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Stanley N. David  
*Arkansas State University*

Clarene L. David  
*Arkansas State University*

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# PLASMA CORTICOSTERONE LEVELS IN CHOLESTEROL-FED COCKERELS BEFORE AND AFTER A TWENTY MINUTE RUN

STANLEY N. DAVID and CLARENE L. DAVID

Department of Biological Sciences  
Arkansas State University  
State University, AR 72467

## ABSTRACT

Cockerels were exercised to observe the influence of physical activity on plasma corticosterone concentrations. The birds were maintained on a commercial mash or on an atherogenic diet. Plasmas were collected on the first day, fifteen days after the first collection and immediately after a 20 minute run on that fifteenth day. The plasma corticosterone levels as determined by radioimmunoassay showed extreme variations within collections. Hence, the data analysis indicated no significant changes of the Compound B in the blood of the cockerels due to diet, or exercise or the combination of both. The causes for the wide variation of plasma corticosterone levels in these birds remain unknown.

## INTRODUCTION

Running on an electrically rotated treadmill, twenty minutes, twice daily, five consecutive days per week for ten weeks by cholesterol-fed cockerels resulted in the decrease of plasma cholesterol and in the reduction of atherosclerosis. These effects of physical activity were postulated as the consequences of an enhancement of the enzymatic degradation of cholesterol. Further, it was hypothesized that the cholesterol oxidizing enzymes were activated by corticosterone in response to the muscular exertion (Orimilikwe et al., 1983). This study investigates the influence of physical activity on cockerel plasma corticosterone levels.

## MATERIALS AND METHODS

Twenty, 16-week-old, Hy-line cockerels were used in this study. At the start of the experiment the birds were fasted over night, their body weights were determined and blood samples were collected from their alar veins. The bloods were centrifuged at 2250 G in an International Clinical Centrifuge and the separated plasmas were stored at  $-10^{\circ}\text{C}$  in sealed vials until assayed.

The cockerels were separated into two equal groups: the Plain Mash + Exercise (PM + Ex), and the Atherogenic Diet + Exercise (AD + Ex). They were housed in separate floor pens (12' x 10'). The PM + Ex was fed a commercial mash (Allied Mills, Inc.) and the AD + Ex was maintained on a diet which consisted of 2% cholesterol and 5% cottonseed oil, w/w, added to the commercial mash. The birds were exercised 20 min, twice daily, five consecutive days per week on a motor driven 6-foot diameter circular treadmill roated at  $5 \pm 0.5$  r.p.m. This exercise was similar to running 500 yards in 20 min two times per day for the cockerels.

On the fifteenth day of the dietary and exercise regimens, the body weights of the birds were recorded and plasma samples were collected. Then the cockerels were exercised for 20 min and final blood samples were collected as described above.

The steroids from the plasmas were extracted with methylene chloride. Purified corticosterone was recovered by column chromatography from the extract. The quantities of pure corticosterone in the samples were determined by radioimmunoassay.

The data were analyzed by two-way analysis of variance and by paired T-test.

## RESULTS AND DISCUSSION

The body weight gains were similar in both groups (Table 1). Cholesterol concentrations were not changed in the birds consuming

Table 1. Body Weights of the Cockerels

Groups	Number of Birds (N)	Body Weights (grams)		
		Initial	Final	Gain
Plain Mash + Exercise	6	1440 $\pm$ 22*	1554 $\pm$ 15	114 $\pm$ 18
Atherogenic Diet + Exercise	6	1446 $\pm$ 173	1557 $\pm$ 42	111 $\pm$ 31

\*Standard Error of the Mean

Exercise—forced running 500 yards in 20 minutes, twice daily, 5 consecutive days per week for two weeks.  
Atherogenic Diet—2% cholesterol plus 5% cottonseed oil (w/w) of mash.

Table 2. Influence of Exercise on Plasma Cholesterol Concentrations of Cockerels

Groups	Number of Birds (N)	Plasma Cholesterol (mg%)	
		Initial	Final
Plain Mash + Exercise	6	142 $\pm$ 15*	142 $\pm$ 12
Atherogenic Diet + Exercise	6	145 $\pm$ 5	315 $\pm$ 34

\*Standard error of the mean

Exercise—forced running 500 yards in 20 minutes, twice daily, 5 consecutive days per week for two weeks.  
Atherogenic Diet—2% cholesterol plus 5% cottonseed oil (w/w) of mash.

the commercial mash only but the cholesterol-fed cockerels had elevated plasma cholesterol levels (Table 2). This high level was significantly lower than the increase of plasma cholesterol in non-exercised cockerels maintained on a similar diet (Orimilikwe, et al., 1983).

In the initial plasma samples the Plain Mash + Exercise birds showed  $0.67 \pm 0.27$  microgram per dl. and the Atherogenic Diet + Exercise cockerels had  $0.82 \pm 0.45$  microgram per dl. corticosterone. The difference between these mean values was not significant. After 15 days of diet and exercise, the Plain Mash + Exercise cockerels were ob-

Table 3. Influence of 20 minute Running on Plasma Corticosterone of Cockerels.

Groups	Number of Birds (N)	Plasma Corticosterone Concentration Micrograms %	After Two Weeks	
			Before Run	After Run
Plain Mash + Exercise	6	0.67 $\pm$ 0.27*	0.43 $\pm$ 0.2	0.48 $\pm$ 0.29
Atherogenic Diet + Exercise	6	0.82 $\pm$ 0.45	0.79 $\pm$ 0.34	0.61 $\pm$ 0.49

\*Standard deviation of the mean

Exercise—forced running 500 yards in 20 minutes

Atherogenic diet—2% cholesterol plus 5% cottonseed oil (w/w) of mash

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served to have  $0.63 \pm 0.2$  micrograms per deciliter, corticosterone. This value was similar to the initial value. After 20 min of running there was a reduction of the hormone in the plasmas of these birds to  $0.46 \pm 0.09$  micrograms per deciliter. However, the decrease was statistically insignificant. Similarly, the Atherogenic Diet + Exercise cockerels showed  $0.77 \pm 0.54$  micrograms per dl. corticosterone after remaining on the diet and exercise regimens for 15 days. This and the previously observed level of the hormone in these birds were not markedly different. The hormone concentration of  $0.61 \pm 0.49$  micrograms per dl. in the plasmas collected after the 20 min run was not statistically lower than the pre-exercise values (Table 3).

The plasma corticosterone concentrations in the bloods of the cockerels were within a range of 0.23 micrograms per dl. to 1.53 micrograms per dl. Due to this extreme variation within samples, the statistical analysis of the data by two-way analysis of variance or by paired T-test indicated no significant differences between the arithmetic means of the values of corticosterone. According to Yates and Urquhart (1962) the plasma concentrations of glucocorticoids fluctuate with changes in the physiological state of the animal. There was no uniformity in the corticosterone levels of the cockerels used in this study. The causes for these differences among the cockerels are not known.

The amount of corticosterone in the plasma is quantitatively the balance between the quantity released by the adrenal cortex and the sum of the quantities of the substance bound to the tissues, metabolized and excreted. The plasma level of Compound B should decrease when the rates of tissue uptake, metabolism and excretion exceed the rates of secretion and release by the gland. Or, the level of the hormone should rise when the secretion and release is at faster rates than the rates of tissue binding, metabolism and excretion. The data from this study do not indicate excessive addition or removal of corticosterone from the plasmas of the cockerels.

Reports on the influence of muscular work on plasma corticosterone concentration are very few in number. Chin and Evonuk (1971) reported that there was no significant change of corticosterone concentration in the bloods of rats which were moderately exercised daily for six weeks. Rose et al. (1970) observed no difference between the amounts of cortisol in the blood of men while at rest and after running a mile. John and George (1973) electrically stimulated the pectoral muscles of anesthetized pigeons to give five wing beats per second for two hours. These investigators reported that there was no significant alterations in the pre and post-experimental plasma levels of Compound B in these birds. The data from our study is similar to the results of these investigations.

A minimum work load, requiring at least 60 percent of maximum aerobic power, is needed to cause a significant change in the plasma level of hydrocortisone in man (Davies and Few, 1973). In rats which were forced to swim daily until exhaustion, for three weeks, Frenkel and Csalay (1962) observed an increase of circulating corticosterone. Seaman and Evonuk (1970) reported a 43% increase in the plasma corticosterone concentration in rats which were forced to swim until they were tired and about to drown. According to these reports, our results suggested that the degree of physical exertion was not strenuous for the cockerels.

However, the data obtained from this study is not conclusive of the influence of physical activity on the plasma concentrations of cockerels. This is due to the overwhelming individual variations of the amounts of Compound B in the bloods of the experimental animals. The causes for the extreme variations among the cockerels with regard to the hormone level remain obscured.

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