Actes Coll. Insectes Sociaux, 5:39-43 (1989)

UPTAKE AND DISTRIBUTION OF NECTAR AND THE STORAGE OF HONEY IN *Melipona favosa* (APIDAE, MELIPONINI)

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RESUME

La récolte du nectar, la distribution et le remplissage des cellules de stockage dans le nid de *Melipona favosa* (Apidae, Meliponini)

On a étudié la récolte du nectar, la distribution et le remplissage des cellules de stockage. Les butineuses sont agées de 2 à 85 jours. A peu près 25% du sirop était apporté directement par les butineuses dans les cellules de stockage. La quantité majeure était distribuée par trophallaxie. On peut distinguer certaines catégories de cellules de stockage selon leur utilisation par les abeilles.

SUMMARY

The uptake of syrup and the subsequent distribution and storage were studied. Uptake was observed in bees aged 20-85 days old. About 25% of the syrup was stored directly by the foragers. The remaining part was distributed trophallactically. Different categories of honey-pots can be distinguished according to their use.

INTRODUCTION

The storing of pollen and honey in perennial colonies of social bees is a well known phenomenon. Foraging on nectar and pollen, and the subsequent conversion of nectar into honey is well studied in the Honeybee (*Apis mellifera*). Earlier, we studied the foraging behaviour of several species of Stingless bees and also the

behaviour of foragers returning to the nest(Sommeijer et al.,1983). As nectar is brought in in the honeystomachs of the returning workers, it is usually rather difficult to obtain quantitative data on nectar-foraging and -storing. This study aimed to acquire such data.

MATERIALS AND METHODS

The three colonies of *Melipona favosa*, used for this study, originated from Surinam and were fed daily with a standardised amount of 5 ml of syrup (50%) and a pollenmixture. All workers were age-marked individually. Observations on uptake of syrup were done with video-equipment. The observations on distribution and storing of honey were done directly.

To study uptake properly we constructed an annexe of perspex in which the syrup was offered in a glass tube, to enhance the view on the marked thoraxes of the workers. During the feeding periods, all drinking workers were recorded. Trophallactic activity was recorded in bouts of 5 minutes, using a focal animal method ,and a random sampling method. These bouts alternated with 5 minute periods in which all activity near storage pots was registered. As almost all of the regurgitations in storage pots for honey were conducted during these feeding-sessions, approximately half of the regurgitating workers were registered. The sugar contents in storage pots was measured every day or once a week, depending on the pots being open or closed, by means of a refractometer.

RESULTS

a/ Uptake and distribution

Uptake of sugar-water was carried out by workers of relatively high ages. From our observations on colonies in the natural habitat, we know that foraging is one of the last tasks performed in a workers' life (Sommeijer, 1984). Not all workers were equally active for this behaviour. Most workers were seen to drink only once. Some individuals were active for several days and visited the sugar-tube for over 20 times in one feeding session. From the viewpoint of sugar transport,the latter group was most important. They took up the largest amount of syrup .

After drinking, workers behaved in one of two ways: some went directly to a storage pot and regurgitated their food in the pot. Others were very actively offering food to nestmates .This frequently resulted in foodtransfers

to other workers. We estimated that about 25% of the syrup is directly stored by the uptakers, and the remainder is trophallactically distributed among nestmates. Of the latter part, approximately one third also reaches the storage pots during the feeding period, so on average about half of the total amount of sugar is stored and the other half remains in workers' stomachs. Our results are summarized in figure 1. The three major sugar containers are distinguished: the feeder, the storage pots in the nest,and the honeystomachs of the bees. The bars indicate the possible routes of transport between these three containers.

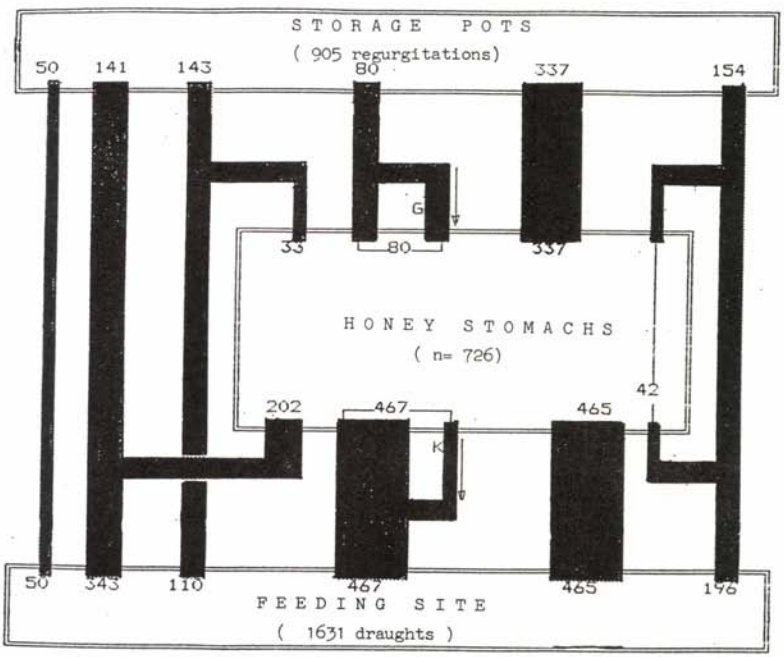

figure 1 Flow of syrup from feeding site to storage pots. Bars indicate no. of workers exhibiting a certain behaviour. G= give food to a nestmate. K= recieve food from a nestmate. *La route du sirop entre l'endroit de nutrition et les cellules de stockage.*
G= donner de la nourriture à une autre ouvrière. K= recevoir de la nourriture d'une autre ouvrière.

Each bar represents a group of transporting workers. The width of the bar indicates the relative importance of the route. From fig. 1 it is evident that only a minor part of the syrup is transported directly from feeder to pots by the foragers.The bulk of the sugar passes through honeystomachs of workers that do not visit the feeder.

b/ Trophallaxis

Observations on trophallactic transfers confirm this pattern. Uptakers had a higher rate of offering than of receiving food. Workers that only regurgitated in storage pots, received significantly more than they offered. Workers seen both uptaking and regurgitating, had similar rates for both behaviours. Finally, workers not seen near sugar tube or honeypot received more food than they gave. Since foragers are relatively old workers, the sugar-flow was directed from older towards younger bees. Thus, this is not an open system as it is often believed to be in social insect colonies.

c/ Storagepots

In hives of *M. favosa*, in general most honey pots are closed.Usually there is in these nests only a small number of open pots. In these open pots the nectar is regurgitated, or taken up to be processed or to be consumed. In closed pots, used for storage, sugar concentration was usually relatively high (70%-80%). In open pots sugar concentrations ranged from 50% to 70% and according to their use, we distinguished three types of open pots.

In type I syrup was regurgitated during feeding-sessions.Consequently, sugar concentrations of the contents of these pots were almost equal to the syrup offered. Usually type I pots were newly built pots.

Type II pots have varying amounts and concentrations of sugar solution. Workers regularly take out some syrup and after some time it is brought back again. In the meantime, workers are seen to sit still, holding a droplet in between their mandibles and sweeping their tongues through this droplet, evaporating water from the liquid. In this way sugar concentrations may be increased by 2-4% daily.

Type III pots contain honey, that is used for consumption. The amount of food we offered , was just sufficient to cover daily needs, so we did not observe the origin of closed pots. Presumably type III can pass

into closed pots and vice versa, depending on the amount of food needed and available.

DISCUSSION

As sugar concentrations are low compared to honey of the Honeybee, honey of Stingless Bees is liable to ferment. Possibly, the moderate sour taste that is found in most *Melipona* honey, is caused by such a process. However, this should than be a very well controlled process, since we have never found alcoholic fermentation in natural honeypots. Some authors mention the occurrence of fungistatic microorganisms in Stingless Bee honey, but the source of these microorganisms is still unknown. Possibly, the waste dump is one of the step stones used for this purpose.

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