

Review

Traces of Honeybees, Api-Tourism and Beekeeping: From Past to Present

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Citation: Topal, E.; Adamchuk, L.; Negri, I.; Kösoğlu, M.; Papa, G.; Dârjan, M.S.; Cornea-Cipcigan, M.; Mărgăoan, R. Traces of Honeybees, Api-Tourism and Beekeeping: From Past to Present. *Sustainability* **2021**, *13*, 11659. <https://doi.org/10.3390/su132111659>

Academic Editors: Julia N. Albrecht and Marco Haid

Received: 15 September 2021

Accepted: 19 October 2021

Published: 21 October 2021

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Abstract: Throughout history, honey has been used for many different purposes and due to its medicinal properties, has been one of the products marketed by traders. The figure of the bee first appeared in drawings on rock with the history of humanity, then on statues, as a logo, on money or stamps, and also in movies. Beekeeping museums, which present the historical process of beekeeping, also reflect an important culture with their ancient hives, documents, beekeeping materials, and historical antiquities. The contribution of bees to the sustainability of natural life is very important and has a history of 100 million years. The importance of bees and their by-products is increasing day by day, and the demand for the beekeeping industry as alternative income determines the emergence of new products and activities. Based on its health properties, apitherapy is the basis of activities such as api-air and api-diet. In natural regions (i.e., mountainous areas, forests) where beekeeping is carried out, people's tradition, food culture, and healthy lifestyle attract society's attention. In this context, api-tourist activity appears as a new phenomenon. In this article, the existing literature was scanned to create a resource about these new fields triggered by the beekeeping sector.

Keywords: bees; history; sustainable beekeeping; tourism

1. Introduction

Since ancient times, humans have intricately intertwined their existence with bees. The earliest archaeological evidence of humans interacting with bee products traces back to the Paleolithic. For example, the use of beeswax to enhance hunting, by mixing wax with resins and ochre to fix stone tips to shafts or to create poisonous adhesive substances with toxic *Euphorbia* [1,2]. Additionally, the history of beekeeping is as old as the history of humanity. Drawings related to beekeeping have been found in cave paintings dating from about 10,000 BCE (Before Common Era). Primitive hives were also used in beekeeping in the Middle Ages, where in some regions only honey produced by bees was utilized without performing beekeeping [3]. It is known that the Sumerians, who lived in Mesopotamia around 3000 BC, also accepted honey as a medicine. Research conducted in the tombs of Egyptian pharaohs found dry honey aged 3200 years, and reports from 4000-year-old tablets suggest that the ancient Egyptians used honey for food, medicine, and religious purposes. There are data regarding beekeeping in images, tablets, and hieroglyphs dating

back thousands of years in Sumerians and Hittites from Anatolia, China, and India from Asia, Egyptian civilization from Africa, and Europe. Honey was also widely present in Etruscan and Romanian cuisine and medicine [4]. Beekeeping, which took place in natural conditions until the 17th century, gained a scientific quality in these data [5–7]. For example, the San people of South Africa harvested honey by taking over wild colonies and marking them with sticks and stones at the entrance. Following the discovery of the first modern hive, the process of collection honey turned into an activity of animal production controlled by human hands [8]. Among the Slavs, beekeeping is a traditional practice. In particular, honey is part of the ritual culture and folk customs of Ukrainian people, descriptions being available since 1843 [9]. Nowadays, honey is the most traded bee product, as beekeeping activities have traditionally focused on honey production. In Figure 1, the schematic representation of the history of beekeeping from museums and personal collections is shown from past to present [4,10–14].

Apitherapy is a type of complementary medicine that implies the use of various bee products as therapeutic agents to prevent diseases and/or reduce their development. Api-tourism combines sustainable beekeeping, niche, historical heritage, and health tourism as an intersection between tradition, alternative medicine, and the sustainable income-generating activity of beekeepers. Beekeeping-oriented activities (bee products, apitherapy, beehive air, bee museums, production activities, historical beekeeping activities, images, and others) aim to attract beekeepers and people inclined to earn and increase the sector and country income [15–19]. Honeybee tracks can be seen in a wide range of areas, such as food, cosmetics, pharmacy, and medicines. In this article, we evaluate beekeeping apitherapy, beehive air, the use of bee products in nutrition, and several topics that attract tourists' attention.

FROM PAST TO PRESENT



Figure 1. Schematic representation of beekeeping history from museums and from Mustafa Kösoğlu's personal collection.

2. From Past to Present

The bee is present in the legends of all societies on Earth, from prehistoric millennia to the Middle Ages. The Sumerians and Egyptians considered the honeybee as a sacred insect, according to the Sumerian–Akkadian tablets depicting the worship of the “bee goddess”, and the figures of bees on the stamps of the Egyptian pharaoh. While the Egyptians believed that honeybees reproduce from the tears of the god Ra, they are said to have been used as symbolic figures of the Egyptian state for thousands of years along with the water or common reed (*Phragmites australis*) [20]. In the Mediterranean mythology, Aristaeus was a kind of god for teaching beekeeping to humans, while in Greek and Roman mythologies Aphrodite and Bacchus were linked to honeybees [4].

According to artifacts of Bahmutin culture found at the burial site near Birsk town in the Republic of Bashkortostan, beekeeping in the southern Ural started about 5–6 centuries BCE among local Finno-Ugric tribes, keeping bees in tree trunk hollows at a height of 15 m in order to protect against bears. Later, beekeeping was adopted by the Bashkir people’s ancestors, who assimilated and drove the Bahmutin peoples away. Current Bashkir peoples in South Ural in the Burzyan region (natural region of mountainous forest area) still use historical beekeeping in pine tree trunk hollows. Bashkir linden honey and wild Burzyan dark bees are famous in Russia and European Countries [21].

Two types of ancient ceramic hives have been identified, vertical and horizontal [22]. The latter, being a tubular container, was widespread in the Mediterranean area in antiquity [23,24]. The oldest horizontal beehive, dating to the 10th–9th c. BCE was discovered in Tel Rehov, Israel [25]. Dating to the classical period, these types of hives were widespread in traditional apiculture in Egypt, Morocco, Israel, Jordan, Syria, Lebanon, Iraq, Iran, and the Arabian Peninsula, as well as in Greece, Crete, the Aegean islands, and Cyprus [26–28]. Details of a wall painting on the tomb of Rekhmire (c. 1450 BCE) in Egypt, depicting horizontal beehives, were also discovered. Furthermore, horizontal beehives were depicted in a vertical position and represented on gold signet rings found in a tomb (Tombe dei Nobili) in Kalyvia, Crete, dating to the Late Minoan IIIa period (c. 1400 BCE), where a capture of bee swarms is also represented [29].

The bee figure was a symbol of power, being printed on money in the past. In the ancient city of Ephesus, located on the west coast of Anatolia, within the current Selçuk district of Izmir province, nearby the Virgin Mary 300–480 BCE Classical period, bees and deer are described on most of the 30–300 Hellenistic coins. Arian became synonymous with Ephesus and its symbol [20]. Again, the cult statue of Artemis Ephesus is presented with its richly detailed high architecture and magnificent jewellery. In ancient Greek, the goddess of victory, Nike, is represented alongside honeybees, which became the symbol of Ephesus; a wide variety of representations from human and animal motifs are placed in neat rows by zodiac signs [30].

Later, in the early 9th century BCE, an extensive apiary with hundreds of straw and clay cylindrical hives was discovered in Tel Rehov, Israel. Evidence of honey, bees, and beeswax within the hives have also been found. Near the hives, several cultic objects and a goddess of fertility altar signified the importance and relationship between Israelite cultic practices and bees, honey, and beeswax [31].

Special stamps for bees and beekeeping were issued by states and institutions, based on the significance and importance of the day, such as World Beekeeping Day. At the initiative of the Association of Slovenian Beekeepers, the Republic of Slovenia proposed World Beekeeping Day to be celebrated in May in memory of Anton Jansa, a renowned pioneer of modern beekeeping. It was adopted unanimously at the United Nations General Assembly on 20 December 2017, jointly hosted by 115 countries. The bee has been used on more postage stamps than any other insect. A collection of beekeeping-related stamps can be created at a modest cost and offers an attractive and interesting display [32].

Postage stamps from the Apoidea family, which include bees (especially honeybees), beekeeping, and other activities such as pollination, were produced in different countries of the world, in some cases in several prints. Bees appeared on national wildlife stamps

and in conservation issues to commemorate beekeeping anniversaries, conferences, and congresses, on emblems and seals, as decorations and hieroglyphs, and on stamps warning of the venomous nature of bees. Bees were also used on stamps to describe diligence, frugality, valuable behaviour, and technical cooperation. Furthermore, the honeycomb was used as a symbol of unity, expressing the individuality of the parts that make up a whole [33].

A source of dissemination of beekeeping and the bee world on honey in Italy, Belgium, Germany, and Switzerland bees has been the Liebig trading cards, which were donated with purchases of meat extract (<https://www.cartantica.it/pages/Apifigurine.asp>, (accessed on 5 October 2021)). In half of the XIX century, these trading cards represented art, shape, and knowledge of the honey bee and beekeeping (Figure 2).

The island of Elba [34], located in the Tuscany region of Italy, had three honeybees on its flag between 1814 and 1862. Historically, many interpretations have been given to the bees, ranging from the Elban people's hard work to the royal symbol created for this place by Napoleon Bonaparte, who was forced into exile on Elba. On the island, the famous residence of Napoleon, Villa San Martino, can be visited, in which three bees are used to decorate the building.

Local types of beehives and tooling equipment in Turkey vary greatly from past to present. Preserving and displaying them is very important for future generations. Bees come to life in beekeeping-oriented museums. For example, in Aydın, the Çine Beekeeping Museum, which was the first beekeeping museum in Turkey and the 71st in the world, was opened in 2010. Besides the training room with a capacity of 40 people prepared for courses and seminars, the museum offers services with a cafe, painting and art workshops, and a playground where 2000-year-old Roman and Turkish plays are exhibited [35].

A fragment of fossil rock with a hexagonal design strikingly resembling a honeycomb was discovered in Buzau County, Romania, and is now on display in the Colti commune section of the Buzau County Museum [13].

In Italy, the great cultural and environmental diversity has led to high diversification in beekeeping traditions. These traditions are now revived in the numerous ethnographic museums scattered across the Country, such as the Museum of Uses and Costumi of Trentino people in San Michele all'Adige or the Piedmont Agriculture Museum of the University of Turin [4]. Small towns in Sardinia host ethnographic museums that are considered little jewels, such as the Windmill Museum of Fluminimaggiore with a small collection of the traditional rustic hives made of cork, and the entomological exhibition inside the Ingurtosu village in which visitors may discover longstanding beekeeping traditions (Figure 1).

In Slovenia, beekeeping is gaining interest, not only as a farming activity, but also as a symbol, representing the crucial role of bees for the environment and the cycle of life in nature. The Slovenian capital of beekeeping, with the only authorized museum of its kind in Slovenia—the Museum of Apiculture—is located in the town of Radovljica and is a great opportunity for discovering the history, unique features, and art of apiculture. The museum is divided into three main objectives. The first objective is represented by the colourful exhibitions of 250 hand-painted beehive panels, the oldest one dating back to 1758. The second objective is dedicated to the autochthonous Carniolan honeybee, one of the most popular bee breeds in Slovenia. Furthermore, one of the museum's key points is the world-renowned beekeepers, whom helped in developing and improving the beekeeping tradition.

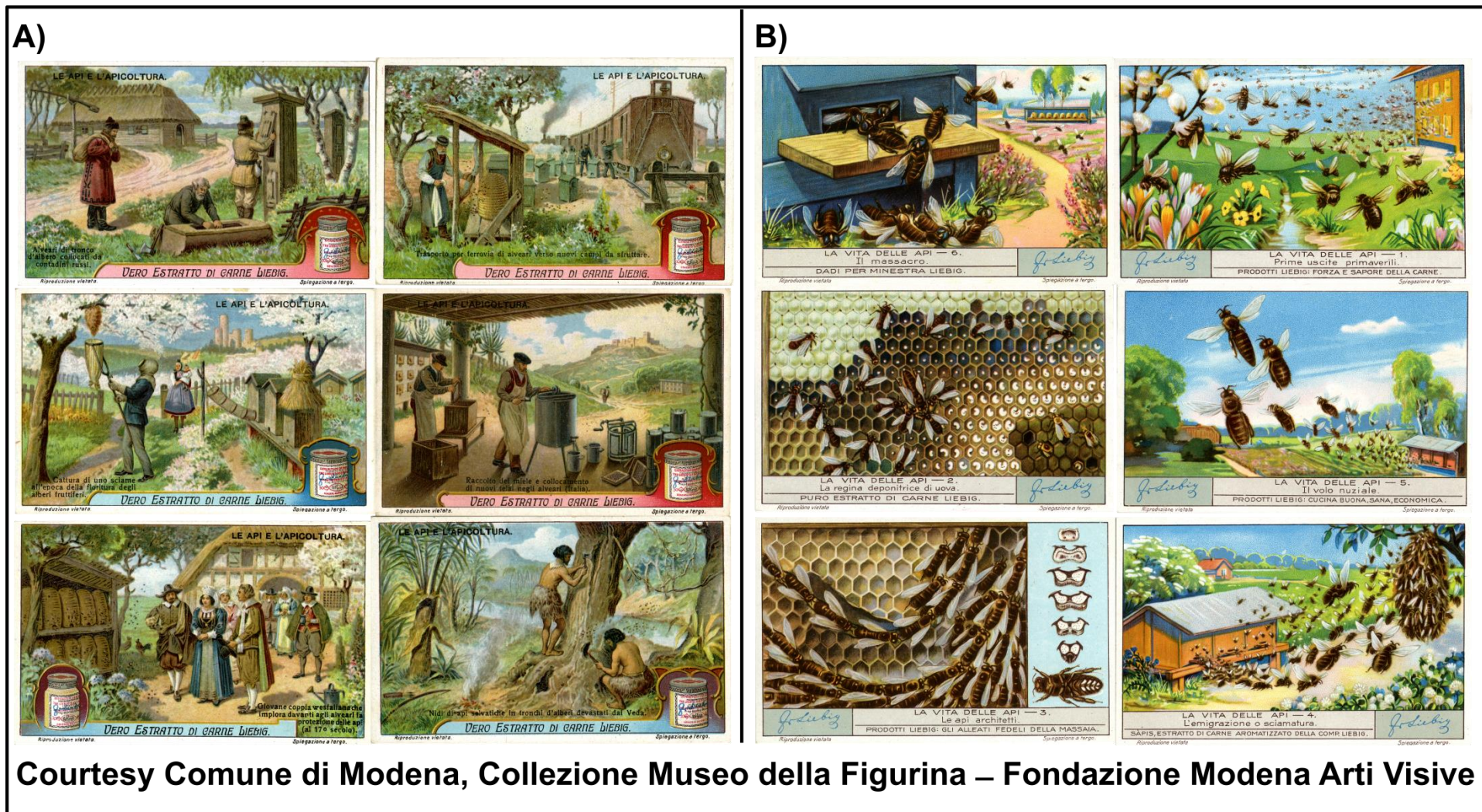


Figure 2. Advertisement of the Liebig meat extract, London. (A) Six trading cards on “Bees and beekeeping”, 1922–1923; (B) Six trading cards on “The life of bees”, 1932 (fmav.org).

The history and art of apiculture in the Museum of Apiculture in Radovljica, Slovenia are presented in Figure 1 (image credits to Karmen Kovac; <https://www.itinari.com/museum-of-apiculture-in-radovljica-the-capital-of-beekeeping-qj4j> (accessed on 16 August 2021)).

A pioneer of modern beekeeping and one of the greatest experts on bees was Anton Janša (1734–1773). He was named a lecturer at the Beekeeping School of Vienna by Maria Theresa, the Holy Roman Empress, his teachings being followed by the state beekeeping teachers. Anton Janša was also interested in art, painting the frontal panels of the beehive. The beginning of this folk art can be traced back to the middle of the 18th century. As seen in Figure 1, the fascinating decorations of the beehive panels have become a tradition, this art being practiced even in the present day.

3. Use of Bee Products as Food and Beverages

Honey, which has played an important role in the nutrition of human beings since prehistoric times, has been used in various fields throughout history, especially in medicine, pharmacy, and cosmetics. Honey, being diverse in different cultures, was considered sacred in antiquity.

In legends, Plato coveys that in Zeus's Garden, Porus became drunk on nectar, before wine was known, and Porphyrius the Neoplatonic philosopher claims that Zeus got Cronos drunk on honey. In the minds of the ancient Greeks, honey and honey-based drinks dominated the times, before Cronos was overthrown and before the gods withdrew from direct interactions with mortals [36].

The use of honey in religious ceremonies was quite common among the Hittites, whose hives were protected by law. At that time, honey mixed with olive oil was poured as a sauce to increase the flavour of fried meat. The Persians used honey in sacrificial ceremonies to the gods [37]. In classical Greek and Roman times, honey was widely used in marinating meat, in a wide variety of sauces, dishes, and desserts. The cookbook *De Re Coquinaria* by Marcus Gavius Apicius, a famous chef in ancient Rome who lived between the 1st century BCE and the 1st century CE, has survived the centuries mostly intact and made available many recipes with honey in salty or spicy dishes, such as the *Dulcia Piperata* (peppered honey cake, Figure 2) [38].

One of Italy's most ancient foods is abbamele or abamele (Figure 3), produced exclusively in Sardinia. Abbamele is obtained from honeycomb, honey, and bee pollen. Honey is manually extracted from the honeycombs and the honeycombs are crumbled and dipped into warm water. Once melted, the wax is separated from the honey and pollen and the remaining syrup is heated for the caramelization of sugars. Abbamele can be eaten with cheese, fresh fruit, or even pasta or vegetables [39].

Among the Slavs, honey has been used as a mythical and ritualistic component of all major religious holidays (both those left behind by paganism and Christianity), as well as during the celebration of births, weddings, and at funeral rites [9]. In modern Ukraine, Holy Evening (the night before Christmas), "Hungry" Kutia (the evening before Epiphany Day, when all the water will be consecrated), Easter, Honey Feast of the Saviour, Apple Feast of the Saviour (Saviour is the folk Christian holiday of the Eastern Slavs) and many other holidays are always celebrated with the use of honey for cooking dishes and wax candles [9,40].



Figure 3. (A) Dulcia Piperata (peppered honey cake), Apicius, *De Re Coquinaria* 7,11,4 (photograph by Carole Raddato, 2015, Creative Commons CC-BY-SA-2.5) and (B) Abamele or abbamele, a traditional product of Sardinia (Italy); (C,D) Health-improving, non-alcoholic honey drinks, (Kyiv) Ukraine.

Along with honey, mead (honey wine) and honey vinegar have also been found in the food chain of the respective periods [41]. Humanity's first drink was mead, obtained by mixing honey and water and letting it ferment. The word "mead" comes from the Latin "hydromeli", derived from the ancient Greek "udor" which means water and "meli", finally meaning honey [42]. Honey, which is used as a sweetener in many civilizations, is considered as the main sweetener in Ottoman cuisine [43]. In the 9–10th centuries, ancient Slavic tribes prepared alcoholic beverages of natural fermentation with honey, such as mead, beer, kvass, and sbiten' [40]. It is known from the Lawrence Codex how the Drevlians boiled mead for the wakes (tradition associated with death) of the husband of Princess Olga (Princess of Kiev from 945 until 964) by her order. This paved the way for honouring great nobles with this beverage [44]. Recipes of ancient meads have been preserved in several publications in the Old East Slavic language [45,46], and the tradition of mead brewing continues now at a modern level [47,48]. In Figure 4, the history of mead and other honey-fermented products, along with their present fermentation processes and uses in multiple countries, is presented.
















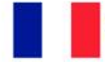


| PAST | | | | PRESENT | | | | PAST | | | | PRESENT | |
|---|---|------------------|---|--|---|-------------------------|---|---|--|--|--|---------|--|
| mildly intoxicating beverage consumed by the ancient Maya |  | <i>Balché</i> |  | made from the bark of <i>Lonchocarpus violaceus</i> tree, soaked with honey and water consumed by the Yucatec Maya |  | <i>Lindisfarne Mead</i> |  | fermented honey with grape juice, herbs, natural well water and fortified with fine spirit | | | | | |
| originated from <i>Balché</i> the Spanish introduced anise to the beverage due to its strong flavour | | <i>Xtabentún</i> | | made from <i>Ipomoea corymbosa</i> honey and anise seeds consumed and manufactured in Mexico's Yucatán | | | | made by alcoholic fermentation of a mixture of honey and water, enriched by the addition of fruit juices, herbs or spices | | | | | |
| originated from the Mandaya and Dibabawon Manobo of northeastern Mindanao | | <i>Bais</i> | | made from a mixture of honey and water at varying proportions and fermented for at least five days to a month |  | <i>Krupnik</i> |  | traditional sweet alcoholic drink similar to a liqueur, based on grain spirit (usually vodka) and honey | | | | | |
| originated from the Mansaka people of Davao de Oro |  | <i>Byais</i> |  | made from boiled <i>Alpinia galanga</i> and mixed with honey or sugarcane juice sharp flavor of citrus fruits or pine needles |  | <i>Sima</i> |  | made from honey, lemon, active dry yeast, and raisins | | | | | |
| traditional pre-colonial Filipino mead-like alcoholic drink | | <i>Kabarawan</i> | | made from the kabarawan tree <i>Neolitsea villosa</i> and mixed with honey |  | <i>Medovukha</i> |  | popular until the 19 th century until it was replaced by wine and beer | | | | | |
| known as a "beverage for the sick" from 1390 made from boiling honey, beer and spices like ginger, clove, and long pepper | | <i>Bochet</i> | | dark, clear mead with a complex flavor, made also by adding fruits such as elderberries, black raspberries, and blackberries |  | <i>Midus</i> |  | nowadays it is made of grain, honey and water | | | | | |
| alcoholic beverage native to Brittany made from the fermentation of buckwheat honey in water known as intoxicant by the presence of bee's venom in the mixture |  | <i>Chouchen</i> |  | made from freshly pressed apple juice, yeasts and honey |  | <i>Tej</i> |  | mixture of one-part honey to five parts water boiled with the stems and leaves of <i>Rhamnus prinoides</i> | | | | | |

Image credits: Wikipedia The Free Encyclopedia

Figure 4. From past to present, a schematic representation of mead and other honey-fermented products from several countries.

In recent years, humans have sought to eat properly for a healthy life, and the food industry offers consumers products that are in line with this trend. Currently, bee products such as honey, pollen, bee bread, apilarnil, bee larvae, royal jelly, and propolis are gaining importance as functional foods with their nutritional and health properties [49–53]. Bee products contain many biochemical components, proteins, saccharides, fatty acids, prebiotics, probiotics, fibre, phytochemicals, bioactive peptides, minerals, vitamins, and organic acids [51].

Honey is added to food and beverages to increase their antioxidant activity. The biological value of wellness tea from *Sambucus nigra* L. (elderberry) supplemented with honey relies on the changes in its physical and chemical properties. The increase in the antioxidant activity of elderberry tea by the addition of honey of different botanical origins has been experimentally confirmed: honey from sunflower increased antioxidant activity by 98%, white acacia—97%, grass/grassland—96%, coriander—92%, and canola—84% under control. The highest antioxidant activity in tea was established with the addition of honey of *Echium vulgare* L. (viper's bugloss) (72.09 units). Caution should be exercised when describing *Echium vulgare* honeys as beneficial to health, even when added to other foods, because they contain high levels of pyrrolizidine alkaloids, which are highly hepatotoxic and, according to various studies, also mutagenic, carcinogenic, and theratogenic [54–57]. The antioxidant activity of tea with honey differs within one species depending on the natural climatic zones of production. Honey of different botanical origin does not have an equal effect on the physicochemical properties of elderberry tea: increased acidity (9.7%); electrical conductivity in the range of 673.62 to 724.44 mS/cm; and total mineralization increased to 9.6%, 11.4%, and 17.9% with the addition of sunflower, acacia, and grassland/meadow honey, respectively [58].

Api-diet/nutrition refers to the use of bee products in nutrition and diets. The value of bee products relies on their nutritional composition, vitamins, and minerals. As a result of the regular use of food and bee products, new flavours are formed, e.g., honey and pollen added to yogurt, ice cream, and other desserts [59–61]. Consumption of pollen and bee bread before breakfast helps to eliminate toxins from the body. Dissolving a tablespoon of fresh pollen in 200 mL of water, mixed with freshly squeezed juice, is an excellent source of energy before breakfast and also aids in weight loss [62].

The antioxidant properties of royal jelly are attributed to proteins and/or peptides potentially associated with the improvement of fatigue. Muscle building performance can also be increased by providing oxygen with royal jelly. Royal jelly has also been shown and confirmed in clinical trials to improve erythropoiesis. It can be used safely and effectively in various functional beverages to increase energy and performance [63].

Along with beekeeping, beekeepers offer tourists the products they have developed from herbal teas, honey syrup, vinegar, wine, kvass, spirits, and bee products [40,47,49].

Currently, all honey drinks (meads) can be classified into health-improving non-alcoholic and alcoholic beverages. The list of non-alcoholic beverages includes water sweetened with honey, sbiten', honey teas, and milkshakes with honey. Water sweetened with honey is a traditional East Slavic beverage based on potable water with honey; it may also contain lemon juice, apple cider vinegar, or honey vinegar. The beverage is used for general immunity improvement and as a preventive and curative agent for diseases of the digestive system. Sbiten' is an ancient East Slavic fermented drink based on honey, water, and extracts of medicinal herbs and spices. It is used for preventive and curative purposes with regard to various diseases (depending on the composition). Honey kvass is a naturally low-carbonated, fermented Slavic traditional beverage based on honey, water, cereal flour, and raisins. Kvass is rich in amino acids and vitamins and has a general strengthening and tonic effect on the body [47]. Traditional mead was also flavoured with spices, such as the Bochet mead from France, and/or aromatic mixtures of plants or fruits, such as the Lithuanian Midus.

In the last 20 years, several attempts have been made to improve the fermentation process of mead: the use of starters and addition of bee pollen or fruit and vegetable

mixtures, such as berry, banana, black rice, coconut milk, and soy [64–66]. These attempts have the ultimate goal to improve the quality of aromatic compounds, as well as the consumer's demands for better aroma, taste, and health characteristics. In this sense, honey-based alcoholic beverages made with black rice generate a pink-coloured product with increased phenolic compounds and anthocyanins [65]. Similar to red wine, daily consumption of the proper amounts of mead might provide multiple health advantages.

To further enhance the current health effects of mead, researchers are inclined to discover and develop novel beverages. To this end, Romano and his collaborators added various parts (inflorescences, leaves, and stems) of *Cannabis sativa* L. (hemp) at different concentrations and *Saccharomyces cerevisiae* biotype M3/5 during mead fermentation [67]. The major constituents of hemp, cannabidiol and cannabinol, have manifold reported health properties, such as anticonvulsant, antispasmodic, anxiolytic, anti-rheumatoid arthritis, and neuroprotective properties [68]. Recently, it has been reported that cannabidiol initiates a physiological response when attached to the G-protein-coupled orphan receptor, signifying novel therapeutic uses of cannabidiol for Parkinson's and Alzheimer's diseases, infertility, and cancer [69]. The addition of inflorescences, leaves, and stems of hemp increased the yield of the fermentation process compared with the control, as well as the polyphenol content. Finally, the highest cannabidiol content was noticed in mead fermented with hemp inflorescences, generating a product with increased bioactive compounds, along with a fruity and fresh flavour.

The type of honey (i.e., lighter or darker), as well as the botanical origin influences mead's physicochemical characteristics and fermentation processes. Suzart Araújo et al. [70] demonstrated that mead fermentation from dark honeys gave better results in terms of cell growth, substrate consumption, and ethanol production than the use of light honey. Honeys varied in their fermentability, with light honeys in general being more difficult to ferment than dark honeys. These results indicate that in contrast to lighter honeys (acacia, linden, multifloral), fermentation with darker honeys (buckwheat, honeydew) may elevate multiple disorders mostly due to their higher concentration in essential nutrients; disorders such as cataracts and age-related macular degeneration, obesity, diabetes, and Alzheimer's [71–73]. Dark honey, such as manuka, has piqued the interest of scientific communities for its biological properties, especially for its antimicrobial and antioxidant capacities. It has been employed for clearing up infections, including surgical wounds, abscesses, burns, and ulcers of different etiology [74–76].

Nowadays, alcoholic honey beverages are starting to gain interest, becoming more popular among individuals that seek health-oriented products. They are classified by volume: honey beer—2–7% vol.; mead (better known as medovukha)—8–16%; sparkling honey drink—10–12%; fortified honey drink—17–25%; honey liqueurs—20–30%; hard honey beverages—from 30 and above. Some countries are resurrecting their traditional beverages. Thus, ancient mead-brewing recipes have been revived in Ukraine and the original beverages «medivka», «medak» (<https://medovary.com.ua/>), and «cikera» (<https://cikera-mead.com/>) are produced. Today, honey drinks are produced by modern certified companies that invite tourists to gastro-excursions to taste honey drinks and other beekeeping products.

In France, the honey museum in Gramont produces and sells mead, described as a traditional artisanal and natural aperitif. Even though many fermented drinks are made using honey, not all should be labelled as “mead”. Mead is the fermented drink made exclusively of water and honey. This drink is one of the first alcoholic drinks that man drank, also known as the drink of gods among the Greeks. The first traces of mead production date back to the Bronze Age in Denmark. In this country, remains of honey drinks were discovered in a tomb at the bottom of cups. Nowadays, fermentation can be produced by endogenous (present in honey) or exogenous (which is added) yeasts, which are added to guarantee regular and quality mead. After sowing the must, a slow fermentation is conducted that provides optimal conditions for yeasts to develop aromas. The aging of mead is an essential step in the quality of the final product; in a few months, it reaches its

aromatic fullness. Even though storage in bottles is feasible, aging in oak barrels is preferable because the wood adds its particular tannins and aromas. The final step consists of racking and bottling sealed with beeswax (Le Musee du Miel in France, https://www.lemuseedumiel.fr/Accueil_Boutique_en_Ligne/121-L\T1\textquoterighthydromel (accessed on 9 August 2021)).

The honey museum in France also produces its own honey vinegar, an artisanal and natural product made from water and honey.

After a first alcoholic fermentation, common with the production of mead, a secondary “acetic” fermentation is carried out. A bacterial veil forms on the surface of the liquid, the famous “mother of vinegar”, studied for the first time by Pasteur. It is in fact the bacteria *Acetobacter aceti*, which converts alcohol into acetic acid by contact with air. Over time, the final product appears and the aromas develop. Thus, vinegar is obtained with beautiful light and golden reflections, very fragrant, as the taste of sugar has faded. Its acidity is lower than that of classic wine vinegar, so it is less aggressive on the stomach. It is presented in two forms, plain vinegar or with aromatics (Lomagne garlic and rosemary), and it can be consumed as classic vinegar. It is particularly useful in vinaigrette and to deglaze cooking juices (Le Musee du Miel in France, https://www.lemuseedumiel.fr/Accueil_Boutique_en_Ligne/122-Le_vinaigre_de_miel (accessed on 9 August 2021)).

4. Api-Air (Hive Air) Therapy

“Bee air or hive-air” treatment was first applied in Germany, this novel treatment being added to the already existing bee products used in apitherapy studies. Nowadays, beehive therapy is also authorized in Austria, Slovenia, and Hungary. The continuous expansion of this therapy is related to its potential contribution to treat asthma, bronchitis, lung fibrosis, and respiratory tract infections. However, scientific evidence is scarce and justification of this therapy by additional biological and chemical analyses is needed. Hive air utilization is based on the principle of systematically and slowly taking the air inside the hive with a fan mechanism and inhaling it (Figure 5). In this application, the air inside the hive is transmitted to a hose-mask by means of a fan assembly, which is prepared on the cover board and whose air flow rate can be adjusted with a regulator. Each patient breathes the air in the hive with the help of his own hose-mask apparatus. By breathing the warm air in the hive, the health and medicinal valuable components in the microclimate are taken directly into the body. The hive, which houses a healthy bee colony, has a high-quality microclimate. There are important volatile and aerosol-containing substances in the water vapor in the air breathed from the hive. The hive air contains saturated water vapor at a temperature of 36 °C and is refreshed by the bees by providing a continuous air flow.

Recently, Kopala and her collaborators [77] surveyed 517 respondents regarding their knowledge of bee products such as beeswax, propolis, bee pollen, beebread, royal jelly, bee venom, and hive-air inhalation. Among individuals, the hive-air inhalation proved to be the least known treatment, as compared to other bee products, used only by 9.7% of the respondents. After learning about the medicinal properties of bee products, over 35% of the respondents were willing to use hive-air inhalation therapy, followed by royal jelly, bee pollen, and beebread preparations. In a different study, out of 220 patients, only 1.8% had previous experiences with hive-air treatment, and 3.4% were willing to use hive air in the future [78].

In 2016, Gontarz et al. [79] evaluated consumer preferences in bee products; even though 73% of them acknowledged their positive health characteristics, they were not using them. Przybyłowski and Wilczewska [80] stated that among women over 35 years of age, 21% chose cosmetics with propolis, 18% with royal jelly, and under 5% with pollen.

Isoprenoids, carotenoids, terpenes, and essential oils, which are found at different levels in other bee products, are also present in the hive air. In addition, there are hormones, pheromones, phytohormones, volatile wax components, high-value alcohols, bees' mandibular gland secretions, aerosol, aerosol originating from propolis, trace elements, enzymes, and choline in the microclimate. In this aspect, Abd El-Wahed et al. [81] evaluated the volatile compounds present in the beehive using solid-phase micro-extraction gas

chromatography–mass spectrometry (SPME GC–MS), as well as the antimicrobial activity against *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, and multi drug-resistant *S. aureus* (MRSA). The beehive air was abundant in fatty acids, volatiles such as *n*-caprylic and geranic acids (14.4% and 10.5%, respectively). Aldehydes accounted for 16.4%, with the highest content of 5-hydroxymethylfurfural (5.2%). Significant concentrations of methyl salicylate and eugenol, responsible for clover flower bud aroma, were also reported. β -Linalool (4.9%) was the dominant terpene, followed by copaene (3.6%), germacrene D (2.7%), and β -Cayophyllene (1.8%), respectively. Dodecanoic acid, isopropyl alcohol, pyranone, and α -farnesene were reported at low concentrations. Regarding the antibacterial activity, the beehive air proved to be effective only against *S. aureus* and MRSA. These results support the use of beehive air aromatherapy against respiratory tract infections, with the need of further investigations for volatiles' mechanistic function and role in the treatment of multiple ailments.

In individuals using beehive air or therapeutic sleep in a beehive, relaxation, uninterrupted and quality sleep, expansion of lung capacity, and, accordingly, comfortable breathing were determined. In medicine, it is known that inhaling drugs is more effective. The active substances directly reach the target area and act quickly. It has been demonstrated that bee air is extremely effective in the treatment of diseases such as bronchitis, asthma, allergies, chronic obstructive pulmonary disease (COPD), emphysema, immune system deficiency, migraines, and depression. In various medical evaluations (attack observation, lung capacity tests, blood tests, isotope measurements) performed on these patients, a rapid and effective recovery course was determined [82–84].

For hive air, the development of a beehive air condensation device was reported from Ukraine [85]. Recently, an appliance (a compression frame) for the condensation of beehive air into water state for further studies and the development of new products was developed [86,87].



Figure 5. Bee accommodation developed for treatment with hive air and sound, (Lviv) Ukraine.

5. Apitherapy

The word apitherapy is derived from the words api (bee) and therapy (treatment). It can be defined as the use of bee products (honey, beeswax, pollen, propolis, apilarnil, queen bee larvae, royal jelly, and bee venom) for health purposes. The use of bee products as a source of healing is as old as humanity. The therapeutic properties of honey, which is sometimes used alone or mixed with plants to make medicines, have been known for 4000 years. The Kahun, Edwin, Smith, Ebers, London Medical, and Berlin Medical papyri

dated between 1990 and 1250 BC are documents showing the therapeutic usage of honey. We understand that the Egyptians widely used honey in apitherapy: honey was included in 147 recipes in the Ebers papyrus, dated around 1550 BCE. Additionally, there are data regarding the use of cream containing honey to beautify the skin and eliminate wrinkles. Poppea Sabina, the wife of the Roman emperor Nero, used honey and donkey milk lotion for facial beauty, then Roman aristocratic women continued to use it [37]. Furthermore, due to its bactericidal activities, it inhibits bacterial growth, which makes it effective in wound healing [88]. Apitherapy is a type of complementary medicine that implies the use of various bee products as therapeutic agents to prevent diseases and/or reduce their development; they are sold as natural medicines in the United States, Germany, Romania, Cuba, China, and many countries in western South America and the Far East, and are used at many clinics [89–92]. Recent studies have shown that bee products have numerous health effects and are used in the treatment of many diseases and as supplementary foods [93–98].

In their extensive review, Ali and Kunugi [93] demonstrated the use of apitherapy as a possible treatment for Parkinson's disease, as well as the use of nutraceuticals as alternative treatments in the prevention of other diseases and cancers.

Propolis (or bee glue), a universal product of the beehive, possesses multiple therapeutic properties, whereas royal jelly is a bee product fed to bee queens during their entire life, contributing to their wellbeing, fertility, and long lifespan. Evidence suggests that propolis and royal jelly can prevent the incidence of age-related incapacitating diseases. Therefore, they have been used to treat various severe disorders such as diabetes mellitus, cardiovascular diseases, and cancer [99].

The first historical evidence of human employment in royal jelly dates back to ancient Greece. The Greeks believed that “ambrosia” and “ragweed”, that gave immortality to the gods of Olympus, were partly composed of royal jelly. In those times, it was already consumed without knowing its precise effects; historians reported that the combs with honey, pollen, larvae, propolis, and royal jelly were crushed and eaten fresh [100]. Aristotle discovered the function of royal jelly in bees, and investigating its effect on the queen bee, he certified the consumption of royal jelly to increase the physical strength and improve intellectual aptitude; the breakfast of his school was exclusively made with honey and royal jelly [101]. In Egypt, Cleopatra used royal jelly as a personal beauty secret; royal jelly became the symbol of the Pharaoh's strength and splendour [102]. Since ancient times, even in old ages of ancient dynasties, royal jelly was a part of China's traditional medicine, associated with longevity and fertility [103]. Since the early 1960s, the use of royal jelly as a functional product in health improvement was explored with the development of “Apitherapy”. Subsequently, the characterization and properties of royal jelly emerged, being extensively used in therapy for both men and the bee itself [101].

Ancient Egyptians illustrated propolis-making bees on vases and ornaments and used it to alleviate many ailments [104]. The Egyptians discovered the “embalming” product from bees. Bees cover the carcasses of invaders with propolis and wax, thus controlling the undesirable spread of infections caused by decomposition. In the 1960s, Derevici et al. [105] showed that propolis is responsible for the lower incidence of bacteria within the hive. Propolis was used by the Greeks as the main ingredient of *polyanthus*, perfume combined with propolis, styrax, olibanum, and aromatic herbs [106]. Hippocrates used propolis to cure wounds, and external and internal ulcers, whereas Pliny used propolis to extract sting and foreign bodies from flesh, disperse tumours, and alleviate the pain of sinews and cicatrizing ulcers (“Propolis: five remedies,” in *Pliny the Elder, the Natural History, Book XXII. The Properties of Plants and Fruits*, J. Bostock and H.T. Riley, Eds., chapter 50 (24), Taylor and Francis, London, UK, 1855, <http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A1999.02.0137%3Abook%3D22%3Achapter%3D50> (accessed on 9 August 2021)) [107].

Nowadays, thanks to its antioxidant, anti-inflammatory, neuroprotective, cardioprotective, antiproliferative, antimicrobial, antilipidemic, antidiabetogenic, antiadipogenic, and antifatigue properties, royal jelly is used as an adjuvant for treating various clinical

situations such as cancer, diabetes, hypertension, hyperlipidemia, and neurodegenerative diseases such as Alzheimer's and Parkinson's diseases [108] (Figure 6).

The most significant flavonoids present in propolis (caffeic acid phenethyl ester, chrysin, and pinocembrin) possess strong free radical scavenging activity, and other potential activities, such as anti-inflammatory, immunomodulatory, antiviral, and antineoplastic [109,110].

To develop new products with the use of bee products, the apitherapeutic effects have been investigated by conducting a study on the use of drone larvae and beeswax, which are considered residual products in the fight against varroa in the production of hand cream [111].

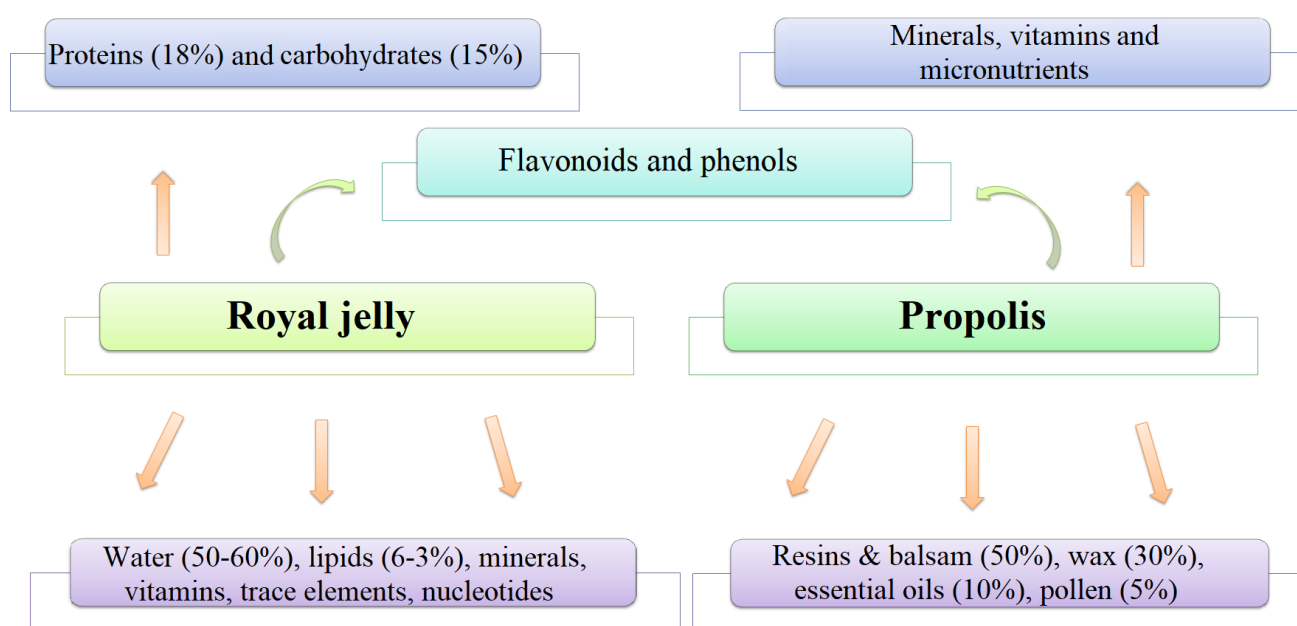


Figure 6. Propolis and royal jelly components and their respective pharmacological activities.

6. Api-Tourism

As a result of the growth of the world's human population, urbanization, time stress, intense work pace, and declining natural habitats, the content of the word holiday has changed. In addition to entertainment, people also consider exploring nature, getting to know local cultures, becoming closer to people living in rural areas, and exploring their "tourism purposes". In developed countries, rural tourism is seen as an important option in alleviating the burden of tourism on cities with important historical and artistic values. Rural tourism is a tool in regional development. In recent years, the quality of tourist demand has changed and there is a cause-and-effect relationship between the structural change in traditional holiday expectations and the reasons motivating rural tourism. Rural origin, economic situation, and low infrastructure costs are among the reasons for the formation of rural tourism [112,113]. Rural tourism leads to agricultural tourism or agrotourism, which also includes beekeeping tourism. Beekeeping tourism positively affects regional development and provides additional income to beekeepers in countries where environmental protection awareness is established [114]. The growing interest in agrotourism has also led to the development of peculiar hives that allow visitors to safely approach bees and to observe the life within the hive without disturbing the insects. These kinds of hives can also support educational programmes for children, youth, and adults (Figure 7).



Figure 7. Hive for teaching purposes at UCSC, Piacenza, Italy (From Seed to Spoon—Erasmus Project).

It is one of the most popular and rapidly growing types of tourism in the modern world, mostly due to the growing interest of tourists of all ages in spending their holidays enjoying bee products (i.e., honey, propolis, royal jelly). Tourists are interested in learning the secrets of technology, i.e., how make high-quality honey and its related products. Hives become travel objects for tourists. The goods in the manufacture of which tourists personally participate are particularly attractive to them [115]. Beekeeping encourages the socio-economic revitalization of rural areas, diversifies agricultural production, and offers new opportunities for both beekeepers and tourists.

Api-tourism combines sustainable beekeeping, niche, historical heritage, and health tourism as an intersection between tradition, alternative medicine, and the sustainable income-generating activity of the beekeeper [113,116,117]. Ecology, known as beekeeping, eco-beekeeping or api-tourism, is a marketing method that combines beekeeping and tourism and has been widely used all around the world. Beekeeping-oriented activities (bee products, apitherapy, beehive air, bee museums, production activities, historical beekeeping activities, images, and others) aim to attract beekeepers and people inclined to earn and increase the sector and country income. Countries such as Slovenia, Hungary, Romania, Chile, and Indonesia are leaders of the implementation of this approach [116,118,119],

while many other countries are investigating the possibilities of introducing and investing in beekeeping and api-tourism [115].

In the study in which Turkey's potential api-tourism was assessed with a SWOT analysis, the strengths and weaknesses, opportunities, and threats of api-tourism were determined. In conclusion, the strengths of beekeeping in Turkey are as follows: the fact that it has the third largest number of hives in the world, it is among the 12 most important genetic centres in the world in terms of flora and the application of apitherapy, which is considered one of the methods of traditional and complementary medicine in accommodation facilities, and was approved by the Ministry of Health. Conversely, the weaknesses of beekeeping are as follows: insufficiently developed api-tourism, lack of awareness of api-tourism, and the fact that provinces with the highest number of hives in Turkey are not yet evaluated in the bee route and they are lacking promotion and marketing activities as a bee route [120]. The findings on beekeeping in Bulgaria stated that the infrastructure is very adequate, but producers do not have enough information and a variety of products should be provided at the regional level [121]. Vegetation, tourism, precipitation, temperature, roads, rivers, and production areas of genetically modified crops were considered when assessing the adequacy of beekeeping in Chile. It was reported that the model allows the identification of priority areas for resources and efforts needed for the development of beekeeping [122].

Slovenia is a country with differences in beekeeping. According to FAO from 2017, the country has 86,500 colonies, which shows a growing interest among tourists worldwide [123]. Beekeeping began in 2007 and after being certified by the tourism product Apirouts in 2013, Slovenia has become one of the top countries in this field [116]. The country attracts families and small groups, prioritizing adventure and experiences for those who want to taste beekeeping, natural beauties, and local flavours. Beekeeping establishments, original hives, bees, beekeeping practices, apitherapy, and non-governmental associations and organizations earn revenue by promoting beekeeping in the country [11,117,118,124,125].

Api-tourism began to develop rapidly in Ukraine, in the form of trips to separate apiaries for sleeping on bees on special beds, tasting beekeeping products directly from the hive, and hand-made candles. L. I. Bodnarchuk Museum of Beekeeping is a particularly attractive location for tourists, with more than a thousand copies in several halls and an open-air exhibition (<http://prokopovich.com.ua/nacionalnij-muzej-bdzhilnictva/> (accessed on 12 July 2021)).

7. Conclusions

It is possible to see the traces of bees in almost all civilizations, in food, therapeutic and religious ceremonies, beauty potions, money, and even cloaks. While bee products are an important source of nutrition on our table, they are widely used in cosmetics and apitherapy. Recently, studies assessing the beneficial effects of hive air and other bee products are gaining interest. Apitherapy, a type of complementary medicine, implies the use of various bee products as therapeutic agents to prevent diseases and/or reduce their development, especially in the treatment of Parkinson's disease. Isoprenoids, carotenoids, terpenes, essential oils, phytohormones, volatile wax components, high-value alcohols, and aerosols present in the hive air are important components that were proved to be effective against respiratory tract infections. Furthermore, in individuals using beehive air or therapeutic sleep in a beehive, relaxation, uninterrupted and quality sleep, expansion of lung capacity, and, accordingly, comfortable breathing were determined.

Nowadays, in a world where the demand for natural life and natural products is growing, the interest in api-tourism is also significant. Thus, while countries can tell their beekeeping past, they have the opportunity to present their natural beauties, traditions, and cultural accumulations. It is our duty to transfer the traces of the past to future generations by preserving them in a healthy way. Since it is a commercial activity, economic opportunities should be evaluated as well.

Author Contributions: Important contributions to design and to the preparation of the manuscript: E.T., L.A., G.P., R.M. and M.C.-C. The manuscript was revised by R.M., E.T., I.N. and M.K. Funding acquisition: I.N. English revision and final editing: M.S.D. All authors helped in preparing the paper and approved the final version. All authors have read and agreed to the published version of the manuscript.

Funding: This project was partly funded by the Project from Seed to Spoon—S2S (2019-1-IT02-KA201-06239), Erasmus Plus 2019 KA2—Cooperation for innovation and the exchange of good practices, and KA201—Strategic partnerships for school education.

Institutional Review Board Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: We thank the Fondazione Modena Arti Visive (fmav.org) for providing the trading cards.

Conflicts of Interest: The authors declare no conflict of interest.

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