*Andrzej CHODYNIECKI, Marek KURPIOS, Mikołaj PROTASOWICKI,
Andrzej OCIEPA, Janina JURAN*

Toxicology

**STUDIES ON MERCURY CONTENT IN SELECTED FISH SPECIES
FROM POMERANIAN GULF AND SZCZECIN FIRTH**

**BADANIA NAD ZAWARTOŚCIĄ RTECI OGÓLNEJ W WYBRANYCH
GATUNKACH RYB ZATOKI POMORSKIEJ I ZALEWU SZCZECIŃSKIEGO**

From Institute of Marine Food Technology

Determinations were made on mercury content in muscles of cod and herring from Pomeranian Gulf and of pikeperch and eel from Szczecin Firth. Additionally, the level of Hg was measured in liver and kidneys of selected cod and herring batch. Eventual relationship was investigated between mercury content, species of fish, weight and fishing grounds.

INTRODUCTION

The increasing usage of mercury-compounds in industry and agriculture during the last thirty years have caused in some regions mercurialism and many cases of death. There were many well-known instances of people being poisoned by preserves of mordanted grain in Iraq, Pakistan and Guatemala in the 1950's. (Diehl, Schelenz, 1971). The Canadians and Americans (Turney, 1971) reported on cases of mercurialism after eating polluted bird's flesh.

In Japan, in the sea-side villages of Minamata and Niigata, 168 people were poisoned with organic mercury, 52 of them died. (Irukayama, 1966). This was caused by chemical factory wastes, which contained methylmercury and were drained off directly into sea water.

Mercury accumulation in the samples taken from bottom of sea was 780 mg/kg and in water organisms – 100 mg/kg. That signalized the problem of mercury pollution.

The investigations carried-out in Sweden (Johnels et al., 1967; Westöö and Rydaly, 1971), in Canada (Wobeser et al., 1970; Zitko et al., 1971), in USA (Dunlap, 1971), in Denmark (Dalgaard-Mikkelsen, 1969) and in West Germany (Nehring et al., 1971) showed

that in many cases, flesh of the tested fish contained more mercury than allowed by the respective standards.

In 1970, 8200 kg of fish from St. Clair Lake in Canada was not permitted for sale. In 1970, the USA state government forbade fishing in many rivers and lakes; 10 millions of the canned tunny were not allowed for consumption, and the Food and Drug Administration decided that, flesh of the swordfish was unmarketable. (Dunlap, 1971).

In Polans, the analyses on mercury accumulation were made by Wierzchowski and Nabrzyski (1971) on fish from Gdańsk Gulf and Wdzydze Lake. They did not found any marked quantity of mercury in sea fish, while in fish from Wdzydze Lake in amounted to 0.028–0.068 mg/kg.

As the Swedish, West German and Danish investigators stated, mercury levels in fish from the south-western part of Baltic did not evidence the downward tendency. That is why the present investigation was taken up. The main purpose of it was to measure the mercury accumulation in fish from Pomeranian Gulf and Szczecin Firth.

MATERIALS AND METHODS

The following material was used:

- 50 pcs of cod – *Gadus morhua* L. – of unit weight from 400 to 2900 g;
- 50 pcs of herring – *Clupea harengus membras* L., of unit weight from 45 g to 200 g;
- 24 pcs of eel – *Anguilla anguilla* (L.), of unit weight from 100 g to 1200 g, and
- 52 pcs of pike-perch – *Lucioperca lucioperca* (L.), of unit weight from 500 g to 1700 g.

The sea fish: cod and herring were caught in Pomeranian Gulf, while eel and pike-perch in Szczecin Firth. Mercury content in each fish's muscles was determined. Additionally, the mercury accumulation in livers and kidney was determined in batch of fishes selected at random. The samples from muscles and parenchymatous organs were treated with the Jacob's method and then the extraction of mercury was made with dition according to Sandells (1959).

Mercuric dithizonate extinction was measured at wave length 485 nm. All tests were repeated three times.

RESULTS

The results showed that, mercury content in investigated fish ranged from 0.00 to 0.37 mg/kg (Table 1). The highest mercury content was found in two eels of unit weight 110 g and 480 g, and was correspondingly 0.37 and 0.25 mg/kg, and in two pike-perches, of unit weight 2440 g and 3470 g and was correspondingly 0.35 mg/kg and 0.21 mg/kg.

Certain relationship between unit weight and mercury accumulation in the investigated sea and freshwater fishes was noted. In general, higher Hg accumulation revealed smaller cod and herring, bigger size ell and pike-perch.

Table 1

The average mercury content in muscles of cod and herring from the Pomeranian Gulf,
as well as in those of pike-perch and eel from the Szczecin Firth

Species	No of samples	Weight interval (g)	Mercury content interval (mg/kg)	The average mercury content*) (mg/kg)
cod – <i>Gadus morhua</i> L.	10	400 – 500	0.04 – 0.17	0.08
	7	500 – 600	0.05 – 0.16	0.08
	13	600 – 700	0.04 – 0.12	0.07
	7	700 – 1.000	0.01 – 0.07	0.05
	13	1.000 – 2.900	0.01 – 0.13	0.06
herring – <i>Clupea harengus membras</i> L.	29	45 – 100	0.00 – 0.20	0.07
pike-perch – <i>Lucioperca lucioperca</i> (L.)	7	100 – 200	0.00 – 0.17	0.06
pike-perch – <i>Lucioperca</i> (L.)	12	480 – 600	0.02 – 0.09	0.06
	12	600 – 700	0.01 – 0.17	0.07
	16	700 – 1.000	0.00 – 0.12	0.06
eel – <i>Anguilla anguilla</i> (L.)	17	1.000 – 3.640	0.01 – 0.35	0.09
	12	100 – 200	0.04 – 0.37	0.10
	12	200 – 1.200	0.00 – 0.25	0.11

*) 4 fish individuals of muscle Hg content above 0.20 mg/kg not considered when calculating the average values.

Fig. 1. The average mercury content in the muscles of: 1-cod, 2-herring, 3-pike-perch, 4-eel

The average mercury content in the muscular tissues of all four investigated species, is shown on Fig. 1. It ascertained that, the average mercury content in the muscular tissues of cod, herring and pike-perch was identical – 0.07 mg/kg, while of eel, was 1.6 times higher.

The results of examining the mercury content in the livers and kidneys of selected species of herring and cod from Pomeranian Gulf are shown on Fig. 2. As it appears that, the largest mercury accumulation was found in liver of both species. The average mercury content in the herring's liver is 2.5 times higher and in the cod's kidneys amounted to 75% only of the corresponding mercury content in tissue.

Fig. 2. Mercury content in herring's and cod's: 1—muscles, 2—liver, 3—kidneys

DISCUSSION

The results obtained show that, all investigated fishes from Pomeranian Gulf as well as from Szczecin Firth were principally polluted with mercury. Its accumulation in the muscles of investigated species (cod, herring, eel and pike-perch) ranged from 0.00 to 0.37 mg/kg.

The present investigation revealed relatively smaller Hg accumulation in fish of Pomeranian Gulf and Szczecin Firth, than other investigators for the same species of other regions: Finland (Helminen et al., 1968), Japan (Irukayama, 1966), Canada and USA (Zitko et al., 1971; Wobeser et al., 1970) and from Sweden (Westöo and Rydaly, 1971). Those investigators, in many cases, indicated to mercury accumulation exceeding 2.0 mg/kg. This was referred to predator type of fish from the rivers and lakes in North America, Scandinavia and from other regions polluted with industrial wastes.

From our investigations and some other reports appears that, the mercury content was different in fishes of the same species caught at the same place and time. Hannerz (1968) observed that such differences may be as high as tenfold of initial value. This may be connected with great activity and fast translocation of the tested species. It seems that, the sedentary species, for example flat-fish, should be more useful as the indicators of mercury contamination in the particular sea-region.

Very similar relations were noticed in fresh water fish by Wobeser et al., (1970), Hannerz (1968) and Rucker and Amend (1969).

CONCLUSIONS

1. Mercury content in muscles of examined species ranged from 0.00 to 0.37 mg/kg.
2. The largest mercury content was found in two eels – 0.25 mg/kg and 0.37 mg/kg and in two pike-perches – 0.35 mg/kg and 0.21 mg/kg.
3. The highest average content was found in the eel's muscular tissue – 0.11 mg/kg.
4. Mercury accumulation in cod's liver was 1.6 times higher in herring than in muscles of these species. Mercury accumulation in herring's kidneys was 1.5 higher than in muscles, and in cod's kidneys amounted 75% of the corresponding value in muscles.
5. Constant checking on mercury levels in fish is necessary from Baltic industrial and adjacent waters.

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Translated: Irena Kliche.

BADANIA NAD ZAWARTOŚCIĄ RTĘCI OGÓLNEJ W WYBRANYCH GATUNKACH RYB ZATOKI POMORSKIEJ I ZALEWU SZCZECIŃSKIEGO

Streszczenie

Przebadano 172 ryby z Zatoki Pomorskiej i Zalewu Szczecińskiego. Należały one do gatunków: dorsz, śledź, węgorz i sandacz. Wykazano, że poziom rtęci w mięśniach tych ryb wahał się w granicach od 0,00-0,37 mg/kg. Najwyższą zawartość Hg stwierdzono u 2 sztuk węgorza i wynosiła ona 0,25 oraz 0,37 mg/kg, a także u 2 sztuk sandacza mianowicie 0,35 i 0,21 mg/kg. U badanych gatunków ryb wykazano pewne zależności między ciężarem ryb a zawartością rtęci. U dorszy i śledzi osobniki mniejsze wykazywały w zasadzie wyższy poziom Hg. U węgorzy i sandaczy natomiast sztuki większe zawierały większe ilości rtęci. Średni najwyższy poziom tego metalu wykazano w tkance mięśniowej węgorza i wynosił on 0,11 mg/kg. Zawartość rtęci w wątrobie dorsza była 1,6-krotnie a u śledzia 2,5-krotnie wyższa aniżeli w mięśniach tych ryb. W nerkach śledzia poziom Hg był 1,5 raza wyższy aniżeli w mięśniach, zaś u dorsza stanowił tylko 0,75 zawartości stwierdzonej w mięśniach.

ИССЛЕДОВАНИЯ НАД СОДЕРЖАНИЕМ ОБЩЕЙ РТУТИ В НЕКОТОРЫХ ВИДАХ РЫБ ИЗ ПОМОРСКОЙ БУХТЫ И ШЕЦИНСКОГО ЗАЛИВА

Резюме

Исследованию было подвергнуто 172 экземпляра рыб из Поморской бухты и Щецинского залива. Они принадлежали к следующим видам: треска, сельдь, угорь и судак. Установлено, что уровень ртути в мышцах этих рыб колебался в пределах от 0,00 до 0,37 мг/кг. Самое высокое содержание ртути установлено у 2 экземпляров угря (оно составляло 0,25 и 0,37 мг/кг), а также у 2 экземпляров судака (0,35 и 0,21 мг/кг). У исследуемых видов рыб установлена определённая зависимость между весом рыб и содержанием ртути. У трески и сельди более мелкие особи содержали, в основном, более высокий уровень ртути. У угря же и у судака более крупные экземпляры имели большее количество ртути. Средний максимальный уровень этого металла констатирован в мышечной ткани угря; он составлял 0,11 мг/кг. Содержание ртути в

печени трески было в 1,6 раз, а у сельди в 2,5 раз выше, чем в мышцах этих рыб. В почках сельди уровень ртути был в 1,5 раз выше, чем в мышцах, а у трески он составлял только 0,75 содержания этого металла, констатированного в мышцах.

Address:

Received: 3 I 1974 r.

Doc. dr hab. Andrzej Chodyniecki
Instytut Technologii Żywności
Pochodzenia Morskiego AR
71-550 Szczecin, ul. Kazimierza Królewicza 4
Polska – Poland