Vol-1 Issue-1 2023
Scientific Research Journal of Agriculture and Veterinary Science
ISSN: 2584-1416, Peer Reviewed Journal

The use of shrimp shells in products that are not intended for consumption

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ABSTRACT

The article focuses on shrimp shells' use beyond the food industry. According to research synthesised from the aforementioned literature, shrimp shells, which are considered an industrial waste product from the technique of preserving and freezing shrimp, may be transformed into commodities that have an increased value. Chitin is extracted from shrimp shells in a multi-step process that also removes protein, minerals, and acetylation to produce Chitosan as a byproduct. Chitosan has several non-food applications, including membrane filtration, biopesticides, drug development substances in biomedicine, and face and body lotion.

Keywords: *Shrimp, seafood, perikanan, chemicals, substances, products*

INTRODUCTION

Waste shrimp shells in Indonesia are generated in the country's processing industries, such as those used for shrimp freezing and canning. The heads, skins, tails, and legs of the shrimp produced in these facilities account for between 40 and 51 percent of the total weight of the shrimp produced as trash.

Since the number of exported shrimp from Indonesia has been rising steadily, a lot of wasted shrimp shells have been produced. Like any other kind of trash, wasted shrimp skin may adversely influence the natural world if it is not put to good use. In addition to having unfavorable health effects, pollution also has the unintended consequence of fouling the air we breathe.
Chitin and calcium carbonate makes up 15%-20% of shrimp shells, whereas protein makes up 31% of the overall composition. If the right technological approach is taken, Chitin [$(C_8H_{13}NO_5)_n$] may be made from this seemingly useless substance. This chitin might be refined into Chitosan [$(C_6H_{11}NO_4)_n$] and glucosamine by further chemical reactions ($C_6H_{13}NO_5$). Given that all three of these things decompose quickly and contain no toxic materials, they pose no threat to the natural environment.

Chitosan is utilized in the fields of nutrition (for the treatment of bone anti-tumor, pain, osteoarthritis, burns, and AIDS inhibitors), biomedicine (for the treatment of bone pain, losing weight, and fiber source materials), food (for the treatment of nutritional deficiencies and as a flavor preservative), cosmetics (for the treatment of hair care and hydrating creams and lotions), and atmospheric science. (cain waste treatment). Glucosamine is a monomer of Chitosan that has a therapeutic use in addition to being an important component in bone treatments (the treatment of rheumatic illnesses).

The potential of this shrimp-shell byproduct should be maximized. This is crucial because unused shrimp shells emit a powerful odor into the surrounding area. This is crucial for several reasons, including the fact that it can educate the public about the many ways trash may be put to good use and the possibility that it will provide new economic opportunities for the region by transforming unwanted materials into something of value. This article's goal is to take a look at how shrimp shells are put to use in non-food items.

Shrimp skin has potential applications outside of the food industry, such as in ultrafiltration membranes, biopesticides, and medicines.

a) biopesticides made from shrimp peel;
b) biofertilizers made from seafood skin
c) One such application is the incorporation of medications into biomedicine via the use of shrimp skin.
d) using shrimp skins as an ingredient in lotion
e) bioplastics manufactured from shrimp shell
f) using shrimp shells in lotions and cosmetics

It is essential to process shrimp shells to extract Chitosan, which will subsequently be employed as a raw material in manufacturing the items indicated above. Chitosan is obtained from shrimp shells by first deproteinating the shells, then demineralizing them, and finally deacetylating them. Crushing the shrimp skin is the first step in the deproteination process. After that, the skin is immersed in a solution containing 3.5% NaOH at 65 degrees Celsius for an hour and a half. The shrimp shells are deproteinized after being cleaned with water or an organic solvent to neutralize the pH, then dried in an oven set at 65 °C for twenty-four hours. After the shrimp have been deproteinized, the shells are placed in a solution that contains 4% HCL and heated to 30 degrees Celsius over an electric burner. While being heated, the shells are swirled continuously during the cooking process, which lasts for an hour to remove the chitin; the shrimp shells are allowed to dry at 55 degrees Celsius for one day. The method begins with a wash in equates, which increases the shells' pH to a more favorable 7 for further processing. The subsequent step in the production of Chitosan involves the deacetylation of chitin. Chitin is given a four-hour bath in a solution containing fifty percent NaOH at a temperature of one hundred degrees Celsius, with constant stirring during the process. To complete the process, the Chitosan solid is washed with aquacades to achieve a pH balance, then dried in an oven. Manufacturing of Chitosan has started recently. Chitosan has to be ground up until it reaches a consistency that allows it to be turned into a powder.

The amount of Chitosan that can be extracted from shrimp shells is determined by dividing the weight of the obtained Chitosan by the heaviness of the raw resources, which consists of the shrimp shells until they are processed. This gives the total amount of Chitosan that can be extracted from shrimp shells. According to the findings of a study carried out by Setha and colleagues, modifications of Chitosan were accomplished in 2019, with concentrations ranging from 6.4% to 6.9%. In the study that Zahiruddin and his colleagues conducted in 2008, they discovered that the proportion of change varied anywhere from 14% to 18%. The amount of Chitosan that can be extracted depends not only on the potency of the chemicals employed but also on the length of time that the extraction process takes and the temperature at which it is conducted.

One of the many factors that may be used to evaluate the product's quality is the amount of ash that is included inside the shrimp shell chitosan. The effectiveness of a demineralization process may be evaluated based on the concentration of ash in a substance, which can be used to identify the types of minerals present in the substance. A low ash content is typically a reflection of a limited number of minerals. When producing Chitosan is considered to be of a better grade and purity when the amount of ash that is produced during production is kept to a minimum. Zahiruddin et al. (2008) conducted a study on the ash content of Chitosan and discovered that it varied from 0.19% to 0.35%. This information was gleaned from their research. These findings were obtained through the analysis and were then reported. This demonstrates that the manufactured Chitosan satisfies the quality criteria set out by Protan Biopolymers for the chitosan ash level, which is less than 2%.

In addition to the amount of ash there, the amount of water present is also a significant component in determining the quality of the Chitosan. Protan Biopolymers has decided that a moisture content of 10% is the bare minimum that is acceptable for Chitosan. (Bastaman 1989). According to the research on the subject, the amount of water present in manufactured Chitosan might vary anywhere from 9 to 12 percent.

The amount of nitrogen that Chitosan contains is the component that ultimately decides how it will behave in other groups. The amount of nitrogen is the following topic. Chitosan has a high degree of chemical reactivity, enabling it to bind water and dissolve in acetic acid. Many molecules make this property possible, one of which is a kind of amine group (NH2). There is a possibility that Chitosan is also responsible for the distinctive flavor of the protein (Benjakula and Sophanodora 1993). The nitrogen content of Chitosan should be less than 5%, as stated by Protan Biopolymer; this is the quality standard that has been created. Many studies have shown that the nitrogen concentration of Chitosan in shrimp shells satisfies all of the parameters that have been set up. The nitrogen content of the finished product falls somewhere in the range of 5% to 6.6%.

The following measurement, which is stated as a percentage, reflects the potential for acetyl group removal from chitin during the synthesis of Chitosan. Chitosan is the polysaccharide that is produced as a byproduct of chitin's deacetylation reaction. If there is a large deacetylation level, the Chitosan only contains a minute amount of the acetyl group. When there is less of an acetyl group present in the Chitosan, hydrogen bonds that are produced by Chitosan are more open to being influenced by ionic interactions. According to the findings, the percentage of deacetylated Chitosan in shrimp skin may range from 75.68 percent to 88.61 percent. Protan Biopolymers require a minimum of 70% acetic group removal again from Chitosan before considering it to be of sufficient quality.

To Prepare Ultrafiltration Membrane Composites Using CHITOSAN

In ultrafiltration, the fluid is filtered through a membrane with pore diameters between 0.15 and 0.25 micrometers. This method has a wide range of applications and is commonly used to execute tasks such as the separation of colloids, dilution of strengths, filtration, and separation of molecules including proteins, dyestuffs, polymer composites, and many more.

Applications in food processing using membrane technology's ultrafiltration approach seem promising. Ultrafiltration is essential to many processes and industries, such as wastewater treatment, agriculture, and nanotechnology. Purifying bio-macromolecules such as proteins and enzymes for recombinant therapies and industrial purposes using ultrafiltration has become more common in recent years.

Various ultrafiltration membranes, including those constructed of cellulose fiber, polysulfone, and polyacrylic acid, have been used in water purification procedures despite their high cost. As a result, there is a pressing need for a sustainable alternative raw material, ideally, one that can be produced with little investment of time, energy, and materials by using a variety of waste streams as membranes. When combined with acetic acid and other substances, the Chitosan in shrimp shells can function as a membrane.

In order to create ultrafiltration membranes from chitosan raw materials, the following steps must be taken:

Molds are used to compress a solution of chitosan powder and acetic acid. The wet film dries wholly and uniformly when placed in a vented mold. Using a 4% NaOH solution, you may remove the film from the mould. The dry membrane still attached to the mould may be removed by submerging it in the NaOH solution. Finally, aqua dest is used to clean the membrane. If a membrane begins to develop, wait until it is dry before proceeding.

Chitosan may be used in ultrafiltration membranes because it is accessible, inexpensive, insoluble in the water yet able to bind water, antibacterial, carcinogen-free, metal-ion-absorbent, and simple to disintegrate or degrade. A smaller pore size was seen for membranes with increasing concentrations of Chitosan, as reported by Setiawan et al. (2015). Chitosan concentration increases when membrane pore size decreases, and vice versa. Therefore, the ultra-filtering approach is superior.

Agrochemical USING CHITOSAN

Biopesticides are a class of biochemical pesticides used to control PDOs; they are made of non-hazardous natural substances. The word "biopesticide" refers to environmentally safe insecticides derived from natural sources. The United States' definitions of biofertilizers are universally acknowledged. Service for Environmental Protection (USEPA). Biopesticides are an alternative to chemical pesticides that are derived from live organisms. These insecticides are often known as organic pesticides. Agricultural harvest organisms, also known as CDMOs, may be managed with biopesticides, which are agents of a biological origin (Mishra et al., 2015).

When used as a covering, Chitosan prevents germs and fungi from harming young plants. Chitosan has the potential as a natural biopesticide, shielding plants from a wide range of potential dangers. The Chitosan in the soil could be used as a carbon source by living bacteria. This would accelerate the conversion of organic molecules to inorganic ones and make it simpler for plant roots to absorb nutrients. According to the results of a number of studies, the emergence of several dangerous fungi, including B. Their growth was suppressed when the fungi were cultivated in vitro using Chitosan.

Chitosan has the potential to carry and preserve essential oils and other antibacterial compounds. Even though they possess antibacterial properties, essential oils are incredibly flammable. Chitosan coatings can inhibit the surface degradation of an active substance and retain a high concentration of the product's active components throughout time.
Several investigations have shown that Chitosan could have an impact, either directly or indirectly, in protecting plants against biotic stress. In conclusion, Chitosan offers various potential agricultural uses, many of which entail decreasing or eliminating the need for potentially hazardous chemical pesticides.

Chitosan may create biopesticides by dissolving it in water and stirring the resultant solution. After that, the chosen plant is sprayed with the solution.

One of its numerous benefits is Chitosan's capacity to guard against and transport antibacterial compounds when employed as a biopesticide. Chitosan coatings can inhibit the surface degradation of an active substance and retain a high concentration of the substance's active components throughout time. Several studies have demonstrated that Chitosan may have an impact, either directly or indirectly, in protecting plants against biotic stress.

Biomedical Applications of Chitosan-Based Drug Delivery Systems

When treating patients, it is sometimes necessary to use non-oral drug delivery methods; one such approach is the lung-based route (the pulmonary drug delivery system). Theoretically, because the drug avoids the first hepatic bridge, this delivery method may assure maximal drug absorption. This is possible since the drug skips the liver's first merger. Diltiazem hydrochloride is among the most promising drugs for lung delivery. The medication is quickly absorbed and enters the bloodstream due to the weak barrier surrounding a portion of the lungs and the high capillary density. In addition to the effective administration of medicine, this offers an additional advantage (Paranjpe and Goymann 2014). In this particular atrioventricular node, microparticles of Chitosan serve as the highly conductive element.

Creating chitosan microparticles is the first step in utilizing Chitosan as a medium for delivering pharmaceuticals. Microparticles of Chitosan may be produced by the evaporation of liquids, dry spraying, or ionic gelatinization.

Solvent evaporation is a typical production technique for microparticles. The bioavailability and composition of the active ingredient, the kind of solvent employed, the temperature, the polymer's composition, and fluidity, and the amount of medicine added to the polymer may influence the features of the generated microparticles (Muhaimin 2013).

Spray drying, in practice, entails distributing the composite materials into the protective coating and then pulverizing the mixture through tubes into a jet of warm airflow that provides the implicit heat of vaporization, all while keeping the air temperature high enough to prevent the mixture from igniting (Muhaimin 2013). One advantage of this technology is that it may be used to integrate compounds of any sort into particles, including water-soluble and not.

As a conductor for cimetidine, ranitidine, and famotidine, He et al. developed small particles made of the bridge and quasi-polymeric materials (1999). His study indicates that uncross-spliced Chitosan produces spherical particles measuring 4–5 micrometers in diameter, while cross-spliced Chitosan creates particles measuring 2–10 nanometers. Due to the larger nozzle size, a greater spray flow rate will increase particle size, yet faster air velocity will result in smaller particles.

The ionic gelation process is often used to create nanoparticles or nanomaterials from polysaccharide polymers because it is straightforward, does not need organic solvents, and is easy to regulate. In addition, no organic solvents are used in this procedure. The process of the particle production is initiated by the complexation generated by the negative charges of polysaccharides and counter ions. This results in ionic gelation and precipitation of carbohydrates and metal complexes, which ultimately leads to microparticle formation.

After being exposed to NH_3^+ in acidic solutions, Chitosan (a polysaccharide) will interact with gelation agents with opposing charges, forming its $-NH_2$ group. Tripolyphosphate (TPP), a joint gelatinization agent, generates a link between the positively charged protonation pair in Chitosan and the negatively charged TPP, resulting in the formation of a nanoscale complex. This interaction yields the formation of the complex.

When loading the medicine onto the chitosan microparticles, its solubility is taken into account. Then, the procedure is split in two directions. The following are the stages of the procedure:

1. Integration (consolidation) allows soluble drugs to be added to the microparticles at the time of manufacture. Chitosan is commonly used by adding the drug to a solution and then stirring it until it is

evenly distributed throughout the mixture. After that, the nanoparticles are fabricated according to strict protocols.

2. Fermentation is part of the drug entry process for drugs which are not water-based. Once microemulsions have been prepared by soaking them in a material solution, the medication is injected into the small particles (Agnihotri et al. 2004).

There may be benefits and drawbacks to using chitosan microparticle delivery systems in the pharmaceutical and medical fields. Cahyaningrum (2014) cites research from Dubey et al. 2009 and Park et al. 2002 that lists many benefits of using microparticles.

- Efforts to hide or cover up the foul odour and flavor.
- Offers shelter for the medicine from the elements
- Shrink the particle size of medications that are notoriously difficult to dissolve to improve their solubility.
- For medications, develop products that allow for a regulated, gradual, and precise release.
- It encases substances that might be harmful in the event of an accident.
- Intensifying the pace at which the powder is poured

The Use of Chitosan in Hand and Body Lotion Production

Lotion for the hands and body is a type of skin care product that can be used on the hands and the rest of the body. Some of the good things about hand and body lotion ingredients are that they can soften and brighten the skin and protect it from the sun's harmful effects. Because it is still pretty rare for cosmetics to be made with natural ingredients, the term "natural ingredients" is usually only used in a few situations. Chitosan's ability to absorb things makes it a good candidate for the role of an antioxidant that comes from the outside. Chitosan-based chemicals could be used with mucilage substances naturally derived, like Spirulina species.

We use the term "hand body cream" or "lotion" to describe an emulsion solution that is applied to your skin on a daily basis. Both oil production and ordinary water emulsions may be used for topical application (Allen et al. 2014). Because of the need for quick and uniform distribution, finger and skin creams and cosmetics should be liquid. A quality arm and hand lotion will have efficacy and safety levels that are up to par. It will have certain characteristics, such as a homogeneous appearance, a pH between 4.5 and 8.0, a surface tension between 350 and 2500 cPs, and a total plate range of somewhere around 102. There are many characteristics that a high-quality hand and body lotion should include, but these are just a few. Antibacterial compounds are often used in hand and body lotions to prevent spoilage. BHT is widely used as an antibacterial agent in many consumer goods (Butylated hydroxytoluene). The antioxidant properties of BHT are distinct from its antimicrobial properties.
Glucosamine has been used in different ways in the world of cosmetics, such as a humectant, a chemical called, stabilizer, and a moisturizer (Lang and Clausen 1989). But Rinaudo (2006) says that Chitosan has effects on the skin that can be thought of as both moisturizing and softening.

Apriadi (2004) says that to make chitosan-based hand and body cream, you need to do the following: weigh out two grams of Chitosan; dissolve the Chitosan in 1% acetic acid at a ratio of one to ten (weight-to-volume); keep adding equates until you reach a total volume of 100 mL. You are adding water for an hour. The material for the aqueous phase, which is made up of 2.5 grams of propylene glycol, 0.2 grams of triethanolamine, and 3.5 grams of glycerin, is heated to 75 degrees Celsius while 25 milliliters of water are heated. The ingredients for the oil phase were heated to 75 degrees Celsius while being stirred. They were 1.5 grams of lanolin, 8 grams of olive oil, and 3 grams of stearic acid. So that the dough is all the same consistency, slowly add the liquid phase ingredients to the solid phase ingredients while stirring all the time. At 35 degrees Celsius, the stirring stops, and the mixture is left to cool until it is at room temperature. You'll have cream for your hands and body when the mixture is cool.

Mixing materials like citric acid, glucosamine, and 1% dissolved acetic acid is simplified when using biopolymers as raw goods for palm and body lotion. This is one of the reasons why Chitosan is useful. Chitosan is a strong base that does not dissolve much in water or alcohol but does not change in acidic solvents. This is why it acts like it does. Chitosan has been used outside the food industry, especially for non-food purposes. Chitosan is used for many things because it is antibacterial (Helander 2001). Chitosan has a lot of different uses, but it can also be used as a source of antioxidants. Chitosan has antioxidative properties, as shown by the fact that it can combine with free radicals to reduce the amount of free radical activity (Lin and Chou 2004).

CONCLUSION

A survey of the relevant literature revealed that shrimp shells, a byproduct of the freezing and canning industries, offer promise as a raw material for novel and valuable goods. Chitosan is the byproduct of acidifying shrimp shells to remove protein, minerals, and acetyl groups. Non-food items that might benefit from the manufactured Chitosan include filtration cell walls, biopeptides, medication delivery materials in healthcare, and face and body treatments.

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