THE EFFECT OF BENZENE HEXACHLORIDE IN POULTRY FEED ON MEAT AND EGG QUALITY.

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SUMMARY.

A commercial form of benzene hexachloride dust (12·5% gamma isomer) and a deodorised form (99% gamma isomer) were each fed to poultry in an all-mash ration at levels equivalent to 5 p.p.m. and 25 p.p.m. of the gamma isomer to study the effect on meat and egg quality.

Groups of 20 cockerels were fed treated mashes from 12 weeks of age. The flesh was found to be tainted within 5 weeks in the group fed commercial BHC at 25 p.p.m. gamma isomer and within 7 weeks in the group fed 5 p.p.m. gamma isomer. No taint was found in groups fed deodorised BHC after 16 weeks' continuous feeding, when the experiment on flesh quality ended.

Groups of 20 pullets were fed treated mashes from 6 months of age. Taint was detected in eggs of the pullets fed mashes treated with commercial BHC after 4 weeks of feeding at the 25 p.p.m. level and after 6 weeks' feeding at the 5 p.p.m. level. In the two groups fed deodorised BHC, at 25 p.p.m. and 5 p.p.m., eggs were tainted 16 and 18 weeks respectively after feeding.

It is concluded that neither commercial BHC nor deodorised BHC should be used to control weevil infestation in grains destined for poultry feeding.

INTRODUCTION.

Excellent results have been obtained in Queensland from the use of benzene hexachloride as a protection against weevil infestation in seed maize and sorghum. In view of the likelihood of the practice being extended to grain stored for stock-feeding purposes, experiments were planned to determine the effect of feeding BHC upon the quality of eggs and flesh of poultry.

The degree of flesh taint caused by BHC has been assessed by several workers as a corollary to investigations of its use for controlling poultry ecto-parasites. Hixson and Muma (1947) showed that the flesh of poultry fed, sprayed, or kept in a house previously sprayed with crude BHC had an objectionable flavour within two weeks of treatment and that the undesirable flavour persisted for 6–10 weeks. Hannken (1950) found that, when a commercial louse powder containing 5 per cent. BHC (15 per cent. gamma isomer) was sprinkled heavily on floor litter and scratch grain was fed in this litter, a high proportion of eggs was tainted 8 weeks after the application. Absence of taint in flesh and eggs was reported by Telford (1947), who applied BHC to perches at a concentration of 1·2 per cent. gamma isomer in fuel oil, and by Milby and Lewatsch (1948), using BHC as an oil emulsion of 1·5 per cent. gamma isomer as a roost paint and as a spray for fowls.

The increasing use of BHC in the United Kingdom for the protection of grain and feeding-stuffs from insect attacks led Black, Getty, Jameson, and Pirie (1950) to investigate the risk of taints in eggs or poultry flesh when small amounts of BHC were fed continuously. A preliminary test suggested that 8 p.p.m. crude BHC (13 per cent. gamma isomer) in a laying ration would taint eggs. In a second experiment the addition of 1 p.p.m. technical grade BHC (90 per cent. gamma isomer), an amount equivalent in gamma isomer content to 8 p.p.m. crude BHC, produced 4·4 per cent. slightly tainted eggs. The results indicated that continuous feeding of 1 p.p.m. technical grade BHC was close to the threshold for producing significant taint. In neither experiment was flesh taint detected even when as much as 84 p.p.m. crude BHC was fed continuously in the ration for 6½ months.

ADDITION OF BHC TO MASHES.

In the experiments reported here, two forms of BHC—a commercial dust (12½ per cent. gamma isomer) and deodorised BHC (99 per cent. gamma isomer)—were added to commercial growing and laying mashes at the rates of 5 p.p.m. and 25 p.p.m. gamma isomer. The commercial dust was added direct to the food, but bran was used as a vehicle for incorporating the deodorised BHC, an acetone solution of the insecticide being sprayed on the bran.

EXPERIMENT I.

Methods.

Five groups each consisting of 10 White Leghorn and 10 Australorp cockerels aged 12 weeks were housed intensively on new sawdust litter and were fed a commercial growing mash composed of wheatmeal, crushed oats, bran, pollard, meatmeal, buttermilk powder and salt and containing synthetic riboflavin and a fish-oil emulsion rich in vitamins A and D_3.

BHC was added to the mash as follows :—

Group 1—No BHC (Control).

Group 2—Commercial BHC equivalent to 5 p.p.m. gamma isomer.

Group 3—Commercial BHC equivalent to 25 p.p.m. gamma isomer.

Group 4—Deodorised BHC equivalent to 5 p.p.m. gamma isomer.

Group 5—Deodorised BHC equivalent to 25 p.p.m. gamma isomer.

For the sake of brevity these groups will be referred to without the "gamma isomer" addendum (e.g., 5 p.p.m. gamma isomer commercial BHC will be referred to as 5 p.p.m. commercial BHC).

Five weeks after feeding commenced, and thereafter at regular intervals, two birds from each group were slaughtered. Each carcase was halved; one half was boiled and tested by a panel of three officers of the Division of Dairying accustomed to grading butter and cream, and the other half was issued for cooking under home conditions.

The method for conducting the laboratory test was as follows. The leg, breast and wing of each half-carcase were boiled until tender and then sampled by the testers, who were unaware of the treatment. A definite taint was recorded only when the individual reports of all three members agreed that tainting was evident.

Results.

A slight off-flavour was first found at 5 weeks in birds fed mashes containing 25 p.p.m. BHC (group 3), and by 11 weeks tainting was so pronounced as to make the flesh inedible (Table 1). Reports on portions of these birds roasted under home conditions indicated slight to strong earthy flavours. Tainting was reported to be most pronounced in the subcutaneous fat.

Table 1.

RESULTS OF LABORATORY AND HOUSEHOLD TESTS OF MEAT OF COCKERELS IN EXPERIMENT I.

Treatment.	Breed.	Assessment of Taint at Stated Periods.													
		5 wk.		7 wk.		11 wk.		13 wk.		16 wk.		19 wk.		24 wk.	
		L	H	L	H	L	H	L	H	L	H	L	H	L	H
Group 1 .. (Control)	A/O	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	W/L	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Group 2 .. (5 p.p.m. commercial BHC)	A/O	N	N	N	N	O	N	O	N	Treatment discontinued after 13 weeks					
	W/L	N	N	N	N	S	N	O	N						
Group 3 .. (25 p.p.m. commercial BHC)	A/O	N*	N	O	N	O	O	**	**	Treatment discontinued after 13 weeks					
	W/L	S	N	O	S	O	**	**	**						
Group 4 .. (5 p.p.m. deodorised BHC)	A/O	N	N	N	N	N*	N	N	N	N	N	N	N	N	N
	W/L	N	N	N*	'N*	N*	N	N	N	N	N	N	N	N	N
Group 5 .. (25 p.p.m. deodorised BHC)	A/O	N	N	N*	N*	N*	N	N	N	N	N	N	N	N	N
	W/L	N	N	N	N	N*	N	N	N	N	N	N	N	N	N

L = Laboratory test.
H = Household test.
N = No detectable taint.
N* = No detectable taint but musty odour.
S = Slight taint evident.
O = Objectionable taint.
A/O = Australorp.
W/L = White Leghorn.
** Not tested at home or not tested in laboratory.

Table 2.

RESIDUAL TAINT IN FLESH OF BIRDS FED FOR 13 WEEKS ON COMMERCIAL BHC.
(KEY AS FOR TABLE 1.)

Previous Treatment.	Breed.	Assessment of Taint at Stated Periods.							
		2 wk.		6 wk.		11 wk.		16 wk.	
		L	H	L	H	L	H	L	H
Group 2	A/O	N	N	N	N	N	N	**	N
(5 p.p.m. commercial BHC)	W/L	N	N	N	N	N	N	**	N
Group 3	A/O	S	N	S	N	S	N	**	S
(25 p.p.m. commercial BHC)	W/L	N	N	S	N	N	N	**	N

At the 5 p.p.m. level of commercial BHC (group 2), off-flavours were not established until 11 weeks after feeding commenced; by 13 weeks the flesh was unpalatable. After 13 weeks, groups 2 and 3 were returned to normal feed. Three weeks later no taint was found in flesh of birds from group 2, but taint persisted in group 3 until at least 16 weeks after feeding of BHC had ceased (Table 2).

Cockerels were fed deodorised BHC mashes continuously for 24 weeks without off-flavours being recorded either by members of the tasting panel or by home consumers, although reports from both sources on a few occasions suggested " earthy " or " musty " odours.

None of the treatments had any visible effect on the health or growth of the birds.

EXPERIMENT II.

Methods.

Five groups each of 22 pullets, consisting of equal numbers of White Leghorns and Australorps which had been in production a few weeks, were used. They were fed an all-mash commercial laying ration to which the two forms of BHC were added as in Experiment I.

Eggs were tested at intervals in the laboratory by the same panel as in Experiment I. The eggs were boiled for 3 minutes and tasted without salt. Only unanimous decisions were counted. It was found that hard-boiling tended to cause masking of any flavours present. No attempt was made to grade large batches of eggs on any occasion, as it was felt that this could cause sensory fatigue to the members of the panel and so lead to inaccuracies.

In addition, all other eggs laid were distributed for normal home consumption and subsequent report on their flavour.

Results.

A report from a home source indicated the presence of taint in eggs from group 3 (25 p.p.m. commercial BHC) 4 weeks after feeding commenced (Table 4). The first panel test held 7 weeks after the experiment commenced substantiated the home report.

Table 3 sets out the percentage of tainted eggs during the 23 weeks of the experiment. Within 8 weeks nearly all eggs from group 3 (25 p.p.m. commercial BHC) were tainted. Slight taints were noted at 12 weeks in group 2 (5 p.p.m. commercial BHC) and the percentage of tainted eggs had increased rapidly by 16 weeks. It will be noted that a home consumer reported taint in eggs from group 2 six weeks after feeding commenced (Table 4). Off-flavours in eggs from pullets in group 5 (25 p.p.m. deodorised BHC) were not detected by the taste panel until after 16 weeks' feeding, but by 20 weeks at least half of these eggs

Table 3.

RESULTS OF LABORATORY TESTS ON EGGS.

Percentage Tainted Eggs—Weeks after Treatment Commenced.		Treatment.					
			Group 1. (Control—No BHC.)	Group 2. (5 p.p.m. Commercial BHC.)	Group 3. (25 p.p.m. Commercial BHC.)	Group 4. (5 p.p.m. Deodorised BHC.)	Group 5. (25 p.p.m. Deodorised BHC.)
7 wk.	No. Tested ..		8	10	10	10	10
	% Tainted ..		0	0	90	0	0
8 wk.	No. Tested ..		8	4	25	3	3
	% Tainted ..		0	0	96	0	0
12 wk.	No. Tested ..		6	7	Treatment dis-continued.	9	9
	% Tainted ..		0	14		0	0
15 wk.	No. Tested ..		6	13		8	6
	% Tainted ..		0	76		0	0
16 wk.	No. Tested ..		6	8		10	11
	% Tainted ..		0	75		0	36
18 wk.	No. Tested ..		4	Treatment dis-continued.		10	17
	% Tainted ..		0			10	29
20 wk.	No. Tested ..		4			9	11
	% Tainted ..		0			55	54
23 wk.	No. Tested ..		4			12	11
	% Tainted ..		0			58	72

Table 4.

RESULTS OF HOUSEHOLD TESTS ON EGGS.

Treatment.	No. of Eggs Tested.	Taint First Reported—Weeks after Commencement.	No. of Eggs Reported Tainted.	Percentage Reported Tainted.
Group 1. (Control–No BHC)	1,198	..	0	0
Group 2. (5 p.p.m. commercial BHC)..	1,081	6	60	5·5
Group 3. 25 p.p.m. commercial BHC)	506	4	51	11·6
Group 4. 5 p.p.m. deodorised BHC) ..	1,023	15	15	1·4
Group 5. (25 p.p.m. deodorised BHC)	1,051	14	38	3·6

Table 5.

PERSISTENCE OF TAINT IN LABORATORY–TESTED EGGS DERIVED FROM COMMERCIAL BHC GROUPS.

			Previous Treatment.	
			Group 2—5 p.p.m. Commercial BHC.	Group 3—25 p.p.m. Commercial BHC.
Percentage Tainted Eggs—Weeks after Treatment Ceased.	2 wk.	No. of Eggs	No Test	10
		% Trainted		50
	4 wk.	No. of Eggs	19	10
		% Tainted	74	10
	6 wk.	No. of Eggs	6	8
		% Tainted	100	0
	8 wk.	No. of Eggs	7	Test Concluded
		% Tainted	57	
	10 wk.	No. of Eggs	10	
		% Tainted	10	

were found to have definite off-flavours. Definite off-flavours were found in eggs from group 4 (5 p.p.m. deodorised BHC) 18 weeks after feeding commenced. The taste panel expressed the opinion that the degree of tainting in eggs from these groups was not nearly as strong as that found in eggs from group 2 (5 p.p.m. commercial BHC).

Table 4 sets out the number of eggs found to be tainted by home consumers. Although the percentages are considerably lower than those obtained from the laboratory tests, it must be borne in mind that the method of cooking could mask the presence and degree of off-flavour. It will be noted also from this table that low percentages of eggs from the deodorised BHC groups were reported as being tainted by home users.

Table 5 shows the frequency of taints in eggs laid by groups 2 and 3 at intervals after the feeding of commercial BHC ceased. Some tainting was still detected in laboratory tests at the close of the experiment, 10 weeks after the feeding of 25 p.p.m. commercial BHC had ceased.

The egg production of each group was recorded for the period of the test, no marked differences in production between groups being found. The health of the birds did not appear to be adversely affected by the various treatments of commercial or deodorised BHC.

DISCUSSION.

The results obtained from the experiments show that commercial BHC when added to either growing or laying mashes at a rate equivalent to 5 p.p.m. or 25 p.p.m. gamma isomer produced definite taints in both eggs and poultry meat.

Black *et al.* (1950) reported absence of taint in flesh of birds fed for $6\frac{1}{2}$ months on a ration containing 84 p.p.m. crude BHC, which approximately equalled the lower level of commercial BHC (5 p.p.m. gamma isomer) used in the experiments reported here. Methods of cooking were similar and the portions tasted were identical. The results obtained through the technique adopted in conducting these tests in the laboratory leave no doubt that the use of commercial BHC at a level equivalent to 5 p.p.m. gamma isomer in poultry feed produces strong and objectionable taints.

Not all cockerels in group 3 (25 p.p.m. gamma isomer) were adversely commented on by home users, although portions from the same carcases tasted under laboratory conditions were found to be objectionable and unpalatable after 7 weeks of feeding (Table 1). It is possible that the method of home cooking, in most cases roasting, tended to mask the presence of taint.

When tainting was definitely established in flesh and eggs from groups fed either level of commercial BHC, treatment was discontinued, and it would appear that the degree of residual tainting and persistence over a period of time is related to the amount of commercial BHC ingested over the test period.

With regard to deodorised BHC (99 per cent. gamma isomer), taints were found in eggs but not in poultry meat, although laboratory and home reports on carcases from groups ingesting the two levels of this form of BHC suggest occasional " earthy " or " musty " odours.

Black *et al.* (1950), using a technical grade of BHC (90 per cent. gamma isomer), also recorded some degree of tainting in eggs when used at a much lower level than the 5 p.p.m. gamma isomer deodorised BHC in this work.

In both experiments and at both levels of commercial and deodorised BHC, laboratory findings on eggs were confirmed by home users' reports.

From these experiments it is concluded that the objectionable flavours encountered in eggs and flesh and resulting from the use of commercial BHC at the rates of 5 p.p.m. and 25 p.p.m. gamma isomer respectively in mashes, and definite taints in eggs associated with the use of deodorised BHC at the same rates, render these preparations totally unsuited for use as insecticides in grain destined for poultry feeding.

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REFERENCES.

BLACK, D. J. G., GETTY, J., JAMESON, H. R., and PIRIE, H. 1950. The effect of continuous ingestion by poultry of benzene hexachloride. Brit. Vet. J. 106 : 386–91.

HANNKEN, P. B. 1950. Experiments with " Gammexane " in the control of lice on poultry and their bearing on the problem of vitamin D intake. Nature 165 : 451.

HIXSON, E., and MUMA, M. H. 1947. Effect of benzene hexachloride on the flavour of poultry meat. Science 106 : 422–3.

MILBY, T. T., and LAWATSCH, M. F. 1948. The effect of benzene hexachloride on the flavour of poultry meat and notes on its use for the control of external parasites. Poult. Sci. 27 : 245–7.

TELFORD, H. S. 1947. Benzene hexachloride to control certain insects affecting domestic animals. J. Econ. Ent. 40 : 918–21.

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