S. S. College, Jehanabad

Department: Zoology

Class: M.Sc. Semester IV

Subject: Zoology

Topic: Role of maternal factors in early zebra fish development

Mode of teaching: Google classroom & WhatsApp

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IV th Semester

Q:- Role of maternal factors in early zebra fish development.

Ans:- **Introduction.**

All processes that occur before the activation of the zygotic genome at the mid blastula transition are driven by maternal products, which are produced during oogenesis and stored in the mature oocytes. upon egg activation and fertilization, these maternal factors initiate developmental cascades that carry out embryonic developmental program. Even after the initiation of zygotic gene expression, perduring maternal products continue performing essential function, either together with other maternal factors or through interaction with newly expressed zygotic products.

Advances in Zebrafish research have placed this organism in a unique position to contribute to a detailed understanding of the role of maternal factors in early vertebrate development. Zebrafish oogenesis and early development the function of these factors in axis formation, germ ~~layer~~ layer and germ cell specification and other early embryonic process.

(A) Intraovarian transplantation

(a) Variation in DNA during oogenesis-

DNA (Cytosine-5) methyltransferase (dnmt-1) temporal and spatial pattern of expression in gonadal tissues and during early development. only one dnmt-1 message of around 5 Kb was observed in all tissues examined and its levels were highest in gonadal tissues. During the course of oogenesis, early oocyte contains significant amount of dnmt-1 transcript while message abundance declines as oocytes mature. During early embryogenesis message levels remain low until blastula stage.

Methyletransferase enzyme assays reveal that the maternal dnmt-1, message accumulated during oogenesis is translated into protein providing necessary dnmt-1, stockpiles to support early embryonic development prior to zygotic gene activation. Such spacial and temporal regulation of dnmt-1, expression suggest specific function for enzyme during oogenesis and early development of zebrafish.

(6) Maternal Control of germline development

Maternal RNAs and Protein play critical roles in oocyte development and the earliest steps of embryogenesis such as fertilization, cell division and embryonic patterning.

Maternal gene effects

Maternal factor roles in maternal gene — Maternal gene products are generated during oogenesis and supplied to the egg. The period of maternal control of embryonic development varies among animals according to the onset of zygotic transcription and the persistence of maternal gene products.

However, recent maternal effect screens in the zebrafish have generated more than 40 unique mutants that are providing new molecular entry point to the maternal control. The mutant genes regulate (12-mutant gene animal-vegetal polarity, egg activation, cleavage development, body plan formation tissues morphogenesis, micro RNA function and germ cell development.

Maternal and zygotic Control

Dorsoventral axial patterning

During oogenesis ~~and~~ a maternal factor is localized to the vegetal pole of the oocyte that is determinant of dorsal tissues. Following fertilization this vegetally localized dorsal determinant is ~~exist~~ asymmetrically translocated in the egg and initiates formation of the dorsoventral axis.

Dorsoventral axis formation and patterning is then mediated by maternal and zygotic factor acting through Wnt, BMP (bone morphogenetic protein), Nodal and F.G.F. (fibroblast growth factor).

Effects on embryonic explant

Zebrafish embryonic tissue explants prepared prior to germ layer induction and lacking extraembryonic tissues, can specify all germ layers and form a seemingly complete mesoderm ~~and~~ anlage. Importantly explant organization requires polarized inheritance of maternal factors from dorsomarginal regions of the blastoderm.

Moreover, induction of endoderm and head-mesoderm, which require peak Nodal-signalling levels, is highly viable in explants

Maternally regulated gastrulation as a source of variation to forebrain evol.

Heterochronies during gastrulation that produce organizer and axial mesoderm tissue with different properties that may have contributed to fish brain evolution. These variations observed during gastrulation depend fully on maternal factors. The developmental evolution of retinal morphogenesis and hypothalamic patterning are among

those traits that retained significant maternal influence at larval stages. Transcriptonic analysis of fertilized eggs from both morphotypes and reciprocal F_1 hybrid showed a strong and specific maternal signature.

Jorge Torres-Paz et.al Elife (2019) work strongly suggests that maternal effect genes and developmental heterochronies that occur during gastrulation have impacted morphological brain change during ~~evolution~~ fish evolution.