Succinoxidase Activity of the Flight Muscles of the Wasp, *Sceliphron cementarium*

In insects, succinoxidase activity has been studied in the milkweed bug[1], in the embryonic cells of the grasshopper *Melanoplus differentialis*[2], in the thoracic muscles of the American cockroach *Periplaneta americana*[3], and in the thoracic muscles of the woodroach *Leucophaea maderae*[4]. Harvey and Beck[3] reported a sex difference in the thoracic muscles of the American cockroach, the males showing three times as much activity as the females. This difference was confirmed by McShan *et al.*[4], who also showed that in the woodroach the male and female thoracic muscles have approximately equivalent succinoxidase activity (see Table 1).

Table 1. Succinoxidase Activity in Insect Thoracic Muscles, after Various Authors

Insect		Average Q_{O_2} values	Author
Periplaneta americana	♂	275	Harvey and Beck, 1953
,, ,,	♂	167	Kramer and McShan (unpublished MS.)
,, ,,	♀	38·1	
Leucophaea maderae	♂	156	McShan *et al.*, 1954
,, ,,	♀	153	
Sceliphron cementarium	♀	128	Present paper

In the latter paper it was pointed out that a much higher concentration of succinate (0·20 *M*) is required for optimum activity of the succinoxidase system of woodroach muscle than for this system in mammalian tissues such as rat liver, which requires only 0·05 *M* succinate[5]. Harvey and Beck[3] found 0·11 *M* succinate optimum for American cockroach muscle. These results suggest that tissues such as roach muscle, which are high in succinoxidase activity, require higher concentrations of succinate for maximum activity than do tissues comparatively low in succinoxidase activity.

With this in mind a study of succinoxidase in the indirect flight muscles of the wasp, *Sceliphron cementarium*, was undertaken, using identical concentrations of reagents and co-factors worked out by McShan *et al.* for the woodroach. Individual wasps (these were all females collecting mud from the margin of an excavation pool) were brought in from the field during late June, dissected, remnants of the gut and tracheal tubes were cleaned away and the large indirect flight muscles were removed. The tissue was weighed, placed in ground-glass homogenizing tubes contained in an ice bath and homogenized within 8–10 minutes after the wasps were killed. Sufficient water was added to give a 2·5 per cent homogenate.

The enzyme determinations were made by use of the conventional Warburg apparatus. Runs were made using 0·05 ml., 0·1 ml. and 0·15 ml. of homogenate together with the required co-factors and reagents as worked out for woodroach muscle. The final concentrations of co-factors and reagents used in the flasks were 0·2 *M* succinate; 0·05 *M* phosphate buffer *p*H 7·3; $1{\cdot}6 \times 10^{-3}$ *M* each of calcium and aluminium chlorides; and 2×10^{-5} *M* cytochrome *c*. Sufficient water was added to each flask to give a total volume of 3·0 ml. Flasks were placed in the bath at 38° C., ten minutes were allowed for equilibration, and readings of oxygen consumption were taken at ten-minute intervals for forty minutes. The average value for the number of ten-minute periods, during which oxygen consumption was constant, was used as a basis for calculating the Q_{O_2} values.

Table 2. Oxygen Uptake in cu.mm. for 0·05, 0·1 and 0·15 ml. of Wasp Muscle Homogenate

Run	Amount of tissue homogenate in ml.			
	0·05	0·1	0·15	Q_{O_2}
1	6·5	14·15	20·3	105
2	7·9	17·9	24·8	130
3	9·8	18·9	26·8	147
Average	8·1	17·0	24·0	128

The results of these runs are shown in Table 2. As indicated in Fig. 1, the average oxygen consumption for three wasps, each taken from the field and run on three successive days, gave almost perfect linearity from 0·05 ml., 0·1 ml. and 0·15 ml. of tissue homogenate. The average dry weight of this muscle on the basis of three wasps was 30·6 per cent, and using this dry weight for all calculations, the average Q_{O_2} for the three runs was 128.

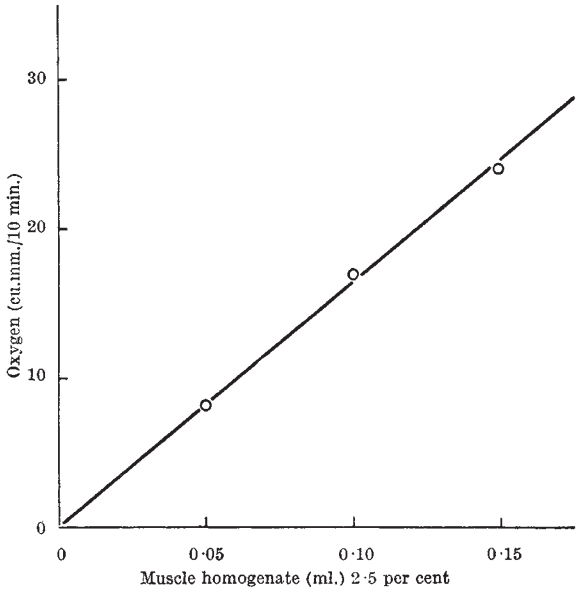

Fig. 1. Relationship between amount of wasp muscle reacting and average amount of oxygen consumed per 10 min.

It is apparent that optimum conditions for the determination of succinoxidase activity of the indirect flight muscles of the wasp *Sceliphron cementarium* are the same as those reported previously for woodroach thoracic muscle.

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