Influence of feed technology (grinding intensity/compaction) on the prececal digestibility of starch, protein and amino acids in broilers

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Introduction

A former study (Witte 2012) showed that even major differences regarding feed structure resulted in no or only minor differences in the digestibility rates of nutrients (whole tract) in broilers. The aim of this study was to evaluate possible differences in the **apparent prececal digestibility** of those diets differing in their feed structure and therefore determine the extend of a further fermentation in the hindgut of enzymatically undigested nutrients in the broiler.

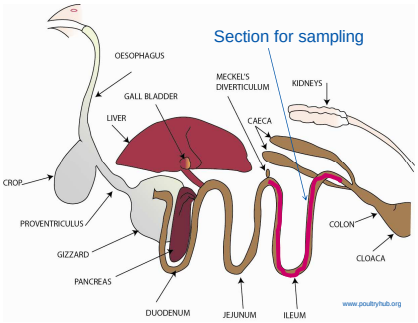
Material and methods

Animals, housing and feeding

- 168 male broilers (Ross 708)
- 7 birds per cage, 6 cages per diet
- Specific diets fed for 7 days prior to sampling
- Dissection on day 28 of life
- Feed and water offered ad libitum
- Diets: 64 % wheat , 30 % soy bean meal, commercial mineral supplement (incl. enzymes)

Digesta samples

- From the last 2/3 of the small intestine
- Digesta was gently flushed out with distilled water
- Pooled samples of 7 individuals (→ 6 samples per feeding group)



Parameters

- Feed intake and body weight gain
- Wet sieve analyses to calculate the Geometric Mean Diameter (GMD) of the experimental diets
- Content of starch (*enzymatic*), crude protein and amino acids (AA) in diets and digesta samples
- TiO_2 concentration (= marker; diets/digesta)
- Calculation of the apparent prececal digestibility rates (marker method)

$$\text{Digestibility rate (\%)} = = 100 - \left[\frac{TiO_{2diet}}{TiO_{2digesta}} \times \frac{nutrient_{digesta}}{nutrient_{diet}} \times 100 \right]$$

Results and discussion

Table 1: Geometric mean diameter (GMD) and nutrient content (%)

	Pellet fine	Pellet coarse	Pellet whole grain	Extrudate
Mill type	hammer mill	roller mill	hammer mill + intact wheat[1]	roller mill
GMD (µm)	316	468	480	244
Starch	31.2	34.3	33.5	30.7
Crude protein	20.7	21.4	21.0	21.6
Methionine	0.49	0.48	0.46	0.51
Lysine	1.21	1.28	1.23	1.24
Xylanase (U/kg)	800	550	617	163

[1] 22% intact grains included into the pellet

As shown in Table 1, the compaction process had a clear influence on the xylanase activity in the diet with a marked decline in the diet "Extrudate". Irrespective of the expected negative influence of a low xylanase activity on the viscosity of the digesta the birds in the group "Extrudate" showed the highest prececal digestibility rates for protein and amino acids (Table 3).

The relevance of particle size for the digestibility of amino acids is shown in Figure 1: The diets "Pellet coarse" and "Pellet whole grain", characterized by a higher GMD, constantly led to lower prececal digestibility rates than the diets with the reduced particle size.

Table 2: Performance parameters (during the digestibility trial)

	Pellet fine	Pellet coarse	Pellet whole grain	Extrudate
Feed intake (g/day)	152 ± 7.64	149 ± 4.88	147 ± 12.2	135 ± 8.87
Body weight gain (g/day)	84.8^{ab} ± 20.4	89.3^{b} ± 12.8	81.3^{a} ± 21.6	77.8^{a} ± 18.2
FCR (feed:gain)	1.77 ± 0.08	1.68 ± 0.05	1.75 ± 0.08	1.74 ± 0.07

Table 3: Prececal digestibility rates (%) of the different diets

	Pellet fine	Pellet coarse	Pellet whole grain	Extrudate
Feed intake prior to slaughter (g)	180 ± 23.8	186 ± 12.2	187 ± 12.8	180 ± 17.1
Starch	94.1 ± 2.10	95.9 ± 2.31	95.1 ± 1.39	96.3 ± 1.29
Crude protein	80.9^{b} ± 4.07	77.8^{a} ± 4.04	76.7^{ab} ± 4.23	85.7^{c} ± 3.09
Methionine	90.6^{b} ± 2.63	88.0^{a} ± 2.32	86.3^{a} ± 2.52	92.2^{b} ± 1.58
Lysine	82.4^{a} ± 4.13	80.2^{a} ± 4.36	79.2^{a} ± 4.21	86.6^{b} ± 2.68

Irrespective of the digestibility rate, animals from the group "Pellet coarse" showed the best feed conversion ratio during the experimental period. Regarding these results, a high feed intake is perhaps more important for a high fattening performance than the digestibility of the diet per se?

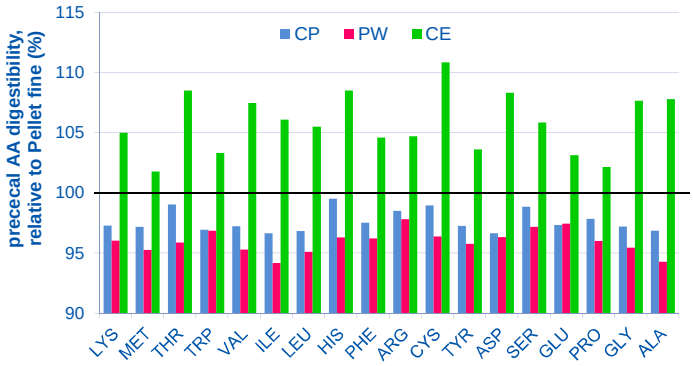


Figure 1: Prececal AA digestibility of the diets Pellet coarse (CP), Pellet whole grain (PW) and Extrudate (CE) compared to Pellet fine (= 100 %)

Conclusion

This study showed that first, **feed structure** had no influence on prececal starch digestibility in broilers, even the diet with 22 % whole grains within the pellet was efficiently digested. In contrast, regarding protein digestibility a smaller particle size and/or further hydrothermal treatment (extrusion) seems to be beneficial. And second, a marked reduction of **xylanase activity** (diet "Extrudate") did not impair the prececal digestibility rate of crude protein or amino acids. And last but not least, in comparison with the data of Witte et al. (2012) it can be stated that **hindgut fermentation** is of minor relevance for starch but occurs in a relevant amount for crude protein (N-corrected total tract digestibility for crude protein: about 86 % in all four groups).

References: Witte, M., B. Üffing, S. J. Sander, M. Tost, J. Kamphues (2012), Proc. Soc. Nutr. Physiol. 21, 140

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