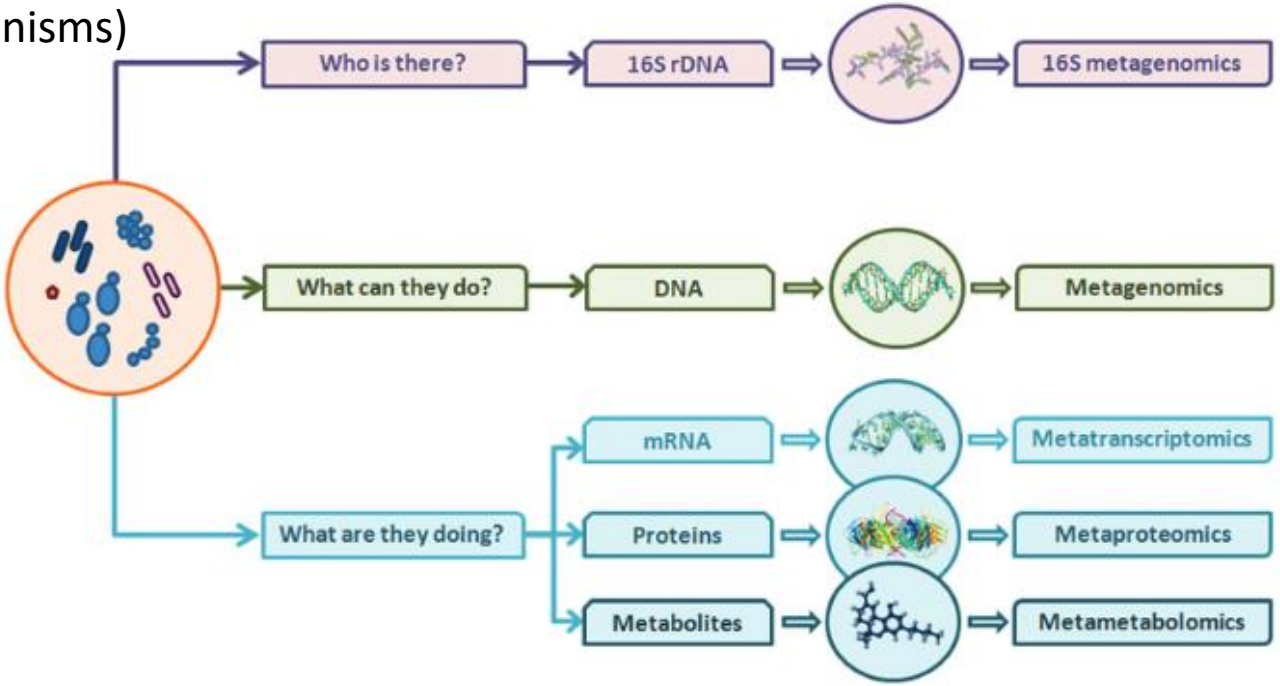
Managing the healthy and productive dairy cow…
–
…from the silo to the feed bunk, through the rumen to the liver
–
What omics-technologies have taught us

Dr. Melanie Schären-Bannert

VEERkracht Dairy Congress 2022

What are omics technologies?

- various disciplines in biology whose names end in the suffix -omics
  - genomics (genes)
  - transcriptomics (gene expression)
  - proteomics (proteins)
  - metabolomics (metabolites)
  - microbiomics (microorganisms)



Sources: https://en.wikipedia.org/wiki/Omics, www.omics.org, https://home.liebertpub.com/publications/omics-a-journal-of-integrative-biology/43/
Addis, M. F., et al. Molecular biosystems 12.8 (2016): 2359-2372.

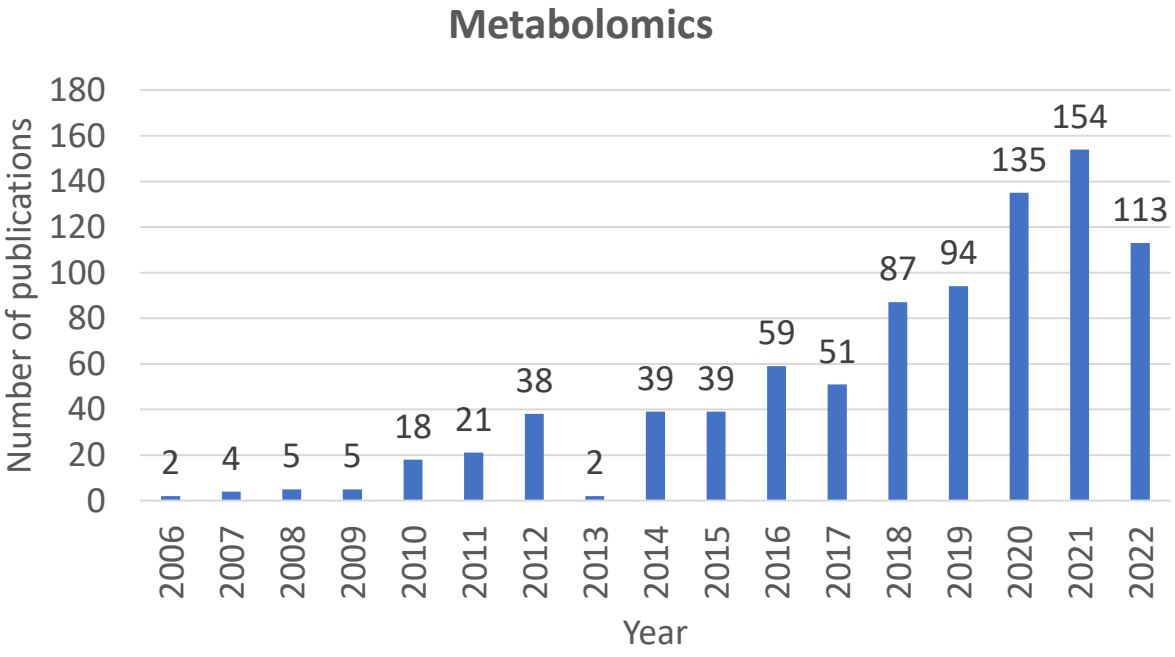
What are omics technologies?

- Sample analysis
  - Next Generation Sequencing (NGS): genes and microorganisms
  - Mass Spectrometry (MS): metabolites
  - Nuclear Magnetic Resonance (NMR): metabolites
  - High-performance liquid chromatography (HPLC): proteins
  - …
- Data processing and analysis
  - comparison with database
  - sophisticated data analysis methods
  - …

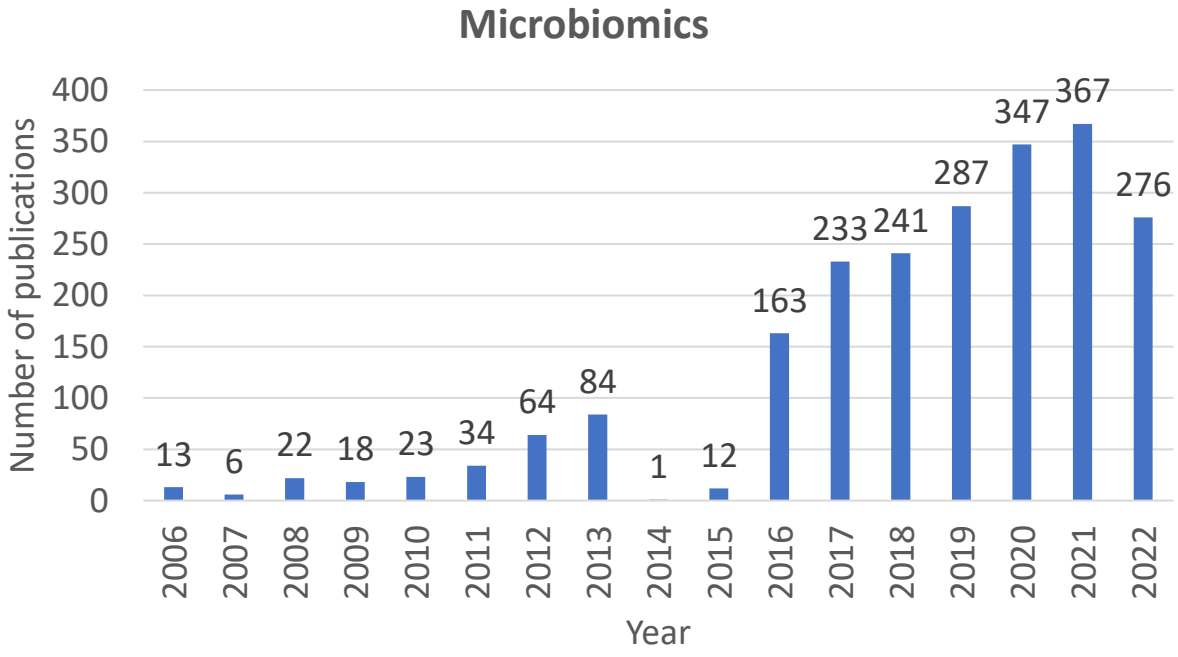
Source: https://jgi.doe.gov/our-science/science-programs/metabolomics-technology/metabolomics-data-analysis-tips-from-users/

Omics technologies in dairy science

PubMed Search „Metabolomics“ or „Microbiomics“ and „dairy cattle“
14.09.2022

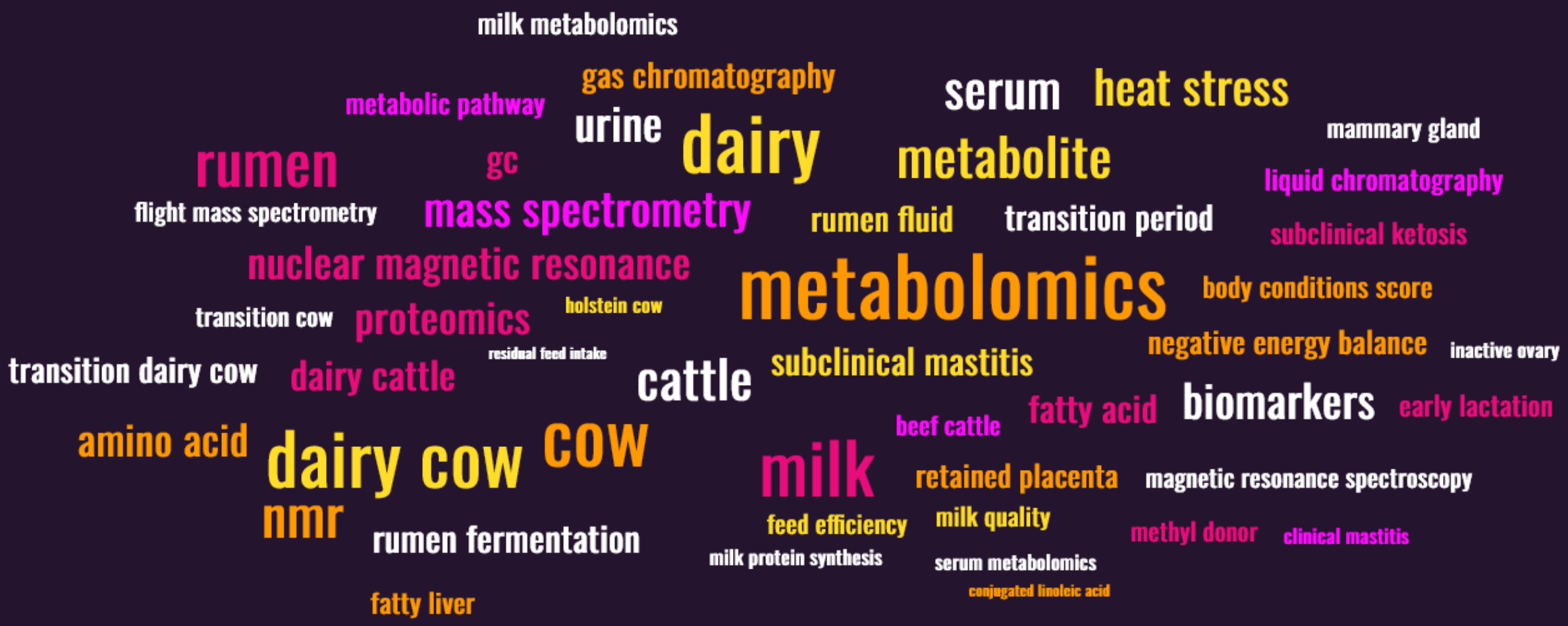


783 results



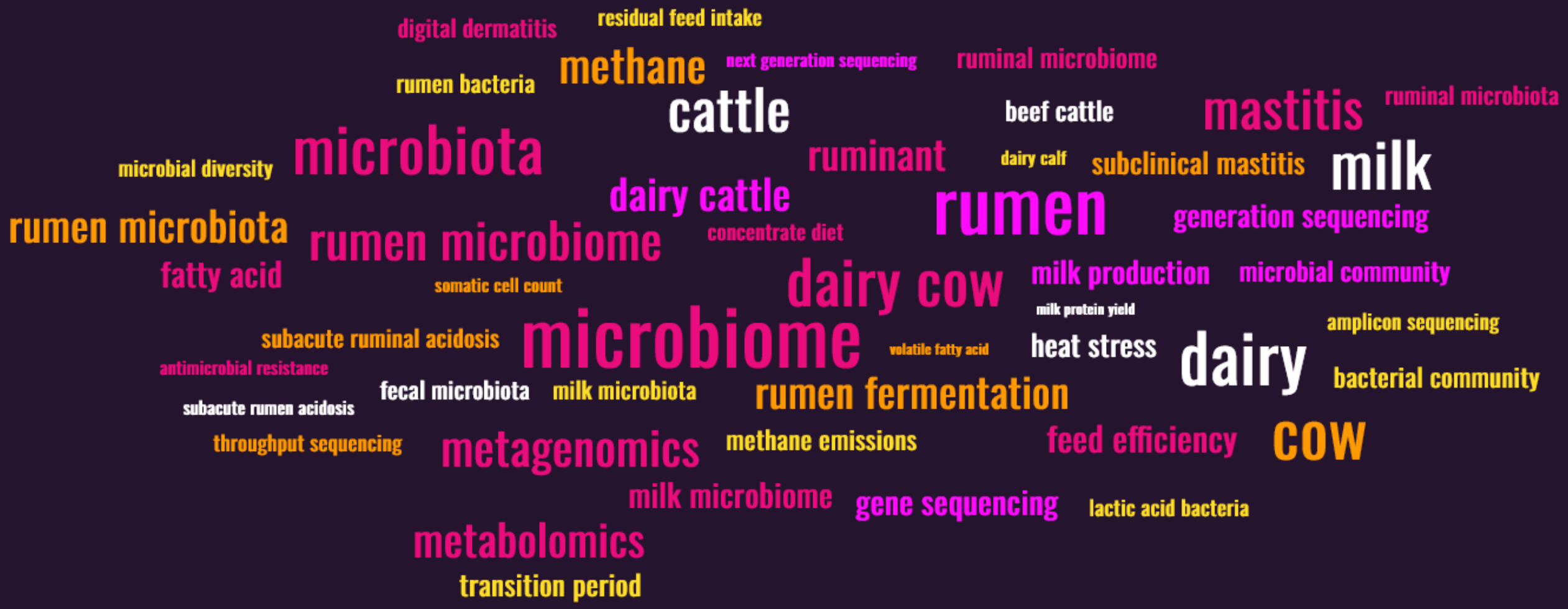
2,123 results

Omics technologies in dairy science



Word Cloud *(https://monkeylearn.com/word-cloud/)* using key words of publications found on Web of Science using „metabolomics“ and „dairy cow“, 14.09.2022, 321 results

Omics technologies in dairy science



Word Cloud *(https://monkeylearn.com/word-cloud/)* using key words of publications found on Web of Science using „microbiomics“ and „dairy cow“, 14.09.2022, 445 results

Omics technologies in dairy science

- Genetics and Breeding (Koboldt et al. 2013; Raszek et al. 2016)
- Epidemiology of viruses (Ridpath et al. 2006)
- BRD-Complex (Sants-Rivera et al. 2021, Ng et al. 2015; Hause et al. 2015)
- Mastitis (Chuang et al. 2021, Haxhiaj et al. 2022, Marcitelli et al. 2022, Ganda et al. 2016; Oultram et al. 2017)
- Metritis (Jeon et al. 2015)
- Retained placenta (Amin et al. 2022)
- Subacute Ruminal Acidosis (Zhan et al. 2022, Khafipour et al. 2009a, b, c, 2011; Golder 2014; McCann et al. 2016)
- Rumen Microbiome (Guan et al. 2008; Hernandez-Sanabria et al. 2010, 2012a, b; Jami et al. 2013; Lima et al. 2015; Myer et al. 2015)
- Paratuberculosis (Taylor et al. 2022; Leao et al. 2015; Fecteau et al. 2016)
- Dermatitis digitalis (Krull et al. 2014, 2015; Nielsen et al. 2016)
- Body conditioning (Riosa et al. 2022)
- Fatty liver, Ketosis (Lisuzzo et al. 2022, Guo et al. 2022, Eom et. al. 2022 a&b)
- Feed efficiency (Elolimy et al. 2021, Martin et al. 2021, Xue et al. 2022)
- Prepartum exercise (Zhenzhong et al. 2022)
- Mycotoxin exposure (Wu et al. 2022)
- Heat stress (Wang et al. 2022)
- Feed supplements (Wang et al. 2022, Retamal et al. 2022, Damat et al. 2022, Hua et al. 2022, Xu et al. 2022, Zhang et al. 2022)

Ration changes and the rumen microbiome

Project „Systemanalyse Milch“

Global trend towards zero-grazing systems in dairy production

55% of dairy farms in Germany are non-grazing operations

„Systemanalyse – Milch“

Pasture vs. Confinement

Influences on…

- **Animals**
- **Environment**
- **Consumer**
- **Farmer**

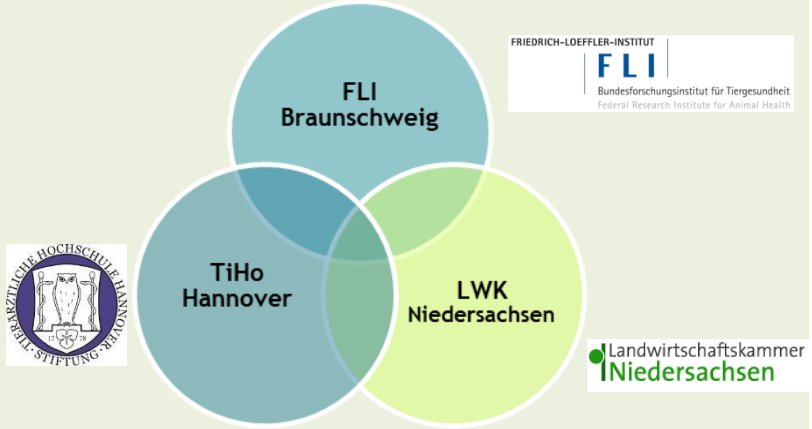
9 Modules

2,6 mio. Euro

Niedersächsisches Ministerium für Wissenschaft und Kultur

systemanalyse milch

Modul 6: Tierernährung und -gesundheit



Quelle: www.systemanalyse-milch.de

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Study design

Two studies: spring 2014 and 2016

60 primi- and pluriparious German Holstein cows

- Second half of lactation
- 10 rumen- and duodenum-fistulated cows

Randomly assigned into two groups:

- Pasture group (PG)
- Confinement group (CG)

Trial 1: “Continuous stocking”

1.75 kg concentrate/day

Trial 2: “Rotational grazing system”

4.50 kg concentrate/day

Study design

1	2	3	4	5	6	7	8	9	10
0 h	3 h	12 h		24 h					
TMR	TMR & Pasture			Pasture & Concentrate					

TMR = Total Mixed Ration

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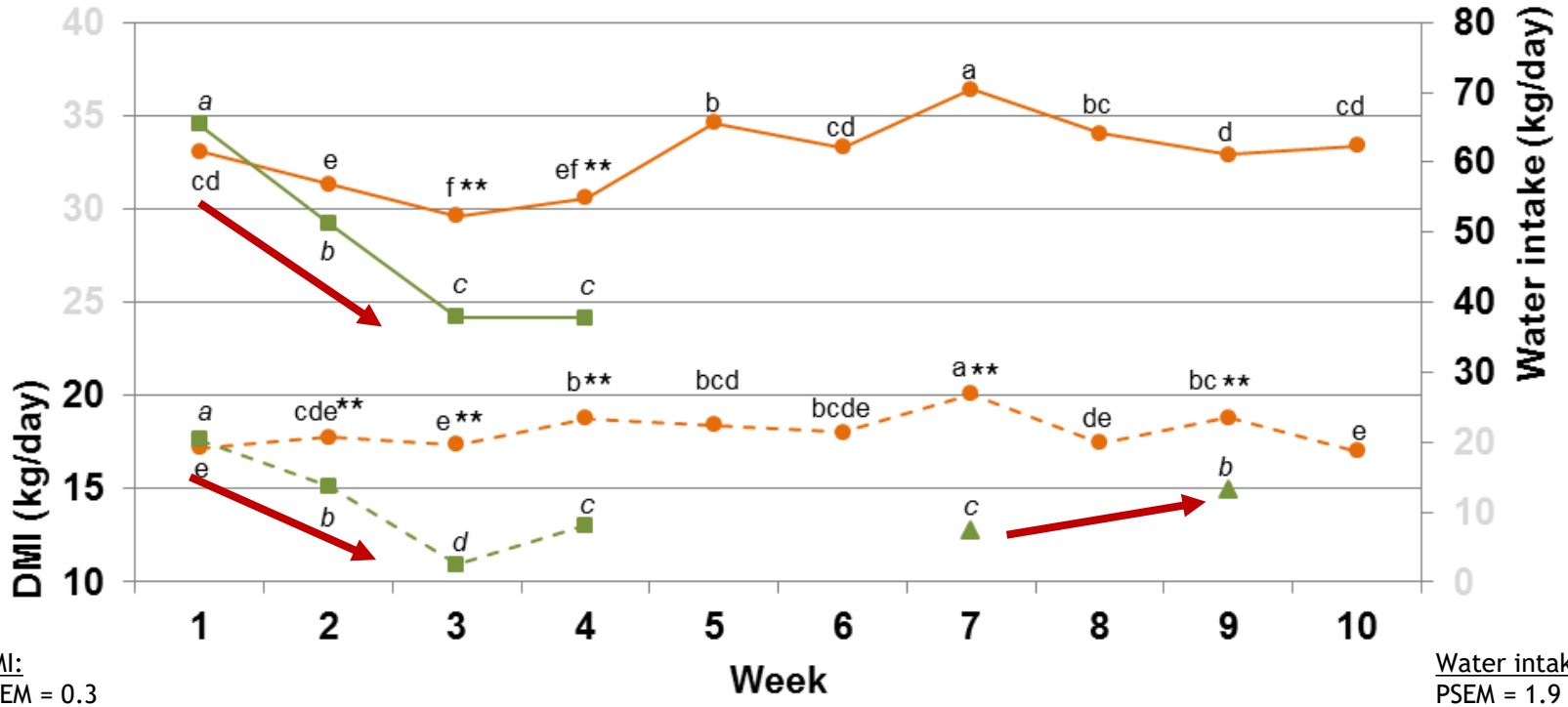
Dry Matter and Water Intake



DMI:
PSEM = 0.3
Group: P < 0.001
Time: P < 0.001
GxT: P < 0.001

Mixed Model (SAS Enterprise Guide 6.1)
** P < 0.01; * P < 0.05; † P < 0.10; n = 29 (PG) and 31 (CG)
Different letters = significant differences between weeks within groups

Water intake:
PSEM = 1.9
Group: P < 0.01
Time: P < 0.001
GxT: P < 0.001

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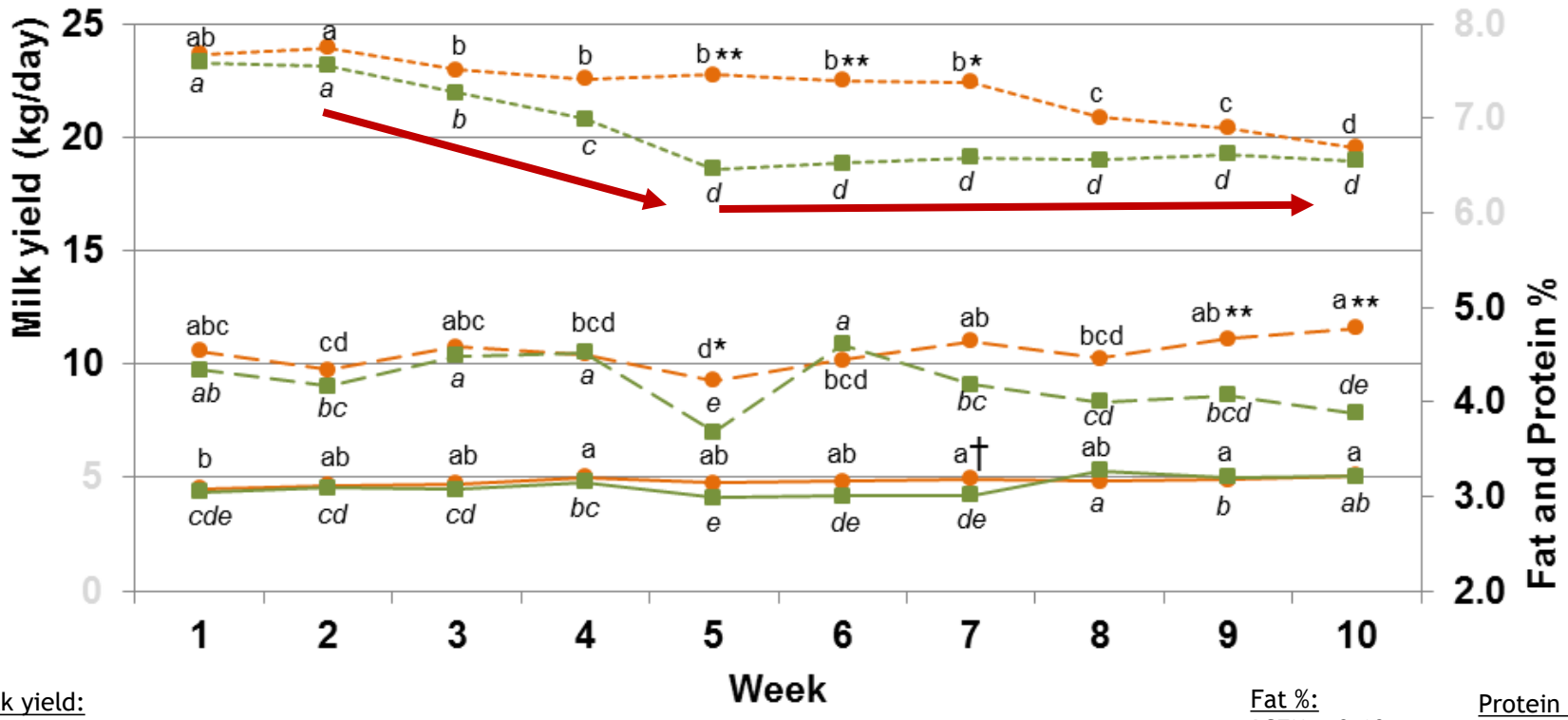
Milk Production and Contents



Milk yield:
PSEM = 0.6
Group: P < 0.05
Time: P < 0.001
GxT: P < 0.001

Mixed Model (SAS Enterprise Guide 6.1)
** P < 0.01; * P < 0.05; † P < 0.10; n = 29 (PG) and 31 (CG)
Different letters = significant differences between weeks within groups

Fat %:
PSEM = 0.10
Group: P < 0.01
Time: P < 0.001
GxT: P < 0.001

Protein %:
PSEM = 0.03
Group: P = NS
Time: P < 0.001
GxT: P < 0.001

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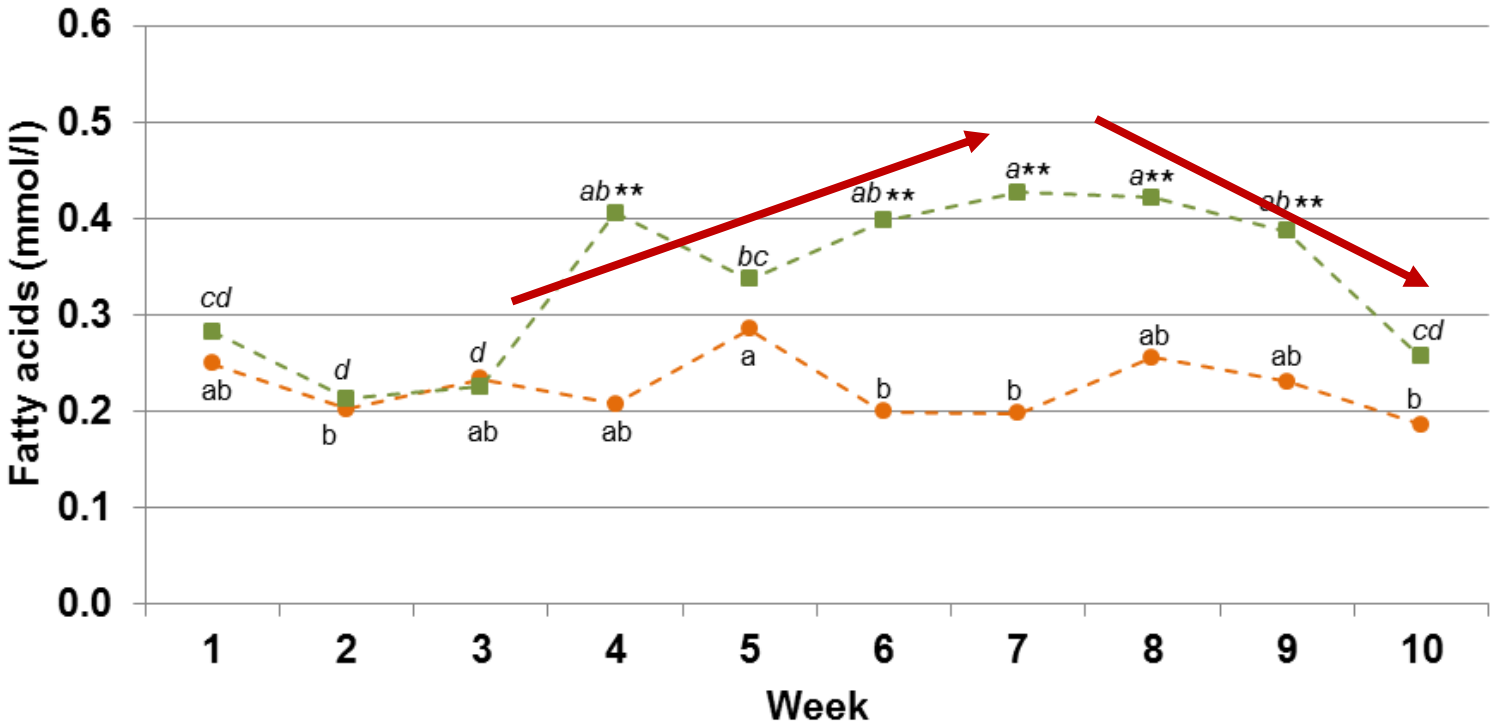
Serum Fatty Acids



Fatty acids:
PSEM = 0.02
Group: P < 0.01
Time: P < 0.001
GxT: P < 0.001

Mixed Model (SAS Enterprise Guide 6.1)
** P < 0.01; * P < 0.05; † P < 0.10; n = 29 (PG) and 31 (CG)
Different letters = significant differences between weeks within groups

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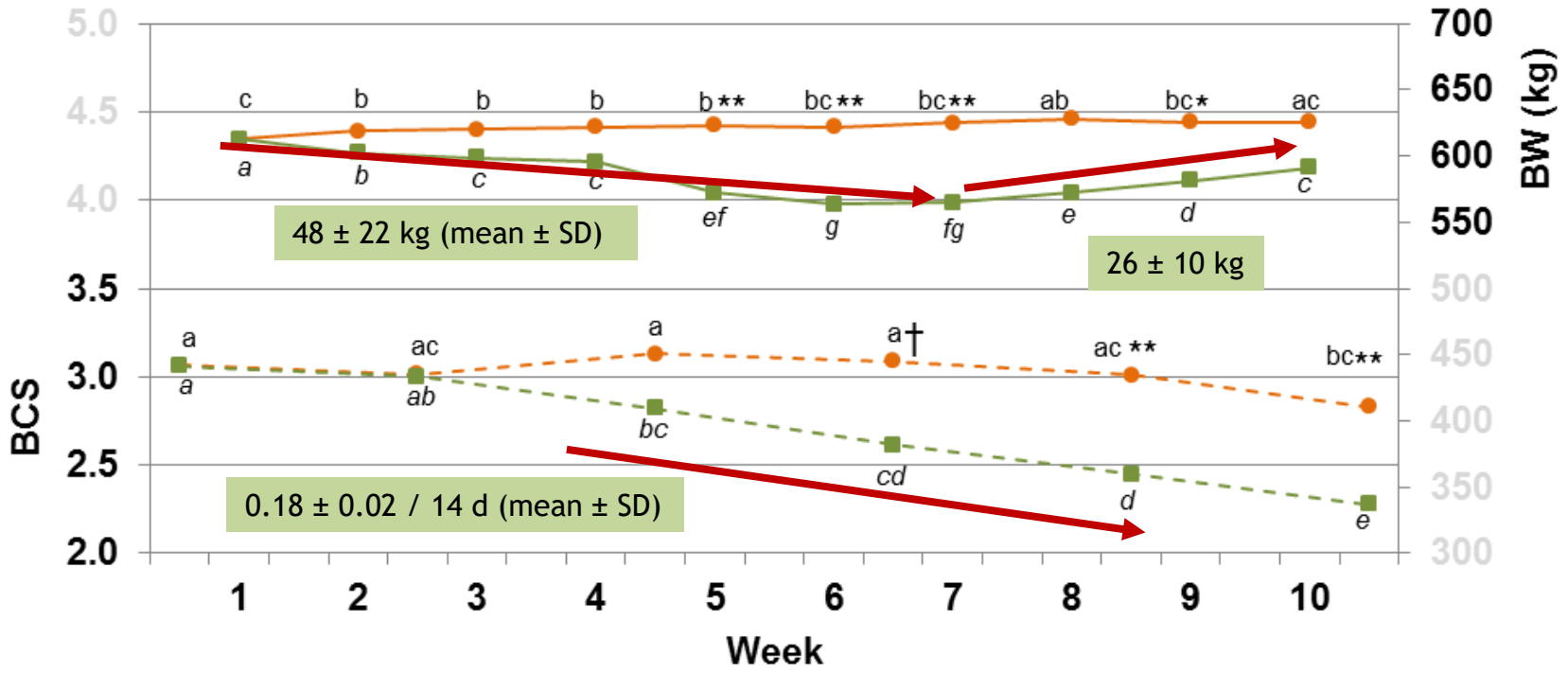
Body Weight and Body Condition



BCS:
PSEM = 0.11
Group: P < 0.05
Time: P < 0.001
GxT: P < 0.001

Mixed Model (SAS Enterprise Guide 6.1)
** P < 0.01; * P < 0.05; † P < 0.10; n = 29 (PG) and 31 (CG)
Different letters = significant differences between weeks within groups

BW:
PSEM = 8
Group: P < 0.01
Time: P < 0.001
GxT: P < 0.001

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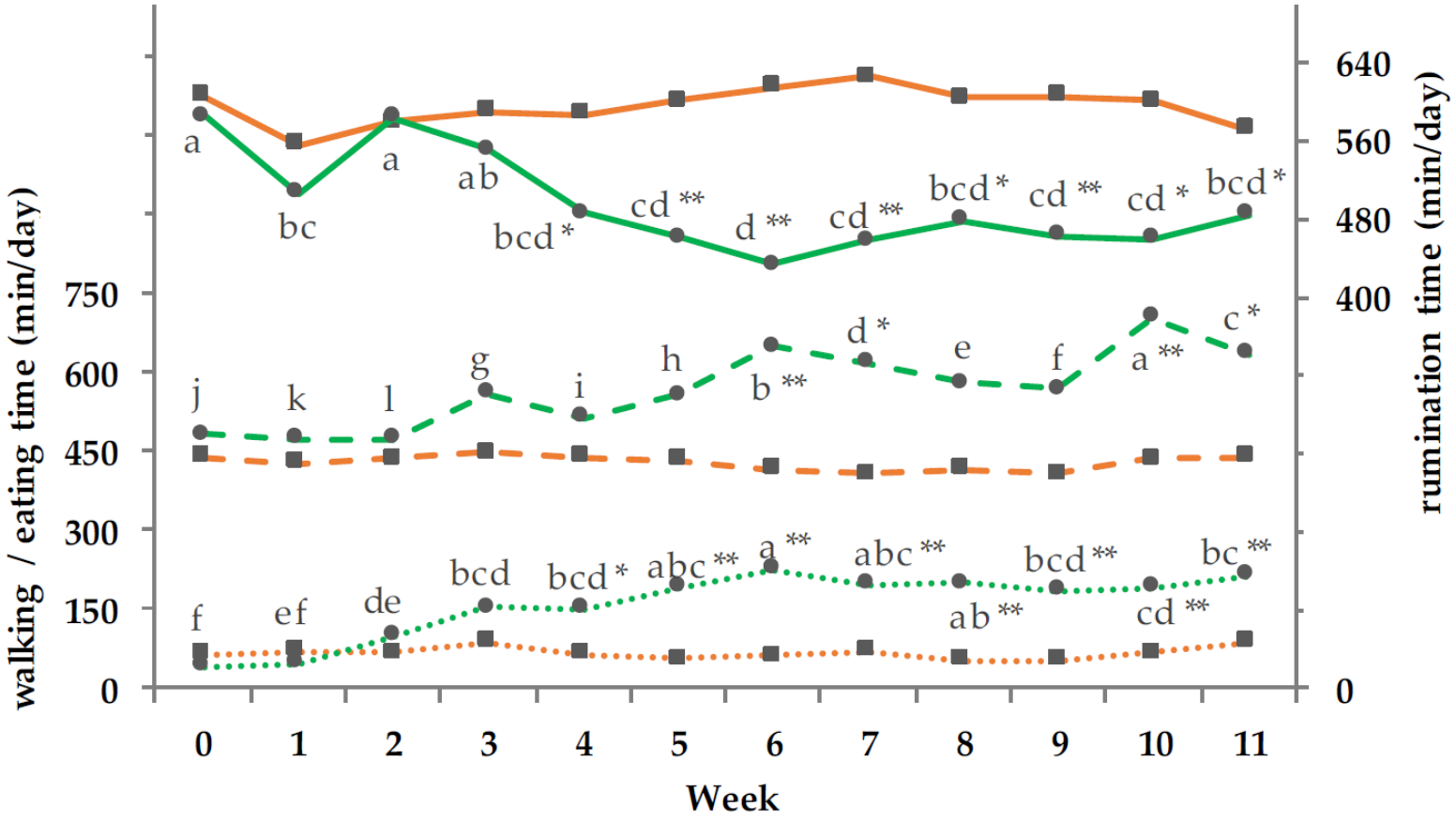
Behavior


walking / eating time (min/day)
rumination time (min/day)
Week
0
150
300
450
600
750
400
480
560
640
0 1 2 3 4 5 6 7 8 9 10 11
a
bc
a
ab
bcd *
cd **
d **
cd **
bcd *
cd **
cd *
bcd *
j
k
l
g
i
h
b **
d *
e
f
a **
c *
f
ef
de
bcd
bcd *
abc **
a **
abc **
ab **
bcd **
cd **
bc **

Rumen fermentation

In the transitioning phase between confinement and pasture concurrently decrease of:

- total rumen content
- papillae surface
- absorption capacity
- pH fluctuation -> fermentation intensity

1	2	3	4	5	6	7	8	9	10
0 h	3 h	12 h		24 h					
TMR	TMR & Pasture			Pasture & Concentrate					

With the increase in DMI -> normalization of rumen variables

Rumen microbiome

Sample collection for microbiota analysis

- three time-points: week 1, 5 and 10

1	2	3	4	5	6	7	8	9	10
0 h	3 h	12 h		24 h					
TMR	TMR & Pasture			Pasture & Concentrate					

- SSCP-gel
- 16S rRNA amplicon sequencing
  - information of approx. 160 different eukaryotes per sample

Sequence coding for the 16S ribosomal RNA (or 16S rRNA)
- prokaryote species specific
- RNA component of the 30S subunit of a prokaryotic ribosome

Particle associated Archaea and Bacteria

Liquid associated Archaea and Bacteria

Epithelium associated Archaea and Bacteria

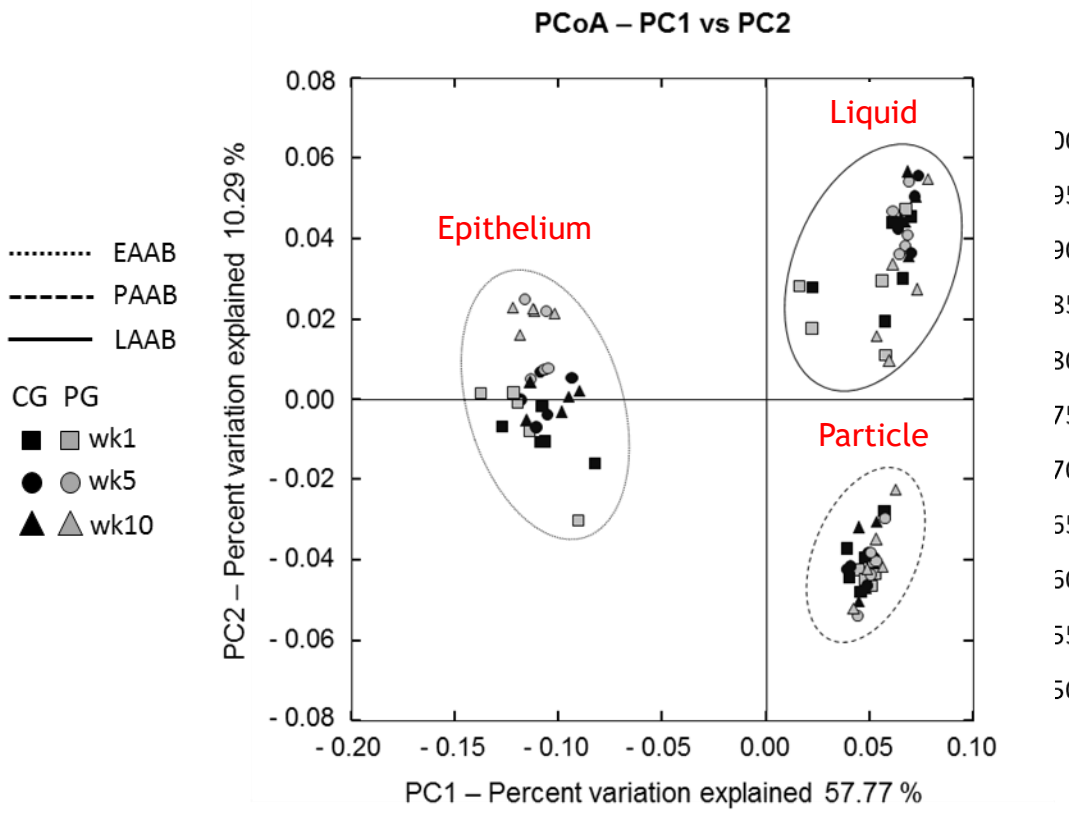
Rumen microbiome

Rumen microbiome different in three locations

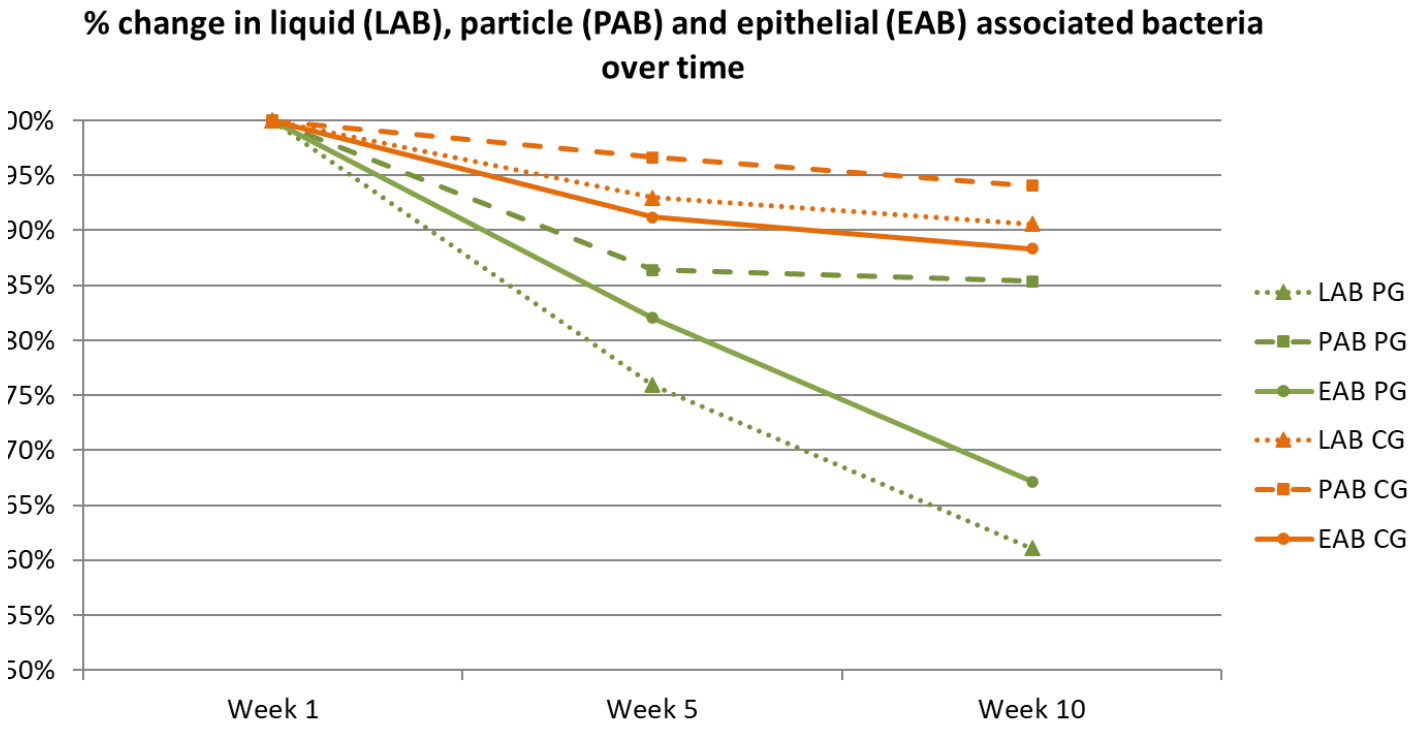
- Epithelium associated microbiome very different & lower diversity

Alterations of the rumen microbiome in all three locations

- NEW! epithelial associated microbiome was assumed to be very stable
- Different in first and fith week on pasture: change takes days to weeks
- confirmation of „core microbiome“



Multivariate Datanalysis - PCoA plot



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Conclusion

- Transition from a confinement (TMR) to a pasture-based husbandry system implicates multilayered and substantial changes for the cow
  - new daily routines and feeding behavior
  - habituation to increased activity -> increased „fitness“ required
  - alteration and habituation of the rumen microbiome to new substrate
- Transition should be implemented step-wise -> transitioning period: at least 3 weeks
- Concentrate supplementation helps to decrease „energy gap“ during this ration change, however SARA risk might be increased
- Further studies are needed to investigate best supplementation and pasturing systems

Publications

Manuscripts

1. Schären et al. 2016 J Dairy Sci. 99(2):1183-200.
2. Schären et al. 2016 J Dairy Sci. 99(5):3549-65.
3. Schären et al. 2017 Frontiers Microb. 8:744.
4. Hartwiger et al. 2018 Animals 8(10).
5. Hartwiger et al. 2018 Animals 8(11).
6. Hartwiger et al. 2019 Vet Sci. 6(2).

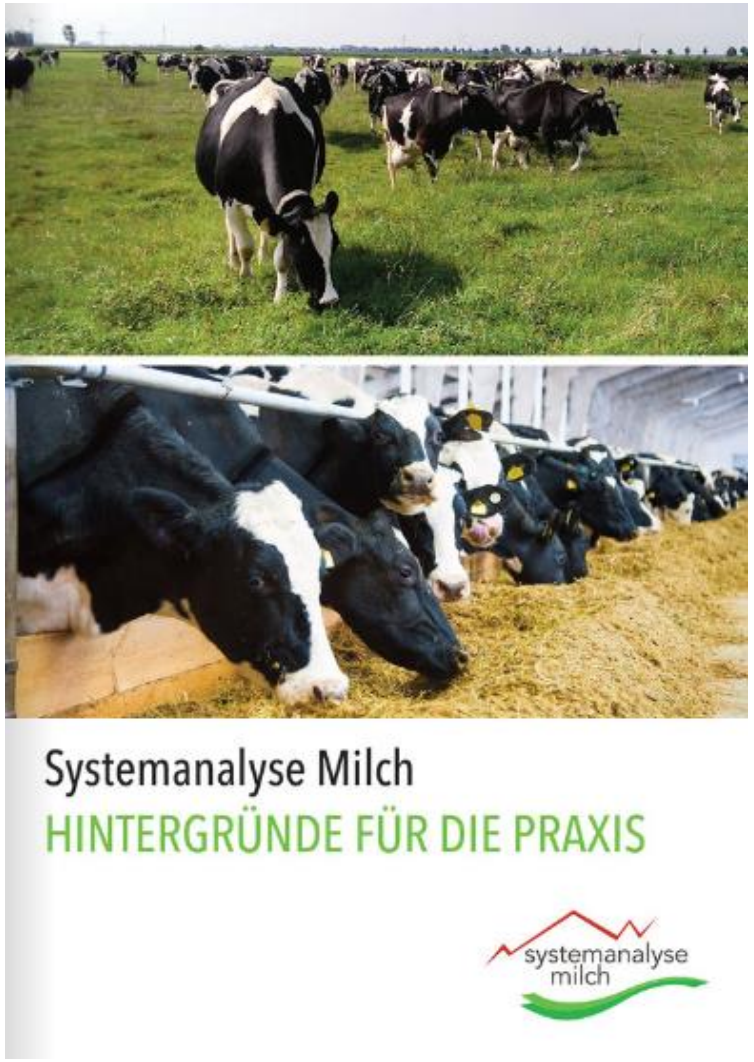
PhD / Dissertation

7. Schären M. - University of Veterinary Medicine Hannover; 2016.
8. Schären M. - Georg-August-University of Göttingen; 2017.
9. Hartwiger J. - University of Veterinary Medicine Hannover, Foundation; 2019.

Master- and Bachelortheses

10. Ruesink, S. - Georg-August-University of Göttingen; 2015.
11. Jostmeier, S. - Georg-August-University of Göttingen; 2015.
12. Speit, J-H. – Hochschule Osnabrück; 2015.
13. Martin, D. – University of Bonn; 2015.
14. Künzel, S. – University of Hohenheim; 2015.

….

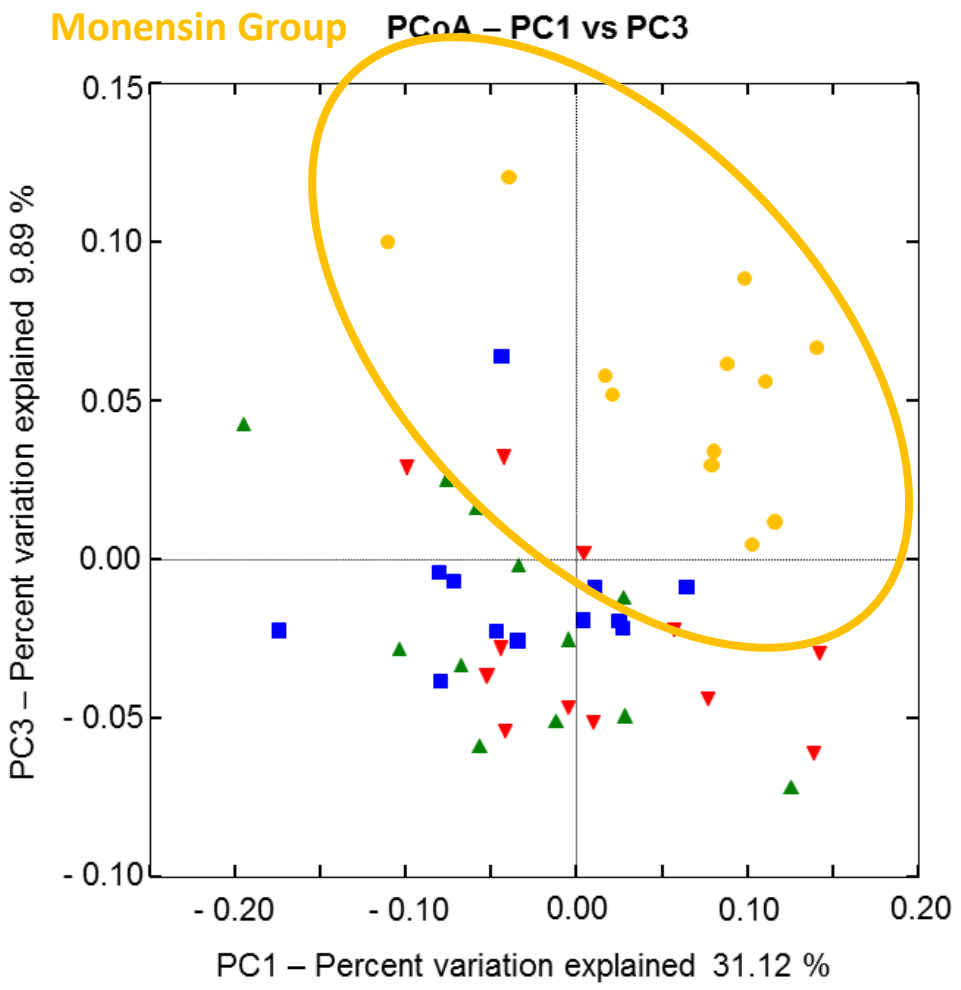


Monensin and rumen microbiome

Interrelations between host and rumen microbiome

Influence of monensin on rumen microbiome

- Transition cow trial investigating the influence of monensin and a blend of essential oils on
  - performance
  - rumen fermentation
  - health and immunology
- 48 German Holstein cows
- rumen fluid sample day 56 in milk
- monensin alters the rumen microbiome
  - lower species diversity
  - increase of succinate and propionate producers
  - increase of taxa with thicker cell wall



J. Dairy Sci. 100:2765–2783
https://doi.org/10.3168/jds.2016-11994
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Differential effects of monensin and a blend of essential oils on rumen microbiota composition of transition dairy cows

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Interrelations between host and rumen microbiome

- 36 German Holstein cows
- rumen fluid sample day 56 in milk
- strong association between rumen microbiome
  - fermentation pattern
  - feed efficiency

General Production

Milk Production

Feed Efficiency

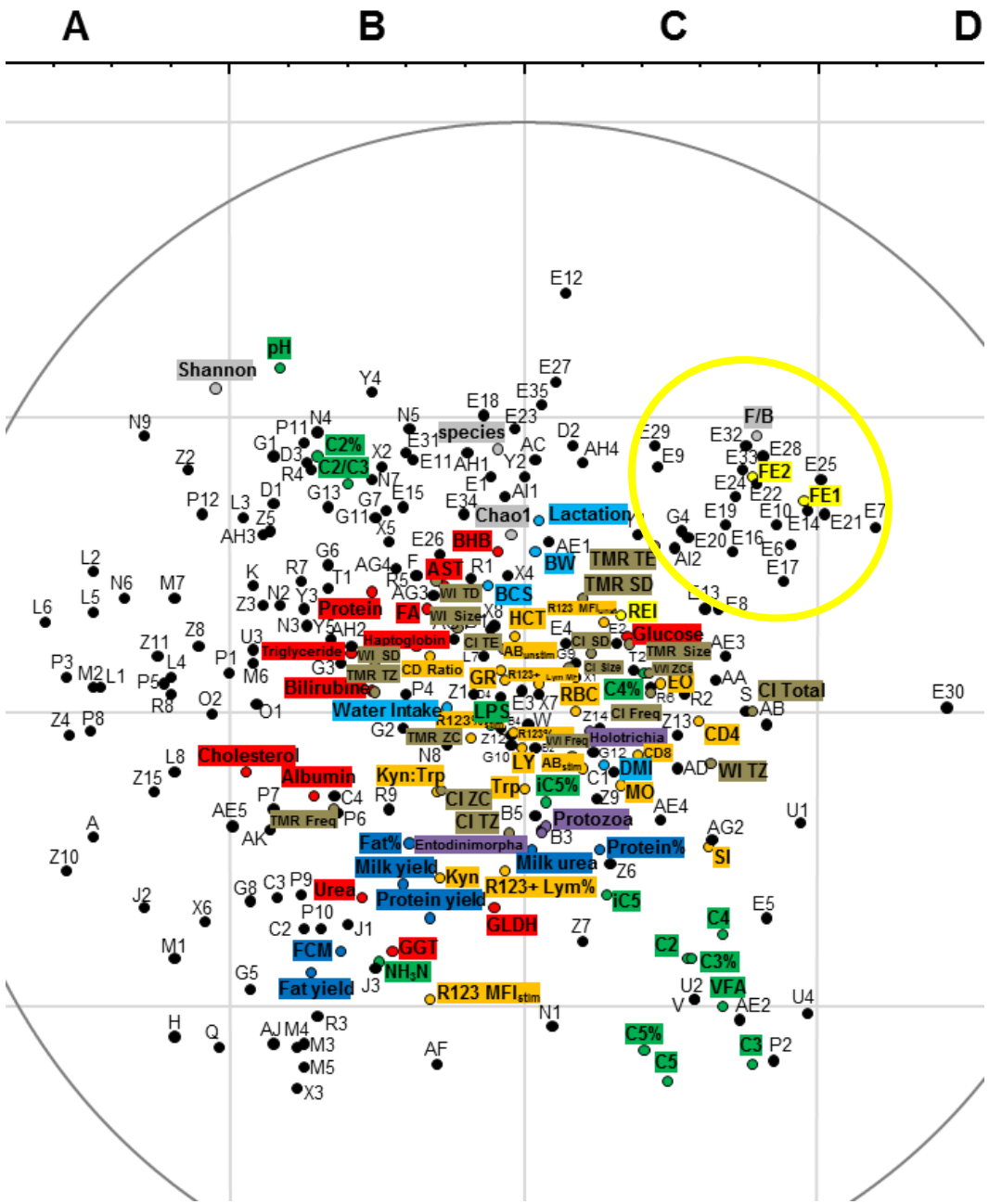
Behavior

Rumen Fermentation

Metabolism

Immunology

Rumen Microbiome



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Interrelations between the rumen microbiota and production, behavioral, rumen fermentation, metabolic, and immunological attributes of dairy cows

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Transition cow metabolomics

Fatty Liver Project

- Dairy cows in modern production systems are at a high risk to encounter metabolic disorders during the transition period

  (Mulligan and Doherty 2007, LeBlanc 2010, Van Saun 2016)

- Lipomobilisation → key role of liver → dysfunction → fatty liver syndrome (Bobe 2004)
- Reasons for individual differences in susceptibility & underlying pathomechanisms: still widely unknown

  (Kessel et al. 2008; Drackley et al. 2005; LeBlanc 2010)

- Identification of
  - prognostic markers → development of practical cow-site tests
  - metaphylactic treatments → identification of substances and protocols

    … is needed

Veterinärmedizinische Fakultät

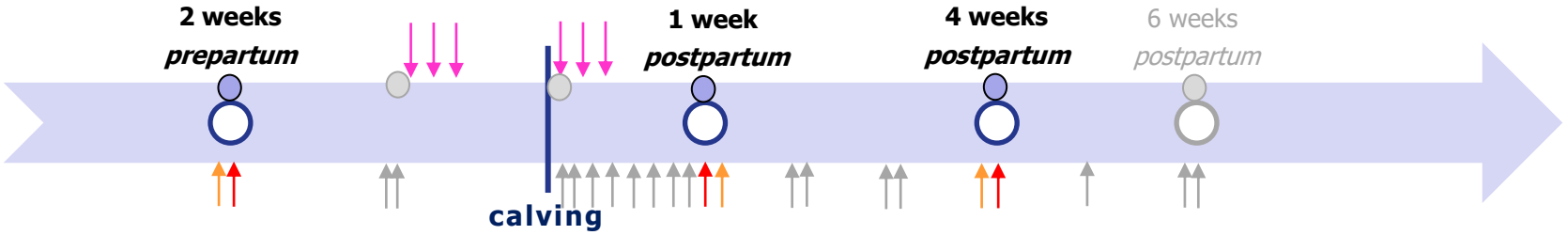
Fatty Liver Project

- Characterization of…
  - liver fat content and fractions of the liver fat
  - histopathological alterations
  - metabolomic alterations in liver, blood and urine
  - … in dairy cows during the transition period → in relation with clinical and production data
- Non-invasive detection of liver fat content in dairy cows by using ultrasonography
- Effect of metaphylactic treatment with Cyanocobalamin + Butaphosphan (Catosal®)
  - Clinic for Ruminants and Swine, Leipzig
  - Veterinary Physiology, Leipzig
  - Institute for Veterinary Pathology Leipzig
  - Radboud UMC
  - Veterinary Physiology Vetsuisse Faculty, University of Bern
  - Itin & Hoch
  - Esaote
  - Wellion
  - Elanco

Material and Methods

Trial

- On-farm trial involving 80 German Holstein dairy cows
  - Dairy farm, 660 cows, TMR-based free-stall confinement system
  - Lactation number: 3.9 ± 1.8 (mean ± SD)
  - 305 d milk production in previous lactation: 10.944 ± 2.013 kg (mean ± SD)
  - Follow-up from 2 weeks *prepartum* until 6 weeks *postpartum*
  - Between November 2015 and 2016
- Treatment group (randomized, 3-fold blinded, prospective study)
  - I & II VERUM: 5 & 10 mL / 100 kg BW 10 % Butaphosphan & 0.005 % Cyanocobalamin
  - III & IV PLACEBO: 5 & 10 mL / 100 kg BW 0.9 % NaCl
  - Timepoint: day -7, -6, -5 *prepartum* & day 1, 2, 3 *postpartum*
- Exact documentation of clinical and production state
- Samples
  - Liver biopsies (4x) ○ and ultrasound (7x) ●
  - Blood (8x) ↑ and urine (15x) ↑ sampling



Veterinärmedizinische Fakultät

Material and Methods

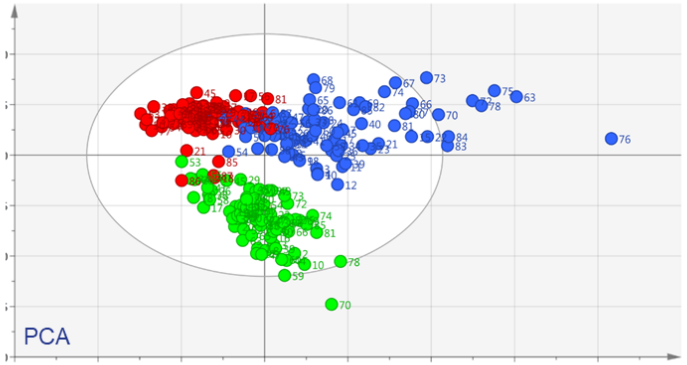
- Blood and liver samples: MS-based metabolomics analysis
  - Complementary to lipid metabolism: lipids, aminoacids, acylcarnithines, …
  - 180 Metabolites (quantitative)
  - *AbsoluteIDQ p180 kit (Biocrates Lifes Sciences)*
  - *Agilent 1290 Infinity UPLC-System attached to a ABSciex5500 Qtrap LC-MS/MS*

- Urine samples: NMR-based analysis
  - General health status of the animals: liver, kidney, amino acids, organic acids
  - 55 Metabolites (quantitative)
  - *Bruker AVANCE III spectrometer equipped with a TCI-Cryo-Probe*
  - *and a sample jet system (Bruker BioSpin, Germany)*

- Statistical analysis:
  - SIMCA 14.0 (Umetrics, Sweden) - multivariate data analysis
  - SAS 9.4 (SAS Institute, Cary, NC, USA) – mixed model

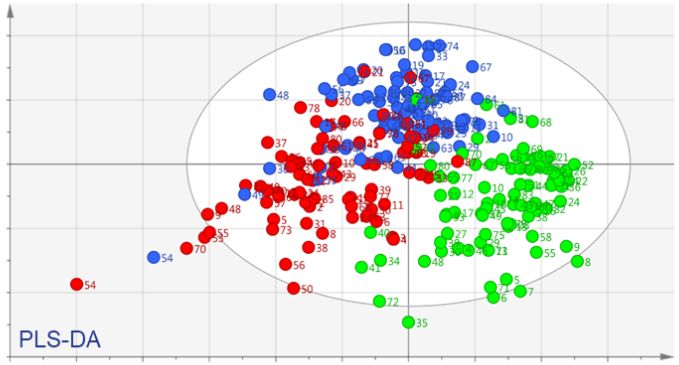
Results

Plasma

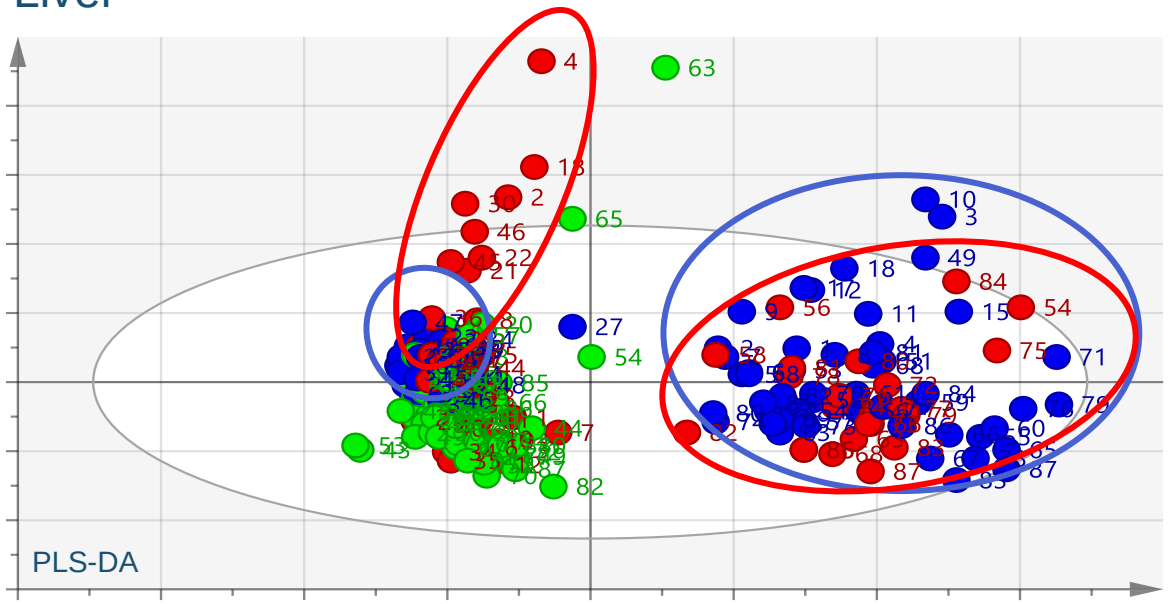


2 weeks *prepartum*
1 week *postpartum*
4 weeks *postpartum*

Urine



Liver

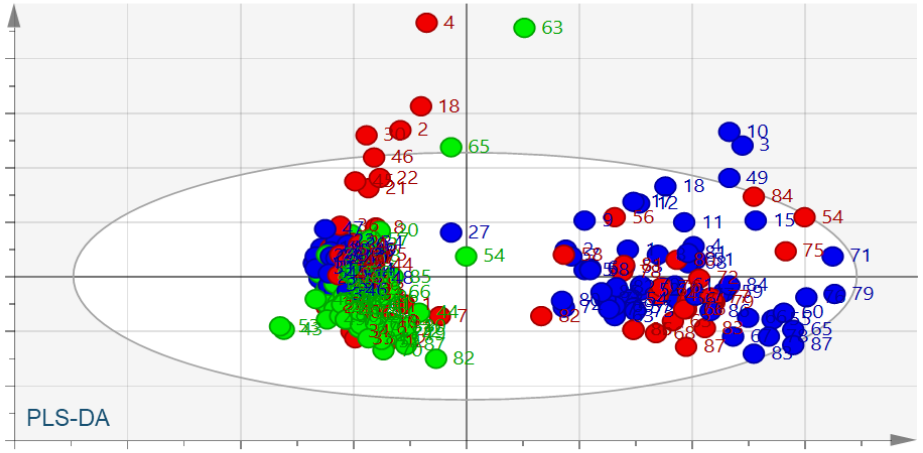


→ *No Treatment effect*

Veterinärmedizinische Fakultät

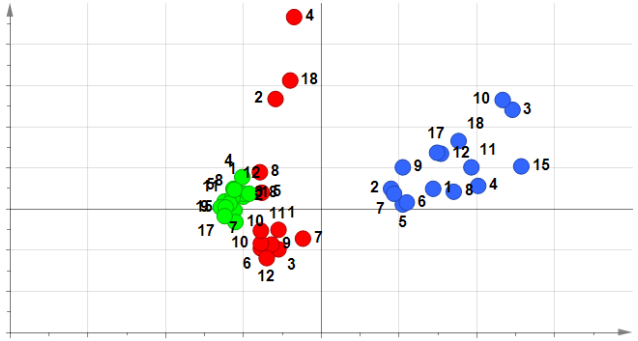
Results

Liver

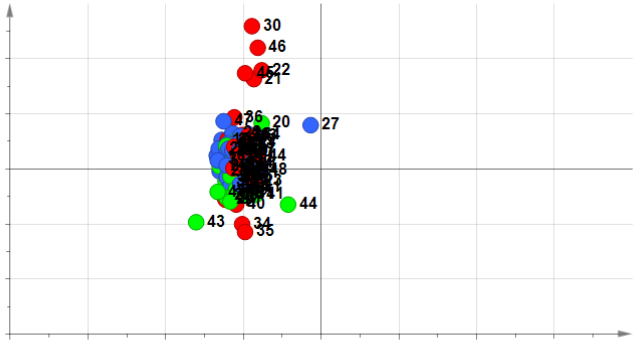


2 weeks *prepartum*
1 week *postpartum*
4 weeks *postpartum*

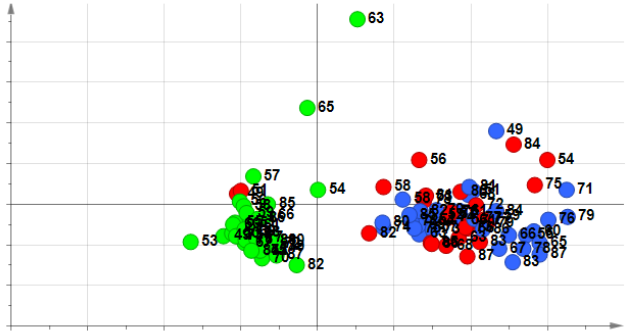
Metabotype A: Animals 1-15,17,18



Metabotype B: Animals 16, 19-48



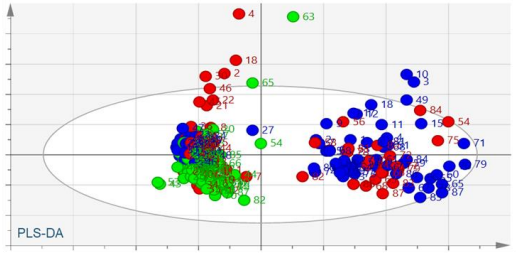
Metabotype C: Animals 49-87



Veterinärmedizinische Fakultät

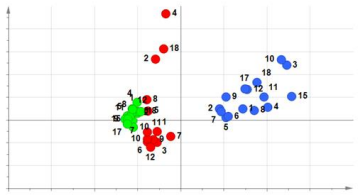
Results

Liver

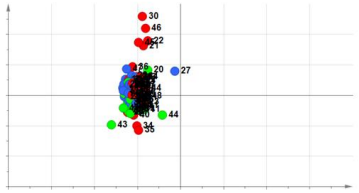


2 weeks *prepartum*
1 week *postpartum*
4 weeks *postpartum*

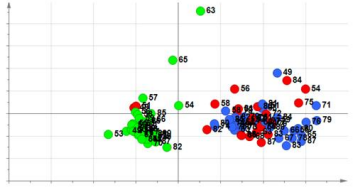
Metabotype A: Animals 1-15,17,18



Metabotype B: Animals 16, 19-48



Metabotype C: Animals 49-87



Trial duration

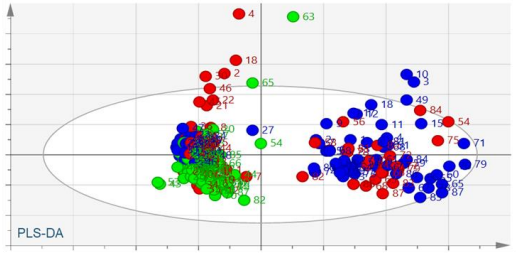
Nov´15 — Nov´16

7. February and 31. May 2016

Veterinärmedizinische Fakultät

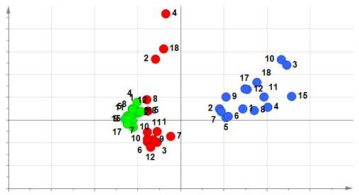
Results

Liver

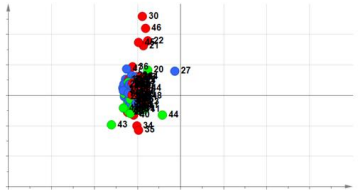


2 weeks *prepartum*
1 week *postpartum*
4 weeks *postpartum*

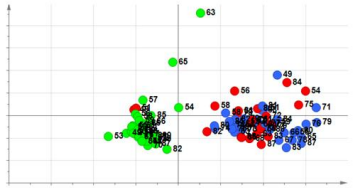
Metabotype A: Animals 1-15,17,18



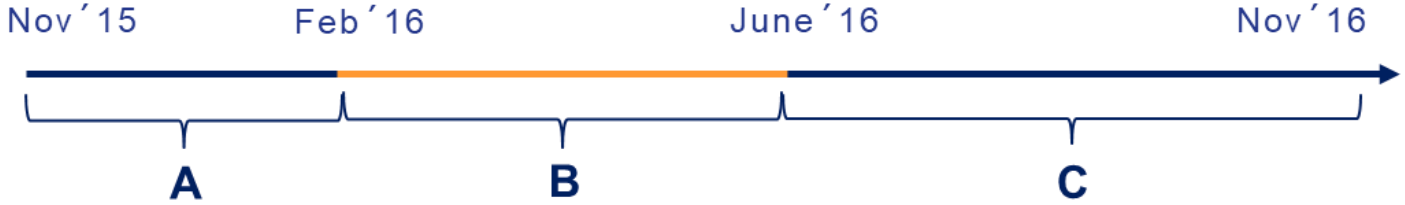
Metabotype B: Animals 16, 19-48



Metabotype C: Animals 49-87



Trial duration



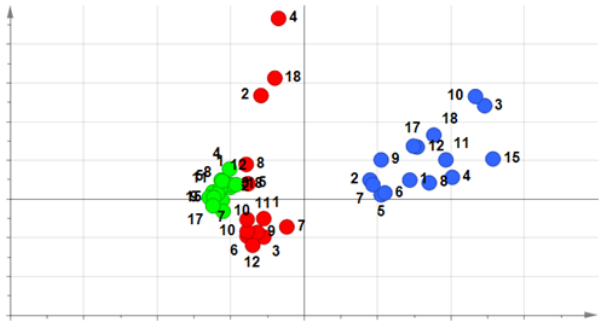
Metabolites involved?

Veterinärmedizinische Fakultät

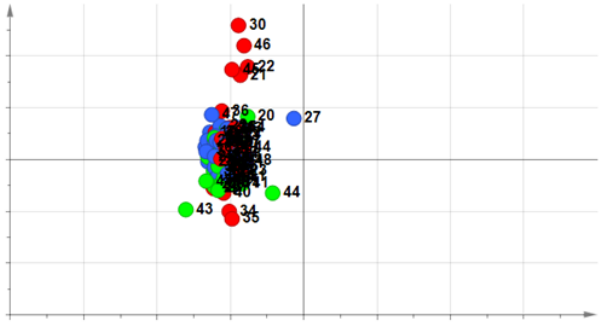
Results

Liver

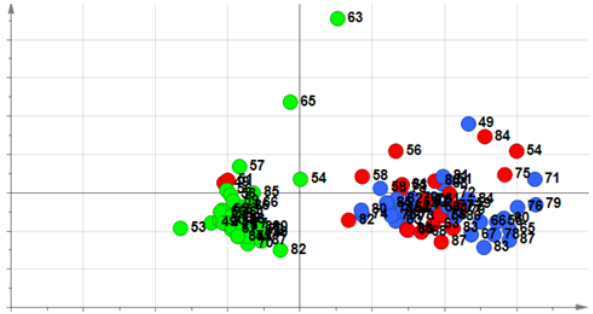
Metabotype A: Animals 1-15,17,18



Metabotype B: Animals 16, 19-48



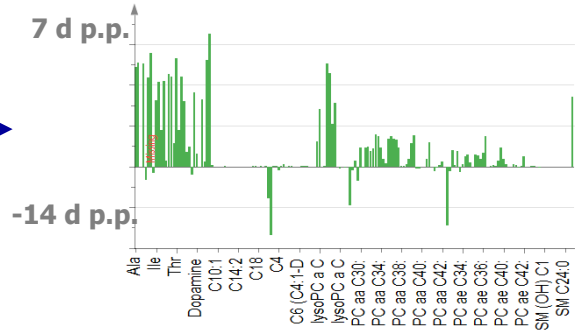
Metabotype C: Animals 49-87



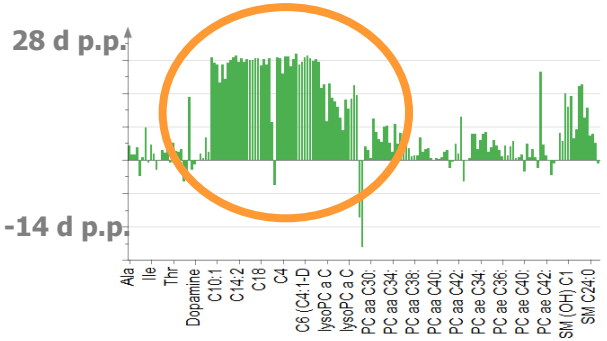
2 weeks *prepartum*
1 week *postpartum*
4 weeks *postpartum*

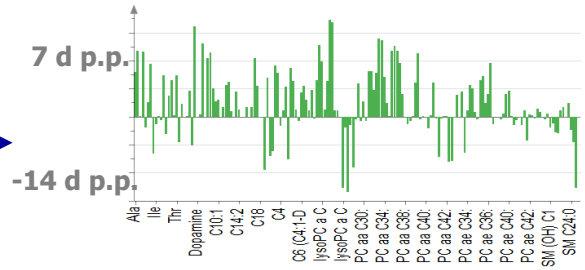
Contribution plots

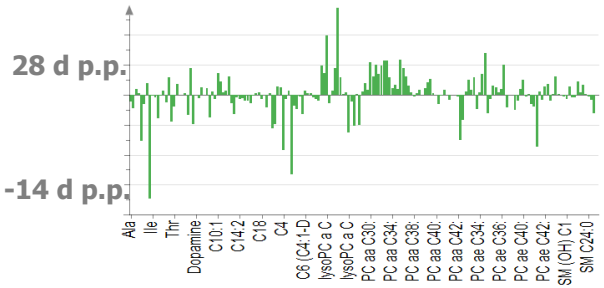
-14 d p.p. <-> 7 d p.p.



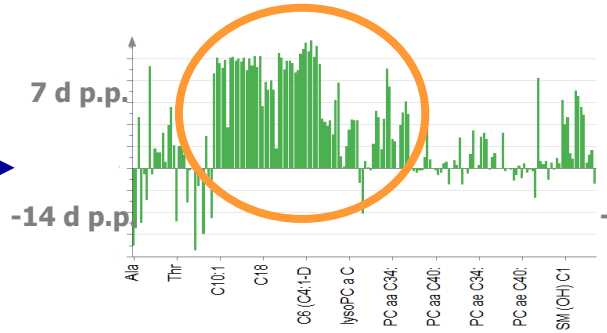
-14 d p.p. <-> 28 d p.p.

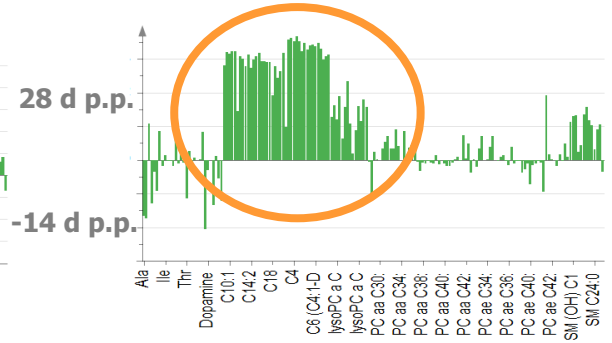






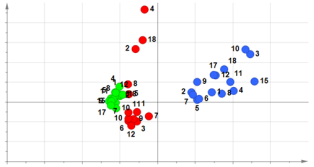
Fatty liver?



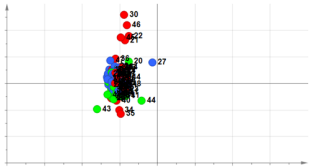


Results

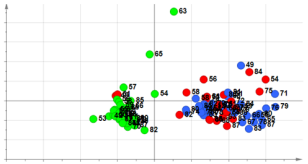
Metabotype A: Animals 1-15,17,18



Metabotype B: Animals 16, 19-48



Metabotype C: Animals 49-87

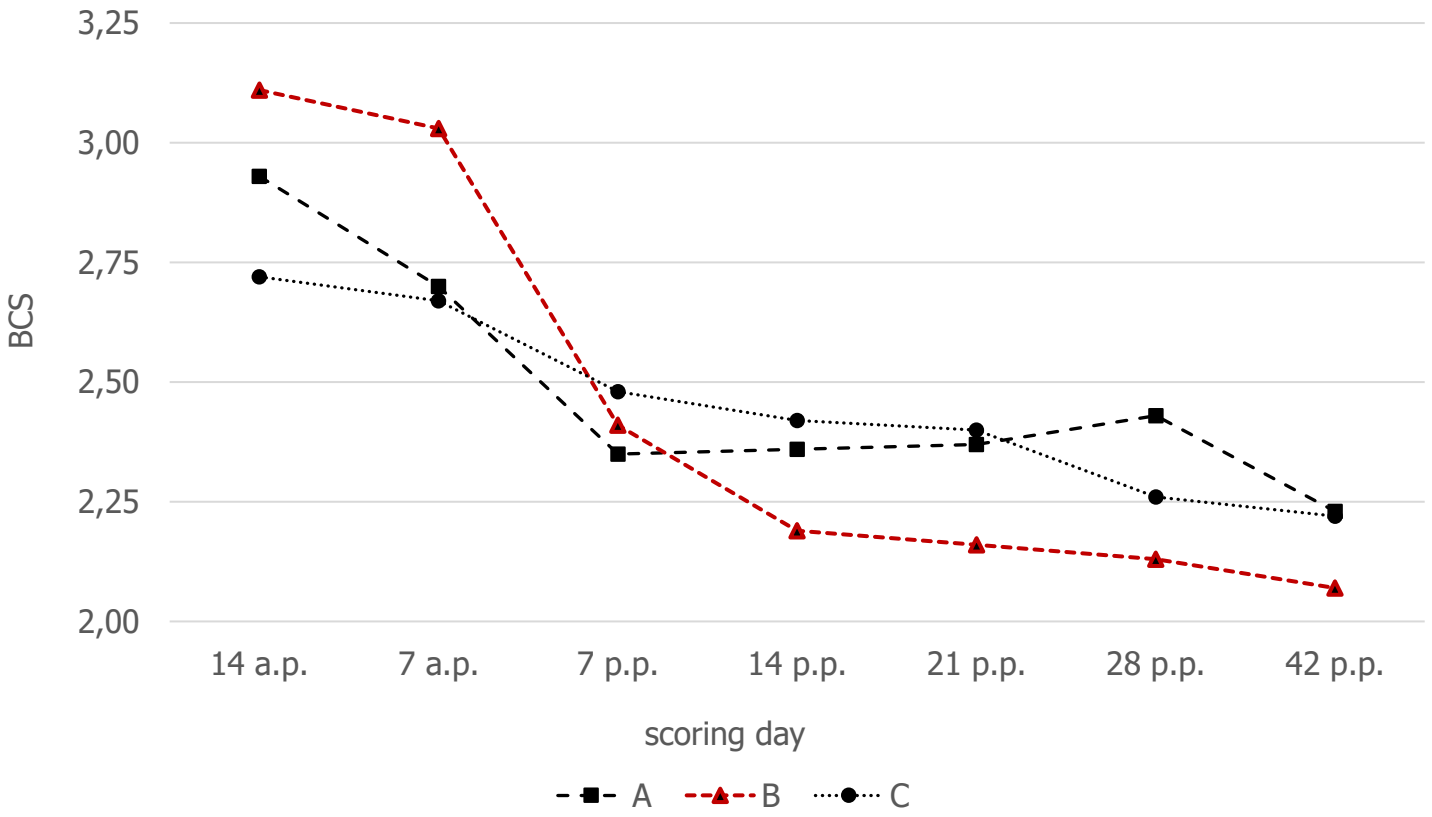


2 weeks *prepartum*
1 week *postpartum*
4 weeks *postpartum*

Metabotype B:

Calving between 7. February and 31. May 2016

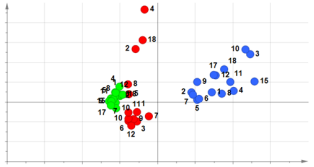
Body Condition Score:



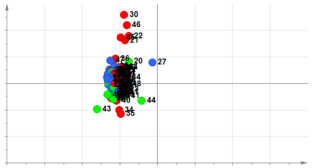
Veterinärmedizinische Fakultät

Results

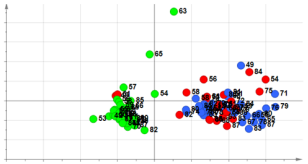
Metabotype A: Animals 1-15,17,18



Metabotype B: Animals 16, 19-48



Metabotype C: Animals 49-87



2 weeks *prepartum*
1 week *postpartum*
4 weeks *postpartum*

Metabotype B:

Calving between 7. February and 31. May 2016

Clinical Chemistry:

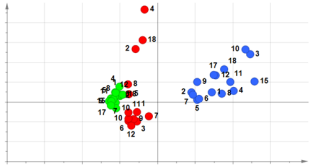
	Metabotype A	Metabotype B	Metabotype C
FA (µmol/L)	326^{AB}	433^{A} ↑	241^{B} ↓
TAG (mmol/L)	0.21^{B} ↓	0.24^{A} ↑	0.21^{B} ↓
γ-GT (U/L)	28.5^{AB}	28.5^{A} ↑	24.2^{B} ↓
BILI (µmol/L)	2.60^{AB}	3.07^{A} ↑	2.15^{B} ↓
CK (U/L)	79^{C} ↓	107^{B} ↓	146^{A} ↑
CL (mmol/L)	98^{AB}	99^{B} ↓	101^{A} ↑
NA (mmol/L)	140^{B} ↓	144^{A} ↑	145^{A} ↑
P (mmol/L)	1.33^{B} ↓	1.53^{A} ↑	1.52^{A} ↑
TP (g/L)	74.5^{B} ↓	80.4^{A} ↑	83.1^{A} ↑
U-CL (mmol/L)	50.2^{A} ↑	28.6^{B} ↓	32.9^{B} ↓

Note: *Different letters indicate significant difference ($P \leq 0.05$) between metabotypes.*

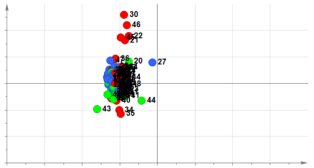
Veterinärmedizinische Fakultät

Results

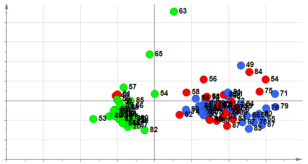
Metabotype A: Animals 1-15,17,18



Metabotype B: Animals 16, 19-48



Metabotype C: Animals 49-87



2 weeks *prepartum*
1 week *postpartum*
4 weeks *postpartum*

Metabotype B:

Calving between 7. February and 31. May 2016

Production:

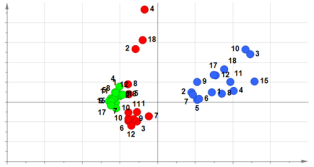
	Metabotype A	Metabotype B	Metabotype C
Milk yield (kg/d): 5-100 DIM	46.6^{A} ↑	41.4^{B} ↓	42.3^{B} ↓
ECM (kg/d): 5-100 DIM	44.2^{A} ↑	39.1^{B} ↓	39.6^{B} ↓
Protein %: 31-60 DIM	3.05^{A}	2.92^{B} ↓	2.97^{AB}
Fat %: 5-30 DIM	4.82^{A} ↑	4.53^{A} ↑	4.06^{B} ↓
SCS (cells/mL): 31-60 DIM	1.43^{A} ↓	2.34^{AB}	3.08^{A} ↑

Note: *Different letters indicate significant difference ($P \leq 0.05$) between metabotypes.*

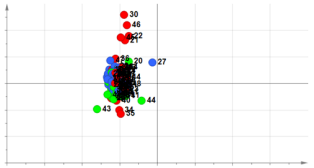
Veterinärmedizinische Fakultät

Results

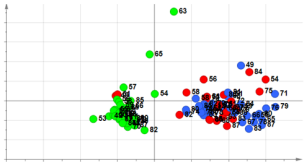
Metabotype A: Animals 1-15,17,18



Metabotype B: Animals 16, 19-48



Metabotype C: Animals 49-87

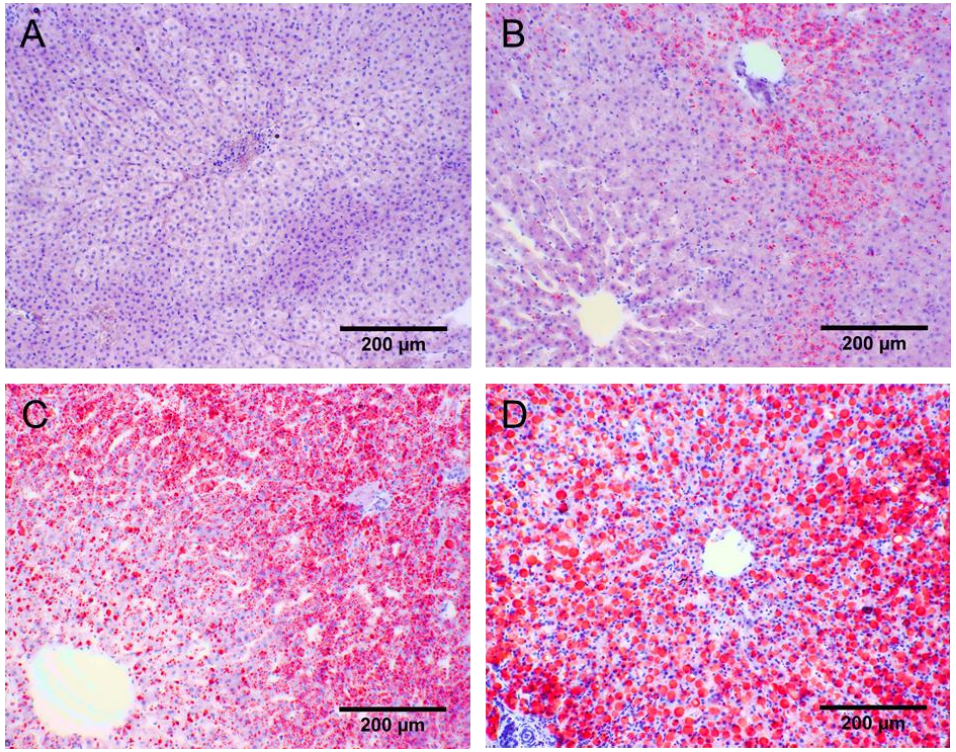


2 weeks *prepartum*
1 week *postpartum*
4 weeks *postpartum*

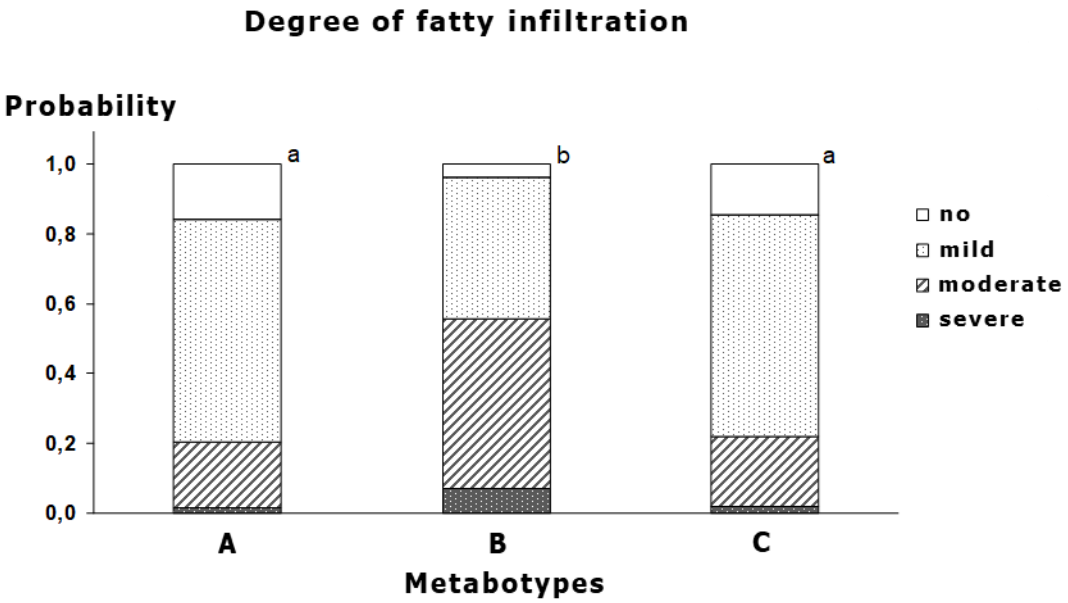
Metabotype B:

Calving between 7. February and 31. May 2016

Histopathology:



Degree of fatty infiltration of the liver (Sudan III-hematoxylin stain)
A: no fatty infiltration
B: mild fatty infiltration
C: moderate fatty infiltration
D: severe fatty infiltration

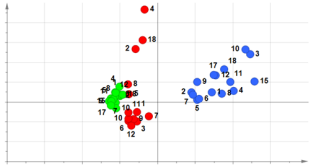


→ highest degree of fat accumulation
→ highest degree of hepatocyte degeneration
→ interrelation with degenerative, inflammatory, fibrotic, and proliferative traits

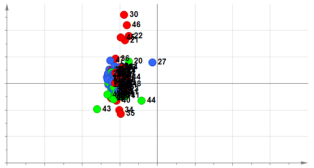
Veterinärmedizinische Fakultät

Results

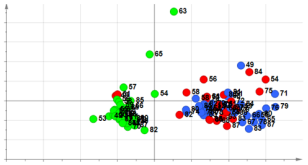
Metabotype A: Animals 1-15,17,18



Metabotype B: Animals 16, 19-48



Metabotype C: Animals 49-87



2 weeks *prepartum*
1 week *postpartum*
4 weeks *postpartum*

Metabotype B:

Calving between 7. February and 31. May 2016

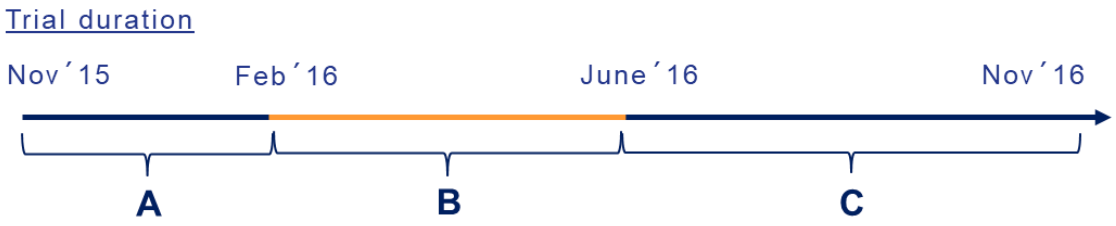
Clinical traits:

	Metabotype A	Metabotype B	Metabotype C
Circulatory system	OR = 6.0 vs. C ↑	OR = 14.5 vs. C ↑	- ↓
Digestive system	- ↓	OR = 8.3 vs. A ↑	- ↓
		OR = 29.7 vs. C ↑	
Skin	- ↓	OR = 5.0 vs. C ↑	- ↓
Jugular vein	- ↓	OR = 4.5 vs. C ↑	- ↓
Ketonuria	- ↓	OR = 13.9 vs. A ↑	- ↓
Endometritis	- ↓	OR = 16.7 vs. A ↑	- ↓
Gynaecological medication	- ↓	OR = 4.0 vs. C ↑	- ↓
Other treatments and operation	- ↓	OR = 4.4 vs. C ↑	- ↓
Average sum of scores	14.6^{B} ↓	25.5^{A} ↑	18.6^{B} ↓

Note: *Different letters indicate significant difference ($P \leq 0.05$) between metabotypes.*

Veterinärmedizinische Fakultät

Results



Overview dry cow ration – Silos

	Nov-15				Dec-15				Jan-16				Feb-16				Mar-16				Apr-16				May-16				Jun-16				Jul-16				Aug-16				Sep-16				Oct-16				Nov-16			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Corn Silage Silo 1	34																																																			
Corn Silage Silo 2					31									34																36					34																
Corn Silage Silo 3																																											27								
Grass Silage Silo 1	44																																																			
Grass Silage Silo 2					34									35																																						
Grass Silage Silo 4																			26	28						31																										
Grass Silage Silo 5																			48	26						42																										
Grass Silage Silo 6																											32																										
Grass Silage Silo 7																																33		31					29					45								
Grass Silage Silo 8																																															41	40				

Numbers indicate % DM; Dates based on ration calculation of consultant

Veterinärmedizinische Fakultät

Chemical composition of silages fed throughout the trial

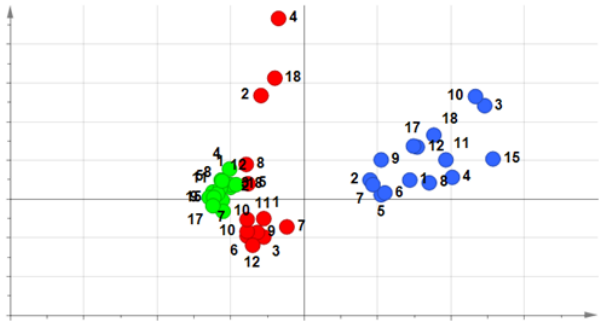
Silo	MS1	MS2	MS2	MS2	MS3	GS1	GS2	GS2	GS3	GS3	GS3	GS4	GS4	GS5	GS5	GS6	GS7	GS7	GS7
Harvest	2014	2015	2015	2015	2015	2014	2015	2015	2015	2015	2015	2015	2015	2014	2014	2015	2016	2016	2016
Analysis	18.09.	06.11.	05.02.	27.05.	09.09.	19.10.	20.11.	05.02.	19.10.	06.11.	06.11.	23.03.	29.04.	23.03.	29.04.	12.05.	13.06.	05.07.	15.08.
Date	2015	2015	2016	2016	2016	2015	2015	2016	2015	2015	2015	2016	2016	2016	2016	2016	2016	2016	2016
DM	339	309	339	361	270	440	336	353	326	298	400	278	314	258	417	315	331	307	285
Ash	28	33	36	37	47	66	73	99	100	99	83	**122**	**125**	**67**	**111**	**117**	76	87	70
CP	74	73	77	73	91	144	145	143	180	179	147	173	173	114	165	160	174	122	158
CF	190	184	192	203	247	246	257	266	263	264	265	220	232	305	250	247	300	258	280
ADF_{om}	-	-	-	-	-	275	278	286	281	283	277	221	235	324	256	259	319	271	305
$aNDF_{om}$	368	341	344	361	483	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EE	32	33	34	37	43	32	36	33	43	45	34	37	39	46	42	42	37	30	38
Starch	352	355	303	322	214	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ELOS	68	67	69	68	61	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sugar	-	-	-	-	-	76	42	13	16	4	57	26	0	7	22	3	1	53	2
HGT	-	-	-	-	-	44	43	44	39	38	51	44	41	39	39	34	42	49	45
pH	4.0	4.0	3.7	3.8	4.3	4.3	4.2	4.0	4.5	4.5	4.1	4.0	3.6	4.2	4.4	5.0	4.5	4.1	4.2
AN	7.9	4.2	9.0	9.4	6.4	6.3	8.5	8.3	11.5	12.4	5.1	7.7	11.1	8.5	16.4	22.1	9.1	7.0	8.2
piCP	-	-	-	-	-	31	28	26	25	26	17	21	22	28	28	32	19	24	20
sCP	54.1	36.6	70.8	74.9	61.9	46	52	57	55	55	64	59	59	45	49	39	60	51	61
uCP	133	133	136	135	133	131	131	129	136	135	138	141	138	119	133	128	133	130	134
RNB	-9.5	-9.7	-9.4	-9.9	-6.7	2.0	2.1	2.2	7.1	7.0	1.6	5	5.5	-0.8	5.1	5.1	6.5	-1.2	3.8
ME	11.2	11.2	11.4	11.4	10.7	10.0	10.0	9.8	9.9	9.8	10.5	10.5	10.2	9.3	9.9	9.5	9.8	10.2	10.0
NEL	6.8	6.8	6.9	6.9	6.4	5.9	5.9	5.8	5.8	5.8	6.3	6.3	6.1	5.4	5.9	5.6	5.7	6.1	5.9

Results

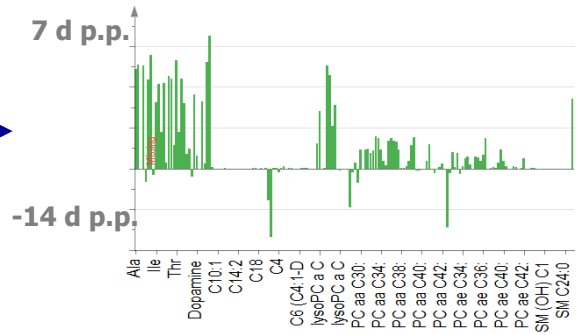
Liver

Contribution plots

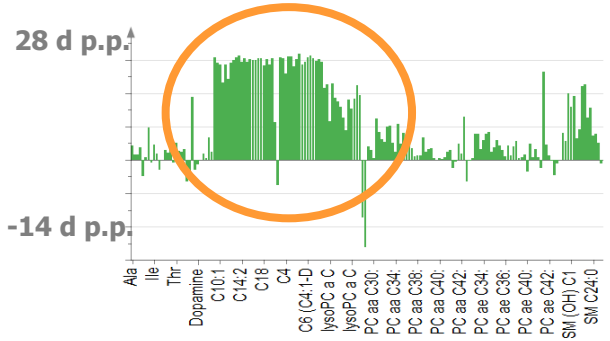
Metabotype A: Animals 1-15,17,18



-14 d p.p. <-> 7 d p.p.

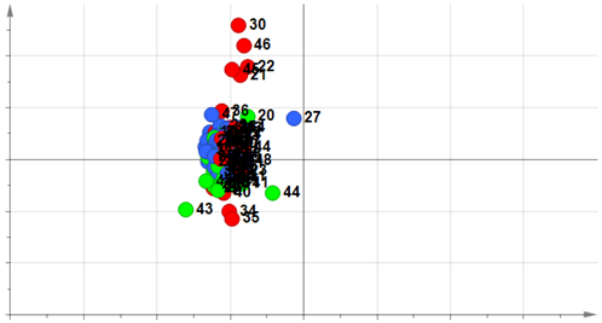


-14 d p.p. <-> 28 d p.p.

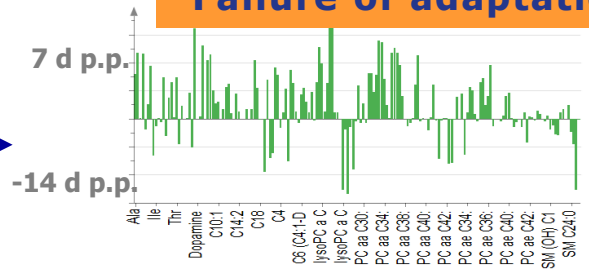


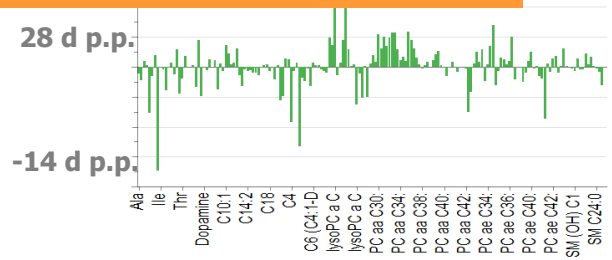
Metabotype B: Animals 16, 19-48

2 weeks *prepartum*
1 week *postpartum*
4 weeks *postpartum*

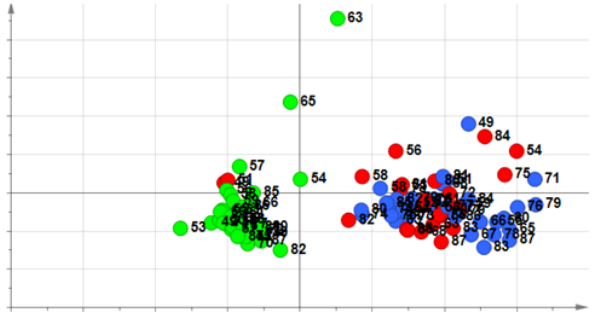


Failure of adaptation to p.p. metabolism?

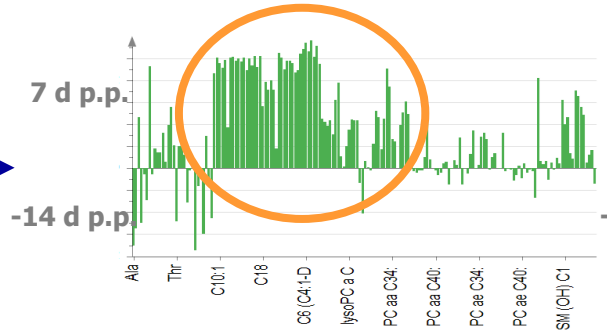


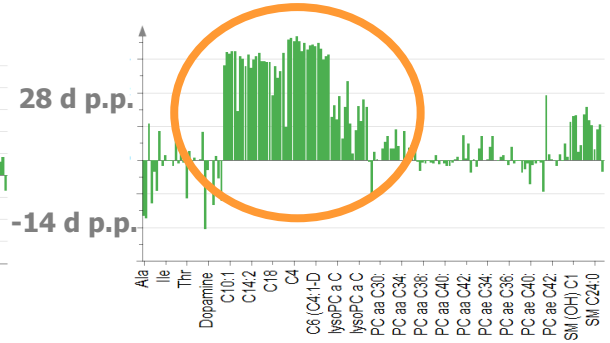


Metabotype C: Animals 49-87



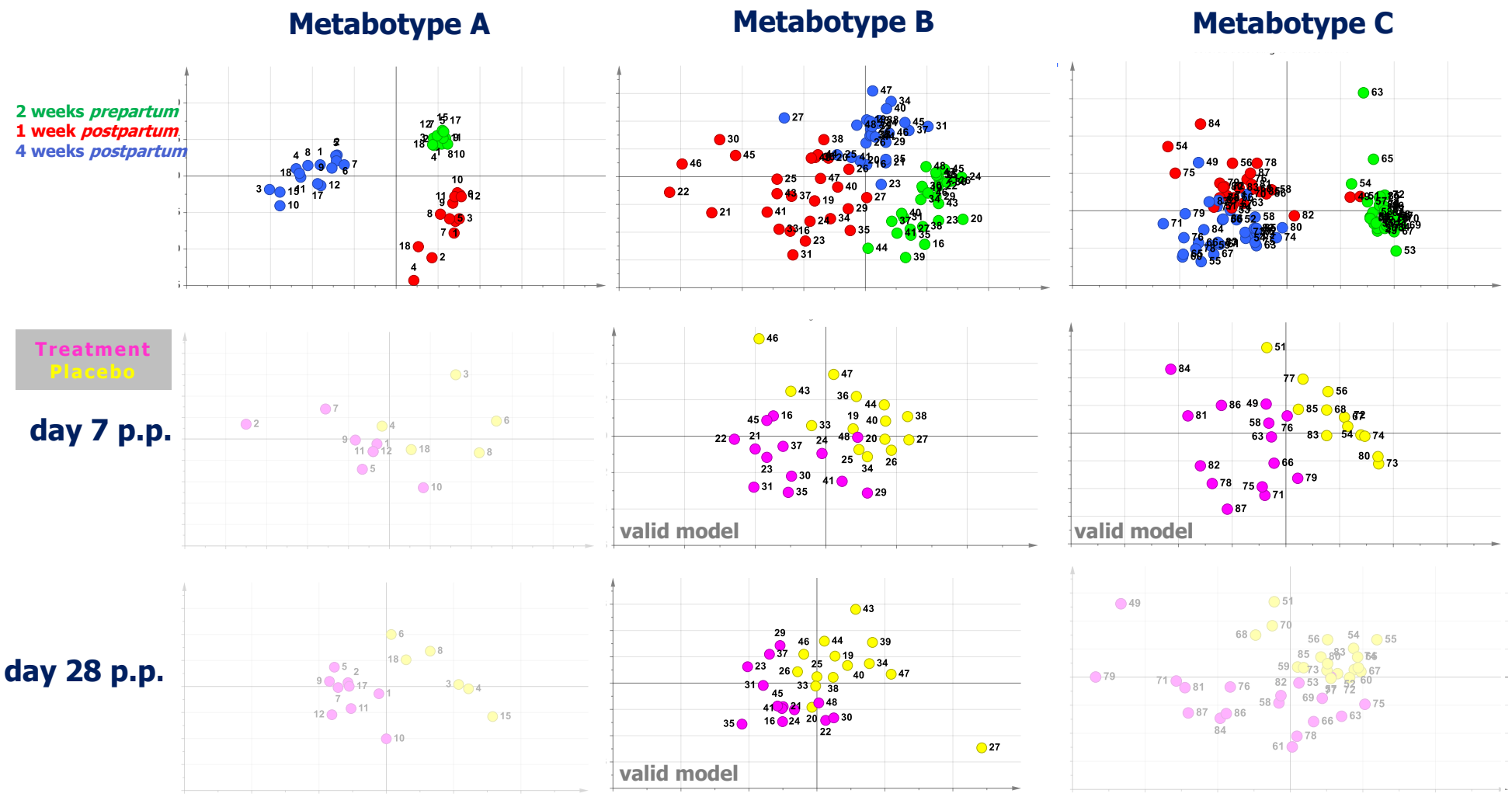
Expression of a more healthy metabolism?





Results

Liver



→ *Metabotypes also identified and treatment effects also observed in plasma and urine*

→ *Treatment effects also different between metabotypes in clinical chemistry*

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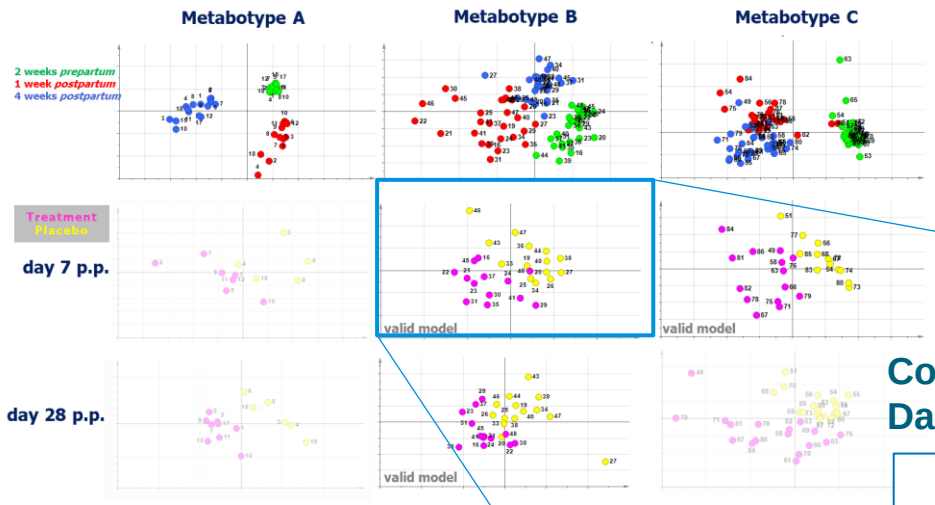
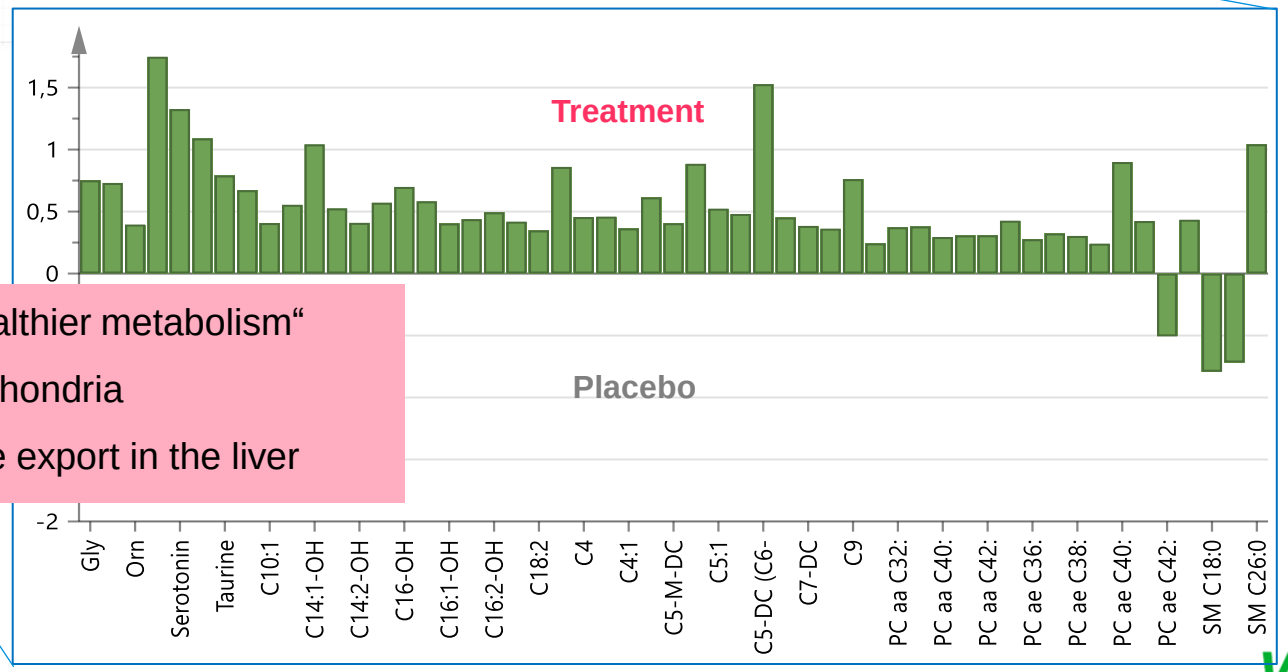
Results

Liver



„High Risk Animals“

Contributions Plot
Day 7 p.p. Group B



Treatment increases the metabolites associated with a „healthier metabolism“

→ more efficient influx and oxidation of fatty acids in mitochondria

→ increase in energy supply and more efficient triglyceride export in the liver

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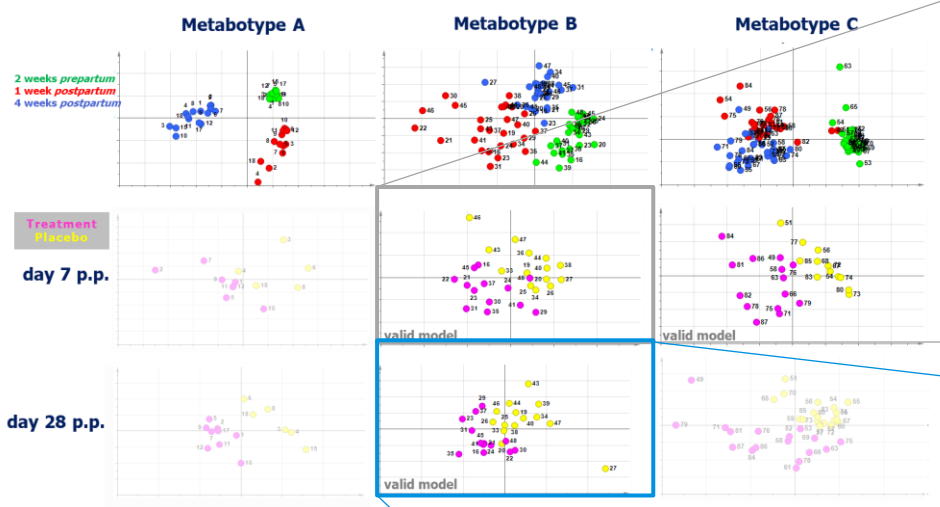
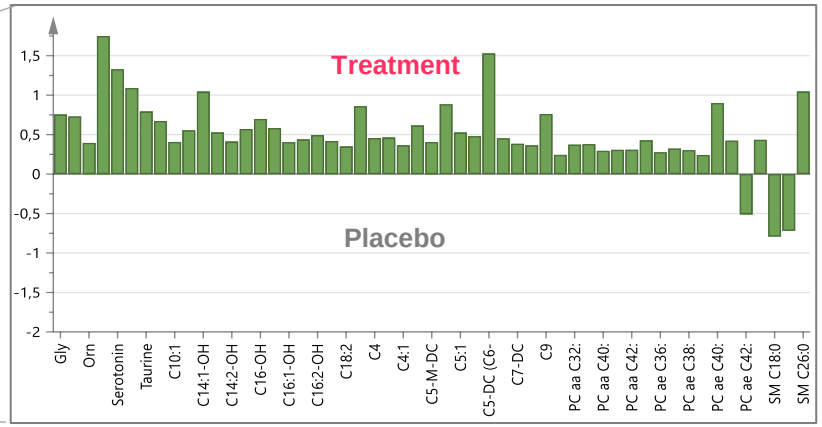
Results

Liver

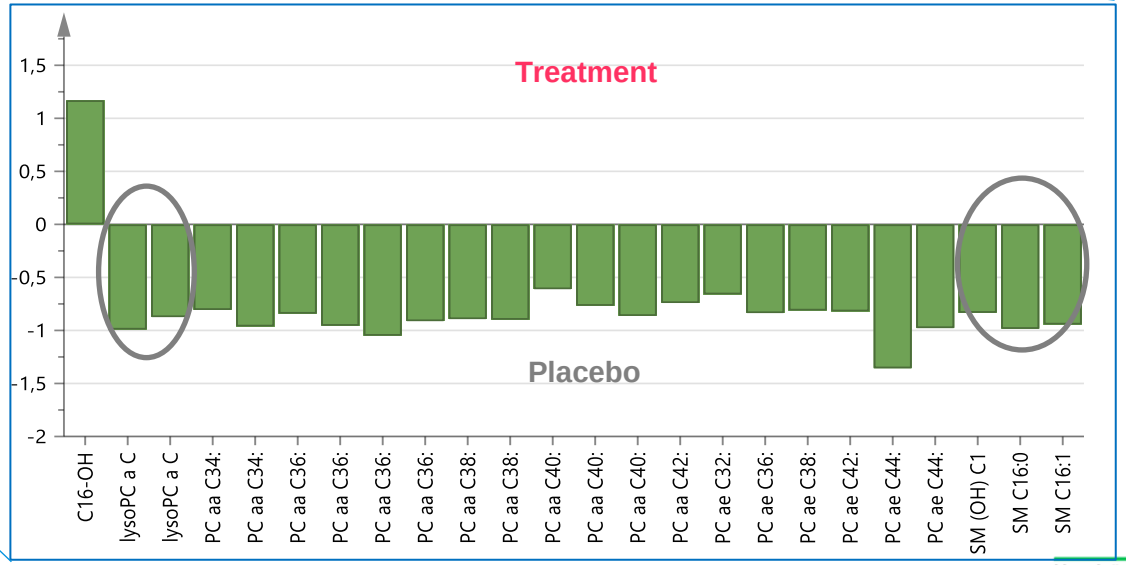


Contributions Plot
Day 7 p.p. Group B

„High Risk Animals“



Contributions Plot
Day 28 p.p. Group B



Three weeks later:
treatment animals show less unfavorable metabolites

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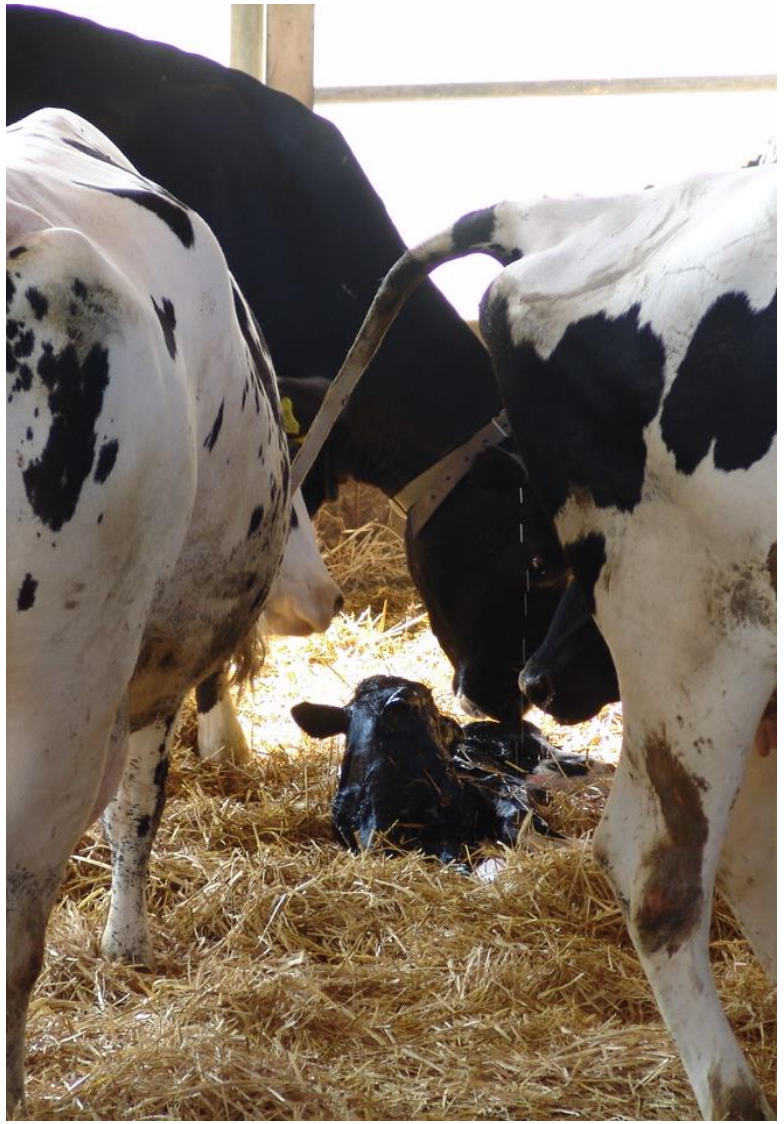
Conclusion

- Partus effect observed in liver, blood and urine metabolome
- Observation of distinct liver metabotypes
  - Interrelation with clinical phenotype and liver histopathology
  - Identification of a likely cause: grass silage quality
  - Already identified prepartum
- Different patterns in liver and blood on many levels → caution should be taken when extrapolating from blood metabolome to liver metabolism
- Treatment effect observed in liver, blood and urine metabolome
- Treatment with Butaphosphan and Cyanocobalamin (Catosal®) causes a shift towards a more favorable metabolic pattern in liver and plasma in „metabolically challenged“ animals



Veterinärmedizinische Fakultät

Publications

J. Dairy Sci. 104:9205–9226
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Aspects of transition cow metabolomics—Part I: Effects of a metaphylactic butaphosphan and cyanocobalamin treatment on the metabolome in liver, blood, and urine in cows with different liver metabotypes

M. Schären,[1*†] T. Snedec,[1*] B. Riefke,[2] M. Slopianka,[2‡] M. Keck,[2] S. Gruendemann,[2] J. Wichard,[2] N. Brunner,[3] S. Klein,[3] K. B. Theinert,[1] F. Pietsch,[1] A. Leonhardt,[1] S. Theile,[1] F. Rachidi,[1] A. Kaiser,[1] G. Köller,[4] E. Bannert,[1] J. Spilke,[5] and A. Starke[1]

J. Dairy Sci. 104:9227–9244
https://doi.org/10.3168/jds.2020-19057
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Aspects of transition cow metabolomics—Part II: Histomorphologic changes in the liver parenchyma throughout the transition period, in cows with different liver metabotypes and effects of a metaphylactic butaphosphan and cyanocobalamin treatment

F. Pietsch,[1] M. Schären,[1*] T. Snedec,[1] K. B. Theinert,[1] A.-S. Leonhardt,[1] A. Kaiser,[1] F. Rachidi,[1] D. Böttcher,[2] J. Scheinert,[2] H.-A. Schoon,[2] P. Wohlsein,[3] J. Spilke,[4] A. Haudum,[5] W. Baumgartner,[6] and A. Starke[1]

J. Dairy Sci. 104:9245–9262
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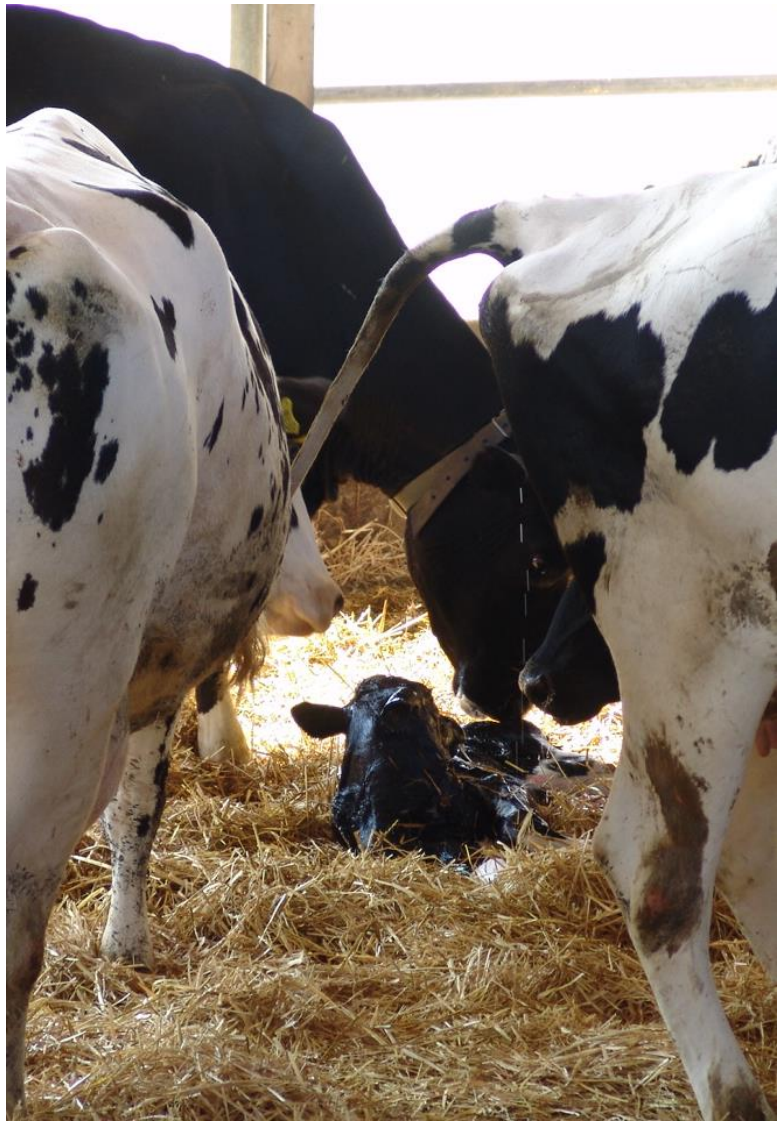
Aspects of transition cow metabolomics—Part III: Alterations in the metabolome of liver and blood throughout the transition period in cows with different liver metabotypes

M. Schären,[1*] B. Riefke,[2] M. Slopianka,[2†] M. Keck,[2] S. Gruendemann,[2] J. Wichard,[2] N. Brunner,[3] S. Klein,[3] T. Snedec,[1] K. B. Theinert,[1] F. Pietsch,[1] F. Rachidi,[1] G. Köller,[4] E. Bannert,[1] J. Spilke,[5] and A. Starke[1]



Veterinärmedizinische Fakultät

Publications

frontiers in Veterinary Science

ORIGINAL RESEARCH
published: 15 March 2022
doi: 10.3389/fvets.2022.814808

Qualitative and Quantitative Changes in Total Lipid Concentration and Lipid Fractions in Liver Tissue of Periparturient German Holstein Dairy Cows of Two Age Groups

Kirsten B. Theinert[1], Teja Snedec[1], Fabian Pietsch[1], Sabrina Theile[1], Anne-Sophie Leonhardt[1], Joachim Spilke[2], Stefan Pichelmann[3], Erik Bannert[1], Kristin Reichelt[4], Gabriele Dobeleit[4], Herbert Fuhrmann[4], Walter Baumgartner[5], Melanie Schären-Bannert[1] and Alexander Starke[1]*

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Effects of an intensive experimental protocol on health, fertility, and production in transition dairy cows

Teja Snedec,[1]* Lilli Bittner-Schwerda,[1]*† Fanny Rachidi,[1] Kirsten Theinert,[1] Fabian Pietsch,[1] Joachim Spilke,[2] Walter Baumgartner,[3] Gerd Möbius,[4] Alexander Starke,[1] and Melanie Schären-Bannert[1]
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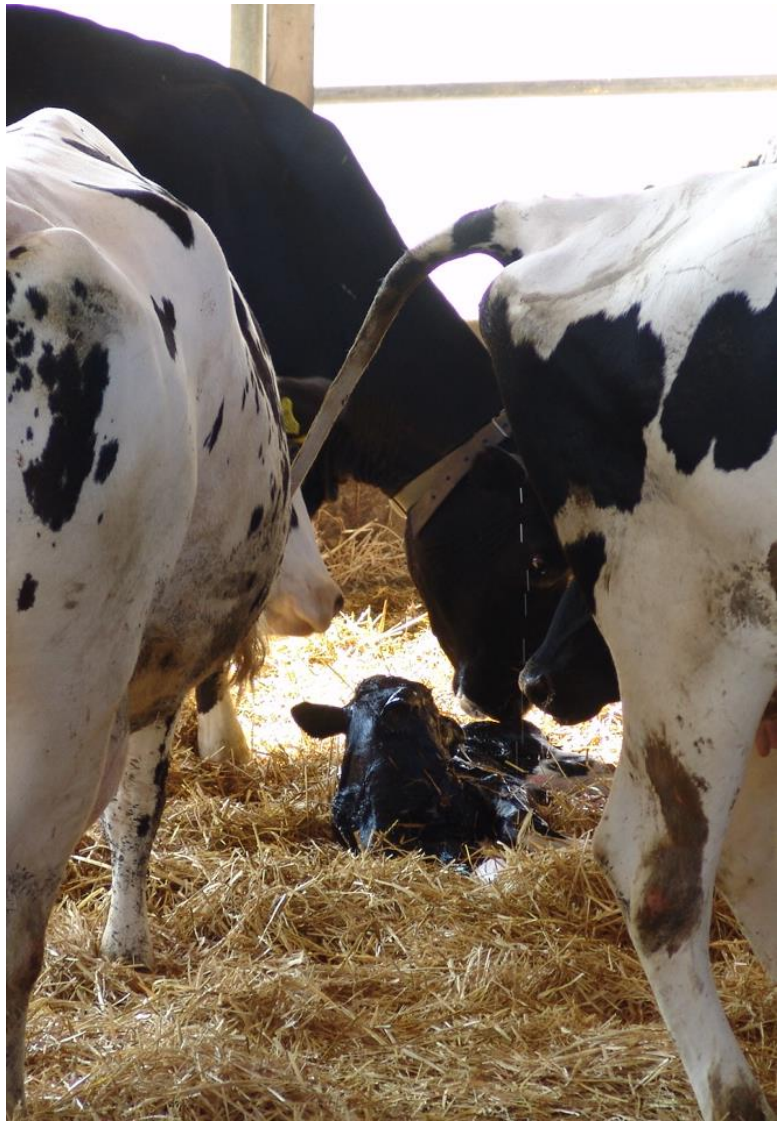
[4]Institute of Animal Hygiene and Veterinary Public Health, Faculty of Veterinary Medicine, University of Leipzig, An den Tierkliniken 1, 04103 Leipzig, Germany



Veterinärmedizinische Fakultät

European Innovation Partnership (EIP) - Project „KUH-mehr-WERT Navigator“

5 years european union funded project

Leader

LVAT Groß Kreutz

12 Farms

farms of the test-herd system in BB
Ø 550 (232 - 1.115) cows

Project-Team

- Project Coordination
- Animal Health
- Feeding
- Management Software
- Economics
- Animal Breeding
- Data Analysis

other OG-Partners

LKV Brandenburg

Rinderproduktion BB

Data Service Paretz

ADTI Leipzig

Associated Members

Univ. Halle-Wittenberg, Agr. Sciences

Univ. Leipzig, Vet. Medicine

Institute for Animal Nutrition, FLI

KUH-mehr-WERT Project

www.lvat-kmw.de

Sonderdruck Blickpunkt Rind · Fach- und Praxiswissen

Prozessstrukturierung und -controlling für Herdenverantwortliche – Wo liegen die Reserven?

Peter Hufe[1], Christina Felgentreu[1], Julia Wittich[1] und Melanie Schären-Bannert [1,2] für das KmW-Team

1) Leibniz-Institut für Nutztierbiologie und Tierhaltung (IMAT) e.V., Groß Kreutz
2) Klinik für Klauentiere der Veterinärmedizinischen Fakultät der Universität Leipzig

Das Team des EIP-Projektes „KUH-mehr-WERT Navigator" hat sich der Frage gewidmet, wie das Herdenmanagement im Alltag auf den Betrieben aussieht und Tätigkeitsfelder, Tagesabläufe, Arbeitsaufwand, Kosten und daraus folgend die Effizienz bis ins Detail analysiert. Wo liegen die Reserven und wie lassen sie sich durch Strukturierung und Controlling mobilisieren?

Datenquelle

Im Rahmen der Innovationspartnerschaft EIP „Landwirtschaftliche Produktivität und Nachhaltigkeit" wird das Projekt „KUH-mehr-WERT Navigator" (KmW) gefördert. Wie bereits in früheren Publikationen dieser Fachzeitschrift berichtet, sollen innerhalb von fünf Jahren mittels wiederholter Systemanalysen in den Arbeitsfeldern Haltungsumfeld, Beratungsmanagement, Fütterung sowie Tiergesundheit Wirkmechanismen und Risikofaktoren identifiziert, gewichtet und ökonomisch bewertet werden. Diese Daten werden die Grundlage für eine erweiterte neue Kennzahl, den „KUH-mehr-WERT" bilden. Zwölf brandenburgische Testherden-Betriebe nehmen an diesem Projekt teil. Zehn dieser Betriebe beteiligen sich aktiv am Projektteil „Tiergesundheitskosten", der wesentlichen Datenquelle für diese Publikation. Diese Betriebe hielten im Mittel 592 Kühe in Boxenlaufställen mit einer Milchmarktproduktion von 9.724 kg energiekorrigierter Milch (ECM) pro Kuh und Jahr.

Analyse der Personalkosten

Die Projektziele können nur erreicht werden, wenn für die teilnehmenden Betriebe eine detaillierte ökonomische Auswertung nach einheitlichem Muster vorliegt. Diese wurde durch den verantwortlichen Mitarbeiter gemeinsam mit den kaufmännischen Verwaltungen der Betriebe vorgenommen, durch das Projektteam plausibilisiert und ausgewertet. Die Personalkosten für die nachfolgend genannten Tätigkeitsfelder betrugen durchschnittlich 19,8 % der Vollkosten in Höhe von 44,94 € (35,83 - 49,67 €) für die Marktproduktion von 100 kg ECM. Die Kosten des unmittelbar im Stall aktiven Personals haben wir in folgende Tätigkeitsfelder untergliedert:

- Milchgewinnung
- Management Haltungsumfeld
- Fütterung
- Reproduktion
- Sonstige Tierpflege und Behandlungen
- Herdenmanagement

Wesentliche innerhalb der Tätigkeitsfelder auszuführende Arbeiten sind der Abb. 1 zu entnehmen. Der prozentuale Stundenanfall der Arbeitskraftstunden (AKh) in den einzelnen Tätigkeitsfeldern wurde zu Beginn des Projektes mittels eines Interviews mit der Geschäftsführung, dem Herdenmanagement und der Buchhaltung erfasst. Diese Anteile wurden zur Berechnung der Personalkostenverteilung in der Projekt-Benchmark verwendet. Diese betrugen im Zeitraum Juli 2020 bis Juni 2021 8,90 € (6,63 - 11,35 €) für 100 kg ECM Marktproduktion. Werden in die Betrachtung der Personalkosten ebenfalls angestellte Mitarbeiter einbezogen, wal-

Overal Conclusion

- Omics technologies help us to
  - … understand our (high yielding) cows and their physiology
  - … adapt our husbandry systems according to their needs

- In our studies: omics technologies pointed out the importance of consistency and precision in the feeding of dairy cows, as part of the herd and animal health management.

- Controlling the production process on every level and every day is key to successful dairying!