FORMULATED FEED PREFERENCE FOR SURVIVAL AND OPTIMAL GROWTH OF *Bulinus* species REARED IN THE LABORATORY

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ABSTRACT

Seventy-seven Bulinus snail species were fed for eight weeks with eleven diets consisting of different feed-formulations and vegetables. Snails reared exclusively on grower's mash, corn fibre meal and fish meal did not survive for up to two weeks. The result from this investigation indicates that there is no significant difference in body growth gain between lettuce + blood meal, lettuce + groundnut fibre meal, blood meal, lettuce and cabbage. But they showed significant difference with lettuce + corn fibre meal and lettuce + fish meal. It is therefore recommended that in a situation where lettuce which is well known as the snail's food is not available as during the peak of rainy season, feeds like blood meal and cabbage can be used as viable substitutes for rearing experimental Bulinus snail species in the laboratory. Also, lettuce + blood meal has been shown by this study as the best feed formulation for the optimal growth and development of Bulinus sp in the laboratory.

Keywords: *Bulinus* snail, Lettuce, Blood meal, Dietary formulations, Survival

INTRODUCTION

Bulinus is a genus of small medically important tropical freshwater snails. Several species of *Bulinus* function as intermediate hosts for *Schistosoma haematobium* (blood fluke). *Bulinus* species found in Nigeria include *B. senegalensis, B. forskalli, B. globosus* and *B. rohlfsi*. Others are *B. forskalii, B. globosus* and *B. rohlfsi* (Ukoli and Asamu, 1979). These snails are known to inhabit marshy pools, pond irrigation canals and quarry lakes (Okafor and Ngang, 2004).

Experimental freshwater snails, when cultured in the laboratory are fed with vegetations and artificial feeds. The quality of the diet provided as food for raising fresh water snails under laboratory conditions, has a significant effect on their growth and the number of egg clutches laid as well as on the size of the snail. Snails raised on a high quality diet are known to produce more cercariae when infected with a digenean parasite species. Also, the raising of snails on a mixture of foods resulted in a better fitness in terms of snail survival and prevalence of infection (Ismail and Haroun, 2001).

Lymnea snail cultured in the laboratory to determine the thermal effect on the life cycle parameters were reported to have been sustained on different vegetables which comprised of lettuce (*Lactuca sativa*), mustard (*Brassica nigra*), radish (*Raphanus sativus*). Spinach (*Spinancea oleracea*) and aquatic weed (C*hara vallisneria*) (Aziz and Raut, 1996). Rondeland *et al.* (2004) observed higher cercarial production in snails raised with lettuce – Tetraphyll combinations than those raised with only lettuce. Lundeba *et al.* (2006*)* reported that *Bulinus nyassanus* feed and survive well on locally formulated fish diet consisting of 30% crude protein with ingredients comprising of fish meal, maize bran, rice bran, soya bean, wheat bran, hemicellulose (binder), vitamin premix and mineral premix.

However, not much literature has shown trials with formulated diets. Formulated feeds are expected to be cheaper and more readily available all year round. The present study was designed to investigate the feed formulation preferred by *Bulinus* species and their effects on the survival and growth of these snails in the laboratory. It is hoped that this research work will contribute immensely to the search for potential formulated feeds for laboratory rearing of experimental freshwater snails.

MATERIALS AND METHODS

Sample Collection: *Bulinus* snail species used in this study were collected from the quarry pit of the Nigeria Cement Company (NIGERCEM), Nkalagu in Ebonyi State, Nigeria. The area consists of limestone rocks on which the Bulinus species were found.

The area lies between latitude $6^0$35' and 6^o35'N and longitude 7^o48'E. The collection was done by scooping method using a plastic kitchen strainer as scoop. The snails were collected from the sieve and stored in a plastic container into which damp vegetation from the immediate environment had been stuffed. The container had no water and the lid was perforated. The sample was transported to the Parasitology and Public Health Laboratory, University of Nigeria, Nsukka. In the laboratory, the container was emptied into a white tray and the snails were sorted and identified to genera and species levels (Madsen, 1992). The snails were then counted, weighed and randomly distributed to eleven dietary types in different labelled dishes.

Experimental Diets: The experimental diets comprised of the following: (a) *Lactuca sativa* - lettuce leaves, (b) *Brassica oleracea* –cabbage leaves, (c) Grower's mash, (d) Groundnut fibre meal, (e) Corn fibre meal, (f) Fish meal, (g) Blood meal, (h) Lettuce and Blood meal, (i) Lettuce and corn fibre meal, (j) Lettuce and groundnut fibre meal and (k) Lettuce and fish meal.

The feed ingredients were weighed out as 1000 grams of the diet and the ingredients were homogeneously mixed with 2.5 litres water to produce dough (Eyo, 2004). The dough was moulded into pellets using hemicellulose as the binding agent. The pellets were sun-dried before use. The lettuce and cabbage leaves were stripped from the ribs and washed before use. Proximate analyses were done for all the dietary ingredients (AOAC, 1975).

Procedures and Management: The snails were raised in plastic bowls containing chlorine-free tap water. Each bowl was covered with fine wire mesh to prevent the escape of snails and entry of foreign organisms. Each container housed seven (7) snails of the same size and weight. The water in which the snails were reared was changed twice each week and a pinch of powdered calcium carbonate ($CaCO_3$) added into each container. Remains of leaves and feeds were removed before the addition of new ones. The mortality rate was recorded daily and the dead snails were removed.

The growth measurements taken were the body weight, shell length, shell breadth and aperture length of the snails. The snails were weighed at the start of the experiment and every fourteen (14) days subsequently. The shell lengths, shell breadths and aperture lengths were measured using a vernier calliper and the body weight measurements were done using electronic weighing balance. The snails were thoroughly cleared to wipe out water or any food remains on the body before weighing.

Ethical Clearance: The ethical standards of the University of Nigeria, Nsukka were fully complied with.

Statistical Analysis: All statistical analyses were performed using the SPSS for windows, version 16 (Chicago, Illinois, USA). The growth performances of the feeds were compared using analysis of variance (ANOVA) and Fisher's Least Significant Difference (F-LSD).

RESULTS

Body Weight: The Mean Bi-weekly changes in body weight (Table 1) shows that snails fed with lettuce + groundnut fibre meal had the highest rate of 0.2232g, followed by those fed with lettuce only, with a mean weight of 0.2221g. Those fed with lettuce + fish meal had the least value of 0.1264g.

Shell Length: The Mean Bi-weekly changes in shell length (Table 2) shows that snails fed with lettuce had the highest rate of 1.029, followed by those fed with lettuce + blood meal (1.012), then those fed with lettuce + groundnut fibre meal follows with a Mean Shell Length of 0.991. While those fed with lettuce + corn fibre meal had the least (0.501).

Shell Breadth: The Mean Bi-weekly changes in shell breadth (Table 3) shows that snails fed with lettuce + blood meal had the highest rate of 0.749 cm followed closely by snails fed with lettuce with a mean shell breadth of 0.718 cm while those fed with lettuce + corn fibre meal had the least (0.363 cm).

Aperture Length: The mean bi-weekly changes in aperture length (Table 4) shows that snails fed with blood meal had the highest rate of 0.877, followed closely by those fed with lettuce + blood meal (0.857). While those fed with lettuce + corn fibre meal had the least (0.422).

Pooled Mean of the Bi-weekly changes in Body Weight, Shell Length, Shell Breadth and Aperture Length: The pooled mean of the Bi-weekly changes in body weight. Shell length, shell breadth and aperture length shows that snails fed with lettuce +blood meal had the highest rate of 0.71, followed closely by those fed with lettuce (0.70) and then by blood meal and lettuce + groundnut fibre meal with the mean of 0.69 and 0.68 respectively. While those fed with lettuce + corn fibre meal had the least (0.34). Snails reared on grower's marsh, corn fibre meal and fish meal did not survive beyond two weeks and therefore not reflected.

Table 1: Mean bi-weekly changes in body weight of *Bulinus* reared with different feeds in the laboratory

Dietary Combinations	Period (Weeks)				Ex	Mean
	2	4	6	8		
1. Blood meal	0.1614	0.1843	0.1929	0.2214	0.7600	0.1900
2. Cabbage	0.1500	0.1543	0.1671	0.1800	0.6514	0.1629
3. Groundnut fibre meal	0.1157	0.1300	0.1371	0.1500	0.5328	0.1332
4. Lettuce	0.1671	0.1971	0.2457	0.2786	0.8885	0.2221
5. Lettuce + blood meal	0.1857	0.2029	0.2229	0.2371	0.8484	0.2121
6. Lettuce + corn fibre	0.0671	0.0757	0.0829	0.0957	0.3214	0.0804
7. Lettuce + fish meal	0.1114	0.1214	0.1300	0.1429	0.5057	0.1264
8. Lettuce + groundnut fibre meal	0.2000	0.2157	0.2314	0.2457	0.8928	0.2232

F-LSD (5% level) = 0.08367

Table 2: Bi-weekly changes in shell length of *Bulinus* sp. reared with different feeds in the laboratory

Dietary Combinations	Period (weeks)				Ex	Mean
	2	4	6	8		
1. Blood meal	0.940	0.971	1.000	1.036	3.947	0.987
2. Cabbage	0.864	0.874	0.887	0.906	3.531	0.883
3. Groundnut fibre meal	0.714	0.721	0.757	0.760	2.952	0.738
4. Lettuce	0.954	1.014	1.057	1.090	4.115	1.029
5. Lettuce + blood meal	0.946	0.984	1.040	1.079	4.049	1.012
6. Lettuce + corn fibre	0.466	0.493	0.509	0.536	2.004	0.501
7. Lettuce + fish meal	0.580	0.611	0.624	0.654	2.469	0.617
8. Lettuce + groundnut fibre meal	0.930	0.967	1.014	1.053	3.964	0.991

F-LSD (5% level) = 0.3670

Table 3: Bi-weekly changes in shell breadth of *Bulinus* reared with different feeds in the laboratory

Dietary Combinations	Period (weeks)				Ex	Mean
	2	4	6	8		
1. Blood meal	0.661	0.683	0.701	0.741	2.786	0.697
2. Cabbage	0.564	0.596	0.643	0.671	2.474	0.619
3. Groundnut fibre meal	0.450	0.492	0.511	0.546	1.997	0.499
4. Lettuce	0.649	0.701	0.746	0.777	2.873	0.718
5. Lettuce + blood meal	0.693	0.730	0.771	0.803	2.997	0.749
6. Lettuce + corn fibre	0.327	0.354	0.370	0.400	1.451	0.363
7. Lettuce + fish meal	0.420	0.453	0.474	0.496	1.843	0.461
8. Lettuce+ groundnut fibre meal	0.656	0.681	0.723	0.761	2.821	0.705

F-LSD (5% level) = 0.2585

Table 4: Bi-weekly changes in aperture length of *Bulinus* reared with different feeds in the laboratory

Dietary Combinations	Period (Weeks)				Ex	Mean
	2	4	6	8		
1. Blood meal	0.820	0.876	0.884	0.929	3.509	0.877
2. Cabbage	0.679	0.689	0.610	0.641	2.619	0.655
3. Groundnut fibre meal	0.570	0.591	0.617	0.630	2.408	0.602
4. Lettuce	0.753	0.827	0.870	0.929	3.379	0.845
5. Lettuce + blood meal	0.793	0.829	0.880	0.929	3.431	0.857
6. Lettuce + corn fibre	0.379	0.413	0.429	0.467	1.688	0.422
7. Lettuce + fish meal	0.477	0.507	0.534	0.550	2.068	0.517
8. Lettuce + groundnut fibre meal	0.744	0.791	0.823	0.866	3.224	0.806

F-LSD (5% level) = 0.3019

Difference in Growth Parameters: From the F-LSD (Table 6), there is insignificant difference between lettuce + blood meal, lettuce, blood meal, lettuce + groundnut fibre meal and cabbage, although lettuce + blood meal showed higher mean growth than others followed by lettuce and so on. Lettuce+ blood meal, lettuce and blood meal showed significant difference between lettuce + corn fibre

Table 5: Pooled bi-weekly changes in body weight, shell length, shell breadth and aperture length of *Bulinus* reared in the laboratory with different feed formulations

Dietary Combinations	Period (weeks)				Ex	Mean
	2	4	6	8		
1. Blood meal	0.65	0.68	0.69	0.73	2.75	0.69
2. Cabbage	0.56	0.58	0.58	0.60	2.32	0.58
3. Groundnut fibre meal	0.46	0.48	0.51	0.52	1.97	0.49
4. Lettuce	0.63	0.68	0.73	0.76	2.80	0.70
5. Lettuce + blood meal	0.65	0.69	0.73	0.76	2.83	0.71
6. Lettuce + corn fibre meal	0.31	0.33	0.35	0.37	1.36	0.34
7. Lettuce +fish meal	0.40	0.42	0.44	0.46	1.72	0.43
8. Lettuce + groundnut fibre meal	0.63	0.66	0.70	0.73	2.72	0.68

Mean F-LSD = 0.25277

Table 6: Fisher's Least Significant Difference at 5% level for different Feeds

Feed comparison	Means	Significance
Blood meal – cabbage	0.69- 0.58 =0.11	NS
Blood meal-groundnut fibre meal	0.69- 0.49 = 0.2	NS
Blood meal –lettuce	0.70 –0.69 =0.01	NS
Blood meal – lettuce + blood meal	0.71- 0.69 = 0.02	NS
Blood meal- lettuce + corn fibre meal	0.69- 0.34 =0.35	S
Blood meal-lettuce fish meal	0.69 –0.43 =0.26	S
Blood meal – lettuce + groundnut fibre meal	0.69- 0.68 =0.01	NS
Cabbage –groundnut fibre meal	0.58–0.49 = 0.09	NS
Cabbage- lettuce	0.70- 0.58 =0.12	NS
Cabbage- lettuce + blood meal	0.71- 0.58 =0.13	NS
Cabbage – lettuce + corn fibre meal	0.58- 0.34 =0.24	NS
Cabbage – lettuce + fish meal	0.58- 0.43 =0.15	NS
Cabbage-lettuce + groundnut fibre meal	0.68- 0.58 =0.1	NS
Groundnut fibre meal – lettuce	0.70-0.49 =0.21	NS
Groundnut fibre meal – lettuce + blood meal	0.71 –0.49 =0.22	NS
Groundnut fibre meal – lettuce corn fibre meal	0.49- 0.34 =0.15	NS
Groundnut fibre meal – lettuce + fish meal	0.49- 0.43 =0.06	NS
Groundnut fibre meal - lettuce groundnut fibre meal	0.68- 0.49= 0.19	NS
Lettuce – lettuce blood meal	0.71- 0.70 =0.01	NS
Lettuce- lettuce corn fibre meal	0.70- 0.34 =0.36	S
Lettuce- lettuce + fish meal	0.70-0.43 =0.27	S
Lettuce – lettuce + groundnut fibre meal	0.70-0.68 =0.02	NS
Lettuce + blood mea l- lettuce + corn fibre meal	0.71-0.34 =0.37	S
Lettuce blood meal - lettuce + fish meal	0.71-0.43 =0.28	S
Lettuce blood meal – lettuce + groundnut fibre meal	0.71- 0.68 =0.03	NS
Lettuce + corn fibre meal – lettuce fish meal	0.43-0.34 =0.09	NS
Lettuce + corn fibre meal – lettuce + groundnut fibre meal	0.68-0.34 =0.34	S
Lettuce fish meal – lettuce + groundnut fibre meal	0.68-0.43 =0.25	NS

NS = not significant, S = significant

meal and lettuce + fish meal. But cabbage and groundnut fibre meal showed no significant difference between lettuce + corn fibre meal and lettuce + fish meal.

Lettuce + groundnut fibre meal showed higher mean growth than lettuce + fish meal but both has no significant difference. Cabbage, groundnut fibre meal, lettuce + corn fibre meal and lettuce + fish meal showed no significant difference over any of the treatments.

DISCUSSION

The present research has shown the food preferences of *Bulinus species* of snails under laboratory conditions. The diets in order of preference based on their effects on the growth and survival of the snails are lettuce + blood meal, lettuce, Blood meal, lettuce + groundnut fibre meal, cabbage and groundnut fibre meal. Diets such as grower's marsh, corn fibre meal and fishmeal, which resulted in total mortality of the snails within a period of two weeks, are not recommended.

The snails reared on mixed diets gave better performance in terms of survival and mean growth rate than those reared on sole diet. This agrees with the findings of Ismail and Haroun (2001), which observed that a mixture of foods resulted in better fitness in terms of survival and prevalence of infection. In the present investigation, the snails reared with lettuce +blood meal and lettuce + groundnut fiber meal gave significantly high growth rates of 0.71 and 0.68 respectively.

In situation as obtains during the peak of the rains and in isolated communities where lettuce vegetable is scarce, very costly or virtually unavailable, the recommended diet from this study are blood meal, cabbage and groundnut fiber meal. The study has also shown the experimental procedure that ensures the survival and adaptability of *Bulinus* snail species in the laboratory.

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