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Toxicology

A STUDY ON THE MERCURY CONTENT IN MUSCLES IN THE FISH
FAMILY *Carangidae* FROM THE FISHING GROUNDS OFF THE COAST
OF NORTH-WEST AFRICA

BADANIA ZAWARTOŚCI RTĘCI W MIĘŚNIACH RYB Z RODZINY
Carangidae Z ŁOWISK PÓŁNOCNO-ZACHODNIEJ AFRYKI

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The mercury content in muscles was determined for 171 fishes belonging to three species of the family *Carangidae*. Significant differences in the content of this element were found between the species. Moreover, as regards the horse mackerel (*Trachurus trachurus*), no correlation was detected between the weight of fishes and the amount of mercury and no difference in the level of this element between males and females.

INTRODUCTION

Fishes have a capacity of accumulating different microelements present in the water environment. As early as 1934 Stock and Cucuel found that some amounts of mercury occur in fishes and that they do not exceed 0.150 mg.kg^{-1} in sea fishes. A series of publications suggest that the mercury content below this level should be regarded as natural (Klein, 1972), i.e. that it has not been affected by the environmental contamination caused by human activity.

The mercury content in muscles of fishes may also be influenced by their ways of living. As can be seen from the studies made by Bligh (1972) and Establier (1973),

predatory fishes contain larger amounts of this element than do the plankton feeders. The authors own studies carried out hitherto do not confirm this relationship (Chodyniecki, et al., 1975; Protasowicki et al., 1975); it has however been demonstrated in them that there is a difference between the fishes living in deep waters and the bottom dwellers; the latter fishes contained larger amounts of this element (Protasowicki et al., 1975).

As far as fresh-water fishes are concerned, it has also been found that the age of fishes and consequently their size determine the mercury content in the muscular tissue (Forrester et al., 1972; Johnes et al., 1967, and the authors' own unpublished studies). It has been pointed out that the larger (older) fishes contain greater quantities of mercury.

In addition to the above-mentioned agents, the mercury content in fishes may also be influenced by sex. This is indicated by studies carried out by Forrester et al. (1972), showed that the males of *Squalus acanthias* contain more mercury than the females.

No publications on the mercury content in horse mackerel have been found in available literature. The filling of this gap and a study of relationships and changes associated with age, sex, and species seem to be very instructive. Members of the family *Carangidae*, besides, from a fairly large proportion of fishes in the catches made by the Polish trawlers in depp-sea fisheries. For these reasons we have undertaken the present investigation.

MATERIAL AND METHODS

Muscular tissue of three fish species – horse mackerel *Trachurus trachurus* (118 specimens), saurel *Trachurus picturatus* (22 specimens) and jack *Caranx rhonchus* (31 specimens) – caught in the fisheries of north-west Africa from January to April 1973, were used for this study.

Fishes were delivered frozen to our laboratory in June 1973. After morphometric were taken and sex determined, the mercury content was measured in muscular tissue. For this purpose 5-gramme samples, weighed to an accuracy of 0.01 g, were taken. The samples were combusted by the method described by Jackobs et al. (1960) in concentrated sulphuric acid and a saturated solution of potassium permanganate at 60–70°C. Mercury ions were extracted with diphenylthiocarbasonone by the Sandell method (1959). The extinction of mercury diphenylthiocarbasonate was determined at a were length of 485 μ .

All the determinations were repeated three times. Blank tests were made at the same time and the data obtained from them were taken into account in the calculation of the final results.

RESULTS AND DISCUSSION

The results of determinations of the mercury content in muscular tissue in the three fish species under study are given in Table 1. The values tabulated have been marshalled in a distribution series.

Table 1

Distribution of mercury contents in muscular tissue of the
horse mackerel fishes caught in the Atlantic off the north-western coast of Africa

Ser.No.	Groups of mercury content, mg·kg ⁻¹	Horse mackerel – <i>Trachurus trachurus</i>		Jack – <i>Caranx rhonchus</i>		Saurel – <i>Trachurus picturatus</i>	
		Number	Frequency	Number	Frequency	Number	Frequency
1	0.00–0.05	36	0.305	19	0.613	5	0.227
2	0.06–0.10	27	0.229	7	0.227	9	0.408
3	0.11–0.15	28	0.238	3	0.096	2	0.091
4	0.16–0.20	13	0.110	0	0.000	1	0.045
5	0.21–0.25	8	0.068	1	0.032	4	0.184
6	0.26–0.30	4	0.033	0	0.000	1	0.045
7	0.31–0.35	2	0.017	1	0.032	0	0.000
	Total	118	1.000	31	1.000	22	1.000

The mean values of the mercury content in the tissues of these fish species, calculated on the basis of the distribution series, are shown in Table 2, which gives also the confidence intervals for the mean at the significance level = 0.05 so that the true mean may be estimated. In order to establish the significance of differences in the amount of mercury between the fish species under study, an analysis of variance for groups with unequal replication with single criteria of classification was carried out. The result of this analysis indicates that there are significant differences in mercury content between the species examined ($P_{\text{cal.}} = 8.92$ against $P_{0.05} = 4.74$). It has been proved by grouping the mean values from samples with the help of Duncan's multiple-range test that the mean mercury content in *Caranx rhonchus* is significantly lower than the mean content of this element in *Trachurus trachurus* and *Trachurus picturatus* (Table 2).

Table 2

Mean mercury content in muscular tissue of selected species of horse mackerel fishes and confidence interval for mean

Ser.No.	Fish species	Number	Mean mercury content and confidence interval ($\alpha = 0.05$) $\text{mg} \cdot \text{kg}^{-1}$	Homogeneous groups
1	<i>Trachurus trachurus</i>	118	0.103±0.014	I
2	<i>Trachurus picturatus</i>	22	0.109±0.035	I
3	<i>Caranx rhonchus</i>	31	0.062±0.024	I

Table 3

Mercury content in muscular tissue of the horse mackerel *Trachurus trachurus* according to sex

Sex	Number	Mean mercury content and confidence interval ($\alpha = 0.05$), $\text{mg} \cdot \text{kg}^{-1}$	$F_{\text{emp.}}$
Males ♂	12	0.120±0.050	2,67
Females ♀	10	0.101±0.034	

Subjects were fishes in the weight group of 201–300 g.

Among the three trachurid species studied, horse mackerel *Trachurus trachurus* was the most numerous, represented by 118 specimens and at the same time characterized by the greatest range of body weight (27–810 g). This is why it was this material that was examined for correlation between the body weight of fishes and their mercury content. No such correlation has been found, for the calculated correlation coefficient $r = 0.128$ does not differ significantly from zero ($t_{\text{cal.}} = 1.39$ against $t_{116;0.05} = 1.98$).

The differences in mercury content between males and females of the same species were also examined for significance. For the purpose specimens for which it was possible

to determine sex unambiguously were selected from all the horse mackerel of this species in the body weight group of 201–300 g. Table 3 gives the results of the analysis of the mercury contents calculated as means with confidence intervals for the male and female specimens, the determination of the significance of differences between the means being based on the F test. The analysis showed that the differences in mercury content in muscular tissue between males and females are not significant.

CONCLUSIONS

1. It has been found that the amounts of mercury in the muscles of *Caranx rhonchus* are smaller than those in *Trachurus trachurus* and *Trachurus picturatus*.
2. No correlation has been demonstrated between the body weight and the mercury content in the muscles of the horse mackerel.
3. No differences were found in the mercury content in the muscles of the horse mackerel between male and female specimens.

ACKNOWLEDGEMENT

The authors wish to express their thanks to Dr Andrzej Kompowski and Eng. Jan Wojciechowski for the collection and determination of materials.

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Translated: mgr Teresa Radziejewska

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Z ŁOWISK PÓŁNOCNO-ZACHODNIEJ AFRYKI

Streszczenie

W niniejszych badaniach przeprowadzono porównanie zawartości rtęci w rybach trzech gatunków rodziny *Carangidae*. Były to: ostrobok – *Trachurus trachurus* – 118 szt., ostrobok czarny – *Trachurus picturatus* – 22 szt. i chropik – *Caranx rhonchus* – 31 szt. Średnia zawartość rtęci w mięśniach wynosiła: u ostroboka – $0,103 \pm 0,014$, u ostroboka czarnego – $0,109 \pm 0,035$ i u chropika – $0,062 \pm 0,024 \text{ mg} \cdot \text{kg}^{-1}$.

Na podstawie analizy statystycznej stwierdzono, że chropik zawierał mniej rtęci aniżeli ryby dwóch pozostałych gatunków. W przypadku ostroboka przeprowadzono analizę korelacji pomiędzy ciężarem ciała a zawartością rtęci. Badano także zależność zawartości tego pierwiastka od płci. W obydwu przypadkach zależności takich nie znaleziono.

ИССЛЕДОВАНИЯ СОДЕРЖАНИЯ РТУТИ В МЫШЦАХ РЫБ СЕМЕЙСТВА
CARANGIDAE ИЗ РАЙОНОВ ЛОВА СЕВЕРО-ЗАПАДНОЙ АФРИКИ

Р е з ю м е

В настоящей работе приводится сравнение содержания ртути в рыбах трёх видов из семейства *Carangidae*. Это были: ставрида обыкновенная – *Trachurus trachurus* – 118 экземпляров, *Trachurus picturatus* – 22 экземпляра и *Caranx rhonchus* – 31 экз. Среднее содержание ртути в мышцах составляло у ставриды обыкновенной – $0,103 \pm 0,014$, у *Trachurus picturatus* $0,109 \pm 0,035$ и у *Caranx rhonchus* – $0,062 \pm 0,024 \text{ мг/кг}^{-1}$.

На основестатистического анализа установлено, что в мышцах *Caranx rhonchus* было меньше ртути, чем в мышцах рыб двух остальных видов. Что касается ставриды обыкновенной, то здесь был проведен анализ корреляции между весом тела а содержанием ртути. Исследовалась также зависимость содержания этого элемента от пола. А обоих случаях такие зависимости не были обнаружены.

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Received: 22 IX 1975 r.

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