Substitution of Corn-flour for Carrot in Medium for Larval Culture of Oriental Fruit Fly

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Introduction

The oriental fruit fly, *Dacus dorsalis* HENDEL, has been distributed in the Amami Islands and the Bonin Islands of Japan. The experimental studies on the eradication of the fruit fly have been performed in these areas based on the male-anihilation method. These works have been carried out with the fresh carrot or sweet potato medium (Taguchi, 1963) for larval culture of the fruit fly. It has been learnt that the utilization of fresh carrot or sweet potato is troublesome for practical use and much expensive. We need an inexpensive and easily preservable substitute for fresh carrot in the medium.

The writers found that the larvae of the fruit fly were able to develop on a medium for *Drosophila*, the base ingredient of which was corn-flour, and tried to substitute corn-flour for carrot in the medium for the fruit fly.

Good results were obtained and will be described below.

Materials and Methods

Source of materials

All eggs used for these experiments were collected from culture of adult flies which had been maintained at 25°C, 70% R.H. and 14 hr daylight (including both 1 hr dim-light before and after dark); the stock of the species had been introduced from the Amami Island and cultured with the carrot medium through 20 generations in our biotron kept under the above-mentioned conditions.

Medium

The carrot medium (Taguchi, 1963) was used as a control one, the ingredients of which are shown in Table 1.

Firstly, corn-flour A medium (Table 1) was examined. In this medium, corn-flour, sugar, agar and additional water were substituted for fresh carrot; all the ingredients were boiled for a few minutes.

Secondly, corn-flour B medium (Table 1) was examined; all the components were equal to those of the A medium except that the agar was exchanged for smashed filter paper; only corn-flour was not boiled.

Thirdly, in order to clarify the optimum density of larvae on the B medium, 25 to 150 eggs were inoculated into 25 g of the medium.

Fourthly, the quantity of yeast and sugar for the larval development in the B medium was evaluated.

The corn flour used was derived from dent corn imported from the United States; the flour was passed through a sieve of 40 mesh/cm.

Table 1 MEDIA FOR ORIENTAL FRUIT FLY

Ingredient		Dosage		
		Carrot	Corn-flour	
			A	B
Carrot	(g)	100.0	—	—
Brewer's yeast	(g)	4.0	4.0	4.0
Hydrochloric acid	(ml)	0.4	0.4	0.4
Butyl *p*-hydroxybenzoate	(g)	0.1	0.1	0.1
Water	(ml)	60.0	150.0	150.0
Corn-flour	(g)	—	17.0	17.0
Sugar	(g)	—	2.0	2.0
Agar	(g)	—	2.0	—
Smashed filter paper	(g)	—	—	10.0

Rearing Method

Eggs used for larval rearing were collected by a pin-holed plastic receptacle in which a cut of banana had been placed as an stimulant for oviposition. Adult flies were allowed to oviposit on this receptacle for 24 hr in each collecting time. For the larval culture, 100 eggs were put into a bottle of 4.5 cm i.d. and 13 cm i.h. containing 50 g of each medium, except the density effect examination. In order to examine the egg mortality, additional 100 eggs were set on soaked cloth in a petri-dish; unhatched eggs were counted on the second day after the setting.

When almost all of the larvae in a vial had matured, all the larvae were transferred into a petri-dish containing sand of ten per cent moisture content. The pupae obtained were weighed on the fifth day after the pupation.

All the tests were carried out in the biotron under above-mentioned conditions and the experiments were replicated three times.

Results

The larval development on the corn-flour A medium was compared with that on the carrot medium (Table 2). Although the larval period was a little shorter, the percentage recovery of pupae was lower and the pupal weight was lesser than those on the carrot medium. It was observed that the larvae could not deeply mine into the A medium, tending to move around the upper surface of the diet. On the contrary, they mined into the carrot medium, making colonies. The reason for the inactive movement of larvae on the A medium

Table 2 LARVAL DEVELOPMENT ON THREE KINDS OF MEDIA (Table 1.) AT 25°C AND 70% R.H.

Kinds of medium		Larval period in days	Percentage pupal recovery	Pupal weight in mg.	
				♀	♂
Carrot		11	80.4	16.6	1.2
Corn-flour	A	10	74.6	15.1	2.3
	B	8	63.5	15.3	1.5

was thought to be the paste-like structure of the medium. Then, the writers tried to make the structure of the medium suitable for the larvae, and found that they moved actively and mined into the diet when the corn-flour had not been boiled and an appropriate amount of smashed filter paper had been mixed instead of agar (corn-flour B medium in Table 1).

The larval period on the corn-flour B medium was much shorter than that on the A medium, though the percentage recovery of pupae was lower.

The relationship between the larval density per 25 g of the B medium and their development is given in Fig. 1. This picture shows that the optimum density is 50 individuals per 25 g of the medium: 2 individuals per 1 g of the medium. The percentage recovery of the pupae in rearing of 50 individuals per 25 g of medium was much higher than that in rearing of 100 individuals per 50 g of the same medium in the former test (Table 2), although the density per unit amount of medium was equal in both cases.

The effect of yeast content of the B medium on the larval development is given in the left column of Fig. 2. These figures show the importance of yeast for the larval development. When yeast was not mixed, all the larvae died before the 3rd instar. When 6 g of yeast was mixed, the larval development was better than that in the carrot medium.

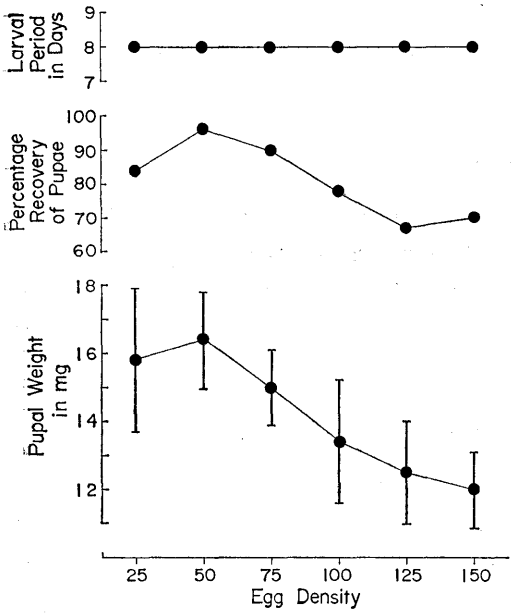

Fig. 1 Effect of the density on the larval development in the corn-flour B medium.

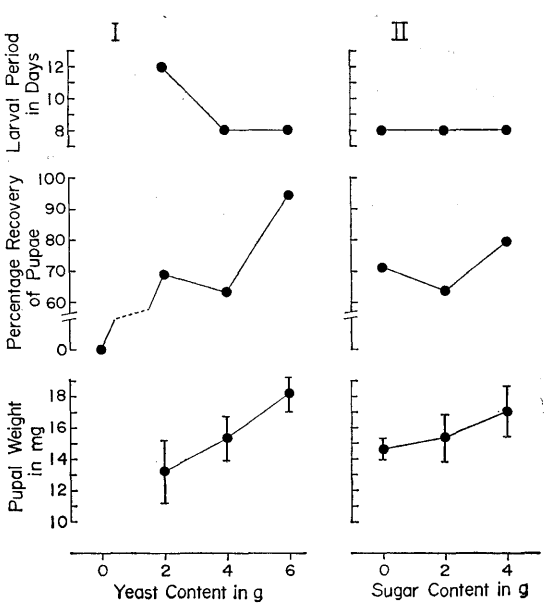

Fig. 2 Effect of the yeast and sugar contents of the corn-flour B medium on the larval development.

The relation between the sugar content of the B medium and the larval development is given in the right column of Fig. 2. These figures indicate the addition of sugar is not so important for the larval development as compared with that of yeast. Even if sugar was not mixed in the medium, larval development was not delayed. The addition of sugar, however, seems to affect the mean weight of pupae.

Discussion

Although the fresh carrot medium has been satisfactory for mass production of the oriental fruit fly, it is difficult to keep inexpensive and constant supply of fresh carrot all the year round. To solve such a problem, a lot of work has been done for the improvement of the carrot medium, which were well summerized by Smith (1966).

On the other hand, substitution of another material for carrot has been tried. Maeda et al. (1952) reported on the synthetic medium and, recently, Tanaka et al. (1969) developed the new medium, the base substance of which being sugar and wheat flour. Taguchi (1963) evaluated various substitutes for carrot and proved that sweet potato as a substitute for carrot gave a good result for the larval development. These facts suggested that carrot might be replaced by some starchy substance.

As far as the writers' experiments are concerned, the medium given below is the best for the larval development: Corn-flour—17 g, sugar—2 g, smashed filter paper—10 g, brewer's yeast—6 g, hydrochloric acid—0.4 ml, butyl *p*-hydroxybenzoate—0.1 g and water—150 ml.

This medium is not less expensive than the carrot one for the practical use, because the cost of filter paper takes much part of the total cost. If the ratio of water content to corn flour can be reduced, much amount of filter paper as a moisture control agent will not be nessesary. Besides this, the moisture control agent will be exchangable by another inexpensive substance for the practical use. These problems may be solved in the future study.

Summary

Substitution of corn-flour for carrot in medium for larval rearing of the oriental fruit fly was studied. Good results were obtained by the following ingredients in the medium. Corn-flour—17 g, sugar—2 g, smashed filter paper—10 g, brewer's yeast—6 g, hydrochloric acid—0.4 ml, butyl *p*-hydroxybenzoate—0.1 g and water—150 ml. All the ingredients except corn-flour were boiled. One gram of this medium could produce two flies.

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摘　　要

トウモロコシ粉を利用したミカンコミバエの人工飼料

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ニンジの代用物としてトウモロコシ粉を利用したミカンコミバエの人工飼料についての実験を行なった。

以下のような組成による飼料で幼虫を飼育した際に好結果が得られた。

トウモロコシ粉	17 g
砂糖	2 g
粉末ろ紙	10 g
乾燥ビール酵母	6 g
濃塩酸	0.4 ml
パラオキシ安息香酸ブチル	0.1 g
水	150 ml

これらの含有物を混ぜる際には，トウモロコシ粉以外の含有物を5～10分間煮沸し，トウモロコシ粉のみを煮沸後に加えた。この飼料によって1gあたり2匹の発育完全なミバエが得られることが分った。この代用によって，飼料のベース物質の費用を下げることができたが新たに添加したろ紙の費用が高くつくので，このろ紙を他のものに変えるか，または，飼料の水分含量を下げることによって添加する紙の量を減らす工夫が将来に残される問題となった。