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Body Temperatures and Weights in Rats during Daily Administration of Closely Controlled Doses of Polychlorinated Biphenyls

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Polychlorinated biphenyls constitute a class of chlorinated aromatic compounds of industrial usage which are environmental hazards because of their chemical and biological stability (HUTZINGER et al. 1974). Humans have also been exposed to PCBs through accidental contamination of foodstuffs (KIRSATSUNE et al. 1972). Patterns of PCBs levels have been demonstrated in human adipose tissue and blood (MASUDA et al. 1974). Although several investigations have reported the effects of PCBs upon basic biological parameters(BRUCKNER et al. 1973, KOMIVES 1979, SAUNDERS et al. 1977), little is known of body temperature change, its time course, or its relation to changes in body weight. The present study was conducted to determine the effect of different doses of PCBs upon body temperature and body weight when administered daily in carefully controlled oral doses.

MATERIALS AND METHODS

Male, Sprague-Dawley rats, 180-200 g body weight were separated into three groups of 4 animals each. Aroclor 1254, dissolved in mineral oil, was administered daily by oral intubation to the first two groups. The dose levels of PCBs were 0.05 g/kg body weight and 0.25 g/kg body weight respectively in these groups. The remaining group, constituting the control animals, was treated the same as the experimental groups except for the administration of PCBs. The animals were housed individually in polypropylene cages with ample bedding material. Each animal received Purina Laboratory Chow ad libitum. Body weights and temperatures were taken daily. Only on regularly recurring cleaning and maintenance days were data gathered for each particular group. The weighings were done with an Ohaus triple beam animal balance and the rectal temperatures were taken with a YSI electronic thermometer using a series 400 small animal thermistor probe.

RESULTS AND DISCUSSION

Rats treated with PCBs at both low and high doses

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demonstrated patterns of decreasing weight gains. In rats treated at a dose of 0.05 g/kg body weight there remained a gain of weight at the rate of 1.12 g/day. Although this pattern of weight gain commenced immediately, the point of 50% of the eventual weight gain was reached after only five days. This is a probable indication that the effects of the repeated administrations of PCBs are overtaking the normal rate of weight gain and slowing it.

TABLE 1

Effect of daily doses of Aroclor 1254 upon body weight (in grams) in male Sprague Dawley rats. The data are expressed as the means in grams ±SE of 4 rats as weighed daily.

Day	Control		PCB at 0.05 g/kg		PCB at 0.25 g/kg	
1	199.5	±SE 7.5	191.2	±SE 13.4	182.5	±Se 11.95
2	203.0	6.5	193.7	26.3	184.5	19.4
3	214.7	5.2	203.2	26.7	188.2	23.9
4	209.0	16.0	197.5	25.2	177.0	27.2
5	214.7	26.0	199.2	30.1	180.0	18.3
6	226.2	20.3	203.5	28.8	*172.7	14.9
7	--	--	--	--	--	--
8	238.0	17.5	208.2	30.0	*165.0	13.2
9	248.0	13.6	208.7	34.1	*160.2	17.6
10	255.2	14.7	209.2	36.7	*154.7	13.6
11	260.0	16.3	209.0	38.3	*142.3	15.2
12	264.2	17.1	210.7	38.4	*136.6	13.1
13	268.7	17.2	211.0	40.4	*138.5	16.0
14	--	--	--	--	--	--
15	275.5	15.6	216.5	46.2	*135.5	13.2
16	278.7	14.7	214.5	41.2	*134.5	10.4
17	282.5	13.8	213.5	46.5	*134.0	8.2
18	286.5	14.2	212.2	45.4	*136.0	--
19	291.5	13.1	214.2	44.8	*129.0	--
20	299.0	11.2	213.7	45.1	--	--
21	--	--	--	--	--	--

* Significant difference from control at the probability < 0.05

In rats treated at a dose of 0.25 g/kg body weight there was an actual loss of weight at the rate of 2.82 g/day over the nineteen days. This weight loss pattern began after only four days of PCBs administration. The point of 50% of the eventual weight loss was reached after nine days. The control animals by contrast showed the weight gain pattern of normal growth. These animals increased their weight at the rate of 5.02 g/day. The point of 50% of the eventual weight gain was reached after eight days. This pattern

of normal growth began immediately and continued constantly, if at a slightly diminished rate, throughout the experiment. We believe that this slight decrease might be due to the normal approach to a mature weight range during the experiment.

TABLE 2

Effect of daily doses of Aroclor 1254 upon rectal temperature T (°C) in male Sprague Dawley rats. The data are expressed as the means in °C ± SE of 4 rats as taken daily

Day	Control		PCB at 0.05 g/kg		PCB at 0.25 g/kg	
1	33°C	±SE 0.0	33.5	± 0.8	*31.6	±SE 0.2
2	32.3	0.2	31.8	0.6	31.0	0.6
3	32.6	0.2	*31.8	0.1	*30.5	0.6
4	33.6	0.2	*31.5	0.3	*30.3	0.5
5	31.2	0.7	31.5	0.3	30.3	0.5
6	31.7	0.1	*31.0	0.2	*28.6	0.2
7	--	--	--	--	--	--
8	31.3	0.2	31.1	0.2	*29.2	0.3
9	30.8	0.2	*30.3	0.1	*28.6	0.3
10	31.2	0.1	30.5	0.0	*28.1	0.4
11	30.6	0.1	*29.5	0.3	*28.0	0.3
12	30.5	0.5	29.3	0.5	*27.3	0.3
13	30.1	0.4	28.8	0.6	*27.2	0.1
14	--	--	--	--	--	--
15	30.3	0.1	28.7	0.7	*27.2	0.1
16	30.2	0.4	28.5	1.2	*26.7	0.1
17	30.1	0.4	28.6	1.0	*27.0	--
18	32.2	0.1	28.7	1.6	*27.5	--
19	30.1	0.1	30.0	0.2	*26.0	--
20	31.5	0.6	*29.6	0.5	--	--
21	--	--	--	--	--	--

*Significant difference from control at the probability < 0.05

Close patterns of weight change which are similar have been observed (KOMIVES 1979). However in that case the animals given the lower dose of 0.05 g/kg PCBs showed a slight decrease in body weights. Also the control group of animals in that case grew at a somewhat slower rate. These differences might be due to age difference of the animals; the animals in this experiment are younger and might be expected to show a more vigorous rate of growth less easily affected by PCBs exposure. In distinctly differing experiments it has been found that there is a decrease in body weight (BUCKNER et al.

1973) and that there is no change in the body weights (ALLEN et al. 1976). Calculations of growth rate, initiation time, and time of 50% of total effect seem to offer useful measures of the effect of different doses of PCBs upon animals at different ages. These results are shown in table 1.

Rats treated with the same doses of PCBs also demonstrated patterns of decreasing body temperatures. In rats treated at a dose of 0.05 g/kg body weight there was a decrease in rectal temperature at the rate of 0.20°C/day. This pattern of temperature decrease began immediately. The point of 50% of the eventual temperature decrease was reached after two days. In rats treated at a dose of 0.25 g/kg body weight there was a decrease in rectal temperature at the rate of 0.30°C/day. This pattern of temperature decrease began immediately. The point of 50% of the eventual temperature decrease was reached after eight days. This indicates that the fall in temperature was rather linear in time with perhaps a slight decrease in the rate of fall during the later days of the experiment. This suggests a possible intervention at that time to maintain the body temperature at least within the range of active regulation. The control animals by contrast showed a constant rectal temperature regulated within a normal range.

The authors consider these temperatures decreases of notable significance. They are reliable, regular and early in their onset. They distinguish themselves from more usual conditions of temperature increase which might occur alone or coupled with a weight loss. They suggest the direct involvement of energy mobilizing mechanisms. It is known that PCBs are capable of inhibiting ATPase activity (KOCH et al. 1972) and shifting the cytoplasmic redox state of the liver toward a highly oxidized condition (MEHLMAN 1974). In addition the adrenal glands are closely associated with temperature regulation and it is these glands which were noted to have been significantly enlarged by PCBs ingestion (SANDERS et al. 1977). Further work is necessary to determine the underlying mechanisms.

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