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Enhancing Bioavailability of Bone Health Supplements

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Bones are structural organs known for keeping other organs safe and regulating hormones. Sadly, several factors, diseases and skeletal disorders can adversely affect bone tissue, affecting mobility and sometimes even proving fatal. Corrective treatments often necessitate administering high drug dosages, which could lead to adverse effects. This is where revolutionary drug delivery methods using liposomal nanotechnology and nanoparticles play an outstanding role in offering highly localised and non-invasive treatments. Here's an overview of how liposomal technology can increase the efficacy and bioavailability of nutritional supplements for bone health.

Liposomal Nanotechnology: An Overview

At the core of liposomal nanotechnology are little particles known as liposomes. These nanoparticles are extremely tiny, about 100-300 nm in diameter. First discovered in 1965, liposomes were used to carry substances like medications, vaccines, and vitamins to human cells. Resembling tiny artificial bubbles, liposomes consist of components (phospholipids) similar to those found around active human cells. They can be used as vehicles to transport active compounds which are either poorly permeable or soluble while preserving their integrity and preventing them from breaking down before reaching their target cells.

Liposomes are specifically favoured as novel drug delivery agents because they are made of biosimilar ingredients, making them biocompatible and less likely to cause adverse effects in the body. These properties also make liposomes preferred as encapsulating agents to incorporate nutrient or non-nutrient compounds with healthy properties in food supplements.

Role of Liposomal Nanotechnology in Bone Therapies

Recently, liposomal nanotechnology has found innovative uses in myriad bone therapies. When dealing with conditions like osteoarthritis, osteoporosis, and bone cancer, the effectiveness of treatment is often compromised, and there can be unwanted side effects because the treatment doesn't focus primarily on the affected area. It is essential to deploy the right system to enhance the delivery of drugs directly to the affected bone site.

Given their small size, large surface area, and the ability to modify surface roughness, nanoparticles can effectively help bone regeneration when aligned with good cell adhesion. Liposomal nanotechnology has offered innovative therapy with nanoceria and cerium in the form of oxide nanoparticles for diseases like osteoporosis that involve deterioration in the bone tissue. Bone infections, such as osteomyelitis, can be treated with nanoparticles.

Moreover, liposomes offer various possibilities for transporting genes to the injured bone, promoting its healing. Liposomal nanotechnology is advantageous for delivering medicines precisely to the bone, avoiding any unwanted effects from medication going to the wrong places. Liposomes can include multiple drugs and release them in a controlled manner through different routes, resulting in improved effectiveness and fewer side effects.

Bolstering Vitamin D Supplements

It has long been established that Vitamin D, or the sunshine vitamin, is essential for good bone, teeth, and muscle health. Unfortunately, in countries like India, as many as 76% of people suffer from Vitamin D deficiency, according to a study conducted across 81 cities. The prevalence was most common among adults in the age group of 18 to 30 years.

According to experts, having below 12 or 10 ng/ml of Vitamin D is a deficiency. The deficiency makes people susceptible to osteomalacia or nutritional rickets. An article in *Nature* found that over 20% of people in countries like India, Tunisia, Pakistan, and Afghanistan have less than 12 ng/ml of Vitamin D.

The increasing global occurrence of vitamin D deficiency could result from insufficient dietary intake and reduced sun exposure. However, few foods naturally contain vitamin D, though some are fortified with the vitamin. One way to get enough vitamin D is by consuming oral nutritional supplements. However, one should take into account the digestive system’s absorption capacity. When taken orally, vitamins tend to lose most of their biological benefits, resulting in lower effectiveness than anticipated.

The use of liposomal nanotechnology in nutrition and supplements has grown as a panacea to the issue of low absorption rates and bioavailability of traditional tablets and capsules. Liposomes have a natural ability to encapsulate lipophilic and hydrophilic nutrients. It has

proven effective in protecting nutrients from harsh stomach and digestive tract conditions, enabling their delivery into cells and tissues.

Besides, given the tiny size of the nanoparticles, it is easier for the body to absorb them. A protective layer stops certain enzymes from breaking them down, and their small size keeps them safe during digestion. These particles remain effective even in different pH environments in the body. They also leave the stomach quickly.

Another advantage of consuming liposomes-based vitamin D is that it can be taken on its own or with water, orange juice, or other such liquids. As opposed to this, other fat-soluble forms of vitamin D need to be consumed with milk, oil, or other fat-based items to enable its absorption.

Benefits of Liposomal Nanotechnology for Vitamin D Consumption

It is safe to say that the liposomal nanotechnology revolution has transformed the vitamin and nutritional supplements industry. This technology enhances the transportation of vitamins into human cells, maximising the absorption of supplements within the body.

Since liposomes are like little shields, they help supplements get absorbed without being destroyed by digestion. They go through the mouth and intestines, bypassing the liver and allowing the body to use more nutrients even with smaller doses.

In contrast to standard vitamins that pass through the digestive system and lose a seminal portion of their benefits before reaching their target cells, liposomal vitamins go directly into the human cell. This causes a significant increase in their concentration in the blood and improvement in the absorption process.

Some benefits of liposomal vitamins are:

Protection: They shield the nutritional supplements from being destroyed by the digestive system, keeping them safe and allowing more nutrients to be used.

Easy absorption: Liposomes mimic cell membranes, because of which supplements are absorbed quickly. This helps nutrients go directly where the body needs them.

Water and fat-friendly: Liposomes can hold watery and fatty nutrients, making them versatile.

Easier to Consume: Liquid liposomal mixes suit people with difficulty swallowing large pills. Instead of many tablets, sometimes liquid medications work better and are easier to handle.

Conclusion

Due to their increased bioavailability, liposomal nanotechnology-based vitamins offer a higher therapeutic value than non-liposomal vitamins. Liposomal nanotechnology has shown great potential to tackle the issues of limited availability and absorption of a wide range of nutrients and compounds.

Numerous vitamins, including vitamin D, can be found in liposomal form. People facing significant vitamin deficiencies can experience improved absorption through liposomal vitamins.

This technology also holds great promise beyond vitamins and nutritional supplements, as shown by various clinical studies investigating their role as carriers for antibiotics, anti-inflammatory and antifungal medications, and so on. While the possibility of liposomal nanotechnology to transform drug delivery is considerable, there is still much more opportunity to explore its usage for orally delivering nutraceuticals.

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