

UNIT-II

Topic-1

NUTRACEUTICAL

4.1 General Aspects

Nutraceuticals are a group of products that are more than food but less than pharmaceuticals. Unfortunately there is still no internationally accepted definition of these products therefore their judgment varies country by country. In most countries nutraceuticals are taken as part of dietary supplements. Frequency of nutraceuticals use is 50%–70% in developed countries' population and this number is increasing by the age. Ladies use more nutraceuticals than men. From a safety point of view nutraceuticals are trusted products even if they are not approved by authorities like pharmaceuticals. With a lot of nutraceuticals clinical studies have been carried out and results originating from these trials support their effectiveness as well as their general safety. Nutraceuticals represent however a certain risk if they were to be used without medical control as interactions with medication can be harmful, especially in vulnerable (old, very young, chronically sick) populations. Examples from fish oil preparations, prebiotics, and probiotics are reviewed. The term 'Nutraceutical' was coined from 'nutrition' and 'pharmaceutical' in 1989 by DeFelice and was originally defined as 'a food (or part of the food) that provides medical or health benefits, including the prevention and/or treatment of a disease.

A Nutraceutical may be a naturally nutrient- rich food such as spirulina, garlic, soy or a specific component of a food like omega-3 oil from salmon. They are also known as medical foods, nutritional supplements and dietary supplements. It ranges from isolated nutrients, dietary supplements, genetically engineered 'designer' foods, herbal products, and processed products such as cereals and soups. They have received considerable interest because of their presumed safety and potential nutritional and therapeutic effects. People can improve their health by supplementation and by consuming foods that have been formulated or fortified. Another reason for the growing trend of Nutraceuticals is public education, renewable source, cultivation and processing, environmental friendliness and local availability. United Kingdom, Germany and France were the first who considered that diet is more important factor than exercise or hereditary factors in achieving a good health. Canada defined them as 'a product produced from foods but sold in pills, powders, (potions) and other medicinal forms not generally associated with food'. In India, Nutraceutical are the food components made from herbal or botanical raw materials, which are used for preventing or treating different types of acute and chronic maladies.

The functional foods revolution, which has swept through human nutrition over the past decade, is now also happening in companion animal nutrition. This is not surprising, since it is estimated that between 50-60% of households in the US own at least one cat or dog and a large portion of these pet owners will be health conscious individuals who not only are particular about their own diets but also those of their pets. Powerful market forces are fuelling the interest in functional foods; with rapid advances in scientific knowledge supporting the vital role of diet in health and disease prevention. This, combined with an increase in consumer demand and the change in perspective on food (no longer viewed as merely a means of providing sustenance), along with technical advances that are allowing the development of health-promoting foods that can be marketed to health-conscious consumers at a premium, means that it is not surprising that the functional food/Nutraceutical industry is booming. As a consequence, the need for high quality

diets and dietary supplements, nutraceuticals and functional foods specifically formulated for companion animals has grown, along with the need for information detailing the evidence supporting claimed health benefits, recommended dosages and safety. Most important, this evidence must be in the target species, and it is therefore essential that the regulatory environment is adequate to cope with the wealth of new products and hence health claims that are likely to be associated with them.

Nutraceuticals and functional foods

As defined by the American Dietetic Association, a Nutraceutical is “any substance that may be considered a food or part of a food and provides medical or health benefits, including the prevention and treatment of disease”. A functional food is defined as “any modified food or food ingredient that may provide a health benefit beyond the traditional nutrients it contains”. A Nutraceutical therefore is not a functional food. It is a dietary supplement that encompasses non-nutritive food components such as phytochemicals, vitamins and minerals, amino acids or botanical compounds such as bioflavonoids or phytochemicals. It is consumed simply for its health promotional or nutritional benefits rather than for its taste, flavor or aromatic attributes. One class of such substances are phytochemicals, which are physiologically active, naturally occurring compounds synthesized by plants that are not classified as nutrients but nonetheless impart a health benefit when consumed. Medicinal herbs, too, have long been valued for their health protecting compounds. Scientists are now working to create nutraceuticals that have higher and more consistent levels of bioactive compounds.

As scientific research identifies more substances with medical or health benefits, further nutraceuticals will be identified. A functional food is one derived from naturally occurring ingredients that is consumed as part of the normal diet and is beneficial to health. It may reduce the risk of acquiring a disease (but generally not prevent it), reduce the severity of symptoms of a disease, and/or enhance physical performance or mental dexterity. If the diet is sufficient already, no effect at all may be seen. A functional food must remain a food, it is not a pill or a capsule, and its benefits must be demonstrable at a normal level of consumption.

Probiotics

Probiotics are defined as live microbial food supplements that beneficially influence the health of the host. Generally this was considered to occur by improving the microbial balance; however it is becoming increasingly clear that probiotics elicit at least some of their health benefits via immunomodulation. The gastrointestinal tract fulfills many functions aside from digesting and absorbing nutrients. One of these is that the gut is host to a complex mixture of microbes that make up our resident gut micro flora, some of which may play a key role in maintaining human health. Bifid bacterium and Lactobacillus are strongly associated with optimum microbial balance in the gut, and it is for these two genera that the greatest body of evidence for health promoting properties of probiotics exists.

Requirements of Probiotics

For a microbe to act as a probiotic it must satisfy a number of important criteria. It must not be toxic or cause disease; it must be capable of resisting the acids and bile involved in the digestive processes of the animal's stomach (microencapsulation); the microbe must be able to establish itself and 'colonize' the gut of the target animal; it should be able to show an ability to inhibit the growth of pathogens or to have some other benefit in laboratory conditions; and it must be capable of surviving manufacturing process and have a reasonable shelf life.

Probiotic use in Animals

Probiotics effectively flood the gut with billions of live, beneficial bacteria to help boost the gut's normal micro flora. In this way they are able to improve various aspects of growth and performance of animals by aiding digestion, by breaking down cellulose and other indigestible substances, promoting the synthesis and absorption of vitamins and minerals, which can in turn stimulate both nonspecific and certain specific host defense mechanisms of the immune system. Probiotics are also able to prevent the proliferation of potential disease causing pathogens such as *E. coli* and *Salmonella*. This can occur in two ways. Firstly, by generating increased resistance to infectious diseases either by direct antagonism or by stimulating immunity (e.g., increased phagocytic activity and elevation of secretory IgA levels). Probiotics have therefore been proposed for use in animals to establish a healthy gut micro flora and prevent establishment of pathogenic bacteria immediately following birth; to re-establish beneficial micro flora depleted by antibiotics and prevent re-infection by pathogens; to treat or prevent scouring by suppression and exclusion of pathogenic bacteria; and to reduce the effects of stress such as fear, transportation, change of environment, diet changes, training, competition, temperature extremes, injury, surgery or vaccination.

A number of probiotic-containing products are currently being sold specifically for use in companion animal diets. Despite this fact, there appears to be a scarcity of relevant literature to support their current usage. Probiotic products are often sold with unsubstantiated or very general health claims, and it is becoming increasingly clear that all probiotic strains are not created equal. In addition, there appears to be some controversy as to the quantity of viable probiotic organisms required to confer health benefits in both man and animals. Levels ranging from 10^6 to 10^9 CFU at the time of consumption have been suggested, and various minimum standards have been set around the world.

Further controversy has arisen following reports that a number of probiotic products either did not contain the listed species, contained extra species, or the levels of viable probiotics were less than one tenth of that stated on the package. Since daily consumption of probiotics is recommended, it is of vital importance that information detailing the probiotic strains (including accurate viability counts, dose, delivery medium and safety), for which specific health benefits have been conclusively demonstrated, and information on the species tested, be made available to the pet owner.

Of the limited studies carried out in companion animals, one aimed to investigate a number of the factors critical for demonstrating that a particular microorganism can act as a probiotic. The authors investigated the effects of the expansion-extrusion process required for pet food manufacture on spore survival of *Bacillus* CIP 5832 in the production of a dry dog food. Not surprisingly, this process resulted in over 99% losses of spores.

More success was achieved by spray-drying the potential probiotic strain onto a previously extruded product. The stability of the product was then studied over a 12 month period. As has been found for a number of probiotic strains, the initial preparation of the product resulted in an immediate drop in the expected level of spores; in this case only 60% of the expected levels were detected, with further losses of greater than 25% occurring over the following 12 months. Such a study highlights the potential problems inherent with the production of probiotic products. A trial aimed at evaluating the ability of *Lactobacillus rhamnosus* strain GG (a strain for which there is considerable evidence supporting its use as a probiotic in humans), to survive passage through the intestinal tract of dogs concluded that faecal colonization in dogs is variable. This serves to further emphasize that the ability of a potential probiotic strain to survive passage through the gastrointestinal tract and beneficial health effects cannot be extrapolated from one species to another.

Future Developments in Probiotics

Using biotechnology, genetically modified microbes can be made that are more effective in improving health or nutrition than the organisms that occur naturally in the digestive system. The first successful genetic modifications of this type of organism have already been reported. Therefore in the future it is likely that custom-designed probiotics will be created to either directly improve digestive function or improve health. However, before such technological advancements are continued, it is essential that information detailing the effective dose, viability counts, safety, delivery medium, along with properly controlled trials carried out in target populations for probiotic strains for which specific health claims are made, should be provided. Further studies are also needed to increase our understanding of the mechanisms of action of probiotics on the gastrointestinal tract and the immune system.

Prebiotics

Prebiotics are “non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon that can improve host health”. The most commonly known prebiotics include inulin, fructooligosaccharides and manna oligosaccharides. The latter is considered more extensively elsewhere in this volume.

Inulin and Fructooligosaccharides

Inulin and fructooligosaccharides (FOS) are natural components of many edible plant materials. They are non-digestible oligosaccharides and therefore classified as dietary fiber. There is a large body of evidence supporting the role of inulin and oligofructose as prebiotics in humans. The data from well-designed human trials has shown significant changes in the composition of faecal

micro flora with FOS promoting beneficial bacteria such as bifid bacteria, which aid in the suppression of potentially pathogenic bacteria. Other reported benefits resulting from the ingestion of inulin and FOS include a bulking effect, increase in stool frequency due to an increase in the microbial biomass resulting from increased fermentation, increased calcium bioavailability and possibly a role in the reduction in the risk of colon cancer. This is reportedly due to supplementation with FOS causing a reduction in the level of toxic metabolites and detrimental enzymes that result from colonic fermentation.

However, data supporting the use of inulin and FOS in companion animals is somewhat limited and also contradictory in nature. One trial in dogs failed to demonstrate any difference in the levels of total anaerobic bacteria, Bifid bacteria or Lactobacilli between animals fed 1-3 g of oligofructose per day; however in a second trial by the same group animals fed oligofructose at the highest concentration of 9 g/kg had higher levels of Bifid bacteria in faeces compared to the control group. Faecal Bifid bacteria levels have been reported to significantly increase following lacto sucrose supplementation along with a decrease in levels of *Clostridium perfringens*. In a different study lactobacilli numbers were shown to significantly increase following supplemental feeding of healthy dogs with FOS. A number of groups have demonstrated in dogs that faecal *E. coli* concentrations do not change significantly following ingestion of a FOS-supplemented diet or lacto sugar. There are several studies investigating the effects of prebiotic supplementation on faecal characteristics and digestibility parameters or in vitro fermentation characteristics.

Issues

As with probiotics, there is currently limited conclusive published evidence detailing the benefits of prebiotic use in cats and dogs. Studies demonstrating health benefits in the target species are required along with information on optimum inulin and/or oligofructose inclusion levels, whether the fructans can be used interchangeably, and whether combinations of inulin and FOS would have any synergistic benefit. Further knowledge of how prebiotics elicit their action is also needed, although there is strong evidence to suggest that inulin and oligofructose fermentation lead to an increase in short chain fatty acids (SCFA) in the gut, primarily acetate, butyrate and propionate, and there is evidence that SCFA have immune-modulatory and anti-inflammatory properties. SCFA also lower the gut pH to levels below which some pathogens such as *E. coli* cannot survive.

Chondroitin Sulphate and glucosamine in the treatment of degenerative joint disease

Chondroitin sulphate consists of repeating chains of mucopolysaccharides. These biological polymers act as the flexible connecting matrix between the tough protein filaments in cartilage to form a polymeric system similar to reinforced rubber. Chondroitin sulphate plays a major role in the growth and repair of cartilage and animal cartilage is the only significant food source of chondroitin sulphate.

Chondroitin sulphate is able to protect existing cartilage from premature breakdown and promote the healing of bone. It does this by inhibiting certain enzymes that destroy cartilage and enzymes that prevent the transport of nutrients.

Glucosamine is an amino sugar, which is synthesized within the body from glucose and amino acids. Once synthesized it is used directly for the synthesis of glycosaminoglycan's and hence cartilage matrix synthesis. It stimulates the manufacture of collagen, which is the protein portion of a fibrous substance that holds joints together. It helps to produce more collagen and also normalizes cartilage metabolism, which helps to keep the cartilage from breaking down, and therefore can help the body repair eroded and damaged cartilage.

There is considerable evidence on the use of glucosamine and/or chondroitin sulphate as chondroprotective agents in experimentally-induced degenerative joint diseases in dogs. A number of uncontrolled testimonial surveys investigating the use of these agents in the treatment of degenerative joint diseases such as osteoarthritis in dogs have also been carried out. The reported benefits include a reduction in symptoms such as joint tenderness, pain on standing, pain on walking, joint swelling and spontaneous pain. Such veterinary surveys are generally performed due to the inherent difficulty in carrying out animal trials assessing the effects on naturally occurring osteoarthritis. However because these surveys are not randomized, controlled trials, definitive conclusions about the efficacy of the nutraceuticals cannot be made.

Chondroitin sulphate and glucosamine, either individually or together are the most commonly used chondroprotective agents in dogs and cats. A combination of the two has a synergistic effect since the low molecular weight glucosamine, and the high molecular weight chondroitin sulphate have unique and overlapping functions, which prevent damage to the connective tissue.

Principal of action

Increased repair processes in degenerating cartilage may require a larger demand for raw materials than that available. The mechanism of action of glucosamine is therefore simple; providing the building blocks and regulatory stimulus, which are necessary for the synthesis of cartilage. Chondroitin sulphate works together with glucosamine to block the action of cartilage-damaging enzymes and to promote the healthy flow of water and nutrients into cartilage-producing cells.

Issues

Osteoarthritis and joint injury are common in animals, particularly in dogs, where osteoarthritis is reported as being one of the most frequently encountered joint diseases. Sources of chondroitin sulphate in pet foods are generally from animal-derived ingredients such as meat and bone meal, and offal's, which however, comprise only a small fraction of a dry diet. Cats, which generally have a lower incidence of osteoarthritis, tend to have a less refined diet containing offal products, which are more likely to contain cartilage and hence chondroitin sulphate.

In addition, cats often supplement their own diet by catching and eating small animals such as birds and rodents. It is interesting to speculate that a dog 50 years ago would have obtained ample chondroitin sulphate from its diet, whereas nowadays intake may be marginal to deficient for optimal joint health, therefore inadvertently increasing the propensity of dogs to develop osteoarthritis.

Omega-3 and omega-6 fatty acids

The potential therapeutic benefits of dietary supplementation with ω -3 eicosapentaenoic acid and the ratio of ω -3 to ω -6 fatty acids (arachidonic acid), which are found primarily in fish oils, has raised great interest in the functional foods arena. Interest in these fatty acids was first raised following the observation that Inuit people, who normally have a diet high in fish, also have a low incidence of heart disease. Since then, investigations into the effects of ω -3 and ω -6 fatty acids on immune function, eicosanoid production, inflammatory responses, and lipid peroxidation amongst others have been carried out in a number of species, including dogs.

The ability of ω -3 fatty acids to prevent or reduce the severity of arrhythmias has been demonstrated in a number of species including the rat and marmoset monkeys. Using an experimentally-induced model of myocardial infarction in dogs, were able to show that an intravenous infusion of ω -3 fatty acids was able to prevent the occurrence of ventricular fibrillation, whereas a similar infusion of soya bean oil was not.

Omega-3 fatty acids have also been shown to reduce wound inflammation in dogs. Omega-3 fatty acids reportedly act as substrates for eicosanoid metabolism, resulting in the production of eicosanoids with lower inflammatory potential than those produced from ω -6 fatty acids. Studies in dogs have also shown that dietary adjustments of ω -3 to ω -6 fatty acids result in altered eicosanoid metabolism.

In some studies in dogs specific ratios of ω -3: ω -6 fatty acids have also been shown to enhance immune responses such as T- and B-cell mitogenic responses, whereas in others suppression of cell-mediated immune responses were reported. The reasons for such differences are unclear, although the age and breed of the subject animals used may have had an effect.

Issues

The apparent broad spectrum of effects that ω -3 fatty acids seem able to elicit, along with unclear effects on immune responses suggests that caution is needed when supplementing diets with ω -3 fatty acids. In stimulating one function, such as controlling inflammatory responses, other deleterious effects may result.

Ex- An increased tendency to bleed, or suppression of immune responses

Antioxidants

Antioxidants have been included in animal feeds in order to protect the nutritional value and improve palatability and the quality of the diets for over 30 years. Nowadays however, it is recognized that antioxidants may play a key role in slowing the aging process, in reducing the risk of cancer and heart disease, and generally improving health and well-being. This explains the interest in the isolation of natural antioxidants, which can be utilized for improving health status by stimulation of the immune system.

There are many nutrients with antioxidant properties. Some of the major dietary antioxidants include vitamin E, carotenoids, vitamin C and flavonoids. Several nutrients, which are important for the endogenous synthesis of other compounds with antioxidant capacity, include sulphur amino acids, selenium and zinc. These nutrients are required for the synthesis of glutathione (GSH), glutathione peroxidase, superoxide dismutase and many other enzyme systems.

Evidence detailing the efficacy of antioxidants or nutrients in stimulating antioxidant defense in companion animal diets is growing. The effects of individual antioxidants in canine and feline diets tend to be similar to the effects described in other animals.

The antioxidants most studied in cats and dogs include vitamin E, ascorbic acid, β -carotene, lutein and isoflavonoids. Antioxidants (vitamin E and ascorbate) have a minimal effect on Heinz body anemia induced by dietary onion powder or propylene glycol. However, they concluded that antioxidants may have subclinical biochemical effects, e.g. GSH-sparing may be important against milder forms of oxidative stress. Oral administration of bioflavonoid antioxidants may assist cat erythrocytes in resisting oxidative injury. The latter two studies showed a limited effect of antioxidant addition to an oxidative challenge.

A greater benefit of antioxidants in companion animal diets can be expected during conditions of increase oxidative stress such as exercise. Sled dogs with a higher plasma vitamin E concentration have enhanced endurance, compared to dogs having lower plasma vitamin E levels. Dogs with higher plasma vitamin E concentrations were less likely to be withdrawn from a race, although teams with higher plasma vitamin E concentrations did not travel faster than other teams. Others have shown that dietary antioxidant (α -Tocopherol, β -carotene and lutein) supplementation of sled dogs can reduce exercise-induced oxidative damage. There is good evidence that a 'cocktail' of antioxidants may be more beneficial than individual antioxidants when included in companion animal diets. Oxidative damage impairs cognitive function in dogs and that antioxidant addition to diets can improve cognitive function. Two studies by the same group showed that inclusion of a broad-based antioxidant and mitochondrial cofactor supplement can partially counteract/reverse the deleterious effect of aging on cognitive function in canines.

Interest in the potential use of vitamin E as a Nutraceutical for companion animals, aside from its antioxidant properties, has been increased by observations in other animals that lymphocyte proliferation to B-cell and T-cell mitogens is affected by the dietary level of vitamin E. The dietary vitamin E requirement to obtain optimal immunological health of animals has been found to be approximately 4- 10 times higher than the dietary vitamin E level to prevent vitamin E deficiency. In a study in young (2.65 years) and older (9.92 years) cats, the effect of vitamin E supplementation on the immune response was measured.

Serum vitamin E levels increased in a dose dependent manner. Lymphocyte proliferation in response to concanavalin A and phytohemagglutinin (both T-cell mitogens) were significantly lower in older cats compared to younger cats, regardless of treatment. There was no significant difference in lymphocyte proliferative responses to pokeweed mitogen (B-cell mitogen) between cats of different ages regardless of dietary treatment. However, vitamin E treatment did enhance proliferation in response to the T-cell mitogens in older cats when compared to old cats fed the control diet. The latter study indicates that vitamin E supplementation may enhance T-cell function in old cats, although the enhancement is not sufficient to elevate the levels to that

exhibited by young cats. Furthermore this study showed that vitamin E supplementation of diets to supraphysiological levels (500 IU/kg diet) does not provide the added benefit that is generally found in other species.

In dogs, vitamin E has been shown to increase a number of immune parameters when included at supraphysiological levels, although the control diet in this study was below AAFCO requirements. Other dietary antioxidants shown to have immune-modulating effects in cats and dogs include lutein and β -carotene.

Requirements for marketing a functional food

If a functional food or Nutraceutical is to bear a claim, then that claim should be scientifically substantiated, even in the absence of regulatory requirements. This means that randomized, double-blind trials in the specified test group need to be conducted. The results cannot be extrapolated to other age groups or other species. A recommended dose based on experimental evidence should also be stated, and naturally the product must have been proven safe for consumption. Safety testing involves a large array of testing including feeding high doses, and feeding the normal dose for long periods of time.

When a functional food contains novel ingredients or is produced by a novel process, it becomes particularly important that safety as well as acceptability be considered. With traditional foods, safety assurance comes from a long history of safe use by large populations over a number of generations. Such history is lacking for novel ingredients and novel processes, and a safety assessment is required.

Issues on functional foods and nutraceuticals in animals

Different species often have different metabolic pathways, and different levels of certain enzymes etc., which can therefore affect the potential function of a putative functional food or Nutraceutical. In certain circumstances, a compound deemed to be a Nutraceutical in one species or age group may be considered as a toxin in others. Therefore it is very important that data not be extrapolated from one species or age group to another.

Particularly for immune claims, the parameters measured are not directly translatable into a health outcome. Enhancement of, for example, lymphocyte proliferative responses or phagocytic activity may not necessarily translate into increased resistance to disease. Trials to determine such effects are very difficult to run, requiring large numbers of test subjects, considerable time and hence money.

The primary aim of dietary guidelines and food guides is to make recommendations on the requirements of essential nutrients in order to prevent deficiencies and support body growth, maintenance and development.

Recently though, recommendations have also been made to avoid excessive consumption of certain nutrients, due to their adverse effects on some diseases. A number of essential nutrients are likely to result in improved health when consumed at higher levels and therefore in the current climate can be considered as functional foods, e.g., vitamin E where consumption at supraphysiological levels enhances immune function. As new evidence on the roles of vitamins

and minerals comes to light, nutrient requirement recommendations are likely to be revised to take into account effects on factors such as immune function.

It is also important to realize that including several nutraceuticals in a diet in an effort to achieve combined benefits may not necessarily be successful. Combinations of nutraceuticals cannot be assumed to have synergistic effects, and in fact, when used in combination could interact with each other so as to negate any potential benefit. Any diets containing 'cocktails' of nutraceuticals therefore must also go through thorough testing to substantiate any claimed health benefits.

Expectation

as pet owners worldwide become more health conscious, not only for themselves but also for their pets, the demand for health-promoting foods and food components for use in companion animals is expected to grow. The market for such foods is predicted to expand significantly, with the range of products being offered likely to increase dramatically in the future as manufacturers can be expected to seek the extra profit arising from sales of these high-value products. However, before the full market potential can be realized, consumers will need to be assured of the safety and efficacy of functional foods. Future scientific studies are therefore essential to provide this assurance and to inspire confidence in the functional foods in the minds of pet owners worldwide.

Summary

Functional foods and nutraceuticals are purported to be efficacious in the prevention and/or treatment of disease and the promotion of health due to the presence of specific concentrations of physiologically active components. The number of functional foods is potentially very large and encompasses natural foods, isolated components from these foods that are added to other foods or packaged as dietary supplements, and food components synthesized in the laboratory.

Although there is evidence to support the use of certain functional foods and nutraceuticals in companion animals, for a number of products beneficial effects are yet to be conclusively proven. Furthermore, it is important for the pet owner to realize that in the context of a balanced diet, no benefit may be gained from consumption of functional foods/nutraceuticals.

4.2 Market, growth

In India, functional foods are expected to see increased consumption over the next five years resulting in functional foods and beverages garnering greater product share in the market as opposed to dietary supplements. The total Indian Nutraceuticals market in 2015 is expected to be roughly US \$ 5 billion .In each product segment, manufacturers can expect a minor shift in consumption, driven by the demand for new and improved product as well their health claims. Interestingly, in the Indian market, the consumption of alternative herbal medicines and supplements (usually Ayurvedic and Homeopathic) is expected to have a detrimental effect on the Nutraceutical market and is considered as a loss to the unorganized market by manufacturers. This segment promises huge potential to Nutraceutical product manufacturers, through customization of their products to include natural and herbal ingredients. The success of the chyawanprash supplements market being case in point.

Increased life expectancy, globally, has led to an increase in the incidence of lifestyle (age related) diseases such as diabetes, high blood pressure and cholesterol, obesity etc. As a result, there has been a significant increase in the deaths due to lifestyle diseases worldwide. Consumers worldwide are looking to follow healthy lifestyles to obtain optimum nutrition to keep these diseases at bay, leading to an increase in Nutraceutical consumption by health conscious consumers.

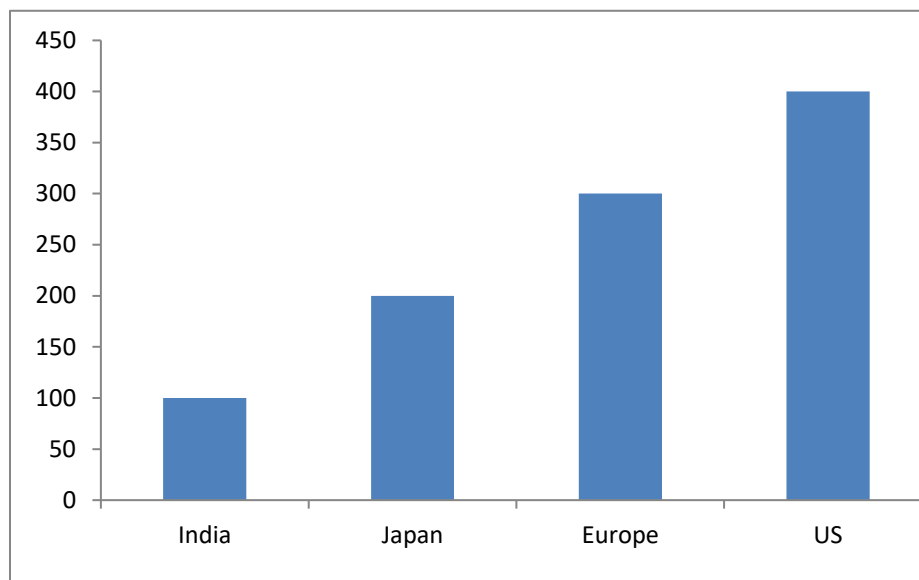


Fig- Nutraceutical Market in different countries

4.3 Scope and types of products available in the market

Nutraceutical from Nutrition and Pharmaceutical, in 1989 refers to foods having a medicinal effect on health of human beings. It consists of food supplements, herbal products, probiotics and prebiotics, medical foods meant for prevention and treatment of diseases. Major Nutraceuticals possess multiple therapeutic effects with lacking of unwanted effects. A Nutraceutical is demonstrated to have a physiological benefit or provide protection against chronic disease. I try to redefine functional foods and Nutraceuticals. When food is being cooked or prepared using scientific intelligence with or without knowledge is called functional food. Thus, functional food provides the body with the required amount of vitamins, fats, proteins, carbohydrates, etc., needed for its healthy survival when functional food aids in the prevention, treatment of disease and disorder other than anemia, it is called a Nutraceutical.

Nutraceuticals are non-toxic food components which claimed to possess multiple therapeutic benefits. Some popular Nutraceuticals include glucosamine, ginseng, Echinacea, folic acid, cod liver oil, omega-3 fatty acid (MUFA, PUFA), calcium-enriched orange juice, green tea, plant phenols etc. Nutraceuticals can be organized in several ways depending upon its easier understanding and application, i.e. for academic instruction, clinical trial design, functional food

development or dietary recommendations. Some of the most common ways of classifying Nutraceuticals can be based on food sources, mechanism of action, chemical nature etc.

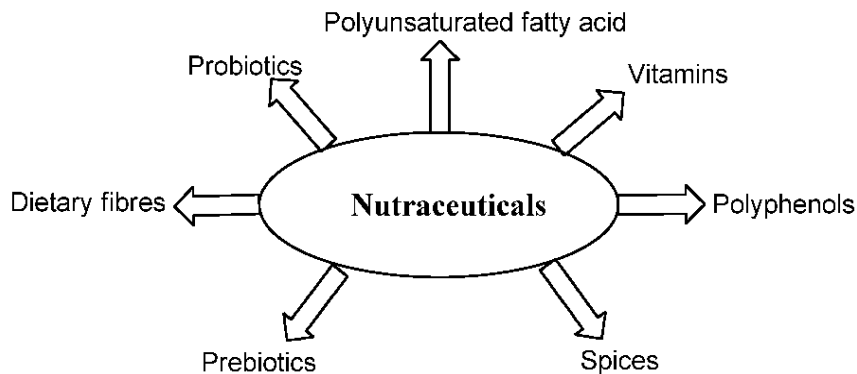


Fig- Types of Nutraceuticals available in market

4.4 Health benefits and role of Nutraceuticals in different ailments

Today the exploration and exploitation of the disease fighting properties of a multitude of photochemical found in both food and nonfood plants have created a renaissance in human health and nutrition research. At the same time, many opportunities for the development of novel dietary products have been created. With all new fields of study come new term knew as "Nutraceuticals". A term combining the words "nutrition" (a nourishing food or food component) and "pharmaceutical" (a medical drug), is a food or food product that provides health and medical benefits, including the prevention and treatment of disease. Such products may range from isolated nutrients, dietary supplements and specific diets to genetically engineered foods, herbal products and processed foods such as cereals, soups and beverages. Hippocrates, the father of Western medicine, said that people should "Let food be thy medicine." The Indians, Egyptians, Chinese, and Sumerians are just a few civilizations that have provided evidence suggesting that food can be effectively used as medicine to treat and prevent disease this fact was supported by Ayurveda, the five thousand year old ancient Indian health science. In Japan during the 1980s the modern Nutraceutical market began to develop and now days the Nutraceutical industry has grown alongside the expansion and exploration of modern Technologies Foods and nutrients play a vital role in normal functioning of the body. They are helpful in maintaining the health of the individual and in reducing the risk of various diseases. Nutraceuticals are medicinal foods that play a role in maintaining well-being, enhancing health, modulating immunity and thereby preventing as well as treating specific diseases. Thus the field

of Nutraceutical can be envisioned as one of the missing blocks in the health benefit of an individual.

It has been scientifically proved and supported that Nutraceutical are efficacious to treat and prevent various disease conditions. About 2000 years ago, Hippocrates correctly emphasized "Let food be your medicine and medicine be your food". In the past five years, the world has witnessed the explosive growth of a multibillion dollar industry known as Nutraceutical. The term "Nutraceutical" combines the word "nutrient" (a nourishing food or food component) with "pharmaceutical" (a medical drug). "Nutraceutical" is a term coined in 1979 by Stephen De Felice. It is defined "as a food or parts of food that provide medical or health benefits, including the prevention and treatment of disease." Nutraceuticals may range from isolated nutrients, dietary supplements, and diets to genetically engineered "designer" food, herbal products, and processed products such as cereals, soups, and beverages. A Nutraceutical is any nontoxic food extract supplement that has scientifically proven health benefits for both the treatment and prevention of disease.

