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THE INFLUENCE OF MICRONIZATION OF CEREALS AND LEGUMES ON FEED CONVERSION, DIGESTIBILITY, AND DAILY GAIN OF WEANED PIGLETS

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Abstract: The main aim of this study was to assess the effect of the micronization process applied on cereals and legumes, as feed components, on the efficiency of feed conversion, digestibility, and daily gain of weaned piglets. The results showed that the digestibility of the investigated micronized maize and wheat flakes was higher than that of the respective raw grains. The digestibility of the feed mixture prepared with micronized cereals and legumes was higher (84.74%) than that of the commercial feed mixture (80.27%). The feed mixture prepared with micronized cereals and legumes manifested beneficial effects on weaned piglets' daily gain, feed conversion, and digestibility in the feeding trial.

Keywords: cereals and legumes, micronization, feed conversion, digestibility, daily gain of piglets

Introduction

Micronization, a short-time high-temperature process that utilizes electromagnetic radiation in the infrared region to rapidly heat materials, is frequently used to modify the functional properties of the biomolecules in cereal grains and legumes. The grain softens and swells before bursting when infrared rays enter the grains core and heat it up, causing the water molecules to vibrate. Critical temperatures can result in destruction and splattering, so the grain needs to be transported to the rollers and pressured in order to obtain the form of flakes (Žilić et al., 2010). Reduced fiber particle size with micronization treatment effectively destroys dense fibrous matrix formations while increasing surface area and porosity of the feed particles (Dhiman & Prabhakar, 2021).

Digestibility of the feed is one of the most important quality parameters used in the diet formulation practices for different stages of pigs (Pomar et al., 2009). Optimizing the diet based on the nutrient digestibility values of the feed ingredients is necessary to provide pigs a diet that meets their nutritional needs.

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The average daily gain of pigs fed the same amount of a meal but with varied nutritional requirements can, however, vary (Verschuren et al., 2021).

The physicochemical grain properties and a variety of other factors may affect the digestibility of a feed (Gómez et al., 2016). Cereal grains and legumes are exceptionally rich in nutrients, especially dietary fiber, B vitamins, minerals, as well as phytochemicals all potentially health-beneficial. However, the fiber-rich grain pericarp is highly resistant to digestion. The main source of energy in diets for non-ruminants is starch. Compound diets made up of grains and legumes depend on the breakdown of starch as a key factor in determining the dietary energy value. Some starches are primarily digested in the small intestine, whilst others (especially those found in field peas) are linked to lower net energy values and potential digestive issues (Wiseman, 2006). Micronized grains and legumes, such as barley, maize, wheat, sorghum, lentils, and peas, have a higher degree of starch gelatinization than raw grains, which enables higher digestibility (Bellido, et al., 2006). Pigs can effectively utilize whole, micronized soybeans, making them a potentially helpful source of protein and energy (Lawrence, 1978).

The objective of this study was to investigate the effect of the micronization of feed components, i.e. cereal grains and legumes on feed conversion, *in vitro* digestibility, and daily gain of weaned piglets.

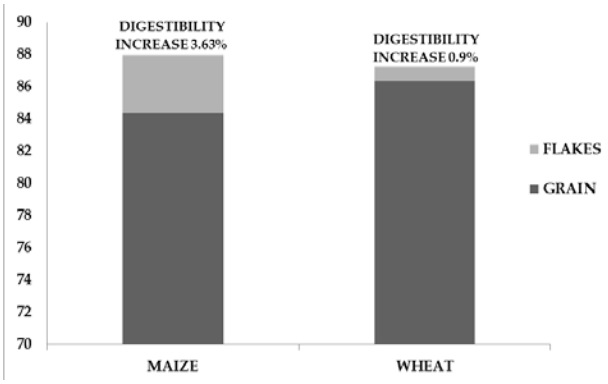
Materials and methods

The plant material used in this study comprised of: maize (*Zea mays* L.), wheat (*Triticum aestivum* L.), barley grain (*Hordeum vulgare* L.), soybean (*Glycine max* (L.) Merr.), field peas (*Pisum sativum* L.), as well as flakes of the respective cereals and legumes. An experimental dry feed mixture for weaned piglets (up to 25 kg) prepared in the pilot plant of the Maize Research Institute, Zemun Polje was also used for the analyses. The experimental dry feed mixture from the pilot plant consisted of: ground micronized maize grain (33%), ground micronized wheat grain (10%), ground micronized barley grain (12%), field peas (10%), soy semolina (26.5%), fish meal, fodder yeast, dicalcium phosphate, fodder chalk, animal feed salt, premix, and acidifier. A commercial feed mixture for weaned piglets (up to 25 kg) obtained under producers' specification was procured from a local supplier and used as a control for the comparison of the investigated parameters. *In vitro* dry matter digestibility of the samples was performed by the pepsin-cellulase Aufréré method (2007) based on the enzymatic solubility of the feedstuff. The grain samples were subjected to the process of dry micronization (infrared treatment) at the temperature of 145 °C for 40 s in a

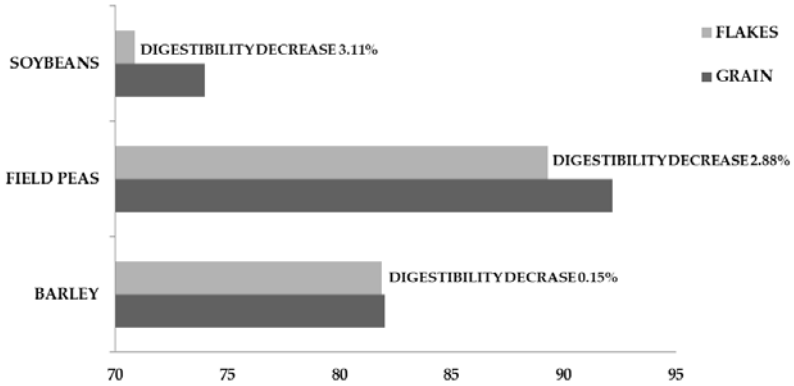
micronizer (model M1044/77, Micronizing Company UK Ltd, Woodbridge, UK). Infrared rays were applied to roast the kernels of the investigated cereals and legumes, which were then flaked under the pressure of rolls. The cereal grains, legumes and micronized flakes were ground on a a laboratory mill with mesh 0.5 mm (Perten MILL 120 CE, Perten Instruments in Hägersten, Sweden). The feeding trial was conducted on 20 weaned piglets in a local pig farm. Ten were fed with a commercial dry mixture for weaned piglests, and the remaining ten were fed a dry feeding mixture produced in the pilot plant of the Maize research Institute, Zemun Polje.

Results and discussion

The *in vitro* dry matter digestibility of the investigated untreated cereals and legumes, as well as micronized flakes obtained from these grains are shown in Graph 1 and Graph 2. The determined digestibility ranged from 81.87% in micronized barley flakes, to 92.17% in raw field peas. The micronization positively affected the digestibility of the maize and wheat grain, demonstrated by the increase of maize flakes digestibility for 3.63%, and wheat flakes 0.9% (Graph 1). However, a decreas in digestibility of soybeans and field peas after micronization and flaking was noticed (Graph 2). Previous studies reported that in comparison to starch from cereals, the total tract digestibility of legume starch was lower, and rolling, as opposed to grinding, decreased the total tract digestibility of both cereal and legume starch (Larsen et al., 2009).



Graph 1 Changes in *in vitro* digestibility of maize and wheat grain after after the micronization and flaking (% d.m.)

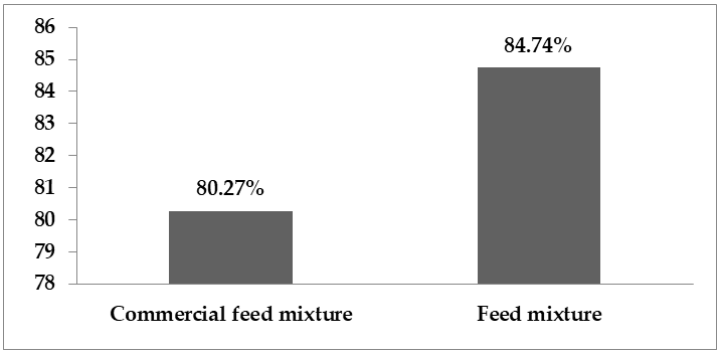


Graph 2 Changes in *in vitro* digestibility of soybean, field peas and barley grain after after the micronization and flaking (% d.m.)

Berrocoso et al. (2014) found that due enhancements in ileal mucosal morphology and nutrient digestibility the use of added value soy products such as micronized soybean meal or soy protein concentrate in diets for healthy pigs weaned at 30 days of age is advised.

Two feed mixtures were used in the feeding trials on piglets weighing up to 25kg. The difference in the digestibility of the investigated feed mixtures is shown in Graph 3. The mixture with micronized grains and legumes showed. 4.47% higher digestibility than the commercial blend.

In the feeding trial with pigs weighing up to 25 kg, the impact of nutrient digestibility was used to calculate daily gain and, consequently, food conversion. Table 1 shows the results of the feedeng trial. The findings of our study in general support the hypothesis that micronization improves the digestibility by incresing it, and hence fascilitates a better nutrient utilization.



Graph 3 Digestibility of feed mixtures (% d.m.)

Table 1 Daily weight gain and feed conversion

	Commercial mixture	Mixture of micronized grain
Daily weight gain (kg)	0.28	0.44
Feed conversion (kg)	4.06	2.15

Piglets fed the commercial combination gained 280 g daily and had a feed conversion of 4.06 kg, as opposed to 440 g for piglets fed a combination of micronized grains and a feed conversion of 2.15 kg.

Conclusion

The results obtained in our study confirmed that micronization positively affected the cereals and legumes regarding feed digestibility. The increased digestibility of the dry feed mixture prepared with micronized cereals and legumes had a beneficial impact on the performance of the weaned piglets in the conducted feeding trial. The weaned piglets fed with the dry feed mixture with micronized ingredients showed higher daily weight gain and lower feed conversion.

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