

Honey Bee Hoarding of High Fructose Corn Syrup and Cane Sugar Syrup¹

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SUMMARY

In hoarding experiments caged honey bees (*Apis mellifera* L.) hoarded more high fructose corn syrup (HFCS) than cane sugar syrup (CSS) at a similar concentration. Also, when given a choice, bees hoarded significantly more HFCS than CSS. These results suggest that feeding colonies HFCS may lead to the unintentional adulteration of honey stores.

INTRODUCTION

FOR SEVERAL years the beekeeping industry has been concerned about the adulteration of honey with high fructose corn syrup (HFCS). This concern has led to the development of analytical techniques (White & Doner, 1978a,b) capable of detecting adulteration. Now that such techniques are available, the honey packing industry is increasing their inspection of honey bought from honey producers, and state regulatory groups are using them to support the enforcement of state honey-adulteration laws. One consequence of these increased inspections has been the discovery of cases of unintentionally adulterated honey. Verbal reports from honey-industry spokesmen indicate a sharp rise that may stem from increased inspection, increased feeding of HFCS, or a combination of both factors.

The cases of unintentional adulteration may come about because bees mix HFCS or cane sugar syrup (CSS) with honey in honey supers, but reports from the honey industry seem to indicate that they occur most often when colonies are fed HFCS rather than CSS. Even the feeding of HFCS in the fall might produce unintentional adulteration the next summer. If honey actually is adulterated more often when bees are fed HFCS, the bees are probably responding differently to HFCS. The experiments we report here are designed to test this possibility.

MATERIALS AND METHODS

Bees for two experiments were obtained from the same seven source colonies located at the USDA Bee Breed-

ing and Stock Center Laboratory at Baton Rouge. Adult worker bees, 0-24 hours old, were collected after they emerged from brood combs and were placed in groups of 30 into hoarding cages (Kuliñević et al., 1973). These cages contained a piece of comb where the bees could put sugar syrup that they collected from feeders placed at the top of the cage. After the bees were placed in the cages, the appropriate sugar syrups were provided in the feeders and the cages were placed in incubators at 35°C and 50% RH.

Unintentional adulteration of honey could result from feeding bees HFCS. However, we do not know certainly that it does.

In the first experiment, the 12 cages of bees from each colony were divided into three groups of four, and each group was given HFCS (69% dissolved solids) as obtained from the supplier, cane sugar syrup (69% dissolved sol-

ids), or cane sugar syrup (50% dissolved solids).

In the second experiment, five cages of bees from each colony were provided with two feeders of syrup, one containing HFCS (adjusted to 50% dissolved solids), and one containing cane sugar syrup (50% dissolved solids). This arrangement allowed the bees to choose between the syrups.

The cages in both experiments were inspected daily; the milliliters of sugar syrup removed from the feeders were measured; and the feeders were replenished as needed. The first experiment lasted 7 days; the second lasted 5 days. Data from both experiments were submitted to analysis of variance.

RESULTS

Bees hoarded significantly more HFCS and 50% cane sugar syrup than 69% cane sugar syrup (Table 1). This was true for bees from all seven colonies.

Also, the bees that had a choice between HFCS and cane sugar syrup (experiment 2) showed a strongly significant preference for HFCS. This prefer-

Table 1. Average hoarding responses^{1,2} of caged bees from 7 colonies given either high fructose corn syrup, sucrose syrup, or less concentrated sucrose syrup.

Colony	Consumption of Syrup in ml.		
	High Fructose (69%) ³	Sucrose (69%) ³	Sucrose (50%) ³
1	12.3 ± 1.3	9.8 ± 0.3	11.5 ± 2.8
2	11.5 ± 0.9	9.3 ± 0.3	15.3 ± 1.0
3	14.0 ± 1.1	10.3 ± 1.3	17.8 ± 1.1
4	14.0 ± 1.1	10.8 ± 0.8	12.0 ± 1.6
5	12.8 ± 0.3	8.8 ± 0.5	14.8 ± 1.1
6	17.0 ± 0.8	9.8 ± 0.9	15.0 ± 2.5
7	17.8 ± 0.9	9.3 ± 0.9	12.0 ± 0.9
Overall average ⁴	14.2 ± 0.3	9.7 ± 0.1**	14.0 ± 0.4

¹4 cages per colony per treatment.

²Mean ± standard error.

³Percentage dissolved solids.

⁴From analysis of variance

** Significantly lower than other groups (P < 0.001).

Table 2. Average hoarding responses^{1,2} of caged bees from 7 colonies given a choice of high fructose corn syrup or sucrose syrup.

Colony	Consumption of Syrup in ml.	
	High Fructose (50%) ³	Sucrose (50%) ³
1	9.0 ± 0.9	5.0 ± 1.0
2	11.0 ± 1.0	5.0 ± 0.5
3	14.2 ± 2.5	5.8 ± 1.1
4	11.0 ± 0.8	5.2 ± 1.0
5	11.2 ± 1.0	6.0 ± 0.5
6	16.2 ± 2.1	7.6 ± 1.6
7	17.4 ± 1.8	5.2 ± 0.2
Overall ⁴ average	13.1 ± 0.3**	5.7 ± 0.2**

¹5 cages per colony per treatment.

²Mean ± standard error.

³Percentage dissolved solids.

⁴From analysis of variance.

**Significantly different (P < 0.001)

ence was consistent for bees from all seven colonies.

DISCUSSION

Our results show clearly that bees hoard more HFCS than CSS and that they prefer to hoard HFCS. This strong preference indicates that colonies of bees fed HFCS probably treat it differently than they do CSS. At the least, field colonies would take more HFCS than CSS. Therefore, beekeepers who judge the need of a colony for food on the basis of the speed with which food is taken would give colonies greater amounts of HFCS. That might be sufficient to cause colonies

to move the HFCS out of crowded brood nest areas and into honey supers when brood nests begin to expand in spring. Thus, unintentional adulteration of honey could result from feeding bees HFCS. However, we do not know certainly that it does. To fully evaluate this question, we are in the process of conducting a field test from fall feeding through a spring-summer honey flow. We are now investigating other suggestions that HFCS, like ordinary corn syrup, may seriously decrease the longevity of bees, because product labels indicate that 6% of the product remains unchanged by the isomerization process. This possibility was investigated by Barker and Lehner (1978)

who showed that HFCS supported bee survival as well as honey.

The experiments we report here were conducted to provide the industry with whatever information could be obtained in a short time during a season without a honey flow. However, we believe that our results indicate a strong possibility that adulteration is associated with feeding HFCS. Consequently, we agree with the recommendation of Robinson (1980) that "every precaution [should be taken at the present time] to see that none of the feed [either HFCS or CSS] is extracted and mixed with the honey to be sold."

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FOOTNOTES

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