

## Effects of Polychlorinated Biphenyls on Poultry Reproduction

J. Kosutzky, O. Adamec, Eugénia Bobáková  
*Poultry Research Institute, 900-28 Ivanka pri Dunaji, Czechoslovakia*

-Polychlorinated biphenyls /PCBs/ are widely distributed environmental pollutants which may produce diverse pathophysiologic and metabolic effects /VOS 1972, FISHBEIN 1974/. Their lipophilic properties and low metabolic and excretion rates result in cumulative disposition for adipose tissue and egg yolk.

Poultry appear to be very susceptible to the adverse effects of these compounds. Previous works /REHFELD et al.1972. PLATONOW and REINHART 1973/ have indicated that PCBs are stored in body fat, excreted in eggs and caused some decrease in egg production and a drastic reduction in hatchability /BRIGGS and HARRIS 1973. TUMASONIS et al.1973, BRITTON and HUSTON 1973. CECIL et al.1974, SCOTT et al. 1975/. PCBs have been shown to affect enzyme systems that metabolize sex hormones, which ultimately leads to reproductive failure.

It was demonstrated by RISEBROUGH et al./1968/ that PCB induce the activity of hydroxylating enzyme which metabolizes estradiol. PLATONOW and FUNNELL /1971, 1972/ reported antiandrogenic effects in PCB-treated cockerels. NOWICKI and NORMAN /1972/ demonstrated increased metabolic rates of steroid hormones after feeding of PCB in chickens.

Little is known about the influence of these compounds on chickens hatched from exposed hens. The present study was initiated to determine the effects of exposure to relatively small concentrations of PCBs on the performance of hens and to investigate biological effects on estrogen-dependent function in their progeny.

### MATERIALS AND METHODS

Eighty-four pullets /hybrid Shaver-Starcross 288/ five months old, selected as active layers, were leg-

-banded and randomly divided into a control and two experimental groups. Water and egg-laying mash were supplied ad libitum. The egg production of each group was between 80 and 90 %.

Commercially produced PCBs<sup>1/</sup> /Delor 103, Delor 105/, chlorine content 42 % and 54 % were used. Diets containing 5 mg kg<sup>-1</sup> of PCBs were prepared. Delor 103 and Delor 105 were dissolved in acetone and added to small samples of egg laying mash. These feed samples were air dried overnight before mixing with commercial ration to obtain the desired levels of PCB.

The diets were fed for 6 wk. the contaminated diet was then withdrawn and the hens were fed the uncontaminated diet for 9 wk. Two hatches were obtained during PCB feeding /2.-3. and 5.-6. wk./ and two hatches during PCB withdrawal /2.-3. and 8.-9. wk./.

The effects of the above compounds on biological activity of estradiol in F<sub>1</sub> progeny of exposed hens were investigated. One-day-old chickens hatched from eggs of both, the PCB exposed and control hens were divided into three groups from each hatches. Chickens were fed with uncontaminated diet for 14 days. In the course of the last six days the chicks were injected intramuscularly with 0,25 mg of estradiol dipropionate /AGOFOLLIN SPOFA/ and 24-hr later they were killed. As a criterion of estrogen activity, the increase in oviduct weight was used. Shell strength was measured by the method of GAŽO et al./1964/. The results obtained in experiment were analyzed statistically by t-test.

## RESULTS AND DISCUSSION

Effect of dietary PCB on egg production, egg weight and shell quality after 6 weeks of feeding the PCB diet is shown in Table 1.

Following a six-weeks application of PCBs, Delor 103 and Delor 105/ the hens didn't show any significant effects on egg production. Both examined types of PCBs did not alter egg weight, shell weight, shell thickness and shell strength during the experimental period. A slight reduction in hatchability

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1/ Delor 103, Delor 105, trade names for the Czechoslovak products

of fertile eggs was noted. This failure disappeared after first weeks of feeding the PCB-free diet /Table 2/.

T A B L E 1

Effect of dietary PCB on egg production, egg weight and shell quality after 6 weeks of feeding the PCB diet.

Groups	Dietary PCB /mg.kg <sup>-1</sup> /	Egg pro- duc- tion %	Egg weight /g/	Shell weight /g/	Shell thick- ness /μm/	Shell strength /C.U./ <sup>1/</sup>
Control	∅	89	58,7	4,8	316	4,5
Delor 103	5	93	57,8	4,9	317	4,9
Delor 105	5	89	57,9	4,8	312	4,6

1/ Conventional unit

T A B L E 2

Hatchability<sup>1/</sup> of fertile eggs from hens fed PCBs for 6 weeks, followed by 9 weeks of uncontaminated feed.

Groups	Dietary PCB mg.kg <sup>-1</sup>	Hatchability of fertile eggs from hens fed PCB by weeks			Hatchability of fertile eggs from hens after removing contaminated feed by weeks		
		0	3	6	3	6	9
Control	∅	% 87,1	% 86,2	% 81,2	% 88,0	% 88,5	% 82,1
Delor 103	5	89,0	75,2	77,0	89,5	86,9	73,5
Delor 105	5	84,8	79,7	87,2	87,2	85,8	70,1

1/ Each hatch represents a sample of 100-120 eggs

The percentage of fertile eggs of the experimental and control groups indicates that relatively low level of dietary PCB does not interfere with fertilization. Our experiment shows that levels of PCB intake of 0,5 mg/hen/day/ when the consumption of this diet is approximately 100 g/hen/day/ can cause a slight reduction of hatchability but do not have any detrimental effect upon egg production and egg shell quality. These results agree with the findings of BRITTON and HUSTON /1973/, SCOTT et al./1975/ and also with our previous experiments /KOŠUTZKÝ et al. 1976/. Owing to the high cumulation of PCBs and the other lipophilic xenobiotics in egg yolk it was of some interest to observe the effect of these compounds on the progeny of treated hens. For this purpose the examination of the changes of biological activity of exogenous estrogens in chickens hatched from those eggs was used. This method proved to be a sensitive test for the detection of the effect of other organochlorine xenobiotics in chickens /ADAMEC et al. 1975, 1975a/. The survey of the results obtained by the measurement of biological activity of standard estrogen doses expressed as oviduct weight is presented in Table 3.

T A B L E 3

Weight of oviducts in F<sub>1</sub> progeny of chickens in control and experimental groups after repeated estradiol application.

Groups	Period of hatch			
	I.	II.	III.	IV.
	O v i d u c t	w e i g h t		/Mean $\pm$ SD/
	/g/	/g/	/g/	/g/
Control	0,79 $\pm$ 0,13	0,81 $\pm$ 0,19	0,80 $\pm$ 0,21	0,81 $\pm$ 0,17
Delor 103	xx	x		
Delor 105	0,50 $\pm$ 0,09	0,59 $\pm$ 0,38	0,79 $\pm$ 0,27	0,77 $\pm$ 0,13
	xx	xx	xx	
	0,46 $\pm$ 0,07	0,53 $\pm$ 0,13	0,57 $\pm$ 0,09	0,72 $\pm$ 0,19

PCBs /Delor 103, Delor 105/ were applied to hens during 6 weeks at dose 5 mg.kg<sup>-1</sup> of feed.

Period of hatch; I. 3 weeks of PCB application  
 II. 6 weeks of PCB application  
 III. 3 weeks after removing of contaminated feed  
 IV. 9 weeks after removing of contaminated feed

<sup>x</sup>P < 0,05, <sup>xx</sup>P < 0,01

In control groups the stimulative effect of the standard dose of estrogens expressed as oviduct weight was approximately at the same level /0,79 - 0,81 g/ during the whole experimental period. Chickens hatched from hens receiving PCB have shown highly significant reduction of oviduct stimulation. It is most apparent in the case of Delor 105. After removing of PCBs from the feed the biological response of oviducts on exogenous estrogen was restored. The progeny hatched from eggs collected 3 weeks after removing of Delor 103 from feed and 9 weeks in respect of Delor 105 didn't show any substantial changes in oviduct weight compared to control.

A significant decrease in biological effectiveness of estradiol in chickens hatched from exposed hens has demonstrated that relatively low doses of PCBs in diets could affect the metabolic rates of exogenous estrogen in the F<sub>1</sub> progeny. Lower activity of injected hormones in progeny of exposed hens is probably due to the induction of liver microsomal drug-metabolizing enzyme system. Further studies are required to confirm the above hypothesis. Under the used experimental conditions it is not possible to make any direct conclusion concerning the metabolism of endogenous steroids, however, it seems that the hormonal status of exposed bird may be affected. In this respect, the findings of PLATONOW et al. /1972, 1976/ are very interesting. They reported on significant biochemical alterations of gonadal hormones in mammals and their results indicate that PCBs have a deleterious effect upon metabolism of endogenous steroids. It is necessary to respect the differences in the reproduction of birds and mammals. The development of birds in ovo is isolated from any maternal factor /placental barriers, transport factors, maternal drug-metabolizing capacity/, and it is closely attached with the inside environment of the egg. There is no doubt that the presence of PCB in the developing egg can direct affect not only embryonic development but also the metabolism of chickens in early weeks after hatching.

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