Penetration and Metabolism of Carbaryl
in *Spodoptera litura* (FAB.) (Lepidoptera:
Noctuidae) and *Galleria mellonella* L.
(Lepidoptera: Pyralidae) Larvae¹

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Carbaryl is toxic to larvae of *Spodoptera litura* (FAB.), but innocuous to *Galleria mellonella* L.; i.e., LD₅₀ (topically, 24 hr) value is for *S. litura* is 50 µg/g (SATO and SUWANAI, 1976), for *G. mellonella* is >11,000 µg/g (SATO, unpublished). To clarify the selectivity of the chemicals, penetration and metabolism of ¹⁴C-carbaryl in the both larvae were investigated.

Ten larvae of *S. litura* (OYAMA and KAMANO, 1976) of *G. mellonella* (MITSUI et al., 1973) (body weight : 0.2 g, respectively) reared on artificial diet, were treated topically on the dorsal part with a 1.0 µl acetone solution containing 0.1 µg of naphthalene-1-¹⁴C-labeled carbaryl (6.1 mCi/mmol) (TSUGE et al., 1976) using a micrometer-driven syringe. Treated larvae were kept in a metabolic cage (Fig. 1).

A half, 1, 2 and 24 hr after application the treated larvae were rinsed with acetonitrile to remove radioactivity remaining on the cuticle. Rinsed larvae were homogenized in a mortar with 66.7% aqueous acetonitrile. Supernatant solution of the homogenates after centrifugation was extracted with chloroform.

Aliquots of acetonitrile, and chloroform and aqueous phases of the supernatant were taken to measure radioactivity (Fig. 2). Chloroform extract was reduced to a suitable volume by evaporation *in vacuo*, and thin layer chromatography was performed on a 20×20 cm-plate coated with silica gel G 0.5 mm thick. Chromatograms were de-

Fig. 1. Metabolic cage.

Fig. 2. Analytical procedure.

veloped with ethyl ether : *n*-hexane (4 : 1, v/v), and were exposed to X-ray film for appropriate periods and then developed.

Radioactivity in the residue fraction after extraction with acetonitrile was performed by combusting the samples using a Sample Oxidizer (Packard Tricarb, Model 306).

Determinations of radioactivity were made by a Packard Tricarb Liquid Scintillation Spectrometer, Model 3003 (KAZANO et al., 1978).

Distribution of radioactivity found on and in the larvae 0.5, 1, 2 and 24 hr after treatment is shown in Table 1. Disappearance of radioactivity from the surface of *G. mellonella* larvae was slower than the case of *S. litura*. This fact would be related to the selective toxicity of the chemicals between the two species of larvae.

Because the amount of radioactivity in the solvent fractions of larval homogenates was at the same level at the same point in time in both

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Table 1. Distribution of radioactivity found in each fraction after topical application of ^{14}C -carbaryl (0.5 $\mu\text{g/g}$) on *Spodoptera litura* and *Galleria mellonella*

Larva	Time (hr)	Outside (ng)	Aqueous	Organo-soluble	Residue	Excretion	Recovery (%)
<i>S. litura</i>	0.5	191	67	85	49	47	88
	1	116	53	87	27	120	81
	2	147	87	187	27	13	92
	24	67	36	141	114	64	84
<i>G. mellonella</i>	0.5	256	16	106	5	31	83
	1	241	27	170	7	27	94
	2	215	29	144	8	38	87
	24	123	20	184	22	43	78

Table 2. Percentage of carbaryl and its degradative metabolites found in organosoluble fraction of the homogenate after *tlc*-autoradiography

Larva	Time (hr)	Carbaryl (%)	1-Naphthol	Others	Origin
<i>S. litura</i>	0.5	37	5	9	49
	1	36	12	13	39
	2	29	24	13	34
	24	4	78	6	13
<i>G. mellonella</i>	0.5	85	1	1	13
	1	82	2	7	9
	2	53	13	6	28
	24	45	27	7	21

Fig. 3. Radioactive metabolites of carbaryl on *tlc*-autoradiogram of *Spodoptera litura* and *Galleria mellonella*.

larvae, this would not be related to the selectivity.

The metabolite data by thin layer chromatogram shown in Fig. 3 indicate the presence of 3 metabolites in *S. litura* and 1 or 2 in *G. mellonella*. Metabolite V in *S. litura* and III in *G. mellonella* and the synthesized compound gave the same *R_f* values as those of 1-naphthol which were confirmed by co-chromatography.

Table 2 indicates that most of the radioactivity

recovered from the chromatograms on *G. mellonella* was the parent compound. The main metabolite in both larvae was 1-naphthol, and the parent compound decreased with time as metabolites other than the parent increased. This, then, would be slightly related to the selectivity.

It is considered that the selective toxicity of carbaryl between larvae of *S. litura* and *G. mellonella* is attributable to difference in the penetration of the chemicals into the two species.

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