Organ and Body Mass Changes in Restrained and Fasted Domestic Fowl[1] (36797)

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Limitation of an animal's mobility—restraint—commonly is associated with physical examinations, animal surgery or shipment of the animal to another destination. The animal's initial response, largely behavioral (1–4), involves adrenocortical participation (2–6) or "alarm response" (7, 8). If the "stressor" is not too severe, the animal adapts to the stimulus, responding only in a minor way when subsequently exposed. But domestic fowl exposed to severe restraint—immobilization—apparently do not adapt to the treatment; they display symptoms not unlike those attending starvation in addition to a generalized dehydration (2, 3, 9). Fasting may cause stress in rats (10); however, domestic fowl fasted for 5 days (11) lost 12% of their body mass while showing no evidence of stress.

In previous studies with restrained domestic fowl (2–4, 9), it was observed that both feed and water consumption were absent in these animals. So change in their body weight—and thus organ weight—may result partly from that fasting condition. To determine if that is so, we compared sized organ and body tissue from restrained, fasted, and control animals; results are reported below.

Methods. The single comb white leghorn (SCWL) adult, male fowl used in our experiments were reared under conditions consistent with established husbandry practices. The animals, all the same age, were caged individually. Feed and water were provided *ad libitum* to the control and restrained groups; the fasted animals received no feed but drinking water was available.

A harness-cage restraint described by Besch *et al.* (2) was used. In this procedure, the animal was placed in a body harness with its body supported by the feet and legs. Movement within the cage was restricted by securing the harness to the sides, top or bottom of the cage. The wings of the animal were freely movable.

After nine days of the experimental treatment—either restraint or fasting—the animals, in series, were weighed and sacrificed by cervical luxation, as were appropriate numbers of control animals for each experimental group. Immediately after they were removed, each animal's organs were weighed individually on a top loading balance (Mettler, Model K-7T) to the nearest 10 mg. Weights also were recorded for tissue heat dried at 105°.

Some birds from both restrained and fasted groups were not sacrificed; the recovery of their body mass was determined, using a similar type of restraint procedure (2).

Results and Discussion. From the data in Table I, it is apparent that fasting loss rate in the restrained animals was 63.5% ($p < .001$) greater than in the fasted group, yet the two groups recovered at the same rate. Those results were unexpected because animals in neither treatment group ate food or drank water (*i.e.*, inputs into the body was the same) although water was available to both groups. The greater body mass losses in

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TABLE I. Body-Mass Loss Rates and Postfast Recovery Rates for Male Single Comb White Leghorns.

Group	Fasting loss rate		Postfast recovery rate	
	N^a	(g/kg/da)[b]	N^a	(g/kg/da)[b]
Control	24	29.6 ± 0.9[c]	16	20.9 ± 2.0
Harness-sling restraint[d]	21	48.4 ± 3.1	14	21.9 ± 2.5

[a] Number of animals per group.

[b] Grams of body weight lost or gained per kilogram of body weight per day.

[c] Mean ± standard error.

[d] A modification of the harness-cage restraint [Besch *et al.* (2)].

the restrained animals indicated that stress is an active process requiring great energy expenditures.

Compared with control and fasted animals, restrained domestic fowl exhibited increased weight of heart, lungs, kidneys, liver, and adrenals (Table II) but greater loss of spleen, superficial pectoral muscle, small intestine, and pancreas masses. Though testes size decreased in both restrained and fasted animals, it is greater in the fasted.

Gabel and Clay (5) reported increased weights of the heart, adrenals, and kidneys in restrained rats; they also found that hearts from stressed animals showed small myocardial lesions and an increase in water content. Our findings were similar, although no myocardial lesions were apparent in either restrained or fasted groups.

Comparing weights or organs from experimental and control animals indicated that restraint results, generally, in a greater loss than does fasting (Table II). Selye (7) has shown that fasting is particularly effective in increasing sensitivity to alarming stimuli. Since restrained domestic fowl consume no feed or water (2), it may be that the effects of fasting become superimposed on the effects

TABLE II. Relative Organ Weights of Male Single Comb White Leghorns.

	Wet tissue wt (g/kg body wt)[d]		
		Duration 9 days	
n^e:	Control 18	Restrained 8	Fasted 5
Heart	4.43 ± 0.11[af]	4.96 ± 0.14[bf]	4.10 ± 0.24[af]
Lungs	5.27 ± 0.19[a]	7.40 ± 0.43[b]	5.65 ± 0.40[a]
Kidneys	7.52 ± 0.18[a]	10.20 ± 0.68[b]	8.81 ± 0.61[ab]
Spleen	1.60 ± 0.07[a]	0.60 ± 0.08[b]	1.25 ± 0.10[c]
Liver	20.78 ± 0.49[a]	25.05 ± 1.25[b]	18.14 ± 1.53[a]
Testes	8.62 ± 0.74[a]	6.32 ± 1.88[ab]	3.23 ± 0.71[b]
S. pectoral m. (left)	37.85 ± 0.50[a]	28.74 ± 2.72[b]	36.88 ± 0.75[a]
Adrenals	0.14 ± 0.01[a]	0.26 ± 0.03[b]	0.19 ± 0.01[c]
Thyroids	0.12 ± 0.01[a]	0.12 ± 0.01[a]	0.15 ± 0.02[a]
Small intestine	5.18 ± 0.18[a]	3.63 ± 0.67[b]	3.87 ± 0.14[b]
Pancreas	2.01 ± 0.08[a]	1.31 ± 0.15[b]	1.66 ± 0.10[c]

[d] Absolute organ weights not shown, as treatments resulted in significant reductions in organ and body mass; however, the mass losses were not so great as to require differential growth (heterogony) considerations.

[e] Number of animals.

[f] Mean ± standard error. No statistically significant differences exist among values in a row having the same superscript (*a*, *b*, *c*) as determined by analysis of variance and Student's *t* test.

TABLE III. Relative Water Content of Fresh Tissues from Male Single Comb White Leghorn Fowl.

	Water content of fresh tissue[a]				
n:	Control 18	Restrained 8		Fasted 5	
	%[a]	%[a]	% Difference[b]	%[a]	% Difference
Heart	78.9 ± 0.23	79.1 ± 1.12	+0.2	78.0 ± 0.68	−1.1
Lungs	76.4 ± 0.46	75.7 ± 1.19	−0.9	75.7 ± 0.24	−0.9
Kidneys	76.5 ± 0.41	78.8 ± 0.86	+3.0[c]	76.1 ± 0.87	−0.5
Spleen	77.4 ± 0.48	77.0 ± 2.66	−0.5	71.8 ± 4.86	−7.2
Liver	70.7 ± 0.39	74.6 ± 0.68	+5.5[c]	72.5 ± 0.73	+2.5[c]
Testes	86.2 ± 0.25	83.3 ± 0.44	−3.4[c]	80.7 ± 1.24	−6.4[c]
S. pectoral m. (left)	73.6 ± 0.25	74.8 ± 0.66	+1.6	74.1 ± 0.31	+0.7
Adrenals	69.1 ± 2.80	75.6 ± 5.99	+9.4	57.7 ± 2.99	−16.5
Thyroids	65.7 ± 3.94	68.0 ± 7.94	+3.5	49.4 ± 2.72	−24.8
Small intestine	75.8 ± 0.43	77.8 ± 1.05	+2.6	76.1 ± 0.31	+0.4
Pancreas	70.4 ± 0.60	76.2 ± 1.45	+8.2[c]	68.9 ± 0.92	−2.1

[a] Mean ± standard error; % fresh tissue weight (percentage differences not significant unless indicated).

[b] % difference = [(experimental − control)/control] × 100.

[c] Denotes either a significant ($p < 0.05$) increase or decrease compared to control group as determined by analysis of variance and Student's *t* test.

of restraint (or vice versa), resulting in a combined effect severer than for fasting or restraint alone. That apparent additive effect is supported by findings of Peters and Boyd (12) in male, albino rats in which stress restraint augmented the loss—more in spleen and thymus but less in liver and heart—caused by starvation.

In restrained animals, the relative water content of tissue generally increased. The kidneys, liver, and pancreas showed a significant increase compared with the controls; the testes, however, showed a significant decrease (Table III). In fasted animals, with water available *ad libitum*, the water content of the organs generally decreased—significantly in the testes; the liver, however, showed a significant increase. These results were expected, because water loss—not loss of food stores—causes much of the weight loss during fasting; and withholding water may increase the severity of the condition (10). Moreover, our results were similar to those of Peters and Boyd (12), who found starvation alone augmented water levels of liver and muscle in male, albino rats; depriving the rats of water eliminated that effect, but it added to stress, resulting in a transient dehydration of kidneys, lungs, and testes.

Conclusion. Animal restraint—although accompanied by inanition—affects organ and body mass in the domestic fowl in a different way than does fasting.

Summary. Organ and body mass changes in restrained adult, male domestic fowl were compared with tissue from control and fasted animals. Body mass loss rate in the restrained animals was 63.5% ($p < .001$) greater than in the fasted group, yet the two groups recovered at the same rate. Compared with controls and fasted animals, restrained fowl exhibited an increase in size of heart, lungs, kidneys, liver, and adrenals but a greater loss of spleen, superficial pectoral muscle, small intestine, and pancreas masses. Relative water content of organs generally increased in restrained and decreased in fasted animals. The data suggest that restraint—although accompanied by inanition—affects organ and body mass in the domestic fowl in a different way than does fasting.

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