Animal Feed Science and Technology 214 (2016) 86–94

Contents lists available at ScienceDirect

Animal Feed Science and Technology

journal homepage: www.elsevier.com/locate/anifeedsci

Effects of sweetener neotame on diet preference, performance and hematological and biochemical parameters of weaned piglets

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ARTICLE INFO

Article history:
Received 3 July 2015
Received in revised form 13 February 2016
Accepted 14 February 2016

Keywords:
Neotame
Weaned piglets
Performance
Diet preference
Hematological parameters
Biochemical parameters

ABSTRACT

Three experiments were conducted to evaluate the effects of a sweetener, neotame (*N*-[*N*-(3,3-dimethylbutyl)-L-α-aspartyl]-L-phenylalanine 1-methyl ester) on diet preference, performance and hematological and biochemical parameters of weaned piglets. In experiment 1, 48 weaned piglets (Duroc × Landrace × Large White), with an initial body weight (BW) of 9.05 ± 0.04 kg, were used in a diet preference study. Pigs were assigned to 8 pens with 6 pigs per pen. Each pen was equipped with two feeders, containing a maize-soybean meal based diet or a similar diet supplemented with 30 mg/kg neotame. The experiment lasted for 15 days, including a 5-d adaptation period and a 10-d experiment period. The diet supplemented with 30 mg/kg neotame was preferred ($P < 0.05$) by the pigs during d 7, d 10 and the entire experimental period (d 1–10). In experiment 2, 216 weaned piglets, with an initial BW of 7.35 ± 0.06 kg, blocked by gender and BW, were allocated to 1 of 6 treatments with 6 pens per treatment and 6 pigs per pen. Weaned piglets were fed the basal diet or similar diets supplemented with 10, 20, 30, 40 or 50 mg/kg neotame. The experiment lasted for 35 days. Average daily feed intake (ADFI) was improved linearly ($P < 0.05$) with increasing dietary neotame level during phase I (d 1–22) and the entire experimental period (d 1–35). A quadratic ($P < 0.05$) effect of neotame was observed on average daily gain (ADG) and ADFI during phase I (d 1–22), phase II (d 23–35) and the entire experimental period (d 1–35). The optimal concentrations of dietary neotame to maximize ADG and ADFI during entire experimental period using a fitted quadratic plot model were 21.7 and 20.7 mg/kg, respectively. Experiment 3 was conducted with 108 weaned piglets averaging an initial BW of 7.34 ± 0.08 kg to evaluate the effects of neotame on hematological and biochemical parameters of weaned piglets. Pigs were divided into 3 treatments with 6 pens per treatment and 6 pigs per pen, and fed the basal diet or similar diets supplemented with 50 or 500 mg/kg neotame. There was no difference ($P > 0.05$) in blood parameters, organ index and morphology among the three treatments. In conclusion, the optimal concentrations of dietary neotame for maximum ADFI and ADG was ranged from 18.0 to 20.4 mg/kg during phase I (d 1–22), 22.0 to 22.9 mg/kg during phase II (d 23–35) and 20.7 to 21.7 mg/kg during

Abbreviations: BW, body weight; ADFI, average daily feed intake; ADG, average daily gain; FCR, feed conversion ratio.

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http://dx.doi.org/10.1016/j.anifeedsci.2016.02.013

entire experimental period (d 1–35), and no adverse effects on indicators of health were observed in pigs offered diets with neotame levels up to 500 mg/kg.

1. Introduction

A number of factors, such as diet change, separation from sows, mixing with strange pen mates and changing environmental conditions all lead to weaning stress (Dong and Pluske, 2007). Weaning stress causes widespread problems for piglets, such as low feed intake, diarrhea and poor growth (Pluske et al., 2001). Low feed intake restricts the performance of pigs, so more attention is needed to solve this problem. Palatability of diet is essential for enhancing appetite which stimulates feed intake. Adding sweeteners to the diet may be an effective means to improve palatability and increase the feed intake of weaned piglets (Jacela et al., 2010), since piglets like the sweet taste (Glaser et al., 2000).

Neotame is a non-nutritive artificial sweetener (*N*-[*N*-(3,3-dimethylbutyl)-L-α aspartyl]-L-phenylalanine 1-methyl ester), which has a clear sweet taste like sucrose without bitter or metallic taste (Nofre and Tinti, 2000). However, the sweetness of neotame is approximately 7,000–13,000 times greater than sucrose and 30–60 times greater than aspartame (Aguilar et al., 2007). Studies on various species, such as mice, rats, dogs, rabbits and humans have shown that neotame is not carcinogenic, teratogenic or mutagenic and does not produce any reproductive or developmental toxicity (Aguilar et al., 2007). Neotame has been widely used as a sweetener and flavor enhancer in the food industry (Nofre and Tinti, 2000). Because of its clear taste and low relative cost, neotame could be an ideal feed additive for weaned pigs. However, to date, there has been no research in pigs. The objective of this study was to evaluate effects of the sweetener neotame on diet preference, performance and hematological and biochemical parameters of weaned piglets.

2. Materials and methods

All animal procedures and animal care were approved by the Institution Animal Care and Use Committee at China Agricultural University (Beijing, China).

2.1. Animals, diets and experimental design

Weaned piglets (Duroc × Landrace × Large White) were raised at the Swine Nutrition Research Center of the National Feed Engineering Technology Research Center (Chengde, Hebei Province, China). Pigs were housed in totally slatted floor pens (1.2 × 2.0 m). Each pen was equipped with a nipple drinker and a stainless steel feeder for experiment 2 and 3, and 2 feeders for experiment 1. Pigs were allowed ad libitum access to feed and water. The basal diet was a maize-soybean meal based diet formulated to meet or exceed NRC (2012) recommendations for weaned piglets.

2.1.1. Experiment 1

The purpose of experiment 1 was to determine if pigs will consume more diet containing neotame than diet without neotame. Forty eight weaned piglets (9.05 ± 0.04 kg), were randomly assigned by litter, BW and gender to 8 pens with 6 pigs per pen. The diet preference protocol was derived from the Richter-type test called the two-bottle preference test (Richter, 1943), which has been previously used for diet preference (Glaser et al., 2000; Takeda et al., 2001; Sclafani, 2002). Each pen was equipped with two feeders, containing either a maize-soybean meal based diet (Phase I in Table 1) or the same diet supplemented with 30 mg/kg neotame. The positions of two feeders were switched daily to avoid any locational preference. The experiment consisted of 5-d adaption period and a 10-d test period. The amount of feed consumed was determined daily to calculate feed intake and diet preference percentage. Diet preference was determined using the following equation as:

$$\text{Diet preference percentage} = \frac{\text{Intake of one diet (g)}}{\text{total feed intake (g)}} \times 100\%$$

2.1.2. Experiment 2

Experiment 2 was conducted to study the effect of neotame on the performance of weaned piglets. A total of 216 weaned piglets (7.35 ± 0.06 kg) were blocked by BW, gender and ancestry and allotted to 1 of 6 treatments with 6 pens per treatment and 6 pigs per pen. The treatments included either the basal diet (Table 1) or the same diets supplemented with 10, 20, 30, 40 or 50 mg/kg neotame. The experiment included two phases (d 1–22 and 23–35) and lasted for 35 days. Pigs and feeders were weighed on d 1, 22 and 35 to calculate average daily gain (ADG), average daily feed intake (ADFI) and feed conversion ratio (FCR).