Endogenous synthesis of lipid yolk in mosquito oocytes

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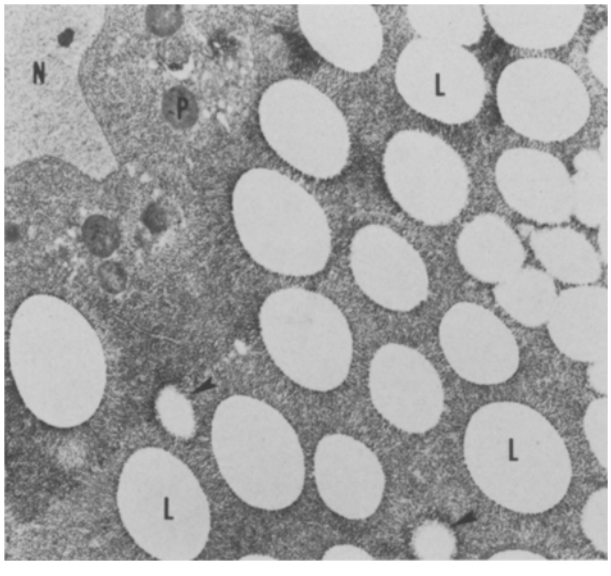
Summary. Morphological and physiological evidence indicate that lipid yolk in the mosquito is synthesized only within the oocyte within dense fields of free ribosomes. It does not come from the fat body or any other exogenous source.

Although it is well known that a considerable amount of protein yolk in insects in general initially arises outside of the oocytes in the cisternae of the rough endoplasmic reticulum of the adipocytes[2-4] we have almost no information on the site of origin of lipid yolk. Despite this fact, it seems to be generally assumed that the latter comes from the fat body too. The present note briefly summarizes evidence which indicates that all of the lipid yolk in the oocytes of the mosquito (*Aedes aegypti*) arises within these cells, and that none of it comes from an exogenous source.

We studied the fine structure of the oocytes and related tissues before, during, and after the eggs fill with both lipid and protein yolk in unfed and blood-fed mosquitoes which were bissected in ice-cold glutaraldehyde. The abdomens were postfixed in osmium, dehydrated in ethanol, and embedded in resin. Thin sections were treated with uranyl acetate and lead citrate, and electron micrographs were taken with a Phillips EM 200 electron microscope. The oocytes of the newly-emerged mosquito have no yolk whatever[5]. This is referred to as stage 1. During the 1st 21 h of adult life, during which time the mosquitoes will not feed on blood even if it is offered to them[6], a few small round yolk granules appear in the cytoplasm[5]. They appear as a delicate ring around the nucleus, as can be seen in fresh whole mounts examined with phase contrast microscopy. Oocytes in this condition are referred to as being in stage 2[5]. In *Aedes aegypti*, the oocytes will not develop further unless the female takes blood. Within 7 h after the females take a blood meal, their oocytes rapidly fill with protein yolk (stage 3). The oocyte then begins to enlarge (stage 4) and a chorion is partially laid down (stage 5)[5]. During and after the deposition of endochorion, the egg continues to grow in size. This postendochoronic period constitutes stage 6, a stage unrecognized heretofore. It seems likely that during this stage the oocyte makes a considerable amount of protein yolk endogenously.



Electron micrograph showing oocyte at 7 h post blood meal containing lipid yolk (L) and protein yolk (P) surrounding the nucleus (N). Ooplasm shows dense radiating patterns of ribosomes around each lipid droplet, arrows indicate lipid droplet in formation. × 11,150.

Although Troy et al.[7] refer to oogenesis in the mosquito as being divided into 4 vitellogenic phases, oogenesis refers to the formation, development, and maturation of the female gamete[8], and not merely to filling of an egg with yolk. The 1st phase of Troy et al.[7] is referred to as being previtellogenuc, but as our figure clearly shows the oocyte develops a little lipid and protein yolk in stage 2 before the blood meal. This occurs deep within the cell around the nucleus, and not at the oolemma, and clearly demonstrates that the oocyte itself has the capacity to make 2 kinds of yolk endogenously.

As shown in the figure, lipid arises within a dense field of free ribosomes. It forms without any specific relationship to either mitochondria or Golgi bodies. When the oocyte begins to fill with exogenous protein yolk which arose from the fat body cells, lipid develops throughout most of the ooplasm but does not appear initially at the cortex. Its formation is thus quite unlike that of protein yolk which is picked up at the surface of the cell. As the lipid droplet expands, it causes the ribosomes surrounding it to be shifted into radiating patterns (figure). The droplets are not secreted at the center of radiating arrays of ribosomes. Unlike protein yolk which grows remarkably in size and character, lipid yolk attains a maximum size and increases no further, and is always smaller than protein yolk in a stage 5 egg.

During this study, 3 out of 15 females did not show the normal sequence of vitellogenesis. All had been starved 4 days before giving them a blood meal. All engorged fully on blood. In each case, their fat bodies were much smaller than those of typical females, and had very little rough endoplasmic reticulum, at least 4 times less than in fat body cells of typical females 7 h after the blood meal. Further, their fat cells had almost no lipid or glycogen, whereas the typical females had both. Although the oocytes had very little protein yolk, they had all made a considerable amount of lipid yolk.

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