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Postmortem Changes in Liver Weight of Japanese Quail

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Among the factors that contribute to error in soft tissue residue data are methods of tissue handling which result in variability of sample weight. Adrian & Stevens (1979) demonstrated that changes in wet weight due to moisture loss occurred when duck liver samples were exposed to ambient environmental conditions for variable lengths of time. They suggested that residues be reported on a dry weight basis, since consistency in dryness is easily achieved. The use of dry weight eliminates error due to evaporative loss after the sample is removed, but a more basic source of error is postmortem change in organ weight in the intact carcass. Iyengar (1980) compared liver weights from rats dissected immediately after death to liver weights from carcasses left intact for 1, 2, and 3 days. Wet weight increased 33% on day 1 with a somewhat lesser increase in dry weight. This has significant implications for residue data from field cases because time since death could be one day or more, depending upon environmental conditions, and a 33% change in liver weight would result in a corresponding error in the residue reported. Depending on the length of time necessary for this weight change to occur, results of controlled studies could also be affected if time between death and liver removal is not standardized. In the present study, postmortem changes in wet and dry liver weights were investigated using Japanese quail (Coturnix coturnix japonica).

MATERIALS AND METHODS

Sixty 6-mo-old male Japanese quail were assigned to four treatment groups of 15 birds each, according to elapsed time between death and liver removal: Immediately, 6 hr, 24 hr, or 48 hr. Birds were killed with CO_2 at 3-min intervals and those in the 6, 24 and 48 hr groups were placed in an environmental chamber (22°C, 30% relative humidity) for the appropriate holding period. Livers were removed in sequence and wet weights were recorded, then livers were placed in a drying oven at 80°C and reweighed at 48 hr.

In a second experiment, 75 6-mo-old male Japanese quail were assigned to five treatment groups of 15 birds each: Livers removed immediately after death, 0.5 hr, 1 hr, 2 hr, or 4 hr. Birds were killed as above and kept at ambient laboratory conditions (22°C, 60% relative humidity) for the appropriate holding period. Livers were removed, weighed, and dried as in the first experiment.

One-way analysis of variance and Duncan's multiple range test (Steel & Torrie 1960) were used for statistical interpretation of data from both experiments. Differences were considered significant at $P < 0.05$.

RESULTS AND DISCUSSION

There were no significant differences in body weight between any of the groups in the first experiment (Table 1). Wet and dry liver weights, expressed as % of body weight, increased significantly between 0 and 6 hr, then remained unchanged throughout the remainder of the experiment. Percent moisture was significantly less at 48 hr than in any of the other groups.

Table 1. Postmortem changes in wet and dry liver weights of Japanese quail from 0 to 48 hr. Means (SD), N=15.

	Time since death (hr)			
	0	6	24	48
Body wt (g)	126.5 (11.7)	129.9 (18.4)	126.8 (14.9)	127.8 (15.3)
Wet liver wt (% of Body wt)	1.94A[a] (0.26)	2.42B (0.34)	2.55B (0.39)	2.52B (0.45)
Dry liver wt (% of Body wt)	0.56A (0.09)	0.70B (0.25)	0.72B (0.11)	0.79B (0.20)
% Moisture	71.2A (1.9)	71.6A (5.2)	71.7A (1.5)	68.6B (4.4)

[a]Means in the same row without letters in common are significantly different ($P < 0.05$).

In the second experiment wet and dry liver weights of control birds were significantly less than all other treatments, but no differences occurred between 0.5 and 4 hr (Table 2). Percent moisture was significantly less in control livers than in the 1 and 2 hr groups, and the % moisture at 0.5 hr was significantly less than the 2 hr group. There were no differences in body weights.

Table 2. Postmortem changes in wet and dry liver weights of **Japanese quail** from 0 to 4 hr. Means (SD), N=15.

	Time since death (hr)				
	0	0.5	1.0	2.0	4.0
Body wt (g)	124.2 (14.6)	129.5 (12.6)	128.6 (12.1)	120.6 (8.6)	128.1 (13.5)
Wet liver wt (% of Body wt)	1.82A[a] (0.29)	2.26B (0.34)	2.32B (0.34)	2.36B (0.19)	2.46B (0.43)
Dry liver wt (% of Body wt)	0.51A (0.08)	0.63B (0.10)	0.61B (0.08)	0.61B (0.05)	0.66B (0.12)
% Moisture	71.6A (4.3)	72.2AB (1.2)	73.5BC (0.8)	74.1C (0.7)	73.1ABC (0.6)

[a]Means in the same row without letters in common are significantly different ($P < 0.05$).

When livers were left in the intact carcasses of Japanese quail for 0.5 hr or longer, wet and dry liver weights were 20-40% higher than weights of livers removed immediately after death. This agrees with data presented by Iyengar (1980) indicating an increase of 32% and 26% in wet and dry weights, respectively, of rat livers after 24 hr. However, Iyengar (1980) reported a decrease in both wet and dry weight at 48 hr, which is contrary to the results in quail. In a similar study with rats, Boyd & Knight (1963) found no differences in wet weight or water content of livers removed at 0, 3, or 24 hr after death. The authors did not express liver weight in terms of body weight, however, so differences may have been masked by body and liver weight variability.

The postmortem change in liver weight of Japanese quail may have been due to leakage of blood from those livers removed immediately after death. Munger & McGavin (1972) studied gross and microscopic postmortem changes in chicken livers, and reported that unclotted blood flowed from freshly dissected livers, leaving almost no blood in the sinusoids. As the blood clotted, numerous erythrocytes were present at 45 min, and sinusoids were distended at 1.5 to 3 hr (Munger & McGavin 1972). The presence of clotted blood helps to explain the increase observed in dry weights of quail livers, since blood is about 22% dry matter (Scanlon 1982).

If the postmortem weight change was the result of clotted blood, one would expect a slight increase in % moisture, since blood has somewhat more water content than liver (Scanlon 1982). Percent moisture for quail livers generally fit this pattern in the second experiment, but not in the first. Another factor which may contribute to increased liver weight is blood being forced into the liver via the vena cava as a result of rigor mortis.

In a practical sense it appears that strict standardization of liver removal may not be necessary in controlled studies, at least after the initial weight increase, since liver weights remain relatively stable for many hours. However, considerable error could occur in residue data, both in controlled and field studies, if freshly removed liver weights are compared with weights of livers removed after 0.5 hr or longer, especially for those toxicants in which blood and liver residues are not similar. The speed with which this weight change occurs may vary with body size, and so may be different for other species.

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