

# The Feeding of Honeybees



SWEETS

PRODUCT RANGE

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## Bee feeds compared

These days, beekeepers can choose from a whole range of different bee feeds. Besides the traditional self-made sugar solution and the long-established ready-made feed based on sucrose, starch-conversion products have been in use for some years. This paper presents the results of scientific feeding experiments with sucrose-based and starch-based ready-made feed.

# 1. Basic requirements of honeybees

The survival of honeybees depends to a large extent on their hive, health and, in particular, their food.

Except in Scandinavia and parts of eastern Europe, bees have practically no chance to form colonies on their own in Europe's man-made environment. This is why honeybees in Europe are kept almost exclusively by beekeepers in man-made hives, of which there are many different types.

Since a bee colony can comprise up to 80,000 bees living in a very crowded space, good health is essential to the continuity of the population. Although propolis

is a very effective means by which bees counter a variety of pathogens, the beekeeper does sometimes have to intervene. This applies in particular to cases of foulbrood disease, nosema disease and varroa mite infestation.

The special importance of food to bees can be illustrated by considering the stages in their development: during development from the egg to an insect, protein uptake is a key factor; for mature bees, by contrast (drones, worker bees and queens), energy supply in the form of carbohydrates takes precedence.



## 2. The need for feeding

Bees need feeding because the beekeeper collects their honey, which is their natural food. In our climates, where winters are often severe, the beekeeper must therefore provide substitute food. Another reason is that nectar flows can vary strongly from region to region and according to the season, so that feeding is necessary to maintain breeding activities and to meet food requirements. Additional food is

also needed for the formation of new colonies and for breeding queen bees.

Due to the major importance of carbohydrate-based food to meet the energy needs of mature bees, the rest of this paper deals with currently available bee feeds.

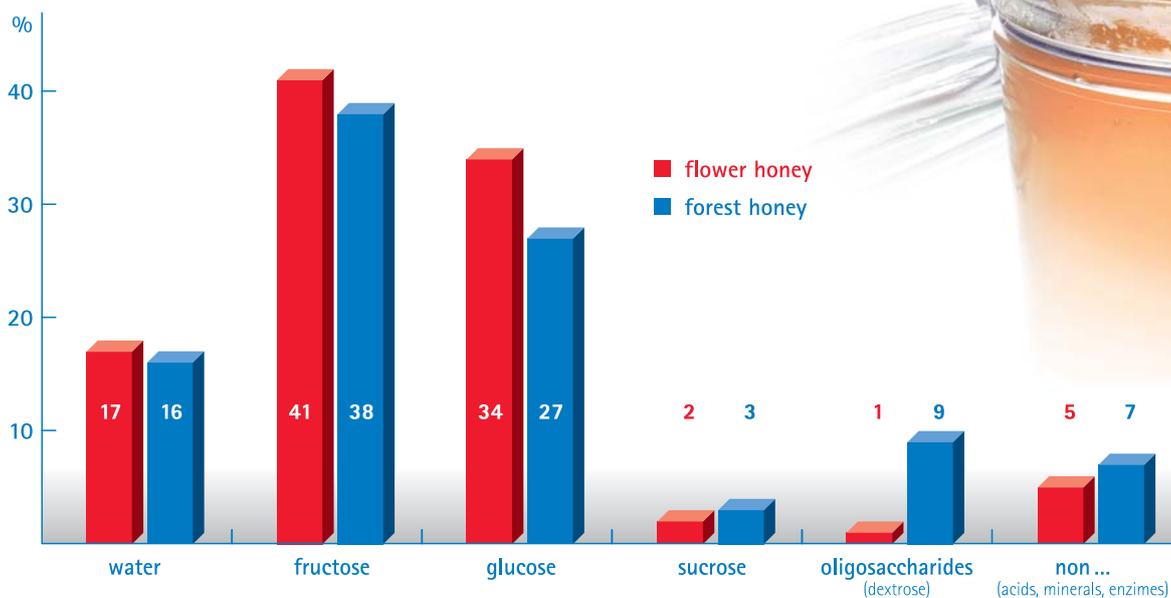
## 3. Various bee feeds

### 3.1 Honey

The natural food of bees is honey, which bees make from the nectar and honeydew they collect. Depending on the plants they are collected from, these raw materials mainly comprise fructose, glucose and sucrose (beet sugar or cane sugar). They also contain small amounts of maltose and other forms of sugar. Fructose, glucose and sucrose are thus the most important nutrients for bees.

Some honeys, such as rape honey and honeys containing melezitose, are less suited as winter food due to their tendency to granulate. High ash and colour contents, such as those typical of most forest honeys but also of some flower honeys, are difficult for the bees to digest and can produce dysentery symptoms if the winter is long.

Typical honey composition according to the German Beekeepers' Association (DIB), 1997



### 3.2 Sugar solution (sucrose solution)

The traditional substitute for honey is sugar solution. As a rule, sugar and water are mixed in a 3:2 ratio or, less frequently, on a 1:1 basis. This sugar is chemically identical to the sucrose contained in nectar and honeydew, the raw materials of honey. As a result, the bees have the necessary enzymes, such as invertase, and can make good use of the sucrose as nutrient.

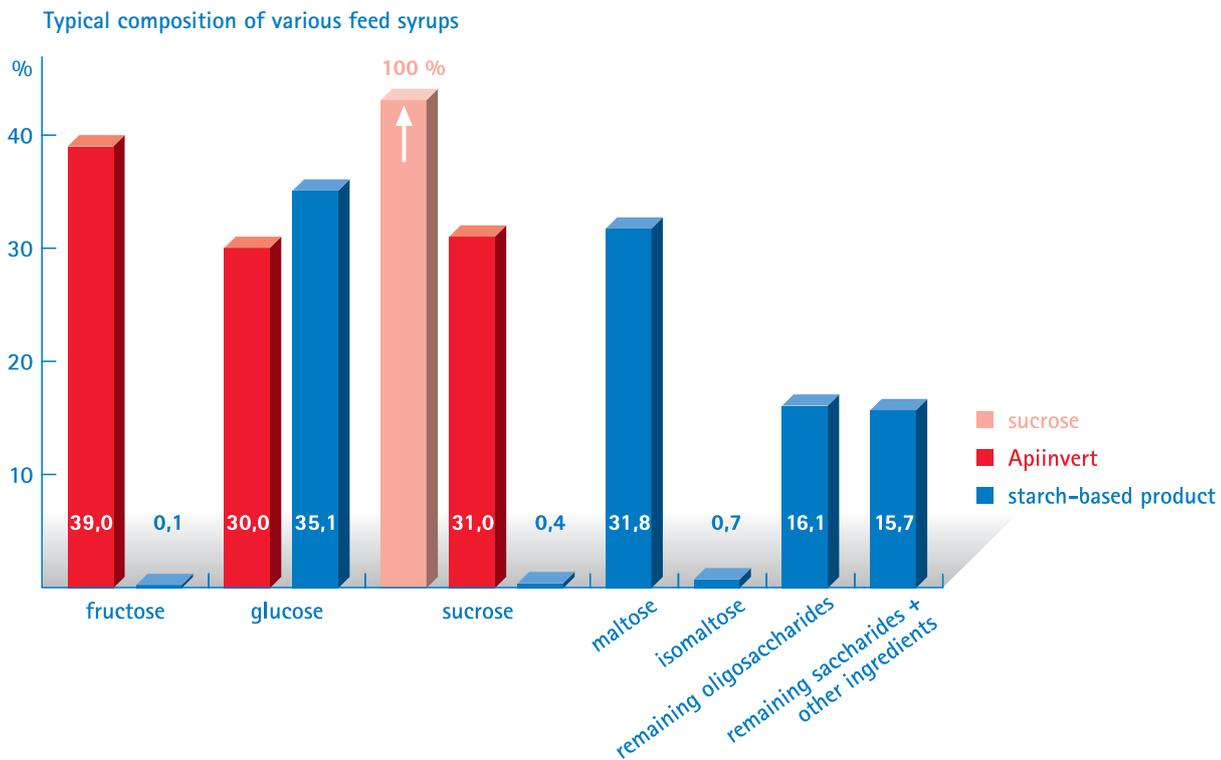
The preparation of sugar solutions is always time-consuming. Attention must also be paid to the microbiological instability of such feed, which limits its shelf life and thus the length of time the sugar solution can be used. As a result, sugar solution must often be prepared in batches.



### 3.3 Ready-made feed based on sucrose

Sucrose-based bee feeds have been produced for decades by Südzucker AG Mannheim/Ochsenfurt, Germany. These feeds are ready-to-use products that meet all the nutritional needs of bees. Consequently,

they are a great help to beekeepers since they can be fed directly to the bees without any additional preparation.



#### Apiinvert

is a syrup containing sucrose and its building blocks, fructose and glucose – the substances that make up 90 % of the solids in flower honeys. Apiinvert contains no forms of sugar that are not easily digestible. The high proportion of fructose means that the product shows little tendency to granulate in the honeycomb, even at low temperatures. Thus it is almost impossible for bees to starve with a full honeycomb. Thanks to its composition, Apiinvert is an ideal bee feed, especially for winter feeding.

#### Apifonda

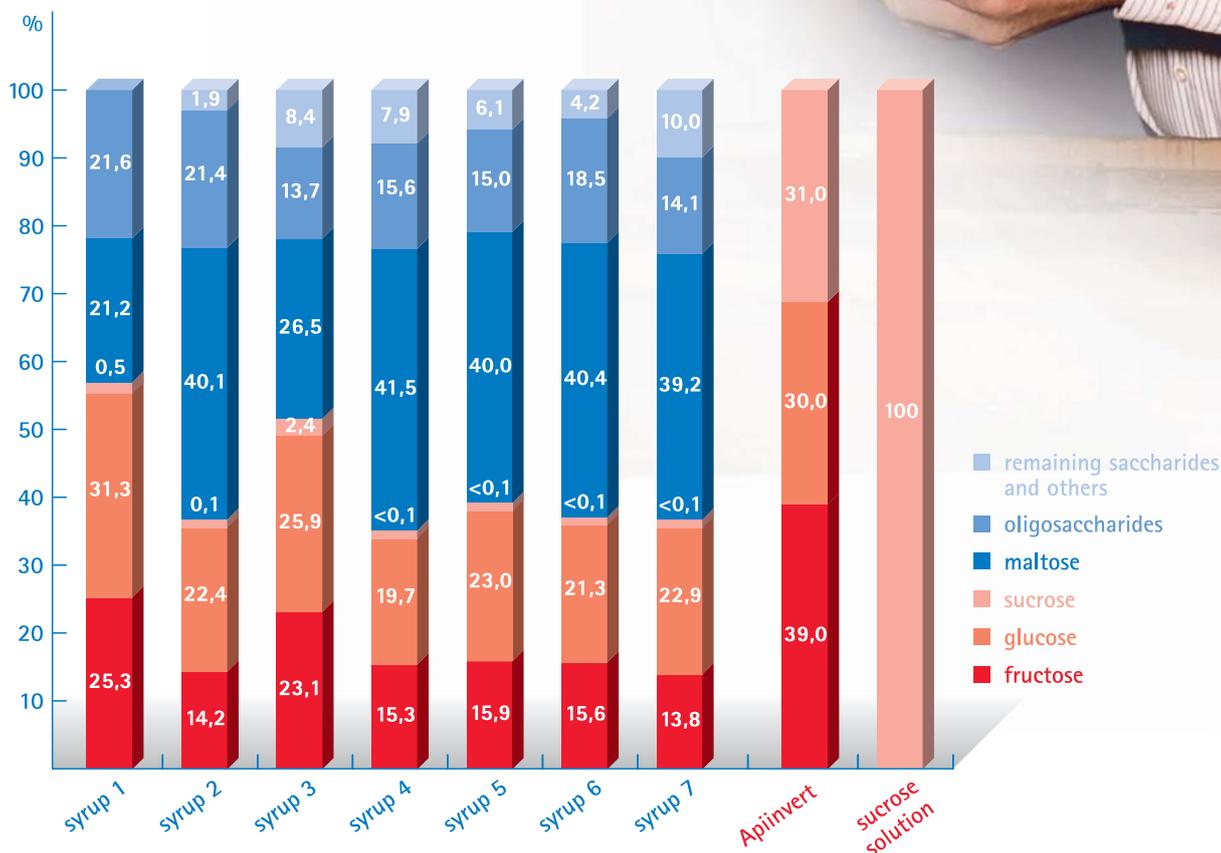
is a paste-like, ready-made feed consisting largely of sucrose. It contains microcrystals each of which is coated with a thin film of syrup. These can be carried off easily by the bees and swallowed directly. Apifonda is suitable as spring stimulation feed, for closing gaps in the nectar flow and for early winter feeding.

### 3.4 Ready-made feed based on starch

Since the middle of the 90s, commercial starch-based products have also been available. These are made up of differing amounts of glucose and maltose as well as malto-oligosaccharides and isomalto-oligosaccharides, which are of higher molecular weight. Of these constituents, only glucose occurs in large quantities in honeys. Maltose can account for up to 8 %. The other oligosaccharides are only present in traces in honeys. Starch-based feeds are thus altogether less similar to the natural nutrients of bees. Moreover, some of these products contain high ash and colour contents resulting from the production process. All in all, starch-based feeds are thus less compatible.



Composition of bee feed syrups from various manufacturers



## 4. Comparative feeding experiments

In 1997 and 1998, the Bavarian Institute for Apiculture in Erlangen/Germany conducted comprehensive experiments in Erlangen and Kringell to investigate the effects of winter feeding with sucrose-based and starch-based feeds. Roughly 100 bee colonies were used for the experiments, the aim of which was to determine whether the composition of the bee feed influences the following:



Experimental station in the Bavarian Forest

### 4.1 Compatibility

All the colonies fed with Apiinvert survived at both locations. In some of the colonies fed with starch-conversion products losses were high. This was especially the case in Kringell, which has a harsher climate. A possible explanation for these results is that oligosaccharides (complex sugars) are broken down only partially or not at all by the bees' enzymes. This is harmful to the intestine and can lead to diarrhea. The high ash and colour contents of some starch-conversion products make this effect even more pronounced.



The hives of the colonies fed with the starch-conversion product were contaminated inside and outside with feces. The colony in this hive did not survive the winter.

### 4.2 Changes undergone by the sugar between the time of feeding and deposition in the hive

Bees have various enzymes, of which invertase is the most important for the digestion of carbohydrates. It breaks down the disaccharide sucrose into its component monosaccharides, fructose and glucose. These monosaccharides are available to the bees as nutrients relatively quickly. The disaccharide maltose contained in starch-conversion products is broken down much

more slowly into glucose, and is thus less readily available to the bees as a nutrient. In some cases, the proportion of maltose in the feed deposited in the hive had increased by the end of the winter, which is an indication of further reactions. The resulting oligosaccharides either cannot be assimilated at all by the bees, or only poorly.



### 4.3 Tendency of the feed to granulate in the comb

The tendency of the feed to granulate was determined at the time of deposition and at the end of the winter. It was found that feed syrups rich in glucose and maltose had a higher tendency to granulate. In some cases, no syrup could be isolated from the cells because the entire cell content had granulated.

In the combs of colonies fed with Apiinvert, only a slight tendency to granulate was observed. The bees thus had sufficient supplies of readily-available food.

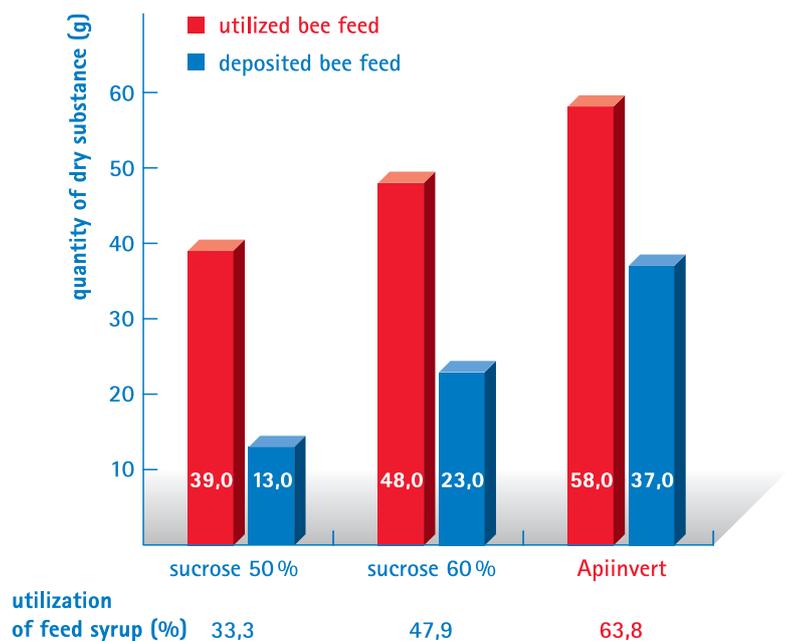
## 5. Cost – benefit ratio of the various bee feeds

In comparing the costs and benefits of the various bee feeds, it is not sufficient just to consider the retail price of the individual feeds. The real cost can only be assessed on the basis of the amount of each kind of feed which is deposited in the combs and is thus available to the bees as a source of nutrient.

A comparison of Apiinvert with sucrose solution shows that the cost per kg of deposited feed is about the same. This is due to the higher solids content of Apiinvert, which means that utilization of the feed syrup is roughly 15 % higher than for a 3:2 sucrose solution.

When the cost of Apiinvert is compared with that of commercially available starch-conversion products, the starch-conversion products initially seem to be better value. It must be remembered, however, that a considerable proportion of the starch-based feed deposited in the comb cannot be utilized by the bees.

Feed deposition performance



## 6. Conclusion

Commercially available bee feeds differ considerably with regard to their raw products and compositions. The suitability of ready-made feeds based on sucrose, and the fact that these feeds do not harm the bees' health, has been acknowledged for decades. A general assessment of the commercially available starch-con-

version products, however, is difficult because of their different compositions and the different ash and colour contents. The suitability of such feed as winter feed appears to depend primarily on the climatic conditions of the location.



### ■ Technical service

Please don't hesitate to contact our specialists if you have any queries about using our bee feeds:

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