A Review Paper on Application of Nanobiotechnology in Food Preservation

Anjali Tiwari
Department of Agriculture
Vivekananda Global University, Jaipur
Email ID:yamini.tiwari@vgu.ac.in

ABSTRACT: *In reducing food spoilage, applications of biotechnological methods in food preservation have shown promising results. One of the main success factors in this application area is the design and production of highly efficient food preservatives. However, due to the inherent limitations of the bulk formulations of these preservatives, research has been under way to identify acceptable alternatives to replace traditional modalities. In almost every area of food security, the intervention of nanotechnology has made this method feasible.In the last few decades, this interface domain of nanobiotechnology has been very well explored and vast literature has been published. For diverse applications, researchers have developed powerful nano preservatives (NPRs). However, molecular perspectives involved in food preservation are not included in the literature available on nano-based food preservation. In the interface area, there is a significant knowledge gap in the physics of intermolecular and interfacial forces and nanotechnology, which play a crucial role in the design of edible coatings (ECs).*

KEYWORDS:*Applications, Food, Nanobiotechnology, Nano, NPRs, Preservation.*

INTRODUCTION

There is an important need to identify contributing factors at the nano and molecular levels for the production of successful NPRs. In addition, in the public interest and concern, it is important to consider the potential health effects of NPRs. This analysis explores the basic aspects of food preservation and examines the applicability, protection, molecular aspects and future direction of NPRs[1].

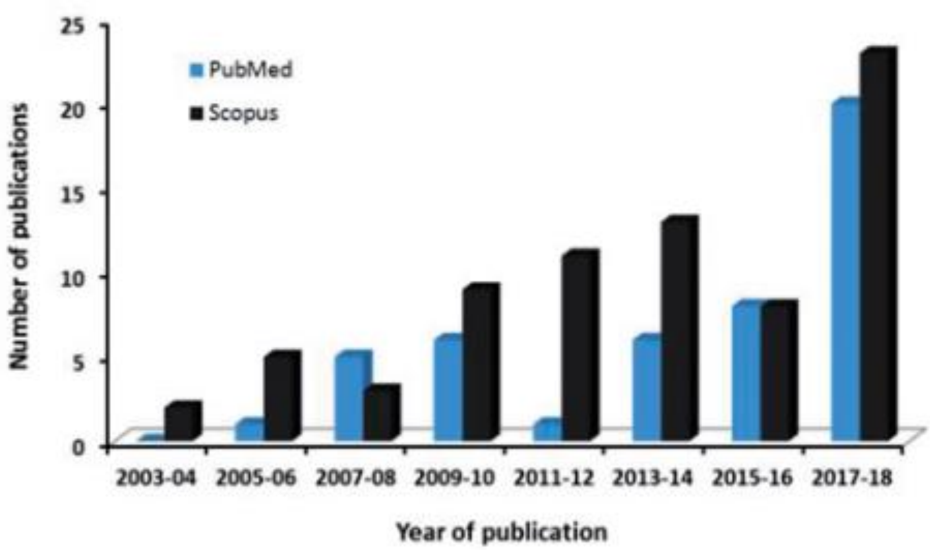

Figure 1: Illustrates the modern trend of publications related to nanotechnology aided food preservation and packaging[2]

Table 1: Overview of nanotechnology-based preservation methods[3]

Methods	Advantages	Disadvantages	Molecular mechanism of actions
Nanoliposomes	i. Encapsulates hydrophilic as well as lipophilic drugs ii. Targeted delivery	i. Short shelf life ii. Rapid release iii. Liposome properties are crucial to efficient packing and delivery	Fluid-liposome fusion increases bacteriocidal ability of liposomes. Bacterial membrane lipid composition is fundamental to the fusion process
Nanoformulations and Nanoemulsions	i. Multi-functional delivery system of compounds with low water solubility and poor bioavailability ii. No flocculation or coalescence iii. Transparent system suitable for use in beverages iv. Kinetically stable for extended periods of time v. Rapid absorption due to small size	i. Rapid release of ingredient not suitable for long term effects ii. Thermodynamically unstable iii. Incompatibility of different functional compounds iv. Flavor may be compromised in some cases	The emulsifier in the formulation plays a role in stabilizing nanoemulsions through repulsive electrostatic interactions and steric hindrance. Encapsulation of functional food ingredient in individual phases of a multilayer emulsion
ECs or films	i. Good gas barrier ii. Enhances antimicrobial and antioxidant characteristics of food	i. Protein and polysaccharide-based films provide inadequate moisture barrier ii. Poor mechanical strength in lipid-based films	Adsorption on the surface due to electrostatic attraction between the food surface and the coating material

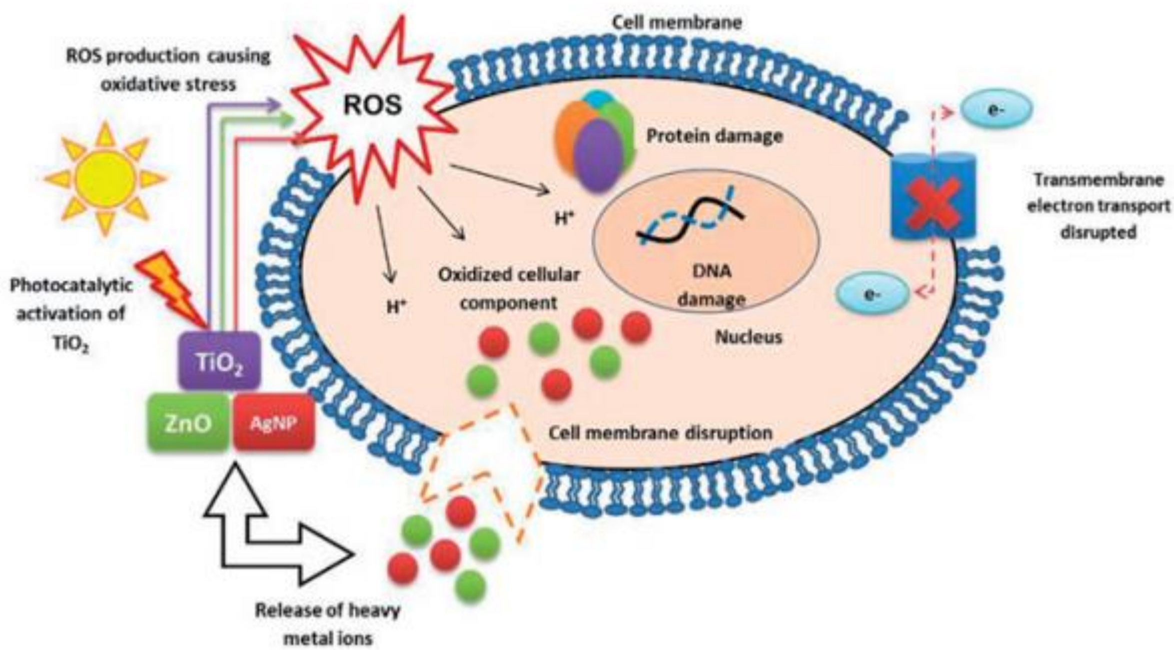

Figure 2: Illustrates the mechanisms of different metallic nanoparticles acting upon a bacterial cell[4]

Nanofoods are the term used to refer to foods that are subjected to nano-intervention in one of the stages of food production, either during cultivation, or during the manufacture or post-harvest processing, or in the packaging of foodstuffs in order to prolong their shelf life without compromising their nutritional quality.Tools such as DNA microarrays, micro-electro-mechanics and micro-fluids also play an important role in the development of new food science techniques such as protein bio-separation, nutraceuticals, smart nutrient delivery systems and nano-carriers in food for nano-encapsulation of antimicrobial compounds to impart antimicrobial and antioxidant activity in food packaging, preventing specification[5].

DISCUSSION

With the convergence of nanobiotechnology, which has had a major impact on food production, processing, storage, transport, and safety, innovative breakthroughs have been made in the food science sector. The recent trend in publications related to food preservation and packaging aided by nanotechnology has been highlighted in Figure 1.

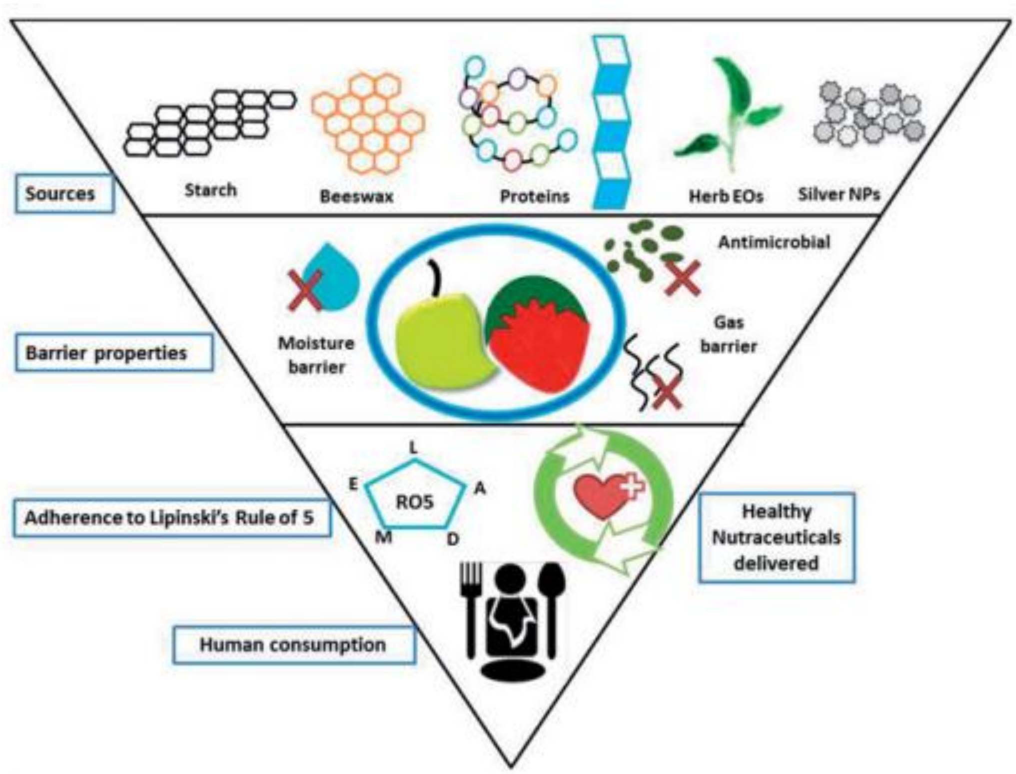

Figure 3: Illustrates theoverall view of the important technical aspects associated with the application of ECs for food preservation[6]

Reports or studies describing the mechanism of how precisely nanotechnology aided preservation techniques affected the post-harvest physiology of fruits, vegetables or other agricultural products at the molecular level are at best scarce during the course of compiling this review, even after exhaustive research. In the following section, a few studies have attempted to study the routes through which nano-interventions help preserve or delay the ripening process, while noting the related effects have been briefly discussed[7].Figure 1 illustrates the modern trend of publications related to nanotechnology aided food preservation and packaging. Table 1 overview of nanotechnology-based preservation methods. Figure 2 illustrates the mechanisms of different metallic nanoparticles acting upon a bacterial cell. Figure 3 illustrates the overall view of the important technical aspects associated with the application of ECs for food preservation[8].

CONCLUSION

Many other important aspects arising from the nano-bio interface, human health and environmental concerns have been described in an in-depth study of nano-enabled food preservation. For most of the NPRs, interaction mechanisms between NPRs and food spoiling microorganisms have not been well known. For certain nano formulations, the advantages of nano-dimension over the bulk shape of food preservatives have been explored. There is no consensual opinion, however, on the choice of NPRs over traditional ones. Edible coating protection of fruit and vegetables has significant human and environmental health issues. As a significant hazard to metallic nanoparticles used as an antimicrobial agent in NPRs, multidrug resistance can be expected. It is not possible to generalize the molecular mechanism that interprets the failure to establish resistance to NPRs because many explanatory domains are missing, such as the route of compensatory mutation, mutation dynamics among susceptible populations and mutation rate.Edible coating protection of fruits and vegetables has significant human and environmental health issues. As a serious threat to metallic nanoparticles used as an antimicrobial agent in NPRs, multidrug resistance can be expected. It is difficult to generalize the molecular mechanism that interprets the failure to establish resistance to NPRs because many explanatory domains are missing, such as the route of compensatory mutation, mutation dynamics among susceptible populations and mutation rate.

REFERENCES

[1] L. Leistner, "Basic aspects of food preservation by hurdle technology," 2000, doi: 10.1016/S0168-1605(00)00161-6.

[2] Richa, J. Pathak, A. S. Sonker, V. Singh, and R. P. Sinha, "Nanobiotechnology of cyanobacterial UV-protective compounds: innovations and prospects," in *Food Preservation*, 2017.

[3] D. Bhuyan, G. W. Greene, and R. K. Das, "Prospects and application of nanobiotechnology in food preservation: molecular perspectives," *Critical Reviews in Biotechnology*. 2019, doi: 10.1080/07388551.2019.1616668.

[4] M. M. Theron and J. F. R. Lues, "Organic acids and meat preservation: A review," *Food Reviews International*. 2007, doi: 10.1080/87559120701224964.

[5] C. E. C. C. Ejike, M. Gong, and C. C. Udenigwe, "Phytoalexins from the Poaceae: Biosynthesis, function and prospects in food preservation," *Food Research International*. 2013, doi: 10.1016/j.foodres.2013.03.012.

[6] X. Zhang, Q. Guo, and D. Cui, "Recent advances in nanotechnology applied to biosensors," *Sensors*. 2009, doi: 10.3390/s90201033.

[7] S. Kumar, A. Gupta, and A. Arya, *Triple Frequency S-Shaped Circularly Polarized Microstrip Antenna with Small Frequency-Ratio*. International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)/ISSN(Online): 2320-9801, 2016.

[8] E. N. Kumar and E. S. Kumar, "A Simple and Robust EVH Algorithm for Modern Mobile Heterogeneous Networks- A MATLAB Approach," 2013.

- Usha Yadav, Gagandeep Singh Narula, Neelam Duhan, Vishal Jain, "Ontology Engineering and Development Aspects: A Survey", International Journal of Education and Management Engineering (IJEME), Hongkong, Vol. 6, No. 3, May 2016, page no. 9 – 19 having ISSN No. 2305-3623.

- Vishal Assija, Anupam Baliyan and Vishal Jain, "Effective & Efficient Digital Advertisement Algorithms", CSI-2015; 50th Golden Jubilee Annual Convention on "Digital Life", held on 02nd to 05th December, 2015 at New Delhi, published by the Springer under ICT Based Innovations, Advances in Intelligent Systems and Computing having ISBN 978-981-10-6602-3 from page no. 83 to 91.

- Vishal Jain and Dr. S. V. A. V. Prasad, "Analysis of RDBMS and Semantic Web Search in University System", International Journal of Engineering Sciences & Emerging Technologies (IJESET), Volume 7, Issue 2, October 2014, page no. 604-621 having ISSN No. 2231-6604.

- S. Balamurugan, K. Amarnath, J.Saravanan and S. Sangeeth Kumar, "Scheduling IoT on to the Cloud : A New Algorithm", European Journal of Applied Sciences 9 (5): 249-257, 2017.

- S.Balamurugan et.al., “Smart Healthcare: A New Paradigm”, European Journal of Applied Sciences 9 (4), 212-218, 2017
- S Balamurugan, N Divyabharathi, K Jayashruthi, M Bowiya, RP Shermy, R Shanker, "Internet of agriculture: Applying IoT to improve food and farming technology," International Research Journal of Engineering and Technology (IRJET), Volume 3 issue 10, pp.713-719,e-ISSN: 2395 -0056, p-ISSN: 2395-0072, 2016