CHAPTER 8

A Functional Food: Anzer Honey

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INTRODUCTION

Functional food is not in the form of drugs, pills, or capsules like nutritional supplements, but the foods that are thought to be beneficial in preventing diseases as well as meeting the body's need for essential nutrients and that people prefer to consume for a healthier life are called functional foods.

Terms such as "functional foods" or "nutraceuticals" are widely used in the marketplace. Such foods are regulated by FDA (Food & Drug Administration) under the authority of the Federal Food, Drug, and Cosmetic Act, even though they are not explicitly defined by law.

Honey is a sweet product created by bees by collecting plant nectar and changing its content in their bodies, then taking its final form with maturation in the honeycomb (Turkish Food Codex Honey Communiqué 2020/7). Honey can be runny, viscous, partially or completely crystallized; its taste and aroma vary according to the type of plant. The color of honey can range from water white to dark brown. The quality and biochemical properties of honey, especially the nectar source, its maturation, production method, climatic conditions, and processing and storage conditions, are determined.

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The price of honey is above all other foods on the market. But the market price of Anzer honey is ten times higher than other kinds of honey (Gok et al., 2015). Today, the world's honey supply cannot meet the demand, leading to honey's debasement. This result usually comes in the form of diluted honey.

Anzer honey is produced by Caucasian honey bees (*Apis mellifera caucasia*, Pollmann 1889) using flower nectars from the Anzer plateau of Rize province. Anzer honey received its geographical indication registration certificate in 2021. New season Anzer honey sales start in September with pre-orders. Although it is sold at high prices due to its popularity, it is sold out in a short time.

Anzer honey is a heterofloral blossom honey containing wildflowers from the Anzer plateau near Ikizdere and Rize in the East Black Sea Region, Turkey (Tezcan et al., 2011). As a result of internet research, it was stated that Anzer honey is expensive because it is produced by more than 400 flower species and unique bee species. Still, no articles support this information. Despite so much scientific research about Turkish honey primarily produced in the Anzer plateau - Black Sea Region of Turkey, there are few scientific publications about honey produced in the Ayder plateau of Rize-Turkey (Fig 1).

Figure 1. Anzer Plateau (https://rize.tarimorman.gov.tr/FotografGalerisi/2021)

When Azer Honey is typed into the academic google search, 498 publications can be accessed. However, only thirteen of them constitute experimental studies on the biological activity and medical use of Anzer honey.

Pollen analysis is important to find the botanical and geographical origin of honey. Malkoç et al., reported that the major pollens detected in the Anzer honey samples were *Thymus, Rumex, Onobrychis, Cistus, Plantago, Ranunculus, Rhododendron, Myosotis,* and *Geranium* (Malkoç et al., 2019). In the study published by Şenyuva et al. in 2009, Anzer honey contains only *Thymus praecox* from *Thymus* spp., while *Trifolium* spp. Pollen of *Lotus corniculatus, Castanea sativa, Cynoglossum glochidiatum* and *Helianthemum nummularium* were also detected. In addition, the highest amino acid content in this study was reached in Anzer honey (Senyuva et al., 2009).

Anzer honey has greater free radical-scavenging and antioxidant activities than numerous honeys cited in the literature (Ulusoy et al., 2010; Şahin et al., 2011; Malkoç et al., 2019). Anzer honey shows high antioxidant activity compared to some flower honeys and low compared to dark-colored honeys such as chestnut and puree. According to Malkoç et al., phenolic substances found in Anzer Honey at the highest levels were pinocembrin, hesperidin, and chrysin. Pinocembrin, detected at the highest concentration in Anzer honey, is an essential flavonoid with proven pharmacological activity in neurodegenerative and cardiovascular diseases (Malkoç et al., 2019). It is known that there is a positive correlation between total phenolic and total flavonoid content and antioxidant activity.

In Saral's article in 2018, the total phenolic and antioxidant properties of eleven different honey samples collected from the Eastern Black Sea region were examined. In this study comparing chestnut and flower honeys, it was stated that chestnut honey showed higher antioxidant activity than flower honey. However, it can be said that the antioxidant effect of Anzer honey is high among flower honeys (Saral 2018).

In a study published by Korkmaz & Kolonkaya in 2009, they reported that Anzer honey protects rats from N-ethylmaleimide-induced liver damage. This in vivo study with a control group showed that Anzer honey is hepatoprotective against N-ethylmaleimide, a sulfhydryl blocker. The authors stated that this result might be due to the high antioxidant activity of Anzer honey (Korkmaz & Kolonkaya, 2009).

Ulusoy et al., in their study published in 2010, investigated antioxidant and antimicrobial activity in flower honey. Honey samples from Anzer and Kars regions reported moderate antibacterial activity on *E. fecealis* compared to standard antibiotics. In the same study, Anzer suggests that honey can be a functional food due to its high antioxidant properties (Ulusoy et al., 2010).

Cakir et al. In the study in which they investigated the chemical composition, structure types/vibrations, and palynological and antimicrobial properties of honey samples obtained from Rize-Anzer, Gümüşhane, and Sivas-Zara regions, all honey samples were effective in *Staphylococcus aureus* and *Saccharomyces cerevisae*, only honey from Anzer region was effective on *Escherichia coli* and reported that none of the honey samples showed activity on *Listeria monocytogenes* and *Candida albicans*. They stated that oleamide, one of the bioactive oil esters, may be responsible for the antibacterial property. Oleamide also adds antioxidant properties to honey (Cakir et al., 2020).

In the study published by Selçuk and Nevin in 2001, seventy-three honeys obtained from different regions of Turkey were diluted in five concentrations and tested on *E. coli*, *Klebsiella pneumoniae*, *S. aureus*, and *C. albicans*. As a result, while honey generally showed antibacterial activity at 50% dilution, Anzer honey was also able to exhibit antibacterial activity at 40% concentration. However, the same situation is not valid for *C. albicans*. (Selçuk & Nevin 2001).

Malkoç et al., published in 2019, is one of the most comprehensive studies on Anzer honey. In vitro in Anzer honey total flavonoid content (TFC), total phenolic content (TPC), antioxidant properties (DPPH, FRAP), and melissopalynological analyzes were performed, pinocembrin, hesperidin, chrysin, protocatechuic acid, p-coumaric acid, catechin, caffeic acid phenyl ester (CAPE), It was determined that p-OH benzoic acid and caffeic acid were major compounds, myricetin, luteolin, rutin, resveratrol, epicatechin, t-cinnamic acid, ferulic acid, and gallic acid were minor components. Antioxidant and anti-inflammatory properties of hesperidin, and anti-tumoral properties of Chrysin are known. The fact that these ingredients are the major components in Anzer honey reveals the medical aspect of this honey (Malkoç et al., 2019).

In Hotaman's master's thesis in 2015, the bioactive properties of Anzer honey and pollen were examined. In the study, the proline value of Anzer honey was reported to be between 808 and 1139 mg/kg. It has been stated that Anzer honey has a higher proline content than other flower honeys, and it is even close to the proline value of puree honey given in the literature. Since the amount of proline in honey is accepted as an indicator of the amount of protein in honey, it has been revealed that Anzer honey is honey with high nutritional value. In addition to the high antioxidant activity of Anzer honey, the inhibition effect on urease and hyaluronidase enzymes was also revealed in the study. This shows that Anzer honey may have medicinal,

anti-ulcerative, antibacterial, and anti-inflammatory effects (Hotaman 2015).

Hepsag et al. In his study in 2019, the physicochemical and bioactive properties of 21 Anzer honey samples were investigated. The rich total phenolic content of honey samples and, therefore, the high antioxidant properties are the first striking results. However, it has been revealed that the minerals found in Anzer honey are potassium, calcium, sodium, and magnesium. The study also mentions the importance of studying the properties of Anzer honey in detail and determining the limit values for the export of Anzer honey.

Medicinal properties of Anzer honey

In a study conducted by Kolaylı et al. in 2008, the antioxidant and antimicrobial properties of chestnut (n=15), Bayburt (n=8), and Anzer honey (n=7) were investigated. Similar to other studies, the total polyphenol content and antioxidant properties of Anzer honey were lower than chestnut honey and higher than Bayburt honey. The study also includes in vitro study results showing that Anzer honey is effective on the ulcer disease agent Helicobacter pylori. (Kolaylı et al., 2008a). In the same year, Kolaylı et al. published an article about Anzer honey being rich in iron. In this study, Na, K, Ca Fe, Cu, Zn, Mn, Cr, Pb minerals were investigated in honey produced on the Black Sea coasts of Turkey, and it was mentioned that there are intense K, Na and Ca in honeys (Kolaylı et al., 2008b).

Protection from cancer: In ethnobotanical studies, it is reported that Anzer honey is used in medicine. It has been reported that its consumption, especially mixed with *Urtica dioica* L (nettle) seed, is protective against cancer (Gürbüz et al., 2019).

Protection from X-radiation: Bagatır et al. reported that genotoxic damage in the peripheral blood lymphocytes of healthy volunteers induced by X-radiation might be prevented or alleviated by adding Anzer honey in vitro. These results encourage further research on the protective effects of honey (Bagatır et al., 2022).

CONCLUSION

As a result of the search on google academic limited publication on the antimicrobial activity of Anzer honey could be reached. Generally, antimicrobial activity studies on Anzer honey pollen and propolis are available in the literature. Studies on Anzer honey are very limited in the literature, and its bioactivity properties are still waiting to be revealed.

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