Chitin from shell waste

By **JC Buendia**

WHAT IS CHITIN?

Chitin is a natural substance composed of sugar molecules strung together. It is one of the most abundant organic compounds in nature. Chitin is present in the exoskeletons of animals such as the shells of shrimps, crabs and lobsters, pens of squids, wings of insects and even nails of humans. It is also found in almost all mushrooms and some algae.

Biodegradable and non-toxic, chitin and its derivatives like chitosan are safe for industrial use. According to Seaborne, a company based in Honolulu, Hawaii, chitin and its derivatives has been considered as functional food in Japan since 1992. As functional food, it functions in the fortification of immunity, prevention of illness and aging, recovery from illness, and control of biorhythm.

MAJOR SOURCES

Waste shell from the shellfish (e.g., crab, shrimp, lobster) industry is an important source of chitin. In fact, finding a solution to the potential environmental problem of waste shell is one reason why R&D on chitin progressed (Van Ornum 1992).

Chitin content of shells from some crabs and shrimps is presented in Table 1. Giant tiger shrimp contain one of the highest amounts of chitin -- 39% and 36.5% from the head and shell, respectively. It is only topped by lobster shell which contains 88% to 97% chitin (Blumberg *et al*. as cited in Das *et al*. 1996).

Another prime source is the waste from fungal fermentation of pharmaceutical industries which produces such products as vitamin C and penicillin. Nicol (1991) foresees that as demand for chitin and its derivatives increase, genetically engineered microorganisms able to produce desired properties under controlled conditions and in fixed quantities will be the major source in the future.

Table 1. **Percentage chitin from some shrimp and crab shells** (Austin et al. 1981; Benjakul et al. 1993; Das et al. 1996; Johnson et al. 1978)

Organism	% chitin
Blue crab (*Callinectus sapidus*)	14.9
Red crab (*Geryon quirquedons*)	27.6
Horseshoe crab (*Limulus polyphemus*)	26.4
Blue swimming crab (*Portunus pelagicus*)	
Body	13.5
Claw	11.7
Leg	20.2
Mud crab (*Scylla serrata*)	
Body	11.7
Claw	10.4
Leg	16.1
Brine shrimp (*Artemia* sp.)	27.2
Mysid shrimp (*Taphromysis bowmani*)	8.55
Green tiger shrimp (*Penaeus semisulcatus*)	13.7
Giant tiger shrimp (*Penaeus monodon*)	
Head (carapace)	34.9
Shell	36.5

PRODUCTION

A shell is made up of proteins, mineral matter and chitin. To isolate chitin, the basic procedures as described by Van Ornum (1992) are:

(1) grinding of the shell to particulate size
(2) addition of sodium hydroxide (NaOH), screening, washing and screening to remove the proteins
(3) addition of hydrochloric acid (HCl), screening, washing and pressing to remove the mineral matter
(4) drying and packaging

Dried chitin can be stored indefinitely before using or conversion to its derivatives. ☞ page 38

Table 2. **Potential uses of chitin and its derivatives** (Austin *et al.* 1996; Elson *et al.* 1996; Harvey *et al.* 1997; Shoemaker 1991; Simpson *et al.* 1997; Van Ornum 1992)

Agriculture and aquaculture
coating of seeds, fruits and vegetables; anti-nematode agent in soil; poultry feed; packaging material for frozen fish and shrimp; coating of shellfish spat collectors; protective coating of raw shrimp

Food and nutrition
flavor preservative and enhancer; filter for deacidifying coffee; removing tannin and clarifying beverages; thickening/gelling agent for binding, stabilizing, or texturing food; fiber source; cholesterol reducer; lactose intolerance aid; weight-loss aid; antacid

Waste treatment
removes dyes, insecticides, petroleum products and heavy metals

Biomedicine
wound, bone and burn healing; contact lenses; eye and gum disease treatment; skin irritation relief; athlete's foot treatment; sutures; clotting agent

Cosmetics
emulsifiers; moisturizers; anti-static agent; emollients; thickeners; film formers

Biotechnology
immobilize enzymes and cells, encapsulation, recover protein

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why we really have to make this project work. Our office constantly monitors our own searanching activities," Mr. Mamasig continues.

Early benefits

What has happened so far? What benefits have been obtained from the project?

Messrs. Mamasig and Dimaano of OPA claim that fishes like *Caesio*, snapper, rabbitfish and parrotfish have been observed to be rapidly growing and multiplying inside the enclosed searanching area. Also, some lobsters, mudcrabs have been seen inside the site. They also point out that some corals inside the sanctuary have regenerated.

The Mandaragat fishers say that they have had some good fish catches in the sea bottom area immediately around the searanch sanctuary. "This was quite significant, compared to the time that we did not have this project yet. You will also note that the grouper fingerlings we have stocked in our netcages were previously caught by our members," exclaims Mr. Manzano of the fishers association.

Pressing concerns

Stirrings in the modest searanching project are sending signals for outside assistance. Residents, officials and technologists involved in the project feel they could not let such a noble cause go into remission. They have invested so much of their effort, time and resources to show local fisherfolks that an environmentally sound fishing livelihood can be achieved.

"Our main problem is the lack of funds to sustain the project" was constantly echoed by the project actors.

Dr. Henry Buzar, executive assistant of Quezon governor Hon. Wilfredo Enverga, while lamenting the usual financial problem that besets most government-sponsored projects, says: "While this is the present constraint, we are trying our best to interest outside parties to lend us a hand."

On the other hand, while aware of the funding concern, the Mandaragat fishers also feel that advocacy and information dissemination among their fellow fishers and other community residents should be intensified. Mr. Manzano emphasizes: "The more the people in our community learn that there is a better alternative to illegal fishing, the more fish will there be, and the better the chances for a sustained livelihood for all of us." ###

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USES

Examples of the applications of chitin and its derivatives are given in Table 2. Food and nutrition, and water treatment industries absorb much of the produce yearly.

MARKETING

Estimated price of chitin in 1994 is US$11 per kg, with some grades priced much higher (Anon. 1994). Around 8 years ago, Japan and the USA are the major producers of chitin and its derivatives (Shoemaker 1991). Most materials produced annually go to Japan where there is advanced technology and commercialization of chitosan. Other main markets are USA, UK and Germany.

PROSPECTS

Technologies to produce the qualities required of chitin and its derivatives from shellfish waste are available (Van Ornum 1994). In addition, new applications, especially of chitosan, are being discovered and refined. One drawback though is competition with biochemical industries. Still, as Nicol (1991) puts it, "a 'natural' material that uses up waste, is biodegradable and does not damage the environment may have a bright future."

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times higher than rotifers. High percentages of 22:6n-3 (DHA) were detected in the fatty acid composition of *Pseudodiaptomus* (13%) and *Acartia* (24%) with DHA/EPA (20:5n-3) values of 1.4 and 2.6, respectively. By providing nauplii of copepods at the early feeding stage, an average survival of 3.4% at harvest (Day 36) was obtained in a pilot scale grouper seed production trial in three 10-tons tanks. ###

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assessment of its potential use using the current practice of immersion or bath method appears limited due to some factors including the difficulty in dissolving the drug in water, the morphological deformities it caused to test animals, and the possible emergence of drug resistance due to inappropriate use.

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