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EFFECT OF CERTAIN PHYTOECDYSTEROIDS ON LARVAE OF COLORADO BEETLE *Leptinotarsa decemlineata*

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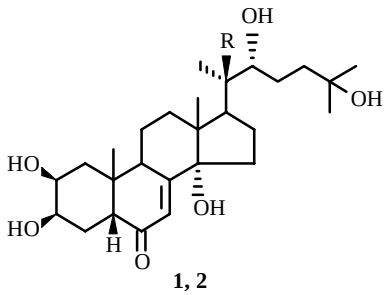
*The toxicity of phytoecdysteroids 20-hydroxyecdysone (**1**), α-ecdysone (**2**), polypodin B (**3**), and poststerone (**4**) for larvae of colorado beetle* Leptinotarsa decemlineata *Say. is studied by topical and GI administration.*

Key words: phytoecdysteroids, *Leptinotarsa decemlineata*, insecticidal activity.

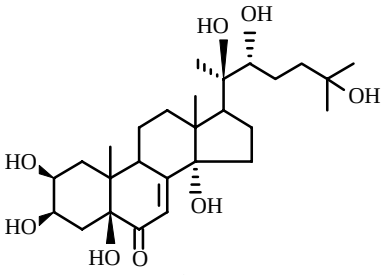
Ecdysteroids form a large group of natural compounds found in plants, invertebrates, and mushrooms [1, 2]. Ecdysteroids are known to be insect hormones that control various vital functions, in particular, molting and metamorphosis. The reasons for the occurrence of large quantities of ecdysteroids in certain plants are not yet known. It is known that exogenic ecdysteroids ingested with food cause significant disruptions of the insect hormonal system and, eventually, death. Therefore, one possible explanation of the function of ecdysteroids in plants is that these substances, called phytoecdysteroids owing to the source, are necessary to protect the plants against herbivorous insects [1, 3]. Because ecdysteroids are relatively nontoxic for warm-blooded animals and humans, it should be possible in principle to use them as a basis to develop modern safe means of controlling populations of agricultural insect pests.

We studied the insecticidal activity of phytoecdysteroids **1-4** on larvae of colorado beetle *Leptinotarsa decemlineata* Say. (Coleoptera). The colorado beetle is oligophagous, potatoes being the main food. This insect is a harmful pest under conditions in Belarus′, inflicting substantial damage on the potato harvest. It should be mentioned that until now the only phytoecdysteroid that has been studied as an insecticide is 20-hydroxyecdysone (**1**) [4, 5]. We investigated the toxicity for colorado beetle larve of **1** and other representative phytoecdysteroids, α-ecdysone (**2**), polypodin B (**3**), and poststerone (**4**).



1, 2

1: R = OH
2: R = H



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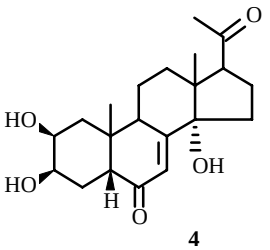

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We determined the insecticidal activity by placing colorado beetle larvae into Petri dishes containing food, i.e., potato leaves, and spraying with solutions (0.01%) of the phytoecdysteroids. According to the experimental conditions, beetle larvae were fed these leaves only for one day, after which they received natural food. Table 1 contains results from the study of the insecticidal activity of phytoecdysteroids **1-4** on colorado beetle larvae. It can be seen that phytoecdysteroids ingested with food were toxic over a long period and led to the death of larvae even five days after administration. Taking into account the dynamics of larval death, these phytoecdysteroids can be considered insect growth regulators.

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TABLE 1. Toxicity of Phytoecdysteroids for Colorado Beetle Larvae

Compound	Larvae, ea.	Larvae death, days							
		1		3		5		Total	
		number	%	number	%	number	%	number	%
1. 20-Hydroxyecdysone	30	2	6.7	4	13.3	10	33.3	16	53.3
2. α-Ecdysone	30	1	3.3	4	13.3	4	13.3	9	30.0
3. Polypodin B	30	0	0	2	6.7	5	16.7	7	23.3
4. Poststerone	30	2	6.7	3	10.0	8	26.7	13	43.3
Control	29	0	0	1	3.4	2	6.9	3	10.3

According to Table 1, it can be concluded that **1**-**4** are highly toxic to colorado beetle larvae. 20-Hydroxyecdysone (**1**) was the most active. The other phytoecdysteroids were less active in the comparison with 20-hydroxyecdysone. It should be noted that the insecticidal activity of **1**-**4** for colorado beetle larvae does not in general correlate with their comparative activity as insect molting hormones, which is determined using the appropriate tests [1]. The comparatively high toxicity of poststerone (**4**) for colorado beetle larvae was somewhat unexpected.

Poststerone has the C_{21}-ecdysteroid chemical structure. It does not have a long side chain. However, according to the literature, a steroidal side chain with several hydroxyls is necessary to produce high insect hormonal activity in ecdysteroids. In particular, previous data [7] indicate that 20-hydroxyecdysone (**1**) and α-ecdysone (**2**) in tests on *Calliphora* exhibit a certain activity; polypodin B (**3**) exceeds this by four times; and poststerone (**4**) is inactive as a molting hormone. Also, the fact that poststerone exhibits high insecticidal activity for the colorado beetle drives the search for new active insecticides among structural analogs of pregnane ecdysteroids.

EXPERIMENTAL

We prepared working solutions by placing phytoecdysteroids (1 mg) in a volumetric tube, adding ethanol (0.5 mL), and adjusting the volume to 10 mL with distilled water containing surfactant OP-10 (1 drop per L of water).

Colorado beetle (*Leptinotarsa decemlineata* Say.) larvae were obtained from egg sacs collected in the field. Second-growth larvae on potato leaves in Petri dishes were sprayed. Each dish contained 10 larvae. The experiments were repeated three times. The control was distilled water with added ethanol (0.5 mL/10 mL water) and surfactant OP-10 (1 drop per L water). Each Petri dish received 0.5 mL of working solution. The concentration of the studied compounds was 0.01%.

Larvae were fed treated food for one day. Then treated leaves were replaced with fresh untreated ones as necessary. The mortality of larvae was calculated on the second, third, and fifth day after treatment.

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