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Chitosan Obtained By Sea Waste Based Materials in Cosmetics

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***Abstract* -** Chitosan is a polysaccharide that can be attained from chitin through deacetylation process. The minimal quantum of chitin is extracted from cell walls in fungi and is mainly derived from crustaceans, especially crab, prawns and shrimp shells, whose exoskeletons are readily available as waste deduced from the food processing assiduity. Chitosan has attracted significant academic and laboratory interest, as well as the attention of the cosmetic industry, as a natural humectant and moisturizer for the skin and a rheology modifier. The review covers the structure of chitosan, the sources of chitosan used in the cosmetic industry, and the role played by this polysaccharide in cosmetics.

***Index Terms* -** Chitosan; Chitin; Structure; Microencapsulation; Cosmetic Applications.

I. INTRODUCTION

Natural polymers and polysaccharides are getting more and more popular in cosmetic industry. In addition, biopolymers meet a significant ecological demand due to their biodegradability, they tend to not pollute the surrounding and environment. One of the most important factor that impact greatly is their subservience with the zero-waste aspect. In addition to the characteristic of biopolymers, biocompatibility, biodegradability, and non-toxicity has a number of unique attributes. The one of the essential properties is its cationic characteristic in cosmeceutical solution. Other important and valuable properties include film-forming, antioxidant capacity, antimicrobial and adsorption ability. This biopolymer can be processed in various forms such as powder, gel, granules etc. Chitosan films are applied as active drug carriers, and often as a base for cosmetic masks and other cosmetic products. According to Coherent Market Insights, the cost of producing chitosan is between $8 and $12 per kilogram for ordinary quality. However, the cost of chitosan can range from $10 to $1,000 per kilogram depending on the product quality and application. The main purpose of this review is to present important information about chitosan, its structure and properties, and a brief discussion of its possible applications, in particular, in the field of cosmetic technology.

II. STRUCTURE OF CHITOSAN:

Chitin and its deacetylated outgrowth, chitosan is a member of linear polysaccharides. This polymer was also found in shrimp-processing waste. The name 'chitin' is derived from a Greek word 'chiton' which means tunic. It is structurally related to the most of the natural polysaccharide cellulose. To explain the biodegradability of chitosan, it is important to remember that it is not only a polymer caring amino group, but also a polysaccharide, which also contains breakable glycosidic bonds.

It's considered as a copolymer of N-acetyl-D-glucose amine and D-glucose amine. It is a linear and semi-crystal polymer. Chitosan has Deacetylation degree and about, at least 60% of glucose amine residue. The deacetylation is conducted by chemical hydrolysis under alkaline conditions or also by enzymatic hydrolysis in the presence of particular enzymes.

Chitosan solubility characteristics depends on the factors such as temperature, particle size, and pressure. Chitosan solubility is determined by the pH of the given solution, which is related to the pKa value (about 6,5). Above pH = 7, the polymer cannot be dissolved due to its compact structure, that is, the high number of hydrogen bonds that can be created with the participation of -NH_2 and -OH groups.

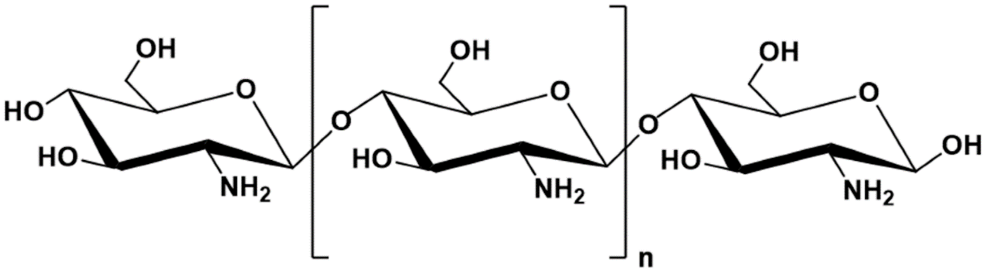

Figure 1. Chitosan Structure

III. MICROENCAPSULATION OF CHITOSAN:

Spray drying system is one of the most common drying methods used to prepare nanoparticles or microparticles based on chitosan and its derivations. After the dissolution of chitosan in an aqueous medium, the active is dispersed in the solution. The problem of poor solubility of non-cross-linked materials is overcome by Tripolyphosphate solvent in aqueous media. The biocompatibility and performance of active is also improved due to the cross-linked materials. Therefore, free-flowing particles can be obtained after the solvent evaporation and atomization of droplets.

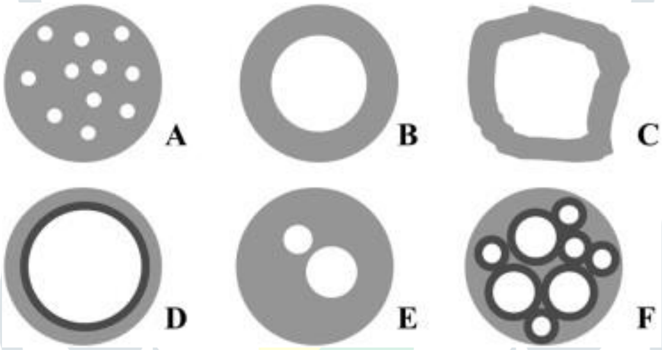

Figure 2. Spray Drying method of microencapsulation of Chitosan

To obtain the suitable particle size there are many parameters that should be considered, which are atomization pressure, extent of cross-linking, size of the nozzle, the spray flow rate, and inlet air temperature. It is considered that the use of an adequate excipient reduces the risk of thermal degradation during the spray drying method.

IV. CHITOSAN IN COSMETICS:

Chitosan isn't considered as an popular component in cosmetic industry compared to other biopolymers, such as collagen or hyaluronic acid; but the interest in this content is growing. However, now a day's more and more products are introduced in the market due to the multiple beneficial functions it can perform in the formulation of a product. Chitosan is an ingredient approved for use in cosmetics by the FDA, USFDA and the EU. In the European Union, cosmetics are subject to the regulations contained in Regulation (EC) No 1223/2009 of The European Parliament and of the council of 30 November 2009 on cosmetic products.

Moreover, chitosan acts as a moisturizer by binding the water, hydrates the skin, and can be used as a thickener, rheology modifier, and emulsion stabilizer. Chitosan provides a hydrophilic film on the skin, which prevents the water loss from the skin. The antimicrobial property of chitosan has two meanings; it is present as an active substance and also, it is possible to reduce the use of preservatives in the formulation or the product. It also has an aptitude for a compound called keratin, with this it is successfully used in haircare products. The film-forming property of chitosan allows its use in cosmetic peel-off masks and other products, that work on the principle as a wound dressing. This polysaccharide compound derivative can be a valuable ingredient of emulsions, sticks, gels, foams, or aerosols in every type of cosmetic product intended for use on skin, hair, nails or in oral preparations.

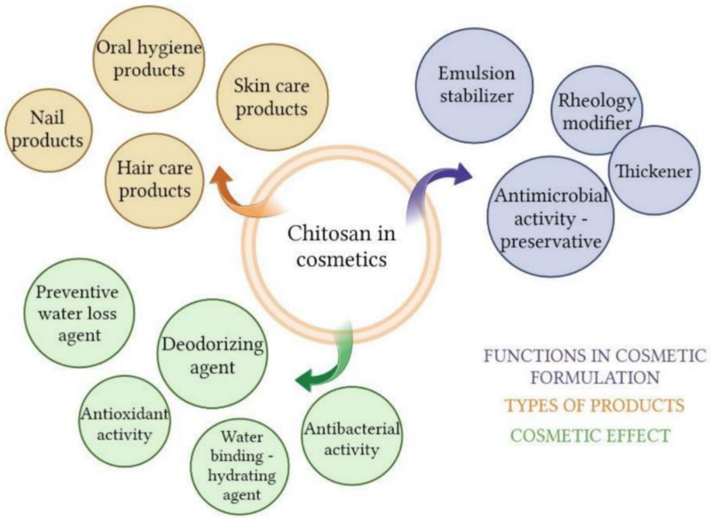

Figure 5. Chitosan in cosmetics (Created with BioRender.com, 9 February 2023)

The antimicrobial property of chitosan is applicable in deodorants and antiperspirants, where it is a seedbed for the bacteria contained in sweat, which reduces the formation of odour-causing germs. Chitosan is also a desirable ingredient in anti-acne cosmetic preparation. Antimicrobial activity has a significantly important role in oral healthcare, where the bacteria play a crucial role in the development of dental plaque.

V. CONCLUSION:

The article provides a comprehensive overview of chitosan, a polysaccharide derived from chitin, and its applications in the cosmetics industry. It discusses the structure of chitosan, its sources, and its various properties that make it suitable for cosmetic formulations. Key points highlighted in the article include: Chitosan's popularity in the cosmetics industry due to its natural origin, biodegradability, and unique properties such as cationic characteristics, film-forming ability, and antioxidant capacity. The structure of chitosan, its derivation from chitin, and the process of deacetylation. Methods of microencapsulation of chitosan, particularly through spray drying, to enhance its solubility and bioavailability in cosmetic formulations.

Chitosan's role in cosmetics as a moisturizer, thickener, rheology modifier, emulsion stabilizer, and antimicrobial agent. Regulatory approval for the use of chitosan in cosmetics by FDA, USFDA, and the EU, along with its applications in various cosmetic products including skincare, haircare, oral care, and anti-acne preparations.

In conclusion, the article emphasizes the growing interest in chitosan as a versatile and effective ingredient in cosmetic formulations due to its beneficial properties and regulatory approval for use in cosmetics.

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