

## The Levels of Mercury and Selenium in Gonad of Big-eyed Tuna\*<sup>1</sup>

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The levels of mercury and selenium in twenty-one gonad specimens (11 testes and 10 ovaries) of big-eyed tuna *Thunnus obesus* are presented.

Total mercury content (T-Hg) correlated significantly between in gonad and in muscle, and T-Hg in gonad was about 15 % of that in muscle. Methyl mercury content (MeHg) in ovary was significantly higher than that in testis.

Selenium content (Se) was relatively high, and Se in ovary was also significantly higher than that in testis. The molar ratio of Se to T-Hg correlated negatively with T-Hg, and tended to drastically decrease with the increase in T-Hg.

The mercury level in ordinary muscle of big-eyed tuna *Thunnus obesus* was previously reported to be higher than that in yellow fin *Thunnus albacares* and albacore *Thunnus alalunga*, while the selenium level was about the same among those three different species of tunas and was nearly constant.<sup>1,2)</sup> From these results, the difference of accumulated amounts of mercury and selenium was speculated to be observed in

other organs than muscle tissue of those species.

We previously reported the levels of mercury and selenium in gonads of marlins<sup>3)</sup> and tunas<sup>4)</sup>, and the relationship between both the levels. Therefore, we report here those levels in gonad of big-eyed tuna and discuss their quantitative relationship in comparison with the results<sup>4)</sup> in yellow fin and albacore.

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## Materials and Methods

### Materials

Twenty-one gonad specimens (11 testes and 10 ovaries) of big-eyed tuna *Thunnus obesus* captured in the Indian Ocean from November to December 1984 were used in the present study. The fishing location was shown in Fig.1, and the fork length and gonad weight were also shown in Table 1.

### Determination of Mercury and Selenium

Total mercury, methyl mercury and selenium content (abbreviated as T-Hg, MeHg and Se, respectively) were measured by flameless atomic absorption spectrometry,<sup>5)</sup> gas chromatography with electron capture detector<sup>6)</sup> and fluorometry using naphthalene-2,3-diamine,<sup>7)</sup> respectively.

## Results and Discussion

Analytical data of T-Hg, MeHg and Se in gonad were shown in Table 1.

### Mercury Level in Gonad

There was no significant difference from

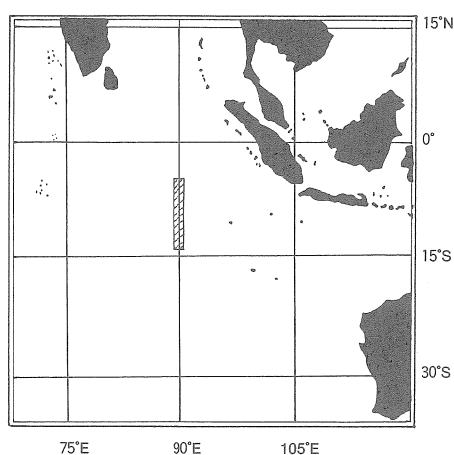


Fig. 1. Fishing location (shaded area).

Table 1. Analytical data in gonad of big-eyed tuna

Gonad	F. L.* (cm)	G. W.** (g)	T-Hg ( $\mu$ g/g)	MeHg ( $\mu$ g/g)	Se ( $\mu$ g/g)
	105.0	172	0.14	0.07	2.09
	112.8	129	0.09	0.05	1.00
	116.0	434	0.09	0.05	0.65
	117.5	316	0.35	0.20	1.22
	118.0	233	0.17	0.07	0.71
Testis	123.0	387	0.17	0.06	1.02
	124.5	167	0.12	0.04	0.68
	129.0	254	0.15	0.08	0.90
	131.0	326	0.10	0.04	0.59
	147.0	540	0.17	0.06	1.09
	154.0	262	0.26	0.12	1.03
Mean	125.3	293	0.16	0.08	1.00
	102.4	184	0.08	0.05	1.70
	112.0	540	0.16	0.12	2.06
	114.0	418	0.14	0.10	5.02
	116.5	739	0.12	0.07	3.48
Ovary	118.5	506	0.11	0.04	1.99
	127.0	425	0.16	0.08	2.44
	127.3	364	0.27	0.19	2.31
	140.5	650	0.22	0.10	1.30
	153.0	747	0.37	0.24	1.99
	177.0	377	0.43	0.35	2.01
Mean	128.8	495	0.21	0.13	2.43
Total mean	127.0	389	0.18	0.10	1.71

\* : Fork Length.      \*\* : Gonad Weight.

t-test in T-Hg between testis and ovary. The ranges of T-Hg was 0.08 to 0.43  $\mu$ g/g (0.18  $\mu$ g/g as mean content). On the other hand, there was a significant difference from t-test in MeHg between testis and ovary. The ranges of MeHg in testis and ovary were 0.04 to 0.20  $\mu$ g/g

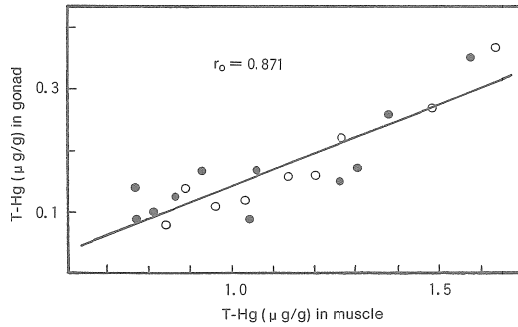


Fig. 2. Relation of T-Hg between in gonad and in muscle of big-eyed tuna (● : testis; ○ : ovary).

and 0.04 to 0.35  $\mu\text{g/g}$  (0.08  $\mu\text{g/g}$  and 0.13  $\mu\text{g/g}$  as each mean content), respectively. The mean content of MeHg in ovary was higher than that in testis as not in the cases of yellow fin and albacore.<sup>4)</sup> Furthermore, both the mercury contents were significantly higher than those in yellow fin and albacore, as in the cases of muscle.<sup>1,2)</sup> As shown in Fig. 2, a positive correlation of T-Hg between gonad and muscle in the same individual was obtained at a significant level of 1%. About 15% of T-Hg in muscle corresponded to that in gonad, and the mean ratio of MeHg to T-Hg (0.56) was about the same in the cases of yellow fin and albacore.<sup>4)</sup> Moreover, from the fact that there was no significant correlation between mercury content and gonad weight (or gonadosomatic index), it was found that mercury accumulates in gonad irrespective of its maturity.

#### Selenium Level in Gonad

There was a significant difference in Se between testis and ovary as in the case of MeHg. The ranges of Se in testis and ovary were 0.59 to 2.09  $\mu\text{g/g}$  and 1.30 to 5.02  $\mu\text{g/g}$  (1.00  $\mu\text{g/g}$  and 2.43  $\mu\text{g/g}$  as each mean content), respectively. The mean content of Se in ovary was significantly higher than that in testis from t-test. Moreover, the total mean content of Se

was also significantly low compared with that in yellow fin and albacore.<sup>4)</sup> On the other hand, there was no significant correlation between selenium content and gonad weight (or gonadosomatic index) as in the case of mercury content. These findings may suggest that selenium essentially exists in gonad and plays an important role in ovary such as oögenesis, or in hatching.<sup>3,4)</sup>

#### Relationships between Se and T-Hg in Gonad

There was no significant correlation between Se and T-Hg in gonad as in the case of another tissues or organs.<sup>1,2)</sup> The ranges of molar ratio (Se/Hg) of Se to T-Hg in testis and ovary were 8.86 to 37.92 and 13.87 to 91.09 (17.29 and 39.84 as each mean ratio), respectively. The total mean ratio (28.03) was considerably small compared with that (yellow fin: 317.8; albacore: 96.6) in yellow fin and albacore.<sup>4)</sup> Therefore, each logarithmic value of Se/Hg (molar basis) was plotted against that of T-Hg (Fig. 3). As two regression curves in the figure show, negative correlations were observed in both cases of testis and ovary. Furthermore, it was observed that the value of Se/Hg (molar basis) tended to drastically decrease with the increase in T-Hg, as in the case of muscle.<sup>1,2)</sup>

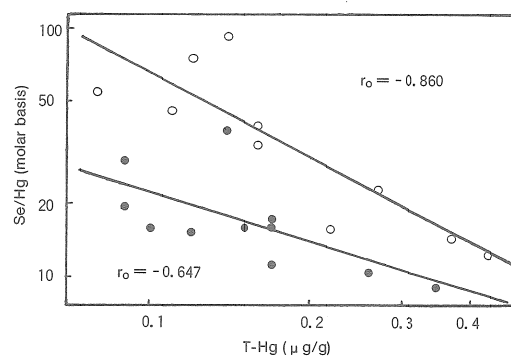


Fig. 3. Relation between Se/Hg (molar basis) and T-Hg in gonad of big-eyed tuna (● : testis; ○ : ovary).

**Table 2.** The molar ratio of  $\Delta\text{Se}/\Delta\text{Hg}$  in testis of big-eyed tuna

	T-Hg ( $\mu\text{g/g}$ )		Se ( $\mu\text{g/g}$ )	
	Range	Mean	Range	Mean
(a) High Hg group*	0.17 - 0.35	0.22	0.71 - 1.22	1.01
(b) Low Hg group**	0.09 - 0.15	0.12	0.59 - 2.09	0.99
$\Delta \text{ (molar basis)} = \frac{(a)-(b)}{\text{atomic weight}}$				
$\Delta\text{Se}/\Delta\text{Hg} \text{ (molar basis)} = \frac{1.01-0.99}{0.22-0.12} \times \frac{200.59}{78.96}$				
=0.51				

\* : The group of higher mercury content than the mean content  
(0.16  $\mu\text{g/g}$ ) of T-Hg.

\*\* : The group of lower mercury content than the mean content  
(0.16  $\mu\text{g/g}$ ) of T-Hg.

In addition to these findings, we estimated the molar ratio of  $\Delta\text{Se}/\Delta\text{Hg}$  in gonad of big-eyed tuna, using a calculation procedure by H. E. Ganther and M. L. Sunde.<sup>8)</sup> The result only for testis is shown in Table 2, because  $\Delta\text{Se}$  in ovary was negative value as in the cases of yellow fin and albacore.<sup>4)</sup> The smaller value (0.51) of  $\Delta\text{Se}/\Delta\text{Hg}$  (molar basis) will suggest that the accumulation amount of selenium over a basal level in testis is considerably small compared with that of mercury as not in the cases of yellow fin and albacore.<sup>4)</sup>

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## メバチの生殖腺における水銀ならびにセレンレベル

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インド洋産メバチの生殖腺21試料（精巣11試料，卵巣10試料）における水銀およびセレンレベルを測定し，次の結果を得た。

生殖腺の総水銀含量（T-Hg）は，普通筋のその約15%であり，卵巣のメチル水銀含量（MeHg）は，精巣のそれより有意に高かった。

生殖腺のセレン含量（Se）は，比較的高く，卵巣のSeもまた精巣のそれより有意に高かった。T-Hg に対するSeのモル比とT-Hgの間には，負の相関が認められ，そのモル比はT-Hgの増加とともに著しく減少する傾向を示した。