

EFFECTS OF DIAZEPAM ON SWIMMING PERFORMANCE, BODY WEIGHT AND SOME HEMATOLOGICAL PARAMETERS OF CARP, CYPRINUS CARPIO.

BY

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ABSTRACT

The effects of diazepam on swimming performance, body weight and some hematological parameters of carp have been investigated. Fish exposed to different concentrations of diazepam resulted in decreasing of the mean swimming speeds significantly. An improvement in swimming time, fish travel and physical effort were observed after exposure to 0.05 and 0.10 mg/l diazepam. In contrast, a rise of diazepam concentration to 0.50 mg/l resulted in the decrease of swimming performance. It was found that diazepam at concentrations of 0.05 and 0.10 mg/l had a good effect on the coefficients connected with gas exchange as well as the parameters connected with acid-base and ionic equilibrium. An increase in the levels of cholesterol and fibrinogen were also detected after diazepam treatment while the level of glucose was decreased. A significant increase in body weight was also observed. The possibilities of the pharmacological effects of diazepam are discussed.

INTRODUCTION

The intensification of fish culture and the consequent rearing of fish in man-made environment has resulted in the exposure of fish to a number of stresses. The problem of stress, in relation to fish and fisheries biology, have received more attention during the past decade (Pickering, 1981). Diazepam "7- chloro-1,3 -hydro-1- methyl-5-phenyl-2-H-1,4 benzodiazepine, -2-one", was found to have strong sedative, muscle relaxing, taming and anticonvulsant properties (Randall *et al.*, 1961; Bozza-Marrubini and Selenati, 1973; Wagner and Zett, 1985; Zherdev *et al.*, 1991). Several authors recommended the use of diazepam in animal breeding, transport and in veterinary practice (Fitko and Troszynski, 1974; Fitko, *et al.*, 1975; Wegrzynowicz *et al.*, 1981;

Mourad, 1992). The main objective of this study is to assess the effects of diazepam on swimming performance, body weight gain and some hematological parameters of the carp (*Cyprinus carpio*).

MATERIALS & METHODS

The experiments were carried out on carp, *Cyprinus carpio* of 451.0 ± 20.1 gm average body weight in the conditions of a productive cycle of the industrial bin culture in cooling water of Dolna Odra power station, Szczecin, Poland. The values of water temperature, dissolved oxygen content and pH during the experiments were $26.2 \pm 3.1^\circ\text{C}$, 9.3 ± 0.7 mg/l and 7.9 ± 0.3 , respectively. Swimming performance of carp after exposure to different concentrations of diazepam (0.05, 0.10 and 0.50 mg/l) was measured using the method of Wegrzynowicz and Klyszejko (1972). To study the effects of diazepam on body weight and some hematological parameters, the fish were exposed daily to 0.05 and 0.10 mg/l diazepam in a granular feed for 105 days of fattening. Blood was collected directly from the caudal artery into heparinized capillary tubes. The following hematological parameters were taken into account: The number of erythrocytes (RBC) count using hemocytometer, hemoglobin content (Hb) using photohemoglobinometer, hematocrit value (Hct) using standard technique of centrifugation to constant cell volume, partial pressure of oxygen (PO_2), partial pressure of carbon dioxide (PCO_2) and blood carbon dioxide (TCO_2) using radiometer microelectrode system, bicarbonate (HCO_3^-) was determined titrimetrically, glucose, cholesterol and fibrinogen using standard kit's. Plasma ion concentrations of sodium (Na^+), potassium (K^+) and calcium (Ca^{++}) were measured by atomic absorption spectroscopy. The body weight was recorded as well. Data were statistically analyzed using a Student's t-test.

RESULTS & DISCUSSION

As shown in (Fig. 1), control fish had mean swimming speeds of 0.141 m/sec.; swimming time of 7537.5 sec.; fish travel of 1073.1 m and physical effort of 85.2 Kgm/Kg. Fish exposed to different concentrations of diazepam resulted in decreasing of the mean swimming speeds significantly ($P < 0.05$) to 0.127, 0.125, 0.120 m/sec., respectively. The decrease in swimming speed can be explained as being caused by the relaxing properties of the drug. It was suggested that, the relaxing properties of diazepam resulted from a reduction in central noradrenergic neurotransmission in the brain (Taylor and Laverty, 1973) and an increase in the level of acetylcholine (Consolo *et al.*, 1972).

On the other hand, an improvement in fish performance as measured by swimming time, fish travel, physical effort was observed after exposure the carp to 0.05, 0.10 mg/l diazepam (Fig. 1). These results are in agreement with Metthew et al., (1986) who reported that diazepam improved performance over the control value. On the contrary, an increase of diazepam concentration to 0.50 mg/l exhibited a significant ($P < 0.05$) decrease in fish performance e.g. the performance parameters were 68-73 % of the control values (Fig. 1).

The decline in fish swimming performance showed in this study is thought to be related to a reduction in their respiratory efficiency (Goodman and Gilman, 1970, Forster et al., 1980, Gross et al., 1982) and to a depression in the mechanism function of muscle contraction (Koga et al., 1992). Julien (1988), reported also that motor performance are significantly impaired because a drug-induce "brain-syndrome" occurred in the manner similar to that seen in individuals taking barbiturates. It has become clear that, the optimum concentration for increasing fish swimming performance was 0.05 mg/l diazepam.

As shown in Fig. (2), control fish had an increase in body weight to about 123.1 % of the original weight after 105 days of experiment, while the increase in body weight for the fish exposed daily to 0.05 and 0.10 mg/l diazepam were 159.3 % and 187.3 % of the original weight, respectively. These changes were statistically significant ($P < 0.05$). The significant increase in body weight is thought to be related to an increase in food intake (Tomohiro et al., 1988; Yukie et al., 1988; Foltin et al., 1989), stimulation of growth hormone secretion (Huupponen et al., 1986) and enhanced the gastric emptying rate (Schurizek et al., 1988). From the above, it is evident that diazepam stimulated considerably the growth of carp. This is in accordance with the results of Zsuzsa et al., (1985).

Table (1), represents changes in some hematological parameters of carp after 105 days of exposure to 0.05 and 0.10 mg/l diazepam. The main findings are; diazepam improved the parameters of gas exchange e.g. the number of erythrocytes, hemoglobin content and hematocrit values were increased significantly ($P < 0.05$) to 10-14 % of the control values. These changes were accompanied by consistent increase in PO_2 (29-32 %) and a decrease in PCO_2 (15-17 %). No effect of diazepam on the level of TCO_2 was observed. This is in agreement with the results of Ranloev and Nielsen (1987). Also, a significant ($P < 0.05$) increase in the levels of fibrinogen (28-34 %) and bicarbonates (13 %) were observed after diazepam treatment. This is in accordance with the findings of Yamagish et al., (1986). On the contrary, a significant ($P < 0.05$) decrease in the level of glucose (26-28 %) was recorded at the end of the experiment.

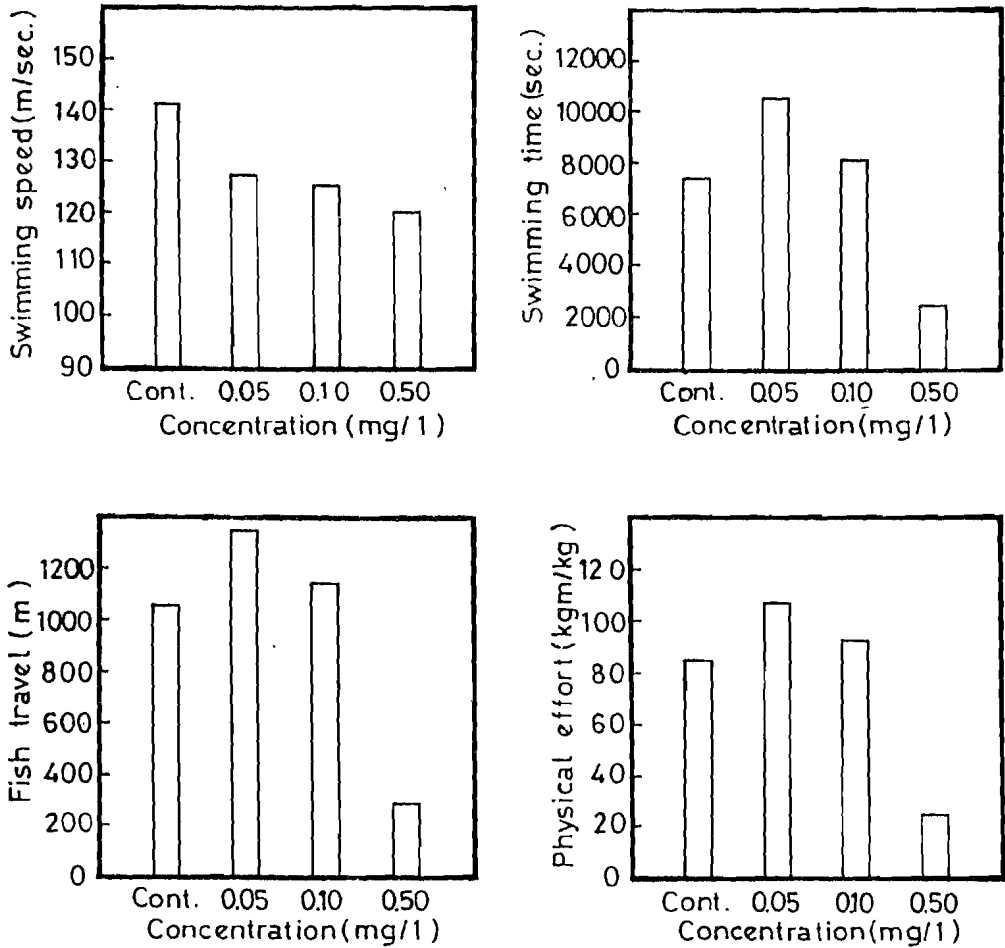


Figure 1: Changes in swimming performance of carp after exposure to different concentrations of diazepam.

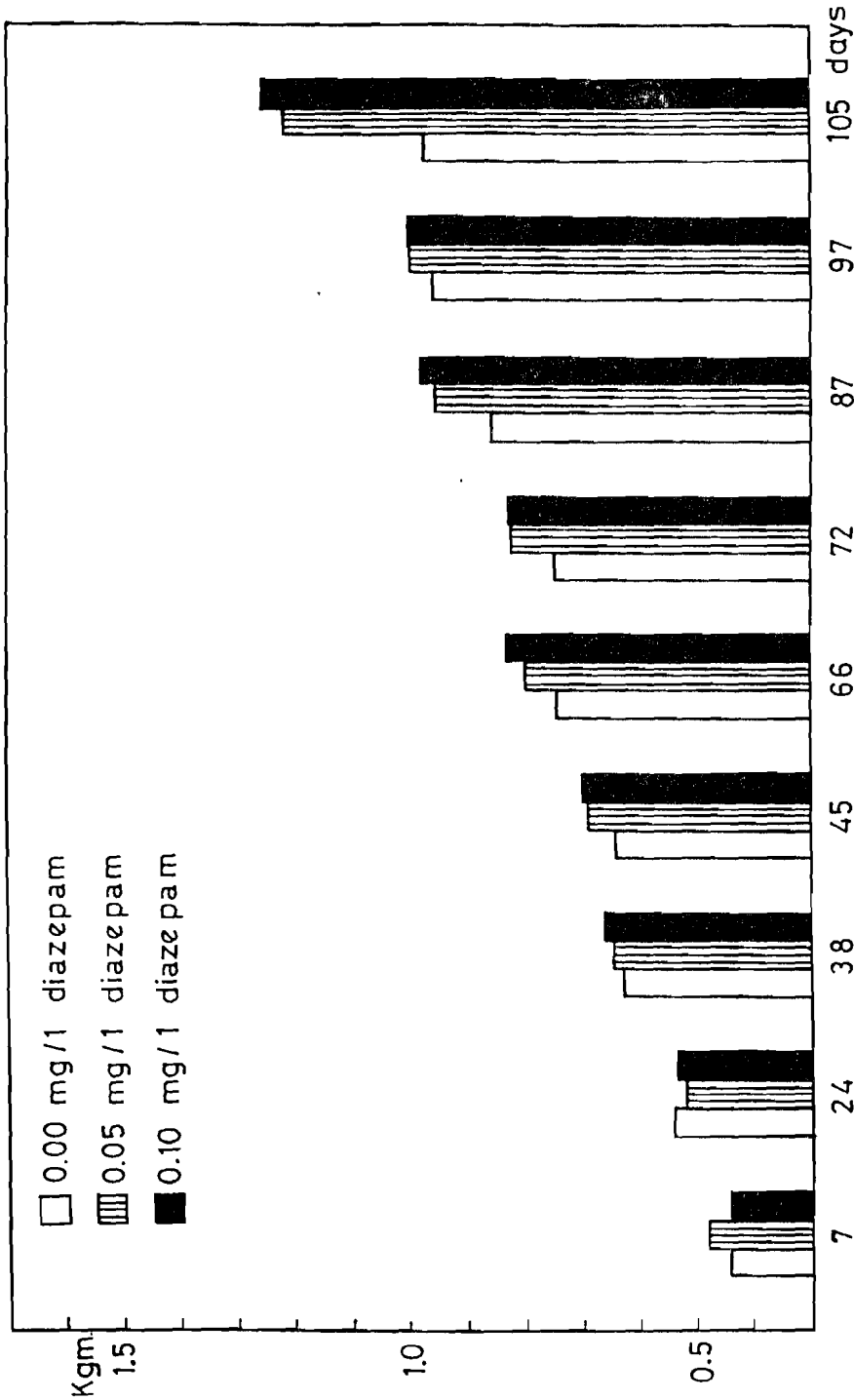


Figure 2: Changes in body weight of carp exposed to different concentrations of diazepam.

Table (1): Changes in the hematological parameters of carp after 105 days of exposure to different concentrations of diazepam.

Parameter	Group	(Group I = 100 %)						P < 0.05
		70	80	90	100	110	120	
Erythrocytes	II					111		+
	III					112		+
Hemoglobin	II					110		+
	III					113		+
Hematocrit	II					113		+
	III					114		+
P _{O₂}	II						129	+
	III						132	+
P _{CO₂}	II			85				+
	III			83				+
T _{CO₂}	II					105		-
	III					105		-
HCO ₃ ⁻	II					113		+
	III					113		+
Glucose	II		72					+
	III		74					+
Cholesterol	II					114		+
	III					103		-
Fibrinogen	II						128	+
	III						134	+
Na ⁺	II				97			-
	III				97			-
K ⁺	II			83				+
	III			80				+
Ca ⁺⁺	II				100			-
	III				100			-

Group I : Control fish 100 %.

Group II : Fish exposed daily to 0.05 mg/l diazepam.

Group III : Fish exposed daily to 0.10 mg/l diazepam.

P < 0.05 : Significant difference at 5 % level.

This hypoglycemic response may be due to the inhibition of the release of some hyperglycemic factors or to the peripheral utilization of insulin and glucose (Cuparencu *et al.*, 1988). The obtained results are in accordance with Horak *et al.*, (1987). As far as cholesterol was concerned, a significant ($P < 0.05$) increase was shown only in the group given 0.05 mg/l diazepam (14 % of the control value). This is in disagreement with Cuparencu *et al.*, (1985), who found that diazepam inhibited cholesterol biosynthesis. The changes in ionic concentrations (Na^+ ; Ca^{2+}) were insignificant except for K^+ concentrations which decreased significantly ($P < 0.05$). This may be resulted from a decreasing of the membrane potential (Wagner and Zett, 1985).

CONCLUSIONS

1. Diazepam at concentrations of 0.05; 0.10 mg/l improved swimming performance over control values while performance at concentration of 0.50 mg/l was impaired significantly.
2. Diazepam stimulated considerably the growth of carp.
3. Diazepam had a good effects on the parameters connected with gas exchange as well as the coefficients connected with acid-base and ionic equilibrium.
4. Diazepam increased the levels of cholesterol and fibrinogen and caused hypoglycemic response.
5. It is recommended for use in fisheries work.

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