MADAGASCAR HISSING COCKROACH (GROMPHADORHINA PORTENTOSA) - A POSSIBLE ALTERNATIVE SOURCE OF PROTEIN FOR ANIMAL FEEDING

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RESEARCH ARTICLE

Abstract

The study was conducted on a batch of 18 Madagascar hissing cockroaches (Gromphadorhina Portentosa). It is based on visual information on cockroach morphology as well as chemical composition. HYBRIMIN software was used to obtain feed rations for certain animal species at different stages of development for the replacement of plant protein with protein meal from the hissing cockroach. he results showed a higher quality of the protein contained in Madagascar hissing cockroach, which is an easier, higher quality and more economical alternative to classical plant protein. With the world's population expected to exceed 9 billion by 2050, they will require twice as much food. Conventional sources of protein will be insufficient, so the priority is to focus on finding other sources, which could be insect consumption.

Keywords: Madagascar beetle, chemical composition, protein, animal feeding
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INTRODUCTION

Every year, there is a growing competition for protein and a growing global need for feed. In order to fulfill future global demand, protein output must increase by 60% by 2050, and research is being done all around the world to avoid any shortages (United Nation, 2023; Gomes et al, 2023).

Since July 2017, the European Union has permitted the use of insects as feed in aquaculture. The Standing Committee on Plants, Animals, Food and Feed, as well as the European Parliament and Council, have also just approved the use of insects as feed for pigs and poultry, with approval in April 2021 (Byrne, 2021; Ahmed et al, 2021). To reduce the negative effects of climate change, insects must be used in food production (Lange and Nakamura, 2023). Worldwide, more than 2000 kinds of edible insects are eaten (Huis, 2015, Shah et al, 2022). The most often eaten insect group includes grasshoppers, locusts, crickets, termites, dragonflies, cockroaches, spiders, and other groups. Beetles, caterpillars, bees, wasps, and ants are all included (Raheem et al, 2018, Kim et al, 2019).

In many nations across the world, insects have been recognized in recent years as a significant potential supply of sustainable raw materials for animal feed, because they are a natural element of the diet of many animal species, satisfy the nutritional needs of animals in terms of nutritional composition, amino acid profile, and feed acceptability (Khalifah et al, 2023). Insects are an excellent source of protein, fat and micronutrients" (Bednářová et al, 2013). The majority of developed nations currently forbid the use of insects as ruminant feed (USA, China, Canada). However, the use of insects as ruminant feed is not specifically regulated in many nations (Lähteenmäki-Uutela et al, 2017, Ahmed et al, 2021). In the upcoming years, it is appropriate to take into account insect proteins as a potential source of commercial feed. The opinions of stakeholders and consumers about the use of insects as animal feed, however, have not been extensively researched (Pinotti et al, 2019).

MATERIAL AND METHOD

A number of 18 Madagascar hissing beetles (*Gromphadorhina portentosa*), were used for this study. The aim of the research was to determine the chemical composition of Madagascar cockroaches and include them in different animal species diets using the HYBRIMIN Futter 2008 software.

The samples of cockroaches studied was homogeneous, consisting of both males and females, and clinically healthy without the presence of parasites. The average weight of the beetle batch is 7.71g, with the largest male being 8.2cm long and 3.1cm wide and the largest female being 6.1cm long and 2.5cm wide. Moisture, crude protein, crude fiber, crude fat, ash and nitrogen-free extract (NFE) were measured using AOAC official method.

RESULTS AND DISCUSSIONS

The fresh matter of *Gromphadorhina portentosa* was characterized by high moisture content of 60.25 %. The analysis of the crude chemical composition of the cockroach sample showed the highest percentage of protein at 26.86%, followed by crude fat at 6.92%. Lower values were recorded for crude cellulose 3.24%, crude ash 1.8% and NFE. 0.93%. Taking into account the chemical composition per 100 g of dry matter, we noticed that the percentage of protein increased to 64.5%, followed by crude fat to 20.13%, crude cellulose to 8.05%, crude ash to 3.79% and S.E.N. to 3.53%.

After the chemical composition, we used the Feed Formulation Software HYBRIMIN® Futter 5.1. to formulate rations for cattle, sheep and pigs by introducing *Gromphadorhina portentosa* flour as a protein source.

Different plant-based meals (soya, sunflower, oilseed rape) are commonly used in cow diets to provide the protein requirements. In the first example was formulated a ration for a 550kg cow with a milk production of 20l/day, in which we replaced the plant-based meal with Madagascar hissing cockroach protein meal. The ration consisted of 3 kg of hay, 22 kg of grass silage, 2.05 kg of maize, vitamins, calcium carbonate, salt and dicalcium phosphate, salt and to balance the protein we introduced Madagascar beetle flour, the required amount being 500 g. Another example was the formulation of a ration for a 65 kg ewe, in the second month of lactation, with a lamb, with a ration consisting of 2.089 kg hay, 160 g barley, salt and the required amount of Madagascar hissing beetle flour was 361 g., thus balancing the protein requirement. The third ration was for a 45 kg piglet with a daily growth rate of 700 g, in which we partially replaced the daily protein requirement with about 400 g of protein meal from *Gromphadorhina portentosa.* The daily ration was 300 g maize, 1.585 g barley, 388 g Madagascar beetle meal, calcium carbonate, monosodium phosphate, lysine, methionine, threonine, tryptophan. In other example where we formulated a ration for a 200 kg sow, pregnant in 13-16 weeks, the protein requirement was provided mainly on protein meal from Madagascar beetle and only to a small amount from peas. Thus a total of 700 g of Madagascar cockroach meal was used. The ration was based on 1 kg maize, 1.421 kg barley, 0.445 peas, calcium carbonate, monosodium phosphate and vitamins. In the last example the previous ration was taken except that the protein requirement was only partially replaced with protein meal from *Gromphadorhina portentosa*, using only 300 g, while the important protein source was provided by sunflower meal. The results showed a higher quality of the protein contained in Madagascar hissing beetle, which is an easier, higher quality and more economical alternative to classical plant protein.

Average of moisture and chemical composition based on dry matter (100 g DM) and sample (100 g sample) of *Gromphadorhina portentosa.*

Parameters	g/100 g sample	g/100 g DM
Moisture	60.25	
DM	39.75	100
Ash	1.8	4.52
Crude protein	26.86	67.57
Crude fat	6.92	17.40
NFE	0.93	2.34
Fibre	3.24	8.15

DM- dry matter; NFE- Nitrogen-free extract

Nowadays, plant-based protein sources like soybean meal, the main sources of protein utilized in farm animal nutrition (Maurer et al, 2016). The use of insects as an innovative feed in livestock meat production has become more popular due to factors such as rising grain prices, environmental concerns, increased consumption and huge feed costs. Many animal species naturally include insects in their meals. They are excellent providers of protein and amino acids, and depending on the species, they can also be lipid-rich foods with little carbon impact (Sogari et al, 2019). Due to its high protein content the Madagascar hissing beetle could be used as a source of protein in feed for livestock and pets.

Given that insects are a natural source of food for birds and have a high feed conversion ratio as well as a strong nutritional profile (rich in minerals and amino acids), insect meal may be a viable substitute for other protein sources in poultry diets (Secci et al, 2018). Newton et al. conducted the first evaluation of the use of insects in swine diets in the 1970s. In that study, the palatability, calcium and phosphorus balance, nutritional digestibility, and amino acid profile of diets containing black soldier fly larvae meal (33%) were assessed.

CONCLUSIONS

Due to the high protein content of the Madagascar hissing beetle (67.57% DM) it could be used as a source of protein in livestock and pet food. We consider it appropriate to use the Madagascar hissing beetle as a source of protein for animal feed, due to its ability to reproduce easily and valorize food residues with low economic value. In some overpopulated countries, the Madagascar hissing cockroach is already being used in human food and could become a real alternative even in developed countries. Breeding cockroaches is much less harmful to the environment, due to the reduced emission of greenhouse gases, but also because they insignificantly pollute water and soil. We suggest using insects in animal and human feed with caution, as some animal species may develop allergies from eating or touching them, especially if the insects have not been raised in a controlled environment.

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