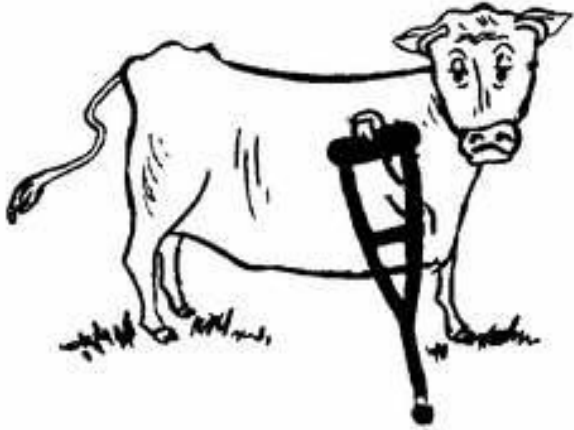


# Mid-infrared based biomarkers in milk as a non-invasive tool for early prediction of lameness caused by metabolic disorders

Axelle MINEUR <sup>1</sup>, Astrid KÖCK <sup>2</sup>, Clément GRELET <sup>3</sup>,  
Christa EGGER-DANNER <sup>2</sup>, Johann SÖLKNER <sup>4</sup>, Nicolas GENGLER <sup>1</sup>

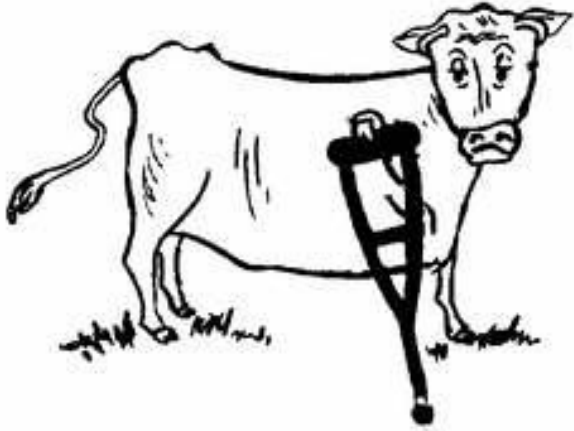


# Lameness in dairy cattle



20 – 40 %

# Lameness in dairy cattle

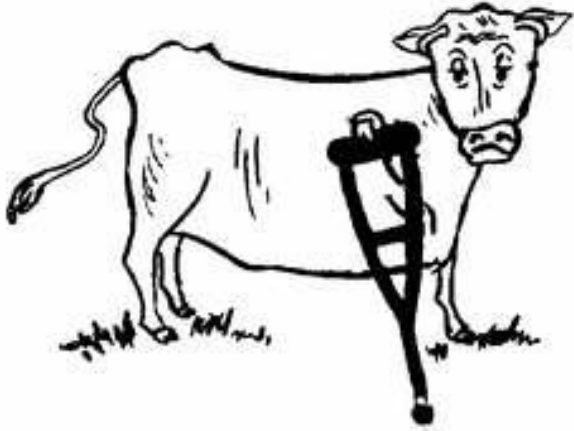


20 – 40 %



Medical repercussions

# Lameness in dairy cattle



20 – 40 %



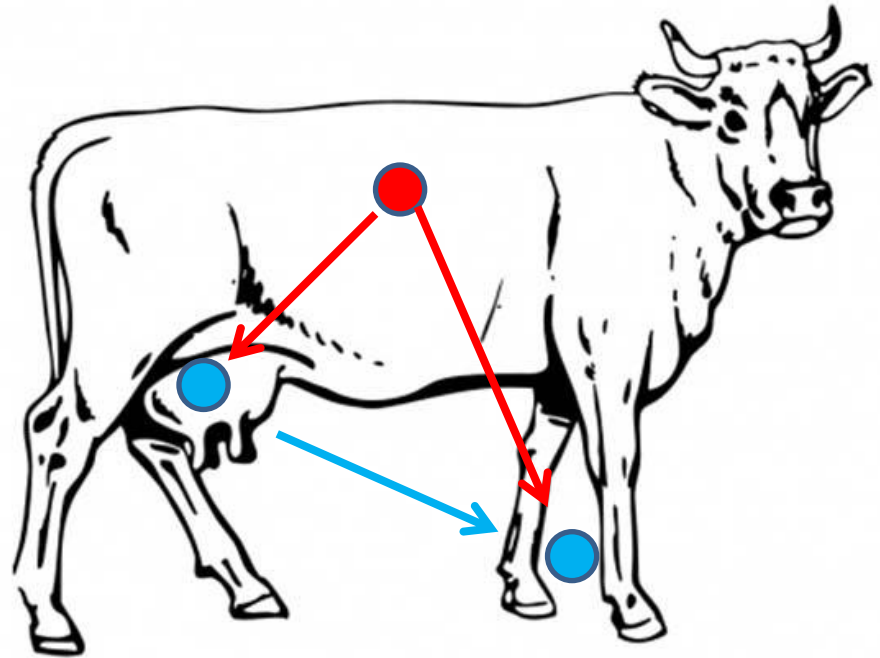
Medical repercussions



250 €

# Spectra as Biomarkers

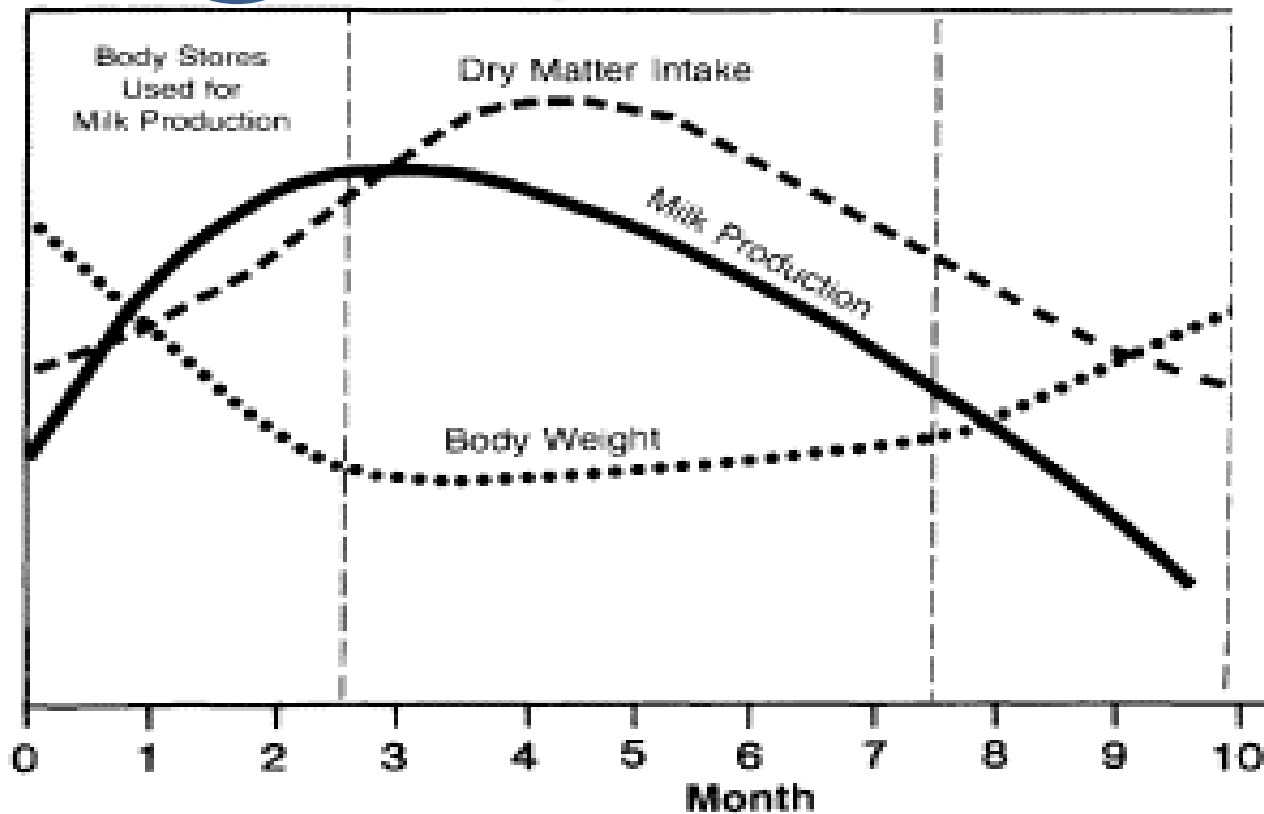
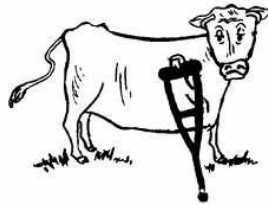
- Cheaper
- Non-invasive
- Simmental, 6828:  
59 – 71 % accuracy  
(L / N-L)



# Temporal relationship, preliminary approach

Metabolic disorder  $\leftrightarrow$  Lameness event

Met  
dis



# Data size

Lactation stage classes = 30 days

Simmental

FL	Lame1	Lame2	Lame3	Lame4	Lame5	Lame6	Lame7	Lame8	Lame9	Lame10
<b>BHB1</b>	120	44	41	40	51	40	39	35	37	41
<b>BHB2</b>	65	68	193	77	86	79	63	63	53	56
<b>BHB3</b>	36	41	75	150	69	47	49	54	45	46
<b>BHB4</b>	52	51	74	70	154	57	52	49	49	46
<b>BHB5</b>	55	44	83	63	70	154	52	46	53	54
<b>BHB6</b>	40	40	51	44	50	53	111	33	38	41
<b>BHB7</b>	36	32	58	52	53	60	46	125	39	39
<b>BHB8</b>	39	44	52	63	50	58	43	49	136	48
<b>BHB9</b>	36	41	41	50	57	59	46	41	51	121
<b>BHB10</b>	35	126	54	46	52	55	59	43	53	50

4775 samples (1700 cows) → mean/animal/class

# Raw results

<b>FL</b>	<b>Lame1</b>	<b>Lame2</b>	<b>Lame3</b>	<b>Lame4</b>	<b>Lame5</b>	<b>Lame6</b>	<b>Lame7</b>	<b>Lame8</b>	<b>Lame9</b>	<b>Lame10</b>
<b>BHB1</b>	0.08	0.22	0.23	0.09	-0.08	0.10	-0.04	0.16	-0.28	0.01
<b>BHB2</b>	-0.06	-0.02	0.00	0.00	-0.08	0.05	-0.04	-0.02	0.07	0.15
<b>BHB3</b>	0.06	-0.06	-0.01	0.19	0.14	0.23	-0.20	0.13	-0.02	0.06
<b>BHB4</b>	0.01	-0.12	0.06	0.19	-0.07	-0.27	-0.09	0.16	0.04	-0.04
<b>BHB5</b>	0.04	-0.03	-0.01	0.22	-0.06	0.07	0.00	0.15	0.00	-0.11
<b>BHB6</b>	-0.14	0.06	-0.20	-0.03	-0.04	-0.25	-0.12	-0.05	-0.08	-0.15
<b>BHB7</b>	-0.05	-0.15	0.21	0.05	0.19	-0.05	0.09	0.12	0.19	-0.12
<b>BHB8</b>	0.03	-0.04	-0.07	0.03	0.07	0.04	-0.03	0.06	-0.02	0.15
<b>BHB9</b>	-0.08	0.16	0.08	-0.05	0.10	0.02	-0.17	0.22	0.20	0.05
<b>BHB10</b>	-0.23	0.01	0.15	-0.08	0.14	0.00	0.20	-0.01	0.04	0.13

Sample size → irregular



# Smoothed results

Correlation function of 2<sup>nd</sup> degree polynome

<b>FL</b>	<b>Lame1</b>	<b>Lame2</b>	<b>Lame3</b>	<b>Lame4</b>	<b>Lame5</b>	<b>Lame6</b>	<b>Lame7</b>	<b>Lame8</b>	<b>Lame9</b>	<b>Lame10</b>
<b>BHB1</b>	0.08	0.08	0.08	0.08	0.08	0.07	0.06	0.04	0.03	0.01
<b>BHB2</b>	0.07	0.07	0.08	0.08	0.08	0.07	0.05	0.02	0.00	-0.03
<b>BHB3</b>	0.03	0.04	0.07	0.08	0.08	0.06	0.03	-0.01	-0.05	-0.11
<b>BHB4</b>	0.01	0.03	0.06	0.07	0.07	0.05	0.02	-0.02	-0.07	-0.14
<b>BHB5</b>	-0.01	0.01	0.05	0.06	0.06	0.04	0.02	-0.02	-0.07	-0.13
<b>BHB6</b>	-0.03	-0.01	0.03	0.04	0.04	0.03	0.02	-0.01	-0.05	-0.10
<b>BHB7</b>	-0.04	-0.02	0.00	0.02	0.02	0.02	0.02	0.01	-0.01	-0.03
<b>BHB8</b>	-0.05	-0.04	-0.03	-0.01	-0.00	0.01	0.02	0.03	0.04	0.05
<b>BHB9</b>	-0.06	-0.06	-0.06	-0.05	-0.03	-0.01	0.03	0.07	0.11	0.17
<b>BHB10</b>	-0.06	-0.07	-0.10	-0.09	-0.07	-0.03	0.03	0.10	0.20	0.31

# Smoothed results

<b>FL</b>	<b>Lame1</b>	<b>Lame2</b>	<b>Lame3</b>	<b>Lame4</b>	<b>Lame5</b>	<b>Lame6</b>	<b>Lame7</b>	<b>Lame8</b>	<b>Lame9</b>	<b>Lame10</b>
<b>BHB1</b>	0.08	0.08	0.08	0.08	0.08	0.07	0.06	0.04	0.03	0.01
<b>BHB2</b>	0.07	0.07	0.08	0.08	0.08	0.07	0.05	0.02	0.00	-0.03
<b>BHB3</b>	0.03	0.04	0.07	0.08	0.08	0.06	0.03	-0.01	-0.05	-0.11
<b>BHB4</b>	0.01	0.03	0.06	0.07	0.07	0.05	0.02	-0.02	-0.07	-0.14
<b>BHB5</b>	-0.01	0.01	0.05	0.06	0.06	0.04	0.02	-0.02	-0.07	-0.13
<b>BHB6</b>	-0.03	-0.01	0.03	0.04	0.04	0.03	0.02	-0.01	-0.05	-0.10
<b>BHB7</b>	-0.04	-0.02	0.00	0.02	0.02	0.02	0.02	0.01	-0.01	-0.03
<b>BHB8</b>	-0.05	-0.04	-0.03	-0.01	-0.00	0.01	0.02	0.03	0.04	0.05
<b>BHB9</b>	-0.06	-0.06	-0.06	-0.05	-0.03	-0.01	0.03	0.07	0.11	0.17
<b>BHB10</b>	-0.06	-0.07	-0.10	-0.09	-0.07	-0.03	0.03	0.10	0.20	0.31

# Smoothed results

<b>FL</b>	<b>Lame1</b>	<b>Lame2</b>	<b>Lame3</b>	<b>Lame4</b>	<b>Lame5</b>	<b>Lame6</b>	<b>Lame7</b>	<b>Lame8</b>	<b>Lame9</b>	<b>Lame10</b>
<b>BHB1</b>	0.08	0.08	0.08	0.08	0.08	0.07	0.06	0.04	0.03	0.01
<b>BHB2</b>	0.07	0.07	0.08	0.08	0.08	0.07	0.05	0.02	0.00	-0.03
<b>BHB3</b>	0.03	0.04	0.07	0.08	0.08	0.06	0.03	-0.01	-0.05	-0.11
<b>BHB4</b>	0.01	0.03	0.06	0.07	0.07	0.05	0.02	-0.02	-0.07	-0.14
<b>BHB5</b>	-0.01	0.01	0.05	0.06	0.06	0.04	0.02	-0.02	-0.07	-0.13
<b>BHB6</b>	-0.03	-0.01	0.03	0.04	0.04	0.03	0.02	-0.01	-0.05	-0.10
<b>BHB7</b>	-0.04	-0.02	0.00	0.02	0.02	0.02	0.02	0.01	-0.01	-0.03
<b>BHB8</b>	-0.05	-0.04	-0.03	-0.01	-0.00	0.01	0.02	0.03	0.04	0.05
<b>BHB9</b>	-0.06	-0.06	-0.06	-0.05	-0.03	-0.01	0.03	0.07	0.11	0.17
<b>BHB10</b>	-0.06	-0.07	-0.10	-0.09	-0.07	-0.03	0.03	0.10	0.20	0.31

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