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Review Article

Discovering Nano-Nutraceutical concepts, existing knowledge and future perceptions

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ABSTRACT

Nanotechnology is a vital progressive technology facilitating role, progress, and viable effect on food, treatment, medicine, cultivation and farming sector. A nutraceutical is characterized as an ingredient that is related to food and gives medical compensations to the human being, including the prevention and healing of illness. The well-being and health of people are to a great extent, directed by the utilization of nutritious diets. Further numerous investigations have connected good diets as supportive in fighting various deteriorating communicable and non-communicable diseases. There are various studies that explore the relationship between health promotion and various plant and animal food. Although, a considerable number of naturally arising health-promotion constituents are the source of plants, there are various physiologically dynamic parts in animal items that have worth considering for their possible function in ideal well-being. Moreover, the utilization of naturally active constituents in leafy foods and fruits has been connected to fighting various illnesses, such as malignant growth, cardiovascular illnesses, weight, and gastrointestinal problems.

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1. Introduction

There are three vital necessities, which are essential for humans' existence, food, clothing, and shelter. However, among these, food occupied the dominant place. The early man survived by hunting, gathering, and fishing. Hence numerous discoveries changed them from food finders to makers and permitted them to develop food and have a settled existence. They ate primarily regular food. However, grains were utilized by all societies before. For example, rice and millet were the main nourishments in the east and wheat, oat, and rye in Europe. Around 5000 years back, more unpredictable lifestyles started to show up in certain parts of the world. Due to industrialization and urbanization, the man began to live in towns and urban areas, where

commerce and trade have grown (Dudeja & Gupta, 2017).

In the advanced civilization, we have begun preparing the grains. It eliminates the supplement-rich external layers to yield a without fiber grain. Alongside this, the general utilization of cereal has declined. Hence, the utilization of meat, refined sugar, and prepared nourishments has expanded. Hence, this deviation in eating regimen from regular nourishments has prompted inadequacy of fundamental supplements in individuals (Espín et al.¹, 2007).

However, of late, individuals have understood that well-being is a significant concern alongside taste, accommodation, and worth. Further, the nutritive estimation of foodstuffs has become an emerging issue. The interest currently is that any food item ought to be "as natural as could really be expected," which matches the layperson's information and view of what is sound. Individuals in the

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developed world know about the way that handled food is nutritionally inadequate, so they would take nutrient enhancements to make up for the deficiency of supplements. Presently the pattern has changed. As opposed to going for drugs, individuals are inclined toward natural alternatives, such as herbals (Tapas et al., 2008).²

Furthermore, drug organizations have misused this inclination of individuals and have advanced advantages of natural items in the form of drugs (nutraceuticals). This can be appropriately called "medicalization in sustenance," where the ideal supplements are procured as tablets, capsules, or beverages instead of typical foodstuffs. There is mounting consciousness about well-being in our country, particularly in the evolving Indian working class. This class has additionally seen ascend in the procurement force of individuals and have been the objective available to be purchased of nutraceuticals (Das et al., 2012).

2. Contextualizing the Concept of Nutraceutical

The meaning of nutraceutical is generally founded on the supposed Hippocrates view "let food be your medication and medication be your food," to anticipate the connection between food for well-being and their particular remedial advantages. However, in Ayurveda, the primordial Indian study of medication, a mass of accentuation is given to the role of nourishment in well-being and illness. The expression "nutraceutical," got from the terms sustenance and drug, was authored in 1989 by Dr. Stephen De Felice, (Chairman of the Foundation for Innovation in Medicine). The term is planned for a wholesome enhancement that is sold with the aim to treat or forestall diseases and doesn't have any administrative definition (Dureja et al., 2003; Gul et al., 2016).

Subsequently, a "nutraceutical" is any ingredient that might be viewed as a food or part of food that gives clinical or well-being benefits, enveloping, avoidance, and treatment of illness. However, separated supplements, dietary enhancements, and diets to hereditarily designed "designer" nourishments, homegrown items, and handled food sources, for example, oats, soups, and drinks, might be incorporated under the umbrella of the term nutraceuticals (Pandey et al.³, 2010; Wildman, R. E. (Ed.). 2016).

3. Understanding the Shift from Nanopharmaceuticals to Nanonutraceuticals

3.1. Features of nanoparticles and broad categorization

The word "Nano" gets from the Latin word "nanus" and the Greek word "νῆκος", both showing an individual of low stature, for example, a diminutive person. The International System (SI) of units considers nano as a prefix to demonstrate 10⁻⁹ piece of a unit; hence, for example, a billion of a meter, a billion of a liter, a billion of a kilogram, and so on not continuously the term nano is alluded to a little

object. For example, in cosmology, a nanostar is a star having a mass tantamount to our Sun or even less. To start with, a simple and pragmatic basis for characterizing nano-materials depends on the measurements "promote court": Nano-materials are ordinarily characterized as materials having, at any rate, a measurement somewhere in the range of 1 and 100 nm.

Within the various connotations of nano-materials, these can be illustrated as nanotechnology outcomes, depicted by in any occurrence one measurement inside the size range under 100 nanometers (Auffan et al.⁴, 2009). Since of their surprising possessions and elasticity, nano-materials are being distorted in various fields, e.g., farming, well-being, hardware, cosmetics, speaking to an extraordinary test, specifically, in food science and innovation, climate, and human well-being (Durazzo et al., 2020).

Moreover, the development in medication nanotechnology has stimulated another class of items, the supposed nano-pharmaceuticals, characterized as drug particles figured in nano-materials. Various kinds of Nano formulations are being misused for the therapy of neurodegenerative illnesses, malignant growth, irresistible sicknesses, and others (Durazzo et al., 2020)..

Nonetheless, nanoparticles can be generated from various natural means such as proteins, polysaccharides, lipids and from engineered means like polymers. Preferably, materials should be biocompatible, decomposable, and bio-tolerable, to be specific the path by which the body endures planned materials, and of by and large perceived as a protected status, to be utilized in drug and nutraceutical items. Among the accessible alternatives, and if the nanoparticles are proposed for oral organization (as occurs with nano-nutraceuticals), lipid nanoparticles are of exceptional interest. Lipids are referred to for their part as assimilation enhancers in the gut, which add to improving the oral bioavailability of a few medications and biomolecules (Doktorovová et al.⁵, 2016).

Further, nanopharmaceuticals and nano-nutraceuticals are acquired individually when a drug or a nutraceutical is planned in nanoparticles. The reasoning for their advancement is principally routed to improve the physicochemical properties (e.g., dissolvability) and pharmacokinetic parameters (t_{max}, C_{max}, area under the plasma drug concentration-time bend (AUC)), with a definitive plan to lessen the portion needed to notice the helpful/nutraceutical result and along these lines the potential danger of poisonousness (Öztürk-Atar et al.⁶, 2016). However, the parameters, for example, effectiveness, superiority, and security, should be given prime consideration. In any case, administrative issues identified with nanopharmaceuticals still need further improvements (Souto et al., 2020).⁷

3.2. Understanding nanomaterial's and health issues

Utilizations of nano-materials are constantly emerging. Today, around 33% of the nano-materials delivered on the planet discover applications in restorative items particularly in sunscreen design. The wide and expanded employments of nano-materials rise the well-being and security worries for some significant reasons:

(a) nano-materials are substantially extra responsive than the atomic analogs in solvents or in the consolidated stage; (b) their minuscule size permits them to relocate simpler in organic frameworks; and (c) they may pass the natural layers in the lung, gut, and even in the cerebrum making harm intracellular constructions and cell capacities. All things considered, lung is the favoured course to enter in the body by nanoparticles. The 100 large numbers of alveoli present and their extremely high surface zone in the lung profoundly encourage the contact with the nanosized material. Luckily, the majority of the presented nano-objects are taken out proficiently by mucociliary transport or by macrophages for the more modest particles. It appears to be likely that solitary delayed overexposure or stress made by smoking for example can incite genuine threat to well-being. Regardless, under 0.05% of the amount managed by inward breath arrives at the circulation system. The second opportunity for a nano-object to enter the body is to follow the olfactory nerve course. This last course is considerably more powerful, and it is straightforwardly associated with the mind; subsequently, for this situation, the nanoparticle can arrive at the focal sensory system in spite of the low by and large sum skilled to arrive at the cerebrum. Then again, skin is a powerful boundary to the entrance of nanoparticles, particularly the non-lipophilic ones.

Nano-materials are perceived to create the arrangement of ROS, prompting extreme irritation measures and related results. It ought to likewise bring up that the variables of danger other than the molecule size, for example the shape, add to the image: this is the situation, for instance, of nanofibers that can't be taken out from the lung by means of mucociliary leeway, as occurs with circular particles, and they can produce fibrosis and even disease. This is notable for asbestos strands and presumably additionally to carbon nanotubes. A realistic synopsis of the potential pathologies related with nanoparticle openness is proposed in Figure 1.18. Danger appraisal is characterized as the result of peril (poisonousness) and openness and decides the persistent and intense well-being concerns. This is likewise legitimate for unfriendly impacts of nano-materials toward CNS (focal sensory system) (Trotta,⁸ F., & Mele, A., 2019).

4. Outlining Divergence Between Nutraceutical and Pharmaceuticals Components

"Pharmaceuticals" might be considered as medications utilized primarily to treat sicknesses, while "nutraceuticals"

are those that are planned to forestall illness. Further, pharmaceuticals or drugs have (or have had) patent insurance because of costly testing to adjust to the determinations of particular governments. Notwithstanding, numerous supplements may never get government endorsement since nobody could legitimize the cost of testing necessities for substances that can't be secured by patent laws (Hardy et al.⁹, 2020; Daliri, E. B. M., and Lee, B. H. 2015).

Additionally, there is by all accounts a dainty line separating terms, for example, nutraceuticals, pharmaceuticals, dietary complements, functional nourishments, and so forth. These terms have frequently been utilized reciprocally. Items, for example, "yogurt," "probiotics," and so forth highlight on the weekly shopping arrangements of numerous families however, few are familiar with the expression "functional foods" or "nutraceuticals." (Daliri, E. B. M., and Lee, B. H. 2015).

Nutraceuticals are additionally described as "functional food," yet for this situation, the contrast between food and medication isn't clear. The traditional meaning of nutraceutical and functional food expresses that both beneficial nourishments and nutraceuticals are grown through food or part of the food (Shahidi, 2009).¹⁰

5. Analysing the Function and Merits of Nutraceutical Elements

As indicated by Haller (2010), the term nutraceutical was first revealed more than 20 years earlier as the mix of nourishment and pharmaceuticals, the two of which add to well-being and health. Meanwhile, nutraceuticals are utilized as the sole point of supporting well-being in quantities that go over those acquired from typical portions and dietary enhancements that transport a severe type of assumed bioactive food elements available in a non-food segment.

It has distinguished that Nutraceutical work by increasing the stock of primary construction parts to the body. The stock of these indispensable building blocks should be possible in two different ways:

- (a) By lessening indications of the illness as protecting specialists for help
- (b) By straightforwardly giving advantages to the well-being of the people

There has consistently been fear about the advantages of nutraceuticals and the negative effect of them. The examination has demonstrated that nutraceuticals have revealed to be resistance supporters (flavonoids, green tea, quercetin in onion) and help in improving from degenerative sicknesses (nutrient E, creatine, turmerine). Aside from the previously mentioned benefits, they likewise forestall or are useful in chronic sicknesses, for example, cardiovascular infirmities.

There are some useful constituents: anti-oxidants, fiber, minerals, nutrients, flavonoids, and so on are useful. They have benefits against corpulence—soy food sources, vitamins, green tea extricates. Some of them, for example, green tea, dietary filaments, cancer prevention agents have demonstrated to be anti-diabetic too. Some are anticancer specialists, for example, lycopene, soy food sources, saponins from spinach, tomato, and potato (Das et al.^{11,12}, 2012).

6. Present Scenario of Nanopharmaceuticals and Nanonutraceutical in India

As of now, the India's market is only 2% of the worldwide nutraceuticals market, and arising nutraceutical brands have an immense undiscovered populace, holding back to be investigated. As purchasers are getting more mindful about preventive medical care, the market size for nutrition supplements has expanded more than two fold. The expertise on sustenance has expanded in the overall population and individuals are looking for comprehensive well-being arrangements and not simply healing medication or a sickness based cure (Gupta et al.⁵, 2010). Moreover, the advancements in internet usage and fast digitisation have additionally supported the development of the medical industry. In the past, the metros were the main business sectors for nutraceutical agreements, however, utilization designs have demonstrated an drastic move. With a consistent expansion popular from Tier II and Tier III urban areas, we are presently ready to support the interest of a lot more topographies inside and outside India (Subramoniam, 2014).¹³ Indeed, even specialists are currently co-endorsing nutraceutical enhancements to assist patients with adapting to their conditions. This expands the certainty among customers which converts into colossal take-up for the items inside classifications, for example, type 2 diabetes, circulatory strain the executives, disease, heart well-being, etc where doctors are encouraging their patients to decide on nutraceutical items to fabricate invulnerability/settle glucose, improve gut well-being and absorption, etc relying upon the condition that the patients are engaging (Shinde et al., 2014).¹⁴

However, add to this the absence of a clinical guide, general incredulity about allopathic meds and food trends, fast digitisation and expanded mindfulness with respect to sustenance and well-being has made the shopper move from clinical medications and manufactured fixings to nutraceuticals contributing fundamentally to the development of the market. When we discuss the nutraceuticals market in India, nutrients and minerals possess a more significant portion of the pie at 40%, trailed by the grown home section contributing 30%, 25% held by proteins fragment, and others contributing around 5% of the total market (Bhowmik et al.¹⁵, 2013). The most recent exertion of Agarwal et al. contributes the

first and picture of nanopharmaceuticals with respect to biomedical application, producing system, and security aspect (Agarwal et al.¹⁶, 2018). Wu et al.¹⁷ accentuated how nano-therapeutics and nano-pharmaceuticals could prompt a more exact individual diagnosis, advance treatments, lessen side effects, and improve recuperating. A similar review likewise underlines that the field of nanomedicine is at its beginning phase and that further endeavors to make an interpretation of their potential into clinical preliminaries and clinical practice are as yet required (Wu, L. P., Wang, D.[32], and Li, Z. 2020). A rising figure of studies is geared towards utilizing nanotechnologies to nutraceuticals to get improved bioavailability, conveyance, and impact. This prompts the advancement of an arising area of inventive items like the nanonutraceuticals (Watkins et al., 2015).

Nanotechnology can be utilized to improve assimilation, bioavailability, solidness, and controlled arrival of supplements and nutraceuticals, along these lines expanding medical advantages; a few instances of likely preferences of utilizations of nanotechnology on the nutraceuticals are (i) proficient exemplification; (ii) powerful delivery and delivery from a nanoformulation. For instance, research on embodiment of nutraceuticals into biodegradable, harmless to the ecosystem nanocarriers, is continuous to build their retention and their remedial potential (Gupta et al.^{1,18–23}, 2010).

7. Certain Bioactive Constituents in Nutrition and Health Benefits

It is usually comprehended that nourishments do not only give supplements to sustenance, though may likewise present extra medical advantages for the anticipation and therapy of different kinds of illnesses. As of late, there is a pool of proof validating the well-being cases of specific nourishments because of the bioactive mixes they contain. These health-advancing nourishments or mixes are either named useful food sources or nutraceuticals (Singh et al., 2017).

7.1. Probiotics and prebiotics in human health

It uncovers that there is a rising comprehension of the pretended by the resident microbiota on human well-being, including the avoidance or improvement of various conditions and indications. Probiotics can be characterized as living beings and substances that add to the intestinal microbial equilibrium. It is a conscious microbial feed supplement that helpfully influences the host creature by improving its intestinal microbial equilibrium. A prebiotic is a nonviable food segment that gives a medical advantage on the host, related with tweak of the microbiota. While probiotics are unfamiliar microbial specialists that go about as enzymatic frameworks and invigorate the neighborhood and foundational resistant

framework, prebiotics act by animating colonic fermentative cycles and improving the expansion of endogenous species and strains of microorganisms. Prebiotics apply extra fundamental impacts through the incitement of endocrine components that control satiety and weight acquire (Saier & Mansour, 2005).²⁴

The human body is inhabited by over a lot of entities, some of which are useful and others destructive. It is accepted that lop-sidedness between the useful and unsafe microorganisms prompts illnesses, for example, corpulence and urogenital diseases. Consequently, probiotic and prebiotic enhancements might be viable in forestalling just as battling such circumstances. Moreover, the World Health Organization (WHO) characterizes probiotics as "Live microorganisms which, when managed in sufficient sums, present a medical advantage on the host." Prebiotics are non-digestible food constituents that encourage the progress and/or movement of microbes in the gastrointestinal structure in ways that professed to be gainful to health (Singh et al., 2017).²⁵

7.2. *Proteins and peptides*

Proteins are long-chain polymers of amino acids, while peptides are short amino destructive chains. Further, proteins in eating regimens may be absorbable or poisonous. Harmful proteins trap and eliminate toxic substances and bile through excrement just as help in cholesterol reduction in the stomach-related organ. Wheat and soya beans are known to contain incredible proportions of harmful proteins and eating them is purported to overhaul a healthy gut. Palatable proteins are in any case isolated into peptides during digestion and burned-through into the blood circulatory system. The peptides from the palatable proteins of soya beans have been represented to be amazing in diminishing blood cholesterol levels. To be sure, bioactive peptides have been bound from various sources, for instance, marine living creatures, milk proteins, meat, and different methods for application in nutraceuticals. The beneficial effects of food-constructed cell fortifications in prosperity headway and disease neutralization are sticking out. Lately, there has been a particular focus on milk-decided peptides (Daliri, E. B. M., and Lee, B. H. 2015; Kris-Etherton et al.²⁶, 1999).

7.3. *Lipids and fatty acids*

Basic polyunsaturated unsaturated fats (PUFA, for instance, omega-3 (n-3) and omega-6 (n-6) are essential in coordinating metabolic cycles. However, docosahexaenoic destructive (DHA; 22:6) and eicosapentaenoic destructive (EPA; 20:5) which are N-3 PUFA have pulled in a lot of thought in light of their likely clinical points of interest. N-3 PUFA hinder atherosclerosis, direct nuclear record factors related with the quality explanation of combustible

markers, stimulate scholarly unforeseen development, and reduce high greasy oil (TG) levels, endothelial brokenness, aggravation, and heart arrhythmia which are markers of cardiovascular ailment. DHA has been shown to be an essential section of the cerebrum which adds to memory limits. This has accordingly caused an extended circuit of DHA into margarines and infant sustenances to redesign cerebrum memory improvement and decline the reality of Alzheimer's ailment. Various food sources, for instance, fish oil, vegetable oils, and nuts, for instance, peanuts and almonds are rich in linoleic and linolenic acids and accordingly give cardiovascular favorable circumstances similarly as cell fortification activities (Ackman et al.²⁷, 2002; Daliri,²⁸ E. B. M., and Lee, B. H. 2015).

7.4. *Catechins (Proanthocyanides)*

The continuous interest of polyphenols in green and dim tea has extended as a result of their cell support practices and their possible parts in the shirking of threatening development, cardiovascular disease, renal infection, and intestinal bacterial verdure (Fukuzawa et al. 2014).¹⁶

A greater piece of phenolic composites (catechins) have a spot with flavonoids. There are four vital kinds of catechins: epicatechin (EC), epigallocatechin (EGC), epicatechingallate (ECG), and epigallocatechingallate (EGCG) describe the effects of catechin-improved green tea food on natural fat incident in adults with a serious degree of instinctual fat, and Fukuzawa et al. (2014) uncovered the limit of green tea catechins to treat nonalcoholic steatohepatitis (NASH) in human subjects (Nile et al., 2020).

7.5. *Lycopene*

Lycopene is the red shade of tomato and other red verdant food sources, for instance, papaya, watermelon, carrot, pink guava, and pink grapefruit. It is a carotenoid with high malignancy counteraction specialist potential. Despite the way that the common limit of lycopene has not been totally known, its constructive outcome in changing the quality enunciations of prostate threat is prominent. Lycopenes are moreover offered an explanation to prevent cardiovascular afflictions and oxidative pressing factor in the liver, kidney, and gonads and besides have an antiproliferative activity (Nile et al., 2020).

7.6. *Herbs and spices*

Spices are elusive food subordinates that are utilized from the beginning of time to improve the tactile nature of food sources. They grant trademark flavor, fragrance, and shading to food sources, invigorate craving, just as alter food surface. Dietary flavors and spices, even in moment amounts, have colossal impact on the human well-being by their antioxidative, chemopreventive, antimutagenic,

calming, and safe modulatory consequences for cells and a wide scope of useful impacts on human well-being. The majority of the zest segments are terpenes and different constituents of fundamental oils.

Veda and Srinivasan have detailed that species, for example, dark pepper, capsaicin, red pepper, and ginger improve the take-up of β -carotene in the digestive organs. Piperine and ginger expanded the take-up of β -carotene by 147 % and 98 %, individually. While an increment in assimilation was 59 % and 27 % in dark pepper and red pepper took care of creatures, individually, dietary capsaicin likewise expanded the take-up by 50 % (Nile et al., 2020; Gul et al., 2016).

8. Future Perspectives

Nanotechnology assumes a significant part in the food area through the quality of food construction ends with innovative processing, packaging, and long-term storage, huge development in the food industry through improvement in food quality by improving its flavor and surface. The nano-materials and nanosensors help the purchasers giving data on the condition of the food inside and its healthful status with upgraded security through microbe location. A large portion of the food bioactive against different sicknesses are hydrophobic in nature, having the least bioavailability and strength; consequently, the nanotechnology-based conveyance frameworks gave an upgraded bioavailability and focused on the conveyance of food bioactive composites. However, various companies currently see more about how supplements influence individuals from a medical care point of view. They are along these lines taking a gander at ways both clinical therapy and sustenance can be incorporated in the clinical field to guarantee that comprehensive clinical consideration is given. Presently, medical consideration is viewed as the area of medications, while sustenance is viewed as a result of a healthy living (Gul et al.¹, 2016).

Further, soon, it is significantly more work on how the two cooperate and supplement each other will be completed. Interest in new innovation and the utilization of hereditarily adjusted innovation inside the food industry for clinical and medical advantages is set to drive further expansion in market incomes inside the nutraceuticals market. Moreover, growing the assemblage of logical examination, which approves the adequacy and well-being of these new items, will animate further interest in the innovation and application. Promising advancements, for example, nutrigenomics, imaging strategies, and meeting advances, are logically being utilized in sustenance research (Jackson et al.²⁹, 2011).

Their colossal potential will upgrade the advancement of nourishments for focused populace bunches with characterized hazard variables or infections, for example, corpulence, diabetes, sensitivity, and cardiovascular illness.

The innovativeness of food innovation may likewise add to additional advances in creating food items that can uphold ideal well-being. The expanded purchaser familiarity with useful nourishments and nutraceuticals will anyway drive further income development around the world. Worldwide development over the industry is relied upon to proceed as agricultural nation's increment nutraceutical utilization (Nile et al., 2020).³⁰

9. Conclusion

The nanotechnology-based foods provide critical complications to both administration and manufacturing, guaranteeing the shopper certainty and acknowledgment for nano foods accessible in the market. However, dynamic use of nano colloidal particles in various parts of the food industry, for example, food quality, security, sustenance, preparing, and bundling, has been broadly testified recently. The properties and conduct of colloidal particles are imperative to plan nourishments that are more secure and more advantageous with improved quality and manageability. Nanoparticles are fabricated everywhere in the world, however, not many nations have the standard administrative principles for the usage of nanotechnology in food items. Inadequate logical investigation on nanosystems makes trouble in coming to any end results with respect to their viability. Although, the uses of nanoparticles in food bundling are less cruel than the usage of nanoparticles as a food constituent. There is consistently a danger that nano-materials may enter the natural way of life through the air, water, and soil during their assembling and use, prompting DNA damage, cell film disturbance, and cell demise. Further, until this point, not many in vivo examines have been led on the impacts of nano foods in human and creature well-being. There should be suitable naming and guidelines informed for showcasing with respect to nano food that can assist with expanding buyer worthiness. Subsequently, usage of these nanotechnologies, whenever oversaw and controlled accurately, can assume a critical function in refining food preparation and item quality that will be profited for human well-being and prosperity.

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None.

11. Conflict of Interest

None.

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