ESTIMATING RESIDUAL SHELL IN SHUCKED SOFT-SHELL CLAMS (Mya arenaria L.)[1/]

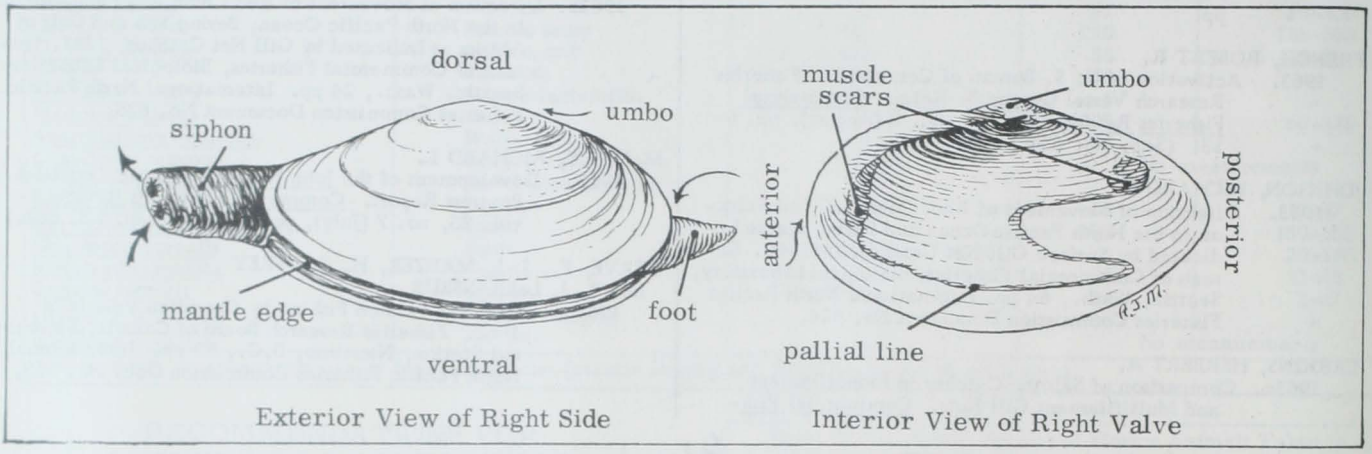
By Baruch Rosen* and Janice Freeman**

ABSTRACT

Residual shell in shucked soft-shell clams was estimated by an improved alkaline digestion method with an average recovery of 98 percent (range 96-102 percent). By using this method, a significant amount of shell can be removed from shucked soft-shell clams by manual sorting.

BACKGROUND

The soft-shell clam (Mya arenaria L.) industry has been increasing in importance to the fishery economy of Maryland the past ten years (Manning and Pfitzenmeyer 1958, Power 1958-1961). Both government and industry have shown interest in promoting higher consumption of soft-shell clams in Maryland and other areas. However, there is still consumer resistance to soft-shell clams. Much of this resistance is due to the presence of grit--i.e., sand and shell.



The soft-shell clam, Mya arenaria L.

Sources and mode of accumulation of sand differ from those of shell; consequently, different processing methods will be required for the removal of each. Before proceeding into the development of such methods, a valid and specific method for estimating the amount present of each fraction is highly desirable.

The following investigation was conducted to (1) find or modify a method (Anon. 1947) applicable for estimating the amount of shell present in shucked soft-shell clams and (2) measure the effect of manual sorting on the total amount of shell present in shucked clams.

For the purpose of this study, shell is defined as broken parts of the calcareous valve (mostly calcium carbonates and phosphates) of the mollusc that will be retained by a 14 x 18 mesh (number of strands per unit in length and width) galvanized iron screen. Because the shell of the soft-shell clam is fragile, the shucked meat is often contaminated with broken pieces of shell material through careless as well as normal handling.

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*Research Assistant
**Summer Student Trainee
Natural Resources Institute, University of Maryland, Crisfield, Md.

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For the present purpose the shell residue present after shucking can be divided into two distinct groups: "splinters" and "fragments." The splinters are long thin pieces of shell with the long axis parallel to the line of growth. Their width varies from a fraction of a millimeter to 2 millimeters (0.08 inch) while their length ranges from 2 to 20 mm. (0.08-0.79 inch). The splinters result from fracturing the ventral edge of the shell when soft-shell clams are shucked by hand, as is the common practice (Hanks 1963).

Larger irregular masses of shell which vary in area from about 4 $mm.^2$ (0.16 $in.^2$) to more than 400 $mm.^2$ (15.7 $in.^2$) are designated as fragments. These originate from all areas of the shell including the umbo and muscle scars. The fragments result from fracturing the whole shells while in the hands of the shucker and subsequent dropping of shell fragments into the previously shucked clams.

The source of pieces of shell smaller than 4 $mm.^2$ can be best determined by association rather than by shape. Splinters smaller than 4 $mm.^2$ will adhere to the edge of the mantle even after digestion. Loose pieces are probably fragments.

METHODS AND MATERIALS

COLLECTION OF SAMPLE: Shucked soft-shell clams in one pint plug-top cans were obtained from commercial sources in Maryland.

REAGENTS AND APPARATUS: Sodium hydroxide reagent (Solution A) was made by dissolving 375 grams of reagent grade sodium hydroxide pellets in distilled water, cooling, and adjusting to one liter (0.26 gallon).

The phosphate reagent (Solution B) was made by dissolving 87.5 grams of reagent grade sodium orthoposphate dodeca hydrate ($Na_3PO_{4.12}\ H_2O$) in distilled water and adjusting to one liter.

Screens were fabricated from 4 x 4-inch squares of 14 x 18 mesh galvanized iron screen. The edges of the squares were soldered and then turned up to form a shallow dish.

One liter pyrex Erlenmeyer flasks covered with 250 ml. pyrex beakers were used as digestion flasks.

Other equipment included: autoclave, forced draft oven adjustable to $\pm 5^{\circ}$ C. and 2 pairs of fine straight $4\frac{1}{2}$-inch long forceps.

ANALYTICAL PROCEDURE: Clams from 8 pint cans (about 450 g. each) were combined and mixed; 200-gram portions of clams were weighed directly from the mixing container into each digestion flask; 160 ml. of Solution A, and 40 ml. of Solution B were added to the digestion flask, which was then covered and autoclaved at 121° C. (15 p.s.i.g.) for 15 minutes. The flasks were kept hot in the autoclave and were removed one at a time for immediate analysis. The solution (hot corrosive gloves should be used) was poured onto a screen and washed with a mild stream of tap water. Any shell material that may have adhered to the flask was washed down. The shells were separated from other undigested material that remained on the screen and were placed on a second screen with forceps. The shells were then washed thoroughly with distilled water. The screen containing the washed shells was put in a preheated forced draft oven and dried for a half hour at 95° C., cooled, and weighed. The shells were removed and the screen was tared. The actual weight of the shells was determined by the difference (table 1).

Table 1 - Amount of Shell Present in Shucked Soft-Shell Clams as Found by Alkaline Digestion

Sample No.	Weight of Clams		Weight of Shell
	Pints	Grams	Grams
6-18	4	1800 1/	1.89
6-24	4	1800	1.00
6-25	4	1800	1.05
7-1	4	1800	0.87
7-2	4	1800	0.98
7-8	4	1800	1.23
7-8a	4	1800	1.20
7-10	4	1800	3.18
7-10a	4	1800	2.95
7-15	4	1800	1.00
7-15a	4	1800	1.08
Average			1.49
Range			0.87-3.18

1/Each sample is the combined result of nine 200-g. lots. See procedure.

RECOVERY AND CONTROL EXPERIMENTS: A recovery experiment was conducted in order to find the effect of the digestion mixture alone on the recovery of the shell material. The analytical procedure previously described was followed except distilled water (200 ml.) was substituted for the clams. A known amount of shell material was added to the digestion flask before digestion (table 2).

Table 2 - Recovery of Added Shell From Water Solution

Weight of Shell Added	Weight of Shell Recovered	Percentage of Shell Recovered
Grams	Grams	%
0.75	0.74	98.6
0.75	0.75	100.0
0.75	0.74	98.6
0.75	0.74	98.6
0.75	0.75	100.0
0.75	0.75	100.0
0.50	0.49	98.0
1.0	0.97	97.0
1.5	1.49	99.3
2.0	1.98	99.0
3.0	2.98	99.3
0.75	0.74	98.6
0.75	0.74	98.6
0.75	0.74	98.6
0.75	0.76	101.3
0.75	0.75	100.0
0.75	0.74	98.6
0.75	0.73	97.3
0.75	0.75	100.0
0.75	0.73	97.3
0.75	0.75	100.0
0.75	0.74	98.6
0.75	0.72	96.0
0.75	0.74	98.6
0.75	0.74	98.6
Average		98.8
Range		96-101.3

Table 3 - Recovery of Added Shell From Preinspected Clams

Weight of Shell Added	Weight of Shell Found by Process	Percentage of Shell Recovery
Grams	Grams	%
0.5	0.53	106.0
1.0	1.01	101.0
1.5	1.49	99.3
0.5	0.51	102.0
1.0	1.01	101.0
1.5	1.50	100.0
0.5	0.53	106.0
0.0	0.03	-
0.0	0.07	-
Average		102.2
Range		99.3-106.0

Table 4 - Effect of Visual-Manual Inspection of Total Shell Present in Shucked Soft-Shell Clams

Weight of Total Shell	Shell Found by Hand		Shell Found by Alkaline Digestion	
	Weight	Percentage	Weight	Percentage
Gram	Gram	%	Gram	%
0.23	0.21	91.3	0.02	8.7
0.28	0.27	96.4	0.01	3.6
0.22	0.18	81.8	0.04	18.2
0.20	0.18	90.0	0.02	10.0
0.37	0.33	89.2	0.04	10.8
0.15	0.07	46.7	0.08	53.3
0.11	0.06	54.5	0.05	45.5
0.20	0.17	85.0	0.03	15.0
0.34	0.27	79.4	0.07	20.6
0.28	0.24	85.7	0.04	14.3
0.94	0.88	93.6	0.06	6.4
0.88	0.70	79.5	0.18	20.5
0.29	0.17	58.6	0.12	41.4
0.53	0.46	86.8	0.07	13.2
0.40	0.35	87.5	0.05	12.5
0.94	0.79	84.0	0.15	16.0
0.91	0.80	87.9	0.11	12.1
	Average	81.1	Average	18.9
	Range	46.7-96.4	Range	3.6-53.3

Another experiment was then conducted to find the combined effect of the clams and the digestion mixture on the recovery of the shell material. The analytical procedure first described was followed. However, before digestion, the clams were inspected several times thoroughly by a number of people, all shell found was removed by hand and with the help of forceps, and a known amount of shell was added to each flask (table 3).

In order to find the relative amount of shell which can be recovered by a thorough, though economically sensible, manual sorting, several lots of clams were obtained from commercial sources. These clams were inspected in the laboratory under conditions typical of better industrial practice, bringing into consideration economics of production as well as quality of product. All shell removed was dried, weighed, and reported as shell found by hand. The analytical procedure first described was followed on the manually inspected clams. The total sum of shell found by hand and by alkaline digestion was assumed for the sake of calculation to be the total amount of shell present in the clams (table 4).

DISCUSSION AND CONCLUSION

Addition of phosphate salt to the digestion mixture gave consistently higher shell recoveries than digestion by sodium hydroxide alone. The digestion by the alkaline solution dissolved most of the clams except for epithelial tissues of the mantle and siphon. However, these did not interfere with the screening procedure or the subsequent picking of the shell. The period specified for digestion (15 min.) was sufficient. A longer period offered no advantage, since all added shell could be recovered after 15 minutes of digestion (table 3).

The choice of the specified type of screen was not arbitrary. It was found that this screen retained practically all shell particles while passing sand freely. This is important in view of the forestated difference between sand and shell. Continued subjection of the galvanized iron screens to the hot alkaline solution may cause a change in tare weight. (This may be prevented by using a more inert screening material.)

Recovery of added shell from both water and clams was statistically significant (t test). Because of the very small amount of undetected splinters that persisted in the clams even after thorough sorting, recovery in this case was higher than 100 percent (table 3). It was found that by careful, yet commercially feasible manual sorting, a significant amount of shell can be removed (t test); however, in each case an amount of residual splinters remained (table 4).

The alkaline digestion method described provides a fast and accurate way for estimating the total amount of residual shell in shucked soft-shell clams. Improvement in the methods for detection of shell and the development of commercial methods for elimination of shell in the shucked soft-shell clams are important to the further development and progress of this industry.

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SOUTH ATLANTIC OCEAN SEAMOUNT HOLDS KEY TO NEW STUDIES

Seamount Vema, a submerged volcanic peak rising to within 84 feet of the surface, lies 540 miles northwest of Cape Town in the South Atlantic Ocean. The unique scientific examination of the mount was carried out under the auspices of the National Committee for Oceanographic Research. It is reported that Seamount Vema is unique in that it is probably the only seamount known which rises from the floor of a deep ocean basin to a level sufficiently high for effective sunlight penetration and for study by SCUBA divers with normal equipment.

As an easily-located shoal area where ships may anchor in the center of the Cape basin, it is strategically placed as a reference point from which to carry out a variety of important scientific and fisheries research in an oceanic area of which little is known in spite of its great potential activity.

The rocks on the mount are covered with prolific and varied growth and rock lobsters were seen in great numbers. Those caught by hand and with a net were larger than the most common sizes encountered in the exploited populations of the South African west coast. (South African Digest, December 18, 1964.)