

# CHITOSAN BASED BIO-FILMS IN FOOD TECHNOLOGY: A REVIEW

**Piyush Khajuria**

*Department of Medical*

*Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India*

**ABSTRACT:** *Chitosan, which may be regarded the most prevalent polymer after cellulose, is derived from chitin. Because of these properties, in terms of applications from scientists and businessmen from divergent fields, chitosan alone or chitosan-based composite film development is attracting great interest. A large medley of plant extracts and supportive polymers has been incorporated into chitosan films to boost the biological (mainly antimicrobial and antioxidant) and physiological (mainly mechanical, thermal and barrier) properties of the chitosan-based films. Considering the up-to-date published studies focused on the development and implementation of chitosan film, it can be mentioned that the study ratio in this region is still poor. Only for particular applications in food technologies can chitosan blend/composite films with specific properties (super-hydrophobicity, excellent mechanical strength, appropriate barrier properties) be made. We tried to summarise the development made in the last 5-7 years in the field of chitosan film technology for its use in the food industry in the current study.*

**KEYWORDS:** *Antimicrobial, Chitosan, Film, Mechanical, Polymer.*

## INTRODUCTION

An intensive attempt has been made by numerous researchers to be able to formulate a packaging cloth which will be applied in food safety for reinforcing the shelf-lifestyles of clean meals commodities against food borne pathogens and fungal attack which reasons superb damage to the meals enterprise. The key reason after this increasing attention is the lifestyles of various apprehensions concerning the alarming decrease in natural assets and disadvantages (fitness and environmental troubles) of petroleum-based artificial polymers, which are hugely the use of in clinical and meals industries. In this regard, biodegradable herbal polymers had been under substantial investigation as suitable alternatives to the artificial petroleum-primarily based merchandise. The applicability of biopolymers is seeking a vast growth daily in diverse industries. However nevertheless, these biopolymers are poor in vital properties necessary to satisfy business standards. Certain physicochemical homes of the chitosan membranes need to be improved for you to make biopolymer based totally wrapping ingredients reasonable, mild, low cost in comparison to petroleum-based synthetic substances. On account that a long time, chitosan has been researched as an wonderful movie-forming agent for the fast and increasingly

gaining hobby for its packages in a large spectrum of arenas including meals, biomedical and chemical enterprise. A selection of different components has been practiced as reinforcing or combo fabric in the manufacturing of chitosan composite films. According to the internet of science, around 1860 information (2007-17) can be discovered concerning the chitosan composite or combination movies, outlining its manufacturing, characterization and feasible programs.

Chitosan is an exciting and promising excipient that became intensively implemented as an opportunity in agriculture, meals and pharmaceutical industry. It's far a herbal bio-lively polymer with an inherent antimicrobial activity which promoted its applicability inside the meals protection and packaging industries. Use of chitosan as an eatable coating for food protection has resulted in enhancement of meals sensory traits and further to chitosan said antibacterial activities which produced an attractive and more healthy appearance to the customer that accelerated the market share of the product[1].

#### *Physicochemical and biological properties of chitosan films and chitosan composites*

Chitosan films comprised of the acid dissolution of chitosan possess numerous suitable physicochemical and organic residences. These houses show high variation with regards to several elements such as the degree of acetylation, the viscosity of the answer, drying temperature, the proportion of acid dissolution and most essential form of composite if the movies are imagined to be composited with different substances. Those parameters are answerable for variant in vital physicochemical and organic houses including tensile strength and stress, barrier homes, wettability, thermal balance, roughness, antimicrobial and antioxidant attributes. Further, these attributes define the software regions of chitosan-primarily based movies such as meals packaging, adsorption research, biomedical packages (wound dressing), agriculture etc[2].

#### *Mechanical properties*

The tensile electricity of chitosan-primarily based films is at once proportional to the molecular weight and deacetylation diploma of chitosan. Drying temperature and relative humidity, also play a extensive role in the mechanical and barrier characteristics of chitosan-based totally movies. The tensile energy of chitosan movies produced with acetic acid increases at some point of the storage at room temperature. A time-structured boom of tensile strength may be described through the time-based conformational changes of chitosan molecules and by means of the discount of the free volume of the polymer. It has been described currently that tensile energy and elongation at spoil increase for chitosan-based films containing propolis extract[3].

#### *Barrier properties*

The barrier attributes of chitosan-primarily based coatings are useful in upholding the garage streak, nutritional price and extending the shelf-lifestyles of stored veggies and culmination. The water vapor uptake and water vapor permeability coefficient of chitosan-based biofilms

growth with increasing chitosan's molecular weight. At some stage in storage at room temperature water vapor uptake of chitosan movies decreases and water vapor permeability coefficient increases, however water vapor uptake of chitosan movies increases in the course of storage at  $-24\text{ }^{\circ}\text{C}$  and  $+4\text{ }^{\circ}\text{C}$ . Water content material and water vapor permeability of the chitosan movies dropped by increasing the storage time for kudzu starch-chitosan composite movies. The modifications in mechanical properties may be defined with the aid of the rearrangement of polymer chains in the course of garage. It's been proposed that Maillard response in chitosan films came about throughout garage time. In chitosan– polyvinyl alcohol blend films the moisture content material become discovered to increase with increasing in polyvinyl alcohol awareness. Recently it has been that the water vapor permeability and oxygen permeability of chitosan films reduced with an increase within the awareness of propolis. In a look at, gallic acid (GA), gentisic acid, protocatechuic acid (PA), syringic acid (SA) and vanillic acid (VA) had been integrated into chitosan via a carbodiimide-mediated coupling reaction. The movies with grafted hydroxybenzoic acids demonstrated barrier houses together with UV mild and moisture as compared to chitosan manage movies. Moreover, the addition of hydroxybenzoic acid made the floor morphology of chitosan movie more difficult as compared to control movies[4][5].

#### *Antimicrobial properties*

Chitosan movies show off a large spectrum of packages in meals packaging materials which may be ascribed to their intrinsic antimicrobial homes. Chitosan-based coatings of culmination and greens with antimicrobial retailers, along with essential oils, acid, and nanoparticles have been recently reviewed by way of. For example, it has been reported that the microbial spoilage of child carrots behind schedule after applying a chitosan-based coating retaining the overall exceptional of the product. Chitosan movies containing propolis prevent taphylococcus aureus, Salmonella enteritidis, Escherichia coli and Pseudomonas aeruginosa. Poly(vinyl alcohol) and chitosan combination films containing bifunctional nano-sized fillers cellulose nanocrystals/zinc oxide confirmed antibacterial pastime towards the bacterial species Salmonella choleraesuis and Staphylococcus aureus. The similar homes have been discovered additionally for poly(vinyl alcohol)/chitosan blend reinforced with cellulose nanocrystals/zno-Ag multifunctional nanosized filler. Few studies demonstrated that chitosan-primarily based silvercontaining nanocomposite movies have an excellent antimicrobial hobby. Lavorgna, Attianese, Buonocore, Conte, Del Nobile, Tescione and Amendola pronounced a widespread discount inside the microbial increase of Pseudomonas spp. By chitosan films loaded with silver-montmorillonite antimicrobial nanoparticles[6].

#### *Antioxidant characteristics*

Chitosan films may be utilized as energetic packaging for preventing oxidation of meals commodities. Antioxidant pastime assays showed that hydroxybenzoic acid grafted chitosan films had higher DPPH scavenging pastime than chitosan movie. Antioxidant residences of the chitosan/nanoclay nanocomposite lively films containing sodium montmorillonite movies had

been progressed by Silybum marianum L. Extract incorporation. Recently defined the function and impact of the homogenization technique at the structure and antioxidant characteristics of chitosan-lignin composite biofilms. Chitosan-based fit to be eaten films integrated with starch containing polyphenols from the extracts of thyme have more antioxidant interest. Incorporation of thinned young apple polyphenols enhanced antioxidant homes of chitosan movies. Phenolic acid grafted chitosan famous improved antioxidant activities if compared with chitosan. The boom in the antioxidant hobby f chitosan become discovered as a result of grafting of brief-duration peptides oligomers[7][8].

#### *Food-related applications of unmodified chitosan*

Chitosan famous a huge set of programs within the meals industry. It can be implemented both in its authentic shape or it is able to be modified according to the call for of the application. In lots of meals-associated applications, chitosan has been using at once without undergoing any change in its chemical structure. Those attractive properties of chitosan were implemented in a have a look at involving coating of dry-cured muscular tissues with chitosan which caused more advantageous sensory qualities, lower moisture drop and antioxidant effect by minor shear pressure values. In assessment, a 2nd half of of the dry cured muscle mass had been covered with the same old (çemen) coating did no longer show similar outcomes. Polysaccharide extracted from the squid's pen (*Loligo vulgaris*) exhibited a  $\beta$ -chitin structure which became then transformed to chitosan following a deacetylation manner. The chitosan produced on this take a look at was located via in-vitro assays and results discovered that it confirmed proper antioxidant and antimicrobial interest making it a suitable opportunity natural antioxidant and antimicrobial ingredient in food structures. Evaluated chitosan for its explanation functionality in apple juice and the writer pronounced wonderful results for chitosan showing god explanation competencies keeping the overall dietary cost of the juice. Microorganism biofilms constitute of microbes living connected to some extracellular polymeric materials. This particular meeting poses an critical risk for public health because it upsurges the health of bacteria to sustain in extreme environments and in the long run escalates the bacterial resistance against antimicrobial substances. Few studies investigated anti-biofilm (antiquorum sensing) consequences of chitosan for *Vibrio parahaemolyticus*, a key meals-borne pathogen. The minimum inhibitory concentration (MIC) of chitosan was 1.25 mg/ml. Sub-MIC of chitosan could appreciably inhibit biofilm formation; reduce the metabolic activities and the secretion of extracellular polysaccharide (EPS). The outcomes discovered that along side the prevention of biofilm improvement, chitosan also gets rid of (eighty five.06%) the already advanced and mature biofilms of *V. Parahaemolyticus*[9].

### CONCLUSION

First and most important, on this overview, thinking about tremendous set development in the field of biopolymers and biomaterials, we concluded that it's time to limit the processing of the synthetic petroleum-based totally polymeric movies in food era because of its downsides. Supplementing natural plant extracts inclusively will increase the general mechanical, barrier

(oxygen and water permeability), thermal and UV properties of chitosan-based totally films. Additionally, mixing other polymers like methylcellulose, carboxymethyl cellulose, polyvinyl alcohol, agarose, and polyphenols and so forth., with chitosan-primarily based films contributed towards the enhancement of numerous physicochemical houses of the movies. Moreover, compositing special polymers and plant extracts and oils rather have an effect on the surface morphologies of the produced chitosan-based totally films. The resulted films with special surface morphologies exhibited one of a kind tiers of water solubility and phone perspective homes. The variation in water solubility of the chitosan-based movies is especially related to the general floor energy of the film. Considering many literature reports associated with chitosan-based movies, nonetheless, a few gaps are present, which may be bridged with the aid of accomplishing some more studies inside the future like. The quantity of research papers regarding the manufacturing and processing of chitosan composite movies is exceptionally better but still, the realistic software of chitosan on an business scale is constrained which instead representing chitosan nevertheless as an unpractical and unsure polymer to the food industrialists. The main motives at the back of this example are; the processing approach of chitosan blend films continues to be along with harsh chemical remedies, which consequently increases the processing price of the combination films. Studies can be carried-out for organising new protocols of chitosan film processing concerning reasonable and herbal elements averting the use of highly-priced chemical substances. The supply of chitosan sources remains confined which limits the mass manufacturing of chitosan at business scale, so in this context, the studies ought to be centered on exploring new and without problems accessible assets of chitosan. Studies may be undertaken for locating novel sources of plant extract, as many novel plant extracts with viable appropriate attributes are nevertheless unexplained in terms in their packages in chitosan combination films. Novel polymer combination mixtures can be investigated for mixing chitosan-primarily based film, a good way to allow the chitosan-primarily based films to compete for the commercially to be had packaging substances.

## REFERENCES

- [1] H. P. S. Abdul Khalil *et al.*, “A review on chitosan-cellulose blends and nanocellulose reinforced chitosan biocomposites: Properties and their applications,” *Carbohydrate Polymers*. 2016, doi: 10.1016/j.carbpol.2016.05.028.
- [2] M. Z. Elsabee and E. S. Abdou, “Chitosan based edible films and coatings: A review,” *Materials Science and Engineering C*. 2013, doi: 10.1016/j.msec.2013.01.010.
- [3] H. Fan *et al.*, “Fabrication, mechanical properties, and biocompatibility of graphene-reinforced chitosan composites,” *Biomacromolecules*, 2010, doi: 10.1021/bm100470q.
- [4] F. M. Pelissari, M. V. E. Grossmann, F. Yamashita, and E. A. G. Pined, “Antimicrobial, mechanical, and barrier properties of cassava starch-chitosan films incorporated with oregano essential oil,” *J. Agric. Food Chem.*, 2009, doi:

- 10.1021/jf9002363.
- [5] L. A. M. Van Den Broek, R. J. I. Knoop, F. H. J. Kappen, and C. G. Boeriu, "Chitosan films and blends for packaging material," *Carbohydr. Polym.*, 2015, doi: 10.1016/j.carbpol.2014.07.039.
- [6] P. K. Dutta, S. Tripathi, G. K. Mehrotra, and J. Dutta, "Perspectives for chitosan based antimicrobial films in food applications," *Food Chemistry*. 2009, doi: 10.1016/j.foodchem.2008.11.047.
- [7] J. Hafsa *et al.*, "Physical, antioxidant and antimicrobial properties of chitosan films containing Eucalyptus globulus essential oil," *LWT - Food Sci. Technol.*, 2016, doi: 10.1016/j.lwt.2015.12.050.
- [8] U. Siripatrawan and W. Vitchayakitti, "Improving functional properties of chitosan films as active food packaging by incorporating with propolis," *Food Hydrocoll.*, 2016, doi: 10.1016/j.foodhyd.2016.06.001.
- [9] F. Shahidi, J. K. V. Arachchi, and Y. J. Jeon, "Food applications of chitin and chitosans," *Trends in Food Science and Technology*. 1999, doi: 10.1016/S0924-2244(99)00017-5.