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Determination of mass differences in the range of units of µg by radioactivity measurement

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Abstract

It has been proved that, under certain experimental conditions in life sciences, the mass differences in the range of units of µg can be determined by a high-sensitive measurement of radioactivity with a comparable precision as by the use of analytical balances. The advantage of determinations by radioactivity of measurements represents a further use of the obtained values in evaluation of the biological experiment.

Keywords: mass differences, units of µg, radioactivity measurement.

1. Background

Termites are serious urban, agriculture and forest pests. Effective termite control represents application of juvenogen [1] which induced an increased and precocious formation of soldiers [2]. This effect causes a disruption of social homeostatis which can result in colony death.

In our Institute, we have recently studied the mode of action of juvenogens in several different laboratory, arrangements with termites [3,4].

2. Experimental arrangement

The termite species used was Reticulitermes santonensis de Feytaud, 1928 (Isoptera: Rhinotermitidae), an important pest in France. It has been previously established to be a model species in the EC for testing the timber resistance against wood pest insects. Thus, it belongs to intensively studied species in both basic and applied research. The experimental termites were individually selected to be in the middle of the intermoult period, and to have equivalent development competence.

Juvenoid W330 labeled with tritium at the required position was used to label juvenogen W700 in a corresponding position (Figure 1).

The groups of 40 R.santonensis workers were kept in 60 mm Petri dishes on fine quartz sand (5 mL) moistened with 2 mL of distilled water. A spruce wood block (2×10×30 mm) was offered to termites as the only source of food. The wooden blocks were impregnated with 0.4 mL acetone solution (0.05 mg mL^{-1}) of the studied compound. Each radiolabeled compound with a non-active carrier was dissolved in acetone p.a. (92.5 kBq mL^{-1}) so that 37 kBq was used for impregnation.

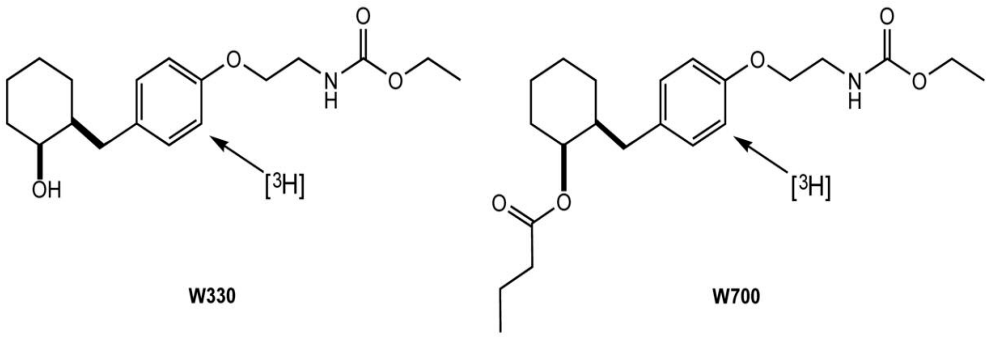

Figure 1. Parent tritiated juvenoid W330 (left) and juvenogen W700 (right) labeled with tritium in the benzene ring.

The worker groups were held in complete darkness at 28°C for 14 days. Then the caste proportions were scored and the activity of each termite washed by chloroform was measured on one side, and, on the other, the bodies were weighted using analytical balances (Sartorius, model 4501 Micro).

Measurements of radioactivity were carried out in a liquid scintillation analyzer (Perkin Elmer, Tri-Carb 2900 TR) with automatic evaluation in dpm. The standard deviations of all measurements were less than ± 1%.

Each washed termite was separately put for six days at a laboratory temperature into a low-potassium scintillation glass vial containing 1 mL of solubilizer (NCS II, Amersham, England). Then 10 mL of a liquid scintillator (Rotiszint eco plus, Carl Roth, Germany) were added into each vial and radioactivity was measured in the tritium channel of liquid scintillation analyzer. The counting channel was set to get the highest figure of merit. All corrections to obtain correct results were applied as, e.g., quenching.

3. Results and discussion

The results obtained by both described methods are summarized in Table 1. It is evident that there exists a correlation between the value obtained by weighting and the corresponding radioactivity of each worker or presoldier, respectively. With the scintillation counting channel set to get the highest figure of merit and application of all necessary corrections, the mass differences down to the range of units of μg can be determined with a comparable precision when a corresponding time interval of measurement is used. On the contrary to the values obtained by weighting, values of radioactivity can be used for evaluation of the juvenogen effect.

Table 1. Measured values in termites by weighting [mg] and radioactivity measurement [dpm] after application of W700

Sample No.	Caste	mg	dpm (S.D. < 1%)	Sample No.	Caste	mg	dpm (S.D. < 1%)
1	Worker	2.695	603	21	Worker	2.686	601
2	Worker	2.775	621	22	Worker	2.824	632
3	Worker	2.684	601	23	Worker	2.362	528
4	Worker	2.337	523	24	Presoldier	2.320	519
5	Worker	2.526	565	25	Presoldier	2.359	528
6	Worker	2.640	591	26	Presoldier	1.703	381
7	Worker	1.913	428	27	Presoldier	2.308	516
8	Worker	3.048	682	28	Presoldier	2.530	566
9	Worker	2.283	511	29	Presoldier	2.372	531
10	Worker	2.031	454	30	Presoldier	2.562	573
11	Worker	2.734	612	31	Presoldier	2.225	498
12	Worker	2.376	532	32	Presoldier	2.521	564
13	Worker	3.256	729	33	Presoldier	2.633	589
14	Worker	4.107	919	34	Presoldier	2.775	621
15	Worker	3.036	679	35	Presoldier	2.005	449
16	Worker	3.437	769	36	Presoldier	2.935	657
17	Worker	2.828	633	37	Presoldier	3.105	695
18	Worker	2.601	582				
19	Worker	2.916	652				
20	Worker	2.204	493				

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4. Acknowledgement

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