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Grass pea seeds as protein-rich feed for weaned piglets

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Abstract

Under the conditions of organic agriculture, a feeding trial was conducted in order to test raw and toasted grass pea seeds as protein-rich feed for weaned piglets. Toasted grass pea seeds at inclusion rates of 20-30% (as fed basis) in diets were found to be a palatable protein-rich feed, resulting in feed intake and body weight gain similar to the control diet. Including 20% raw grass pea seeds, however, led to significantly lower body weight gain and consequently a significantly higher feed conversion ratio. Therefore, if 20% or more raw grass pea seeds are included in diets for weaned piglets, toasting of grass pea seeds prior to feeding is recommended in order to avoid performance deficits.

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Introduction

The European market for organically produced pork is still a small niche, partly due to the inadequate supply with cost-efficient high-quality protein feeds. The research project ICOPP (Improved contribution of local feed to support 100% organic feed supply to pigs and poultry) is addressing this issue, and is helping to further develop organic pig and poultry production in Europe. As part of ICOPP, a feeding trial was conducted in which grass pea seeds were included in diets for weaned piglets. The grass pea (*Lathyrus sativus*) is a grain legume that prospers both under drought and waterlogged conditions and produces seeds with crude protein contents between 200 and 300 g kg^{-1} (as fed). Unfortunately, it contains the neurotoxin ODAP, which causes nerve damage after prolonged and/or intensive feeding. Since ODAP is water-soluble and susceptible to heat, hydrothermal treatment (=toasting) greatly reduces toxicity. Therefore both raw and toasted grass peas were fed in the feeding trial.

Animals, material and methods

Grass pea seeds were purchased from an organic farmer in the Austrian province of Burgenland, and toasting was done at 98° C for 20 minutes. The feeding trial took place at the Austrian Research and Education Center, Institute of Biological Agriculture and Biodiversity of Farm Animals in Wels, Austria, between May and November 2012. The experimental design was a complete 4 x 4 latin square with 4 diets, each fed to one group of piglets per replicate, and four replicates. Diets were fed to a total of 144 piglets (crosses of [Landrace*Large White]*[Pietrain*Duroc]) during the 4-week rearing phase which started immediately after weaning at 47 ± 5.5 days. Division into four equally large groups was done based on body weight, sex, sow and blood haptoglobin level. No piglet died throughout the feeding trial, but 4 piglets suffering from severe diarrhoea were removed from the trial as a precaution. Each group of piglets was housed in a straw bedded pen of 5 x 1.7 m equipped with a creep area, drinkers and an outdoor area of 3 x 1.7 m. Feeding was restricted, using an automatic feeding system programmed to supply feed 5 times a day, in amounts slightly increasing every day. Four isocaloric diets with a similar lysine content were compared: A control diet (C), one diet containing 20% raw grass pea seeds (R 20), and two diets with toasted grass pea seeds (20 [T 20] and 30% [T 30], respectively; as fed basis). While the control diet contained 19% peas and 17% soybean cake, grass pea seeds completely replaced the peas in all experimental diets, and soybean cake was reduced to 13% in diets R 20 and T 20, and further to 7% in diet T 30. In Table 1, the nutrient contents of the diets are summarised.

Table 1: Nutrient contents of the diets, g kg^{-1} (as fed) unless stated otherwise

	C	R 20	T 20	T 30
Crude protein	182	178	180	177
Lysine	9.7	9.2	9.5	9.4

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Lys:Meth+Cyst: Thr:Try	1:0.61: 0.64:0.21	1:0.62: 0.65:0.21	1:0.60: 0.64:0.20	1:0.60: 0.64:0.20
NDF[a]	118	115	114	117
ADF[b]	61	62	61	64
Starch	401	412	412	421
Sugar	42	42	42	39
Energy, MJ ME[c]	13.5	13.6	13.6	13.5
g Lys / MJ ME	0.72	0.68	0.70	0.70
Calcium	7.6	6.8	7.2	7.0

[a] Neutral detergent fibre; [b] Acid detergent fibre; [c] Metabolisable energy

Piglets were weighed weekly, and feed intake was automatically documented by the feeding system. Whenever symptoms of diarrhoea were observed, all piglets were given tea of *Cortex quercus*, dry peat and an electrolyte solution. Persisting diarrhoea in individual piglets was treated with antibiotics (Baytril®). Statistical analysis of body weight data was performed using SAS 9.1 procedure MIXED with a model including the random effect of piglet nested within treatment, the fixed effects diet, pen, replicate, sow nested within replicate, day, body weight at weaning, and the interaction diet*day. The covariance structure TOEP (Toeplitz) was used. For analysis of feed intake and feed conversion ratio procedure GLM was used, with a model including the fixed effects of treatment, pen, replicate, day and day*day. Pairwise comparison of means was done using the Tukey Test. Statistical differences were considered to be significant at $P<0.05$, and differing superscripts indicate significant differences. Tables 2 and 4 show ls-means for diets from regression analysis, P values for the effect of diet and R^2 values. Table 3 gives the ls-means and the P value for the interaction diet*day and the residual standard deviation (s_e).

Results

Including grass pea seeds in the diet had no significant influence on feed intake of the piglets, even though feed intake was numerically lowest for diet R 20 (see Table 2). On average, piglets consumed 731 g feed day^{-1} (as fed basis).

Table 2: Average feed intake of piglets, g d^{-1} (as fed)

	Diet				P value	R^2
	C	**R 20**	**T 20**	**T 30**		
Week 1	355	296	321	336	0.102	0.75
Week 2	652	593	617	633		
Week 3	895	836	860	876		
Week 4	1085	1026	1050	1066		
Total	758	701	723	742		

The body weight development of the piglets did not differ between the control diet and the two diets containing toasted grass pea seeds, whereas including raw grass pea seeds in diet R 20 had a significantly negative effect, as shown in Table 3: Two weeks after weaning, piglets fed diet R 20 weighed significantly less than all other groups, and this difference became even more pronounced with time. At the end of the rearing phase, piglets fed the control diet had reached an average body weight of 24.3 kg, while piglets fed diet R 20 only weighed 21.6 kg.

Table 3: Body weight of piglets, ls-means of interaction diet*day, kg

	Diet				P value	S_e
	C	**R 20**	**T 20**	**T 30**		
Day 1	13.0	12.9	12.9	12.9	<0.001	1.44
Day 8	13.5	13.2	13.3	13.4		
Day 15	15.9^{b}	15.1^{a}	15.7^{ab}	16.0^{ab}		
Day 22	20.2^{b}	18.3^{a}	19.5^{b}	19.5^{b}		
Day 29	24.3^{c}	21.6^{a}	23.7^{bc}	23.4^{b}		

Feed conversion ratio was similarly affected by dietary treatment, and feeding raw grass pea seeds led to a significantly higher feed conversion ratio (see Table 4). Over the whole rearing phase, 2.28 kg of diet R 20, but only 1.96 kg of diet C was needed to achieve 1 kg of body weight gain. The diets containing toasted grass peas did not differ from the control diet.

Table 4: Average feed conversion ratio of piglets, kg feed intake / kg body weight gain

	Diet					
	C	**R 20**	**T 20**	**T 30**	P value	R^2
Week 2	1.78	2.13	1.75	1.83		
Week 3	1.71	2.06	1.68	1.76	0.007	0.39
Week 4	1.88	2.23	1.84	1.92		
Total	1.96a	2.28b	1.92a	2.00a	0.001	0.95

Discussion

Toasted grass pea seeds at inclusion rates of 20-30% (as fed basis) in diets for weaned piglets resulted in feed intake and body weight gain similar to the control diet. However, including 20% raw grass pea seeds led to significantly lower body weight gain and consequently a significantly higher feed conversion ratio. This observation is in accordance with Schipflinger et al. (2011), who found a slightly higher body weight gain in piglets when 20% toasted grass pea seeds were included in the diet (as fed basis) instead of raw grass pea seeds. When feeding diets with 10-40% (as fed basis) raw grass pea seeds to conventionally reared piglets, Castell et al. (1994) observed a significant reduction in feed intake and body weight gain that increased proportionally with the share of grass pea seeds in the diet. For fattening pigs, Winiarska-Mieczan and Kwiecien (2010) recommend that raw grass pea seeds should not exceed an inclusion rate of 50% of the protein-rich feeds (as fed basis) in the diet. In the presented trial, this would have translated to 19.5% (as fed basis) grass pea seeds in the diet. Assuming that newly weaned piglets react more sensitively to anti-nutritive factors than fattening pigs, the current observations complement the recommendation by Winiarska-Mieczan and Kwiecien (2010) quite well. Because neither ODAP nor trypsin inhibitors or other anti-nutritive factors were analysed in the grass pea seeds, the negative effect of raw grass pea seeds cannot be directly ascribed to ODAP. The observed negative effects will more likely have been the combined result of all anti-nutritive factors present in grass pea seeds.

References

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