Short-term effect of dietary yeast nucleotide supplementation on total and diurnal variation of small intestinal enzyme activities in piglets1,2

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ABSTRACT: A study was carried out to investigate, whether short-term supplementation of dietary yeast nucleotides affects total and diurnal variation of enzyme activities in the small intestine of weaned piglets. Twelve barrows, weaned at 18 d of age (5 kg initial BW), were fitted with a simple T-cannula at the distal ileum. Twice daily (0730 and 1930 h), 6 piglets each received a cereal–soybean (Glycine max) meal-based diet with or without supplementation of 1 g/kg of a yeast nucleotide product in 2 consecutive periods. In each period, digesta samples were collected 6 times at given intervals during 24 h digesta collection. Dietary supplementation with yeast nucleotides did not affect (P > 0.05) total enzyme activities for α-amylase, leucine aminopeptidase (LAP), maltase, and lactase in ileal digesta. Therefore, data of both treatments were pooled to determine diurnal variations in enzyme activities. For α-amylase, a diurnal variation in enzyme activity could be observed (P < 0.05). Variations in diurnal activities of LAP, maltase, and lactase were not observed (P > 0.05). In conclusion, yeast nucleotides do not affect total small intestinal enzyme activities. Independent of diet composition, α-amylase activities may vary over time, with peak flow at 6 h postprandially.

Key words: diurnal variation, enzyme activity, nucleotide, pig

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INTRODUCTION

In addition to effects on nutrient digestibility, supplementation of dietary nucleotides to pig diets may affect enzyme activities. The aim of the present study was to assess the effect of yeast nucleotide supplementation on total and diurnal enzyme activities including maltase (α-glucosidase, EC 3.2.1.20), lactase (β-galactosidase, EC 3.2.1.23), leucine aminopeptidase (LAP) (leucinearylaminidase, EC 3.4.11), and α-amylase (1,4-α-D-glucanohydrolase, EC 3.2.1.1) at the ileal level.

MATERIALS AND METHODS

Animals, Experimental Design, and Diets

The research protocol was approved by the German Ethical Commission for Animal Welfare. Care and treatments of animals followed guidelines described by Lorz and Metzger (1999). The experiment was conducted with 12 barrows (German Landrace × Piétrain), which were weaned at 18 d of age at an average initial BW of 5 kg. On day 4 and day 5 after weaning, the pigs were fitted with simple T-cannulas at the distal ileum according to the principles described by Li et al. (1993). Twice daily (0730 and 1930 h) pigs were fed (45 g/kg of individual BW) a barley (Hordeum vulgare)–wheat (Triticum aestivum)–soybean meal-based basal diet (Table 1) either alone or supplemented with 1 g/kg yeast nucleotides, Nucleoforce Piglets (BIOIBERICA, S.A., Barcelona, Spain), containing at least 50% of free nucleotides and active precursors according to the manufacturers’ specification, at the expense of corn (Zea mays) starch. The light was turned off between 2200 and 0600 h. Repeated measurements included 2 experimental periods with 5 d for adaptation to the experimental diets and 2 d for digesta collection. Digesta samples for the measurement of enzyme activities were collected at 1030, 1330, and 1630 h on day 6 and at 2230, 0130, and 0430 h on day 7.

Chemical and Statistical Analyses

Digesta samples were immediately centrifuged
(14.200 × g; 3°C; 20 min), and the supernatants were collected into plastic tubes and stored at −80°C. Activities of α-amylase and LAP were measured photometrically using kits for α-amylase (Greiner Diagnostic, Bahlingen, Germany) and LAP (Randox Laboratories Ltd., Crumlin, U.K.), respectively. Activities of maltase and lactase were determined according to the method of Dahlquist (1974).

Data were analyzed using the MIXED procedure of SAS (2003) considering feed, period, time, and feed × time as fixed effects and feed × time × animal as random effect. Repeated measurements on the same subject (animal) were assumed to be serially correlated. Effects of enzyme activities were modeled by linear, quadratic, cubic, and quartic regression on time point. The significance level for all Wald-type F-tests was set at α = 0.05.

### RESULTS

All animals were healthy throughout the experiment and readily consumed their daily feed allowances. Dietary supplementation with yeast nucleotides did not affect (P > 0.05) ileal α-amylase, LAP, maltase, and lactase activities. Period did not affect (P > 0.05) enzyme activities. Therefore, both treatments and periods were pooled to determine diurnal variations in enzyme activities during day and night sampling (Table 2). For α-amylase, activity increased (P < 0.05) 6 h postprandially. Diurnal LAP, maltase, and lactase activities did not vary (P > 0.05). Diurnal α-amylase activities could be described using a quartic function (P < 0.05). For brush border enzyme activities (LAP, maltase, and lactase) none of regressions assessed did fit (P > 0.05).

### DISCUSSION

In a study with rats, withdrawal of dietary pure nucleotides decreased the total content and specific activity of alkaline phosphatase, LAP, maltase, sucrase, and lactase in the villous tip. The enzymes have been described as maturation markers of intestinal cells (Ortega et al., 1995). In contrast in the present study, dietary yeast nucleotides did not affect the intestinal maturation status of pigs. The differences between species and studies may be due to differences in nucleotide administration, that is, free nucleotides vs. a nucleotide-containing yeast product.

Functional changes in the small intestine of piglets fed without restriction during the transition from liquid (milk replacer) to solid feed (pelleted grain–soybean meal diet) were determined by measuring brush border enzyme activities 3 times daily (morning feed: 1 and 4 h postprandially; evening feed: 1 h postprandially; Sileikiene et al., 2002). Specifically, both diet and age (BW) can affect brush border enzyme activities including maltase, sucrase, LAP, lactase, and alkaline phosphatase (Sileikiene et al., 2002); however, such effects were not confirmed in the present study with restricted fed piglets. Furthermore, Sileikiene et al. (2002) observed variations in diurnal brush border enzyme activities, with lowest enzyme activities 4 h postprandially whereas in the present study brush border enzyme activities remained constant. Obviously, the feeding regime rather than diet composition was responsible for the observed diurnal variations between the studies.

According to Botermans and Pierzynowski (1999), exocrine pancreatic secretion of growing pigs increased during feeding; however, this increase was independent of the amount of feed consumed, referred to as “cephalic phase” effect. Similarly, ileal α-amylase activities in the present study followed a quartic function, with highest α-amylase activities 6 h postprandially, which supports the existence of the aforementioned cephalic phase effect.
In conclusion, yeast nucleotides do not affect total small intestinal enzyme activities in restricted fed pigs. Independent of diet composition, α-amylase activities vary over time, with peak flow of α-amylase around 6 h postprandially. However, whether this variation in enzyme activity may affect starch digestibility needs to be elucidated.

**LITERATURE CITED**


