A SIMPLE METHOD FOR MEASURING DESICCATION RESISTANCE OF SPIDER EGG SACS

Spider eggs are enclosed in a silken sac that can camouflage them, permit females to transport them, and protect them from desiccation, egg parasitoids, and fungal invasion. This protection extends from the time eggs are laid until spiderlings hatch, molt, and emerge as second instars, a period ranging from a few weeks in many species to several months in those that overwinter as eggs. This paper describes a simple method of evaluating and comparing desiccation protection provided by egg sacs and presents examples from the family Uloboridae.

As egg sacs are routinely encountered while studying or collecting spiders, this technique should provide additional information to both ecologists and systematists. Scanning electron microscope examination of uloborid egg sacs shows that spiderlings deposit little, if any, silk within the egg sac. Thus, empty egg sacs are satisfactory for this technique and desiccation retardation can be assessed without compromising ecological studies.

This technique uses egg sac samples as small as 3 mm square, thereby, allowing small egg sacs to be studied and large egg sacs to be divided into several samples. This also greatly reduces error imposed by the curvature of more rigid egg sacs. Each sample is sealed to the end of a glass capillary tube. In the example presented a 75 mm long hematocrit tube with an inner diameter of 1.2 mm and a wall thickness of 0.20 (±0.02) mm was used. Sealing was accomplished by pressing an open end of the tube lightly against the sample's inner surface and bonding the two with melted dental wax applied with a small brush (Fig. 1). Capillary action draws the melted wax to the perimeter of the tube's opening, but pressure exerted on the tube prevents the wax from extending inward beyond the tube wall. Preparations can be examined under a dissecting microscope to determine if the sample is properly sealed. Tubes are next partially immersed in distilled water, permitting capillary action to partially fill them. Critoseal vinyl plastic putty is pressed into the tube's open end to plug it and bring the water meniscus to within about

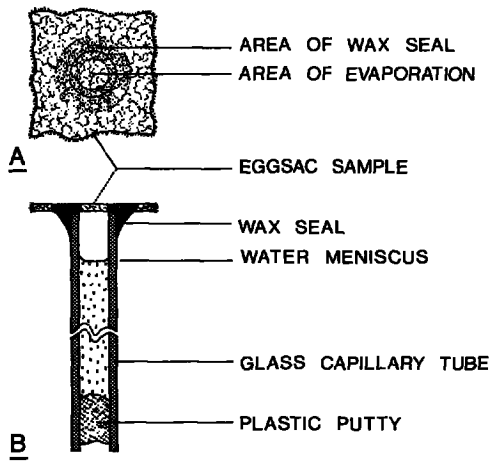

Fig. 1.–Egg sac sample preparation in top (A) and side (B) views.

5 mm of the sample (Fig. 1). These tubes and unsealed controls are individually weighed on an analytical balance before and after a timed evaporation period. Vacuum and desiccant were used in the following example to speed evaporation and reduce the likelihood of fungal contamination of samples. Mean water losses can be statistically compared using T-tests appropriate for samples with equal or unequal variances. Percent evaporation retardation is computed by dividing the evaporation difference of an open and sealed tube by the evaporative loss from an open tube. Because it takes into account experimental variables, this index can be used to compare the results of different studies.

Data from filter-paper-sealed and open tubes (Table 1) indicate that the lowest comparative value (C.V.) achievable with this method is about 10 and that roughly 60 percent of this error results from differences in sealing and the remainder from variability in tube diameter and water level and from weighing error.

Egg sacs of *Uloborus glomosus* (Walckenaer), *Hyptiotes cavatus* (Hentz), *Zosis geniculatus* (Olivier), and *Octonoba octonaria* (Muma) used in this study were kept in dry, stoppered vials prior to study. These lenticular egg sacs were separated into upper and lower halves and larger ones cut into several samples. Because *H. cavatus* attach their egg sacs to twigs rather than suspend them in the web, only the upper halves of these egg sacs were used in the study. Controls consisted of unsealed tubes and tubes sealed with either 0.2 or 3.0 μm Nucleopore nitrocellulose membrane filter. Tubes were individually weighed with a Mettler H-31 AR balance before and after being held at 22-24° c for 95-97 hours in a desiccator containing 3-8 mesh silica gel desiccant and a vacuum of 20 cm Hg.

Table 1 summarizes the results. When compared to open tubes, all egg sac and filter paper samples significantly reduced water loss ($p < 0.05$). Only *U. glomosus* egg sacs had significantly lower water loss than other treatments, although intact *H. cavatus* egg sacs had conspicuously lower values ($p < 0.18$) than remaining egg sacs ($p > 0.60$) and, in view of small sample sizes, probably also afford greater evaporation retardation for eggs.

When the outer two silk layers of *H. cavatus* egg sacs are removed, the remaining layer has thickness and evaporation retardation values similar to those of *Z. geniculatus* and *O. octonoba*. *Zosis geniculatus* is a pantropical species and *O. octonoba*, although found in the United States (Muma and Gertsch, 1964, Amer. Mus. Novit. No. 2196, pp. 1-43; Opell, 1979, Bull. Mus. Comp. Zool., 148:443-549), appears to be an Oriental introduction (Yoshida, 1980, Acta Arachnol., 29:57-64). By contrast, *U. glomosus* and *H. cavatus*

Table 1.–Water loss across egg sacs.

	Mean (sd) Evaporation Rate 10^{-2} mg/mm^2/hr @ 22-24°c, -20 cm Hg	Sample Size Number (Egg sacs)	C.V.	Mean Percent Evaporation Retardation
Uloborus glomosus	2.10 (0.10)	5 (5)	11.1	86
Hyptiotes cavatus	8.05 (1.39)	4 (4)	34.5	47
Zosis geniculatus	10.83 (1.05)	6 (4)	23.9	29
*Hyptiotes cavatus**	11.04 (0.88)	3 (3)	13.7	27
Octonoba octonaria	11.42 (1.71)	3 (2)	25.9	25
Filter paper (0.2 μm)	11.14 (0.39)	9	10.6	27
Filter paper (3.0 μm)	10.49 (0.50)	10	15.1	31
Open tube	15.19 (0.09)	48	4.3	0

*Egg sac with two outer silk layers removed.

are temperate species whose eggs may be subjected to dryer conditions. *Uloborus glomosus* egg sacs are produced from late June through July (Comstock, 1912, The Spider Book, 1st ed.; Kaston, 1948, Conn. St. Geol. Nat. Hist. Surv. Bull., 70:1-874; personal observations) and are, therefore, exposed to the year's hottest and driest conditions during the three to four weeks they contain eggs and spiderlings. Although *H. cavatus* egg sacs are produced in late summer and early autumn, they do not yield spiderlings until the following spring and, therefore, must protect eggs for about eight months.

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