International Journal of Scientific and Technological Research www.iiste.org
ISSN 2422-8702 (Online), **DOI:** 10.7176/JSTR/6-09-02
Vol.6, No.9, 2020

A Survey Study on Parasite Presence of Edible Wild Terrestrial Snails (*Helix pomatia* L.) in Northern Cyprus

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Abstract
Edible terrestrial snails are important protein source for human nutrition with low fat. On the other hand, it is known that snails are hosts for some of the parasites which may pose serious health hazards for humans. That's why the reason it is important to put those edible molluscs under spotlight in terms of food safety. Depending our scientific report survey, no studies have been carried out related to terrestrial snails subjected to human consumption in North Cyprus. In this study, it was aimed to determine the parasite presence of snails consumed as food in Northern Cyprus. The snail samples (n=250), were collected from their natural wild habitat at Buyukkonuk region in rainy season at April-May 2019. The samples were dissected and internal organs were examined for the presence of parasites. As a result of the study, no parasites were observed in a total of 250 snail samples. In order to understand the public health risk regarding snail consumption, more studies should be planned on bacteriological, parasitological and virology investigations in Northern Cyprus.

Keywords: Roman snail, food, public health, Cypriot cuisine

DOI: 10.7176/JSTR/6-09-02

1. Introduction

Snails are member of the phylum Mollusca and class Gastropoda. The genus, includes about 40 species in Europe, the Mediterranean, North Africa and some parts of Asia. *Helix* species (e.g. *H. aspersa* Müller, *H. pomatia* L., *H. lucorum* L.) are the one which are consumed by humans as food [1]. Roman snail (*Helix pomatia* L.) has a long history of being used as food. It is widely consumed in countries such as France, Belgium, Germany and Italy. Nutritional value of snail meat has been reported to contain high protein (13,4-16,33 %) and low-fat content (1,08-1,40 %) and is rich in essential fatty acids such as linolenic, linoleic acids [2, 3]. In addition, snail meat is rich in copper (29.3mg / 100g) and iron (14.0mg / 100g) and has been reported to contain high amounts of zinc in comparison to other meat species. It is also stated that snail meat is an" important source of selenium [4]. The ever-increasing demand has made it a valuable food product and added to the luxury product group such as caviar, foie gras, truffles [5]. As Omole et. al. [6] mentioned, snail consumption rate is rising against red meat. Studies have shown that *Helix pomatia* L. is more preferred due to its high protein, amino acid and mineral salt content compared to other species of terrestrial snails [7-9].

More than 300 million people suffer from a range of diseases caused by gastropod-borne helminths, predominantly flatworms and roundworms, whose life cycles are passed through a gastropod. Molluscs have been long known to serve as ideal hosts for several parasites, including nematodes and trematodes [10]. Snails are found and live on soil either scavenging for food or for purposes of reproduction; thus snails could get infected with parasites. So contaminated snail consumption could be one route to human infection particularly when eaten raw or undercooked [11]. *Angiostrongylus cantonensis* is a zoonotic parasite that causes eosinophilic meningitis in humans after they ingest infective larvae in terrestrial snails [12]. *Fasciola hepatica* and *Fasciola gigantica* have also ability to infect snails and have a cosmopolitan distribution [13]. As Dorny et al. [12] rewied in their manuscript, the most important mollusc borne protozoa are *Giardia* spp., *Cryptosporidium* spp. and helmints are *Angiostrongylus cantonensis Echinostoma* spp. It is reported that, *Brachylaima cribbi* is a trematode which infects *Helix aspersa* Müller and other *Helix* species in Australia [14]. Sufficient heat treatment, freezing, conventional salting, fumigation, fermenting and marinating methods can be considered as methods used to neutralize parasites in foods. The main factor leading to human infection is the consumption as raw or insufficient heat treatment [5, 12].

In this study, we observed that snail species, which are the subject of Cypriot food and drink culture, are mostly roman snails and is more concentrated in the Karpas region of the country. The Cypriot people named these edible snails as garavolli which derives from the Greek word garaolos [15]. In Turkish Cypriot cuisine garavolli is mostly consumed in the form of boiled, kebab (grilled), and pickles [16, 17]. The way of cooking the snails in Cypriot cuisine culture may provide survival of parasites in these hosts especially if the heat treatment is insufficient. When the garavolli dish is prepared as ragout (yahni) the snails were cooked with their shells and mixed with vegetables (such as onion and tomatoes) in a pan. During this process internal temperature of snail meat may be low due to the shells. Kirkan et al. [18] observed in their study that internal temperature of snail meat was 85 °C after boiling at 100 °C for 4 min.

Depending our scientific report survey, no studies have been carried out related to terrestrial snails subjected to human consumption in North Cyprus. To date, we have not encountered one study indicating the parasitological quality of snail meat that consumed in within this region. The aim of this study was to evaluate the presence of parasites in mostly consumed edible terrestrial snail genus *Helix pomatia* L. in terms of public health, in Northern Cyprus and to contribute to the database.

2. Material and Method

2.1. Surveyed area

Snail samples were collected from the village named as Büyükkonuk which is formerly known as Komi Kebir (35°24′36″N 33°59′49″E). This village with a population of about 800, is located on the foothills of the Five Fingered (Beş Parmak) Mountain Range as it stretches into the 'panhandle' shaped peninsula which is called Karpas [19]. It is located on 33 kilometres north of Famagusta and at an altitude of 90 metres. İskele is neighbouring to the south-west and Mehmetcik to the north-east (Fig 1). Büyükkonuk is the first, Ministry confirmed, eco-touristic village in North Cyprus [19]. On the other hand, Büyükkonuk province and depending on our observations on field, the mostly consumed edible terrestrial snails (*Helix pomatia* L.) are concentrated in this area.

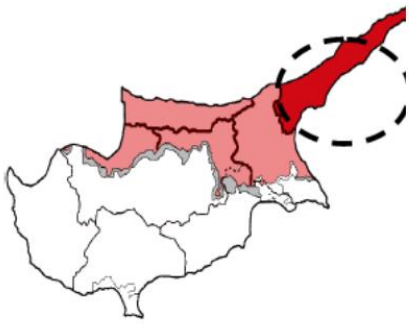

Figure 1: Karpaz peninsula and Büyükkonuk (Komi Kebir)

2.3. Sample collection

The mature, sizable snails were collected by handpicking from their natural habitat (farmland, bushes and around of houses) on soil, on leaves, on the trunk of trees and from the walls of the houses in the study area. A total of 250 samples were collected and studied for our research. The collection took place

ISSN 2422-8702 (Online), **DOI:** 10.7176/JSTR/6-09-02
Vol.6, No.9, 2020

in April and May (April 2019 - May 2019) in the rainy season for once a week. Each snail was kept separately in sterile bag until they were brought to laboratory.

2.3. Snail identification and dissection

Snails were identified according to their shape, size, markings, colour. According to the identification, the snail species with a large shell that can reach 30-50 mm in height and 32-50 mm in width are confirmed to be *Helix pomatia* L. (Figure 2). This snail has a thin shell, pale spiral lines, a brownish colour [20].

Figure 2: The typical shell of *Helix pomatia* L.

The snails were individually anaesthetized with ethereal cotton placed in sterile plastic sample cup and then separated from the shell with scissors and forceps [21, 22]. Food Hygiene and Technology and Parasitology Laboratory of the Faculty of Veterinary Medicine, Near East University.

2.4. Parasitological investigation

Internal organs and hepatopancreas were collected in petri dishes containing saline. The tissues in the petri dish were cut into small pieces with the help of forceps and needles. The parasites were allowed to dissolve for a while. The stereo microscope (Kent Scientific Corporation) was examined for parasitic larvae. In addition, samples taken from the physiological water between the slide and coverslip by pasteur pipette were examined under a microscope (Leica 8040124363VR0055).

3. Results and Discussion

No parasites were detected in 250 snail samples collected from Büyükkonuk region. Further studies should be planned with higher number of samples and within a wider area.

Parasitic foodborne diseases have become more widespread with international travels and increased human population and fast food habits. Studies have shown that they are detected more because of better diagnostic tools and improved technology [12]. Snail-induced parasitic diseases (SBPDs) are major parasitic diseases that continue to be a major public health problem worldwide, particularly in poor countries where snails are consumed as human food [23]. Snail consumption may cause human infection, especially when eaten raw or undercooked [24, 11]. Therefore, determination of parasites in snails is of great importance. Many studies conducted so far, have mentioned the existence of parasites that cause serious diseases by passing from snails to humans and other animals [25]. In a study conducted in Galicia in Spain, in *Helix aspersa maxima* snails, *Tetrahymena rostrata*, *Tetrahymena limacis*, *Tetratrichomonas limacis*, *Alloionema appendiculatum*, *Riccardoella limacum*, *Cryptobia helicogenae*, *Nemhelix baker* and *Brachylaima aspersae* parasites are detected [26]. In another study, 20 snails were investigated in terms of endohelmint in Elazig region of Keban region. As a result of this examination 20% (4 parasites) of snail samples observed to carry *Paragonimus* sp. (Trematoda; Digenea) and 30% (6 parasites) of them carried *Protostrogylus* sp. (Nematoda; Metastrongyloidea) [25]. In the study carried out in Biwa Lake, 28 digenetic trematod taxa were detected in 19209 snails consisting of 10 morphological species [27]. In a study in Ghana, 150 snails (75 *Achatina achatina* and 75 *Achatina fulica*) were examined bacteriologically, parasitologically and mycologically. *Giardia* spp, *Balantidium coli* and trophozoites, unidentified parasite cysts were isolated. The results of the study indicate that snails can carry risks for public health [28]. Safer [29] detected *Strongyloides stercoralis* in snails. According to this study,

Strongyloides stercoralis can easily penetrate into the snail and infect internal organs easily, as well as being the main parasites of terrestrial snails. Libero et al. [30] examined *Achatina fulica* snails (n = 452) in terms of parasites presence. At the end of this study, *Schistosoma mansoni*, *Trichuris* spp., *Hymenolepis* spp., *Strongyloides* spp. detected in snail samples.

3. Conclusion

Snails are considered as a pollutant vector because they live in soil and are fed with plants with potential microbiological risks. Because of that, the edible snails may carry many parasitic and bacterial hazards and the evaluation of hygienic aspects is of great importance. In our study, *Helix pomatia* L. snail samples in Büyükkonuk region showed a good hygiene status in terms of parasites. In order to preserve the consumption volume of this product, which is becoming more and more popular in the food market, control measures and necessary legislative arrangements are needed. In particular, food enterprises should also pay attention throughout the production chain and distribution to prevent parasitic contamination and also other microbiological parameters that related with public health. It should be aimed to prevent foodborne diseases by taking care of the quality of the raw materials and production practices with hygienic care. Care should be taken to wash fresh snails, which are at risk for human health, before being consumed and to cook with sufficient heat treatment. In order to understand the public health risk regarding snail consumption, more studies should be planned on bacteriological, parasitological and virology investigations in Northern Cyprus.

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