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Authors: O'DONNELL, J. A., GARBETT, R., and MORZENTI, A.

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NORMAL FASTING PLASMA GLUCOSE LEVELS IN SOME BIRDS OF PREY

J. A. O'DONNELL, III, R. GARBETT and A. MORZENTI, Department of Physiological Sciences and Department of Avian Sciences, University of California, Davis, California 95616 USA.

Abstract: Blood samples taken from five great horned owls *(Bubo virginianus)*, eight red-tailed hawks *(Buteo jamaicencis)*, four marsh hawks *(Circus cyaneus)*, two prairie falcons *(Falco mexicanus)*, five golden eagles *(Aquila chrysaetos)*, and five white leghorn chickens *(Gallus domesticus)* that had been fasted for 24 h were used to determine plasma levels of glucose by the glucose oxidase method. The mean plasma glucose levels were: great horned owls 374.6 mg/100 ml, red-tailed hawks 346.5 mg/100 ml, marsh hawks 369.3 mg/100 ml, prairie falcons 414.5 mg/100 ml, golden eagles 368.4 mg/100 ml, and white Leghorn chickens 218.2 mg/100 ml. The plasma glucose levels obtained for the raptorial birds in this study were considerably higher than those found for the chickens. These values are discussed in relation to the carnivorous food habits of raptors.

INTRODUCTION

Little information has been published on the normal blood glucose levels of raptorial birds, thus making it difficult to compare the physiologic state of diseased or injured raptors to normal birds of the same species. Nelson *et al.*[4] and Scott *et al.*[6] have reported whole blood glucose levels of the great horned owl *(Bubo virginianus)* to be 155-256 mg/100 ml and 200-350 mg/100 ml respectively, and Migliorini *et al.*[3] reported blood glucose levels in the black vulture *(Coragyps atratus)* to be 163-176 mg/100 ml. However, whole blood glucose levels in chickens were found by Tapper and Kare[7] to be considerably lower than plasma glucose concentrations, hence the published data may be difficult to compare to the levels obtained in this study.

In this paper, we report normal plasma glucose concentrations in the following birds after 24 h food deprivation: great horned owls *(Bubo virginianus)*, red-tailed hawks *(Buteo jamaicencis)*, marsh hawks *(Circus cyaneus)*, prairie falcons *(Falco mexicanus)*, golden eagles *(Aguila chrysaetos)*, and white leghorn chickens *(Gallus domesticus)*.

MATERIALS AND METHODS

Birds of prey used were housed under natural lighting conditions in partially covered outdoor pens. They were fed daily on a diet of dead whole day-old chicks supplemented with a vitamin and mineral mixture.[1] Water was made available in the summer months only.

The data was collected in the autumn, winter and summer months. Both male and female birds were used. Most of the birds were unable to fly because of injuries from which they had recovered. They had no known systemic disorders or recent traumatic experiences. With the exception of one prairie falcon and one golden eagle which had been in captivity for only two months prior to the experiment, all the birds had been in captivity and under daily observation for at least

[1] A one to one mixture of *Vitamycin*, vitamin-mineral supplement, Pitman Moore, Inc., Washington Crossing, New Jersey 08560, and *Bone Building* (dicalcium phosphate), Nutro products Inc., So. El Monte, California 91733.

one year. The chickens used were 7 month old male single comb white leghorns (SCWL). They were housed indoors in wire cages and fed a commercial poult starter containing 26% crude protein. The light regime was maintained at 14 h of light/day.

All birds were fasted for 24 h and .5 ml of blood was drawn without anesthesia from the brachial vein of the birds. No effort was made to take blood at the same time of day for each bird. The blood was quickly transferred to heparinized tubes and centrifuged. The plasma was separated from the cells, deproteinized and refrigerated. Plasma glucose levels were determined by the glucose oxidase method of Keilin and Hartree[2] within 3 days.

RESULTS

The results of the determinations are presented in Table 1. The values indicate that the plasma glucose concentrations of all the birds of prey are similar, and all are higher than those of the domestic fowl.

DISCUSSION

The plasma glucose levels of the raptors used in this study ranged from approximately 330-415 mg/100 ml, whereas those for chickens averaged 218 mg/100 ml which is comparable with plasma glucose levels found in other studies on chickens by Muirini *et al.*[4] and Tapper *et al.*[7] Other studies with raptors by Migliorini *et al.*,[3] Nelson *et al.*[5] and Scott *et al.*[6] were based on whole blood samples. A comparison with the present study is not possible because concentrations of glucose in the erythrocytes of birds (such as chickens) are considerably lower than plasma glucose concentrations.[7] Direct comparison of whole blood and plasma on 6 ½ month SCWL chickens by Tapper and Kare[7] yielded values of 188 ± 2.2 mg/100 ml and 273 ± 4.6 mg/100 ml, respectively.

The marked differences between the plasma glucose levels of raptors and chickens as demonstrated here suggests that there are major differences in glucose metabolism between the two groups of birds. The carnivorous diet of raptors (high in protein and fat) compared to the granivorous diet of chickens (relatively low protein and fat) may account for this difference. Migliorini *et al.*[3] has shown that the gluconeogenic enzyme activity in the liver of the black vulture (a carnivorous bird), is 2-4 times higher than that of the chicken. An increased gluconeogenic capacity in raptors, combined with a low glucose utilization, could explain the higher plasma glucose levels found in this study. Eisenstein and Strack[1] found that gluconeogenesis was increased and blood glucose levels were higher in rats fed a high-protein, low-carbohydrate diet than in rats fed a normal diet. Thus, it is possible that the high glucose levels and gluconeogenic capacity of raptors are responses to their high protein diet. A

TABLE 1. Fasting plasma glucose levels in birds of prey.

Species	No. Birds	Mean (mg/100 ml)	Standard Deviation	Standard Error of the mean
Great horned owl	5	374.6	28.9	12.9
Red-tailed hawk	8	346.5	31.1	11.0
Marsh hawk	4	369.3	29.2	14.6
Golden eagle	5	368.4	24.6	11.0
Prairie falcon	2	414.5	2.1	1.5
SCWL chicken	5	218.2	11.4	5.1

direct study of this possibility could be done by varying the amount of carbohydrate in the diet of carnivorous bird and observing the effect on the rate of gluconeogenesis and plasma glucose concentrations.

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