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STRONTIUM-90 AND GROSS BETA ACTIVITY IN THE FAT AND NON-FAT FRACTIONS OF COCONUT CRAB (Birgus latro) LIVER COLLECTED AT RONGELAP ATOLL DURING MARCH 1958

by

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ABSTRACT

The values for strontium-90 and gross beta activity in the fat and non-fat fractions from the livers of twelve coconut crabs (Birgus latro) collected at Rongelap Atoll during March 1958 are presented.

Although fat constituted an average of 47 percent by weight on a wet weight basis (74 percent on a dry weight basis), gross beta activity of the fat fraction amounted to less than 0.5 percent of the total activity on a wet weight basis. Fat content on a wet weight basis had a range of 31 percent to 65 percent. There is a linear relationship between strontium-90 activity and gross beta activity. Since the fat content of coconut crab liver is variable and the fat fraction contains practically no radioactivity, it is suggested that the radioactivity (and mineral content) of liver samples be compared on the basis of the non-fat solids.

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INTRODUCTION

There has been a large individual variability in the levels of radioactivity per unit weight of biological samples collected in the vicinity of the Eniwetok Test Site (1, 2, 3, 4, 5). This variability may be great enough to mask or obscure differences which might exist between species or with time or locality of collection. Practical considerations do not permit, in most cases, increasing the number of samples in an attempt to elucidate possible differences. The work reported in this paper points out a source of variability that exists in comparing the radioactivity of various samples of coconut crab liver.

Birgus latro, the coconut crab, is of particular interest since it is edible and known to concentrate strontium-90. In the course of preparing samples of Birgus latro liver for radioassay, it appeared that the fat content varied considerably from specimen to specimen. A crude determination indicated that the fat contained little or no radioactivity, which was expected because of the low mineral content of fat.

It was therefore decided to determine accurately the fat content and the proportions of strontium-90 and gross beta activity in the fat

and non-fat fractions. The objective was to determine whether more uniform results could be obtained when radioisotopic content was expressed on a basis of non-fat solids rather than total solids as had been done in the past.

MATERIALS AND METHODS

Liver samples of coconut crab (Birgus latro) were collected from Kabelle, Rongelap and Eniaetok Islands at Rongelap Atoll in March 1958. The samples were oven dried at 98 ± 2° C and partially pulverized. The fat was extracted from the dried samples by a modification of the Johnson method (6). Petroleum ether was used as the extracting solvent. The fat-free solids were wet ashed with concentrated HNO_3 and H_2O_2. The ash obtained from non-fat solids was dissolved in a known volume of 1 N. HNO_3 and the strontium-90 levels of the samples were determined by the method of Kawabata and Held (7). The gross beta activity was also measured from an aliquot of the solution. The fat content was determined on a dry weight basis by weighing and on a wet weight basis by using the wet weight to dry weight ratios in Table 1. The fat samples were dry-ashed in a muffle furnace at 550° C overnight. The ash obtained from the fat fraction was dissolved in a small volume of 1 N. HNO_3 and was transferred to a plate for determining the gross beta activity. The gross beta activity of the fat fraction was less than one percent of that in

the non-fat fraction, making strontium-90 determinations impractical with the facilities available.

All counting was done with an Anton end-window geiger tube, number 1001-T, which was standardized against a National Bureau of Standards strontium-90 standard.

RESULTS AND DISCUSSION

The ratio of wet to dry weight and the fat content of the liver samples are presented in Table 1. The fat constituted an average of 47 percent by weight on a wet basis with a standard deviation of 9.71, and 74 percent by weight on a dry weight basis with a standard deviation of 9.29. The average ratio of wet to dry weight was 1.603, with a standard deviation of 0.156, indicating that the moisture level of the samples was relatively constant.

Strontium-90 levels expressed as disintegrations per minute per gram of non-fat solids and of total solids given on a dry weight and a wet weight basis are presented in Table 2.

Table 3 presents the gross beta activity in the fat and non-fat fractions of the liver. Although fat constituted an average of 47 percent of the wet weight and 74 percent of the dry weight (Table 1) of the total solids, gross beta activity of the fat fraction amounted to less than 0.5 percent of the total sample on a wet weight basis, and less than 1.0 percent on a dry

weight basis.

The gross beta activity of the samples on a wet and dry weight basis is given in Table 4.

There is a linear relationship between strontium-90 activity and gross beta activity (Tables 2 and 3). The percentage of gross beta activity due to strontium-90 at Kabelle, Eniaetok and Rongelap Islands on a non-fat solid dry weight basis and based upon the average values at each island are 32, 35, and 31 percent respectively.

The strontium units for the liver of coconut crab of earlier collections from Rongelap have been reported previously (4, 5, 8). To report the strontium units for the March 1958 collection, Table 5 has been included.

As a result of these studies, radiochemical analyses of the liver of coconut crab should be made on the basis of non-fat solids rather than the entire liver as has been done in the past.

Table 1. Percentage of fat content and the ratio of wet weight to dry weight of coconut crab (Birgus latro) liver* collected at Rongelap Atoll in March 1958.

Sample number	Percentage of fat in liver		Wet weight / Dry weight Ratio
	Wet	Dry	
34	44.70	78.81	1.763
35	48.24	74.38	1.542
36	31.50	55.37	1.758
37	38.01	67.88	1.786
38	42.34	67.99	1.606
61	40.38	71.83	1.779
62	42.76	73.04	1.708
84	56.10	83.20	1.483
85	64.62	87.69	1.357
86	50.76	71.02	1.399
87	61.49	88.55	1.440
88	43.89	70.97	1.617
Mean	47.07	74.23	1.603
Standard deviation	9.71	9.29	0.156

*Sample weights ranged from 9 to 18 grams

Table 2. Strontium-90 in non-fat solid and total solids of coconut crab (Birgus latro) liver.

Sample number	Location of collection	Non-fat solids d/m/g		Total solids d/m/g	
		Wet	Dry	Wet	Dry
34	Rongelap Atoll	260±10*	458±17*	55±2*	97± 4
35		353±13	544±20	90±3	140± 5
36	Kabelle	276±12	484±20	130±5	288±10
37	Island	605±35	1080±44	194±8	347±14
38		420±20	674±33	134±6	216±11
Mean		383	648	121	218
Standard deviation		140	255	52	103
84		236±10	350±15	40±2	59± 3
85		245±11	332±13	30±1	41± 2
86	Rongelap	159± 8	222±10	46±2	64± 3
87	Island	409±23	589±33	47±3	67± 4
88		224±13	362±21	65±4	105± 6
Mean		255	371	46	67
Standard deviation		93	134	13	23
61	Eniaetok	248± 9	442±17	70±3	124± 5
62	Island	321±20	548±34	87±5	148± 9
Mean		285	495	79	136
Standard deviation		52	75	12	17

*Counting error is less than 5 percent

Table 3. Gross beta activity of fat and non-fat fractions and percentage of gross beta activity in fat of coconut crab (Birgus latro) liver.

Sample number	Location of collection	Fat d/m/g*	Non-fat d/m/g* Wet weight basis	Non-fat d/m/g* Dry weight basis	Percentage of gross beta activity due to fat: Wet weight basis	Percentage of gross beta activity due to fat: Dry weight basis
	Rongelap Atoll					
34		4	1116	1967	0.29	0.77
35		8	1086	1674	0.67	1.36
36	Kabelle	6	618	1086	0.45	0.68
37	Island	14	1929	3446	0.44	0.84
38		2	1219	1958	0.11	0.22
Mean		7	1194	2026	0.39	0.77
84		1	753	1117	0.18	0.42
85		0	661	897	0.00	0.00
86	Rongelap Island	-2	513	718	0.00	0.00
87		1	1169	1684	0.13	0.45
88		1	545	882	0.13	0.26
Mean		0.2	728	1060	0.09	0.23
61	Eniaetok	6	824	1466	0.49	0.99
62	Island	6	984	1681	0.45	0.97
Mean		6	904	1573	0.47	0.98

*Counting error is less than 8 percent

Table 4. Gross beta activity of coconut crab (Birgus latro) liver.

Sample number	Location of collection	Total sample d/m/g*	
		Wet weight basis	Dry weight basis
	Rongelap Atoll		
34		617	431
35		563	428
36	Kabelle Island	423	485
37		1196	1110
38		702	627
Mean		700	616
Standard deviation		295	288
84		330	188
85	Rongelap Island	234	110
86		253	208
87		450	194
88		306	257
Mean		315	191
Standard deviation		85	52
61	Eniaetok Island	492	413
62		564	454
Mean		528	434
Standard deviation		51	29

*Counting error is less than 8 percent

Table 5. Strontium units and calcium in coconut crab (Birgus latro) liver.

Sample number	Location of collection	Sr^{90} d/m/g Wet weight basis	mg Ca/gm Wet weight basis	Strontium units*
	Rongelap Atoll			
34		55	7.25	3448
35		90	10.03	4079
36	Kabelle Island	130	23.93	2469
37		194	15.72	5609
38		134	17.18	3545
Mean		121	14.82	3830
Standard deviation		52	6.51	1152
84		40	8.39	2167
85		30	5.40	2525
86	Rongelap Island	46	12.67	1650
87		47	6.18	3457
88		65	10.99	2688
Mean		46	8.73	2497
Standard deviation		13	3.09	668
61		70	8.00	3977
62	Eniaetok Island	87	7.22	5477
Mean		79	7.61	4727
Standard deviation		12	0.55	1055

*Strontium unit = micro-micro curie of Sr^{90} per gram of calcium.

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