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TOXIC RESIDUES IN CONTROLLED PRODUCTION OF VINEYARD SNAIL (Helix pomatia)

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SUMMARY
Vineyard snail (*Helix pomatia*) is an exclusive dish in elite restaurants. By uncontrolled collection, snails became rare in nature, so that the need of the world market requires farm upbringing and fattening. In our regions this activity becomes traditional and products are completely directed toward export [Tojagic et al, 2004]. Regarding the fact that snails can accumulate high levels of toxic metals and pesticides and in order to fulfil demands of healthy food production, permanent control of toxic residues is necessary. This paper deals with the results of the toxic elements and pesticides residues in snail foot and vegetable food used for their fattening.
KEY WORDS:
vineyard snail (*Helix pomatia*), toxic elements, pesticides

1. INTRODUCTION

"Vineyard snail" (*Helix pomatia*) belongs to the Helicid snails' family (*Helicidae*) and represents exclusive dish in elite world restaurants. Generally, edible snails are called Escargots [members.lycos.co.uk], no matter which systematical group they belong to (most commonly *Helix pomatia* and *Helix aspersa* [Raising Snails]). As a result of uncontrolled and excessive collecting, edible snails become quite rare in nature. Nowadays, they are not supposed to be collected in nature and in many countries they are put under wildlife protection [members.lycos.co.uk].

Therefore almost all edible snails come from snail farms. Snail farms present the only possibility to meet the need of world market [members.lycos.co.uk]. In our regions the activity of collecting snails becomes traditional and products are completely directed toward export [Tojagic et al, 2004]. Food designed for export must fulfil demands of healthy food production and must satisfy all requirements for the maximal allowed concentration of toxic elements and pesticides. In laboratory experiments snails have proved to be fairly tolerant even to very high concentration of heavy metals in their food. This is possibly due to the efficient binding of metal ions by metallothioneins and deposition in insoluble intracellular granules [Laskowski and Hopkin, 1996]. Prolonged exposure to heavy metal contamination may also lead to selection of metal-tolerant phenotypes [Laskowski and Hopkin, 1996].

Because snails are important component in many ecosystems and can accumulate substantial amounts of heavy metals [Laskowski and Hopkin, 1996] they are often used in experiments as bioindicators of polluted environment [Gomon and Pihan, 1997]. Beside toxic elements, pesticides are important food residues. Organochlorine pesticides are synthetic compounds that are found in nature as a consequence of modern manufacturing processes and agricultural productivity efforts. Because of their stability and hydrophobicity organochlorine pesticides are

accumulated in lipids and fatty tissue and their concentration increases up the food chain [Lemaire et al, 2004].

Regarding the fact that snails can accumulate high levels of toxic metals and pesticides they can represent a "critical pathway" for the food-chain [Laskowski and Hopkin, 1996], and that's why permanent control of toxic residues is necessary.

The aim of the present study was to analyse the concentrations of toxic elements (Pb, Cd, Cu, Fe) and organochlorine pesticides (α HCH; β HCH; lindane; heptachlor; aldrin; heptachlor epoxide; endosulfan; dieldrin; 4,4 DDE; 4,4 DDD; endosulfan sulfate; 4,4 DDT; endrin aldehyde) residues in vineyard snail meat (foot) farmed under controlled conditions and in vegetable food used for fattening.

2. MATERIAL AND METHODS

"Vineyard snails" (*Helix pomatia*), approximately two years old, were collected from snail farm near Novi Sad. Snails were put on starvation for seven days. After cooking in boiling water, for eight minutes, soft tissues were removed from the shell and dissected into two components: foot and viscera. Then, components were chopped and homogenized. Fresh vegetable food, used for snails fattening, was homogenized in blender.

Following analyses were performed

1. Snail physical characteristics:
   - Soft tissue (foot and viscera) weight, with accuracy of 0,01 g
   - Shell weight, with accuracy of 0,01 g and shell dimensions, with accuracy of 0,1 mm,
   - Cooking loss, with accuracy of 0,01 g.
2. Content of toxic elements (Pb, Cd, Cu, Fe) in soft tissues (foot and viscera) and in vegetable food.
   - Content of pesticides residues (α HCH; β HCH; lindane; heptachlor; aldrin; heptachlor epoxide; endosulfan; dieldrin; 4,4 DDE; 4,4 DDD; endosulfan sulfate; 4,4 DDT; endrin aldehyde) in foot and in vegetable food.

For the determination of toxic elements, samples were subjected to dry ashing procedure at 450°C [FAO, 1980]. The content of toxic elements were determined using the Atomic Absorption Spectrophotometer VARIAN SpectrAA-10.

Organochlorine pesticides were determined using the gas-chromatography method [FAO, 1980].

3. RESULTS AND DISCUSSION

"Vineyard snail" (*Helix pomatia*) is the largest European terrestrial snail [members.lycos.co.uk]. Average values of snail physical characteristics are given in Table 1.

Table 1. Snail physical characteristics

Snail weight (g)	17,33	
Shell dimensions (mm)	Across the shell	35,4
	height	28,3
Foot (%)	9,2	
Viscera (%)	31,78	
Shell (%)	28,36	
Cooking loss (%)	30,6	

Values obtained in this experiment were lower than previously reported [Raising Snails]. Across the shell dimensions and shell height were 21 and 36 % lower, respectively, probably because individuals used in experiment did not reach maturity.

Only 9,2 % of snail weight represent snail meat (foot) and that is 1,5 g/snail which can be used in food production. Concentrations of investigated toxic elements are summarized in Table 2.

Table 2. Content of toxic elements in soft tissue and vegetable food

	Pb (mg / kg)	Cd (mg / kg)	Cu (mg / kg)	Fe (mg / kg)
foot	-	0,031	11,81	25,60
viscera	0,450	0,14	18,01	24,78
vegetable food	-	-	1,79	52,66

Pb was detected in viscera in concentration of 0,450 mg/kg. In foot and vegetable food Pb concentration was under the limit of detection (less then 0,1 mg/kg). It was suggested that shell could be a short-term "sink" for Pb [Laskowski and Hopkin, 1996].

Although Cd was not detected in vegetable food it was found in soft tissue. Concentration in viscera (0,14 mg/kg) was higher than in foot (0,031 mg/kg) what is in correlation with previously reported data [Scheifler et al, 2002].

The fact that Pb and Cd were found in soft tissue and that their concentrations in vegetable food were under the limit of detection could be explained by snails' ability to accumulate toxic elements. This contamination might be from previously used vegetable food for fattening or from soil. Still, foot (snail meat) tender to accumulate less contents of Pb and Cd than viscera and satisfies regulation, of maximal allowed concentrations of toxic elements, of Serbia & Montenegro [Sl. list 5/92 i 11/92].

Cu is the essential trace element in the snail's biology because it enters in the constitution of the respiratory pigment. Cu is often emitted in large quantities during human use of products (fertilizers, pesticides, herbicides, industrial wastes, etc.) [Gomot and Pihan, 1997]. Cu was uniformly spread in foot (11,81 mg/kg) and viscera (18,01 mg/kg), and concentrations were lower than found by Gomot, 1997. Accumulation of Cu depends of the age of the animal, time of exposure, and chemical form of Cu. Cu in form of $CuSO_4$ is more readily available for snails then the $CuCl_2$ [Gomot and Pihan, 1997].

Fe was found in vegetable food (52,66 mg/kg) and in soft tissue. Concentrations of Fe were almost equal in foot and viscera, 25,60 and 24,78 mg/kg respectively.

Maximal allowed concentrations of Cu and Fe are not set by regulation, but since their contents were lower than reported [Jokić et al, 1999] we can say that this elements do not have toxic effects.

Concentrations of all analysed organochlorine pesticides' residues (α HCH; β HCH; lindane; heptachlor; aldrin; heptachlor epoxide; endosulfan; dieldrin; 4,4 DDE; 4,4 DDD; endosulfan sulfate; 4,4 DDT; endrin aldehyde) were under the limit of detection.

4. CONCLUSION

Obtained results indicate that snails can accumulate toxic elements in their soft tissues. Although obtained values of toxic elements were under the permitted limits and accumulations of organochlorine pesticides residues were under the limit of detection, permanent control is necessary. Regarding all the mentioned above, controlled farming of snails fulfil demands of healthy food production and snail meat (foot) could be use in food production.

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