

# A Generalized Linear Mixed Regression Model of BHB to Early Detection of Nutritional and Management Problems in Dairy Herds

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# Hypothesis

- ❖ **beta-hydroxybutyrate (BHB) evaluated in milk (non-invasive fluid), may be an easy tool for the dairy farmers, vets, monitoring the eating patterns and cows' welfare ?**



# Background

## Threshold



< 0,1;   0,1 – 0,2;   > 0,2

Mobilization of  
Body Fat

Diets with Hight  
Concentration of  
Butyric Acid

BHB

BHB (mmol/L)	Metabolic Disorder
> 0.1 <sup>(1)</sup>	Hyperketonemia
> 0.15 <sup>(2,3)</sup>	
> 0.2 <sup>(4,5)</sup>	
0.15 – 0.2 <sup>(2,5,6)</sup>	Medium Risk/Suspected of Cinical Ketosis
> 0.2 <sup>(2)</sup>	Hight Risk of Clinical Ketosis
> 0.2 <sup>(5,6)</sup>	Clinical Ketosis
0.5 – 0.8 <sup>(7)</sup>	

# Research paper's



J. Dairy Sci. 99:9263–9270  
<http://dx.doi.org/10.3168/jds.2016-11128>  
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## Prevalence of elevated milk $\beta$ -hydroxybutyrate concentrations in Holstein cows measured by Fourier-transform infrared analysis in Dairy Herd Improvement milk samples and association with milk yield and components

D. E. Santschi,<sup>1</sup> R. Lacroix, J. Durocher, M. Duplessis, R. K. Moore, and D. M. Lefebvre  
Valacta, 555, boul. Des Anciens-Combattants, Ste-Anne-de-Bellevue, Québec, H9X 3R4, Canada



J. Dairy Sci. 100:1308–1318  
<https://doi.org/10.3168/jds.2016-11453>  
© American Dairy Science Association®, 2017.

## Investigating the within-herd prevalence and risk factors for ketosis in dairy cattle in Ontario as diagnosed by the test-day concentration of $\beta$ -hydroxybutyrate in milk

Elise H. Tatone,\* Todd F. Duffield,<sup>\*1</sup> Stephen J. LeBlanc,\* Trevor J. DeVries,† and Jessica L. Gordon\*

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†Department of Animal Biosciences, University of Guelph, Guelph, ON, Canada, N1G 2W1

J. Dairy Sci. 88:2441–2453

© American Dairy Science Association, 2005.

## Predicting Risk of Ketosis in Dairy Cows Using In-Line Measurements of $\beta$ -Hydroxybutyrate: A Biological Model

N. I. Nielsen, N. C. Friggens, M. G. G. Chagunda, and K. L. Ingvarsen  
Department of Animal Health, Welfare and Nutrition, Danish Institute of Agricultural Sciences,  
Research Centre Foulum, 8830 Tjele, Denmark



## Prevalence and impacts of subclinical ketosis detected by mid infra-red analysis of BHB in DHI milk samples

D.E. Santschi, R.K. Moore and D.M. Lefebvre

Valacta, Ste-Anne-de-Bellevue, Quebec, Canada

Contact: [dsantschi@valacta.com](mailto:dsantschi@valacta.com)



Abstract #1779  
W238





# Webpage ... Conferences



**Poland**

3.3

Monitoring of subclinical ketosis in Poland, based on monthly milk recording

Zygmunt M. Kowalski\*, Krzysztof Słoniewski\*\*, Wojciech Jagusiak\*, Artur Phyta\*, Paweł Górka\*

\*Department of Animal Nutrition and Feed Management, University of Agriculture in Krakow, Krakow, Poland, \*\*Polish Federation of Cattle Breeders and Dairy Farmers, Warsaw, Poland [rkowalsk@cyf-kr.edu.pl](mailto:rkowalsk@cyf-kr.edu.pl)

3.2

**NORWAY**

Use of milk infrared spectra as animal health and welfare indicators

Tesfaye K Belay and Tormod Ådnøy

Norwegian University of Life Sciences Department of Animal and Aquacultural Sciences P.O.Box 5003, 1432 Ås, Norway [tesfaye.kebede.belay@nmbu.no](mailto:tesfaye.kebede.belay@nmbu.no)



**Base**

Biotechnologie, Agronomie, Société et Environnement  
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**OptiMIR project**

**OptiMIR – A European Milk Recording in the Age of Precision Livestock Farming**

Through OptiMIR the MIR spectral data from the milk recording are used in mathematical models to provide decision making tools. Dairy farmers access to predictions for every recorded cow such as fertility status, metabolic diseases, environmental impact, energy balance, etc.

The project is a transnational cooperation between 5 research institutions, 11 milk recording organizations and 1 lab from Belgium, Germany, France, Ireland, Luxembourg and United Kingdom. It is cofounded by INTERREG IVB NWE, Wallonia and Luxembourg.

The screenshot shows the Progressive Dairyman website. The header includes navigation links for Progressive Dairyman: U.S., Progressive Dairyman: Canada, El Lechero, Progressive Forage, and Progressive Cattleman. The main article is titled "Navigate your way through high levels of BHBA" by Progressive Dairyman Editor Peggy Coffeen, published on 22 May 2015. The article discusses the correlation between BHBA levels and cow health, noting that a high BHBA test is not always a red flag for subclinical ketosis. A sidebar on the right promotes "Put the PLUS+ in your herd productivity" with an image of a smiling man in a cap.



**The Future of Disease Detection:  
Should you Check the Cow or  
Check the Computer?**

**Tools for Diagnosing Nutriti**

**Problems in Dairy Herds**

**Milk Urea Nitrogen - A  
Nutritional Evaluation Tool?**

**Monthly Webinar Review:  
Treatments for Dairy Cows with  
Ketosis**

The banner includes the logo of the College of Agriculture, Food and Environment (UK) and the text "Welcome to the UK Dairy Program". Below this, it says "DEPARTMENT OF ANIMAL & FOOD SCIENCES".

# Material & Methods



- 27 farms
- 1 milk sample / month / cow
- January 2015 – March 2017
- 110461 records - 9523 lactation

## Data:

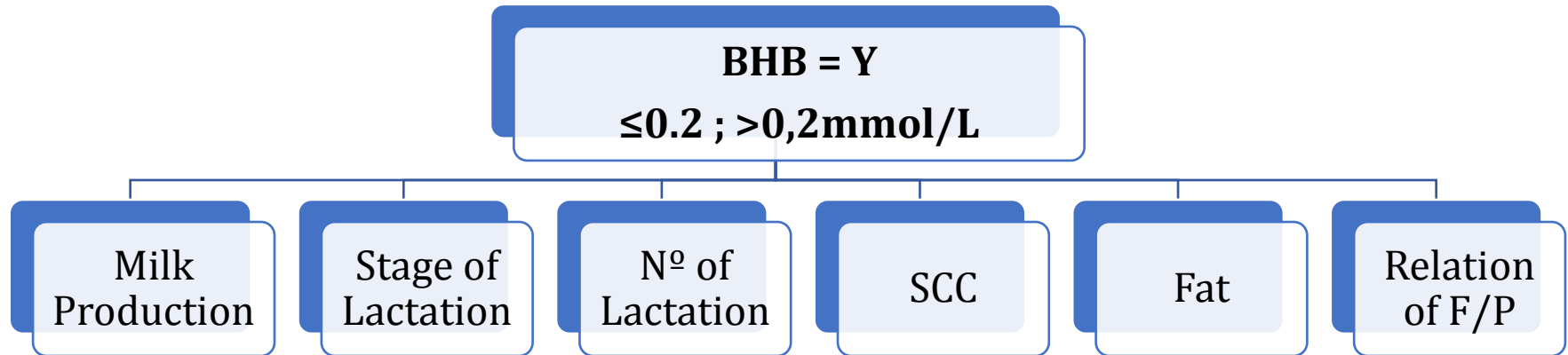
- Don't have Normal Distribution
- Don't have Homogeneity of variance and homoscedasticity
- Are Dependent



- Descriptive Statistics
- Boxplots
- GLMM
- Spearman's Correl.



# Material & Methods - GLMM



**OR (odds ratio):**  $<1$  ;  $=1$  ;  $>1$

**OR** is the quotient between the possibility of an event occurring in a group and the possibility of that event occurring in another group.

**Example:** A cow that have Relation of F/P over 1.4 have 2.3 times more possibilities of having BHB over 0.2mmol/L, than a cow that have Relation of F/P less than 1.4.



# Results - Descriptives



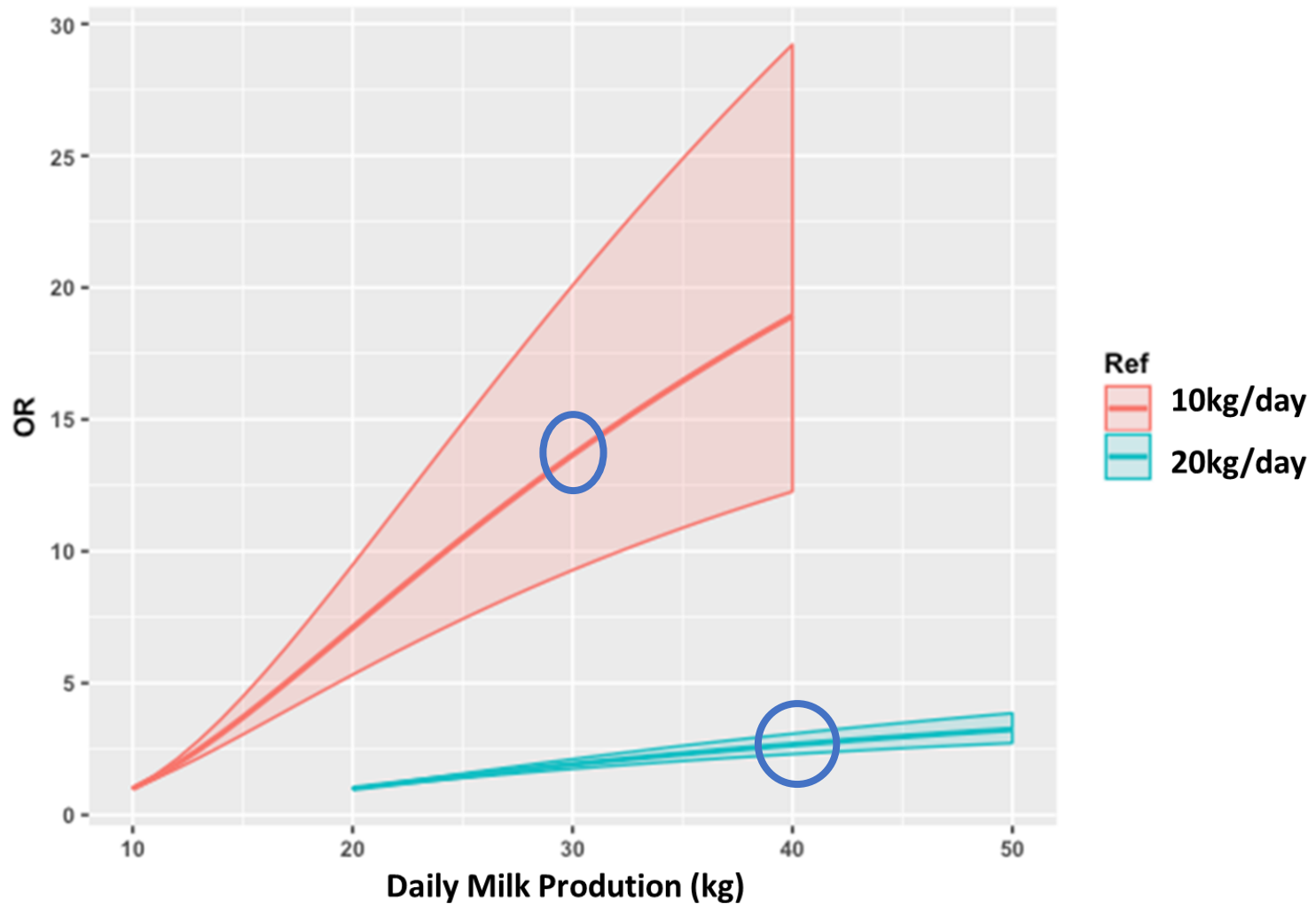
Mean of lactating cows per herd =  $353 \pm 270$

Parameters	Mean $\pm$ SD	Median	CV (%)	Min.	Max.
Daily Milk Production (kg)	<b>35,08</b> $\pm$ 9,80	34,1	27,94	4,2	83,5
BHB (mmol/L)	<b>0,06</b> $\pm$ 0,08	0,04	133,33	0,0	3,42
Fat (%)	<b>4,16</b> $\pm$ 1,09	4,09	26,20	1,5	9,0
Protein (%)	<b>3,37</b> $\pm$ 0,39	3,33	11,57	1,04	6,62
Relation of F/P	1,24 $\pm$ 0,32	1,21	25,81	0,37	3,69
SCC ( $\times 10^3$ células/mL)	254 $\pm$ 770	74,0	303,15	6,0	25203
LS	2,79 $\pm$ 1,85	2,57	66,31	-1,06	10,98
MUN (mg/kg)	<b>242</b> $\pm$ 68	238	28,10	11	500
Days of Lactation	<b>177,6</b> $\pm$ 107,8	171,0	60,70	5	6
Nº of Lactation	2,39 $\pm$ 1,49	2	62,34	1	12

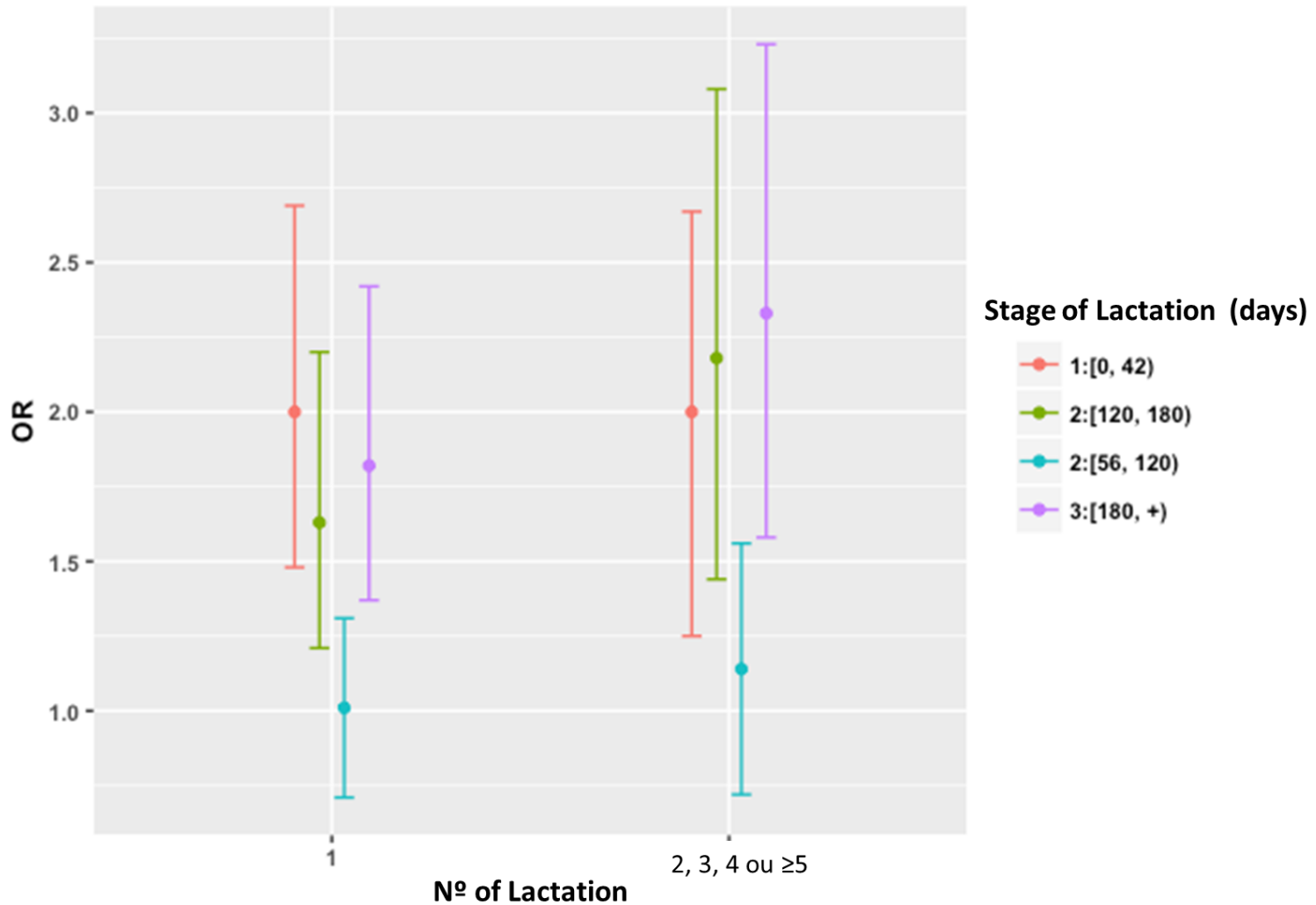




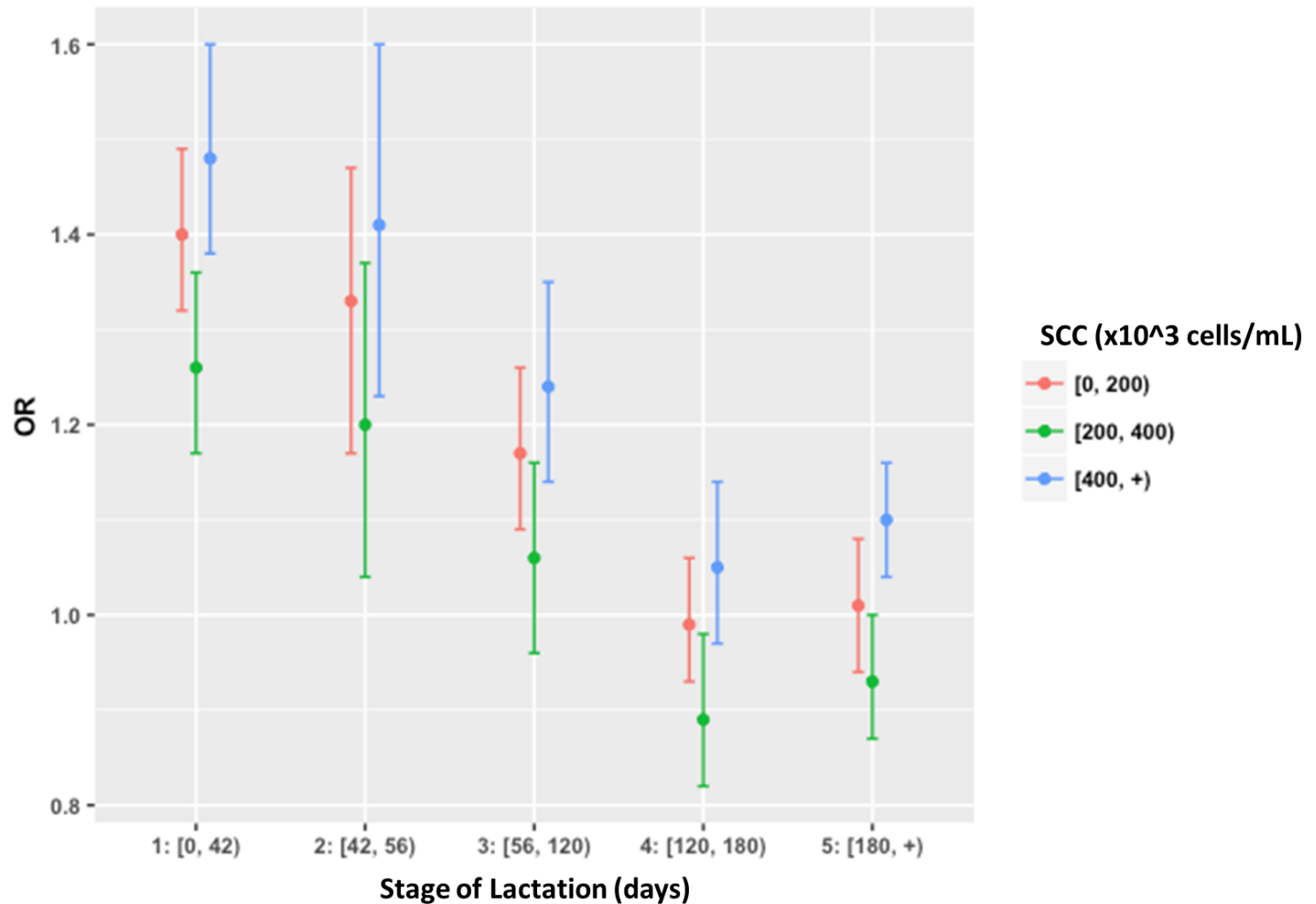
# Results - Effect of Milk Production



# Results – Effect of Stage & N° of Lactation



# Results – Effect of Stage, N° of Lactation & SCC



# Conclusion

- ✓ .. In conclusion, the GLMM application optimize the potential using of milk recording to advise dairy farmers.
- ✓ non-nutritional factors, should be considered in order to use milk metabolites as a tool to monitor milk farmers.
- ✓ The BHB levels are not always higher in higher cow milk level
- ✓ Increased levels of BHB contribute to the suppression of the immune system and may cause the incidence of mastitis





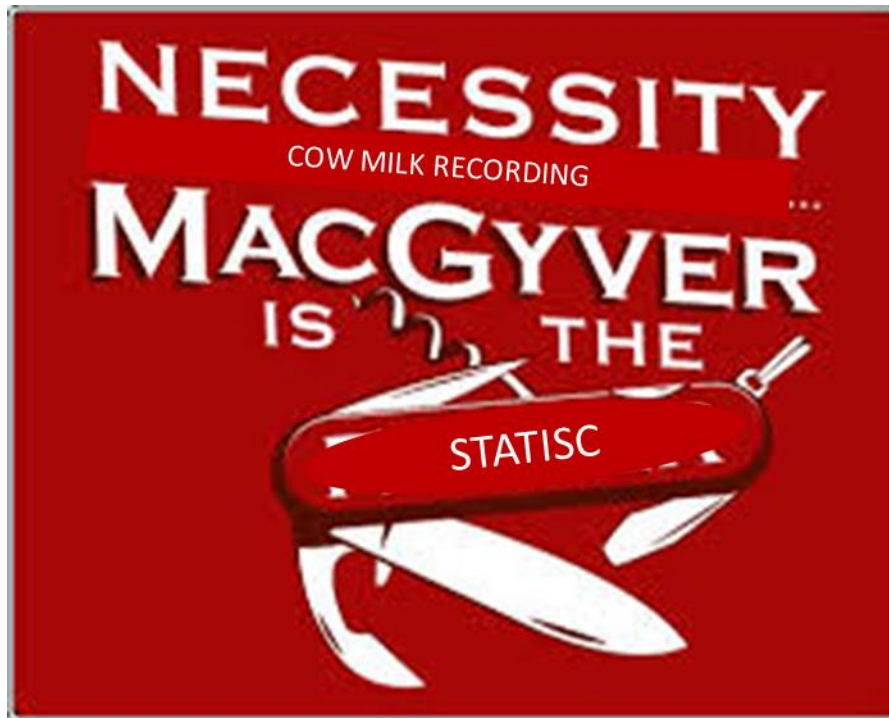
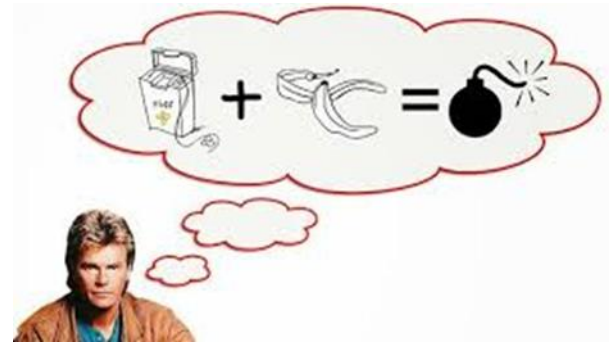
[ccp@uevora.pt](mailto:ccp@uevora.pt)



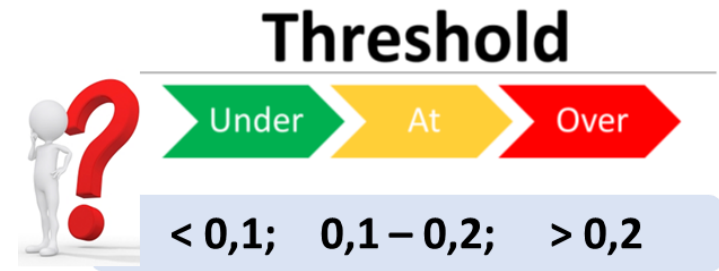
[inesdomingues@eabl.pt](mailto:inesdomingues@eabl.pt)







# Background



Relation F/P	Metabolic Disorders
> 1.3 <sup>(4)</sup>	Ketosis
> 1.4 <sup>(10,11)</sup>	
> 1.5 <sup>(12,13)</sup>	
> 2.0 <sup>(9)</sup>	

> 1.4

FAT (%)	Metabolic Disorders
> 4.2 <sup>(14)</sup>	NEB
> 4.5 <sup>(16)</sup>	
> 5.5 <sup>(11,15)</sup>	

> 4.5

