Adding Ginger Root Oil or Ginger Powder to the Larval Diet Has No Effect on the Mating Success of Male Mediterranean Fruit Flies

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ADDING GINGER ROOT OIL OR GINGER POWDER TO THE LARVAL DIET HAS NO EFFECT ON THE MATING SUCCESS OF MALE MEDITERRANEAN FRUIT FLIES

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Adult males of the Mediterranean fruit fly, *Ceratitis capitata* (Wied.), exposed to the aroma of ginger root oil (GRO hereafter) or supermarket-brand ginger powder (GP hereafter) gain a mating advantage over non-exposed males (Shelly et al. 2004, 2007). However, exposure of pupae to the odor of GRO has no effect on the mating success of subsequently emerged males (Shelly 2001). Here, we present the results of mating trials that compared the mating success (relative to wild-like males) of mass-reared males reared on standard larval diet versus standard larval diet to which GRO or GP had been added.

Mass-reared males were from a *tsl* strain (Vienna-7/Tol-99) produced by the California Department of Food and Agriculture Hawaii Fruit Fly Rearing Facility, Waimanalo, Oahu. Eggs were obtained from this colony and placed on standard larval diet (Tanaka et al. 1969) or the standard diet plus GRO or GP. In all cases, 0.25 mL of eggs (~6,000 eggs, J. Nishimoto, personal communication) was distributed evenly on 1 L of diet held within a rectangular, plastic tray (volume 1.9 L). For the ginger treatments, GRO (0.1 or 0.5 mL) or GP (1 g) was added to the larval diet before the eggs and mixed thoroughly. (These doses were selected arbitrarily, and whether different doses would yield different results from those presented below is unknown.) The trays were held in screen-covered tubs, and pupae were sifted from vermiculite covering the bottom of the tub. Pupae were not irradiated (as in sterile insect release programs), but Shelly et al. (2005) found that irradiation had no effect on the mating competitiveness of males from this same *tsl* strain. The adult males were collected within 24 h of emergence and held in plastic buckets (5 L volume) with a sugar-yeast hydrolysate mixture (3:1, v:v) and water. The *tsl* males reared from trays with standard larval diet were termed 'control' and those from ginger-supplemented larval diet were termed 'treated'.

Wild-like flies were from a laboratory colony started with >500 adults reared from field-collected coffee berries and maintained in the laboratory for 5 generations. The colony was held in a screen cage containing the yeast hydrolysate-sugar mixture, water, and a perforated, plastic vial for oviposition. Eggs were placed on the standard larval diet over vermiculite for pupation. Adults used in the mating tests were separated by sex within 24 h of emergence and held in the same manner as the *tsl* males.

The mating trials were conducted following the same protocol described previously (Shelly et al. 2004). For the mating trials, we introduced 75 *tsl* males (control or treated, 5-7 d old), 75 wild-like males (7-11 d old), and 75 wild-like females (8-12 d old) into field cages (2.5 m high, 3 m diameter) containing 2 artificial trees (2 m tall) at 0800 h and collected mating pairs over the next 3 h. In all tests, wild-like males were marked 1 d before testing with a paint dot on the thorax. On a given test day, we ran 4 cages, 2 with control *tsl* males and 2 with treated *tsl* males. The *tsl* males released into a given cage were reared in the same larval tray, and males from a given tray were used in only 1 cage. For a given ginger treatment, we ran tests over 5 d for a total of 10 replicates each for control and treated groups. For each of the 3 experiments (2 GRO doses, 1 GP dose), we compared the number of matings obtained by (i) wild-like males versus control or treated *tsl* males and (ii) control versus treated *tsl* males using a paired *t*-test ($df = 9$ in all cases) as parametric assumptions were invariably met. We also compared the proportion of total matings obtained by control and treated *tsl* males over all 3 experiments using ANOVA (with arcsine transformed values).

Results were similar across all 3 ginger treatments (Table 1). For each experiment, wild-like males obtained significantly more matings than either control or treated *tsl* males ($P < 0.001$ in all comparisons), and there was no significant difference in the number of matings achieved by control and treated *tsl* males ($P > 0.05$ in all cases). Over all 3 experiments, the average proportion of total matings obtained by control and treated *tsl* males varied only slightly (17.7%-23.3%), and this variation was not statistically significant ($F_{5, 54} = 0.03$, $P = 1.0$).

We thank Don McInnis for permission to use field cages on the grounds of USDA-ARS, Honolulu.

SUMMARY

Adding GRO or GP to the larval diet did not influence the mating success of subsequently emerged males from a *tsl* strain. As GRO exposure to pupae similarly failed to improve mating performance, and it appears that GRO exposure is effective only when applied to adult males of *C. capitata*. This conclusion parallels that obtained in the oriental fruit fly, *Bactrocera dorsalis* (Hendel), where feeding on methyl eugenol by adult

TABLE 1. RESULTS OF FIELD-CAGE TESTS COMPARING THE MATING SUCCESS OF CONTROL AND TREATED *TSL* MALES IN DIRECT COMPETITION WITH WILD-LIKE MALES FOR COPULATIONS WITH WILD-LIKE FEMALES. CONTROL *TSL* AND WILD-LIKE MALES RECEIVED NO EXPOSURE TO ANY GINGER SOURCE; TREATED *TSL* MALES WERE EXPOSED TO GINGER SOURCES AS INDICATED. MEAN NUMBER OF MATINGS PER REPLICATE (± 1 SE) ARE GIVEN; n = 10 IN ALL CASES.

Ginger supplement/dose	Male type	Number of matings	% Matings by *tsl* males
GRO/0.1 mL	Wild-like	29.9 (1.8)	
	Control *tsl*	9.1 (0.9)	23.3 (2.4)
	Wild-like	30.0 (2.2)	
	Treated *tsl*	8.8 (1.7)	22.6 (2.3)
GRO/0.5 mL	Wild-like	30.7 (2.6)	
	Control *tsl*	7.0 (0.9)	19.0 (2.3)
	Wild-like	33.4 (1.9)	
	Treated *tsl*	7.1 (0.8)	17.7 (2.0)
GP/1 g	Wild-like	32.4 (2.8)	
	Control *tsl*	7.9 (1.4)	19.6 (3.0)
	Wild-like	30.6 (2.4)	
	Treated *tsl*	7.2 (1.2)	19.7 (3.4)

males enhanced their mating success, but feeding on methyl eugenol-supplemented diet by larvae had no effect on the mating success of the subsequently emerged adult males (Shelly & Nishida 2004).

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