



A RESEARCH ON NEW PROSPECTIVE AND APPROACHES OF NUTRACEUTICAL IN HUMAN HEALTH

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Abstract

The terms "nutrition" and "pharmaceutical" make up the term "nutraceutical." Nutraceuticals are products that are either foods or components of foods and have a considerable positive impact on health when consumed. Nutraceuticals and nutritional therapy have grown in popularity in the prevention and treatment of diseases because they are sources of nutrients and energy as well as having potential therapeutic benefits. The treatment of diseases like obesity, cancer, diabetes, osteoporosis, osteoarthritis, Alzheimer's, cardiovascular, Parkinson's, and COVID 19, among others, has greatly benefited from their use. Both contemporary and conventional biotechnology techniques are used to generate and develop nutraceuticals. Non-traditional nutraceuticals include (recombinant and fortified nutraceuticals), chemical nature, and mode of action. Traditional/conventional nutraceuticals contain chemical components (nutrients, herbs, and phytochemicals), probiotic bacteria, and nutraceutical enzymes.

The food sector adopted a research-oriented strategy similar to that of the pharmaceutical industry, ushering in a new era of the nutraceutical revolution's promised medical and health benefits.

Keywords: Health, Nutraceuticals, Pharmaceutical, Therapeutics.

Introduction

Numerous laboratory and clinical studies have shown that consuming dietary supplements may improve health and lessen the burden of disease. A higher percentage of the population consistently meets the estimated average nutrient requirements in nations where nutritional supplements are widely used.

Dietary supplement use has become widespread among the general public's daily activities. More than half of American citizens, according to national polls conducted in the US, consume supplements on a daily basis. In the same-age groups, supplement use rises with age, education, and income, and it is more prevalent among women than males. Additionally, the demands of the workplace have been connected to supplement use. Additionally, supplement users are more likely to practice healthier lifestyle habits like quitting smoking and drinking less alcohol. (1)

The market for functional foods and nutraceuticals is rising as a result of public interest and consumer demand, as well as ongoing research efforts to determine the qualities and prospective uses of nutraceutical compounds. Current demographic and health trends are the main drivers of the functional food market's expansion. Populations all across the world are ageing. The proportion of senior people in the population is increasing along with life expectancy. Additionally, due to the fact that the prevalence of obesity is increasing in nations around the world, it is now acknowledged as a global problem. According to body mass index (BMI), more than half of individuals in the U.S. are considered obese and around 62% of the adult population is overweight. In the United States, heart disease still accounts for 32% of fatalities, while other leading causes of mortality include cancer, osteoporosis, and arthritis. The International Obesity Task Force reports that, as of this writing, the prevalence of obesity has increased by 10% to 50% during the past ten years in the majority of European nations. Despite the fact that genetics play a significant influence in the development of the diseases listed above, the majority of them are thought to be preventable or could be significantly reduced with adequate food, exercise, weight control, and a better lifestyle that includes the surroundings. Additionally, individuals can enhance their diet's capacity to promote health by taking supplements and ingesting foods that have been created or fortified with such ingredients. The words nutrition and pharmaceutical are combined to form the term nutraceutical. It is said that De Felice and the Foundation for Innovation in Medicine came up with the term in 1989. In a press release from 1994, it was restated and defined that it meant "any substance that may be regarded a food or part of a food and delivers medical or health advantages, including the prevention and treatment of disease. These items can include everything from isolated nutrients, dietary supplements, and diets to 'designed' foods made using genetic engineering, herbal products, and processed foods including cereals, soups, and drinks. (2)

Examples of Nutraceutical Substances Grouped by Food Source (3)

1. Plant Sources

β -Glucan, Ascorbic acid, γ -Tocotrienol, Quercetin, Luteolin, Cellulose, Lutein, Gallic acid, Perillyl alcohol, Indole-3-carbonol, Pectin, Daidzein, Glutathione, Potassium, Allicin, δ -Limonene, Genestein, Lycopene, Hemicellulose, Lignin, Capsaicin, Geraniol, β -Ionone, α -Tocopherol, β -Carotene, Nordihydrocapsaicin, Selenium, Zeaxanthin, Minerals, MUFA.

2. Animals Sources

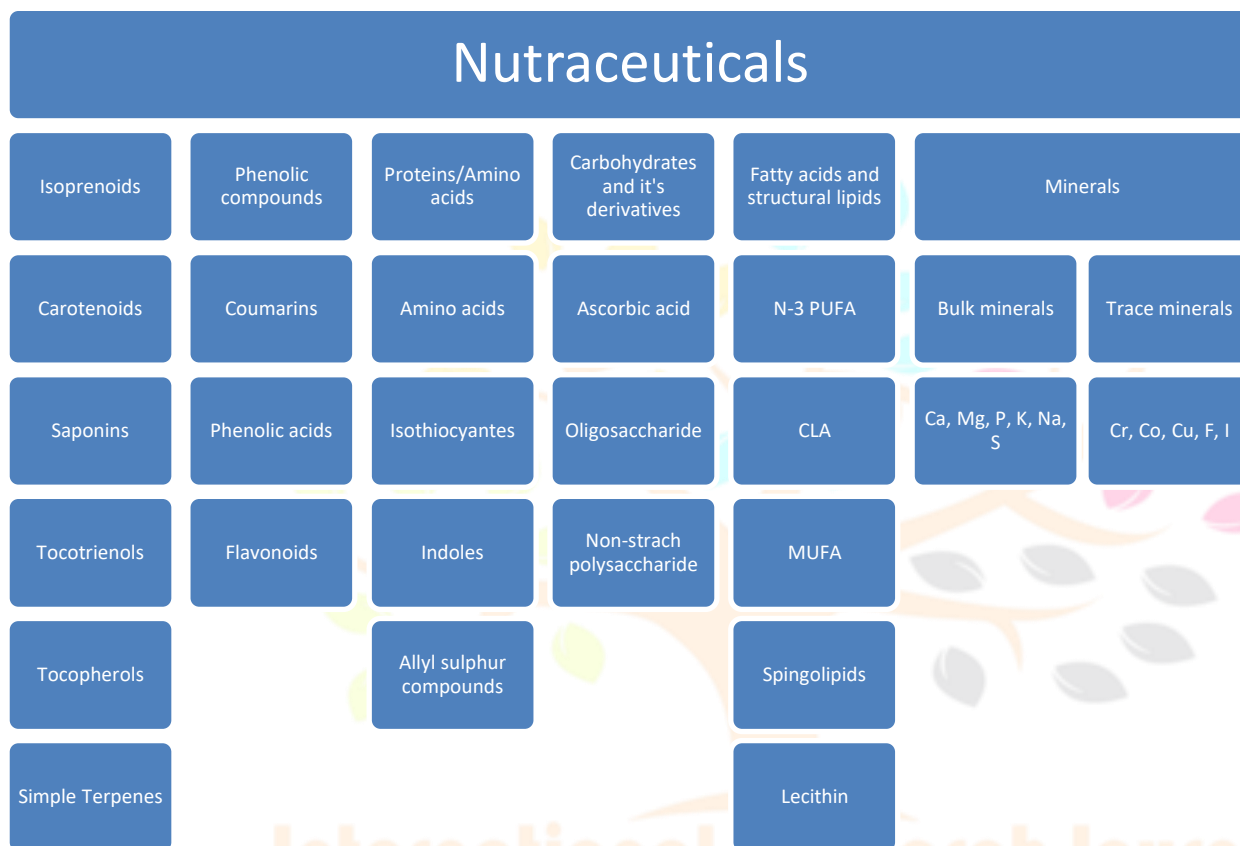
Conjugated Linoleic Acid (CLA), Eicosapentaenoic acid (EPA), Docosahexenoic acid (DHA), Spingolipids, Choline, Lecithin, Calcium, Coenzyme Q10, Selenium, Zinc, Creatine, Minerals

3. Microbial sources

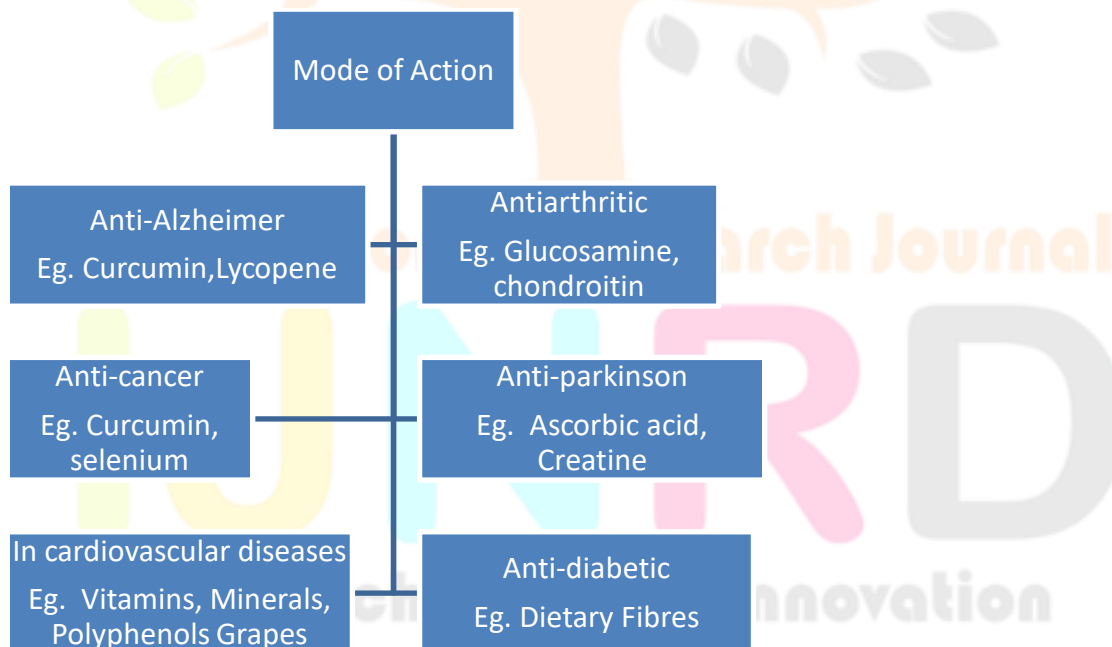
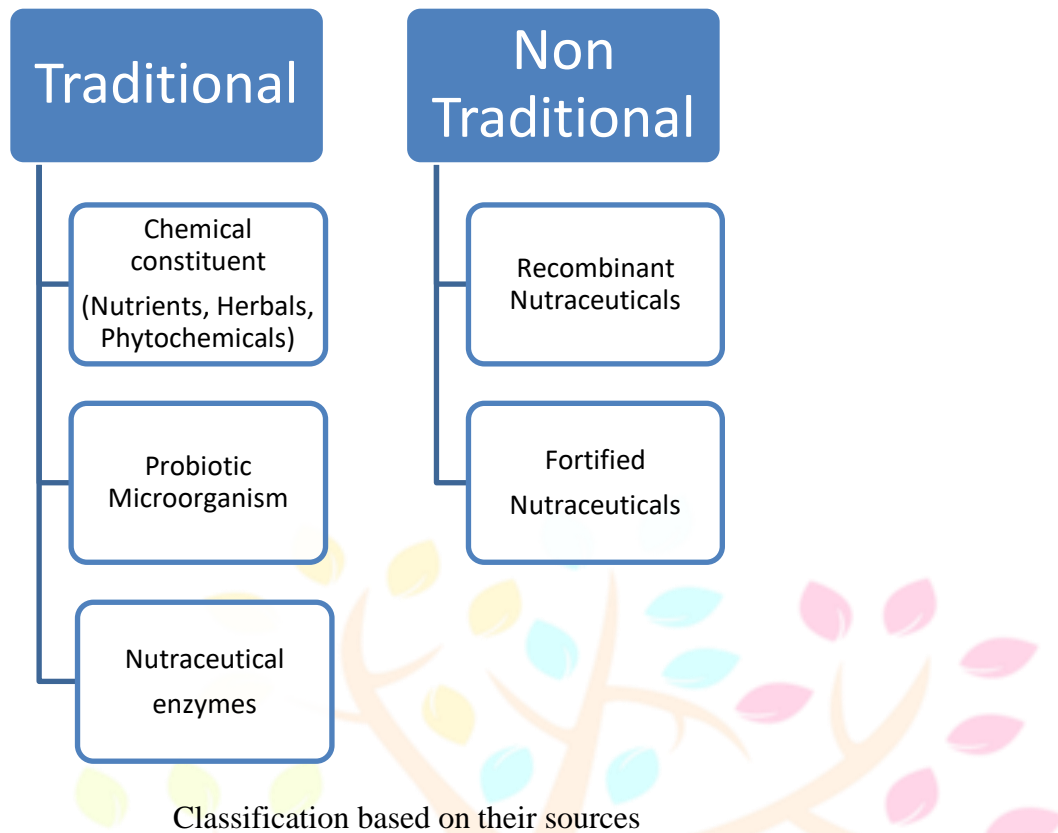
Saccharomyces boulardii (yeast), *Bifidobacterium bifidum*, *B. longum*, *B. infantis*, *Lactobacillus acidophilus* (LC1), *L. acidophilus* (NCFB 1748), *Streptococcus salvarius* (subs. *Thermophilus*)

Note: This table includes chemicals that are recognized as or that are allegedly used as nutraceuticals.

Types of Classifications



Classification of nutraceutical based on chemical nature



Aim and Objective

AIM: - To gather studies on therapeutic effects and strategies for using nutraceuticals to advance and manage human health.

Objective: -

1. Application of creatine monohydrate for improving exercise performance and increasing muscle strength. It is also used for muscle disorders (such as McArdle's disease), Parkinson's disease, and heart failure.
2. To examine studies, suggest that calcium, along with vitamin D, may have benefits beyond bone health, perhaps protecting against cancer, diabetes and high blood pressure.
3. Vitamin C in eliminating free radical intermediates that start harmful cell reactions and its essentiality for immunological function, collagen production, and cortisol synthesis.
4. The use of Vitamin E in enhancing performance.
5. Lv-52 as a measure to battle liver cirrhosis.
6. Fish oil and Multivitamin Multi Mineral supplement effect on lower fasting blood triglyceride levels and body functioning respectively.
7. Using nutraceuticals to treat illnesses including type 2 diabetes, obesity, and cardiovascular disease that are connected to metabolic disorders. Also, to assist with relieve the signs of neuromuscular conditions like Parkinson's and Alzheimer's. Its role in thwarting COVID-19 and enhancing body resistance to it. It helps lower oxidative stress to treat cancer and prevent chronic inflammation. Chondroitin sulphate, glucosamine, and calcium are among the nutraceuticals that increase bone mass and joint flexibility to prevent osteoarthritis and osteoporosis.

Review of Literature

Important dietary supplements for enhancing human health

Creatine Monohydrate Supplement

Creatine monohydrate improves muscular function during brief, intense bouts of resistance training that depend on the phosphocreatine shuttle for adenosine triphosphate. The most effective dosage for creatine supplementation consists of loading for 5–7 days at 0.3 g/kg/d, then maintaining for 4–6 weeks at 0.03 g/kg/d. Loading doses are not required to boost the intramuscular creatine reserves, though. The most researched type of creatine is creatine monohydrate; creatine ethyl ester has not demonstrated any further advantages. With few recorded negative effects, creatine is a relatively safe dietary supplement. Transient water retention during the initial phases of supplementing is the most frequent adverse effect.

The amino acids glycine and arginine are the first steps in the kidney's endogenous production of creatine. The result is subsequently transported to the liver, where creatine is created by adding a methyl group from methionine. Creatine from the bloodstream enters the skeletal muscle through transporters in the cell membrane. Exercise, catecholamines, and insulin-like growth factor have all been demonstrated to affect the rate of creatine absorption. Creatine kinase helps in a reversible enzymatic process whereby creatine can be phosphorylated once inside the cell to create

phosphocreatine. Adenosine diphosphate (ADP), which is created by ATP, has the phosphate group. When the cell is using ATP, the opposite reaction takes place, and phosphocreatine can transfer a phosphate group to ADP.

Both anaerobic glycolysis and phosphocreatine shuttle provide the ATP required for short-duration, high-intensity exercise. The phosphocreatine shuttle predominates as an ATP source during maximal effort activities lasting less than 10 s, while anaerobic glycolysis is the predominant route of ATP synthesis between 10 and 30 s. It is thought that by extending the phosphocreatine shuttle, one can lessen muscle fatigue and improve performance by boosting phosphocreatine reserves through creatine supplementation.

There are several suggested processes by which creatine supplementation can enhance performance during these activities in addition to boosting phosphocreatine reserves. Faster phosphocreatine resynthesis during periods of rest and recovery in between bouts of maximal activity is one mechanism put forth; more creatine in the muscles would imply more potential phosphocreatine. There are contradictory studies on the benefits of adding creatine supplements to phosphocreatine resynthesis. Other ways include enhancing phosphofructokinase activity or buffering hydrogen ions to assist ATP synthesis through glycolysis.

Effects on Performance: - Research on the effects of creatine monohydrate on weight training exercises is vast. In short-duration, maximum-intensity exercises, performance and muscle strength have been shown to increase in multiple controlled trials. Exercises including the bench press, leg press, biceps curl, leg extension, jump squat, and bicycle ergometry have all been used to measure the effects of resistance training in the literature. In creatine research, the one repetition maximum, mean power, total force, and number of repetitions are the methods used to quantify strength and performance. There is disagreement among the findings about the ergogenic effects of creatine supplementation. However, a sizable body of research suggests that creatine improves performance during brief bouts of maximal intensity resistance training.

Studies on the impact of creatine supplementation on anaerobic performance have shown contradictory results. Studies have repeatedly found no effect of creatine supplementation on aerobic performance. Evidence has shown improvements in Type II muscular fiber area and fat-free mass in addition to performance metrics. Creatine supplementation may potentially have an impact on muscle glycogen stores, most likely as a result of increased cellular water content. As early as 1928, studies on the effects of creatine supplementation on body mass were published. Current research, however, points to a decreased urine output and water retention during the initial phases of creatine loading as the causes of the body mass increase seen with creatine. (4)

Calcium Supplement

Calcium is a vital integrative element of the human body and is essential to maintaining human health. It is well known that calcium intake aids in the treatment and prevention of osteoporosis, one of the most important public health issues in the world today. Adults living in the community, both those with and without osteoporosis, are rarely worried about or even aware of the potential negative effects of consuming excessive or incorrect amounts of calcium. According to some recent studies, consuming too much calcium may raise the risk of cardiovascular illnesses. Reviewing the health advantages, costs, and effects of calcium supplements on osteoporosis/osteoporotic fractures, cardiovascular events, kidney stones, gastrointestinal illnesses, and other significant conditions was the goal of this paper. (5)

Acutely increasing circulation calcium concentrations, decreasing parathyroid hormone levels, and decreasing markers of bone resorption are all effects of ingesting a calcium bolus in the form of a supplement, which is followed by a fall in bone formation markers 2-3 months later. In the hip and spine, this improves bone density by roughly 0.5–1%, primarily in the first year of treatment. In the majority of trials, there was no connection between subjects' initial dietary calcium consumption and their bone density response. In research on dietary supplements, calcium doses of 1000 mg per day have typically been employed. With the exception of people who consume very little calcium, doses of 250–600 mg per day have been found to have little or very little impact on BMD. (6)

It's interesting to note that certain research showed that calcium supplementation improved bone mass density (BMD) and reduced the morbidity of osteoporosis and osteoporotic fractures in people of diverse genders and ages. The National Osteoporosis Foundation (NOF) states that there is best evidence (grade A) for both children and adults about the beneficial effects of calcium intake on osteoporosis prevention. It has also been demonstrated that calcium treatment prevents fractures. Radford et al. investigated the effects of calcium on fracture incidence and BMD following the discontinuation of calcium supplements. They came to the conclusion that while the forearm and vertebral fracture rates were significantly reduced, the beneficial effects on BMD seen in the initial trial did not continue after the calcium supplementation was stopped.

Calcium supplements can reduce bone loss, according to a randomized, double-blind, placebo-controlled trial that included 1,471 postmenopausal women with a 5-year follow-up. Participants received either 1,000 mg/d of calcium supplements or an equivalent placebo. One meta-analysis found that adequate calcium intake with or without vitamin D is associated with a lower risk of fractures of any kind (the RR =0.88, 95% CI =0.83-0.95) as well as a modest benefit on slowing bone loss, with 0.54% less bone loss in the hip and 1.19% less bone loss in the spine. This meta-analysis included 29 randomized trials with men and women aged >50 years (including menopausal women).

In one study, 187 women over 65 years old were participated in a descriptive cross-sectional trial that was only conducted in postmenopausal women without a history of osteoporosis. The results showed that adequate calcium intake combined with appropriate exercise can successfully prevent osteoporosis. The findings of some significant studies have supported the dosage of calcium supplements that should be taken by postmenopausal women, regardless of whether they have osteoporosis. The largest study, which included 36,282 postmenopausal women who were randomly assigned to receive 1,000 mg/d of calcium and vitamin D or a placebo, found that hip bone density was increased by calcium supplements.

In a 2008 study, the effects of two calcium citrate dosages (600 mg/d, 1,200 mg/d, or placebo) on BMD in healthy men were compared. The 1,200 mg/d group demonstrated enhanced BMD, according to the results of the double-blind, randomized controlled experiment conducted on 323 healthy males aged >40 over a 2-year period. However, it should be emphasized that urine calcium tended to rise in proportionally by 57%. Increasing dietary calcium consumption significantly increased BMD in both men and women, according to a recent study conducted in Korean individuals, including 5,955 men, 1,256 premenopausal women, and 4,494 postmenopausal women.

Children who have a high risk of osteoporosis (such as those with celiac disease, inflammatory bowel disease, or congenital bone disorders) or who consume insufficient calcium may benefit from calcium supplements, according to clinical practice. (5)

Vitamin C Supplement

Vitamin C eliminates free radical intermediates that start harmful cell reactions and is essential for immunological function, collagen production, and cortisol synthesis. Reactive oxygen species (ROS) or their derivatives have been shown in numerous studies to increase during moderate to vigorous exercise. Supplementing with vitamin C may be expected to improve athletic performance by lowering the potential negative effects of ROS, which can modify target proteins by oxidizing thiol groups and forming disulfide bonds that reversibly alter protein structure and function. On the other hand, vitamin C inhibits the cell signaling that exercise-induced ROS generation causes, which leads to training adaptations. Therefore, taking vitamin C supplements can make you perform worse.

The 60 mg per day of vitamin C that is advised by the U.S. for healthy people is based on the requirements of healthy people who are not active, thus it may not be suitable for athletes. Given the evidence discussed above, it is evident that athletes should ingest $<1 \text{ g} \cdot \text{d}^{-1}$. According to several reviewers, taking 0.2 to 1 g of vitamin C daily will lessen oxidative stress. While low dosages of vitamin C may only slightly lessen oxidative stress, there are probably other health advantages that may help an athlete. (7)

Levine et al. suggested an adequate intake of vitamin C to be 0.2 g daily from five servings of fruits and vegetables to maintain immune cell concentrations of vitamin C and prevent chronic diseases such as cancer.

Due to its antioxidant activity, vitamin C also has a hypotensive impact by boosting the production and bioavailability of nitric oxide (NO). Superoxide is neutralized by vitamin C, which can also lessen the reactivity of NO with superoxide and prevent the generation of peroxynitrite. Tetrahydrobiopterin, a cofactor of the endothelium NO synthase that is essential for maintaining NO production, can be preserved in vitamin C concentrations. (8)

Vitamin E Supplement

Vitamin E has two characteristics that make it useful for enhancing physical performance. It works as a stabilizing antioxidant in membranes while also promoting an efficient energy metabolism. Over the course of a 10-week excursion, two 200 mg doses of dl-alpha-tocopheryl acetate were administered to a group of six high altitude mountain climbers, and placebos were given to the other group. Investigated were the effects on pentane exhalation and lactic acid production. The anaerobic threshold (AT) was greater in both groups after two weeks. The AT of the treatment group continued to rise throughout the experiment, while the AT of the control group dramatically declined ($p < 0.01$) over time.

Pentane exhalation, which is used as a marker for lipid peroxidation, did not alter significantly in the treatment group after 4 weeks of vitamin E replacement, but it was more than 100% higher in the control group. Additionally, the difference is substantial ($p < 0.01$). The findings of this study demonstrate that, at least at high altitudes, vitamin E has positive effects on both physical performance and cell protection. (9)

30 elite cyclists participated in a study to assess the impact of 5 months of -tocopherol supplementation on physical performance during aerobic exercise training. Studies have also been done on the antioxidant properties of supplements. The vitamin E-supplemented group experienced a considerable rise in plasma -tocopherol concentration, whereas the placebo group experienced a slight decline. Comparing the -tocopherol supplemented group to the placebo group, physical performance did not increase. Also, not much different were the heart rates. The levels of lactate at the anaerobic and aerobic thresholds were comparable. Therefore, the group that received supplements of -tocopherol did not do any better. However, the serum level of CK was significantly lower in the E-supplemented group. With -tocopherol supplementation, a tendency towards a reduction in GOT, GPT, and LDH was seen. Additionally, the E-supplemented group's malondialdehyde serum levels were found to be considerably lower.

The results show that supplementing with α -tocopherol has a protective effect against the oxidative damage brought on by vigorous exercise. (10)

The reduction in HbA1C, fasting glucose, and fasting insulin was not linked with vitamin E intake, according to a meta-analysis of fourteen RCTs involving 714 participants. In all three pooled analyses, considerable heterogeneity was seen. Therefore, additional subgroup analysis was carried out in order to pinpoint the origin of heterogeneity. In studies with low blood vitamin E concentrations and worse glycemic control, vitamin E treatment significantly lowered both HbA1c and fasting insulin, according to the subgroup analysis. HbA1c and fasting insulin concentrations also benefited from higher vitamin E doses and longer research durations. Our findings imply that T2DM people with low serum vitamin E concentrations or worse glycemic control experience a beneficial effect on blood sugar levels, even though this meta-analysis was unable to detect any significant correlations between vitamin E supplementation and improvements in glycemic control.

Mechanistic investigations that looked at how vitamin E affected glycemic control support the biological plausibility of these results. There is now a lot of proof that oxidative stress is crucial for the glycation of hemoglobin and beta-cell dysfunction in type 2 diabetes (T2DM). In experimental diabetes, vitamin E reduces the production of ROS in the pancreas and preserves the structural integrity of the pancreatic islets. By halting glycosylation at an early stage of the Maillard reaction or by partially preventing the development of AGE, there is evidence that vitamins E supplementation prevents the glycation of haemoglobin for the diagnosis of diabetes

in clinical settings. Vitamin E partially counteracts the oxidative stress-induced beta-cell death, demonstrating positive benefits on the maintenance of pancreatic beta cell function. (11)

Liv-52 on liver cirrhotic patients

The outcomes of Liv-52, a supplement made up of Mandur basma, Tamarix gallica, and herbal extracts of Capparis spinosa, Cichorium intybus, Solanum nigrum, Terminalia arjuna, and Achillea millefolium, were compared to those of a placebo in 36 cirrhotic patients who were referred to the Tehran Hepatic Centre. Child-Pugh score, ascites, serum alanine aminotransferase (ALT), aspartate aminotransferase (AST), total bilirubin, albumin, prothrombin time, platelet, and white blood cell counts were among the outcome measures. All patients had their indices taken before and after receiving medication or a placebo for six months. According to the findings, patients who took Liv-52 for six months had dramatically improved Child-Pugh scores, ascites levels, and blood ALT and AST levels. This can be attributed to the diuretic, anti-inflammatory, anti-oxidative, and immunomodulating properties of the component herbs. (12)

Fish Oil Supplement

In individuals with hyperlipidemia, fish oils have been generally recognised as a helpful supplement to lower fasting blood triglyceride levels.

To quantitatively assess all the randomised studies of fish oils in hyperlipidemic subjects, a meta-analysis was conducted.

It covered all parallel, placebo controlled, randomised trials that assessed any of the primary blood lipid outcomes, including total, high-density lipoprotein (HDL), low-density lipoprotein (LDL), or triglyceride (TG) cholesterol. DerSimonian

Laird's random effects model was used to pool the data. The final analysis comprised of 47 studies in otherwise untreated subjects showed that taking fish oils (weighted average daily intake of 3.25 g of EPA and/or DHA) produced a clinically significant reduction of TG (-0.34 mmol/L, 95% CI: -0.41 to -0.27), no change in total cholesterol (-0.01 mmol/L, 95% CI: -0.03 to 0.01) and very slight increases in HDL (0.01 mmol/L, 95% CI: 0.00 to 0.02) and LDL cholesterol (0.06 mmol/L, 95% CI: 0.03 to 0.09). Both the intake of EPA + DHA and the starting level of TG were associated to the decline in TG. (13)

Multivitamin and minerals Supplement

Older persons frequently have micronutrient deficiencies, therefore taking a multivitamin/multimineral supplement (MVM) could help them. Data from the National Health and Nutrition Examination Survey were analyzed to assess the micronutrient intakes of persons

aged 51 years depending on diet and MVM use. Nutrient biomarkers were employed to assess deficiencies. The average intakes of 18 micronutrients were calculated using the National Cancer Institute Method and stratified by age and frequency of MVM usage. MVM use was linked to higher nutritional intake, lower frequency of nutrient deficiencies for nearly all micronutrients investigated, and improved nutrient biomarker status for folate, iodine, selenium, and vitamins B6, B12, and D compared to eating only food. Regular MVM use (16 days/month) reduced the likelihood of vitamin B6 and D inadequate amount as determined by the status of biomarkers. (14)

For older persons, maintaining cognitive function is crucial, yet there are currently very few efficient methods for delaying cognitive loss. Supplementing with multivitamins helps older persons maintain their overall health. 3562 senior citizens participated in the Cocoa Supplement and Multivitamin Outcomes trial Web (COSMOS-Web) auxiliary trial (NCT04582617). For three years, participants were randomized to receive a daily multivitamin supplement (Centrum Silver) or a placebo, and they were assessed every year with a suite of online cognitive tests. After one year of intervention, the primary outcome was a change in episodic memory, which was operationally defined as immediate recall performance on the ModRey test. Secondary end measures included changes in executive function and novel object recognition on neuropsychological tasks during a 3-year period, as well as changes in episodic memory over the same period. Participants who were randomly assigned to take multivitamin supplements showed significantly improved ModRey instantaneous recall at 1 year and 3 years of follow-up compared to placebo. Supplementing with multivitamins had no notable influence on side effects. We calculated that the effect of the multivitamin intervention increased memory performance above placebo by the equivalent of 3, based on cross-sectional study of the association between age and performance on the ModRey. Hence daily multivitamin supplementation on comparison with placebo, improves memory and holds promise as a safe and accessible approach to maintaining cognitive health in older age. (15)

Multi Digestive enzymes, Probiotic-Prebiotic Supplement

Digestive enzymes are involved in food digestion, also offered as dietary supplements (produced naturally in the body and can be obtained with a prescription). Supporters of digestive enzyme supplements promise that these over-the-counter enzymes can assist in treating a wide range of medical conditions, including difficulties relating to the stomach, such as irritable bowel syndrome (IBS), heartburn, Ulcerative colitis, Chron's disease, and Celiac disease. Digestive enzymes aid the body in breaking down lipids, proteins, and carbohydrates. They are mostly released by the pancreas. The small intestine can also manufacture it. Digestive enzymes can be divided into three main categories: lipases (which break down lipids into fatty acids and glycerol) and proteases (which break down proteins into amino acids).

Supplemental enzymes guard against malabsorption, which can slow down digestion and result in cramps, flatulence, bloating, and diarrhea. The digestive enzymes found in supplements come

from a variety of sources, including plants and the pancreases of pigs, cows, and sheep. For instance, lactase is made from filtered yeasts or parasites, whereas papain and bromelain are created from papayas and pineapples, respectively.

According to studies, digestive enzymes are beneficial to health since they:

1. Decrease Irritable Bowel Syndrome Symptoms

The bacteria in your stomach are overfed and crowded, which can cause swelling, gas, problems, loose stools, and other frequent IBS side effects. This is another usual sign that food is not being broken down properly in the digestive tract. A digestive enzyme called pancrelipase is believed to reduce some IBS symptoms. Inflammation in the gut has also been linked to conditions including Crohn's disease and ulcerative colitis. According to preliminary research, the use of the proper digestive enzymes can help treat food sensitivities and illnesses like lactose intolerance.

2. Improves Nutrient Absorption: Digestive enzymes assist in nutrient breakdown for improved absorption.

3. Boosts Energy: Digestive enzymes aid in the conversion of carbohydrates into glucose. Amylase-containing supplements may help with the process of turning sugar into energy.

4. Prevents Gut Leakage: Undigested particles push and tear cell walls, which triggers your immune system and irritates the lining of your intestines. Supplemental digestive enzymes aid in appropriate food digestion, preventing immune system activation brought on by bigger food molecules invading the digestive tract.

5. Healthy Inflammatory Response: Proteolytic enzymes that can break down protein into smaller polypeptides or amino acids include rutin, pancreatin, trypsin, chymotrypsin, and bromelain. These biological enzymes, also known as proteases, aid in the breakdown of the proteins present in meats, poultry, fish, nuts, eggs, and cheese. Proteases are linked to a variety of protein interactions, such as inflammatory response, immunological function, and circulation because they increase the bioavailability of protein.

6. Reduces Chronic Fatigue and Pain: Lack of nutrients can cause inflammation in your gut, which can lead to headaches and migraines. With the aid of digestive enzymes, the pancreatic digestive enzyme amylase specifically converts carbs into glucose, reducing inflammation in your gut and alleviating pain and weariness.

7. Encourages Methylation: In our DNA, methylation alludes to the critical processes of cell division and creation. Detoxification, inflammation management, and energy production are all governed by it. By taking supplements with digestive enzymes, Vitamin B is adequately absorbed and methylation is not interfered with.

8. Fights Anxiety: Gut health affects anxiety and fights nervous system inflammation, just as depression and sleep disorders including insomnia.

9. Hypochlorhydria Relief: Low hydrochloric acid (hypochlorhydria) results in malabsorption of several nutrients, such as B12, which causes anemia (low iron levels) and exhaustion symptoms. A digestive enzyme supplement can help in the production of hydrochloric acid.

10. Implications for Healthy Weight Support: Research on lipase, the enzyme that breaks down fat, is very encouraging in terms of how it affects weight. In 2012, scientists had an opportunity to alter a molecular "switch" that turns the substance on and off in order to increase lipase's effectiveness by threefold. By accelerating digestion and promoting metabolism, biological catalysts aid in weight loss. A more efficient digestive system can reduce swelling and toxic stagnation, which in turn reduces excess weight. This brings to a close the extensive—yet not exhaustive—list of health advantages of using digestive enzymes. Additionally, natural digestive enzymes can be found in foods like pineapple, papaya, mango, honey, bananas, avocados, etc. (16)

Therapeutic potential of nutraceuticals in treating diseases/disorders affecting human health

Cardiovascular Diseases (CVD): cardiovascular diseases are linked to heart ailments such hypertension (high blood pressure), coronary heart disease (heart attack), and various types of cerebrovascular disease (stroke) (17). Overeating meals that are high in calories, lacking in nutrients, processed extensively, and simple to absorb can lead to systemic inflammation, impaired insulin sensitivity, and a number of metabolic disorders, such as obesity, hypertension, dyslipidemia, and glucose intolerance. Studies on the ability to prevent cardiovascular disease have focused on the polyphenols found in tea, cocoa, grapes and grape derivatives, and cocoa. Vitamin D, coenzyme Q10, folic acid, omega-3 fatty acids, and polyphenols aid to prevent arterial disease through modifying cellular metabolism. The Angiotensin Converting Enzyme (ACE) is inhibited by flavonoids found in onions, grapes, apples, and cherries, which lowers blood pressure and lowers the risk of coronary artery disease and myocardial infarction (18). By blocking the "suicide" enzyme cyclooxygenase, which breaks down prostaglandins, flavonoids prevent platelet stickiness and buildup. They help maintain the circulatory system and promote tiny capillaries that transport oxygen and essential nutrients to the entire cell (19).

Nutraceuticals in diabetes mellitus: Diabetes mellitus is a chronic metabolic disease in which the pancreatic islets of Langerhans, which produce the hormone insulin, are completely or partially

absent from the body, impairing the body's capacity to use carbohydrates. Blood glucose levels in people with diabetes mellitus are unusually high, either as a result of insufficient or poor insulin synthesis. Involved in glucose metabolism are nutraceuticals and a wide range of bioactive substances such phenolic compounds, Sulphur compounds, herbs, and natural antioxidants that may help ward off the onset of diabetes and other issues. Phytoestrogens, L-carnitine-lipoic acid, omega-3 fatty acids, berberine, chromium, soy, and other dietary supplements are currently on the market and frequently prescribed by doctors. (20)

Nutraceuticals in cancer: Malignant cells can affect our normal cells, and cancer is defined as abnormal cell division in any part of the body. Cancer is brought on by a variety of intricate factors that gradually come together, finally causing the unchecked multiplication and spreading of cancerous cells throughout the body. With ongoing rises in mortality and revenue, it is one of the most significant worldwide health companies.

In addition to environmental factors, oxidative stress and redox waving play a significant role in the development and progression of cancer. Reactive oxygens are also detrimental to the susceptibility of cancer cells to treatment therapies. Cancer risk is increased by chronic inflammation. Additionally connected to immune suppression, a risk factor for cancer, is chronic inflammation. Free radicals and aldehydes created by persistent inflammation have the potential to encourage gene changes and posttranslational modifications of proteins associated with cancer.

Instead of using other pharmaceutical adjuvants to chemotherapy, natural compounds or antioxidants (such as microbial and plant secondary metabolites) are used. Some foods and herbs with a high anticancer activity include ginger, garlic, flaxseed, cabbage, soybeans, fenugreek, green tea, and vegetables from the umbellifers family.

The treatment of cancer involves the use of nutraceuticals, particularly phytochemicals. All commonly used cancer treatments up to this point have all been derived from plants. Cancer patients should consume foods with a reasonable amount of protein, dietary fiber, and fat and modest amounts of carbohydrates (21).

Nutraceuticals in obesity: As a result of excessive consumption of high-fat and calorie-dense foods, fatty plaques are formed on the inner surface of arteries, which restrict blood flow to different parts of the body and contribute to obesity. A shortage of blood flow to some organs can result in angina pectoris, heart attacks, cardiac arrest, transient ischemic episodes, and stroke (22). It is characterized by an excess of body fat; however, the cutoff point that determines what percentage of body fat is "unhealthy" is uncertain, and the capacity to accurately measure body fat mass requires specialized equipment that is not commonly available in most clinical settings. Following that, body mass index (BMI) data is used to categorize individuals as "normal weight" (BMI 18.5-24.9 kg/m²), "overweight" (BMI 25-29.9 kg/m²), or "obesity" (BMI 30 kg/m²), which stratifies health risk based on the relationship between weight and height (23).

The following foods are helpful in the treatment and prevention of obesity: fortified margarine (Plant sterol and stanol esters), oolong tea (catechins), green tea (Organosulfur compounds), garlic (Organosulfur compounds), psyllium (Soluble fiber), and soybean (protein). By blocking pancreatic lipase, boosting thermogenesis, limiting adipocyte differentiation, enhancing lipid metabolism, and reducing hunger, these functional meals help the body burn extra fat (24).

Nutraceuticals in Alzheimer's disease: The most prevalent type of dementia is Alzheimer's disease, which is also a degenerative neurological condition. There is no cure for this illness, and everyone will eventually pass away. Necrobiosis in Alzheimer's disease is caused by a buildup of beta-amyloid protein fragments that form solid plaques, which interfere with acetylcholine's ability to affect synaptic communication, start an inflammatory response, and change the chemical makeup of the specific proteins. Necrobiosis also occurs when a neuron's microtubule couples with another tubule to form neurofibrillary tangles, which result in tubule formation. By reducing the impacts of oxidative stress, mitochondrial dysfunction, and neuronal degeneration, -carotene, curcumin, lutein, lycopene, and turmeric have anti-disease capabilities (25).

Nutraceuticals in COVID-19: Since its appearance at the beginning of 2020, SARS-CoV-2 has had an impact on the health and economy of the entire world. The World Health Organization (WHO) regional office in China first received a report of the virus infection in Wuhan on December 31, 2019, and on March 11 the infection was deemed an epidemic. The coronavirus SARS-CoV-2, also called COVID-19, is highly virulent. Since it is a single-stranded positive-sense RNA virus, infected cells may rapidly transform its RNA into viral proteins. Memory loss, gastrointestinal issues, and fever are only a few signs and symptoms of SARS-CoV-2 infection. The present COVID-19 virus has raised demand for foods, vitamins, and nutraceuticals that support the immune system. Based on their anti-inflammatory qualities as well as their ability to reduce virus activity (such as SARS-CoV, MERS-CoV, and SARS-CoV-2) by disrupting their protein envelopes, food bioactive and nutraceuticals have been proposed as an alternative therapy for COVID-19 disease. Functional foods can act as natural therapeutic agents against SARS-CoV-2 or preventive therapy for COVID-19 patients, in addition to boosting the body's immunity to fight COVID-19 infection. Functional foods contain a variety of functional components, such as vitamins (A, B, C, and D), minerals (selenium, zinc, and iron), and polyphenolic compounds (quercetin, resveratrol, catechins, and anthocyanins) (26).

Research Through Innovation

Nutraceuticals in osteoarthritis: Articular cartilage degeneration, synovial membrane inflammation, and subchondral bone resorption are the hallmarks of osteoarthritis. It is the most well-known type of arthritis and affects millions of people worldwide. This disorder is brought on by the gradual breakdown of the protective cartilage on the bones' extremities. In the body, it can hurt any joint. The joints of the hands, knees, hips, and spine are most frequently affected. Although osteoarthritis cannot be cured, there are treatments that can help with pain management and joint mobility. The symptoms of osteoarthritis are commonly treated with chondroitin sulphate (CS) and glucosamine (GLN), also known as 2-amino-2-deoxy-d-glucose (C₆H₁₃NO₅). Osteoarthritis and joint issues are treated with MSM (Methyl Sulfonyl Methane), a synergistic mixture of glucosamine and chondroitin. An amino

monosaccharide called glucosamine (GLN) is present in the exoskeletons of both crustaceans and mushrooms. It is a part of the GAG (glycosaminoglycan) chain. Acetyl-d-galactosamine sulphate and glucuronic acid are the two sugars that make up GAG. (27)

Nutraceuticals in osteoporosis: Osteoporosis symptoms include low bone mass, weakening bone tissue, and alteration of bone microarchitecture. Numerous factors that contribute to low bone mass can be adjusted or cannot be addressed, respectively. Gender, age, size, and race cannot be modified, but hormonal status, lifestyle factors like eating habits, drinking habits, and physical activity levels may (28).

Herbs, minerals, and dairy products are examples of nutraceuticals that are increasingly used to treat this ailment. A widely advertised nutraceutical called Calcirol D-3 contains vitamins and calcium to help cure osteoporosis. Probiotics are helpful in reducing the risk of osteoporosis and easing its symptoms.

Nutraceuticals in Parkinson's disease: It is a neurodegenerative condition that causes striatal dopamine exhaustion due to a deficiency of dopaminergic neurons in the substantia nigra. In animal studies, a variety of nutraceuticals have demonstrated their ability to provide neuroprotection, and they may be advantageous as an alternative to synthetic pharmaceutical compounds like L-Dopa, which have a long list of unfavorable side effects. Some of the mechanisms by which they function include iron chelation, modulation of cell signaling pathways, Reactive Oxygen Species (ROS)/free radical scavenging, anti-inflammation, anti-apoptosis, and mitochondrial homeostasis. However, several nutraceuticals actually function through a variety of unconscious pathways rather than just one mechanism. Unsaturated fatty acids, coenzyme Q10, soybeans, plant polyphenols, stilbenes, and other phytoestrogens have been demonstrated to slow the progression of Parkinson's disease (29).

Conclusion

The aforementioned advantages and methods for using/administrating nutraceuticals enable people improve their quality of life, readily obtain its advantages at an affordable price, and even use it to cure underlying health issues. Nutraceuticals, which include herbal products, nutrients, and dietary supplements, are widely utilized today to enhance quality of life, control illness signs and symptoms, and suppress various disease-related processes.

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