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PROTEIN CONTENT OF FIVE TISSUES FROM SOME EDIBLE AND NON-EDIBLE SNAILS AND BIVALVES DISTRIBUTED WITHIN TURKISH TERRITORIES

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ABSTRACT
Present study has evaluated the protein contents of four land snails (*Helix lucorum, Assyriella mardinensis, Assyriella vanensis, Eobania vermiculata*) and six bivalves (*Mytilus galloprovincialis, Pecten jacobaeus, Tapes decussatus, Unio elongatulus, Corbicula fluminalis, Anodonta piscinalis*) selected tissues including foot, mantle, hepatopancreas, visceral mass and whole body, as well as presented comparative study concerning the edible and non edible mollusc species. The results showed that generally tissues from the snails have richer protein than tissues from the bivalves. Examinations revealed that composition of crude protein varied from 6.04% and16.21% on a wet weight basis. The maximum values were found to be 16.21% in the foot of *E. vermiculata* among snails and11.30% in the foot of *M. galloprovincialis* among bivalves. By and large, the foot provides greater percentage of protein than other tissues and the protein content of the same genus (*A. mardinensis,* and *A. vanensis*) were observed roughly similar. The values imply that flesh of studied molluscs, particularly edible foot tissues, is a good protein source.

KEYWORDS: Land snails, Bivalves, Protein, Tissues.

INTRODUCTION

In spite of decades of research on nutritional and biochemical composition of mollusc, there are still significant gaps in our basic knowledge about Anatolian marine, freshwater and land molluscs. Studies on biochemical and nutritional value of Turkish molluscs, most of them are endemic, are still scarce, compared to other traditional fields, such as ecology, biogeography and taxonomy. Recently, many studies have been conducted about the nutritional value of mollusc and investigations reported that they are high in protein quality however low in fat contents. Proteins are major constituents of tissues and play significant roles in most biological processes of living beings, including enzymatic catalysis, coordinated motion, functioning in immune system, transport and storage, mechanical support, structural function and control of growth and differentiation (Zaia *et al.*, 1998).The major source of protein for most of populations comes mainly from livestock, non-conventional wildlife protein source such as snail and bivalves are not preferred by a majority. Whereas, mollusc meat is considered to be highly nutritious and salutary, due to its content of essential amino acids, proteins, rich vitamins and minerals (Thanonkaew *et al.*, 2006). Turkey is one of the zoogeographically unique areas and has an interesting aquatic and terrestrial mollusc species, richer than Europe owing to its location between two continents (Demirsoy, 1996). Despite this abundance, snails and river mussels are not consumed as food in Turkey. Noteworthy, many edible and non-edible endemic and non-endemic species dwell in Anatolian peninsula, for instance, *Assyriella mardinensis* and *Assyriella vanensis* are non-edible endemic and *Helix lucorum, Eobania vermiculata* are edible examples. Additionally, *Mytilus galloprovincialis, Pecten jacobaeus, Tapes decussates* are edible marine bivalves distributed in the sea of Turkey and *Unio elongatulus, Corbicula fluminalis* and *Anodonta piscinalis* are river mussels which are highly distributed in Anatolian rivers. The objective of the present study was to examine and compare the nutritional values of four land snail and six bivalves selected tissues commonly inhabited in Turkish territories.

MATERIALS & METHODS

About 25 to30 matured specimens of each mollusc species were collected from different part of Turkey in spring season of 2015. *H. lucorum* and *E. vermiculata* were provided from Diyarbakır; *A. mardinensis* from Şırnak; *A. vanensis* from Van; *U. elongatulus, C. fluminalis, A. piscinalis* from Tigris River (Diyarbakır) and *M. galloprovincialis, P. jacobaeus, T. decussates* from Marmara Sea (Istanbul). The bivalve species brought to the laboratory and kept in the tanks having filtered sea water and alimentary products for 24 hours in order to allow them to empty their guts and shells of snails thoroughly washed in tap water. Then, the molluscs dissected to remove different body components including mantle, hepatopancreas, foot, visceral mass and whole body. The dissected parts are labeled and shocked at -70°C and then the specimens are kept at -18°C until chemical analyses. Wet weight of mollusc samples were analyzed in

triplicate for crude protein composition by Kjeldhal method (OAOC, 2005). The results were expressed as mean values ±s.d. (standard deviation). All estimated values were expressed in percentage. Analysis of variance (ANOVA) was used for cooperation of average values.

TABLE 1. Protein analyses (expressed in g/100 g of fresh substance) of some bivalves and snails edible and non-edible parts.

Snails and Bivalves	Foot Means ±s.d.	Mantle Means ±s.d.	Visceral mass Means ±s.d.	Hepatopancreas Means ±s.d.	Whole Body Means ±s.d.
Helix lucorum	12.52±0.20	7.10±0.09	6.94±0.09	9.72±0.13	6.78±0.07
Assyriella mardinensis	15.79±0.34	9.07±0.12	10.61±0.11	8.01±0.09	10.09±0.19
Assyriella vanensis	15.34±0.36	8.94±0.09	11.03±0.16	7.95±0.08	11.44±0.26
Eobania vermiculata	16.21±0.19	9.21±0.10	7.27±0.08	8.11±0.09	10.17±0.19
Pecten jacobaeus	10.48±0.11	8.55±0.06	7.69±0.07	10.01±0.13	10.10±0.19
Mytilus galloprovincialis	11.30±0.32	6.82±0.05	8.83±0.12	9.34±0.14	6.04±0.07
Tapes decussatus	10.19±0.21	8.91±0.13	8.47±0.10	9.22±0.18	7.14±0.06
Unio elongatulus	10.01±0.15	6.32±0.05	8.11±0.10	8.71±0.16	9.92±0.19
Corbicula fluminalis	9.62±0.18	6.91±0.06	7.79±0.08	8.11±0.17	8.54±0.07
Anodonta piscinalis	9.93±0.08	9.02±0.13	7.56±0.09	9.51±0.14	8.86±0.11

RESULTS

The protein proportions from some selected tissues of the snails and bivalves observed during the experimental work has been given in Table 1. The maximal protein quantity among the snails found in the foot tissues (12.52% for *H. lucorum*, 15.79% for *A. mardinensis*, 15.34% for *A. vanensis*, and 16.21% for *E. vermiculata*) formed edible part of the species. The protein content of five tissues from *A. mardinensis* and *A. vanensis* were similar two each other. Mantle and hepatopancreas from the snails contained less protein than other tissues. The percentages of protein from whole body (6.78%) and visceral mass (6.94%) of *H. lucorum*, most exported and eaten snails, were found low quantity comparing to other snail species. The amount of protein from mantle tissues were not showed much variability, ranged between 7.10% and 9.21% (Table 1). Three of the six bivalve species (*M. galloprovincialis*, *T. decussates* and *P. jacobaeus*) used in the current study are rarely consumed as food in Turkey just for curiosity about their taste, not eaten on a daily basis. As the snail like results, foot tissues of the bivalves contained a higher proportion of protein than other tissues; 11.30% in *M. galloprovincialis*, 10.19% in *T. decussates*, 10.48% in *P. jacobaeus*, 10.01% in *U. elongatulus*, 9.62% in *C. fluminalis* and 9.93% *in A. piscinalis*. In general, the percentages of the protein from different tissues of the bivalves showed that marine and river species seemed not to be quite different. Among the bivalves the highest amount of protein was recorded from the foot of *M. galloprovincialis* (11.30%). There are not noteworthy differences among the hepatopancreas (ranged from 10.01% to 8.11%) and visceral mass (ranged from 7.56% to 8.83%) of six bivalves. On the other hand, the different pattern was observed for protein contents from whole body and mantle, increase and decrease was detected (Table 1).

DISCUSSION

Numerous literatures is accessible on taxonomy, ecological distribution, feeding patterns, detection of new species and new records etc. about Turkish molluscs fauna superficially but not so far on related to nutritional and biochemical constituent levels in different tissues of these animals. Thereupon, the present study was carried out to evaluate the changes on nutritional value of four snails and six bivalves' foot, mantle, hepatopancreas, visceral mass and whole body. The investigation also showed that there were some differences between edible and non-edible snails and bivalves. Baby *et al*. (2010) stated that in their study, the highest amount of protein was recorded from *Anisus convexiusculus* (12.92%), followed by *Melania tuberculata* (12.36%) and the analysis of different molluscan species totally results that molluscs are moderate sources of protein. In their study the amount of protein was found between 6.46% and 12.92%. The amount of proteins in four snails species recorded by Fagbuaro *et al*. (2006) varied from 18.66% to 20.56%. Sando *et al*., (2012) acclaimed that snail meat has lower protein content than meat of cattle for slaughter and their results were varied from 15.02% to 17.22% in wild and farm snails. Additionally, in the study on Turkish edible snail *H. pomatia* (Özoğul *et al*., 2005) and *H. aspersa* (Çağiltay *et al*., 2011), the protein content was reported 16.35% and 12.87% in whole body, respectively. In fresh water snail *Pila ampullaceal*, protein percentage was found to be 10.67% (Obande*et al*., 2013).In the examining papers, protein content was higher in some of the land snails while others were in close proportion to our work. The most possible explanation for these differences may be due to physiological differences in species, regional, dietary and environmental factors. In our study, the protein proportion of ten molluscs was detected between 6.04% and 16.21% (Table 1).In general, our data were in concordance with the values mentioned above.

On the percentages of dry basis, Imevbore and Ademosun (1988) also reported that snails have a protein content of 88.42% which compares with animal protein of 82.37% for pork and 92.75% for beef. Eneji *et al*., (2008) emphasized that in their study, percentage of crude protein ranged from 70.00% to 84.43% with *Archachatina marginata ovum* having the highest value, *Lanistes varicus* having the least value. *A. marginata ovum* (84.43%), *A. marginata saturalis* (80.95%) and *Limicolaria spp*. (71.75%) are land snails and *L. varicus* (70.00%) and *Nucella lapillus* (82.25%) are fresh water snails. In another study on tissues of *Perna viridis*, the results are

followings; whole body between 62.73% and 57.00%; mantle between 68.59% and 59.67%; digestive gland (hepatopancreas) between 60.72% and 55.74% (Soumady and Asokan, 2011). These surprising high values are quite normal since the dry weight of the organisms were used in the experiments. Not seen huge differences between tissues, also shows that protein undertakes structural tasks in all tissues.

On the percentage wet basis, Wosu (2003) reported snail meat of 20.70% crude protein. In a study on terrestrial snails, the ratio was again reported high; *A. marginata* ovum 20.56%, *A. marginata saturalis* 20.34% *Achatina achatina* 19.27% and *Limicolaria* spp. 18.66% (Fagbuaro *et al*., 2006). In comparison with our findings, these results were higher. The discrepancy of the protein in mollusc species is likely linked with food availability, physiological, structural and developmental activities; this is due to increase the quantity of protein so much in some species. Studies about protein contents of mollusc tissues are not much more available; therefore, provide comparative information about the present work become quite difficult. In a study on protein quantity of fresh water mussel *Lamellidens marginalis* selected tissues (mantle, hepatopancreas, gonad and foot) from Jayakwadi dam, during different seasons, the maximum protein content was found in the gonad throughout all the three seasons. The quantity of protein from gonad (8.11%) and foot (8.27%) were nearly equal during monsoon seasons. The value of protein from mantle was detected between 3.31% and 5.64%. Hepatopancreas has shown maximum values (6.29%) on April and minimum (3.25%) on December. Protein content of the foot ranged from 5.29% to 8.73% (Jadhav and Gulave, 2012).In the current study, the protein contentof hepatopancreas, foot and mantle from freshwater mussels (*U. elongatulus, C. fluminalis* and *A. piscinalis*) were found higher than *L. marginalis* mussel. The study area, Tigris River, is unique for its dense and diversified aquatic vegetation which may have affected the protein content.

Proteins of snails have satisfactory amino acid composition and contain significant quantities of essential amino acids, particularly leucine, isoleucine, phenylalanine, valine, lysine and threonine. These proteins are more digestible than proteins of cattle for slaughter, and less digestible than fish proteins (Sando *et al*., 2012). Our experiments include two edible land snails mostly collected from the wild and are exported to European countries for consumption as a food source. In this regard, the study performed on the protein content of each of these creatures gains importance. In Turkish society, the snail meat is not consumed as food. But marine mussels in coastal cities, often consumed due to the wonders of their taste. Several studies about these edible species, that purposed to explore their nutritional value, have contributed to increasing their consumption. Increased intake of a variety of edible molluscs should be encouraged to provide a healthy diet. Molluscs are low in saturated fat, contain the omega-3 fatty acids, are ideal protein sources, and are particularly good sources of mineral and some vitamins. In the current study, nutritional value of non-edible snails and mussels was found to be as high as other edible snails and mussels. After a detailed study on parasitic and toxicological content of their flesh, these snails may be including in edible snails group.

Last of all, in the present investigation, the protein contents were found to be high in the foot tissue followed by whole body, visceral mass, hepatopancreas and mantle. This study revealed that studied species both edible and non-edible samples are a good source of protein and there is not much more differences between edible and non-edible snails and bivalves tissues. Essentially, it is time for us to give suitable emphasis to improve all aspects of snail and mussel consumption. Their providing either from the wild or cultured environment could be a good source of income for the teaming population.

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