PAPER VI

# Studies on the Contamination of the Fishes Caught by the No. 5 Fukuryu Maru and the Foods Manufactured from These Fishes

Takehiko KIKUCHI, Hiroshi GOTO, Tsuyoshi KONO, Shuichi FUJIOKA, Toshi SANO, Takashi MATSUKI, Masanobu WATANABE, Masando FUJIO, Hiroaki AKAGI, Gyoichi WAKISAKA

(The Second Medical Clinic, Faculty of Medicine, Kyoto University)

and

Sunao OKAMOTO, Fumio HIRAYAMA

(Nuclear Research Laboratory, Institute for Chemical Research, Kyoto University)

## INTRODUCTION

On March 17th 1954, 41 tunas arrived at the Central Market in Kyoto from Yaizu Harbor. In compliance with the request of Dr. Imamura, Chief of the Sanitary Department of Kyoto Municipal Office, these tunas were investigated on their contamination with radioactive ashes. As it was found that one of these tunas was contaminated, further investigation was made of this tuna. On March 18th and 19th 1954, when the No. 5 Fukuryu Maru was investigated at Yaizu Harbor, several fishes caught by the No. 5 Fukuryu Maru and some foods manufactured from these fishes were collected from the Fish-market in Yaizu City. These materials were also investigated on their contamination.

## MATERIALS

1) Tuna obtained from the Kyoto Central Market.

Among 41 tunas examined by a survey meter at the Kyoto Central Market, one was found contaminated. This tuna, together with another one, was brought to our laboratory. The contaminated tuna was 120 cm. in length and 30 cm. in width, and weighed 40 kg. The internal organs had been removed. The other tuna was 100 cm. in length and 30 cm. in width, and weighed 35 kg.

2) Materials obtained from the Fish-market in Yaizu City.

A) Fishes

| | | |
|---|---|---|
| 1) | Tuna | Skin, muscle, and bone (from 4 fishes) |
| 2) | Dolphin fish | Skin, muscle, bone, and gills (from 2 fishes) |
| 3) | Shark | Skin, muscle, and bone (from 3 fishes) |
| | | Liver (removed from the fish and preserved in a can on the deck of the No. 5 Fukuryu Maru) |

(from 5 fishes)
Dried fin (dried, and preserved on the deck of the boat) (from 20 fishes)

4) Sword fish — Skin, muscle, and bone (from 2 fishes)
5) Sardine — 5
6) Mackerel pike — 5

B) Foods manufactured from fishes
1) Steamed fish — 2
2) Hashed fish — 20
3) Fish pie — 3

## METHODS AND RESULTS

For the measurement of radioactivity, an end-window type Geiger-Mueller counter with a thin mica window (3mg./cm$^2$.) and a "100" scaler were used. The distance between the counter and sample was 3.5 cm. The background was 20 counts per minute. Under the same conditions 0.4 $\mu$c. of $Co^{60}$ gave 10,000 counts per minute.

1) Tuna obtained from the Kyoto Central Market.

In order to examine the contamination of the skin, 1 to 2 cm$^2$. tissues were removed from various parts of the tuna, and their radioactivity was measured by the Geiger-Mueller counter. The results are shown in Table 1. Then 1 to 2 grams

Table 1. Radioactivity of the tuna obtained from the Kyoto Central Market (measured on March 20th, 1954)

| Side | Sample | c. p. m. per cm$^2$. |
|---|---|---|
| Right | Cornea | 40.8 |
| 〃 | Gill | 125.5 |
| 〃 | Skin at the root of the fin (with scales) | 60.0 |
| 〃 | Skin 5 cm. above the fin ( 〃 ) | 163.4 |
| 〃 | Skin direct below the fin ( 〃 ) | 166.7 |
| 〃 | Skin 5 cm. below the fin ( 〃 ) | 389.9 |
| 〃 | Skin at the middle part of the trunk ( 〃 ) | 543.1 |
| 〃 | Distal part of the fin | 620.1 |
| 〃 | Distal part of the caudal fin | 276.6 |
| 〃 | Abdominal wall | 100.0 |
| Left | Cornea | 42.8 |
| 〃 | Skin bellow the fin (with scales) | 112.5 |
| 〃 | Skin at the middle part of the trunk ( 〃 ) | 39.0 |
| 〃 | Muscle | 0.0 |

of the skin and scales were weighed, wet ashed with perchloric acid and hydrogen peroxide, transferred into a glass dish 3 cm. in diameter, dried, and the radioactivity

was measured under the same conditions as mentioned above. The results are shown in Table 2. No radioactivity was detected in the other tuna.

Table 2. Radioactivity of the tuna obtained from the Kyoto Central Market (wet ashed and measured on March 20th and 21st, 1954)

| Sample | c. p. m. per gram |
|---|---|
| Scales 1 | 3000 |
| 〃 2 | 3800 |
| 〃 3 | 4500 |
| Skin (without scales) | 30 |
| Muscle | 0 |
| Rib | 0 |
| Vertebra | 0 |
| Brain | 0 |

2) Materials obtained from the Fish-market in Yaizu City.

The materials were wet ashed and the radioactivity was measured in the same way as mentioned above. The results are shown in Table 3.

Table 3. Radioactivity of the materials obtained from the Fish-market in Yaizu City (measured on March 22nd, 1954)

| Sample | c.p.m. per gram | Sample | c.p.m. per gram |
|---|---|---|---|
| Tuna muscle | 0 | Dolphin fish gill | 0 |
| 〃 bone | 0 | Shark muscle | 0 |
| 〃 rib | 0 | 〃 bone | 0 |
| 〃 skin 1 | 66 | 〃 skin | 26 |
| 〃 〃 2 | 320 | 〃 liver 1 | 12 |
| 〃 〃 3 | 0 | 〃 〃 2 | 5 |
| 〃 〃 4 | 0 | 〃 〃 3 | 0 |
| Sword fish muscle | 0 | Shark fin (dried) | 4688 |
| 〃 〃 bone | 0 | Steamed fish | 0 |
| 〃 〃 skin 1 | 73 | Hashed fish | 0 |
| 〃 〃 〃 2 | 184 | Mackerel pike 1 | 0 |
| Dolphin fish muscle | 0 | 〃 〃 2 | 4 |
| 〃 〃 bone | 0 | Fish pie | 0 |
| 〃 〃 skin | 0 | Sardine | 0 |

## DISCUSSION

As shown in Tables 1, 2 and 3 the contamination of the tuna was limited to the exterior part of the body, and no radioactivity was detected in muscles and bones. In the market in Yaizu the same knife was used for the removal of skins

and muscles of the tuna. However, when the knife was washed after each use, no contamination was detected in the muscles. The contamination of the livers of the shark might be explained by the fact that they were removed from the fish and left alone on the deck of the boat. The fins of shark were also left alone on the deck for drying, and the marked contamination of the fins might be attributed to the fact that the radioactive ashes came down on them, when the fins were still suitably wet for the sticking of ashes. The radioactivity of the tuna obtained from the Kyoto Central Market as compared with that of $Co^{60}$ was as follows :

| | | |
|---|---|---|
| Skin (1 $cm^2$.) | $2.4\times10^{-3}$ — $2.4\times10^{-2}$ $\mu$c. | of $Co^{60}$ |
| Scales (1 gram) | $1.2\times10^{-1}$ — $1.7\times10^{-1}$ | 〃 |
| Skin (without scales) | $1.2\times10^{-3}$ | 〃 |

The instruments used for the preparation of samples were easily decontaminated by washing with water.

## SUMMARY

1) Contamination studies were made of the tunas obtained from the Kyoto Central Market and of the materials obtained from the Fish-market in Yaizu City.

2) The contamination of these materials was caused directly by the radioactive ashes and limited to the surface of the materials. No radioactivity was detected in muscles and bones.

3) Contamination of muscles by the radioactive ashes adhered to the skin could be avoided by proper caution.

4) The contamination of the skin of the tuna as compared with the radioactivity of $Co^{60}$ was $10^{-2}$ to $10^{-3}$ $\mu$c. per $cm^2$. and $10^{-1}$ $\mu$c. per gram scales.

## ACKNOWLEDGEMENT

The authors wish to express their gratitude to Dr. T. Maekawa, Chief of Sanitation Division of Shizuoka Prefecture, and the staffs of Yaizu Municipal Office and of Yaizu Fish-market for their kind help in collecting the materials. This work was supported by a special research grant from the Ministry of Education.