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PII: S0306-4565(16)30020-1
DOI: http://dx.doi.org/10.1016/j.jtherbio.2016.07.014
Reference: TB1796

To appear in: *Journal of Thermal Biology*

Received date: 25 January 2016
Revised date: 15 July 2016
Accepted date: 15 July 2016

Cite this article as: Talal A. Zari, Seasonal metabolic acclimatization in the herbivorous desert lizard ***Uromastyx philbyi*** **(Reptilia: Agamidea) from western Saudi Arabia**, *Journal of Thermal Biology* http://dx.doi.org/10.1016/j.jtherbio.2016.07.014

Seasonal metabolic acclimatization in the herbivorous desert lizard Uromastyx philbyi (Reptilia: Agamidea) from western Saudi Arabia

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ABSTRACT
Many ectotherms adjust their metabolic rate seasonally in association with variations in environmental temperatures. The range and direction of these seasonal changes in reptilian metabolic rates are thought to be linked to the seasonality of activity and energy requirements. The present study was conducted to measure the standard metabolic rate (SMR) of seasonally-acclimatized Uromastyx philbyi with different body masses at 20, 25, 30, 35 and 40 °C using open-flow respirometry during the four seasons. SMR was mass-dependent. The mean exponent of mass, "b", in the metabolism-body mass relation was 0.76 (variance = 0.0007). Likewise, SMR increased as temperature increased with low Q_{10} values at high temperatures and high Q_{10} values at low temperatures. The lowest and highest Q_{10} values were achieved for temperature ranges of 30 to 35°C for summer-acclimatized dhabbs (Q_{10}=1.6) and 20 to 25°C for winter-acclimatized dhabbs (Q_{10}=3.9). Seasonal acclimatization effects were obvious at all temperatures (20-40 °C). Winter-acclimatized dhabbs had the lowest metabolic rates at all temperatures. The seasonal acclimatization patterns displayed by U. philbyi may represent a valuable adaptation for herbivorous desert lizards that inhabit subtropical deserts to facilitate activity during their active seasons and to conserve energy during inactivity at low temperatures.
Keywords: seasonal acclimatization; lizard; Uromastyx philbyi; standard metabolic rate; temperature

1. Introduction

Seasonal acclimatization of metabolism has been examined in several lizard species (Bennett and Dawson, 1976; Gregory, 1982; Tsuji, 1988; Zari, 1996a, 1999a). Many factors affect the metabolic rate of lizards such as temperature, body mass, activity, latitude, photoperiod, phylogeny, behaviour and ecology (Bennett and Dawson, 1976; Andrews and Pough, 1985; Zari, 1991, 1992, 1993, 1996b; Mcnab, 2002; Milsom et al., 2008, Toledo et al., 2008; Bickford et al., 2010). Numerous ectotherms adjust their resting metabolism seasonally in association with differences in environmental temperatures (Precht et al., 1973; Prosser, 1973). In lizards, the range and direction of these seasonal changes in metabolic rate are thought to be linked to the seasonality of activity and energy requirements. Lizards from temperate zones generally display distinct seasonal fluctuations in metabolic rate, while lizards that live in more constant thermal environments, i.e., tropical latitudes, show little or no seasonal changes in their metabolic rate (Bennett and Dawson 1976). The effect of thermal acclimation on metabolic rate can take one of several forms, including Precht type 1 (overcompensation), Precht type 2 (complete compensation), Precht type 3 (partial compensation), Precht type 4 (no compensation) and Precht type 5 (inverse compensation)