Honey Technology

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Cristallisation

The honey crystallization is a natural process. This depends on the following factors:

Sugar content

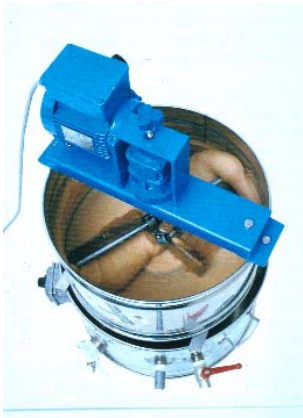
The higher the glucose content, the faster the crystallization. Honeys with more than 28% glucose crystallize fast. Honeysdew honeys with more than 10% melezitose crystallize to so-called cement honey.

Temperature

The optimal temperature for honey crystallization lies between 10 and 18° C constant temperature of 14° C is regarded as optimal. At low temperatures crystallization is slowed down. In the deep-freezer honey remains liquid for longer time. Very fast crystallizing honeys like rape honey crystallize in a fine-crystalline texture. At higher temperatures (more than 25° C) the crystallization is slowed down. At these temperatures the honey crystallizes with a rough crystalline texture.

Water content

Honeys with a water content between 15 and 18 % crystallize optimally. Honeys with more and less and water crystallize more slowly. Best spreadability have crystalized honeys with water content between 17 and 18%. Honeys with lower water content have harder crystallization texture, those with more than 18% to remain softer.



Guided crystallization

The guided crystallization is applied with fast crystallizing blossom honeys in order to avoid the building of frost and coarse crystallisation. There are two procedures: mechanical cutting of the crystals up by agitating the honey Inoculate the honey with 5 to 10% finely crystalline starter honey and following agitating. Agitating can pass agitating devices with motor drive, e.g. stronger hand drills by hand with a triangular staff, with larger quantities is better suitable (with more than 800 W) with special agitating staffs: (Illustration)

Crystallization defects

Formation of frosting

In some honeys with low humidity frosting arises on the surface of the honeys. These are cavities, which are formed by air during the crystallization. Frosting is a natural process, which does not impair the honey quality. It can be prevented by applying of vacuum to the honey before filling and following the guided crystallization. With guided granulation and storage at constant temperature around 14° C one frosting can be avoided.

Rough granulation

This occurs particularly in slowly crystallizing honeys and also after the liquefaction of honey, which decreases honey granulations speed. This can be prevented with guided crystallization.

Building of two phases

This defect arises when honeys with high water content granulate (with more than 18 % water.

Liquefaction and softening of granulated honey

Heating is the most widely used method. According to the Codex Alimentarius and other honey regulations it is forbidden to heat honey as to impair significantly its quality. Therefore, honey should be liquefied in such a way as to avoid heat damages. The liquefaction time depends on the glucose concentration and on the crystal form: the higher the glucose content and the larger the crystals, the longer the liquefaction time. Heating at higher temperatures of for a longer period of time will cause honey damage, decrease of aroma and in extreme cases building of a caramel like taste. Overheating is determined most easily by the measurement of hydroxymethyl furfural and honey enzyme activity (see table below). Honey should be heated with care to prevent overheating.

1. Heating at lower temperatures

It is often prescribed not to heat honey at temperatures higher than 40^{o} C in order to prevent overheating. However, higher temperatures are needed for a complete dissolution of all crystals. Granulated honey is a very poor heat conductor and thus should be stirred to decrease granulation time. Heating for 1-2 days at 40-50^{o} will not damage honey. There are different means of honey heating.

Heating by water bath

From point of view of optimal heat transfer this type of heating is the best one. A 25 kg honey recepient is heated in a water bath up to 40^{o} for 43 hours, while 72 hours are necessary for heating by air [3, 4] Due to practical reasons, heating in water baths is used in recipients of up to 25 kg size. There are only few commercially available heating water bath systems.

Heating by air

Heating by air is widely used. Compared to a water bath, air heating needs a longer period of time. When heating greater amounts of honey, air circulation should be used to prevent overheating. For liquefaction of a granulated blossom honey with 17.5 % water, following relation between vessel size, temperature and liquefaction time was found [9]:

Recipient capacity	**40 ^{o} C**	**45^{o} C**	**50^{o} C**
20 kg	24 hours	18 hours	16 hours
50 kg	48 hours	36 hours	24 hours
80 kg	108 hours	72 hours	60 hours
300 kg	-	108 hours	72 hours

Other methods of heating

Honey can be liquefied by placing the vessels on **electric plates**. This type of heating is widely used by small beekeepers and it is practical for up to 25 kg recipients. However, in order to prevent overheating, there should be an air layer of 5-6 cm between the plate and the vessel. According to the producers, heating to 45 ^{o} of a 25 kg vessel will liquify the honey within 24 to 48 hours.

Immersion heaters can be placed on the granulated honey, which progressively sink upon honey melting.

"Melitherm" heaters, developed by Spürgin [13] are used for honey liquefying in some European countries. This liquefaction method is particularly gentle and does not cause any honey damage [2], but the honey crystals are not completely liquefied.

2. Heating at higher temperatures: pasteurisation

In some countries, honey is heated to destroy honey crystals and yeasts through pasteurisation. Commercial pasteurisation practice is flash-heating for a few seconds at 70-78 ^{0} C and then rapidly cooling for minimisation of heat damage. The commercial practice is described in detail [16]. After pasteurisation, diastase activity and HMF content remain almost unchanged, while invertase is damaged [6, 15].

Pressure filtering, for a clarification of honey, is carried out mostly in North America, after honey pasteurisation. The resulting honey is very clear and remains liquid for a longer period of time. Liquefied, pasteurised honey will crystallise slowly to build coarse crystals. The drawback of this procedure is that it filters off pollen, making it impossible to control claims of specific declaration of botanical and geographical origin.

Wave application

There are different kind of waves, which can be used for honey liquefaction:

- Ultrasonic waves [8, 10, 11]
- Microwave oven [1, 5, 7, 12, 14, 17]
- Infrared oven [7, 14]

Microwave and infrared ovens are well distributed commercially and are suitable for use. Honey can be liquefied very quickly, due to its specific composition[12]. Microwaves with frequency between 915 MHz and 2450 MHz are widely used in for food heating and can be used for honey liquefaction. However, the research results cited above show than both types of ovens cause HMF increase and enzyme activity decrease, the effects depending on the time and the energy amount applied, and also on the type of honey [1]. Thus, special microwave ovens for liquefaction of honey, taking into account the above mentioned factors should be constructed in order to avoid honey damage.

Dehumidification

Honey with too high water content should be dehumidified before harvest, i.e. in the combs, by placing the hives in warm rooms and using dehumidifiers. This can be done easily by beekeepers and this procedure should not influence significantly honey quality.

However, if too humid honey is already harvested it can be dehumidified also in the honey plant. This, however, leads to loss of honey volatiles and aroma. Thus, such dehumidification is also not allowed according to the Codex Alimentarius and other honey standards, as it states than “no honey constituents may be removed from honey except where it is unavoidable in the removal of foreign inorganic or organic matter”.

References

1. BATH, P K; SINGH, N (2001) Effect of microwave heating on hydroxymethylfurfural formation and browning in Helianthus annuus and Eucalyptus lanceolatus honey. *Journal of Food Science and Technology Mysore* 38 (4): 366-368.

2. BOGDANOV, S (1994) Verflüssigung von Honig mit dem Melitherm-Gerät und dem Abdeckelungswachsgerät. *Schweizerische Bienen-Zeitung* 117 (8): 458-460.

3. BÜDEL, A; GRZIWA, J (1959) Die Erwärmung des Honigs im Heizschrank. *Deutsche Bienenwirtschaft* 10 (2): 30-35.

4. BÜDEL, A; GRZIWA, J (1959) Die Rolle des Wärmeübergangs bei Erwärmung des Honigs. *Sonderdruck Z.Bienenforsch.* 4 (7): 149-150.

5. DEVROYE, H (1990) Comparative study of the degradation of honey during liquefaction by treatment in a hot room and by microwaves. *Abeille de France* (753): 418-420.

6. GONNET, M (1975) La pasteurisation du miel. *Bulletin Téchnique Apicole* 3: 27-32.

7. HEBBAR, H U; NANDINI, K E; LAKSHMI, M C; SUBRAMANIAN, R (2003) Microwave and infrared heat processing of honey and its quality. *Food Science and Technology Research* 9 (1): 49-53.

8. IVANOV, T; IVANOVA, T (1995) Effect of ultrasonic, microwave and x-ray treatments of honey on its quality, Apimondia congress No 34, Lausanne: pp 385-388.

9. JÉANNE, F (1985) La refonte du miel. *Bulletin Téchnique Apicole* 12 (1): 33-40.

10. KALOYEREAS, S A; OERTEL, E (1958) Crystallization of honey as affected by ultrasonic waves, freezing, and inhibitors. *American Bee Journal* 98 (11): 442-443.

11. LIEBL, D E (1978) Ultrasound and granulation in honey. *American Bee Journal* 118 (2): 107.

12. NATIONAL, H B (1998) Honey and microwaveable foods. Honey: A natural microwave reactive ingredient for baked goods formulation. *Honey Information Kit for the Food and Beverage Industries*

13. SPÜRGIN, K N (1978) Method for processing honey and apparatus for carrying out the method. Verfahren zum Behandeln von Bienenhonig und Gerät zur Durchführung dieses Verfahrens, 13pp. *German Federal Republic Offenlegungsschrift (Patent Application)* (27 02 132)

14. SUBRAMANIAN, R; HEBBAR, H U; RASTOGI, N K (2007) Processing of honey: A review. *INTERNATIONAL JOURNAL OF FOOD PROPERTIES* 10 (1): 127-143.

15. TABOURET, T; MATHLOUTHI, M (1972) Essai de pasteurisation de miel. *Rev.franc.Apic.* 299: 258-261.

16. TOWNSEND, G F (1975) Processing and storing liquid honey*, In* Crane, E (ed.), Heinemann, London: pp 269-292.

17. VALBUENA, A O; SILVA, M C (1995) Liquefazione del miele con microonde. *Rivista di Apicoltura* (No. 3): 24-26.

18. WHITE, J W (1975) Composition of honey., *In* Crane, E (ed.) *Honey. A Comprehensive survey,* Heinemann Edition; London; pp 157-206.