

BIOACCUMULATION OF PCB'S (AROCOR 1242) AND ITS EFFECTS  
ON THE ELECTROCARDIOGRAM OF THE EEL, ANGUILLA ANGUILLA L.

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ABSTRACT

Fish exposed to 200 and 300 µg/L PCB'S (Aroclor 1242) for 24hr demonstrates negative chronotropic effect; increase in the duration of segments and intervals as well as the waves amplitude. A tachycardia was also observed during the experiments. On the other hand, bioaccumulation of PCB's in the eel fish was depended upon the concentration and time of exposure. It has been confirmed that, at 0 time, the level of PCB's in the liver was significantly higher than that observed in other tissues. The descending order of PCB's accumulated after 24hr was found in the gills; blood; kidney; liver and muscles, respectively.

INTRODUCTION

The polychlorinated biphenyl mixtures (PCB's) are synthetic compounds that have been used for various industrial purposes. These compounds are extremely stable, not hydrolyzed by water, acid or alkali and are able to withstand high temperature without disintegrating. As expected from these properties, the PCB's undergo extremely slow biodegradation. The widespread occurrence of PCB's has been well documented for a number of marine organisms (Risebrough et al. 1968; Jensen et al. 1969; Zitko, 1971; Stalling and Mayer, 1972; Hansen et al. 1974). However, the actual mode of action and ecological effects of these compounds are poorly understood (Walker, 1976). Therefore, there is a need for further study for the information on the physiological effects of PCB's to aquatic organisms. The aim of this work is to assess bioaccumulation of PCB's (Aroclor 1242) and its effects on the bioelectrical activity of the eel heart.

MATERIALS AND METHODS

Specimens of the eel, Anguilla anguilla L. weighing  $210 \pm 73.3$  gm were brought to the laboratory and acclimated for one week under appropriate experimental conditions. Fish electrocardiogram (ECG) were obtained by the method of Labat (1966) using a single channel CGK-301 electrocardiographic apparatus and CMK-405 cardiomonitor. According to this method, the exploring electrodes were inserted in the abdominal surface over the position of the heart

transversely to the longitudinal axis of the body and tangentially to the pericardial sack. The earthed electrode was usually placed on the tail of the fish. Recording of the ECG began after returning the fish with the electrodes to normal condition at paper speed 25 mm/sec. The heart rate per minute was calculated directly from the obtained ECG. Fish were individually subjected to 200 and 300 µg/L PCB's (Aroclor 1242) in a glass aquarium containing 20 liters of aerated dechlorinated tapwater and changes in the ECG were recorded. The values of temperature, dissolved oxygen and pH during the experiments were  $18.0 \pm 0.5^{\circ}\text{C}$ ;  $8.6 \pm 0.6$  mg/l and  $7.5 \pm 0.3$ , respectively.

Bioaccumulation of PCB's in the liver, gills, muscles, blood and kidney were also determined. The tissues were blended with anhydrous sodium sulphate (50 gm) and n-hexane (150 ml) for 10 minutes. The extracts were concentrated to 10 ml. 5 ml were used to determine fat tissue percentage. The other were concentrated to 3 ml and purified with 7 %  $\text{SO}_3$  in  $\text{H}_2\text{SO}_4$  and with 5 % KOH in 96 %  $\text{C}_2\text{H}_5\text{OH}$ . The content of PCB's in different organs was determined according to the method of gas chromatography using Chromatron GCHF 18.3 apparatus. Statistical test (t-test) was made to evaluate the significant changes caused by PCB's.

#### RESULTS AND DISCUSSION

Changes in the bioelectrical activity of the eel heart exposed to different concentrations of PCB's (Aroclor 1242) are shown in Table (1). It is evident that, at 0 time the ECG appears normal and the heart rate was 49.70 beats/min. Fish exposed to 200 and 300 µg/L PCB's for 24hr resulted in decreasing of the heart rate to 38.80 and 40.79 beats/min., respectively which can be explained as being caused by the depressing action of the vagal nerve (Siato, 1973). This is in agreement with the results of Bruckner et al. (1973) who found that PCB's had a depressing action on the Central Nervous System. A tachycardia was also recorded after 2hr of exposure to different concentrations of PCB's (68.69, 53.66 beats/min.) respectively. This may be due to the inhibition of the parasympathetic fiber and reduction in the vagal tone. On the other hand, changes in the heart rate was found to be associated with an increase in the duration of S-T, T-P segments and P-Q, Q-T intervals from 0.41, 0.31, 0.21, 0.74 sec. to 0.42, 0.52, 0.28, 0.98 sec. at 200 µg/L and to 0.47, 0.46, 0.25, 0.92 sec. at 300 µg/L, respectively.

In this study, fish exposed to different concentrations of PCB's exhibited an increase in the waves amplitude. As shown in Table (1), the amplitude of the QRS, T, P waves increased from 2.70, 0.61, 0.03 mV. to 3.79, 1.18, 0.30 mV, at 200 µg/L and to 3.77, 0.97, 0.26 mV. at 300 µg/L, respectively. This phenomenon reflects a disturbance in the

Table 1.  
Changes in the bioelectrical activity of eel exposed 200 and  
300 ug/l PCB's (Aroclor 1242).

Time hr.	Dose ug/l	QRS		Waves "mV."		P	Segments "sec."		Intervals "sec"		Heart rate beats/min.
		QRS	ORS	T	I		S-T	T-P	P-Q	Q-T	
0	00	2.70 ± 0.55		0.61 ± 0.52		0.09 ± 0.02	0.41 ± 0.06	0.31 ± 0.05	0.21 ± 0.05	0.74 ± 0.14	49.70 ± 8.46
1	200	2.80 ± 0.81		0.66 ± 0.75		0.50 ± 0.19	0.42 ± 0.23	0.37 ± 0.04	0.26 ± 0.03	0.92 ± 0.41	43.63 ± 14.67
	300	3.44 ± 1.17		0.67 ± 0.61		0.18 ± 0.07	0.52 ± 0.03	0.71 ± 0.61	0.28 ± 0.03	0.96 ± 0.04	33.53 ± 12.87
2	200	1.16 ± 0.46		0.60 ± 0.58		0.30 ± 0.14	0.30 ± 0.14	0.20 ± 0.09	0.18 ± 0.02	0.62 ± 0.25	68.69 ± 16.47
	300	2.51 ± 0.60		0.42 ± 0.28		0.12 ± 0.07	0.32 ± 0.05	0.25 ± 0.04	0.22 ± 0.05	0.67 ± 0.02	53.66 ± 9.33
6	200	2.96 ± 0.70		1.16 ± 1.58		0.16 ± 0.09	0.35 ± 0.18	0.26 ± 0.08	0.24 ± 0.02	0.78 ± 0.61	57.99 ± 18.50
	300	3.45 ± 1.43		0.66 ± 0.37		0.26 ± 0.14	0.46 ± 0.06	0.38 ± 0.08	0.24 ± 0.04	0.86 ± 0.05	42.49 ± 4.20
24	200	3.79 ± 1.24		1.18 ± 0.80		0.30 ± 0.12	0.42 ± 0.10	0.52 ± 0.29	0.28 ± 0.03	0.98 ± 0.38	38.80 ± 9.78
	300	3.77 ± 1.18		0.97 ± 0.40		0.26 ± 0.12	0.47 ± 0.06	0.46 ± 0.12	0.25 ± 0.03	0.92 ± 0.03	40.79 ± 1.17

Average of three observations.

electrical potential of the cardiac muscle membrane. It is likely that the positive inotropic effect in the eel heart showed during the experiments resulted from changes in  $Ca^{2+}$  metabolism (Andrew, 1989). Statistically, changes in the bioelectrical activity was significant ( $P > 0.05$ ) which shows that these concentrations of PCB's had a limited effects on the eel heart.

Bioaccumulation of PCB's (Aroclor 1242) in the eel fish at different concentrations and time of exposure are shown in Fig. (1). The basic finding are, at 0 time the liver tissue generally had concentration of PCB's 2 to 4 times higher than the levels observed, in the other tissues analyzed, with statistically significant different ( $P < 0.05$ ). This is probably due to its high lipid content. The obtained results are in agreement with Stalling and Mayer (1972) and McDermott et al. (1976). As shown in Fig. (1), the highest concentrations of PCB's accumulated in the eel fish after 24hr of exposure to 200 and 300  $\mu\text{g/L}$  were found in the gills (11.7 ; 12.1  $\mu\text{g/kg}$ ), respectively. Suteau et al. (1987) reported that the level of  $^{14}\text{C}$  activity measures in gills appeared to be related to the PCB's water concentration. The blood concentration of PCB's showed also a rapid initial distributive phase and slow terminal elimination phase with average concentration of 7.9 and 10.7  $\mu\text{g/kg}$ . The obtained results are in accordance with Kulkarni and Karara (1990). However, a significant concentrations ( $P < 0.05$ ) of PCB's was also found in the kidney (8.3 ; 9.2  $\mu\text{g/kg}$ ) and in the liver (7.2 ; 7.9  $\mu\text{g/kg}$ ) of the eel fish. In this study, the lowest concentration of PCB's was found in the muscles (4.3 ; 7.1  $\mu\text{g/kg}$ ). This is in agreement with the results of Hansen (1976). From the above results, it is clear that fish exposed to different concentrations of PCB's can accumulate it directly from water and leads to much higher accumulation in the tissues with highly significant differences ( $P < 0.05$ ). Further, the mean values of PCB's accumulated in the eel fish were correlated to its concentration in the water and the duration of exposure.

#### CONCLUSIONS

1. PCB's had a limited effects on the bioelectrical activity of the eel heart.
2. At 0 time, the liver appeared to function as the major site of PCB's storage.
3. The values of PCB's accumulated depended upon the concentration and time of exposure.
4. The highest concentration of PCB's accumulated in the eel fish after 24hr was found to be in the gills followed by the blood, kidney, liver and muscles.

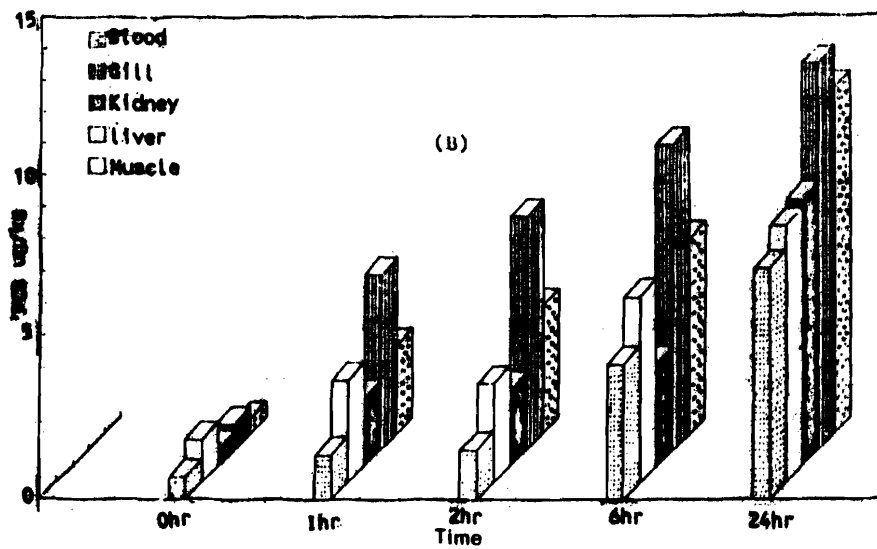
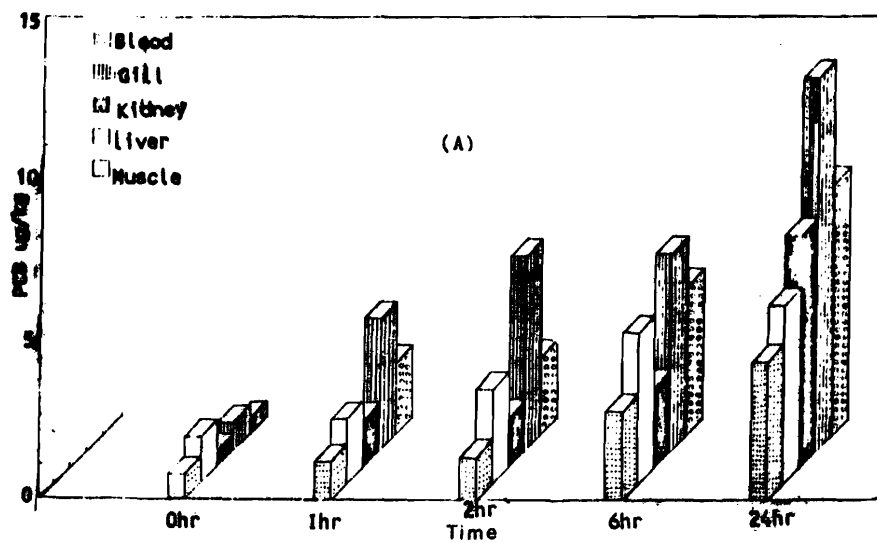


Fig. 1

Bioaccumulation of PCB's (Aroclor 1242) in different organs of eel exposed to: A. 200  $\mu\text{g/L}$ . B. 300  $\mu\text{g/L}$ .

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