The Black Sea Journal of Sciences 7(1), 117-125, 2017

KFBD

Karadeniz Fen Bilimleri Dergisi
The Black Sea Journal of Sciences
ISSN (Online): 2564-7377

Research Article / Araştırma Makalesi

Opportunities for Using the Insect Potential in Wetlands of Turkey as an Alternative Protein Source

Ümit İNCEKARA

Atatürk University, Faculty of Science, Department of Biology, Erzurum, Turkey

Corresponding Author: uincekara@atauni.edu.tr

Received: 06.03.2017
Accepted: 20.04.2017

Abstract

It is known that insects are used as a protein source in a widespread manner all around the world. In this study, it is emphasized that Turkey, just like many other countries, can fulfill its protein need significantly using its current potential. The general properties of aquatic insect groups that are still used or have the possibility to be used as protein sources in the world are summarized briefly. That the food policies applied to terrestrial insects are also applied to aquatic insects was provided as a solution proposal in order to benefit from the protein potential in the wetlands of Turkey at a maximum level.

Key Words: Turkey, Wet lands, Aquatic insects, Alternative protein source.

Türkiye Sulak Alanlarındaki Böcek Potansiyelinden Alternatif Protein Kaynağı Olarak Yararlanma Olanakları

Özet

Böceklerin tüm dünyada yaygın bir şekilde protein kaynağı olarak kullanıldıkları bilinmektedir. Bu çalışmada, birçok ülke gibi Türkiye'nin de sulak alanlarındaki mevcut potansiyeli ile protein ihtiyacını önemli ölçüde giderebileceğine dikkat çekilmiştir. Halen dünya genelinde protein kaynağı olarak kullanılan ya da kullanma olanağı bulunan sucul böcek gruplarının genel özellikleri kısaca özetlenmiştir. Türkiye sulak alanlarındaki protein potansiyelinden en üst seviyede yararlanabilmek için, karasal böceklere uygulanan gıda politikalarının benzerlerinin sucul böceklere de uygulanması çözüm önerisi olarak sunulmuştur.

Anahtar Kelimeler: Türkiye, Sulak alanlar, Sucul böcekler, Alternatif protein kaynağı.

1. Introduction

As a natural consequence of the rapid population increase in the world, the food shortage has started to gain more place on the agenda, and the severity of the situation led to seeking solutions both at the individual level and that of the states. In this sense, insects, which have the largest variety and total mass among animal organisms, rank at the top places among the options shown as alternative protein sources.

It is known that insects are very rich in terms of vitamins and minerals. Caterpillars are rich in iron, zinc and vitamin B_{12}. Termites have a high level of Mg and Cu. *Palm weevil* larvae are rich in zinc, thiamine, and riboflavin. Many edible insects with a high level of iron and zinc solve a big problem like iron deficiency especially in the eating habits of women in some countries. Iron deficiency, especially among pregnant women, is quite high for vegetarians, and it is provided for that this could be overcome with the insect consumption (FAO 2013).

The comparison of certain foods in terms of protein content is: Grasshopper: 50-75%; spider: 64%; ant: 24%; chicken: 23%; fish: 21%; beef: 20%; lamb: 17%. The above rates are as striking as leading us to review our inaction in the sense of benefiting from the protein potential of insects. The rates in question are average values, and there are insect types that contain much more protein (maximum 79%) (Chopra et al. 1970).

Although less than 3% of the total varieties of insects are aquatic, 95% of the macroinvertebrates in certain freshwater biotopes consist of aquatic insects on the basis of species or individuals. The life cycles of aquatic insects may pass in salty water, intermittent streams, hot and cold water sources and water where tides are seen. They cannot (rarely) exist in natural conditions or dirty water where insects cannot exist (Daly 1984).

The economic significance of aquatic animals in terms of harmfulness is low. For example, the larvae and adults of *Lissorhoptrus soppi* harm rice in agriculture at a negligible extent. Especially big predators such as Dytiscidae are harmful to the eggs of the fish. Nevertheless, while some big Dytiscidae and Hydrophilidae are used as food in China, dry Elmid insects are used as the spice seasoning called “chupe de chiche” (Brown 1987).

The Japanese use insects as human food since ancient times. Catching and eating many aquatic insects practically possibly started in the Japanese Alps. Thousands of years ago, this area had a great human population despite the scarcity of animal protein (Anonymous 2016). Aquatic animals started to be very important as a food source for human life as they are abundant in this area. The Japanese still use insects in many recipes. If you go to a restaurant in Tokyo, you may get the opportunity to taste many types of insects. The famous “Zaza-mushi” made of aquatic insect larvae is one of them.

While considerable ecological information about aquatic insects is obtained, many studies remained limited to their zoogeographical distribution and taxonomic characters. Hence, their economic importance was disregarded.

Turkey has rich wet lands and their aquatic beetles fauna relatively (Kakman et al. 2003; Darılmaz and İncekara 2011; Darılmaz and Salur 2015; Darılmaz et al. 2016; Kazancı and Türkmen 2012). With this study, aquatic insects as alternative protein sources in the wetlands of Turkey (Figure 1) attract the attention.

Figure 1. Wet lands of Turkey

2. Materials and Methods

In Turkey, there are many aquatic insect groups, but most of them do not have the biomass that can be used as an alternative protein source. The list of the insects with the potential to be used as an alternative protein source was prepared based on the study by Ramos Elorduy et al. (2009). Certain information on the intensity of the main insect groups living in wetlands was presented based on the observation information obtained by the author in faunistic studies carried out in the wetlands of Turkey since 2000.

3. Results

3.1. Insects as Protein Sources around the World

The insects that are most commonly used as human food in the world are the species belonging to Grasshoppers, Moths, Water scorpions, Cicadas, Termites, Ants, Bees and Stick. Contrary to the popular opinion in Turkish society, insects are not generally used as human food in the Far East, but they are also significantly used as human food in many countries, mainly African and North American countries. Mexico ranks at the top with 40% when the total insects consumed around the world are proportioned by countries. Many terrestrial and aquatic insect species faced extinction due to excessive hunting and consumption. Thus, wetlands were turned into natural culture environments where aquatic insects are commercially produced.

3.2. Main Insect Groups Living in Wetlands

Thirteen insect groups include aquatic or half-aquatic insect species. All of the species of five groups among them (Ephemeroptera, Odonata, Plecoptera, Megaloptera and Trichoptera) have aquatic stages. The remaining eight groups contain aquatic or half-aquatic as well as terrestrial ones. Just like some Hemiptera, half-aquatic insects (rare) live in damp habitats; they have a relationship with the upper surface of the water just like Collembola members, or they live on the surface of the water, and they only dive temporarily (Daly 1984).

3.3. Examples of the Protein Potential of Insects in Wetlands

According to Edmunds (1973), the dead individuals of *Ephoror virgo* that emerged suddenly and large amounts in the Vitva River in Paraguay were collected and used as feed for cage birds. The mass that formed with the death of the individuals of the same species nesting in North America reached the depth of 1 m. This means tons of protein sources.

Large masses of *Chaoborus* and Chironomids are widely seen in big lakes of Africa. Beadle (1974) summarizes this as follows: "*Chaoborus edulis* individuals create a smoke mass on the lake with a width of 50 m and 1 km in length. The individuals of this species are boiled in water and consumed by people living along the lake shore by putting into cakes".

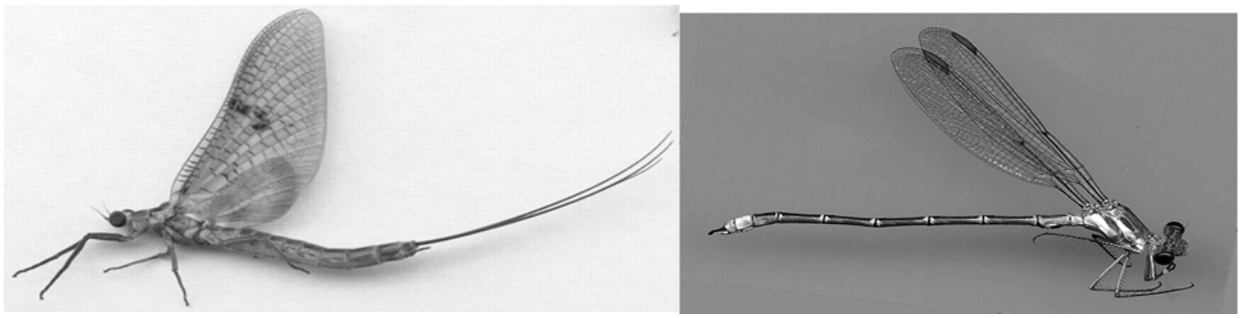
3.4. Aquatic Insect Groups that can be used as Alternative Protein Source in Turkey

3.4.1. Ephemeroptera

The life of the adults is quite short and is 1-2 days (Figure 2a). They hatch at the same time and in large quantities. It is quite widespread in Turkey and causes epidemics in some regions each year. At such times, it can be used as animal feed (fish) by collecting; but it does not have economic value.

3.4.2. Odonata

The sign of clean water, Odonata (dragonfly) (Figure 2b) is also used as human food and caught mostly on Bali. Interesting hunting techniques are used as they are caught very hard. Although they are quite widespread in Turkey, their collection from nature and production do not bear economic value.



a **b**

Figure 2. a) Ephemeroptera. B) Odonata.

3.4.3. Hemiptera

Aquatic Hemiptera constitutes a potential in the biological control of mosquito (Ellis and Borden 1970) and is used as a bioindicator of water quality. A traditional soup (Figure 3a) is made of the species known as “water scorpion” (Figure 3b) of this insect group in China. Again, the same insects are exported to the whole world from Thailand. The food products of this insect group can be accessed via the Internet. The same species and close species are quite widespread in Turkey, as well.

a **b**

Figure 3. a) A traditional soup made from water scorpion. b) Water scorpion.

3.4.4. Coleoptera

More than 100 insect species of 17 families are used as the food of this group, which is the richest group of insects in terms of the number of species and contains approximately 40% of insects. Generally, the larvae of both aquatic and terrestrial types are eaten. Large individuals of the families Hydrophilidae (*Hydrophilus piceus*) and Dytiscidae (*Dytiscus marginalis*) among aquatic ones are used as food (figure 4a-d) (Jäch, 2003). Both species are quite widespread in the wetlands of Turkey.

a **b**

c **d**

Figure 4. a) *Hydrophilus piceus*. b) *Dytiscus marginalis*. c) Aquatic insects gathered in boxes to be sold in China. d) Ready-to-serve insect dish made from frying aquatic insects in China (photos c, d from Jäch, M. A. 2003).

3.5. Benefiting from the Insect Protein Potential in Wetlands Effectively

Just as with all natural sources, the most important issue is to ensure an effective and sustainable utilization of wetlands. The existence of all animal organisms in wetlands is subject to the permanence of the habitats in question. For this, it is necessary to protect specifically the wetlands. Habitat corruptions and losses are encountered due to such reasons as illegal well establishments, making agricultural land works, infrastructure and tourism investments, taking sand and gravel stones from wetlands and river beds feeding them, uncontrolled reed cutting, burning of reeds, overfishing, and overgrazing, although these have decreased to some extent when compared to past years. All these affect not only aquatic insects but all organisms in wetland ecosystems.

Similar policies to those policies of "providing to the economy" implemented by certain countries for terrestrial insects. For example, approximately 35 species of Acrididae (short-horned grasshoppers) are eaten. In recent years, there is an increasing interest of science people and governments in these species (as they are harmful species). In 1983, the farmers in Thailand started to collect short-horned grasshoppers with the sponsorship of the government as the insecticides treated through spraying failed to be effective. The state paid 0,12 dollars per kilogram in 1983, and 2,80 dollars in 1992. Thus, the farmers earned more than two times in the same area. Whereupon, the government presented grasshopper dish recipes containing various grasshopper sauces and grasshopper spices (Defoliart 1995). Similar practices may be started in pilot wetlands of Turkey. The species of insects that are large in dimension and have a high population in the wetlands where they already exist can be produced in a controlled way in the same region. In faunistic studies carried out on aquatic insects in many wetlands of Turkey by the author since 2000, it was determined that

high population intensity is reached in all research areas of *Hydrophilus piceus* and *Dytiscus marginalis* species of aquatic insects. These insects that prefer cut reed residues in large lakes as a shelter and breeding grounds are large in dimension and used as human and animal food in the Far East.

On the other hand, *Hydrophilus piceus* species is also used as a diuretic in alternative medicine in China with its antidiuretic property. Thus, it is among insect groups that are mostly collected from nature and face extinction. That such rare types in nature with high economic value exist abundantly in the wetlands of Turkey should be considered as a protein potential waiting for being utilized.

3.6. Situation in Turkey

In Turkey, there are people and institutions with a restricted point-of-view that wetlands exceeding 1 million 645 thousand hectares can be used economically only by producing fish or reeds. However, the wetlands that are regarded as natural richness museums of the world due to their biological variety are the most important ecosystems of the world with their natural functions and economic values. Apart from the elements of wetlands with economic value, even the existence of wetlands on their own is an ecological gain by itself.

The climatic variation that results from height differences among the regions has made Turkey one of the most important countries of its geography in terms of wetlands. Thus, many aquatic insect groups with a food potential exist in our country. Unfortunately, there is no national/international practice on the economic gain of neither terrestrial nor aquatic insects and the management of relevant sources. The grasshoppers produced in Antalya province are only exported abroad as animal feed.

4. Discussion

There are more than 300 wetlands in Turkey. Fourteen of these areas being Ramsar Areas, 135 of them have international importance, and their total area exceeds 1 million 645 thousand hectares. The registration works continue in many wetlands, and temporary aquatic habitats apart from them host significant aquatic insect existence.

As a result of a natural consequence of the existing wetlands in Turkey, these areas host many aquatic insect types that can be regarded as alternative protein sources. First, it is necessary to prepare a detailed inventory of wetlands in order to turn this potential into added value. Then, aquatic/semi-aquatic insect types of each wetland and their intensity should be determined. Efficient practices similar to those developed by certain countries regarding terrestrial insects should be implemented in

pilot wetlands of Turkey. Insect species that are determined to bear economic value should be opened for use and production in a controlled manner.

References

Anonymous, 2016. https://entomology.ca.uky.edu/content/insect-snacks-around-world (access date: 28.03.2016).

Beadle, L.C. (1974). The Inland Waters of Tropical Africa. *Prentice Hall Press*, First Edition, London, 350p.

Brown, H.P. (1987). Biology of Riffle Beetles. *Ann Rev Ent.*, 32, 253-273.

Chopra A.K., Malik, N.S., Ichhponnai, J. S. (1970). Evoluation of Poultry Feeds in India. I. Proximate analysis, energy values and basic Amino-acid Contend of Feed Ingredients. *J Res Ludhania*, 8, 6-232.

Daly, H.V. (1984). General Classification and Key to Orders of Aquatic and Semiaquatic Insects. In R.V. Merrit and K.W. Cummis (Eds.), An Introduction to the Aquatic Insects of North America. Kendall/Hunt, Dubuque, Iowa, pp. 76-81.

FAO, 2013. http://www.fao.org/docrep/018/i3107e/i3107e00.htm (access date: 28.03.2016).

Darılmaz, M.C., İncekara, U. (2011). Checklist of Hydrophiloiedea of Turkey (Coleoptera:Polyphaga), Journal of Natural History, 45(11), 685-735.

Darılmaz, M.C., Salur, A. (2015). Annotated Catalogue of the Turkish Caddisflies (Insecta: Trichoptera). Munis Entomology & Zoology, 10 (Suppl.): 521-734.

Darılmaz, M.C., Salur, A., Muranyi, D., Vinçon, G. (2016). Contribution to the knowledge of Turkish stoneflies with annotated catalogue (Insecta: Plecoptera). Zootaxa, 4074 (1), 001–074.

Defoliart, G.R. (1995). Edible insects as minilive stock. Biodiversity and Conservation, 4, 306-321.

Edmunds, G.F. (1973). Trends and Priorities in Mayfly Research. In W.L. Peters and J. G. Peters (eds.), *Proc. First Internat. Conf. Epheremeroptera*. Brill, Leiden, pp 7-11.

Ellis, R.A., Borden, J.Y. (1970). Predation by *Notonecta undulata* on Larvae of the Yellow Fever Mosquito. *Ann Ent Soc Am*, 63, 963-973.

Jäch, M.A. (2003). Fried Water Beetles Contonese Style. *American Entomologists*, 49, 134-37.

Kakman, V.J., Vasscher, M., Pelt, G.J.Van. (2003). An annotated checklist of the Odonata of Turkey. *Odonatologica*, 32(3), 215-236.

Kazancı, N., Türkmen, G. (2012). The checklist of Ephemeroptera (Insecta) species of Turkey. *Review of Hydrobiology*, 5 (2), 143-156.

Ramos Elorduy, J., Pino, J.M, Martínez ,VHC. (2009). Edible aquatic Coleoptera of the world with an emphasis on Mexico. *J Ethnobiol Ethnomed*, 5(11), 1-10.