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Sainfoin seeds as protein source for weaned piglets – a new utilization of a long-known forage legume –

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Abstract

Sainfoin (Onobrychis viciifolia) has been used as a forage legume for centuries and is also popular for use as green manure in some Austrian regions, but so far the protein-rich seeds have not been utilized as a feedstuff. As part of the EU Core Organic II research project ICOPP (Improved contribution of local feed to support 100% organic feed supply to pigs and poultry), sainfoin seeds have recently been tested as a protein source for weaned piglets. The protein-rich components of the control diet were peas and soybean cake, which were substituted by sainfoin seeds in the experimental diets H (10% sainfoin seeds), D 10 and D 16 (10 and 16% dehulled sainfoin seeds, respectively; as fed basis). Neither feed intake and body weight gain nor feed conversion ratio differed between treatments. This leads to the conclusion that sainfoin seeds can be used as a protein source for piglets just as well as peas and soybean cake.

Key words: Sainfoin, protein, piglets, legume

Introduction

On January 1, 2012 the obligation to feed all organic pigs in the EU with 100% organic feed should have come into effect, but the temporary arrangement allowing 5% conventional feedstuffs was extended. Nonetheless the challenge of ensuring adequate supply of high-quality protein feeds for organically reared pigs needs to be addressed.

As part of the EU Core Organic II research project ICOPP (Improved contribution of local feed to support 100% organic feed supply to pigs and poultry), a feeding trial was conducted in which sainfoin (*Onobrychis viciifolia*) seeds were fed to weaned piglets. Sainfoin as a tanniniferous and therefore non-bloating forage legume for ruminants and horses has been used for centuries in Europe, but the high-protein seeds have only been fed in times of feed shortage. In several Austrian regions organic farmers plant sainfoin as green manure, therefore seed surpluses could be fed to pigs, given that the results of relevant feeding trials are satisfactory.

Animals, materials and methodology

Sainfoin seeds were purchased from an organic farmer in the Austrian province of Burgenland, and a centrifugal dehulling machine was used for dehulling.

The feeding trial took place at the Institute of Biological Agriculture and Biodiversity of Farm Animals in Wels, Austria (LFZ Raumberg-Gumpenstein) between November 2011 and May 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 137 piglets (crosses of [Landrace*Large White]*[Pietrain*Duroc]) during the 4-week rearing phase which started immediately

after weaning. Piglets were weaned at an age of 43 ± 2.0 days and divided into four groups of 9 piglets each (except in replicate 3 where each group consisted of 8 piglets) based on body weight, sex, sow and blood haptoglobin level. Throughout the feeding trial a total of 3 piglets died, two of them because of severe diarrhoea and one of unknown reasons. The piglets were housed in groups, in straw bedded pens of 5 x 1.7 m equipped with a creep area, drinkers and an outdoor area of 3 x 1.7 m.

Piglets were restrict fed using an automatic feeding system that was programmed to supply feed 5 times a day, in amounts slightly increasing every day. Four experimental diets were compared: A control diet (C), one diet containing 10% sainfoin seeds with hulls intact (H) and two diets with completely dehulled seeds (10 [D 10] and 16% [D 16], respectively; as fed basis). The protein-rich components of diet C that were substituted by sainfoin seeds were peas and soybean cake. Nutrient contents of the diets are summarized in table 1. Among the collected data were body weight (piglets were weighed weekly) and feed intake (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).

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

	C	H	D 10	D 16
Crude protein	182	191	191	197
Lysine	9.6	10.0	9.5	9.6
Lys:Meth+Cyst:Thr:Try	1:0.63:0.67:0.21	1:0.63:0.66:0.21	1:0.69:0.71:0.23	1:0.70:0.69:0.23
NDF*	157	171	164	162
ADF**	63	73	65	67
Energy, MJ ME***	13.8	13.6	13.9	13.8
g Lys / MJ ME	0.70	0.74	0.68	0.70
Calcium	12.4	11.9	10.3	9.9

* NDF: Neutral detergent fiber; ** ADF: Acid detergent fiber ***ME: Metabolizable energy

Statistical analysis of body weight was performed using proc mixed of SAS 9.1, with a model including the random effect of piglet nested within treatment and the fixed effects treatment, pen, replicate, sow nested within replicate, day and body weight at weaning. The covariance structure UN (unstructured) was used. Feed intake and feed conversion ratio (FCR) were analysed using proc glm, 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 $p < 0.05$. Tables 2-4 show ls-estimates for treatments from regression analysis, p values for the effect of treatment and R^2 or residual standard deviation (s_e).

Results

The sainfoin seeds with hulls intact/dehulled contained 279 and 388 g crude protein, 295 and 136 g NDF, 238 and 111 g ADF, 11.1 and 15.3 MJ ME and 15.4 and 20.8 g lysine (as fed basis), respectively. The proportion of lysine:(methionine+cysteine): threonine: tryptophan was 1:0.57:0.60:0.17.

Neither feed intake and body weight nor feed conversion ratio of weaned piglets were significantly influenced by treatment, although slight numerical differences were observed. Pairwise comparison of treatment means with the Tukey test did also not show any significant differences (Tables 2 to 4).

Table 2. Average feed intake of piglets, g d-1 (as fed)

	Dietary treatment				P value	R^2
	C	H	D 10	D 16		
Week 1	325	315	314	316	0.765	0.95
Week 2	545	535	535	537		
Week 3	816	806	805	807		
Week 4	1137	1128	1127	1129		

At weaning, piglets weighed on average 12.9 ± 1.7 kg, and reached an average body weight of 24.4 ± 4.4 kg at the end of the 4-week rearing phase (see table 3).

Table 3. Average body weight of piglets, kg

	Dietary treatment				P value	s_e*
	C	H	D 10	D 16		
Day 8	13.7	13.7	13.8	13.5	0.349	2.11
Day 15	16.1	16.1	16.2	15.9		
Day 22	19.7	19.6	19.8	19.5		
Day 29	24.3	24.3	24.4	24.1		

*s_e = Residual standard deviation

The feed conversion ratio during the first week after weaning was considerably higher than during the remaining three weeks of the rearing phase. On average, 2.11 kg of feed were needed to achieve 1 kg of body weight gain.

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

	Dietary treatment				P value	R^2
	C	H	D 10	D 16		
Week 1	3.05	3.20	3.08	3.30	0.677	0.55
Week 2	1.83	1.98	1.86	2.09		
Week 3	1.40	1.54	1.42	1.65		
Week 4	1.75	1.90	1.78	2.01		

Discussion

Back in 1947 Woodman and Evans published a digestion trial testing sainfoin seeds as feed for sheep. The idea behind it was that especially during times of severe feed shortage - World War II was just barely over - seed quantities that were discarded due to unsatisfactory germination should not go to waste. Because of the hulls crude fiber content of the seeds was 178.6 g kg^{-1}, but still crude protein content was as high as 263.8 g kg^{-1} (as fed basis). Sainfoin seeds were found to be palatable and the authors concluded that seed surpluses could be successfully utilised as feed.

The present experiment is the first published work since then, and it allows the conclusion that sainfoin seeds can be a valuable feed for piglets. The lack of difference in feed intake was of course the result of restrict-feeding of the piglets. But since the ensuing body weight gains did not differ as well no significant differences in feed conversion ratio could be found, proving that sainfoin seeds provided protein just as well as the protein-rich peas and soybean cake which they were substituted

for. The observed growth level is in accordance with findings of Vielhaber et al. (2010) who examined the effect of plant-derived feed additives on diarrhea in organic piglets.

In organic animal husbandry phytotherapeutic products shall be used in preference to antibiotics, therefore phytotherapy measures were taken when symptoms of diarrhoea were observed and only individual piglets were treated with antibiotics unless their condition improved. Most of the piglets recovered without administration of antibiotics, but one of the consequences of this approach was that on average the piglets showed a growth depression in the first week after weaning. This is reflected in a considerably higher feed conversion ratio in week 1 as compared to the remaining three weeks. Similar observations have been reported previously, e.g. Officer et al. (1995) found feed conversion ratios of 2.44 during the first week after weaning and 1.76 in the following three weeks in the control ration of a feeding trial supplementing diets of early-weaned piglets (29 days at weaning) with enzymes.

Suggestions to tackle the future challenges of organic animal husbandry

Utilizing locally available surpluses of unconventional feedstuffs is only one out of several options to master the challenge of the currently existing protein deficit in organic pig nutrition. Sainfoin seeds are a promising protein source for pigs and other non-ruminants. However, in order to avoid potential bottle necks in the feed supply of organic livestock, other options (e.g. optimized feeding management, channeling high protein feedstuffs towards livestock categories with the greatest demand) need to be addressed simultaneously.

References

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