

## Specific Dynamic Action in the Toad, *Bufo woodhousii*

LYNNETTE M. SIEVERT AND JANET K. BAILEY

Twelve *Bufo woodhousii* from Lyon County, Kansas, were acclimated to  $20 \pm 1$  C with a 14:10 photoperiod for at least 10 days. Oxygen consumption was measured in each toad at 3, 7, 28, and 120 h after eating an insect meal equal to 5% of the toad's mass. Half of the toads were first measured at 120 h after the meal, and this was followed by a second meal. The rest of the toads were first measured 3 h after the feeding. Oxygen consumption values were significantly higher 3 h after eating than at 7, 28, and 120 h postfeeding. At 3 h postfeeding, oxygen consumption was 1.7 times the value at 120 h after feeding.

AFTER feeding, vertebrates (Sievert et al., 1988; Chakraborty et al., 1992; Wang et al., 1995) and invertebrates (Bayne and Scullard, 1977) exhibit elevated metabolic rates. This phenomenon, known as specific dynamic action (SDA), is positively correlated with both the quantity of protein ingested and the size of the meal (Coulson and Hernandez, 1979; Chakraborty et al., 1992; Secor and Diamond, 1997). This increase in energy use is related to processing the nutrients ingested during the meal: producing digestive enzymes, transporting nutrients, producing nitrogenous wastes, synthesizing proteins, and in some cases up-regulating the gut (Wang et al., 1995; Secor and Diamond, 1997).

The increase in metabolic rate caused by feeding decreases the amount of energy an animal can gain from its meal. For ectotherms, the energy lost to SDA is normally a small fraction of the energy ingested in the meal, although for some infrequently feeding species, it can represent a substantial fraction of the energy ingested (Chakraborty et al., 1992; Secor and Diamond, 1997).

Very few data exist regarding SDA in amphibians, and much of what exists deals with frogs that eat large, infrequent meals (Secor and Phillips, 1997; Powell et al., 1999). Our purpose was to determine the duration and amplitude of SDA in *Bufo woodhousii* allowed to eat natural food equivalent to 5% of their body mass. These toads eat small, frequent meals in contrast to the dietary habits of most of the anuran species in which SDA has been studied.

### MATERIALS AND METHODS

Male, female, and juvenile *B. woodhousii* ( $n = 12$ , mean mass  $\pm$  SE =  $82 \pm 15$  g; range = 25–150 g) were collected in Lyon County, Kansas. The toads were housed in groups of no more than three per clear plastic container (50.5 cm

$\times$  50.5 cm  $\times$  22.2 cm) with a ventilated lid. Retreats and water were available at all times, and a mixed diet of crickets (*Acheta*) and/or mealworm larvae (*Tenebrio*) was provided three times per week. The toads were acclimated to  $20 \pm 1$  C with a photoperiod of LD 14:10 with photophase beginning at 0600 h CST. Basking lamps with 25 or 40 W bulbs above the plastic containers were on the same photoperiod. The toads were handled during cleaning and feeding to prepare them for handling during the experimental period. All toads were acclimated at least 10 days before testing.

After being induced to urinate and being weighed, each subject was placed alone in its home container along with a meal of *Acheta* and/or *Tenebrio* and allowed 20 min to eat a meal equivalent to 5% of its body mass. If the food was ignored or only partially eaten, the meal was removed and another subject was chosen. After eating a full meal, the toad was placed in an opaque plastic 750-ml holding container that was identical to the experimental chamber except that the bottom of the holding container was lined with a damp paper towel. The subjects were habituated in the chamber at  $23 \pm 1.5$  C for up to 3 h before measurements were taken. An hour before each oxygen consumption measurement, the toad was placed in the experimental chamber.  $O_2$  consumption was measured for 1 min every 11 min with an open-flow system Gas Sensor Model 180C (Columbus Instruments). During each minute of sampling, continuous measurements were taken and averaged to give a mean  $O_2$  consumption value for the minute. Air flow into the experimental chamber was  $47.5 \pm 3.5$  ml/min. Air traveling between the experimental chamber and the oxygen sensor passed through a column containing Drierite® and soda lime to remove water and  $CO_2$ , respectively. Oxygen consumption was measured for 12 toads at 3, 7, 28, and 120 h after feeding. The order in which the measure-

