

Comparative evaluation of *Bacillus subtilis* delivery forms reveals their effects on biogenic element excretion in pigs

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Streszczenie

Excess nitrogen, phosphorus and trace element losses from pig manure accelerate eutrophication and soil degradation. Probiotic *Bacillus subtilis* produces phytase, protease and other enzymes and postbiotics that may enhance nutrient retention, yet the influence of delivery matrix on environmental outcomes is unclear. Three hundred and eighty-four weaned pigs (Yorkshire × Landrace; 28 d) were assigned to four diets until 30 kg body weight: positive control (PC, complete diet), negative control (NC, no additives), BS (NC + 0.1% *B. subtilis* 87Y spores) and FR (NC + 8% rapeseed meal fermented with *Bacillus subtilis* 87Y). Apparent total-tract and ileal digestibility (AID), daily excretion and retention of macro- and micro-elements were determined over 72 d. FR pigs showed the greatest improvements: faecal nitrogen fell by 32% and urinary nitrogen by 29% versus NC, lowering total nitrogen output from 6.6 to 4.5 g pig/day. Total phosphorus excretion declined 39% (from 3.05 to 1.85 g pig/day) and calcium retention rose 187%. Faecal zinc and copper were reduced by 63% and 39%, respectively. FR increased AID of phosphorus (from 47 to 70%) and magnesium (from 22 to 43%) by > 20%-points; BS achieved intermediate gains. Predicted farm-gate savings equal 26 kg N and 3.6 kg phosphorus per 1 000 weaners. Embedding *Bacillus subtilis* in fermented rapeseed meal immobilizes enzymes and metabolites, protects spores and supplies prebiotic levan, delivering larger environmental benefits than free spores alone. Integrating this synbiotic into nursery diets simultaneously valorizes a regional oil-seed by-product, displaces imported soy, and helps swine operations meet nutrient-loss reduction targets.

Słowa kluczowe

Synbiotic feed additive, Nutrient excretion, Eenvironmental mitigation, Biogenic element balance, Solid-state fermentation, Sustainable pig production

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