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Nutrient Requirement of the Lobster and Nutrition Pathology

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Disease problems are observed to increase with high density confinement rearing as practiced in lobster aquaculture or pound holding, where up to 100,000 pounds of legal-sized lobsters are held for up to 4 months. The nutritional status of these animals undoubtedly influences their disease resistance under stress conditions associated with holding in a pound or rearing unit; either a dietary imbalance or insufficiency represents an additional stress to the confined lobsters.

In recent years, several artificial diets have been formulated to attempt to grow or maintain lobsters. Formulation of these test diets was based on limited information of the nutritional requirements of the lobster (Castell et al., 1975; Conklin, 1975; Gallagher et al., 1976). One of the objectives of the present study was to determine the lobsters' dietary intake by analysis of stomach contents of naturally feeding lobsters. This intake was defined in proximate nutritional terms. Lobsters were taken by scuba diving from the mouth of the York River, an area closed to lobster fishing, and their stomach contents analyzed for protein, energy, ether extract, total mineral, calcium, and amino acid profile. When lobsters having hard shells were compared with lobsters having soft shells (Table 1), their dietary intake consisted of more protein, energy, and ether extract; ether extract, however, was not significantly different.

The soft-shell lobsters appeared to have a greater mineral and calcium requirement as their stomachs contained more of these components than did the hard-shell lobsters. This increased mineral intake probably indicates an additional need for minerals involved in calcification of the new shell. The critical nature of mineral balance has been demonstrated in feeding trials in which juvenile lobsters were fed diets with varying Ca/P ratios. Scanning electron micrographs of lobster shells showed that all animals receiving synthetic diets had an abnormal epicuticle. Histological examination of lobsters' shells revealed that all synthetic diets produced thinner shells. Furthermore, in those diets with a Ca/P ratio of 1.55 or greater, extreme abnormalities were noted in the endocuticle, indicating a disruption of the laminar protein matrix required for the calcification process. Mortality was greatest in the lobsters fed diets containing a high Ca/P ration. All lobsters that died were in the process of molting and were unable to complete the molt, remaining partially attached to their old shell. Since the shell is the primary physical and perhaps chemical barrier to microbiological invasion, the weakening of this barrier could have severe effects on the ability of the animal to resist disease.

Table 1.—Mean proximate analysis values of stomach contents from hard-shell, intermediate-shell, and soft-shell lobsters. The numbers of observations is in parentheses. Values differing from each other significantly ($P<0.05$) have different superscripts; identical superscripts indicate no significant differences.

Constituent	Hard-shell (60)	Intermediate-shell (7)	Soft-shell (11)
Crude protein (percent sample)	34.07 ± 2.74[a]	23.24 ± 2.49[b]	12.16 ± 2.15[b]
Gross energy (cal/gm)	2,142 ±238[b]	1,535 ±125[ab]	1,040 ±253[b]
Ether extract (percent sample)	1.09 ± 0.53[a]	0.53 ± 0.15[a]	0.58 ± 0.17[a]
Total mineral (percent sample)	47.57 ± 3.15[a]	52.33 ± 1.46[a]	67.70 ± 2.49[b]
Calcium (percent sample)	17.44 ± 1.66[a]	24.69 ± 1.14[b]	30.77 ± 1.53[b]
Calcium (percent total mineral)	37.23 ± 2.57[a]	47.12 ± 1.28[b]	45.43 ± 1.44[b]

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