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REVIEW PAPER DERLEME MAKALESİ

Effects of Bees and Bee Products on Human and Animal Health

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Abstract: One of the creatures that are beneficial to nature and humans is bees. In addition to their production in their life cycle, they ensure their nutrition, the nutrition of their offspring, and the protection of their hives. As a result of these purposes, they create valuable products. The importance of bee products is better understood when natural nutrition is considered. Bees and bee products have been used for therapeutic purposes in the past. This rapidly developing method, now called Apitherapy, has been accepted in the medical world as it is based on the results of scientific research and supports modern medicine. Honey bee products such as honey, pollen, royal jelly, propolis, bee venom, and bee bread are widely used in human and animal health. Information about some properties of honey and bee products and their effects on health are compiled and conveyed in this review.

Keywords: Apitherapy, bee, bee products, health, honey.

Arı ve Arı Ürünlerinin İnsan ve Hayvan Sağlığı Üzerine Etkileri

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Öz: Doğaya ve insana faydalı olan canlılardan birisi de arılardır. Yaşam döngülerinde üretimlerinin yanı sıra kendi beslenmeleri ve yavrularının beslenmesi, kovanlarının korunmasını sağlarlar. Bu amaçların sonucunda değerli ürünler ortaya çıkartırlar. Doğal beslenme göz önünde bulundurulduğunda arı ürünlerinin önemi daha iyi anlaşılmaktadır. Arı ve arı ürünleri geçmiş zamanlarda tedavi amacıyla kullanılmıştır. Günümüzde Apiterapi diye isimlendirilen hızlı gelişim gösteren bu yöntem bilimsel araştırmaların sonuçlarına dayanması ve modern tıbba destek olması ile tıp dünyasında kabul görmüştür. Bal arısı ürünlerinden bal, polen, arı sütü, propolis, arı zehri ve arı ekmeği insan ve hayvan sağlığında yaygın olarak kullanılmaktadır. Bal ve arı ürünlerinin bazı özellikleri ve sağlık üzerine etkilerine ait bilgiler bu derlemede derlenerek aktarılmıştır.

Anahtar kelimeler: Apiterapi, arı, arı ürünleri, bal, sağlık.

INTRODUCTION

Bees are called membrane-winged creatures that form the Apoidea family. Features; It has wings in two pairs of transparent membranes with transverse and longitudinal veins. The body of a bee consists of three parts: head, thorax, and abdomen. Their bodies are soft and covered with a dense hair cover. The color of the hair varies depending on the species (Özbek, 2010). Honey bees live as colonies. The bee colony has three types of individuals: queen bee, worker bee, and drone bee (Akyol, 2007). The only duty of the queen bee, who leaves the hive during her life only for mating purposes or if the colony swarms is to lay eggs. Beekeepers renew the queen bees every 2 years in order to prevent the productivity characteristics of the colony from decreasing (Özkök & Selçuk, 2020). Worker bees undertake different task distributions at different ages, such as cleaning the colony, caring for the larvae, caring for the queen bee, and collecting pollen, nectar and water (Yadav et al., 2017). The only task of male bees is to mate. A queen bee mates with more than one drone at a time. It uses the sperm obtained from this mating throughout its life. (Brutscher et al., 2019).

Figure 1. worker bees.

The honey bee belongs to the genus Apis (Karagözoğlu et al., 2022). It is the most common of the 7-12 honey bee species worldwide. The lifespan of honey bees may vary depending on the season. Life span is generally 28-35 days. Worker bees: They feed the queen bee and larvae, guard the hive entrance, and ventilate with their wings to adjust the hive temperature (Korkmaz, 2010). The number of male bees, which develop from infertile eggs and have an incubation period of 24 days, varies depending on the season. Structurally, they are larger than the worker bee and smaller than the queen bee. Male bees, which have no other duty than mating with virgin queen bees, do not participate in any activities in the hive (Erkan & Kızıltaş, 2017).

Figure 2. Queen bee.

In the world of beekeeping, various bee races are recognized. These include the Caucasian, Carniolean, Italian, Anatolian, Cypriot, Syrian, and brown bee races. Each race has its unique characteristics and is found in different regions, contributing to the rich diversity of honey bees worldwide.

BEE RACES AND THEIR DISTRIBUTION AREAS

Apis mellifera anatolica (Anatolian Bee): This race, native to Turkey, is resistant to hot climates and harsh winters. It is usually brown in color and is distributed along the Thrace, Aegean, central Anatolia, and Mediterranean coastlines (Kırpık & Gülen, 2014).

Apis mellifera caucasica (Caucasian Bee): This race is known for its suitability for cold climates. It is dark in color and calm in nature. It is distributed in Northeastern Anatolia and the eastern Black Sea Region (Kırpık & Gülen, 2014).

Apis mellifera meda (Iranian Honey Bee): They are distributed in the Southeastern Anatolia Region (Kırpık & Gülen, 2014).

Apis mellifera syriaca: They are distributed in the Southeastern Anatolia Region (Kırpık & Gülen, 2014).

Apis mellifera ligustica (Italian Bee): This yellow or yellowish brown race is known for its calm nature and high honey production. It is widespread in the Mediterranean region (Kırpık & Gülen, 2014).

Apis mellifera carniaca (Carniolan Bee): This race is known for its endurance and low energy consumption during winter. It is Gray or Grey-Brown in color and is distributed around Aydın province.

Apis mellifera cypria: It is a subspecies of the Western honey bee. It is widespread in Northern Cyprus (Kırpık & Gülen, 2014).

Bee products from honeybees (Apis mellifera L.) can be divided into two categories. In the first category, there are bee pollen, propolis, honey, and bee bread, to which bees add their secretions and which they collect from their environment. In the second category, there are products such as royal jelly, beeswax, and bee venom that bees provide directly from themselves (Karagözoğlu et al., 2022).

Bee products have been used for therapeutic purposes throughout history because they have biologically active properties and can be evaluated as nutrients (Altıntaş, 2018). Bee products can support the immune system (Aybü, 2020). Apitherapy is a treatment option; Products such as honey, beeswax, propolis, pollen, royal jelly, and bee venom are used (Altıntaş,2018). Products containing honey are used for wound and burn treatments, and bee venom application is used for support in treating diseases accompanied by muscle joint problems (Aybü, 2024). Some issues need to be reviewed before using bee products in apitherapy. Let's consider the significant ones. Which bee product will be used in the treatment and what issues should be considered when using this product. The following is the question of for what purpose, by whom, and in what doses the products will be used in the treatment. It is necessary to carefully monitor whether sensitivity or allergy may occur to the products used for this purpose (Bektaş, 2018). Honey has an antimicrobial effect, low water activity, and high acidity values. Thanks to its properties, honey creates an environment that prevents the development of pathogenic

bacteria that cause human diseases. Studies report that the inhibitory properties of honey are not only against bacteria but also against viruses, fungi, and parasites (Mutlu et al., 2016).

Honey bees make propolis from resin and sap, which they collect from deciduous trees, sap streams, and other botanical sources. In addition to its pain-relieving properties, propolis has an antibacterial effect on oral and dental health. It is vital in vitamin content and is rich in minerals (Polat et al., 2023). *Bee pollen* is the flower pollen that bees collect and deposit in their hives. Bee pollen contains high protein and supports the body's collagen needs. Depending on the pollen source, it affects health, such as antibacterial, probiotic, and memory enhancer (Bakkaloğlu, 2021). Royal jelly has fatigue-reducing, antibacterial, anti-diabetic, antioxidant, anti-inflammatory, antitumor, and antimutagenic potentials (Ramanathan et al., 2018). Royal jelly protects reproductive health, neurodegenerative disorders, wound healing, and aging (Pasupuleti et al., 2017). In addition, royal jelly is effective in reducing cholesterol blood levels and improving lipid values (Kaya et al., 2022). Bee products are as healing as honey, and their value is determined by being increasingly researched with developing analysis techniques (Apan et al., 2021). This compilation study aims to introduce bee products and explain and emphasize their importance in terms of health.

DEFINITION OF HONEY, HONEY TYPES AND AREAS OF USE

Honey Definition: Honey is defined in the Turkish Food Codex honey communiqué numbered 2020/7 as follows: "Honey: Plant nectar, the secretions of the living parts of plants or the secretions of plant-sucking insects living on the living parts of plants, after being collected by the honey bee, it is modified by combining it with its substances, reducing the water content and storing it in the honeycomb." It is defined as "a natural product that matures and crystallizes by nature" (Official Gazette, 2020/7). Honey bees, on the other hand, process the liquids they collect from these sources after breaking down the sucrose in the nectar with the help of some digestive enzymes (Interferase enzyme), converting it into fructose and glucose, and storing it in the honeycombs in the hives as their essential nutrients (Şahinler et al., 2021). When honeybees first fill the honeycombs in the hives, the honey has a watery consistency. The amount of water in honey varies depending on the source of the plant collected. However, the current temperature of the hive and the airflow caused by the bees flapping their wings inside the hive cause the honey to lose its water. Depending on the source of the nectar, the average amount of water, which is 30-70%, decreases to 17-18% with this airflow, and honey is ripened by the bees (Bengü, 2022). The process of evaporating the water from the nectar is carried out at a level that does not cause fermentation. The production of honey, which takes its place on our tables, by bees is a very laborious process. Our bees visit tens of thousands of flowers to produce 1 kg of honey (Burucu & Bal, 2017).

Types of Honey: According to the honey standard, honey is divided into two according to its source and marketing method. Depending on their source, they are flower and secretion honey. According to their marketing methods, they are honeycomb honey, filtered honey, pressed honey, filtered honey, and bakery honey (Sorucu,2019).

Uses of Honey: Honey's uses are quite wide and active. Research studies have emphasized the benefits of its use in the food, pharmaceutical, and cosmetic industries.

Use of Honey in Food Technology: Samples are taken from the honey reaching the facilities from the beekeeper on a beekeeper basis for quality control. Its quality and compliance with food safety are analyzed in the laboratory. If the honey complies with quality standards, in other words, if it is 100% natural, pure, additive-free, and residue-free, it can be packaged to deliver to the consumer (Beeo, 2024). Honey, the essential nutrient of bees, is produced worldwide and in Turkey. It has taken its place in the markets under the name table honey. All honey that takes its place on people's tables is produced through food quality control stages around the world and must meet specific standards. Honey that falls outside the specified standards is used in some sectors as raw materials or additives (Bengü, 2022). Honey has an important place in the food industry. In the food industry, as a spoilage preventer and sweetener in the milk and yogurt sector, in the production of products such as sugar-confectionery-jam, in the alcoholic and non-alcoholic beverage industry, as a sweetener in cakes and patisseries, dried honey-starch, milk powder-honey mixture, etc. It has many uses in products, such as a nutritional element and as an inhibitor of spoilage in foods (Ay & Yiğit, 2016).

Use of Honey in Apitherapy: Apitherapy, whose origins are as old as human history, dates back to ancient Egypt 6000 years ago. Nowadays, alternative medicine has a great share in gaining importance again. Apitherapy centers that apply the apitherapy method have also become widespread recently (Altıntaş, 2018). Considering the use of honey in the field of apitherapy, it is reported that it has been used in treating wounds and burns from past to present. It is also reported that it is used as an alternative treatment method in the treatment of skin diseases, stomach diseases (such as ulcers, acute and chronic lesions, gastritis, duodenitis, and gastric ulcers), intestinal diseases by taking advantage of its antibacterial properties (Biglari

et al., 2012). Studies have also reported that it provides positive results in the treatment of liver patients and reduces the formation of dental plaque in teeth and gum diseases (El Denshary et al., 2011). In a study conducted in Saudi Arabia, it was reported that alternative treatment options were used in 653 patients with chronic ulcers, open wounds, and some lesions on the foot, and approximately 56.6% of these patients used honey in their treatment (Bakhotmah & Alzahrani, 2010). In a study conducted in New Zealand, it was reported that the use of honey in the treatment of dermatitis caused by radiation in breast cancer patients gave positive results (Naidoo et al., 2011). In addition to these treatments, they have suggested that it has a stopping effect on the treatment of herpes, bacterial and fungal infections, and prostate cancer cells, gives positive results in the treatment of cardiovascular and cerebrovascular disorders, and may be chemoprotective against colon cancer. It has been reported to aid rapid epithelial healing in inflamed or damaged cornea (Samarghandian et al., 2011). Honey may contain Clostridium botulinum spores. These sports can affect the nervous system of babies and cause serious diseases. Honey should never be mixed into the food of children under one year of age. (Reis et al.,2018).

OTHER BEE PRODUCTS

Bee Pollen: It refers to the bee product that worker bees collect the pollen from flowering plants and combine it with their secretions, then turn it into spherical colored pellets and are harvested with the help of traps in the hive (TGK, 2024/6). Pollen, known as flower pollen, contains many amino acids, minerals, and vitamins (vitamins B, D, E, and C) (Şahinler, 2022). Pollen is a nutritional supplement with high nutritional properties. Many benefits can be enjoyed when consumed regularly. Pollen can provide many benefits, from skin diseases to reducing aging effects, energy generation, and heart health (Ötekan, 2024). The use of pollen in Apitherapy has been reported to benefit from its bleeding-stopping properties, and current research focuses on its use in cancer types (prostate cancer) and allergic diseases (Aydın, 2018). Due to its allergenic content, its use in cosmetics is not preferred (Demirhan, 2022). It is stated that using pollen as food accelerates growth and development, especially in research conducted with laboratory and domestic animals (Toy, 2022).

Bee Bread (Perga): It refers to the bee product formed by the fermentation of bee pollen stored in the comb cell in the bee colony environment (TGK, 2024/6). This product is a source of protein, vitamins, and fat for honey bees. This product obtained by fermentation can be stored for a long time without losing its nutritional value. Beebread is essential for adult bees and larvae (Silici, 2015). Bee bread has average pollen content and contains minerals, vitamins, and other phenolic components. Bee bread is more valuable for human consumption than raw pollen. It is used to increase sexual power, muscle strength, and muscle volume due to its effect on reproductive hormones. It is used to treat blood pressure and chronic constipation due to the acetylcholine it contains (Sorucu, 2019).

Royal jelly: It refers to the bee product that is secreted from the hypopharyngeal and mandibular glands of young worker bees, has a jelly consistency, light cream-bone color, has a unique odor and taste, and does not contain larvae (TGK, 2024/6). Royal jelly reduces cholesterol, total lipid, phospholipid, triglyceride, and beta-lipoprotein levels in the blood. It has blood pressure lowering, blood sugar lowering, and vasodilating activities. Its antimicrobial properties treat skin and hair diseases and regulate abnormalities resulting from loss of appetite, chronic illness, and irregular and unbalanced nutrition (Akyol, 2015). Royal jelly has regulating effects on reproductive disorders and sexual functions. Other effects are: It is reported that it is suitable for nervous and psychological disorders, insomnia, liver disorders, and tuberculosis. It is also reported that it prevents tumor development in some types of cancer and has cell-repairing and rejuvenating effects (Baran, 2015).

Propolis: Raw propolis is the unprocessed product that honey bees create by mixing the resinous substances collected from parts of plants such as stems, leaves, and buds with wax and their enzymes. Propolis is processed in liquid, concentrated, or powder form, obtained by extracting raw propolis with various solvents and containing standard bioactive components specific to propolis (TGK, 2024/6).

Caffeic acid phenyl ester and clerodane diterpenoid contained in propolis are thought to prevent the development of cancerous cells and reduce the possibility of healthy cells turning into cancerous cells. It has been reported that propolis plays an effective role in cancer treatment (Mutlu et al., 2017).

Wax: It is the substance secreted by 12-18-day-old worker bees from the wax glands in the rings in their abdomen, which is initially white and then darkens and turns yellow. Honeycombs, which are the habitat of bees and are produced from honey, are made of beeswax (Şahinler et al., 2022). Biopolymeric coatings are effective in preserving the chemical and sensory properties of fruits and vegetables in long-term storage (Topal et al., 2020). In a study, the use of beeswax in the ripening of kosher cheese, one of the cheeses we enjoy for breakfast, was examined. As a result of the research, it was observed that there was an increase in the water-soluble nitrogen number

and ripening index of beeswax-coated cheddar cheeses after storage. It has also been reported that the formation of the crust layer that causes moisture loss is prevented (Şahinler et al., 2022). It has been reported that beeswax is a better coating material than gelatin for a healthy and long shelf life of chicken eggs and that these eggs can be stored successfully at 30 ° C for six weeks (Topal et al., 2020). In short, we will summarize the usage areas of beeswax. It is used in many areas such as the cosmetics industry, dentistry, polishing of fruits, coating of pills in the pharmaceutical industry, and polishing of furniture floors and musical instruments (Sorucu, 2019).

Bee Venom (Apitoxin): Bee venom, also known as Apitoxin, is the defense mechanism of bees. It is a liquid bee product with a sharp and bitter taste, sour smell, and clear structure, and it dries quickly when in contact with air. Bee venom is stored in the venom sac and is pumped out through the bee's sting. It has been stated that the level of bee venom is at its highest in 16-19-day-old bees. The amount of poison varies depending on the age of the bees. Studies have shown that the amount of bee poison is approximately 0.05-0.3 ml/bee (Apan et al., 2021). Nowadays, bee venom is generally; It is used in bee venom-containing ointments and antibacterial, antitumoral, multitype sclerosis, systemic lupus erythematosus, scleroderma, joint pain, gouty arthritis, rheumatoid arthritis, bursitis, fibrositis, depression, epilepsy, chronic pain, amyloid neuropathy, migraine (Sorucu, 2019). dentistry, polishing of fruits, coating of pills in the pharmaceutical industry, and polishing of furniture floors and musical instruments (Sorucu, 2019).

Drone larva (Apilarnil): Male bee larvae, which are 3-7 days old and have not yet reached the pupa stage (during the 15-day pupa period, the drones complete their development by developing mouth parts, wings, and legs and become adults) are called apilarnil (Yücel, 2021). These larvae have the highest nutritional value before the bees close their honeycomb eyes. Drone larva is a biologically effective and active bee product. It resembles milk but has the consistency of boza, has a color between yellow and gray, and has a bitter taste. It has a structure rich in protein, fat, carbohydrates, amino acids, polyphenols, vitamins, and minerals. The most striking feature of its content is amino acids that humans and animals cannot synthesize. If apilarnil is not preserved in the cold chain while fresh after harvesting, a serious amount of nutritional loss will occur (İnci et al., 2021). It is usually consumed by mixing it with honey. (Topal et al.,2018). In addition, it is also consumed as a mixture of honey, apilarnil, and royal jelly. Although Apilarnil is a little-known beekeeping product, it can be a nutrient-rich, cheap, safe, and effective natural substance in animal nutrition, protecting animal health and treating diseases (Karagözoğlu and Şahin, 2022). The (Apiterapeutic) Use of Larvae for Human Health renews skin tissue and shows its nourishing, stimulating, and revitalizing effects. It treats chronic diseases (chronic hepatopathy, chronic constipation, chronic bronchitis of the elderly), cirrhosis, ulcers, and atrophic rhinitis (Topal et al., 2018).

STUDIES CONDUCTED IN HUMANS AND ANİMALS AND THEIR EFFECTS ON HEALTH

Apitherapy: Honey, pollen, propolis, royal jelly, and bee venom, which are the products of the honey bee, are prepared in different doses and used to support immune systems and human health and for treatment purposes for some diseases. Apart from these products, apilarnil, bee air, and perga are also among the bee products used in apitherapy (Fratellone et al., 2016). Apilarnil is drone larvae's 3-7 day larval period, the stage before the pupa period (Silici, 2019). In studies conducted on humans and animals, it has been reported that apilarnil, which has a chemical composition rich in mineral salts, vitamins and amino acids, has a direct effect on the brain and adrenal glands, in addition to its biostimulating effect (Yücel et al., 2019).

In obstetrics, apitherapy products are used to deal with health problems during pregnancy and postpartum (Rahimjanova et al., 2022).

Stria Gravidarum (SG) occurs in approximately 60-90% of women during pregnancy in fine lines that are common on the abdomen, hips, and legs (30). Risk factors and life habits are very influential in the formation of SG. In a comparative study in China, in which a total of 400 primiparous pregnant women, 200 with and 200 without SG, were included, it was determined that pregnant women's lifestyles and nutritional habits affected the formation and severity of stretch marks. It was also concluded that regular consumption of honey, milk, and eggs could reduce the incidence of SG (Rahimjanova et al., 2022).

The randomized controlled study conducted by Bruyère et al. (2019) investigated the effectiveness of the combination of propolis and cranberry in preventing and reducing urinary tract infections in women. Accordingly, it has been determined that cranberry and propolis supplementation significantly reduces the incidence of urinary tract infections in the first three months and delays the onset of cystitis attack (Rahimjanova et al., 2022).

For mastitis problems, There are a number of treatment options available, including antibiotics, lactoferrin, cytokines, vaccines, and immunoglobulin. Bee venom, as a non-specific anti-infectious agent, has various biological functions such as anti-inflammatory, antibacterial, and anti-aging. In a study evaluating the

effectiveness of bee venom on mastitis, four different doses of bee venom (3, 6, 12, and 24 mg) were administered subcutaneously to 15 cows with mastitis. Looking at the milk samples taken on the 3rd and sixth days after the application, it was seen that pathogens decreased at all doses (Rahimjanova et al., 2022).

The decrease in estrogen production during the menopausal period directly affects the autonomic nervous system. As a result, women may develop symptoms such as back pain, lower back pain, and anxiety disorders. Forty-two postmenopausal women with such symptoms were given 800 mg of royal jelly per day for 12 weeks and compared with the placebo group. No side effects were observed in either group within four weeks after the intervention. As a result of the study, it was stated that symptoms such as back and waist pain were relieved in the group using royal jelly compared to the placebo group (Rahimjanova et al., 2022).

In Şengül's (2016) experimental study on female lambs, the effect of royal jelly on sexual desire and ovarian activity was evaluated. The study divided lambs into three groups: Royal jelly was administered intravaginally and orally and compared with the control group. Sexual desire (mating desire) and ovarian activity were found to be higher in the group where royal jelly was applied orally than in other groups (Rahimjanova et al., 2022).

In another study, the percentage of some physicochemical parameters (moisture, ash, total lipid, total protein, and cholesterol), the level of some hormones (estradiol, prolactin, progesterone, and testosterone), and some fatty acids of Drone larvae (apilarnil) samples collected from Turkey were determined. It was examined in terms of characterization. The biostimulant, which directly affects basic measurements of sexual function, has been found to have an effect on hypothalamic-pituitary-adrenal axis function, and detailed physicochemical characterization of apilarnil was revealed in the study. According to the data obtained from the study, it has been reported that apilarnil can be seen as a significant natural resource due to its high level biological properties (İnci et al., 2021). Muscle mass increased when Apilarnil was used as a nutritional supplement in athletes (Topal et al., 2018).

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CURRENT SITUATION AND PROBLEMS IN THE BEEKEEPING SECTOR IN TURKEY

We can define *beekeeping* as the activity of acquiring and breeding bee colonies in order to obtain bee products. A beekeeper is a person who can manage his colony. When starting beekeeping, the region should be chosen carefully, and the vegetation and climate of the region should be suitable for beekeeping (Kırpık & Gülen, 2014). Beekeeping is an agricultural and economic activity. Beekeeping is very important for our country. Our country has approximately ¾ of the world's honey plant species. Turkey has excellent beekeeping potential in terms of its rich flora, suitable ecology, colony existence, and genetic variation in bee populations (Kırpık and Gülen, 2014). Apart from honey, an essential beekeeping product, beekeeping products are newly recognized and found in markets in Turkey.

Products such as pollen, propolis, beeswax, bee venom, and royal jelly, which are products of membrane-winged birds, are among the precious products of beekeeping, apart from honey. (Kırpık & Gülen,2014).

Our country's natural conditions, geographical location, suitable climatic conditions, and rich vegetation are suitable for beekeeping activities (Çevrimli & Sakarya, 2018).

Global warming and climate change are important risk factors for the beekeeping sector. In addition to these risks, incorrect methods of combating bee diseases and pests, not using bee breeds suitable for the region, and pesticides used in agricultural control continue these risk factors. For sustainable beekeeping, the current risk should be determined, relevant research and studies should be carried out, and precautions should be taken (Varalan, 2023).

Following these risks are risk factors originating from queen bees, risk factors originating from migratory beekeeping, risk factors arising from pesticide use, and economic, financial, and marketing risk factors in beekeeping. Other risk factors in the beekeeping sector are risks arising from malnutrition, risks arising from wintering losses, risks arising from theft and hive theft, and risks arising from natural disasters (Varalan, 2023). In addition, it is very important to protect genetic resources. However, it is also necessary to pay attention to the problems associated with inbreeding (Özkök, 2022).

In order to reduce or prevent the effects of these risk factors, studies and efforts can be made to increase the efficiency of bee products. Apart from these, producers can increase their solidarity level by receiving support from

cooperatives and increasing their welfare level by selling their products at a specific price (Varalan, 2023). In addition, it is possible to increase the productivity characteristics of the queen bee with the conscious use of artificial insemination (Özkök, 2023).

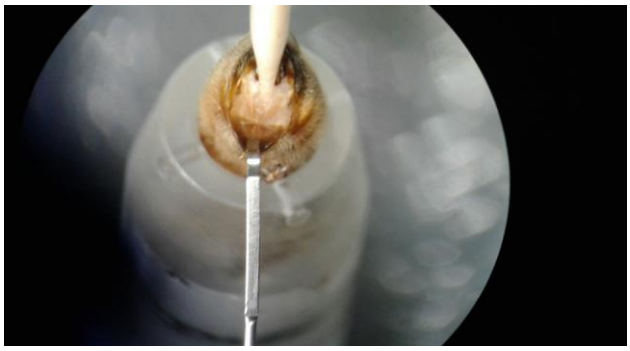

Figure 3. Queen bee artificial insemination.

Studies are being carried out on artificial insemination and cryopreservation of semen in honey bees. Honey bee sperm can be stored at room temperature for a short time. However, more studies are needed regarding long-term storage. For this purpose, the use of antioxidant-containing substances, as in mammals, remains up-to-date (Özkök and Yalçın, 2022).

It should be aimed to research, develop and implement appropriate strategies by adopting beekeeping activities that manage to solve the risks.

CONCLUSION

Bee products are essential for people's nutrition and health. Although it is not consumed as a medicine in the pharmaceutical industry, many food supplements contain bee products as active ingredients. The reasons why bee products have been preferred from past to present, especially in treating daily but common problems, are explained. It is known that bee venom and Apitherapy are used in modern medicine. With developing technologies, the use of natural products is becoming widespread in apitherapy, the food industry, the cosmetics industry, medicine, and pharmacy sectors. The number of products obtained from bees has increased. As a result, it has been understood that essential bee products (honey, pollen, royal jelly, propolis, bee bread, and bee venom) should be given by humanity to beekeeping in the future as in the past. It has been determined that beekeeping and bee products benefit animals and humans. Bee products will find wide usage areas with their naturalness. The bioactive properties and chemical content of male bee larva (apilarnil), one of the new bee products, should be investigated using updated analysis methods. It should be evaluated in terms of human health. These issues have been mentioned in line with the literature.

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