Review Article

Functional Nutrition is a Deterimental Factor in Biological Aging

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ABSTRACT

Aging is defined as a genetic physiological process associated with morphological and functional changes in cellular and extracellular components influenced by lifestyle and environment factors. Nutrition is an integral part of health in elderly population. Infact , the nutritional status which is detrimental in the lifespan has been recognized over the past decade as a significant factor, in a variety of morbid conditions including cancer, heart disease, and dementia in persons over the age of 65. Such nutritional status is highly affected by the type, variety, quantity and quality of foods consumed by the elderly. Particularly, the specific nutrients or functional foods containing health rendering bioactive components are regarded as to cater the special needs of this senile population. In the present article, the light has been thrown on the contribution of diet and nutrition in active and healthy ageing (AHA) and to highlight its importance in the ageing process and co-morbid conditions.

Keywords: Aging, Nutrition, Antioxidants, Phytochemicals, Functional foods.

INTRODUCTION

Aging can be defined as a genetic physiological process associated with morphological and functional changes in cellular and extra cellular components aggravated by injury throughout life and resulting in a progressive imbalance of the control regulatory systems of the organisms, including hormonal, autocrine, neuroendocrine and immune homeostatic mechanisms [1]. Aging is inevitable and it is classified into biological and chronological aging. However, biological aging can be seriously managed with various preventive strategies and therefore its progression can be controlled. Although different hypotheses have been put forward to explain the cellular and molecular mechanisms of aging, recent studies made it increasingly clear that aging is due to accumulation of molecular damage, giving rise to a unified theory of aging [2-7]. Among reactions contributing to this damage, reactions of free radicals and other reactive oxygen species are the main reason, apart from reactions of metabolites such as sugars and reactive aldehydes and spontaneous errors in biochemical processes [8].

Under the perspective of the "Free Radical Theory of Aging" (FRTA) [9], now more commonly termed as the oxidative damage theory of ageing, seems to address a key facet of intrinsic biological instability of living systems[10, 11].

THE FREE RADICAL THEORY OF AGING

More than 300 theories have been proposed to explain the ageing process [12], but none has yet been generally accepted by gerontologists. However, the initial proposal by Denham Harman postulates that free radicals are causally related to the basic aging process [13] is receiving growing acceptance as a possible explanation of the chemical reactions at the basis of ageing [14]. The free radical theory of aging hypothesizes a single common process, modifiable by genetic and environmental factors, in which oxygen-derived free radicals are responsible (due to their high reactivity) for the age-associated damage at the cellular and tissue levels. In fact, the accumulation of endogenous oxygen radicals generated in cells and the consequent oxidative modification of biological molecules (lipids, proteins and nucleic acid) have been indicated as responsible for the aging and death of all living beings [13, 15].

The free radical theory was revised in 1972 when mitochondria were identified as responsible for the initiation of most of the free radical reactions occurring in the cells [16]. It was also postulated that the life span is determined by the rate of free radical damage to the mitochondria. In fact, mitochondria, in which there is a continuous generation of free radicals throughout cell life and especially mitochondrial DNA, are key targets of the free radical attack. Cells which use oxygen, and consequently produce reactive oxygen species, had to evolve complex antioxidant defence systems to neutralize reactive oxygen species and protect themselves against free radical damage. Thus, the increasing oxidative stress in ageing seems to be a consequence of the imbalance between free radical production and antioxidant defences with a higher production of the former [17]. An ideal "golden triangle" of oxidative balance, in which oxidants, antioxidants and bio molecules are placed at each apex, has been described [18]. In a normal situation, a balanced-equilibrium exists among these three elements. Excess generation of free radicals may overwhelm natural cellular antioxidant defences leading to oxidation and further contributing to cellular functional impairment [19,

[20]. The identification of free radical reactions as promoters of the aging process implies that interventions aimed at limiting or inhibiting them should be able to reduce the rate of formation of aging changes with a consequent reduction of the aging rate and disease pathogenesis [21]. In fact, the free radical theory of aging fostered an important body of research investigating the potential role of antioxidant nutrients in therapeutic or preventive strategies [22]. However, even if antioxidant supplementation is receiving growing attention and is increasingly adopted in Western countries, supporting evidence is still scarce and equivocal.

PHYSIOLOGY OF AGING AND NUTRITIONAL STATUS

Metabolic Rate and Energy Requirements

Age-related changes in body composition result in a slight decline in lean body mass. This decline is usually more dramatic after the age of 60. Consequently, basal metabolism or energy requirements for the elderly diminish by about 100 kcal/day per decade. For some seniors it may be difficult to meet daily micronutrient requirements with this reduced caloric intake [23- 25]. To combat this, a multivitamin supplement for seniors is recommended [26-28], especially for those whose caloric intake is less than 1500 kcal/day [25].

Cardiovascular, pulmonary, and neurological diseases, as well as osteoarthritis and osteoporosis, may alter energy requirements in the elderly either by increasing energy expenditure or reducing requirements through muscle loss related to inactivity. Actual energy needs may vary widely from calculated energy needs because of these factors [25, 29]. This makes the elderly a heterogeneous group and more difficult to assess nutritionally. An increase in metabolic requirements has not been associated with pressure ulcers (an unfortunately common condition in hospitalized elderly patients), although frequently concomitant conditions such as infection might encourage weight loss in older patients as a result of increased energy expenditure, decreased albumin, and protein undernutrition [29, 30].

Age-Related Changes to the Gastrointestinal Tract

Alterations in taste and smell are associated with aging. It is unclear if these normal physiological changes contribute to decreased food intake[32, 33]. Other gastrointestinal changes occur with age and may affect oral intake. For example, greater satiation after a meal and a delay in gastric emptying has been shown in older people. Appetite after an overnight fast is often lower in the elderly. Oral and dental issues, esophageal motility, and atrophic gastritis may also affect nutritional status. The latter may be implicated in impaired vitamin B12 and iron adsorption[32].

Age-Related Renal Impairment

In addition to gastrointestinal physiological changes, renal function declines with age. This decreases responsiveness to antidiuretic hormone, which often results in an increased risk for dehydration in older patients. This impaired thirst drive makes it difficult to replenish fluid losses by oral intake alone. Renal impairment may also affect vitamin D metabolism and result in a reduction of vitamin D levels, which contributes to osteoporosis in the elderly[25].

Reduced Immunity

Nutrition has an impact on the immune system of patients over the age of 65. The elderly are more likely to die of infections than young adults [34], and malnutrition is related to an increased risk of sepsis in the elderly [35]. Impaired T-cell response, changes in phagocyte and macrophage function, and reduced delayed-hypersensitivity response contribute to an overall decline in age-related immune function [34, 36]. Infections of all kinds increase metabolic rate, making it more difficult for older persons to eat enough to keep up with elevated energy demands [37].

Studies have shown that in community-dwelling seniors randomized to vitamin and mineral supplements or placebo, supplemented seniors exhibited less nutritional deficiencies [34], improved immune cell function[34,36], fewer sick days, and less antibiotic use than those patients randomized to placebo. Additionally, improved post-vaccination immune responses have been demonstrated in subjects given nutritional supplements rather than placebo [36]. Potentially, nutritional supplements may have other value in the senior population [38], as cost-benefit analyses have shown that multivitamin supplementation may reduce healthcare expenditures associated with medical care consumption (including length of stay in hospital, nurse visits, and medication intake) in community-dwelling elderly persons [39].

Protein Undernutrition

There is no consensus on the definition of protein energy malnutrition (PEM) in elderly people [40]. One view categorizes PEM as an inadequate intake of calories and protein (marasmus-type malnutrition). Another suggests PEM arises from a response to a biological stress (low-albumin malnutrition). Classically, in marasmus-type malnutrition the patient loses weight by decreasing body fat and muscle mass while maintaining a normal serum albumin. This type of weight loss is more typical of a senior living either in the community or in the long-term care setting. The metabolic stress of insufficient protein intake, as well as the effects of hepatic, renal, or bowel disease, will further impair an older patient's overall nutritional state. Protein under nutrition has been associated with an increased risk of injury in elderly patients [41, 42], while additional protein administration has been shown to help reduce adverse outcomes following injury in patients over the age of 65[43, 44].

Weight loss

Weight loss in the elderly is a worrisome clinical sign. Weight loss in the elderly due to voluntary or involuntary

causes has been associated with mortality [45- 47]. Although lean body mass may decline because of normal physiological changes associated with age [48], a loss of more than 4% per year is an independent predictor of mortality [49]. Rapid weight loss of 5% or more in one month is considered significant and needs to be immediately evaluated by a physician [50, 51]. It has been shown that even moderate decline of 5% or more over three years is predictive of mortality in older adults [46]. However, early identification, assessment, and treatment of weight loss and nutritional deficiencies may prevent the morbid sequelae of malnutrition. Functional, psychological, social, and economic issues associated with concomitant medical problems may all contribute to poor nutrition and weight loss in the frail elderly patient [52].

NUTRITION THAT TRIGGER HEALTHY AGING

Fat

Fat is the most energy-dense nutrient, i.e. it contains the most calories per gram [53]. It is an important energy source and facilitates the absorption of fat-soluble vitamins A, D, E and K, and has vital structural and regulatory functions in the human body. However, because of its high energy density, overconsumption of fat can lead to excessive total energy intake, which promotes overweight and obesity [54]. Furthermore, the consumption of trans fatty acids (TFA) is found to have adverse effects on cardiovascular health [55]. On the other hand, monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids are suggested to have beneficial effects on human metabolic health such as improving cardiovascular risk [56, 57] and insulin sensitivity [58, 59], although the current evidence is somewhat stronger for PUFA than MUFA [57].

In recent years, long-chain omega-3 fatty acids (n-3 fatty acids) have been proposed to have protective effects on brain health through reducing oxidative stress and inflammation [60] and therefore may have implications on brain function in ageing adults. Thus far, the evidence mainly comes from cross-sectional and longitudinal observational studies that demonstrated some encouraging effects of n-3 fatty acids on cognitive function in healthy older adults; the evidence from intervention studies is less clear. One review found that 19 out of 26 studies of various study designs observed positive relationships between fish consumption or n-3 fatty acids intake (from diet or supplement) and cognitive status while the other seven studies found either little or no beneficial effects [61]. The evidence on supplementation from clinical trials is weaker, a review on clinical trials found only one RCT out of seven supported beneficial effects from n-3 fatty acids supplementation and the prevention of dementia and cognitive decline [62].

Long chain n-3 fatty acids have been proposed to have other health-promoting properties in normal ageing, including immune function, bone and muscle health. Several clinical studies have found that even low doses of n-3 fatty acids supplementation can influence immune response in older people [61]. A systematic review of 23 clinical trials found a modest, but fairly consistent benefit of fish oil containing n-3 PUFA on joint swelling and pain associated with rheumatoid arthritis [63]. In addition, reduced duration of morning stiffness as well as improvement in other indicators of the disease were found [64]. Very few studies have examined the relationships between n-3 fatty acids and musculoskeletal health so far; however, a review which identified three relevant studies has found protective effects [61]. The EFSA panel also proposed setting 'Adequate Intake' levels for specific n-3 and n-6 fatty acids including: linoleic acid (n-6 fatty acids) of 4 E%, alpha-linolenic acid (n-3 fatty acids) of 0.5 E%, and eicosapentaenoic acid plus docosahexaenoic acid (n-3 fatty acids) of 250 mg/day for health-protective benefits in adults [65]. However, it has not been specifically recommended for senile population by this association.

Vitamins B6, B12 and folic acid

There has been a growing interest in supplementation of three B vitamins – B6, B12 and folic acid (henceforth B-vitamins) in relation to a number of age-related vascular diseases due to their role in homocysteine metabolism. Perhaps, stress during aging particularly could affect homocysteine levels and could pave way to cardiovascular diseases. This, homocysteine is an amino acid that, at high levels, is considered an independent risk factor for vascular diseases too, probably by atherosclerosis cascade . Previous epidemiological studies on B-vitamin status and cognition found that older people with elevated homocysteine levels (hyperhomocysteinaemia) tend to have lower B-vitamin status, as well as lower cognitive tests scores [66, 67]. They were also at higher risk of vascular diseases including dementia and AD [68- 71] than those who had normal homocysteine or B-vitamin status. These observations sparked the theory that adequate intake of these vitamins can lower homo-cysteine levels, resulting in the prevention of these diseases. A number of RCTs have since been undertaken to examine the effectiveness of B-vitamin supplementation on cognitive function and other vascular disease outcomes. To date, relatively few trials have investigated the vitamins independently and most have had little success on preventing or treating cognitive decline. This section discusses the current evidence for each of the three vitamins, as well as the effects of multi B-vitamins on cognition or vascular disease.

Vitamin B6

Bryan et al., 2002 conducted a study on the effect of vitamin B6 supplementation on cognition identified only two relevant trials in healthy older adults. One study found no significant effect on mood or cognition from supplementation in older women [72]; the other found a modest but significant effect of vitamin B6 on long term memory in older men, yet no improvements on other cognitive measures [73]. Due to the limited number of studies and very few subjects, the authors of the review

concluded there is insufficient evidence to support the beneficial effects of vitamin B6 in improving mood or cognitive function. A separate review examined the effects of vitamin B6 supplementation and the prevention of CVD recurrence in clinical trials. Similar to the cognition studies, the collective results failed to show positive effects, despite relatively consistent associations between low vitamin B6 status and CVD incidence in epidemiological studies [74].

Vitamin B12

A Cochrane review, conducted in parallel with the review for vitamin B6 (2003), examined the effect of B12 supplementation on cognitive function of demented versus healthy elderly people, to prevent the onset or progression of cognitive impairment or dementia. The results, which included two trials, did not show improvements in cognitive functions in older adults with dementia [75]. A more recent review (2010) of seven intervention studies showed no effect of B12 supplementation on cognition in six studies, while one study found some improvement in the intervention group on the performance of verbal word learning test but not in other cognitive tests [76].

Folic Acid

At present, the effects of folic acid supplementation on cognition are inconclusive. A Malouf et al., 2003 of eight clinical trials (of which four included healthy older adults and four trials recruited those with mild to moderate cognitive impairment or dementia), did not find consistent evidence that folic acid (with or without B12) can improve cognitive function or mood [73]. One trial in the review however, which recruited healthy older adults with raised homocysteine level (but normal serum vitamin B12), found that after the three-year intervention period, the folic acid supplementation group had lower homocysteine level and better performance in various cognitive tests (memory, information processing speed and sensorimotor speed) than the control group [77, 78]. Despite that long-term use of folic acid supplementation appeared to improve the cognitive function of healthy older people with high homocysteine levels, eventually the authours concluded more studies with positive findings and longer study durations are needed to warrant its effectiveness.

Vitamin D and Calcium

Vitamin D and calcium are well known for their important roles in bone health. Calcium is an essential architectural component of bones and teeth–where 99% of total body calcium is found. Vitamin D plays a role in calcium absorption and maintaining serum calcium and phosphorus homeostasis [66]. When vitamin D status is low, calcium absorption is disturbed and triggers the compensatory release of a specific hormone called parathyroid hormone that promotes bone resorption and accelerates bone loss [79]. Vitamin D is synthesised in the skin by the action of UVB light from the sun. However in older people, the production of vitamin D from sun exposure is limited due to the reduction of vitamin D precursor in the ageing skin and also the time spent outdoor is usually lower in older people [80]. Therefore, in older adults who are prone to deficiency, increasing intake of vitamin D is important for bone health.

Avenell, 2009 evaluated the effects of vitamin D supplementation with or without calcium in preventing bone fractures in older adults. The review which included 45 clinical trials and more than 84 000 participants found that vitamin D alone appeared to have little effect on the risk of fractures [81]. In trials where subjects were supplemented with vitamin D and calcium, hip fractures reduced by 16%. However, further analysis showed it was mainly older people in institutional care that had a significant reduction in hip fractures but not the older adults in community-dwelling. Furthermore, subjects who received an active form of vitamin D3 (calcitriol) as supplements were more susceptible to elevated calcium in blood (hypercalcaemia) and experiencing gastrointestinal symptoms and renal disease. Vitamin D3 is synthesised in the skin as cholecalciferol or is obtained from dietary sources or supplements as alfacalcidol and calcitriol. [82].

Bjelakossic et al., 2011 further evaluated the evidence on various types of vitamin D supplementation and prevention of mortality. A specific form of vitamin D (cholecalciferol) appeared to decrease mortality in predominantly older women who were in institutions and dependent care, whereas other forms had no effect on mortality. This review also found that active forms of vitamin D3–alfacalcidol and calcitriol–increased the risk of hypercalcaemia significantly, and that combining vitamin D and calcium in supplements increased the risk of kidney stone formation [82]. Calcium and vitamin D supplementations are often used in postmenopausal women to prevent osteoporosis. While some studies have indicated such supplements, in particular calcium, may be related to increased rates of cardiovascular events seen in older women [83], both observational studies and clinical trials have shown inconsistent results. In 2012, the EFSA Panel on Dietetic Products, Nutrition and Allergies evaluated the existing data to determine a tolerable upper intake level of calcium. In relation to its risk on CVD, the Panel concluded that, calcium intakes up to about 2,000 mg/day from food and supplements have not been associated with an increased risk of CVD events. Furthermore, the Panel concluded that long-term calcium intakes from diet and supplements up to 2,500-3,000 mg/ day are not associated with an increased risk of CVD in all adults [66].

Vitamins A, C and E – antioxidant vitamins

The mitochondrial free radical theory of ageing was proposed several decades ago and has been actively investigated [84]. Free radicals are produced in the mitochondria during respiration [85] and, if in excess, they cause oxidative damage in cells and tissues, which over

time, has been hypothesised to lead to the development of a number of age related degenerative conditions including AD, dementia, cancer, CVD and AMD [86, 87]. To protect cells from damage, antioxidants are needed to neutralise free radicals through a series of chemical reactions. Antioxidants come from two sources: 1) the body's internal production like glutathione or 2) through the intake of antioxidant nutrients, such as vitamins A, C and E, as well as a number of polyphenolic compounds [85]. Reviews of epidemiological studies have indicated that consuming a diet rich in antioxidants may lower CVD risk [88], the risk of cognitive decline, AD and dementia [89], as well as age-related eye diseases [90].

Other Antioxidants – Selenium and Zinc

Selenium is a trace element that has antioxidative and anti-inflammatory properties when incorporated into certain proteins to form selenoproteins [91]. Dietary sources of selenium vary vastly between countries, but usually include meat and offal, fish, eggs, grains and cereals, as well as certain fruits and vegetables (garlic bulbs, onion and broccoli), and Brazil nuts [91, 92]. This trace element is less well-researched compared to vitamin antioxidants, however it has been suggested that selenium may have a beneficial effect on lowering gastrointestinal cancer occurrence [93]. Low selenium status may also be associated with increased risk of mortality, poor immune function and cognitive decline [91]. Similar to the use of antioxidant vitamin supplements, some studies have indicated that the use of selenium supplements in people with normal selenium status may be detrimental, e.g. by increasing the risk of type 2 diabetes 91. Rees et al, 2013, found limited evidence on the use of selenium supplementation to prevent CVD events or related mortality [94]. Overall, more rigorous clinical trials are needed to confirm the link between selenium intake and its effects on various age-related diseases.

In the line with the super antioxidant mineral Selenium, Zinc is also a micronutrient that can have antioxidative functions in the body. It has been suggested that zinc deficiency is linked to neuronal damage seen in AD, as zinc may be important in lowering the level of copper in the brain, which in excess, can act as a pro-oxidant and may increase the risk of AD [95]. However, there is a lack of consistent evidence to confirm this link. Zinc has also been suggested to be potentially beneficial for eye health. While, aging is detrimental in causing eye abnormalities, particularly degenerative eye disorders like cataracts, macular degeneration, retinitis etc., A systematic review assessed the evidence on zinc in preventing and treating AMD[96]. One RCT showed that zinc supplementation significantly reduced the risk of progression to advanced AMD, two RCTs showed positive results in visual acuity in older people with early AMD and the remaining RCT showed no effect. The results from the cohort studies on the other hand, were inconsistent on zinc's role in AMD prevention. Zinc has an essential role in the immune system. It is known that the immune system undergoes alterations with advancing age; the ability to respond to infections and to develop immunity after vaccination deteriorate with age and leads to a higher risk of mortality caused by infections in older people [97]. One small RCT with fifty elderly subjects investigated the effectiveness of 12 months supplementation of zinc and the incidence of infections. Zinc supplementation was able to reduce oxidative stress in the treated subjects and their mean infection incidence was also lower than in the controls [98]. These results and zinc's potential role in reducing infections and related mortality are encouraging. However, more research is needed, as currently, there are very few studies in this area with a specific focus on older people. Actually, elderly are more prone to develop infectious diseases. Particularly, old people are more susceptible to upper respiratory diseases–the leading cause of death due to infections [99]. Apart from chronic dreadful infections aged people also develop frequent common cold or rhinitis. This either may be attributed to allergic reactions or mild infections. Singh et al, 2013 assessed the role of zinc in treating common colds. Rhinovirus is responsible for around 80% of common colds and it has been suggested that zinc may exert an antiviral effect by attaching itself to the virus and blocking its action in infecting the nasal cells. It was found that when zinc was taken within 24 hours of onset of the cold, the average duration of the symptoms in healthy people was reduced, and their symptoms were less likely to persist beyond seven days of treatment, but there were no differences in the severity of symptoms between the treatment and the control groups. However, the authors warned to interpret the results with caution due to the variability of methods used between studies [100].

PHYTOCHEMICALS

Catechins

There has been widespread interest in the role of certain antioxidative phytochemicals Tea leaves for example, contain catechins–a family of polyphenolic compounds which are believed to have strong antioxidative properties [101]. Various clinical trials have studied the effects of tea catechins, mainly from green tea, on the prevention of CVD and cancer as well as weight loss. Hartley, 2013 investigated the effects of green and black tea on CVD risk factors in eleven RCTs. Black tea was found to lower low-density lipoprotein (LDL) cholesterol and blood pressure, whereas green tea was associated with lower total cholesterol, LDL and blood pressure [102]. However, the long-term effects of tea and CVD events remained unclear due to lack of trials of sufficiently long duration, although one Australian prospective study found that older women aged 75 years and older with a habitual high intake of polyphenols from tea over a five year period had a lower risk of CVD death [103]. Boehm et al, 2009 assessed the relationship between green tea catechins and cancer prevention. The studies included in the review were of mixed quality, varied in methodologies and reported conflicting results regarding

incidence of cancer. Overall, there was not enough evidence to support drinking green tea to prevent cancer; however, the authors concluded that regularly drinking three to five cups or up to 1.2 l/ day (providing 250 mg/day of catechins) appeared to be safe [104]. Hence, such green tea may be suggested regularly depending on their tolerance to elderly that could render beneficial effects.

Resveratrol

Resveratrol is another antioxidative polyphenol molecule that is found in grape skins and seeds, and medicinal plants and its intake is mainly from red wine [105]. The same author's studies have shown that resveratrol could increase lifespan, lower fasting glucose, improve insulin sensitivity, prevent liver damage and improve performance in animals (e.g. invertebrates and mice). Because of the health benefits seen in animals, it is believed that resveratrol may have similar effects in humans. Currently, resveratrol is being actively investigated in human clinical studies. In one comprehensive review on resveratrol and human health, the authors wrote that 'the evidence is sufficiently strong to conclude that a single dose of resveratrol is able to induce beneficial physiologic responses, and that either weeks or months of resveratrol supplementation produces physiologic changes that are predictive of improved health, especially in clinical populations with compromised health' **106**. Despite such conclusions, further meta-analyses are needed to critically assess the combined effects of resveratrol on different aspects of human health. It is too early to determine the efficacy of resveratrol supplementation in increasing lifespan or preventing chronic diseases in humans, particularly in the long-term.

Probiotics and Prebiotics

The gut flora or microbiota (i.e. all the microorganisms living in the human gut and the metabolites they generate) are essential for the maintenance of gut health. Changes in microbiota composition have been linked to inflammation and metabolic disorders such as inflammatory bowel disease, irritable bowel disease, diabetes, CVD, colorectal cancer, and frailty in old people [107]. Healthy adults have a relatively stable microbial composition in the gut. However, in older people, the composition tends to vary greatly between individuals and the microbiota diversity declines with age. Therefore, improving the microbial balance and composition in older people may help to reduce their risk for inflammation and metabolic diseases. Probiotics and prebiotics have been proposed to promote gut health, particularly in older people [107]. Probiotics are live microorganisms that, when administered in adequate quantities, can confer a health benefit on the host [108]. Common types of probiotics include Lactobacilli and Bifidobacteria that are found in yoghurt and fermented milk products, as well as probiotic drinks and some fortified fruit juices [109]. However, elderly population are usually reluctant to consume curds (Fermented milk containing probiotics which is also called as dahi) thinking that it may cause common cold or would cool the body. It is also a superficial taboo among public that consumption of even 50ml of curds would increase body lipid parameters but studies with animal models have proven that infact curds containing probiotics or administration of isolated probiotics strains can even bring down the lipid levels [108, 110] .

Prebiotics are non-digestible molecules that act as the substrate for the probiotic bacteria and selectively promote their growth and activity in the gut. Prebiotics can be found naturally in some vegetables, as well as in synthetic forms of non-digestible carbohydrates (e.g. oligosaccharides) [109]. To date, there are few clinical studies that have investigated the effects of probiotics and prebiotics on the health of older people. However, some benefits have been recorded including improving bowel functions, e.g. reducing faecal transit time and relieving constipation , preventing antibiotic associated diarrhoea , increasing immune defence, and reducing inflammation, infections and allergies in older people [111].

Meat and Meat Products

Although non-vegetarian foods are unfavourable and as studies have proven elderly vegans tend live without much complication, yet it is imperative that in terms of nutrient density the animal foods are capable of furnishing high biological value proteins and even rare micronutrients in an appreciable quantity. However, the senior citizens should be very choosy when they go for animal foods. Perish ability and hygiene of animal foods are highly concerned. Lean meats, fish and designer eggs are safe options. The recently introduced designer eggs are the ones which are produced by feeding the birds with a hygienic wholesome feed with specific nutrients rich feeds as desired or resultant nutrient density of the eggs to be produced. For example, if eggs to be produced with more of omega-3 fatty acids and less of cholesterol in the yellow yolk, a pure wholesome grains along with flax seeds are fed to the hen and thereby produced eggs will be possessing appreciable amounts of omega-3 fatty acids and less amounts of cholesterol. Thus, such eggs are very safe and may be prescribed to the aged persons to achieve a considerable quality nutrients and high digestibility rate.

CONCLUSION

Aging is inevitable and is indeed influenced by various physiological and environmental factors. Though, more than 300 theories have been proposed to describe aging process, yet nutrition has been regarded as significant factor that affects the rate of aging and allows one to be with advance in aging but still without any complications. Similarly, health aging also means living devoid of infectious that is taken care by profound immunity. The favourable association between healthy aging and nutritious diet has been affirmed by various rigorous studies. Apart from general diet, intake of functional foods, rich in antioxidants and specific phytonutrients

also favour healthy aging. Hence a prudent diet comprising of variety of wholesome cereals, colourful fruits, and vegetables, lean meat and designer eggs along with probiotics and omega-3 fatty acid supplementation would pave way for a healthy senile life.

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