Chapter

Introductory Chapter: The Importance of the Physicochemical Characterization of Honey

Emerson Dechechi Chambó
and Vagner de Alencar Arnaut de Toledo

1. Apiculture and Meliponiculture

Beekeeping is an emerging activity on small farms around the world, as well as in regions where diversification of food products is essential for generating income and subsistence for families. Meliponicultural and beekeeping activities, when well managed, are profitable, with low environmental impact and require little input. But in addition to the products of the colony, there are still the benefits of cross-pollination performed by these insects, considered the most important among all animals. In many rural properties, there are inexhaustible sources of food for bees, and the pollination process carried out by them benefits agricultural crops, generating higher yields of fruits and seeds.

Among the products of the colony, honey occupies a prominent place in production, mainly because it is a valuable source of food and much appreciated due to its sweet aroma and flavor. It is estimated that in the world, there are more than 20,000 species of bees [1], but the bee *Apis mellifera* L. is the main producer of honey for human consumption due to its ancient keeping them in the main consuming countries. However, there is a great diversity of other bee species that produce honey of excellent quality and extremely appreciated, such as that produced by meliponine bees. In Brazil, there are more than 250 known species, which present heterogeneity in color, size, shape, nesting habits, and nest population [2].

Meliponine bees produce less honey compared to *A. mellifera* L., but their slightly more acidic taste, greater fluidity, and lower viscosity have attracted the most demanding consumers and are gaining more and more space in the consumer market worldwide and in haute cuisine. This linked to the higher market value of honey from meliponine bees compared to that of *A. mellifera* L. has also aroused interest in keeping them by beekeepers.

2. Honey properties

The floral honey produced by the bees originates from the nectar of the flowers and the extra floral honey from aphide excretion, after collection; they transform it using specific substances, then store, and let it mature in the colony, in pots of honey (stingless bees) or combs (*A. mellifera* L.). This product is a complex blend of nutrients, which include carbohydrates, amino acids, fatty acids, enzymes, and

minerals. These substances vary within a range of minimum and maximum values; some are present in a greater proportion, but the point is that they are influenced by several factors, such as the botanical, geographical origin, and species of bee among others [3]. In addition to being a food product, honey has several benefits for human health and has for many years been used in alternative medicine. Recently, many studies have reported the effectiveness of honey for various medicinal purposes, due to its components and its antibacterial, anti-inflammatory, antioxidant, antiviral, antifungal, and anticancer properties. A particular chapter in this book will address the beneficial properties of honey for human health and factors that can alter the therapeutic properties of honey, such as the physical factors of the environment.

The expanding world honey market has intensified efforts to authenticate and characterize honey, as they play an important role for both consumers and producers. The authenticity of honey is defined internationally by the Codex Alimentarius [4], which establishes the identity and essential quality requirements of honey intended for human consumption. These standards are applied to honey produced by bees and cover all styles of honey presentations, which are processed and ultimately intended for human consumption. Studies for the authentication of honey involve various analysis techniques in order to determine the botanical and geographical origin of honey, as well as of unauthorized substances.

Honey can be called unifloral or multifloral depending on the percentage of specific pollen types present in its composition. The richness and diversity of bee or honey flora, both from wild and cultivated plants, can give rise to a variety of honey with different properties. Many studies seek to identify specific chemical markers for unifloral honey based on the analysis of data on the composition of volatile compounds, phenolic acids, flavonoids, carbohydrates, amino acids, and some other constituents of honey. However, the identification of reliable chemical markers for the discrimination of honey collected from different floral resources is still difficult due to the chemical composition of honey also depending on other factors, such as geographical origin, harvest season, storage method, bee species, and even interactions between chemical compounds and honey enzymes (Kaškonienė; Venskutonis, [5]).

In addition, the results of the honey's chemical constituents may depend on sample preparation and analysis techniques. Traditionally, physicochemical and melissopalynological analyses have been the most used to determine the botanical origin of honey. However, these techniques when performed individually can provide ambiguous results, making it difficult to discriminate between uni- and multifloral honey. Estevinho et al. [6] analyzed 112 samples of unifloral honey from *Lavandula* spp. and reported that the combination of melissopalynological and physicochemical analyses of honey associated with multivariate data processing techniques can be effective for the discrimination of uni- and multifloral honey. In this book there is a literature review that provides an overview and summary of the instrumental and analytical methods available for authenticating honey, from conventional molecular techniques to the most recent ones, being very useful as a guide for choosing the appropriate method for analysis, classification, and honey authentication.

The global concern is to carry out more and more a characterization of regional honey to strengthen local markets, such as this one from a region of Mexico, that presents the advances in the characterization of botanical origin of stingless bees' honey, and the analysis of their physicochemical properties in the Alto Balsas, Michoacan, Mexico, or this which aims at botanical characterization of *Apis mellifera* honey samples from the main beekeeping Mexican regions with melissopalynological studies. This method has been used with more intensity because it allows to know the plants visited by the bees and to identify the pollen grains present

in honey. In addition, some countries do not have standard regulatory norms for honey from stingless bees or even honeybees. Others need to update these standards, so we present in this book more data about that from countries like Uganda where several samples do not fit the country's standards.

It is hoped that this book will help in the discussion on the identification/location of honey, as well as in the creation and/or updating of standard norms at the national and even international level.

Author details

Emerson Dechechi Chambó[1] and Vagner de Alencar Arnaut de Toledo[2*]

1 Universidade Federal do Amazonas, Culture and Nature Institute, Benjamin Constant, State of Amazonas, Brazil

2 Universidade Estadual de Maringá, Animal Science Department, Maringá, State of Paraná, Brazil

*Address all correspondence to: vagner_abelha@yahoo.co.uk

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