Abstract

The effects of mill type and particle size on *in-vitro* starch and protein digestion were investigated using 15 genotypes of cereals and pulses consisting of field peas (*Pisum sativum*), wheat (*Triticum spp.*), barley (*Hordeum vulgare L.*), and lupins (*Lupinus L.*). The grains were cryo- and hammer-milled to yield different particle sizes, and the milled grains were analysed in a randomised and duplicated experimental design. Irrespective of the particle size, grain and mill type, starch and protein digestion in the grains exhibited a monophasic digestogram pattern. The hammer-milled grains digested better than the cryo-milled grains possibly because of the frictional heat generated during hammer milling that may have damaged/disrupted the starch and protein bodies.

The starch and protein digestograms were adequately described by a first-order kinetic model, from which the rates of starch and protein digestion were obtained. The reciprocal of the rate of starch or protein digestion of the cryo- and hammer-milled grains significantly related to the square of the particle size to show that a two-fold reduction in particle size will lead to a four-fold increase in starch or protein digestion. Moreover, the results revealed that irrespective of the mills and their settings, starch and protein digestion in the milled grains proceeded by diffusion. Protein digestion proceeded at a much faster rate than starch digestion in the milled grains, and this has implications for nutrient asynchrony, and availability of glucose for energy and amino acids for growth. Being the first study on the dependence of starch and protein digestion on grain particle size in field peas, wheat, barley, and lupins, the study concluded that particle size and type of mill affected starch and protein digestion.

In pig feeds, cereals and pulses such as field pea, wheat, barley, and lupins are notable ingredients, while different mills such as hammer, disc and roller mills are used in feed processing. Feed mills need to be aware that there could be mill differences in particle size, damage to starch and protein bodies, and feed quality. Moreover, particle size influences the digestibility of feed macronutrients for energy delivery to animals and their growth. Hence, particle size of pig feeds needs to be controlled, within an acceptable feed processing cost, to maximise animal performance.