PRELIMINARY TEST OF RADIOACTIVITY IN COCONUT CRABS AT ENIWETOK ATOLL COLLECTED IN 1972

PROCEDURE

Samples of skeleton and muscle from two specimens of coconut crabs (Birgus latro L.) collected on 21, January 1972, Glenn Islet, Eniwetok were dried, pulverized and placed in liquid scintillation vials with Insta-Gel as a suspending and scintillation medium. These samples were compared with similar tissues from the crab Pachygrapus crassipes collected near Laguna Beach, California in June 1972. These latter specimens are assumed to not contain significant amount of radioactive nucleides. Table I gives a description of the samples.

Samples were compared using a Packard Series 2000 Liquid Scintillation Spectrometer. For total radioactivity a window of 50 (on a 1000 maximum scale) to infinity was used, using the 20, 60, and 80% gain values of the instrument. For characterization of the spectrum a 10% window width (50-150) was employed at various gain levels.

RESULTS

Preliminary tests indicated that there is definite excess of radioactivity in the coconut crabs for Eniwetok. However, it is so small that considerable amounts of sample had to be used to permit detection and characterization of the spectral distribution.

Tests on the total count are reported in Table I. Analysis of this data also gives considerable evidence of quenching as the weight of the sample used increases. This was tested further (following spectrum analysis) by adding a standard amount of ^{45}Ca to each tube. The increase in counts was inversely proportional to the size of the sample. Quenching (in sample 5) was noted to be less pronounced (23% decrease) when a higher energy nucleide (^{90}Sr) was added as compared to a weaker nucleide (^{45}Ca) which showed a 66% decrease. Scintillation vials without any crab tissue present but with a standard amount of ^{90}Sr or ^{45}Ca were used for comparison.

Because of this excessive amount of quenching, total radioactivity is estimated only by comparing Eniwetok and California crab samples of 416 to 616 mg in weight. On this basis one can get estimates that suggest that the Eniwetok crabs contain an excess of 3 to 33 counts per minute per gram of tissue. This figure could easily be doubled or quadrupled because of quenching and also to allow for a safety factor. One specimen (No. 4) of Eniwetok crab skeleton gave the same count rate as California crab tissue. Since this specimen had three times as much tissue and it quenched a ^{45}Ca standard by over 90% it is assumed that the sample is truly radioactive. All other Eniwetok samples gave count rates higher (57.7-78.6 cpm) than California crab samples regardless of weights which were both less and more than the California crab tissue specimens. See Table I. The maximum of 33 (x2-4) counts per minute per gram dry weight obtained is about 100 times less than the figures of 10^4 per gram of wet weights given for Cenobita crab specimens collected at Eniwetok in 1955. (See Held, H.E., 1960, Pacific Science 14:18-27). The difference may be due to species difference, time for dilution, and local collecting sights. The Cenobita specimens came from Bell islet in the north part of the atoll, Birgus from Glenn in the south.

Analysis of the spectral distribution of the counts (see the 5 pages of graphs following) gives further evidence of the excess of radioactivity of the Eniwetok crabs compared to California crabs. One can compare samples 1, 3, 5, 7, 8, 9, 10, from Eniwetok with samples 11 and 12 from California for the skeleton. Also samples 2 and 6 with sample 11 respectively for muscle tissue which shows that muscle tissue of the Eniwetok crabs also contains above normal levels of radionucleides. The spectral distribution for scintillation vials that are blank and vials containing ^{90}Sr, ^{137}Cs, ^{45}Ca, ^{60}Co, and ^{3}H is also given for comparison. This indicates that the increase in radioactivity of the Eniwetok crabs is due to medium to low energy nucleides. However, it is suspected that the high degree of quenching evident may have shifted the peaks of the crab specimens to the right and probably the radioactivity present is due to ^{90}Sr and ^{137}Cs, as found in residual radioactivity reported by other researchers. (See Held, H.E., 1960, Pacific Science, 14:18-27). The habit of the coconut crabs of eating their exuviae (molted shell) would favor the perpetuation of radioactivity

within this species. Further study with such low levels of radioactivity would require a different system then the one used here in order to overcome the quenching problem which is due to having to use large samples of tissue in the scintillation vials.

Special acknowledgement for assistance is due to Gene Helfman who provided the samples and to Larry Roth, Lance Hodges, and Lanny Fisk who helped in the preparation and analysis of the samples.

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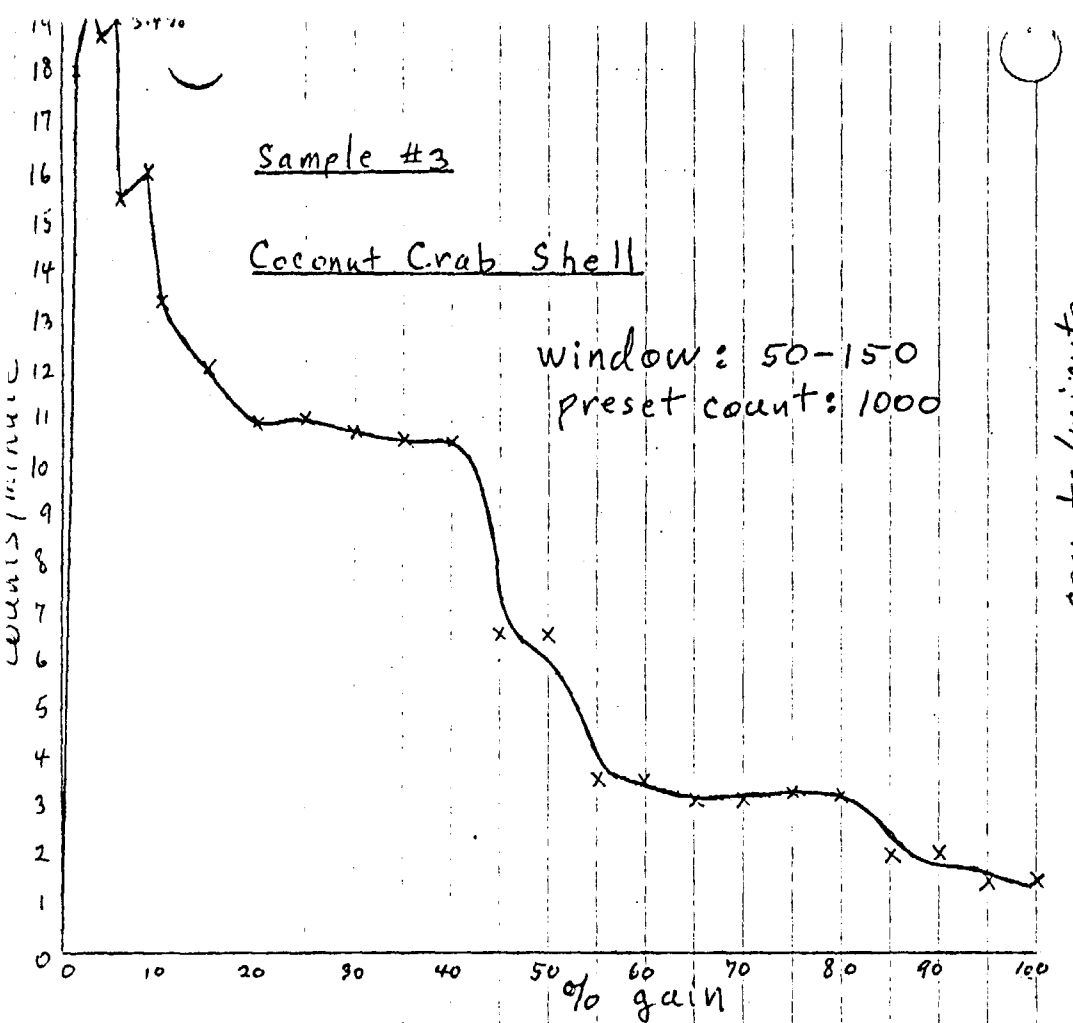
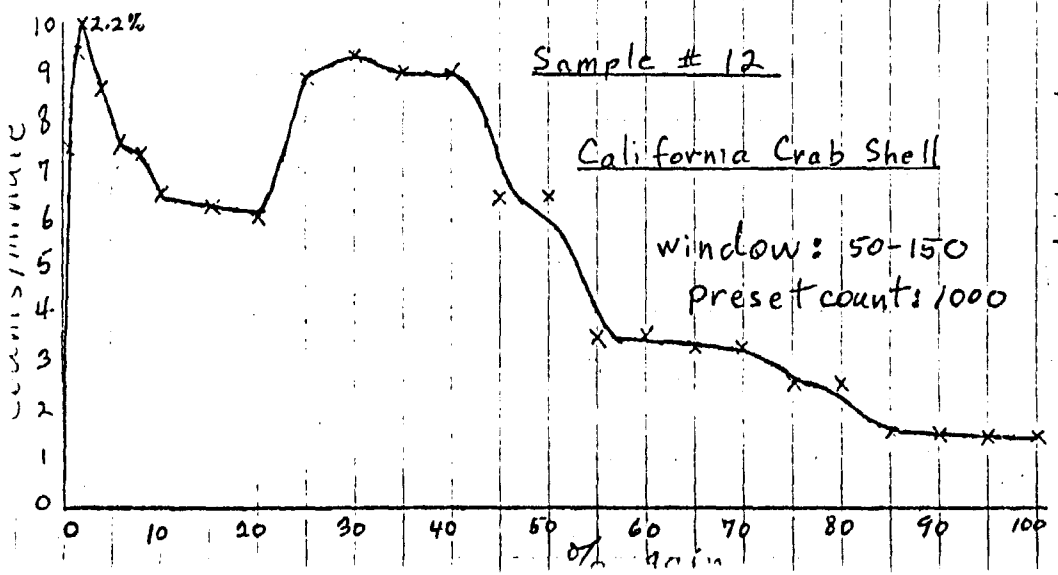
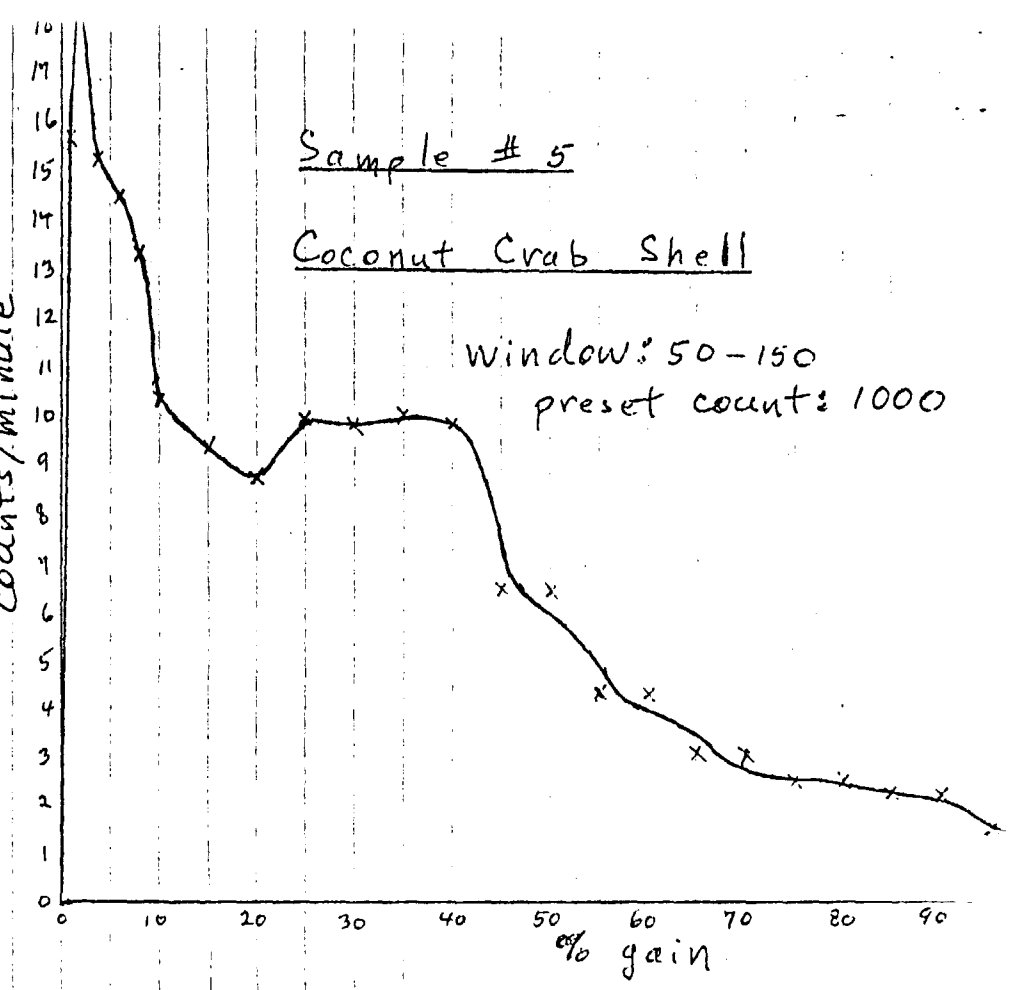
TABLE I

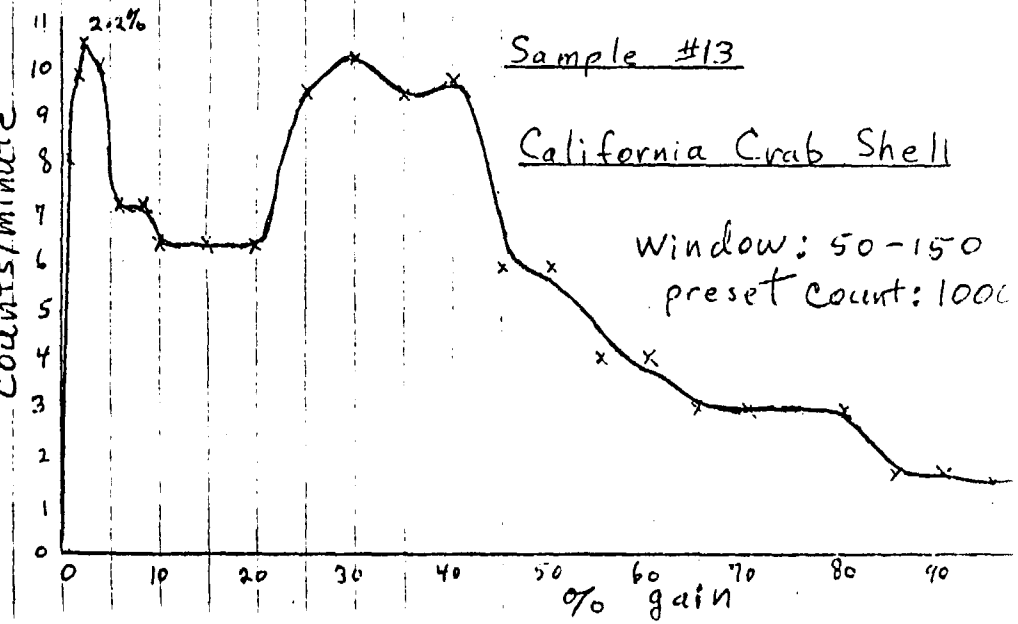
Description of samples and count rate per minute for various gain levels without and with internal standard of ^{45}Ca. Counts done with window setting of 50 to ∞ on a 1000 scale. See section on procedure.

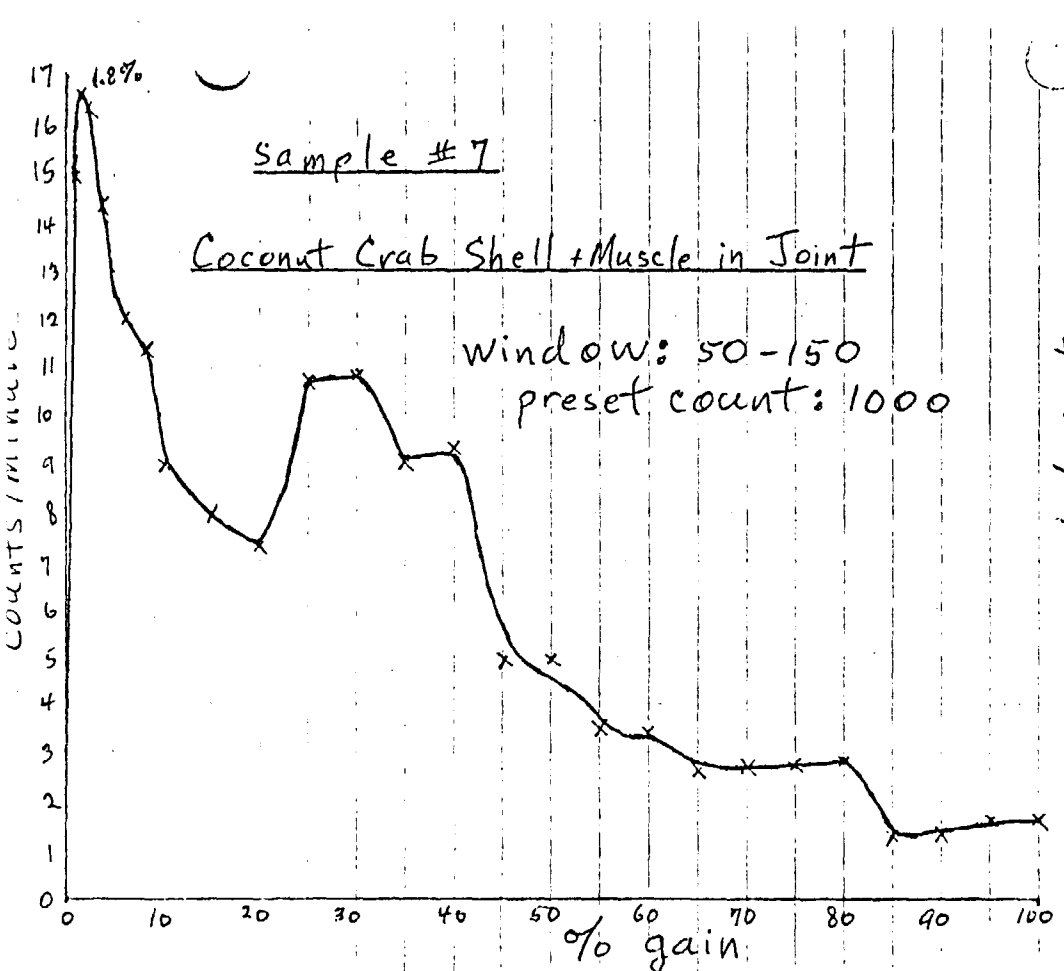
	DESCRIPTION		COUNT RATE PER MINUTE			
			Without Standard			With ^{45}Ca Internal Standard
	Number and Type of Specimen	Wt. in mg.	20% gain	60% gain	80% gain	60% gain
1	Eniwetok crab #1 shell	1491	53	64	58	281
2	" " #1 muscle	616	70	79	75	704
3	" " #1 shell	1477	70	78	76	422
4	" " #1 shell	1794	41	49	45	162
5	" " #2 shell	826	69	77	75	613
6	" " #2 muscle	284	66	70	72	1171
7	" " #2 shell and muscle	576	58	71	65	651
8	" " #2 shell	338	67	77	67	963
9	" " #2 shell	306	58	68	63	791
10	" " #2 shell	610	48	58	57	387
11	California crab muscle	416	41	48	47	219
12	" " shell	706	39	49	45	438
13	" " shell	555	42	50	45	525
14	Blank	---	60	67	64	1538
15	Blank	---	64	68	65	---

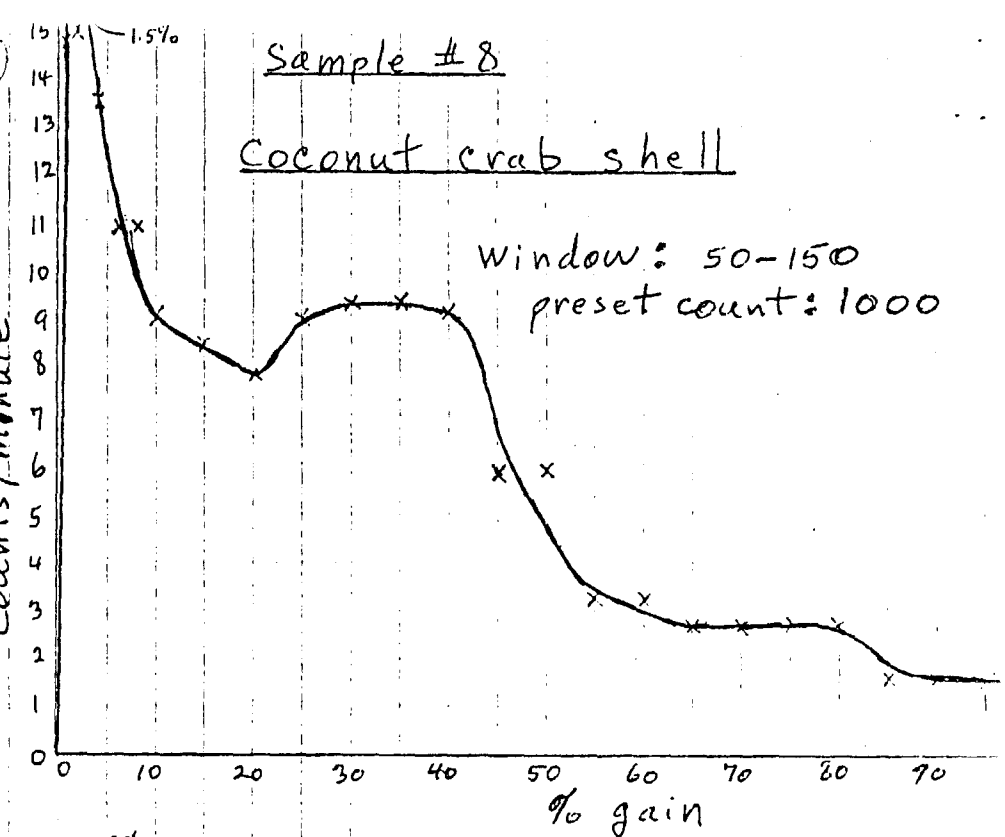

Sample #3
Coconut Crab Shell
window: 50-150
preset count: 1000
counts/minute
% gain

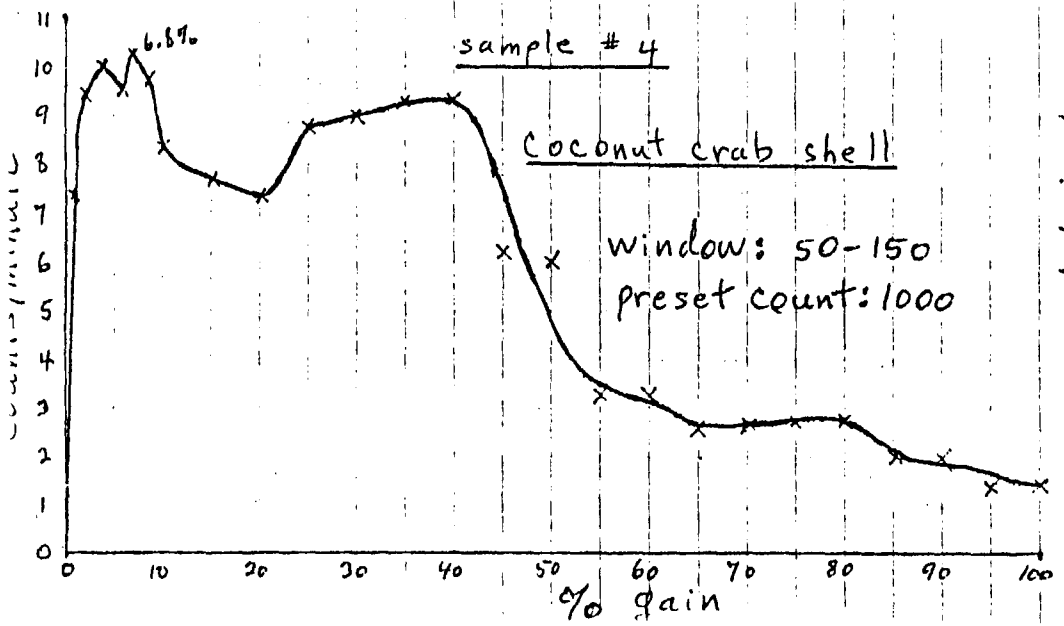

2.2%
Sample # 12
California Crab Shell
window: 50-150
preset count: 1000
counts/minute

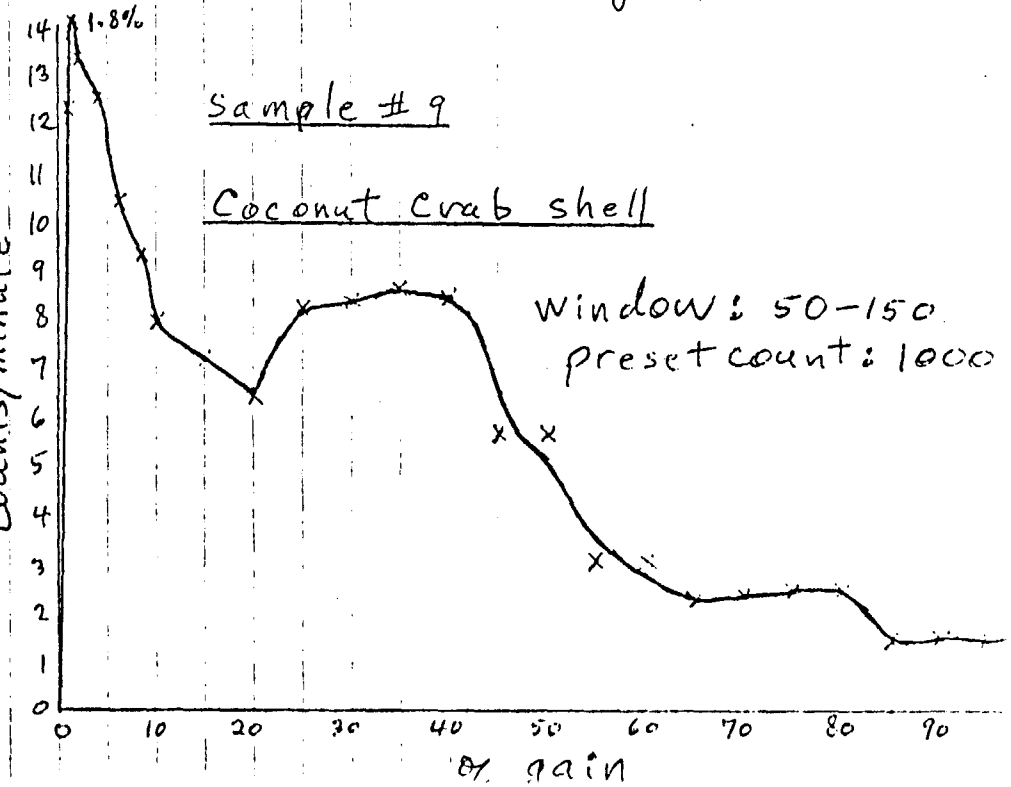

Sample # 5
Coconut Crab Shell
window: 50-150
preset count: 1000
counts/minute
% gain

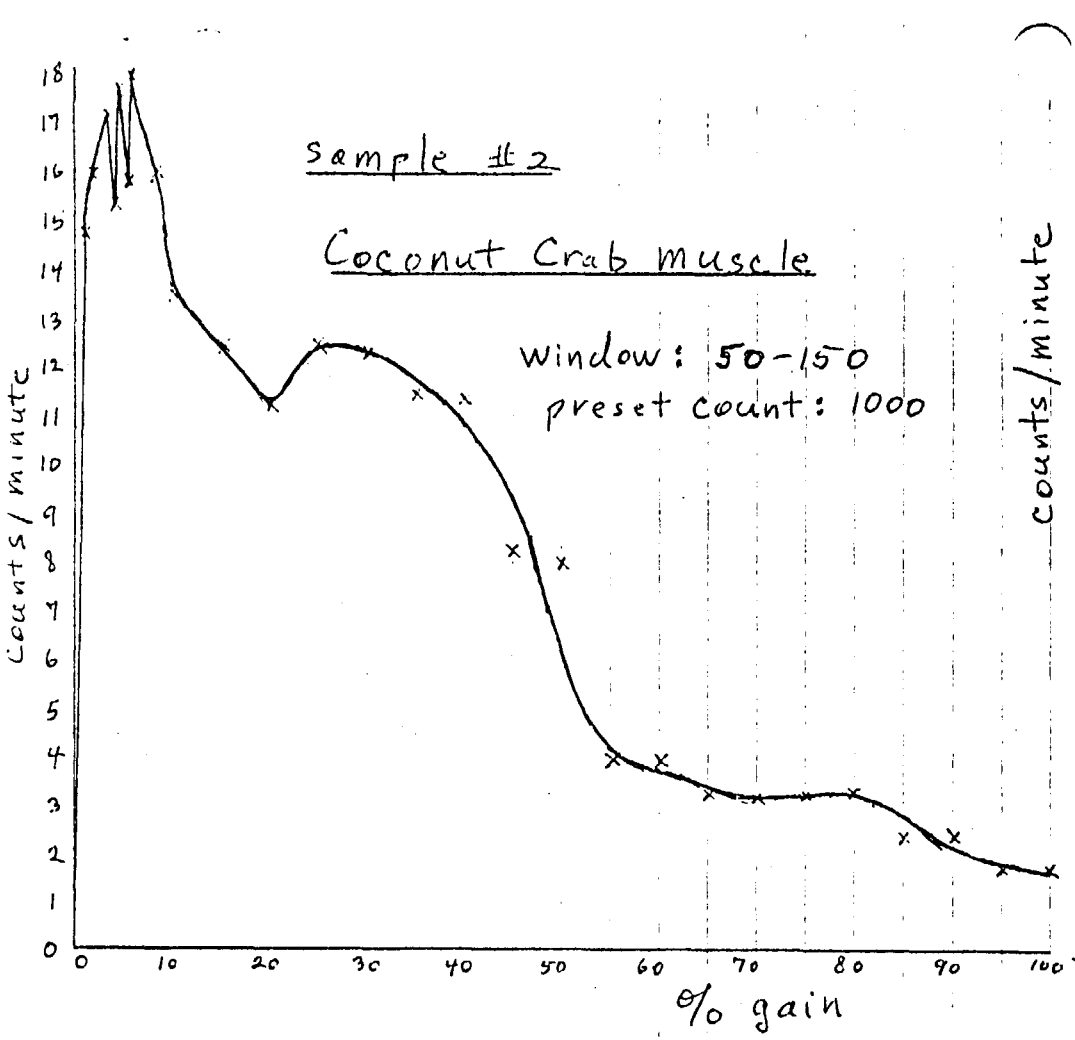

2.2%
Sample #13
California Crab Shell
window: 50-150
preset count: 1000
counts/minute
% gain

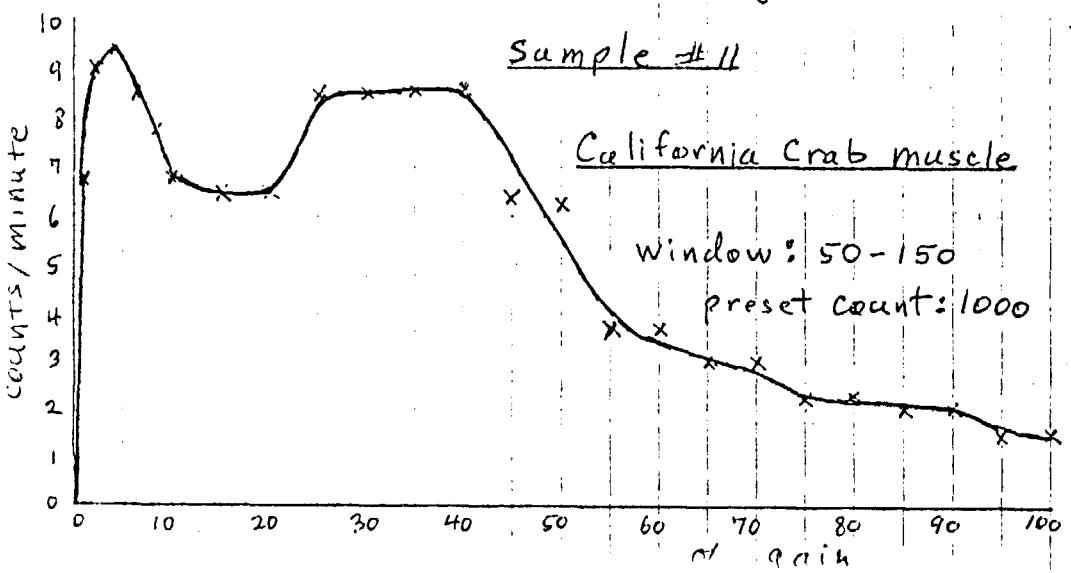

1.8%
sample #7
Coconut Crab Shell + Muscle in Joint
window: 50-150
preset count: 1000
counts/minute
% gain

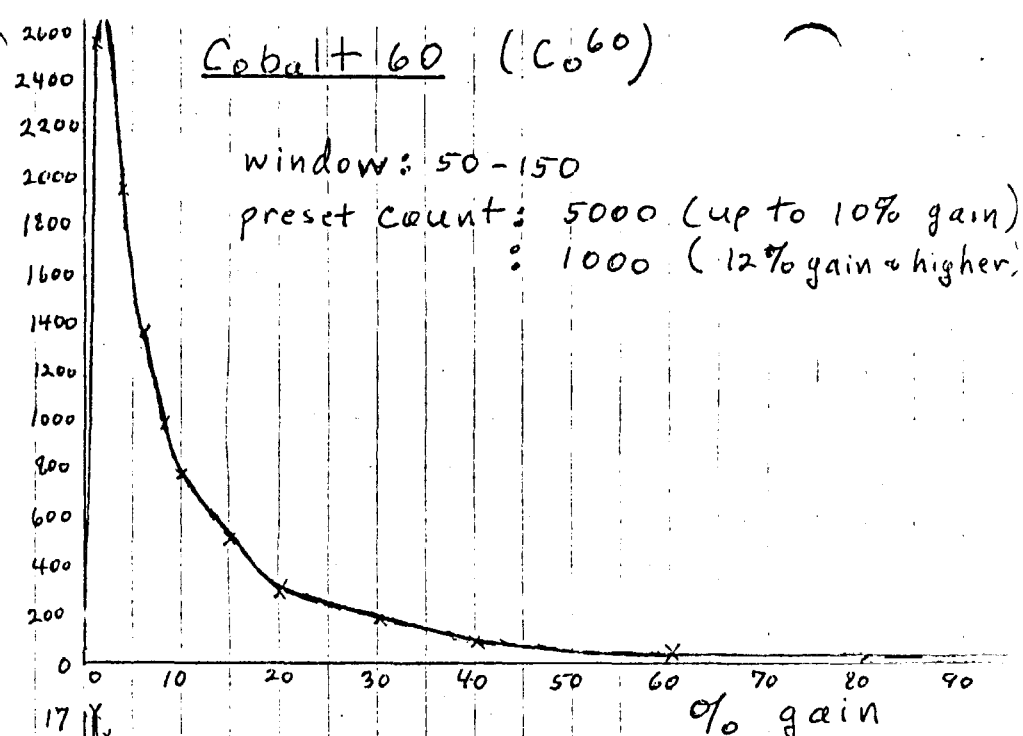

1.5%
Sample #8
Coconut crab shell
window: 50-150
preset count: 1000
counts/minute
% gain

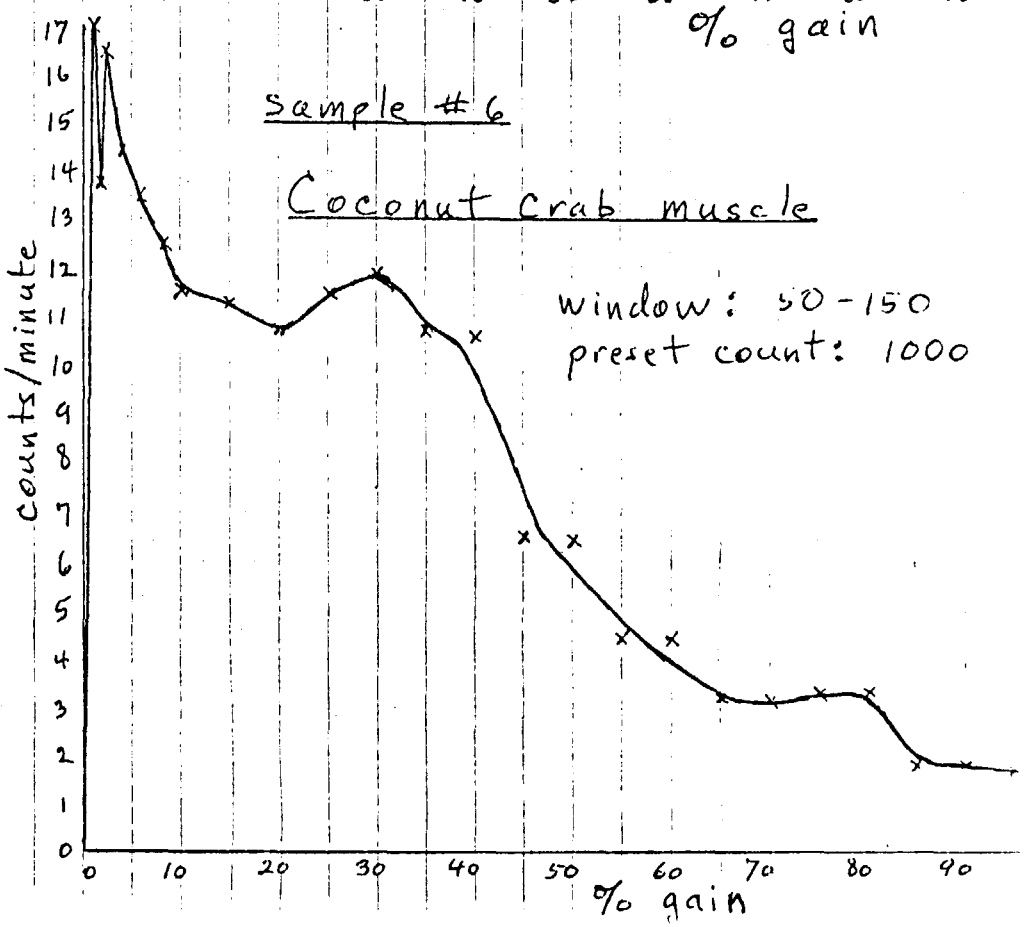

6.8%
sample #4
Coconut crab shell
window: 50-150
preset count: 1000
% gain

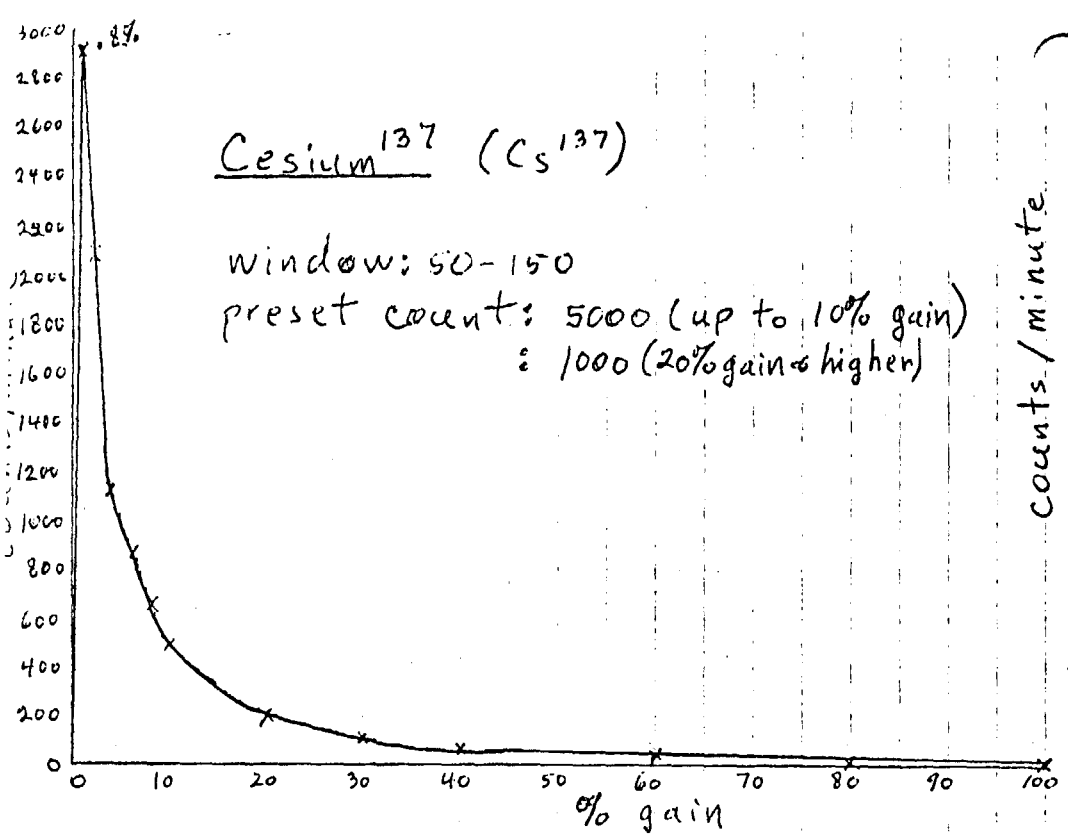

1.8%
Sample #9
Coconut crab shell
window: 50-150
preset count: 1000
counts/minute
% gain

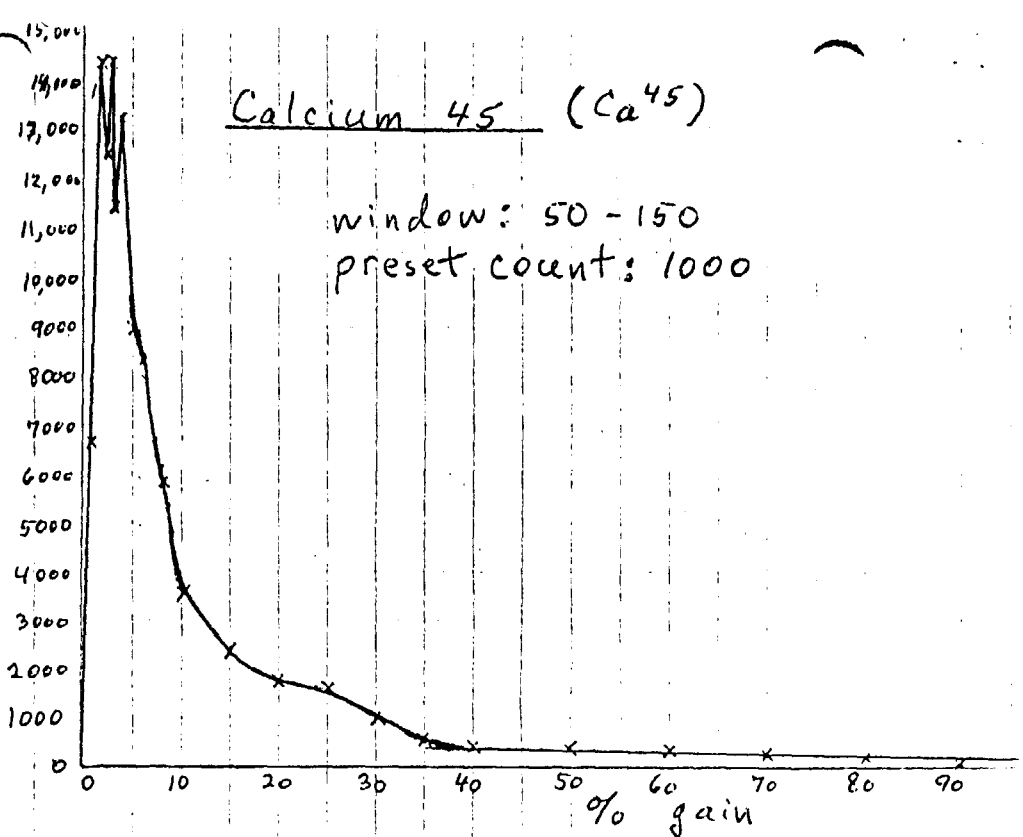

Sample #2
Coconut Crab muscle
window: 50-150
preset count: 1000
counts/minute
% gain

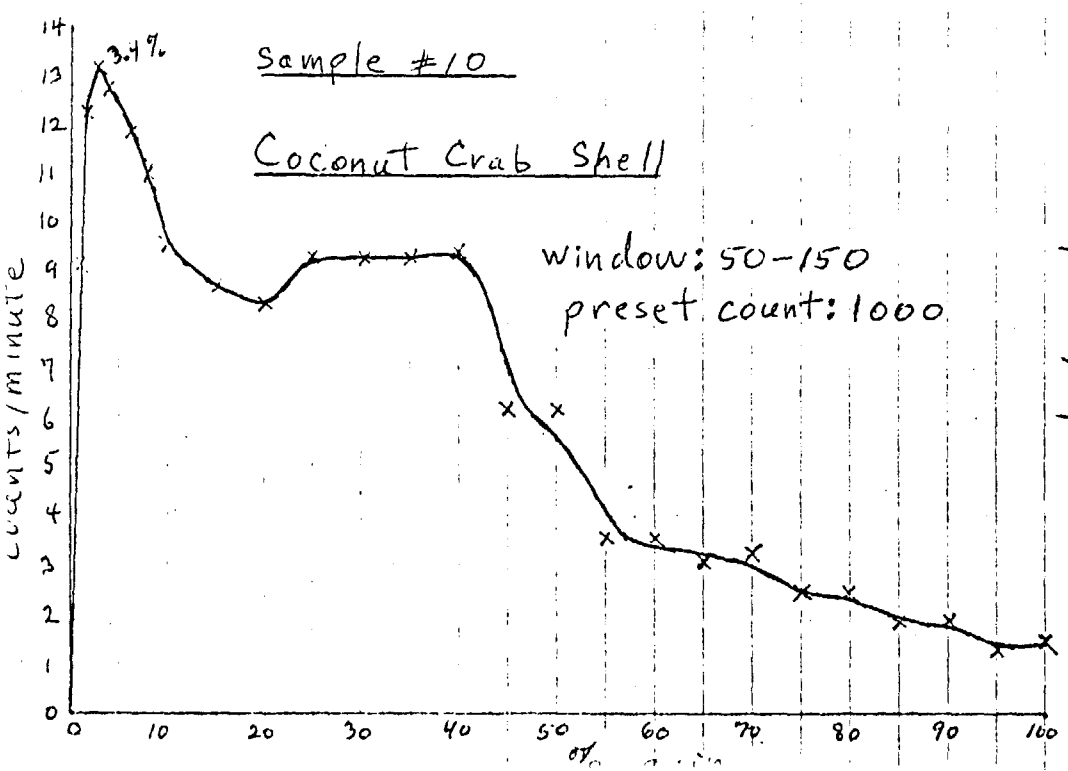

Sample #11
California Crab muscle
window: 50-150
preset count: 1000
counts/minute

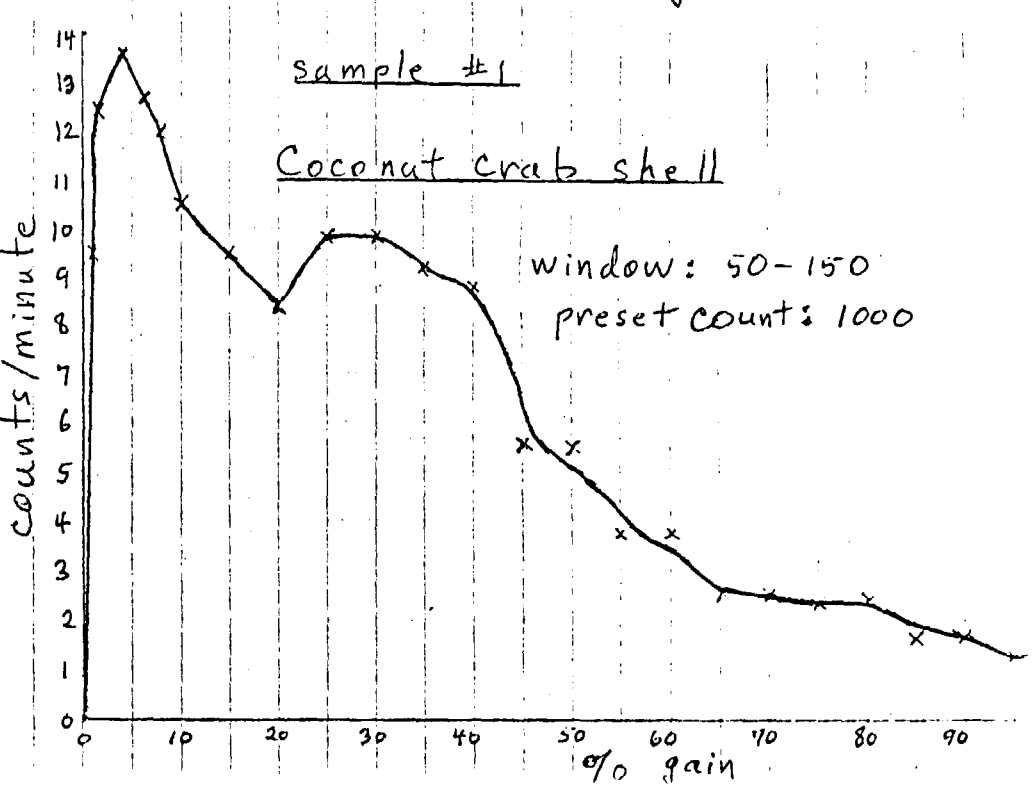

Cobalt 60 (Co^{60})
window: 50-150
preset count: 5000 (up to 10% gain)
: 1000 (12% gain & higher)
counts/minute
% gain

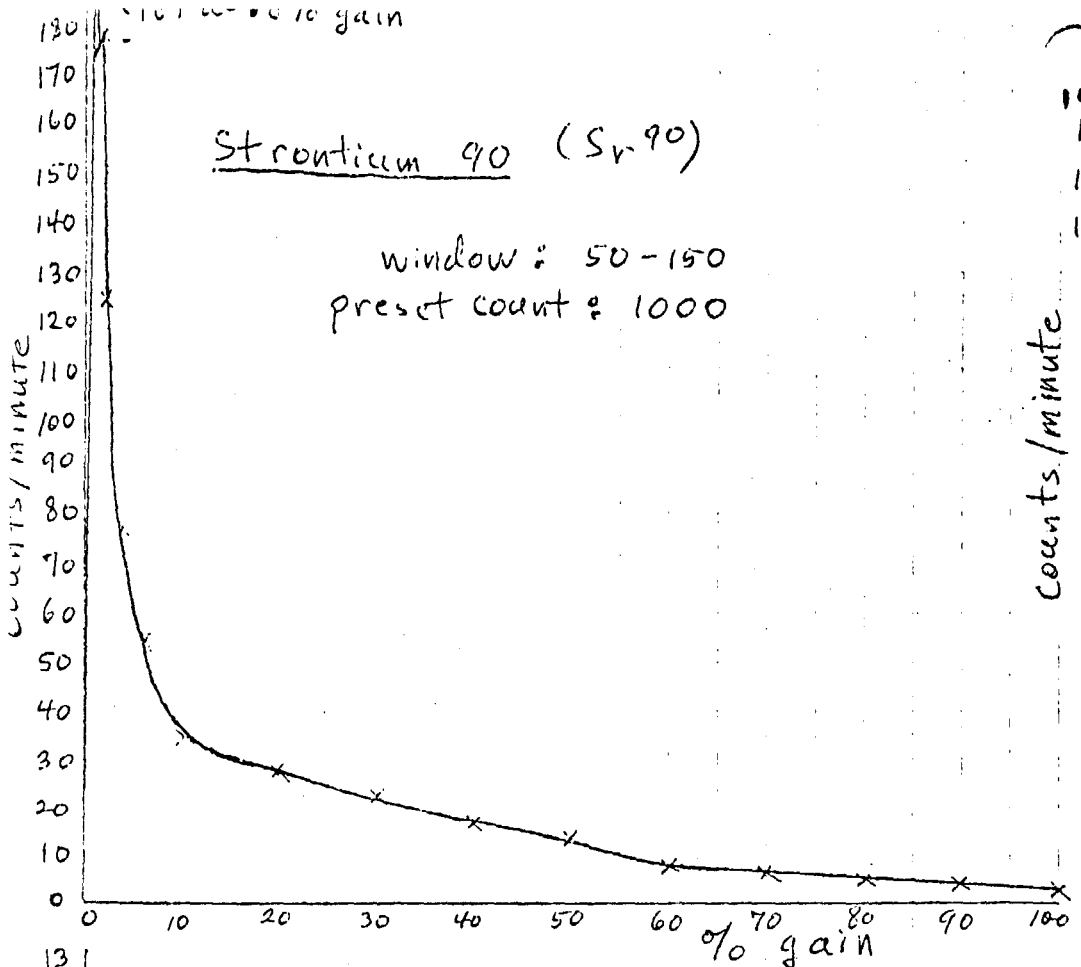

Sample #6
Coconut Crab muscle
window: 50-150
preset count: 1000
counts/minute
% gain

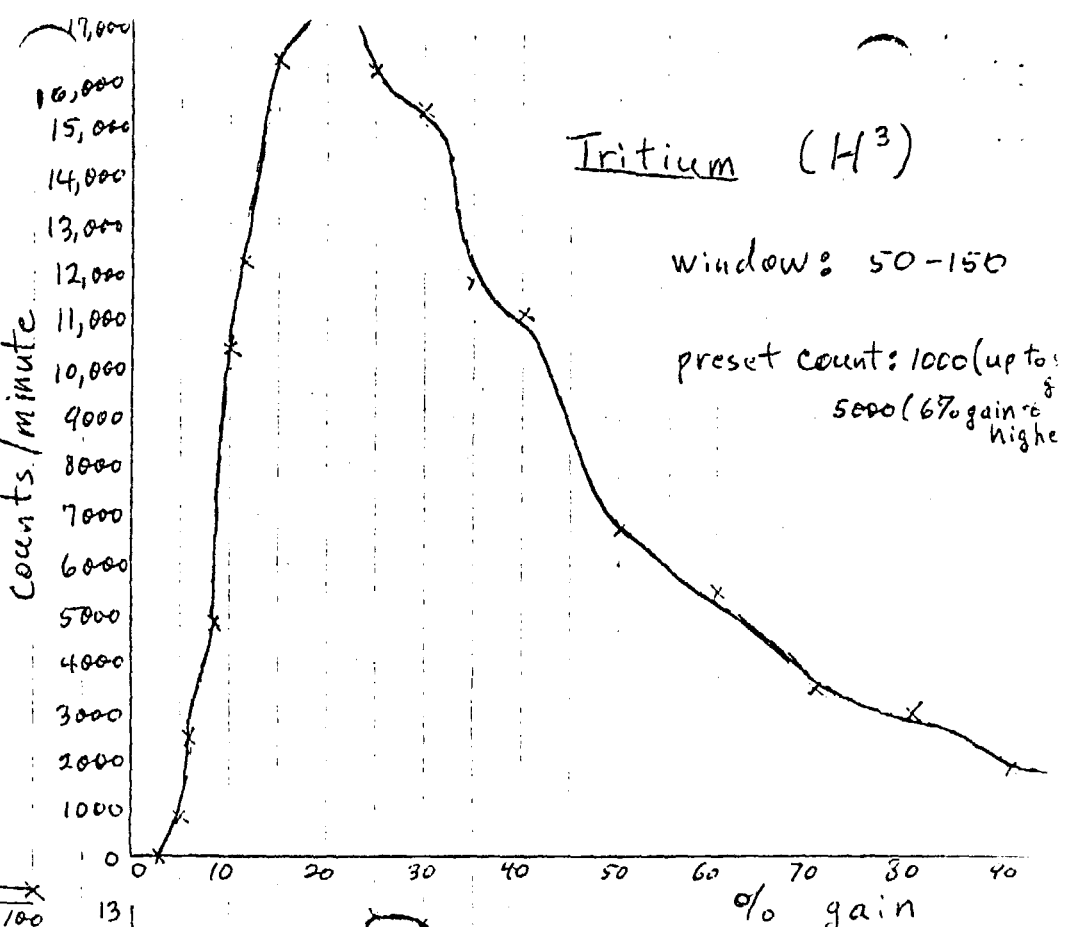

Cesium 137 (Cs 137)
window: 50-150
preset count: 5000 (up to 10% gain)
: 1000 (20% gain & higher)
8%
counts / minute
% gain

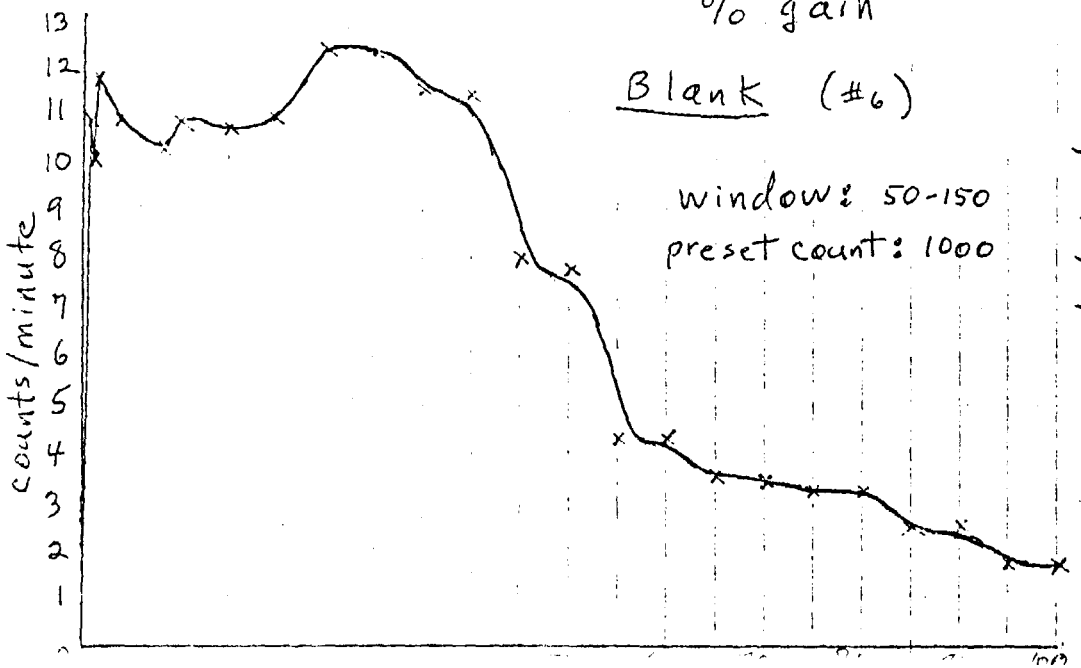

Calcium 45 (Ca 45)
window: 50 - 150
preset count: 1000
counts / minute
% gain

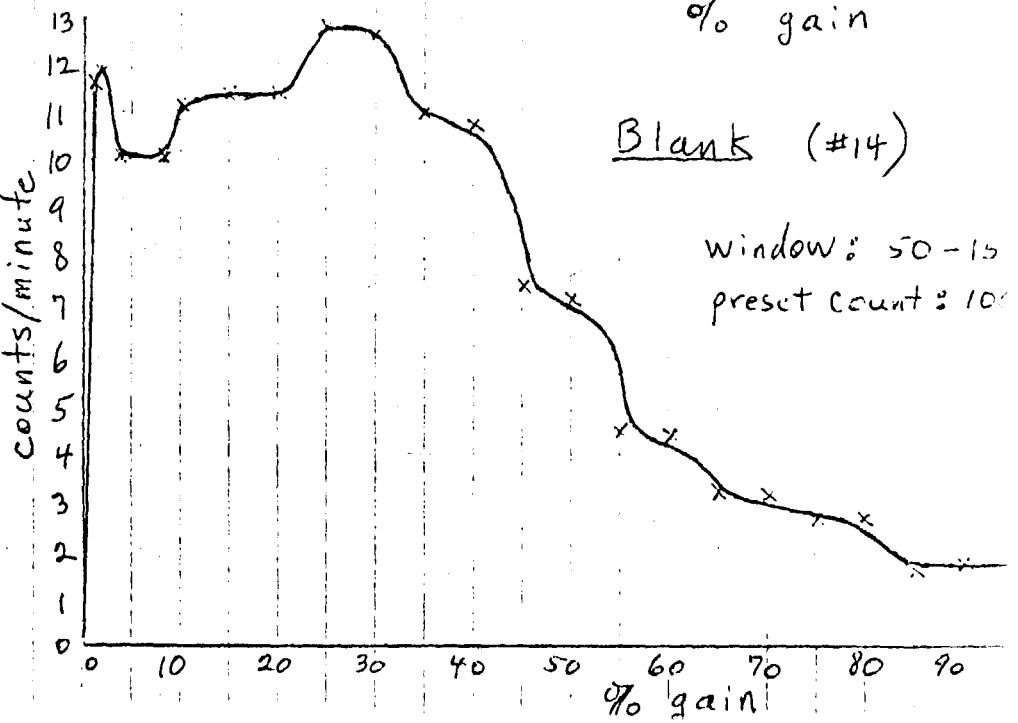

Sample #10
Coconut Crab Shell
window: 50-150
preset count: 1000
3.4%
counts/minute


Sample #1
Coconut Crab shell
window: 50-150
preset count: 1000
counts/minute
% gain


Strontium 90 (Sr-90)
window: 50-150
preset count: 1000
counts/minute
% gain


Tritium (H3)
window: 50-150
preset count: 1000 (up to
5000 (6% gain
counts/minute
% gain


Blank (#6)
window: 50-150
preset count: 1000
counts/minute


Blank (#14)
window: 50-15
preset count: 10
counts/minute
% gain