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RESEARCH ARTICLE

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A SYSTEMATIC REVIEW ANALYSIS ON FUNCTIONAL FOOD FORMULATION EFFICACIES AND CHALLENGES: HOPEFULNESS FOR HEALTH ENDURANCE AMONG GERIATRIC

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ABSTRACT

Dietary lifestyles certainly found to have direct influence on ageing process. Typically ageing is associated with increased susceptibility to degenerative process often exacerbated by nutritional inadequacy. Detrimental healthy life expectancy at ageing period is a significant global issue. An advance in functional foods has shown increased life expectancy, healed various lifestyle diseases as a preventive & ideal nutraceutical for geriatric. Evidences on the NCD interlinked with the nutritional etiology and morbidities outcomes among elderly in India are limited. Proposed review research yields new insight regarding functional food role on various age related ailments such as malnutrition, hypertension, bone fractures and frailty. In particular, this scientific data base establishes the impact of functional food as a comprehensive nutrition regime for the effective disease management that could diminishes chronic disease risks and nutritional deficits in Geriatric.

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INTRODUCTION

Ageing is the biological process where the physiological functions in the form of hair greying, skin wrinkling, reduced weight, height, etc changes occur. Scientifically aging is defined as an age dependent or age-progressive decline in intrinsic physiological function, leading to an increase in age-specific mortality rate (i.e., a decrease in survival rate) and a decrease in age-specific reproductive rate(1). Psychological and environmental factors indeed influence the survival and fertility of the group. As a contributing factor, poor nutrition plays a significant role in aging process. The concept of successful aging or healthy aging often not only increase life expectancy and dominant elderly in the society but extend healthy active days as well as explains the factors leading to the life sustainability(2–5). Approximately 7% total elderly population was estimated during 2009 in India and a 20% growth in ageing population is predicted in 2050(6). An increased life expectancy in 60 years and above is noticed as a result of elderly survivance and deteriorating fertility. Typically 60 to 65 years is declared to be the age of retiring. In general older individuals are experienced with inactiveness in social activities, disabilities and illness.

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Dietary practices tend to influence all the age group to uphold optimum wellbeing especially in the older adults. Nutritional intervention is crucial in maintaining adequate nutritional level, delaying degenerative process among older adults and sustaining functional independence without depending to external support and living a healthy lifestyle(7), (8). Functional foods are the potent bioactive compounds that exert positive effect on health beyond basic nutrition. It acts as secondary metabolites, prebiotics, probiotics followed by antioxidants. Importantly it promotes optimal health and reduces the risk of disease. Functional foods cover a variety of foods, including whole foods along with fortified, enriched or enhanced foods. Functional foods have proven to improve mobility, absorption capacity as well protect from various infections and diseases during ageing. Often it enhances energy level, immune function, body composition and nutrient utilization. Common morbidities experienced during ageing are diabetes, hypertension, cardiovascular diseases, cancer, dementia and Alzheimer's disease. Functional foods possess curative or preventive elements which act as an anti-diabetic, anti-ulcerative, anti-microbial activity and neuro protective activity(9). Foods are the essential substances for human health often gets utilized by the process of ingestion, digestion and optimizes nutrients for the metabolic activities. Metabolic activities such as tissue repair, immune-enhancing, boosting energy is essentially dependent on dietary approach. Food can be consumed by varieties of forms, essentially meets the individual's physiological needs required for the systemic reflux (10).

As a result of the demographic living transition; most of the elderly populations are moving to old age home. Often appropriate feeding practices becomes challenging due to the negligence, immobility during elderly. Inadequate nutrition support could lead to malnutrition followed by chronic non communicable diseases. Thus evidently functional foods meet the expected nutrients level for physical and emotional functioning during ageing. It also helps to energize the elderly to prevent or escape from the health complications.

In view proposed review investigation aims at establishing evidences on the quality of health among geriatric population in relation to the functional foods on health outcomes

METHODOLOGY

The proposed systematic review throws light on the significance of functional foods towards quality product promotion and health productivity.

Research Design: investigation aims at analyzing scientific review and original article findings from advance science, Elsevier, Blackwell and peer reviewed journals. With respect to the objectives; the research criteria include scientific articles evidences those in English and full-text from experimental, in-vivo and in-vitro studies.

Documentation: Citations used for the review study (google scholar, Research Gate, PubMed, Semantic Scholar and Science Direct).

Criteria: 78 papers were pre-reviewed, among which 53 papers were included as part of the research criteria and rest were excluded as it didn't meet up in relevance with the objective of establishing review findings.

Data acquisition /analysis: Among 53 research papers included: Review article (12), experimental studies (8), and original articles(35)

Findings: *Data emphasizes on the therapeutic uses of functional foods on health productivity on geriatric.*

SALIENT FINDINGS

OVERVIEW OF GERIATRIC

Generally elderly has been defined as a chronological age of 65 years old or older, while those from 65 through 74 years old as early elderly and those over 75 years old as late elderly(11).

The aging process is generally accepted to collapse physiologically into three classes of events that occur with advancing age.

Firstly; variations in cellular homeostatic mechanisms such as body temperature, blood, and extracellular fluid volumes.

Secondly; related to a decline in organ mass; and

Thirdly; a reduction and depletion of the functional reserve of the body's processes in terms of their effectiveness. Loss of these functional reserves can inhibit the ability of a person to manage several other challenges such as surgery or trauma. Restoring physiological function in an aging population is of vital importance not only for the well-being of the elderly person but also from a sociological perspective, significantly reducing the pressure on medical services and systems (12). Healthy Ageing is the process of developing and maintaining the functional ability that enables well-being in older age.

Quality of Health in aging not only meant to of biological changes or medical care. Additionally, an important role of society and individual care is a prerequisite. Normally during the decline of health individual lose their social roles, independence, changes in their own perception, becomes economically weak, discrimination by the family members,

offended by the society, and even tend to move to home care institutions(13).

GLOBAL SCENERIO OF GERIATRIC POPULATION

The global population aged 60 years or over numbered 962 million in 2017, more than twice as large as in 1980 when there were 382 million older persons worldwide. The number of older persons is expected to double again by 2050, when it is projected to reach nearly 2.1 billion.

INDIAN SCENERIO OF GERIATRIC POPULATION

According to 2001 census, the elderly population of India containing of 28 states and 7 Union Territories accounted for 77million. In 1961, old age population had been only 24 million; it increased to 43 million in 1991. The proportion of elderly persons in India has raised from 5.63 percent in 1961 to 6.58 percent in 2001(14). Later as stated by 2011 population census of India 104 million elderly people are present in India, among them 51 million is males and 53 million people are females. From the last two decades population trends has been changed in the number of elderly population by gender wise. In 1991 population census, the numbers of males are more than female elderly. In compare between rural and urban residence 73 million elderly reside in rural areas that is 71 percent while 31 million or 29 percent of elderly inhabitants are in urban areas (15). In 20th century increase in aged population is an important occurrence and whole world has been influenced especially in developing countries. In India Karnataka is no less in the elderly proportions. After kerala, Karnataka is the sixth state to consists if aged residents, followed by Himachal Pradesh (9%), Tamil Nadu (8.8%), Maharashtra (8.7%), Goa (8%), Karnataka (7.7%)(16).

AGEING PHYSIOLOGY: PHYSIOLOGICAL CHANGES IN DIFFERENT VITAL SYSTEMS

Physiological changes in all organ systems arise with aging. Cardiac production appears to decline, blood pressure found to arise resulting to arteriosclerosis development. Lung functionality indicates an impaired exchange of oxygen, reduced vital ability, and slower the rate of respiration flow. The creatinine clearance decreases with age although the serum creatinine level remains relatively constant due to decreased creatinine synthesis concerning age. Functional variations, mainly linked to altered motility patterns, occur with senescence in the gastrointestinal system, and atrophic gastritis and altered hepatic drug metabolism are common in older people. On a multi-factorial level, osteoporosis is often seen due to a gradual decrease in bone mass after the fourth decade and progressive blood glucose elevation increases with age. The skin epidermis deteriorates with age, and skin loses its appearance and elasticity result of changes in collagen and elastin. In the aging process because of the loss or degenerative of muscle cells changes occur in the body structure with losing the muscle mass. Joint pain issues also comprise the loss of muscle mass and cause immobility among the elderly. Such changes with age have significant practical consequences for the clinical care of elderly patients: changes in appetite, changes in reaction to widely prescribed medications necessitate different dosages of drugs, and appropriate preventive diet and exercise interventions are required in an attempt to postpone or reverse some of these changes (17).

DEGENERATIVE PROCESS: ONSET OF DISEASES

PROGRESSION: Examination conducted in the community-dwelling older adults in Kolkata, India to identify the nutritional status and the reasons for changes in it. 263 male and 237 female participants were included in the examination. Based on the full MNA assessment, 104 participants (46 males and 58 females) were at risk of undernutrition and 34 participants (13 males and 21 females) scored less than 17, indicating undernutrition. Undernutrition factors include poor schooling, psychological stress, acute illness, loss of appetite, digestive, and chewing issues, and a small proportion of protein-rich food. Specific factors to the high prevalence of undernourishment

among women participants include a low level of education and lack of financial security(23). In a communitybased study conducted in the urban area of Uttar Pradesh, India; the prevalence of cataract observed to be highest (78.2%), followed by depression (35.6%), locomotors problem (21.3%), hearing loss (13.8%) and refractive error (27.6%). Hearingloss problem was highly found out in females compared to males(24).

Findings by George LS *et al*; reports that the most common morbidities including musculoskeletal (50.5 %) and cataract (50.4 %) were experienced at higher rate by older people. Inheritable diseases were more commonly experienced among females than among males. Evidently arthritis was experienced significantly at higher rate with fractures attributed to falls being spread equally between both genders. Common morbidities that are significantly accompanied are diabetes mellitus (17.4%), hypertension (20.9%), dental problems (23.9%), gastrointestinal problems (26.6%), and respiratory disorders (31.3%). Hypertension was found to be prevalent in both sexes. Respectively greater proportion of females (60%) had experienced with diabetes mellitus than males (40%). Constipation and gastritis were the common complication experienced in both males and females (25). Importantly elderly population need to be conscious about their health, lifestyle modification, regular health checkup for a healthy aging. Evidence on the disease prevalence among elderly reports; Out of 150 elderly, the prevalence of vision problem was 125 (cataract), followed by anemia as one of the common nutritional problems. Noticeably, 73 older people were detected as anemic among them 39 were males and 52 were females. Distinctively 43.3% had experienced hypertension and 40.7% had diabetes. Other physical health problems observed were hearing problems; musculoskeletal problems; neurological problems at 14.6%, 22.0% and 67.0% respectively. Study reveals a greater proportion of elderly were unnoticed of their onset of diseases prevalence and had experience comorbid risks (26). There is a need for a wider conceptual model of health-related life satisfaction nutritional aspects including effect and cognitive sense of control. Precised nutrition regime reduces health problems, functional impairments, and enhances the quality of life and well-being of older adults. Optimized nutrition therapy notably is a remedial measure that could stimulate medical outcomes in older groups (27). Healthy aging often not only increases life expectancy but also prolongs health productivity. Evidently chronic conditions are becoming more prevalent with advance age and are viewed as an inevitable phenomenon during aging. Correct nutritional periodization is essential throughout life for meeting longevity. During past few decades, the significance of nutritional status among older people has been increasingly identified as a contributory factor for several chronic illnesses such as cancer, heart disease, and dementia. Various physiological changes arise as when an individual grow up that can influence nutritional status. Most frequent health problems challenged by the elderly are loss of bone density, osteoporosis, sarcopenia, loss of lean body mass, muscle wasting, weakness, and metabolic changes(28).

SPECIFIC NUTRIENT ACTIONS IN AGEING: Notably there are changes observed in the requirement of nutrients for the elderly in comparison to other age populations. As the calorie intake is proportionate with energy consumption. ICMR has suggested lower intake level for the calories among the individual's growing old.

FINDINGS ON THE VALUE ADDITION OF FUNCTIONAL FOODS ON GERIATRIC HEALTH: Functional foods often claimed as a vital bioactive components that are easily bioavailable, accessible contributing functional properties. Regular ingestion of natural bioactive content seems to reduce chronic disease and enhance productivity in life (41). Since five decades perception of food among people has been changing with conscious of the healthy diet and expecting risk of chronic diseases to be minimized by means of plant origin like fruits vegetables. There is an enormous literature documented on the modified dietary intake with whole grains, fruits vegetables, and nuts towards reducing the risk of developing the diseases (42).

It is well established that free radicals are noted to damage cell vitality increasing the disability and risk of diseases. There has been lack of immune response against the oxidative stress as a result of higher free radicals activity often highly present in elderly. Consuming antioxidants rich foods could inhibit the development of free radicals among the elderly and breaks the chain reaction or reduce the number of free radicals. Antioxidants like beta carotene, vitamin A, vitamin C, and E highly present in fruits, vegetables, and green leafy vegetables essentially beneficial for productive health. There are antioxidants produced within the body and obtained through the diet which plays a significant role in minimizing several diseases among elderly. Polyphenols are the natural bioactive compounds obtained from fruits, vegetables, legumes, whole grains, and beverages. Research evidence suggests that diet rich in polyphenols could fight against ultraviolet radiation or aggression and reduction the risk of degenerative diseases (43). Curcuminoid polyphenols present in turmeric plant mainly functions as anti-inflammatory properties and also anti-diabetic, neuroprotective properties. Curcumin also fights to prevent cognitive issues especially Alzheimer's disease. Significantly cereal grains contain highest concentration of phenolic acid. Citrus fruits are the major source of flavonones that are highly present in the orange juice. For a normal individual the polyphenols recommendation is about 1g/day (44).

Carrots, spinach, green leafy vegetables, sweet potatoes are the remarkable source of carotenoids. It comprises red, orange, yellow color pigments. Lutein and zeaxanthin are the carotenoid compounds that aids in macular degeneration. Supplementation of lutein and zeaxanthin could inhibit eye disease. Lycopene is also one of the carotenoid which present in the tomato and watermelon. It has shown a significant role in the prevention of cancer. Omega-3 and Omega 6 fatty acids are the essential fatty acids to be obtained from the diet. Sea foods specially fish are excellent sources of fatty acids. Consumption of high omega 3 fatty acid rich foods decreases the risk of cognitive problems and dementia in elderly. It also helps to reduce the incident of Alzheimer disease in human subjects (45). Treating age related disorders like non communicable diseases using customized diet comprising macro and micronutrients in appropriate proportion found to be significant. Evidence on the physical, sensory, chemical, and biological characteristics among elderly, using instant soup mixture as dietary supplement. Instant soup mixtures were formulated using chickpea, vegetables, and byproducts (at 5% and 10%). A geriatric animal model has been used to study the biological effects of the mixtures. Results revealed a reasonable acceptance of the two mixtures even after storage period (4 months) in addition to their contents from protein, fat, crude fiber and carbohydrates (16.62, 6.20, 6.60 and 65.89%, respectively in the mixture I; 16.89, 6.30, 6.30 and 54.16%, respectively in mixture II). Mixture II was more promised in flavonoids content and scavenging radical activity than mixture I. Feeding the geriatric rats on the two mixtures did not produce any change in either liver or kidney functions and suggested the ability of these mixtures to prevent the hyperglycemia and hyperlipidemia and improve bone health and a slight decrease in brain lipid peroxidation. Also, the two mixtures increased the feces weight of rats which indicates the beneficial effects of these mixtures in the prevention of constipation. In conclusion, the formulated instant soup mixtures with high acceptability and antioxidant activity markedly provide high percentage of macro and micronutrients required for the elderly (46).

Findings by Satusap *et al*, on the ready to eat products formulated using cereals and legumes reports: the formulation of flake snacks, instant beverage, and instant soup using rice flour, brown rice flour, moong bean has contributed significant proportion of carbohydrate; protein and fat. Soybean flour, black sesame seed, and rice bran oil contributed as a complementary fat source. Markedly the formulation had a significant energy contribution from carbohydrate (601kcal/100 kcal), protein (15 kcal/100 kcal), and fat (25 kcal/100 kcal). In sensory evaluation, flake was preferred better as per the taste quality by the elderly (47).

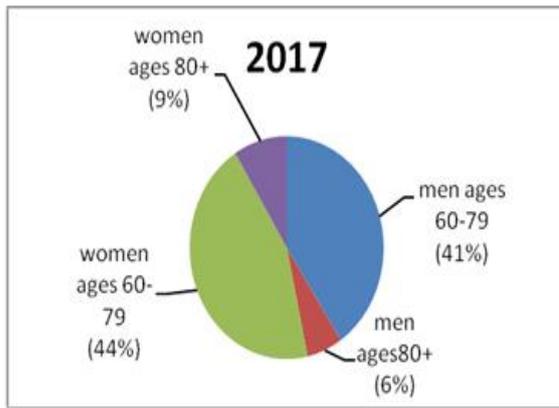


Figure 1a

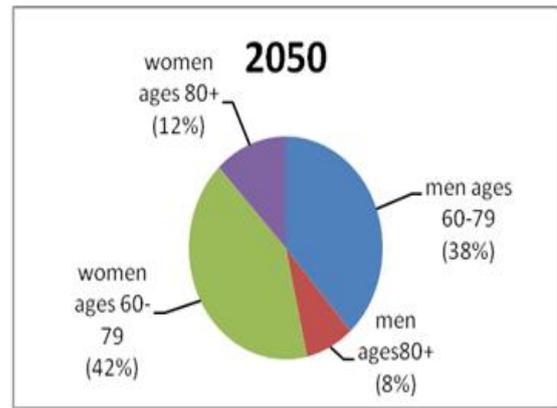
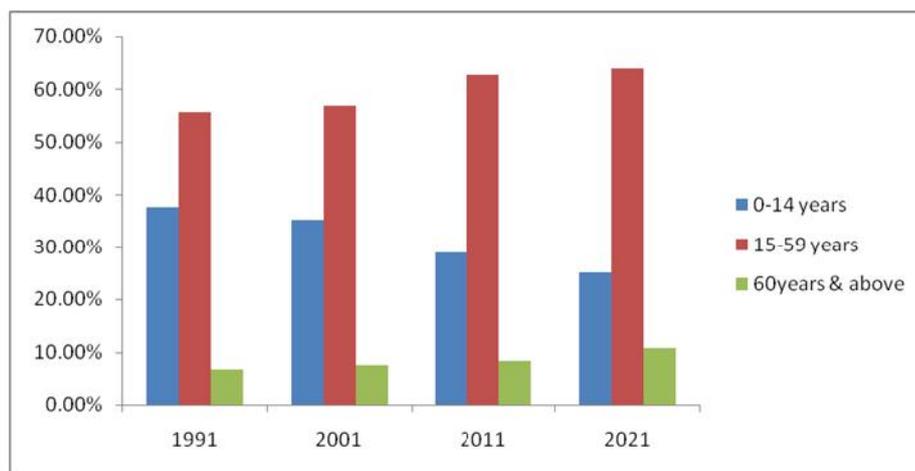


Figure 1b

Figure 1a & 1b. Global scenario of old age population



Source: Situation Analysis of the Elderly in India; 2011 Central Statistics Office Ministry of Statistics & Programme Implementation Government of India [16].

Figure 2. Indian scenario of geriatric population

Table 1. Evidences on Physiological changes in elderly

Physiological Role	Reports
Taste and Smell	Decreased taste buds and papillae on tongue. Declining olfactory functions*
Salivary glands	Decrease in salivary secretion causes dysphagia, xerostomia and feeling of dry mouth*.
Teeth	Defective teeth or teeth loss Difficulty chewing*
Gastric function and emptying	Decreased secretion of hydrochloric acid and pepsin. Delayed gastric emptying due to the non peristaltic contraction especially among aged people[18].
Small intestine	Alteration in lower esophageal sphincter relaxation or contraction[19]. Increased proximal small bowel pH and bacterial over growth in bowel. Decreased secretion of lactase. Shorter villi in the elderly*
Liver and biliary function	The volume and blood flow of the liver gradually decrease with aging. Blood cholesterol, HDL, neutral fats increases over time[20]. Gall bladder becomes sluggish in releasing bile A decreased area of smooth endoplasmic reticulum[21].
Metabolic function	Impaired glucose tolerance Decreased metabolic rate due to changes in body composition and reduction in physical activity. Body protein level decreases.*
Neurologic function	Confusion stress*
Respiratory function	An increase in airspace size with aging resulting from loss of supporting tissue. Alteration in chest wall structure and decreased respiratory muscle strength, loss of alveolar surface area.*
Skeletal function	Changes in bone density*
Ophthalmic function	Opacity of eye lens*
Psychological factors	Depression*
Cardio vascular function	Increased Wall Thickening and Arterial Stiffening, Endothelial Dysfunction[22]
Renal function	Glomerular filtration rate can diminish as much as 60% changes in fluid and acid base balance.*
Immune competence	Declines with age*

*Source: Srilakshmi B, 2014. Dietetics, 7th Multi Colour Edition, New Age International (P) Ld., Publishers, Chapter 9, Page 146 and 147 [24].

Author	Study	Method	Result
(Joshi et al.,) [28]	Morbidity profile and its relationship with disability and psychological distress among elderly people in Northern India.	Cross sectional study: 200 elderly partaken in the study.	The most prevalent morbidity was anaemia, followed by dental problems, hypertension, chronic obstructive airway disease (COAD), cataract, and osteoarthritis.
(Prakash et al., 2004) [29]	A study of morbidity pattern among geriatric population in an urban area of Udaipur rajasthan.	Cross-sectional study: 300elderly subjects males: 190 & females: 110	48% of population had hypertension, musculoskeletal problem was found in both males (11.6%) & females (20%). Among them males had 34.7% of cataract problem whereas females had 60%.
(Banker et al., n.d 2011) [30]	Study of health profile of residents of Geriatric home in Ahmedabad district	Cross sectional study: 530 respondents. Males:243 Females:287	Among the participants most common health issues were insomnia 34%, weakness 34.9%, impaired vision 44.2%, joint pain 60.2% and loss of teeth 70%. They were also suffering from one or the other main health problem like diabetes (14.9%), cataract (16%), hypertension (54.2%) and osteoarthritis (54.9%).
(Rk & Kaur, 2013) [31]	Prevalence of Common Physical Health Problems among Elderly in Selected Old Age Homes of a Cosmopolitan City	Cross sectional descriptive study: 150 elderly, Females-111 and Males-39	Majority participants were suffering from one or the other health problems, 83.3% of them were having vision problem followed by anemic 48.7%. 43.3% & 40.7% of elderly had hypertension and diabetes respectively. They had other physical problems like neurological problem (10.67%), hearing issue (14.67%) and musculoskeletal problem (22%).
(Thakur et al., 2013) [32]	Health Problems Among the Elderly: A Cross-Sectional Study	Cross sectional study:407 elderly were participated	Prevalence of hypertension was 30.7%, 12% had diabetes, 7.6% of ischemic heart disease, 29.2% of had cataract.
(Maroof et al., 2016) [33]	Health problems among the aged: a community based study from urban Aligarh, Uttar Pradesh, India	Community based cross-sectional study: 225 individuals	The prevalence of cataract observed to be highest (78.2%), followed by depression (35.6%), refractive error (27.6%), locomotor problems (21.3%) & hearing loss (13.8%).
(Rao, 2016) [34]	Morbidity pattern among the elderly population in the rural area of Pondicherry	Cross-sectional study: 360 were participated in the study	Among the study population 96% were anemic, major problem was hypertension (28%), arthritis (25%), followed by diabetes (22%).
(George et al., 2017) [35]	Morbidity pattern and its socio-demographic determinants among elderly population of Raichur district, Karnataka, India	Cross-sectional study: 576 elderly were participated	Musculoskeletal (50.5%) and cataract (50.4%) were most common problem among them. Also many of the seniors were suffering from respiratory illnesses (31.3%), gastrointestinal problems (26.6%), dental problems (23.9%), hypertension (20.9%), and diabetes mellitus (17.4%).
(Mangal et al., 2019) [36]	Geriatric health related problems in an urban area of southern Rajasthan	Cross sectional study: 536 respondents. Males:257 Females: 279	Out of 536 individuals 10.07% had cardiovascular problems, 14.78% dental problems, cataract (19.03%), hypertension 22.57% followed by arthritis 37.05%
(Verma et al., 2017) [37]	A comparative study of morbidity pattern in elderly of rural and urban areas of Allahabad district, Uttar Pradesh, India	Cross-sectional study: 400 elderly were participated. Female-185 & Male-215	Elderly had significant morbidity profile like respiratory problems (16%), diabetes (23.5%), obesity (35%), hypertension (39%), musculoskeletal (59.7%) followed by ocular problems (68.5%).

Table 2. Specific Nutrient actions during Ageing

INVESTIGATION	TARGET POPULATION		FINDINGS
Nutrients (macros)	Male	Female	OUTCOMES
Energy (kcal)*	1600 – 2500	1400 - 2200	Increased basal metabolic rate, consistent with long-term good health [29].
Carbohydrates (g)*	300-400	300-350	Enhanced digestive process and also muscle resistance [32].
Protein (g/KBW)*	0.83	0.83	Enhanced protein and muscle protein synthesis, onset of chronic diseases prevention, maintains energy balance [33], [34].
Fat (g)*	25 – 30	20 - 25	Fats and oils - sources of energy, compensate energy to the body when carbohydrate supply is less, palatable, essential for the absorption of fat-soluble vitamins such as A, D, E, beta carotene.
Fiber (g)*	15 – 30	15 - 25	
Minerals (micros)			
Calcium (mg)*	700	600	Reduction in the risk of fractures, osteoporosis, and diabetes [35]
Zinc (mg)*	11	8	improves cognitive functions among elderly; reduced incidence of pneumonia [36].
Iron (mg)*	16	12	Important for body bio physiological mechanisms, hemostasis and blood regulation. Required for the body functions like immunity, physical performance, metabolisms [37]
Vitamins (micros)			
Vitamin C*	60 mg	60 mg	Fight against the oxidative damage that occurs during ageing leading to the cognitive diseases like Alzheimer's diseases [38].
Vitamin D (IU)*	500 IU	500 IU	Associated with cognition, depression and cardiovascular disease, skin cancer and skin disease [39]
Vitamin E (mg)*	15	15	

*Source: Nutrient requirements and recommended dietary allowances for Indians (2009). A Report of the Expert Group of the Indian Council of Medical Research; National Institute Of Nutrition, Indian Council of Medical Research[40].

Physiological mechanism	Bioactive compound	Food	Reference
Reducing blood pressure	Anthocyanin, Lycopene, Dietary fibre	Whole grains, green leafy vegetables	[52]
Hypocholesterol	Allicin, Gingerols, Curcuminoids, Capsaicinoids, Piperine	Garlic, Ginger, Turmeric, Chilli pepper, Black pepper	[53]
Anti-cancer	Curcumins, Myricetin, Geraniin, Tocotrienol	Turmeric, Bird chillies, Vegetables oil	[54, 55]
Anti-diabetic	Polyphenols (Resveratrol, Quercetin), vitamins, Carotenoids	Nuts, Vegetables, Milk & milk products	[56, 57]
Increasing immunity	Fatty acids like omega-3,6	Fish & fish products, flax seed	[58]
Reducing macular degeneration	Vitamin A, lutein, and zeaxanthin	Papaya, spinach, carrot, milk & products	[59]

Evidence by Banu *et al*, testified that multigrain composite mixes developed using cereals, legumes, millets, nuts had significantly contributed 10 to 12% moisture, 56 to 61% carbohydrate, 15 to 20% protein, 9 to 13% crude lipid and 2 to 3% ash. Energy value ranged from ~1600 to 1700 kJ/100 g. Among vitamins studied, thiamine and riboflavin content varied from 0.23 to 0.45 mg and from 8.7 to 21.6 microgram% respectively. Dietary fiber was in the range of 12.4–16.5%. Polyphenols ranged from 1.2 to 1.5%, DPPH free radical scavenging activity ranged from 75.2–86.2% and metal chelating activity ranged from 1.9 to 3.9%. The phytic acid content of the multigrain composite mixes has varied from 0.6 to 0.8% (48).

Research findings by Ketki Dhumketi *et al* reports: The Upma mix developed using different combinations of foxtail millet, semolina, and soy had significant nutrition contribution in comparison to modified recipe followed by its sensory characteristics like color, and cooking quality evaluation. Modified upmamix using combination of 65% foxtail millet, 30% semolina, and 5% soy shown to be highly suitable with respect to the sensory properties. The cooked upmaevidently contributed moisture content from 37.4 to 40.2%, protein 11.8 to 12.9%, fat 6.3 to 8.1%, ash 2.05 to 3.91%, carbohydrate content 30 to 38% and provided energy value 245 to 258 Kcal/100 g. The L* value of cooked upma was decreased with an increasing level of foxtail millet during hunter color analysis. Cooking time of the modified upma found to be higher compared to the control sample prepared from wheat semolina and black gram dal. Upma formulation prepared from 95% foxtail millet and 5% soy exhibited higher water uptake and rehydration ratio. Modified Upmadeveloped offer inherent health benefits and open up better avenues for the millet product utilization towards nutritional security (49).

Maize based vermicelli using normal (NV) as well as QPM (quality protein maize-QV) was evaluated for nutritional composition, cooking quality, storage quality, and microbial load. The QV had significant proportion of protein (14.4 g), calcium (108.8 mg), magnesium (89.49 mg) compared to control vermicelli. The soluble and insoluble fiber contents of NV and QV were 9.38, 32.04, and 7.23, 18.22 mg respectively. While significantly more of insoluble fiber (32.04 mg) and zinc (7.65 mg) were found in NV compared to QV and CV. Maize based vermicelli took more time (seven min each) compared to CV (four min). Even the cooked weight was (251 and 250 g) respectively more for NV and QV compared to CV (239 g). Maximum overall acceptability scores were observed up to 3 months of storage, beyond which sensory scores affected significantly. Fresh samples were free of yeast and molds, while at the end of 6 months storage period fungal and mold counts were 1.10, 1.62, and 1.98 respectively for NV, QV, and CV samples. However, vermicelli was safe for consumption throughout the storage period of 6 month (50). In developing geriatric nutraceuticals, certain remarkable physiological changes, including taste loss during aging should be taken account. Therefore, in premix production, the substances should be carefully considered for the inclusion of flavor enhancers and textual enhancers. Since the taste of the product is vital, care must be taken to strengthen taste as well as flavors. Herbs and spices could add flavor to the premix product resulting to the success of the formulation. A Focus on medical issues experienced during ageing is crucial during the formulation as an adjunct therapeutic approach for managing disability and illness in elderly (51). Deepaterdal *et al*. (52)reports; the effect of wholesome grain based functional food formulation on 24-30 months old wistar albino rat equivalent to 60-75 years old human age.

In the group of diets, experimental diet groups were compared to control rat diet group I. Among four experimental formulation, group II was wheat based followed by finger millet (groupIII), group IV contains wheat based + fenugreek seed powder and finger millet diet + fenugreek seed powder was group V. The designed diets were fed to rats for 6 weeks. Then feeding time was over hematological biochemical parameters were evaluated. In the result group IV showed marked increase in the serum hemoglobin, the total serum protein values were significantly highest in Group III. Serum cholesterol and glucose were significantly reduced in Group IV. Several hematological and serum mineral values were influenced by the type of diet. A moderate hypoglycemic and hypercholesterolemic effect was observed in composite mix fed rats. Findings showed a significant health effects by using grain based functional foods in geriatric population. Total anti-oxidative properties of extracted foods like ragi, rajmah, amla, pomegranate juice and peel, wheat, sesame, flaxseeds, and turmeric was evaluated using In vitro method. Among the selected foodstuff; pomegranate peel gave the maximum antioxidant activity due to the presence of its high polyphenolic content. Along with pomegranate peel, extracts of rajmah, amla and turmeric also inhibited linoleic acid oxidation in a concentration-dependent manner(53).

CONCLUSION

The proposed review finding addresses the vital role of functional foods on the physiological condition during ageing. Achieving nutritional demand using functional foods as therapeutic regime are also highlighted. Vital roles of functional foods along with the consequences faced with medicinal values were underlined. Significantly findings depict the nutraceutical role of optimised functional food formulation on various clinical comorbidities and disease management during ageing.

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