Decalcification of Crustacean Meals

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The decalcification of crustacean meals (Blue Crab and Freshwater Crayfish) was accomplished by drying the waste material to a moisture level of 6% or less, grinding through a Wiley mill with a 1/4 in. screen, and sieving through a No. 12 U.S. standard mesh screen. Protein content of the meals was almost doubled by such processing. Calcium levels were reduced by as much as 68%. The processing of such materials should allow larger quantities to be incorporated into rations for monogastrics, thus effecting greater economic utilization of these byproducts.

In Louisiana and other coastal areas of the United States, Blue Crab (*Callinectes sapidus*) and Freshwater Crayfish (*Procambarus clarkii*) are commercially important food products. Approximately 60 to 85% of these raw shellfish are considered waste and represent a disposal problem to the industry. Increasing pressure from local, state, and federal agencies to reduce pollution of water and air, coupled with a cost-price squeeze on profits, indicates a need for a commercial use of these byproducts.

Present recommendations concerning use of dried crustacean meals in rations demonstrate they are satisfactory substitutes for fish meal only when they are used in conjunction with other protein supplements and when calcium-phosphorus contents are adjusted properly. Lovell *et al.* (1968) stated that crayfish meal contains approximately 18% calcium and should constitute no more than 10% of most animal rations. Kifer and Bauersfeld (1969), Lubitz *et al.* (1943), and Parkhurst *et al.* (1944) also restricted crab meal to 10% of poultry rations, due to high calcium levels. Due to this 10% restriction, crustacean meals themselves supply little protein, therefore contributing greatly to the reluctance of feed manufacturers to include these meals in their rations. Therefore, it is the author's opinion that before widescale use of crustacean meals in various rations can be made, the calcium content must be decreased. Hence, the purpose of this investigation was to reduce calcium levels in crustacean meals.

EXPERIMENTAL METHODS

Calcium carbonate ($CaCO_3$) is responsible for scleratization (hardening) of the exoskeleton. Consequently, it was concluded that separation of the exoskeleton from the remaining material would significantly reduce calcium levels of resultant meals. The author noted that in grinding dried crayfish and crab waste, it was extremely difficult to reduce exoskeletal material to the same mesh size as fleshy material. This particular fact was utilized in separating shell from flesh material.

Processing. The process of decalcification was accomplished by drying crustacean waste to a moisture level of 6% or less, and grinding through a Wiley mill with a 1/4 in. screen. The impact and shock wave created in the mill were sufficient to reduce protein constituents to finer mesh sizes than the exoskeleton. Shell was separated from the flesh material by the use of a No. 12 U.S. standard mesh sieve.

Analysis. Fifty pounds of frozen Freshwater Crayfish and an equal quantity of Blue Crab waste were dried in a Virtus (Model USM-15) freeze dryer. Other drying procedures worked equally as well; however, freeze drying was chosen strictly as a matter of convenience. Samples were crushed to facilitate drying. Each lot was processed and screened in the manner described above.

Chemical Composition. Proximate analyses were conducted on 20 samples of each lot before and after processing in accordance with methods described by the Association of Official Agricultural Chemists (1960). Chitin was accounted for in appraising protein values employing the method of Black and Schwartz (1950). In addition to proximate analyses, calcium content was determined on both lots before and after processing using a Perkin-Elmer atomic absorption spectrometer; phosphorus content was determined by the standard colorimetric procedure.

Processing Efficiency. In an attempt to determine the percentage skeletal material removal during processing, 20 100-g samples of the crustacean material before and after processing were subjected to proteolytic digestion with papain. A liquid solid ration of 3 to 1 was made using distilled water. Papain was added at the rate of 1 g per 100 g of dry waste material. Samples were incubated for 10 hr at 56° C. After washing, samples were refluxed with 5% sodium hydroxide for 2 hr to remove any residual flesh material. The residue after drying was weighed and presumed to be entirely skeletal material. Percent reduction in skeletal material was assumed as processing efficiency.

RESULTS AND DISCUSSION

Chemical Composition. Proximate analysis of Blue Crab and Freshwater Crayfish prior to processing are presented in Table I. Percentage calcium in both crab and crayfish meal were between 17 and 18%. If calcium is assumed to be primarily in the form of calcium carbonate, this would represent roughly 42 to 44% of the total meal, which is indeed high. Lovell *et al.* (1968) maintains that the ash determination was not a true indication of total mineral in crustacean samples. His work indicated that approximately 10.8% of the calcium carbonate is pyrolyzed at 550° C. This often leads to a false value which appears as nitrogen free extract. Crude protein values reported in Table I have been corrected for chitin, since chitin is a glucosamine polymer containing 6.89% nitrogen.

Proximate analyses of decalcified crab and crayfish waste are presented in Table I. Protein of both meals were substantially increased over the unprocessed meals coupled with a corresponding decrease in total ash. Calcium levels were reduced by 56 to 68% for each meal, respectively.

Processing Efficiency. Skeletal material for both crab and crayfish waste was found to constitute about 80.2 to 75.4%

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Table I. Proximate Analyses of Crab and Freshwater Crayfish Waste Before and After Processing[a]

Constituent	Before Processing		After Processing	
	Blue Crab	Crayfish	Blue Crab	Crayfish
	Percentages		Percentages	
Moisture	4.5	5.7	8.2	6.4
Protein[b]	24.0	28.1	58.4	58.5
Fat	2.0	4.4	2.7	6.0
Chitin	12.9	12.5	2.6	2.1
Ash	56.0	44.0	20.5	16.8
Calcium	17.0	18.0	7.5	5.7
Phosphorus	1.7	1.2	1.4	0.9

[a] Average of 20 analyses. [b] Corrected for chitin.

Table II. Processing Efficiency[a]

Determination	Blue Crab	Crayfish
	Percentage	
Skeletal material in waste prior to processing[b]	80.2	75.4
Skeletal material in meal after processing[b]	21.6	15.8
Processing efficiency	73.0	79.0

[a] Average of 20 analyses. [b] Percent of total dry material.

of total dry material before processing. About 60 to 65% of total waste material is separated as shell in the course of processing, which would represent about 75 to 80% of the total skeletal material. The data are presented in Table II. Examination of the screened material revealed that it consisted of primarily exoskeletal material, whereas internal skeletal structures were reduced to sizes sufficient to pass through the No. 12 sieve. As these latter skeletal structures passed through the sieve, they probably prevented further reductions in calcium levels.

Processing. The ratio of calcium to phosphorus is indeed important in formulating any ration. When a feedstuff contains 18% calcium, it markedly restricts levels of incorporation. However, adequate processing of such waste as described previously will tend to reduce imbalances between calcium and phosphorus, as well as increase protein content. If it is feasible to dry such waste material, additional cost of milling and screening should be nominal.

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