TOXICOLOGICAL STUDIES OF PESTICIDE FORMULATIONS IMIDACLOPRID AND MALATHION ON ALBINO MICE

By

WALID SAID HELMY

B.Sc. Agric. Sci. (Plant Protection), Fac. Agric., Cairo Univ., 2005

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APPROVAL SHEET

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APPROVAL COMMITTEE

Dr. ABDALLA ELHUSSEIN ABDEL MONEM.....
Professor of Pesticides, Fac. Agric., Al-Azhar University.

Dr.MOHAMMAD ABD-ELHADY KANDIL .....
Professor of Pesticides, Fac. Agric., Cairo University.

Dr. ESSAM ELDIN ABDEL-RAOUF EWEIS.....
Professor of Pesticides, Fac. Agric., Cairo University.

Dr. AMAL YOUSEF SALEH .....
Professor of Pesticides, Fac. Agric., Cairo University.

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SUPERVISION SHEET

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Dr. AMAL YOUSEF SALEH
Professor of Pesticides, Fac. Agric., Cairo University

Dr. ESSAM ELDIN ABDEL-RAOUF EWEIS
Professor of Pesticides, Fac. Agric., Cairo University

Name of Candidate: Walid Said Helmy **Degree:** M.Sc.
Title of Thesis: Toxicological Studies of Pesticide Formulations Imidacloprid and Malathion on Albino Mice.
Supervisors: Dr. Amal Yousef Saleh
Dr. Essam Eldin Abdel-Raouf Eweis
Department: Economic Entomology and Pesticides **Branch:** Pesticides

Approval / /

ABSTRACT

The toxicity of imidacloprid (in two formulations Gaucho 70% WP and Confidet 35% SC and malathion El Nasr and Kafr El Zayat 57 % EC) was investigated on male albino mice using 1/8, 1/4 and 2/5 oral sub-lethal doses of LD_{50} in plasma, brain, liver and kidney for 24 and 48 hrs. Confidet caused a decrease in total protein content in plasma, brain, liver and kidney at of 1/8, 1/4 and 2/5 LD_{50} doses versus an increase in total protein when using the same concentrations of Gaucho after 24 and 48 hrs. Confidet further inhibited the cholinesterase in plasma at 1/8, 1/4 and 2/5 of LD_{50} doses after 24 and 48 hrs while treatment with Gaucho increased the activity of the same enzyme. The activity of aspartate aminotransferees in plasma increased after treatment with 1/8, 1/4 and 2/5 LD_{50} in both Confidet and Gaucho but the rate of increase of activity was greater in Gaucho than Confidet, meanwhile enzyme activity decreased in liver in the cases of treatment with both formulations but the rate of decrease activity for Confidet was greater than it in the case of Gaucho. The activity of Alanine aminotransfers decreased in plasma after treatment with 2/5 LD_{50} of both Confidet and Gaucho formulations after 24 and 48 hrs versus an increase in the activity of the same enzyme in liver in the case of treatment with Gaucho. Urea content in plasma increased after treatment with both Confidet and Gaucho after 24 and 48 hrs for all treatments. For all considered doses, Treatment with malathion 57% EC (EL Nasr Company) decreased the total protein content in plasma, liver, brain and kidney after 24 and 48 hrs. cholinesterase inhibited after the treatment of both malathion compounds. Aspartate aminotransfers level increased in plasma by the all treatments of both malathion formulations, but in liver it decreased in all treatment of malathion compounds after 24 and 48 hrs. Alanine aminotransfers level increased in plasma for all treatments of malathion, while in liver the same enzyme decreased as a result of using 1/8 and 1/4 LD_{50} of malathion from Kafr El Zayat company. Urea in plasma and kidney increased in treatment with malathion (El Nasr and Kafr El Zayat) after 24 and 48 hrs, and increased in kidney by using 2/5 LD_{50} of malathion (El Nasr) after 24 and 48 hrs.

Key words: Imidacloprid, malathion, Total protein, cholinesterase, aspartate aminotransferase, alanine aminotransferase.

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INTRODUCTION

In Egypt, the majority of pesticides are imported as ready-to-use formulations. As a matter of fact, establishing the industry of pesticides formulations utilizing local basic ingredients would contribute much to the national income. Therefore, efforts should be directed towards using local raw materials and products for the formulation of different types of pesticides. Moreover, pesticide formulation at reasonable prices should be regarded as a consequent approach for decrease in the cost of pest control. Adjuvants are solvents, knockdown materials, sprayer materials, synergism materials … etc that increases the toxicity of pesticide formulations (Tsuji and Fuyama 1982). The discovery of neonicotinoids as important novel pesticides may be regarded as a milestone in insecticide research throughout the past three decades (Nellore *et al*., 2013). It is related to nicotines in their structure and action at the nicotinic acetylcholine receptor. (Casida and Quistad 1998).

Imidacloprid, as a member of the neonicotinoid insecticides, has become an important pest control agent on many crops. The selective toxicity of imidacloprid to insects but not to mammals refers to differences in its binding affinity or potency at the nicotinic acetylcholine receptor (Chao & Casida, 1997 and Casida & Quistad, 1998). Such advantage made imidacloprid one of the fastest

sold insecticides across the world. (Soujanya *et. al.,* 2013). Neurophysiological studies confirmed that imidacloprid is an agonist at the postsynaptic nicotinic acetylcholine receptor of insects. It appears to act like acetylcholine, by exciting specific nerve cells (Nagata, 1998).

Malathion (diethyl mercaptosuccinate S-ester with O,O-dimethyl phosphorodithioate) is one of the least toxic organophosphorus insecticides to mammals. It is extensively used to control a wide range of sucking and chewing pests of field crops, fruits and vegetables (Wankhade *et al.,* 2009). malathion, like the other members of the OP common mechanism group, inhibits ChE as a mode of toxic action. It blocks the acetylcholinesterase enzyme which decomposes acetylcholine. Immobilization of this enzyme results in accumulation of excessive amounts of acetylcholine in the nervous tissues and muscular motor plates, and reflects symptoms of poisoning. (Harlin and Dellinger, 1993). malathion is usually formulated as a technical preparation, a dust, EC, a ready-to-use, a pressurized liquid, and WP.

This study compare two different formulations of the same active ingredient (imidacloprid) and also two different formulations of the same percent of active ingredient of malathion, produced by two different Egyptian companies. The two tested formulations of imidacloprid were Confidet 35% SC and Gaucho 70% WP while the 2 tested formulations of malathion are malathion 57% EC from El Nasr Company and also malathion 57% EC from Kafr El Zayat Company.

Each company has its special additives that may enhance the formulation properties. Also every active ingredient could be formulate in a different form to use it against different kinds of organisms (insects, nematodes, fungi…..etc.). This work investigates how the various additives added by each company can change either pesticide efficacy or their side effects on non-target organisms.

The objectives of this study are:

1) Determination of the acute oral LD_{50} for albino mice of both tested imidacloprid and malathion insecticidal formulations
2) Comparative studies of the sublethal toxicity of two imidacloprid formulations (Confidet 35% SC and Gaucho 70% WP) on the activity of certain enzymes in albino mice at 24 and 48 hours after treatment.
3) A comparative study of the sub-lethal toxicity of malathion 57% EC emulsion concentrates produced by different companies (El-Nasr and Kafr El-Zayat companies) on the activity of different enzymes in albino mice after 24 and 48 hours after treatment.

LIST OF ABBREVIATIONS

Abbreviation	
3β HSDH	3β- hydroxysteroid dehydrogenase
AChE	Acetylcholinesterase
ACP	Acid phosphatase
AKP	Alkaline phosphatase
ALT	Alanine aminotansferase
AST	Aspertate aminotransferase
BChE	Butyrylcholinesterase
BUN	blood urea nitrogen
CAT	Catalase
ChE	Cholinesterase
EC	Emulsifiable concentrate
GGT	Gamma-glutamyl transferase
GST	Glutathione-S-transferase
LD_{50}	Median lethal dose
LDH	Lactate dehydrogenase
MDA	Malondialdehyde
NOEL	No observed effect level
Ops	Organophosprous insecticides
OS	Oil solutions

SC	Suspension concentrate
SChE	Serum cholinesterase
SOD	Superoxide dismutase
TLC	Total leukocyte count
ULV	Ultra low volume
VLDL	Very low density lipoprotein
WBC	White blood cell
WP	Wettable powder

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