Finger Millet Prolamin Based Nanodelivery Vehicle for Lipohilic Substances

Food-derived nutraceutical products are beneficial to consumers as it provides a better alternative to pharmaceuticals. Lipohilic substances such as poly unsaturated fatty acids (PUFA), fat soluble vitamins, carotenoids and phytosterols have the potential to reduce the risks associated with many chronic diseases and improve public health in general. However, the efficacy of most of these bioactive compounds has been low due to limiting factors such as low uptake, bioactivity and bioavailability which are mainly due to limited residency time or stability in the gastro-intestinal (GI) tract. Encapsulation as a delivery mechanism helps to overcome these challenges by enhancing bioavailability, stability, absorption and improving organoleptic properties of bioactive compounds. In recent years, nanoparticles are being increasingly used as delivery vehicles in a wide variety of applications such as in therapeutics and diagnostics. Polymers, both artificial and natural, can be used to encapsulate important nutraceuticals into nano-formulations for their efficient delivery. Nano-encapsulation prevents the bioactive compounds from the harsh environments inside the living system and protects the encapsulated materials from enzymes, pH and oxidation before reaching the target cells, thereby improving the native state and bioactivity of the encapsulated compound. Nanoparticles also enhance the absorption of bioactive compounds by increasing the surface area available for interaction with the enterocytes in the small intestine. Due to their small size, they efficiently cross epithelial lining of the gut and are taken up by cells, resulting in enhanced bioavailability.

Food grade proteins are attractive targets for nano encapsulation due to their natural origin, ease of availability, sustained release properties and increased stability against adverse conditions. The seed storage protein from finger millet called prolamin, is one such food grade protein that harbors all the required qualities for use in encapsulation. Prolamin being amphiphilic can be used for encapsulation of both hydrophilic and lipophilic bioactive compounds. This protein was used as the encapsulating matrix over oil in water nanoemulsion of sesame oil containing dissolved β-carotene and Vitamin D_3.

Advantages:

1. The nano delivery system is more effective than commercially available oral agents in terms of sustained release of lipophilic substances.
2. The nanoemulsion was prepared in a single step ultrasonication process and did not involve the use of organic solvents and cross-linking agents.
3. The delivery system was shown to have high encapsulation and loading efficiencies of lipohilic substances
4. It has higher bioavailability of bioactive compounds such as carotene and Vitamin D_3 as nanodelivery system.
5. It has higher permeability due to better biostability and solubility of nano-emulsion through lipid bilayers,
6. They will not harm human or any other non-target organism because they are formulated from food grade materials.
7. It has more retention time leading to better uptake or absorption in human cells.
8. The use of prolamin protein derived from a low agri-input requiring crop, finger millet could provide a platform for value addition, creating a new market for the agri-produce and thereby helping the farming sector.
9. Such products are also beneficial to consumers, providing a better alternative to pharmaceuticals.
10. It has the potential to be incorporated and developed into various forms for nutraceuticals for general health benefits of the population.
11. They can be manufactured even in small scale industry due to less expenditure.
12. Development of processed value-added products from traditional sources such as the finger millet can have large scale socio-economic impacts to the farmers.