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Effects of potato (*Solanum tuberosum* L. cv. Golden valley) protein having antimicrobial activity on the growth performance, and intestinal microflora and morphology in weanling pigs

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Abstract

A total of 280 weanling pigs (Landrace × Yorkshire × Duroc) at an average initial body weight of 7.2 ± 0.88 kg were used in a 28-day growth study to investigate the effect of potato protein (PP) on growth performance, digestibility, small intestinal morphology and microbial populations in feces and large intestine. Pigs were randomly allotted on the basis of their body weight and sex to five dietary treatments in a randomized complete block design. There were four replicate pens per treatment and each pen comprised of 14 pigs. The dietary treatments were: PC (positive control; basal diet + 1.5 g

Abbreviations: PP, potato protein; PC, positive control; ADG, average daily gain; ADFI, average daily feed intake; DM, dry matter; CP, crude protein; AMP, antimicrobial peptide; GIT, gastrointestinal tract; MIC, minimum inhibitory concentration; spp., species.

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apramycin sulfate/kg and 1.0 g colistin sulfate/kg) and PP (basal diet supplemented with 0.00, 2.50, 5.00 and 7.50 g PP/kg diet. The PP was extracted from a special breed of potato (*Solanum tuberosum* L. cv. Golden valley) and had minimum inhibitory concentration of 1000–1250 μg/ml against *Staphylococcus aureus*, *Salmonella* spp. and *E. coli*. Pigs offered PC diets exhibited significantly faster ($P<0.05$) and more efficient ($P<0.05$) growth over the 28-day period than those offered PP diets while pigs offered the PP diets exhibited a linear improvement in feed:gain ($P<0.05$) with increasing PP inclusion rate. Higher coefficients of total tract apparent digestibility (CTTAD) of DM (phases I and II) and CP (phase II) were noted in pigs offered PC diets and increasing the PP levels linearly ($P<0.05$) improved the CTTAD of DM during phase II. Dietary treatments had no effect on the coefficient of ileal apparent digestibility (CIAD) of amino acids. The population of total bacteria (days 14, 21 and 28), coliforms (days 21 and 28) and *Staphylococcus* spp. (days 21 and 28) in the faeces was lower ($P<0.05$) for pigs offered the PC diet. When pigs were offered the PP diets there was a linear decline in fecal bacteria on days 21 and 28 as the inclusion rate of PP increased. The total bacteria in rectum and coliforms in caecum and colon were lower ($P<0.05$) in pigs offered PC diets, and those offered PP diets had linearly lower ($P<0.05$) total bacteria, coliforms and *Staphylococcus* spp. in caecum and rectum. The dietary treatments had no effect on the morphology of the small intestine. These results suggest that antibiotics elicit better performance by reducing pathogenic bacteria and that potato protein obtained from Golden valley had antimicrobial properties since it (PP) effectively reduced the pathogenic bacteria in feces and large intestine and hence may be an alternative to medicated feed with antibiotics.

Keywords: Antimicrobial activity; Growth performance; Nutrient digestibility; Potato protein (PP); Weanling pigs

1. Introduction

At weaning piglets are subjected to a number of stresses, including separation from the dam, being moved and transition from a liquid to solid diets. These lead to depressed feed intake (Odle et al., 1996), bacterial overgrowth causing diarrhea (Frydendahl, 2002) and ultimately poorer growth performance. To counteract these effects antibiotics are generally added to their diets to maintain health and improve growth performance. Nevertheless, their continuous use and misuse have led to the emergence of drug resistance (Monroe and Polk, 2000) and risk of antibiotic-residue in animal products (Schwarz et al., 2001). In addition regulatory pressure from various agencies and public perception for the need to remove antibiotics from animal feed has made it necessary to identify alternatives that can replace antibiotics and maintain the growth performance benefits (Bae et al., 1999).

Potatoes (*Solanum tuberosum*) are commonly cultivated for human consumption worldwide and are reported to have antimicrobial (Jussi-Pekka et al., 2000; Do et al., 2004), and anticarcinogenic effects (Berrocal-Lobo et al., 2002). Potatoes are also used as dietary therapy for patients with peptic ulcers (Pouvreau et al., 2001).

Antimicrobial peptides (AMPs) are small gene-encoded peptides having a broad range of activity against gram-negative and gram-positive bacteria, fungi, and mycobacteria (Zasloff, 2002). These AMPs have been isolated and characterized from tissues and organisms representing virtually every kingdom and phylum and are an important component of antimicrobial defence system. Plants produce several types of such proteins that mediate defence against pathogens and invading organisms (Ye et al., 1999; Pouvreau et al., 2003). Potato