Forman, M. and S.K. Majumdar. Lafayette College, Easton, Penn. Studies on the effects of monosodium glutamate on development and productivity of D. melanogaster.

Monosodium glutamate (MSG) is a widely used food additive. The first indication of possible ill effects from consumption of MSG was recorded in what has come to be known as the Chinese Restaurant Syndrome (Schaumberg, 1968) in man. Administrating high doses of MSG subcutaneously Olney (1969) and Olney and Sharpe (1969) produced brain lesions in the hypothalamous of mice and Rhesus monkey. As a result of these findings baby food manufacturers were asked to remove MSG from their products. Recent studies by Bazzano et al (1970) found no clinical or pathological changes in adult humans and adult gerbils when MSG was administered orally. Similarly Turner and Wright (1971) reported that 1% and 3% solutions of MSG caused no change in the development of D. melanogaster. Because of the conflicting reports the present investigation was undertaken to study the effects of MSG on the development and productivity of D. melanogaster. After initial work, the possibility of a lethal recessive sex-linked mutation was studied.

Eight female and eight male two-day-old Oregon-R flies were placed in vials containing Carolina Biological instant Drosophila medium. To the medium, one of the three solutions was added, with each solution being used in eight vials except for the sucrose where only four vials were used. One solution was pure distilled water, used as a control. A second control was a 0.7 M solution of sucrose. The third solution contained 0.7 M MSG. The P_1 flies were removed after seven days and the F_1 adults were counted on the seventeenth day according to sex and total number.

To determine the effect of MSG on the productivity, two-day-old Oregon-R male and female flies were allowed to drink 0.7 M solution of MSG for 24 hours. The drinking procedure involved soaking lens paper in the MSG solution and placing it in a bottle. Both sexes were kept together in order to insure mass culturing during consumption of the chemical. The control flies drank distilled water. After 24 hours the flies were transferred to vials containing instant medium and distilled water--two males and one female in each. The five-day brood system was used and four broods were obtained. Seventeen days after a brood was set up, the offspring were counted and the sex ratio was recorded.

It is apparent from Table 1 that 0.7 M MSG had an inhibitory effect on the development of the flies; as a result fewer F_1 offspring were produced. Table 1 shows that the average number of F_1 adults in the control (494.4) was greater than twice the average number of F_1 flies in the MSG (215.1). However, the numbers of the F_1 adult flies developed in the sucrose (519.5) and in the control were quite similar. The results of Turner and Wright (1971) seem to be contrary to the findings presented here. However, since they used only 1% and 3% solutions, it is possible that there is a threshold point somewhere between 3% and 10% solutions (0.7 M MSG is approximately 10%) at which the chemical produces an effect on the flies. An abnormal sex ratio occurred in the MSG cultures. There were 60.1% females in the MSG cultures compared with 49.95% in the control and 50.05% in the sucrose. A chi-square performed for determining the probability of the sex ratio obtained in the MSG cultures showed a significant difference ($p<0.001$).

Table 1. Effects of monosodium glutamate (MSG) on the development of D. melanogaster.

Treatment	No. of vials	Total no. of F_1 flies produced	Average no. of F_1 flies produced per vial	% female produced
Control (Water)	8	3955	494.4	49.95
Control (0.7 M Sugar)	4	2078	519.5	50.05
MSG (0.7 M)	8	1724	215.1	60.1

The results of the brood experiment are summarized in Table 2. In brood 1 (0-5 days), there was a control:MSG ratio of 2:1 for the average number of F_1 progeny. In the second and third broods, the ratio fell to approximately 1.75:1:00 and 1.50:1.00 respectively, and in the last brood, the ratio was almost 1.0:1.2 with the MSG flies producing a greater number of offspring in the last brood. The total average number of flies in the control (423.52) was greater than the total in the MSG (261.94) by nearly 60%. It appears that MSG has more noticeable effect on the productivity in the first and second broods. The sex ratio in the MSG culture was not significantly altered.

Table 2. Five-day brood showing comparative productivity between control and 0.7 M MSG treated D. melanogaster

Treatment	Brood 1 0-5	Brood 2 5-10	Brood 3 10-15	Brood 4 15-20	Total	Sex Ratio
Control						
Total	3982	2887	1068	267	8204	
No. of vials	21	21	16	9		
Average	189.62	137.48	66.75	29.97	423.52	
Percent of total	44.77	32.46	15.77	7.00		
Monosodium Glutamate						
Male	1035	890	302	135	2362	1:1.017
Female	1058	834	287	144	2323	
Total	2093	1724	589	279	4685	
No. of vials	21	21	13	8		
Average	99.67	82.10	45.31	34.88	261.94	
Percent of total	38.05	31.34	17.30	13.31		

The Muller-5 method was used to determine the mutagenic activity of MSG. The male Oregon-R flies drank 0.7 M MSG for 24 hours and the flies were tested for sex-linked recessive lethal mutations. This test on 474 F_1 females yielded no recessive mutations.

References: Bazzano, G., J.A. Delia, and R.E. Olson 1970 Science 169: 1208-1209; Olney, J.W. 1969. Science 164: 719-721; Olney, J.W. and L.G. Sharpe 1969. Science 166: 386-388; Schaumberg, H.H. 1968. New Eng. J. Med. 278: 1122-1124; Turner, D.C. and C.P. Wright 1971. DIS 46: 118.

Thomas-Orillard, M. Faculté des Sciences de Paris VI, France. Influence of the culture medium on the number of ovarioles in D. melanogaster.

The phenotypic expression of the number of ovarioles is influenced by the environment. The rearing temperature (David et Clavel, 1967) and the food (Saviliev, 1928; David, 1960) have an important effect on this character. Control of the temperature is always possible: all the experiments are carried on at 25±0.5° C. It is more difficult to appreciate the quantity of food which is necessary for a perfect ovary development. A study of the influence of the food on the phenotype expression of the ovarioles number is necessary to establish the experimental conditions for a study of the action of genes. Culture medium nature, density of population, sensibility of each instar larva to feeding were examined on two laboratory strains with very different geographical origins: one from France, the other from Japan and also on crosses between French and Japanese strains.

The phenotypic expression of the number of ovarioles is different on cornmeal medium and on yeast medium: t test with 98 degrees of freedom gives a significant value for t; P = .05. It depends also on the quantity of culture medium available for each larva. The biometrical characteristics of a strain are stable when all the larvae are well fed during the three instars. When first, or first and second or three instars are not well fed the mean of ovarioles number decrease significantly (F test between effect of the culture medium at different instar and residual variation gives F = 4.15 for 3 and 41 degrees of freedom).

When the density of adult population does not exceed more than 50 animals for each culture bottle, the mean of the strain is stable; but when the density is bigger than 50 the mean decreases significantly from 36 ovarioles per female to 28. The ovarioles number of the females of the first generation is significantly greater than the arithmetic mean when the number of imagos is lower than 50 in the rearing bottles. It is not far from the arithmetic mean value when the density of the population varies from 100 to 150. We conclude, in the first case that there is evidence of heterosis, in the second case that genes have additive effects.

We see that in fact, this orientates the conclusions about the genes action. In all experiments on the genetic control of ovarioles number it is necessary to work with rearing bottles where the population density is maintained around 50. By this way, controlling the effect of feeding and working at constant temperature we can expect to run into the purely genetic problems.