

# Comparative Protein Requirements Of Three Species Of Parrots With Distinct Dietary Specializations

Gregory S. Pryor

Department of Zoology, University of Florida, Gainesville, Florida USA

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## INTRODUCTION

Highly specialized nectarivorous and frugivorous birds have overcome the constraints of low dietary protein levels. Proposed physiological mechanisms that enable such specialists to subsist on low-protein diets include low protein requirements, low endogenous protein losses, high feed intake, and high protein digestibilities. These traits were compared among nectarivorous red lorries (*Eos bornea*), frugivorous Pesquet's parrots (*Psittrichas fulgidus*), and granivorous budgerigars (*Melopsittacus undulatus*).

## MATERIALS AND METHODS

To calculate maintenance protein requirements, nitrogen (N) balance trials were conducted in which isocaloric diets of varying protein content were fed to individually caged birds [Robbins, 1983; Murphy, 1993; Pryor et al., 2001]. Fruit-based diets were fed to red lorries and Pesquet's parrots, and seed-based diets were fed to budgerigars. Body mass of all individuals of each species did not change significantly throughout feeding trials. For each species, N excretion was plotted against N intake to determine N equilibrium and minimum endogenous N losses. Nitrogen equilibrium occurred where N intake = N excreted (calculated from the regression equation), and was used for interspecific comparisons. Minimum endogenous N losses (i.e., theoretical N excretion on a protein-free diet) were estimated by the y-intercept and were also used for comparisons. Once N equilibrium was determined, crude protein (CP) requirements for maintenance were calculated by regressing CP% in the diet against N intake. The point at which CP% equals N intake at N equilibrium represented the CP requirement.

## RESULTS

Endogenous N losses were 0.10, 0.05, and 0.26 gN • kg body mass<sup>-0.75</sup> • d<sup>-1</sup> for red lorries, Pesquet's parrots, and budgerigars, respectively. Nitrogen equilibrium for these species occurred at 0.13, 0.32, and 0.38 gN • kg<sup>-0.75</sup> • d<sup>-1</sup> (Fig. 1). Dietary protein requirements were 1.0% CP for red lorries, 3.2% CP for

Pesquet's parrots, and 8.2% CP for budgerigars (using nitrogen-to-protein conversion factors of 4.05, 4.05, and 6.25, respectively).

## **DISCUSSION**

Red lories exhibited the highest dietary dry matter (DM) intake and Pesquet's parrots had the lowest DM intake. These intake levels are at variance with the hypothesis that specialists of low-protein diets rely upon high intake to increase overall protein consumption. In a separate analysis of 56 species of birds, it was determined that intake in birds is strongly correlated with body mass and food habits, but not dietary protein levels. Frugivorous birds, including Pesquet's parrots, exhibit low mass-specific DM intake levels. This pattern may reflect the seed, fiber, and water bulk in their fruit-based diets.

There were also significant interspecific differences in apparent protein digestibilities; digestibilities were highest for red lories and lowest for Pesquet's parrots. These results are in disagreement with the hypothesis that low-protein specialists have high protein digestibilities to compensate for low dietary protein levels. This pattern may be due to differences in gut retention times, since longer retention times are associated with increased digestibilities. Indeed, upon further investigation it was found that nectarivorous birds exhibit very high protein digestibilities and long retention times (scaled to body mass), and frugivorous birds display low protein digestibilities and short retention times, relative to other birds.

## **CONCLUSIONS**

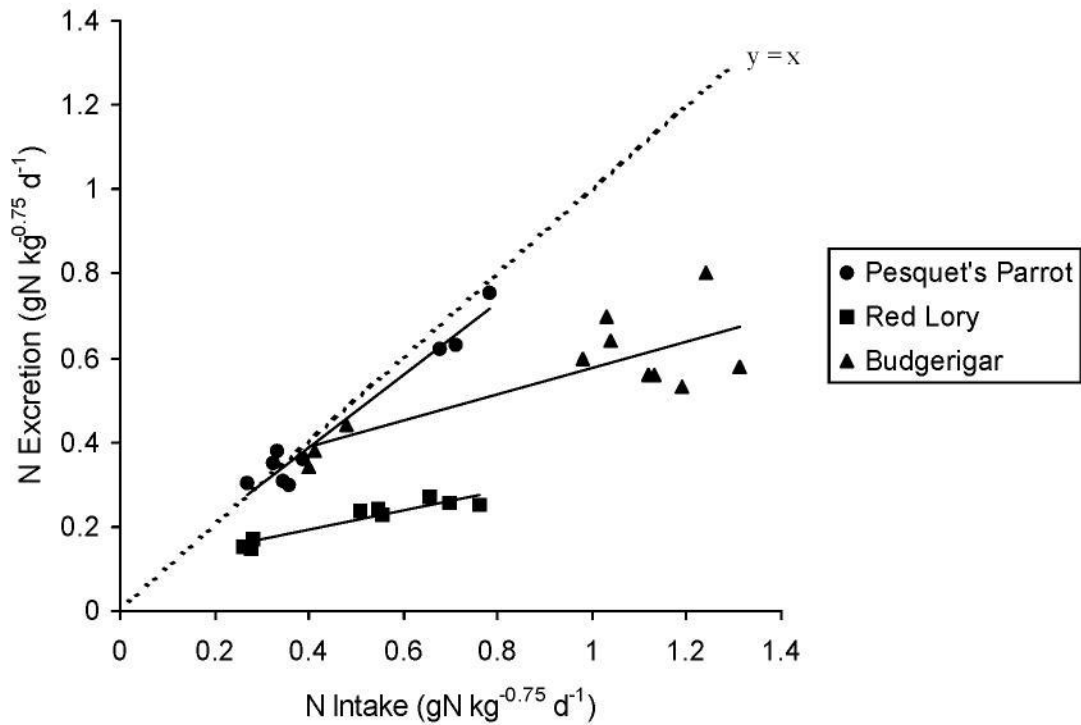
In summary, highly specialized nectarivorous red lories and frugivorous Pesquet's parrots have low protein requirements and reduced endogenous protein losses compared to granivorous budgerigars. However, while intake is high in the nectarivore, it is very low in the frugivore. These results indicate that not all low-protein specialists rely upon increased intake to increase overall protein consumption, as hypothesized. Differences in protein digestibilities between red lories and Pesquet's parrots are also at variance with the prediction that low-protein specialists have increased protein digestibilities to compensate for low dietary protein levels. While reduced protein requirements and endogenous protein losses are shared by these low-protein specialists, contrasting intake and apparent protein digestibilities suggest alternative strategies to coping with their low-protein diets.

## **REFERENCES**

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**Fig. 1.** Nitrogen balance among 3 species of psittacines with dietary specializations. For Pesquet's parrots,  $y = 0.86x + 0.05$  ( $R^2=0.96$ ;  $n=9$ ); for red lorries,  $y = 0.23x + 0.10$  ( $R^2=0.88$ ;  $n=9$ ); and for budgerigars,  $y = 0.31x + 0.26$  ( $R^2=0.62$ ;  $n=11$ ). Values below the dotted line ( $y = x$ ) indicate N accumulation, while values above this line indicate N loss.