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A BIOCHEMICAL STRATEGY OF OOGENESIS AND EGG PROGRESS IN TRIATOMINES

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A Biochemical Strategy of Oogenesis and Egg Progress in Triatomines

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Abstract – In Triatomines, and additionally in different insects, amassing of yolk is a methodology in which an additional ovarian tissue, the fat body, produces yolk proteins that are pressed in the egg. The principle protein, blended by the fat body, which is aggregated inside the oocyte, is vitellogenin. This procedure is otherwise called vitellogenesis.

There are developing confirmations in Triatomines that furthermore fat body the ovary additionally processes yolk proteins. The way these yolk proteins enter the oocyte will be talked over. Yolk is a mind boggling material made out of proteins, lipids, carbohydrates and other minor segments which are pressed inside the oocyte in a composed way. Preparation triggers embryogenesis, a methodology where an embryo will improve. Throughout embryogenesis the yolk will be utilized for the development of another individual, the first instar sprite. The test for the one decade from now is to see how and where these egg proteins are utilized up together with their non-protein parts, in pace with the genetic system of the embryo, which empowers unit separation (unanticipated stage of embryogenesis) and embryo separation (late stage) inside the egg.

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INTRODUCTION

Throughout the advancement of species an extremely significant accomplishment, by Mother Nature, was the advancement of multicellular organisms beginning from a special unit, the treated oocyte. This system was embraced by most multicellular organisms and around them we can distinguish oviparous and non-oviparous living organisms. In oviparous organisms, incorporating insects, embryonic advancement happens separated from the maternal body. In this manner, egg survival depends on the use of awhile ago saved material for embryo's development. This material, the yolk, is formed of proteins, lipids, sugars and other minor parts, also is archived in a quite sorted out way inside the egg. Accompanying treatment the egg will offer ascent to a whole new life form. Throughout improvement, yolk will be continuously utilized as a part of agreement with the requirements of particular units forced by the genetic system of the embryo.

The amassing of yolk, or vitellogenesis, is a procedure in which additional ovarian tissues produce yolk protein forerunners, for example, vitellogenin (VG) the central protein of the oocyte (Postlethwait and Giorgi 1985, Raikhel and Dhadiala 1992). Because of the heterosynthetic nature of vitellogenesis in insects, their oocytes are particular for the particular amassing of yolk proteins. Accordingly, insect oocytes display an entire set of structures outlined to select, disguise and store particular proteins, such as microvilli, covered pits, covered vesicles and yolk granules. In most insects, a solitary phospholipoglycoprotein, notwithstanding named Vitellin (VT) to separate it from VG, is the fundamental part of the eggs and serves both for embryonic and, in a few cases, early larval improvement (Postlethwait and Giorgi 1985, Zhu et al. 1986, Oliveira et al. 1989).

Triatomines were the first aggregation of insects where the aggregation of an additional ovarian protein by vitellogenic oocytes was accounted for. The paper of Sir V.b. Wigglesworth in 1943 depicted the vicinity in the egg of Rhodnius prolixus of a pink pigment thatwas began from a hemolymphatic antecedent.

The pigment was thought to be incompletely corrupted hemoglobin "katahemoglobin". The pigment depicted by Wigglesworth was secluded fifty two years after the fact, and described as RHBP (Rhodnius Heme-Binding Protein) in our lab (Oliveira et al. 1995), a protein that capacities as a cell reinforcement while in the hemolymph (Dansa-Petretski et al. 1995) and which is aggregated inside the oocytes (Machado et al. 1998). The striking paper of Wigglesworth was, truth be told, the exact first report on the aggregation of an additional ovarian protein by vitellogenic oocytes, opening the trail that accelerated the characterization of VG uptake by Telfer (1954).

William Telfer (1960) was the first individual to cohort endocytosis with yolk affidavit in oocytes of Hyalophora cecropia. He reported a particular amassing of hemolymph-borne proteins and, in 1961, the track of passage in yolk granules. Before long, Roth and Porter (1964) and Roth et al. (1976) watched, in oocytes of the mosquito Aedes aegypti, the vicinity of covered vesicles, the cellular structures connected with specific endocytosis. These were the pioneering reports that were emulated by an colossal measure of different reports that supported the introductory examinations, as checked on by Telfer et al. (1982), Raikhel and Dhadiala (1992), and Snigirevskaya furthermore Raikhel (2004). These studies headed to real breakthroughs in our comprehension of how macromolecules are consumed from encompassing extracellular liquids into both mammalian and insect units.

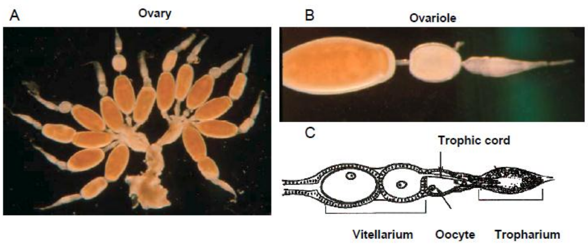

Fig. 1 – The ovary of *Rhodnius prolixus*: The ovary was dissected at day 5 after blood meal and spread onto a glass slide and photographed. The ovary (A) is composed of two hemi-ovaries that are connected by a common oviduct. Each hemi-ovary is composed of seven structures named ovariole. From the hemi-ovary depicted at the right side of Fig. 1A one ovariole was removed to be shown in detail (B). A line drawing of the ovariole is shown in (C), in order to represent the internal structures (After Huebner and Anderson 1972).

oocytes of triatomines necessity different parts such as heme, calcium, and likewise mechanical insurance of the egg and security against microorganisms, since embryo advancement happens outside maternal body. When treated, the egg is laid and the embryo advancement is started. Thus, parts important for embryo advancement, for example, DNA, proteins, lipids, carbohydrates and enzymes should all be stuffed inside the egg.

THE OVARIES OF TRIATOMINES

An expansive range of studies with hemipterans, incorporating triatomines, has secured that they are telotrophic (Bonhag 1955, 1958, Davis 1956, Masner 1968, Brunt 1971, Huebner and Anderson 1972, Schreiner 1977, Couchman and King 1979, Buning 1981). Telotrophic ovary is a truly mind boggling structure; as demonstrated in Fig. 1a R. prolixus ovary is made out of two hemi-ovaries. Every hemi-ovary is made out of seven structures named ovarioles which are portrayed in Fig. 1b. Interior structures of the ovariole are portrayed in Fig. 1c. The cell science what's more structures of telotrophic ovaries were explored by Telfer et al. (1982) and Huebner (1984).

A female of R. prolixus has the ability to generate around 40 to 42 eggs in 15 days after a solitary blood supper, accordingly every ovariole has the ability to generate more or less three eggs, since Rhodnius ovary holds 14 ovarioles. The way these eggs are transformed will be remarked here. The reason for this survey is to carry into exchange the oocyte proteins of triatomines, particularly in light of the fact that these insects eat blood and use them as substrates to advance their eggs. We present a concise overview of the principle proteins and attempt to depict their mode of entrance, their gathering inside the oocyte and their utilization by the developing embryo.

Around the proteins that will be remarked are Vgs, lipophorin, Rhodnius Heme-tying protein (RHBP) and Rhodnius Calcium-tying Protein (RCBP). The association of enzymes, for example, phosphatases, proteases and kinases in the assembly of yolk, throughout embryogenesis, will likewise be remarked.

LIPOPHORIN

Throughout oogenesis in insects, oocytes amass a extraordinary measure of lipids, which are supplied by lipophorin, a real hemolymphatic lipoprotein (Chino et al. 1981, Kawooya and Law 1988, Sun et al. 2000, Ziegler and Ibrahim 2001). Lipophorin transports diverse classes of lipids, for example, diacylglycerol, phospholipids, cholesterol, hydrocarbons, free fatty acids, between insect different tissues, concurring to physiological interest (Soulages and Wells 1994, Blacklock and Ryan 1994, Ryan and Van der Horst 2000). Hematophagous insects, for example, the triatomines R. prolixus and Panstrongylus megistus, ingest a lot of blood at every dinner and, like it happens in different insects, assimilation causes the arrival of free fatty acids in midgut lumen which, after retention, are utilized within the midgut epithelium for the union of different lipids, as phospholipids, cholesteryl esthers, tri- and diacylglycerol (Tsuchida andwells 1988, Turunen and Crailsheim 1996, Canavoso et al. 2004, Grillo and Gondim, unpublished information). Lipids are then exchanged to circling lipophorin that transports them to the organs where they are archived or used (Atella et al. 1995, Coelho et al. 1997, Canavoso et al. 2004).

In R. prolixus, oocytes store triacylglycerol (Santos and Gondim, unpublished information), perhaps in lipid droplets, that will be utilized throughout embryogenesis, as talked over underneath. Thus, in triatomines, lipophorin most likely conveys not just phospholipids, at the same time likewise diacylglycerols to the developing oocytes, as it does in Manduca sexta, where the interest of a layer cohorted lipoprotein lipase may be included (Van Antwerpen et al. 1998). In this moth, where lipophorin of two thickness classes (Beenakkers et al. 1988) might be found in grown-up hemolymph, Hdlp (high thickness lipophorin) is consumed, cohorted lipids are uprooted and the lipoprotein is changed over to a quite high thickness lipophorin (Vhdlp) inside the oocytes, and saved there (Kawooya et al. 1988).

Be that as it may, in this same insect, most lipids are supplied to the ovaries by flowing Ldlp (low thickness lipophorin), that exchanges lipids to the oocytes without protein fuse (Kawooya and Law 1988). In an alternate lepidopteran, Hyalophora cecropia, lipophorin is additionally aggregated by the ovaries (Telfer et al. 1991), and in the mosquito Aedes aegypti this lipoprotein might be found in oocytes (Sun et al. 2000).

EICOSANOIDS AS LOCAL REGULATORS OF OOGENESIS

The control of insect oogenesis is connected with hormones, for example, adolescent hormone and ecdysone (Engelmann 1979, Kunkel and Nordin 1985). These hormones control the amalgamation of yolk protein and its receptors (Raikhel and Dhadiala 1992); the patency of follicular cells (Sevala and Davey 1989, Raikhel and O'lea 1991); and uptake of yolk proteins (Stoffolano et al. 1992). The incredible intricacy also mixed bag of cells that form insect ovaries propose the interest of neighborhood go betweens that additionally control and direction oogenesis. Be that as it may, neighborhood go betweens which could help in the control of oogenesis are minimal caught on.

Eicosanoids are nearby lipid go betweens transformed from the oxygenation of C20 polyunsaturated fatty acids, most quite arachidonic harsh corrosive (C 20:4ω-6). When discharged from layer phospholipids, arachidonate might be oxygenated via prostaglandin G/h synthase (cyclooxygenase) or (5-, 8-, 12-, 15-) lipoxygenases to structure prostaglandins (Pgs), leukotrienes (Lts) or identified hydroxy acids, which can assume a part as intra or extracellular indicators (Smith 1989, Stanley 2000, Funk 2001). These mixes control numerous physiological and physiopathological forms notwithstanding tweaking provocative what's more immunological reactions in vertebrates (Samuelson 1983, O'neill and Ford-Hutchinson 1993, Murdoch et al. 1993, Funk 2001, Pai et al. 2003), yet their preparation is not confined to these creatures, as numerous invertebrate species have been demonstrated to handle Pgs and Lts (Meijer et al. 1986, Stanley- Samuelson et al. 1991, Petzel et al. 1993, Stanley- Samuelson and Pedibhotla 1996, Stanley 2000, Reddy et al. 2004)

Eicosanoids have several actions in reproductive biology of vertebrates (Murdoch et al. 1993, Priddy and Killick 1993, Funk 2001), which have encouraged many research groups to study their relevance in insect reproduction. The first report on the biosynthesis of eicosanoids in the insect reproductive system was in the house cricket *Acheta domesticus* by Destephano and Brady (1977). They showed that male testes and seminal vesicles were able to produce PGs, and a PG synthesizing complex was transferred from male to female via spermatophore during mating. That study also showed that PGs have had a stimulating effect on egg-laying behavior. Since then, the prostaglandin biosynthesis has been recognized in reproductive tracts of several insects as *Bombyx mori* (Yamaja-Setty and Ramaiah 1979), *Teleogryllus commodus* (Loher et al. 1981), *Trichoplusia ni* (Hagan and Brady 1982), *Locusta migratoria* (Lange 1984), *Musca domestica* (Wakayama et al. 1986), *Triatoma infestans* (Brenner and Bernasconi 1989) and *R. prolixus* (Medeiros et al. 2002).

The late 1980s and the 1990s saw many reports on molecular biology of genes involved with eicosanoid signaling in mammals, but this is still to be achieved in invertebrates (Stanley 2000). Thus, the insect genomes (Heckel 2003), trancriptomes and proteomes of some organs of these animals could bring light to this area, allowing a better understanding of synthesis, targeting and metabolism of eicosanoids in insect reproductive physiology.

CONCLUSION

Although VT is the most represented protein in the majority of insect eggs studied, a classicalwork done byYamashita and Irie (1980) on *B. mori* showed that eggs with noVGin them can produce normal insects.

They demonstrated thatVGorVT is not essential for egg maturation and embryonic development. Thus, other proteins can replace the function played by VT in normal egg development. In *R. prolixus*, the presence of three different populations of VT with different origins, produced at different periods of oocyte maturation, suggests that each of them may play different roles during embryogenesis. In *B. mori*, part of these roles was substituted by different proteins. Insects adapted to food sources as different as the blood of vertebrates and plants produce VGs (lipoglycophosphorylated proteins) which are stored inside their eggs. These molecules contain most, but not all, of the basic elements needed to construct an embryo, including amino acids, carbohydrates, and lipids. Non-VT yolk proteins, such as RHBP, RCBP and lipophorin of *R. prolixus*, play a specialized role. Each insect has its own particular non-VT protein, possibly complementing particular nutritional elements in function of its adaptation to a particular source of food during evolution.

Among triatomines information on VT and non-VT proteins is very scarce yet and future research must include efforts on the characterization of these types of molecules in species other than *R. prolixus*. Cloning sequencing and expressing receptors for VT and non-VT yolk proteins will be crucial to understand the cellular pathway involved with the yolk granule assembly, and to give us some clues about the role performed by each of the non-VT yolk proteins during embryogenesis of triatomines. The localization of these proteins and receptors inside the oocyte but also the characterization of the organelles to which they are associated must be subject of future research. Although yolk granules seem morphologically very similar, they are probably heterogeneous in composition and play distinct function. Insects initiate their embryonic development, after fertilization, by nuclei fusion followed by mitotic nuclear division without the corresponding cytoplasmatic division, resulting in a sincitial blastoderm. Cellularization takes place at the periphery of the egg, and the embryo initiates its development in the cortical area of the egg. Thus, the yolk granules of the cortical area may possibly be different from those found in the central core. The yolk is used gradually, during embryogenesis, supplying materials to support metabolic demands of growing embryo dictated by the genetic program of the insect. As VT can be replaced by other proteins, non-VT proteins seem to be essential for providing specific substrates, such as their associated non-protein component such as heme, calcium, iron and lipids for embryo formation.

Enzymes of maternal origin (proteases, phosphatases, kinases and proton-pump enzymes) involved with the degradation of yolk can, possibly, be differentially distributed inside the egg. Immunolocalization of enzymes and other non-VT yolk proteins along with the different populations ofVT will give us a good picture about the organization of the insect egg and will help us to understand the physiology of embryo development. The common fact observed during early embryogenesis, that only part of the total content of VT is used along with some non-VT proteins, is consistent with the idea of differentVT populations playing different roles during embryogenesis.

Finally, it is necessary to recognize that this review is a consequence of a lifetime effort by Dr. Lent who encouraged young Brazilian students and scientists to engage in the study of triatomines. We were all stimulated by reading his papers, books and notes, and also by the scientists he trained.

REFERENCES

- Allerton SE and Perlmann GE. 1965. Chemical characterization of the phosphoprotein phosvitin. J Biol Chem 240: 3892–3898.

- Chino H, Downer RGH, Wyatt GR and Gilbert LI. 1981. Lipophorin, a major class of lipoprotein of insect haemolymph. Insect Biochem 11: 491.

- Beenakkers AMTh, Chino H and Law JH. 1988. Lipophorin Nomenclature. Insect Biochem 18: 1–2.

- Fagotto F. 1991. Yolk degradation in tick eggs: III. Developmentally regulated acidification of the yolk spheres. Develop Growth and Differ 33: 57–66.

- Braz GRC, Abreu L, Masuda H and Oliveira PL. 2001. Heme biosynthesis and oogenesis in the bloodsucking bug, *Rhodnius prolixus*. Insect Biochem Mol Biol 31: 359–364.

- Davey KG. 1987. Inputs to the hormonal control of egg development in *R. prolixus*. Mem Inst Oswaldo Cruz 82: 103–108.

- Kawooya JK and Law JH. 1988. Role of lipophorin in lipid transport to the insect egg. J Biol Chem 263: 8748–8753.

- Blacklock BJ and Ryan RO. 1994. Hemolymph lipid transport. Insect Biochem Mol Biol 24: 855–873.

- Downer RGH and Chino H. 1985. Turnover of protein and diacylglycerol components of lipophorin in insect haemolymph. Insect Biochem 15: 627–630.

- Couchman J and King PE. 1979. Germarial structure and oogenesis in *Brevicoryne brassicae* (L) (Hemiptera:Aphiidae). Int J Insect Morphol Embryol 8: 1–10.

- Zhang Y and Kunkel JG. 1992. High abundance calmodulin from *Blatella germanica* eggs binds to VT subunits but disappears duringVT utilization. Insect Biochem Mol Biol 22: 293–304.

- Engelmann F. 1970. The Physiology of Insect Reproduction. Oxford, NewYork: Pergamon Press.