

An Automated Method for Dispensing Fruit Fly (*Drosophila melanogaster*) Food into Culture Vials and Bottles

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Introduction

The vinegar fly or fruit fly, *Drosophila melanogaster*, has been utilized in medical and biological research laboratories for over 100 years (see Figure 1). It was one of the first organisms used for genetic research and is the genetically best-known of all eukaryotic organisms. *Drosophila* is the only organism for which one can begin with a list of genes active in the egg and follow the morphological changes and gene activation through adulthood (Brody, 1995). The genome of *D. melanogaster* was sequenced in 2000 (Adams et al., 2000).



Figure 1. *Drosophila melanogaster*.

Research in the past twenty years has demonstrated that humans and fruit flies are very similar at the molecular level. About 75% of known human disease genes have a recognizable match in the genetic code of *Drosophila melanogaster* (Reiter, et al., 2001) and 50% of fly protein sequences have mammalian analogs. Thus, *D. melanogaster* is an excellent animal model for studying a variety of human diseases. The fruit fly is currently being used as a genetic animal model to study the mechanisms underlying aging, immunity, diabetes, cancer, neurodegenerative diseases (Alzheimer's, Parkinson's and Huntington disease) and sleep disorders. Fruit flies have recently been used to study the toxicity of carbon nanoparticles (Brown University, 2009).

Drosophila melanogaster have the advantage over other animal models in that they are easy to handle, small in size, have a short life-cycle and are cheap and easy to keep large numbers. A large number of flies are usually grown in order to meet research demands. *Drosophila* larvae eat and grow continuously over a four-day period before hatching. Preparing food for these large numbers of larvae requires the preparation of large quantities of fly food (or fly media). Fly food must be dispensed into a large number of culture tubes or other vessels which can be very time consuming. This application note describes the use of an automated instrument for filling large numbers of culture vials with fly food or fly culture media.

Experimental Conditions

Preparing Fly Larvae Food

Fly food is a gel at room temperature. When heated to 65 degrees C., it becomes a liquid with a consistency of thin oatmeal that can then be dispensed into tubes or other vessels.

A typical recipe (this recipe was obtained compliments of the Yale School of Medicine, New Haven, CT) contains the following ingredients:

Ingredient	Quantity
Water	57,200 mL
Agar	355 g
Molasses	4700 mL
Corn Meal	3,840 g
Yeast	510 g
Propionic Acid	745 g

Propionic acid is added as an antifungal agent. There are alternative formulas which utilize the commercial anti-fungal agent known as Tegosept (contains methyl paraben).

The ingredients are mixed in a large heated pot with a large stainless steel stirrer (Figure 2). The fungicidal agent is added last after the solution has cooled to prevent any heat inactivation. The solution is then ready to dispense into appropriate vessels.

For automatic dispensing of the food, this pot serves as a reservoir from which the food is pumped to the Gilson 215 Liquid handler.



Figure 2. Heated pot with stirrer for making fruit fly larva food.

Automated Dispensing of Fly Food

Automation of the dispense process utilizes a Watson Marlow 620 DI Pump with a 625L pump head (flow typically 1.4 L/min) and a Gilson 215 Liquid Handler modified for dispensing the fly food into 5 vials simultaneously. See Figures 3 through 6.



Figure 3. Watson Marlow 620 Pump with 625L head used to pump food from heated pot to 215 Liquid Handler.

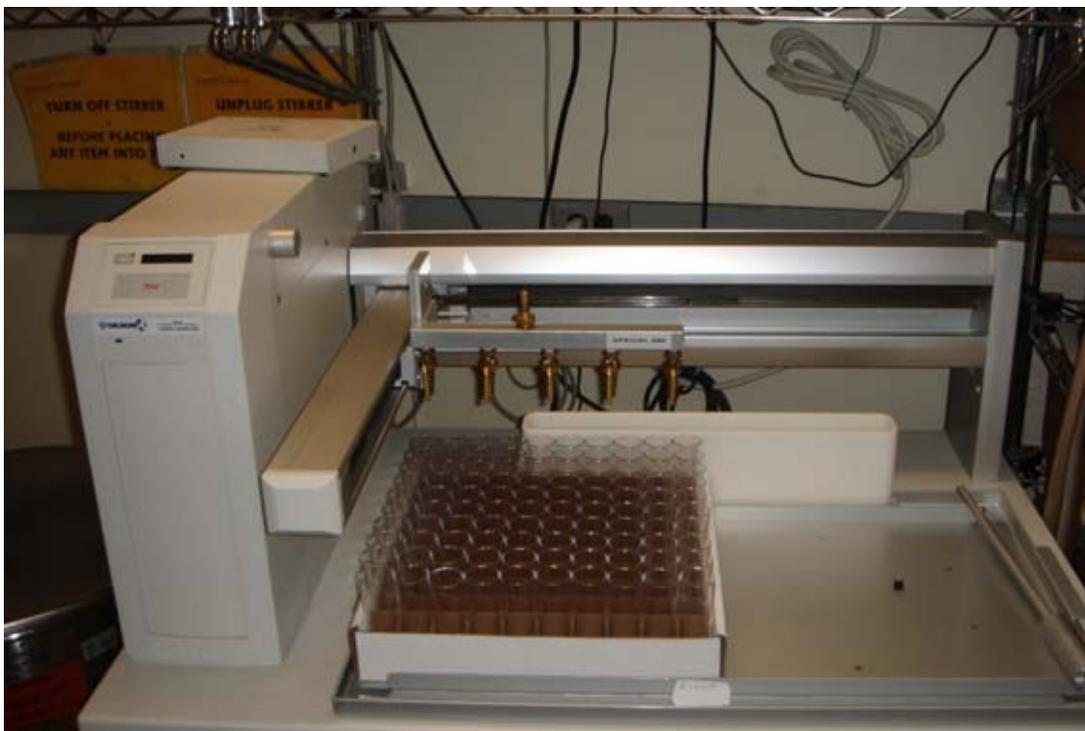


Figure 4. Gilson 215 Liquid Handler modified to dispense fly food. Note the “sinker” on the right side of the picture. This is used to hold the inlet tubing for the pump in the heated pot.



Figure 5. A close-up of the 215 Fly Food Dispensing Head.



Figure 6. Typical layout of a fruit fly food dispensing system. Note that some of the plumbing fixtures/connections may vary. The system can be customized to suit the needs of the lab.

Typical Hardware Items Needed to Convert a Gilson 215 Liquid Handler into an Automated Fly Food Dispenser.

Note: Modifications can be made to the standard configuration to best meet the needs of the individual laboratory.

Table 1. Hardware Items to Order from Gilson

Description	Part Numbers
215 Liquid Handler without syringe pump	2510191
Modified Z-arm to hold dispensing head and Modified PROM to remove Z control	Specials 737 and 738
Custom 5-channel dispensing head with plumbing fittings	Special 1541A
Inlet line sinker to hold pump inlet tubing into heated pot	Special 739
Wash Station	Special 482
Custom rack to hold fly food culture tubes and flasks. (See Figure 6.) Modifications of this rack are available.	Special 441

606 GSIOC-to-RS232 Converter (110/120V) with Special PROM and Software Driver	362841 and Specials 586 and 600
25-pin Female to 9-pin Male Adapter	36083130
Computer w/ Windows XP or earlier version of software	Can be purchased through Gilson (21101NG7F) or separately

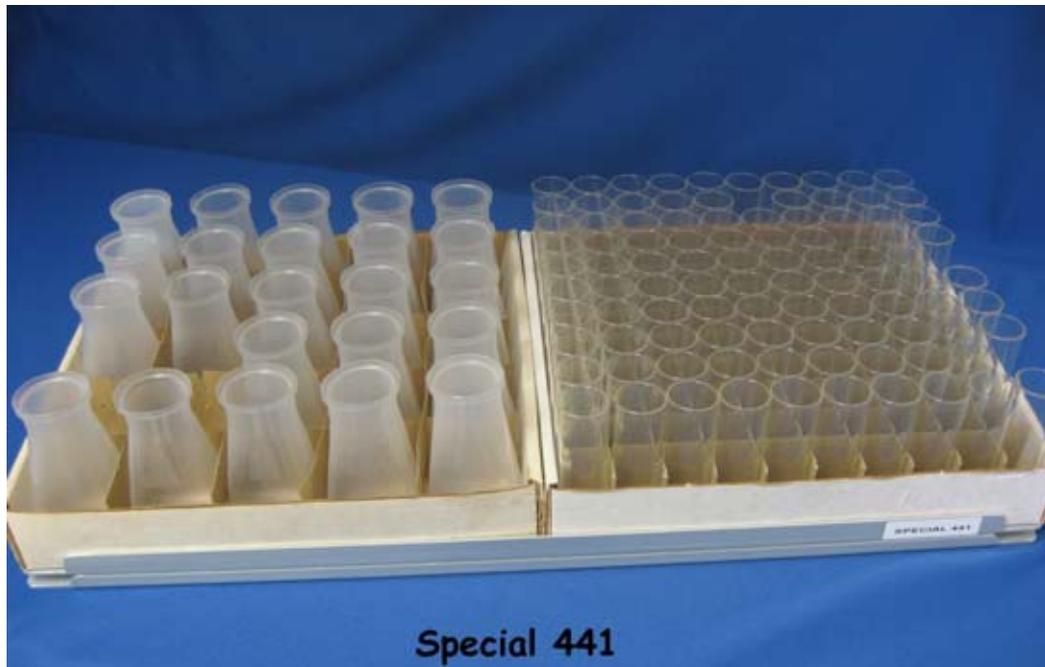


Figure 7. Special Rack 441. Note that trays can be customized and configured to hold different bottles and vials and are not limited to the rack displayed.

The following hardware must be obtained from other vendors:

- Watson Marlow 620 DI Pump with 625L Pump Head. This is available through your local Watson-Marlow distributor.
- Teflon Tape
- Two Brass Y Connectors, McMaster Carr part number 4429K361
- Two Brass Hose Fittings and Two Hose Clamps to Connect Y to 9.5mm ID Nalgene Braided Tubing, McMaster Carr part number 5346K19
- Five Barbed Hose Fittings and Five Hose Clamps to Connect Y to Both 16mm ID Marprene Tubing From Gilson 215 and 16mm Nalgene Braided Tubing, McMaster Carr part number 5346K65
- 16mm Nalgene Braided Tubing From Thermo Fisher, part number 14-169-10D
- 5/8 inch Pharmed Pump Tubing From Thermo Fisher, part number 14-170-08

Software for Automated Fly Food Dispenser

The Gilson 215 Automated Fly Food Dispenser System utilizes a custom program. (See Figure 7 below.) The Gilson part number is 257001 with description "Custom program for 215 Sampler, written". A software driver file is also needed for the 606 GSIOC-to-RS232 converter as noted in the table above (Special 586). The program is currently written for Windows XP.



Figure 8. Software program for operating the automated 215 Fly Food Dispenser System with a Watson Marlow Pump.

Conclusion

This article describes a fast and effective automated method for filling large numbers of culture tubes and flasks with food to grow large numbers of *Drosophila melanogaster* for use in medical research studies. For more information about using fruit flies for medical research, refer to the references cited.

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