THE FUNCTIONAL SIGNIFICANCE OF AMYLASE POLYMORPHISM IN DROSOPHILA MELANOGASTER

IV. STARCH AND MALTOSE AS FOOD COMPONENTS

by

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SUMMARY

Larvae of two variants of Drosophila melanogaster were raised on aseptic chemically defined media and flies of these strains were fed with carbohydrate solutions. The results of these experiments demonstrated that maltose has the same nutritive value as starch in larvae. Adult flies of both strains lived longer on maltose solutions than on solutions with glucose or starch or without any carbohydrates. Higher carbohydrate concentrations resulted in a proportional longer duration of adult life.

INTRODUCTION

In a study of the functional significance of the amylase polymorphism in Drosophila melanogaster De Jong & Scharloo (1976) showed that an allozyme variant Amy* with high amylase activity has a selective advantage over a variant with low amylase activity, Amy1, when starch is a limiting factor in the food. An important problem in this type of experiments is the difficulty to separate the selective effects of environmental factors on the gene locus under observation from selective effects on linked loci. An essential aspect of De Jong & Scharloo's experiments was a comparison of the survival of larvae of the two variants on food with equivalent concentrations of either starch, the substrate of amylase, or maltose, the product of amylase action on starch.

However, Sang (1956, 1978), in his classical paper on the minimum requirements of Drosophila food, found that maltose was not used by larvae, although Hassett (1948) demonstrated a favourable effect of maltose on survival of adults. In previous experiments Hoorn & Scharloo (1978b) showed that larvae and adults of Drosophila possess α-glucosidases in the gut, which can split maltose in vitro. Moreover, they showed that another pathway in which glucose is directly split off from starch—so called γ-amylase activity—is not available in Drosophila (Hoorn & Scharloo, 1978a).

To clarify this contradiction we repeated the experiments of Sang (1956) on larval development on similar chemically defined sterile media and studied the effects of starch and maltose on adult survival.
MATERIALS AND METHODS

Strains
Stocks were used that were homozygous for Amy\(^1\) and Amy\(^4,6\) and had been isolated from a Kaduna population of *Drosophila melanogaster*. Further details are given in De Jong & Scharloo (1976).

Chemicals
Cholesterol, lecithin, ribonucleic acid and all vitamins used were obtained from Sigma; casein (vitamin free) from Calbiochem and agar from Oxoid (no. 3). All other chemicals were the best grade available from Merck.

Experiments with larvae
Well fed flies of standard age (4–8 days) were used for egg laying on watch-glasses filled with 2% (w/v) agar, supplemented with a thick suspension of living yeast. The first eggs collected during 1 hour before the actual laying period of 2 hours were discarded to eliminate asynchronus embryos (Sonnenblick, 1950). After the actual laying period the eggs were rinsed off the agar surface with Drosophila Ringer solution (Ephrussi & Beadle, 1936) into a sieve and washed thoroughly to eliminate the yeast. Subsequently the eggs were sterilized with a 0.006% (w/v) NaOCl in 33% ethanol and a 0.05% (w/v) HgCl\(_2\) solution in 70% ethanol and rinsed with Ringer solution.

The composition of the culture media is given in table 1 and was almost completely in accordance with the medium C of Sang (1956) and Burnet & Sang (1968). Only slight changes occur in the salt composition, which were altered after Burnet (personal communication). If different carbohydrates were used they were present in the same concentration, so that equal numbers of glucose units were present. Further, one extra casein concentration was applied. The insoluble substances (agar, casein, cholesterol and lecithin) were grinded to a fine powder and added on weight basis to the culture tubes (80 x 25 mm). Four ml of the vitamin mixture was added to this powder and the vials were sterilized at 120° C for 15 minutes. After autoclaving 1 ml sterile water or 1 ml sterile carbohydrate solution was added to each tube. The tubes were shaken to disperse the medium and cooled in cold water.

Each tube was stocked with 40 eggs (5 replicates per medium) and kept at 25° C, 60% R.H. Emerged adults were counted each day. The mean larval periods were computed from the time of exclosion by subtracting 1 day for embryogenesis and 4.3 days for the duration of the pupal stage (Sang, 1956).