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Insects As an Alternative Protein Source

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Abstract: This article analyzes the synthesis of the Tenebrio molitor protein (Coleoptera: Tenebrionidae) belonging to a food insect, depending on its nutrient content. Differences in protein synthesis by Tenebrio molitor larvae were shown when wheat bran and flour from the macrophytes Lemna minor and Azolla carolina were added. In particular, it was noted that TMO-2 and TMO-6 T.molitor F6 larvae are synthesized on average 31.02% protein in wheat bran, 38.13% in duckweed and 30.87% in azole.

Keywords: Tenebrio molitor, mealworm, edible insects, feed, fish feed, protein.

Introduction

By 2050, there will be a problem with the provision of food to more than 9 billion people [FAO, 2009]. According to FAO (2001), by 2050, compared with 2010, the demand for meat products will increase by 58%, and the demand for dairy products - by 70%. One of the global problems is a sharp change in the natural climate, drought due to abiotic and biotic factors, a decrease in the area of land for agricultural production due to increased salinity and soil degradation, and serious problems arise in the production of agricultural products under the influence of various pests and diseases. By breeding industrially insects with a nutritious chemical composition, it is possible to create an unlimited number of feed industries and feed additives for livestock production [van Huis et al., 2013]. Thus, food insects can be considered as an alternative source of providing the livestock, poultry, and fishing industries with a continuous nutritious food base [Khujamshukurov., 2011]. It is known that *Tenebrio molitor* is one of the most widely used food insects in the world practice [Khujamshukurov et al., 2016].

This may be due to the area of distribution of these insects, living conditions, type of feeding under controlled conditions, nutritional value of the food base.

The Purpose of The Work

Growing in the conditions of Uzbekistan consists in determining the stock of protein, amino acids, fats and fatty acids *Tenebrio molitor* (Coleoptera: Tenebrionidae).

Material Methods

Object of study. The sixth generation (F_6) Tenebrio molitor (Coleoptera: Tenebrionidae) was used, collected from the southern foothills of Uzbekistan and propagated under controlled conditions. During the study, from larvae and beetles collected by nature and numbered *Tenebrio molitor* (128: larvae 108, 20 beetles), 2 larvae (TMO-2: 5.36 cm, TMO-6: 4.83 cm) were selected (F_1 variant), which were the largest in size compared to others, upon visual observation, a *Tenebrio molitor* colony was formed on their basis. Growing conditions: used dry biomass of wheat bran with a standard content, as well as from *macrophytesLemna minor* and *Azolla carolina.* Temperature is 20-22°C. The duration of cultivation in all samples was 28 days. Method R. Scoups (1985) was used in protein purification. The amount of protein in the supernatant was determined by the standard Lowry method. The statistical significance of the results was determined using Student's t-test.

Results And Their Discussion

When studying the direct storage of protein of *Tenebrio molitor* larvae (3-4 cm long), variant F_1 collected from the Angren mountain ranges, Republic of Uzbekistan, Tashkent region, the average protein content was 43.09%. It was noted that the average protein content in the variants of F_1 larvae 1-3 cm long collected from nature is 42.74%. During the study, from larvae and beetles collected by nature and numbered *Tenebrio*

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molitor (128: larvae 108, 20 beetles), 2 larvae (TMO-2: 5.36 cm, TMO-6: 4.83 cm) were selected (F_1 variant), which were the largest in size compared to others, upon visual observation, a *Tenebrio molitor* colony was formed on their basis. Although the larvae of the TMO-2 variant obtained on the basis of the F_6 variant synthesized 30.89% of the protein in wheat bran, it was found that they synthesize 12.2% less protein than in the control variant (F1). The TMO-2 variant grown in duckweed-based nutrient medium showed an average of 38.65% protein synthesis. 4.44% less than the F_1 control, and 7.71% more protein synthesis than F_6 grown on wheat bran. Therefore, the fact that duckweed stores more protein than wheat bran from the point of view of protein storage, could serve as the basis for this. It was found that the larvae of the TMO-2 variant obtained on the basis of variant F_6 synthesize an average of 31.48% of the protein when grown on the basis of azole.

The larvae of the TMO-6 *Tenebrio molitor* variant obtained on the basis of F_6 synthesized 31.15% of the protein in wheat bran, while protein synthesis was observed to be 11.59% less compared to the control variant (F_1). The TMO-6 variant grown in a nutrient medium based on *Lemna minor* Synthesized an average of 37.60% protein, 5.14% less than the F_1 control, and 6.45% more protein synthesis than the F6 variant grown on wheat bran. It rs observed that the larvae of the TMO-6 variant obtained on the basis of the F_6 variant synthesized on average 30.26% of the protein when grown on the basis of azole and 12.48% less protein synthesis than on the F_1 control. Variant TMO-6 larvae grown on *Azollea carolina* flour synthesized 0.89% less protein than larvae of TMO-6 variant grown on wheat bran.

However, studies have shown significant differences in the overall development and mortality of larvae feeding on duckweed and azole. In particular, the laying of eggs of larvae based on azole was 38.14%, and in duckweed - 58.38%. It was noted that the percentage of egg laying in larvae grown on wheat bran was 68.85%.The mortality rate of larvae feeding on wheat bran was only 18.22%, on duckweed - 44.63%, and on azole - 62.27%. This situation is explained by the fact that in duckweed and azole there is not enough moisture (average humidity 3.4-4.2%), the content of wheat bran is relatively high (average humidity 9.58-10.12%).Summing up these indicators, we believe that the lack of nutrients in the body eating macrophyte larvae, the low moisture content in the feed led to their death, egg laying and larvae of variant F_6 produced significantly less protein than variant F_1. Therefore, when feeding macrophytes, it is advisable to take into account its moisture content or add flour based on them to other food sources. Then the larvae can die, lay eggs and achieve maximum protein synthesis.

Conclusion

Typically, agricultural products such as soybean meal, wheat bran, corn bran and cornmeal, which are expensive and inconvenient to grow, are used in the production of *Tenebrio molitor* under controlled conditions and in the production of feed products based on it. In our study, their properties of protein synthesis during the propagation of *Tenebrio molitor* based on macrophytes were demonstrated. The production of feed based on feed insects will provide the fast-growing fish industry in Uzbekistan with a source of continuous. full nutritional value. The cultivation of these species of insects using macrophytes of duckweed and azole, which are easy to breed, will reduce their cost and increase their nutritional value.

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