 0,66 = 1000 €

Gain of 1,000 € is a return on investment of 6 to 8!

CetoDetect® Membership

Membership
17 MRO
30 countries
62 % herds
65 % cows



Stratégic interest

New indicator:

Adds value on Milk Recording samples

Reinforces the dimension advice: the link between Performance, Nutrition and Health Service → high perceived value

Consolidates MRO in a competitive environment

Strengthens the commercial range if it exists

Helps to maintain the innovative view of MRO

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Donner du sens à la mesure

CÉTODÉTECT

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