CHAPTER-4

STUDIES ON THE DIFFERENT DEVELOPMENTAL STAGES BY THE TREATMENT OF DIFFERENT TYPE OF GLYCOSIDES EXTRACTED FROM SEEDS OF ABRUS PRECATORIUS AND SEED KERNELS OF CERBERA THEVETIA IN LYMNAEA SPS.
STUDIES ON THE DIFFERENT DEVELOPMENTAL STAGES BY THE TREATMENT OF DIFFERENT TYPE OF GLYCOSIDES EXTRACTED FROM SEEDS OF ABRUS PRECATORIUS AND SEED KERNELS OF CERBERA THEVETIA IN LYMNAEA SPS.

This chapter deals with the spawning egg capsule and the different subsequent developmental stages of *Lymnaea sps.* as follows:

1. SPAWN AND EGG CAPSULES

*Lymnaea sps.* are oviparous. Eggs were laid two or three hours after copulation. Generally the eggs were laid in the early hours of the morning from about 5 to 9 A.M. though sometimes eggs were laid at other hours of the day as also observed in the present investigation.

During oviposition as the eggs laid in succession and were sticky in the fresh condition. They get pressed and glued together due to the muscular action of the foot. The eggs thus become slightly flattened at their places of contact.

Development evidently begins as soon as the eggs were laid. Apparently all the eggs were fertilized and were capable of development under favourable conditions and no sterile eggs were observed in control group in the present investigation.

In control group the egg capsules in egg masses showed the different way of arrangement. In *Lymnaea stagnalis* the eggs were
laid generally in two or three rows and they were ovoid in shape having somewhat more distance between two adjacent egg capsules. Stiff and bit yellowish in colour, while egg capsules of *Lymnaea acuminata* were found in equidistance from each other, while in treated groups the egg masses not only showed the variable number but also showed variable sizes of egg capsules in which most of them did not show further progressive development as seen in photograph No. 38,45.

The gelatinous secretion was large in amount in treated groups in comparison to the control groups and the amount was much more secreted in *abrin* glycoside treated groups more probably the indication of hypersecretion due to toxicity.

In the present investigation, it was observed that the jelly became swelled and turned somewhat viscous the viscosity was more pronounced in *abrin* and *cerberin* extracted in petroleum ether while methonalic extract treated egg masses showed shrinkage after *abrin* and *cerberin* exposure. The colour of egg capsules was dark cream in the control group, but the colour changed from light yellow to whitish due to glycoside intoxication, owing to the dissolution of yolky material within the egg capsules. The contour of egg capsules were more irregular in the egg masses treated with plant extracts as shown in photograph No. 41,43.
2. The development of *Lymnaea sps.* was studied into following stages:

2.1 Cleavage

2.2 Blastula

2.3 Gastrula

2.4 Post gastrular changes

2.5 Organogenesis and Morphogenesis

2.6 Formation of trochophore larvae

2.7 Formation of veliger larvae

2.8 Torsion in veliger larvae.

2.9 Formation of young snails within the egg capsules.

2.10 Hatching

2.11 Emergence of young snails and their growth till adulthood.

The different developmental stages of *Lymnaea sps* in the control group are shown in photograph no. 1-8, and 29-36.

Fresh egg masses laid by the snails of F0 generation were introduced to different concentrations of plant seed extracts and data was recorded and summarized in table no. 10-17.

3 CLEAVAGE

Cleavage is spiral. In the present investigation cleavage begins about 2 ½ to 3 hours after the eggs were laid in the control groups of *Lymnaea sps* but it started after 5±2 hours and 4 ± 2 hours and after 6 ± 2 hours and 4 ± 2 hours after treatment with methanolic and
petroleum ether extracts of cerberin and abrin in Lymnaea stagnalis and Lymnaea acuminata respectively.

The dose and duration of treatment dependent increase in the duration of cleavage has been observed in the experimental snails of Lymnaea sps.

4 BLASTULA

In the present investigation in Lymnaea sps it was observed that blastula period was increased in abrin and cerberin treatment. However, mortality during blastula stage ranges from 1 to 1.5 percent.

The increase in the duration of blastula was more or less same in the experimental snails of Lymnaea sps. The abrin was proved to be more toxic than cerberin and the effects were more prominent in Lymnaea acuminata in comparison to Lymnaea stagnalis.

5 GASTRULA

In the present investigation in Lymnaea sps the gastrulation period increased by 6 ± 2 hours in abrin 4 ± 2 hours in cerberin treatment. This stage was found to be more susceptible as mortality occurred in the later gastrula stages. Mortality percentage was higher in Lymnaea acuminata in comparison to Lymnaea stagnalis.
6 POST GASTRULAR CHANGES

After gastrulation three germinal layers were formed and organogenesis and morphogenesis were started in control as well as in experimental snails but the duration was somewhat more prolonged in experimental insects and was found to be dependent on dose and duration of treatment in comparison to the control groups.

7 ORGANOGENESIS AND MORPHOGENESIS

After the formation of three germinal layers, organogenesis and morphogenesis took place. The organs formed by these three germinal layers are as follows:

7.1 Ectoderm:

In the ectodermal hemispheres as a rule a large celled and a vesicle and apical plate of normal embryo were noticed. These cells often showed a good differentiation, partly into ciliary cells corresponding to those found in velum and apical plate of normal embryos. The small-celled ectoderm represented the cephalic plates. Its cells remain more or less undifferentiated.

7.2 Endoderm:

In the endodermal hemisphere as well large and small cell regions were found. The large celled endoderm corresponds to the "albumen cells" forming the larval livers of the embryo. They attend a fair kind of differentiation showing apocrine secretion and uptake of
egg capsule fluid which is laid down in the cells in large “albumen vacuoles”. The small celled endoderm representing the primordium of mid gut and hind gut remains undifferentiated.

7.3 *Mesenchyme Tissue* :

The marginal zone developed from an equatorial girdle of cells surrounding the blastopores in normal embryos. It contains the primordial of the post trochal ectoderm and the mesoderm. Most of the part remains undifferentiated. Sometimes a stomodaeum may be formed at the bottom of which oesophagus enlarge shows a beginning of differentiation. In the mesoderm in some instances a more or less typical proonephridium may be formed.

7.4 *Polar lobe* :

The formation of the post trochal body region (the differentiation of the main organs) is dependent on the substance, which is localized in the first polar lobe passes with the latter into the CD, is again present in the second lobe and finally in CD. The formation of apical tuft is controlled by the substance present in the first polar lobe but not in the second lobe. For other organs as the velum or stomodaeum still other determining factors were found.

8 **FORMATION OF TROCHOPHORE LARVAE**

After organogenesis and morphogenesis specific two larvae have been formed. These two larval forms are e.g. Trochophore and
veliger larvae during development of these experimental snails viz. *Lymnaea stagnalis* and *Lymnaea acuminata*.

In the present investigation in *Lymnaea sps*; the torchophore larval period was prolonged by $6 \pm 2$ hours in *abrin*, $5 \pm 1$ hour in *cerberin* treatment. High percentage of mortality was observed during this stage.

All the egg capsules showed the development of trochophore larvae in *Lymnaea sps* as seen in photograph no. 4,31. In treated groups most of the egg capsules showed “polyembryony” in *Lymnaea sps* as seen in photograph no. 38,45. However in some egg capsules the development was totally arrested. Disintegration in larvae was very prominent as seen in photograph no. 13 due to intoxication of *cerberin* and *abrin*. Empty egg capsules were also observed in treated groups of *Lymnaea sps* but effects were much more pronounced in the *Lymnaea acuminata* in comparison to *Lymnaea stagnalis* as seen in photograph no. 14 and 30 respectively.

*Lymnaea stagnalis* was found to be more susceptible to the plant extracts intoxication. The trochophore larval stage was found to be most susceptible in both species of snail as in case of higher concentration of toxicants the developmental is arrested at this stage in most of the egg capsules.
9 FORMATION OF VELIGER LARVAE

In the present investigation in *Lymnaea* sps. the veliger larval period was increased by $6 \pm 2$ hour and $4 \pm 2$ hours in *cerberin* glycosides treatment. Mortality during this period was high but less in comparison to trophophore larval stage and the order was *cerberin* < *abrin*. In the present investigation in *Lymnaea* sps. the veliger larval period was prolonged by $12 \pm 2$ hours and $8 \pm 2$ hours in *abrin* glycosides treatment. High percentage of mortality was observed in this developmental stage but lesser than trophophore larval stage and the toxicity order was *cerberin* < *abrin*. Mortality in *Lymnaea stagnalis* was lesser in comparison to *Lymnaea acuminata*.

10 TERATOGENESIS

Certain anomalies and teratogenic effects were also observed after treatment with glycosides as seen in photograph no. 13,21,34 of *Lymnaea* sps. respectively which are as follows:

10.1 Deformation of cortical field had been observed.

10.2 Some cyclocephalic embryos were obtained from *Lymnaea* sps. egg masses treated with petroleum ether and methonalic extracts of seeds of *Abrus precatorius* and *Cebera thevetia*. Such embryos showed the characteristic malformation. The cephalic plates are connected by the small celled ectoderm across the mid line. In this unpaired field of small celled ectoderm the eyes and tentacles approach each other or are
fused in the mid line. The left and right cerebral ganglia are often fused and the cerebral commissure is shortened. The differentiation of velum and head vesicle was often suppressed. No characteristic defects in the mesodermal and endodermal organs were found. It was concluded that the effect of the treatment showed the suppression of the differentiation of the ectoderm being most pronounced at the animal pole and decreasing with the increasing distance from the pole.

10.3 In _Lymnaea stagnalis_ eggs treated with plant seed extracts of _Cerbera thevetia_ and _Abrus precatorius_: In this investigation archenteron found in more or less abnormal way and part of the presumptive endoderm remaining at the surface.

11 EMERGENCE OF THE YOUNG SNAILS AND THEIR GROWTH TILL ADULTHOOD

Though after full development in treated groups, some young larvae were weakened so that they were unable to break the egg capsule and died due to starvation and that was the potent cause of the higher percentage of mortality during hatching of young snails.

In the present investigation it was observed that the young snails hatched from the treated egg masses showed much delay in attaining maturity in comparison to the control groups. They were mostly found attached to the walls of the container and were apathetic towards feed. They had very thinner shells. Tentacles were short. Movement was slow. They were smaller in size. Life
span was very short with decreased rate of fecundity which was in order cerberin < abrin.

In the present investigation it could be concluded that the increase in developmental period was dose and duration of treatment dependent. High percentage of mortality and low percentage of fecundity was achieved by the treatment of different types of plant extracts suggests that these toxicants are able to control the population density of these pestiferous snails while inhibiting their development at any stage as evidenced from the photographs in the present investigation.

Why I selected these two snails *Lymnaea Stagnalis* and *Lymnaea acuminata* for the studies of development, so there are so many answers of this question as follows:

- They provided very good material (egg capsules) from the point of view of developmental biologists. The egg capsules were transparent that one can see the development from first cleavage upto hatching of young snails in the egg capsules. It is very enthusiastic to see each and every event by its own eyes.

- Very special type of cleavage i.e. spiral cleavage is found which is very rare in animals.

- Two subsequent larval stages were found which are developed within the egg capsules. These stages are
trochophore and veliger larval stages which is the specific character of gastropod.

- Organogenesis is so peculiar that some mesodermal organs were formed by the induction of polar lope.
- Phenomenon of torsion which is one of the specific character of snails (gastropod) is also exhibited and symmetrical larvae become assymetrical as found in adult snails.
- Teratogenic larvae would not developed into healthy young snails.
- Though two larval stages were observed but no metamorphosis was observed as the young snail directly emerged from the corresponding egg capsules.
- Young snails are so weak as they have not developed properly hence they were impotent to break the egg capsules and due to lack of nutrients within the egg capsules they died due to starvation.

Though both the snails are pathogenic and act as intermediate host in the development of liver fluke which create liver disorder in the effected vertebrate animals, so for the control of disease the control of population density of these snails is very necessary.
DISCUSSIONS

*Lymnaea stagnalis* and *Lymnaea acuminata* are oviparous snails as observed by Sedgwick (1913), Wilbur and Yonge (1964), Hyman (1967), Goel (1984), Kotpal (1996) and Barnes *et al.* (1998).

Shanmugam (1998) in ellobid snail reported that egg laying starts from middle of April and extends for another month while in the present investigation egg laying was observed throughout the year in *Lymnaea sps.* and it was observed that egg masses were laid in huge number from July to October.

In the present investigation the egg was encircled by vitelline membrane, which in case of eggs shed directly into the water covered with an evanescent jelly. Usually eggs are laid in the gelatinous strings or masses or in capsules and each egg then floats in a albumin's fluid bounded externally by an albumen membrane as reported by Mc Murrich (1887) in *Prosobranch gastropods*, Holmes (1900) in *Planorbis*, Sedgwick (1913) in *Gastropods*, Drummond(1902) in *Peludina*, Bahl (1928) in *Pila globosa*, Nagaraja (1942) in *Pila virens*, Fernius *et al.* (1946) in some Molluscs, Raven (1946) in *Lymnaea stagnalis*, Dewit (1954) in *Physa gyrina*, Ramamoorthi (1955) in *Melania crenulata*, *Melanoides tuberculatus* and *Melanoides lineatus* and Natarajan (1957) in some Prosobranchs.
EGG MASSES

Jones et al. (1996) observed the spawn or egg masses of Adalaria proxima in the laboratory and stated that individual adult may lay up to eleven spawn masses in the laboratory and in the present investigation this data was true with control groups of Lymnaea sps. While experimental groups showed the less number of egg masses with less number of egg capsules in comparison to control groups.

In the present investigation it was observed that the egg masses swelled and turned somewhat viscous in treated groups. Shrinkage of egg masses was observed sooner and more clearly after abrin and cerberin treatment. Their colour changed from dark yellow to whitish owing to the dissolution of yolky material within the egg capsules. The contours of the egg capsules were more irregular in egg masses treated with abrin and cerberin as also reported by Bhide & Bhargava (1986) in Lymnaea stagnalis after thiourea treatment, Bhide (1987) in Pila globosa after thiourea and DDT treatment, in Lymnaea stagnalis by Bhide (1989) after thiourea and BHC treatment, Bhide (1991) after nuvan and methyl parathion exposure, Bhargava (1992) after thiourea and DDT treatment, Bhide (1998) after nuvan, methyl parathion and thimet exposure, Gupta and Bhide (2000) after endosulfan administration and Gupta (2003) in Lymnaea stagnalis and Gyraulus convexiusculus after treatment with some toxicants respectively.
It had been observed by Gupta (2003) that the eggs were turned blue due to the accumulation of trypane blue dye while in the present investigation the residues of *abrin* and *cerberin* were accumulated in the egg masses of *Lymnaea sps.* showing different developmental stages. But so far no research work has been done on the intoxication of plant extracts on the egg masses of *Lymnaea stagnalis* and *Lymnaea acuminata.*

**CLEAVAGE**

In the present investigation it was observed that in the control group the development evidently begins as soon as the eggs are laid. Apparently all the eggs are fertilized and capable of develop under favourable conditions. No sterile eggs were observed by Mc Murrich (1887) in *Prosobranch gastropods,* Holmes (1900) in *Planorbis,* Bahl (1928) and Ranjah (1942) in *Pila globosa* respectively.

In the present investigation it was observed that the eggs of *Lymnaea sps.* undergo typical spiral, determinate cleavage. The first two cleavage furrows are meridional at right angles to one another and resulted in the formation of four blastomeres of equal size. The third cleavage furrow was latitudinal and nearer of the animal pole. In the fourth and fifth cleavage two more tiers of micromeres were separated from the macromeres and a cleavage cavity is absent in all stages of development as also observed by Holmes (1900) in

By certain toxicant treatments, the first cleavage is equalized the polar lobe substance being equally divided between the two blastomeres then both the blastomeres as a rule behave as CD cells at further cleavage, as seen in the present investigation after treatment with abrin and cerberin glycosides as also observed by Tyler (1930) in Molluscs and Grasveld (1949) in Lymnaea stagnalis.

Isolated blastomeres generally give rise to the same sequence of cells as in normal development, while in the present investigation blastomeres were not isolated.

1. Polarity and Symmetry in Cleavage:

In eggs possessing a "polar lobe" the factors of bilateral symmetry lie within the lobe. If the lobe is removed at first cleavage, the four quadrants are of the same size and no indication of bilateral symmetry appear at further cleavage (Crampon 1896, Wilson 1904,
Clement 1952). Animal pole fragments of an fertilized eggs showed equal cleavage without polar lobe as a rule. Vegetal pole or meridional fragments as far as they cleave at all do so as a normal egg (Wilson 1904 Morgan 1936) if by certain treatments the first cleavage is equalize the polar lobe substance being equally divided between the two blastomeres than both blastomeres as a rule behave as CD cells at further cleavage as also observed by Crampton (1896). Tyler (1930) and Morgan (1936) and also in normal or control groups. In the present investigation the glycoside treated egg masses showed development arrest at cleavage stage in some egg capsules and the effect was more prominent in abrin treatment in comparison to cerberin treatment. The clavage stage of Lymnaea acuminata was more susceptible than Lymnaea stagnalis.

2. Determination of Cleavage Pattern:

The direction of cleavage planes and the relative sizes of blastomeres are dependent on the direction and place of the cleavage spindles and an local activities of the egg cortex directly influencing the course of cleavage furrows.

The orientation of cleavage spindle may be altered by mechanical mean e. g. by compression (Tyler 1930, Morgan 1936). The deviations in the direction of cleavage spindle may be effected by agents influencing the egg cortex e. g. lithium chloride (Raven and
Roborgh, 1949) and quinine derivatives (Abd-el-Wahab 1957 and 1958) as also seen in Lymnaea sps. after treatment with abrin and cerberin glycosides in the present investigation and the effects were more pronounced in abrin in comparison to cerberin.

It has been noticed by Raven (1946) and Stalfoort (1952) in Lymnaea stagnalis that calcium is essential for preserving the normal properties of egg cortex. The role of Calcium may be taken by Lithium but not by Sodium and Potassium as reported by Degroot (1948) and Grasveld (1949) while in the present investigation the snails were never treated with Calcium or other ions.

In the present investigation it was observed that the dextral or sinistral coiling of the shell was based on the direction of 3rd cleavage determined in the cytoplasm of the unfertilised eggs as also observed by Holmes (1900) in Planorbis, Sedgwick (1913) in Gastropods, Drummond (1902) in Peludina, Gatenby (1919) in Lymnaea stagnali, Bahl (1928) in Pila globosa, Nagaraja (1942) in Pila virens, Ranjah (1942) in Pila globosa, Rao (1944) in Lymnaea acuminata & Indoplanorbis exustus, Raven (1946, 1948) in Lymnaea stagnalis, Natarajan (1957) in some Proso branchs, Mc Craw (1961) in Lymnaea humilis, Wilbur and Yonge (1964) in Molluscs, Hyman (1967) in Proso branchs, Muley (1978) in Melania scabra, Agrawal (1972) in Lymnaea acuminata, Islam (1977) in Indoplanorbis exustus, Dutt and Bahl (1977) in Lymnaea luteola, L. auricularia rufescens and

3. **Polar lobe**: 

   In the present investigation it was observed in Lymnaea sps. that polar lobes were responsible for the mesodermal organ development (muscles, shell gland and foot) as also observed by Ranjah (1942) in Pila globosa, Wilber and Yonge (1964), Parsad (1977) in some Molluscs, Goel (1984) in Gastropods, Gupta (1999) in some molluscs and Gupta (2003) in Lymnaea stagnalis and Gyraulus convexiusculus respectively.

4. **Gastrulation**: 

   In further development the micromeres spread over the macromeres. This is followed by slight invagination of the macromeres resulting in a small depression representing a rudimentary archentric cavity and blastopore as also observed in the present investigation in Lymnaea sps.

   The endodermis cells originate from the macromeres and fill the whole of the interior of the embryos. The gastrula is therefore a sterogastrula. The cell limits disappear in the endodermal mass which consequently presents the appearance of mass of yolk sph erules with few scattered nuclei.
Immediately after gastrulation, the blastopore elongates in the anterior direction and lastly the anterior end of the slit closes, giving rise to the stomodaeum as mouth near the point of its closure.

The mesoderm originates from two mesodermal teloblasts, which are derived from the daughter cells of 4d as reported by Wilbur and Yonge (1964) as also observed in the present investigation in *Lymnaea sps.* as also observed by Gupta & Bhide (2001), Gupta (2003) and Bhide *et al.* (2004) in some pulmonates.

**(a) Gastrulation in partial embryos:**

Gastrulation may occur in partial embryos derived from isolated blastomere AB, CD, A, B, C or D as reported by Crampon (1896), Wilson (1904), Clement (1952), Rattenbury and Berg (1954) in some molluscs but in the present investigation normal gastrulation has been exhibited in control and experimental groups of *Lymnaea sps.* as also observed by Gupta & Bhide (2001), Gupta (2003) and Bhide *et al.* (2004) in the control groups of some pulmonates.

**(iv) Post Gastrular Changes:**

Immediately after gastrulation the blastopore closes and the mouth arosed as a new formation near the point of its closure as reported by Ramamoorthi (1955) in *Melania crenulata, Melanoides tuberculata, M. lineatus* and Muley (1978) in *Melania scabra.* Ranjah
(1942) in *Pila globosa* and reported that blastopore gives rise to anus which is contradictory to the findings of Nagaraja (1942) in *Pila virens* in which the blastopore closes while in the present investigation in *Lymnaea sps.* it was observed that the mouth is formed after the closure of blastopore.

(v) Larval development :

Two larval stages e.g. trophophore and veliger larval stages were found in the development of *Lymnaea sps.* as also observed by Gupta & Bhide (2001), Gupta (2003) and Bhide *et al.* (2004) in *Lymnaea* and *Gyraulus sps.* and it was observed in control and experimental groups of *Lymnaea sps.* that these larval stages were developed within the egg capsule as also observed by Holmes (1900) in *Planorbis*, Drummond (1902) in *Peludine*, Sedgwick (1913) in some Gastropods, Bahl (1928) in *Pila globosa*, Agarwal (1972) in *Lymnaea acuminata*, Bahl and Dutt (1978) in *Gyraulus convexiusculus*, Muley (1978) in *Melania scabra* and Barth and Broshears (1982) in some gastropods respectively. In the present investigation high percentage of mortality in larval stages of *Lymnaea sps.* was observed at the time of torsion as also observed by Bhide (1986), Bhide and Bhargava (1986) in *Lymnaea stagnalis* after thiourea application, Bhide (1987) in *Pila globosa*, after nuvian, methyl parathion and thimet treatment, Bhargava (1992) after thiourea and DDT treatment, Gupta and Bhide (2000) after endosulfan treatment in *Lymnaea stagnalis*, Gupta and
Bhide (2002b) in *Gyraulus convexiusculus* after baygon treatment and
Gupta and Bhide (2002 c, d) in *Lymnaea stagnalis* after nuvan and
baygon administration respectively, while in the present
investigation, larval development arrest has been observed in large
number of egg capsules in *Lymnaea sps.* due to the intoxication of
*abrin* & *cerberin* glycosides and the effect was more pronounced in
*abrin* treatment in comparison to *cerberin.*

**(vi) Teratogenesis:**

In the present investigation in *Lymnaea sps* it has been
observed that treatment with *abrin* & *cerberin* glycosides resulted
into anamalies in morphogenesis and organogenesis of corresponding
larval stages as also obesrved by Bhide (1986), Bhide and Bhargava
in *Pila globosa* after thiourea and DDT application, Bhargava (1992)
after thiourea and DDT application, Bhide (1991) after nuvan, methyl
parathion and thimet treatment in *Lymnaea stagnalis* respectively. In
the present investigation it has been observed in *Lymnaea sps.* that
the development was arrested at any stage of development as also
observed in *Planorbis exustus* by Dowam and Joshi (1967) after
diaminopurine treatment, Sherbet and Lakshmi (1964 a,b) after
barbituric acid, Chloramphenicol and Cobalt sulphate and in
*Lymnaea stagnalis* by Bhide (1986) and Bhide and Bhargava (1986)
after thiourea application, Bhide (1987) in *Pila globosa* by thiourea

In the present investigation in *Lymnaea sps* it was observed that the snails developed from the treated egg masses had thin and transparent shell due to decalcification as also observed in *Planorbis exustus* by Sherbet and Lakshmi (1964a) after CoSO₄ [Cobalt Sulphate] and Chloramphenicol exposure, Bhide (1986) & Bhargava (1986) in *Lymnaea stagnalis* after thiourea application, Bhide (1987) in *Pila globosa* after thiourea and DDT, application, Bhide (1991) in *Lymnaea stagnalis* after nuvan and methyl parathion exposure, Bhide (1998) after nuvan, methyl parathion and thimet treatment, Bhargava (1992) after thiourea and DDT application, Gupta (2003) in *Lymnaea stagnalis & Gyraulus convexiusculus* after some pesticide &
dye treatment and Bhide et al. (2004) in Gyraulus convexiusculus after treatment with some pesticides respectively.

It has been observed by Raven and Mighorst (1946) in Lymnaea stagnalis that CaCl₂ is the essential factor for the development of the shell as also observed in the present investigation in Lymnaea sps. treated with abrin and cerberin glycosides while Grasveld (1949) in Lymnaea stagnalis stated that the role of Calcium may be taken over by Magnesium and to a certain extent by Lithium but Magnesium, Sodium, and Potassium were not used in the present investigation in Lymnaea sps.

(vii) Embryogenesis:

In the present investigation the development was indirect. The first larval stage was trochophore which later on transformed into veliger which emerged into young snails.

The trochophore was divided by the band of cilia the prototroch into a pretrochal and posttrochal region. The cephalic plates may give rise to cerebral ganglia. Eyes and tentacles are separated by a medium apical plate in the posttrochal region. The dorsal side bears the shell gland while the stomodaeum and foot are situated on its ventral side as also observed by Holmes (1900) in Planorbis, Wilbur and Young (1964) in some Molluscs, Hyman (1967) in Prosobranchs, Barth and Broshears (1982) and Barnes et al. (1998) in some
Gastropods, while in the present investigation in *Lymnaea sps.* the embryogenesis was arrested in some severely affected egg capsules and the effect was more pronounced in *abrin* in comparison to *cerberin* treatment.

**(viii) The determination of organ development:**

In the ectoderm hemisphere as a rule a large celled and small celled part can be observed. The large celled ectoderm represents the velum, head vesicle and apical plate of normal embryos. These cells often showed a good differentiation partly into ciliary cells corresponding to those found in the velum and apical plate of normal embryos. The small celled ectoderm represents the cephalic plate. The cells remain more or less undifferentiated.

It is clear therefore that a certain degree of histological differentiation has taken place in exogastrulae, but it has stopped at an early stage, moreover it is mainly restricted to level differentiation (ciliary cells, albumen's cells, protonephridium), the adult type of tissue differentiation do not occur and such adult organs are gut, redial sac, nervous system and sense organs, which were developed in exogastrulae.

It could be concluded from the present investigation that abnormal embryos were developed in *Lymnaea sps.* by the treatment of *abrin* and *cerberin* glycosides and the determination of the organs
of the head was completed at an early trochophore stage as also reported by Raven (1958) in some Molluscs.

Occasionally in *Lymnaea* sps. in the eggs treated with Lithium the invagination of archenteron does occurs in a more or less abnormal way. Part of the presumptive endoderm remaining at the surface. In such embryos protonephridia are formed much more frequently than in true exogastrulae, Sometimes paired protonephridia developed, moreover in great number of cases shell gland is formed. It is always situated at a place where the tip of the archentron touches the inner side of the ectoderm. In those cases where the archenteron has grown inward in an abnormal direction, its tip may come into contact with the inner side of the pretrochal part of the ectoderm. Then a shell gland may even develop in this abnormal location. It has been concluded that the formation of shell gland is due to an inductive action exerted by the tip of the archenteron on the ectoderm with which it makes the contact (Raven 1952).

(ix) **Malformation:**

According to Wilbur and Yonge (1964) the organ forming substance are not properly displaced by centrifugal force while in the present investigation the affect of centrifugation has not been observed. They also stated that egg fragments lacking part of the substance may develop to more or less normal harmoniously built
dwarf larvae as also observed in the present investigation after treatment with glycosides. Moreover double monsters may develop from the eggs treated with dyes as also stated by Tyler (1930) after compression and centrifugation while Souyza et al. (1997) after treatment with latex of crown of Thorns, Euphorbia milii reported that malformation was noted only at very high doses of latex which were embryolethal and maternally toxic but in the present investigation malformation were observed even after treatment with low doses of the glycosides abrin & cerberin in Lymnaea sps.- and the effect was more pronounced in abrin in comparison to cerberin.

The cyclocephalic embryos were obtained from Lymnaea egg treated with lithium (Raven,1942) such embryos showed the characteristic syndrome of malformation.

The cephalic plates were connected by small celled ectoderm across the mid line. In this unpaired field of small celled ectoderm the eyes and tentacles approach each other or are fused in the mid line. The right and left cerebral ganglia are often fused and the cerebral commissure is shortened (Raven,1949). The differentiation of velum and head was observed in the present investigation.

Anaerobiosis may produce similar effects as lithium in Lymnaea as observed by Raven and Rijkevorsel (1953). In the present investigation in Lymnaea sps. the head malformation was
noticed after treatment with glycosides *abrin* and *cerberin* and the *abrin* was more effective than *cerberin*.

Cyclocephalic malformations may be noticed by calcium and cyanide (Haye and Raven, 1953) at certain concentration might be entirely suppress the effect of lithium, while in the present investigation cyanide and calcium were not used for experimental purpose.

It could be concluded from the present investigation that the glycosides *abrin* and *cerberin* were used for the treatment, were able to arrest the development at any stage, in which larval stages were most susceptible suggested the larvecidal nature of the glycosides which induces teratogenicity. The anamalies of the organs was resulted into development of small sized, malformed young snails, so the two alternatives were achieved as follows:

(a) The teratogenic larvae did not show the phenomenon of torsion or in other words further development was totally arrested.

(b) If the teratogenic larvae were developed into young snails then the young snails were weak and tiny, so it could not be possible for them to break the wall of the corresponding egg capsule and hence they died within the egg capsules due to starvation and in this way we could control the population density of these pestiferous or pathogenic snails just like *Lymnaea sps.*
Egg capsules of *Lymnaea stagnalis* showing different stages of the control groups

Fig. 1: Cleavage stage
(60x)

Fig. 2: Blastula stage
(60x)

Fig. 3: Gastrula stage
(100x)

Fig. 4: Trochophore larval stage (60x)
Egg capsules of *Lymnaea stagnalis* showing different developmental stages of control groups

Fig. 5: Veliger larval stage (60x)

Fig. 6: Breaking of egg capsule (100x)

Fig. 7: Prior to hatching stage (100x)

Fig. 8: Hatched young snail (100x)
Egg capsules of *Lymnaea stagnalis* showing different developmental stages after treatment with sublethal concentration of methanolic extract of abrin

- **Fig. 9:** Trochophore larval stage (60x)
- **Fig. 10:** Veliger larval stage (60x)
- **Fig. 11:** Before hatching stage (100x)
- **Fig. 12:** Young snail (60x)
Egg capsules of *Lymnaea stagnalis* showing different developmental stages after treatment with sublethal concentration of petroleum ether extract of abrin.

**Fig. 13:** Disintegrated egg capsules showing teretogenesis in larvae (60x)

**Fig. 14:** One empty egg capsule & other showing development arrest (30x)

**Fig. 15:** Rounded egg capsules (60x)

**Fig. 16:** Trochophore & veliger larval stages (60x)
Egg capsules of *Lymnaea stagnalis* showing different developmental stages after treatment with sublethal concentration of petroleum ether extract of cerberin.
Egg capsules of *Lymnaea stagnalis* showing different developmental stages treatment with sublethal concentration of petroleum ether extract of cerberin.

Fig. 25: Veliger larval stage (30x)

Fig. 26: Development arrest at cleavage stage (60x)

Fig. 27: Development arrest at cleavage & gastrula stage (30x)

Fig. 28: Development arrest at veliger & trochophore larval stages (30x)
Egg capsules of *Lymnaea acuminata* showing different developmental stages of control groups

Fig. 33: Before hatching stage (30x)

Fig. 34: Teratogenesis showing one egg capsule (60x)

Fig. 35: Trochophore & veliger larval stage (30x)

Fig. 36: Young snails before hatching (100x)
Egg capsules of *Lymnaea acuminata* showing different developmental stages after treatment with sublethal concentration of methonolic extract of abrin.

Fig. 37: Veliger larval stage (60x)

Fig. 38: Development arrest (30x)

Fig. 39: Development arrest at cleavage & veliger larval stage (60x)

Fig. 40: Before hatching (30x)
Egg capsules of *Lymnaea acuminata* showing different developmental stages after treatment with sublethal concentration of petroleum ether extract of abrin.

→ Fig. 41: Cleavage stage (60x)

Fig. 42: Development arrest at trophophore larval stage (30x) ←

Fig. 43: Development arrest at veliger larval stage (60x)

Fig. 44: Before hatching stage (30x) ←
Fig. 45: Cleavage Stage (30x)

Fig. 46: Blastula Stage (30x)

Fig. 47: Development arrest at cleavage & gastrula stages (30x)

Fig. 48: Trochophore larval stages (30x)
Fig. 49: Gastrula stages (30x)

Fig. 50: Development arrest at trophophore stage (30x)

Fig. 51: Round egg capsules showing Development arrest (30x)

Fig. 52: An egg capsule showing Development arrest at blastula stage (30x)
Table No. 10

DEVELOPMENTAL DATA OF *Lymnaea stagnalis* UNDER THE INFLUENCE OF ABRIN (METHANOLIC EXTRACT)

<table>
<thead>
<tr>
<th>Kind of the Glycoside</th>
<th>Conc. of the Glycoside</th>
<th>Total No. of Egg Capsules</th>
<th>No. of eggs completed cleavage</th>
<th>No. of eggs completed blastula</th>
<th>No. of eggs completed gastrula</th>
<th>No. of trochophore formed</th>
<th>No. of veliger formed</th>
<th>No. of veliger completed torsion</th>
<th>Total No. of young snails hatched</th>
<th>No. of young snails survived upto adulthood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>No. of trace of any Glycoside</td>
<td>50</td>
<td>49 ± 1</td>
<td>49 ± 1</td>
<td>49 ± 1</td>
<td>48 ± 1</td>
<td>48 ± 1</td>
<td>48 ± 1</td>
<td>48 ± 1</td>
<td>47 ± 1</td>
</tr>
<tr>
<td><strong>Abrin</strong></td>
<td><strong>Methanolic Extract</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.65%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>45 ± 1</td>
<td>34 ± 2</td>
<td>29 ± 1</td>
<td>24 ± 1</td>
<td>22 ± 2</td>
<td>19 ± 1</td>
<td></td>
</tr>
<tr>
<td>0.33%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>45 ± 2</td>
<td>28 ± 2</td>
<td>20 ± 2</td>
<td>19 ± 2</td>
<td>18 ± 1</td>
<td>16 ± 1</td>
<td></td>
</tr>
<tr>
<td>0.16%</td>
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<td>47 ± 2</td>
<td>44 ± 1</td>
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<td>16 ± 1</td>
<td>14 ± 1</td>
<td>11 ± 2</td>
<td></td>
</tr>
<tr>
<td>0.15%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>42 ± 1</td>
<td>22 ± 2</td>
<td>18 ± 1</td>
<td>16 ± 1</td>
<td>13 ± 2</td>
<td>11 ± 1</td>
<td></td>
</tr>
</tbody>
</table>
Table No. 11

DEVELOPMENTAL DATA OF *Lymnaea stagnalis* UNDER THE INFLUENCE OF ABRIN (PETROLEUM ETHER EXTRACT)

<table>
<thead>
<tr>
<th>Kind of the Glycoside</th>
<th>Conc. of the Glycoside</th>
<th>Total No. of Egg Capsules</th>
<th>No. of eggs completed cleavage</th>
<th>No. of eggs completed blastula</th>
<th>No. of eggs completed gastrula</th>
<th>No. of trophophore formed</th>
<th>No. of veliger formed</th>
<th>No. of veliger completed torsion</th>
<th>Total No. of young snails hatched</th>
<th>No. of young snails survived upto adulthood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>No. of trace of any Glycoside</td>
<td>50</td>
<td>$49 \pm 1$</td>
<td>$49 \pm 1$</td>
<td>$49 \pm 1$</td>
<td>$48 \pm 1$</td>
<td>$48 \pm 1$</td>
<td>$48 \pm 1$</td>
<td>$48 \pm 1$</td>
<td>$47 \pm 1$</td>
</tr>
<tr>
<td><strong>Abrin</strong></td>
<td>0.5%</td>
<td>50</td>
<td>$48 \pm 1$</td>
<td>$47 \pm 2$</td>
<td>$45 \pm 1$</td>
<td>$34 \pm 2$</td>
<td>$29 \pm 1$</td>
<td>$24 \pm 1$</td>
<td>$22 \pm 2$</td>
<td>$19 \pm 1$</td>
</tr>
<tr>
<td>(Petroleum Ether Extract)</td>
<td>0.25%</td>
<td>50</td>
<td>$48 \pm 1$</td>
<td>$47 \pm 2$</td>
<td>$44 \pm 2$</td>
<td>$25 \pm 2$</td>
<td>$24 \pm 2$</td>
<td>$22 \pm 2$</td>
<td>$19 \pm 1$</td>
<td>$15 \pm 1$</td>
</tr>
<tr>
<td></td>
<td>0.13%</td>
<td>50</td>
<td>$48 \pm 1$</td>
<td>$47 \pm 2$</td>
<td>$43 \pm 1$</td>
<td>$24 \pm 2$</td>
<td>$19 \pm 1$</td>
<td>$18 \pm 1$</td>
<td>$16 \pm 1$</td>
<td>$14 \pm 2$</td>
</tr>
<tr>
<td></td>
<td>0.12%</td>
<td>50</td>
<td>$48 \pm 1$</td>
<td>$47 \pm 2$</td>
<td>$40 \pm 1$</td>
<td>$20 \pm 2$</td>
<td>$15 \pm 1$</td>
<td>$13 \pm 1$</td>
<td>$11 \pm 2$</td>
<td>$9 \pm 1$</td>
</tr>
</tbody>
</table>
Table No. 12

DEVELOPMENTAL DATA OF Lymnaea stagnalis UNDER THE INFLUENCE OF CERBERIN (METHANOLIC EXTRACT)

<table>
<thead>
<tr>
<th>Kind of the Glycoside</th>
<th>Conc. of the Glycoside</th>
<th>Total No. of Egg Capsules</th>
<th>No. of eggs completed cleavage</th>
<th>No. of eggs completed blastula</th>
<th>No. of eggs completed gastrula</th>
<th>No. of trochophore formed</th>
<th>No. of veliger formed</th>
<th>No. of veliger completed torsion</th>
<th>Total No. of young snails hatched</th>
<th>No. of young snails survived upto adulthood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>No. of trace of any Glycoside</td>
<td>50</td>
<td>49 ± 1</td>
<td>49 ± 1</td>
<td>49 ± 1</td>
<td>48 ± 1</td>
<td>48 ± 1</td>
<td>47 ± 1</td>
<td>48 ± 2</td>
<td>47 ± 1</td>
</tr>
<tr>
<td>Cerberin (Methanolic Extract)</td>
<td>1.0%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>38 ± 1</td>
<td>32 ± 1</td>
<td>25 ± 2</td>
<td>24 ± 1</td>
<td>22 ± 2</td>
<td>19 ± 2</td>
</tr>
<tr>
<td></td>
<td>0.5%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>25 ± 2</td>
<td>24 ± 1</td>
<td>22 ± 2</td>
<td>19 ± 2</td>
<td>15 ± 2</td>
<td>15 ± 1</td>
</tr>
<tr>
<td></td>
<td>0.26%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>24 ± 1</td>
<td>19 ± 2</td>
<td>18 ± 2</td>
<td>16 ± 2</td>
<td>14 ± 1</td>
<td>11 ± 2</td>
</tr>
<tr>
<td></td>
<td>0.25%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>20 ± 2</td>
<td>15 ± 2</td>
<td>13 ± 2</td>
<td>11 ± 2</td>
<td>11 ± 1</td>
<td>9 ± 1</td>
</tr>
</tbody>
</table>
Table No. 13

DEVELOPMENTAL DATA OF *Lymnaea stagnalis* UNDER THE INFLUENCE OF CERBERIN (PETROLEUM ETHER EXTRACT)

<table>
<thead>
<tr>
<th>Kind of the Glycoside</th>
<th>Conc. of the Glycoside</th>
<th>Total No. of Egg Capsules</th>
<th>No. of eggs completed cleavage</th>
<th>No. of eggs completed blastula</th>
<th>No. of eggs completed gastrula</th>
<th>No. of trophophore formed</th>
<th>No. of veliger formed</th>
<th>No. of veliger completed torsion</th>
<th>Total No. of young snails hatched</th>
<th>No. of young snails survived upto adulthood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>No. of trace of any Glycoside</td>
<td>50</td>
<td>48 ± 1</td>
<td>48 ± 1</td>
<td>47 ± 1</td>
<td>47 ± 1</td>
<td>47 ± 1</td>
<td>47 ± 2</td>
<td>47 ± 1</td>
<td></td>
</tr>
<tr>
<td>Cerberin</td>
<td>0.98%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>46 ± 1</td>
<td>38 ± 2</td>
<td>32 ± 1</td>
<td>31 ± 1</td>
<td>30 ± 2</td>
<td>28 ± 2</td>
</tr>
<tr>
<td>Cerberin</td>
<td>0.48%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>45 ± 2</td>
<td>30 ± 2</td>
<td>26 ± 2</td>
<td>24 ± 2</td>
<td>22 ± 2</td>
<td>20 ± 1</td>
</tr>
<tr>
<td>Cerberin</td>
<td>0.25%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>45 ± 1</td>
<td>26 ± 1</td>
<td>21 ± 2</td>
<td>19 ± 2</td>
<td>17 ± 1</td>
<td>15 ± 1</td>
</tr>
<tr>
<td>Cerberin</td>
<td>0.24%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>45 ± 1</td>
<td>25 ± 1</td>
<td>21 ± 2</td>
<td>19 ± 2</td>
<td>17 ± 1</td>
<td>15 ± 1</td>
</tr>
</tbody>
</table>
Table No. 14
DEVELOPMENTAL DATA OF *Lymnaea acuminnata* UNDER THE INFLUENCE OF ABRIN (METHANOLIC EXTRACT)

<table>
<thead>
<tr>
<th>Kind of the Glycoside</th>
<th>Conc. of the Glycoside</th>
<th>Total No. of Egg Capsules</th>
<th>No. of eggs completed cleavage</th>
<th>No. of eggs completed blastula</th>
<th>No. of eggs completed gastrula</th>
<th>No. of trophophore formed</th>
<th>No. of veliger formed</th>
<th>No. of veliger completed torsion</th>
<th>Total No. of young snails hatched</th>
<th>No. of young snails survived upto adulthood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>No. of trace of any Glycoside</td>
<td>50</td>
<td>49 ± 1</td>
<td>48 ± 1</td>
<td>48 ± 1</td>
<td>47 ± 1</td>
<td>47 ± 1</td>
<td>47 ± 1</td>
<td>47 ± 1</td>
<td>47 ± 1</td>
</tr>
<tr>
<td>Abrin (Methanolic Extract)</td>
<td>0.53%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>46 ± 1</td>
<td>39 ± 2</td>
<td>38 ± 2</td>
<td>32 ± 1</td>
<td>30 ± 2</td>
<td>28 ± 2</td>
</tr>
<tr>
<td></td>
<td>0.26%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>45 ± 2</td>
<td>31 ± 2</td>
<td>30 ± 2</td>
<td>28 ± 2</td>
<td>24 ± 2</td>
<td>22 ± 1</td>
</tr>
<tr>
<td></td>
<td>0.13%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>44 ± 1</td>
<td>28 ± 2</td>
<td>26 ± 2</td>
<td>22 ± 2</td>
<td>21 ± 1</td>
<td>19 ± 2</td>
</tr>
<tr>
<td></td>
<td>0.12%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>43 ± 2</td>
<td>26 ± 2</td>
<td>23 ± 2</td>
<td>20 ± 1</td>
<td>19 ± 1</td>
<td>17 ± 1</td>
</tr>
</tbody>
</table>
Table No. 15

DEVELOPMENTAL DATA OF *Lymnaea acuminata* UNDER THE INFLUENCE OF ABRIN (PETROLEUM ETHER EXTRACT)

<table>
<thead>
<tr>
<th>Kind of the Glycoside</th>
<th>Conc. of the Glycoside</th>
<th>Total No. of Egg Capsules</th>
<th>No. of eggs completed cleavage</th>
<th>No. of eggs completed blastula</th>
<th>No. of eggs completed gastrula</th>
<th>No. of trophophore formed</th>
<th>No. of veliger formed</th>
<th>No. of veliger completed torsion</th>
<th>Total No. of young snails hatched</th>
<th>No. of young snails survived upto adulthood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>No. of trace of any Glycoside</td>
<td>50</td>
<td>49 ± 1</td>
<td>48 ± 1</td>
<td>48 ± 1</td>
<td>47 ± 1</td>
<td>47 ± 1</td>
<td>47 ± 1</td>
<td>47 ± 1</td>
<td>47 ± 1</td>
</tr>
<tr>
<td>Abrin (Petroleum Ether Extract)</td>
<td>0.5%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>46 ± 1</td>
<td>38 ± 2</td>
<td>32 ± 2</td>
<td>31 ± 1</td>
<td>30 ± 2</td>
<td>28 ± 2</td>
</tr>
<tr>
<td></td>
<td>0.25%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>45 ± 2</td>
<td>30 ± 2</td>
<td>28 ± 2</td>
<td>24 ± 2</td>
<td>22 ± 2</td>
<td>20 ± 1</td>
</tr>
<tr>
<td></td>
<td>0.12%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>44 ± 1</td>
<td>26 ± 2</td>
<td>23 ± 2</td>
<td>21 ± 2</td>
<td>18 ± 1</td>
<td>16 ± 1</td>
</tr>
<tr>
<td></td>
<td>0.1%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>43 ± 1</td>
<td>23 ± 2</td>
<td>20 ± 2</td>
<td>19 ± 1</td>
<td>17 ± 1</td>
<td>15 ± 1</td>
</tr>
</tbody>
</table>
Table No. 16

DEVELOPMENTAL DATA OF Lymnaea acuminnata UNDER THE INFLUENCE OF CERBERIN (METHANOLIC EXTRACT)

<table>
<thead>
<tr>
<th>Kind of the Glycoside</th>
<th>Conc. of the Glycoside</th>
<th>Total No. of Egg Capsules</th>
<th>No. of eggs completed cleavage</th>
<th>No. of eggs completed blastula</th>
<th>No. of eggs completed gastrula</th>
<th>No. of trophophore formed</th>
<th>No. of veliger formed</th>
<th>No. of veliger completed torsion</th>
<th>Total No. of young snails hatched</th>
<th>No. of young snails survived upto adulthood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>No. of trace of any Glycoside</td>
<td>50</td>
<td>49 ± 1</td>
<td>49 ± 1</td>
<td>49 ± 1</td>
<td>47 ± 1</td>
<td>48 ± 1</td>
<td>48 ± 1</td>
<td>48 ± 1</td>
<td>47 ± 1</td>
</tr>
<tr>
<td>Cerberin (Methanolic Extract)</td>
<td>0.9%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>45 ± 2</td>
<td>38 ± 2</td>
<td>32 ± 2</td>
<td>31 ± 1</td>
<td>30 ± 2</td>
<td>28 ± 2</td>
</tr>
<tr>
<td></td>
<td>0.45%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>45 ± 2</td>
<td>30 ± 2</td>
<td>26 ± 1</td>
<td>24 ± 2</td>
<td>22 ± 2</td>
<td>20 ± 1</td>
</tr>
<tr>
<td></td>
<td>0.23%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>44 ± 1</td>
<td>26 ± 1</td>
<td>21 ± 2</td>
<td>19 ± 2</td>
<td>17 ± 1</td>
<td>15 ± 1</td>
</tr>
<tr>
<td></td>
<td>0.22%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
<td>42 ± 1</td>
<td>25 ± 1</td>
<td>21 ± 2</td>
<td>19 ± 2</td>
<td>17 ± 1</td>
<td>14 ± 1</td>
</tr>
</tbody>
</table>
Table No. 17

DEVELOPMENTAL DATA OF *Lymnaea acuminnata* UNDER THE INFLUENCE OF CERBERIN (PETROLEUM ETHER EXTRACT)

<table>
<thead>
<tr>
<th>Kind of the Glycoside</th>
<th>Conc. of the Glycoside</th>
<th>Total No. of Egg Capsules</th>
<th>No. of eggs completed cleavage</th>
<th>No. of eggs completed blastula</th>
<th>No. of eggs completed gastrula</th>
<th>No. of trophophore formed</th>
<th>No. of veliger formed</th>
<th>No. of veliger completed torsion</th>
<th>Total No. of young snails hatched</th>
<th>No. of young snails survived upto adulthood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>No. of trace of any Glycoside</td>
<td>50</td>
<td>49 ± 1</td>
<td>48 ± 1</td>
<td>47 ± 1</td>
<td>47 ± 1</td>
<td>47 ± 1</td>
<td>47 ± 1</td>
<td>47 ± 1</td>
<td>47 ± 1</td>
</tr>
<tr>
<td>Cerberin (Petroleum Ether Extract)</td>
<td>0.85%</td>
<td>50</td>
<td>48 ± 1</td>
<td>47 ± 2</td>
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