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Experimental and Modelling Performances of a Sustainable Integrated System of Conditioning for Bee-Pollen

Authors : Andrés Durán, Brian Castellanos, Marta Quicazán, Carlos Zuluaga-Domínguez

Abstract : Bee-pollen is an apicultural-derived food product, with a growing appreciation among consumers given the remarkable nutritional and functional composition, in particular, protein (24%), dietary fiber (15%), phenols (15 – 20 GAE/g) and carotenoids (600 – 900 µg/g). These properties are given by the geographical and climatic characteristics of the region where it is collected. There are several countries recognized by their pollen production, e.g. China, United States, Japan, Spain, among others. Beekeepers use traps in the entrance of the hive where bee-pollen is collected. After the removal of foreign particles and drying, this product is ready to be marketed. However, in countries located along the equator, the absence of seasons and a constant tropical climate throughout the year favors a more rapid spoilage condition for foods with elevated water activity. The climatic conditions also trigger the proliferation of microorganisms and insects. This, added to the factor that beekeepers usually do not have adequate processing systems for bee-pollen, leads to deficiencies in the quality and safety of the product. In contrast, the Andean region of South America, lying on equator, typically has a high production of bee-pollen of up to 36 kg/year/hive, being four times higher than in countries with marked seasons. This region is also located in altitudes superior to 2500 meters above sea level, having extremes sun ultraviolet radiation all year long. As a mechanism of defense of radiation, plants produce more secondary metabolites acting as antioxidant agents, hence, plant products such as bee-pollen contain remarkable more phenolics and carotenoids than collected in other places. Considering this, the improvement of bee-pollen processing facilities by technical modifications and the implementation of an integrated cleaning and drying system for the product in an apiary in the area was proposed. The beehives were modified through the installation of alternative bee-pollen traps to avoid sources of contamination. The processing facility was modified according to considerations of Good Manufacturing Practices, implementing the combined use of a cabin dryer with temperature control and forced airflow and a greenhouse-type solar drying system. Additionally, for the separation of impurities, a cyclone type system was implemented, complementary to a screening equipment. With these modifications, a decrease in the content of impurities and the microbiological load of bee-pollen was seen from the first stages, principally with a reduction of the presence of molds and yeasts and in the number of foreign animal origin impurities. The use of the greenhouse solar dryer integrated to the cabin dryer allowed the processing of larger quantities of product with shorter waiting times in storage, reaching a moisture content of about 6% and a water activity lower than 0.6, being appropriate for the conservation of bee-pollen. Additionally, the contents of functional or nutritional compounds were not affected, even observing an increase of up to 25% in phenols content and a non-significant decrease in carotenoids content and antioxidant activity.

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