DEHYDRATION AND DRYING OF HONEY FOR PHARMACOLOGICAL STABILITY

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Introduction. Honey is a bee's natural product with a rich history of use from ancient medicine, food, and cosmetic industries. In Biblical times, and ancient Egypt honey held various uses and significance:

Culinary purposes. Honey powder is a versatile alternative used in ancient Egypt as an important dietary supplement. Also honey was a sweetener and flavoring agent in food and beverages, adding taste to bread, cakes, and other dishes.

Medicinal applications. Honey was valued for its medicinal properties and used to treat chronic diseases, wounds, soothe sore throats, and alleviate various ailments.

Cultural, ritual and offerings. Honey played a role in religious practices, being offered as a gift to gods and used in ceremonies and rituals.

Embalming. In ancient Egypt, honey was sometimes used in the embalming process for mummification body preservative.

Throughout history, honey has held medical, cultural, culinary, and symbolic significance in various civilizations and continues to be cherished for its natural sweetness and medicinal properties. Its therapeutic properties have been attributed largely to its biochemical composition, which includes sugars, bioactives, enzymes, amino acids, vitamins, and a plethora of phenolic compounds. The object of the study is the production of natural powdered dried honey. Honey in powder form has a high commercial potential. The great advantages of using dry honey, is ease of processing and dosing, usage in a large gamma of medications.

However, honey's natural composition also makes it susceptible to fermentation and spoilage if moisture levels are too high. Therefore, appropriate dehydration and drying techniques are essential for pharmacy and other industries preserving honey's quality, extending its shelf life, and maintaining its diverse beneficial properties.

Honey is characterized by organoleptic and physico-chemical parameters affecting the drying process and the quality of the final product. Consequently, reducing the water content during the drying process significantly contributes to increasing the stability of honey during storage. The resulting powdered dry honey, in compliance with the drying retaining all its useful biological properties and most of active compounds.

The aim of the study. The conversion of honey into powder form has emerged as an innovative preservation technique, enabling increased shelf life and the potential for diverse applications. The limited use of honey in the pharmacy industry is due to its physicochemical properties. Viscosities, stickiness, crystallization, create problems during its dosing, mixing, storage and transportation.

When honeys are just produced by bees - are all liquid. However, most of honeys have the vocation to change the density and to crystallize. This change of natural state will take place in different period of time depending on their composition and their environment, with main factor temperature. This paper's comprehensive overview offers insight into the importance of dehydration technology in honey production, emphasizing the need for careful selection and implementation of drying methods to maintain the high standards expected by consumers.

Materials and methods. Liquid honey was used in this study supplied from local apiary, some types of honey, acacia honey, tilia honey, flower honey etc. Liquid honey was analyzed for moisture content by the refractive method. The measurement was done by lab methodology. Equipment, lab dryers and dehydrators, measurement tools etc.

More treatments approach were carried out and the honey powder were obtained by using some methods. The temperature parameters for the spray drying method were lowered: inlet temperature of +40-50C, outlet temperature of +28~30C.

Honey powder was analyzed for moisture content by moisture meter. The hygroscopic rate was measured by determining of weight change of honey powder by time storage in a special condition.

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Results and their discussion. Various dehydration technologies and methods can be employed for honey. Each method differs in how it removes moisture, temperature control, airflow, rotation, and the equipment required.

Air drying. Air drying involves exposing honey to circulating air at ambient temperature. This, however, is a slow process and might not be efficient in humid environments.

Experiments have been conducted for honey dehydration by using drying air at ambient temperature, 35 and 40 °C. The honey was heated below maximum permissible temperature to maintain its quality. The dehydration and drying rate of honey has been found to be strong depending on air flow speed and temperature, also of the surface area with thickness of honey substrate fig. 1. For dehydration stage of honey the streams help in increasing the exposed surface area of honey in contact with drying air, thus resulting in faster dehydration of honey.

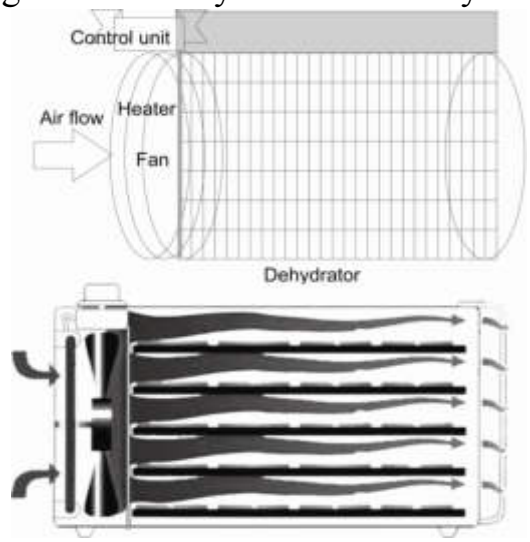

Fig. 1. Diagram of a small scale honey dehydrator with control unit of air flow speed and temperature.

The advantages, easy installation are and not hight-cost.

Disadvantages: Inefficient in high humidity; slow evaporation can lead to fermentation. In a laboratory and a pilot scale the efficiency of such solution are not the best.

Solar drying. This is an experimental technique uses solar energy to dehydrate honey. Solar dryers collect sunlight and convert it into heat, which evaporates the moisture.

Advantages: Environmentally friendly and energy-efficient.

Disadvantages: Weather-dependent and requires rigorous monitoring to prevent overheating. Difficult to treating on production line of honey.

Temperature air controlled drying. In warm air drying, honey is placed in an air dryer, where heated air circulates. This method can provide more controlled and rapid dehydration.

Advantages. Adjustable parameters for drying speed and quality.

Disadvantages: High energy consumption and potential for thermal degradation of nutrients in case of increasing of temperature.

Variations of drying T from 20 to 40 °C whereas air relative humidity ranged from 20 to 70%. Additionally air dehumidifying system, include an evaporator, a compressor and a condenser, process in an open airflow circulation.

Freeze drying (Lyophilization). It requests an additional preparation in dependence of type of honey. Freeze drying involves freezing honey and then lowering the pressure to allow the frozen water in the honey to sublimate directly from a solid to a vapor.

Advantages: Preserves flavor, aroma, and nutritional components.

Disadvantages: High cost and complexity of equipment, limitations of production.

Vacuum Drying. Vacuum drying is performed in a chamber where the pressure is reduced, allowing moisture to evaporate at lower temperatures. A vacuum honey dryer is used to dehydrate remove moisture from honey at sub-atmospheric pressure. This highly efficient and innovative vacuum drying process guarantees honey drying rates exceeding 1% per hour. The dryer allows for quick and gentle drying of honey at temperatures up to 39°C without increasing hydroxymethylfurfural (HMF) levels. Any heat source for example, hot water, steam can be used to supply thermal energy to the dryer's jacket.

Advantages. Preserves honey’s organic compounds and reduces thermal degradation.

Disadvantages. Requires specialized equipment and can be cost-prohibitive, limitations of production.

Spray drying is the most commonly used dehydration technique in the food industry. Spray-dried honey powder has good commercial potential in a large gamma of industries.

Advantages. Adjustable parameters for quick drying speed.

Disadvantages: High temperature and energy consumption and potential for thermal degradation of nutrients.

When selecting a drying and dehydration method for honey, several factors must be considered to ensure high-quality final products:

Temperature control. High temperatures can destroy beneficial bioactives, enzymes and vitamins, affecting honey’s quality.

Moisture measurement. Regularly measuring moisture content is critical to avoid bio fermentation.

Airflow. Proper airflow must be maintained to facilitate even drying and distribution of moisture.

Impacts on honey quality. The method of dehydration can significantly affect the quality of honey:

Flavor and aroma. Certain methods like freeze drying help retain the natural flavors and aromas of honey better than high-temperature drying.

Nutritional profile. Low-temperature and gentle drying methods maintain most of honey's bioactives, vitamins and amino.

Color. Some drying methods may cause honey oxidation to darken, impacting its quality, marketability and consumer preferences.

Conclusion. As the demand for honey continues to grow, advancements in dehydration technology will play a significant role in ensuring product quality and sustainability in pharmacy, cosmetics and food industries. The technology behind the dehydration and drying of honey is essential for the preservation and enhancement of this valuable natural bioactive product. Selecting the appropriate method is significant for maintaining honey's nutritional, bioactives, and functional qualities. Future research should focus on developing energy-efficient and cost-effective methods that minimize nutrient loss, processing time. Dehydration and drying are important processes in food preservation etc. For honey, these processes serve to:

Inhibit Fermentation. Lowering the moisture content prevents fermentation, which can lead to spoilage during the time.

Enhance Shelf Life. Well-dried honey can remain bioactive stable for extended periods.

Improve Flavor and Texture. Controlled drying can enhance the flavor profile and alter the texture of honey, making it suitable for various production uses.

Facilitate Transportation. Dehydrated honey weights less and is easier to save and transport.

Powdered honey is in demand in the food, pharmaceutical and cosmetic industries, due to increased dosing accuracy due to the flowability of dried honey. However, it should be borne in mind that dried honey is very hygroscopic due to the presence of sugars and the amorphous state after drying. Powdered honey is best stored in a dark airtight container.

On the basis of literature review, it can be concluded that bee honey is a biologically bioactive product, the advantage of which is not only high energy value (on average it is about 300–340 kcal per 100 g), but also it obtains a large number of valuable minerals, enzymes, vitamins, organic acids, aromatic and antimicrobial substances causing its healing properties. One of the advantages of this product is the fact of its 100 % absorption by the body, unlike most other sweet foods. Ripe honey contains not more than 21 % water, about 35 % glucose, 40 % fructose, 1.3 % sucrose, 0.45 % protein, 0.1 % organic acids and 0.2 % minerals. Dehydrated and dried honey becomes a concentrate source of bioactive substances with flavonoids and polyphenols, which act as antioxidants.

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