Histological and Ultrastructural studies on the effect of certain plant extracts on the digestive and hermaphrodite glands of the Egyptian giant garden slug, *Limax maximus*

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By

Ustina Nasser Tawfeek Habib

B. Sc. and Education (2013)

General Diploma for Teacher Preparation in Science (Zoology) 2014

Special Diploma for Teacher Preparation in Science (Zoology) 2015

Supervised By

Prof. Dr. Ahmed Abdel-Salam Abdel-Haleem

Professor of Invertebrates, Biological and Geological Sciences Department, Faculty of Education, Ain Shams University.

Dr. Omaima Mohamed Mustafa

Assistant Professor of Invertebrates, Biological and Geological Sciences Department, Faculty of Education, Ain Shams University.

Dr. Eman Hassan Ismail Abdel-Razik

Assistant Professor of Entomology, Biological and Geological Sciences Department, Faculty of Education, Ain Shams University.

To

Biological and Geological Sciences Department, Faculty of Education, Ain Shams University

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APPROVAL SHEET

NAME: Ustina Nasser Tawfeek Habib

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Approved

Supervisors:

Prof. Dr. Ahmed Abdel-Salam Abdel-Haleem.
Professor of Invertebrates, Biological and Geological Sciences Department, Faculty of Education, Ain Shams University.

Dr. Omaima Mohamed Mustafa.
Assistant Professor of Invertebrates,
Biological and Geological Sciences Department,
Faculty of Education, Ain Shams University.

Dr. Eman Hassan Ismail Abdel-Razik
Assistant Professor of Entomology,
Biological and Geological Sciences Department,
Faculty of Education, Ain Shams University.

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ABSTRACT

The Egyptian giant garden slug, *Limax maximus* Linnaeus, 1758 (Family: Limacidae: Pulmonata: Gastropoda: Mollusca) had been manually collected from of garden in Faculty of Education, Ain Shams University.

The main aspects of the present work can be summarized as follows:

- Study of morphological features of *L. maximus*.
- Study of the internal anatomical organs of *L. maximus*.
- Susceptibility of *L. maximus* to LC_{50} and LC_{90} of two extracted botanical molluscicids, namely thymol and caffeine.
- Histological investigations of untreated digestive and hermaphrodite (ovotestis) glands of *L. maximus*.
- Study of histological altrnations in the two glands due to treating of *L. maximus* with LC_{50} and LC_{90} of thymol and caffeine, as poison baits.
- Cytological investigations, using TEM, of untreated digestive and hermaphrodite glands of *L. maximus*.
- Cytological altrnations in the two glands of *L. maximus* due to treating with LC_{50} and LC_{90} of thymol and caffeine.

LC_{50} of treated *L. maximus* with thymol and caffeine are 269.77 ppm and 652.52 ppm respectively, whereas LC_{90} are 362.79 pmm and 873.53 ppm respectively, and could be arranged based on their toxic effects in the order: thymol>caffeine. Histological and ultrastructure investigations of digestive and hermaphrodite glands of *L. maximus* with LC_{90} of thymol and caffeine showed severe histological changes and ultrastructure abnormalities, including severe damage in architecture of digestive gland-cells and hermaphrodite gland. These results may be of great value in the field to control the target *L. maximus*-slug, as safe and economic molluscicide, which no harm upon ecosystems, instead of using chemical pesticides that could pollute the environment.

KEY WORDS

- Pulmonata.
- Stylommatophora
- Limacidae.
- Egyptian terrestrial slugs.
- *Limax maximus.*
- Morphology.
- Digestive gland.
- Hermaphrodite gland (ovotestis).
- Histology.
- Cytology.
- Fine structure (or ultrastructure).
- TEM
- Thymol.
- Caffeine.

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List of Abbreviations

Ac	Acinus of ovotestis
AbSz	Abnormal spermatozoa
Af	Axial filament complex
Al	Ancel's layer
An	Abnormal nucleus
Ax	Axoneme
AgSz	Aggregated spermatozoa
BM	Basement membrane
CdAc	Completely degeneration of acinus
CF	Central fibers
CS	Calcium spherules
CT	Connective tissue
CTa	Cysts of numerous toxic agents
DC	Digestive cell
DCT	Degenerated connective tissue
DgECM	Degenerated extracellular matrix
Dg	Degenerated
DgM	Degenerated mitochondria
DMo	Degeneration of mature oocyte
Dn	Degenerated nucleus
DgRER	Degenerated-rough endoplasmic reticulum
EP	End piece
FS	Fibrous sheath
GEC	Germinal epithelium cells
gl	Glycogen
H	Head
H	head
L	Lumen
LD	Lipid droplets
Ly	Lysosomes
M	Mitochondria

MD	Mitochondrial derivative
MO	Mature oocyte
MP	Middle piece
Mv	Microvilli
N	Nucleus
NDC	Necrosis of digestive cells
NE	Nuclear envelope
NP	Nuclear pores
Nu	Nucleolus
ODF	Outer dense fibers
Oo	Oogonia
PdAc	Partially degenerated of acinus
Po	Primary oocytes
PS	Primary spermatocyte
RER	Rough endoplasmic reticulum
RMv	Rupture of microvilli
SC	Secretory cell
Sd	Spermatids
SeC	Sertoli cell
Sg	Spermatogonia
SeN	Sertoli nucleus
So	Secondary oocyte
Sp	Spermatid
SS	secondary spermatocytes
Sz	spermatozoa
T	Tail
Ta	Toxic agent
V	Vacuoles
WS	Wide space

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