

Natvig, L. R. 1948. Norsk Entomologisk Tidsskrift. Suppl. I. Contributions to the knowledge of the Danish and Fennoscandian mosquitoes Culicini. A. W. Broggers Boktrykkeri A/S, Oslo. 561 p.

Wesenberg-Lund, C. 1921. Contributions to the biology of the Danish Culicidae. Hovedkommissionær: Andr. Fred. Host & Son, KGL. Hof-Boghandel, Copenhagen. 210 p.

RECONSTITUTED COLLAGEN SAUSAGE CASINGS FOR THE BLOOD FEEDING OF MOSQUITOES¹

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The increasing cost and manpower requirements associated with the mass rearing of blood-feeding arthropods for research and biological control programs have made blood-feeding through membranes a viable alternative or adjunct to the use of living animals (Bailey et al. 1978). Numerous researchers (Tarshis 1958) have developed and evaluated techniques for the feeding of arthropods through natural and synthetic membranes. These have ranged from bat wing skin to latex prophylactic condoms, each with its advantages and disadvantages.

We have tested collagen sausage casings for the blood-feeding of 6 species of mosquitoes (*Aedes aegypti*, *Ae. taeniorhynchus*, *Anopheles albimanus*, *An. quadrimaculatus*, *An. stephensi* and *Culex pipiens*) and 2 species of blood-sucking bugs (*Rhodnius prolixus* and *Triatoma barberi*). The casings used are formed from processed beef hide corium collagen which has been chemically rearranged to form the pure collagen casings (Devro, 1976). Two sizes of sausage casings, #300-812-0 and #360-911-0 (Devro, Inc., Somerville, N.J.), were tested (Table 1). No difference between the 2 casings was noted in respect to mosquito probing activity or feeding to repletion after 14 trials using 28 sections of each size casing. Both sizes became

Table 1. Collagen sausage casings used for insect blood feeding.

Casing Number	Stuffed Diameter (mm)	Thickness (microns)*	Price \$/8 in Section
300-812-0	30	2.86 ± 0.20	\$0.0213
360-911-0	36	3.92 ± 0.16	\$0.0310

* Mean ± s.d. of measurements taken on 9 casings 1 hr after immersion in distilled water.

supple after a few seconds of exposure to blood or water, remained pliable through numerous feedings and were resistant to tearing. In tests using over 200 sections of casing only one hole, attributable to a defect in the casing, was detected.

We used blood-feeding methods similar to those of Bailey et al. (1978). Outdated human blood, to which 2.5 mg adenosine triphosphate per ml was added as a feeding stimulant, was used in all tests. Eight-inch sections of casing were cut and tied shut at one end with heavy string. The open end of the casing was slipped over the stem (20 mm diameter) of a powder funnel and secured with a second piece of string that could be pulled tight after slipping the filled casing off the funnel stem. The funnel was placed on a ring stand with the closed end of the casing in contact with the base of the stand (Fig. 1). Approximately 50 ml of blood was poured into the casing, which was then removed from the funnel. The air was expelled to prevent distention during warming, and the casing was tied shut. The blood filled casings were heated in a 44°C water bath for 10-15 minutes and transferred to the screened top of the insect rearing cage for 10-15 minutes to permit feeding. Placing a warm damp cloth over the heated casing extended the feeding time. The filled casings were reheated and reused until the colonies had been fed.

Mosquito colonies were allowed to blood feed once per week using the casing (#300-812-0, Table 1) and twice per week on anesthetized rabbits for 12 weeks. This regimen was followed by biweekly casing feedings and weekly rabbit feedings for 4 weeks. No noticeable changes in egg production or fecundity occurred. Observations indicated that, with the exception of *Cx. pipiens*, all strains would feed as well on the casings as on rabbits in respect to the number of mosquitoes feeding to repletion. *Cx. pipiens* were observed to feed less readily; however, this species showed no drop in egg production. After 2 weeks of feeding by the casing method exclusively, egg production

¹ The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense.

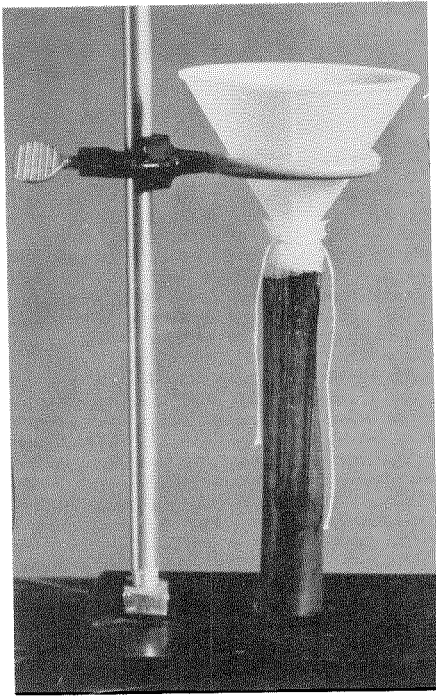


Fig. 1. Apparatus used for filling collagen sausage casings with blood.

fell in 11 of the 14 mosquito strains. Blood-feeding on rabbits was then resumed, and egg production returned to pre-experimental levels in all strains. We did not continue our feeding experiments long enough to observe the results of Bailey et al. (1978) who reported a 58% reduction in egg production after switching *An. albimanus* from feeding on rabbits to feeding on defibrinated bovine blood through sheep intestine membranes. They observed no marked effect on overall colony size, and egg production increased with time, presumably due to selection of an *An. albimanus* strain adapted to membrane feeding.

We used similar feeding methods for the blood-sucking bugs with the exception that smaller 4-inch sections of casing containing 25 ml of blood were used because of the smaller size of the rearing cages. Adult and larval insects of both species readily fed to repletion

following these procedures. We did not examine egg production and fecundity in *R. prolixus* and *T. barberi*.

The major advantage of these casings over other membranes used for arthropod blood feeding is their low price. Current prices for casings #300-812-0 and #360-911-0 are \$0.0213 and \$0.0310 per eight-inch section, respectively (Table 1). Bailey et al. (1978) obtained sheep intestine prophylactics (condoms) for \$0.17 to \$0.28; these had been cured, dried, and tested for holes, but not lubricated or packaged. These prophylactics can be used repeatedly, which lowers their per use cost; however, this requires that they be washed and stored between feedings. While the collagen casings can also be used repeatedly, washed and stored, their initial low cost makes disposal after a single use a cost effective method of membrane blood-feeding.

References Cited

- Tarshis, I. B. 1958. Feeding techniques for bloodsucking arthropods. Proc. 10th Int. Congr. Entomol. 3:767-784.
- Bailey, D. L., D. A. Dame, W. L. Munroe and J. A. Thomas. 1978. Colony maintenance of *Anopheles albimanus* Wiedemann by feeding preserved blood through natural membrane. Mosquito News 38:403-408.
- Devro, Inc. 1976. Specifications and data book for Devro edible collagen sausage casings. Somerville, N.J. pp 1-20.

NOISE LEVELS PRODUCED BY THE MICRO-GEN AND LECO ULV FOGGERS

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An evaluation of the noise produced by the Leco (Model HD) and the Micro-Gen (Model ED2-20A) Ultra Low Volume Foggers was conducted by the Benton County Mosquito Control District in July of 1979. This study was initiated in view of hearings held by the Department of Ecology on the noise produced by motor boats, and the testimony that was given at these hearings. The decibel level was checked on both machines in a typical residen-