IN THE LABORATORY

Rearing Houseflies and Blowflies on Dog Biscuit

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Houseflies (*Musca domestica* Linn.) are now widely reared either on the medium first described by Richardson (*3*) or on moistened crimped oats, as recommended by Eagleson (*1*). These methods have been adequately reviewed (*1, 4, 5*). Although they are satisfactory, we have developed a new method for rearing houseflies which seems to us more convenient and easier than these. This method, which utilizes dog biscuit moistened with yeast suspension as the larval rearing medium, is similar to that previously described (*2*) for the rearing of blowflies.

Adult houseflies are kept in screening cages where they are supplied with water, sugar cubes, and dried milk powder. The use of dry food minimizes spoilage such as is encountered when moist gels or liquids are used to feed the adults. Thus, servicing of the cages containing the adults requires little time.

The oviposition medium is dog biscuit which is moistened as described in the previous article (*2*), has yeast added, and is fermenting. This is placed in the cages in glass containers with straight sides, such as beakers or small museum jars. The number of eggs laid by the flies on a small amount of this fermenting material is almost unbelievable.

While it is quite simple to prepare the dog biscuit as above, we find it most convenient to keep a small mass of fermenting biscuit in a covered jar as a "seed." To this "seed" mass we add the amount of moistened dog biscuit we expect to use in the next few days and mix the two. The yeast grows rapidly, and within a day or two the whole mass is actively fermenting. When this is used for oviposition or for rearing, a small amount is left in the bottle for future "seed." We have kept a quart jar full of moistened fermenting dog biscuit for three weeks at room temperature without malodorous decomposition, and at no time did molds develop in this material. Thus, it is simple to prepare large amounts of the medium, if desired, for use over a period of time.

The rearing containers are two-quart Mason jars with two-piece lids, the solid central disks of the lids replaced with disks of 60-mesh screening. Fermenting dog biscuit is placed in one of these jars to a depth of about 2″, and to this the eggs and young larvae are added. Since the larvae do considerable wandering about in the jars, the screening caps are necessary. Cloth covers are not too satisfactory, for the larvae can escape through these.

[1] The technical assistance of Joseph Jumber in testing these methods is gratefully acknowledged.

As in the rearing of blowflies with dog biscuit, regulation of the moisture content of the medium is most important. Frankly, only experience in this can be trusted. It should be noted, however, that housefly larvae seem to tolerate wider differences in moisture content than do blowfly larvae. As the larvae develop, the medium tends to become more moist, and usually it is necessary to add some fine wood shavings or coarse sawdust. The larvae mix this with the dog biscuit and thus produce a mass of loose consistency and correct moisture content.

When the larvae are ready to pupate, further shavings or sawdust are added, either in a layer over the rearing mass or mixed with it. When the first pupae appear, the whole mass is poured into a shallow enameled pan, where it can dry out while the larvae pupate. Although the larvae will pupate in the bottles, the process is more rapid and emergence apparently better if pupation occurs in fairly dry material, away from the decomposition which sets in after the larvae have left the dog biscuit. Sorting the pupae out of the soiled shavings or sawdust for emergence seems to give the best results.

For the production of well-formed flies, one must control the density of larval population. Eight to 9 gm of dog biscuit will serve for the rearing of about 100 flies. Dog biscuit to the depth given above in a two-quart Mason jar will support easily about 2,000 larvae. With average conditions and using dog biscuit purchased in small quantities at retail for about $.18/lb, about 300 flies can be produced for $.01. Bulk purchases at wholesale prices reduce the cost still further.

This method has two advantages over those usually used: (1) no compounding of the larval medium is necessary, and (2) dog biscuit is easily and regularly available. The cost is low, and, except for the not too disagreeable odor of alcohol formed in the fermentation, there are few bad odors.

Certain difficulties have turned up in the rearing of the blowfly (*Phormia regina*), both in our laboratory and elsewhere. Some of these are clearly traceable to differences in commercial dog biscuits. Some brands do not work as well as others, and some cannot be used at all. Milk Bone Tiny Bits, manufactured by the National Biscuit Company, has given us the most consistent results.

In Minnesota, where the method was first developed for blowflies, there was no trouble with molds growing on the moistened dog biscuit. In Pennsylvania, molds have occasionally become a problem. If the larval population is inadequate and growth is not rapid, the insects do not stir the molds under. The trouble is easily overcome, however, by adding a layer of fine wood shavings or coarse sawdust, which smothers the molds and allows normal progress of the culture. Naturally, the addition of yeast to control molds was viewed as a possibility. So far this has uniformly resulted in the death of blowfly

larvae. Apparently the products of fermentation are injurious to them.

As a routine part of the rearing of blowflies we now add shavings or sawdust when the larvae reach the crawling prepupal stage, and, when the first pupae appear, the whole mass is poured from the rearing jar into a shallow enameled pan, where it dries out as pupation proceeds. The pupae are then either left in the dry material for emergence or sorted out. As in the case of houseflies, the latter results in a somewhat better emergence.

With regard to the sawdust or shavings used in the methods described, the best material we have found to date is the very coarse sawdust produced in the sawing of fresh timber with a large circular saw. Fine shavings from a wood-working shop are satisfactory, however. Ordinary fine sawdust packs too tightly, and coarse shavings are too loose. Preliminary work with cellucotton, such as is used for packaging, indicates that this material may also have value. Obviously, the moisture content of the shavings or sawdust is an important factor in their use.

In the previous paper (*2*), the question of whether blowflies reared on meat will oviposit on dog biscuit was raised. This can now be answered in the affirmative. We have obtained oviposition on moistened dog biscuit by *Phormia regina* and by other species of blowflies captured wild.

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Use of Papergrams in the Study of the Urinary Excretion of Radioactive Sulfur Compounds[1]

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In applying the paper partition chromatography technique (*1*) to the detection and separation of constituents of biological fluids, Dent (*2, 3*) has developed a method that is convenient and particularly suitable to the study of small-volume samples. The present publication deals with the application of this technique to the study of the distribution of radioactive sulfur compounds excreted in the urine of rats fed methionine containing S^{35}.

One-dimensional papergrams were prepared in the manner described by Dent (*3*), care being taken to confine the urine spot to as small an area as possible. A total of 0.06 ml of urine may be deposited on the filter paper within a circular area 1 cm in diameter if applied in 0.01-ml aliquots and allowed to dry before the next application. The papergrams are developed overnight with liquefied phenol, the phenol traveling down 11–14″ from the top of the paper. After removal of the phenol by heating, the paper is treated with some chromogenic reagent (ninhydrin) to outline the pathway followed by the urinary constituents. A strip, 1″ wide, enclosing all the colored areas and presumably all the radioactivity, is then cut from the larger piece of filter paper. The distribution of the radioactivity along the strip is determined by means of a Geiger counter, mounted on a shielded base, so constructed that the papergram may be passed beneath the window of the counter. The base is shown in Fig. 1. The radioactivity readings

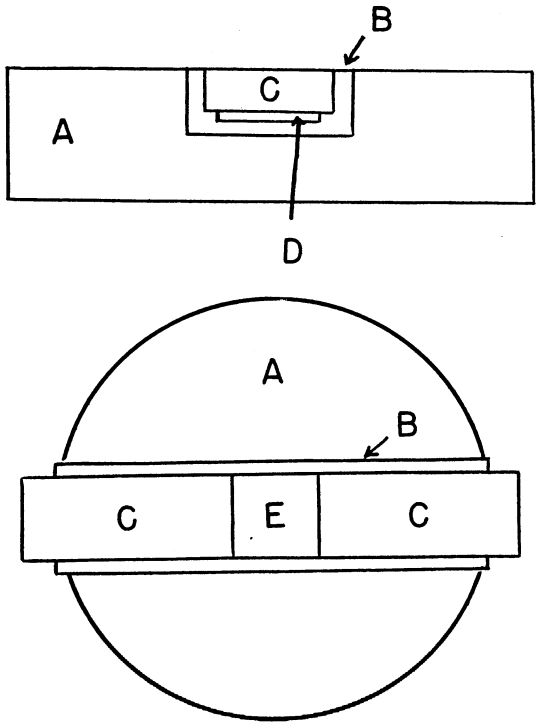

FIG. 1. Slotted base for reading of the papergram: A, lead base; B, machined brass part; C, sliding bar; D, slot; E, aperture.

The papergram is passed into the slot, D, until the first inch is under the square aperture, E, thereby exposing this section of the paper to the Geiger tube. A radioactivity count is taken, and the paper strip is then pulled into position for the reading of the next and succeeding areas.

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The term "papergram" is more applicable than paper chromatogram, since color is not the guide to the distribution of the components being separated.