STUDIES ON POTENTIAL PESTICIDES—PART XII

Synthesis and Biological Activity of N^1-Aryloxyacetyl-N^4-aryl-3-thiosemicarbazide, 1, 2, 4-triazole and 1, 3, 4-oxadiazole derivatives

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Fifteen N^1-(4-Nitrophenoxyacetyl)N^4-aryl/cyclohexyl-3-thiosemicarbazide, eleven 3-(4-Nitrophenoxymethyl)-4-aryl/cyclohexyl-5-mercapto 1, 2, 4-triazoles and four 2-Arylamino-5-(4-Nitrophenoxymethyl)-1, 3, 4-oxadiazole derivatives were prepared and tested for their pesticidal properties. All compounds exhibited significant pesticidal activity.

Thiosemicarbazide derivatives are known to possess antibacterial[1,2], antifungal[3-5] and herbicidal[6] activities. Further, it is known that on cyclization, thiosemicarbazide derivatives yield substituted 1, 2, 4-triazoles[7-11] and 1, 3, 4-oxadiazoles[12-16], all possessing insecticidal, bactericidal, herbicidal, fungicidal and pesticidal properties. For example, Amitrol [3-amino-1, 2, 4-triazole], is a well-known herbicide and Wepsin[17], [5-amino-1-bis-(dimethylamino)-phosphoryl-3-phenyl-1, 2, 4-triazole], is well-known fungicide Pianka[18] reported a number of organophosphorous compounds containing oxadiazole nucleus, as a potent insecticides.

With these points in view, synthesis of new thiosemicarbazide derivatives viz. N^1-(4-Nitrophenoxyacetyl)-N^4-aryl/cyclohexyl-3-thiosemicarbazides, as well as, their cyclized traizole and oxadiazole derivatives was undertaken and their pesticidal activities were studied by the present authors. The structure of the synthesised compounds were confirmed by the characteristic IR spectra which exhibited bands (ν max in cm^{-1}) around 1490 and 1700 cm^{-1} for *N-C-N-* and *CO* grouping in thiosemicarbazides, a band

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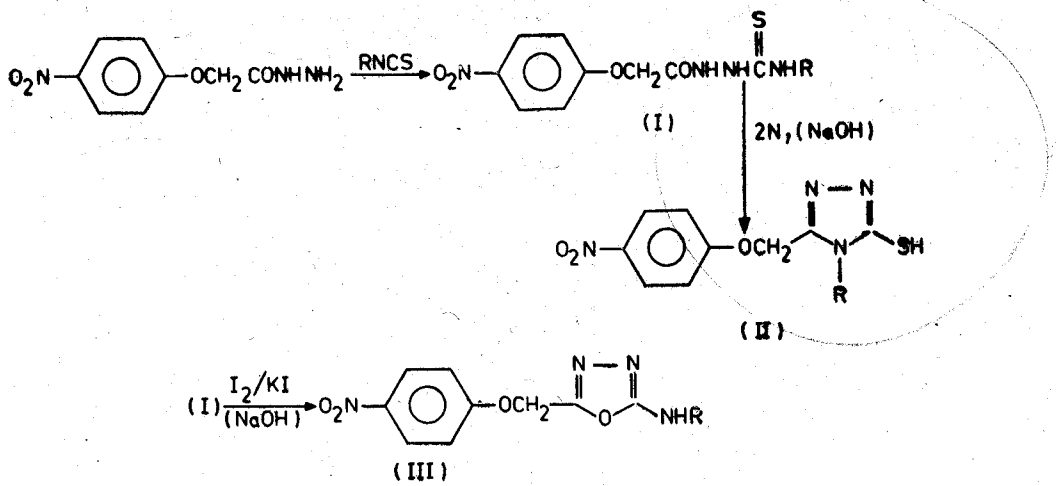
at 1600 cm^{-1} for *C=N* grouping in triazoles and a band at 1640 cm^{-1} for *OCN* grouping in oxadiazoles.

Cockroaches and some species of bacteria were employed for testing the pesticidal activities of all these synthesised compounds. Most of these exhibited marginal activities but some did exhibit significant insecticidal as well the bactericidal properties such as reported in literature.

EXPERIMENTAL PROCEDURE

Melting points were taken in open capillary and are uncorrected. IR spectra were taken on a Perkin-Elmer spectrophotometer in *KBr* pellets. 4-Nitrophenoxyacetyl hydrazide was prepared by the method of Garner[19] and various isothiocyanates were prepared according to known procedure[20].



N^1-(4-Nitrophenoxyacetyl)-N^4-aryl/cyclohexyl-3-thiosemicarbazides

A mixture of 4-Nitrophenoxyacetic acid hydrazide (0.01 mole) and aryl/cyclohexyl isothiocyanate (0.01 mole) in absolute ethanol (30 ml) was refluxed on steam bath at 100°C for 4 to 7 hours. The reaction mixture was filtered and crystallised from ethanol. The various derivatives obtained by using different isothiocyanates are listed in Table 1.

3-(4-*Nitrophenoxymethyl*)-4-*aryl/cyclohexyl*-5-*mercapto*-1, 2, 4-*triazoles*

For cyclization to obtain triazole, a thiosemicarbazide (0.005 mole) was dissolved in 10 ml of 2*N* sodium hydroxide solution. The clear solution was heated on water bath at 100°C for 4 hours, filtered after cooling and, then, neutralized with dilute acetic acid. The precipitated compound thus formed was filtered and crystallised from ethanol as the solvent. The various triazoles, thus synthesised, have also been listed in Table 1.

TABLE 1

	Compd. R	m.p. (°C)	Yield (%)	% of *N*	
				Calcd.	Found
	THIOSEMICARBAZIDE DERIVATIVES (I)				
1.	Phenyl	165	72	16.18	16.27
2.	3-Chlorophenyl	204	60	14.69	14.73
3.	4-Chlorophenyl	179	62	14.69	14.65
4.	2-Methylphenyl	210	67	15.55	15.31
5.	3-Methylphenyl	160	57	15.55	15.73
6.	4-Methylphenyl	167	55	15.55	15.19
7.	2-Methoxyphenyl	180	75	14.89	14.86
8.	3-Methoxyphenyl	175	68	14.89	14.76
9.	4-Methoxyphenyl	165	77	14.89	14.82
10.	4-Bromophenyl	189	51	13.17	13.35
11.	2-Ethylphenyl	153	45	14.97	14.76
12.	4-Ethoxyphenyl	160	55	14.35	14.32
13.	Benzyl	176	70	15.55	15.60
14.	Cyclohexyl	183	75	15.95	15.97
15.	1-Naphthyl	183	50	14.16	14.21
	1, 2, 4-TRIAZOLE DERIVATIVES (II)				
16.	Phenyl	205	65	17.07	17.10
17.	3-Chlorophenyl	270	60	15.42	15.41
18.	4-Chlorophenyl	227	65	15.42	15.62
19.	2-Methylphenyl	198	60	16.37	16.43
20.	4-Methylphenyl	233	67	16.37	16.37
21	4-Methoxyphenyl	224	58	15.64	15.51
22.	4-Bromophenyl	242	54	13.75	13.64
23.	2-Ethylphenyl	206	50	15.73	15.76
24.	4-Ethoxyphenyl	265	53	15.05	15.15
25.	Benzyl	194	55	16.37	16.39
26.	Cyclohexyl	222	57	16.76	16.71
	1, 3, 4-OXADIAZOLE DERIVATIVES (III)				
27.	4-Chlorophenyl	123	54	16.13	16.32
28.	4-Methoxyphenyl	253	60	16.47	16.51
29.	2-Ethylphenyl	217	43	16.47	16.49
30.	Cyclohexyl	268	50	17.61	17.32

2-Arylamino-5-(4-Nitrophenoxymethyl)-1, 3, 4-oxadiazoles

For cyclization to obtain oxadiazoles, a thiosemicarbazide (0.01 mole) was mixed with sodium hydroxide (6*N*, 5 ml) and 400 ml of ethanol (95%) was, then, added to the mixture. A solution (5%) of I_2 in *KI* was slowly added to the mixture till it could hold the I_2 and showed its colour. Then the solution was refluxed for 4 hours on steam bath at 100°C and more I_2 solution added if necessary. Finally, the mixture was poured into ice-water. The solid mass was filtered out, washed with water and CS_2, and crystalised using ethanol as the solvent. The various oxadiazoles thus prepared are listed in Table I.

BIOLOGICAL ACTIVITIES

All newly synthesised thiosemicarbazides (I), triazoles (II) and oxadiazoles (III), were tested for their insecticidal activity against adult cockroaches, using micrometer syringe method[21]. Agar plate diffusion technique[22] was employed for determination of their bactericidal activities against *Staphylococcus aureus Bacillus subtilis, Bacillus pumilus and Sarcina lutea.*

All these compounds exhibited insecticidal as well as bactericidal activities. Triazoles and oxadiazoles were found to be more active. Methyl and chloro group substituted thiosemicarbazides, triazoles and oxadiazoles are comparatively more effective than other substituted compounds. The effectiveness is reduced in the order methyl, methoxy and ethoxy substituted compounds. Oxadiazole derivatives were found to have marginal activity.

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