Fatty acid profile in edible eggs of snails from the *Cornu* genus

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Abstract

**Introduction:** The aim of this study was to determine the content of fatty acids in eggs harvested from two edible subspecies of Polish-bred common garden snail from the *Cornu* genus, as well as this content in the retail-ready product obtained from these eggs. **Material and Methods:** Material for the study consisted of eggs from two subspecies of edible snails: the small (*Cornu aspersum aspersum*), and large (*Cornu aspersum maxima*) common garden snails. The eggs studied were in two forms, the first of which had undergone initial processing to the half-product stage and the second of which was the final product available on the Polish market under the name “Snail Eggs”. The gas chromatography method was used to determine the content of fatty acids. **Results:** More than 75% of the studied fats were saturated fatty acids, dominated by palmitic and stearic acids. The average content of polyunsaturated fatty acids was 0.37%, and it was a combination of two acids: linoleic (C18:2n6c), and its trans isomer (C18:2n6t). No significant differences were found comparing individual fatty acids content between the two species’ eggs as half-products, or between the half-products and the final product. **Conclusion:** The fat in raw and processed eggs of common garden snails holds low nutritional value, and the processing did not affect the content of fatty acids.

**Keywords:** *Cornu aspersum*, snail eggs, fatty acids.
eggs are transferred into sieves, and then rinsed with water and selected by hand. The processing of the final product takes place at 4°C in relative humidity of approximately 70% and includes weighing eggs into individual 50 g portions for retail in glass jars. Afterwards, brine based on sea salt and the water used in processing is poured over the eggs (5).

The available literature lacks data regarding the profile of fatty acids and their percentage in the fat of eggs from the common garden snail. It is only known that the fat in snail eggs occurs in trace amounts (3). According to Nunes Almeida (9), its content in raw large common garden snail eggs is 0.1%. The level of fat in the caviar substitute discussed by Massari and Pastore (6) produced from small common garden snail eggs equaled 0.3%. The goal of this study was to determine the content of fatty acids in eggs harvested from two edible subspecies of common garden snail from the *Cornu* genus, bred in Poland, as well as in the final product obtained from these eggs.

**Material and Methods**

The material was harvested during the production cycle; it consisted of the half-product and the final product. The half-product was eggs from two subspecies of edible snails, the small (*Cornu aspersum aspersum*) and large (*Cornu aspersum maxima*) common garden snails, which underwent initial processing, *i.e.* segmentation, washing, and cold storage at 5°C for 24 h. The final product is available on the Polish market under the name “Snail Eggs” in small glass jars containing eggs of both subspecies of common garden snail from the *Cornu* genus. Study samples each weighing 100 g and comprising the final product contents of two retail packages were transported at 4°C to the laboratory within 24 h of their harvesting.

**Chemical analysis.** The fatty acid profile was determined using the gas chromatography method. Fat extracted from the snails’ eggs was weighed and added to glass ampoules at 100 mg each, then saponified in 0.5N methanolic KOH solution, evaporated at 86°C, and finally esterified in 4 mL of 14% boron trifluoride. The obtained esters were salted out with 2 mL of saturated NaCl solution. Chromatographic separation was performed in a Varian 450 gas chromatograph (Agilent Technologies, Santa Clara, CA, USA) equipped with a split/splitless injector (250°C) and flame ionisation detector (300°C). The chromatograph was fitted with a Select TM Biodiesel for fatty acid methyl ester column (Agilent Technologies) of 30 m length and 0.32 mm of inner diameter. The initial column temperature was 200°C and a 3°C/min increase up to 240°C was programmed. Helium was used as the carrier gas. The retention time readouts from the chromatograph served to identify particular fatty acids, while the relative percentage of fatty acids was calculated using the GalaxieTM Chromatography Data System software package (Agilent Technologies).

**Statistical analysis.** The obtained results were analysed statistically with SAS Enterprise Guide 5.1 (SAS Institute, Cary, NC, USA) and expressed as the arithmetic means and standard deviation. The normal distribution in each group was checked with the Shapiro–Wilk test. Levene’s test determined the homogeneity of their variance. The influence of each variability factor on the determined parameters was established using the one-way analysis of variance (ANOVA) for groups for which the assumption of homogeneous variances was fulfilled. Tukey’s test was used as post-hoc analysis. The level of statistical significance was assumed at *P* ≤ 0.05.

**Results**

The percentage of fatty acids in the fat of both studied half-products and the final product is presented in Table 1. The analysis of results indicates that over 75% of the fat in both types of half-product and the final product consisted of saturated fatty acids (SFAs). In the fat from products at both stages eight acids were identified, in which the main components were palmitic (C16:0 – hexadecanoic) acid and stearic (C18:0 – octadecanoic) acid. These two acids constituted approximately 81% of all fatty acids. The remaining acids included: capric (C10:0 – decanoic), lauric (C12:0 – dodecanoic), myristic (C14:0 – tetradecanoic), C15:0 (pentadecanoic), and margaric (C17:0 – heptadecanoic), and were present in markedly smaller amounts. The smallest constituent in this group of acids was C11:0 (undecanoic) acid. Comparing the content of individual SFAs – both between the half-products and between the half-products and the final product – no significant differences in their levels were found.

Monounsaturated fatty acids (MUFAs) constituted more than 23% of all identified fatty acids. The fat from the studied material contained three monoenic acids, of which oleic (C18:1 n9c – octadecenoic) acid and its trans isomer elaidic acid (C18:1 n9t) together formed the highest content by a large margin. The lowest content was myristoleic acid (C14:1). No significant differences in the levels of respective acids between the two types of eggs when unprocessed or processed were found.

Polyunsaturated acids (PUFAs) comprised a small percentage in the fat of the studied half-products and final product. Only the combined content of two acids was determined: linoleic (C18:2 n6c) acid and its trans isomer and linolelaidic acid (C18:2 n6t), which in the cases of as-harvested eggs from the small common garden snail, large common garden snail, and as-sold “caviar” equalled 0.32%, 0.38%, and 0.41%, respectively. In the case of polyenoic acids there were also no differences between the two studied groups of half-products and the final product.
Discussion

The level of fat in raw and processed eggs of snails from the *Cornu* genus is low. The authors’ own research showed that the fat content amounted to 0.09% in the final product, while in the eggs of the large and small common garden snails it reached 0.04% and 0.03%, respectively (5). It contained saturated, monounsaturated, and polyunsaturated fatty acids. The ratio between the three groups of fatty acids in the eggs of common garden snails is unfavourable, due to the high level of SFAs (Fig. 1).

According to FAO/WHO experts, the ratio of saturated to mono- and polyunsaturated fatty acids in the human diet should be 1:1:1 (14). Saturated fatty acids are used almost exclusively as an interim or auxiliary energy source, while monounsaturated fatty acids play a role in the prevention of cardiovascular diseases. The relatively high levels of these in common garden snail eggs do not differ much from those in the fish roe of predominantly marine species (20.3%–49.8%) (4). From the nutritional point of view, the presence and reciprocal ratio of polyene acids, especially the essential fatty acids, are the most important. The level of these acids in snail eggs is very low. There were only two acids from the ω-6 (n-6) family found, linoleic acid and linolelaidic acid. There were no acids from the ω-3 (n-3) family in the studied samples of half-products or final product.

In contrast to the eggs of common garden snails, fish roe, and in particular that of marine varieties, is considered a valuable source of PUFAs (36.1%–48.9%), especially long-chain n-3 docosahexaenoic (DHA) (10.3%–33.2%), and eicosapentaenoic (EPA) (4.7%–11.91%) acids (4, 12). The available literature lacks data regarding the fatty acid profile for eggs of common garden snails.

To conclude, the present study showed that the fat contained in common garden snail eggs holds low nutritional value due to its high content of unsaturated fatty acids, favourable ratio of n6:n3 fatty acids, and appropriate ratio of PUFA:MUFA (16).

Table 1. Fatty acid profile for the half-products and the final product (%)

| Acid          | Half-product CAA (n = 10) | Half-product CAM (n = 10) | Final product (n = 10) |
|---------------|---------------------------|---------------------------|------------------------|
| Saturated acids |                           |                           |                        |
| C10:0         | 1.84 ± 0.34               | 1.31 ± 0.29               | 1.56 ± 0.41            |
| C11:0         | 0.63 ± 0.21               | 0.59 ± 0.18               | 0.53 ± 0.16            |
| C12:0         | 3.82 ± 0.93               | 3.02 ± 0.76               | 3.21 ± 0.79            |
| C14:0         | 6.68 ± 0.98               | 6.65 ± 0.89               | 6.3 ± 0.73             |
| C15:0         | 1.45 ± 0.24               | 1.27 ± 0.18               | 1.32 ± 0.21            |
| C16:0         | 39.35 ± 3.42              | 38.67 ± 4.02              | 39.24 ± 4.33           |
| C17:0         | 1.14 ± 0.18               | 1.49 ± 0.23               | 1.26 ± 0.2             |
| C18:0         | 21.56 ± 2.78              | 22.27 ± 3.01              | 22.09 ± 2.69           |
| Σ             | 76.47 ± 1.71              | 75.27 ± 1.94              | 75.51 ± 1.89           |

| Monounsaturated acids |                           |                           |                        |
|-----------------------|---------------------------|---------------------------|                        |
| C16:1                 | 2.24 ± 0.31               | 3.26 ± 0.42               | 2.43 ± 0.29            |
| C18:1n9c + C18:1n9t   | 21.17 ± 1.83              | 19.84 ± 1.79              | 20.27 ± 1.62           |
| Σ                     | 23.8 ± 0.93               | 23.52 ± 0.89              | 23.11 ± 1.03           |

| Polyunsaturated acids |                           |                           |                        |
|-----------------------|---------------------------|---------------------------|                        |
| C18:2n6c + C18:2n6t   | 0.32 ± 0.09               | 0.38 ± 0.07               | 0.41 ± 0.11            |

CAA – *Cornu aspersum aspersum* (small common garden snail); CAM – *Cornu aspersum maxima* (large common garden snail). No levels for the same fatty acid differed significantly within species or product stage.

![Fig. 1. Average content of saturated, monounsaturated, and polyunsaturated fatty acids in the fat from the eggs of common garden snails](image-url)
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