

Causes of Deficiency of Soybean Flour as a Pollen Substitute for Honeybees¹

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Soybean flour is used as an ingredient for preparing pollen substitutes or pollen supplements for feeding colonies of bees when the latter lack adequate amounts of pollen—the main source of protein, lipids, minerals and vitamins in the nutrition of the bees.

Although soybean flour when fed alone is adequate for rearing brood (Haydak, 1940, Haydak & Tanquary 1942) the amount of brood reared is considerably below that reared when dried skim milk or dried brewers' yeast is added to the soybean flour. It has been pointed out that the heat-treated soybean flour is an excellent source of protein of a high biological value and that its mineral and fat contents are high enough to justify the assumption that those constituents are supplied in amounts sufficient for the proper development of bees. The same cannot be said of the vitamins present in soybean flour, which is rather low in riboflavin. Its niacin (nicotinic acid) content is also considerably below that of either pollen or the dried brewers' yeast (Haydak 1945).

It is known (Fraenkel 1943) that both riboflavin and niacin are indispensable for the normal growth and development of insects. In order to ascertain whether the insufficiency of these two vitamins plays an important role in the inadequacy of soybean flour alone as food for bees or whether a lack of some other factors is contributing to this deficiency, experiments were undertaken in the summers of 1947 (preliminary) and 1948.

Experimental colonies were formed using bees which had never eaten pollen (not over 10 hours old). They were hived on pollen free combs placed in three-frame nuclei located in isolated cages. A paste made of 70 gm. soybean flour, 400

gm. honey, 20 cc. ethyl alcohol and 20 cc. water was placed in cells of the combs given to the control colonies. For the positive controls 70 gm. soybean flour-dried brewers' yeast mixture (4:1) was used. To ascertain the value of vitamin supplementation pure soybean flour was fortified with 40 mg. riboflavin, 100 mg. niacin, or with a mixture of 40 mg. riboflavin and 100 mg. niacin and thus fortified foods were given to the respective experimental colonies.

The vitamins were dissolved in the alcohol-water mixture and the solution was incorporated into the food. The resulting paste was distributed to the cells of the combs by means of a spatula. Two colonies were used for testing each food.

The bees were weighed before being added to the nuclei. On an average, there were 8.61 bees per gram. A good laying queen was introduced in each of the colonies. On the fifth day water was given and the pollen substitute candy was placed directly over the frames of the nucleus.

The candy was made by mixing 70 gm. of dry food, 170 gm. honey, 10 cc. of ethyl alcohol and 15 cc. of water. The vitamins were dissolved in the alcohol-water mixture which was incorporated into the candy. Two control colonies received pure soybean flour candy. The other two were offered soybean flour-dried brewers' yeast mixture (4:1). Each other group of two experimental colonies was given the pure soybean flour candy with an addition of 20 milligrams of riboflavin, 50 mg. of niacin, or a mixture of

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