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J ANIM SCI 2012, 90:439-441.
doi: 10.2527/jas.53868

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Behavioral changes in response to feeding pancreatic-like enzymes to exocrine pancreatic insufficiency pigs¹

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ABSTRACT: Behavioral changes during pancreatic enzyme therapy have never been studied. The present study investigated behavioral changes in exocrine pancreatic insufficiency (EPI) pigs when their feed was supplemented with pancreatic-like enzymes of microbial origin. A crossover design study was used to test the effect of enzyme supplementation in 2 × 4 EPI pigs that underwent pancreatic duct ligation (PDL). After 40 d of adaptation, the study commenced, comprising 2 control and 2 enzyme feeding periods of 10 d each in sequence. On days 7 and 10 of each experimental period, behavior was monitored for 24 h and feed consumption and BW were recorded. Behavioral observations focused on the

pigs' activity— lying down or passive, or sitting, or standing or active—and were expressed as percentage activity for 24 h. During the adaptation period, BW gain was completely inhibited after PDL whereas for the entire study period, the body weight increased from 10.5 ± 1.1 to 14.0 ± 1.4 kg ($P < 0.01$). Exocrine pancreatic insufficiency pigs were more active when fed the enzymes (21 vs. 18% per 24 h; $P < 0.01$). Microbial enzyme supplementation not only improved the growth of the EPI pigs but it also increased their activity. This behavior change contradicts the generally accepted norm that satiety evokes by digestion and subsequent nutrients absorption reduces human or animal motility.

Key words: behavior, exocrine pancreatic insufficiency pig, microbial derived enzymes

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J. Anim. Sci. 2012.90:439–441
doi:10.2527/53868

INTRODUCTION

The aim of supplemental enzyme therapy in exocrine pancreatic insufficiency (EPI) is to minimize nutrient malabsorption. Therefore, it is important to achieve an adequate concentration of active pancreatic enzymes in the duodenum at the same time that food is administered. Data demonstrates that EPI human subjects that are properly supplemented with porcine pancreatic enzymes, apart from improving the overall nutritional status, also have reduced abdominal swelling and discomfort and fewer gastrointestinal tract motility disorders. Pancreatic enzyme supplementation is also recommended for reducing pain in chronic pancreatitis (Fieker et al., 2011). The present study investigated

behavioral changes in total exocrine pancreatic insufficient pigs after feed supplementation with pancreatic-like enzymes of microbial origin that have never been studied in patients or in EPI animal models.

MATERIALS AND METHODS

All experimental procedures were approved by the University of Lund Ethics Review Committee on Animal Experiments.

Animals and Housing

The experiment was carried out on the research farm of the Swedish University of Agricultural Sciences. Eight male piglets (Swedish Landrace × Yorkshire × Hampshire) 10 to 14 wk of age and weighted at surgery 10.5 ± 1.1 kg were used in the study. The pigs were housed in individual pens designed to keep visual between pigs and equipped with a dry feeding trough,

¹Financial support of this work by the FORMAS and SGPlus, Sweden, is acknowledged.

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a drinking nipple, and a constant heating lamp (150 W, 24 h/d). The room light was controlled automatically and turned on from 0600 to 1800 h.

Surgery and Feeding

Exocrine pancreatic insufficiency was induced by pancreatic duct ligation (PDL) (Gewert et al., 2004). After PDL surgery animals were given a 4-d recovery period. The pigs were fed twice daily (0800 to 0900 and 1600 to 1700 h; 2% of BW per meal) with a cereal-based pellet feed for young growing pigs (Växtill, Lantmännen) and free access to water. Enzymes were administered as a mixture twice daily, in the middle of the morning and evening feedings, with 20 mL of yogurt (0.5% fat, Skånemejerier, Sweden). Mixture consisted of 60,000 units lipase activity (*Burkholderia cepacia*), 50,000 units protease activity (*Aspergillus melleus*), and 7000 units amylase activity (*Aspergillus oryzae*) per dose.

Monitoring of Behavior

Behavior monitoring was conducted with the MSH video system (Video Server Company, Sweden) on the 7th and 10th d of each period. The behavior was noted by looking at the pigs on video film at 5 min intervals, scan sampling and focused on the pigs' position—lying down or passive, or sitting, or standing or active—and were expressed as percent activity during 24 h.

Study Design and Analysis

The 8 pigs were randomly divided into 2 groups ($n = 4$). The adaptation and experimental periods lasted for 40 d each. In this crossover study in each of 10 d periods, one group of pigs received enzymes and the other acted as a control. At day 7 and 10 of each experimental period, behavior was monitored during 24 h and feed consumption and BW was recorded. The percentage of observations was calculated and corrected for pig activity effect. Individual difference in activity was calculated between periods with enzymes and periods without enzymes. Results and comparison of the activity between groups were calculated were tested by using a *t*-test in the UNIVARIATE procedure in SAS (version 9.2; SAS Institute, Cary, NC).

RESULTS

Activity

Higher activity of the pigs was noted during 3 of the 4 periods, when enzymes were administered. Overall, the pigs treated with enzymes were active 21% of the time whereas the pigs not receiving enzymes were active 18% of the time ($P < 0.05$; Figure 1).

Body Weight Gain

The growth of piglets was completely inhibited after PDL, during the adaptation period, whereas for the entire study period, the body weight increased from 10.5 ± 1.1 to 14.0 ± 1.4 kg ($P < 0.01$) in spite of feeding enzymes only every second week ($P < 0.05$).

DISCUSSION

Besides being crucial for nutrient digestion, pancreatic enzymes can potentially exert several important direct and indirect functions such as fueling of the carbohydrate, lipid, and protein metabolisms or positive effects in the treatment of some viral infections (Kabil and Stauder, 1997) as well as acute and chronic inflammation including autoimmune diseases (Mazurov et al., 1997). However, the porcine pancreas preparation also possesses antibacterial components as described previously (Pierzynowski et al., 1993). In the present study, aside from the improved BW gain and feed usage we also observed a higher level of activity in the pigs fed a diet supplemented with enzymes. Exocrine pancreatic insufficiency is associated with low vitamin D and P levels, which is known to cause muscle weakness (Teichmann et al., 2008), and therefore the possible explanation could be that treating the EPI provides for the correction of impaired gait and skeletal muscle weakness (Christensen et al., 2011). Microbial enzyme supplementation not only improved the growth of the EPI pigs but also increased their activity. This behavior contradicted the generally accepted norm according to which satiety caused by elemental dietary components absorbed after food digestion reduces human or animal motility.

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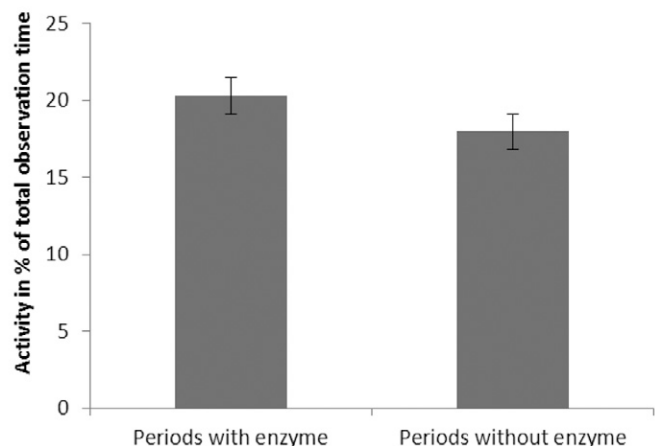


Figure 1. Pig activity (% observation time when standing and when sitting or lying; observation $n = 8$; $P > 0.01$).

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