OOGENESIS

The process of production of ovum is known as Oogenesis. The process of oogenesis occured in the cells of the germinal epithelium of the ovary, such cells are known as primordial germinal cells.

The Oogenesis is completed in the following three successive stages:

1. Multiplication phase
2. Growth phase
3. Maturation phase

1. Multiplication phase:

The primordial germinal cells divide repeatedly to form the oogonia. The oogonia multiply by the mitotic division and form the primary oocyte which pass through the Growth phase.

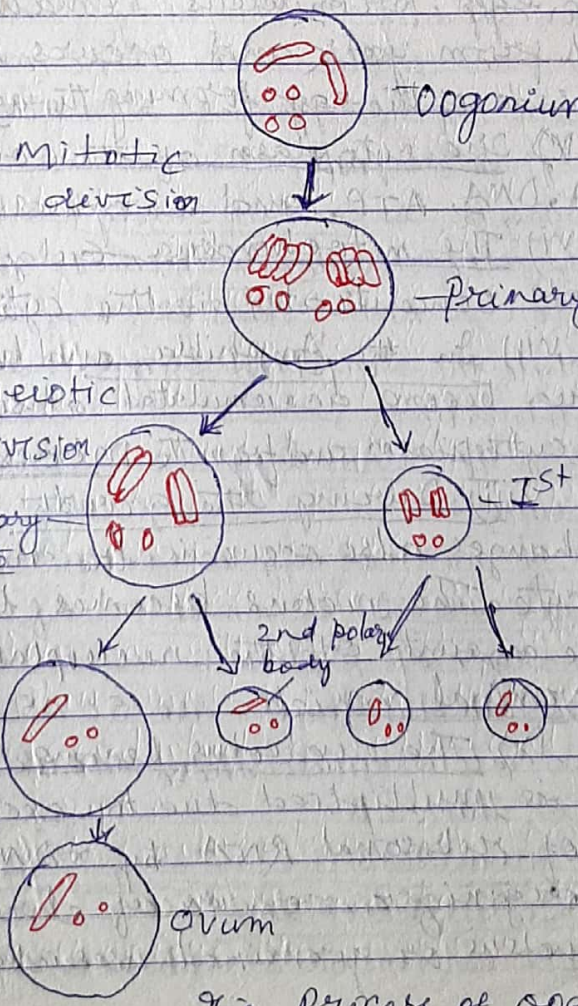

Fig- Process of Oogenesis.

2) Growth phase :

i) The growth phase of Oogenesis is comparatively longer than the growth phase of Spermatogenesis

ii) In the growth phase, the size of the primary Oocyte increase enormously. For instance, the primary oocyte of the frog in the begining has diameter of about 50 µm but after the growth phase the diameter became 1,000-2000 µ

iii) In the primary oocyte, large amount of fate and protein becomes accumulated in the form of yolk and due to its heavy weight or gravity, it is usually concentrated towards the vegetal pole.

iv) The portion of the cytoplasm containing the egg, pronucleus remains often separated from yolk and occurs towards the upper side of the egg forming the animal pole.

v) The cytoplasm of the oocyte become rich in RNA, DNA, ATP and enzymes.

vi) The mitochondria, Golgi apparatus, ribosomes etc concentrated in the cytoplasm of oocyte

vii) In the Amphibia and birds the mitochondria become accumulated at some place in the oocyte cytoplasm and form the mitochondrial cloude

viii) During the growth phase tremendous changes also occur in the nucleus of primary oocyte. The nucleus becomes large due to the increase amount of the nucleoplasm and is called germinal vesicle.

ix) The nucleolus become large or its number is multiplied due to excessive synthesis of ribosomal RNA by rDNA of nucleolar organizer region of chromosomes. Thus, the nucleus or germinal vesicle or primary

oocyte or triturus has six hundred nucleoli, of Siruden has one thousand nucleoli and xenopus has 600~1200 nucleoli due to synthesis of rRNA.

x) The chromosomes change their shape and become giant lampbrush chromosomes which are directly related with increase transcription of mRNA molecules and active protein synthesis in the cytoplasm. When the growth of the cytoplasm and nucleus of the primary oocyte is completed it becomes ready for the maturation phase.

3) Maturation phase:

i) The maturation phase is accompanied by the maturation or meiotic division. The maturation division of the primary oocyte differs greatly from the maturation division of spermatocyte. Here after the meiotic division of the nucleus, the cytoplasm of the oocyte divides unequally to form a single large size haploid egg and three smaller haploid polar bodies or polocyte at the end.

ii) This type of equal division has the great significance for the egg. If the equal division of primary oocyte might have been resulted, the stored food amount would have been distributed equally to the four daughter cells and which might prove insignificant for the developing embryo.

Therefore, these unequal division allow one cell out of the four daughter cells to contain most of the cytoplasm and reserve food material which is sufficient to the developing embryo

a) First Maturation division:-

i) During the first maturation division of first meiosis, the homologus chromosomes of the

primary oocyte nucleus pass through pairing or Synapsis, duplication, chaisma formation and crossing over.

ii) Soon after nuclear membranes break and bivalent chromosomes moves towards the opposite poles due to contraction of chromosomal fibres. A new nuclear envelope is developed around the daughter chromosomes by the ER.

iii) After the karyokinesis the unequal cytokinesis occure and a small haploid polar body or polocyte and a large haploid Secondary oocyte or ootid are formed.

b) Second Maturation division:

i) The haploid Secondary oocyte and first polar body pass through the second meiotic division.

ii) Due to the second meiotic division the Secondary oocyte forms a mature egg and a Secondary polar body or polocyte.

iii) By the Secondary meiotic division the first polocyte also divide into two Secondary polocytes. The polocyte ooze out from the egg and degenerate while the haploid egg cell becomes ready for the fertilization.

STRUCTURE OF MATURE Egg:

① plasma membrane:

i) The mature egg is covered by a plasma membrane. It is composed of an outer and an inner layer of protein.

ii) Both the layers are 50 A° in thickness. Between the protein layer there occur a lepid layer of 60 A° thickness.

② Primary egg membrane:

i) In addition to plasma membrane, the eggs of most animals consists of certain

other additional egg membranes.

ii) These membranes are known as the primary and secondary egg membrane. The primary egg membrane is secreted around the plasma membrane by the oocyte itself and known as vitelline membrane and in some others is known as chorion.

iii) The mammalian eggs contain similar membrane and called zona pellucida.

iv) The vitelline membrane usually remain closely adhered to the plasma membrane and this space is known as the previtelline space.

3) Secondary egg membranes:

i) The secondary egg membranes are secreted by the ovarian tissues around the primary egg membrane.

ii) They are either composed of either jelly coats amphibians or chitinous shells in insects, ascidians and cyclostomes.

4) Tertiary egg membrane:

i) The tertiary egg membrane are formed by the oviduct or other accessory part of the female reproductive system.

ii) They may be composed of either jelly coats in amphibia, albumen and hard horny capsule in elasmobranch fish or albumen, shell membrane and calcareous shell in birds.

5) The ooplasm:

i) The cytoplasm of the egg cell is known as ooplasm. The ooplasm consists of large amount of reserve food material in the form of yolk.

ii) It is also composed of lipoprotein, pigment granules, water, RNA, ribosomes, mitochondria and various other cellular inclusions.

iii) The peripheral layer of ooplasm is known as the cortex and it contain many microvilli

and cortical granules. The microvilli are formed by the outpushing of the plasma membrane and help in transportation of the substances from the follicle cells to the egg during development of the egg.

(v) The cortical granules are surrounded by the unit membrane and are originated from Golgi apparatus. They contain homogenous and granular acid mucopolysaccharides and are present in the egg of Sea-urchin, frog, fishes, bivalves molluscs, some annelids and certain mammals. But they are not occur in the Ova of man, rat, guinea pig, gastropod molluscs, Urodele amphibians, insects, Bird

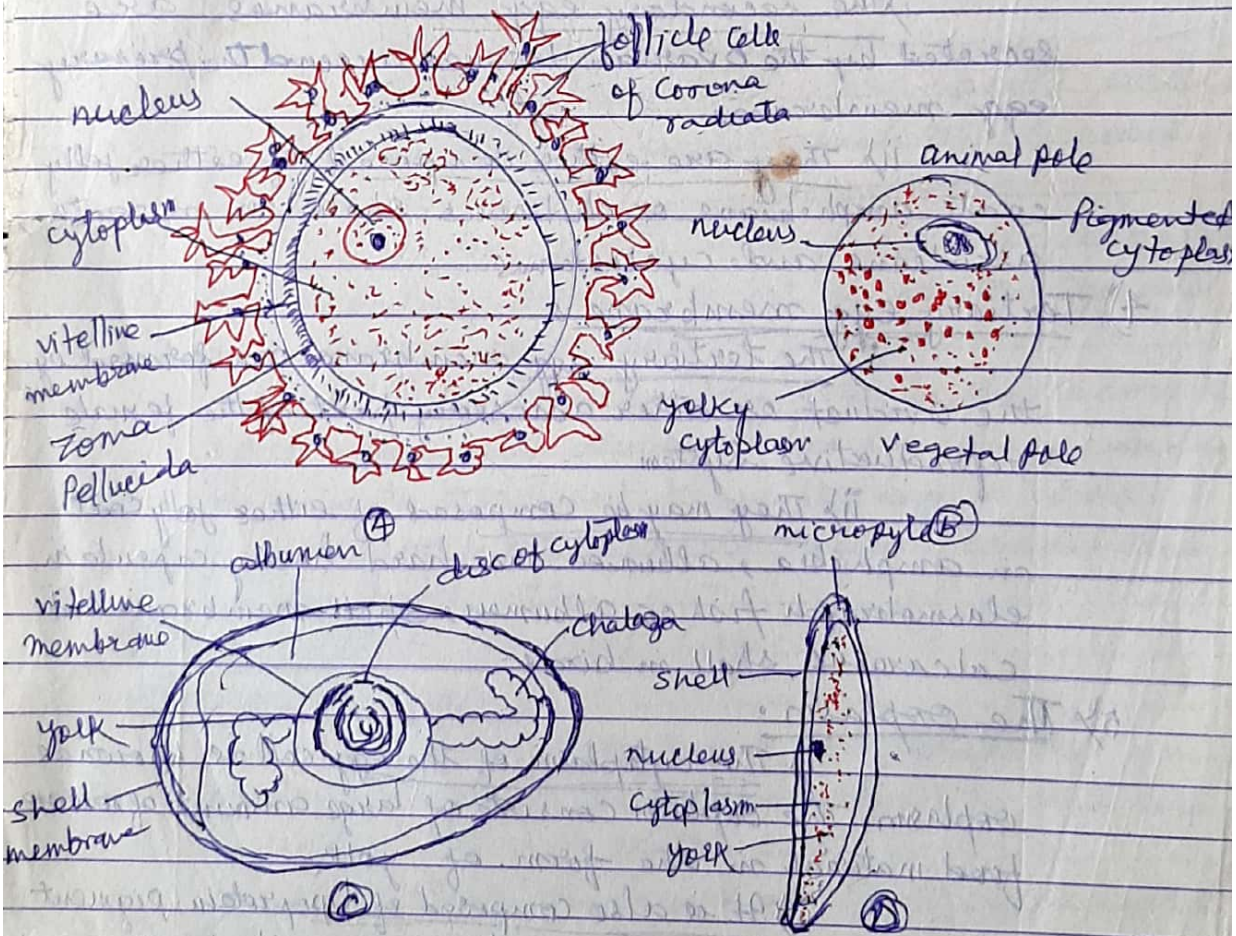

Fig - Four main types of eggs. ~~egg of man~~
(A) Microlecithal or Isolecithal - egg of man
(B) Mesolecithal & (C) Macrolecithal - egg of hen.
(D) Macrolecithal & Centrolecithal - egg of insects