Abstract for Chitosan and Melanin Production out of Black Soldier Fly Waste

The following abstract considers the main aspects of chitosan production from Black Soldier Fly (BSF)

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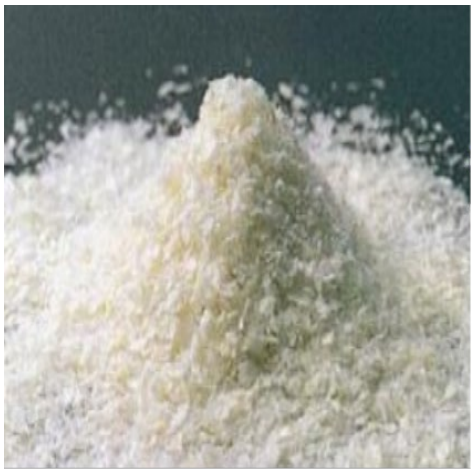
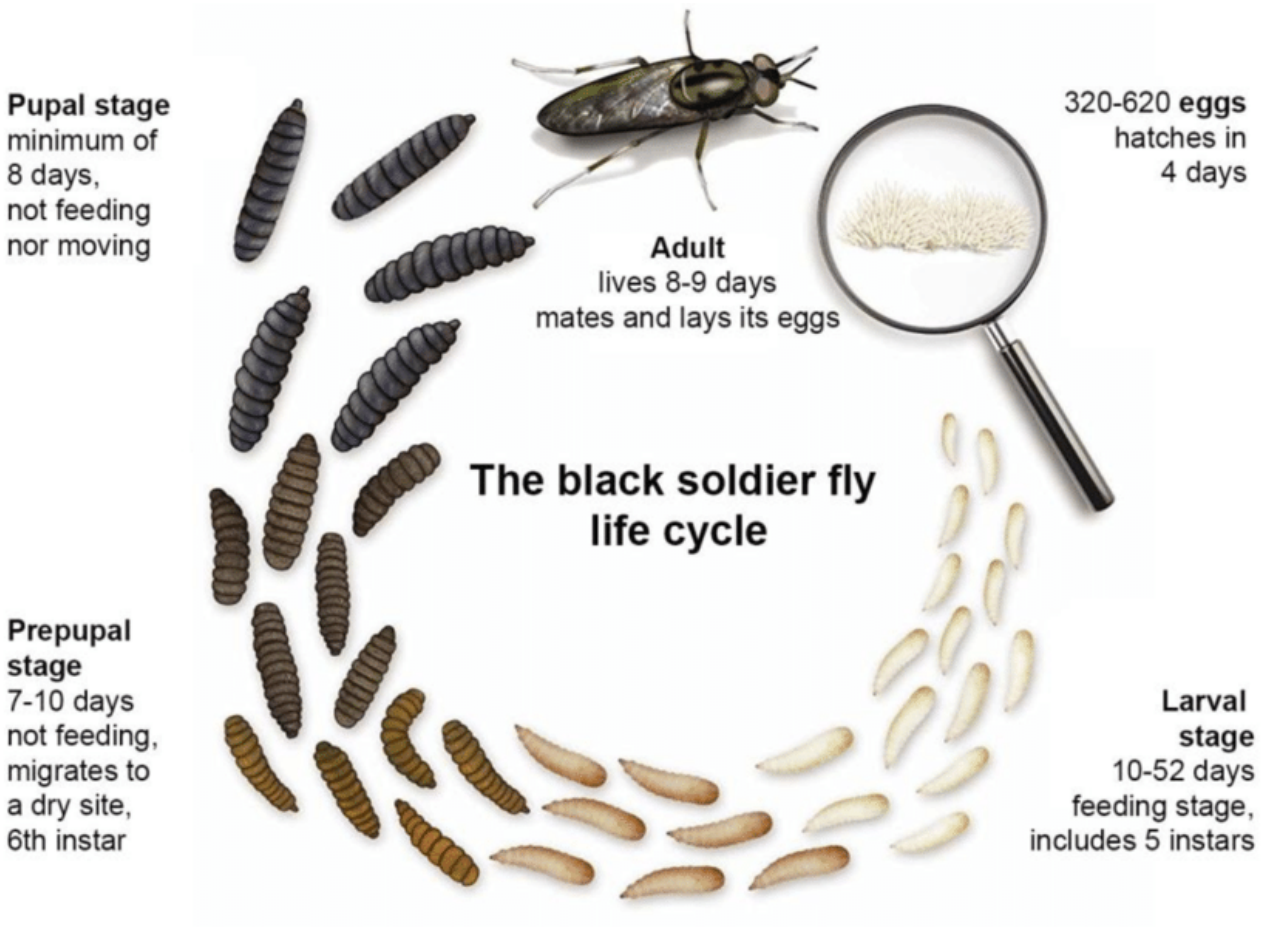


Black Soldier Fly Lifecycle

The Black Soldier Fly (*Hermetia illucens*) (BSF) adult female lays between 320 and 620 eggs at a time. These eggs are typically deposited in crevices or on surfaces above or adjacent to decaying matter such as manure or compost and hatch in about 4 days. Freshly emerged larvae are 1.0 mm, being able to reach a length of 25 mm by the end of larval stage. The larvae are able to feed on a wide variety of organic matter, adapting to diets with different nutrient content. The length of larval stage can be delayed by months due to low temperature or lack of food. Adults can survive for about 8 to 10 days on fat reserves gathered during larval stage when water is provided, or even longer when food is provided additionally.



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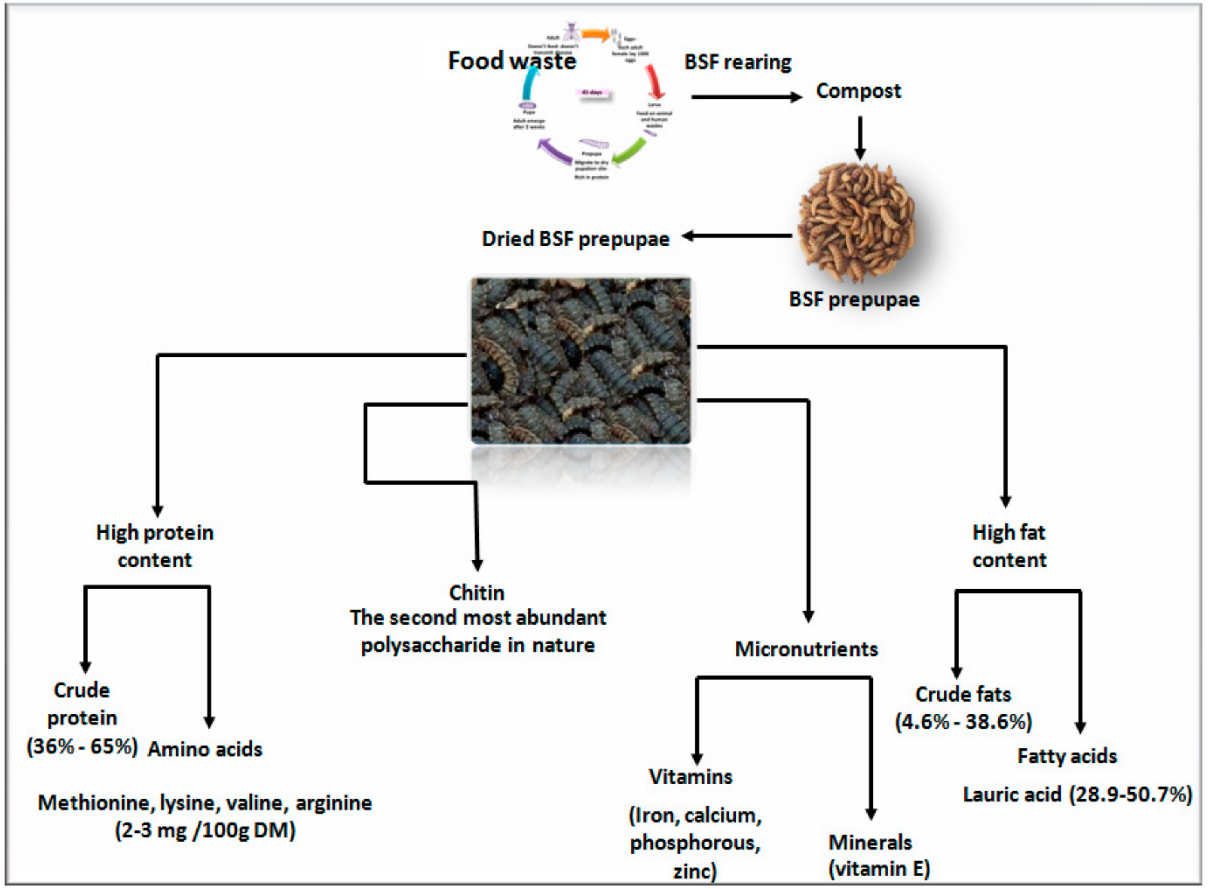
Black Soldier Fly for Organic Waste Processing

Organic waste can easily be processed by BSF rearing. Waste streams from food production, animal breeding or agriculture farming, to which they introduce high volumes of Black Soldier Fly (BSF) larvae that feed and break down the mix, are used for such processing. This process creates Frass, at a 2:1 conversion rate, which can then be used as a nutrient rich soil ameliorant which is comparable to some synthetic fertilizers. There is also a conversion of 5:1 for waste to Soldier Fly larvae. The larvae is being trialled as high protein feed for the aquaculture and pet food industries or reduced to oils and meal as ingredients in the feed industry.



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INTRODUCTION

Chitosan, a deacetylated derivative of chitin, is polysaccharide with an amino group, can be obtained from chitin, a primary component of cell walls in fungi, the exoskeletons of arthropods, such as crustaceans and insects, the radulae of molluscs, cephalopod beaks, and the scales of fish and skin of lissamphibians. Most commercially available chitosan on the world market is derived from Crustacean shells, but alternative raw material sources like insects are increasingly being used.

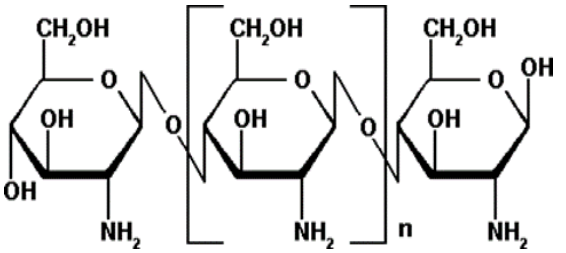
Chitosan is a white to light-red solid powder, insoluble in water, but soluble in organic acid and indigestible by human digestive enzymes. Therefore, it is used as one of the so-called dietary fibers.

Chitin is one of the three most abundant polysaccharides in nature, beside to cellulose and starch. It ranks second to cellulose as the most plentiful organic compound on earth. Chitin and its derivatives have many properties that make it attractive for a wide variety of applications from food, nutrition and cosmetics to biomedicine and agriculture.

Its antibacterial, anti-fungal and anti-viral properties make it particularly useful for biomedical applications, such as wound dressings, surgical sutures and aids in cataract surgery and periodontal disease treatment.

Chitin/chitosan is the most important additive and product from marine bio sources beside Calcium, Astaxanthin /Melanin.

. It strongly depends on the process and know how of which kind of extraction grade and quality the production has to reach.



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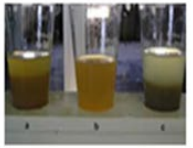
CHITOSAN APPLICATION

Commercial chitosan is usually offered as flakes or powder. The products of various companies differ in purity, granulation, color, DD, average molecular weight, and solubility. Depending on the grade chitosan gets used for various applications. The following illustration refers to the main applications.

Animal Feed
- Enhancement of performance and improving the immune function macroscopically



Coagulant
- One major application is the use as coagulant for example in water cleaning industry

Textile Industry
- Used for microbial growth purposes

Paper Industry
- Chitosan and its derivatives are used as strengthen additive, retention and drainage aids, size agent and flocculation agent

Agriculture
- Enhance disease resistance of plants, and decrease diseases
- Promote growth and increase yield
- Improve the quality of fruits and vegetables

CHITOSAN APPLICATION

Bio-Pharmaceutical Future Application
- chitosan for applications in vaccine delivery
- Also other applications using chitosan as transport agent are under development

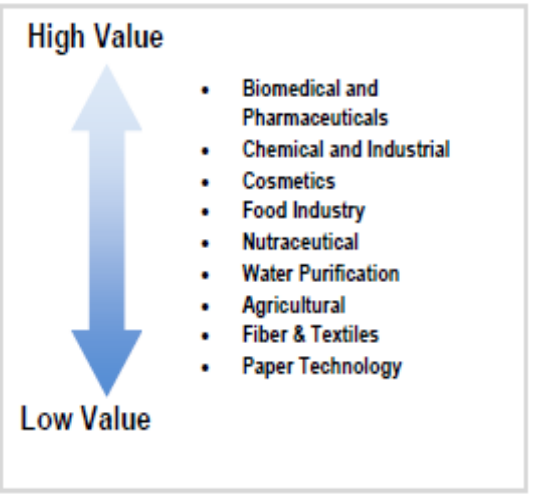
Pharmaceutical Application
- chitosan has the property to enhance blood coagulating processes. Further it acts antibacterial-both properties make it a highly valuable intermediate for pharmaceutical applications in bandages, nasal stripes, plasters etc

Food supplements
- widely used in food supplements for weight management purposes

Cosmetics
- used viscosity-building and antimicrobial properties, and its use in cosmetic emulsions and gels.

Food
- Japan produces dietary cookies, potato chips and noodles enriched with chitosan because of its hypocholesterolemic effect
- Chitosan gets also use because of its antimicrobial effect

The different product applications require different chitosan standards. The more sensitive the application (e.g. pharmaceutical use in bandages) the higher the standard. The value and the margins are positively related with the standard.



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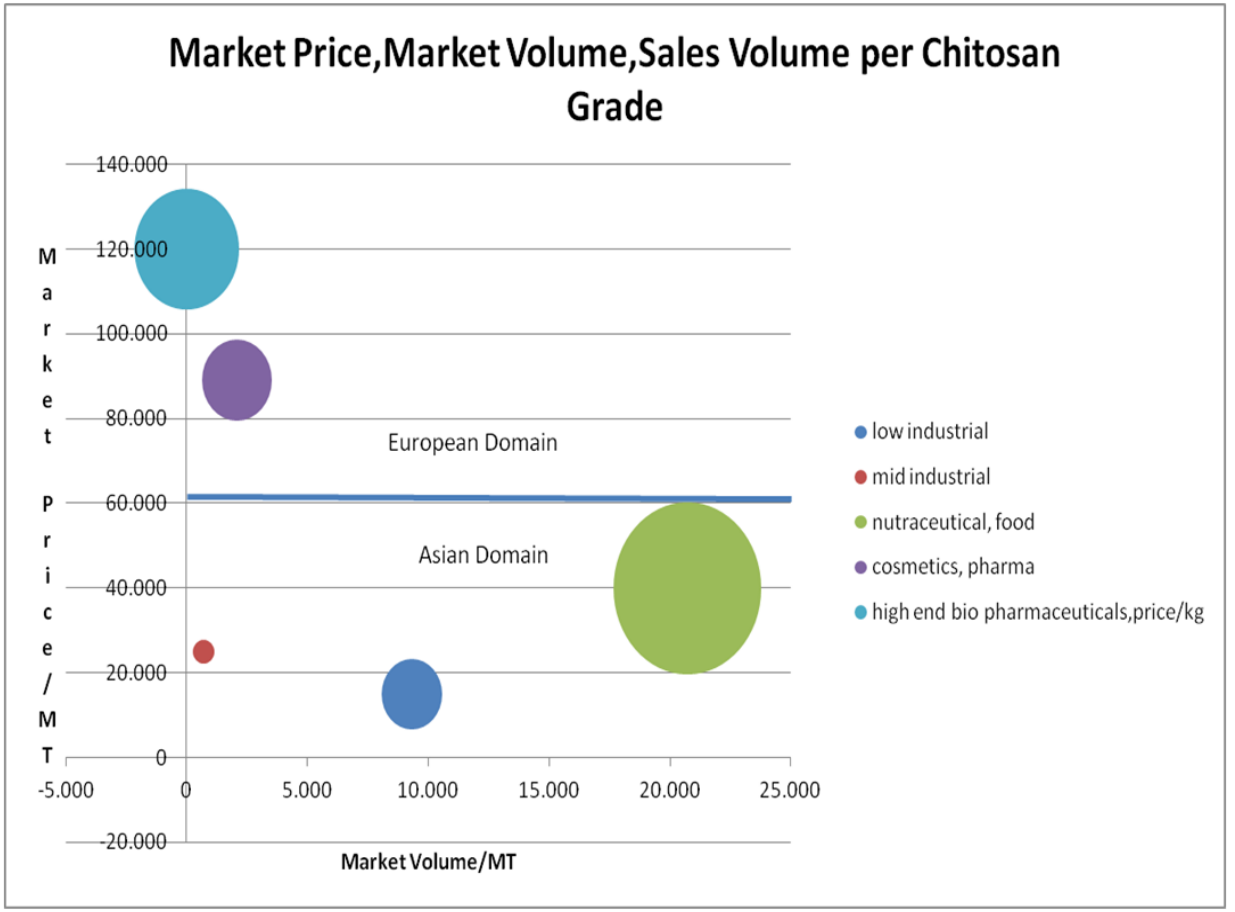
CHITOSAN MARKET

The natural polymer, chitin, and the increasing number of useful products derived from chitin such as chitosan, it´s derivatives, oligosaccharides and mono-saccharides (e.g., glucosamine) continue to attract commercial development. Prices for chitin and chitosan range from below $20 to more than $1,000 per kilogram depending on product quality.

The table on the right shows the average price of chitosan for different qualities and applications.

Further the size of the bubbles shows you the estimated relative market volume per application grade.



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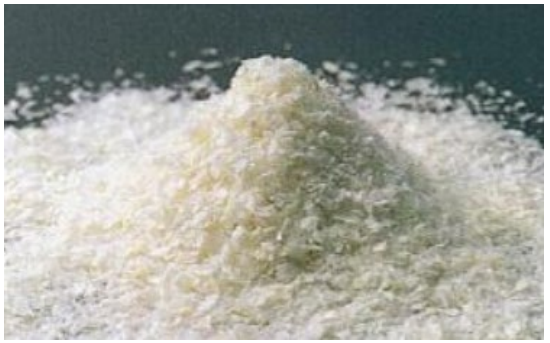
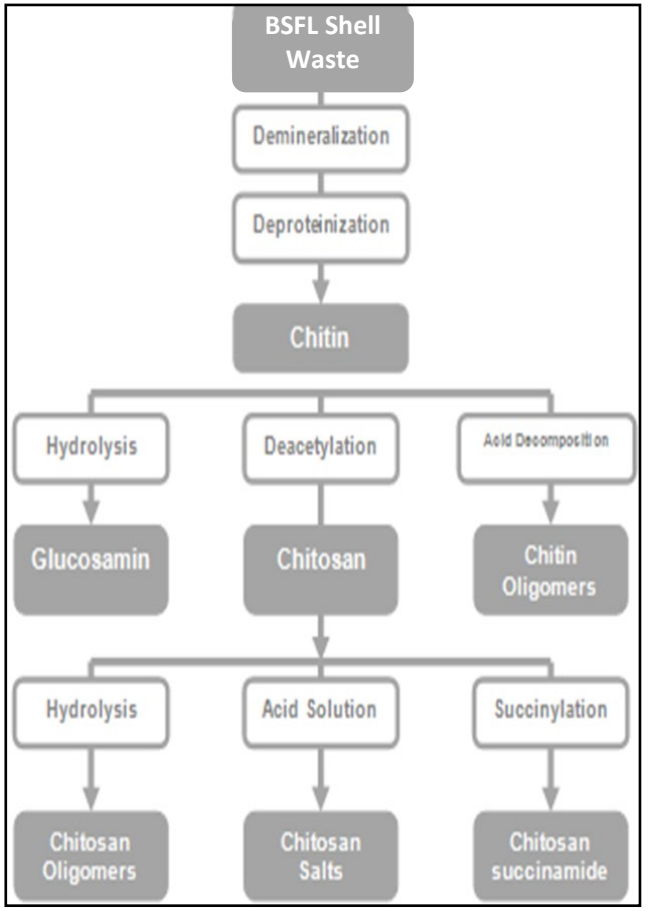
CHITOSAN PRODUCTION PROCESS

The BSF larvae (BSFL) are a highly nutritious insect quickly becoming a popular staple food source for a variety of pets and livestock. BSFL processing results in large quantities of waste materials which can be processed into chitin, or its more valuable derivative, chitosan. The amount of chitin present in the shell may be affected by a number of factors, such as type of shell (e.g. larval stage, used shell components, etc.), shell composition, and portion of the shell used.



The chitin/chitosan process involves the crushing and drying of BSFL shell or other suitable species. The product is processed with acid and alkaline/enzyme in order to remove protein and calcium then further processed to deacetylation. The product is then further bleached, dried, grinded, and packaged as a finished or semi-finished product. A plant set-up will involve a complex equipment for grinding or particularization, drying, acid and alkaline/enzyme treatment, packaging and effluent treatment.



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DIFFERENT PRODUCTION PROCESS

There are two different technologies and processes to produce chitin, chitosan :

- The chemical process that is the regular way and process worldwide.
- The second option is the enzymatic process that is a new technology. To produce chitin, it is already at industrial scale but for chitosan it is first in the pilot phase.also an optimized chemical process with using solvent free process and using natural organic acid is adapted to our process.
- Also a combination as a chemo enzymatic process is feasible. Details will be shared with you at a personal meeting.

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