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Physiology

INFLUENCE OF THE DBS (DETERLON) AND TBS (MARLON) TYPE DETERGENTS ON THE BREAM *ABRAMIS BRAMA* (L.) UNDER THE APPLIED LOAD OF THE GENERAL PHYSICAL EFFORT

WPŁYW DETERGENTÓW TYPU DBS (DETERLON) I TBS (MARLON) NA LESZCZA *ABRAMIS BRAMA* (L.) OBCIĄŻONEGO OGÓLNYM WYSIŁKIEM FIZYCZNYM

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The influence of the DBS (Deterlon) and TBS (Marlon) type detergents concentration in water on the adaptability to the physical effort of the bream (*Abramis brama* L.) in the aquarium conditions was investigated using our own method for application of the general physical effort to fishes.

INTRODUCTION

Detergents (the mixture of surface active substances, mineral and organic elements) belong to the increasing together with the industry development, group of the chemical polluters of the water habitat.

The presence of detergents in water accelerates the corrosive action, impedes the filtering, sedimentation and coagulation processes, decreases the saturation of water with oxygen and also deteriorates the taste properties of water (Chojnacki, 1970).

Of the particular importance is the influence of the detergents on the vital processes of the water organisms: they hinder the sprawn insemination process and cause injury to the gill epithelium (Mann et al., 1961), they decrease the survival rate of the fry (Trzebiatowski, 1973), they act toxically upon the invertebrate water fauna (Mann, 1955; 1957), as well as the water flora (Sierp et al., 1954).

The degree of the toxicity of the detergents depends on their chemical properties and also on their concentration in the water habitat.

Depending on the type of the main element (the surface active substance) detergents are divided into ionproductive (anion and cation) and ionnonproductive – the latter ones are not subject to the electrolytic dissociation (Chojnacki, 1970).

It was ascertained that, the most harmful effect upon the biological processes in water are the anion and nonionic detergents (Sierp et al. 1954; Chojnacki, 1961), so called the hard ones, which are subject to the biological degradation to a small extent only. The less harmful ones, so called "soft" – are easily decomposed in the water habitat.

The aim of the present work was to investigate the influence of the widespread in Poland detergents like Deterlon ("soft") and Marlon ("hard"), the components of the municipal und industrial sewage, upon the adaptability to the general physical effort of the bream under the applied load of a given work.

MATERIALS AND METHODS

The investigation was carried out in January, 1973 upon 39 breams weighing 170–570 g, originating from the Dąbie Lake, after having adapted them (for about a fortnight) in the aquarium conditions.

The experiments were carried out in the 500 litre capacity aquaria filled with the tap water additionally aired, at the temperature of 13.5–15.0°C with the pH ranging from 7.6 to 8.5.

Our own method for application of physical effort to fish was used (Węgrzynowicz et Kłyszejko 1972).

For the % quota of the adaptability to the general physical effort of the bream, the application of load equal 45.4 kG/h/kg of the fish weight was assumed, at which load according to the previous research (Węgrzynowicz et Kłyszejko, 1972b), the bream does not appear to be tired for at least 2 hours.

The following detergents were used in the research:

1. Deterlon – anionactive dodecylobenzenosulphonian of sodium (DBS), (51% active substance, 49% unsulphonated compounds and water) – produced on the base of alcilobenzen "Doban" by the Wrocław Soap Factory;
2. Marlon TP 370 – anion tetrapropylenobenzenosulphonian of sodium (TBS), (70% active substance, 0.6% sodium sulphate, 0.4–0.5% sodium chloride, 0.5% unsulphonated compounds, 28% water) – produced in West Germany by the Chemische Werke "Huels".

The adaptability to the general physical effort of fish was examined in water with the Deterlon concentration of 1, 2, 3 and 4 mg active substance per one litre of water, and in the Marlon concentration of 1, 2, 3 and 4 mg active substance per one litre of water (mg SA/1).

Simultaneously, the fishes under the applied load were examined in the water without the detergents (the control group).

The obtained data were described statistically, calculating the arithmetic averages, the standart error and the degree of statistic variability at the confidence level Q = 0.95 utilising the t-Student Test.

RESULTS AND DISCUSSION

The obtained results (Tab. 1, Fig. 1) showed that, the content of 1–2 mg SA/1 of Deterlon (DBS) in water considerably decreased the adaptability of the bream to the general physical effort, while the same concentration of Marlon (TBS) resulted in a very slight decrease of the adaptability.

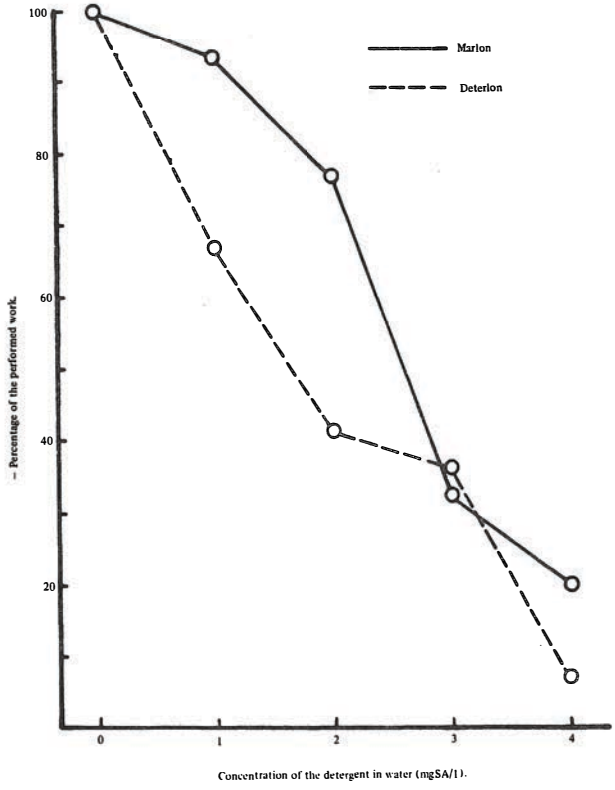

Fig. 1–Influence of Deterlon and Marlon concentration in water upon the general effort of the bream under the applied load of 45 kGm/h/kg of the weight of the body of the fish

After the fish being placed in the concentration of 3 mg SA/1, the effort adaptability of the bream decreased by about 30% both in DBS and in TBS.

The increase of the concentration up to 4 mg SA/l decreased the effort adaptability of the bream to 19% (TBS) and to 6.7% (DBS) in comparison to the quota achieved in the pure water.

The displacement of the water habitat pH towards the alkaline from 7.6 to 8.1–8.2 in proportion to the increase of the DBS and TBS concentration in water (Tab. 1).

Table 1

The general physical effort of the bream under the applied load in water containing 1, 2, 3 and 4 mgSA/1 of Deterlon and Marlon

Number of fishes	Weight of fishes (g)	Detergent (mg SA/1)	Water ph	Applied load (kGm/h/kg)	Performed work (kGm/h/kg)	Performed work (%)
		Marlon				
3*	220–440	0	7.6	45.4	45.4	100.0
4	260–450	1	7.7	45.4	42.4 ± 0.2	93.3
3	190–410	2	7.9	45.4	34.8 ± 0.1	76.6
5	240–560	3	8.0	45.4	17.9 ± 0.3	32.2
4	180–470	4	8.1	45.4	8.7 ± 0.5	19.2
		Deterlon				
3*	220–430	0	7.6	45.4	45.4	100.0
3	170–360	1	7.7	45.4	30.3 ± 0.1	66.6
4	100–570	2	7.9	45.4	18.9 ± 0.3	41.7
5	180–220	3	8.1	45.4	16.3 ± 0.5	36.0
5	200–410	4	8.2	45.4	3.8 ± 0.4	6.7

* control group

The results of the research estimating the degree of the detergent noxiousness for the water organisms that have been obtained so far and based on the period of survival in certain concentrations, indicate considerable differences in the species susceptibility. The value of the threshold lethal concentration for TBS type detergents oscilates between 6 mg SA/l for trout and 10 mg SA/l for carp (Trzebiatowski, 1973) and 20 mg SA/l for *Lebistes reticulatus* (Niemitz et Pestein, 1962); for DBS type detergents between 2 mg SA/l for trout and 6 mg SA/l for carp (Trzebiatowski, 1973) and 5 mg SA/l for trout (Mann, 1962).

Our own research confirmed by other authors (Ludemann et Mount, 1963; Mann, 1962; Trzebiatowski, 1973) indicated greater susceptibility of fish to the DBS detergents as compared to the TBS detergents.

The decrease of the adaptability to the general effort of the bream in both the DBS and the TBS concentration of 1–2 mg SA/l was most probably due to the impediment of gas exchange between the organism and the water habitat, as well as to the circulatory system insufficiency.

The problem of the mechanism of the detergent toxic action in the respiratory process and the circulatory system activity not unimportant in the present research, is conducted by means of the histochemical method and the ECG. Apart from their toxic action, the changes taking place in water (smaller saturation with oxygen and the increase of the pH) connected with the presence of detergents influence the decrease of the adaptability to the physical effort.

The obtained results indicate that, the utilisation of the method for application of the general physical effort to fishes as the test allows for the considerable reduction of the time required for the biological research to only about 1 or 2 hours, as compared to 48 hours or more (in the investigation of survival).

The results presented here allow also the determination of the fish reactions in much smaller content of the detergents in water than by the biological methods, which have been used so far (Mann, 1962; Niemitz et Pestlin, 1962; Trzebiatowski, 1973).

CONCLUSIONS

1. DBS (Deterlon) and TBS (Marlon) type detergents present in the water habitat, cause the considerable decrease of the adaptability to the general physical effort of the bream under the applied load.

2. The decrease of the adaptability of the bream to the general effort takes place in smaller concentrations of Deterlon as compared to Marlon.

3. The method for application of the general physical effort to fishes used as the test in case of the water habitat pollution with the detergents reduces the time of the biological research.

4. The used method allows to determine the reaction of fishes in considerably smaller concentrations of detergents in water than the biological tests that have so far been applied.

REFERENCES

Chojnacki A., 1961: Zanieczyszczenie wód powierzchniowych przez detergenty. Gospodarka wodna, 1: 14–16

Ludemann A.E., Mount D.I., 1963: Beiträge zur Toxicität von grenzflachenaktiven Substanzen (Detergentien) für Fische. Ztschr. f. Angewandte Zoologie. 50, 2: 229–238.

Mann H., 1955: Die Einwirkung von grenzflaechenactiven Waschmittel auf Fische und Fischnährtiere. Arch. f. Fischerei-Wissenschaft, 6: 131–137.

Mann H., 1957: Über die Einwirkung verschiedener Desinfectionsmitteln auf Fische und Fischnährtiere. Ztschr. f. Fisch., VI. N. F.: 135–140.

Mann H., Schmidt O.J., 1961: Der Einfluss von Detergentien auf Sperma. Befruchtung und Entwicklung bei der Forelle. Int. Rev. Hydrobiol., 46, 3: 419–426.

Mann H., 1962: Die Bedeutung der synthetischen Waschmittel (Detergentien) für die Fischerei. Fischwirt., 12, 4: 97–101.

Niemitz W., Pestlin W., 1962: Über den Einfluss der biologischen Abwasserreinigung auf die Fischschädlichkeit von Detergentien. Städtehygiene, Hamburg, 13, 11: 231–233.

Sierp F., Thiele J., 1954: Der Einfluss von grenzflächenaktiven von Substanzen auf die Abwasserreinigung und Selbstreinigung der Flüsse. Vom Wasser, 21: 297–246.

Trzebiatowski R., 1973 Toksyczność detergentów typu DBS i TBS dla ryb. Roczniki Nauk Rolniczych, 95, ser. H, 2: 83–94.

Węgrzynowicz R., Kłyszejko B., 1972: Method for application of physical effort to fish. Acta Ichthyologica et Piscatoria 2. 1: 91–94.

Węgrzynowicz R., Kłyszejko B., 1972b: Specific adaptability to dynamic effort of fishes Abramis brama (L.), Rutilus rutilus (L.), Perca fluviatilis (L.), Anguilla anguilla (L.). Acta Ichthyologica et Piscatoria 2, 2: 21–25.

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WPŁYW DETERGENTÓW TYPU DBS (DETERLON) I TBS (MARLON) NA LESZCZA *ABRAMIS BRAMA* (L.) OBCIĄŻONEGO OGÓLNYM WYSIŁKIEM FIZYCZNYM

Streszczenie

Przeprowadzono badania wpływu detergentów typu DBS (Deterlon) i TBS (Marlon) na zdolność do wysiłku fizycznego u leszcza (*Abramis brama* (L.)) w warunkach akwaryjnych, przy zastosowaniu metody własnej – obciążania ryb ogólnym wysiłkiem fizycznym.

W wyniku badań stwierdzono, że obecność w środowisku wodnym niewielkich (uznanych za nietoksyczne) koncentracji obu wymienionych detergentów – znacznie obniża zdolność ryb do wysiłku fizycznego, przy czym działanie Deterlonu wystąpiło silniej i przy niższej koncentracji w porównaniu z Marlonem.

ВЛИЯНИЕ ДЕТЕРГЕНТОВ ТИПА DBS (DETERLON) И TBS (MARLON) НА ЛЕЩА Abramis brama (L.), ПОДВЕРГНУТОГО НАГРУЗКЕ ОБЩИМ ФИЗИЧЕСКИМ УСИЛИЕМ

Р е з ю м е

Проведены исследования влияния детергентов типа DBS (Deterlon) и TBS (Marlon) на способность к физическому усилию леща (Abramis brama (L.)) в аквариальных условиях при применении авторского метода - нагрузки рыб общим физическим усилием.

В результате исследований установлено, что наличие в водной среде небольших (признанных нетоксичными) концентраций обоих вышеназванных детергентов значительно снижает способность рыб к физическому усилию, причём действие детергента Deterlonu проявилось сильнее и с более низкой концентрацией по сравнению с детергентом Marlon.

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