Nutritional quality of snails (Helix aspersa)

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Introduction

Snail consumption in Belgium is almost exclusively derived from import. This situation as well as a recent government decision for protection of snails has stimulated interest in snail breeding.
Although snail breeding for human consumption is well known (Daguzan, 1981, 1982), data on chemical composition and nutritive value are scarce. Thomas et al (1974) give values for protein, lipid and carbohydrate contents and more detailed results are presented by Melgar Armaiz (1964-65) and Cadart (1975). Coughtrey and Martin (1976) presented results on trace mineral content of Helix aspersa, whereas amino acid composition of the Giant African Snail is given by Mead and Kemmerer (1953).
This study was carried out to obtain an idea about the nutritive value of the snail Helix aspersa.
Nutritive value is often defined as the content of nutrients which includes proteins and their amino acid composition, carbohydrates, lipids and fatty acids, minerals, trace elements and vitamins. The amount as well as the nature of these nutrients are important. (Henderickx and Demeyer, 1979).

Materials and methods

The snails (Helix aspersa) were bred in plastic boxes on a commercial snail feed. The proximate composition of the feed was determined in our laboratory and is presented in table 1.
Snails were kept alive in an open jar in the refrigerator for at least a week. After cleaning the snails by means of a dry absorbant paper, they were lyophylized overnight. Weighing of each snail, before and after freeze drying enabled us to determine the water content of snail + shell. Then snails were separated from the shell and both parts weighed. Some snails were dissected alive, the shells air-dried at room temperature, weighed and dried at 105°C for 3 hours to determine shell dry matter. These data allowed calculation of body water content. Freeze dried bodies were ground in a coffee mill for several minutes and sampled to determine crude protein (Kjeldahl method : % N x 6.25), crude fat (Bligh and Dyer, 1959), carbohydrates (phenol sulphuric acid reaction), ash content (method ISO/R 936-1969 (E)), collagen content (method ISO/DIS 3496.2), amino acid composition (Technicon TSM amino acid analyser) and trace metal content (Varian atomic absorption spectrofotometer). Techniques used were discribed by Vandekerckhove and Demeyer (1975) and Demeyer and Dendooven (this meeting). These analyses were carried out on two groups of Helix aspersa snails : 10 small and 20 larger snails.

Table 1 : Composition of the commercial snail feed[1].

%	snail feed
water	6.4 ± 0.2
crude protein	9.9 ± 0.3
crude fat	3.0 ± 0.8
ash	58.3 ± 2.2
carbohydrates[2]	16.4 ± 0.3
crude fiber	2.8 ± 1.1

1. Values given as mean of 2 determinations ± standard deviation expressed as % on fresh material.
2. Sum of soluble carbohydrates + starch determined after enzymatic hydrolysis.

Results and Discussion

Table 2 shows data obtained for snail proximate composition. The values show besides a significant difference in mean weight between small and larger snails a significantly higher percentage of dry matter in small snails. However the values correspond with those given by Melgar et al (1964) (13.5%) and Cadart (1975) (18%).

Table 2 : Proximate composition of shell and body of Helix aspersa [1].

	small snails (8-10)[2]	larger snails (20-26)[2]
weight (g)	2.51 ± 0.94*	3.56 ± 1.17
shell weight (%)	28.6 ± 4.1	28.3 ± 3.6
% D.M. body	16.7 ± 3.3*	12.4 ± 3.5
shell	97.7 ± 0.2 (2)[2]	95.1 ± 3.4 (6)[2]
% in body D.M.		
crude protein	72.3 ± 0.5*	80.6 ± 0.3
crude fat	4.1	4.1
ash	16.05	9.99 ± 0.05
carbohydrates	3.20	3.15 ± 0.21
collagen[3]	6.97	8.50 ± 0.45

1. All values expressed as mean ± standard deviation
2 ( ) : number of observations
3. as percentage of crude protein
* at least $p < 0.05$

A significantly higher protein content was observed in the larger snails, with a lower ash content which probably explains their lower dry matter content. The crude protein values in table 2 are much higher than those given by other authors : 35,1 - 69,9 % (Thomas, 1974 , Cadart, 1975, Melgar, 1964 and Mead et al, 1953). This finding may be related to low carbohydrate contents (values of 10.1 - 28.5 % are given by Thomas et al, 1974) resulting from the fastening period in the refrigerator. Fat contents correspond with data given by Thomas (1974) and Cadart (1975), but are somewhat lower than the 7,5 % mentioned by Melgar (1964). It can be mentioned that determination of diaminopimelic acid (DAPA), an amino acid used as a marker to measure bacteria (Dufva et al, 1982), shows very low bacterial contamination of the snail body : values less than 700 ug DAPA/g dry matter are found.
Table 3 shows the amino acid composition of total snail body protein. No significant differences between small and larger snails were observed.

Table 3 : Amino acid composition of the snail body[1].

Amino acid	small snails	larger snails
lysine	4.32 ± 0.02	4.38 ± 0.04
histidine	1.90 ± 0.09	1.92 ± 0.01
arginine	4.46 ± 0.11	4.47 ± 0.40
proline	4.80 ± 0.78	4.75 ± 0.17
aspartic acid	10.35 ± 0.06	10.13 ± 0.13
threonine	5.79 ± 0.18	5.38 ± 0.10
serine	6.04 ± 0.25	6.09 ± 0.16
glutamic acid	12.25 ± 0.08	12.66 ± 0.26
alanine	7.59 ± 0.30	7.55 ± 0.23
glycine	13.77 ± 0.57	14.64 ± 0.93
valine	5.67 ± 0.08	5.48 ± 0.04
methionine	1.57 ± 0.01	1.63 ± 0.10
isoleucine	4.24 ± 0.15	4.38 ± 0.03
leucine	7.76 ± 0.01	7.85 ± 0.11
tyrosine	3.20 ± 0.03	3.03 ± 0.11
phenylalanine	4.36 ± 0.05	4.13 ± 0.29
cysteine	1.82 ± 0.21	1.56 ± 0.18

1 Values (molar %) expressed as a mean of 2 determinations ± standard deviation.

Amino acid N accounted for 66.6 % and 64.9 % of crude protein N for small and larger snails respectively. This may indicate the presence of large amounts of non-protein N present e.g. in mucoïd substances.

Amino Acid composition differs from meat (muscle) protein and lower amounts of essential amino acids are present. Fig 1 shows that essential amino acid content in snail protein (molar % of Lys + Met + Ileu + Leu + Val + Phe + Thr) is different ($p < 0.05$) from the meat value predicted from collagen content in crude protein (Demeyer and Dendooven, this meeting). This finding requiers further research.

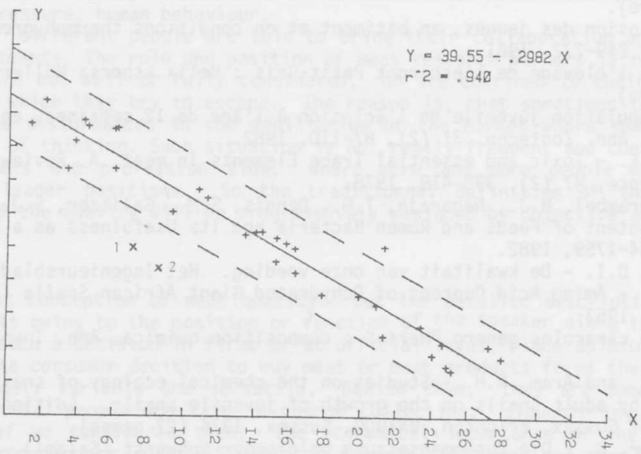

Fig 1 Relation between the molar % of essential amino acids (Met + Phe + Thr + Val + Leu + Ileu + Lys) (Y) and collagen (% in crude protein) (X) for meat.
1 : small snails
2 : larger snails

The snail bodies were also analysed to determine trace metal content and the results expressed as ppm in dry weight are presented in table 4. Values for Cr, Mn and Cu are significantly higher in small snails than in larger ones.

Table 4 : Trace metal composition of Helix aspersa (ppm in dry weight[1].)

metal	small snails	larger snails	liver + Kidney[2]	Muscle[2]
Pb	11.70	9.17 ± 1.74	0.4 - 8	0.2 - 1.1
Cd	4.00	9.49 ± 1.29	0. - 8	0.0 - 0.3
Zn	671.9	705.3 ± 48.2	40 -- 320	20 -- 143
Ni	9.54	2.55 ± 1.03	-	-
Co	4.62	2.94 ± 0.48	-	-
Cr	19.7	0.82 ± 1.16	-	-
Mn	161.9	85.5 ± 1.3	1.5 -12.8	0.11 - 1.03
Cu	162.2	85.7 ± 1.4	2 -1150	4 - 8.4
Fe	546.9	479.6 ± 32.5	50 -1050	44.6 - 130

1. Values for larger snails : mean of 2 determinations ± standard deviation.
small snails : one single determination was carried out.
2. Extreme values reported by Doyle and Spaulding (1978).

In general, concentrations of Zn, Cu and Mn are greater than reported earlier (Coughtrey and Martin, 1976). The amounts of trace metals found largely exceed those present in muscle, but are similar to those reported for kidney end liver (Doyle and Spaulding, 1978). The content of the toxic elements Pb and Cd in snails may cause some concern and this finding should be taken into account during snail breeding.

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