

EFFECT OF DIETARY SOYBEAN MEAL REPLACEMENT WITH A COMBINATION OF WHITE LUPINE SEEDS AND INSECT MEALS ON THE GROWTH PERFORMANCE, CARCASS TRAITS, AND MEAT QUALITY OF RABBITS

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Abstract

The aim of this study was to determine the effect of complete dietary replacement of soybean meal (SBM) with combinations of silkworm pupae meal and white lupine seeds (SPM+WLS), mealworm larvae meal and white lupine seeds (MLM+WLS), and Zophobas larvae meal and white lupine seeds (ZLM+WLS) on the growth performance of rabbits, carcass dressing percentage, the proportion of primal cuts in the carcass, the content of selected compounds in the loin, and the concentrations of short-chain fatty acids (SCFAs) in the large intestine. A total of 80 New Zealand White rabbits at 35 days of age were divided into four feeding groups. The control diet (group C) contained 10% SBM. In experimental groups, SBM was completely replaced with SPM+WLS, MLM+WLS, and ZLM+WLS (5% + 5%). Complete replacement of SBM with the above combinations of protein sources had no negative effect on the growth performance of rabbits. The loin of group C rabbits had the highest DM content, the lowest EE content, the lowest proportion of total polyunsaturated fatty acids (PUFAs), and the highest levels of retinol and α -tocopherol. The concentrations of SCFAs in the large intestine were higher in rabbits fed diets containing SBM than in their counterparts fed diets supplemented with insect meals and white lupine seeds. This indicates that SBM in rabbit diets can be replaced by a combination of the above components, but further research is needed to optimize the proportion of insect meals and white lupine seeds in rabbit diets and evaluate their effect on the health status and performance of animals.

Key words: rabbit feeding, silkworm pupae meal, mealworm larvae meal, Zophobas larvae meal, short-chain fatty acids

In intensive farming systems, rabbits are fed complete diets containing up to 18% protein. Soybean meal (SBM) is the most common source of dietary protein for broiler rabbits (Purwin et al., 2019). However, in some regions, particularly those where soybeans are not grown, a recent trend has emerged of eliminating SBM from livestock diets. Consequently, efforts are being made to avoid importing SBM and to address concerns regarding the feeding of genetically modified products to farm animals (Tudisco et al., 2006). Therefore, alternative dietary protein sources are being tested. Edible insects are a rich source of high-quality protein. Insects grow relatively quickly and reproduce easily. Approximately 2 kg of feed biomass are required to produce 1 kg of insects (Collavo et al., 2005). Insect meals are characterized by high nutritional value, and their protein content varies between 40% and 60%, depending on the growth stage and species (Makkar et al., 2014). Most insects, including Coleoptera, Lepidoptera, Hymenoptera, and Diptera, undergo complete metamorphosis and pass through four main stages in their life cycle: the egg, the larva, the pupa, and the imago. Some other insects, such as Hemiptera and Acrididae, undergo incomplete metamorphosis that con-

sists of only three main stages: the egg, the nymph, and the imago. Insect larvae are most often used as animal feed, followed by pupae and imagines. Examples include black soldier fly (*Hermetia illucens*) larvae (Diener et al., 2011), house fly (*Musca domestica*) larvae (Calvert et al., 1969), mealworm (*Tenebrio molitor*) larvae (Klasing et al., 2000; Bovera et al., 2016), Zophobas (*Zophobas morio*) larvae (Józefiak et al., 2020), silkworm (*Bombyx mori*) pupae (Donatti, 1992), and locust and cricket imagines (Kierończyk et al., 2018). In rabbit nutrition, edible insects are a source of both protein and fat (Dalle Zotte et al., 2020; Gasco et al., 2020; Kowalska et al., 2020; Cullere et al., 2022; Volek et al., 2023).

Legume seeds, including white lupine seeds, are yet another source of protein in rabbit diets. Wild white lupine is an annual plant that is widespread in the Mediterranean region, where it has been cultivated since ancient times. At present, white lupine is cultivated in Eurasia, Africa, and both Americas. White lupine seed production in Europe has increased from 88 000 tons in 2000 to 458 000 tons in 2020 (Pereira, 2022). In 2020, the leading European lupine producers were Poland (261 000 tons), followed by Germany (34 000 tons), France (13 000 tons),



Article

The Effect of the Duration of Feeding a Diet Containing Cuban Cricket (*Gryllus assimilis*) Meal on Fecal Bacterial Enzyme Activity and Nutrient Digestibility in Adult Rabbits

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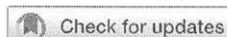
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Simple Summary

Insects are increasingly being considered as an alternative protein source in animal nutrition. However, their effects on gut function, especially in terms of how quickly animals adapt to such diets, are still unclear. This study examined whether the duration of feeding adult rabbits a diet containing Cuban cricket meal influenced fecal bacterial enzyme activity and apparent nutrient digestibility. Short-term feeding (two weeks) did not result in noticeable changes in fiber utilization, whereas longer feeding periods (four and six weeks) led to clear increases in the activity of enzymes involved in degrading structural carbohydrates, including chitin. This was accompanied by improved digestibility of fiber fractions. These results could be interpreted as indirect evidence that rabbits' gut microbiota requires an adaptation period to effectively respond to insect-derived components, and that this response is linked to changes in microbial enzyme activity rather than to nutrient digestion itself.

Abstract

Insect-derived feed ingredients are increasingly considered alternative protein sources, but their time-dependent effects on digestive function remain unclear. This study evaluated how the duration of feeding a diet containing Cuban cricket meal (CCM) affected fecal bacterial enzyme activity and apparent nutrient digestibility in adult rabbits. Thirty-two New Zealand White male rabbits were allocated to four groups. The control group received a diet containing 14% soybean meal throughout the six-week trial, whereas experimental groups received soybean meal followed by a diet in which 10% CCM replaced soybean meal for the final two, four, or six weeks. It was found that the fecal enzymatic response depended on feeding duration. Short-term feeding induced limited changes, whereas longer feeding periods (four and six weeks) increased the activity of enzymes involved in the degradation of complex substrates, including chitin, and enhanced the extracellular activity of several enzymes. Digestibility of dry matter, crude protein, ether extract, and energy was unaffected. By contrast, neutral detergent fiber, acid detergent fiber, and acid detergent lignin digestibility increased after four and six weeks ($p < 0.001$). These results could be interpreted as indirect evidence that rabbits' gut microbiota requires an adaptation period to effectively respond to insect-derived components.



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