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THE EFFECT OF TWO DIFFERENT PROTEIN LEVELS IN THE DIET ON THE GROWTH PERFORMANCE OF TURKISH SNAIL (*Helix lucorum*)

UTICAJ ISHRANE SA DVA RAZLIČITA NIVOA PROTEINA NA RAST TURSKOG PUŽA (HELIX LUCORUM)

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ABSTRACT

In order to determine the optimum level of protein required in the diet of Turkish snail (Helix lucorum) was investigated at the Snail Research Base of the Faculty of Agriculture, Trakia University, Bulgaria. Eighty Turkish snails with initial body weight 5.47±1.0 g, were divided into two groups of 40 snails each and were fed ad-libitum with the experimental diets for 90 days. The snails were grouped and assigned to the diets at two crude protein levels (16 and 26 %). The results showed that feed intake and weight gain were significantly influenced by dietary protein. Diets containing 26 % protein level appeared to be utilized more efficiently in term of food conversion ratio (1.51) than diets containing the other dietary protein (2.01). Survival of each group was 100 % and no significant difference among treatments. It was concluded that snail fed lower diet protein level (16 %) performed lower in growth at the end of the feeding trial.

Key words: *Helix lucorum, diet, protein levels, growth performance.*

REZIME

U cilju utvrđivanja optimalnog nivoa proteina potrebnih u ishrani Turskih puževa (Helik lucorum) obavljena su ispitivanja u Snail Research Base na Poljoprivrednom fakultetu, Trakija univerziteta, Bugarska. Osamdeset turskih puževa početne mase 5,47 ± 1,0 g, bili su podeljeni u dve grupe od po 40 puževa u svakoj i hranjeni su ad-libitum eksperimentalnim načinom ishrane tokom 90 dana. Gajeni su u drvenim kavezima ispunjenim ilovastim zemljištem do 10 cm debljine. Puževi su grupisani u dve grupe i dodeljen im način ishrane na dva nivoa sirovih proteina (16 i 26%). Rezultati su pokazali da na unos hrane i povećanje mase značajno utiče ishrana proteinima. Ishrana sa nivoem proteina od 26% pokazala se efikasnijom u smislu koeficijenta konverzije hrane (1,51) u odnosu na ishranu sa različitim sadržajem proteina (2,01). Opstanak svake grupe bio je 100%, a nije ustanovljena značajna razlika među tretmanima. Zaključeno je da puževi hranjeni nižim nivoem proteina (16%) imaju niži prirast na kraju perioda hranjenja.

***Ključne reči**: Helix lucorum, ishrana, nivo proteina, performanse rasta.*

INTRODUCTION

Heliciculture is a successful business in most European countries. Snail farming, in its modern version, began in Bulgaria in 2003. Before that the market supply of snails is from the gatherers that hand-picked them from nature between 10 May and 30 June. Nowadays mainly of the established farming systems were extensive (open-type) and little part intensive (closed-type) farming (*Georgiev and Atanasov, 2011*).

One of the main conditions for sustainable production of snails is the formulating and preparation of nutritionally balanced diets for snails. This could be made possible by well-known and established of feed requirements. Snails belong to a group of invertebrate and more of them are herbivores, feeding on green vegetation including fruits and vegetables as white clover on farm fields. Intensive approach to snail production entails the use only commercial feed other than the already existing conventional ones (*Okon et al., 2012*).

Growth performance of land snails on different studies based on different plant food materials cannot be directly compared with formulated diets because of differences in protein and energy contents (*Ejidike, 2004*). This study therefore, aims at assessing the effect of two commercial diets of different crude protein levels on survival, weight gain, and nutrient utilization of Turkish snail (*Helix lucorum*) under captive rearing.

MATERIAL AND METHOD

The experiment was carried out at theSnail Research Base of the Faculty of Agriculture, Trakia University, Bulgaria.A total of 80 Turkish snails (5.47±1.0 g) were randomly divided to two treatment groups in 4 replicates with 10 snails per replicate. The snails were housed in four square cages (1 m^3). The cages were constructed of wooden frame and wire mesh filled with loamy soil up to 10 cm thickness. The soil was moistened daily by automatic sprinkling system. Feed and water were provided *ad libitum* throughout the 90 days' period. Two diets of different protein levels were tested: diet I (16 % crude protein diet) and diet II (26 % crude protein diet). Feed ingredients such as corn, wheat, soybean and sunflower meals, chalk, vitamin, premix andetc. used to formulate the experimental diets were delivered from domestic animals food factory Bonmix, Bulgaria. The proximate mineral and amino acid compositions of the diets were determined according the methods proposed by Association of Analytical Chemists (*AOAC, 2006*) and present in Table 1. Crude protein content was calculated by converting the nitrogen content, determined by Kjeldahl's method (AOAC method 990.03) using an automatic Kjeldahl system (Kjeltec 8400, FOSS, Sweden). Fiber content was determined by AOAC method 978.10. Crude ash was determined by AOAC method 942.05 after incineration in a muffle furnace (MLW, Germany) at 550 °C for 8 h. Crucibles were brought about the room

temperature and weighted. The standard solutions for ETAAS determination of Ca and P with concentration of 1000 mg.l^{-1} were supplied by test kit Merck (Darmstadt, Germany). The samples were analyzed with Perkin-Elmer AAnalyst 800 atomic absorption spectrometer (Norwalk, CT).

Table 1. Proximate mineral and amino acid composition of experimental diets

	Diet I	Diet II
Metabolic energy, kcal/kg^{-1} (1 kcal = 4,184 kJ)	1782	1980
Crude protein, g	161.8	265.1
Crude fiber, g	24.9	29.8
Crude ash, g	360.7	165.0
Ca, g	123.2	127.0
P, g	122.0	120.0
Lysine, g	8.5	10,2
Methionine-cysteine, g	6.2	4.9
Threonine, g	5.2	5.9
Tryptophan, g	1,5	1.9

The shell length and width were measured with digital caliper with the accuracy of 0.1 mm and method described by *Atanasoff et al.,* (2014). The end of the trial feed conversion ratio (FCR) was calculated.

Data is reported as means ± Std.Dv. and all statistical analyses were performed using STATISTICA version 6.0 (StatSoft Inc., 2002). Significant effects (p<0.05) were determined after applying t-test for dependent samples.

RESULT AND DISCUSSION

One of the essential conditions for the growth of snails is water. Water should always be sprinkled on the environment to moisten it because when there is water stress, snails instinctively assume a dormant state (aestivation) during which growth cease. The mean daily temperature 25.6±0.24 ^{o}C and humidity 92 % respectively during the experiment were within normal limits for snail.

Table 2. Growth response and nutrient utilization of snail fed experimental diets

	Diet I	Diet II
Initial body weight, g	5.47	5.47
Final bodyweight, g	29.67^{b}	37.39^{a}
Daily weight gain	0.26^{b}	0.37^{a}
Total weight gain, g	24.20^{b}	31.92^{a}
Initial shell length, cm	2.3	2.3
Final shell length, cm	4.5	5.4
Initial shell width, cm	2.02	2.15
Final shell width, cm	3.49	3.62
Total feed consumption	48.64	48.47
Feed conversion ration	2.01^{b}	1.51^{a}
Survival rate, %	100	100

*means with different superscripts are significantly different (p<0.05)

The growth response, nutrient utilization and survival rate of snail (*Helix lucorum*) fed on different artificial diets are shown in Table 2. The values for each growth parameter (final body weight, daily weight gain, and total weight gain) among diets were not very wide but differ significantly (p<0,05). The higher daily and total weight gain in Diet I could be attributed to the nutrient composition of the feed. Being a formulated feed, it is expected to have a better balance of nutrients. Therefore, consumption in smaller quantities of food would give a corresponding gain in weight. Similarly, *Ani et al.* (2013) demonstrated that weight gain and feed efficiency were improved with higher amount of dietary protein and energy. A similar report with another kind of land snail had been documented (*Sampelayo et al., 1991*).

Snails from both treatments had comparable (P>0.05) final shell length and width. The measurements of the snail shell areimportant indicators because it defines the space available for vital activity of the snail (*Örstan, 2006*). Besides this the shell volume of the shell is related to quantity of edible part of the snail meat (*Atanasoff et al., 2014*). Results showed that average shell lengthand shell width of snails which consumed diet content 26 % of crude protein were superior (*P>0.05*) to those of diet with 16 %. The superior shell length and width could be attributed to the direct proportional relationship between enhanced growth performance of snails and the shell parameters (*P>0.05*). A positive correlation between body weightgain, shell length and width gains had beenreported in land snails (*Plummer, 1975*; *Odunaiya and Akinnusi, 2008*; *Alikwe et al., 2013*). The superior (*P>0.05*) in shell length of snails fed Diet I, could be also attributed to the higher calcium content of them (*Mogbo et al., 2014*).

Snails on Diet II (CP 26 %) had significantly (P<0.05) higher feed conversion ratio by those of Diet I (CP 16 %).They are capable of utilizing artificial diets effectively as reflected by the general low FCR that decreased with increase in protein level of the diets.

Survival rate of 100 % was recorded for both groups throughout the experimental confirm the report of *Oluokum et al.,* (2005). They have relatively low mortality rate if proper management is observed compared to other conventional livestock (*Nyameasem and Borketey-La, 2015*).

Each specie and category of snails has different nutritional requirement which must be calculated with care to ensure maximum productivity. The growth rate in snails is simply a consequence of the amount of nutrient they consume. That is why the growing snails require feed rations that are complete and balanced nutritionally. For the one of most critical factor in limiting growth of snails could be accept the reduce in protein intake (*Sampelayo et al., 1991*). That is very important and useful in connection with one new strategy for combines the use in the snail farming activity of plants and solar energy capture infrastructure presented on Figure 1 (*Toader, 2012*). According to official figures, Bulgaria has fully achieved the objectives of the "Europe 2020" strategy on the consumption of energy from renewable sources. The installed capacity now exceeds 2.2 GWh, and reports for 2015 show that 16 % of electricity consumed in Bulgaria was produced from renewable sources. Provided that in Bulgaria ground-mounted system were constructed on land previously used for intensive cultivation of crops, they become powerful factor in changing the nature of soil and the relationship with plants that can grow there. Researches carried out so far into PV parks showed that solar photovoltaics (PV) evoked shading and changes to wind flow over the land, and in principle is likely to alter temperature, change the rainfall distribution, which influence on soil moisture. This requires defining very carefully the kinds of plants and rations which will be supplemented by artificial snail feed.

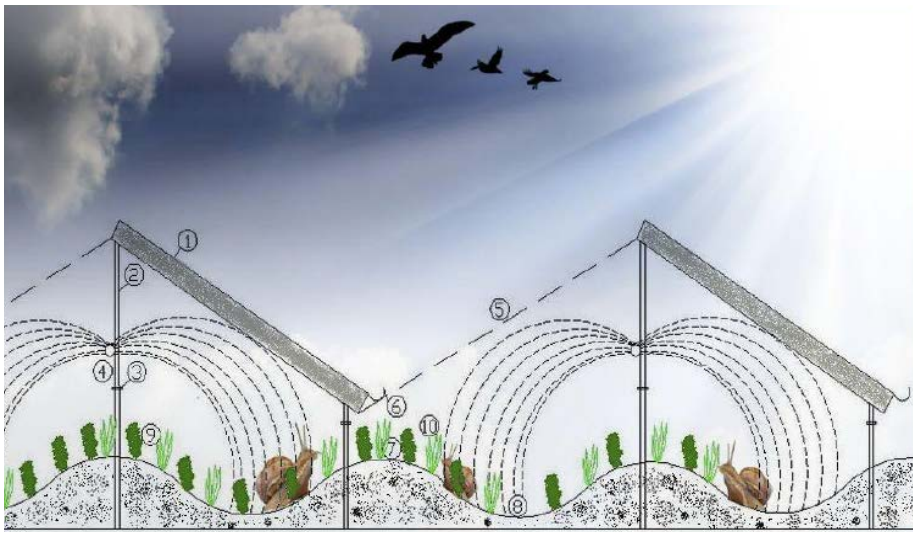

Fig. 1. Solar energy installation and farming system for edible terrestrial snails (Toader, 2012)

CONCLUSION

In conclusion, from the variation of the different analyzed parameters and results obtained in the end of study we can conclude that the best protein level for optimum growth of *Helix lucorum* is 26 % CP. Incorporation and availability of low cost artificial diet in snail farming especially during the process of produce electricity from solar photovoltaic (PV) would be useful.

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