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On the duration of the fertilization and of the waterproofing process of the egg in the genital duct of Drosophila female.

When the egg (mature oocyte) migrates from the ovaries to the uterus, it is fertilized by a spermatozoon coming from the ventral receptacle of the female. At the same time, a waterproofing of the external surface takes place. This can be easily demonstrated by the fact that, in the ovarioles, mature eggs are always highly permeable to distilled water, dyes or fixatives. However, eggs taken from the uterus are always strictly impermeable, so that the chorion can be removed by hypochloride without affecting the developing embryo.

The impermeability is determined by the deposition of a thin waxy layer below the chorion on the surface of the vitellin membrane. This is not a consequence of fertilization, because it occurs in the same way in virgin females. The origin of this wax is still a matter of speculation, as is also the duration of the waterproofing process. Concerning the latter, some details may be obtained by studying the kinetics of oviposition.

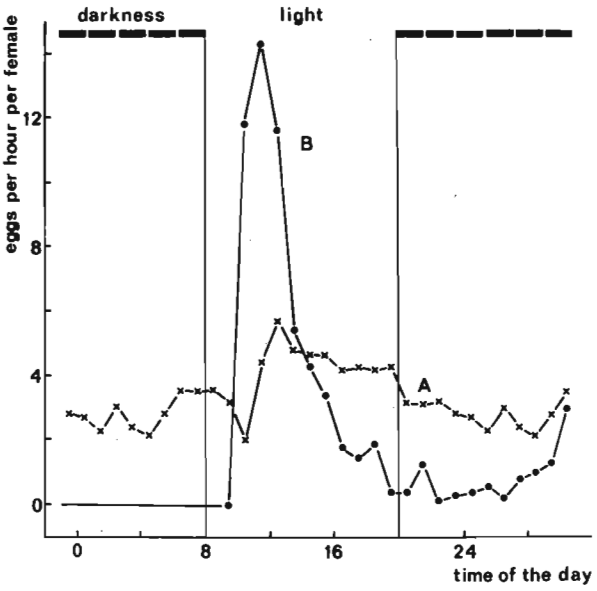

Figure: Hourly record of egg production by D. melanogaster at 25°C. A: curve of normally fed females (control). B: females starved for 24 hours, having mature oocytes in their ovaries, transferred to fresh food at 10 o'clock.

Under the optimal conditions, a female of Drosophila melanogaster can lay a little more than 120 eggs per day. In this species the circadian rhythm of oviposition is slight (David and Fouillet, 1972); so that the duration of fertilization and waterproofing can be estimated as being no more than 10 minutes. However it is possible to obtain more accurate data by inducing the deposition of a great number of eggs in a minimum period of time.

For this purpose, well-fed females, producing about 90 eggs per day, were deprived of food during 24 hours. Under these conditions, oviposition stopped completely, although the developing oocytes in the ovaries reach maturity. Many mature eggs in retention, sometimes more than 100 for a female, were thus observed in the ovarioles. After starvation, the flies were transferred to fresh food and the hourly egg production was recorded, using the technics of David and Fouillet (1972). Under such conditions, the females quickly laid the mature oocytes and it is probable that fertilization and waterproofing were the only limiting processes of the rate of oviposition.

The data (hourly curves of egg laying) are presented in the figure. Oviposition clearly reached a maximum of about 15 eggs per hour. Therefore it may be concluded that the minimum duration of the fertilization and of the waterproofing process at 25°C is only 4 minutes.

Moreover, when mature oocytes are in retention in the ovaries for some time, their volume decreases and their surface appears shrunk. This is probably the consequence of an osmotic phenomenon. The internal osmotic pressure of the oocyte cytoplasm is probably lower than that of the hemolymph. But, when such eggs are laid, they always appear normal and swollen. Therefore, it must be concluded that penetration of water, restoring a normal turgescence, takes place probably in the uterus, before the deposition of the waxy impermeable layer.

These observations illustrate the complexity and the rapidity of the changes taking place in the oocyte when it enters the uterus.

Reference: David, J., P. Fouillet, Enregistrement continu de la ponte chez D.m. et étude du rythme circadien d'oviposition. Rev. Comp. anim. (in press).