YOUNG PIGS SHOW DIETARY PREFERENCES FOR TRYPTOPHAN

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Summary: A choice feeding trial was carried out over a period of 6 weeks to investigate, whether piglets show preferences for diets with various tryptophan (Trp) concentrations and whether these preferences change with time. Piglets were randomly subdivided into 6 groups of 8 pigs each. Three reference groups (treatments (treat) 1 to 3) were fed either 0.09 % Trp, 0.16 % Trp or 0.24 % Trp diets. Three other groups had the choice from 2 diets containing 0.09 or 0.16 % Trp (treat 4), 0.09 or 0.24 % Trp (treat 5), or 0.16 % or 0.24 % Trp (treat 6). Piglets of treat 4 and 5 selected equal amounts of both diets on offer at random at the start of the experiment. Over the time course of the experiment, they developed a preference for the respective diet higher in Trp concentration and consumed almost exclusively this diet at the end of the experiment. On the contrary, animals given the choice of 0.16 and 0.24 % Trp diets consumed approximately equal amounts of both diets throughout the experiment. It is concluded that piglets are able to distinguish between diets with various Trp concentrations and that dietary selection is linked to the piglet's requirement.
Key words: dietary selection, tryptophan, piglets.

PARŠELIAI RENKASI RACIONĄ SU TRIPTOFANU

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Santrauka. Atliktas 6 savaičių šėrimo bandymas. Juo buvo siekiama nustatyti, ar paršeliai renkasi racionus su triptofanu, ar jie kinta, kintant laikui. Buvo sudarytos šešios paršelių grupės, po aštuonis paršelius kiekvienoje. Trijų tiriamų grupių paršeliai buvo šeriami 0,16 proc. Trp arba 0,24 proc. Trp racionais. Kitų trijų grupių paršeliai galėjo pasirinkti racioną su 0,09 ar 0,16 proc. Trp (4 bandymas), 0,09 ar 0,24 proc. Trp (5 bandymas) 0,16 proc. ar 0,24 proc. Trp (6 bandymas). Ketvirtosios ir penktosios grupės paršeliai pasirinko tokį patį racioną, koks buvo pasiūlytas eksperimeno pradžioje. Eksperimento eigoje buvo pastebėtas raciono su triptofanu pasirinkimas, iki eksperimento pabaigos šis racionas buvo beveik sunaudotas. Priešingai, gyvuliai, kurie galėjo pasirinkti tarp 0,16 ir 0,24 proc. Trp racionų, sunaudojo beveik vienodą racionų kiekį viso eksperimento metu. Taigi galima teigti, kad paršeliai gali pasirinkti racionus su įvairiomis triptofano koncentracijomis, ir šis pasirinkimas susijęs su individualiais poreikiais.
Raktažodžiai: raciono pasirinkimas, triptofanas, paršeliai.

Introduction. Several studies have shown that growing pigs given a choice of feeds deficient or adequate in lysine content will show a specific preference for lysine in order to avoid and partly redress lysine deficiency (Henry 1987, 1993; Kirchgessner et al. 1999). Moreover it has been demonstrated that such a feeding behaviour is not only shown by pigs given a choice of diets varying in their lysine content, but that pigs are also able to show specific preferences for threonine (Ettle and Roth 2005) or methionine (Roth et al. 2006). Nevertheless, in none of these studies responses were as high as the preference of piglets for a diet more adequate in tryptophan (Trp) concentration over a diet clearly deficient in Trp (Ettle and Roth 2004). In this study, piglets rejected a diet with a Trp concentration of 0.11 % almost to the maximum possible extend, what may be seen as a result of involvement of Trp in feed intake regulation. On the other hand, the alternative diets given to the animals for a choice in this study were set slightly below or at the suggested Trp requirement of piglets. Thus, the question remained whether piglets are able to balance the intake of two diets offered simultaneously for a choice, when one of these diets is below and the other diet is above the suggested Trp requirements. For this reason, the present study was conducted to evaluate the feeding behaviour of piglets given free choice of diets with various Trp concentrations ranging from marginal supply to a slight excess.

Material and methods. The experiment was conducted over a period of 6 weeks and used 48 crossbred piglets (German Landrace x Piétrain) with an initial body weight of 7.45 ± 0.70 kg. Female as well as male piglets were randomly subdivided into six groups of eight animals each. Animals of treatment (treat) 1 to 3 were

used as reference groups whereas animals of treat 4 to 6 were given the choice of two diets with various Trp concentrations. Trp concentrations in diets given to animals of treat 1 to 3 were 0.09, 0.16 and 0.24 %, respectively. Animals of treat 4 to 6 were offered simultaneously pairs of diets with Trp concentrations of 0.09 or 0.16 % (treat 4, Trp choice 1), 0.09 or 0.24 % (treat 5, Trp choice 2) or 0.16 or 0.24 % (treat 6, Trp choice 3), respectively. The experimental design is given in table 1. The piglets were housed in individual pens (size: 60 x 100 cm) in a fully air-conditioned experimental piggery with free access to the diets and drinking water provided by nipple drinkers placed in the corner at the backside of the pen. Left over feed was removed from the feeders and weighed back twice weekly. After removing the feed, piglets had no access to feed for about 30 min. At refilling the feeders, the position of the two diets of the Trp choice groups were altered in the feeders in order to exclude influences of position of diets on selection behaviour. Animal housing and care was conducted under supervision of the veterinarian office of the Bavarian government. The handling protocol ensured proper care and treatment of all animals in conformity with the German law for animal protection.

Table 1: **Experimental design**

Treatment	Reference groups			Trp choice groups		
	1	2	3	4	5	6
	Diet 1	Diet 2	Diet 3	Diet 1/2	Diet 1/3	Diet 2/3
Diets on offer (Trp, %)	0.09	0.16	0.24	0.09 / 0.16	0.09 / 0.24	0.16 / 0.24

Measurement criteria were feed intake, proportions of ingested diets in amino acid choice groups, growth performance criteria and plasma amino acid pattern.

The effect of the intake of the respective amino acid on food intake, growth performance and plasma amino acid pattern was tested for statistical significance ($p < 0.05$) by Student-Newman-Keuls test using the statistic package of SAS (SAS Inst., Inc., Cary, NC).

Results. In the negative control group (treat 1), feed intake and daily gains were depressed ($p < 0.05$) compared to all other treatments. Animals of treat 6 had daily gains of about 360 g, which were significantly higher than observed in animals of treat 4. Daily gains in treat 2, 3 and 5 were not different from daily gains in animals of treat 4 and 6. Mean daily feed intake in animals of treat 2 to 6 was 558 g with only minor treatment differences. However, highest feed intake was observed in animals of Trp choice group 3 (treat 6). As a result of variations in feed intake and growth rate, animals of the negative control group (treat 1) had a higher ($p<0.05$) feed to gain ratio compared to all other treatments.

Dietary selection behaviour of animals of the Trp choice groups is given in figure 1. Animals given the choice of diets containing 0.09 and 0.16 % Trp, developed a high preference for the diet higher in Trp over the time course of the experiment. Animals of this group consumed approximately the same amounts of both feeds on offer in the first experimental week, but selected almost exclusively the diets higher in Trp in the last week of the experiment. A similar development of dietary selection was observed in animals given the choice of diets with Trp concentrations of 0.09 or 0.24 %, respectively (treat 5). In contrast, animals given the choice of diets with 0.16 and 0.24 % Trp (treat 6) showed hardly any preference for the diet higher in Trp. On the contrary, they consumed slightly higher amounts of the 0.16 % Trp diet than of the 0.24 % Trp diet throughout the time course of the experiment. As a result of different dietary Trp concentrations and differences in dietary choice in the choice treatments, daily Trp intake was highly influenced by dietary treatment. Animals of treat 1 to 6 had a daily Trp intake of 0.2; 0.9; 1.4; 0.8; 1.2; and 1.2 g, respectively.

The sum of essential amino acids in plasma of animals of treat 1 as well as plasma urea concentration was significantly ($p<0.05$) higher than in the other treatments. On the contrary, the sum of non essential amino acids in plasma of animals of treat 1 was depressed ($p<0.05$). Plasma Trp concentration responded in a linear manner to daily Trp intake.

Discussion. The high preference for the 0.16 or 0.24 % Trp diets in treat 4 and 5 is in accordance to a former study conducted to investigate dietary preferences for piglets given a choice of diets which were either clearly deficient or more adequate in Trp (Ettle and Roth 2004). Comparable to the present study, animals given the choice of pairs of diets with Trp concentrations of 0.11 and 0.16 % or 0.11 and 0.20 %, respectively, were able to distinguish between the diets on test and responded with a preference for the diets more adequate in Trp concentration. Moreover, comparable to the present study, these animals increased their preference for the diets higher in Trp in the time course of the experiment and selected almost exclusively the high Trp diets in the last experimental week. As discussed earlier (Roth et al. 2006), regulation of dietary selection for amino acids may be based on the concentration of limiting amino acids in the brain. As a consequence of a deficient supply of a specific amino acid, the concentration of this amino acid in specific brain areas declines, and this decrease may serve as a signal for recognition of the deficiency (Hrupka et al. 1997). The recognition of deficiency seems to occur in the anterior pyriform cortex, but other brain areas seem also to be involved in the responses due to ingestion of amino acid deficient diets (Blevins et al. 2003). After recognition of deficiency, a conditioned taste aversion develops (Gietzen et al. 1993), and in a situation of choice

feeding this aversion can result in a preference for the alternative feed more adequate in amino acid concentration. Thus, the development of dietary selection over the time course of the present experiment may be explained by the fact, that dietary selection is based on learning processes.

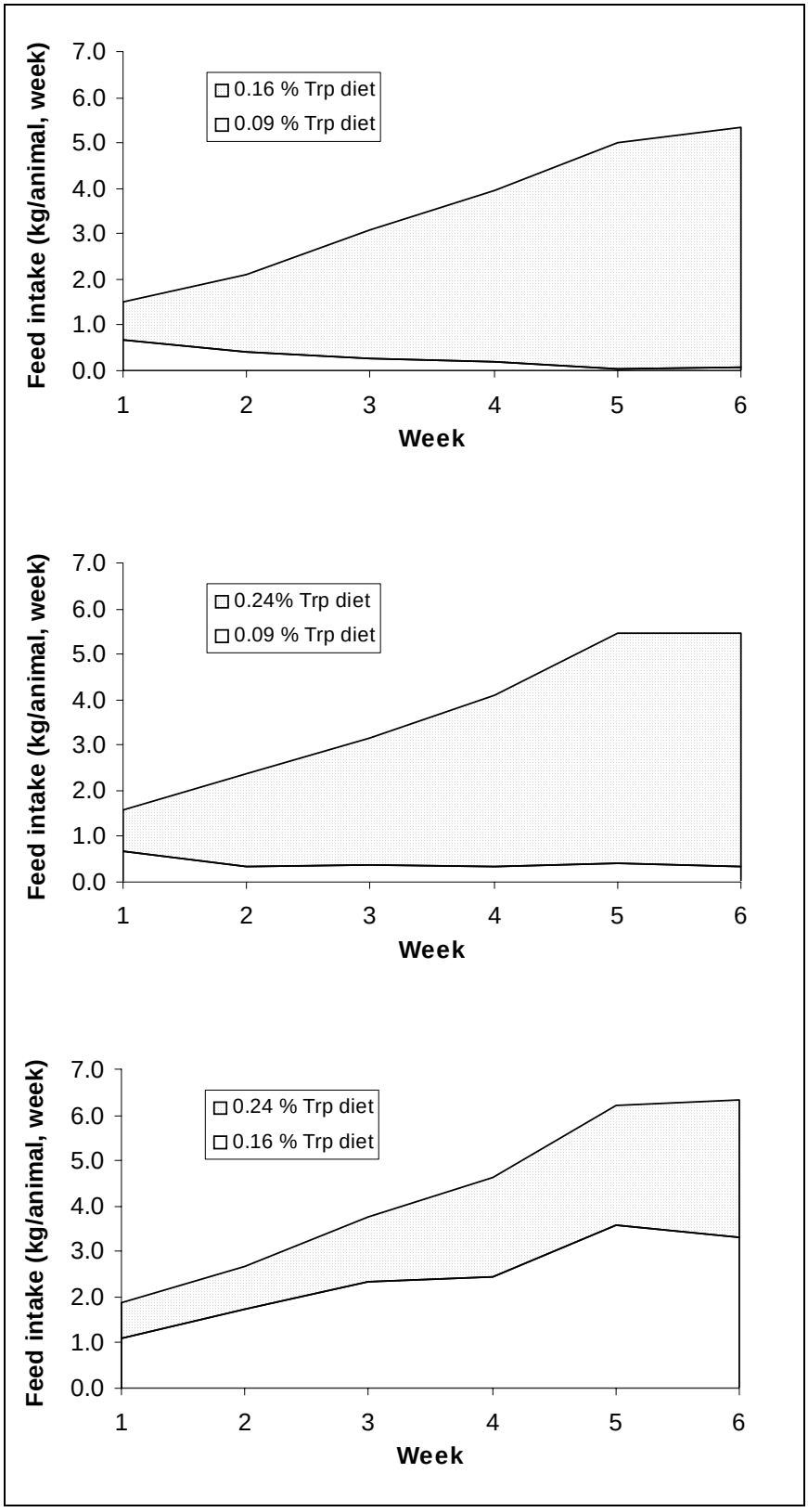

Figure 1. **Weekly intake (kg / animal) of the diets on offer in treatments 4, 5 and 6.**

In contrast to animals of treat 4 and 5, animals of treat 6 showed no preferences for the diet higher in Trp (0.24 % Trp diet) but in contrary selected slightly more of the 0.16 % diet. From these data it can be concluded that pigs do not only select for a diet high in Trp concentration or reject a diet low in Trp, but that they are able to balance the intake of two diets with different Trp concentrations. Comparably, in a study regarding to dietary selection for Thr (Ettle and Roth 2005) it was shown, that dietary selection was made at random, when the resulting dietary Thr concentration was apparently sufficient to meet the piglet's requirement. According to NRC (1998) a dietary Trp concentration of 0.16 % is clearly below the requirement of piglets in the given live weight range, but a dietary Trp concentration of 0.24 % represents a clear oversupply. Thus, it may be concluded that animals of treat 6 fed themselves a diet with an adequate Trp concentration because they selected equal amounts of both diets on offer. On the other hand, because growth performance was only marginally better than in groups fed exclusively the 0.16 or 0.24 % Trp diets (treat 2 and 3, respectively), this conclusion is hardly to statistically verify.

Conclusions. Results of the present study indicate that piglets are able to distinguish between diets with various Trp concentrations and to prefer a diet higher in Trp concentration over a low Trp diet in order to avoid deficiency. Piglets given the choice of diets either above or below current requirement estimations selected both diets to similar extent. Thus, it can be concluded that piglets were able to balance the intake of the two diets on test in order to meet their actual Trp requirement.

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