Zoology

VITELLOGENESIS

B.Sc. III
Sem V

Yolk is the most prominent cytoplasmic component of the egg in many animals. The process of laying down yolk in the primary oocyte is called vitellogenesis. It takes place in the prophase - I of meiosis.

a) Composition of yolk:

Yolk is a heterogenous substance, a mixture of many chemical substances which vary in different animals. Its main components are proteins, phospholipids, neutral fats & glycogen.

The yolk in which proteins dominate is called protein yolk & that in which phospholipids & fats dominate is termed fatty yolk.

Both types of yolk are present in the eggs of most oviparous & ovoviviparous animals. Protein yolk is the main food reserve in the eggs of many invertebrates & in lower chordates.

b) Forms of yolk:

Yolk occurs in the eggs in two forms: granules & platelets.

Eggs of invertebrates & lower chordates have yolk in the form of granules & is called granular yolk.

In vertebrate eggs, yolk is present as large, flattened ovoid, membrane bound organelles called yolk platelets. The yolk platelets consist primarily of 2 components: phosvitin & lipovitin.

Phosvitin is a phosphoprotein. About half of the aminoacid residues in phosvitin are phosphorylated serine.

Lipovitin is a lipophosphoprotein. It contains about 17% lipid.

The yolk forms about 45% of the weight of the amphibian egg & as much as 90% or more of the bird egg.

c) Synthesis of yolk:

Yolk synthesis is of 2 types: autosynthesis, in which the raw materials for yolk production are formed in the oocyte itself. & heterosynthesis, in which the raw materials are formed outside the oocyte & imported into it.

Yolk production in vertebrates is mainly heterosynthetic. The yolk precursor vitellogenin is synthesized in the maternal liver & carried by blood to the ovaries by receptor-mediated endocytosis.

The endocytotic vesicles have a bristle coat of protein (clathrin) on the cytoplasmic side & a fuzzy layer of glycocalyx (glycolipid & glycoprotein) on the extracellular side.

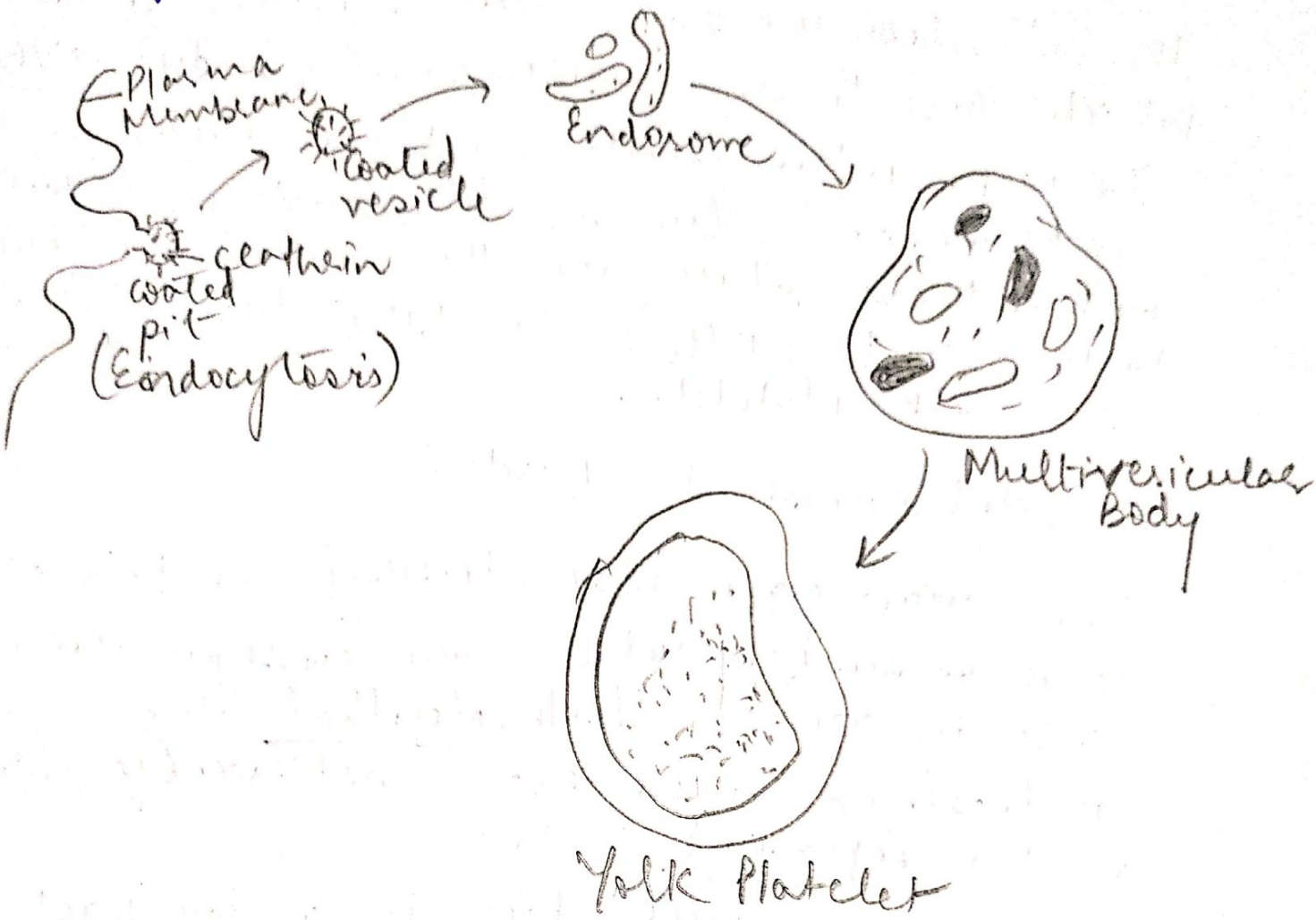
The vesicle recieve vitellogenin & pinch off from the plasma membrane & form coated vesicles. The latter lose the bristle coat to become endosomes which fuse to form multivesicular bodies (MVBs). The MVB contains small membrane vesicles in a membrane bound lumen. Yolk condenses & crystalizes within MVBs which are then called primordial yolk platelets (PYPs). The latter fuse to form the yolk platelets.

→ Vitellogenesis in Birds:

The avian egg is macrolecithal (contain a very large amount of yolk & are consequently very large in size) & heterolecithal (the yolk is localized in the egg & not evenly distributed in the ooplasm).

The avian yolk lies in a compact mass inside the egg & the cytoplasm is restricted to a thin layer on the surface with a thickened cytoplasmic cap on the upper side. This cytoplasmic cap contains eggs nucleus. Most of the yolk is liquid but about 23% of the yolk occurs as solid yolk spheres. The composition of yolk is 48.7% water, 16.6% proteins, 32.6% phospholipids & fats. The proteins & lipids of yolk are produced in the liver & then transported to the ovary by blood.

Phosphovitin & lipovitin are the main proteins of bird yolk.



Formation of yolk platelet from endocytosis vitellogenin.