Lipotropic Agents and DDT Residue in Birds and Eggs

by C. R. CREGER
Department of Poultry Science
Texas A&M University
College Station, Texas 77843
and
L. F. KUBENA
South Central Poultry Research Laboratory
State College, Mississippi 39762

Surveys have shown that chlorinated hydrocarbon pesticide residues are widespread. These pesticides are fat soluble and can accumulate in fatty tissues and in the eggs of birds when they are exposed to these compounds (1,2,3,4).

Many factors which affect pesticide metabolism have been studied in attempts to develop methods for more rapid depletion of residues from tissues and eggs of the avian species. Previous work has shown that low protein diets or periodic starvation may facilitate the depletion of DDT from the tissue of growing birds and eggs of laying hens (5,6,7).

For several years choline chloride has been used in conjunction with vitamin B_{12}, vitamin E, and antibiotics for the mobilization of infiltrated hepatic fat in laying hens affected with the Fatty Liver Syndrome (8). Inositol in combination with choline chloride has also been reported to be effective in mobilizing hepatic fat (9,10). The purpose of this study was to determine if the lipotropic agents, choline chloride and inositol, could mobilize fat, DDT, and metabolites to the eggs and reduce the quantity of residual DDT and metabolites in the birds.

---

[1]This is a contribution of the Texas Agricultural Experiment Station supported in part by the Caesar Kleberg Research Program in Wildlife Ecology.

Bulletin of Environmental Contamination & Toxicology,
Vol. 6, No. 5, 1971, published by Springer-Verlag New York Inc.

Methods and Materials

Fifteen mature laying Japanese quail (Coturnix c. japonica) were randomly housed in individual cages, divided into three groups, and administered a single oral dose of 50 mg commercial grade 1,1,1-trichloro-2,2-bis-(-chlorophenyl)-ethane (DDT) via capsule. Group 1 received a basal diet containing no added choline chloride or inositol. Group 2 received the basal diet supplemented with 1.32 gm of choline chloride and 1.0 gm of inositol per kg of diet. Group 3 received the basal diet supplemented with 2.65 gm of choline chloride and 2.0 gm of inositol per kg of diet. Each group received its respective diet and water ad libitum for the duration of the experiment. After initiation of the experiment, the 7th, 21st, and 28th eggs from each bird were collected, marked, and placed in a cooler for subsequent analysis. All birds were killed after laying the 28th egg and individually weighed, freeze dried, ground, and analyzed for DDT and metabolites.

The determinations for DDT and metabolites of the carcasses and the egg yolks were made in accordance with a previously described procedure (11). Data were treated to analysis of variance (12) and multiple range and multiple F tests (13).

Results and Discussion

The effect of dietary treatment on total carcass residue of DDT and metabolites is shown in Table 1. The group receiving the basal diet contained 3.8 ppm total carcass residue of DDT and metabolites. The group receiving the basal diet supplemented with 1.32 gm of choline chloride and 1.0 gm of inositol per kg of diet contained only 1.2 ppm. The group receiving the basal diet supplemented with 2.65 gm of choline chloride and 2.0 gm of inositol per kg contained 1.23 ppm total carcass residue of DDT and metabolites.

TABLE 1.

Effect of dietary treatment on total carcass residue of DDT and metabolites on a wet weight basis (WWB) and percent dry weight[1].

Dietary treatment	Total carcass residue of DDT and metabolites[2]	Dry weight[2]
	(ppm)	(%)
Basal	3.8[b]	36.3 [b]
Basal + 1.32 gm choline chloride + 1.0 gm inositol per 1.0 kg of diet	1.2[a]	35.0[b]
Basal + 2.65 gm choline chloride + 2.0 gm inositol per 1.0 kg of diet	1.2[a]	32.9[a]

[1]Pre-experimental levels analyzed less than 0.2 ppm for both feed and total carcass.

[2]Means not having common letter superscripts were significantly different at the 0.05 level of probability.

Dry weight as a percent of wet weight declined from 36.3 percent for the group receiving the basal diet to 35.0 percent for the group receiving the basal diet supplemented with 1.32 gm of choline cloride and 1.0 gm of inositol per 1.0 kg. The dry weight as a percent of wet weight declined significantly to 32.9 percent for the group receiving the basal diet supplemented with 2.65 gm of choline chloride and 2.0 gm of inositol per 1.0 kg. Since moisture and fat are inversely related, these data indicate that the fat content of the groups receiving the diets supplemented with choline chloride and inositol contained less fat than did the

group receiving the basal diet. This is in agreement with previous results (14). These data show that supplementation of the diet with 1.3 gm of choline chloride and 1.0 gm of inositol per kg of diet reduced the total carcass residue of DDT and metabolites to approximately the same extent as did supplementation of the basal diet with 2.65 gm of choline chloride and 2.0 gm of inositol per kg of diet.

TABLE 2.

Effect of dietary treatment and time after exposure on residue of DDT and metabolites in egg yolk[1].

Dietary treatment	Residue of DDT and metabolites in egg yolk[2]		
	Egg number after exposure		
	7	21	28
	(ppm)	(ppm)	(ppm)
Basal	90.7[c]	28.5[b]	17.6[b]
Basal + 1.32 gm choline chloride + 1.0 gm inositol per kg of diet	65.5[b]	23.5[a]	8.5[a]
Basal + 2.65 gm choline chloride + 2.0 gm inositol per kg of diet	56.2[a]	23.8[a]	7.8[a]

[1]Pre-experimental levels analyzed less than 0.2 ppm for both feed and egg yolk.

[2]Means not having common letter superscripts were significantly different at the 0.05 level of probability.

Table 2 shows a significant effect of dietary treatment and egg number on the residue of DDT and metabolites in the egg yolk. The residue of DDT and metabolites for the group receiving the basal diet was 90.7 ppm in egg number

7. This was significantly higher than the residue of DDT and metabolites for the group receiving 1.32 gm of choline chloride and 1.0 gm of inositol per kg, and the group receiving 2.65 gm of choline chloride and 2.0 gm of inositol per kg of diet. These groups had residues of DDT and metabolites of 65.5 ppm and 56.2 ppm, respectively. The group receiving the basal diet supplemented with the higher level of choline chloride and inositol contained significantly less total yolk residue of DDT and metabolites than did the group receiving the lower level of supplementation.

The effect of dietary treatment was less pronounced on egg number 21. The group receiving the basal diet produced eggs having a significantly higher total yolk residue of DDT and metabolites than did the two groups receiving the basal diet supplemented with choline chloride and inositol. Egg number 28 indicated significant differences in total egg yolk residue of DDT and metabolites. The group receiving the basal diet contained 17.6 ppm; whereas, the groups receiving the basal diet supplemented with the low level and high level of choline chloride and inositol, contained 8.5 ppm and 7.8 ppm, respectively. These values are significantly less than the group receiving the basal diet. These data are in agreement with other workers (15) who found that the quantity of pesticide in the yolk was proportional to the quantity present in the body adipose tissue, and that the egg yolk is an important means for the elimination of chlorinated hydrocarbon residue from the body. The lipotropic agents employed were effective in reducing total carcass DDT levels. Since the DDT levels were also reduced in the egg from birds fed the lipotropic agents, reduction of DDT in the body was not due to elimination through the egg yolk.

Summary

Dietary supplementation of liptropic agents, choline chloride and inositol resulted in a significant decrease in the total carcass residue of DDT and metabolites; and the residue of DDT and metabolites observed in the egg yolk was a direct reflection of the DDT present in the carcass. Choline chloride and inositol supplementation at levels of 2.65 or 1.32 and 2.0 or 1.0 gm

per kg of diet, respectively, caused a more rapid depletion of DDT and metabolites; but, this increased elimination rate was not due to elimination in the egg yolk.

References

1. Couch, J. R., Feedstuffs, 46 (November, 1956).

2. Donaldson, W. E., T. J. Sheets and M. D. Jackson, Poultry Sci. 47, 237-243 (1968).

3. Draper, G. I., J. R. Harris, D. A. Greenwood, C. Biddulph, L. E. Harris, F. Mangelson, W. Binns and M. L. Miner, Poultry Sci. 31, 388 (1952).

4. Duncan, D. B., Biometrics 11, 1 (1955).

5. Griffith, M., Proc. 58th Annual Meeting Poultry Sci. Assoc., 38 (1969)

6. Ivey, M. C., R. H. Roberts, H. D. Mann and H. U. Claborn, J. Econ. Entomol. 54, 487 (1961).

7. Liska, B. J., B. F. Langlois, G. C. Mastert and W. J. Stadelman, Poultry Sci. 43, 982 (1964).

8. Naber; E. C. and G. W. Ware, Poultry Sci. 40, 1435 (1961).

9. Reed, J. R., L. E. Deacon, F. Farr and J. R. Couch, Proc. 23rd Texas Nutr. Conf. 226 (1968).

10. Smith, S. I., C. W. Weber and B. L. Reed, Poultry Sci. 49, 233 (1970).

11. Snedecor, G. W., Statistical Methods, Iowa State College Press, Iowa (1957).

12. Stadelman, W. J., Poultry Sci. 43, 273 (1964).

13. Stemp, A. R., B. J. Liska, B. E. Langlois and W. J. Stadelman, Poultry Sci. 43, 273 (1964).

14. Wesley, R. L., A. R. Stemp, B. J. Liska and W. J. Stadelman, Poultry Sci. 45, 321 (1966).

15. Wesley, R. L., A. R. Stemp, R. B. Harrington, B. J. Liska, R. L. Adams and W. J. Stadelman, Poultry Sci. 48, 1269 (1969).