Development of Calcium Rich Snacks and Instant Health Mix for Postmenopausal Women

S.Iswarya

(13PFN007)

Thesis submitted to
Avinashilingam Institute for Home Science and
Higher Education for Women
Coimbatore-641043.

In Partial Fulfilment of the Requirement for the Degree of

Master of Science in Food Science and Nutrition

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I INTRODUCTION

"You can't help getting older, but you don't have to get old"

- GEORGE BURNS

Nutrition is human's basic need and essential to a healthy life. Good nutrition, physical activity and maintaining a healthy body weight are fundamental to health and for the prevention of disease and disability. Food not only is a means of maintaining and improving physical health but has a valued place in the society (Ministry of health, 2003).

Good nutrition, health and access to an adequate diet are essential for growth and development, body maintenance and protection from both infectious and non-communicable diseases (NCDs). (FAO, 2013).

The aged or elderly belong to post mature adult group of the population. Ageing process involves changes in physiological, pathological, social and psychological condition of a person (Reddy, 2005). When a person grows older organs show reduced ability to perform physiological functions due to cell loss and reduced cell metabolism. Physiological changes that take place in old age may affect the food patterns, such as decreased secretion of digestive juices, decreased mortality of the gastro intestinal tract and decreased absorption and utilization of nutrients (Shubangini, 2010).

During aging process lifestyle changes occur and so degenerative diseases such as cardiovascular and cerebrovascular diseases, diabetes, osteoporosis and cancer, affect older persons. Micronutrient deficiencies are also common in elderly people due to a number of factors such as reduced food intake and lack of variety in the foods they eat. Compounding this situation is the fact that the older people often suffer from decreased immune function, which contributes to this group's increased morbidity and mortality. Other significant age-related changes include the loss of cognitive function and deteriorating vision, all of which hinder good health and dietary habits in old age (www.who.intu).

Women's health began to be obsessively debated by the whole society, with allegations of the frailty and illness, and the 19th century was called by some "the age of the womb". Weight (Martin et al., 2005). Disease and disability increase with advanced

aging but women face unique challenges with aging, partially due to their long life expectancy. Women live longer and have more chronic health conditions like osteoporosis, rheumatoid arthritis and other auto immune disorder (U.S. Department of Health and Human Services, 2006).

One of the conditions women face due to ageing is menopause. Like adolescence, it is a natural process in a woman's life span. Menopause is defined by the World Health Organization and the Stages of Reproductive Aging Workshop (STRAW) working group as the permanent cessation of menstrual periods that occurs naturally or is induced by surgery, chemotherapy, or radiation (National Institute of Health, 2005).

A woman is in menopause when she has not had a menstrual cycle for 12 consecutive months. For many women menopause brings unpleasant side effects such as hot flushes, mood swings, sleep disturbances, night sweats, depression and weight gain. Menopause can also bring serious health concerns because it increases the risk for bone loss and heart disease. Eighty percent of adults with osteoporosis are women (National Institute of Arthritis and Musculoskeletal and Skin Diseases, 2006).

At menopause, due to decreased gonadal sex steroid production rapid bone loss is present. The most rapid bone loss associated with decreased estrogen levels occurs in the first 8–10 years after menopause, with slower age-related bone loss occurring during later life. Age-related bone loss in women after the early menopausal phase of bone loss is caused by ongoing gonadal sex steroid deficiency, vitamin D deficiency, and secondary hyperparathyroidism (Bart, 2010).

Osteoporosis, often called the "silent epidemic", is a disease that takes a lifetime to develop and consequently a lifetime to prevent. It is characterized by a decrease in bone mass and deterioration of bone tissue with no outward signs or symptoms until late in the disease when bones become much fragile and are apt to break (Edelstein, 2009).

Women are four times more likely than men to develop osteoporosis. All over the world as the population increases the women are outnumbering men in osteoporosis cases and it is becoming women's public health issue. (Sundaravalli, 2012). Cummings, 2002 claims that osteoporosis is an increasing clinical and public health issue.

Calcium is a nutrient needed for strong bones, but the body cannot absorb it properly without the help of vitamin D. The combination of calcium and vitamin D helps strengthen bones and prevent osteoporosis. Vitamin D is a fat-soluble vitamin that is naturally present in very few foods and available only as a dietary supplement. It is also produced endogenously when ultraviolet rays from sunlight strike the skin and trigger vitamin D synthesis. Vitamin D obtained from sun exposure, food, and supplements is biologically inert and must undergo two hydroxylations in the body for activation. The first occurs in the liver and converts vitamin D to 25-hydroxyvitamin D (25(OH)D), also known as calcidiol. The second occurs primarily in the kidney and forms the physiologically active 1,25-dihydroxyvitamin D ($1,25(OH)_2D$), also known as calcitriol (Institute of Medicine, Food and Nutrition Board, 2010).

Vitamin D promotes calcium absorption in the gut and maintains adequate serum calcium and phosphate concentrations to enable normal mineralization of bone (Cranney, 2007 and Institute of Medicine, Food and Nutrition Board, 2010). Without sufficient vitamin D, bones can become thin, brittle, or misshapen. Together with calcium, vitamin D helps protect older adults from osteoporosis. Foods high in calcium include milk, yogurt and beverages fortified with calcium such as soy beverages, orange juice and Cheese. Very few foods have vitamin D in them. Foods with a higher amount of vitamin D include fish, liver, and egg yolk. (www.healthlinkbc).

Exercise especially of the weight bearing type, is important in maintaining bone density. Smoking, alcohol and poor diet are the predisposing factors in reducing bone density. Hence these life style modifications help in maintaining a bone density.

Snacks and health mix are the best way to enrich the diet with calcium rich foods because it can be easily prepared and is a light meal which can be taken in between regular meals. It is widely accepted because it is attractive. Snacking is an effective way to fit extra nutrients into the diet and avoid overeating at mealtimes. But portion control is an essential component for snacking to avoid complications like obesity and CVD. Hence healthy cooking practice along with portion control helps in avoiding such complications.

Calcium rich ingredients like ragi, soya flour, agathi leaf, spinach leaf, fenugreek leaf, drumstick leaf and broccoli are selected. No other cereal comes close to ragi when it comes to calcium content. Calcium is a significant factor when it comes to bone development and prevention of osteoporosis.Soy is high in isoflavones which is a type of phytoestrogen. Soy products may improve menopausal symptoms, such as hot flashes. Green leafy vegetables like agathi leaf, spinach leaf, fenugreek leaf, drumstick leaf and broccoli leaf are rich in calcium and are locally available leafy vegetables and the leaves retain lots of vitamins and minerals. These ingredients are rich in several vitamins and minerals which help in maintaining the bone health and the isoflavone properties help in reducing the menopausal symptom.

Hence it is important to "Enrich the diet in Postmenopausal women" with calcium foods to sustain their health status. Therefore the present study was undertaken for the development of calcium rich snacks and instant health mix for promoting the health of postmenopausal women.

With these backdrops, an earnest effort has been taken to use the locally available low cost calcium rich foods in the most meaningful way.

Hence the present study was designed and carried out in the following objectives.

1. Elicit the information on socioeconomic status and dietary pattern of the postmenopausal women residing in selected area for identification of subjects and imparting nutrition education to the selected postmenopausal women.
2. Development and formulation of calcium rich snacks and instant health mix.
3. Shelf life study of instant health mix with different packaging material.

II REVIEW OF LITERATURE

The review of literature pertaining to the study **"Development of calcium rich snacks and instant health mix for postmenopausal women"** is discussed under the following aspects.

A. Ageing and its indication
B. Nutritional requirements for postmenopausal women
C. Effect of calcium and vitamin D on postmenopausal women
D. Health benefits of ragi, soya, agathi, spinach, fenugreek, drumstick and broccoli leaves
E. Management of osteoporosis.

A. Ageing and its indication

Human biological growth and decline extends over the entire life time. Throughout life, all experiences make their imprint on individual's genetic heritage. Every one ages in different ways depending upon individual makeup and resources. (Stacimix, 2008)

Ageing is a lifelong activity from the stage of birth, through infancy, childhood and adolescence to adulthood and onwards towards maturity. Old age is defined as the age of retirement for it is at that time the combined effect of aging, social changes and diseases are likely to cause a breakdown in health. (John and Arulmani, 2004)

Beevi, 2008 states that aging is a universal phenomenon and natural biological process of the lifestyle. As people grow older, they tend to become physiologically less active and therefore need few calories to manage their weight. These are mostly determined by nutrition, genetics, socio-economic, physiological conditions, illness and health care are necessary for them to lead a normal life.

Immuno competence declines with age, immune response is slower and less efficient. The progressive decline in T. lymphocyte function and cell-mediated immunity is a major contributor of the increased infection and cancer rate seen in aging population. (Brave et al., 2004).

B. NUTRITIONAL REQUIREMENTS OF POSTMENOPAUSAL WOMEN

Energy expenditure decreases with advancing age at a rate of about 150 kcal per decade and is accompanied by a decrease in energy consumption. Nutrition could be an important modifiable factor in the development and maintenance of bone mass and the prevention and treatment of osteoporosis. (JZ Ilich et al., 2003).

Improving the nutritional status by consuming a varieddiet and maintaining a healthy lifestyle throughout aging process has immense benefits. Adequate nutrition helps to give the immune system a boost in its fighting power by providing the necessary amounts of vitamins and minerals.

Energy

Basal metabolic rates (BMR) decrease linearly with age, this change is the result of the body composition changes. Energy needs decrease approximately three percent per decade. The body needs energy for maintaining body temperature and metabolic activity and for supporting physical work and growth. The energy allowances recommended are designed to provide enough energy to promote satisfactory growth and to maintain constant appropriate body weight and good health in adults. The energy requirements for adult women are 1900-2850 Kcal/day depending upon their activity. (ICMR, 2009)

Carbohydrates

Carbohydrates should make up 45-65 percent of the calories in the diet. Because food with primarily simple carbohydrates provides little nutritive value, the best choices are foods with complex carbohydrates. The reference value for carbohydrate for an average adult is 310 grams. The adequate intake for fibre is 21g/day for women (http://www.mydailyintake.net/nutrients/).

Protein

Dietary proteins provide amino acids for the synthesis of body proteins, both structural proteins and biologically active enzymes and other biologically important nitrogenous compounds in the body. Dietary proteins should supply the eight essential amino acids (EAA) in proper proportions and in adequate quantities to synthesize tissue

proteins in the body. The protein requirement for adult women is 1.0g/k/day (ICMR, 2009).

Protein should be the fundamental part of a complete diet for adults. While physical growth occurs only for a brief period of life the need to repair and remodel muscle and bone continues all through life. The majority of the observational studies support a positive association between protein intake and bone health. These studies reveal that individuals who consume the most dietary protein have the highest BMD. In addition, prospective studies have observed that individuals with the highest protein intake have the slowest rate of bone loss (Rapuri et al., 2003). Robert (2014) observational data suggest improved health outcomes in the elderly, who have higher protein intakes.

Fat

Dietary fat (lipids) provides energy and essential fatty acids, serves as a vehicle for fat-soluble vitamins and facilitates their absorption. Since fat provides high energy value (9 kcal or 37.7kJ/g) as compared to carbohydrates or proteins (4 kcal or 16.7 kJ/ g), the fat content of a diet contributes significantly to its caloric density. The dietary recommendations for fat is 20g/day. (ICMR, 2009)

Women need dietary fat to help with vitamin absorption, energy production and hormone regulation. Certain types of fat, called omega-3 fatty acids promote heart health and brain function. Omega-3 fatty acids can be obtained specifically from fatty fish, flaxseed and walnuts. (livewell.jillianmichaels.com)

Vitamin D

Vitamin D is necessary for the development and maintenance of bone, both for its role in assisting calcium absorption from the diet, and for assuring the proper renewal and mineralization of bone tissue. Vitamin D deficiency is characterized by inadequate mineralization of the skeleton. In adults, severe vitamin D deficiency leads to a mineralization defect in the skeleton causing osteomalacia (International osteoporotic foundation, 2006).

In addition, the secondary hyperparathyroidism associated with low vitamin D status enhances mobilization of calcium from the skeleton. There is considerable evidence that vitamin D deficiency is an important contributor to osteoporosis through less efficient intestinal absorption of calcium, increased bone loss, muscle weakness, and a weakened bone microstructure. In a meta-analysis study, the anti fracture efficacy of oral vitamin D supplementation in older persons was evaluated by Bárbara, 2010. The author showed that vitamin D intakes of 700-800 IU/day reduced the relative risk of hip fracture by 26 percent and any non vertebral fracture by 23% percent compared with calcium or placebo (Bárbara, 2010).

Increasing vitamin D intake can significantly reduce the risk of osteoporosis and bone fracture in older people. A recent study of Caucasian postmenopausal women from the National Osteoporosis Risk Assessment study (NORA) reported that lifetime vitamin D intakes were also associated with reduced risk for osteoporosis over three years (Nieves, 2008).

Vitamin A

Vitamin A is involved in immune functions, vision, reproduction and cellular communication. Vitamin A also supports cell growth and differentiation, playing a critical role in the normal formation and maintenance of the heart, lungs, kidneys and other organs (Ross, 2010).

The ICMR, 2004 recommends 600 µg/kg for an adult women. Epidemiologic data show that populations with high levels of vitamin A intake are at increased risk for osteoporotic fractures, although possibly only in those who are deficient in vitamin D. The tolerable upper limit intake (UL) for vitamin A is 3,000 mcg per day. (Caire-Juvera, 2009)

Vitamin K

Vitamin K is found in green leafy vegetables, and its intake varies widely. The RDA for vitamin K is approximately 1 mcg per kg of body weight and is based on the amount needed for normal functioning of the clotting cascade. Osteocalcin is a protein produced by osteoblasts which has a role in bone mineralization, the activity of which is determined by its level of vitamin K-dependent carboxylation. Studies have correlated a

higher fracture rate with under-carboxylatedosteocalcin. Since vitamin K intakes reported for the general population do not ensure complete carboxylation of osteocalcin, vitamin K requirements for bone function may be higher than what is needed to maintain hemostasis (Booth, 2009).

Calcium

The mineral calcium plays a major role in bone strength and is of prime nutritional importance in osteoporosis, being essential for bone health throughout life (North American menopause society, 2006).

The primary role of calcium in the body is structural, providing the rigidity necessary for the skeleton and teeth to function mechanically. Bone contains about 99% of the body's calcium. Calcium in body fluids also exerts critical metabolic functions, binding to proteins, and operating as a signal transmitter and protein activator within cells. Muscle contraction and nerve transmission are two of the many body functions that rely on calcium for activation. Additionally, calcium is also involved in blood clotting (Heaney, 2009).

ICMR published a review on calcium nutrition and osteoporosis in Indian females where they carried out a study in two groups of women in the age range 20-90 years with median intakes of calcium of 800 (with lifetime milk consumption) or 480 mg/d (who consumed no milk or less) in whom BMD was measured. The group with higher intake of calcium entered osteoporotic and fracture zones of bone density 10 years later than those with lower intake. (ICMR, 2009).

Magnesium

Approximately 60 percent of the magnesium (Mg) in the body is in bone. Magnesium also influences bone health by direct effects on bone quality, decreasing hydroxyapatite crystal size, thereby preventing the larger, more perfect mineral crystals that could lead to brittle bone. Magnesium is fairly widespread in the food chain particularly good sources include green vegetables, legumes, nuts, seeds, unrefined grains, and fish. Macdonald, 2005 have found a positive association between fruit and vegetable consumption and bone health. The ICMR, 2009 recommends 5.7mg/kg/day of magnesium.

Phosphorous

The majority of the Phosphorus in the body is found as phosphate (PO4). Approximately 85percent of the body's phosphorus is found in bone. Phosphorus is found in most foods because it is a critical component of all living organisms. Dairy products, meat, and fish are particularly rich sources of phosphorus (Bonjour, 2009). The ICMR, 2009 recommends 600-800mg of phosphorous per day.

Iron

The association of dietary iron with bone mineral density (BMD) has not been widely studied and its role in bone mineralization remains largely unknown. It has been established that iron is an important mineral for all cells, including osteoblasts, which are involved in bone formation. Several studies reported that iron overload and iron deficiency are both associated with low bone mass. (Margaret, 2003)

Iron requirements for premenopausal women are more than twice that for men, but after the age of menopause those requirements decrease so that requirements are the same for both sexes. Iron deficiency in the elderly is more commonly the result of illness than inadequate intake. (Robert, 2014) The ICMR, 2009 recommends 30 mg of iron per day.

C. Effect of calcium and vitamin D on post menopausal women

Nutrition plays an important role in the etiology and pathogenesis of senile osteoporosis. Postmenopausal women are most vulnerable to osteoporosis. Normal bone is constantly being remodeled. During menopause, the balance between these processes changes, resulting in more bone being reabsorbed than rebuilt. Nutrition plays a critical role in reducing the risk of osteoporosis through its effect on all of these fragility factors, especially on the development and maintenance of bone mass. Maintaining optimal nutrition and weight bearing activities have been shown to reduce the risk of osteoporosis by as much as 50% (Bárbara, 2010)

Two of the most important nutrients for bone health are calcium and vitamin D. Approximately 99 percent calcium is found in bone and it is a component of hydroxyapatite. In later years inadequate dietary calcium accelerates bone loss and may contribute to osteoporosis. Because osteoporosis is irreversible, the most effective

approach to reduce morbidity and mortality from this disease is to maximize peak bone mass and minimize bone loss (Albert, 2003).

In 1993, the U.S. Food and Drug Administration authorized a health claim related to calcium and osteoporosis for foods and supplements. In January 2010, this health claim was expanded to include vitamin D. Model health claims include the following: "Adequate calcium throughout life, as part of a well-balanced diet, may reduce the risk of osteoporosis" and "Adequate calcium and vitamin D as part of a healthful diet, along with physical activity, may reduce the risk of osteoporosis in later life"(U.S. Food and Drug Administration, 2010).

Vitamin D is a fat-soluble vitamin that is naturally present in very few foods, added to others, and available as a dietary supplement. It is also produced endogenously when ultraviolet rays from sunlight strike the skin and trigger vitamin D synthesis. Vitamin D promotes calcium absorption in the gut and maintains adequate serum calcium and phosphate concentrations to enable normal mineralization of bone and to prevent hypocalcemictetany. It is also needed for bone growth and bone remodeling by osteoblasts and osteoclasts (cranney 2007).

Milk, yogurt, and cheese are rich natural sources of calcium. Nondairy sources include vegetables, such as Chinese cabbage, kale, and broccoli. Very few foods in nature contain vitamin D. Vitamin D in these foods is primarily in the form of vitamin D_3 and its metabolite $25(OH)D_3$. Some mushrooms provide vitamin D_2 in variable amounts. Mushrooms with enhanced levels of vitamin D_2 from being exposed to ultraviolet light under controlled conditions are also available. (Calvo, 2004).

Institute of Medicine (IOM) Food and Nutrition Board recommends 1200 mg of elemental calcium per day. National osteoporotic foundation (NOF) recommends 800–1000 IU of vitamin D after age 50, Association of Clinical Endocrinologists (AACE) recommends 800 IU for the elderly (Institute of Medicine and National Osteoporosis Foundation, 2010).

A review by heaney indicated that among vitamins and minerals, calcium and vitamin D are the most closely related to bone health. Therefore if calcium and vitamin D are below optimal levels, supplementation has an important role in bone health, to reduce calcium loss and bone remodeling, which are responsible for the osteoporotic changes (Hitz, 2007).

D. Health benefits of the ingredients used ragi, soya, agathi, spinach, fenugreek, drumstick and broccoli leaves

1. Ragi

Finger millet or ragi is one of the ancient millets in India (2300 BC). It has high dietary fiber, minerals, and sulfur containing amino acids compared to white rice, the current major staple in India. (Shobana et al., 2013)

It is a very good source of dietary fibre, micronutrients and polyphenols. The lower fat contents could be one of the contributing factors for the extremely good shelf life of finger millet. (Mathanghi et al, 2012)

Finger millet contains about 5–8% protein, 1–2% ether extractives, 65–75% carbohydrates, 15–20% dietary fiber and 2.5–3.5% minerals. It has the highest calcium content among all cereals (344 mg/100 g). (Pragya and Rita singh, 2012)

2. Defatted soy flour

Allen 2007, studied the effect of supplementation of soya protein in postmenopausal women with metabolic syndrome and showed significant reduction in cholesterol level after 8 weeks of replacing a daily serving of red meat with soy protein. North American Society in 2006 recommended that 40-80mg of soy isofalvones daily to help relieve menopausal symptoms. The phytoestrogens in soy foods are “anti-estrogens”, they may block estrogen from reaching the receptors-therefore potentially protecting women from developing breast cancer.

Mehrabi, 2007, quoted that many soy foods are naturally high in calcium (some fortified with calcium because it is a good source of a particular coagulating agent). In addition, soy also contains magnesium and boron, which are important co-factors of calcium for bone health.

3. **Agathi**

Agathi is an excellent source of chromium that helps regulate insulin and blood sugar Along with diabetes it is a complete package of versatile disease fighters. It has antiviral, anti ulcer activity (http://www.medindia.net)

Laladhas, 2009 conducted a study to show potential anticancer and chemo preventive efficacy, in vitro and in vivo of a novel protein fraction from agathi and the study strongly support in vitro findings as administration increased the shelf span and decreased the tumour volume in mice bearing tumour.

4. Spinach

Spinach is one of the best green vegetables for the health. It contains a huge quantity of nutrients and offers several specific health benefits. Among the most concentrated nutrients are magnesium, folate, iron, potassium, calcium, vitamin E, protein and zinc. (Ronald, 2008)

5. Fenugreek

Thomas et al, 2011 stated that the green leaves of fenugreek one of the most ancient medicinal herbs. The green fenugreek leaves (fresh or dried) are used as herb. The fresh leaves are used in the vegetables as green leafy vegetable in the diets. Fenugreek leaves provide β-carotene, fibre, calcium and zinc. (Murlidhar, 2012)

The leaves contain moisture 86.1%, protein 4.4%, fat 0.9%, minerals 1.5%, fiber 1.1%, and carbohydrates 6%. The plant contains active constituents such as alkaloids, flavonoids, steroids, Saponins etc. It is an old medicinal plant. It has been commonly used as a traditional food and medicine. Fenugreek is known to have hypoglycemic, and hypo cholesterolaemic, effects, Anti inflammatory effects. (Helambe et.al, 2012)

6. Drumstick leaves

Drumstick leaves (Moringaoleifira) which is available at low cost is very rich in all the micronutrients. The leaves are highly nutritious, being a significant source of beta - carotene, Vitamin C, protein, iron, and potassium. Its leaves are full of medicinal properties. The tree is a good source for calcium and phosphorus. (Pallavi and Dipika et al., 2010).

7. Broccoli

Broccoli is known as the “crown jewel of nutrition” since it posses all the nutrients namely vitamins, minerals, secondary metabolites and fiber proclaiming its exceptional health benefits. The breakdown products of the sulfur containing glucosinolates, isothiocyanates are the active principles in exhibiting the anticancer property at every stage (Hannah et al., 2009).

Broccoli leaves are one which are available at no cost and are rich in all the macronutrient. It is an exceptionally nutritious vegetable with a variety of potential uses.). It is a good source of protein, thiamin, niacin, pantothenic acid, calcium, iron, and selenium and a very good source of vitamin A, Vitamin C, riboflavin, vitamin B6, folate, magnesium, phosphorus, potassium and manganese(Mahro and Timm, 2007).

Broccoli is considered a low glycemic food which helps to normalize blood sugar. One of the keys to weight loss in controlling response to insulin. It also gives a boost to enzymes which helps to detoxify the body. Detoxification leads to weight loss and helps prevent certain diseases Thus, broccoli floret and leaf powder have the potential to be used as food natural supplements as well as raw material for the extraction of chemopreventive compounds (Madhu and Kochhar, 2014).

E. Management of osteoporosis in postmenopausal women

Osteoporosis is a condition in which bones become very weak and can break easily. Often, the first sign of osteoporosis is a bone that cracks, sometimes after just straining or twisting. Osteoporotic fractures are associated with substantial morbidity and mortality in postmenopausal women. Management strategies for osteoporosis in postmenopausal women require assessment of risk factors for BMD-defined osteoporosis and osteoporotic fracture, followed by institution of measures that focus on reducing risk factors through lifestyle changes. (The Journal of the North American Menopause Society, 2010).

A balanced diet is important for bone development and maintenance. A combination of calcium and vitamin D is important for helping to prevent the bone loss associated with menopause. Optimal bone health depends on adequate calcium. The National Osteoporosis Foundation recommends a daily calcium intake of 1200 mg/day for women over the age of fifty years (National osteoporotic foundation, 2003).

Vitamin D plays a critical role in promoting absorption of calcium from the gut and that insufficient absorption results in lower serum calcium levels. These lower levels trigger the release of parathyroid hormone, which mobilizes calcium from bone (secondary hyperparathyroidism), ultimately resulting in osteopenia and eventually osteoporosis (Golowaki, 2003).

In addition to ensuring adequacy of calcium and vitamin D, a balanced diet throughout life is important for bone health. Adequate calcium intake is a fundamental aspect of any osteoporosis prevention or treatment program and a lifestyle issue for healthy bones at any age. Adequate calcium intake from food sources and supplements promotes bone health. When food sources do not provide enough calcium, supplements can be used to meet this goal. Bioavailability of calcium in food sources and supplements is a factor in achieving daily calcium recommendations (American association of clinical endocrinologist, 2010).

Exercise for women with osteoporosis should not include high-impact aerobics or activities in which a fall is likely, such as exercising on slippery floors or step aerobics. Physical activity plays an important role in reducing the risk of falls by maintaining muscle strength, agility, and balance. Among women age 75 and older, muscle strengthening and balance exercises have been shown to reduce the risk of falls and fall-related injuries by 75% (Robertson, 2002).

Hallström et al. (2013) opines that high intakes of coffee and caffeine have been associated with increased risk of fractures in some observational studies of women. , it has been suggested that caffeine has direct or indirect deleterious effects on osteoblasts . Caffeine might contribute to loss of bone by increased urinary calcium excretion and a decreased intestinal absorption efficiency of calcium.

All postmenopausal women should be encouraged to employ lifestyle practices that reduce the risk of bone loss and osteoporotic fractures: (i.e) maintaining a healthy weight, eating a balanced diet, obtaining adequate calcium and vitamin D, participating in appropriate exercise, avoiding excessive alcohol consumption, not smoking, and taking care to prevent falls. Periodic reviews of calcium and vitamin D intake and lifestyle behaviors are useful. After menopause, a woman's risk of falls should be assessed annually and at any time her physical or mental status changes.

III METHODOLOGY

The methodology pertaining to the study on "**Development of calcium rich snacks and instant health mix for postmenopausal women**" is presented under the following headings.

PHASE I

To elicit information about socio economic, life style and dietary pattern of selected postmenopausal women

A. Study design
B. Selection of locale and subjects
C. Formulation of the tools to conduct socio-economic survey
D. Anthropometric measurement of the selected postmenopausal women
E. Assessment of the dietary pattern of the selected postmenopausal women

PHASE II

A. Selection of ingredients for development and formulation of calcium rich snacksand instant health mix
B. Composition of recipes compared with standard
C. Organoleptic evaluation and overall acceptability of the developed snacks and instant health mixes.
D. Shelf life of the instant health mixes with different packaging material
E. Imparting nutritional education to the selected postmenopausal women

PHASE III

A. Analysis of data

PHASE I

A. Study Design

Talbot (1995) defined study design as the structural frame work for the study implementation, including selection of design, data collection and methods of sampling

and data entry or analysis of data. As such the design includes an outline of what the researchers will do from writing the hypothesis and its operational implications to the final analysis of data (Kothari, 2005)

Sampling is simply the process of learning about the population on the basis of a sample drawn from it (Gupta, 2005). A sample design is a definite plan for obtaining a sample from a given population. It refers to the technique or the procedure the researcher would adopt in selecting items for the sample (Kothari, 2005).

B. Selection of Locale and Subjects

The area chosen for the conduct of the study was in and around Coimbatore city due to the familiarity of the investigator with these areas.

Coimbatore district called as "Manchester of south India"is one of the districts of the state of Tamilnadu in India. As of 2011, Coimbatore district has a population of 3,458,045.In 2011 census, Coimbatore had a population of 1,728,748 elderly women. This city has most wide infrastructure to facilitate the study and so Coimbatore city was selected for the conduct of study.

Old age, the pivotal stage in the lifecycle is critical in terms of natural cessation of menstruation. They need extra nutritional care to promote and to maintain their nutritional and health status. The subjects for the survey were selected by purposive sampling method. "Purposive sampling is one arbitrarily selected because there is good evidence that it is very representative of the total population". (Taylor et al, 2007)

A total of 100 female subjects aged 48-65 years were selected for the assessment of their anthropometry and diet pattern. The inclusion criteria for selecting the subjects were women who had attained menopause within the age of 48-65 years and who were willing to volunteer for the study. The exclusion criteria were the women who have not attained the menopause.

The research design and the protocols used in the study were submitted for scrutinisation and approval to the Institutional Ethical Committee and Ethical Clearance

approval **NO. IHEC/14-15/FSN/12** was obtained. The Ethical clearance certificate was given by the Instituitional Ethical Committee is given in Appendix I.

C. Formulation of Tools to Conduct Socio-economic Survey

According to Kothari (2007), an interview schedule is a proforma containing a set of questions. They are generally asked and filled by the investigator in a face to face situation with another person (Gupta 2007). Interview schedule is a commonly used method of data uptake due to their case of analysis and their ability to target groups. They are inexpensive and also allow participant anonymity to be kept. The questionnaire was prepared in conformity with the objectives of the study.Personal interviewing is a two way purposeful conversation initiated by an interviewer to obtain information that is relevant to some research purpose (Saravanavel, 2007)(Plate I).

A well structured interview schedule was developed by the investigator to survey the postmenopausal women to elicit the required information on the socio-economic status and dietary pattern. The formulated questionnaire had details about the background information relating to age, education, number of family members, occupation, income of the family, monthly food expenditure pattern, meal planning, nutrition and health status, age at menarche, problems faced during menstrual cycle, age at menopause, problems faced during menopause, frequency of calcium and vitamin intake were all collected with the help of the interview schedule. (Appendix II)All the subjects were personally interviewed by the investigator and the relevant data was ensured by questioning and cross-questioning the subjects. The information were recorded in the proforma and consolidated.

D. Anthropometric Measurement of the Selected Postmenopausal Women

The nutritional status is the assessment of the state of nourishment of an individual. The nutritional status of an individual is often the result of many interrelated factors,influenced by the adequacy of food intake both in terms of quantity and quality and also by the physical health.

PLATE I

INVESTIGATOR INTERVIEWING THE SUBJECT

Anthropometry is a measurement of body size, weight and proportions and is one of the most intermittently performed health and nutrition screening procedures. The measurements of human body reflect changes in morphological variation occurring due to a significant functional physiological change (Bamji, 2009). Anthropometry is a simple and reliable method for assessing nutritional status.

The most commonly used anthropometric measurements to determine the nutritional status are measurement of height and body mass index, waist hip ratio and waist circumference. They were measured using standardized techniques as given below.

i) Measurement of height

The height or total length of an individual is influenced both by genetic and environmental factors (Bamji, 2009). The height was measured with the help of anthropometer to the nearest 0.1 cm by making the individual stand barefooted with heads straight and legs erect. The height was recorded accurately to the nearest 0.1 cm. each recording was taken twice to ensure correctness of the measurement. The average of both the readings was recorded as the actual height.

It is the most sensitive means of evaluating the overall wellbeing of an individual. It is considered as index of chronic or long duration mal nutrition.

ii) Measurement of weight

Weight indicates the body mass and is a composite of all body constituents and was measured using a portable weighing scale. The weighing scale had 0.5 kg sensitivity and checked for accuracy and adjusted to zero before each measurement. The individual was asked to remove foot wear, wear light clothing and to stand on the platform with one foot on either side of the scale without holding on to anything with head comfortably erect. Their weight was recorded to the nearest 0.1kg. Each reading was taken twice to ensure correctness of the measurement and the average of both the readings was recorded as the actual weight (Plate II).

PLATE II

ASSESSING ANTHROPOMETRIC MEASUREMENT

iii) Body mass index

Weight for height indicates muscle fat mass in the body. The ratio of weight in kg by height in m^2 is referred to as body mass index (BMI). (Bamji, 2009)

BMI=Weight in Kg/Height in m^2

TABLE I

BMI Weight classification

BMI	Weight Status
Below 18.5	Underweight
18.5 - 24.9	Normal
25 - 29.9	Overweight
30.0 +	Obese

(World health organization, 2004)

BMI provides a reasonable indication of the nutritional status of the adults. The BMI has good correlation with fatness. It may also be used as indicator of health risk (Bamji, 2009). The BMI was calculated with the help of the height and weight

iv) Waist- hip ratio

Waist hip ratio gives distribution of fat in the human body. The ratio of waist to hip is an indicator of central obesity. Adult men with waist hip ratio of ≥1.0 and women with ≥0.8 are considered as having central obesity (Bamji, 2009).

People with more weight around their waist are at greater risk of lifestyle related diseases such as heart disease and diabetes than those with weight around their hips. The hip circumference was taken at the widest part of the hip and waist circumference of the belly bottom.

v) Waist circumference

Waist circumference refers to a numerical measurement of waist. It is measured using fibre reinforced plastic tape. The tape should pass midway between the lower rib

margin and iliac rest. Adult men with waist circumference ≥102cms and adult women with ≥88cm considered as abdominal obesity (Bamji, 2009).(Plate II)

E. ASSESSMENT OF THE DIETARY PATTERN OF THE SELECTED POSTMENOPAUSAL WOMEN

Diet is vital determinant of health and nutritional status of people. Precise information on food consumption patterns of people, through application of appropriate methodology is often needed not only for assessing the nutritional status of people but also for elucidating the relationship of nutrient intake with deficiency as well as degenerative diseases (Bamji, 2009).

Twenty four hour recall method is used for assessing the dietary pattern of the selected postmenopausal women. The 24-hour` diet recall interview is a quantitative research method used in nutritional assessment, which asks individuals to recall foods and beverages they consumed in the twenty-four hours prior to the interview. This method records the daily, self-reported consumption of individuals and is most authentic when administered more than once for each participant.

PHASE II

A. SELECTION OF INGREDIENTS FOR DEVELOPMENT AND FORMULATION OF CALCIUM RICH SNACKS AND INSTANT HEALTH MIX

By conducting dietary survey for postmenopausal women, the ingredients for the formulation of the health mix and snack recipes were selected, based on their intake of calcium rich foods (Gupta, 2005)

Survey revealed that intake of calcium rich foods in the diet was very less among the postmenopausal group. So a calcium rich snacks and health mix was developed which is low in fat. The developed snacks are Momos, khakra, pan cake, mutia and chapathi roll and the health mix was prepared incorporating different green leafy vegetables. The ingredients used for health mix and recipes are ragi flour, soya flour, agathi leaf, drumstick leaf, broccoli, palak leaf and fenugreek leaf powder.(Plate III and Appendix III)

Product development is systematic, commercially oriented research to develop products and processes, satisfying a known or suspected consumer need. Product development is a method of industrial research in its own right. It is a combination and application of natural sciences with the social sciences – of food science and processing

with marketing and consumer science – into one type of integrated research whose aim is the development of new products (Ray and Gavin-FAO, 2006).

Instant mixes are the most convenient stable foods which requiresreconstituition in boiling water simmering for 2-10 minutes, depending on the type of processing and the composition of the food. In general these are precooked and dehydrated foods which need rehydration later to bring then to cooked form, ready to be eaten (Gade, Kshirsagar, Sawate and Patil, 2012).

1. Ragi flour

Finger millet or ragi is one of the ancient millets in India (2300 BC). It has higher dietary fiber, minerals, and sulfur containing amino acids compared to white rice, the current major staple in India. It has the highest calcium content among all cereals (344 mg/100 g).(Shobana et al., 2013)

2. Defatted soy flour

Allen 2007, studied the effect of supplementation of soya protein in postmenopausal women with metabolic syndrome and study showed significant reduction in cholesterol level after eight weeks of replacing a daily serving of red meat with soy protein. North American Society in 2006 recommended that 40-80mg of soy isofalvones daily to help relieve menopausal symptoms.

3. Agathi leaves

Laladhas, 2009 conducted a study to show potential anticancer and chemo preventive efficacy, in vitro and in vivo of a novel protein fraction from agathi and the study strongly support in vitro findings as administration increased the shelf span and decreased the tumour volume in mice bearing tumour

4. Spinach leaves

Spinach is one of the best green vegetables for the health. It contains a huge quantity of nutrients and offers several specific health benefits. Among the most concentrated nutrients are magnesium, folate, iron, potassium, calcium, vitamin E, protein and zinc. (Tom et al, 2014)

Spinach has only 41 calories/100g, but it is extremely nutrient-dense. It has an excellent source of vitamin K and carotenes. It was regarded as a plant with remarkable

abilities to restore energy, increase vitality, and improve the quality of the blood (Michael, 2010).

5. Fenugreek leaves

Thomas et al, 2011 stated that the green leaves of fenugreek are one of the most ancient medicinal herbs. The fresh leaves are used in the vegetables as green leafy vegetable in the diets. These leaves provide β-carotene, fibre, calcium and zinc. (Murlidhar, 2012).

Jani et al.tested about the mineral content of various food items like pulses (dal), bread (chapatti) and fenugreek leaf vegetables by feeding them to children of 13-24 months of age group and found that fenugreek leaves had high calcium, iron and zinc content compared to those available in other food items chosen for this study (Jani, 2009).

6. Drumstick leaves

Drumstick leaves (Moringaoleifira) which is available at low cost and is very rich in all the micronutrients. The leaves are highly nutritious, being a significant source of beta - carotene, Vitamin C, protein, iron, and potassium. Its leaves are full of medicinal properties. The tree is a good source for calcium and phosphorus. (Pallavi and Dipika et al., 2010)

7. Broccoli

Broccoli is known as the “crown jewel of nutrition” since it posses all the nutrients namely vitamins, minerals, secondary metabolites and fiber proclaiming its exceptional health benefits. The breakdown products of the sulfur containing glucosinolates, isothiocyanates are the active principles in exhibiting the anticancer property at every stage (Hannah et al., 2009).

Other constituents are proteins (2.82%), total dietary fibre (2.60%) and carbohydrates (6.64%). It is a rich source of minerals such as potassium, phosphorus, calcium and sodium. Additionally, broccoli provides vitamins, especially vitamin C, vitamin A and folic acid (US Department of Agriculture, 2011).

KHAKRA

PANCAKE

CHAPATHI ROLL

MOMOS

MUTIA

PLATE III

DEVELOPED RECIPES

B. COMPOSITION OF RECIPES AND HEALTH MIX COMPARED WITH STANDARD

1. Khakra

Table II presents the composition of the ragi flour and soya flour in khakra

TABLE II

COMPOSITION OF THE RAGI FLOUR AND SOYA FLOUR IN KHAKRA

Ingredients	Standard	Variation 1	Variation 2	Variation 3
Ragi flour	-	10g	15g	20g
Soya flour		10g	15g	20g
Wheat flour	100g	80g	70g	60g

2. Pancake

Table III presents the composition of the ragi flour and soya flour in pancake.

TABLE III

COMPOSITION OF THE RAGI FLOUR AND SOYA FLOUR IN PANCAKE

Ingredients	Standard	Variation 1	Variation 2	Variation 3
Ragi flour		10	15	20
Soya flour		10	15	20
Maida	100	80	70	60
Salt	½ tsp	½ tsp	½ tsp	½ tsp
Egg	1	1	1	1
Milk	250 ml	250 ml	250 ml	250 ml
Sugar	60	60	60	60
Lime	½	½	½	½
Fat	10	10	10	10

3. Steamed Mutia

Table IV presents the composition of the ragi flour and soya flour in steamed mutia.

TABLE IV

COMPOSITION OF THE RAGI FLOUR AND SOYA FLOUR IN STEAMED MUTIA

Ingredients	Standard	Variation 1	Variation 2	Variation 3
Ragi flour	-	10	15	20
Soya flour	-	10	15	20
Besan	80	60	50	40
Methi leaves	10	10	10	10
Semolina	10	10	10	10

4. Momos

Table V presents the composition of the ragi flour and soya flour in momos.

TABLE V

COMPOSITION OF THE RAGI FLOUR AND SOYA FLOUR IN MOMOS

Ingredients	Standard	Variation 1	Variation 2	Variation 3
Ragi flour	-	10	15	20
Soya flour	-	10	15	20
Maida	100	80	70	60

5. Chapathi roll

Table VI presents the composition of the ragi flour and soya flour in chapathi roll

TABLE VI

COMPOSITION OF THE RAGI FLOUR AND SOYA FLOUR IN CHAPATHI ROLL

Ingredients	Standard	Variation 1	Variation 2	Variation 3
Ragi flour	-	10	15	20
Soya flour	-	10	15	20
Wheat flour	100	80	70	60

6. HEALTH MIX

Table VII presents the composition of the health mix with green leafy vegetables incorporation.

TABLE VII

COMPOSITION OF THE HEALTH MIX WITH GREEN LEAFY VEGETABLES INCORPORATION

Ingredients	Standard	Variation 1	Variation 2	Variation 3
GLV's (Fenureek powder/ broccoli powder/ palak leaf powder/ agathi leaf powder/ drumstick leaf powder	-	10	15	20
Ragi	20	10	15	20
Soya flour	-	10	15	20
Broken wheat	50	40	25	10
Roasted gram	15	15	15	15
Barley	15	15	15	15

C. ORGANOLEPTIC EVALUATION AND OVERALL ACCEPTABILITY OF THE DEVELOPED SNACKS AND INSTANT HEALTH MIXES

Sensory evaluation is a part of food science called sensory science, which is dedicated for finding ways to use humans to accurately describe the flavors and other sensory properties of foods (Potter and Hotchkiss, 2007). It has been defined as a scientific discipline used to evoke, measure and analyse and interpret.

Quality is the ultimate criterion of desirability of any food product, and acceptance of product is dependent upon the quality of the product, which depends on the nutritional and other hidden attributes of the product, and sensory quality as assessed by means of human sensory organs (Manay and Shadaksharaswamy, 2007). Hence the product developed was evaluated for its sensory properties.

Sensory evaluation or 'taste testing', consists of judging the quality of food by a panel of judges (Stone and Sidel, 2004). Panels of 10 members were selected for the sensory evaluation of the recipes and health mix. To avoid errors due to physical, physiological, environmental and individual characteristics, panel of evaluators were used rather than a single assessor.

The panel members were selected on the basis of their health, cooperation, willingness and knowledge of sensory analysis as also ability to discriminate the various criteria's for sensory evaluation.

Score card is a tool which help in evaluation through direction and degree of judgment using suitable defined scores (Manay and Shadaksharaswamy, 2007). A score card was developed for the purpose of evaluation of the acceptance of colour, taste, texture and flavor and scores were given according to the acceptanace of the snacks and health mix. (Appendix IV)

The recipes which obtained the highest acceptability scores through sensory evaluation were considered the best acceptable recipes.

D. SHELF LIFE OF THE INSTANT HEALTH MIXES WITH DIFFERENT PACKAGING MATERIAL

According to Rody (2007), nutritional quality and cost factor are the major factors affecting food selection.

Shelf life is the recommendation of time that products can be stored, during which the defined quality of a specified proportion of the goods remains acceptable under expected 0r specified conditions of storage and storage (Akbars, 2008).

The developed health mix was weighed 100g of each and were packed in ziplock covers, sealed and stored at room temperature for a period of three to four weeks. Every week the products were evaluated for change in colour, appearance, flavor, texture and taste by the investigator.

Shelf life is influenced by several factors: exposure to light and heat, transmission of gases (including humidity), mechanical stresses and contamination of micro organisms(http://wwww.wisegeek.com/what-is-a-shelf-life.htm)

E. IMPARTING NUTRITIONAL EDUCATION TO THE SELECTED POSTMENOPAUSAL WOMEN

Awareness was created among the selected subjects on the importance of high calcium and vitamin D, low fat and low calorie diet to the selected postmenopausal women using specially designed pamphlet. The selected postmenopausal women were educated for the importance of calcium rich diet, preparation of the formulated healthmix and its storage, preparation of the recipes and lifestyle modification.

A pamphlet was developed using software's namely adobe photoshop 7.0, Adobe page maker 7.0 and Corel draw 11.0 (Appendix V)

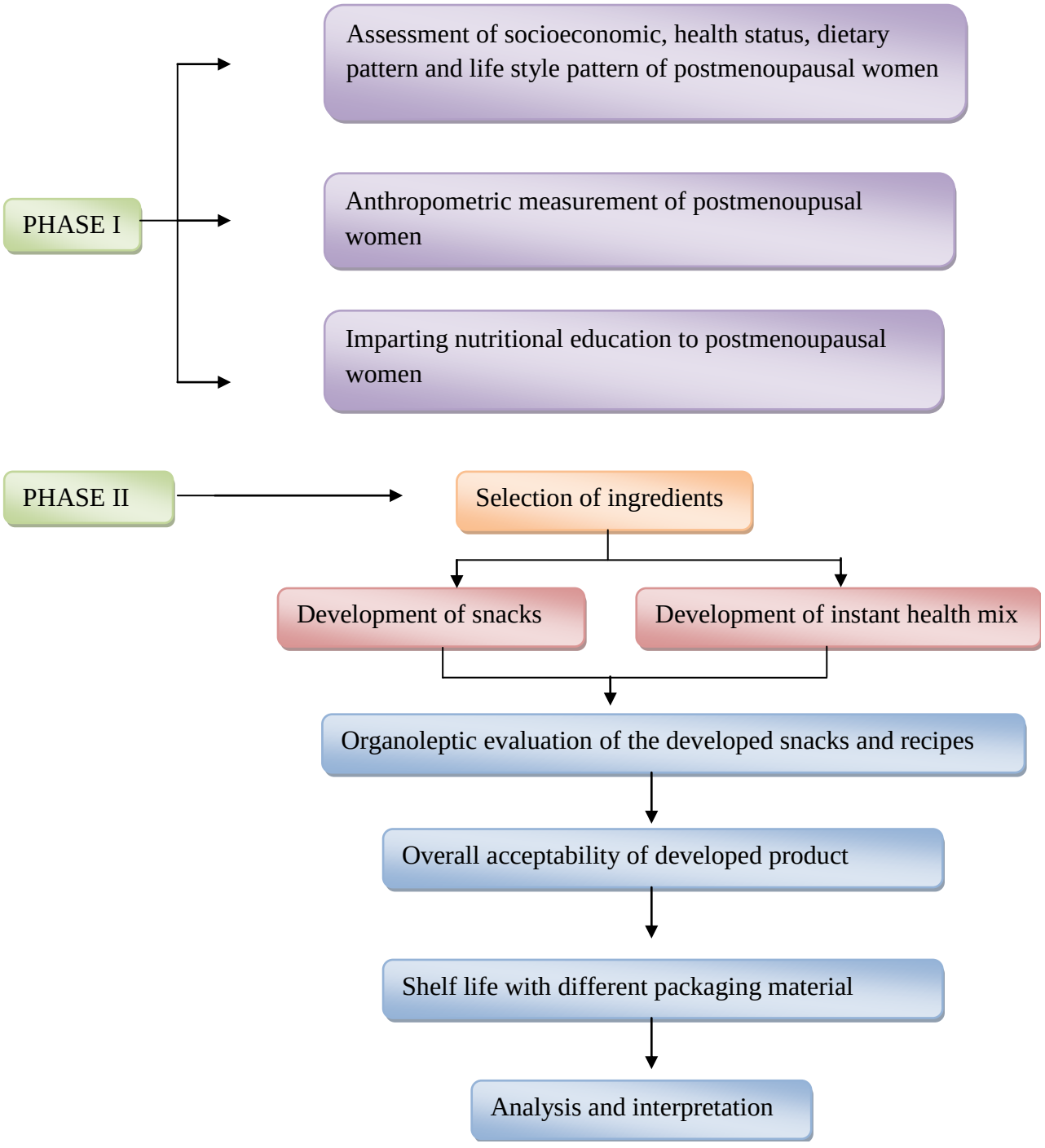
PHASE III

A. ANALYSIS OF DATA

The collected data were analyzed and the results and discussions are tabulated and discussed.

FIGURE I

RESEARCH DESIGN



IV. RESULTS AND DISCUSSION

The results of the study titled **"Development of calcium rich snacks and instant health mix for postmenopausal women"** are discussed under the following headings:

A. Socio-economic background of the postmenopausal women
B. Anthropometric assessment of the selected postmenopausal women
C. Health status of the postmenopausal women
D. Lifestyle practices and dietary pattern of the postmenopausal women
E. Overall acceptability of the developed recipes and health mix
F. Nutritive value of the developed recipes and health mix
G. Shelf life of the instant health mix with different packaging material
H. Impact of nutrition education on postmenopausal women

A. SOCIO-ECONOMIC BACKGROUND OF THE POSTMENOPAUSAL WOMEN

1. Age wise distribution of the postmenopausal women

Table VIII presents the data on the age wise distribution of the selected postmenopausal women.

TABLE VIII

AGE WISE DISTRIBUTION OF THE POSTMENOPAUSAL WOMEN

Age in years	Number(N=100)	Percentage
45-50	28	28
51-55	19	19
55-60	29	29
60-65	24	24
Marital status		
Married	90	90
Unmarried	2	2
Widow	8	8

Out of the selected subjects majority of 29 percent of women belonged to the age group of 55-60 years followed by 28 percent of women in the age group of 45-50 years, 24 percent of women belonged to the elderly age group of 60-65 years and 19 percent belonged to the age group of 51-55 years.

The majority of the women (i.e.) 90 percent were married and living with their family and only two percent were unmarried while eight percent were married but widow.

2. Educational status of the postmenopausal women

Table IX presents data on the educational status of the selected postmenopausal women

TABLE IX

EDUCATIONAL STATUS OF THE POSTMENOPAUSAL WOMEN

Marital status	**Number (N=100)**	**Percentage**
Studied up to		
High school level	29	29
Higher secondary	41	41
Under graduate level	28	28
Post graduate level	2	2

From the data presented in table III it is evident that all the selected women were educated and the educational level varied from high school to post graduation. Majority of 41 percent were educated up to higher secondary level, while 29 and 28 percent were educated up to high school level and undergraduate level respectively and a minimum of two percent of women were educated up to post graduate level.

3. Type of activity of the postmenopausal women

It was found that 78 percent of the women were leading a life with sedentary activity, 19 percent were doing moderate type of activity and only three percent of women were doing heavy work.

B. ANTHROPOMETRIC ASSESSMENT OF THE SELECTED POSTMENOPAUSAL WOMEN

1. Distribution of the postmenopausal women according to their height and weight

It was seen that 45 percent of the postmenopausal women were having normal weight (i.e.) between 50-60 kg of weight, 22 percent of women were between 40-50 kg of weight, 18 percent of women belonged to 60-70 kg of weight, and the remaining seven percent were underweight with only 30-40 kg of weight and eight percent women were obese with their weight weighing more than 70 kg.

It was found out that the maximum percent (48 percent) of women belonged to the height range of 150-160 cm, 13 percent and 30 percent of women belonged to 130-140 cm and 140-150 cm range of height and the remaining nine percent of women belonged to the height range of 160-170 cm.

2. Body mass index and waist hip ratio of the postmenopausal women

Table X gives information regarding the BMI and Waist-Hip ratio of the postmenopausal women.

TABLE X

DISTRIBUTION OF POSTMENOPAUSAL WOMEN ACCORDING TO BODY MASS INDEX AND WAIST HIP RATIO

Details	Number (N=100)	Percentage
Body Mass Index (BMI)		
Less than 18.5	2	2
18.5-24.9	54	54
25-29.9	33	33
≥30	11	11
Waist Hip Ratio(WHR)		
Below 0.8	50	50
Above 0.8	50	50

Fifty four percent of the postmenopausal women had normal weight for height and hence their BMI was normal and within 18.5-24.9 range. Thirty three percent of the women belonged to overweight category and 11 percent of the women were obese. A minimum of two percent women belonged to the underweight category.

Fifty percent of the women had waist hip ratio within the normal range (i.e.) ≤0.8, while the others had a waist hip ratio of ≥0.8, an indication of overweight.

C. HEALTH STATUS OF THE POSTMENOPAUSAL WOMEN

1. Problems present among postmenopausal women during menarche

The problems faced by the women during menarche is given in the Table XI.

TABLE XI

PROBLEMS FACED BY THE WOMEN DURING MENARCHE

Problems	Number*(N=100)	Percentage
Back pain	42	42
Breast pain	20	20
Excessive bleeding	32	32
Head ache	25	25
Irregular periods	20	20
Leg pain	38	38
Nervousness	14	14
Physical discomfort	18	18
Stomach pain	42	42
Tension	19	19
Tiredness	45	45
Urinary tract infection	15	15
Vomiting sensation	11	11

*Multiple responses

From the study it was evident that all the subjects selected for the study had one or other problem during menarche and majority of the women (i.e. 45 percent) were tired, 42 Percent of women complained about back pain and stomach pain, 32 percent and 38 percent of women complained about excessive bleeding and leg pain. Minimum percentage of women reported that they experienced tension (19 percent), urinary tract infection (15 percent), nervousness (14 percent), breast pain (20 percent), irregular periods (20 percent) and vomiting sensation (11 percent) during menarche.

2. Age of menopause

The results indicated that70 percent of women had attained menopause at the age of 45-50 years and around 30 percent of women had attained menopause at the age of 50-55 years. Among them most of the women expressed that they attained menopause gradually and very few women attained menopause due to hormonal problems and due to removal of ovaries.

3. Problems faced during and after menopause by the postmenopausal women

The problems faced during and after menopause is given in the Table XII.

TABLE XII

PROBLEMS FACED BY THE WOMEN DURING AND AFTER MENOPAUSE

Problems	Number*(N=100)	Percentage
Fracture	9	9
Frequent urination	24	24
Hot flushes	46	46
Head ache	45	45
Hair loss	55	55
Night sweat	39	39
Palpitation of heart	16	16
Physical discomfort	18	18
Sleep disorder	50	50
Tiredness	39	39
Weight gain	38	38
Forgetfulness	16	16
Irritation	11	11
Depression	23	23
Anxiety	14	14
Vaginal dryness	21	21
Loss of height	17	17

*Multiple responses

Here again the study indicated that majority of the women underwent many problems before attaining menopause, 50 percent of the women had sleep disorder, 46 and 45 percent of them had hot flushes and head ache, 39 percent complained about night sweat and tiredness and around 38 percent of women had gained weight after menopause and 55 percent and 17 percent of them had loss of hair and height respectively after menopause stage. Nine, 16, 11 and 14 percent of the postmenopausal women complained of problems like fracture, palpitation of heart, irritation and anxiety respectively.

4. Health complication of the postmenopausal women

The health complications of the postmenopausal women is presented in the Table XIII.

TABLE XIII

HEALTH COMPLICATION OF THE POSTMENOPAUSAL WOMEN

Details	Number (N=100)	Percentage
Cardiovascular disease	12	12
Diabetes mellitus	34	34
Hypertension	26	26
Osteoporosis	13	13
Arthritis	1	1
Renal failure	1	1

After attaining menopause women develop complications due to hormonal changes. In this study about thirty four percent of the women became diabetic and 26 percent of women were suffering from hypertension. Around 12 and 13 percent of them were suffering from cardiovascular disease and osteoporosis and a minimum of one percent were suffering from arthritis and renal failure. Mccarr, 2003 quotes that the prevalence of the metabolic syndrome increases with menopause and may partially explain the apparent acceleration of cardiovascular disease after menopause. The emergence of these risk factors may be a direct result of ovarian failure or, alternatively, an indirect result of the metabolic consequences of central fat redistribution with estrogen deficiency.

D. LIFESTYLE PRACTICES AND DIETARY PATTERN OF THE POSTMENOPAUSAL WOMEN

1. Exercise pattern of the postmenopausal women

The exercise pattern of the postmenopausal women is presented in the Table XIV.

TABLE XIV

EXERCISE PATTERN OF THE POSTMENOPAUSAL WOMEN

<table>
<tr><th colspan="2">Exercise pattern</th><th colspan="2">Number(N=100)</th><th colspan="2">Percentage</th></tr>
<tr><td colspan="2">Exercises regularly</td><td colspan="2">36</td><td colspan="2">36</td></tr>
<tr><td colspan="2">Exercises irregularly</td><td colspan="2">63</td><td colspan="2">63</td></tr>
<tr><td colspan="6">If exercising, type of exercise and frequency</td></tr>
<tr><td>Type of exercise</td><td colspan="5">Duration of exercise per day</td></tr>
<tr><td rowspan="3">Walking</td><td colspan="2">30 Minutes</td><td colspan="2">One hour</td><td colspan="2">➢ than one hour</td></tr>
<tr><td>Number</td><td>Percentage</td><td>Number</td><td>Percentage</td><td>Number</td><td>Percentage</td></tr>
<tr><td>21</td><td>58.3</td><td>11</td><td>30.5</td><td>4</td><td>11.1</td></tr>
</table>

The women selected for the study were not aware of the health benefits of regular exercising. Hence, majority of (i.e.) 63 percent of the postmenopausal women exercised irregularly while only 36 percent of women exercised regularly. It was found that the only exercise performed by the women was walking for a maximum duration of 30 minutes. Hence it is evident from the table that only a minimum number of the subjects had the habit of undertaking regular exercise to maintain their health. Onset of menopause may augment the physiological decline associated with aging and inactivity.Kristina, 2014 stated that onset of menopause may augment the physiological decline associated with aging and inactivity.So, a higher incidence of metabolic syndrome has been shown in middle aged women during the postmenopausal period.

2. Food habits of the postmenopausal women

With regard to the food habits of the subjects majority of the postmenopausal women, i.e. 63 percent were non vegetarian and 28 percent of women were vegetarian while only nine percent were ova vegetarian.

3. Frequency of consumption of cereal and cereal products

Table XV presents the frequency of consumption of cereal and cereal product.

TABLE XV

FREQUENCY OF CONSUMPTION OF CEREAL AND CEREAL PRODUCTS

Food Items	Daily		Twice a week		Weekly		Twice a month		Occasionally	
	N	%	N	%	N	%	N	%	N	%
Whole wheat flour	32	32	23	23	20	20	15	15	10	10
Rice	85	85	0	0	15	15	0	0	0	0
Ragi	17	17	1	1	35	35	10	10	36	36
Maida flour	-	-	30	30	-	-	13	13	57	57
Semolina	-	-	18	18	37	37	13	13	30	30
Vermicelli	-	-	28	28	32	32	18	18	22	22
Bread (Brown)	-	-	30	30	22	22	28	28	42	42
Bread (White)	-	-	-	-	-	-	40	40	60	60

Cereals are the most important staple food and therefore cereal products play a central role in human nutrition. These products represent a good source of energy, carbohydrates, proteins and fibers in nutrition, as well as a range of micronutrients such as vitamin E, some of the vitamins, magnesium and zinc.

The study revealed that among the cereal grains, rice was consumed most frequently by the subjects, 85 percent of the adults consumed rice every day. Whole wheat

flour was consumed every day by 32 percent of the subjects, 23 percent of the subjects consumed wheat flour twice a week. Seventeen percent of the women consumed ragieveryday, 35 percent consumed weekly, one percent consumed twice a week, 10 percent consumed twice a month and the remaining 36 percent consumed ragi occasionally. Most women (57%) consumed maida flour only occasionally. Semolina and vermicelli was consumed mostly once a week and biweekly. Most women consumed white bread more frequently than whole wheat bread.

4. Frequency of consumption of pulses and legumes

Table XVI presents the frequency of consumption of pulses and legumes.

TABLE XVI

FREQUENCY OF CONSUMPTION OF PULSES AND LEGUMES

Food Items	Daily		Twice a week		Weekly		Twice a month		Occasionally	
	N	%	N	%	N	%	N	%	N	%
Bengal gram	0	0	29	29	32	32	24	24	15	15
Black gram	55	55	12	12	28	28	5	5	0	0
Cow pea	0	0	28	28	18	18	38	38	16	16
Green gram	0	0	23	23	50	50	27	27	0	0
Peas	0	0	31	31	26	26	24	24	19	19
Red gram	0	0	16	16	67	67	17	17	0	0

Pulses and legumes form the major source of protein in Indian diets. Among pulses black gram dhal was consumed more frequently, because dosa and idli are the two dishes that are consumed more frequently in South India as breakfast foods. Fifty five percent of the women consumed black gram dal every day, 28 percent consumed once a week and the remaining women consumed twice a week and twice a month. Bengal gram dal was consumed weekly by 32 percent of the women, 29 percent consumed Bengal gram bi weekly, twenty four percent consumed twice a month and 15 percent consumed occasionally. Majority (38%) of the women consumed cow pea twice a month, 28 percent

consumed bi-weekly. Green gram dal was consumed once a week by 50 percent of the women, 23 percent consumed bi-weekly, 27 percent consumed twice a month. Green peas were consumed bi weekly by 31 percent of the adults, 24 percent consumed twice a month and 19 percent consumed occasionally. Red gram dhal was mostly consumed once a week, 67 percent of the women consumed red gram once a week, 16 percent consumed bi weekly and the remaining 17 percent consumed twice a month.

5. Frequency of consumption of green leafy vegetables

Table XVII presents the frequency of consumption of green leafy vegetables.

TABLE XVII

FREQUENCY OF CONSUMPTION OF GREEN LEAFY VEGETABLES

Food Items	Daily		Twice a week		Weekly		Twice a month		Occasionally	
	N	%	N	%	N	%	N	%	N	%
Amaranth	-	-	31	31	30	30	29	29	-	-
Spinach	-	-	32	32	29	29	27	27	12	12
Drumstick leaves	4	4	17	17	69	69	8	8	1	1
Coriander	74	74	-	-	11	11	15	15	-	-
Curry leaves	82	82	-	-	18	18	-	-	-	-
Cabbage	-	-	-	-	13	13	61	61	26	26

Green leafy vegetables are probably the most concentrated source of micronutrients of any food. They are rich source of minerals such as iron, calcium, potassium and magnesium and vitamins, including vitamins K, C, E and many of the B Vitamins.

Green leafy vegetables were consumed once a week by adults as it was used for seasoning in all the recipes prepared. Thirty one percent of the women consumed amaranth twice a week, 30 percent of the women consumed bi-weekly and the remaining 29 percent consumed twice a month. Coriander and curry leaves were consumed almost daily by most

adults. Drumstick leaves were consumed mostly once a week and only one percent consumed occasionally. Twenty nine percent of the women consumed spinach once a week, 32 percent consumed spinach bi weekly, 27 percent consumed once a month, 12 percent consumed occasionally. Sixty one percent of women consumed cabbages twice a month, 13 percent consumed weekly and the remaining 26 percent consumed cabbage occasionally.

6. Frequency of consumption of roots and tubers

Table XVIII presents the frequency of consumption of roots and tubers.

TABLE XVIII

FREQUENCY OF CONSUMPTION OF ROOTS AND TUBERS

Food Items	Daily		Twice a week		Weekly		Twice a month		Occasionally	
	N	%	N	%	N	%	N	%	N	%
Beet root	-	-	34	34	30	30	28	28	10	10
Carrot	-	-	23	23	25	25	29	29	23	23
Onion (Big)	100	100	-	-	-	-	-	-	-	-
Potato	27	27	17	17	23	23	15	15	18	18
Radish	-	-	23	23	29	29	37	37	11	11
Yam	-	-	-	-	7	7	50	50	43	43

The vegetables in this group are nutritionally diverse. The range of colours, from the orange of carrots to the purple beetroot, reflects the range of phytochemicals these vegetables contain, which in turn impacts on the health benefits that the particular vegetable will deliver.

Beet root was consumed once a week by 30 percent of the women. Thirty four percent of the women consumed twice a week and the remaining 28 percent consumed beetroot twice a month. Twenty five percent consumed carrots once a week, 23 percent consumed carrots twice a week, 29 percent consumed carrots twice a month and 23 percent

consumed carrot occasionally. Onion was highly consumed everyday by all the women. Twenty seven percent of women consumed potatoes every day. Radish was consumed once a week by 29 percent of the women, 23 percent consumed bi-weekly, and 37 percent consumed twice a month and 11 percent consumed radish occasionally

7. Frequency of consumption of other vegetables

Table XIX presents the frequency of consumption of other vegetables

TABLE XIX

FREQUENCY OF CONSUMPTION OF OTHER VEGETABLES

Food Items	Twice a week		Weekly		Twice a month		Occasionally	
	N	%	N	%	N	%	N	%
Bitter gourd	23	23	24	24	33	33	20	20
Bottle gourd	34	34	43	43	23	23	-	-
Ridge gourd	44	44	-	-	25	25	31	31
Snake gourd	22	22	38	38	27	27	13	13
Ladies finger	27	27	18	18	34	34	21	21
Brinjal	28	28	23	23	36	36	13	13
Broad beans	15	15	20	20	38	38	27	27
Cluster beans	23	23	8	8	26	26	43	43
Cauliflower	39	39	17	17	22	22	22	22
Drumstick	23	23	60	60	17	17	-	-
French beans	24	24	27	27	30	30	19	19
Plantain stem	30	30	19	19	26	26	25	25

From the data presented in the Table XIX, it is evident that none of the women consumed other vegetables daily and intake of vegetables was very poor which are the rich source of micronutrients and fibre. All these vegetables were consumed only either weekly or twice a week.

Bitter gourd was consumed mostly twice a month by 33 percent of the women and 20 percent consumed occasionally. Bottle gourd,drumstick and snake gourd was consumed once a week by 43, 60 and 38 percent of the women, 44 percent consumed ridge gourd twice a week. Ladies finger and brinjalwas consumed twice a month by 34 and 36 percent of the women. Broad beans, cluster beans and French beans were consumed twice a month by 38 percent, 26 percent and 30 percent of the women respectively. Cauliflower was consumed twice a week by 39 percent of the women.

8. Frequency of consumption of fruits

Table XX presents the frequency of consumption of fruits.

TABLE XX

FREQUENCY OF CONSUMPTION OF FRUITS

Food Items	Daily		Twice a week		Weekly		Twice a month		Occasionally	
	N	%	N	%	N	%	N	%	N	%
Apple	-	-	19	19	22	22	33	33	26	26
Banana	39	39	8	8	51	51	2	2	-	-
Grapes	-	-	23	23	26	26	45	45	6	6
Guava	-	-	30	30	16	15	23	23	32	32
Papaya	-	-	27	27	40	40	15	15	18	18
Orange	-	-	25	25	12	12	28	28	35	35
Tomato	100	-	-	-	-	-	-	-	-	-

Fruit has been recognized as a good source of vitamins and minerals, and for their role in preventing vitamin C and vitamin A deficiencies. Fruit are important sources of many nutrients, including potassium, fiber, vitamin C and folate (folic acid). Fruit helps maintain optimum health due to the health promoting phytochemicals.

Tomatoes were the only fruit consumed daily by the women as this fruit was used in preparing recipes similar to using curry and coriander leaves. Other than this no other fruit was consumed daily and banana was the only fruit consumed by 39 percent of the women. The other fruits like apple and papaya was consumed by 22 and 40 percent of women weekly, while grapes was consumed by 45 percent of women twice a month and guava and oranges were consumed occasionally by 32 and 35 percent of women.

9. Frequency of consumption of non vegetarian foods

Table XXI presents the frequency of consumption of meat and meat product.

TABLE XXI

FREQUENCY OF CONSUMPTION OF NON VEGETARIAN FOODS

Food Items	Daily		Twice a week		Weekly		Twice a month		Occasionally	
	N	%	N	%	N	%	N	%	N	%
Egg	2	2.7	10	13.8	50	69.4	10	13.8	-	-
Mutton	3	4.7	20	31.7	15	23.8	15	23.8	5	7.9
Chicken	4	6.3	9	14.2	40	63.4	10	15.8	-	-
Fish	0	0	0	0	5	7.9	50	79.3	5	7.9

The study revealed that egg was consumed weekly by 69.4 percent of women while 13.8 percent women consumed twice a week or twice a month.With regard to the intake of meat and meat products it was observed that the non- vegetarian food was consumed weekly once by the majority of women. 69.4, 23.8, 63.4 percent of women consumed egg, mutton and chicken once in a week. Mutton was consumed twice a week by 31.7 percent of women. The fish consumption was low when compared to other meat products. It was revealed that 79.3 percent of women consumed fish twice a month and only 7.9 percent of women consumed weekly and occasionally.

10. Frequency of consumption of milk and milk products

Table XXII presents the frequency of consumption of milk and milk products.

TABLE XXII

FREQUENCY OF CONSUMPTION OF MILK AND MILK PRODUCTS

Food Items	Daily		Twice a week		Weekly		Twice a month		Occasionally	
	N	%	N	%	N	%	N	%	N	%
Milk	0	0	0	0	61	61	39	39	0	0
Curd	59	59	5	5	25	25	1	1	1	1
Butter milk	38	38	22	22	13	13	27	27	0	0
Cheese	1	1	3	3	4	4	0	0	61	61

Milk was consumed on weekly basis by 61 percent of the postmenopausal women and the remaining 39 percent of women consumed milk twice a month. Fifty nine and 25 percent of women consumed curd daily and weekly once and the remaining five and one percent of women consumed curd twice a week and occasionally. Butter milk was consumed by 38 percent of women on daily basis and cheesewas the most occasionally consumed milk products.

11. Frequency of consumption of fats and edible oils

The survey revealed that cooking oil was the only fat consumed on a daily basis by all women. Eighty percent and 20 percent of the women consumed butter occasionally and twice a month. Thirty four, 27, 21 and 18 percent of women consumed ghee twice a month, twice a week, occasionally and once a week. Vanaspathi was consumed by 53 and 35 percent of women twice a month and occasionally while 12 percent consumed vanaspathi weekly, and the women expressed that they used vanaspathi for the preparation of breakfast recipe pongal.

12. Frequency of consumption of sugar and jaggery

The study revealed that sugar was consumed daily by 70 percent of women while the remaining 30 percent of women avoided sugar because of diabetes. Sixty percent of

women consumed jaggery occasionally while 22 percent and 17 percent of women consumed jaggery twice a month and weekly.

13. Frequency of consuming calcium and vitamin D rich foods by the subjects

Table XXIII presents the frequency of consuming calcium and vitamin D rich foods by the subjects.

TABLE XXIII

FREQUENCY OF CONSUMING CALCIUM AND VITAMIN D RICH FOODS

Food items	Daily		Twice a week		Weekly		Twice a month		Occasionally	
	N	%	N	%	N	%	N	%	N	%
Calcium rich Foods										
Ragi	17	17	1	1	35	35	10	10	36	36
Agathi	6	6	13	13	59	59	6	6	12	12
Drumstick leaves	4	4	17	17	69	69	8	8	1	1
Cheese	1	1	3	3	4	4	-	-	67	67
Broccoli	-	-	1	1	8	8	4	4	57	57
Curd	59	59	5	5	25	25	1	1	1	1
Egg	10	10	4	4	48	48	2	2	8	8
Fenugreek leaves	5	5	12	12	59	59	4	4	10	10
Sesame seeds	2	2	3	3	17	17	12	12	46	46
Poppy seeds	1	1	3	3	14	14	13	13	44	44
Orange	12	12	6	6	48	48	8	8	21	21
Soya	4	4	7	7	37	37	2	2	34	34
Yoghurt	1	1	-	-	3	3	2	2	59	59
Almonds	3	3	10	10	13	13	4	4	39	39
Tofu	3	3	4	4	5	5	52	52	-	-
Palak	2	2	11	11	54	54	3	3	13	13
Vitamin D rich foods										
Butter	1	1	5	5	15	15	2	2	58	58
Egg yolk	3	3	3	3	53	53	-	-	11	11
Fish	2	2	9	9	36	36	1	1	17	17
Liver	-	-	11	11	26	26	-	-	26	26
Orange juice	7	7	13	13	47	47	-	-	25	25

During the menopause, an adequate daily calcium intake is important to help protect and maintain bone density as bone loss accelerates. Vitamin D is required to maintain bone health. It helps the body absorb calcium and is made in the skin due to sunlight. Lack of sunlight due to poor climate, people being housebound often leads to lack of vitamin D, particularly in the elderly. Only few dietary sources of vitamin D are available.

The present study revealed that among the calcium rich foods green leafy vegetables like drumstick, fenugreek and agathi leaves were consumed weekly by 69 and 59 percent of women. Only minimum amount of poppy seeds, sesame seeds, almonds, cheese and broccoli were consumed occasionally. Some of the subjects were aware of calcium rich foods like yoghurt, tofu and soya but the intake of these foods was occasional and also in minimum quantity. With regard to the intake of vitamin D rich foods, 58 percent of the women consumed butter occasionally and it also revealed that maximum amount of consumption is seen in diary and meat products like egg yolk(53 percent), fish (36 percent), and liver (26 percent) which were consumed weekly while 47 percent of women consumed orange juice weekly.

14. Frequency of consumption of tea/coffee by the postmenopausal women

Table XXIV presents the Frequency of consumption of tea or coffee by the postmenopausal women.

TABLE XXIV

FREQUENCY OF CONSUMPTION OF TEA OR COFFEE BY THE POSTMENOPAUSAL WOMEN

Tea/Coffee	Number (N=100)	Percentage
Once a day	65	65
Twice a day	14	14
Thrice a day	12	12
Rarely	9	9

Sixty five percent of the women consumed tea or coffee once a day while 14 percent and 12 percent of women consumed tea or coffee twice to thrice a day. Only a minimum of nine percent of women consumed tea or coffee very rarely. Hallström et al, 2010 quotes that caffeine is the most widely used central nervous system stimulant in the world. Caffeine increases calcium excretion and decreases intestinal calcium absorption , with five mg net loss of calcium per cup of coffee . A high intake of coffee could therefore also induce loss of bone mineral.

E. OVERALL ACCEPTABILITY OF THE DEVELOPED RECIPES AND HEALTH MIX

Adequate intake of calcium is an important component for maintaining bone health and should be encouraged. From the survey it was revealed that majority of the subjects were not aware of the importance of calcium and calcium rich foods in relation to bone health. Enriching the diet with calcium rich foods prevents bone loss and is effective in improving the blood calcium levels. Including snacks and health mix are one of the best methods to enrich the diet with calcium rich foods as it can be easily prepared, stored and used whenever required and is an alluring form of food which is highly acceptable by all age groups. Recipes like pancake, momos, chapathi roll, khakra and mutia were prepared by incorporating soy flour and ragi flour at 10 percent, 15 percent and 20 percent level and presented as V_1, $V_2$and $V_3$and these recipes were subjected to sensory evaluation for acceptability.

The acceptability of the recipes was assessed by a five point scale. The sum of all attributes (appearance, flavour, taste, texture and colour) was used to calculate overall acceptability.

1. Mean acceptability score for pancake

Table XXV and Figure I presents the mean acceptability score for pancake.

TABLE XXV

MEAN ACCEPTABILITY SCORE FOR PANCAKE

Variations	**Appearance Mean±SD**	**Flavor Mean±SD**	**Taste Mean±SD**	**Texture Mean±SD**	**Colour Mean±SD**	**Overall acceptability Mean±SD**
Standard	4.5±0.7	4.8±0.4	4.7±0.4	4.8±0.4	4.2±0.6	4.1±0.8
V_1	3.7±0.5	3.9±0.6	4.2±0.7	4.6±0.5	4±0.8	4.2±0.4
V_2	3.9±0.6	3.8±0.7	4.1±0.8	4.6±0.5	4.1±0.6	4.4±0.8
V_3	4.2±1	4.1±0.9	4±0.8	4.4±0.9	4.1±0.8	4.1±0.7
t value						
$SvsV_1$	1.8^{*}	3.1^{*}	1.7^{**}	0.9^{**}	0.3^{NS}	1.4^{**}
$SvsV_2$	2.3^{*}	3.5^{*}	1.8^{**}	0.9^{**}	1.0^{**}	0.3^{NS}
$SvsV_3$	1.0^{**}	2.4^{*}	2.3^{*}	1.2^{**}	0.5^{NS}	1.3^{**}

*- 1% level significant, **- %% level significant, NS- not significant

After incorporating ragi flour and soya flour in the pancake there was not much change in the appearance. Ragi flour had a strong flavour than soya flour. Hence with successive increase in incorporation of ragi flour, the flavourof ragi flour dominated the recipe. With regard to taste and texture, the taste and texture was good and did not differ much from standard. The overall acceptability of pancake was found to be 4.2±0.4, 4.4±0.8 and 4.1±0.7 for V_1, $V_2$and V_3 respectively. The V_2 was the most acceptable pancake with a mean value of 4.4±0.8 whereas pancake with 10 percent and 20 percent incorporation had the least score with a mean value of 4.2±0.4 and 4.1±0.7. There was five percent difference ($P<0.05$) observed between standard and 10 percent and 20 percent level of incorporation but no significant difference was observed between standard and 15 percent level of incorporation.

2. Mean acceptability score for momos

Table XXVI and Figure I presents the mean acceptability score for momos

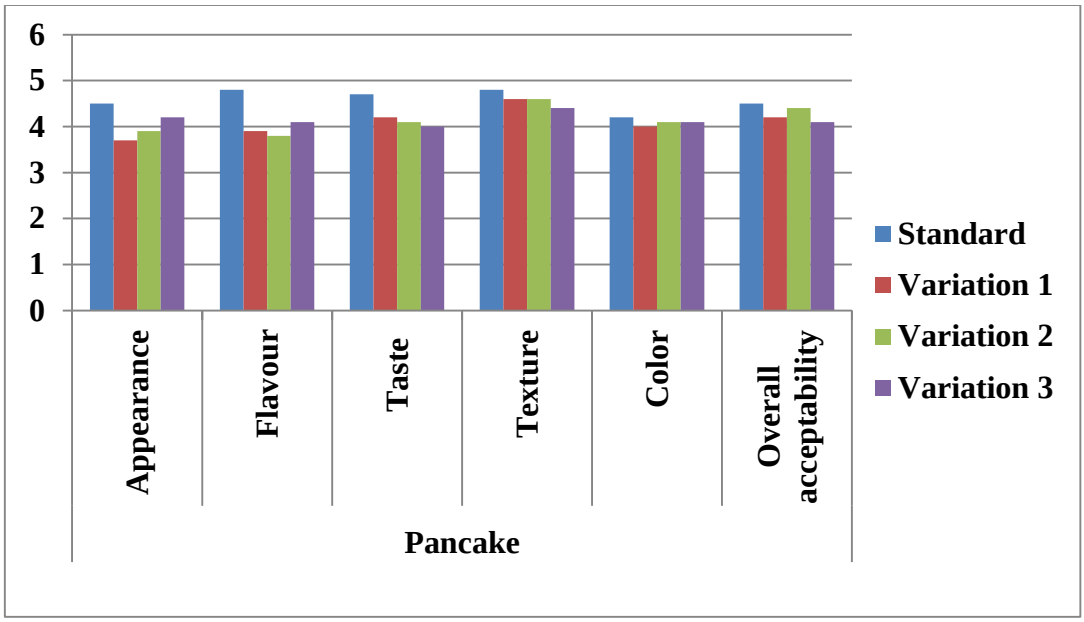
TABLE XXVI

MEAN ACCEPTABILITY SCORE FOR MOMOS

Variations	**Appearance Mean±SD**	**Flavor Mean±SD**	**Taste Mean±SD**	**Texture Mean±SD**	**Colour Mean±SD**	**Overall acceptability Mean±SD**
Standard	4.4±0.6	4.9±0.3	4.8±0.4	4.6±0.5	4.6±0.6	4.7±0.4
V_1	4.1±0.5	4.5±0.5	4.1±0.7	4.3±0.8	4.1±0.7	4.2±0.6
V_2	3.9±0.8	4.5±0.5	4.2±0.9	4.2±1.0	4.2±0.6	4.1±0.9
V_3	3.9±0.7	4.2±0.7	4±0.8	4.1±1.1	4.3±0.6	4.2±0.9
t value						
SvsV_1	1.0^{**}	2.0^{*}	2.6^{*}	1.2^{**}	1.5^{**}	1.9^{*}
SvsV_2	1.4^{**}	2.0^{*}	1.8^{*}	1.0^{**}	1.3^{**}	1.7^{**}
SvsV_3	0.9^{**}	2.6^{*}	2.7^{*}	1.2^{**}	0.9^{**}	1.5^{**}

*- 1% level significant, **- %% level significant, NS- not significant

After incorporating ragi flour and soya flour in the momos there was not much change in the appearance. Ragi flour had a strong flavour than soya flour. Hence with successive increase in incorporation of ragi flour, the flavourof ragi flour dominated the recipe. With regard to taste and texture, the taste and texture was good and did not differ much from standard. The overall acceptability of momos was found to be 4.2±0.6, 4.1±0.9 and 4.2±0.9 for V_1, $V_2$and V_3 respectively.. The V_1 and V_2 was the most acceptable momos with a mean value of 4.2±0.6 and 4.2±0.9 whereas momos with 15 percent incorporation had the least score with a mean value of 4.1±0.9. There was five percent difference ($P<0.05$) observed between standard and 15 percent and 20 percent level of incorporation but one percent ($P<0.01$) difference was observed between standard and 10 percent level of incorporation.



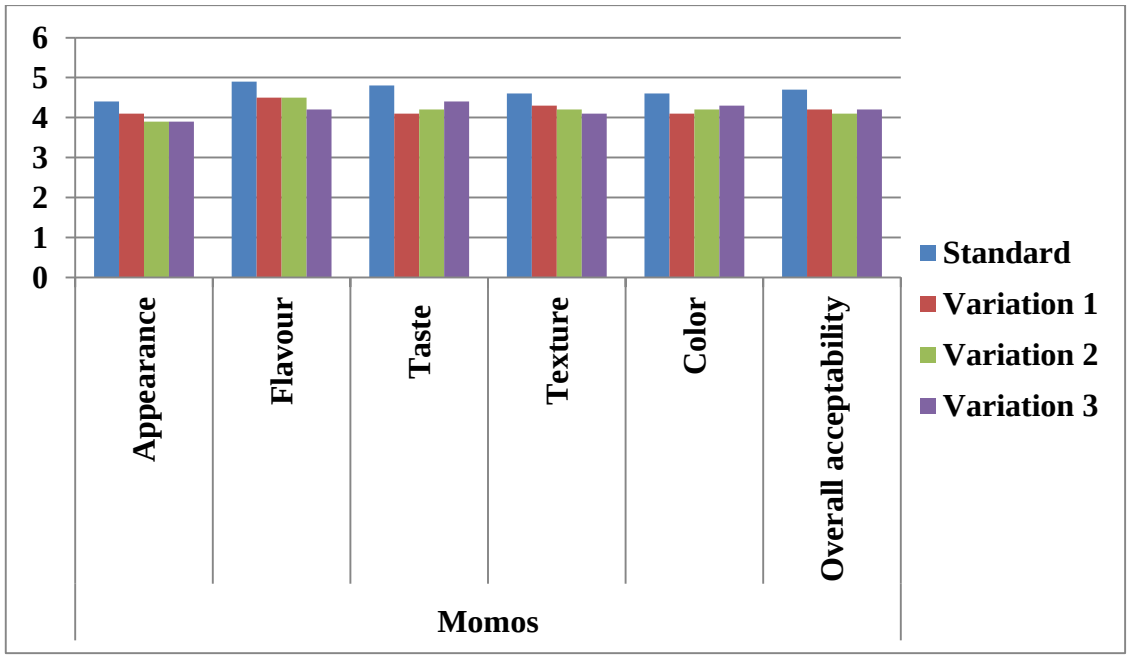


FIGURE II

OVERALL ACCEPTABILITY FOR THE PANCAKE AND MOMOS

3. Mean acceptability score for chapathi roll

Table XXVII and Figure II presents the mean acceptability score for chapathi roll

TABLE XXVII

MEAN ACCEPTABILITY SCORE FOR CHAPATHI ROLL

Variations	**Appearance Mean±SD**	**Flavor Mean±SD**	**Taste Mean±SD**	**Texture Mean±SD**	**Colour Mean±SD**	**Overall acceptability Mean±SD**
Standard	4.5±0.5	4.9±0.5	4.6±0.8	4.3±0.7	3.9±0.8	4.5±0.5
V_1	4.8±0.4	5±0.5	4.6±0.5	4.1±0.7	4.4±0.5	4.7±0.4
V_2	4.7±0.4	4.6±0.5	4.1±0.5	4±0.8	4.2±0.6	4.1±0.7
V_3	4.7±0.6	4.7±0.4	4.2±0.7	3.9±0.8	4±0.6	4.1±0.7
t value						
SvsV_1	1.4^{**}	2.0^{NS}	0.9^{**}	0.3^{NS}	1.8^{*}	0.8^{**}
SvsV_2	8.8^{**}	0.8^{**}	0.6^{NS}	0.0^{NS}	2.4^{*}	1.3^{**}
SvsV_3	0.7^{**}	0.7^{**}	0.2^{NS}	0.2^{NS}	2.4^{*}	1.3^{**}

*- 1% level significant, **- %% level significant, NS- not significant

Ragi flour and soya flour was incorporated in the standardchapathi roll and there was not much change in the appearance of different variations prepared. Ragi flour had a strong flavour than soya flour. With successive increase in incorporation of ragi flour, the flavourof ragi flour dominated the recipe. With regard to taste and texture, the taste and texture was good and did not differ much from standard. The overall acceptability of chapathi roll was found to be 4.7±0.4, 4.1±0.7 and 4.1±0.7 for V_1, $V_2$and V_3 respectively. The V_1 was the most acceptable chapathi roll with a mean value of 4.7±0.4 whereas chapathi roll with 15 percent and 20 percent incorporation had the least score with a mean value of 4.1±0.7. The difference was significant at five percent ($P<0.05$) between standard and V_1 (10 %), V_2 (15 %) and V_3 (20 %) level of incorporation.

4. Mean acceptability score for khakra

Table XXVIII and Figure IIpresents the mean acceptability score for Khakra.

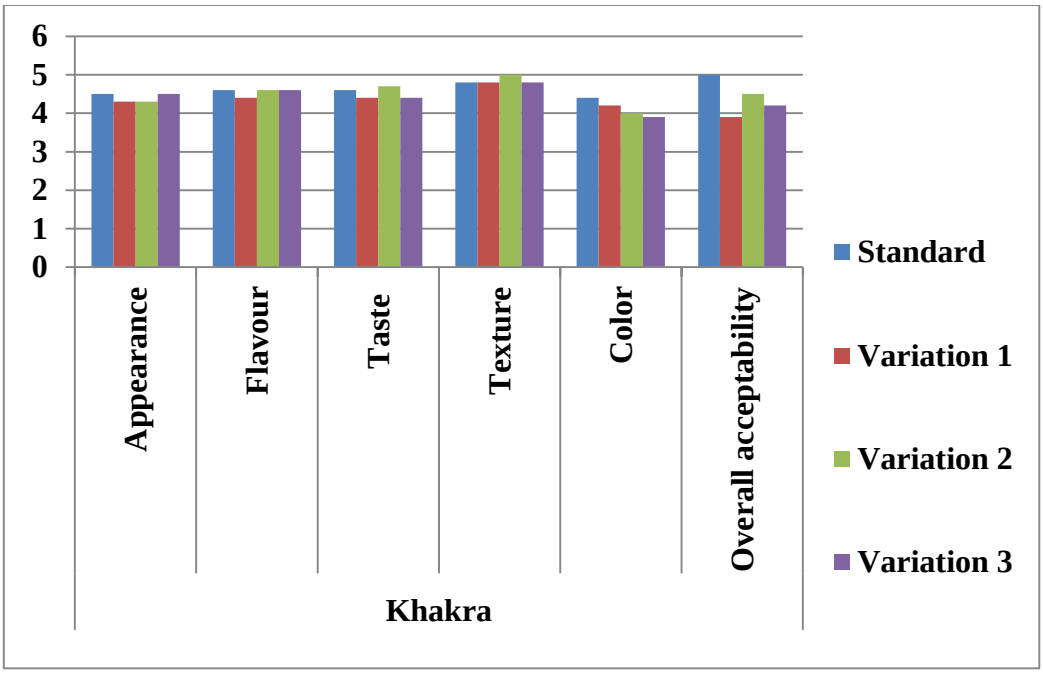
TABLE XXVIII

MEAN ACCEPTABILITY SCORE FOR KHAKRA

Variations	Appearance Mean±SD	Flavor Mean±SD	Taste Mean±SD	Texture Mean±SD	Colour Mean±SD	Overall acceptability Mean±SD
Standard	4.5±0.8	4.6±0.6	4.6±0.8	4.8±0.6	4.4±0.8	5±0.8
V_1	4.3±0.5	4.4±0.6	4.4±0.7	4.8±0.6	4.2±0.6	3.9±0.8
V_2	4.3±0.6	4.6±0.5	4.7±0.6	5±0.4	4±0.7	4.5±0.7
V_3	4.5±0.7	4.6±0.5	4.4±0.5	4.8±0.4	3.9±0.5	4.2±0.6
t value						
SvsV_1	0.5^{NS}	0.6^{NS}	0.5^{NS}	0.0^{NS}	0.6^{NS}	1.5^{**}
SvsV_2	0.5^{NS}	0.0^{NS}	0.0^{NS}	0.0^{NS}	0.2^{NS}	0.2^{NS}
SvsV_3	0.0^{NS}	0.0^{NS}	0.3^{NS}	0.0^{NS}	0.2^{NS}	0.6^{NS}

*- 1% level significant, **- %% level significant, NS- not significant

After incorporating ragi flour and soya flour in the khakra there was not much change in the appearance of the variations prepared. Ragi flour had a strong flavour than soya flour. With successive increase in incorporation of ragi flour, the ragiflavour dominated the recipe. With regard to taste and texture, the taste and texture was good and did not differ much from standard. The overall acceptability of khakra was found to be 3.9±0.8, 4.5±0.7 and 4.2±0.6 for V_1, $V_2$and V_3 respectively. The V_2 was the most acceptable khakra with a mean value of 4.5±0.7 whereas khakra with 10 percent and 20 percent incorporation had the least score with a mean value of 3.9±0.8 and 4.2±0.6. The difference was significant at five percent ($P<0.05$) between standard and V_1 (10%) but no significant difference between standard and V_2 (15 %),V_3(20 %) level of incorporation.



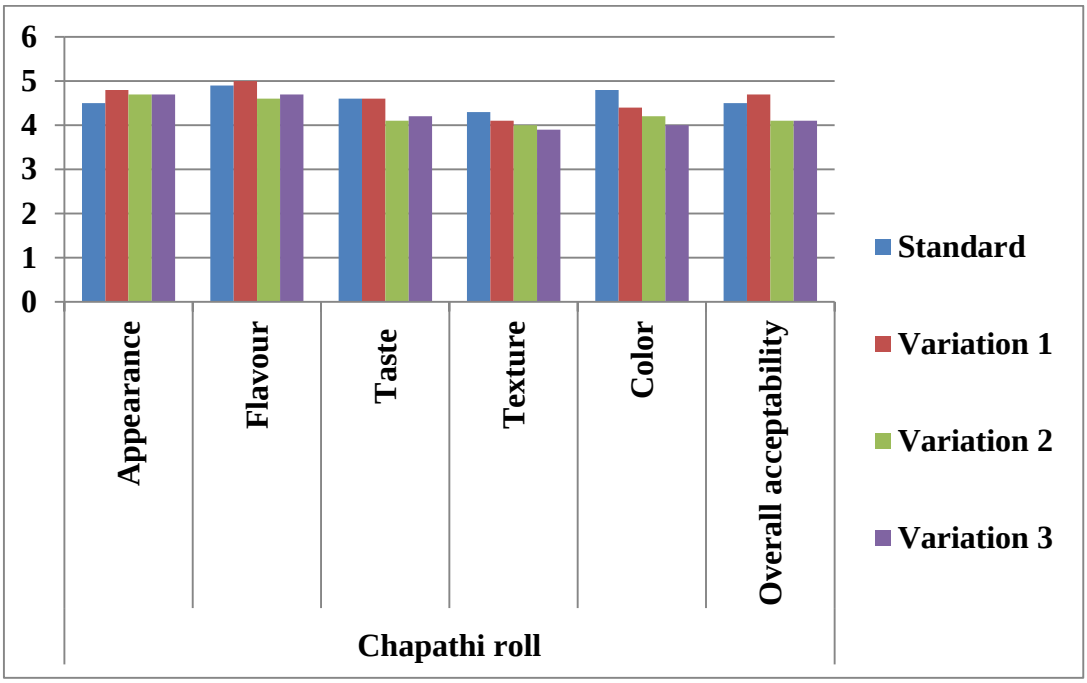


FIGURE III

OVERALL ACCEPTABILITY FOR THE KHAKRA AND CHAPATHI ROLL

5. Mean acceptability score for mutia

Table XXIX and Figure III presents the mean acceptability score for mutia

TABLE XXIX

MEAN ACCEPTABILITY SCORE FOR MUTIA

Variations	Appearance Mean±SD	Flavor Mean±SD	Taste Mean±SD	Texture Mean±SD	Colour Mean±SD	Overall acceptability Mean±SD
Standard	4.3±0.6	4.8±0.4	4.3±0.9	3.6±1.0	4.5±0.7	4.2±0.7
V_1	4.4±0.6	4.6±0.5	4.1±0.7	3.3±1.6	4.5±0.7	4.1±0.7
V_2	4.2±0.7	4.5±0.7	3.9±1.1	2.8±1.6	4.3±0.7	4.1±0.7
V_3	4.3±0.6	4.5±0.5	3.7±1.0	2.7±1.4	4.2±0.7	4.2±0.7
t value						
SvsV_1	0.3^{NS}	0.9^{**}	0.5^{NS}	0.8^{NS}	0.0^{NS}	0.2^{NS}
SvsV_2	0.3^{NS}	1.1^{**}	0.8^{**}	0.5^{NS}	0.8^{**}	0.2^{NS}
SvsV_3	0.0^{NS}	1.4^{**}	1.3^{**}	1.2^{**}	0.8^{**}	0.0^{NS}

*- 1% level significant, **- %% level significant, NS- not significant

Mutia was prepared by incorporating ragi flour and soya flour at 10 percent, 15 percent and 20 percent level and named as V_1, V_2 and V_3. After incorporating ragi flour and soya flour in the mutia there was not much change in the appearance. Ragi flour had a strong flavour than soya flour. Therefore with successive increase in incorporation of ragi flour, the ragiflavour dominated the recipe. With regard to taste and texture, the taste and texture was good and did not differ much from standard. The overall acceptability of mutia was found to be 4.1±0.7, 4.1±0.7 and 4.2±0.7 for V_1, $V_2$and V_3 respectively. The V_3 was the most acceptable mutia with a mean value of 4.2±0.7 whereas mutia with 10 percent and 15 percent incorporation had the least score with a mean value of4.1±0.7. There was no significant difference observed between standard and V_1 (10 %), V_2 (15 %) and V_3 (20 %) level of incorporation.

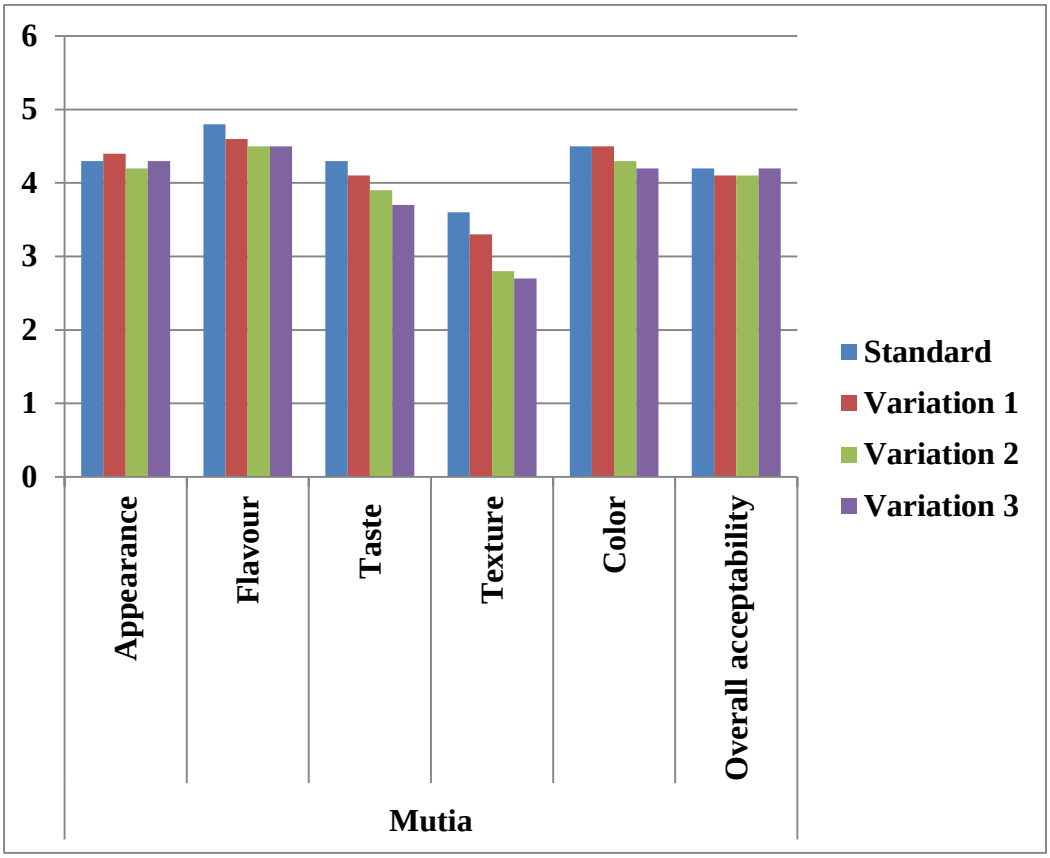


FIGURE IV

OVERALL ACCEPTABILITY FOR THE MUTIA

TABLE XXX

MEAN ACCEPTABILITY SCORE FOR HEALTH MIX

CRITERIA		Agathi leaf powder				Palak leaf powder			Broccoli leaf powder			Drumstick leaf powder			Fenugreek leaf powder		
		S	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3
Appearance	Mean ±SD	4.7± 0.4	4.2± 0.7	4± 0.8	4±0.9	4.3± 0.8	4.2± 0.7	4.2± 0.7	3.6± 0.9	4.1± 0.8	4± 0.9	4.3± 0.8	4.2± 0.7	4.1± 0.9	4.3±1.0	4.3± 0.8	4.2± 1.0
t value	$SvsV_1$ $SvsV_2$ $SvsV_3$	1.7^{**} 2.3^{*} 2.0^{*}				1.5^{**} 1.7^{**} 1.7^{**}			2.5^{*} 1.8^{*} 2.0^{*}			1.3^{**} 1.7^{**} 1.7^{**}			1.3^{**} 1.3^{**} 1.0^{**}		
Flavor	Mean ±SD	4.6±0.6	4.1± 1.3	3.8± 0.5	3.7± 1.1	4.1±0.8	4.1 ±0.8	3.8 ±1.2	4±0.9	4.2± 0.9	4±1.2	3.7±1.0	4.1± 0.8	3.9 ±1.1	4.1±0.9	4.1±0.9	3.8± 1.2
t value	$SvsV_1$ $SvsV_2$ $SvsV_3$	1.4^{**} 2.6^{*} 2.1^{*}				1.4^{**} 1.4^{**} 1.7^{*}			1.6^{**} 0.8^{**} 1.6^{**}			1.0^{**} 1.4^{**} 1.5^{**}			1.5^{**} 1.6^{**} 0.7^{**}		
Taste	Mean ±SD	4.1±0.9	3.4± 0.6	3.4± 0.8	3.3± 1.1	3.6±1.0	3.4± 1.2	3.1± 1.2	3.5± 0.9	3.3± 1.0	3.6± 0.9	3.7± 1.0	3.8± 1.0	3.5± 1.2	3.6±1.0	3.7±0.9	3.5±0.9
t value	$SvsV_1$ $SvsV_2$ $SvsV_3$	1.8^{*} 1.6^{**} 1.6^{**}				1.0^{**} 1.3^{**} 2.0^{*}			1.8^{*} 1.7^{*} 1.1^{**}			0.8^{**} 0.6^{NS} 1.1^{**}			0.8^{**} 1.1^{**} 1.1^{**}		

CRITERIA		Agathi leaf powder				Palak leaf powder			Broccoli leaf powder			Drumstick leaf powder			Fenugreek leaf powder		
		S	**V_1**	**V_2**	**V_3**	**V_1**	**V_2**	**V_3**	**V_1**	**V_2**	**V_3**	**V_1**	**V_2**	**V_3**	**V_1**	**V_2**	**V_3**
Texture	Mean ±SD	4.7±0.4	4.5±0.8	4.4±0.8	4.2±0.8	4.3±0.8	4.1±1.1	4.1±1.1	4.5±0.8	4.4±1.0	4.3±1.2	4.4±0.8	4.5±0.8	4.3±1.2	4.2±0.9	4.5±0.8	4.3±1.2
t value	$SvsV_1$ $SvsV_2$ $SvsV_3$	0.6 NS 0.9** 1.1**				0.6 NS 0.9** 1.1**			0.6 NS 0.8** 0.9**			0.9 ** 0.6 NS 0.9**			0.6 NS 0.6 NS 0.9**		
Color	Mean ±SD	4.5±0.7	4.3±0.9	4.3±0.8	4.1±1.1	4.3±0.8	4.1±1.1	4.1±1.1	3.7±0.9	4.4±0.8	4.2±1.2	4.5±0.7	4.5±0.8	4±1.1	4.3±0.7	4.4±0.8	4.2±1.2
t value	$SvsV_1$ $SvsV_2$ $SvsV_3$	0.5 NS 0.5 NS 0.9**				0.5 NS 0.9** 0.9**			1.4** 0.2 NS 0.6 NS			0.0 NS 0.5 NS 1.1 **			0.8** 0.1 NS 0.6 NS		
Overall acceptability	Mean ±SD	4.1±1.1	3.8±0.8	3.6±0.9	3.3±1.1	3.8±1.1	3.6±1.3	3.7±1.4	3.9±1.1	3.7±1.2	3.6±1.3	3.8±1.1	3.5±1.1	3.7±1.2	3.8±1.2	3.9±1.0	3.7±1.4
t value	$SvsV_1$ $SvsV_2$ $SvsV_3$	0.6 NS 1.0** 1.5**				0.6 NS 0.9** 0.7**			0.3 NS 0.7** 0.9**			0.6 NS 1.1** 0.7**			0.3 NS 0.3 NS 0.7**		

6. Mean acceptability score for health mix

Health mix are the most convenient stable foods which requires reconstituition in boiling water simmering for 2-10 minutes, depending on the type of processing and composition of the food. The health mix was prepared using ragi flour, sago, barley and broken wheat and in this basic powder different green leafy vegetables were incorporated and acceptability trials were carried out. Five variations of health mix was prepared by incorporating five different types of green leafy vegetables like agathi leaf powder, palak leaf powder, broccoli leaf powder, drumstick leaf powder and fenugreek leaf powder each at 10 percent, 15 percent and 20 percent level and named as V_1, V_2 and V_3. After incorporating the green leafy vegetables there was not much change in the appearance and texture. The green leafy vegetable powders had a strong flavour in the health mix. Hence with successive increase in incorporation of ragi flour and the green leafy vegetable powders, the flavour dominated the recipe. With regard to taste, the taste was good. Out of the five different powders the broccoli leaf powder at 10 percent (V_1) level of incorporation was the most acceptable health mix with a mean value of 3.9±1.1 whereas the fenugreek leaf powder at 15 percent (V_2) level of incorporation was the most acceptable health mix with a mean value of 3.9±1.0 and the palak, drumstick and fenugreek leaf powder of V_3 variation obtained the most acceptable score with a mean value of 3.7±1.4, 3.7±1.2 and 3.7±1.4 respectively.

F. NUTRITIVE VALUE OF THE DEVELOPED RECIPES AND HEALTH MIX

Nutritive value of standard and variation recipes was calculated using food values given by Gopalan et al, 2004. From the consolidated nutritive value it was observed that by incorporating the calcium rich ingredients like ragi and soya it was found out that there was a decrease in energy and carbohydrate which helps to maintain an adequate weight in the postmenopausal women and the protein, calcium and phosphorus increased gradually by increasing the percentage of incorporation which is an important factor in maintaining the bone health. The iron, carotene, thiamine, niacin, B_6, folic acid and vitamin C did not have much change in its nutritive value and it remained standard.

TABLE XXXI

NUTRITIVE VALUE OF THE RAGI AND SOYA FLOUR INCORPORATED RECIPES

Recipes	Energy (K Cal)	CHO (g)	Protein (g)	Fat (g)	Fibre (g)	Calcium (mg)	Phosphorus (mg)	Iron (mg)	Carotene (µg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	B_6 (mg)	Folic acid (µg)	Vit- C (mg)
Khakra															
Standard	341	69.4	12.1	1.7	1.9	48	355	4.9	29	0.49	0.17	4.3	-	36	0
V-1	306	65	15	3.4	2.25	96.8	381	5.52	70	0.50	0.19	3.87	-	40	0
V- 2	353	62	16	4.3	2.42	121.2	394	5.57	90	0.51	0.20	3.65	-	43	0
V-3	357	60	17	5.1	2.6	145.6	408	6	111	0.52	0.21	3.44	-	45	0
Pan cake															
Standard	1000	145	32	32	0.3	390	567	5.3	674	0.34	0.94	2.75	-	100	5
V-1	964	139	35	34	0.97	444	640	6.6	715	0.43	0.98	2.7	-	111	5
V- 2	1010	136	37	35	1.3	470	676	6.7	720	0.42	1.01	2.67	-	117	5
V-3	1013	134	38	36	1.64	498	713	1.1	757	0.52	1.03	2.65	-	123	5
Momos															
Standard	348	74	11	1	0.3	23	121	2.7	25	0.12	0.07	2.4	-	-	0
V-1	312	68	14	3	0.9	77	194	4	67	0.21	0.11	2.3	-	12	0
V- 2	358	66	15	4	1.3	104	231	4.03	72	0.25	0.13	2.3	-	18	0
V-3	361	63	17	5	1.6	131	267	4.48	109	0.30	0.15	2.3	-	24	0
Chapathi roll															
Standard	341	69	12	2	1.9	48	355	4.9	29	0.49	0.17	4.3	-	36	0
V-1	306	65	15	3	2.2	97	381	5.5	70	0.50	0.19	3.8	-	40	0
V- 2	352	62	16	4	2.4	121	394	5.5	91	0.51	0.20	3.6	-	43	0
V-3	357	60	17	5	2.6	146	408	5.8	111	0.52	0.21	3.4	-	45	0
Mutia															
Standard	337	56	18	5	1.0	86	280	4.5	337	0.4	0.2	2.16	-	-	6
V-1	296	53	19	6	1.5	134	317	7.8	358	0.4	0.2	2.11	-	100	5.8
V- 2	340	52	19	6	1.8	157	327	5.1	369	0.4	0.2	2.08	-	91	5.7
V-3	341	50	20	6	2.07	180	342	5.3	379	0.4	0.2	2.06	-	82	5.6

TABLE XXXII

NUTRITIVE VALUE OF THE DEVELOPED HEALTH MIX INCORPORATED WITH DIFFERENT GREEN LEAFY VEGETABLES

Health mix	Energy (K Cal)	CHO (g)	Protein (g)	Fat (g)	Fibre (g)	Calcium (mg)	Phosphorus (mg)	Iron (mg)	Carotene (µg)	Thiamin (mg)	Ribo-flavin (mg)	Niacin (mg)	B_6 (mg)	Folic acid (µg)	Vit- C (mg)
Agathi leaf powder															
Standard	348	26	13	2	1.5	41	297	5.3	63	0.39	0.14	4.8	0.5	46	0
V-1	329	58	16	4	2.1	200	311	6	617	0.40	0.13	3.2	-	47	17
V- 2	320	53	17	5	2.4	280	318	6	906	0.39	0.15	2.8	-	47	25
V-3	310	47	18	6	9.4	360	324	6	1195	0.39	0.16	2.5	-	48	39
Palak leaf powder															
Standard	348	26	13	2	1.5	41	297	5.3	63	0.39	0.14	4.8	0.5	46	0
V-1	323	57	15	4	2	95	305	5.3	635	0.38	0.15	3.2	-	47	0
V- 2	310	51	16	5	2.2	121	309	5.3	933	0.36	0.17	2.7	-	47	0
V-3	298	45	17	5	9.0	148	313	5.2	1230	0.35	0.19	2.3	-	48	0
Broccoli leaf powder															
Standard	348	26	13	2	1.5	41	297	5.3	63	0.39	0.14	4.8	0.5	46	0
V-1	324	58	15	4	2.2	92	310	5.2	113	0.38	0.14	3.12	-	53	0
V- 2	311	52	16	5	2.5	118	316	5.2	150	0.36	0.15	2.80	-	57	0
V-3	299	46	17	5	9.4	143	322	5.2	187	0.36	0.17	2.41	-	61	0
Drumstick leaf powder															
Standard	348	26	13	2	1.5	41	297	5.3	63	0.39	0.14	4.8	0.5	46	0
V-1	329	58	16	4	2.03	131	310	5.3	755	0.38	0.13	3.2	-	47	22
V- 2	320	53	17	5	2.25	176	316	5.2	1113	0.36	0.14	2.8	-	47	33
V-3	310	47	18	6	9.15	222	322	5.2	1465	0.36	0.15	2.4	-	48	44
Fenugreek leaf powder															
Standard	348	26	13	2	1.5	41	297	5.3	63	0.39	0.14	4.8	0.5	46	0
V-1	325	57	15	4	2.0	127	308	5.41	311	0.38	0.16	3.2	-	47	5.2
V- 2	314	52	16	5	2.2	170	313	5.41	447	0.36	0.18	2.8	-	47	7.8
V-3	302	46	17	5	9.1	213	319	5.44	583	0.35	0.20	2.4	-	48	10.4

G. SHELF LIFE OF THE INSTANT HEALTH MIXES WITH DIFFERENT PACKAGING MATERIAL

Table XXXIII present the microbial plate count of the instant health mix powder.

TABLE XXXIII

MICROBIAL PLATE COUNT OF THE INSTANT HEALTH MIX POWDER

S.No	Sample name	Total plate count (cfu/ml)
1.	Standard powder	42.5×10^3
2.	Agathi leaf powder	242.5×10^3
3.	Broccoli powder	159×10^3
4.	Drumstick leaf powder	101×10^3
5.	Fenugreek leaf powder	86.5×10^3
6.	Palak leaf powder	70×10^3

Hundred gram of the developed health mix was weighed in a zip lock covers, sealed and stored at room temperature for a period of four weeks. At the end of fourth week the powder was evaluated for the microbial plate count and the powders were found to be acceptable.

H. IMPACT OF NUTRITION EDUCATION ON POSTMENOPAUSAL WOMEN

Nutrition education was imparted to the interested postmenopausal women through nutrition counselling with aid of booklet. There was a remarkable increase in the nutrition knowledge, observed in the selected postmenopausal women after imparting nutrition education.

V SUMMARY AND CONCLUSION

Good nutrition is an integral component of health and well being. It enables one to lead socially and economically active life and improves the quality of life, better work efficiency rate, reduced mortality, morbidity rate and plays a vital role in positive health, functional efficiency and productivity of the community.

Adequate nutrition and a well balanced diet are of vital importance in old age so as to prevent and control common hazards of ageing. Under nutrition, obesity, diabetes, cardiovascular disease, breast cancer and osteoporosis has been identified as the most important and commonly prevalent nutrition related health problems in old age.

The present study entitled "**Development of calcium rich snacks and instant health mix for postmenopausal women**" was aimed at studying the dietary pattern of the selected postmenopausal women and developing calcium rich snacks and health mix for postmenopausal women.

A sample of 100 postmenopausal women in the age group of 48-65 years was selected from the Coimbatore city because of the accessibility of the subjects and convenience. Information on their socioeconomic, lifestyle and dietary intake details were collected using an interview schedule developed for that purpose. Nutritional status was evaluated through anthropometric measurements. After studying their dietary and lifestyle pattern calcium rich snacks and health mix was developed. Nutrition education concentrating on different topics (Awareness of osteoporosis, prevention of osteoporosis, treatment of osteoporosis, healthy food and balanced diet was planned and conducted to the selected postmenopausal women.

The salient findings in the research are presented in the following.

- ✓ A majority of 29 percent of women belonged to the age group of 55-60 years while 28 percent of women belonged to 45-50 years of age group and around 19 and 24 percent of women belonged to the age group of 50-55 and 60-65 years of age.
- ✓ The outcome of the study indicated that majority of the women (i.e.) 90 percent were married and living with their family.

- ✓ It was found that maximum of 41 percent of women had education up to higher secondary level, while 29 and 28 percent were educated up to high school level and undergraduate level respectively and a minimum of two percent of women were educated up to post graduate level.
- ✓ From the study it was found that 78 percent of the women were leading a life with sedentary activity, 19 percent were doing moderate type of activity and only three percent of women were doing heavy work.
- ✓ Forty five percent of women were between 50-60 kg of weight.
- ✓ The present study revealed that 48 percent of women were between the heights of 150-160 cm.
- ✓ Fifty four percent of the postmenopausal women had normal weight for height and hence their BMI was normal. Thirty three percent of the women belonged to overweight category and 11 percent of the women were obese.
- ✓ Fifty percent of the women had waist hip ratio within the normal range (i.e.) ≤ 0.8, while the others had a waist hip ratio of ≥ 0.8, an indication of overweight.
- ✓ From the study it was exposed that a majority of 63 percent of them were non vegetarian. Twenty eight Percent of them were vegetarian and only 9 percent of them were ova vegetarian.
- ✓ With regard to calcium and vitamin D rich foods, majority of the women were not aware of the foods rich in calcium and their significance in improving the health, and hence consumed calcium rich foods rarely. 36 percent of women consumed ragi occasionally.Regarding green leafy vegetables like drumstick, fenugreek and agathi leaves were consumed weekly by 69 and 59 percent of
- ✓ With regard to the intake of vitamin D rich foods, it was revealed that maximum amount of consumption was seen in the consumption of diary and meat products like egg yolk only.
- ✓ Sixty five percent of the women consumed tea or coffee once a day while 14 percent and 12 percent of women consumed tea or coffee twice to thrice a day.

- ✓ When their dietary pattern was studied, it was revealed that 85 percent of women consumed rice daily, 67 percent of the women consumed red gram dhal weekly as sambhar or for any other preparations.
- ✓ Consumption of green leafy vegetables showed that majority of 69 percent of the postmenopausal women consumed drumstick leaves weekly while Coriander and curry leaves were consumed almost daily by most adults.
- ✓ About roots and tubers beetroot, carrot, potato and radish are the most frequently consumed vegetable while onion was consumed by all the subjects everyday.
- ✓ With regard to fruit intake tomatoes were the only fruit consumed daily by the women. Other than this no other fruit was consumed daily and banana was the only fruit consumed by 39 percent of the women.
- ✓ Most of the women consumed curd and buttermilk regularly than milk.
- ✓ The study revealed that egg was consumed weekly by 69.4 percent of women. 69.4, 23.8, 63.4 percent of women consumed egg, mutton and chicken once in a week. Mutton was consumed twice a week by 31.7 percent of women. The fish consumption was low when compared to other meat products.
- ✓ The survey revealed that cooking oil was the only fat consumed on a daily basis by all women.
- ✓ The study revealed that sugar was consumed daily by 70 percent of women while the remaining 30 percent of women avoided sugar because of diabetes.
- ✓ The result indicated that majority of the women experienced physical discomforts, back pain and stomach pain during menarche.
- ✓ The results of research indicated that 70 percent of women had attained menopause at the age of 45-50 years and majority of women underwent problems like sleep disorder, hot flushes and headache during menopause.
- ✓ The calcium rich recipes and health mix developed were all acceptable with a good mean score.

- ✓ In the snacks and health mix, the calcium level increased when compared to the standard recipes and the increase of calcium was proportionate to the increase in the incorporation of ragi and soya flour.

SUGGESTION FOR FUTURE STUDY

- Knowledge about calcium rich ingredients for postmenopausal women
- Importance of exercise and exposure to sunlight for postmenopausal women
- Software about osteoporosis to educate postmenopausal women could be developed

CONCLUSION

Diet and nutrition play a very important role at all stages of an individual's life. Adequate nutrition at an early phase will prevent nutrient deficiencies with advancing age. Calcium plays an essential and varied role in the body and is vital for health.Vitamin D plays a key role in assisting calcium absorption from food, ensuring the correct renewal and mineralization of bone tissue, and promoting a healthy immune system and muscles. Being physically active can not only reduce risk of fractures but can also help in increasing the bone mineral density.

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APPENDIX I

HUMAN ETHICAL COMMITTEE CLEARANCE

INSTITUTIONAL HUMAN ETHICS COMMITTEE

Avinashilingam
Institute for Home Science and Higher Education for Women
University
(Estd. u/s 3 of UGC Act 1956)

Chairman
Dr. S. Ramalingam
Principal, PSG Institute
of Medical Sciences
& Research, Coimbatore

Member Secretary
Dr. P. R. Padma
Professor, Department of
Biochemistry, Biotechnology and
Bioinformatics

Members
Dr. S. Premakumari
Mr. C. G. Kumar (Legal Expert)
Dr. A. Saraswathy
Mrs. V. Mangayarkarasi
Dr. S. Kowsalya
Dr. N.S. Rohini
Dr.Subhashini K. Sripathi
Mrs. S. Radha Devi
Mrs. Judith Justin

9th March 2015

To
Ms. Iswarya, S.
Department of Food Science and Nutrition
Avinashilingam Institute for Home Science and
Higher Education for Women
Coimbatore – 641 043

Dear Madam,

Ref : Your proposal No. IHEC/14-15/FSN/12 entitled "Development of calcium rich snacks and instant health mix for postmenopausal women" submitted for approval of the IHEC on 3rd January 2015.

The Institutional Human Ethics Committee of our University hereby grants approval to your research proposal No. IHEC/14-15/FSN/12 entitled "Development of calcium rich snacks and instant health mix for postmenopausal women" submitted by you. The Approval number for the same is AUW/IHEC-14-15/XMT-11.

We wish you all the best in your research endeavours.

Regards,
9/3/15
Dr.P.R.Padma
Member Secretary

Institutional Human Ethics Committee

APPENDIX II

DEVELOPMENT OF CALCIUM RICH SNACKS AND INSTANT HEALTH MIX FOR POSTMENOPAUSAL WOMEN

INTERVIEW SCHEDULE

PERSONAL PROFILE

1. Name of the investigator :
2. Name of the interviewer :
3. Age of the subject (yrs) :
4. Address of the interviewer :
5. Marital status:

a) Married b) Unmarried c) Widow d) Divorcee

6. Educational qualification :
7. Occupation :
8. Type of activity:
   a) Sedentary b) Moderate c) Heavy
9. Source of income:
   a) Salary b) Pension c) Family resources d) Investments e) Others
10. Monthly expenditure pattern of the family

S.no	Items	Amount spent	Percentage
1.	Clothing		
2.	Education		
3.	Food		
4.	Medicine		
5.	Recreation		
6.	Savings		
7.	Shelter		
8.	Transport		

ANTHROPOMETRY AND BIOPHYSICAL

11. Height in cm :
12. Weight in kg :
13. Body mass index (BMI) :
14. Waist measurement in cm :
15. Hip measurement in cm :
16. Waist hip ratio :

HEALTH STATUS

17. Details of the subject:
    a) Age at menarche:

18. Problems during menarche

S.No	PROBLEMS	YES	NO	TREATMENT
A	Back pain			
B	Breast pain			
C	Excessive bleeding			
D	Head ache			
E	Irregular periods			
F	Leg pain			
G	Nervousness			
F	Physical discomfort			
I	Stomach pain			
J	Tension			
K	Tiredness			
L	Urinary tract infection			
M	Vomiting sensation			
N	Others			

19. Age at marriage :
20. Age at first pregnancy:
21. Number of children :
22. Age at menopause(yrs):
23. Problems during and after menopause

S.No	PROBLEMS	YES	NO	TREATMENT
A	Fracture in a) hip b)Wrist c)Spinal			
B	Frequent urination			
C	Hot flushes			
D	Head ache			
E	Hair loss			
F	Night sweat			
G	Palpitations of heart			
H	Physical discomfort			
I	Sleep disorder			
J	Tiredness			
K	Weight gain			
L	Forgetfulness			
M	Irritation			
N	Depression			
O	Anxiety			
P	Vaginal dryness			
Q	Loss of height			

24. Do you suffer from any of the following disorder?
    a) CVD b) Diabetes mellitus c) Hypertension
    d) Osteoporosis e) arthritis f) renal failure
25. What are the remedies you took to overcome the above problems?
    a) Medications b) Exercise c) yoga d) Dietary modifications
    e) All the above f) others

26. Have you been benefited by these remedial measures?
    a) Yes b) No c) Partially
27. Do you have any bone fractures?
    a) Yes b) No
    If yes, area of fracture _____
28. Do you have any thyroid problems?
    a) Yes b) No
    If yes,
    a) Hyperthyroidism b) Hypothyroidism
    c) Parathyroidism d) Other problems
29. Is it hereditary?
    a) Yes b) No
    If yes,
    a) Father b) Mother c) Grandfather d) Grandmother e) others

LIFESTYLE PATTERN

30. Do you exercise regularly?
    a) Yes b) No
    If yes, the type of exercise you perform?
    a) Walking b) Cycling c) Swimming d) Yoga e) Others
31. How often do you exercise?
    a) Daily b) Once a week c) Twice a week
    d) Thrice a week e) Monthly f) Rarely
32. Duration of exercise?
    a) 30mins b) 1 hour c) More than 1 hour d)rarely
33. How many hours do you sleep daily?
    a) 5-6 hrs b) 7-8 hrs c) More than 8 hrs

DIETARY PATTERN

34. Are you a
    a) Vegetarian b) Non-vegetarian c) Ova-vegetarian
35. If you are a non-vegetarian? What are the foods commonly consumed?
    a) Fish b) Chicken c) Mutton d) Crab e) Prawn f) Others

36. How frequently do you consume non-veg foods?
    a) Daily b) Once a week c) Twice a week
    d) Thrice a week e) Monthly f) Rarely
37. Do you have the habit of skipping meals?
    a) Yes b)No c) Rarely
    If yes,
    a) Breakfast b) Lunch c) Dinner Daily meal pattern?
    a) 2 meals/day b) 3 meals/day c) 4 meals/day d) less than 2 meals/day
38. 24 hour recall

Morning	
Mid morning	
Lunch	
Evening	
Dinner	

39. How frequently do you consume the following foods?

Foods	**Daily**	**Weekly**	**Twice a week**	**Twice a month**	**Occationally**
Cereals					
Pulses					
Fruits					
Roots and tubers					
Other veg's					
Fatty foods					
Sugar &jiggery					

40. How frequently do you consume calcium rich foods like?

Food items	**Daily**	**Weekly**	**Twice a week**	**Twice a month**	**Occationally**
Ragi					
Agathi					
Drumstick leaves					
Cheese					
Broccoli					
Curd					
Egg					
Fenugreek leaves					
Poppy seeds					
Orange					
Soya					

Yoghurt					
Almonds					
Tofu					
Sesame seeds					
Palak					

41. How often do you consume vitamin D rich foods like?

Food items	**Daily**	**Weekly**	**Twice a month**	**Thrice a month**	**Occationally**
Butter					
Egg yolk					
Fish					
Liver					
Orange juice					

42. How long you are exposed to sunlight per day? _____
43. Reasons for exposure? _____
44. Special foods included and avoided during and after menarche?

Included	**Avoided**

45. Special foods included and avoided during and after menopause?

Included	**Avoided**

46. How often do you consume milk & milk products?
    a) Daily b) Twice a day c) Thrice a day d) Once a week
    e) Twice a week f) Rarely
47. What type of milk & milk products do you consume?
    a) Skimmed milk b) Whole milk c) Powdered milk
    d) Curd e) Butter milk f) Yoghurt g) Others
48. Do you consume health drinks?
    a) Yes b) No
    If yes, specify_____
49. How frequently do you consume coffee/tea?
    a) Daily b) Twice a day c) Thrice a day d) Once a week
    e) Twice a week f) Rarely
50. Do you take any calcium/vitamin D supplement
a) Yes b) No c) Rare
If yes, specify_____

APPENDIX III

STANDARD RECIPES AND HEALTH MIX

1. KHAKRA

Ingredients- Whole wheat flour– 100 g, 1 tsp black sesame seeds andsalt to taste

Method:

- Combine all the ingredients together in a bowl and knead into a firm dough using water as required. Keep aside for 10 to 15 minutes.
- Divide the dough into 6 equal portions and roll out each portion into large thin circles of 150 mm. (6") in diameter.
- Heat a non-stick pan and cook each circle over a low flame pressing from all sides with a cloth to make the khakhras crisp.
- Cool and store in an air-tight container.

2. PAN CAKE

Ingredients -Maida – 50g, Salt – ½ tsp, Egg – 1, Milk – 250g,Sugar – 30g, Lime – ½, fat-30g

Method:

- Mix flour and salt in a bowl.
- Add egg and stir it gradually adding milk till the consistency of thick cream is got.
- Preheat the pan with little fat on it.
- Pour sufficient batter to cover the bottom of the pan thinly.
- Fry quickly until golden brown.
- Turn on to sugared paper. Sprinkle with sugar and lemon juice.
- Roll up and keep hot until the pancake fried and served immediately.

3. STEAMED MUTIA

Ingredients: Besan – 80g, Methi leaves-10g, Sugar- a pinch, Semolina-10g, Sesame seeds- 1 tsp, Turmeric powder, Coriander powder, Cumin powder and Red chilli powder- to taste

STEP 1: making the dough:

- Take all the ragi, besan, chopped methi leaves, salt, sugar, semolina, sesame seeds, turmeric powder, coriander powder, cumin powder, red chili powder, in a bowl.
- Mix well.
- Add ginger-green chilli paste, baking soda and lemon juice. mix the ingredients and keep aside for 15-20 minutes. The methi will release water in the mean time
- Now add water or yogurt and knead to smooth dough.

STEP 2: making the steamed methimuthia:

- Take half of the dough. shape them into sausage type rolls and place them on a greased tray.
- Heat water and when the water becomes hot. place the greased tray in the pan. cover and let the muthia steam for 10-12 minutes.
- The muthia is steamed and cooked. check with a tooth pick or knife to see for doneness. if its properly steamed then the dough will not stick to the tooth pick and will come out clean.
- slice the muthia
- Heat a pan or kadai and temper the ingredients for the steamed muthia. The mustard seed should pop…
- Add the sliced steamed muthia to the tempering and fry these for 2-3 minutes on a medium flame.

4. MOMOS

Ingredients:

Maida-100g, Salt- to taste

Stuffing – mushroom, Onion, Green chilli, Ginger garlic paste, Pepper, Salt, Oil

Method:

Add the maida flour and salt with luke warm water and make a dough. Divide the dough in to a equal portions and roll out each portion in to thin circles. Place the stuffing inside the dough and seal it together and steam it for 15 minutes. Serve hot.

For stuffing:

Take a pan and add little oil and add onion, ginger, garlic, pepper. Sauté the ingredients and add mushroom with little amount of water and stir till it cooks. Add salt and cheese.

5. SPRING ROLL

Ingredients: Rice flour-100g,Salt to taste

Stuffing – Capsicum**,** Corn**,** Carrot**,** Onion, Tomato**,** Ginger**,** Garlic, Salt**,** Oil

Method:

Add the flour with salt and make a dough with water. Divide it in to equal portions and roll it in to circles. Place it in a tava and heat it till it gets cooked.

Stuffing:

Take a pan and add little oil and add all the stuffing ingredients and sauté it till it gets cooked. Then place the stuff in the dough and roll it.

HEALTH MIX

Ingredients

Ragi-20g, Broken wheat- 50g, Roasted gram- 20g, Barley- 20g, Almond-- to taste, Cardamom-for flavour

METHOD

Dry roast each of all the given ingredients separately, let it coolfor sometime and grind together into a fine powder and sieve it. Transfer the powder into an airtight container.

APPENDIX IV

SCORE CARD

Recipe/ health mix name:

NAME: **DATE:**

SENSORY EVALUATION		**RECIPE -**		
Variations	**Standard**	**V_1**	**V_2**	**V_3**
APPEARANCE				
Excellent				
Very good				
Good				
Fair				
poor				
Flavor				
Highly acceptable				
Moderately acceptable				
acceptable				
Slightly acceptable				
Unacceptable				
TASTE				
Excellent				
Very good				
Good				
Fair				
poor				
TEXTURE				
Excellent				
Very good				
Good				
Fair				
poor				
COLOR				
Excellent				
Very good				
Good				
Fair				
poor				
OVERALL ACCEPTABILITY				
Excellent				
Very good				
Good				
Fair				
poor				

APPENDIX V

PAMPHLET USED TO IMPART NUTRITION EDUCATION TO SELECTED POSTMENOPAUSAL WOMEN