ENERGY METABOLIZABILITY AND NUTRIENT DIGESTIBILITY IN THE MAGPIE (*PICA PICA*)

Harper, E. J.[1] *and MacDonald, D. W.*[2]

[1]WALTHAM Centre for Pet Nutrition, Waltham-on-the-Wolds, Melton Mowbray, Leics., LE14 4RT, UK

[2]Wildlife Conservation Research Unit, Department of Zoology, South Parks Road, Oxford, OX1 3PS, UK

A number of studies have been conducted to determine energy requirements in avian species. However, this is a complex area and one which is driven by a number of factors. For example, environment is one of the major factors which governs energy requirements, and the metabolizable energy requirements of avians housed in controlled conditions probably do not reflect the normal basal requirements of free-living birds. Environmental temperature is a strong determinant, and energy requirements decline as temperature increases (NRC, 1984; Bryant and Furness, 1995; Prinzinger *et al*, 1989; Ellis, 1984). Phylogeny is also very influential in determining energy requirements in avian species, and species-dependent characteristics such as body conformation and composition, flight duration, posture and feather coverage all exert an effect; factors which complicate inter-species extrapolation of energy data and may explain why energy equations derived from data on one species do not correlate well with data derived from others.

The requirement for food energy is determined by the basal metabolic rate (BMR), which ideally is measured in a post-absorptive state at complete physical rest and shortly after walking. The requirement for complete inactivity is not practical in birds and it is therefore more usual to quote resting energy expenditure (REE) or maintenance energy expenditure (MEE); the latter includes a minimum amount of muscular activity and movement. However, the most practical method of estimating and understanding the energy needs of captive birds is the daily energy expenditure (DEE). Measuring the DEE is difficult in any species and is frequently calculated in terms of metabolizable energy (ME) intake, where DEE is assumed to be equivalent to ME intake, when bodyweight is maintained. ME is calculated on the basis of energy intake (food consumption) with measures of energy out calculated via faecal and urinary analysis, or, in the case of birds, total energy content of excreta. When an animal is in steady state (i.e. bodyweight maintenance) it is considered safe to assume that energy intake is equivalent to energy expenditure.

The energy costs of maintenance are directly related to lean body mass and the relative size of the different organs since it is these tissues that actively use oxygen. As for other species, a bird's bodyweight is corrected for surface area to volume ratio and consequently the energy requirement is expressed per unit of metabolic body weight as an allometric relationship. This is a particularly useful method of expressing the energy requirements of birds where bodyweight can range between a few grams for some of the small passerines to as much as 150 kg for ostriches.

$$\text{Energy Requirement} = k\ x\ \text{bodyweight}(W)^x$$

Where k = constant and *x* = a power function, usually around 0.75

Birds in different taxonomic groups vary markedly in body composition and plumage coverage and hence in the metabolic rate of their body and in the amount of energy lost through their skin. Consequently different power functions are often applied to different major groups of birds.

The common magpie (*Pica pica*) is one of some 113 corvid species, belonging to the order Passeriformes. Many corvids, including the common magpie are omnivorous eating grain, wild fruit, carrion, invertebrates and the eggs and chicks of other wild birds. The specific nutrient requirements of magpies have not been reported, nor have measurements been made of energy intakes or digestibility coefficients; knowledge which would have ramifications for other birds of a similar bodyweight.

In a study to establish energy requirements of magpies, the ME and nutrient digestibility were investigated in a captive colony of nine adult magpies over a 12 day period. Mean digestibility coefficients ranged from 0.84 for protein to 0.94 for fat and were generally close to those reported for other birds. Mean protein intake was 10.5g/bird/d which is relatively high when compared to values reported for other species (Martin, 1968; Berthold, 1976; Drepper *et al*, 1988). Raptor studies have also reported high protein intakes, which not only reflects diet composition, but may suggest that meat eating birds have a high protein requirement. The measured ME intakes of the magpies were all higher than the values predicted using published allometric equations (Aschoff and Pohl, 1970; Kirkwood, 1981). Typical ME intakes ranged from 1322.6 to 2502.1 kJ/kg bwt/d. Combining these data from the magpies with those from other studies on carnivorous birds derives an equation to predict the daily ME requirements of carnivorous birds. We propose that this predicts the daily ME requirements of birds between 100-1500g.

$$\text{ME (kJ)} = 15.16W^{0.65}$$

This newly derived equation for magpies is appropriate for adult birds in captive conditions in a temperate climate. As mentioned earlier, many factors influence absolute energy requirements and expenditure, and therefore values derived using this and other equations are approximations, but currently provide a basis for determining MER in birds of this size.

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