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Harnessing Mealworms for Livestock Nutrition in Nordic Regions

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Description

The yellow mealworm stands out as one of the few species poised for large-scale commercial production. These mealworms possess the potential to thrive in various agricultural and low-quality organic substrates, offering an alternative nutrient source for livestock, particularly monogastric animals. In Nordic countries, the self-sufficiency regarding domestic animal feed resources is relatively lacking. Therefore, local production and utilization of novel feed sources like mealworms could bolster the regional supply of raw materials for feed industries. This necessitates understanding if locally available bio-resources, such as Nordic agricultural by-products, can effectively yield high-quality mealworm biomass for livestock.

Mealworms for livestock nutrition

The mealworm larvae's capacity to thrive on different substrates may hinge on their interaction with the gut microbiome. Yet, the alterations in mealworm larvae gut microbial communities due to short-term nutritional changes remain largely unexplored. This study delves into potential shifts in the gut microbial population of mealworm larvae when exposed to nutritional variations. Such insights could be pivotal in harnessing the gut microbiome to enhance the feed efficiency of mealworm larvae in commercial farming.

The mealworm undergoes complete metamorphosis, transitioning through four distinct stages: Egg, larva, pupa and adult. Previous investigations have examined mealworm larvae biomass for its nutritional value as animal feed, showing improvements in nutrient digestibility and growth performance in pigs and poultry. Notably, mealworms at different metamorphic stages possess unique chemical compositions, with factors like chitin levels influencing their suitability as animal feed. However, the impacts of these metamorphic stages on nutritional profiles and their utilization as feed ingredients have often been overlooked. This study seeks to characterize the stage-specific nutritional compositions and *in vitro* digestibility of mealworms for both monogastric and ruminant animals. The study's objectives encompass testing the hypotheses that Mealworms attain high nutritional quality using locally available agricultural by-products in the Nordic region, the nutritional value and digestibility of mealworms vary across metamorphic stages and short-term nutritional challenges influence the gut microbiome of mealworm larvae.

Macronutrients, excluding fiber and water, play essential roles in providing structural material, such as amino acids for protein synthesis and lipids for cell membranes and signaling molecules, as well as serving as a source of energy. However, the net energy derived from these nutrients can vary depending on factors like absorption and digestive effort.

Role of macronutrients

Vitamins, minerals, fiber and water, while not providing energy directly, are crucial for various bodily functions. Fiber, a non-digestible material like cellulose, is essential for both mechanical and biochemical reasons, although the exact mechanisms are not fully understood. Carbohydrates and fats are composed of carbon, hydrogen and oxygen atoms. Carbohydrates range from simple sugars like glucose, fructose and galactose to complex polysaccharides such as starch. Fats, on the other hand, are triglycerides consisting of fatty acid monomers bound to a glycerol backbone. Some fatty acids are considered essential as they cannot be synthesized in the body.

Protein molecules contain nitrogen in addition to carbon, hydrogen and oxygen. They are composed of nitrogen-containing amino acids, with essential amino acids being those that cannot be synthesized by the body. Some amino acids can be converted to glucose for energy production, while the excess is eliminated, primarily as urea in urine. Additionally, certain dietary substances found in plant foods, like phytochemicals and polyphenols, while not classified as essential nutrients, can influence health positively or negatively. Most foods contain a combination of nutrients and other substances. Some nutrients can be stored internally, while others are required continuously. Imbalance in nutrient intake, either deficiency or excess, can lead to poor health. For instance, while salt provides essential nutrients like sodium and chloride, excessive intake can lead to illness or even death.