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Weight changes and survival of a tropical earthworm *Pontoscolex Corethrurus*

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Abstract. The ability of healthy individuals of *Pontoscolex corethrurus* to survive and maintain its weight in tap water and different concentrations of NaCl and sucrose solution is studied. In water, earthworms survived normally but died at 48 hr exposure in 5% sugar and 0.4% NaCl. In water, an increase of 26% in total body weight was observed at 4 hr exposure. Weight also increased when exposed to 1, 2, 3 and 4% sugar solution, but it decreased in 5% sugar solution. This decrease in weight may be due to osmotic crisis. Similar weight changes have also been observed in NaCl solutions. An increase in weight was observed up to 0.3% NaCl and a decrease in weight in 0.4% NaCl and above.

Keywords. *Pontoscolex corethrurus*; earthworm; exposure; weight changes; survival in different media.

1. Introduction

Earthworms are often subjected to changes in soil water and chemicals and have to adapt themselves to the changing conditions. Earthworms have to maintain their water equilibrium for their vital activities. Hence information on osmotic balance in tropical earthworms become imperative. Osmoregulation has been studied in terms of weight regulation in aquatic oligochaetes (Ganapathy and Subba Rao 1972) and a few semi-terrestrial oligochaetes (Bahl 1945; Oglesby 1970; Dietz and Alvarado 1970) with reference to water and different salinity levels. *Pontoscolex corethrurus*, a tropical earthworm, faces the problem of water and chemical content of the soil. Some preliminary studies on its biology (Arunachalam 1978) and distribution (Kale and Krishnamoorthy 1981) have been carried out in this species, but not on its weight regulation when exposed to adverse media. An attempt has therefore been made to investigate the ability of *P. corethrurus* to maintain its weight with reference to tap water and different concen- trations of NaCl and sucrose solutions.

2. Material and methods

P. corethrurus were collected from the field and reared in the laboratory in a large glass aquarium (65 × 35 × 35 × cm) containing natural medium. Dried leaves were added to the soil to supplement the natural medium and water sprinkled to make the soil sufficiently wet. The soil temperature of the culture medium was 28 ± 1° C. From this stock, earthworms were selected for various experiments.

To find out the effect of certain adverse media on body weight, *P. corethrurus* (396 ± 106.2 mg body weight) were individually immersed in tap water, in different concentrations of sugar (1, 2, 3, 4 and 5%) and NaCl (0.05 , 0.1, 0.2, 0.3, 0.4

Table 1. Survival of *P. corethrurus* when exposed to different concentrations of sugar solution at different times of exposure (No. of individuals tested: 10).

Concentration of sugar (%)	% survival at different times of exposure (hr)			
	24	48	72	96
Freshwater	100	100	100	100*
1	100	100	100	100
2	100	100	100	100
3	100	100	100	0
4	100	100	0	0
5	100	0	0	0
10	0	0	0	0

* No mortality till one month.

Table 2. Survival of *P. corethrurus* when exposed to different concentrations of NaCl at different times of exposure. (No. of individuals tested: 10).

Concentration of NaCl (%)	% survival at different times of exposure (hr)				Remarks
	24	38	72	96	
Freshwater	100	100	100	100	Normal
0.1	100	100	100	100	"
0.2	100	100	100	100	"
0.3	100	100	100	100	"
0.4	100	100	100	100	Shrunken
0.5	100	100	100	100	"
0.6	0	0	0	0	

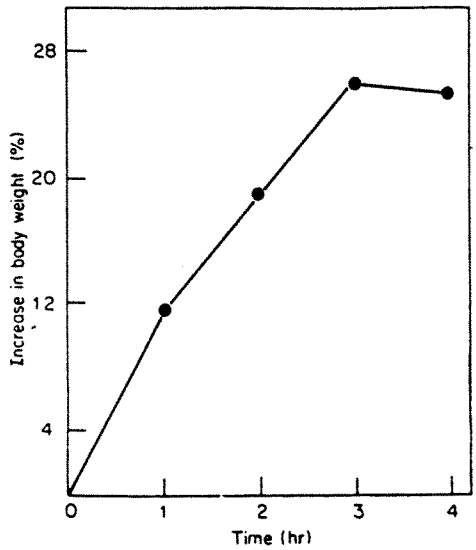

Figure 1. Increase in the body weight of *P. corethrurus* when immersed in water as a function of time. Each value (mean) is the average performance of five individuals.

Table 3. Effect of different concentrations of sugar on body weight in *P. corethrurus*.

Concentration of sugar (%)	Live body weight (mg)	Changes in body weight (%)			
		1 hr	2 hr	3 hr	4 hr
1	450.2± 96.78	4.6±1.23	10.4 ±2.11	19.1±2.67	21.0±4.52
2	385.7±100.21	5.0±1.18	9.97±1.97	27.8±3.88	31.3±7.48
3	416.7± 80.32	2.5±0.89	12.8±2.56	26.2±6.41	28.9±6.21
4	424.7±104.78	2.5±0.91	10.4±1.91	21.6±5.94	29.3±4.79
5	380.8± 75.32	−5.7±2.31	−10.4±2.14	−16.2±3.81	−16.9±3.41

Each value (mean±SD) is the average performance of 5 individuals (− denotes decrease in weight).

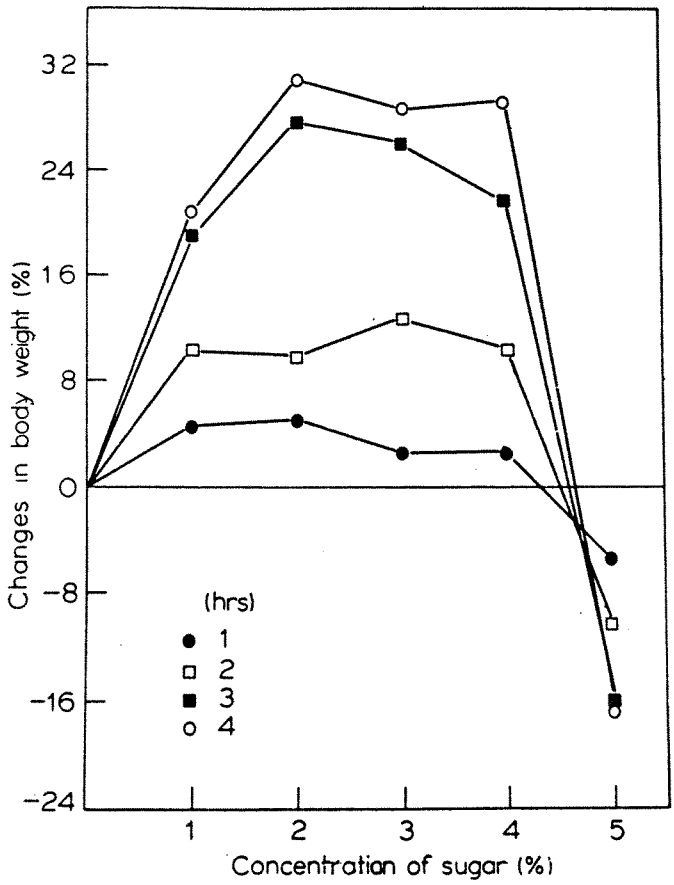

Figure 2. Changes in the body weight of *P. corethrurus* as a function of sugar concentrations. Each value (mean) is the average performance of five individuals.

and 0.5%). The individuals were exposed to different media and weighed at an interval of 1 hr for a 4 hr immersion. Suitable corrections were made in the weight of individuals for sand particles present in the gut at different times of exposure (Arunachalam *et al* 1982). The weight changes in different media at different

hourly exposure were expressed in terms of percentage of its initial live weight. Five individuals were tested in each media.

For survival studies, groups of individuals (10 in number) were exposed to tap water, different concentrations of sugar solutions (1, 2, 3, 4, 5 and 10%) and NaCl solutions (0.1, 0.2, 0.3, 0.4, 0.5 and 0.6%). The media (2*L*) in which the individuals were exposed was aerated continuously. The survival of *P. corethrurus* in different media was observed at an interval of 24 hr for a total period of 96 hr exposure and was expressed in terms of percentage.

3. Results and discussion

3.1 *Survival in different media*

When *P. corethrurus* were submerged in aerated water, no mortality was observed for one month (tables 1 and 2). Similar observations have been made in several species of earthworms (Edwards and Lofty 1977).

The effect of different concentrations of sugar solution on the survival of *P. corethrurus* in different hourly exposure are presented in table 1. For 1 and 2% sugar solutions, no mortality was observed at 96 hr exposure. In 3% and above, mortality occurred within 96 hr exposure. On increasing the concentrations, the time of exposure for 100% mortality decreased *i.e.*, the resistance time decreased with increase in concentrations.

Earthworms exposed up to 0.3% NaCl were healthy and exhibited normal movements; but in 0.4 and 0.5% they were shrunken in their nature with feeble movements (table 2). However, they survived till 96 hr exposure. In 0.6% NaCl *P. corethrurus* did not survive even for 1 hr exposure.

These results revealed that the survival limit of sugar and NaCl concentrations were 2 and 0.3% respectively. Above these levels of sugar and NaCl, changes in the body conditions occurred causing death.

3.2 *Changes in weight in different media*

When *P. corethrurus* were immersed in tap water, the live weight increased as a function of time. The weight gradually increased up to 3 hr exposure and was then levelled off (figure 1). For instance, the average weight in *P. corethrurus* increased to 11.6% at 1 hr exposure, to 26% at 3 hr exposure and no further increase in weight at 4 hr exposure. This is in accordance with Wolf (1940) who reported that *L. terrestris* gained up to 15% of its total live weight in 5 hr

Table 4. Effect of NaCl concentrations on body weight of *P. corethrurus*.

Concentration of NaCl (%)	Live body weight (mg)	Changes in body weight (%)			
		1 hr	2 hr	3 hr	4 hr
0.05	380.2± 65.21	6.4±2.10	11.5±3.47	19.6±4.12	22.8±2.26
0.1	426.9± 70.18	7.9±1.89	15.8±3.18	22.4±5.21	21.2±1.12
0.2	395.2±100.26	4.8±1.21	9.9±1.98	14.8±3.17	17.2±2.28
0.3	416.7± 98.65	4.4±1.08	5.8±1.04	12.0±2.55	14.1±2.14
0.4	383.7± 65.45	−0.8±0.21	− 1.3±0.82	− 4.9±1.94	− 7.8±2.10
0.5	414.8± 78.65	−4.3±1.24	− 6.4±1.28	−11.0±2.78	−15.8±2.52

Each value (mean±SD) is the average performance of 5 individuals (− denotes decrease in weight).

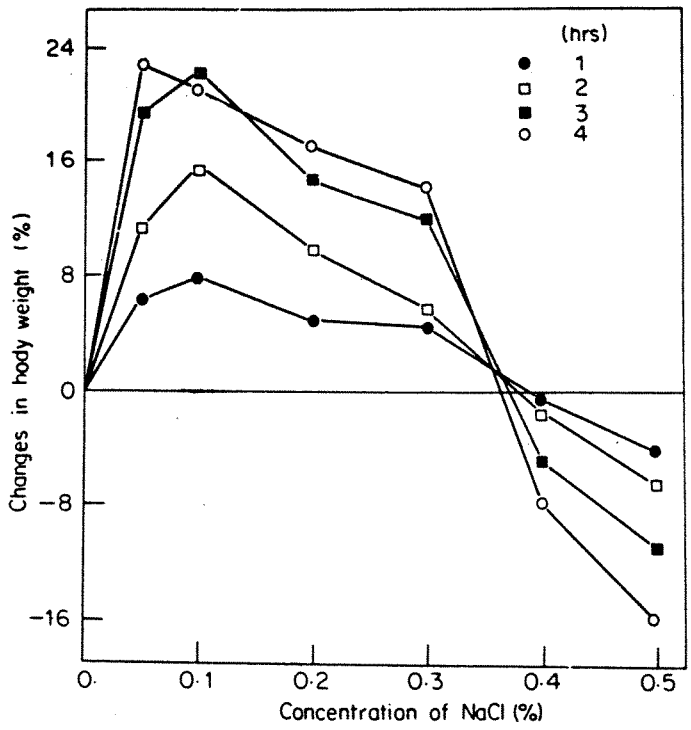

Figure 3. Changes in the body weight of *P. corethrurus* as a function of NaCl concentrations. Each value (mean) is the average performance of five individuals.

immersion in tap water. The weight difference between these two species may be due to the distribution in two different climatic zones and absorption of water through the body surface to hydrate the body tissues fully. Similar findings have been reported by Edwards and Lofty (1977).

The changes in body weight of *P. corethrurus* when immersed in different concentrations of sugar solutions are shown in table 3 and figure 2. Gradual increase in weight was found as a function of concentrations up to 4% sugar solutions. The weight increase, 21% in 1% sugar solution gradually increased to 29.3% in 4% at 4 hr immersion by absorption of water from the medium. In 5% sugar solution, loss of weight was noticed. The decrease in weight was gradual from 1 to 4 hr exposure due to loss of water from the body in response to external concentration of sugar medium. Graphical representation of these results (figure 3) indicates that the level of sugar solution at which *P. corethrurus* can control its body weight without loss or gain is 4.5%.

Changes in body weight of *P. corethrurus* were also observed as a function of NaCl concentrations and exposure time (table 4). *P. corethrurus* gained weight in concentrations up to 0.3%. But the gain in weight decreased as concentration increased from 0.05 to 0.3%. For instance, the gain in weight which was 22.8% of its body in 0.05% NaCl, decreased to 14.1% in 0.3% NaCl at 4 hr exposure. In higher concentrations, loss in its weight was observed. The loss in weight was 7.8% and 15.8% of its body weight in 0.4 and 0.5% NaCl respectively at 4 hr exposure. The weight increase in lower concentrations of NaCl might be due to absorption of water and the decrease in weight in higher concentrations might be due to loss of water from the body in accordance with external concentration. As visualized from figure 3, the salinity level at which *P. corethrurus* can regulate its

body weight without loss or gain is 0.375%. This is the survival limit. Hanumante and Nagabhushanam (1977) reported that the survival limit of NaCl for *P. excavatus* was 0.22%. This indicates that *P. corethrurus* is more tolerant to NaCl than *P. excavatus*.

The tolerance limit of sugar medium for *P. corethrurus* is generally greater than that of NaCl with reference to survival as well as weight regulation. This can be attributed to the different chemical nature of the substances. Only further studies on this line can throw more light on this aspect.

The weight changes in *P. corethrurus* when exposed to tapwater, sugar and NaCl concentrations reveal that it is a poor osmoregulator like other tropical species of earthworms (e.g. *Phretima posthuma*: Bahl 1945; *Perionyx excavatus*: Hanumante and Nagabhushanam 1977). This ability to change its body weight in accordance with the concentration of the substance is an ecophysiological adaptation of this species to overcome the adverse effects.

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