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COMPARISON OF BLOOD PROTEINS OF COALFISH FROM NORWEGIAN AND ICELANDIC WATERS

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ABSTRACT

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Blood samples of coalfish from Norwegian and Icelandic waters were collected and analyzed for hemoglobin, serum protein, and serum esterase variations in order to study the relation between the two coalfish stocks. Clear intraspecific variation was found in the serum transferrins, but the distributions of phenotypes were nearly the same in the sample from Iceland as in the total samples from Norwegian waters.

INTRODUCTION

The coalfish, *Pollachius virens,* spawns on the banks off the west coast of Norway and in the northern North Sea. Other spawning grounds are located at Iceland and the Feroe Islands. The three stocks of coalfish have been regared as separate selfsustaining populations, but tagging experiments have shown a rather extensive emigration from Norway to Iceland and Feroe waters (OLSEN 1961).

In the investigations reported here an attempt have been made to use frequencies of polymorphic or Mendelian characteristics to study the relation between coalfish from Norwegian and Icelandic waters. The electrophoretic patterns from analyses of coalfish hemoglobins are described elsewhere as a part of a comparative study on hemoglobins of gadoid fishes (MØLLER and NÆVDAL 1969).

MATERIAL AND METHODS

Numbers of specimens in each sample, sampling date and sampling localities are shown in Table 1. The Norwegian sampling localities are also plotted in Fig. 1. Samples 1—3 were collected from coalfish brought alive for commercial sale at Bergen harbour, and detailed catching localities are unknown. Samples 7 and 12 were collected from fishes of the O-group, and samples 8 and 10 were collected from mature fishes (sample 8 in the spawning season). All the other samples were collected from one to three years old immature fishes.

Fig. 1. The location of the Norwegian sampling stations listed in Table 1.

Bloods were collected by cardiac puncture or by cutting the tail (small fishes). Samples 1—6 and 12 were analyzed for hemoglobin variation, and in the these samples heparin was used as anticoagulant. The hemoglobins were analyzed fresh, but most sera were stored for some days or weeks in a deep freeze before analyses.

The hemoglobins were analyzed by agar gel electrophoresis (SICK 1965). Sera were analyzed by the combined starch and agar gel electrophoresis described by MØLLER (1966). The proteins were stained by Amidoblack 10 B or Nigrosin. Autoradiography was carried out as for cod sera (MØLLER 1966) based on the method of GIBLETT, HICKMAN and SMITHIES (1959). Staining of esterase activity was performed by 1 % napthylacetate in aceton using Fast Blue BB Salt as dye coupler.

RESULTS AND DISCUSSION

The hemoglobin analyses did not reval any individual variation in coalfish, except one single specimen which showed two strong fractions while all the other specimens analyzed showed only one strong fraction (MØLLER and NÆVDAL 1969). As intraspecific variations were very rare, further studies on hemoglobins of coalfish were omitted.

Also the results of esterase analyses were discouraging as only a diffuse area of esterase activity with no clear intraspecific differences was found.

Serum protein variation of coalfish has been briefly dealt with in preliminary reports (MØLLER and NÆVDAL 1966, MØLLER, NÆVDAL and VALEN 1967).

Some serum protein electrophoretograms are outlined in Fig. 2. A strong fraction of intermediate anodic mobility was shown by autoradiography to represent serum transferrins and was named Tf A. Tf A occurred in all specimens analyzed. Also the weaker component in front of it was found to possess ironbinding capasity. In a few per cent of all specimens analyzed another strong component occurred at the cathodic side of Tf A, and in two specimens (one in sample 8 and one in sample 12) a corresponding strong component occurred at the anodic side of Tf A, also this component with a weaker component in front of it. Sera in which these components occurred were not available when the tracing experiments were made, but their strength and position imply that they represent rare transferrin components, and they were named Tf B and Tf A' respectively. The phenotype which contained Tf A alone, was named Tf AA, and the phenotypes in which Tf B and Tf A' occurred, were called Tf AB and Tf AA' respectively.

The distribution of the phenotypes Tf AA and Tf AB in the collected

Table 1. Observed distributions of transferrin phenotypes in samples of coalfish from Norwegian and Icelandic waters with calculated gene frequencis and expected Hardy-Weinberg distributions.

Sample no	Locality	Date of sampling	Transferrin type			Numbers in sample	Gene frequency q_B
			TfAA	TfAB	TfBB (exp)		
1	Hordaland	4 Aug. 1965	97	3	—	100	0.015
2	Rogaland	11 » 1965	57	3	—	57	—
3	Hordaland	16 Dec. 1965	108	4	—	112	0.018
4	Smøla, Nordmøre	16 » 1965	108	3	—	111	0.014
5	Sandøy, Romsdal	16 » 1965	86	4	—	90	0.022
6	Veidholmen, Nordmøre	17 » 1965	38	—	—	38	—
7	Gamsvik, Vestfjorden .	26 Sept. 1965	13	—	—	13	—
8	Røstbanken	8 March 1966	157	6	—	163	0.018
9	Husøy, Nordland	8 Aug. 1966	93	2	—	95	0.011
10	61°00N, 03°E' Viking Bank	22 » 1967	79	3	—	82	0.018
11	Borgenfj. Trøndelag ..	25 Oct. 1967	20	1	—	21	0.024
	Total, Norwegian waters		856	26	—	882	0.0157
	Expected Hardy-Weinbergs distribution		856	25	0.2		
12	Husavik, North-Iceland	13 Aug. 1967	190	10	—	200	0.025
	Expected Hardy-Weinberg distribution		190.1	9.8	0.1		

samples are shown in Table 1. The numbers of Tf AA' are lumped with the numbers of Tf AA.

A hypothesis of genetic control of the transferrings involving two co-dominant alleles, Tf^A and Tf^B, has been adopted to explain the observed variation. In Table 1 the frequencies of Tf^B are calculated for each sample, and expected distributions of genotypes are calculated for the total of Norwegian samples and for the sample from Iceland respectively. The expectance of the genotype Tf^B/Tf^B in the present material is low, and the overall accordance between observed and expected distributions is reasonable good, implying that the hypothesis is correct.

TfA' may have a similar control, but because this component is very rare, this hypothesis can not be tested from population data.

Also in other serum proteins intraspecific variations were observed (Fig. 2), but they occurred as presence or absence of weak fractions and clear-cut typing of the individual specimens was impossible.

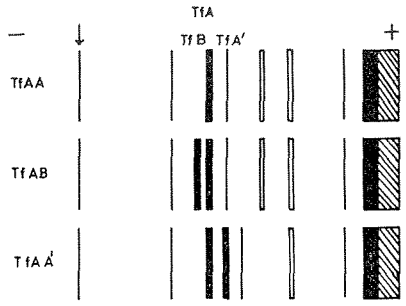

Fig. 2. Outline of serum protein patterns in coalfish obtained by combined starch and agar gel electrophoresis at pH 0.9.
Filled in bars: Strong bands. Open bars: Moderately strong bands. Hatched bars: Diffuse bands. Single lines: Faint bands. Arrow indicate the point of application.

Table 1 shows that no great differences were found among the samples in distribution of transferrin phenotypes. The q^B-value varied between zero and 0.024 in the Norwegian samples, but showed a somewhat higher value, 0.025, in the sample from Iceland. However, χ^2 homogenity test on the distribution of phenotypes showed that the difference between the Norwegian and the Icelandic samples was not significant $\chi^2 = 2.14$, 1 d. f.,$0.1 < P < 0.2$).

Thus no significant difference between Norwegian and Icelandic coalfish was detected in the present study. This may imply that the two stocks are not genetically isolated, but the reason may also be that the transferrin variation is a balanced polymorphism where the controlling factor (probably one or another abiotic ecological factor) shows so similar values in the two environments that similar gene frequencies are established.

REFERENCES

GIBLETT, E. R., HICKMAN, C. G. and SMITHIES, O. 1959. Serum transferrins. *Nature, Lond.*, 183: 1589—1590.

MØLLER, D. 1966. Serum transferrings in cod. *FiskDir. Skr. Ser. HavUnders., 14* : 51—61.

MØLLER, D. and NÆVDAL, G. 1966. Serum transferrins of some gadoid fishes. *Nature, Lond., 210* : 317—318.

MØLLER, D. and NÆVDAL, G. 1969. Hemoglobins of some gadoid fishes. *Fisk.Dir. Skr. Ser. HavUnders., 15*: 91—97.

MØLLER, D., NÆVDAL, G. and VALEN, AA. 1966. Rapport om arbeidet med blodanalyser for populasjonsundersøkelser. *Fisken* og *Havet, 1966* (2): 1—17.

OLSEN, S. 1961. An account of the Norwegian coalfish investigation with special reference to the tagging experiments. *Coun. Meet. int. Coun. Explor. Sea, 1962* (125): 1—8. [Mimeo.]

SICK, K. 1965. Hemoglobin polymorphism of cod in the Baltic and the Danish Belt Sea. *Hereditas, 54*: 19—48.

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