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Short communication

MORE INSIGHT INTO ORGANIC BEE HONEY PROCESSING, STORAGE AND SHELF LIFE

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Summary

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Bee honey produced in organic apiculture conditions should be natural, without contaminations and with the product-specific quality traits. Available sources specifying the requirements for organically produced honey lack some specific details related to the processing, storage and sales of the product. Factors, influencing the quality of organic bee honey are described. More specific requirements to the processing and storage conditions, and shelf life of this unique food product are proposed with regard to preservation of its natural physical, chemical, organoleptic and antibacterial quality traits.

Key words: bee honey, organic produce, processing, storage

Organically produced bee honey should be of high quality with respect to physico-chemical and biological parameters, free of contaminants (Bogdanov, 1997; 2006; Zhelyazkova, 2011), and to possess traits, both type-specific and close to natural quality indices (Bogdanov *et al*., 1997).

The requirements to organically produced bee honey (Anonymous, 1999*;* 2001a; 2008a; 2008b), do not contain any specific norms related to the processing, storage and expiry terms of the product for preserving its unique traits. The European legislation (Anonymous, 1999), specifies only partially some requirements in Art. 7: Husbandry Management Practices and Identification (para. 5). According to this document, particular care shall be taken to ensure adequate extraction, processing and storage of beekeeping products, record-keeping of all measures taken to comply with these requirements as well as entering records about the removals of the supers and the honey extraction operations in the register of the apiary.

US certification documents (Anonymous, 2008b), provide more details about the organic honey production plan and the management of the apiary. The plan includes a description of practices and procedures to be performed and maintained, including the frequency with which they will be performed; a list of each substance to be used as a production or handling input, indicating its composition, source, location(s) where it will be used, and documentation of commercial availability,

as applicable; description of the monitoring practices and procedures to be performed and maintained, including the frequency with which they will be performed, to verify that the plan is effectively implemented; description of the recordkeeping system implemented (to comply with the requirements established in § 205.103); description of the management practices and physical barriers established to prevent commingling of organic and nonorganic products on a split operation and to prevent contact of organic production and handling operations and products with prohibited substances; and any additional information deemed necessary by the certifying agent to evaluate compliance with the regulations.

The provisions of New Zealand (Anonymous, 2001a) and Canada (Anonymous, 2008a) legislations are also incomplete with regard to the elucidation of issues.

Bulgarian requirements for organic production of animal foodstuffs (Anonymous, 2006), are neither specific about the processing, storage and determination of the "*best before...*" shelf life of organic bee honey.

Therefore, despite the numerous normative requirements and standards, some of them are not specific enough with regard to organic honey processing, terms and conditions of storage, and shelf life.

The aim of the present work is to sum up the factors influencing the physicochemical composition and organoleptic and antibacterial properties of organic bee honey on the basis of available literature data and our professional experience, and to suggest some definite requirements to its processing, storage and shelf life.

Organic bee honey producers should adhere to best beekeeping practices for optimal quality of organic honey produce (Bogdanov, 2010) by using only allowed alternative drugs, no antibiotics or chemicals for control of wax moths or chemical repellents; sugar withdrawal at least a month before harvesting of honey, not using excessive smoking, not harvesting honey from brood combs, harvesting honey only when the major part of the comb contains capped honey. The water content of honey should be as little as possible: <20% and if possible, <18%; the centrifugation area should be clean, the water used should be fresh and clean; all equipment in contact with honey should be clean, the pore size of honey filters should be < 0.2 mm.

According to the different normative documents, organic honey varieties are described as: comb honey (honey, sold in the original wax comb it was produced into) or honey, produced after centrifugation of combs in several forms as defined by the United States Department of Agriculture Standards for Grades (liquid, crystallized, or partially crystallised) (Anonymous, 2008b). Other specified honey types are: the commercially unprocessed – minimally processed honey, often labelled as unprocessed honey); filtered honey (honey filtered to remove particles of wax, propolis etc. without removing the pollen) (Anonymous, 2001b). Regardless of the retail market brand, the organic honey should preserve its natural quality traits.

The storage conditions, the exposure to other environmental factors or the additional heat processing influence the quality of bee honey (Anonymous, 2001b).

In general, consumers do not prefer crystallised honey. Crystallisation inevitably influences the sales of the product. That is why, producers often liquefy the crystallised honey through several physical methods: heating at high temperatures in a water bath or through other

heating techniques, as ultrasound waves, microwaves, infrared ovens. On the other side, it is well known that the continuous storage at temperatures >50 ^{o}C results in reduction of honey flavour compounds. Increased temperatures worsen honey quality due to the increased content of hydroxymethylfurfural (HMF) and the reduced enzyme activity (White, 1975). Such temperatures are often used by beekeepers and enterprises for liquefying crystallised honey (Wooton et al., 1978). That is why the Canadian Organic Honey Standards (Anonymous, 2008a), require that the heating of honey for extraction shall not exceed 35°C, and the decrystallisation temperature shall not exceed 47°C.

It is acknowledged that enzyme activity, antimicrobial properties, the colour and chemical compounds of bee honey are altered after heating and storage (White, 1992). Invertase is among the most heat-sensitive enzymes of honey. Its destruction begins at temperatures over the optimal values of 25 °C (Ivanov, 1978). Such conditions are frequently encountered in some countries during honey harvesting in summer. A research conducted in honeys of different botanical origin, heated over 24 hours, established lowest losses of invertase activity at 35°C compared to those at 45, 55, 65 and 75°C (Karabournioti & Zervalaki, 2001). Our research (Dinkov, 2010) on the effect of different processing temperatures (37°C and 42°C) in four types Bulgarian bee honey showed a statistically significant reduction ($P<0.01$) of invertase activity at 42 ºC vs 37 ºC.

It was found out that at 20°C the half-life (i.e. time for 50% reduction) of diastase activity was 4 years, whereas that of invertase activity – 2 years and that the time needed for formation of 40 mg/kg HMF in honey was 2–4 years (White, 1975; Bogdanov, 2009). These time intervals should be considered when establishing the shelf life of honey as "*best before...*"

Bee honey could be preserved for a longer period of time provided that it is stored under optimal conditions. The product is very hygroscopic and should be therefore stored in airproof containers and packages for prevention of negative effects of odours and humidity. The optimal temperature is 10–16°C, and the ambient relative humidity should be lower than 65% (Bogdanov, 2010).

The processing mode and the storage conditions influence also the antibacterial properties of honey. Two antibacterial substances are known to exist in honey, the so-called inhibins. Some of them (peroxidase activity) are due to accumulation of hydrogen peroxide obtained from glucose degradation by glucose oxidase (White *et al*., 1963). Hydrogen peroxide is believed to be the main antibacterial agent in bee honey (White *et al*., 1963; Dustmann, 1979; Brudzynski, 2006). It should be remembered that the peroxidase activity of honey is lost during heating, under the effect of light and during storage (Bogdanov, 1997).

Aromatic acids are other antibacterial substances of honey, with a different chemical origin (Russell *et al*., 1988). The aroma compounds in honey are at very low concentrations and are a complex mix of volatile components with various functions and relatively low molecular weight (Cuevas-Glory *et al*., 2007). Thus, the additional heating and mechanical decrystallisation of stored organic honey results inevitably in reduction of its odourous compounds. This is supported by the studies of Castro-Vázquez *et al*. (2008). The authors investigated a freshly har-

vested citrus honey stored at 10, 20 and 40 °C over 12 months. It was found out that significant losses occurred in the content of volatile components (especially terpenes and terpene derivatives), monosaccharides and disaccharides. The storage of honey at 10 or 20°C has preserved its floral, fresh, citrus and fresh fruit aroma together with decreased intensity of these features.

In conclusion, the presented information about the circumstances influencing the quality of organically produced honey, allowed us to recommend more specific conditions of processing, storage and realisation of this unique foodstuff in order to preserve its natural organoleptic, physical, chemical and antibacterial features:

- During processing, heating >37 °C should be prohibited, and the second processing after harvesting should be done via heating <37 °C;
- Storage conditions should be at temperatures <20 °C (the optimum temperature is 10–16°C) and relative humidity < 65%;
- Shelf life (*best before…*) should not exceed: 2 years after packaging (for unheated, industrially unprocessed and filtered organic honey) and 1 year after packaging (for industrially unprocessed and filtered organic honey heated only at temperatures <37°C).

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