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Physiology

CHANGES OF TISSULAR RESPIRATION OF BREAM
ABRAMIS BRAMA (L.) ADAPTED TO AQUARIUM CONDITIONS

ZMIANY INTENSYWNOŚCI ODDYCHANIA TKANKOWEGO
U LESZCZA *ABRAMIS BRAMA* (L.) W WYNIKU ADAPTACJI
DO WARUNKÓW AKWARYJNYCH

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Studies on oxygen metabolism dynamics of liver and kidney of bream *Abramis brama* (L.) from Zalew Szczeciński prove that adaptation period of bream transferred into aquarium conditions is characteristic for increased respiration of liver and kidney during first days of adaptation. A tendency for respiratory metabolism in liver is noted to stabilize from 6th day and in kidney from 7th day of adaptation to aquarium conditions.

Dynamics of organ metabolism defined by quantity of oxygen used were investigated in aspect of various species of fish, various individuals (age, weight) and of various conditions of environment (chemical composition, salinity, temperature).

It appears from various publications that intensity of metabolism of respiratory organs is interrelated to changes of environmental conditions (E k b e r g, 1958; H o l m e s et al., 1960; P e i s s and F i e l d, 1950; U m b r e i t et al., 1957).

According to contemporary opinions, changes of environment cause an introduction of organism adapting reactions by influencing various chains of metabolism. Owing to wide varieties of species and of environmental conditions, the existing publications are still fragmentary only.

Studies of physiological processes occurring in fish organism under aquarium conditions require an analysis of adaptation process which is taking place due to changes of artificial environment in regard to certain basic parameters of natural environment.

This study was aimed to investigate the dynamics of metabolism processes in respiration of liver and kidney of bream *Abramis brama* (L.) in aspect of adaptability to aquarium conditions under which the fish were kept for experiments.

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METHOD

Investigations performed on breams of both sexes, of length 33-44 cm and of weight 260-540 g, caught in Zalew Szczeciński during November. The fishes were kept in aquarium filled in with water from supply system, additionally aerated, of temperature $11 \pm 1^\circ\text{C}$ and pH 7.6, within one to fifteen days. Consumption of oxygen by tissues examined by direct method of Warburg (Kleinzeiler, 1965; Umbreit et al., 1957). After taking out from water, the fishes were decapitated; kidney and liver were cut-out and placed in ice. The sections of kidney and liver were washed in Ringer iced liquid of pH 7.5 suitable for fish tissue (Pequignot, 1964) and microsections of 15-20 mm² and of average thickness 0.4-0.5 mm were prepared. The liver was cut perpendicularly to outer surface and the kidney - sideways (Holmes et al., 1960). The microsections of weight 100 mg of wet tissue were placed in Warburg tubes situated in ice. Wetted filter paper 0.2 ml 15% KOH was used as CO₂ absorber. Atmospheric air formed gaseous phase. The tubes were oscillating at rate of 116-120 times per minute in water bath of temperature 25°C. Preincubation period lasted 15 minutes. Readings were taken every 20 minutes during 1 hour. Intensity of respiring processes were defined in $\mu\text{l O}_2$ and calculated on 1 g of wet tissue per hour.

RESULTS AND DISCUSSION

As appears from investigations, the dynamics of metabolism defined by quantity of oxygen consumed by kidney is more intensive than metabolism of liver (Tab.1).

The results of our investigations are concurrent with results obtained on other species of fish, or of birds and mammals (Freeman, 1950; Jankowsky, 1966; Kołłątaj, 1967; Madhu et al., 1959; Romanowski and Strażyński, 1968; Sumner and Doudoroff, 1938; Wells, 1935). The kidney shows more variable intensity of respiration during adaptation within limits of 490-575 $\mu\text{l O}_2/\text{g/h}$. The difference of intensity oscillation of kidney respiration during 15 days amounted to 85 $\mu\text{l O}_2/\text{g/h}$. Variations of respiration intensity of liver were within limits of 261-400 $\mu\text{l O}_2/\text{g/h}$. and the difference of intensity oscillation in respiration during 15 days in aquarium amounted to 139 $\mu\text{l O}_2/\text{g/h}$.

Respiration metabolism in subsequent days of adaptation varied in intensity of both organs (Fig.1). In liver, an increase of oxygen consumption is noted from the second day and its peak on the fourth day. Beginning from fifth day, intensity is decreasing with slight variation towards the initial values attained on the eighth day of adaptation. A tendency for stabilization of metabolism is noted beginning from eighth day with slight deviations, which are becoming more intense from 12th to 15th day.

The kidney, after negligent increase of metabolism on second day, shows transitory decrease of respiration intensity and then, increase again to attain the peak on 5th day of adaptation. The decrease slightly below the values of

Table 1

Consumption of oxygen by liver and kidney of bream *Abramis brama* (L.)
($\mu\text{l O}_2/\text{g}$ of wet tissue/hour) in subsequent days of adaptation

Days in aquarium	n	Liver		Kidney	
		\bar{x}	δ	\bar{x}	δ
1	10	290	± 50	529	± 27
2	10	342	± 73	540	± 42
3	11	360	± 27	498	± 24
4	12	400	± 43	527	± 40
5	11	350	± 63	575	± 48
6	11	324	± 71	541	± 64
7	11	323	± 54	507	± 43
8	12	261	± 34	555	± 24
9	10	296	± 36	556	± 37
10	11	290	± 35	550	± 40
11	11	284	± 29	544	± 47
12	11	329	± 55	570	± 31
13	11	356	± 65	561	± 74
14	12	321	± 48	490	± 33
15	11	379	± 45	511	± 28

n - number of experiments

\bar{x} - arithmetic mean

δ - standard deviation

first day is noted on sixth day. Beginning from eighth day, stabilization of metabolism is noted on level higher than initial values. Slight oscillations nearing the initial values take place from 12th to 15th day.

The ascertained course of metabolism indicates that adaptation period of bream *Abramis brama* (L.) in aquarium is characteristic for increased respi-

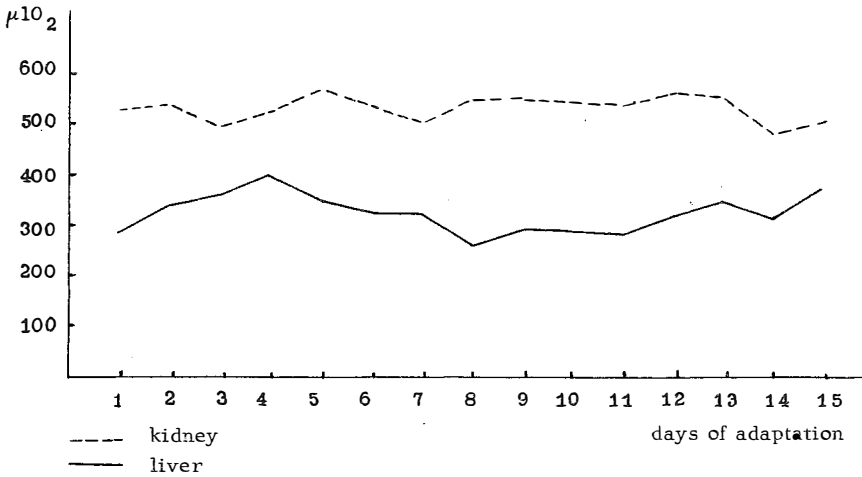


Fig. 1. Changes of intensity in oxygen consumption by kidney and liver of bream *Abramis brama* (L.) ($\mu 10_2$ /g/hour) in subsequent days of adaptation to aquarium conditions

ration of liver and kidney during first days of adaptation. Restitution to values nearly initial is observed on sixth day in liver and on seventh day in kidney. Further course of metabolism shows tendency towards stabilization.

CONCLUSIONS

1. Kidney of bream shows more intensive metabolism of respiration in comparison to liver.
2. More distinct deviations of intensity in respiratory metabolism during adaptation shows the liver.
3. Kidney shows most intensive metabolism on fifth day and the liver on fourth day of adaptation.
4. Respiratory metabolism in liver and kidney show tendencies towards stabilization to aquarium conditions beginning from sixth day of adaptation.

REFERENCES

- Ekberg D.R., 1958: Respiration in tissue of goldfish adapted to high and low temperatures. - *Biol. Bull.* 114: 308-316.
- Freeman J.A., 1950: Oxygen consumption, brain metabolism and respiratory movements of goldfish during temperature acclimatization, with special reference to lower temperatures. - *Ibid.*, 99: 416-424.

- H o l m e s W.N., G a e l H., S t o t t, 1960: Studies of the respiration rates of excretion tissue in the cutthroat trout. *Physiol. Zool.* 1, 33: 9-14.
- K l e i n z e l l e r A., 1965: Manometrische Methoden und ihre Anwendung in der Biologie und Biochemie. G. Fisher, Jena.
- J a n k o w s k y H.D., 1966: The effect of adaptation temperature on the metabolic level of the eel *Anguilla vulgaris* (L.). *Helgolander Wiss. Meeresuntersuch.*, 13, 4: 402-407.
- K o ł ł a t a j A., 1967: Tissue respiration in the kidney, liver and skeletal muscle in chicks. - *Acta Physiol. Polonica* XVIII, 1, 23: 23-32.
- M a d h u S., K a n u n g o and L a d d P r o s s e r, 1959: Physiological and biochemical adaptation of goldfish to cold and warm temperatures. - *J. of Cell. Comp.*, 54, 3: 265-274.
- P e i s s C.N., F i e l d J., 1950: The respiratory metabolism of excised tissue of warm and cold adapted fishes. *Biol. Bull.* 99: 213-224.
- P e q u i g n o t J., 1964: La respiration tissulaire chez poissons. - *Experientia* 20: 221-222.
- R o m a n o w s k i W., S t r a ż y ń s k i Wł., 1968: Effect of exercise on the tissue respiration of the brain, skeletal muscle, heart, liver, kidneys and spleen. - *Int. Z. angew. einschl. Arbeitsphysiol.*
- S u m n e r F.B., D o u d o r o f f P., 1938: Some experiments on temperature acclimatization and respiratory metabolism in fish. - *Biol. Bull.* 74: 403-429.
- U m b r e i t W., B u r r i s R.H., S t a u f f e r J., 1957: Manometric techniques Minneapolis, Burgess Publ. Co.
- W e l l s N.A., 1935: Change in rate of respiratory metabolism in a teleost fish induced by acclimatization to high and low temperatures. - *Biol. Bull.* 361-367.

ZMIANY INTENSYWNOŚCI ODDYCHANIA TKANKOWEGO U LESZCZA
ABRAMIS BRAMA (L.) W WYNIKU ADAPTACJI DO WARUNKÓW
AKWARYJNYCH

S t r e s z c z e n i e

Przeprowadzono badania dynamiki procesów przemiany tlenowej wątroby i nerki leszcza *Abramis brama* (L.) w aspekcie zdolności adaptacyjnych do warunków akwaryjnych. Badania przeprowadzono przy pomocy metody Warburga.

Stwierdzony przebieg przemian wykazuje, że okres adaptacyjny leszcza przebywającego w akwarium charakteryzuje się zwiększeniem intensywności oddechowej wątroby i nerki w pierwszych dniach adaptacji.

Powrót zbliżony do wartości wyjściowych obserwuje się w wątrobie w 6 dniu, w nerce w 7 dniu przebywania w akwarium. Dalszy przebieg przemian wykazuje tendencje stabilizacji.

ИЗМЕНЕНИЯ ИНТЕНСИВНОСТИ ТКАНЕВОГО ДЫХАНИЯ У ЛЕЩА
ABRAMIS BRAMA L. В РЕЗУЛЬТАТЕ АДАПТАЦИИ К АКВАРИУМНЫМ УСЛОВИЯМ

Р е з ю м е

Проведены исследования динамики процессов кислородного обмена печени и почки леща *Abramis brama* L. в аспекте адаптационных способностей к аквариумным условиям. Исследования были проведены по методу Варбурга.

Установленный ход изменений указывает на то, что период адаптации у леща, пребывающего в аквариуме, характеризуется увеличением интенсивности дыхания печени и почки в первые дни адаптации.

Поворот, близкий к исходным данным, наблюдается в печени на шестой день, в почке - на седьмой день пребывания в аквариуме. Дальнейший ход изменений указывает на тенденцию к стабилизации.

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