RASĀYAN *J. Chem.*
Vol. 15 | No. 4 |2946-2949| October - December | 2022
ISSN: 0974-1496 | e-ISSN: 0976-0083 | CODEN: RJCABP
http://www.rasayanjournal.com
http://www.rasayanjournal.co.in

INSECTICIDAL ACTIVITIES OF SOME MIXED LIGAND COMPLEXES OF ZINC

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ABSTRACT
The present manuscript deals with the insecticidal and toxicological activities of some mixed ligand complexes of Zinc which are recently been reported. The newly synthesized complexes were also tested for their contact, stomach, antifeedant, and acaricidal activities against insects, pests, and mites. The outcome of screening clearly indicates them as potent insecticidal agents.
Keywords: Mixed Ligands, Zinc, Contact, Stomach, Antifeedant, and Acaricidal Activities.
RASĀYAN *J. Chem.*, Vol. 15, No. 4., 2022

INTRODUCTION

The studies on insect/pest behavior and their management are fruitful areas of study with a perspective to protect Indian crops.[1] They affect the life of mankind in a number of diseases like malaria, dengue, and cholera in addition to painful bites.[2] All insects do not come under the harmful category; few are beneficial such as honeybees, silkworms, etc. Insecticides are basically used for killing, repelling, and preventing treated areas from insects.[3] Their application started with the discovery of Paris green[4], a synthetic compound of arsenic, in 1867 to control the Colorado potato beetle. Most of the insecticides were inorganic chemicals[5] but much attention has been focused recently on organics[6] and metal organics[7] as insecticides which have made a revolutionary change in insect and pest control. The phenolics[8] and carbamates[9] derivatives are the major organic insecticides, but metal-based organic derivatives as insecticides made a new revolution in entomology.[10] The present manuscript covers the insecticidal studies of some mixed ligand complexes of Zn.

EXPERIMENTAL

The mixed ligand complexes of Zinc were synthesized and characterized by proper sophisticated instrumental analysis as reported[11] and tested for their insecticidal activities as per the methods given.

Contact Toxicity

The contact toxicity of the compound was carried out by topical application method[12] against larvae of *Spodoptera litura*. The compounds were dissolved in acetone and different concentrations *viz*., 0.06%, 0.12%, 0.25%, 0.50%, and 1.00% were prepared followed by application of 10 µl on the dorsal surface of the larvae. Some larvae were treated with acetone alone as a control. The mortality data were recorded after 24 hrs which was used for the calculation of LC_{50}/LD_{50} using the Maximum Likelihood program MLP 3.01.

Stomach Toxicity

The stomach toxicity was carried out by leaf dip method[13] using fourth instars larvae of *Spodoptera litura* using different concentrations of test compounds in acetone. The discs were prepared from caster leaf dipped in different concentrations of the test compound. Leaf discs in acetone only served as control. The mortality data were recorded after 24 hrs. and were used for the calculation of LC_{50}/LD_{50} using the maximum likelihood program, MLP 3.01.

Antifeedant Activity

The antifeedant activity of these compounds was also carried out by leaf dip method[13] using the same larvae of *Spodoptera litura* using different concentrations of test compounds in acetone. The insects were allowed to feed for 24 hrs; the leaf area uneaten was measured by a leaf area meter to find out the leaf

http://doi.org/10.31788/RJC.2022.1547024

area consumed. The feeding inhibition was calculated and used for the calculation of effective concentration (EC_{50}/LD_{50}) using the Maximum likelihood program, MLP 3.01.

Acaricidal Activity

The acaricidal activity of these compounds was also carried out by leaf dip method[13] using different concentrations of the compound in acetone using 0.2% tween 20 as an emulsifier. Leaf discs of 5 cm^2 dia. dipped in different concentrations were placed over wet cotton in a Petri plate. The adult female mites were released on treated leaf discs and mortality data were recorded after 48 hrs used for the calculation of LC_{50}/LD_{50} using the Maximum Likelihood Programmed (MLP). 3.01.

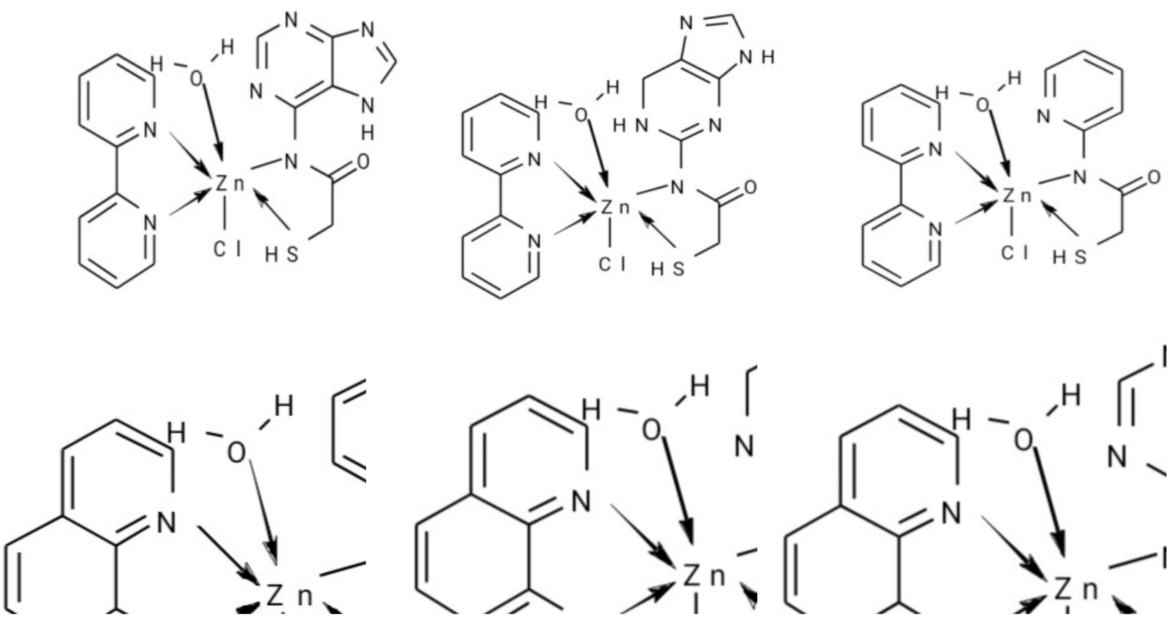

Fig.-1: Structure of Mixed ligand complexes of Zinc

RESULTS AND DISCUSSION

The mixed-ligand complexes of Zn(II) are appreciably soluble in ethanol and slightly soluble in nitrobenzene, acetone, etc. These complexes dissolve readily in acetic acid. All these complexes do not melt sharply but decompose above 150°C.

Contact Toxicity

The contact toxicity of Zn complexes was effective against larvae of *Spodoptera litura.* Compounds **3, 4,** and **5** show higher toxicity while the rest of the compounds show moderate toxicity. The variation in the efficacy was found due to ligands, which affect the nervous systems of the insect larvae and ultimately cause the death of the insects.

Stomach Toxicity

The stomach toxicity of complexes of Zn was found effective in compounds **3, 4,** and **8** while the rest of the compounds show moderate behavior. The presence of different carboxylic acid moieties as ligands changes the value of toxicity against the insect.

Antifeedant Activity

The antifeedant activity of mixed ligand complexes of Zn was found to be effective against the insect larvae of *Spodoptera litura* in different concentrations. The compounds show a high value of the antifeedant activity. The variation in activity was found due to variation in ligands.

Acaricidal Activity

The acaricidal activities of mixed ligand complexes of Zn were tested and found that compounds **4 and 6** show higher activity while the rest of the compounds show moderate activity. The variation in activity is generally based on the nature of the ligand.

Table-1: Contact Toxicity on Insect

S. No.	Compounds	Fiducial Limits	Slop ±	Chi. Sq. (3)	LC_{50}/LD_{50} at 24 hrs.
1.	$C_{17}H_{17}ClN_4O_2SZn$	1.61–2.54	1.17±0.19	0.22(3)	2.37
2.	$C_{17}H_{16}ClN_7O_2SZn$	0.92–2.60	11.11±0.16	0.26 (3)	1.36
3.	$C_{17}H_{18}ClN_7O_2SZn$	0.41–0.61	1.63±0.15	1.84 (3)	0.49
4.	$C_{16}H_{16}ClN_5O_3SZn$	0.40–0.60	1.58±0.15	0.72 (3)	0.48
5.	$C_{19}H_{17}ClN_4O_2SZn$	0.69–1.32	1.40±0.67	1.67(3)	0.90
6.	$C_{19}H_{16}ClN_7O_2SZn$	1.72–7.94	1.31±0.21	0.16 (3)	2.93
7.	$C_{19}H_{18}ClN_7O_2SZn$	2.37–32.67	0.95±0.19	0.61(3)	5.38
8.	$C_{18}H_{16}ClN_5O_3SZn$	0.41–0.61	1.63±0.15	0.26 (3)	1.36

Table-2: Stomach Toxicity

S. No.	Compounds	Fiducial Limits	Slop ±	Chi. Sq. (3)	LC_{50}/LD_{50} at 24 hrs.
1.	$C_{17}H_{17}ClN_4O_2SZn$	1.65–6.93	1.35±0.21	0.29 (3)	2.75
2.	$C_{17}H_{16}ClN_7O_2SZn$	1.69–7.75	1.28±0.21	0.38 (3)	2.89
3.	$C_{17}H_{18}ClN_7O_2SZn$	0.44–0.67	1.65±0.16	3.89 (3)	0.53
4.	$C_{16}H_{16}ClN_5O_3SZn$	0.44–0.67	1.69±0.16	3.30 (3)	0.53
5.	$C_{19}H_{17}ClN_4O_2SZn$	2.49–3.65	0.93±0.18	0.501 (3)	5.88
6.	$C_{19}H_{16}ClN_7O_2SZn$	1.47–5.17	1.38±0.21	0.35 (3)	2.33
7.	$C_{19}H_{18}ClN_7O_2SZn$	1.88–14.44	1.01±0.18	1.06 (3)	3.70
8.	$C_{18}H_{16}ClN_5O_3SZn$	0.45–1.09	0.87±0.13	1.71 (3)	0.64

Table-3: Antifeedant Activity

S. No.	Compounds	Fiducial Limits	Slop ±	Chi. Sq. (3)	LC_{50}/LD_{50} at 24 hrs.
1.	$C_{17}H_{17}ClN_4O_2SZn$	0.32–0.53	1.15±0.14	7.53 (3)	0.40
2.	$C_{17}H_{16}ClN_7O_2SZn$	0.25–0.40	1.17±0.14	7.23 (3)	0.31
3.	$C_{17}H_{18}ClN_7O_2SZn$	0.64–1.16	1.47±0.16	3.73 (3)	0.83
4.	$C_{16}H_{16}ClN_5O_3SZn$	0.37–0.63	1.18±0.14	2.36 (3)	0.47
5.	$C_{19}H_{17}ClN_4O_2SZn$	0.21–0.32	1.31±0.14	5.70 (3)	0.25
6.	$C_{19}H_{16}ClN_7O_2SZn$	0.33–0.61	1.00±0.13	0.68 (3)	0.43
7.	$C_{19}H_{18}ClN_7O_2SZn$	0.45–1.09	0.87±0.13	1.71 (3)	0.64
8.	$C_{18}H_{16}ClN_5O_3SZn$	0.68–1.72	1.03±0.14	0.66 (3)	0.98

Table-4: Acaricidal Activity

S. No.	Compounds	Fiducial Limits	Slop ±	Chi. Sq. (3)	LC_{50}/LD_{50} at 24 hrs.
1.	$C_{17}H_{17}ClN_4O_2SZn$	0.12–0.30	0.78±0.88	1.70 (3)	0.18
2.	$C_{17}H_{16}ClN_7O_2SZn$	0.14–0.31	0.96±0.09	7.52 (3)	0.20
3.	$C_{17}H_{18}ClN_7O_2SZn$	0.12–0.30	0.80±0.08	6.91 (3)	0.18
4.	$C_{16}H_{16}ClN_5O_3SZn$	0.01–0.02	1.03±0.07	25.30 (3)	0.02
5.	$C_{19}H_{17}ClN_4O_2SZn$	0.10–0.23	0.88±0.08	2.14 (3)	0.15
6.	$C_{19}H_{16}ClN_7O_2SZn$	0.03–0.06	0.76±0.07	15. 89 (3)	0.40
7.	$C_{19}H_{18}ClN_7O_2SZn$	0.06–0.10	1.24±0.10	14.27 (3)	0.08
8.	$C_{18}H_{16}ClN_5O_3SZn$	0.16–0.37	0.09±0.09	8.28 (3)	0.23

CONCLUSION

The newly synthesized mixed ligand complexes of Zinc were found potentially active against insects, pests, and mites by using tween 20 as an emulsifier. The result clearly indicates that these complexes may be used in the future to control insects to damage Indian crops.

ACKNOWLEDGEMENT

The authors are highly thankful to the Principal, Narain P.G. College, Shikohabad, for providing laboratory and other facilities and Director, CSIR-NBRI, for providing insect culture and other facilities for the studies.

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[RJC-7024/2022]