

CHAPTER III

RESULTS

3.1 Efficiency of the Gamma Spectrometer.

Measurements of cesium-137 and potassium-40 activity were obtained with a 3" x 3" NaI(Tl) scintillation detector. The system was calibrated with a set of food samples to which known amounts of standard Cs-137 and K-40 solution had been added. The samples were examined under the same geometry. The result of the efficiency in counting spiked food samples for Cs-137 and K-40 were 3 and 4 percent respectively. The minimum detection limit were thus calculated to be 0.03 and 0.04 pCi/g. wet wt.

3.2 The Reliability test

3.2.1 For strontium-90 determination.

The results of the precision test and the reliability test were tabulated in Table 3 and 4 respectively. The data obtained indicated the good precision and reliability of the extraction procedure.

3.2.2 For calcium determination.

Only the precision test was performed. The result was shown in Table 5. The reproducibility of the titration was rather good.

3.3 Results of the investigation.

The results of the analysis for gross β activity, activity concentration of K-40, Cs-137, Sr-90 and calcium content in 89 samples collecting from January 1976 to January 1977 were shown in Table 6-16. In addition, the range of activity concentration and calcium content was presented in Table 17.

Table 3

The precision for Sr-90 determination by TBP extraction

No. of observation	Concentration of Sr-90 (pCi)
1	5.52
2	5.57
3	5.74
4	5.82
average	5.66 \pm 0.141
amount added	6.0

Table 4

The reliability test for Sr-90 determination by TBP extraction

No. of observation	Concentration of Sr-90 (pCi)
1	2.81
2	2.94
3	3.19
4	3.19
average	3.03 ± 0.189
certified value	3.08

Table 5

The reproducibility of Ca determination.

Amount of Ca added was 99.7 mg.

No. of analysis	permanganate used ml	amount of calcium mg	Error %
1	4.95	97.02	2.7
2	5.00	98.00	1.7
3	4.95	97.02	2.7
average		97.3	2.4

TABLE 6

SAMPLE OF JANUARY 1976

Sample No.	Type of sample	wet wt. ash wt.	Gross β activity		Sr-90 pCi/g ash	Ca g. Ca/g ash	Sr-90 pCi/g. Ca	activity of (cpm)		content of pCi/g. wet wt.	
			net cpm/g ash	pCi/g ash				Cs-137	K-40	Cs-137	K-40
1	SARDINE FISH	42	43	626	7.10	0.102	70	238	14	5.69	0.484
2	SARDINE FISH	32	12	182	4.38	0.138	32	247	BDL	5.46	0.04
3	SARDINE FISH	37	10	151	5.69	0.141	40	215	8	5.08	0.277
4	SARDINE FISH	38	13	189	N.S	N.S	N.S	BDL	12	<0.03	0.490
5	SARDINE FISH	32	17	247	6.5	0.125	52	BDL	5	<0.03	0.251

* N.S. = no sample

B.D.L. = below detection limit.



TABLE 7

SAMPLE OF FEBRUARY 1976

Sample No.	Type of sample	wet wt ash wt	Gross β activity		Sr-90 pCi/g ash	Ca g Ca/g ash	Sr-90 pCi/g Ca	activity of (cpm)		content of pCi/g wet wt.	
			net cpm/g ash	pCi/g ash				Cs-137	K-40	Cs-137	K-40
1	SARDINE FISH	44	23	333	6.65	0.115	58	↑	↑	↑	↑
2	CORNERD BEEF	35	40	587	8.57	0.006	1428	↑	↑	↑	↑
3	SALMON FISH	29	30	438	7.55	0.062	122	↑	↑	↑	↑
4	HERRING FISH	33	14	200	8.15	0.022	370	NOT YET DETERMINED			
5	SARDINE FISH	30	15	214	4.8	0.089	54	↓	↓	↓	↓
6	TUNA FISH	36	12	173	11.87	0.054	220	↓	↓	↓	↓

TABLE 8

SAMPLE OF MARCH 1976

Sample No.	Type of sample	wet wt.	Gross β activity		Sr-90	Ca	Sr-90	activity of (cpm)		content of pCi/g wet wt.	
		ash wt.	net cpm/g ash	pCi/g ash				pCi/g ash	Ca/g ash	pCi/g Ca	Cs-137
1	MACKEREL FISH	44	25	362	9.15	0.194	97	7.03	1.21	0.227	0.059
2	SALMON FISH	43	12	178	8.05	0.060	134	9.06	1.03	0.318	0.054
3	MACKEREL FISH	40	13	196	4.76	0.042	113	10.03	3.71	0.375	0.028
4	CLAM	28	4	56	5.36	0.021	446	BDL	BDL	<0.03	<0.04
5	CORNED BEEF	30	15	222	6.34	0.011	576	N.S	N.S	N.S	N.S
6	SARDINE FISH	37	13	184	7.66	0.083	92	BDL	BDL	<0.03	<0.04
7	SARDINE FISH	31	10	146	7.47	0.046	162	BDL	1.36	<0.03	0.062
8	SARDINE FISH	39	10	143	6.27	0.056	112	10.43	2.43	0.365	0.128
9	OYSTERS	36	21	301	11.9	0.015	793	4.91	0.63	0.221	0.042

TABLE 9
SAMPLE OF MAY 1976

Sample No.	Type of sample	wet wt. ash wt.	Gross β activity		Sr-90 pCi/g ash	Ca g Ca/g ash	Sr-90 pCi/g Ca	activity of (cpm)		content of pCi/g wet wt.	
			net cpm/g ash	pCi/g ash				Cs-137	K-40	Cs-137	K-40
1	SARDINE FISH	33	5	80	4.73	0.066	72	↑	↑	↑	↑
2	SARDINE FISH	32	10	152	4.59	0.065	71	↑	↑	↑	↑
3	SALMON FISH	36	5	71	8.65	0.079	109	↑	↑	↑	↑
4	MACKEREL FISH	27	6	88	862	0.039	175	← NOT YET DETERMINED →			
5	SHELL	29	2	26	9.04	0.024	377	↓	↓	↓	↓
6	CORNERD BEEF	40	6	86	6.24	0.002	3120	↓	↓	↓	↓
7	CORNERD BEEF	48	11	155	9.14	0.009	1016	↓	↓	↓	↓
8	THREADFIN FISH	37	8	112	6.36	N.S	N.S	↓	↓	↓	↓
9	SARDINE FISH	45	13	194	6.36	0.156	41	↓	↓	↓	↓

TABLE 10

SAMPLE OF JUNE 1976

Sample No.	Type of sample	wet wt.	Gross β activity		Sr-90	Ca	Sr-90	activity of		content of	
		ash wt.	net cpm/g. ash	pCi/g ash				pCi/g ash	g Ca/g ash	pCi/g Ca	Cs-137
1	SMOKEE OYSTER	28	9	135	7.80	0.012	650	BDL	BDL	<0.03	<0.04
2	SARDINE FISH	34	10	152	5.50	0.096	57	BDL	BDL	<0.03	<0.04
3	SARDINE FISH	39	11	166	2.04	0.122	17	6.35	1.27	0.177	0.053
4	SARDINE FISH	35	13	186	N.S.	N.S.	N.S.	8.25	BDL	0.276	<0.04
5	SARDINE FISH	36	13	193	10.09	0.167	60	6.45	BDL	0.192	<0.04
6	SARDINE FISH	35	16	228	11.80	0.092	128	5.85	2.34	0.134	0.08

TABLE 11
 SAMPLE OF JULY 1976

Sample No.	Type of sample	wet wt.	Gross β activity		Sr-90	Ca	Sr-90	activity of (cpm)		content of pCi/g wet wt.	
		ash wt.	net cpm/g ash	pCi/g ash	pCi/g ash/g	Ca/g ash	pCi/g Ca	Cs-137	K-40	Cs-137	K-40
1	SARDINE FISH	36	13	185	12.47	0.186	67	4.4	BDL	0.168	<0.04
2	SARDINE FISH	19	11	158	6.67	0.106	63	5.6	BDL	0.164	<0.04
3	TUNA FISH	29	14	198	6.92	N.S	N.S	8.3	BDL	0.212	<0.04
4	HERRING FISH	30	9	131	3.5	0.177	20	5.4	BDL	0.137	<0.04
5	SALMON FISH	37	12	176	28.89	0.160	180	2.0	BDL	0.046	<0.04
6	SARDINE FISH	34	8	111	BDL	0.187	N.S	1.8	BDL	0.042	<0.04
7	SARDINE FISH	36	17	244	6.59	0.105	63	4.4	BDL	0.131	<0.04



TABLE 12
 SAMPLE OF AUGUST 1976

Sample No.	Type of sample	wet wt. ash wt.	Gross β activity		Sr-90 pCi/g ash	Ca g Ca/g ash	Sr-90 pCi/g Ca	activity of (cpm)		content of pCi/g wet wt.	
			net cpm/g. ash	pCi/g. ash				Cs-137	K-40	Cs-137	K-40
1	CORNEDBEEF	4.6	20	298	10.32	0.008	1290	BDL	14.45	<0.03	0.971
2	CORNEDBEEF	4.6	12	178	5.97	0.007	853	BDL	0.76	<0.03	0.052
3	OYSTER	3.6	22	321	4.89	0.021	232	← NOT YET DETERMINED →			
4	SARDINE FISH	4.0	21	304	6.54	0.117	56	9.88	11.19	0.287	0.488
5	SARDINE FISH	3.0	21	314	5.56	0.124	45	41.2	5.2	0.889	0.168
6	SARDINE FISH	2.8	11	158	4.59	0.114	40	BDL	12.8	0.03	0.575
7	SALMON FISH	3.8	8	121	5.23	0.078	67	← NOT YET DETERMINED →			
8	TUNA FISH	5.7	19	273	3.33	0.173	19	BDL	1.37	<0.03	0.077
9	SARDINE FISH	3.0	9	N.S	4.40	0.114	39	BDL	7.7	<0.03	0.440

TABLE 13

SAMPLE OF OCTOBER 1976

Sample No.	Type of sample	wet wt.	Gross β activity		Sr-90	Ca	Sr-90	activity of (cpm)		content of pCi/g wet wt.	
		ash wt.	net cpm/g ash	pCi/g ash	pCi/g ash	g Ca/g ash	pCi/g Ca	Cs-137	K-40	Cs-137	K-40
1	WHEAT GERM	21	34	332	8.91	0.016	557	58.44	BDL	2.98	<0.04
2	MILKPOWDER	30	25	248	11.76	0.122	96	BDL	7.31	<0.03	<0.04
3	OATS	20	31	305	12.28	0.187	55	BDL	0.81	<0.03	<0.04
4	BARLEY	31	36	352	9.30	0.014	664	BDL	3.68	<0.03	0.091
5	CEREAL	34	12	114	12.30	0.196	63	BDL	4.73	<0.03	0.260
6	CEREAL	23	13	129	9.86	0.101	98	51.24	BDL	1.59	<0.04
7	CEREAL	24	18	176	31.97	0.077	415	BDL	0.71	<0.03	0.052
8	BARLEY	30	N.S	N.S	4.62	0.148	31	BDL	0.57	<0.03	0.027
9	MILKPOWDERED	14	31	299	4.86	N.S	N.S	BDL	29	<0.03	1.17

TABLE 14

SAMPLE OF NOVEMBER 1976

Sample No.	Type of sample	wet wt. ash wt.	Gross β activity		Sr-90 pCi/g ash	Ca g Ca/g ash	Sr-90 pCi/g Ca	activity of (cpm)		content of pCi/g wet wt.	
			net com/g ash	pCi/g ash				Cs-137	K-40	Cs-137	K-40
1	SARDINE FISH	39	13	123	4.13	0.084	49	BDL	8.04	<0.03	0.259
2	PILCHARD FISH	33	17	169	3.12	0.071	44	BDL	4.37	<0.03	0.148
3	SARDINE FISH	34	14	140	4.28	0.066	65	BDL	3.8	<0.03	0.127
4	SARDINE FISH	30	10	101	4.42	0.088	50	1.5	4.14	0.039	0.162
5	MACKEREL FISH	30	14	134	10.05	0.040	250	BDL	8.57	<0.03	0.424
6	SARDINE FISH	43	12	121	N.S	N.S	N.S	BDL	9.85	<0.03	0.396
7	SARDINE FISH	29	14	134	6.43	0.083	77	BDL	6.22	<0.03	0.281
8	SARDINE FISH	28	8	74	8.17	N.S	N.S	BDL	8.17	<0.03	0.333
9	SARDINE FISH	34	13	130	3.06	0.062	49	BDL	2.17	<0.03	0.122
10	SARDINE FISH	28	13	128	3.69	0.116	32	BDL	7.76	<0.03	0.366
11	SARDINE FISH	27	10	99	N.S	N.S	N.S	BDL	9.08	<0.03	0.462
12	CONDENSED MILK	29	13	125	5.37	0.067	80	BDL	BDL	<0.03	<0.04

TABLE 15

SAMPLE OF DECEMBER 1976

Sample No.	Type of sample	wet wt.	Gross β activity		Sr-90 pCi/g ash	Ca Ca/g ash	Sr-90 pCi/g Ca	activity of (cpm)		content of pCi/g wet wt.	
		ash wt.	net cpm/g ash	pCi/g ash				Cs-137	K-40	Cs-137	K-40
1	BARLEY	33	21	206	4.99	0.131	38	2.50	8.78	0.06	0.331
2	CEREAL	25	17	167	5.53	0.172	32	11.36	BDL	0.29	<0.04
3	CEREAL	19	26	255	4.68	0.113	37	BDL	BDL	<0.03	<0.04
4	CERCIAC	38	38	373	6.40	0.118	54	BDL	9.15	<0.03	0.240
5	SEMOLINA	54	43	422	3.54	0.155	23	BDL	BDL	<0.03	<0.04
6	OATS	29	36	353	6.35	0.148	43	BDL	BDL	<0.03	<0.04
7	CEREAL	29	12	118	5.96	0.198	55	BDL	1.35	<0.03	<0.04
8	INFANTFOOD	48	21	206	6.11	0.094	65	BDL	9.77	<0.03	0.229

TABLE 16

SAMPLE OF JANUARY 1977

Sample No.	Type of sample	wet wt.	Gross β activity		Sr-90 pCi/g ash	Ca gCa/a ash	Sr-90 pCi/g ash	activity of (cpm)		content of pCi/g wet wt.	
		ash wt.	net cpm/g ash	pCi/g ash				Cs-137	K-40	Cs-137	K-40
1	CEREAL	17	27	264	10.77	0.115	94	BDL	2.84	<0.03	0.128
2	INFANT FOOD	50	50	235	13.53	0.135	100	BDL	4.11	<0.03	0.185
3	CEREAL	18	14	137	5.50	0.145	38	BDL	5.02	<0.03	0.245
4	CEREAL	26	6	59	N.S.	N.S.	N.S.	BDL	2.00	<0.03	0.952
5	WHEATGERM	19	27	264	11.29	0.127	89	BDL	13	<0.03	0.498
6	CERELAC	44	29	284	6.31	N.S.	N.S.	BDL	1.33	<0.03	0.07
7	SARDINE FISH	31	14	137	10.68	0.102	104	BDL	6.37	<0.03	0.289
8	SARDINE FISH	44	15	147	7.77	N.S.	N.S.	BDL	0.44	<0.03	0.023
9	BARLEY	23	14	137	N.S.	N.S.	N.S.	BDL	1.07	<0.03	0.053

Table 17: Range of activity concentration and calcium content in Marine fish and Shellfish, Meat, Cereal and Milk.

Type of Sample	amount of sample analyzed	Concentration range of determined parameters					
		gross β pCi/g ash	K-40 pCi/g wet wt	Cs-137 pCi/g wet wt	Sr-90 pCi/g ash	Ca g Ca/g ash	Sr90 pCi/gCa
<u>Marine fish and shellfish</u>							
Sardine	37	80-626	<0.04-0.576	<0.03-5.69	2.04-12.47	0.022-0.200	17-128
Tuna	3	69-273	<0.04-0.077	<0.03-0.212	3.33-11.87	0.054-0.173	19-220
Mackerel	4	88-134	0.059-0.424	0.03-0.227	6.82-10.05	0.039-0.094	97-250
Salmon	3	71-438	-	-	5.23-28.89	0.046-0.318	67-180
Herring	2	131-200	<0.4	0.137	3.5 - 8.15	0.022-0.177	20-370
Threadfin	1	112	-	-	6.36	-	-
Pilchard	1	169	0.259	<0.03	3.12	0.071	44
Shell, clam, - oyster	7	56-321	<0.04 -0.042	<0.03-0.221	5.36-11.9	0.012-0.121	232-793

Type of Sample	amount of sample analyzed	Concentration range of determined parameters					
		gross β pCi/g. ash	K-40 pCi/g. wet wt	Cs-137 pCi/g. wet wt	Sr-90 pCi/g. ash	Ca g Ca/g. ash	Sr-90/Ca pCi/g Ca
<u>Meat</u>							
Cornedbeef	6	86-587	-	-	6.24-9.14	0.002-0.011	576-3120
<u>Cereal</u>							
Cornflake, Barley Oat, infant- food	22	59-353	<0.04-0.952	<0.03-2.98	4.62-13.53	0.069-0.198	23-664
<u>Milk</u>							
milk pow- dered, con- densed- milk	2	125-299	<0.4	<0.03	4.86-11.76	0.067-0.122	80-96