Evaluation of structural effectiveness of mixed rations for dairy cows – an on farm comparison of systems
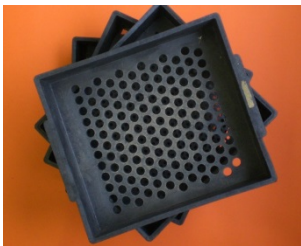
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Introduction

- Quantification of structure effectiveness constant topic in dairy cow nutrition

- Germany: to date 3 systems discussed
  (see Communications of the
       Society of Nutrition Physiology - Proceedings 2014)
  - **structure-effective crude fibre (seCF)** (Hoffmann/Piatkowski)
  - **Structure value (SV)** (de Brabander)
  - **physically effective NDF (peNDF)** (Zebeli/Steingass)

- How different do systems evaluate diets?

Application of the different structure evaluation systems to diets of farms _retrospectively_

Major questions:

1) How is ranking of systems in their fulfilment of requirement (% of requirement)?

2) How well is fulfilment of requirement correlated with indicators of diet adequateness?

- Quantification of diets on 40 farms (areas Stade + Göttingen)
  - intake (offer - orts)
  - chemical analysis of all relevant nutrients
  - particle size (Penn State Forage Particle Separator)

- <u>Statistics:</u> Mixed model, factors:
  - structure evaluation system
  - % concentrate in diet
  - % maize silage in forage
  - (% maize silage in forage)^2

  Comparison of means (Tukey-Kramer)

Material and methods

- Potential indicators for adequateness of diet

  – Milk: fat content

  – Milk: fat/protein ratio* } herd level

  – faecal score

  – chewing rate rumination (chews/min)

  – urinary net acid base excretion } 10 animals/herd (~50 d lactating)

  – Energy balance (energy deficit)

  *proportion of animals <1.0

- <u>Statistics:</u> Correlation (Pearson) of indicators with % of requirements for all structure evaluation systems

Material and methods

Composition of diets

	Mean	SD
aNDFom (% DM)	35.6	2.65
Crude fibre (% DM)	18.2	1.69
NEL[1] (MJ/kg DM)	6.9	0.25
Crude protein (% DM)	17.0	1.22

[1] NEL = net energy lactation

Material and methods

Average values for herds

	Mean	SD	Min - Max
Milk yield (kg)	33.8	$\pm$ 3.96	27.3 – 42.3
Milk fat (%)	4.03	$\pm$ 0.26	3.46 – 4.61
Milk protein (%)	3.34	$\pm$ 0.15	3.03 – 3.62
Fat/protein ratio	1.21	$\pm$ 0.11	1.06 – 1.38
No of lactations	2.70	$\pm$ 0.41	1.94 – 3.82
Days in lactation	113	$\pm$ 53	44 - 216

Structure effective fibre according to systems

- Feed (diet) evaluation

	$peNDF_{1.18}$	$peNDF_{8.0}$	SV	seCF
Average	31.4 ±3.2 [% DM]	19.8 ±4.1 [% DM]	1.59 ±0.29 [/kg DM]	2.79 ±0.44 [kg/day]

- Proportion of recommendation (%)

	$peNDF_{1.18}$	$peNDF_{8.0}$	SV	seCF
LS Mean	117[ab]	124[b]	159[c]	107[a]
(Median	101	101	150	106)

(Anova results: Significant effects of structure evaluation system, % concentrate in diet and % maize silage in forage)

Correlation of systems with indicators SARA /energy deficit

Indicators		$peNDF_{1.18}$	$peNDF_{8.0}$	SV	seCF
Fat content milk	r	0.1351	0.1827	0.3559	0.1539
	p	0.406	0.259	0.024	0.346
fat/protein ratio (% animals < 1.0)	r	-0.3591	-0.4177	-0.5478	-0.1760
	p	0.023	0.007	<0.001	0.278
chewing rate (rumin.) (chews/min)	r	-0.3414	-0.4196	-0.3031	0.1011
	p	0.031	0.007	0.057	0.535
faecal score	r	-0.1205	-0.1714	-0.1936	-0.2050
	p	0.459	0.290	0.231	0.205
net acid base excretion	r	0.1640	0.1892	0.1309	-0.0924
	p	0.312	0.242	0.421	0.571
energy balance	r	-0.5612	-0.5070	-0.3451	0.1594
	p	<0.001	<0.001	0.029	0.326

Discussion I

- Approach of this study can **<u>not</u>** tell quality of prediction of stable rumen pH (but assumption: majority of diets appropriate)

- Result 1: SV estimates highest structure-effectiveness

	peNDF$_{1.18}$	peNDF$_{8.0}$	SV	seCF
Proportion of recommendation, %				
Mean	117	124	159	107

(132)

(1.0/kg DM $\Longrightarrow$ 1.2/kg DM)

- true even if SV requirement is adapted as suggested
- confirms e.g. results of Meyer et al.(2001) (SV vs. seCF)

- Evaluation of diets high in grass silage of long particle size with peNDF (no-maize) - overestimation of structure effectiveness?

	$peNDF_{1.18}$	$peNDF_{8.0}$	SV	seCF
	% of recommendation			
Mean	117	124	159	107
without no-maize-silage diets (3 of 40)	108	112	154	108

- Correlations of indicators with structure effectiveness values for SV and peNDF promising (fat/protein content milk; energy balance)
- seCF: almost no correlation with (indirect) indicators

Conclusion

In sum: Support of peNDF as sound system for evaluation of structure effectiveness

(Potential exception based on our sample: Diets with forage of 100% grass silage of long particle size)

Thank you for your attention!