RATES OF WATER VAPOUR UPTAKE AND LOSS BY THE HOUSE DUST MITE, *DERMATOPHAGOIDES PTERONYSSINUS* (ACARI: PYROGLYPHIDAE)

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INTRODUCTION

House dust mites can take up water vapour from the ambient air if the relative humidity (%RH) is above a certain level, the so called CEH-level. At 16°C the CEH of our strain of *Dermatophagoides pteronyssinus* was found to be 56-58%RH and at 20°C it was 58-60%RH (de Boer et al., 1997 & 1998). The present study concerns the rate of water vapour uptake and loss at 18°C and within the range of humidities that normally occur in the mite's habitat.

MATERIAL AND METHODS

Adult females and tritonymphs of *D. pteronyssinus* were used. For each series of experiments (A through D) mites were taken simultaneously from the same sub-culture. Total body mass of single mites was determined as described previously (de Boer et al. 1998). Dry mass was determined after exposure of heat killed mites during 3 days to 35°C in air dried with P_2O_5. Also the distribution of replicate weight readings (6 per mite) was examined and outliers were removed as described (de Boer et al. 1998). For exposure to test humidities pre-treated mites were confined in gauze walled cages which were hung in 100 ml containers with a saturated salt solution on the bottom (de Boer et al. 1998). All experiments were done at 18°C.

Rehydration (series A and C)

Pre-treatment (fasting and dehydration): one week above dry silica gel (<5%RH) at 25°C without food.

Test humidities: 75-76%RH (NaCl, series A: 3, series C: 4) and 63-64%RH ($NaNO_2$, series A: 3, series C: 5).

Total body mass was determined after approximately 0, 3, 6 and 9 h. and again the next day (exact durations of intervening periods: 2.3-3.4, 2.7-2.8, 3.1-3.5 and 19.0-22.1 h., respectively). One mite in series A was lost before dry-weight could be established.

Dehydration (series B and D)

Pre-treatment (fasting): 2-3 days at 75 %RH and 18°C without food.

Test-humidities: 42-44%RH (K_2CO_3, series B: 1, series D: 10) and 55-56%RH ($Mg(NO_3)_2$, series B: 2, series D: 11).

Total body mass was determined after 1, 4 and 7 days. Mites that were still alive on day 7 were transferred to 75%RH and 18°C, allowed to rehydrate for 3-4 days and weighed.

Table 1. *Mass of body water, m(t), after one day of exposure to dehydrating conditions*

mite RH)	D5 (42-44%)		D9 (42-44%)		D11 (42-44%)		D16 (55-56%)		D20 (55-56%)	
	t (days)	m(t) (μg)	t (days)	m(t) (μg)	t (days)	m(t) (μg)	t (days)	m(t) (μg)	t (days)	m(t) (μg)
weighing 1	0	4.393	0	5.401	0	7.300	0	7.002	0	5.196
weighing 2	0.945	3.943	0.920	4.464	0.944	6.600	0.949	6.223	0.956	4.779
weighing 3	3.941	3.336	3.903	3.521	3.906	5.693	3.878	5.580	3.840	3.411
weighing 4	7.001	3.029	6.967	2.836	6.961	4.929	6.893	4.846	6.840	3.107
extrapolation to 50%of initial body water content										
method 1	12.798 (r = -0.9770)		7.265 (r = -0.9841)		12.333 (r = -0.9917)		13.339 (r = -0.9824)		8.482 (r = -0.9675)	
method 2	14.110 (r = -0.9873)		7.561 (r = -0.9994)		13.126 (r = -0.9999)		14.726 (r = -0.9979)		8.729 (r = -0.9469)	
water mass after rehydration during 3-4 days at 75%RH										
weighing 5	>10	4.687	>10	5.928	>10	7.958	>10	5.929	>10	5.236
dry mass (μg)		1.621		2.457		2.600		2.312		2.179

RESULTS AND DISCUSSION

Rehydration (Figure 1.)
After 9 h. body weight was already close to the level that was reached on the next day. For mites kept at 75-76% RH the average water mass was initially 54.5 %, after 9 h. it was 65.2 % and after one day it was 68.5 % of total body mass. For mites exposed to 63-64% RH these values were 58.0 %, 63.1 % and 66.1 % respectively.
A 2-way ANOVA (series x periods) on the increase rates (μg/h.) indicated that the results were quite similar in the two series. When the series were pooled a 2-way ANOVA could be done to examine the influence of humidity on the rate of rehydration (test humidity x periods). A significant effect of periods ($p = 0.0001$) as well as humidity ($p = 0.001$) was shown but no interactions between the two ($p = 0.143$). At 63-64% the increase rate is less in all four periods. Whether the increase of body weight continues longer or settles at a lower level or both at this humidity, cannot be determined from these experiments. However, at both humidities body weight levels off after 9 h. and is unlikely to increase much further after one day. Thus one day seems to be sufficient time to fully regain the water lost during the previous dehydrating conditions. It would be interesting to see how long it takes before the same fraction of body water is lost under dehydrating conditions. The mass of body water at the start of rehydration was 45-85% of the mass attained after one day of rehydration (45-67% and 60-85% for the groups exposed to 75-76%RH and 63-64%RH respectively).
Dehydration (Figure 2.)
Only 5 mites, all in series D, lived long enough to yield a complete set of data. These survivors tended to have higher initial body mass and to lose weight more slowly in the first period (Mann-Whitney U-test, two-sided, $n_1=5$, $n_2=19$, $p>0.05$ and $p<0.025$, respectively). Linear regression analysis was done on the quantity $Ln((m(t)/m(0))$, where m(t) is the water mass at time t and m(0) is the initial water mass. Theoretically the decrease is linear only if RH=0%, but also under the present test conditions the regression coefficient r is close to 1 (Table 1, method 1). It is known that a small fraction of the mite's body water, presumably the fraction that is associated with the water vapour uptake mechanism, evaporates faster and disappears within a few hours (Arlian & Veselica, 1979). Indeed, if the first weighing is ignored and the result of the second weighing is taken as m(0), the r-values are closer to unity in 4 of the 5 cases (Table 1, method 2). If the same trend continues it will take 1-2 weeks before half op the body water is lost (Table 1). It is known however that some *D. pteronyssinus* can survive much longer in similar or more severe conditions (de Boer et al., 1997 & 1998).

CONCLUSIONS

In hydrating conditions it takes *Dermatophagoides pteronyssinus* only one day to regain the same amount of body water that is lost during 1-2 weeks of dehydration. During the period of dehydration severe mortality was recorded but this may be due, partly, to the experimental manipulations.

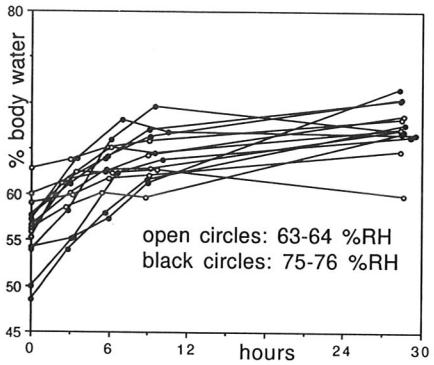

Figure 1. Water vapour uptake

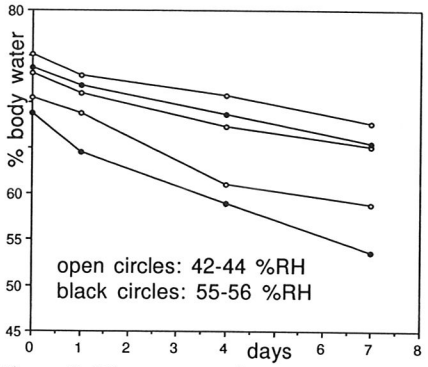

Figure 2. Water vapour loss

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