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Acute Toxicity of Brestan and Fentin Acetate on Some Freshwater Organisms

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This work was undertaken because of the growing fear that aquatic fauna may be adversely affected by the intensive and indiscriminate use of numerous phytodrugs and other means for protecting the reproduction of certain vegetable species (Corbett 1974).

MATERIALS AND METHODS

The herbicide used was stannic triphenylacetate (Brestan), an organic tin compound with the empirical formula $C_{20}H_{18}O_2Sn$, which is used in rice cultivation to suppress algae and molds (such as *Saprolegnia* spp.) harmful to rice, and in agriculture against potato and sugar beet blight (Chiapparini et al. 1964).

It is slightly soluble in water (28 mg/L at 20 °C) and almost not soluble in organic solvents such as alcohol and acetone. The active principle (fentin acetate) represents 60% of the total weight, providing a strong anticryptogamic effect.

In the experiments Brestan (a commercial product) and pure fentin acetate were compared.
In arranging for equal concentrations the fact that Brestan contains 60% of fentin acetate was allowed for, because the objective was to see whether, and to what extent, the toxicity of fentin acetate is affected by the absence of the other substances in the commercial product.
Brestan has a wide spectrum of effectiveness, corresponding to that of products based on copper. It is very toxic to fish and other aquatic animals. It has already been observed that many species of fish have mortality rates of 100% within 24 h of treatment with a concentration of 0.4 mg/L of triphenylacetate.

The species used in these experiments were: the isopod *Asellus aquaticus* L., the dipterous larva *Chironomus riparius* Meigen, and the ciprinid *Carassius auratus* L. In this type of toxicity test plastic thermostatic tanks at least 20 cm deep were used, kept at a constant temperature of 20 °C.

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Before the experiments started the animals were kept in stabilizing tanks in water well oxygenated (60-100%) by bubbling air (APHA 1971). The water used in preparing the solutions was ordinary tap water from the mains of the City of Milan, with pH 7.4, conductivity 515 μS/cm, hardness 307 mg $CaCO_3$/L.

Mortality rates (TLm) for 24 and 48 h were then calculated as recommended by IRSA. The safe dilution, a parameter which, by adopting animals of different species and hence different sensitivity, can give a sufficient guarantee for safeguarding the entire biological environment was also calculated by the recommended IRSA procedure.

RESULTS AND DISCUSSION

The experimental results and the safe dilutions for each of the animal species were as follows (D = Safe Dilution):

Carassius auratus L.	(TLm 24 h = 0.676 mg/L;
	TLm 48 h = 0.62 mg/L;
	D = 0.16 mg/L)
Asellus aquaticus L.	(TLm 24 h = 3-5 mg/L;
	TLm 48 h = 1.1 mg/L;
	D = 0.02-0.04 mg/L)
Chironomus riparius M.	(TLm 24 h = 0.07 mg/L;
	TLm 48 h = 0.05 mg/L;
	D = 0.008 mg/L)

The toxic effects of fentin acetate were appreciably less in the absence of the other substances in the commercial product (Brestan) (Tables 1-3).

A toxicological scale has thus been estimated on the basis of the different sensitivities of the various species to the action of the poison.

In the case of Carassius auratus the quantities used, although showing the highest safe dilution, give TLm values below those for Asellus aquaticus, thus confirming that even goldfish are sensitive to this phytopharmaceutical.
Asellus aquaticus showed a higher tolerance to the poison than the other species examined (although the values for D are fairly close to those for Carassius auratus, its TLm 24 h is about five to seven times higher).
The larva of Chironomus riparius, which is described as living in water polluted by organic matter and poor in oxygen, suffered seriously from this new pollution, which selectively attacks key points in its energy metabolism.

In conclusion, we have drawn a toxicity curve, which is the definitive expression of the results of a toxicological experiment. Its parameters are (Litchfield,J. T., 1949): C (concentration of poison), TL_{50} (lethal time for 50% of the animals), L.F. (95% probability limits) and S (slope of the line "time percent" of the effect) (Table 4, Figures 1-3)

Table 1. Survival percentages for <u>Carassius auratus</u> L. treated with Brestan and with fentin acetate (*).

mg/L \ h	6	24	48	72	96	120	144	168	192
0.5	100	80	70	50	0				
0.3	100	100	80	70	50	20	0		
0.1	100	100	100	80	80	70	50	0	0
0.3(*)	100	100	100	40	40	20	0		
0.18(*)	100	100	100	90	90	90	90	80	80
0.06(*)	100	100	100	100	90	90	90	80	80

Table 2. Survival percentages for <u>Asellus aquaticus</u> L. treated with Brestan and with fentin acetate (*).

mg/L \ h	6	24	48	72	96	120	144	168	192
5	100	50	0						
3	100	60	0						
2	100	100	20	20	0				
1	100	100	60	60	40	30	20	0	
0.5	100	100	80	50	50	50	40	0	
0.1	100	100	100	90	90	80	60	40	20
3(*)	100	80	40	20	0				
1.8(*)	100	100	80	60	50	30	0		
1.2(*)	100	100	90	70	60	40	10	0	
0.6(*)	100	100	100	90	80	70	50	50	30
0.3(*)	100	100	100	90	90	80	70	50	50
0.06(*)	100	100	100	100	100	100	100	90	90

Table 3. Survival percentages for <u>Chironomus riparius</u> M. treated with Brestan and with fentin acetate (*).

mg/L \ h	1	2	4	6	10	12	24	48	60	72
3	100	50	10	0						
2	100	80	30	10	0					
1	100	90	40	10	0					
0.5	100	100	40	20	0					
0.08	100	100	100	100	80	/	50	0		
0.07	100	100	100	100	90	/	60	30	30	0
0.05	100	100	100	100	100	/	60	50	25	0
1.8(*)	100	90	50	30	0					
1.2(*)	100	100	70	50	20	0				
0.6(*)	100	100	80	60	30	20	0			
0.3(*)	100	100	90	70	40	20	0			
0.05(*)	100	100	100	100	100	60	40	30	10	0
0.04(*)	100	100	100	100	100	60	50	40	30	20
0.03(*)	100	100	100	100	100	70	50	40	20	10

Table 4. Results of the toxicity tests of Brestan with *Carassius auratus* L., *Asellus aquaticus* L.(*), *Chironomus riparius* M. (°).

C (mg/L)	TL50	L.F.	S
0.5	84	63-117.2	1.58
0.3	85	73-98	1.54
0.1	142	112.5-178.9	1.9
0.09	131	117-146	1.35
0.08	146	129-164	1.38
0.07	138	123.7-153	1.35
0.06	178	156-202	1.42
0.05	206	191-221	1.23
0.04	125	110.4-141.5	1.42
8(*)	24	19-29	1.75
3(*)	26	21.4-31.4	1.71
2(*)	37	33-40	1.32
1(*)	94	63.5-139	3.1
0.6(*)	102	76-137	2.3
0.5(*)	116	89-150	2.6
0.3(*)	130	104-160	1.77
0.18(*)	145	128-163	1.43
0.1(*)	140	125-126	1.41
0.06(*)	304	285-323	1.18
3(°)	2	1.6-2.4	1.70
2(°)	3.10	2.4-3.9	1.88
1(°)	3.30	2.8-3.8	1.58
0.5(°)	3.33	2.5-4.2	2
0.3(°)	9.3	7.9-10.8	1.54
0.1(°)	13	10.5-15.9	1.8
0.09(°)	17	13.4-21.4	1.96
0.08(°)	23	17.4-30	2.3
0.07(°)	33	29-37	1.4
0.04(°)	54	47-61	1.49
0.02(°)	50	44-56	1.43
0.005(°)	72	64-80	1.34

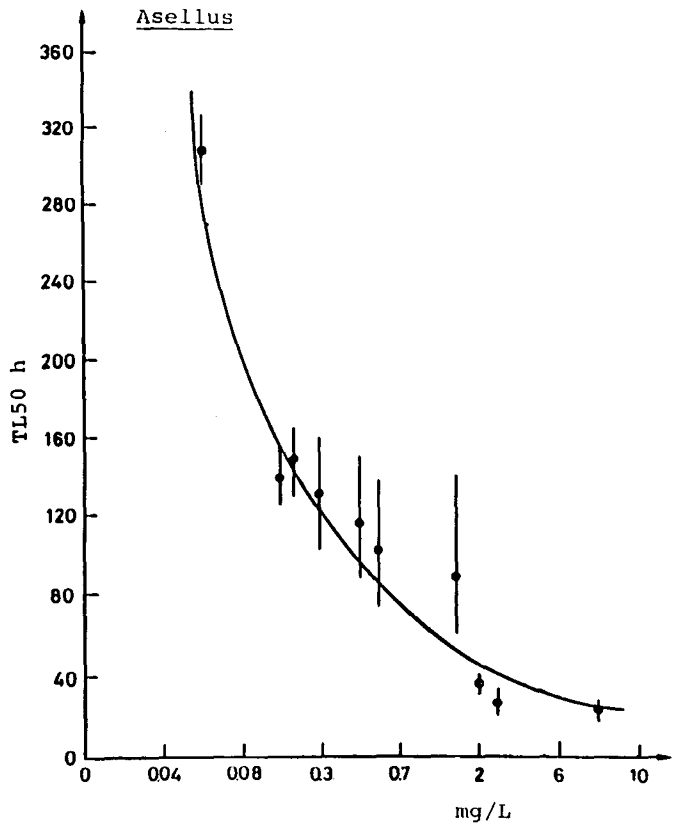

Figure 1. Toxicity curve of Brestan with *Asellus aquaticus* L..

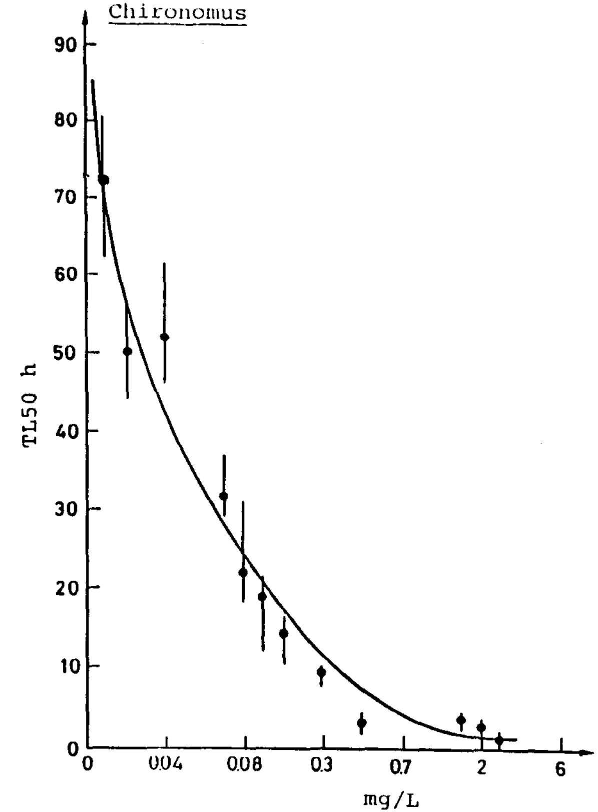

Figure 2. Toxicity curve of Brestan with *Chironomus riparius* M..

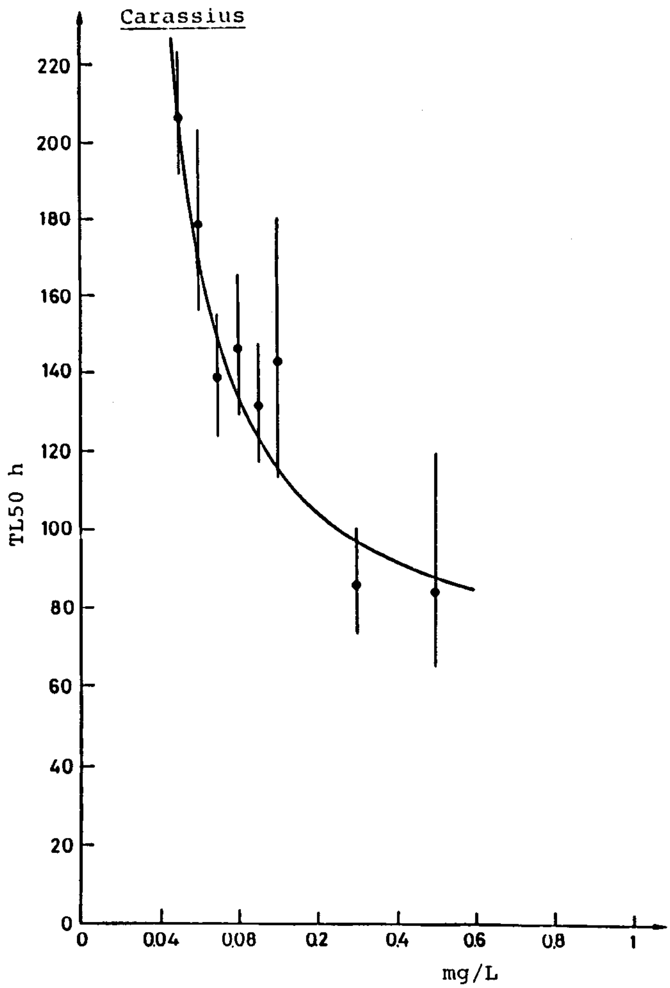

Figure 3. Toxicity curve of Brestan with _Carassius_ _auratus_ L.

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