

This paper not to be cited without prior reference to the author

International Council for
the Exploration of the Sea

C.M.1980/H:20
Pelagic Fish Committee

On migration of larval Anisakis sp. into
the flesh of blue whiting (Micromesistius poutassou)

by

A.V.Zubchenko, V.K.Mitenev, A.B.Karasev, T.V.Bezgachina*

Abstract

175 specimens of blue whiting (7 samples of 25 fish) frozen 0, 2, 4, 6, 8, 10 and 12 hours after capture were investigated. Larval Anisakis sp. nematodes were found in the flesh of 99.4% of the examined fish. The dorsal muscular tissue of only 14.3% of blue whiting was parasitised by larval nematodes. The ventral part of musculature of 99.4% of blue whiting turned out to be infested, human consumption. It is shown that larval Anisakis sp. penetrated the blue whiting flesh not while being kept at positive temperature but in the sea.

* PINRO, Murmansk, USSR

Résumé

Le poutassou (*Micromesistius poutassou*) est une des plus nombreuses espèces de poissons de l'Atlantique Nord-Est qui, sous le rapport parasitologique, est insuffisamment étudiée. Jusqu'à présent on ne dispose que des renseignements fragmentaires sur la parasitofaune du poutassou habitant les régions limitrophes des mers de Barents et de Norvège (Polianski, 1955) et les eaux de Spitzberg (Szuk, Lorenz, Steding, 1978), ainsi que des données sur quelques espèces de parasites tels que les *Octodactylus* (= *Diclidophora*) minor provenant des régions au sud-ouest des Iles Hébrides (Williams, 1959), les *Eyxobolus meglefini* retrouvés chez les poissons des différentes régions de l'Atlantique Nord-Est (Gaevskaïa, Kovaleva, 1976), les *Diphyllobothrium* sp., retrouvés au banc Faerøer (Andersen, 1977). Les rares publications traitent le problème de la valeur alimentaire du poutassou contaminé par les nématodes (Mouraviev, 1970; Grabda, 1978). D'autre part, vu l'accroissement de l'exploitation du poutassou, ce problème acquiert aujourd'hui une grande importance. Un de ses aspects particulièrement compliqués consiste à l'évaluation du temps de la pénétration des larves des *Anisakis* sp. dans les tissus musculaires du poisson. D'après certaines données, les larves des *Anisakis* sp. pénètrent activement dans les muscles du hareng lors de son stockage de 14 à 37 heures à la température au-dessus du zéro. (Smith, Wootten, 1975). D'où l'intérêt au problème de la contamination des muscles du poutassou vivant et à celui de l'accumulation des parasites dans les muscles du poisson lors de son stockage de 0 à 12 heures à la température "+".

Introduction

Blue whiting (*Micromesistius poutassou*) is one of the most abundant fish species in the North-Eastern Atlantic parasitology of which is studied very poorly. At present there are few data on parasitic fauna of blue whiting in the border area

between the Barents and Norwegian seas (Polyansky, 1955) and in the Spitsbergen waters (Szuks, Lorenz, Steding, 1978) as well as the information on finding certain species of parasites such as Octodactylus (=Dielidophora) minor in the areas to the south-west of the Hebrides (Williams, 1959), Myxobolus acglefini in fish of different areas of the North-Western Atlantic (Gaevskaya, Kovalyova, 1976), Diphyllobothrium sp. on the Faeroe Bank (Andersen, 1977). Very few papers deal with the problem of the suitability of blue whiting infested with nematodes for human consumption (Muravyov, 1970; Grabda, 1978). At present this problem is of growing importance in connection with increased catches of blue whiting. Determining the period of larval Anisakis sp. penetrating the fish flesh is one of the special points of this problem. There is information that larval Anisakis sp. actively penetrate herring musculature after 14-37 hours of keeping fish at positive temperature (Smith, Wootten, 1975). That is why we were interested in the problem, to what degree the musculature of live blue whiting is infested, and if the worm burden in the fish flesh increase while being kept at positive temperature from 0 to 12 hours.

Materials and methods

The investigations of blue whiting caught on July, 5, 1979, in the Norwegian Sea, were the material for the paper.

7 blue whiting samples of 25 specimens (175 fish in all) frozen 0, 2, 4, 6, 8, 10 and 12 hours after capture were inspected by the method of incomplete parasitological dissection. Fish were taken from the same landing. In so doing muscular tissue

of fish was examined visually. All the found nematodes were collected and counted. The received data were generalized and listed in Table 1 where extensity of infestation in per cent, minimal, maximal and average intensity of infestation in specimens for each sample as well as for dorsal and ventral muscles of fish separately are given.

Systematical part

As a result of the investigations larval Anisakis sp. relating to the order of Ascaridida Skrjabin et Schulz, 1938, and the family of Anisakidae Skrjabin et Karokhin, 1945 were found in the flesh of blue whiting.

The first intermediate hosts of Anisakis sp. are planktonic invertebrates - euphausiids, mostly Thysanoessa spp. (Smith, 1971), Caprella septentrionalis (Uspenskaya, 1963), and also Crustacea of the genus Pandalus (Shiraki, Hasegawa, Kenmotsu, Otsuru, 1976). The second intermediate hosts of these parasites are marine fish of different species. The final hosts of Anisakis sp. are, mainly, sea mammals - Pinnipedia and Cetacea (whales) (Davey, 1971; Scott, Fisher, 1959; Margolis, Dailey, 1972; Platt, 1975; etc.)

Davey (1971) inspected the genus Anisakis and singled out three species: A. simplex (Rudolphi), A. physeteris Baylis and A. typica (Diesing). The first two species are found in whales of the North Atlantic and Arctic waters. The third species (A. typica) was found in the area between 40°N and 36°S. That is why it may be supposed that larval Anisakis sp. found in fish of the North Atlantic and neighbouring areas as well as in blue whiting are of the genera A. simplex and A. physeteris.

Results

Anisakis sp. 1. nematodes were found in the flesh of 99.4% of the investigated fish. The mean intensity of infestation was 5.49 (1-4) specimens per one fish. Extensity and intensity of infestation are high enough, but in this case larval nematodes were found in the dorsal muscular tissue of 14.3% of blue whiting with mean intensity of infestation of 0.16 (1-3) specimens per one fish. At the same time ventral musculature of 99.4% of the investigated fish turned out to be infested. The mean intensity of infestation in this case was 5.3 (1-33) specimens per one fish.

On the whole while investigating 7 samples of blue whiting frozen 0, 2, 4, 6, 8, 10 and 12 hours after capture, no notable changes in the infestation of fish with larval nematodes were registered (Table 1). The similar situation is observed in the infestation of the dorsal and ventral muscular tissue of blue whiting with larval Anisakis sp. (Table 1) where there were no conspicuous changes in the infestation of fish from different samples either. Insignificant fluctuations of mean intensity of infestation are connected apparently with the availability of some fish specimens highly infested with larval nematodes. For instance, 29 specimens of nematodes were found in the flesh of one fish from the 4th sample while the intensity of infestation in other samples was 2-6 specimens per one fish.

Thus, there was no active migration of larval Anisakis sp. in the flesh of the examined fish specimens which were kept before freezing for not longer than 12 hours. It is proved by approximately equal mean infestation intensity of fish from

7 samples. It is estimated that accumulation of larval Anisakis in the flesh of blue whiting in this case occurred not during the experiment when fish were kept at positive temperature up to 12 hours, but under natural conditions, i.e. in the sea. Larval Anisakis sp. were localized mainly in the ventral part of fish musculature.

Discussion

The localization of larval Anisakis sp. in blue whiting flesh undoubtedly worsens commercial state of the product and also inflicts economic losses connected with additional expenses for technological processing or makes fish completely unsuitable. Besides larval Anisakis sp. are dangerous for man (Myers, 1976).

Though the bulk of larval Anisakis sp. are localized amongst the blue whiting viscera not used for human consumption and fish are processed before use, the possibility is not excluded that dead nematodes are able to cause heavy contamination because of dissimilation products concentrating in the primary cavity of nematodes. Depending on technology of fish processing some nematodes preserve viability and are able to perforate the walls of the alimentary canal. By Grabda's data (1974), larval Anisakis sp. in herring kept in 15-19% saline solution were viable for 7-35 days. The similar data are presented by V.I. Muravyov (1970), in whose experiments larval Anisakis sp. taken from the body cavity of fish and put into the sea water at 6.5-8°C were viable for 35-36 days. Survival of larvae grows shorter up to 20-25 minutes only with the rise of temperature

up to 25°C and declines to 4-5 minutes with the rise of temperature up to 35°C.

Studying mortality of Anisakis sp. and their penetrating capacity, Oishi and Hiraoki (1973) proved that after 15 days of keeping larvae in physiological solution their mortality was a little higher than 10%, and penetrating capacity was approximately constant during the experiment. On this basis the authors assume that parasites viable in underdone food are still dangerous for human health, and penetrating capacity of live larvae in human digestive tract is constant at least within 18 days.

In this connection it may be supposed that larval Anisakis sp. can penetrate the blue whiting flesh after capture and keeping fish at positive temperature for a long time. However, we did not manage to prove it in our experiment. At the same time, the data of Smith and Wootten (1975) illustrate that after 14-37 hours of keeping herring at +3, +10°C, counts of larvae in ventral muscular tissue increase - the fact, which is, in their opinion, connected with active migration of larval Anisakis sp. in the fish flesh.

Thus, the migration of larval nematodes in the blue whiting flesh is likely to be observed with the increase of the period of keeping fish before freezing (it was not longer than 12 hours). That is why only short-term keeping of caught fish at positive temperature is permitted.

Conclusions

As a result of parasitological analysis of 175 blue whiting specimens (7 samples of 25 fish) caught on July, 5, 1979, in the Norwegian Sea, larval Anisakis sp. were found in the flesh of 99.4% of fish with mean intensity of infestation of 5.49 (1-34) specimens per one fish.

In dorsal musculature larval nematodes were found in 14.3% of fish with mean intensity of infestation of 0.16 (1-3) specimens per one fish. As to ventral musculature larval nematodes were found in 99.4% of fish. The mean intensity of infestation was 5.3 (1-33) specimens per one fish.

As a result of parasitological analysis of blue whiting frozen 0, 2, 4, 6, 8, 10 and 12 hours after capture, no notable changes in infestation of fish flesh were registered.

It is proved that larval Anisakis sp. penetrated the blue whiting flesh under natural conditions, that is in the sea.

Table 1

Infestation of blue whiting flesh with larval Anisakis sp.

No. of sample	Period of time after capture	Dorsal part					Ventral part					Total		
		Infested fish in %	Intensity of infestation			Infested fish in %	Intensity of infestation			Infested fish in %	Intensity of infestation			
			min.	max.	mean		min.	max.	mean		min.	max.	mean	
1	0	8,0	I	I	0,08	96,0	I	I7	6,36	96,0	I	I7	6,44	
2	2	16,0	I	I	0,16	100,0	I	11	4,12	100,0	I	11	4,23	
3	4	16,0	I	I	0,16	100,0	I	13	4,04	100,0	I	13	4,20	
4	6	16,0	I	3	0,20	100,0	I	29	6,04	100,0	I	29	6,24	
5	8	12,0	I	I	0,12	100,0	I	24	5,32	100,0	I	24	5,44	
6	10	16,0	I	I	0,16	100,0	I	19	5,44	100,0	I	19	5,60	
7	12	20,0	I	2	0,24	100,0	I	33	5,96	100,0	I	34	6,20	

References

- Andersen K. 1977. A marine Diphyllobothrium plerocercoid (Cestoda, Pseudophyllidea) from blue whiting (Micromesistius poutassou). "Z. Parasitenk," v. 52, No.3, pp.289-296.
- Davey J.T. 1971. A revision of the genus Anisakis Dujardin, 1845 (Nematoda: Ascaridata). "J.Helminth," v.45, pp.51-72.
- Gaevskaya A.V., A.A. Kovaleva. 1976. On blue whiting infestation with Myxosporidia in the Northeast Atlantic. "Trudy AtlantNIRO, vyp. 65, pp. 164-167.
- Grabda J. ^{1974.} Badania nad przezywalnoscia larw niceni Anisakis simplex. "Rocz PAM Szczecinie", v. 10, pp.47-52.
- Grabda J. 1978. Studies on parasitic infestation of blue whiting (Micromesistius sp.sp.) with respect to the fish utilization for consumption. "Acta ichthyol. e piscator", v.8, No.1, pp.29-41.
- Margolis Z., M.D. Dailey. 1972. Revised annotated list of parasites from sea mammals caught off the west coast North America. "Tech. Rept. Nat. mar. Fish. Ser. U.S., SSRF-647", pp.1-23.
- Muravyov V.I. 1970. On biology of parasitic nematodes of herring and blue whiting in the North Atlantic waters. "Materialy rybokhoz. issledov. Sev. basseina, vyp. 14, pp.86-95.
- Myres B.J. 1976. Research then and now on the Anisakidae nematodes. "Trans. Amer. Microsc. Soc.", v. 95, No.2, pp.137-142.
- Oishi K., M. Hiraoki. 1973. Food hygienic studies on Anisakis larvae.IV. On the relation between the mortality and the penetration capacity of the larvae into an agar layer. "Bull. Jap. Soc. Sci. Fish.", v.39, No.12,

pp. 1345-1348.

1975
Platt N.E. Infestation of cod (Gadus morhua L.) with larvae of codworm (Terranova decipiens Krabbe) and herringworm Anisakis sp. (Nematoda: Ascaridata), in North Atlantic and Arctic waters. "J. Appl. Ecol.", v. 12, No. 2, pp. 437-450.

1955
Polyansky Yu. I. USSR northern seas fish parasitology materials. Barents Sea fish parasites. Trudy ZIN AN SSSR, 19: 1-170.

Scott D.M., M.D. Fisher. Incidence of a parasitic Ascarid ferro-caecum decipiens in the common porpoise, Phocaena phocaena, from the lower Bay of Fundy. "J. Fish, Res. Bd. Can.", v. 15, pp. 1-4.

Shiraki T., H. Hasegawa, Kennotsu M., H. Otsuru. 1976. Larval Anisakid Nematodes from the Prawns, Pandalus spp. "Jap. J. Parasitol.", v. 25, No. 3, pp. 148-152.

Smith J.W. 1971. Thysanoessa inermis and T. longicaudata (Euphausiidae) as first intermediate host of Anisakis sp. (Nematoda: Ascaridata) in the northern North Sea, to the North of Scotland and at Faroe. "Nature, Lond.", No. 234, pp. 478.

Smith J.W., R. Wootten. 1975. Experimental studies on the migration of Anisakis sp. larvae (Nematoda: Ascaridida) into the flesh of herring, Clupea harengus L. "Int. J. Parasitol.", v. 5, No. 2, pp. 135-136.

Sauks H., Lorenz H., Steding D. Zur Parasitierung des Blauen Wittling Micromesistius poutassou (Risso, 1810). "Wiss. Z. Päd. Hochschule "Liselotte-Herrmann" Güstrow. Math.-Naturwiss. Fac.", 1978, No. 1, pp. 143-151.

Uspenskaya A.V. 1963. Barents Sea benthic crustacean parasitic fauna. M.L., izd. AN SSSR: 1-128.

Williams H.H. 1959. A list of parasitic worms, including 22 new-record from marine fishes, caught off the British Isles. "Ann. Mag. Nat. Hist.," ser.13, v.2, No.24, pp.705-715.