Qatar Univ. Sci. J. (1996), 16(1): 109-111

THERMAL ACCLIMATION IN THE RESTING METABOLISM OF THE NOCTURNAL GECKO, *HEMIDACTYLUS FLAVIVIRIDIS*

By

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التأقلم الحراري في الأيض السكوني للبرص الليلي هيميداكتلس فلافيفيريدس

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تمت أقلمة هيميداكتلس فلافيفيريدس إلى نظامين حراريين عند درجتي حرارة ٢٠ و٣٠°م . ثم قيست معدلات الأيض السكونية (مل جم ـ ١ س ـ ١) لكل مجموعة عند درجات حرارة ٢٠، ٢٥، ٣٠ و ٣٥°م بإستعمال أجهزة التنفس ثابتة الضغط . وقد لوحظ أن معدلات الأيض في الأبراص المتأقلمة لـ ٢٠°م كانت أقل منها في الأبراص المتأقلمة لـ ٣٠°م عند قياسها في ٢٠°م فقط . كما أزدادت معدلات إستهلاك الأكسجين بزيادة درجة الحرارة مع وجود حساسية حرارية مرتفعة بين ٢٠ و ٢٥°م في الأبراص المتأقلمة لـ ٢٠°م وحساسية حرارية منخفضة بين درجتي حرارة ٢٠ و ٢٥°م في الأبراص المتأقلمة لـ ٣٠°م .

Key Words: Gecko, *Hemidactylus flaviviridis,* Resting Metabolic Rate, Thermal Acclimation

ABSTRACT

Hemidactylus flaviviridis was acclimated to two temperature regimes (20 and 30°C). The resting metabolic rates (ml g^{-1} h^{-1}) were determined at 20, 25, 30 and 35°C, using constant pressure manometric respirometers. The 20°C- acclimated geckos had significantly lower metaobolic rates than the 30°C- acclimated geckos only at 20°C. Oxygen consumption rates increased as temperature increased with high thermal sensitivity ($Q10 = 5.6$) Between 20 and 25°C for the cold-acclimated group, and low thermal sensitivity ($Q10 = 1.1$) between 20 and 25°C for the warm-acclimated group.

INTRODUCTION

Acclimation effects on metabolic rate can be in the form of one of a number of different patterns [1 and 2]. The nocturnal gecko *Hemidactylus flaviviridis* inhabits chiefly the coastal areas of Arabia. It occurs also in coastal northeast Africa, Iraq, Southern Iran, Afghanistan, Pakistan and Northern India [3]. There are no other published studies on thermal acclimation in metabolic rate of this gecko. Therefore, the objective of this paper is to investigate the pattern of thermal acclimation in the resting metabolic rate (RMR) of *Hemidactylus flaviviridis* from Jeddah, Western Saudi Arabia.

MATERIALS AND METHODS

Spicimens of adult *H. flaviviridis* were captured by hand in or near buildings in Jeddah (21° 30'N, 39 ° 10'E), Saudi Arabia during the autumns of 1993 and 1994. Geckos were kept in 100 x 60 x 60 cm glass vivaria with netwire sliding tops, and placed in a fluctuating-temperature room (23-29°C). A 60-W heat lamp was hung over one end of each vivarium and was turned on automatically for 10 hs to provide a temperature gradient.

Food (Small insects and spiders) and water were constantly available to the animals. Geckos were kept under these conditions for at least two weeks. They were then divided into two acclimation groups (12 cold-acclimated geckos, mean mass = 8.35 g, S. E. = 0.53; 13 warm-acclimated geckos, mean mass = 8.46 g, S. E. = 0.46 which were isothermally acclimated to environmental termperatures of 20 and 30°C respectively. Therefore, two constant-temperature rooms were used in acclimation experiments, one was kept at 20°C and the other at 30°C. These temperatures roughly correspond to the mean minimum nighttime temperatures encountered in Jeddah, Saudi Arabia during winter and summer. During the acclimation period the geckos were housed in large glass vivaria with netwire sliding tops. Drinking water was continually available during the acclimation period. All geckos were fed up until 3 days before the oxygen consumption rate was measured. Both groups of lizards were maintained at these acclimation temperatures for 4 weeks with a photoperiod of 12L: 12D. The rates of resting oxygen consumption were measured for both acclimated groups to determine acclimation effects on metabolism.

The RMRs of cold and warm-acclimated geckos were measured as the rates of resting oxygen consumption (ml g^{-1} h^{-1}) at different temperatures, using constant pressure manometric respirometers havng both animal and control chambers as described by Zari [4]. At noon, the animals were weighed and placed in the animal chambers, which were immersed in a water bath adjusted to the test temperpature. Oxygen consumption rates were measured for *H. flaviviridis* at 5-degree intervals from 20 to 35°C. Measurements of RMR were made on quiescent and post-absorptive lizards at night. Consequently, geckos were deprived of food for 3 to 6 days prior to respirometry. All Oxygen consumption determinations were carried out between 1900 and 2400 h during the autumn.

Regression analyses of log-transformed oxygen consumption rate (ml g^{-1} h^{-1}) and body mass (g) data were carried out by the method of least squares. Comparisons of regression lines were made using the analysis of covariance (ANCOVA). Comparisons of mean Q 10 values among experimental groups were performed using analysis of variance (ANOVA). Differences were considered to be statistically significant when $p < 0.05$.

RESULTS

Comparisons of the values of regression slopes 'b-1' for cold and warm-acclimated geckos among the different temperatures indicated no significant variations over the temperature range 20-35°C and these values did not differ significantly from -0.30 ($P > 0.05$ by ANCOVA). However, the intercept 'a' values had increased significantly with the rise in tempetature between 20 and 35°C for cold-acclimated geckos and between 25 and 35°C for warm-acclimated geckos ($P < 0.001$ by ANCOVA).

Figure 1 shows two different metabolic-rate temperature curves (RT curves) for *H. flaviviridis* from the two acclimation regimes. There was no significant effect of acclimation regime on resting metabolic rate ($p < 0.05$ by ANCOVA) at any temperature except 20°C, where the resting metabolic rate of the 30°C-acclimated group was significantly higher than that of the 20°C-acclimated group ($P > 0.01$ by ANCOVA). The temperature coefficient (Q10) values were calculated over the temperature range 20-35°C for both acclimated groups (Table 1). The Q10 value of the 30°C acclimation group was significantly lower than that of the 20°C acclimation group only at the temperature range 20-25°C ($P < 0.001$ by ANOVA). Significant differences existed among the Q10 values for each acclimation group over the temperature range 20-35°C ($P < 0.01$ by ANOVA).

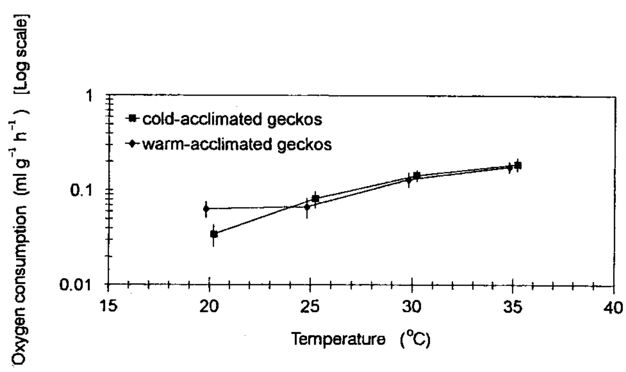

Fig. 1. Mean rates of resting oxygen consuomption (ml g^{-1} h^{-1}) for cold and warm-acclimated *H. flaviviridis* at different temperatures. Each point represents the mean of different measurements. Means are offset from temperature treatments to faciliate comparison. The vertical lines above and below each mean are 95 % confidence limits of that mean.

Table 1

Comparison of thermal acclimation effects on Q10 values of *H. flaviviridis* acclimated at 20 and 30°C for 4 weeks measured at different temperatures (Fig. 1).

Acclimation temperature	Q10 values for the oxygen consumption			Overall Q10
	20-25°C	25-30°C	30-35°C	
20°C	5.60*	3.09	1.72	3.10
30°C	1.11	3.81	1.86	1.99

* Stastistically significant ($p < 0.001$).

DISCUSSION

The observed values of RMRs of *H. flaviviridis* in the present study at different temperatures are in close agreement with the values predicted from the allometric equations of Bennett and Dawson [1], Bennet [6], and Andrews and Pough [7]. These values of metabolic rates in *H. flaviviridis* are reasonably consistent with the values reported for most geckos in other studies [8, 9 and 10].

In this study, thermal acclimation effects were only obvious at low temperature (20°C). *H. flaviviridis* responded to 20°C acclimation with reducing rates of oxygen consumption at 20°C (Fig. 1). Consequently, 20°C acclimated *H. flaviviridis* appear to exhibit Precht type 5 or inverse compensation only at 20°C [1 and 2]. This depression in metabolic rate at 20°C for cold-acclimated group may occur during reduced activity to conserve energy at lower temperatures during winter. These geckos show reduced activity through the winter months and they are rarely seen when night air temperatures drop to or below 20°C in Jeddah (Zari, unpublished data.) A similar pattern of acclimation was observed in some diurnal lizards at low temperatures [11 and 12]. A high thermal sensitivity (Q10 =5.1) at the temperature range 20-26°C has also been noted in Hemidactylus [13].

On the other hand, low Q 10 value and elevated metabolism in 30°C acclimated *H. flaviviridis* at low temperatures may facilitate activity during their active seasons. Most nocturnal geckos are normally active with body temperatures in the range 20-28°C [14]. *H. flaviviridis* are nocturnal and therefore their activities and rhythms are associated with low temperatures. Night air temperatures ranged from 23 to 30°C throughout their active seasons from April to November in Jeddah (Zari, unpublished data).

The mean minimum and maximum temperatures in Jeddah were 27 and 37°C in July; 19 and 28.5°C in January [4]. Similarly, a low thermal dependence at the temperature range 20-25°C has been observed in adult *Ptyodactylus hasselquistii* and adult *Bunopus tuberculatus* from Riyadh, Saudi Arabis [15]; juvenile *Hemidactylus turcicus* and juvenile *Ptyodactylus hasselquistii* from Jeddah, Saudi Arabia during summer [16].

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