Honey Mixing Tools made by beba
Mischtechnik

beba
Mischtechnik GmbH
Bartmannsholte 21
49632 Essen Oldenburg
Telefon:+49 5434 9246-0
Telefax: +49 5434 9246-29
E-mail: Info@beba-Mischtechnik.de
www.beba-Mischtechnik.de
It should be the goal of every beekeeper to be able to offer a fine-crystalline, easy to spread honey. Freshly centrifuged honey that is filled into glasses without being stirred crystallizes to large, sugar-like crystals. Careful and gentle stirring causes the growing sugar crystals which form especially on the walls of the honey container to be broken apart and distributed throughout the honey. This is the way that further, new crystal centers form and the honey crystallizes into the fine crystalline, easy to spread consistency which make it so popular with consumers.

The art of making honey
To promote the development of a fine-crystalline honey, it must be stirred as soon as crystallization sets in. It is important here that all areas, especially the walls of the honey container are reached. Five minutes of slow and careful stirring every day are sufficient. It is not a simple task to find the right moment to begin stirring. When honey begins to crystallize, it takes on a mother-of-pearl shimmer during the stirring process. Streaks become visible, indicating that the honey now contains very fine crystals. And now is the time when making honey becomes an art.

Spring honey as well as honey made from rape, clover or fruit blossoms contain more glucose than fructose which causes them to crystallize to a relatively solid state faster. In this case, daily stirring must begin only a few days after centrifuging. Honey dew honeys typically contain more fructose and less glucose. They seldom crystallize or only very slowly. Here, stirring can be itiated somewhat later although even now the proper moment should not be missed.

Air should not be drawn into the honey!
When stirring, drawing too much air into the honey must be avoided. Mixing tools that run too fast, mixing the honey too much and especially too fast damage more than they help. Honey that has been mixed too strongly becomes foamy and suffers in quality as a result.

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* The results of these tests were published in:
DBJ 1 pp 48-50
Mixing tools should convey the material to be mixed centrally to the top and then over a wide surface to the bottom along the edges of the container. Rotating speed should not exceed 300 rpm and mixing time should not last longer than 5 minutes a day. At room temperature honey crystallizes quickly, at higher temperatures it often remains liquid. At lower values the crystallization process is clearly delayed.

**Climatic conditions influence crystallization and storage**

Climatic conditions are also important when storing honey. The ideal storage temperature ranges from 14 – 16 °C. Honey is hygroscopic which means that it attracts water. Relative humidity in a honey storage area should therefore not exceed 40 – 60 %. If this value is exceeded, the honey attracts water from the surroundings, its water content increases beyond the permissible 20 % and it begins to ferment. Air bubbles form, especially on the surface. The honey develops a sour odor and is not longer fit for human consumption.

<table>
<thead>
<tr>
<th>Honey Ordinance</th>
<th>DIB regulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water content</td>
<td></td>
</tr>
<tr>
<td>a. in general</td>
<td>max. 21 %</td>
</tr>
<tr>
<td>b. clover honey</td>
<td>max. 23 %</td>
</tr>
<tr>
<td>c. heather honey</td>
<td>max. 23 %</td>
</tr>
<tr>
<td>Invertase</td>
<td>Required only for honeys marked as &quot;especially enzyme-rich&quot;</td>
</tr>
<tr>
<td>(= saccharase)</td>
<td></td>
</tr>
<tr>
<td>Diastase</td>
<td>Minimum activity 8 E (according to Schade) or 3 E for honeys naturally low in enzymes</td>
</tr>
<tr>
<td>(= amylase)</td>
<td></td>
</tr>
<tr>
<td>Hydroxymethylfurfural (HMF)</td>
<td>Max. 40 mg/kg or max. 15 mg/kg for honeys naturally low in enzymes</td>
</tr>
</tbody>
</table>

**III. 1:** A comparison of the requirements set by the (German) Honey Ordinance (German food and Druc Act) and the German Beekeepers Ass. (DIB).

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Warming crystallized honey
The crystallization process must be carefully observed by the beekeeper. Just before the honey becomes solid it should be filled into smaller containers. In this case, no warming is necessary and the honey is absolutely natural.

Honeys that have crystallized in larger containers and are to be liquified for filling into smaller containers must be warmed very gently. Honey warming cabinets which are available in trade stores are suitable for this purpose. They guarantee that the honey will not be warmed over 40 °C. But it is quite sufficient if honey is warmed to about 28 – 30 °C (temperature is measured at the core of the container) since at this temperature it has “thawed” enough to flow easily and can be filled into smaller containers. Any further increase in temperature or lengthening of the warming process has a negative effect on its naturalness and therefore on the quality of the honey – a natural product.

Blending honeys
Honeys that have been heated in this manner can be easily mixed (blended) if the beekeeper so desires. Blending is permitted, even essential if the beekeeper is to be able to guarantee his customers a quality uniform in taste.

Seeding honey
A special case of blending is called seeding. Here, a small amount of crystallized honey is added to the still liquid honey (max. 10 %) and mixed in. The crystals from the crystallized honey give additional crystallization centers to the freshly centrifuged, still liquid honey which accelerates the crystallization process.

<table>
<thead>
<tr>
<th>Enzymes</th>
<th>Vitamines</th>
<th>Minerals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose-oxidase</td>
<td>Nicotinic acid PP factor</td>
<td>Magnesium</td>
</tr>
<tr>
<td>Phosphatase</td>
<td>Pantothenic acid</td>
<td>Silic acid</td>
</tr>
<tr>
<td>Invertase</td>
<td>Ascorbic acid = vitamin C</td>
<td>Phosphorus</td>
</tr>
<tr>
<td>Diatase</td>
<td>thiamin vit. B1</td>
<td>Sulphur</td>
</tr>
<tr>
<td>Catalase</td>
<td>riboflavin vit. B2</td>
<td>Manganese</td>
</tr>
<tr>
<td></td>
<td>pyridoxin vit. B6</td>
<td>Silicon</td>
</tr>
<tr>
<td></td>
<td>folic acid</td>
<td>Potassium</td>
</tr>
<tr>
<td></td>
<td>biotin H</td>
<td>Sodium</td>
</tr>
</tbody>
</table>

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### Acids

<table>
<thead>
<tr>
<th>Acids</th>
<th>Inert ingredients 3.21 %</th>
<th>Amino acids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pyroglutamic acid</td>
<td>Multiple sugars 10.12 %</td>
<td>Leucine / soleucine</td>
</tr>
<tr>
<td>Phosporic acid</td>
<td>Grape sugar (glucose) 31.28 %</td>
<td>Aspartic acid</td>
</tr>
<tr>
<td>Citric acid</td>
<td>Grape sugar</td>
<td>Glutamic acid</td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td>Fruit sugar (fructose) 38.19 %</td>
<td>Phenylalanine</td>
</tr>
<tr>
<td>Acetic acid</td>
<td>Fruit sugar</td>
<td>Threonine</td>
</tr>
<tr>
<td>Malic acid</td>
<td>Fruit sugar</td>
<td>Alanine</td>
</tr>
<tr>
<td>Lactic acid</td>
<td>(fructose) 38.19 %</td>
<td>Arginine</td>
</tr>
<tr>
<td>Butyric acid</td>
<td>Water 17.2 %</td>
<td>Histidine</td>
</tr>
<tr>
<td>Succinic acid</td>
<td></td>
<td>Glycine</td>
</tr>
<tr>
<td>Gluconic acid</td>
<td></td>
<td>Lysine</td>
</tr>
<tr>
<td>Formic acid</td>
<td></td>
<td>Serine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Valine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cysteine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Proline</td>
</tr>
</tbody>
</table>

### Hormones

- Acetylcholine
- Growth substances
- Osmotic powers
- Arbutine
- Hydrogen peroxide
- Penicillin B
- Further bactericides
- partially sensitive
- Partially insensitive
- to heat and light

### Inhibitors

- Isobutyl aldehyde
- Formaldehyde
- Acetaldehyde
- Acetone
- Biacetyl
- etc.
- 50 fragrances

### Fragrances

- 50 fragrances

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**III. 2: The honey spectrum: What is found in honey?** The individual ingredients may vary highly as far as quality and quantity are concerned, depending on the type of honey (according to HEROLD 1970).

**What is honey?**

Honey is a food and therefore subject to the Food and Drug Act (in German). The German Beekeepers Ass. (DIB), the largest German trade association for beekeepers, has stipulated higher quality requirements for German honey than those set down by the German Honey Ordinance. Anyone who wishes to sell his/her honey under the German Beekeeper label must meet these requirements. In illustration 1 the important characteristics are listed.

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Honey bees collect nectar mainly from blossoms and honey dew, especially from the leaves of trees. These basic substances in honey often contain more than 80 % water and are therefore very perishable. That is why bees actively dry up the nectar and honey dew by repeatedly sucking it up and spitting it back into the comb and then fanning it with their wings to reduce the moisture content. During this process, water escapes and at the same time the honey is enriched with important substances contained in the bee’s saliva. That is how nectar and honey dew mature into honey.

According to the German Honey Ordinance, honey may consist only of honey dew or nectar. Neither may substances be added, nor may they be removed. Just the way the beekeeper collects it from the honey comb is the way it must be passed on to the customer. Strong warming, for example, that destroys or modifies its ingredients is not allowed and leads to a ban on sales. The most important ingredients in honey are listed in illustration 2. Important are the various types of sugars. The so-called invert sugar, a mixture of fruit and grape sugar, makes up the greater part. Invert sugar is formed by enzymatic hydrolysis of cane sugar (beet or household sugar). The enzymes (ferments) in the honey are another important ingredient. They are, for example, responsible for its antibiotic effect. Enzymes are very sensitive to heat and light. Heat damage to honey can be determined by a reduction in enzyme activity. The most important enzymes are invertase (saccharase), which hydrolyzes (inverts) cane sugar as described above, as well as diastase and glucose oxidase. Contrary to popular belief, honey is not rich in enzymes. According to the German Honey Ordinance the water content of honey may not exceed 21 %.

**Honey stirrers most commonly used**

In illustration 3 we have put together some of the most commonly used honey mixing tools. The triangular beechwood rod has been in use for a long time, either for stirring by hand or in connection with an electric drill which, when equipped with a reducing gear, serves the purpose well. It moves the honey gently and breaks down the growing crystals during crystallization. This tool is not, however, very suitable for stirring honeys because it has practically no mixing effect.

![Honey mixing tools](image)

III. 3.: The most common mixing tools for preparing honey: triangular beechwood rod with reducing gear unit, stirring stamper, stirring rod, beba mixers B 050-45 “Standard” (flat steel), B 050-45 NRK (round steel) and B 050-45 NR (round steel).

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For smaller beekeeping operation the stirring stamper is often recommended which has a perforated, sharp-edged and curved end plate on its lower end. This tool is suitable for crystallization as well as for mixing honeys. You just have to expend more or less force, depending on the consistency. Viscous honeys, however, are very difficult to work through. Another problem may be that because of the sharp edges on the stamper, pieces of metal or plastic from the walls of the container could find their way into the honey. Recently the stirring rod has been much publicized. This is a six-edged stainless steel rod that has two large-surfaced wing sections and is driven by an electric drill. On the stirring rod, the stirring disks stand toward each other in a way that builds up suction during rotation which conveys the honey from the top and from the bottom to the stirring rod and then presses it outward between the disks.

Ill. 4: The beba mixer in action, the flow direction of the honey is easily visible.

In the German Beekeeper Journal 11/92 under the heading “Current themes of the month”, Ernst BÖSE (1992) referred to a new type of mixing device made by beba Mischtechnik GmbH, Bartmannsholte 21, in D-49632 Essen/Oldenburg, Germany.

This double mixer works on the same principle as a “kitchen mixer”. Two counteracting spiral sections allow effortless stirring and mixing without torque. The mixer was primarily developed for use in the building trade to mix mortar, sand and gravel. That is why the spiral sections are robustly constructed and even highly viscous honey can be worked through. The double mixers can be driven with any commercially available 1.000 Watt drill that has a EURO-collar (43 mm diameter). The mixing tools are equipped with a reducing gear unit that has a gear reduction ratio of 3 : 1. Connected to an electronically controlled drill, even freshly centrifuged honey can be gently mixed through for crystallization with an extremely low number of revolutions per minute.

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The mixing tools draw the honey from the bottom, leading it vertically through the double spiral sections to the top. It appears at the surface at the center along the stirring rods, flows to the sides of the container and is then drawn over a wide surface at the edge of the container to the bottom so that the stirring rods automatically pull themselves down into the honey (ill. 4 and 5). With light tilting motions, using just one hand, the stirrer can be guided through the honey (ill. 6) so that all areas in the container (e.g. hobbock or bucket) can be effortlessly reached and mixed through.

Ill. 5: Creamy stirred honey flows off the B 050-45 NR mixing tools.

The beba mixer compared to the stirring rod
The beba company provided us with various models of their double mixers with the request to test them in practical applications.

We then tested two beba-models that appeared to be especially suitable in the 1991/92 preliminary trials in a comparative approach with the stirring rod. Concerned were the double mixer B 050 “Standard” (155 mm spiral section made of flat stainless steel) and B 050-45 NR (155 mm spiral section made of round stainless steel) (see also ill. 3).
In order to determine the stirring and mixing performance of the three mixing tools being compared, in each case a hobbock with approx. 36 kg completely crystallized blossom honey was warmed in a warming cabinet for a certain length of time and subsequently worked with one of the three mixing tools. The viscosity of the honey was determined before mixing and after predetermined mixing times. At the same time we recorded the temperature in three different areas of the material to be mixed: 1. approx. 5 cm below the surface (T-top); 2. at the core (T-core) and 3. at the bottom edge of the hobbocks (T-edge).

Ill. 6: The double mixers can be operated with one hand.

The viscosity of the honey was determined by approximation (see Ill. 7) with the aid of a method described by HANNSON (1966) which can be looked up in ZANDER and MAURIZIO (1975) (pp 114 – 115). When developing the measuring instrument, HANNSON utilized the fact that the settling speed of a cone is dependent on the viscosity of the honey. In highly viscous honeys, the cone sinks more slowly and therefore needs longer to reach a certain settling depth than in liquid or less viscous honeys. At each measuring time we carried out ten measurements with a plexiglass cone weighing 20 g (see ill. 7). In warmed but unstirred honeys, a 20 g cone does not sink appreciably so a value for viscosity can only be determined after a stirring time of one minute. A value could be determined for heavier cones (brass 100 g; see ill. 7), but the settling time for this cone is too short in stirred honeys to allow an exact measurement. In illustrations 8 to 10 the average values of these measurements are given respectivley.

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Taking the gear reduction of the beba mixers into consideration, the mixing tools were driven at approx. 300 rpm. They were connected to electronically controlled drills (500/100 watt).

**Ill. 7: Experimental set-up for measuring viscosity with the HANNSON measuring instrument (1966); weight of the brass cone 100 g; honey warmed but not stirred.**

**beba B 050-45 NR (round stainless steel, spiral section height 155 mm)**

A hobbock of crystallized blossom honey was warmed for 26 hours in a warming cabinet. When stirring began the temperature was 28.5°C at the bottom edge and 26°C at the core. After 6 minutes of stirring with the beba B 050-45 NR the temperatures were uniform to a large extent. The measurement for viscosity showed that even after approx. 6 – 8 minutes no further increase in viscosity could be achieved. The honey was creamy and ready to be filled (ill. 8).

**beba B 050 “Standard” (flat stainless steel, spiral section, height 155 mm)**

To test this mixer, a hobbock of honey was warmed for 24 hours. The temperature then ranged from 25.5°C at the core and 30°C at the edge. In this test as well, a balance in temperature was approximately achieved after 6 minutes. Also, the settling time of the cone ranged below 5 sec. (ill. 9) after 6 minutes of stirring.

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Stirring Rod
This mixing tool had to be operated with a 1.000 watt drill because the 500 watt machine was not able to move the stirring rod in the warmed, crystallized honey. After 14 hours of warming the honey temperature ranged from 23° C at the core and 28° C at the upper edge of the hobbock.

![Graph showing viscosity and temperature curve in warmed honey while being mixed with the beba double mixer B 050-45 NR.](image)

**Ill. 8: Viscosity and temperature curve in warmed honey while being mixed with the beba double mixer B 050-45 NR (round steel spiral section).**

Viscosity measured in sec. Settling time for 4 cm with the HANNSON measuring instrument (1966). T-top = temperature 5 cm below the surface in the middle, T-core = temperature at the core, T-edge = temperature at the bottom edge of the hobbock.

The first 4 minutes of mixing time had to be executed with the **beba mixer B 050-45 NR** because the stirring rod could not be operated with the 1.000 watt drill. The drill ran hot causing the overheating protection device to switch on. Only when a viscosity of 6.6 sec. settling time was reached could the stirrer rod be moved in the honey for 25 sec. when again the overheating protection device switched on. Stirring had to be continued with the beba double mixer. After 5 min. total mixing time (viscosity 2.1 sec. settling time), the stirring rod was still not able to mix the material. Since the viscosity of the honey has already achieved an optimal value and could not be further improved with the beba mixer, we abandoned the test at this point (**ill. 10**).

A higher expenditure of force was necessary to hold the drill when operating the stirring rod. The hobbock began to rotate and had to be held.

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![Viscosity and temperature curve in warmed honey while being mixed with the beba-double mixer B 050-45 “Standard” (flat steel spiral section); for explanation, see ill. 8](image)

**Ill. 9:** Viscosity and temperature curve in warmed honey while being mixed with the beba-double mixer B 050-45 “Standard” (flat steel spiral section); for explanation, see ill. 8

**Valuation**
All three pieces of equipment are distinguished by clean machining. The stirring rod stands out by especially clean welded seams and the stainless steel used is of higher quality than the stainless steel used for the beba mixer.

The running noise which occurred when operating the equipment was within range although the beba mixer was somewhat more quiet because of the reducing gear unit.

In more solid honeys the beba mixer showed its advantages. No expenditure of force is necessary during stirring and the torsional forces counterbalance each other completely because the shafts run in opposite directions. The direction of movement can be changed by slightly turning and tilting the drill. The spiral sections automatically work their way through the honey. The one-armed stirring rod clearly needs a greater expenditure of force for this. This is also evident when the honey container tries to turn as well and has to be held.

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The beba mixer with the spiral sections made of round steel offer somewhat less resistance to the material being mixed than the spiral sections made of flat steel. These do more mixing in a shorter amount of time but this is not necessarily desirable for gentle preparation of honey.

II. 10: Viscosity and temperature curve in warmed honey while being mixed with the stirring rod, B = mixing only possible with beba mixer, A/B = mixing with the stirring rod and the beba mixer, for explanation, see text and ill. 8.

At 400 mm, the length of the beba mixing tools is sufficient to be able to mix a hobbock (approx. 35 cm filling height). These mixing tools may be too short for buckets that are higher. In this case, the stirring rod has a better prerequisites.

Warmed honey can be filled into smaller containers after 6 – 8 minutes of mixing with the beba double mixers. Right from the beginning, the beba mixers could be placed into the honey and guided through all areas of the material without any problem. The drill did not become warm. The surface of the honey showed only light movement and hardly any air was drawn in. Very positive is the fact that the honey is drawn in again over a wide surface along the edges of the container. Here, flow rates are very low and drawing in air is practically impossible.

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On the other hand, the stirring rod can only be used for less viscous honeys or for crystallizing freshly centrifuged honeys and in this case the mixing results are good. Gently warmed honeys which are not warmed over 30°C, as in our test, are too viscous, however, for this piece of equipment. Then mixing with the stirring rod, the highly viscous honeys must be warmed to a higher temperature. It would be helpful if the stirring rod were equipped with a reducing gear unit. This would considerably increase its usefullness and the danger of air being drawn into the honey in large amounts would be reduced. The danger of drawing in air is given because the honey is drawn centrally down to the bottom along the rotating axis. Swirls form because of the high flow rate.

The beba double mixers unite the advantages of the triangular beechwood rod with the high mixing performance of an electric mixing tool. The larger spiral sections made of thin, round steel, the reducing gear unit and the counterrotation principle of the spiral sections make the mixers an all-purpose tool at an acceptable price which can be used not only for crystallizing freshly centrifuged honey as well as seeding or blending, but also for mixing through warmed honey as we have tested here, and is therefore recommended especially for smaller beekeeper operations.

To make sure that errors do not occur when operating the mixing tools, it should be pointed out that only electronically controlled drills with a max. power of 1.000 watt may be used. Honey that have not been heated or only insufficiently heated cannot be mixed even with the beba mixers.

Along with the hand held mixers described here, the beba company also produces more powerful equipment for stationary operation that work on the same principle. We could imagine that some of this equipment could be used extremely well, for example for the production of sugar dough and mash.

**Literature**


HANNSON, A. (1966): Ein Messgerät für die Konsistenzbestimmung des Honigs. Z. Bienenforsch. 8 pp 187-190


Mixing Tool Tested

After reading your report in dbj 1/93 [German Bee Journal], page 48, I decided to purchase the described mixing tool, Type 45 NR made by the firm beba Mischtechnik GmbH, Bartmannsholte 21, 49632 Essen/Oldenburg, Germany because I was not too happy with the many stirring rods and spirals I already had.

I have been keeping approx. 25 colonies of bees for more than 20 years, producing seven different types of honey (rape, robinia, blossom, sunflower, edible chestnut, wild and fir).

I used this new mixing tool throughout the whole 1993 season to mix liquid honey and to make honey in hobbocks creamy. I also used it before filling honey into glasses, in which case the honey was "thawed" in the hobRock in a water bath for 24 hours and then stirred for several minutes at a temperature of 30-35°C. After just a short standing time, the foam could be removed and the honey filled into glasses.

The special features I particularly noticed about this mixing tool were:

1. It works on the same principle as a kitchen mixer with two counter-rotating spirals which allows mixing to take place without torque. That means that the hobbock does not wander while you are mixing, so you do not have to fasten the container in place.
2. Mixing takes place practically without any effort when this mixing tool is used as intended which you quickly find out how to do. This means, for example, that the speed, position of the stirring rods – whether vertical or at an angle and the immersion depth have to be adjusted to the consistency of the honey. When these things are taken into consideration, the mixing process is smooth, without any beating or jumping around.
3. The mixing tool draws the honey up from the bottom of the container, leading it up through the spiral section. So it is neither necessary nor desirable to set the mixing tools on the bottom of the container since this causes friction and therefore abrasion which not only can damage the container but also add undesirable plastic or metal particles to the honey, making it impure.
4. I used a 520 watt/220 volt electronically controlled drill with an infinitely variable speed of 0 to 600 rpm. The drill had no problems handling the mixing tool and never ran hot since it was not overloaded.
5. The length of the Type 45 NR stirring rods (400 mm) was just right for the height of my hobbocks (400 mm) and since they were not filled all the way to the top, there was plenty of room for easy mixing.
6. This mixing tool has a 1:3 reducing gear which I think is just right. With the tool attached to the drill, the total weight is just 3 kg which makes it easy to handle and yet quite stable. Since my drill has a Euro-collar as do most modern drills, connecting the mixing tool to the drill was no problem at all.

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I am very pleased with the way this mixing tool works and think the purchase price of € 120.00 is justified.

Helmut Schreck  
*Chairman of the Ass. for the Care of Bees and Production of Honey, IV Rhineland-Pfalz 67346 Speyer, Brahmsweg 6*

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