HARVESTING AND PROCESSING OF PROPOLIS[1]

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Abstract

Propolis is a unique substance created by bees, which collect plant resins and process them using specific enzymes and mixing them with wax. Due to its antibacterial and antifungal properties, propolis is often used as a dietary supplement and in the treatment of certain human diseases. Propolis can be very different, both in terms of its chemical composition and its color, which mostly depend on the plant species from which the resin is collected. Official statistical data on the production of propolis in the world and by country, do not exist, but experts estimate that the world's largest producers of propolis are China and Brazil, followed by Russia, the USA, Spain, Romania, Argentina and Chile. In Serbia, propolis is the third most common bee product that is collected at apiaries, right after honey and wax. Harvested raw propolis is processed into final products, mostly into alcoholic tinctures or into mixtures with other bee products, which are sold at the local market.

Key words: *propolis, production, processing, Serbia*

Introduction

Propolis is a unique substance in nature which is created by bees that collect plant resins and mix them with enzymes and beeswax (Bankova et al., 2019). Honey bees (*Apis mellifera* L.) use this sticky substance to seal cracks in hives, repair irregularities in the internal structure of the hive, and cover frames with honeycomb. In this way, the bee colony is protected from wind, rain, the entry of undesirable organisms into the hive and the effects

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of pathogens (Wilson-Rich et al., 2009). Given that it has scientifically proven antibacterial and antifungal properties, propolis is often used as a dietary supplement and in the medical treatment of humans, mainly in dentistry and oral hygiene (Tambur et al., 2021). Also, propolis represents a very promising source of compounds with antibiotic properties, which can be used in the treatment of diseases, in combination with standard antibiotics (Benhanifia & Soltani, 2022).

Propolis can be very different, both in terms of its chemical composition and its color, which depend on the characteristics of the geographical area where it was created, i.e. most of the plant species from which the resin was collected (Simone-Finstrom & Spivak, 2010). Medicinal properties of propolis depends on its chemical composition, and the most common composition of propolis is as follows: resins (55%), wax (30%), aromatic oils (10%), pollen (5%), minerals and vitamins (Khalil, 2006). According to Okhale et al. (2021), several types of propolis have been identified in the world, of which three types are found in Europe: Birch (area of Russia), Mediterranean (area of Sicily, Greece, Crete and Malta) and Poplar type (Europe).

At the territory of Serbia, two subtypes of propolis have been registered so far, orange and blue, both of which come from the resins of plants of the genus Populus (Dimkić et al., 2016). Given that Serbia has a pronounced diversity of flora and vegetation, with the presence of autochthonous and endemic plant species, it can be expected that propolis from Serbia has a specific and unique chemical composition, with variations in relation to the region where it was harvested.

Production of propolis in the world and in Serbia

Currently, there are no official statistical data on the total production of propolis in the world, nor individually by country, but experts estimate that between 1,800 and 2,400 tons of raw propolis are produced annually in the world (Clarke, 2019). The world's largest producers of this product are China, with about 300 tons, and Brazil, with about 250 tons of raw propolis per year (Crane, 2009). Other countries with large production of propolis are Russia, USA, Spain, Romania, Argentina and Chile (Clarke, 2019). In terms of propolis consumption, countries with a developed market are China, Japan, Australia and New Zealand, which show an increasing demand trend (Miguel and Antunes, 2011). Countries such as New Zealand and Australia, in addition to domestic

production, are also large importers of raw propolis, mainly from China, which is also the main export market for their final propolis products (Clarke, 2019). Although China is the largest producer and consumer of propolis products in the world, there are major issues related to the counterfeiting of propolis products in this market. Namely, in the last decade there were cases of large-scale counterfeiting of this substance in China, which resulted in a drastic decrease in the demand for domestic propolis products on the Chinese market, and thus in a large economic loss for national production (Fung, 2016).

There are no official statistical data on the production of propolis in Serbia, but research by the authors of this paper shows that propolis is the third most common bee product, which is collected by beekeepers in apiaries, right after honey and wax. Propolis from apiaries is sold at the local market, usually in the form of alcoholic tinctures, or as part of mixtures with honey and other bee products. As far as the health safety of propolis products at the Serbian market is concerned, research has been done on the chemical composition of raw propolis from Serbia, which showed that systematic quality control of this product is necessary in order to put a health-safe product on the market (Tošić et al., 2017).

Harvesting of propolis

Propolis production is affected by seasonal conditions, as well as by harvesting methods. The harvesting method usually involves scraping this material from the body and moving parts of the hive, i.e. the frames, when it may contain broken wood particles and other mechanical impurities, or using more modern propolis harvesting techniques, introduced in practice to obtain cleaner raw material and facilitate the collection of larger quantities, by placing plastic grids on upper parts of the beehives (Okhale et al., 2021).

In order for propolis to be sold to a buyer or marketed to consumers, it needs to meet certain purity criteria. For example, in New Zealand, collected propolis handed over to buyers must not contain less than 15% raw propolis (Clarke, 2019). There is no single international standard for the quality of propolis, but there are national standards in individual countries that have requirements for the quality of propolis on the market. In the Republic of Serbia, according to the Rulebook on the quality of honey and other bee products („Službeni glasnik RS", br. 101/15), propolis that is placed at the market must not have more than 5% of mechanical impurities and more than 30% of wax, and must have a minimum of 35% alcohol-extractable substances.

In general, quality propolis should meet the following conditions (Okhale et al., 2021):

a) that it has a low content of mechanical impurities such as dead bees and wood remains,

b) that there is a minimal share or complete absence of contamination with pesticides and heavy metals (the best would be propolis from organic production),

c) that it has a high content of biologically active substances,

d) and that it has a low beeswax content.

Processing of propolis

The processing of propolis can be industrial, as is the case with e.g. New Zealand, where there are a small number of professional processors, who buy raw propolis from local beekeepers, refine it and process it into final products (Clarke, 2019). Hovewer, the processing can be directly on the farm where beekeepers themselves process the propolis collected at their apiaries into final products.

Industrial processing of propolis requires capital investments, knowledge, technology, regular quantities of raw propolis and secure access to larger markets. At developed markets, propolis is mainly sold in the form of capsules, tinctures, lozenges, toothpaste or tinctures, and the same are sold in health food stores, pharmacies, online, at airports, etc. (Clarke, 2019). Raw propolis can be used in human nutrition in different ways, in ground form, as an addition to drinks, as an addition to honey products, or most often in the form of an alcoholic tincture (Bogdanov, 2014).

In countries where processing of propolis is developed, there is investing in the branding of the final product, which gives added value to the final product. Good example is *Kangaroo Island propolis* produced in South Australia, an area rich in endemic flora which causes the unique chemical composition of this propolis (Duke et al., 2017).

Whether it is industrial or farm processing, the collected propolis needs to be purified in order to obtain propolis that can be used safely. The stages of processing raw propolis on the beekeeping farm include compacting the propolis

into larger pieces and keeping it in the freezer for a few hours, because it has a sticky consistency. Then, propolis is turned into a powder and mixed with alcohol, in order to extract flavonoids, remove wax and other impurities. The liquid propolis is then filtered, and the final product is obtained, which can then be packaged in spray bottles or mixed with pollen, honey, royal jelly and/or perga into final products for the market (Authors' research, 2022). Also, cosmetic preparations can be made, which require larger investments and knowledge. Propolis products presented at Serbian market, made at local apiaries, include both cosmetic and food supplement products (Figure 1).

Figure 1. *Propolis products from National Beekeeping Fair, Serbia*

Source: Authors' archive, 2022

With every new product that is put on the market, before larger production, it is necessary to carry out a sensory analysis of the product, in order to see if the product is commercially promising and sustainable (Osés et al., 2015). This rule also applies to propolis products produced at agricultural farms, which should initially be made in smaller quantities for the local market, in order to see if the product is sensorially acceptable to potential consumers, and whether there is any demand for this product at the local market. This is especially important when it comes to e.g. alcoholic tinctures of propolis, because they can have too strong a taste, that can repel consumers.

Also, it is necessary to work on popularizing the use of propolis products in the diet, as shown by some researches. Namely, Adekayanti et al. (2022) showed that the more limited is the consumer's general knowledge about a product, the less interested they will be in purchasing that product. Furthermore, the same authors emphasize that, as the experience of the health benefits of using a given product increases, so does the consumer's interest in purchasing the same product.

Conclusion

Propolis is a product that is gaining more and more importance, and for which there is a growing trend. In Serbia, comprehensive research is needed to describe and standardize propolis, taking into account the specifics of the area where beekeeping takes place, and with the aim of ensuring the quality and health safety of this product at the market.

Also, it is necessary to work on educating and informing the population about the health benefits of using propolis products in the diet. Regarding the production of propolis products at beekeeping farms, before starting a larger production, the beekeeper should conduct a research of the local market, in terms of demand for a given or similar products, and make a quality and sensory-pleasing product.

Industrial processing of propolis requires capital investments, technological knowledge, regular quantities of raw propolis and safe access to larger markets. However, processing of propolis at beekeeping farms does not require large investments, and can be done in addition to other activities at the apiary, which would make beekeeping more profitable activity.

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