Review article

Nutrition in Oral Health and Disease

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Abstract

Diet and nutrition are important factors in the promotion and maintenance of good health for the entire life. Nutrition plays an important role to establish and sustain the structure and function of the body to keep it running in a perfect order. Oral health and nutrition have a synergistic relationship. Oral infectious diseases, as well as systemic diseases with oral manifestations, impact functional ability to eat as well as diet and nutrition status. Likewise, nutrition and diet may affect the development and integrity of the oral cavity as well as the progression of diseases of the oral cavity. This article reviews the effects of nutritional elements on the oral cavity.

Keywords: diet; health; minerals; nutrition; vitamins

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Introduction

Nutrition is the act of using food by series of co-ordinated processes thus affecting the nourishment of the body. The primary purpose of nutrition is to establish and sustain the structure and function of the body maintaining the state of health.[1] American Dietetic Association states that "nutrition is an integral component of oral health. Oral infectious diseases, as well as acute, chronic and terminal systemic diseases with oral manifestations, impact functional ability to eat as well as diet and nutrition status." [2] Nutrition and diet affect the development and integrity of the oral cavity along with the progression of diseases for example, nutritional influences on craniofacial development, oral cancer, oral infectious diseases and exacerbation of periodontal diseases.[3] Nutritional intake can largely be divided into two main groups of nutrients, the macronutrients (carbohydrates, protein and fats) and the micronutrients (vitamins and minerals).[4]

Role of nutrition in health

a) Carbohydrates: They are the most abundant organic molecules in nature primarily comprising of elements carbon, hydrogen and oxygen being classified into monosaccharides, oligosaccharides and polysaccharides.[5] Carbohydrates are also known as protein sparing in that if inadequate amounts of dietary carbohydrate are ingested, the body will breakdown protein to provide glucose for essential functions.[6]

b) Proteins: Protein is the most common substance in the body after water, making up about 50% of body's dry weight.[7] Proteins are polymers of amino acids which form the fundamental basis of structure and function of life and are components of defensive molecules that help to control the disease process.[6] From the nutritional point of view, proteins are classified into complete proteins (consisting of all essential amino acids), partially incomplete proteins (partially lack one or more essential amino acids) and incomplete proteins (completely lack one or more essential amino acids).[8]

c) Lipids: Lipids are a heterogeneous group of organic compounds relatively insoluble in water and soluble in organic solvents. They are the concentrated fuel reserves of the body and are important as cellular metabolic regulators. They constitute the cell membrane, give shape and smooth appearance to the body, protect the internal organs and act as an insulating material.[9]

d) Vitamins: In 1912, Casimir Funk originally coined the term "vitamine".[10] Vitamins are organic substances that are required in the diet in small quantities to perform specific biological functions for normal maintenance of optimum growth and health of an individual. Vitamins are not made by the body hence must be supplied by food or made from a provitamin. Vitamins are classified as fat soluble and water soluble.[6] (Table 1)

e) Minerals: Minerals are inorganic elements that constitute only a small proportion of the body weight but are essential for life and are required for normal growth and maintenance of the body. Minerals are considered as macrominerals (principal elements) if present in relatively high amounts in the body and microminerals (trace elements) if requirement is less than 100mg/day.[11] A delicately balanced homeostasis of metals is achieved by coordinated interaction among highly evolved and regulated uptake, storage and secretion processes. Shortage or excess of metal ion availability due to nutritional imbalance can tilt this balance with deleterious effects including the very survival of the cell.[12] (Table2)

Role of nutrition in disease

a) **Carbohydrates:** Displacement of foods containing complex carbohydrates and naturally occurring sugars is involved in the causation of specific diseases viz. coronary heart disease, diabetes mellitus, obesity and dental disorders. The number of diseases, severity and time to develop is directly related to the percentage of carbohydrates in the diet. Carbohydrates drive insulin production that cause cardiovascular disease which along with high-cortisol levels resulting in demineralization of bones with reduction in their tensile strength by weakened connective tissue at the joints. Dietary carbohydrates lead to the colonization of microorganisms on the tooth surface which coupled with their continuous metabolic activities permit plaque formation resulting in dental caries and periodontal diseases.[13, 14]

b) Proteins: One of the principal consequences of protein deficiency is depressed phagocytic function and T-cell mediated responses resulting in increased susceptibility to infection, periodontitis and alveolar bone loss.[4] Protein depletion results in pathologic changes, including muscular atrophy, weakness, weight loss, anemia, leucopenia, edema, impaired lactation, slow wound healing, reduced ability to form certain hormones and enzymes.[15] Degeneration of the connective tissue of the gingiva and periodontal ligament, osteoporosis of alveolar bone, retardation in the deposition of cementum and atrophy of the tongue epithelium, accentuation of the destructive effects of local factors and occlusal trauma on the periodontal tissues is also noticed. Conversely, excess protein can have a deleterious effect on calcium homeostasis in bone.[16,17]

c) Lipids: Growing animals who are totally deprived of essential fatty acids show a range of symptoms, including poor wound healing due to failure of connective tissue, loss of membrane integrity, in particular the skin and impaired immune function and increased host susceptibility.[6]

d) Vitamins:

Vitamin A: Deficiency of vitamin A results in ocular, dermatologic and mucosal manifestations. Ocular manifestations include nocturnal blindness (nyctalopia), xeropthalmia, keratomalacia and total blindness. Dry and rough skin with degeneration of mucosa leading to infections constitutes dermatological effects. Epithelial cells of gastrointestinal tract, urinary tract and respiratory tract can undergo keratinizing metaplasia.[8,18] In experimental animals, hyperkeratosis and hyperplasia of the gingiva with a tendency for increased periodontal pocket formation has been noticed.[19] Deficiency has been associated with enamel hypoplasia and salivary gland atrophy.[19] Retinoids prevent tumoral promotion and progression by sequestration of free radicals, activation of cellular differentiation processes and stimulation of immune system.[1]

Hypervitaminosis A leads to gradual loss of hair, dryness of skin, lips and oral mucosa, hepatomegaly, skeletal decalcification, pigmentation, follicular keratosis and purpura.[8]

Vitamin D: Vitamin D is not a vitamin in a strict sense as its main source does not come from diet hence is considered as a prohormone.[20] Vitamin D has been traditionally considered important for skeletal health.[21] Deficiency causes rickets in children and osteomalacia in adults, conditions where the ratio of mineral to osteoid in bone is reduced.[22] Clinical manifestations include irritability, growth retardation, prominence of costochondral junctions (rachitic rosary), bowing of long bones, developmental anomalies of dentin and enamel, delayed eruption, high caries rate, abnormally wide predentin zone, interglobular dentin. Osteomalacia frequently results in diffuse skeletal pain and fracture with relatively mild injury.[8,15]

Hypercalcemia is responsible for producing most of the symptoms of vitamin D toxicity. Symptoms include gastrointestinal disorders, demineralization of bone, bone pain, drowsiness, continuous headaches, irregular heartbeat, loss of appetite, muscle and joint pain, frequent urination, excessive thirst, weakness, nervousness, itching and kidney stones.[23] Primary hyperparathyroidism, granulomatous diseases and some cancers also cause vitamin D hypersensitivity.[24]

Table 1: Role of Vitamins in Health[8,15,18]

Nutrient	Major Function	Major sources
Fat Soluble vitamins		
Vitamin A - Retinol, beta-carotene and various other carotenoids	Helps maintain good vision (necessary for night vision), resistance to infections, and supports growth and repair of body tissues. Also maintains integrity of white and red blood cells, assists in immune reactions, helps maintain the stability of cell membranes, regulation of epithelial differentiation	Milk, eggs, meat, fish liver oils. Beta-carotene and other carotenoids are found in: Green leafy vegetables, Yellow vegetables - carrots, sweet potatoes, pumpkin. Yellow and orange fruits - mango, papaya and apricots.
Vitamin D Cholecalciferol, ergocalciferol	Regulates absorption of calcium and phosphorus for bone health, has a role in the immune system- Antigen-presenting cells, macrophages and lymphocytes express a nuclear receptor for vitamin D.	Formed in skin when exposed to sunlight. Also found in dairy products, egg yolk, fish liver oils, Yeast
Vitamin E Tocopherol, Tocotrienols	Fat-soluble antioxidant. Helps maintain cell membranes, red blood cell integrity, prevents peroxidation of polyunsaturated fatty acids	Found primarily in plant oils, green leafy vegetables, wheat germ, whole grains, egg yolk, nuts, seeds and liver
Vitamin K	Helps make factors that promote blood clotting, necessary for postransitional carboxylation of glutamic acid	Bacterial synthesis in the digestive tract. Green, leafy vegetables, cabbage-type vegetables and milk
Water Soluble Vitamins		
Vitamin B1 Thiamine	Helps metabolize carbohydrates, maintain appetite and normal digestion. Part of a coenzyme used in energy metabolism, have a role in peripheral nerve conduction	Whole grain cereals, legumes, beans, nuts, brewer's yeast, wheat germ and liver.
Vitamin B2 Riboflavin	Part of coenzymes used in energy metabolism, supports normal vision and skin health	Milk, yogurt, meat, leafy greens, whole grains.
Vitamin B3 Niacin, nicotinic acid, niacinamide	Part of coenzyme used in metabolism, supports skin, nervous and digestive system, important in pentose, steroid, fatty acid biosynthesis, glycolysis, protein metabolism and oxidation of lactate and pyruvate	Meat, whole grains, cereals, pulses nuts
Vitamin B5 Pantothenic Acid	Part of Coenzyme A, which is used in energy metabolism	Widespread in foods.
Vitamin B6 Pyridoxine, pyridoxal,	Part of a coenzyme that helps the body to synthesize nonessential amino acids. role in protein metabolism especially tryptophan	Green leafy vegetables, meats, fish, poultry, shellfish, wheat, corn, cabbage, legumes, whole grains
Vitamin B12 Cobalamin	Part of coenzymes used in new cell synthesis; helps to maintain nerve cells.	Animal products (meat, fish, poultry, shellfish, eggs, cheese, milk, curd).
Biotin	Part of a coenzyme used in energy metabolism, fat synthesis, amino acid metabolism and glycogen synthesis.	Widespread in foods, rich sources are liver, kidney, egg yolk, milk, tomatoes, grains
Folic acid Folate, folacin	Part of coenzymes used in new cell synthesis. blood cell formation, protein metabolism and prevention of neural tube defects, synthesis of DNA is impossible in the absence of folic acid	Green leafy vegetables, liver, fortified grain products, legumes, milk
Vitamin C (ascorbic acid)	Essential element in collagen formation (strengthens blood vessels, forms scar tissue, is a matrix for bone growth); an antioxidant; strengthens resistance to infections and improves absorption of iron, involved in formation of folinic acid	Abundant in most fresh fruits (esp. citrus) and vegetables

Vitamin E: α-tocopherol was discovered nearly 100 years ago because it was required to prevent fetal resorption in pregnant rats.[25] Role of vitamin E in cancer prevention is accredited to its action as an antioxidant, by protecting the cell membrane from oxidative damage, by blocking nitrosamine formation, by influencing humoral and cell-mediated immunity and increasing cell-repair capacity.[1] Severe symptoms of deficiency are not seen in humans except increased fragility of erythrocytes and minor neurological symptoms. Deficiency in experimental animals, attributes to decreased male fertility, nutritional muscular dystrophy, increased vascular disruption, loss of pigment and atrophic and degenerative changes in enamel organ.[26]

Vitamin E is the least toxic amongst all fat soluble vitamins

Vitamin K: Deficiency leads to coagulopathy because of inadequate synthesis of prothrombin and other clotting factors. The most common oral manifestation is gingival bleeding, with chances of spontaneous bleeding at levels below 20%.[6,8]

Vitamin B Complex: Deficiencies of vitamin B-complex can cause disturbances in protein, carbohydrate and fat metabolism. Deficiencies can also decrease resistance to infection secondary to antibody formation. Oral changes common to B-complex deficiencies are gingivitis, glossitis, glossodynia, angular cheilitis and inflammation of the entire oral mucosa.[15]

A) **Vitamin B_1**: Deficiency of Vitamin B_1 results in beri beri disease which is insidious in onset and chronic in course. Alcoholic patients with chronic thiamine deficiency manifest neurologic symptoms known as Wernicke's Encephalopathy.[27] Oral disturbances include hypersensitivity of the oral mucosa, minute vesicles (simulating herpes) on the buccal mucosa, under the tongue or on the palate and erosion of the oral mucosa.[28]

B) **Vitamin B_2**: Riboflavin deficiency results in pallor of lips followed by cheilosis, dermatitis and glossitis characterized by a magenta discoloration and atrophy of the papillae and engorged fungiform papillae, which project as pebble-like elevations. Ocular changes comprising of corneal vascularization, photophobia and interstial keratitis have also been described.[27]

C) **Vitamin B_3:** Niacin deficiency results in a condition called as pellagra characterized by dermatitis, diarrhoea and dementia. Glossitis and stomatitis may be the earliest sign of niacin deficiency.[28] In acute stages, entire oral mucosa becomes fiery red and painful with profuse salivation and desquamation of tongue. Ulceration begins at interdental papillae and spreads rapidly. Epithelial changes particularly in the areas exposed to sunlight (neck region) result in a characteristic skin rash called Castle's necklace.[8,28]

D) **Vitamin B_5:** Pantothenic acid deficiency in experimental animals results in anaemia, fatty liver and decreased steroid synthesis. However, no deficiency manifestations have been reported in humans.[18]

E) Vitamin B_6: Pyridoxine deficiency is associated with neurological symptoms such as depression, irritability, nervousness, mental confusion and convulsions, hypochromic microcytic anemia, albuminuria and leucopenia. Deficiencies of vitamin B_6 are usually related to an overall deficiency of all the B-complex vitamins.[27]

F) Vitamin B_{12}: Cyanocobalamin deficiency is associated with neuropathy, subacute combined degeneration of spinal

cord, paresthesia of fingers and toes, confusion, loss of memory and psychosis. Most commonly deficiency leads to a relatively common chronic hematological disease, pernicious anemia which was first described by Addison in 1855. It is also called as Addisonian anemia, Biermer anemia, Hunter Addison anemia and Lederer anemia.[18] Oral symptoms include glossitis, glossodynia, glossopyrosis, atrophy of papillae of tongue resulting in smooth and bald tongue (Hunters glossitis or Moellers glossitis) and inflamed tongue which is described as beefy red in color. Gatrointestinal manifestations (diarrhea, anorexia, weight loss, dyspepsia), hepatomegaly, spleenomegaly, congestive heart failure and hemorrhagic manifestations may also be noticed.[29,30]

Vitamin C: Vitamin C insufficiency in the food or as a conditioned deficiency affects the immunocompetence and results in scurvy. Clinical manifestations of scurvy include ecchymoses, hemorrhagic lesions into the muscles of the extremities and joints, petechial hemorrhages, often around hair follicles; increased susceptibility to infections and impaired wound healing.[31] Other manifestations are bone pain, osteoporosis, arthralgias, myalgias, joint effusions, hyperkeratosis, edema, ascites, cardiomegaly and electrocardiographic abnormalities suggestive of cardiac disease. Fatigue, lassitude and emotional changes (depression and hypochondriasis) sometime may precede the development of frank scurvy.[32] Cardinal oral signs of scurvy include fetid odor and loosened teeth with bright red, hemorrhagic, swollen, smooth and shiny interdental and marginal gingiva.[33] In a retrospective analysis of 12,419 adults studied in the Third National Health and Nutrition Examination Survey (NHANES III), Nishida et al[34] found that there was a statistically significant dose-response relationship between the levels of dietary vitamin C intake and periodontal disease in current and former smokers as measured by clinical attachment. Ascorbic acid, and some polyphenolic compounds found in green tea, fruit and vegetables, has shown to be effective in inhibiting tumoral promotion.[35]

Minerals

Macrominerals

Calcium: Calcium in crystalline form is the major structural support of the body with its normal serum level being about 9-11mg/dl. Hypocalcemia exists when the serum calcium level falls below 7 mg/dl and results due to renal failure, hypoalbuminemia or surgically induced hypoparathyroidism causing tetany.[8] Osteoporosis, a systemic skeletal disease characterized by low bone mass and microarchitectural deterioration with a consequent increase in bone fragility and susceptibility to fracture occurs due to various extrinsic or intrinsic factors (Estrogen deficiency associated with menopause, decreased secretion of parathyroid hormone, increased secretion of calcitonin and decreased calcium absorption).[36]

Hypercalcemia (serum calcium level > 11mg/dl) occurs as a result of primary hyperparathyroidism, acute adrenal insufficiency or acute renal failure and is characterized by lethargy, loss of appetite, constipation, nausea, increased muscle contractility and susceptibility to fractures.[11]

Phosphorus: Body phosphorous is intimately associated with calcium in the metabolism of bones and teeth. Hypophostasia occurs due to vitamin D deficient rickets, renal rickets, liver disease decreased intake or malabsorption of phosphorous leading to

weakness, malaise, anorexia and bone pain. Usually phosphate depletion in man does not exist under most dietary regimens.[8,11]

Hyperphosphatemia occurs due to factitious hemolysis, increased vitamin D intake or decreased excretion of vitamin D.

Sodium: Sodium deficiency in man probably never occurs in an uncomplicated form but may present as sodium and chloride deficiency. When diets low in salt are used for long period of time, gradual weakness, excessive fatigue, lassitude, apathy, anorexia, sense of exhaustion, nausea, muscle cramps and peripheral vascular collapse may occur.[11]

Sodium is generally reported to be elevated in most cases of heart failure and in ischemia/reperfusion.[37]

Potassium: Primary dietary deficiency of potassium has not been observed but depletion secondary to some pathological condition has been noticed. Signs of this deficiency are decreased muscular irritability, reduced or absent reflexes, mental confusion, paralysis, contractility of heart muscles, alterations in gastrointestinal tract and death.[11]

Hyperkalemia may be associated with mental confusion, numbness, tingling of extremities, pallor, cold skin, weakness, disturbances in cardiac rhythm and peripheral collapse. The effects of potassium deficiency or excess on the oral structures have not been reported.[37]

Chloride: A reduction in serum chloride level may occur due to vomiting, diarrhea, excessive sweating, respiratory alkalosis, Addison's disease. No oral manifestations of this mineral deficiency have been reported. [8]

Magnesium: Low levels of magnesium have been associated with a number of chronic diseases including migraine headaches, Alzheimer's disease, cerebrovascular accident, hypertension, cardiovascular disease, type 2 diabetes mellitus, sickle cell disease, pre-eclampsia, atherosclerosis, postmenopausal osteoporosis and chronic alcoholism.[38,39] Recent research found that increased serum Mg/Ca was significantly associated with reduced probing depth and a higher number of remaining teeth.[41] Researchers theorize that low magnesium content of white blood cells has an important effect on the pathogenesis of asthma.[42]

Microminerals

Flouride: Fluoride is called as a double edged sword as inadequate ingestion is associated with dental caries and excessive intake leads to fluoride toxicity (acute or chronic). Signs and symptoms of acute toxicity include nausea, vomiting, diarrhea, abdominal cramps, paresthesia, central nervous system depression, coma, hypotension, pallor, shock, acidosis, hypocalcemia and hypomagnesemia. The effect of chronic fluoride toxicity is on the enamel (dental fluorosis) and bone fluorosis. Fluorosis is an endemic disease characterized by lusterless, opaque white patches in the enamel leading to pitting and mottling of enamel.[43,44]

Iodine: Inability of the thyroid gland to produce thyroxine hormone during infancy leads to cretinism characterized by mental defects, retarded somatic growth, generalized edema, dentofacial changes like underdevelopment of the mandible and overdevelopment of the maxilla. If this insufficiency occurs in childhood then juvenile myxedema results wherein the tongue is enlarged due to edema leading to continuous protrusion and malocclusion, delayed

eruption of permanent teeth and retained deciduous teeth. In adults it causes myxedema due to extravascular and extracelluar accumulation of water and proteins leading to edematous and swollen tongue, lips, nose, eyelids , suborbital tissues, puffiness of face and slowness in mental and physical activities. Iodine deficiency in diet results in simple endemic goiter and is normally seen in hilly areas.[45,46]

Overproduction of thyroid hormone leads to thyrotoxicosis / hyperthyroidism (Grave's disease) or enlargement of thyroid gland (exophthalmic goiter). In children premature exfoliation of teeth and early eruption of the permanent dentition occurs with increased metabolic rate, nervousness, irritability, loss of weight despite increased appetite, diarrhea, sweating, sensitivity to heat and exophthalmoses.[45,46]

Iron: The commonest nutritional deficiency disorder present throughout the world is iron deficiency anaemia which develops when supply of iron is inadequate for the requirement of hemoglobin synthesis. Long standing iron deficiency anaemia results in development of the Plummer-Vinson syndrome or Paterson-Brown-Kelly or sideropenic dysphagia. Characteristic features include dysphagia, iron deficiency anemia and upper esophageal web, glossitis, glossopyrosis, glossodynia, angular cheilitis, koilonychia, fragility, thinning of nails, brittle hair and rarely clubbing of nails and tortuous esophagus.[47]

One of the earliest suggestions that diet may play a role in the etiology of oral cancer is based on studies from Sweden that found a link between Plummer-Vinson syndrome and pharyngeal cancer in women. High cellular turnover rate of epithelium, depletion of the oxidative enzymes of epithelial cells and DNA damage predispose the patients of Plummer-Vinson syndrome to malignant changes especially squamous cell carcinomas.[48]

The most common iron-loading anaemias are intermediate and major forms of β-thalassaemia and rare anaemias like congenital dyserythropoietic anaemia and X-linked sideroblastic anaemia.[49]

Selenium: Selenium deficiency is associated with several disease conditions such as anemia, asthma, adult respiratory distress syndrome (ARDS), AIDS and increased cardiovascular disease mortality. Low blood selenium concentration and incidence of carcinogenesis in various organs including liver, skin, stomach, mammary gland and oral cavity have been observed in both animal and human studies. Selenium deficiency results in the development of two diseases, Keshan (cardiomyopathy) & Kaschinbeck Disease (Osteoarthropathy).[50]

High Se levels in blood can result in a toxic condition called "selenosis". Symptoms of Se toxicity include gastrointestinal upsets, hair loss, white blotchy nails, garlic breath odor, irritability, fatigue and mild nerve damage.[51]

Zinc: Zinc deficiency is largely related to inadequate intake or absorption of zinc from the diet, although excess losses of zinc during diarrhea may also contribute. The deficiency is associated with depressed immunity, frequent infections, impaired taste and smell, onset of night blindness, impairment of memory, bullous pustular dermatitis, alopecia, neurodevelopmental disturbances, short stature, hypogonadism and anorexia.[52]

Gestational zinc deficiency may affect immunological development in the newborn in ways that compromise immune function throughout the lifespan irrespective of zinc status.[5]

Table 2: Role of Minerals in Health[8,11,18]

Nutrient	Major Function	Major sources
	Macrominerals	
Calcium	The principal mineral of bones and teeth, also involved in normal muscle contraction, coagulation of blood, secondary messenger in hormone action	Milk and milk products, small fish with bones, tofu, broccoli, chard and legumes.
Phosphorus	A principal mineral of the bones and teeth; part of every cell; maintains acid-base balance, helps in muscle contraction	Abundant in all animal foods.
Sodium	Maintenance of acid- base equilibrium and osmotic pressure, maintains neuromuscular excitability, viscosity of blood and fluid balance	Table salt, salt added foods
Potassium	Works in coordination with sodium, influences muscular activity, nerve conduction activity, acid-base balance and also has a role in cardiac function	Fruits, nuts, vegetables
Chloride	An electrolyte that maintains normal fluid balance and proper acid-base balance, part of hydrochloric acid found in the stomach	Salt, soy sauce, moderate quantities in whole, unprocessed foods and large amounts in processed foods.
Magnesium	Involved in bone mineralization, the building of protein, normal muscular contraction and transmission of nerve impulses, acts as a co-factor and activator of many enzymes	Nuts, legumes, whole grains, beans, green leafy vegetables, seafood, chocolate.
	Microminerals	
Fluoride	Involved in the formation of bones and teeth.	Drinking water (if fluoridated), tea, seafood
Iodine	Essential component of thyroid hormones that regulate tissue growth and cell activity.	Iodized salt, seafood, plants
Iron	Part of the protein hemoglobin which carries O2 in the body. Part of the protein myoglobin in muscle which makes O2 available for muscle contraction. Necessary for the utilization of energy as part of the cells metabolic machinery	Red meats, liver, poultry, fish, shellfish, beans, peas, dried fruit, eggs.
Manganese	Involved in the formation of bone, acts as a co-factor and activator of many enzymes involved in amino acid, cholesterol, and carbohydrate metabolism	Nuts, whole grain cereals, beans, rice, dried fruits, green leafy vegetables.
Molybdenum	Important in a variety of enzyme systems.	Legumes, grains.
Selenium	Involved in antioxidant function along with vitamin E; constituent of glutathione peroxidase and selenocysteine	Organ meats, sea foods
Zinc	Cofactor for enzymes	Meat, fish, milk

Conclusion

A balanced diet plays an important role in maintaining good health. Good dietary practices and optimal nutritional status are important in mitigating the severity of inflammatory periodontal lesions. Although periodontal disease is not a nutritional deficiency disease per se, malnutrition plays a role in predisposing the host to the progression of preexisting periodontal lesions and influences the outcome of periodontal treatment. Nutrition and diet affects the

development and integrity of the oral cavity as well as the progression of diseases of the oral cavity.

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