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Electrophoretic separation of blood plasma of perch (*Perca fluviatilis* L.) living in the Rybnik and Goczałkowice reservoirs

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Abstract — Polyacrylamide gel electrophoresis of the protein of blood plasma was carried out in perch populations from the Rybnik and Goczałkowice reservoirs, greatly differing in environmental conditions. Perch populations from the two reservoirs differed in protein separation. In both reservoirs two perch varieties of different patterns of electrophoretic separation of blood plasma protein more observed.

Key words: water reservoirs, fish, genetics.

1. Introduction

The perch is a widely distributed freshwater fish whose two ecological varieties frequently occur in lakes: a coastal variety, chiefly feeding on invertebrate fauna, and a deep-water predatory variety. It seemed therefore interesting to find out whether the populations of perch living in various environmental conditions differed genetically.

The local populations from the Rybnik and Goczałkowice reservoirs which differed considerably in environmental conditions, were included in the study. The Rybnik reservoir is used for cooling the power stations installations and the temperature of its water is 6°C higher than the normal water temperature in this region of Poland. It also contains considerable quantities of industrial wastes from the Rybnik coal basin. The Goczałkowice is reservoir chemically unpolluted, being the tap water supply for Katowice.

The genetic analysis of perch populations from the two reservoirs was carried out using electrophoretic separation of blood plasma proteins. The separation illustrates polymorphous protein forms which have a direct connection with the genotype. This is therefore the simplest method of determining genetic variability and has been widely used in taxonomic investigations (Thompson 1960, Tsujuki et al. 1965, Tsujuki, Roberts, 1966, Nyman 1965, 1966, 1971, 1972, Nyman, Westin 1968, 1969, Johanson et al. 1972, Wilkins 1972, Payne et al. 1972, Child et al. 1976, Paver 1979, and many others).

2. Material and method

Eighty specimens of perch caught in the Rybnik and Goczałkowice reservoirs were used in the investigation. Blood for analyses was taken from the anal vain and immediately fixed with acidum citricum dextrose fluid, used for human blood preservation, in the ratio 1 : 3. The plasma of the preserved blood was centrifugated and kept at $-20^{\circ}C$.

Disk electrophoresis was carried out on 10% polyacrylamide gel for 110 min. at a current intensity of 2 mA per 1 tube (6 mm in diameter), using the following buffers: 0.050 M H_3BO_3 in vessels and 0.0040 M tris to the gel. After the completion of electrophoresis, the proteins separated on the gel were stained using the method described by Nyman (1970) for esterases and by Chranbach et al. (1967) for total protein.

3. Results

Different patterns of electric separation of total protein and non-specific esterases in the blood plasma of perch specimens from the two investigated reservoirs were found. This was particularly pronounced in the separation of esterases which in the band of "fast" esterases, had one strip in the fishes from Rybnik and two strips in those from Goczałkowice (figs 1a, b, and fig. 3a, b), except for two individuals from Rybnik which showed the Goczałkowice pattern, and one perch from Goczałkowice with the characteristic pattern of the Rybnik population. Besides, the patterns presented in figs 1a, b and 3a, b, in respect of the migration rate in the electric field and in colour, were fairly constant and identical in all the investigated fish of the two populations. In the perch from Rybnik the total protein of the blood plasma formed two polymorphic patterns (figs 2a, b, and 3c, d) in the ratio of 29 : 11 individuals. They differed in band "C" of the patterns in the arrangement and colour of the

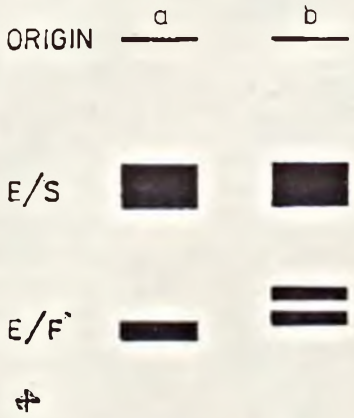

Fig. 1. Patterns of esterases separation of perch blood plasma: a — specimens from Rybnik; b — specimens from Goczałkowice. E/s — slow esterases; E/f — fast esterases

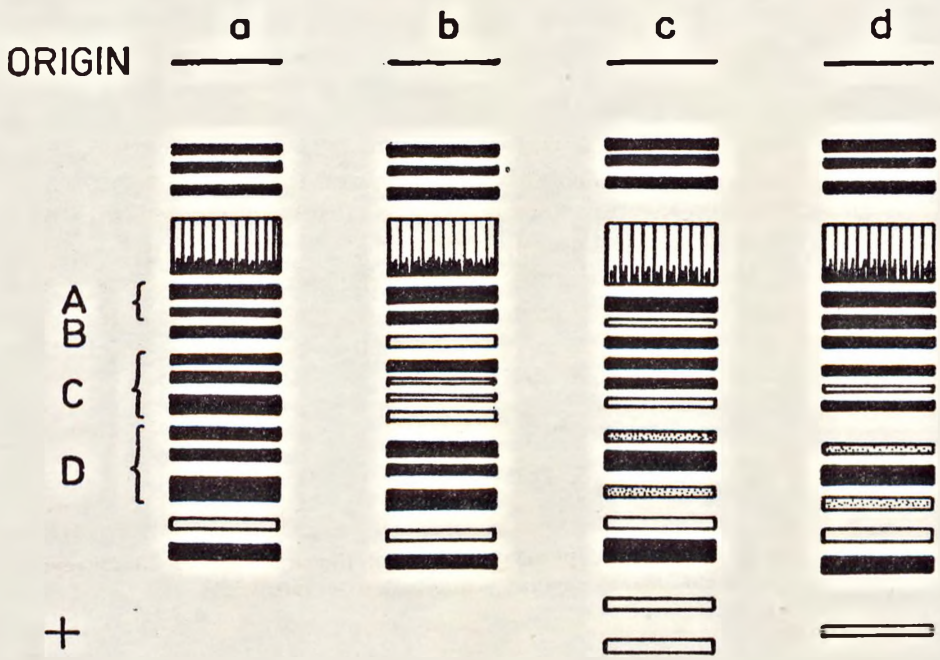

Fig. 2. Patterns of total protein separation of perch blood plasma: a, b — specimens from Rybnik; c, d — specimens from Goczałkowice. Symbols A—D denote places of occurrence of differences in the patterns

individual strips. The perch from Goczałkowice also showed two polymorphic separation patterns of total protein of blood plasma (figs 2c, d, and 3e, f) appearing in band "A" in the ratio of 34 : 6 and band "C" in

the ratio of 26 : 24. The difference between the Rybnik and Goczałkowice perch populations was found in parts B, C, and D of the patterns (figs 2a, b, c, and d and figs 3d, e, and f).

4. Discussion

The electrophoretic investigation showed that perch populations in the Rybnik and Goczałkowice reservoirs had different patterns of separation of total protein and blood plasma esterases. Moreover, the separation of total proteins revealed that, independently of differences between the reservoirs, two populations of perch, characterized by different patterns, were found in each water body. This fact supports the observations of other authors on the occurrence ot two types of perch in every reservoir (Gąsowska 1962, Nikolski 1970) and showed the polymorphism of the investigated species, increasing the number of phenotype in the populations. This is an important factor facilitates the adaptation of fish populations to given environmental conditions, as it was shown among other works by Mayer (1963), Nyman (1967, 1972), Sick (1961, 1965a, 1965b), Wilkins (1972), Child et al. (1976), and by the author's own publications (Starmach 1975, 1976) on the loach and gudgeon living in montane and lowland streams, whose patterns of electrophoretic separation were closely connected with physiological adaptation to the living conditions.

Genetic differences between the individual perch populations, found by the electrophoretic separation of proteins, fully account for their capacity to live in the various environmental conditions which they encounter in their area of distribution.

5. Polish summary

Elektroforetyczne badania nad plazmą krwi okoni (*Perca fluviatilis* L.) żyjących w zbiornikach zaporowych Rybnik i Goczałkowice

Przeprowadzono elektroforetyczny rozdział na żelu poliakryloamidowym białek plazmy krwi okoni pochodzących ze zbiorników zaporowych Rybnik i Goczałkowice, znacznie różniących się między sobą warunkami środowiska.

Badania powyższe wykazały, że wzory rozdziału białka ogólnego i esteraz plazmy krwi okoni z Rybnika i Goczałkowic są odmienne (ryc. 1a, b; ryc. 2a, b, c, d oraz ryc. 3a—f). Rozdział białka ogólnego ujawnił ponadto, że niezależnie od różnic pomiędzy zbiornikami w obrębie każdego z nich znajdują się po dwie odmiany okoni charakteryzujące się innym układem wzorów. Świadczy to o istnieniu w tym samym zbiorniku różniących się genetycznie dwu grup okoni oraz polimorfizmie badanych ryb zwięk-

szającym liczbę fenotypów. Jest to ważnym czynnikiem ułatwiającym przystosowanie się populacji do określonych warunków środowiska.

Stwierdzone za pomocą elektroforetycznego rozdziału białka różnice genetyczne poszczególnych populacji okoni dobrze tłumaczą ich możliwości życia nawet w bardzo różniących się środowiskach.

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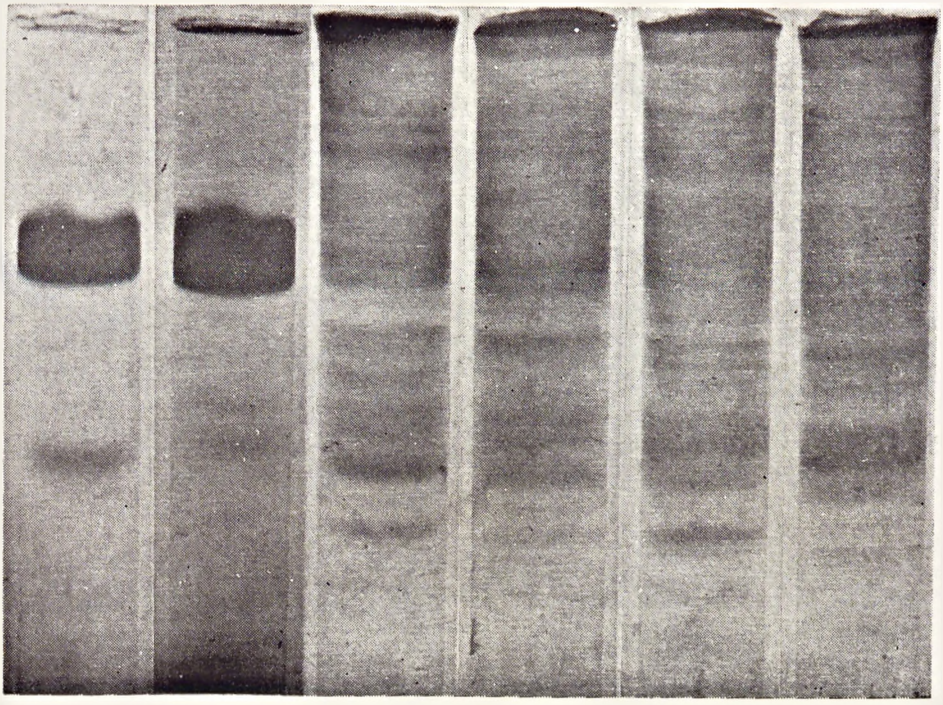

Fig. 3. Pattern of esterase separation of perch blood plasma: a — from Rybnik; b — from Goczałkowice; and of total protein; c, d — specimens from Rybnik, and e, f — specimens from Goczałkowice