DEVELOPMENT AND EVALUATION OF HERBS INFUSED WHOLESOME SMOOTHIE MIX FOR ELDERLY PEOPLE

VISHALAKSHI S
(21PFD030)

Thesis submitted to

Avinashilingam Institute for Home Science and Higher Education for Women,
Coimbatore -641043

In Partial Fulfilment of the Requirements for the Degree of Master of Science in
FOOD SERVICE MANAGEMENT AND DIETETICS

May 2023

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Signature of the Supervisor

Signature of the Head of the Department

CERTIFICATE

This is to certify that the thesis entitled, **"Development and evaluation of herbs infused wholesome smoothie mix for elderly people"** submitted to Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore in partial fulfilment of the requirements for the award of the degree of Master of Science in Food Service Management and Dietetics, is a record of original research work done by **Ms. Vishalakshi S** with Register Number 21PFD030 during the period of this study under the Supervision and guidance of **Dr. R. Radha** Assistant Professor (SG), Department of Food Service Management and Dietetics, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore-641043, Tamil Nadu, India.

Signature of the Supervisor

Signature of the Candidate

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"Let food be thy medicine, thy medicine shall be thy food."

Hippocrates

I.INTRODUCTION

Old age is the period in the life cycle. Generally, people of age 60 and above are considered old age. According to Aman *et al* (2021) and Yıldız *et al* (2017) aging is the gradual degeneration of the individual's body physically and physiologically. The process is the changes that take place psychologically, sociologically, and chronologically.

Biologically, ageing is the result of the impact of the accumulation of a wide variety of molecular and cellular damage over time. This results in a gradual decline in physical and mental capacity, increasing the risk of illness and ultimately death. These changes are neither linear nor coherent and are generally associated only with the age of a person in years. The diversity found among seniors is not random. (WHO, 2016).

According to Unal *et al* (2019) the World Health Organisation (WHO) defines old age as a period or phase in the life of an individual where there is a decrease in environmental responsibility that is not in his/ her control. According to WHO old age is classified into 3 types as in

- 65-75 years of age are named "Young Old age". This phase is considered to be the period of progression from work life to retirement life.
- 75-85 years of age are called "Advanced adult age". In this phase, the physical metabolic-related functioning capability of the body is lost.
- 85 years above of age are considered a "very advanced adult age" where they need specialized nutritional, and medical care and support.).

Steverson (2022) stated that traditionally India is a country where the concept of a joint family is very common. But due to the emergence of the nuclear family structure, the most affected group of people is the geriatric population of the country. It is estimated by WHO that the world population of the old age group will be increased from 15 %to 22% between 2015 to 2030. All countries face great challenges in ensuring that their health and social systems are prepared to take full advantage of this demographic change. By 2050, 80 percent of seniors will be in low- and middle-income countries. The pace of population aging is a lot faster than in the past.

Santoni ,2015 opined old age population as a widely diversified group. The variations may include brain functioning ability and physical, physiological, and sensory functioning

capacity. It is necessary to have a better understanding of age-oriented changes in older age to help in proper management .The age of 80 to 85 is a time of transition during which important health changes occur. Up to the age of 80, most people do not have any type of functional inabilities, despite the presence of chronic disorders that is common for the age. This involves an increased need for medical care after age 70, while social care, including institutionalization, becomes necessary.

Gabrovec(2021) stated that a widespread and significant geriatric syndrome known as frailty is defined by age-related vulnerability to unfavourable health consequences. (Chen *et al* , 2014)The nutritional status of the old age population is related to frailty. Frailty can be any age-oriented decrease in the functioning capability of the individual. This can be the loss of stored nutrients in the body which can cause a negative impact on the health condition of the person.

The negative impact directly leads to Malnutrition. Malnutrition is an imbalance in nutrient intake, absorption, and utilization of the body. This can be of two types named Undernutrition and overnutrition. In the case of the geriatric population, the type of malnutrition that is prevailing is undernutrition.

Leslie, (2015) defined malnutrition as the state of deprived food and nutrient intake. Since the older population is more susceptible to the condition, the risk of morbidity and mortality is high. This may include frequent falling due to imbalance, lack of energy, and poor body healing and functioning capability of the organs.

Despite of the malnutrition there is a gradual muscle mass loss observed in old age which is a natural phenomenon. The percentage of loss varies depending on age. The prevalence of condition Sarcopenia is common among people of age above 85. In this condition there is 50% of muscle loss and strength is observed. (Dodds,2017)

Walston (2017) listed the possible reasons can be age-related chronic inflammation, hormonal function decline, decreased mitochondrial activity, and stem cell activity. There is also a significant change in fat metabolism and absorption.

Apart from the factors mentioned in the phase of old age, all decreases in the functions and the organs reserves are observed. This is also called geriatric syndrome which has multifaced parameters like difficulty in excretion and bladder release, changes in sleep pattern, nerve dysfunctions, neurotransmission dysfunctions, and metabolic inabilities such as

changes in digesting capacity, the quantity of food intake, chronic pain-associated physical disabilities. (Liang *et al*., 2018)

Conzade,(2017) stated as people age, their systems become less efficient at absorbing and utilising some micronutrient from food. Due to the significance of micronutrient status in chronic illness and health prevention, measuring subclinical micronutrient deficiencies and identifying subgroups at risk in the aged population are critical. Certain micronutrient requirements may influence and potentially raise the prevalence of several chronic diseases.

Tan(2018) opines that the damage to cells and molecules is thought to arise from oxidative stress, which is thought to be an imbalance between pro- and antioxidant species. Age-related disorders occur largely as a result of oxidative stress. Only a few of the age-related diseases that are significantly impacted by oxidative stress include arthritis, diabetes, dementia, cancer, atherosclerosis, vascular disorders, obesity, osteoporosis, and metabolic syndromes.

Reactive oxygen species (ROS) are created in the body to regulate biological processes such cell survival, stressor responses, and inflammation. Elevated ROS has been connected to the onset and progression of ageing. Due to their reactivity, high ROS concentrations can produce oxidative stress by causing imbalance between prooxidant and antioxidant levels. (Norhaizan, *et al* 2018)

Hou *et al* (2019) opines that the majority of neurodegenerative disorders, such as Alzheimer's disease (AD) and Parkinson's disease (PD), are primarily influenced by ageing. One in ten people under 65 years old has AD, and the frequency of the condition rises with age. Age-related neurodegenerative disorders tend to advance irreversibly and are linked with high socioeconomic and personal expenses, and there are very few effective therapies available.

Taylor& Dillin, (2017) highlighted that the protein homeostasis (proteostasis) mechanism in ageing cells experiences functional degradation, which reduces cellular viability and promotes the emergence of protein-misfolding illnesses including Alzheimer's and Huntington's. Proteostasis can be influenced in a wide range of ways by metabolic signalling pathways that control the ageing process, dietary restriction, and decreased mitochondrial activity.

Senescence is considered to be a causative factor in the malfunction of ageing tissues and organs as well as numerous chronic age-related illnesses. Senescence depletes the various types of cells in an organism, in different ways. Senescence obstructs tissue homeostasis and regeneration . It plays a major role in complex biological processes such as growth, tissue repair, ageing, and illnesses associated with old age. (Van Deursen ,2016)

Govindaraju, (2018) stated that the five dimensions of physical well-being, material well-being, social well-being, emotional well-being, and development and activity are common classifications for quality of life (QoL), which are both subjective and objective. QoL is a crucial indicator of effective or healthy ageing because it gives a measure of overall welfare that takes into account both positive and negative aspects of life. Age-related physical restrictions, financial reliance, social issues such as housing arrangements, and lifestyle elements such as physical exercise, diet, and nutrition are all likely to have an impact on older individuals' quality of life.

Older adults must take into account not only physiological changes with age but also their lifetime food preferences. Physiological, psychosocial, and economic factors can all be obstacles to an appropriate diet as we get older. There is a consensus that dietary habits change throughout life and as people age, their nutritional requirements often differ. (Stosovic,2021)

Khole & Sollletti, (2018) highlighted that the nutrition plays a pivotal role in the health and well-being of the population of any age group. Being healthy is not just the absence of any disease and disorders but the overall state of physical and mental well-being. Nutrition is a tool to determine the quality of life of any individual or a group of the population. The state of a nutritious and healthy lifestyle is determined by the economic stability of the individual. The Centres of Disease and Control (CDC) have proved that there is a significant relationship between the health and wealth of the individual. The nutrition factors can be used as an indicator of the health status of the individual.

Early-stage life nutrition helps in building and functioning of the body. But in the later stage of life, it plays a major role in maintaining and performing the functions. So, a healthy and nutritious way of lifestyle is recommended through all the stages of life. This also promotes an independent way of living. The nutrition of old age is affected by certain factors. These can be classified as physical, social, and psychological.

- Physical factors may include, reduced physical and motor activity, sleep pattern disturbance, loss of teeth, etc
- Physiological factors loss of appetite due to a decrease in basal metabolic rate, gastrointestinal changes like reduced digesting capacity, swallowing difficulty, hormonal changes, loss of taste sense
- Social factors can be less importance given to self-care, social and family isolation, and inability to cook and purchase nutritious foods from the market. (WHO, 2018)

Motohashi(2017) opined that an healthy food choice for the elder population significantly has more advantages. Functional foods are much valued in the market. There are many benefits in consuming functional foods. These foods provide optimal digestive health and support some specific scientific claims about the benefits for elderly people. Including these foods in the daily diet provides multiple health benefits beyond what is provided by traditional nutrients. In addition, incorporating this food into a healthy lifestyle helps maintain good immune response, digestive health, movement abilities, cardiovascular function, and general well-being in older adults

The use of an healthy diet is essential for effective aging. Several medical organizations and governments are working to develop special dietary guidelines for seniors to ensure they are healthy in terms of nutrition and prevent the onset of diseases. However, several studies have revealed that the consumption of food for the elderly is insufficient. The intake of proteins and calories often declines as aging progresses,. (Sulmontm,2020).

The commercial market has many foods specifically made for the elder population. They are of various types like “Ready to Cook”, Ready to Eat”. Some commercial examples can be health mixes, biscuits, cookies, etc which are ready to consume. Soup mixes and oats are “Ready to Eat”. Although there are many commercial products, all the products available are not the healthier option as they are high in calories and extensively processed. Products that are healthy substitutes with functional properties are highly recommended for the older population.

Although ageing is a natural and ongoing process, if handled effectively, people will have the chance to live longer in better health conditions. A healthy, balanced diet can delay the onset of food-related diseases, enhance well-being and life expectancy, and/or slow down the ageing process. With ageing comes several physiological changes that affect the quality and

quantity of food that is consumed. Therefore, it is necessary to create a new food category that is especially suited to the requirements of the elderly. Meals for the elderly should be designed to satisfy their specific needs, much like other food categories, like infant foods. (Calligaris, *et al* 2022)

As people grow old their affinity to cook an elaborate meal diminishes. further their level of appetite reduces. To compensate for both these factors and its resultant micronutrient deficiency an attempt was made to develop a wholesome smoothie mix was planned.

The main objectives of the study are

- To develop herbs-infused wholesome smoothie mix for elderly people.
- To perform sensory and quality analysis of the developed smoothie mix.

II.Review of literature

The review of literature pertaining to the study titled "**Development And Evaluation of Herbs Infused Wholesome Smoothie Mix for Elderly People**" is presented under the following headings,

A. Old age health status, health care, its need, and importance.
B. Prevalence of nutritionally related disease and associated disorders of old age.
C. Importance of convenient foods for old age.
D. Available convenient foods suitable for old age.

According to the World Health Organisation (WHO ,2016), good health means having all parts of the body functioning properly – both now and in the future. It also implies a sense of well-being overall, free from any physical or mental illnesses, injuries or pain. Having Good health always allows to live longer and work productively. It is generally accepted that good health is an important part of a happy life. A healthy person does not require the help of others for carrying out their daily routine work.

It has been estimated that by 2050 almost 75% of this aging population would live in developing countries where healthcare systems are already struggling with providing adequate care for an increasing number of citizens. These demographic transitions essentially require shifting the global focus to cater to the preventive health care and medical needs of the elderly population. (WHO,2016)

Domhnall McHugh (2018) in his review stated that aging is an ongoing functional deterioration. Age, serves as a risk factor for a variety of illnesses, including glaucoma, osteoporosis, cancer, type 2 diabetes, idiopathic pulmonary fibrosis, cardiovascular disease. He also highlighted that despite these connections to human illness, there are very few studies on the process of ageing. The biological reasons for ageing are still largely unknown, investigations in recent decades have shown similar cellular and molecular characteristics connected to ageing.

"Hallmarks of aging" aids in forecasting negative outcomes as people age. Identifying the biomarkers of ageing will help in the actions to lessen , and to track the effectiveness of these efforts. It aids in a better knowledge of the biological processes of aging, the prevention and/or postponement of the onset of chronic illnesses and incapacity, as well as the mitigation of the severity of these unfavourable clinical outcomes. (Guerville *et al* 2020)

Gil (2018) stated that the discovery of 'ageing hallmarks' has aided in conceptualizing ageing research and raised the enticing possibility of slowing the progression of several age-related disorders by focusing on the ageing process. He then classified Age-related damage into three groups: Primary, or the causes; Antagonistic, or the reactions; Integrative, or the results underlying causes of the ageing . Senescence, a biological reaction that prevents injured or old cells from proliferating,

Senescence is a condition of prolonged cell-cycle halt that cannot be reversed and is brought on by various intracellular or extracellular stress or damage. This cell cycle arrest has three main goals: to stop the spread of damaged cells, to get rid of toxic substances that have accumulated, and to prevent the transformation of healthy cells into cancerous ones. This can be used as identifiers and biomarkers to indicate of biological or physiological age**.** (Dodig, *et al* 2019)

A. Old age health status , care its need and importance

Chitra *et al* (2021) stated that health status has historically been linked to a society's economic and social progress. The health of an aging population is determined by the prevalence of physical, psychological, and mental diseases or conditions.

Neeraj (2022) highlighted that as the population ages, health problems become a more significant concern for society. Illness and physical ailments are common among elderly people, but poor mental health is also on the rise due to factors such as senility, neurosis, and satisfaction with life. The health status of elderly people has a significant impact on their quality of life. In old age, the health status of aged persons deteriorates significantly and this often leads them to become dependent on others for support.

Shrivastava *et al* (2016) opines that the rapidly aging population is more likely to suffer from chronic diseases, physical disabilities, and mental illnesses. A wide range of determinants all play a role in an older person's health status, social concerns, maltreatment towards the elderly, poor knowledge and awareness about the risk factors, food requirements.

Additionally, Ramasamy *et al* (2013) stated that the psychological and emotional problems, such as loneliness among the elderly, can also be harmful to the health. Financial restrictions (resulting from reduced income and expenses after retirement), problems with the healthcare system (such as a lack of insurance coverage or insufficient facilities), and

physical conditions are only a few of the many variables that can cause mental stress in older persons. The quality of life for elderly individuals is also significantly impacted by these issues.

Quality of life (QOL) is defined by the WHO as a person's perception of where they are in life in respect to their goals, standards, and concerns, as well as the culture and value systems in which they live. Physical deterioration, psychological suffering, and mental decline are typically experienced by elderly adults with poor health-related QOL. The increase in life expectancy among the elderly is a result of the demographic change in emerging countries. India had an 8.6% older population in 2011; by 2026, that number was expected to increase to 11.6%. (Devraj,2019)

Shah *et al* (2017) stated that Quality of life as a wide concept that includes a person's environment, social relationships, spiritual beliefs, level of independence, and physical and mental health. For the first time in history, the number of adults 60 and older will surpass that of children under the age of five by the year 2020. There will be 2 billion people in the globe who are 60 years of age or older by the year 2050, up from the current 841 million Delaying the onset of impairment and ensuring the highest possible QOL for elderly persons are the challenges of the twenty-first century.

Dietary patterns vary significantly based on one's culture and lifestyle. Individual dietary needs may be impaired by factors such as pathological physiology, economic status, or social norms associated with aging A study found that countries with higher incomes have healthier eating habits than those who are in lower- or middle-income brackets. The factors associated with socioeconomic status include education levels, financial security, personal opinion of social status, and income. (Jeewon *et al* 2022)

Senee *et al* (2022) highlighted that there is a significant relationship between socioeconomic position and dietary choices, especially the consumption of fruits and vegetables. A multitude of factors, including an elderly person's financial situation, the price of food products, their marital status, psychiatric disorders, changes in their sensory abilities, and access to food, have been found to have an impact on their eating patterns.

1. Geriatric syndromes

Geriatric syndromes are characterized as complex illnesses brought on by deficiencies in a variety of areas, including clinical, psychological, and environmental vulnerabilities. Geriatric syndromes are a key concept in gerontology that offer signs of aging and forecast clinically significant consequences like death and healthcare use. Studies have also revealed that several risk factors for middle-aged persons' development of geriatric syndromes coincide with those for adults 65 and older. (Deeks, *et al* ,2015)

Onder *et al* (2016) have mentioned that Geriatric syndromes, which include pain, falls, incontinence, and delirium, are described as "multifactorial health problems that develop when the cumulative impact of deficiencies in several systems make an older person vulnerable to situational obstacles." Geriatric syndromes are extremely common in the elderly population and are linked to poor health and life outcomes. Comorbidity may result in further deficits, which may help geriatric syndromes develop.

Malmstrom *et al* (2020) have stated that the prevalence of the geriatric syndromes of frailty, sarcopenia, weight loss, and dementia in aged people is high. Despite the detrimental effects on mortality, disability, and quality of life in older persons, they are routinely ignored. The prevalence of one or more of the geriatric syndromes of frailty, sarcopenia, weight loss, and dementia in older population is also increasing.

B. Prevalence of nutritionally related disease and associated disorders of old age

Ghosh (2021) has stated that in senior people, nutrition has a significant role in determining health. In the past ten years, the significance of nutritional status has come to be understood more and more in relation to several morbid disorders, such as cancer, heart disease, and dementia in those over 65. Involuntary weight loss, an abnormal Body Mass Index (BMI), particular vitamin deficiencies, and reduced nutritional intake are some symptoms of malnutrition among the elderly, yet there is no widely recognized diagnosis of the condition.

1. Dysphagia and Presbyphagia

Age-related changes in swallowing physiology have led to the recognition of dysphagia (difficulty swallowing) as a health issue affecting the aged. Dysphagia is more likely to occur due to age-related changes in swallowing physiology and prevalent illnesses that affect the elderly. Presbyphagia refers to changes and challenges in swallowing in otherwise healthy older persons. Muscle loss in the skeletal and

swallowing muscles leads to the development of sarcopenic dysphagia. An independent contributor to malnutrition is dysphagia. (Bender *et al* 2020)

2. Malnutrition in old age

Khan (2021) has noted that the worsening physiological and psychological health conditions appeared to be more indicative of the burden of social starvation. The majority of older adults who are malnourished are at risk for developing a number of chronic illnesses connected to nutrition that would make them unable to live independently. Malnutrition risk is consequently raised as a result. Hence, the comorbidities of elderly persons and their dietary state are interlinked.

The terms "malnutrition" and "undernutrition" are interchangeable and refer to a state when there is a lack of both energy and nutrients. Malnutrition is more likely to occur in older adults due to age-related variables such sensory loss of taste and smell, poor chewing capacity, digestion issues, and a fall in muscle strength.(Naseer *et al* 2016)

Donini, *et al* (2015) stated that age-related changes in physiological, pathological, and environmental variables are the main causes of malnutrition and decreased food intake. Moreover, increased food and energy needs, comorbidities, psychological and socioeconomic status and polypharmacy may have a detrimental impact on energy balance and contribute to the development of malnutrition.

Jaul and Barron (2017) stated that “multiple medications or polypharmacy” as the condition where there is an intake of different medications or a combination of the drugs by the individual. The consumption of five or more varieties of drugs also leads to polypharmacy. This may cause dangerous drug-drug or drug and nutrient interactions, which can elevate the existing problems.

3. Multimorbidity

Disorders among adults 60 years and older are responsible for 23% of the worldwide illness burden. Disability-adjusted life years (DALYs) per head are 40% higher in low-income and middle-income regions even though the proportion of the burden caused by older people (60 years) is highest in high-income regions. This difference is due to the increased burden per head of the population caused by cardiovascular diseases, as well as sensory, respiratory, and infectious disorders. (Martin *et al* 2015)

Prince *et al* (2016) have said that with age, multimorbidity and the demand for social support rise. The individual, his or her family, and public health care systems are all heavily burdened by age-related illnesses and impairments in. It is necessary to take action to stop and postpone the incapacitating cascade to ensure the long-term viability of public health systems and enhance the standard of treatment offered. According to the most recent data, a disproportionate number of elderly residents of the community have conditions that put them at risk for serious medical problems and unmet clinical requirements.

Sedentary lifestyles, which are prevalent in older age, cause the early onset of illness, disease, and frailty. Evidence suggests that engaging in regular physical activity is safe for older adults in good health as well as those who are frail. Regular physical activity reduces the risk of developing major cardiovascular and metabolic diseases, obesity, falls, cognitive impairments, osteoporosis, and muscular weakness. (Mcphee, *et al* 2018)

The "frailty syndrome" is a condition of particular concern in this scenario. Frailty is a condition in which an individual is extremely vulnerable to both endogenous and external stresses, increasing their risk of adverse health-related consequences. In order to restore strength in the person at risk, frailty may serve as a transitional stage between healthy aging and incapacity. Given that frailty is syndromic, treating it calls for an all-encompassing strategy. (Thiyagarajan, *et al* 2016)

A key step in initiating preventive treatments for age-related illnesses is to identify frailty as the goal. Healthcare authorities should attempt to optimize their efforts in this area while balancing goals, requirements, and resources. The population has to be made more aware of frailty and age-related illnesses, which is essential for successful prevention and should encourage healthy lifestyles and habits for the rest of one's life.(Cesari *et al* 2016)

4. Inflammation

Some fundamental mechanistic pillars that connect aging and age-related illnesses all are due to inflammation. Chronic, sterile, low-grade inflammation known as "inflammation" emerges with age and has a role in the etiology of age-related illnesses. There are a range of triggers, such as infections (non-self), endogenous cell debris and misplaced molecules (self), nutrients, and gut bacteria, that aids in the formation of inflammation .(Guasti *et al* 2021)

Inflammations are signals sensed by a small number of receptors, whose degeneration enables them to identify various signals and activate innate immune responses. In this case, it is believed that the chronic inflammation brought on by nutritional excess or overnutrition is

called metaflammation, which has the same processes as inflammation. Metaflammation is the metabolic inflammation that accompanies metabolic disorders. (Franceschi 2018)

A pro-inflammatory condition associated with ageing. Systemic and local inflammation caused on by age . Aging-related alterations in adipose tissue that lead to an increase in cytokine production can induce systemic inflammation. Cell senescence and the emergence of the senescence-associated problems can lead to an increase in the production of pro-inflammatory mediators, such as cytokines and chemokines, as well as enzymes crucial for the destruction of joint tissue. (Greene *et al* 2015)

5. Metabolic disorders

a. Diabetes mellitus

Due to " longer life expectancies, the prevalence of diabetes mellitus is rising, and its epidemiology is high among the elderly population. The complexity of controlling diabetes in the elderly is exacerbated by the rising frequency of co-morbidities linked to ageing, paired with the rising incidence of geriatric syndromes that cause physical and mental difficulties. (Sinclair *et al* 2019)

Mordarska, *et al* (2019) said that diabetes in the elderly may have varied clinical characteristics. Due to unusual symptoms (such as dementia and urine incontinence) and the predominance of postprandial hyperglycemia, diabetes in older persons is frequently detected too late. Elderly adults are more susceptible to the side effects of diabetes, are at higher risk for myocardial infarction and end-stage renal disease. Elderly diabetics are a diverse population with varying life expectancies, co-occurring chronic illnesses, and the capacity to self-manage blood glucose or administer an injection.

Chentli *et al* (2015) stated that the magnesium and diabetes are related.The magnesium acts as cofactor in enzymes that are involved in oxidation of carbohydrate . Due to its involvement in both the production and action of insulin, a deficiency might result in insulin resistance. Hypomagnesemia in the elderly can be brought on by a number of factors, such as inadequate intake, digestive issues, and renal decline. Hypomagnesemia often raises the risk of retinopathy, nephropathy, and foot ulcers as well as poor glycaemic control.

b. Cardiovascular illnesses

Paneni, *et al* (2015) stated that vascular shape and function change as human age, especially in the big arteries. Endothelial cells, smooth muscle cells, and pericytes are only a few examples of the numerous cell types whose phenotypic abnormalities contribute to age-

related deterioration of vascular function. Morphological alterations, such as arterial wall thickening, collagen deposition, perivascular fibrosis, and vessel dilatation, are often organ-specific.

A significant characteristic of the aging vasculature that contributes to arterial stiffness is thickening. A different vasculartone, which is caused by an imbalance between vasoconstriction and vasorelaxation, also contributes to changes in arterial stiffness. Vascular impedance, which impacts the pulsatile ejection of blood from the heart, is significantly influenced by arterial stiffness. Age-related declines in aortic distensibility lead to an imbalance between ventricular ejection and aortic flow energy, which raises the aortic systolic pressure. (Costantino *et al* 2015)

Adults of all ages have multimorbidity, but as people become older, the number and complexity of comorbid illnesses tend to multiply, such that cardiovascular disease (CVD) in older people is frequently accompanied by multimorbidity. Current clinical practise and research are mostly focused on treating a single disease and do not take into account the complexity imposed by coexisting disorders (Rich *et al* 2018).

Orkaby *et al* (2018) highlighted the two main symptoms of cardiovascular disease (CVD), which are the leading causes of death and morbidity worldwide, are coronary artery disease (CAD) and stroke. The atherosclerotic processes underlying CAD and stroke overlap, as do their associated risk factors. According to estimates from the World Health Organization, stroke and coronary artery disease (CAD) account for over 20% of all fatalities globally and are the two main contributors to the burden of illness globally.

c. Hypertension

Setters (2017) stated that adults with hypertension (HTN) frequently experience severe morbidity and death. HTN is characterized by an isolated increase in either systolic or diastolic blood pressure. The prevalence of hypertension (HTN)is high in old age. Orthostatic hypotension is more common in elderly people with cardiovascular risk factors due to normal aging changes, drug side effects, and multi-morbidity).

Blood pressure is divided into one of four categories according to the 2017 American Heart Association (ACC/AHA) Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: Normal, Elevated, Stage 1, and Stage 2.4 The recommended systolic and diastolic blood pressure values are 120 and 80 mm Hg, respectively, to be considered normal. SBP 120-129 mm Hg and DBP 80 mm Hg are

considered to be elevated blood pressure. Stages 1 and 2 of hypertension are indicated by blood pressure readings between 130 and 139 mm Hg or 80 and 89 mm Hg, respectively. (Bowling *et al* 2021)

Guasti *et al (*2021) opines that elderly patients frequently have hypertension. Frailty can be linked to older age-related hypertension, which can also be a risk factor for frailty. A reduction in health status and/or increased frailty may result from cardiovascular disorders such heart failure, atrial fibrillation, and stroke, which are recognised as major risk factors for hypertension.

Orthostatic hypotension is defined by a minimum 20 mmHg drop in blood pressure while rising from a laying posture. The primary reasons include age-related dysregulation of the autonomic nervous system, which results in reduced baroreceptor sensitivity, severe volume depletion, and adverse pharmacological reactions from nitrates, diuretics, calcium channel blockers, antidepressants, antipsychotics. In the event of falls or collapses, orthostatic testing should be done, and the blood pressure should be kept at a safe range. (Gado *et al* 2022)

6. Vitamin deficiency

According to Vincenti, *et al* (2021) cobalamin, often known as vitamin B12, is a necessary water-soluble vitamin that is crucial for several physiologic processes throughout a person's lifetime. Since only some microbes can synthesise B12, humans must only get cobalamin through their diet, especially from foods produced from animals. A subset of individuals is at risk for subclinical vitamin B12 insufficiency for a variety of reasons, including inadequate dietary consumption of foods derived from animals and aging-related declines in intestinal B12 absorption ability.

Worldwide, vitamin D insufficiency is a widespread health issue, especially among the elderly. Numerous studies on the impact of vitamin D on muscle have found that this can increase the growth and differentiation of skeletal muscle fibres, preserving and enhancing physical stamina. Due to the lower food consumption and less exposure to UV light, older people are more likely to have low Vitamin D levels and may be at risk for developing sarcopenia, a geriatric condition marked by the gradual loss of skeletal muscle mass and strength. (Remelli *et al* 2019)

Meehan, & Penckofer (2014) stated that in the past, vitamin D was primarily utilised to support elderly adults' bone health. Due to decreasing cutaneous production and dietary

vitamin D consumption, older persons are at risk for lower vitamin D levels. Low vitamin D levels have been linked to age-related illnesses like cancer, type 2 diabetes, cardiovascular disease, depression, osteoporosis, and cognitive decline, according to epidemiologic research.

One of the best nutrients for modulating immune function is vitamin E, a strong lipid-soluble antioxidant that is concentrated in immune cells more than other blood cells. It has been shown that humans with vitamin E deficiency have impaired immune systems that can be restored with vitamin E supplementation. Vitamin E supplementation above the current dietary recommendations has been found to improve immune system performance and lower the risk of infection, especially in elderly people.(Lewis *et al* 2019)

7. Obesity

Obesity epidemic does not only affect young people or middle-aged people. Body mass index (BMI)-based measures of obesity in older persons have been on the rise over time. Recent estimates from the National Health and Nutrition Examination Surveys show that obesity rates among individuals over 60 are above 37.5% for men and 39.4% for women.(Batsis *et al* 2017)

Mckee *et al* (2021) highlighted that the frequency of obese people rises together with the percentage of the population that is over 65. One big issue with treating older people who are obese is that many of them may have sarcopenic obesity, which might get worse with weight loss as some loss of lean body mass is unavoidable. While different weight reduction strategies may be advised for certain senior people who are obese, it is obvious that any selected strategy has to be supported with a resistance exercise programme in order to maintain muscle mass.

Increased abdominal obesity, a primary cause of insulin resistance and the metabolic syndrome, is linked to ageing. Obesity has grown to be a serious public health issue. Due to the current rise in life expectancy, obesity is becoming more common among older age groups. The increase in lifespan is frequently accompanied by an increase in the number of years during which older people are susceptible to chronic illnesses linked to obesity. Both obesity and ageing are conditions that raise the chance of disease and death as well as major health issues**.(** Jura *et al* 2016)

8. Osteopenia

Osteopenia is the natural aging-related reduction of bone density. Many persons over the age of 85 suffer from osteoporosis, which causes a more serious loss of bone density.

Women over 65 should get screened for bone density. The efficacy of osteoporosis screening for males has not been convincingly shown, even though the frequency of fractures in men increases by the age of 85. Supplementing calcium and vitamin D to prevent fractures is still debatable in terms of its efficacy and safety. (Jaul and Barron,2017)

According to Nourmohammadi *et al* (2022) aged people are at risk for a wide range of physical, social, and economic health issues as well as chronic diseases like diabetes, cardiovascular, joint, and bone ailments as the ageing population increases. Reduced bone mass and an increased risk of fracture are two signs of metabolic bone disease. The local bone tissue renin-angiotensin system is directly engaged in bone metabolism and affects bone health

9. Osteoarthritis

Loeser (2017) identified one of the most prevalent causes of pain and impairment in adults is osteoarthritis (OA). Numerous variables, such as joint damage, obesity, hereditary susceptibility, and incorrect joint alignment and form, increase the chance of developing OA. By 2030, the number of people with OA is predicted to have more than doubled to 67 million as a result of population ageing and rising obesity rates throughout all age groups, with more than 50% of OA cases occurring in those 65 and older.

The three main management techniques for arthritis patients, according to Osteoarthritis Research Society International (OARSI), are physical activity, physical mobility, and a healthy diet. Since the beginning of 2020, the globe has been battling an unprecedented COVID-19 pandemic. People who are subjected to lockdown procedures are more susceptible to osteoarthritis as a result of their increased social isolation, lack of social support, additional medical issues, functional limitations, and loss of physical activity chances. (Basu, *et al* 2022).

10. Osteoporosis

Sozen *et al* (2017) highlighted that the most prevalent chronic metabolic bone disease, osteoporosis is characterised by increasing bone fragility and is linked to several events, including menopause and age. Although it affects people of all ages, genders, and ethnicities, it is more prevalent among the elderly, and females. Osteoporosis is spreading over the world at an alarming rate due to an older population and increased life expectancies.

Osteoporotic fractures, which can lead to poor quality of life, disability, loss of independence, institutionalisation, and greater mortality, are more common in older people.

Osteoporosis and sarcopenia, an age-related illness characterised by losses in muscular mass, strength, or function, have a separate pathophysiologic link. Osteosarcopenia is the term for these two conditions together. (Zanker, *et al* 2019)

11. Sarcopenia

Cruz-Jentoft (2019) has stated that a generalised skeletal muscle condition called sarcopenia, which causes an accelerated loss of muscle mass and function, is linked to a higher risk of poor outcomes like falls, functional decline, frailty, and death. It frequently develops in older persons as an age-related process, affected not just by current risk factors but also by genetic and lifestyle variables active throughout one's lifetime. It can also happen in middle age and be accompanied by a number of diseases.

The risk of a wide range of unfavourable health outcomes, including falls, illness, loss of independence, disability, and death, is increased by sarcopenia, the gradual and natural loss of skeletal muscle mass, strength, and function associated with age. The agreement of academics, medical experts, and policymakers on a specific operational definition of sarcopenia is a preliminary, crucial stage in such a process. This will make it easier to define a precise clinical entity that can be used in standard practise, comprehend the underlying pathophysiology, and find potential biological targets for drugs. (Landi *et al* 2018)

12. Oral illnesses

Mathur *et al* 2019 said that the quality of life for persons affected by oral disorders is significantly reduced because they are among the most common diseases in the world and have substantial health and financial consequences. Dental caries (tooth decay), periodontal disease, tooth loss, and malignancies of the lips and oral cavity are the most common and serious oral disorders in the world. Oral illnesses are chronic and have significant societal patterns, like the majority of non-communicable diseases (NCDs).

Daly *et al* (2019) said that majority of persons who suffer from oral disorders and have limited access to dental treatment are older people, socially excluded groups, and children who are growing up in poverty. Because the expenses of therapy exceed the available resources, oral illnesses are frequently left mostly untreated . Chronic untreated dental disorders have serious personal repercussions that might include unrelenting pain, sepsis, lower quality of life, disturbance of family life, and decreased productivity at work.

Families and healthcare systems have a heavy financial burden due to the expense of treating oral disorders. Oral illnesses are a major public health concern on a worldwide scale.

This is especially true there is an increase in oral diseases due to broader social, economic, and commercial trends. (Peres *et al* 2019)

Jaul and Barron (2017) in their study have observed the major problem in the older population is “multiple medications”. It is the condition where there is an intake of different medications or a combination of the drugs by the individual. The consumption of five or more varieties of drugs also leads to polypharmacy. This may cause dangerous drug-drug or drug and nutrient interactions, which can elevate the existing problems.

Most of the age-dependent diseases (such as dementia, stroke, chronic obstructive pulmonary disease, and vision impairment), where the cost of long-term care exceeds the cost of medical care and where the burden of the disease is primarily borne by disability rather than mortality. These illnesses have a severe economic impact on society. (Martin *et al* 2015)

Age related neuro degenerative diseases.

One of the main risk factors for the emergence of neurodegenerative diseases like Parkinson's disease (PD) and Alzheimer's disease (AD) is ageing of the central nervous system (CNS). The two neurodegenerative disorders that occur most frequently, Parkinson's disease (PD) and Alzheimer's disease (AD) have ageing in common as a risk factor.(Spittau, B 2017).

a. Alzheimer’s Disease

The most prevalent of the degenerative nerve disorders, Alzheimer's disease is a neurodegenerative illness that is gradual, irreversible, and incurable. It often begins after the age of 60 and can last for eight to twelve years. This disease causes a slow and steady decline that is marked by cognitive impairment, loss of functional independence, behavioural changes, and rising care needs. (Zverova ,2019).

Alzheimer's disease results in an irreversible loss of brain cells that impairs thinking, which causes identity loss and changes in behaviour, emotions, and the capacity to carry out fundamental everyday tasks. Alzheimer's disease has a complicated aetiology. Aging, a history of the disease in the family, severe head trauma, and the presence of the apolipoprotein APOE4 are all unchangeable risk factors for Alzheimer's. (Beckett 2015)

b. Parkinson's disease.

Meara (2018) stated that the second most prevalent neurodegenerative ailment and a disease primarily affecting elderly people is Parkinson's disease (PD). As a heterogeneous condition, PD affects a large portion of the global population. The most important risk factor is ageing. Monogenetic types of familial parkinsonism may be relevant to a minority of early-onset PD cases, and genic variables in the form of susceptibility genes are crucial in the aetiology of PD.

Cognitive impairment is a typical non-motor symptom of Parkinson's disease (PD) and can potentially develop at any stage of the disease, in addition to the disease's characteristic motor symptoms. There is a general and gradual, cognitive decline or occasionally be quick. Increasingly, attention has been placed on the earliest stages of cognitive decline, common and may be accompanied by memory problems, increasing the likelihood that dementia may develop sooner rather than later. (Aarsland,2021)

C. Importance of convenient foods in old age

Vyoma (2021) stated that daily tasks might be challenging for elderly persons since aging impairs their bodies' ability to operate normally. Due to challenges with food purchasing, preparing, chewing, and eating, there is a danger of insufficient nutrition. Loss of vision makes eating and cooking more challenging. The elderly's eating habits may vary as a result of these changes, which may have an impact on their intake of nutrients.

To suit the evolving demands of the aging population, there is significant potential to produce convenience food items. When creating goods for older consumers, it is preferable to alter the food's consistency to make it easier to swallow, make it nutrient-dense, and make it easy to handle and consume for senior persons who don't want to cook or aren't interested in cooking, the availability of nutrient-dense "ready-meals" can be a benefit. (Illa 2021)

Based on these factors and with the ultimate goal of combating senior malnutrition, it is necessary to produce and offer foods particularly made to support the health and well-being of the old. The requirements for food (re)formulation must be defined. Considering that not only "content" but also "functionality" of food components play a critical role, in food health benefits . (Calligaris, *et al* 2022)

Moretton, *et al*(2022) said that it is strategically important to define the right hierarchical arrangement of food components, or food structure, in order to achieve the

intended food functionality. Food acceptability and sensory perception are influenced by food structure in a way that is related to the macro features of meals as well as the rate at which aromas are released and how flavors are perceived when consumed.The nutritional and physiological effects of macro- and micronutrients as well as bioactive substances during digestion are significantly influenced by dietary structure.

Due to anatomical and physiological changes, aging people have growing difficulty chewing and swallowing oral food. Dysmasesis, or the difficulty chewing brought on by tooth loss (edentulism. Dysphagia, or the challenge of securely ingesting oral contents through the appropriate pipe, is more important. Senescence causes a sharp rise in dysphagia, which can lead to malnutrition and morbidity from aspiration pneumonia. Therefore, it is advised that meals for people with dysphagia break down into small, soft particles that are wet, cohesive, and slippery, making them easier to swallow. (Aguilera & Park 2016).

Jackson and Viehoff (2018) stated that convenient food as a vital addition to daily life that is socially economically, and culturally acceptable. In addition convenience food may enhance eating habits and avoid malnutrition in the elderly. Elder people who lack the physical stamina to prepare meals and who frequently have preconceived notions about food would benefit from a well-planned, prepared meal.

In addition to reducing time, convenience meals are said to provide several other advantages. They support people's eating patterns and help senior citizens maintain healthy eating patterns. (Nakano & Washizu,2020).

Melchior *et al (* 2022) stated that aging brings about a number of physiological changes that affect food intake. Therefore, it is necessary to create a new food category that is especially suited to the requirements of the elderly. Meals for the elderly should be designed to satisfy their specific needs, much like other food categories, like infant foods, do. Given that food structure is responsible for the ultimate functionality of food items, applying a food structure design method to this end might be highly advantageous.

As a result, the development of diets specifically suited for the elderly the mentioned food structure design techniques are only one part of the solution to the complex problems brought on by population aging. These strategies are intended to create the next generation of food for the elderly. (Mosca, *et al* 2022)

Wholesome nutrition for elderly

Wholesome nutrition refers to a diet that prioritises minimally processed foods and focuses primarily on plants. The main food groups consist of fruits and vegetables, whole grains, potatoes, legumes, and dairy products. It is also important to consume native cold-drawn plant oils, nuts, oleaginous seeds, fruits, and nuts in moderation. This idea has four equally important components connected to health, the environment, the economy, and society. (Leitzmann, 2017)

It is generally advised that all elderly people change their lifestyles to include eating wholesome foods rich in antioxidant and anti inflammatory flavonoids, polyphenols, and retinoids in order to slow the onset and prevent chronic Central Nervous System (CNS) disorders. Diets like the Mediterranean diet, Dietary Approaches to Stop Hypertension diet, and Intervention for Neurodegenerative Delay diet have been shown to be effective for delaying the development of neurodegenerative illnesses and for the primary prevention of cardiovascular diseases. (Wichansawakun *et al* 2022)

D. Available convenient foods suitable for old age

Health Mix

Shekar,(2021) developed health mix that can be prepared by combining it with milk or other recipes. It includes a number of all-natural, conventional components, including ragi [finger millet], dried fruits, and dates. It was analysed that the product provided excellent levels of calories, protein, and calcium. With the use of the scoring technique on the hedonic scale, a four-week shelf life research was conducted.

Divya *et al* (2017) developed a health mix with the help of common grains and pulses, milk alternatives, almonds, and cardamom. Utilizing various ratios of broken sorghum flake powder, black grams, puffed Bengal gram, and green gram-based healthy mixes, three health mixes were created and then analysed for nutritional and a few selected sensory quality factors. The overall acceptance of the healthy mix was evaluated.

Soup Mix

Sudarsan, *et al* (2017) developed soup mix using sprouted horse gram, radish leaf powder, onion powder, garlic powder, coriander powder, curry leaf powder, pepper powder,

and salt in various proportions. The developed product samples were assessed for quality and shelf life using sensory assessment.

The instant soup mix was kept in laminated pouches for a month in a regular room environment. The soup mix claimed to have health benefits for managing diabetes. This soup mix is so simple to make that it may be referred to as a handy healthy soup mix.

Instant fish soup

Islam *et al* (2018) development of a protein-enriched instant fish soup mix. The mix can be consumed the by reconstituting it in boiling water. According to the research, the ideal composition for a protein-enriched instant soup mix is a blend of 55% fish powder.

Snack bar

Roslan, *et al* (2016) developed a snack with locally available Malaysian ingredients to create a "energetic" snack bar that provides both energy and electrolytes in one bar. This snack bar was made with bananas, glutinous rice flour, and coconut milk as local ingredients. It is a healthy and nourishing for individuals of all ages, from young children to the elderly. The created snack bar has 454.51 kcal of energy , 6.36% crude protein, 22.39% crude fat,1.16% crude fibre, 56.89% total carbohydrate.

Multi grain ladoo

Shekhar *et al* (2013) developed a multigrain ladoo prepared with several types of flours, nuts, functional food "dink," and ghee that was galactogogue and nutritionally dense. The product offers sufficient levels of biological proteins, useful elements, vitamins and minerals, enough fibre, and a decent satiety value. Evaluations were conducted on the product's general acceptability as well as sensory qualities. An examination of microbes was done to determine its shelf life. A product with a range of nutrients and that may be recommended for all age groups due to its high biological value proteins is multi-grain ladoo

Rich in nutrients a product named “Cal-Pro ladoo” was standardised a with ragi as , a main ingredient which will help partially meet the calcium needs. Along with calcium, it offers some protein, fat, iron, phosphorus, and fibre. A sensory evaluation using a scoring system using a five-point scale was included in the shelf life research .To determine its shelf life, microbial investigation was done. Additionally packaging, nutrition labelling, and marketing were also done . (Anuradha Shekhar *et al*, 2019)

Instant food mix

Green gram, roasted Bengal gram, and groundnut were added to convenience meal mixes made with three main grains—pearl millet, finger millet, and sorghum. Three breakfast dishes and three snacks were made from the mixtures, and a sensory analysis was conducted. The mean energy content of the mixes ranged from 388.09 kcal to 372.35 kcal aids in creating convenience mixes that combine malted millet with pulses and nuts to produce micronutrient-rich mixtures (Kowsalya *et al* 2015).

Shekhar *et al* (2019) developed , simple, nutrient-dense, and cost-efficient mix. Dates, garden cress seeds, oats, rice puffs, pumpkin seeds, milk powder, and coconut powder were the key components. Dates serve as a binding agent, sweetness, and taste in this product. Sensory qualities such colour, texture, flavour, chewiness, appearance, and general acceptability were evaluated. The study also explored other topics including packaging, marketing, budgeting, and nutritional labelling .

III. METHODOLOGY

The study titled "**Development and Evaluation of Herbs Infused Wholesome Smoothie Mix for Elderly People**" was carried out in the following phases

A. Selection of ingredients, procurement and processing of the ingredients for the development of herbs infused wholesome smoothie mix.
B. Development and standardization of the developed smoothie mix.
C. Quality analysis (Nutrient analysis, pH, TSS, Phytochemical, Antioxidant, toxicity shelf life and Microbial analysis) of the developed herbs-infused wholesome smoothie mix
D. Packaging and labelling of the developed smoothie mix.

Phase A : Selection of ingredients, procurement and processing.

The study aims to develop an instant and convenient food for elderly people. The major problem faced by the elderly population is their inability to spend more time in the preparation of food due to their physical and physiological problems. The product developed is a wholesome smoothie mix that is ready-to-eat food.

The primary reason to develop a wholesome food is to incorporate all the food groups into food as one meal which would aid in the management of the nutritional needs of the elderly population. The study also aims to incorporate herbs that have phytochemical and nutraceutical properties specifically aimed to benefit elderly people.

Though rice is the staple food for most of the elderly population, it has a high glycemic index of 79. Hence a substitute which is equally nutritious as rice but having a lower GI was preferred. As the GI of the millets are around 54 to 69, it can be considered as best suited and they were selected. Further it is one of the earliest meals consumed by humans and has been the first cereal grain employed in household cooking.

When compared with other staple foods of the elderly population like rice and wheat, the millets are either equal or more nutritious. The protein, calories, vitamins and minerals of millet have a high nutritional value than rice and wheat. They are also an abundant source of vitamins and phytochemicals. The low carbohydrate content is definitely a plus and further certain millets are gluten-free making them a great choice for the elderly**.** It can be moderately included in the day-to-day diet for better health condition. Hence millets are selected as one of the major ingredients to make a wholesome smoothie mix.

PILOT STUDY

However, for the initial part of the study, rice based RTE food/ smoothie mix was tried out.

In the rice category, black rice was selected due to its high nutrient content and health benefits. But the milk obtained from the rice was very diluted/ thin making it not suitable for the next stage of the processing. A combination of black rice and peanuts was also tested. Milk obtained from the mixture of black rice(Oryza sativa L. indica) and peanut(Arachis hypogaea) milk was tried. The consistency of the milk was thick when compared with the one obtained from black rice only. But the milk had a strong flavor of peanut and in the later

stage of processing, the milk got curdled and was not suitable for consumption. Hence the rice-based milk was not selected as the base for the smoothie.

Subsequently a variety of millets that can be a better alternate/ replacement for rice were selected and tested for their milk on the criteria like milk consistency and yield . The result of this exercise revealed that among millets, finger millet (ragi) had the best yield as well as consistency. Hence ragi was selected as the millet of choice for the preparation of the RTE food.

Phase II

All the commercial smoothies available had a base of chemical fruit mix flavors, with an added chemical binding agent such as gelatin, pectin, agar agar and or guar gum. Hence a good nutritional substitute for the binding agents was selected to bind the ingredients and also give creamy consistency to the smoothie when mixed with milk. The selected substitutes were chia seeds, sago powder, oats, and rice flakes. Trials on the selected binders were carried out to find out the most suitable one.

Trial I-Chia seeds.

Chia seeds were dry-roasted and powdered. It was added from 4 gm with the increase in the quantity of 2 g until the 10 g mark was reached. The outcome obtained by adding 10g of chia seeds brought about a creamy consistency. But the flavor of chia seeds was very dominating. The colour of the smoothie was also not appealing. Due to its ability to absorb moisture and swell, the texture of the smoothie was also coarse. Sediments were also observed. Hence the chia seed powder was not selected.

Trial II-Sago

Sago obtained from tapioca was selected for its ability to gell. It was roasted and powdered. Initially 4gm of of sago was added and subsequently increments of 2 gm were added until 10 gm. The result revealed that a creamy consistency was not obtained. It was also noticed that the gelling property of the sago is initiated only after the application of heat and not by directly blending with a liquid at room temperature. This highlights the major reason for not selecting the sago powder.

Trial III-Oats powder

Oats was selected for their bulking ability. It was roasted and powdered and it was added from 4g by adding 2g intervals in increasing order upto 10g. With Oats, the creamy

consistency was not obtained with 10g of powder instantly. However, increasing the oats to 20g powder addition resulted in the desired consistency. But the flavor of the roasted oats was dominant. It was observed that on storage, the condition of the oats mixed smoothie had drastic changes in the consistency of the liquid. The mixture was very thick and the consistency was similar to porridge. Due to this property of oats, it is not selected.

Trial IV-Rice flakes

Rice flakes were roasted and finely powdered. It was added from 4g by adding 2g in increasing order upto 10g. The creamy consistency was obtained which also had no changes in storing cold conditions also. The flavor of the rice flakes was observed but not as dominant compared to other ingredients. The color and texture also were also good when compared with other ingredients selected. Hence rice flakes are selected as binders and nutritionally a better choice for elderly people for day-to-day consumption.

Ingredients selected

The ingredients selected are finger millet, sprouted green gram, rice flakes binder, banana and herbs (Pirandai, Vallarai, Modakathan)

Finger millet (*Eleusine coracana*)

Finger millets are widely consumed in India. It is a dense source of calcium and iron. It is selected as all age group of people can consume finger millets. In India finger millets is an integral part in the weaning foods of the infants. Finger mill*et al*so commonly called Ragi belongs to the family Poaceae and is botanically called Eleusine coracana. (Sood *et al.*, 2016)

Finger millet was selected because of its high nutrient content when compared to wheat and rice. It is high in calcium. It also contains essential amino acids such as methionine, isoleucine, leucine and phenylalanine which are not synthesized by the body naturally. The ragi has proved to have beneficial effects of anti-diabetic, atherosclerogenic, and antioxidant capabilities. (Chandra *et al* 2016 and Puranik, *et al* 2017).

The daily intake of ragi can aid in the management of age-related calcium deficiency diseases like osteoporosis and its anti-inflammatory properties helps to manage osteoarthritis (Shobana *et al* ., 2013).

Sprouted green gram (*Vigna radiata)*

Green gram was selected because it is low in fat and high in proteins, carbohydrates, dietary fibre, vitamins, and minerals. Green gram is one of the most important ingredients of the Indian kitchen since olden days. It has been consumed in various form as green gram dhal in routine diet, green gram whole and sprouted for as snacks. (Kamboj & Nanda 2018).

Green gram is considered a nutritious food as it has antioxidant, is anti-inflammatory, anticancer and has hypolipidemic properties. Significant amounts of oligosaccharides, prebiotics and nutraceuticals, present in egg can help the growth of good gut bacteria. Green gram also aids in weight management, manage blood pressure and heart diseases and also has detoxification effects when it is consumed daily. (Kumar *et al* 2021 and Sudhakaran *et al.,* 2021)

Rice Flakes (*Oryza sativa L*)

Rice flakes were selected because they are very commonly used in India. Rice flakes are also a major dietary source of folic acids, niacin, thiamine, chromium, magnesium, manganese, phosphorus, zinc, copper and iron. (Shinde *et al* 2017)

Rice flakes are easily digestible and suitable for all age group. It aids in management of blood sugar as it is rich in Vitamin B1. It also has good probiotic benefits and helps in the maintenance of gut health and improves metabolism. (Sumczynski *et al.,* 2018)

Banana (*Musa paradisiaca)*

Banana was selected because it is a well-liked fruit and commonly available. Banana is a fruit that is packed with nutrients. It is high in calories and fibre. It helps in digestion and improves the health condition. It serves as a functional ingredient in a variety of food products and is either consumed raw or processed. (Singh *et al.,* 2016).

It is rich in dietary anti-oxidants. Numerous bioactive substances are found in bananas including phenols, carotenoids, biogenic amines and phytosterols which are highly desirable in the diet because of their beneficial effects on human health and well-being**.** (Khoozani *et al.,* 2019)

Selection of Herbs:

Herbs are selected as it can be used to treat a variety of illnesses, both acute and chronic, including serious conditions including cardiovascular disease, prostate issues, depression, inflammation, and immune system weakness. Herbs are utilised to treat ailments and disorders all over the world (Sam, 2019). Hence to combat the age related diseases and deficiency herbs such as pirandai, vallarai and mudakathan are selected as components of the smoothie.

Pirandai (*Cissus quadrangularis)*

The selected herb *Cissus quadrangularis* is locally called Pirandai in the Tamil language is a perennial climber and is widespread throughout India, especially in tropical areas. There is evidence about the therapeutic benefits of the entire plant, including all parts such as stems, leaves and roots (Jain *et al*.,2020).

The herb pirandai has been used to treat osteoarthritis, rheumatoid arthritis and osteoporosis**.** The plant has therapeutic benefits for, anorexia, dyspepsia, colic, flatulence, skin conditions, tumors, chronic ulcers, and swellings**.** Pirandai is also a good source of antioxidants, has high quantity of beta carotene and also has anti-inflammatory and analgestic properties that are beneficial for the elderly people. (Malathi 2014 and Mubeen *et al.,* 2022)

Vallarai (*Centella asiatica*)

Vallarai was selected as it has anti-aging properties and aids in combating age related problems. It helps in improving brain functions, boosting immune system, maintaining heart functioning capacity and improves digestion. (Khundrakpam *et al.,* 2016)

Vallarai is botanically called as *Centella asiatica*,which is a perennial herbaceous creeper that grows in damp areas and is a member of the Apiceae family. It is selected as it has chemical components that have several therapeutic uses in the fields of wound healing, neuroprotection, anti-inflammatory, anti-cancer, and antibacterial activity proved to have beneficila effects on elderly people. (Prasad *et al*., 2017 and Hariram 2021)

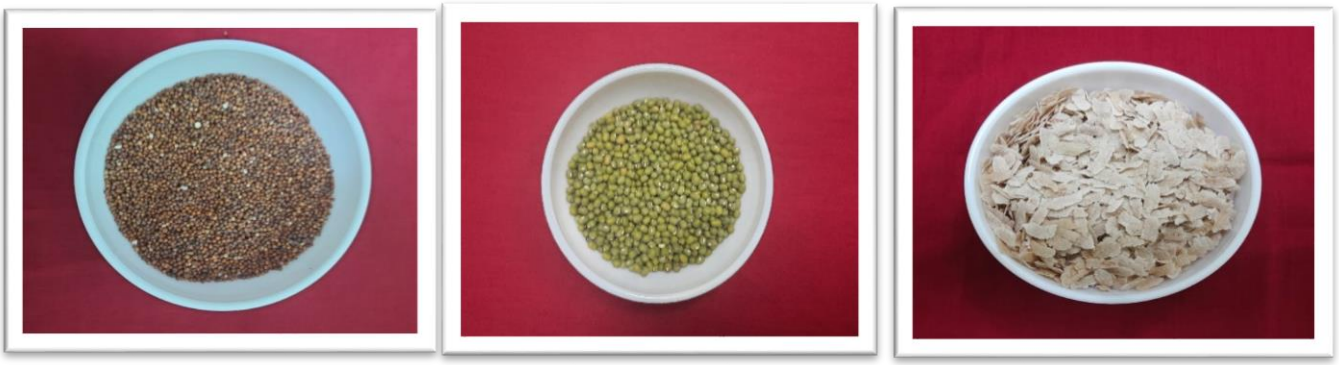
Mudakathan (*Cardiospermum Halicacabum)*

Mudakathan leaves are selected as it has anti-inflammatory properties which aids in the management of arthritis. The leaves also have gastric and laxative properties that is helpful in the management of digestion (Bernard *et al* 2022). This plant is selected as it is commonly used to cure rheumatism, stomach discomfort, neurological disorders, and also has beneficial effect on older people. (Elangovan. 2021).

Cardamom Powder (*Elettaria cardamomum)*

The cardamom powder was selected as it is one of natural flavouring agent containing many health benefits. It has antioxidant and diuretic properties which aids in lowering blood pressure, anti-inflammatory properties. It also has proven beneficial effects on lowering blood glucose level. It also has positive effects on cancer, and protects the body from gastric and cardiac diseases. (Singletary.2022, Souissi *et al.*, 2020, Daneshi *et al.*, 2017, Qiblawi *et al.*, 2020)

The selected ingredients were processed in different methods to develop an instant smoothie mix powder.



Finger Millet (***Eleusine coracana***)

Sprouted Green Gram (***Vigna radiata)***

Rice Flakes (***Oryza sativa L***)

Banana (***Musa paradisiaca)*** (***Elettaria cardamomum)***

Dried Herbs Mixture
Pirandai (*Cissus quadrangularis)*
Vallarai (*Centella asiatica*)
Mudakathan (*Cardiospermum halicacabum*)

Cardamom Powder

Fig I- Ingredients selected for the development of herbs infused wholesome smoothie mix

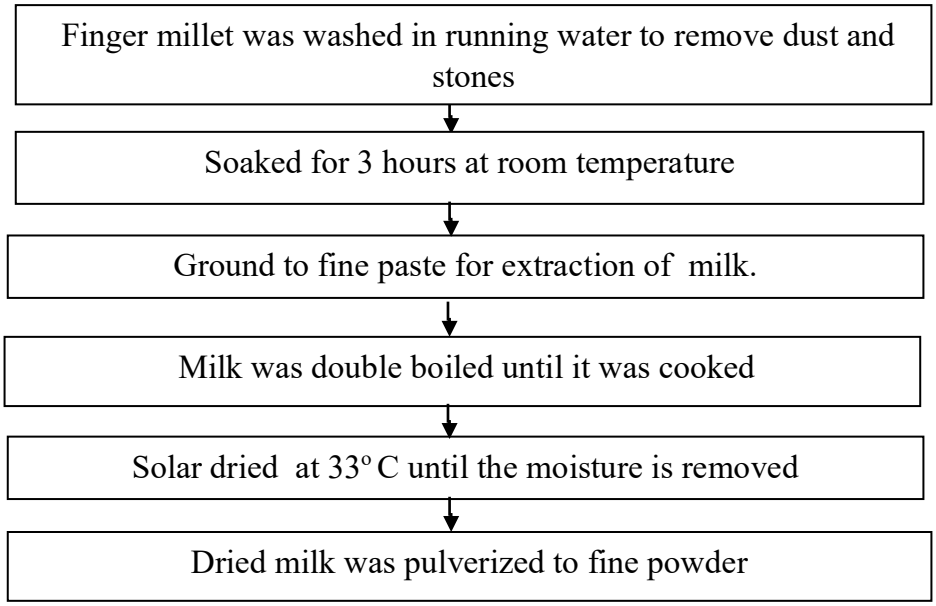
The present study was approved by the Institutional Human Ethical Committee proposal No IHEC/22-23/FSMD-24 and approval No AUW/IHEC/FSMD-22-23/XPD-24 enclosed as Annexure I.

Procurement and Processing of the Ingredients

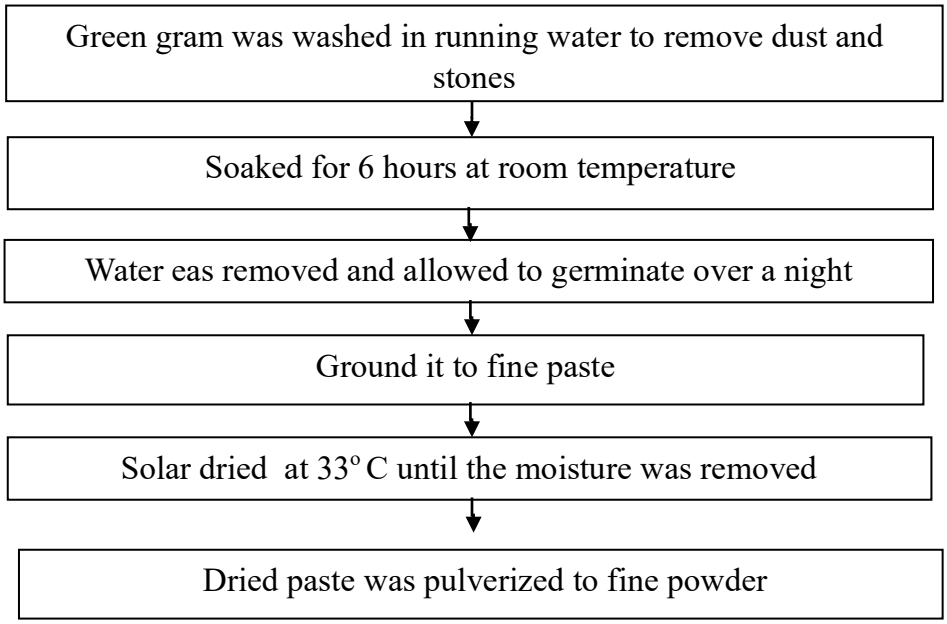
Pre -Preparation and Processing.

All major ingredients (Ragi, Green Gram, Rice Flakes, Banana, Herbs) were procured locally from the market and pre-treated by multiple washing to remove all the physical impurities like stones, dust, etc.

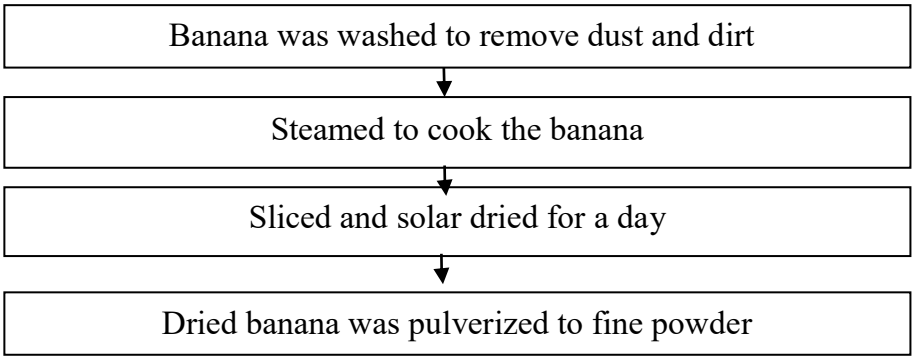
Finger millet milk powder Preparation (Fig II)



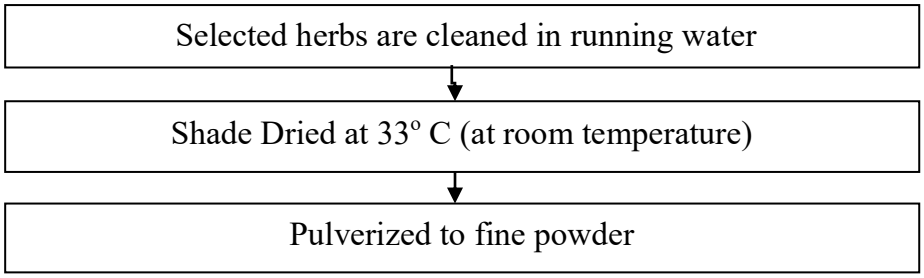
Sprouted green gram powder preparation (Fig III)



Banana powder preparation (Fig V)



Herbal mixture preparation (Fig IV)



Processing of ingredients

Finger millet milk powder - Pre-processing

The selected finger millet was washed and soaked as in 3 parts of water and 1 part of millet at room temperature for 5 to 6 hours.

Processing

- It was then ground by adding water into a coarse paste. The paste is filtered with a clean muslin cloth with the addition of water.
- The filtrate obtained is the milk of the finger millet. It is then allowed to rest for one hour. The excess water is removed by not perturbing the settled contents.
- Then the thick solution is cooked in a double-boiling method. It is then solar-dried and pulverized to a fine powder.

Sprouted green gram powder-Pre-processing

The green gram was washed and soaked as in 3 parts of water and 1 part of green gram for 6 hours and the water is removed.

Processing

- It was then allowed to germinate for 12 hours.
- Then it was ground to a fine paste, solar dried and pulverized to a fine powder.

Rice flakes powder

- The rice flakes is dry roasted until it is cooked
- It was then cooled and pulverized to a fine powder.

Banana powder

The banana was washed and steamed and cut into thin slices. It is then solar dried and pulverized to a fine powder.

Herbal mixture processing preparation

- The selected pirandai (*Cissus quadrangularis)*, vallarai (*Centella asiatica*) modakathan (*Cardiospermum Halicacabum)* herbs are cleaned
- Then it is shade dried for 2 to 3 days at room temperature until it is crips and easily crushed
- It was then pulverized to a fine powder

Process of Drying

The two types of drying methods adopted are solar drying and shade drying.

Solar Drying

Ragi milk ,sprouted green gram, and banana was processed using solar drying. It is the conventional method of using the radiation of the sun to remove moisture from the food product. The indirect method of the greenhouse system is used to process the food product. The purpose of a greenhouse dryer is to integrate a greenhouse system with the solar function. The method is more conventional and eco-friendly. The nutrient loss is minimum when compared to other methods of drying. (Tiwari 2016).

Shade Drying

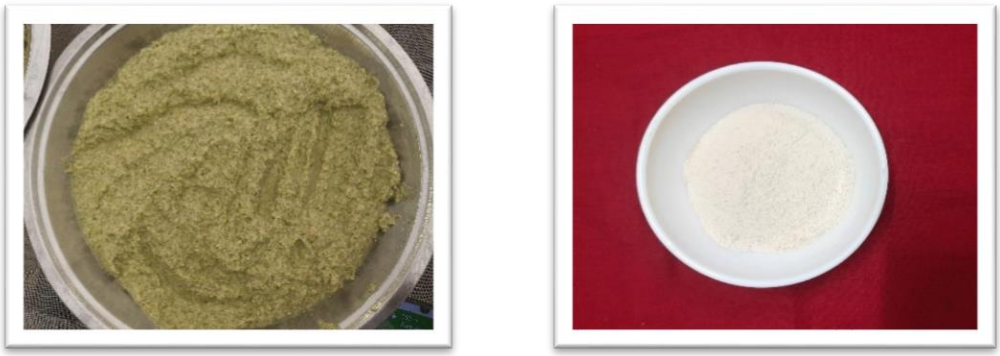
The shade drying method is used to process herbs (Pirandai, Vallarai, Mudakathan). It is the process where the herbs are cleaned and dried at room temperature for 3 to 5 days after being powdered. One of the best techniques for drying herbs is shade-drying. Shade-drying uses lower temperatures than other drying techniques, which results in less evaporation of aromatic compounds and retention of higher levels of essential oils. (Hazrati. 2021)

Conditioned Finger Millet (*Eleusine coracana*) **Ground Finger Millet** **Finger Millet Milk**

Doubled boiled Milk **Solar Dried Milk** **Finger Millet Milk Powder**

Fig II Processing of Finger Millet Milk Powder

Soaked Green Gram (*Vigna radiata)* **Sprouted Green Gram** **Ground Green Gram paste**



Solar Dried Green Gram **Sprouted Green Gram Powder**

Fig III Processing Sprouted Green Gram

Rice flakes (*Oryza sativa L*) **Dry roasted Rice flakes** **Rice Flakes Powder**

Fig IV Processing of Rice Flakes

Banana

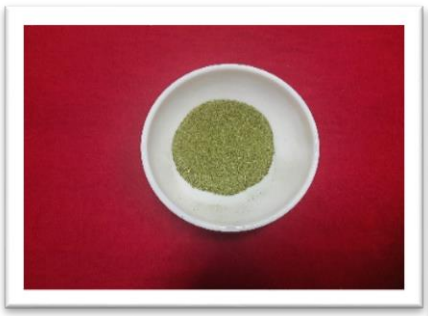
(*Musa paradisiaca)*

Steamed and Sliced Banana

Solar Dried Banana

Banana Powder

Fig V Processing of Banana powder

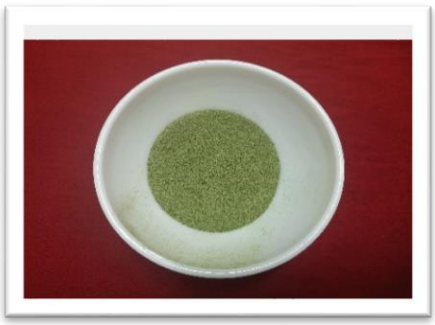


Mudakathan Powder

(*Cardiospermum halicacabum*)

Pirandai Powder

(*Cissus quadrangularis*)



Vallarai Powder

(*Centella asiatica*)

Fig VI Processed Herbal mixture

Phase B : Development and standardization of the developed smoothie mix

The ingredients were prepared in various ratios to obtain a proper consistency, taste, and flavour.

Standardized ingredients for one serving of the developed smoothie mix .

The ingredients ragi milk powder, sprouted green gram powder, roasted rice flakes powder, banana powder and cardamom powder and quality and quantity of milk are standardized for one serving are. In 150 ml of milk, ragi milk extract powder 5g, sprouted green gram powder 5g, roasted rice flakes powder 5g, banana powder 5g with cardamom powder for flavour are added. It was mixed well. Its consistency was not creamy. The flavour was also bland. The ingredients with same quantity was added to 100 ml milk. A slight change in the consistency was observed but the smoothie had no flavour and taste.

In order to add flavour and increase consistency, the banana powder and rice flakes powder quantity was increased. Hence in 100ml of milk, 5g of ragi milk powder, 5g of sprouted green gram powder, 10 g of rice flakes and 10 g of banana powder were added. The consistency obtained was creamy. In order make the smoothie more palatable, the addition banana powder in the quantity was further increased from 10 gm to 12g and 1 gm each of ragi milk extract powder and sprouted green gram were reduced respectively. The consistency obtained was creamy, the appearance was good, taste and flavour were also excellent.

The final recipe and ratio of the ingredients (Milk 100ml, ragi milk extract powder 4gm, sprouted green gram 4gm, poha powder 10gm, banana powder 12gm & cardamom powder of 0.5g) was repeated multiple times to standardise the ingredient ratio

TABLE I

Standardized Composition of ingredients for one serving

S.No	Ingredients used	Quantity
1	Ragi milk powder	4g
2	Sprouted green gram powder	4g
3	Rice flakes powder	10g
4	Banana powder	12g
5	Cardamom powder	0.5g
6	Pirandai Vallarai Mudakathan	0.25 to 1g*
7	Milk	100ml

***Based on the sensory evaluation**

Phase C: Quality analysis of the developed smoothie mix powder

The standardized product was tested for its parameters in terms of sensory, nutrients, pH, total soluble substance, anti-oxidant, phytochemical, toxicity and microbial analysis.

Sensory analysis

Sensory analysis was conducted for the standardized product by a panel of 20 members between the age group of 18- 24 years. Nine point hedonic scale was used for evaluation. It was conducted for 4 variations in the difference in the quantity of herbs added from 0.25g, 0.5g, 0.75g, 1g. The variations are listed in the table with the composition of ingredients. The score card for the developed wholesome smoothie mix is attached as Annexure II

Table II

Variations with Composition of Ingredients

Variations	**I (Smoothie mix +0.25g of herbs mixture)**	**II (Smoothie mix + 0.5g of herbs mixture)**	**III (Smoothie mix + 0.75g of herbs mixture)**	**IV (Smoothie mix + 1g of herbs mixture)**
Ragi milk powder	4g	4g	4g	4g
Sprouted green gram powder	4g	4g	4g	4g
Roasted Rice Flakes powder	10g	10g	10g	10g
Banana powder	12g	12g	12g	12g
Cardamom powder	0.5g	0.5g	0.5g	0.5g
Herb mixture	0.25g	0.5g	0.75g	1g

Fig VII Sensory Evaluation of The Developed Wholesome Smoothie Mix

Nutrient analysis

Nutrients such as energy, carbohydrates, protein, fat, fibre, vitamin A, Vitamin C, Vitamin B, Iron, sodium, calcium, zinc and magnesium, moisture and ash were analysed using the procedure FSSAI/IS/AOAC was followed for nutrient analysis. The report of the analysis is attached as Annexure III

pH Analysis

It is done to ensure that food product have an appropriate acidity level to prevent the incidence of foodborne diseases and also make it suitable for consumption. The pH is determined by pH meter, an instrument that is commonly employed in the laboratories for the analysis of the pH of the food products . The report of the analysis is enclosed as Annexure IV.

Total Soluble Substance Analysis

The total suspended solids were analysed. This also indicates the quality of fruit added and the concentration of sugars present in the product. A refractometer is used to determine refractive index of the powder at 20^{o}C. The soluble solid content is read directly on the

refractometer (Stevens,& Baier,2016). The analysis was done to find out the quantity of sugar present in the sample. The report of the analysis is enclosed as Annexure IV

Anti-oxidant analysis

Antioxidants are chemicals that can prevent free radicals from forming or slow down the oxidation process of other molecules. It is used to assure the effectiveness of functional foods, preventing and treating illnesses associated with oxidative stress. The analysis is conducted to find out the various quantity of antioxidants present in the developed smoothie powder. The procedure DPPH assay was followed for analysis of the antioxidant levels. The report of the analysis is enclosed as Annexure V.

Phytochemical analysis

The components of plant extracts were revealed through phytochemical screening, it is beneficial for identifying bioactive substances that can be utilized to create valuable medications. The analysis was conducted to identify the presence of various metabolites, phytochemical elements and bioactive components of the developed smoothie mix powder. Annexure VI encompasses the report of phytochemical analysis.

Toxicity analysis

The purpose of the analysis is to test the nature of the ingredients and herbs added to the product. The analysis is conducted to test the acceptability of the product for human consumption. The procedure brine shrimp assay was followed for analysis of the toxicity of the developed smoothie mix powder. The report of the analysis is attached as Annexure VIII.

Shelf-Life analysis

The shelf life of the product is analysed by storing the developed powder in various storage material. The materials selected were glass container, a plastic container, a zip lock cover (51 microns) and a stainless-steel container. The powder for one serving is stored and tested. The analysis was carried out for 8 weeks and the changes with respect to parameters like appearance, colour, flavour, taste and texture were analysed by reconstituting it with milk.

Smoothie mix stored in Stainless-steel container

Smoothie mix stored in Glass container

Smoothie mix stored in Plastic container

Smoothie mix stored in Ziplock cover

Fig VIII Shelf-Life Analysis of the Developed Smoothie Mix

Microbial analysis

It is used to analyse the presence of yeast, bacterial counts and food-borne pathogen which can deteriorate the quality of the product during the storage. It is done twice with the interval of 30 days. The total plate count is analysed as per the procedure IS 5402(part 1):2021 and yeast and mould are estimated as per the procedure IS 5403: 1999. The microbial analysis of 1st day and the 30th day was analysed and compared for the colony growth. The report of the analysis is attached as Annexure VII.

Phase D: Packaging and nutritional labelling of the product.

To protect food products from contamination and other elements including aroma, shock, dust, temperature, physical damage, light, microorganisms and humidity, the packaging is crucial. It is essential to ensure the food product's quality and safety, prolonging its shelf life and lowering food losses and wastage. The type of packaging chosen is crucial for improving

food quality and safety as well as extending the food's shelf life because packaging helps to protect the food from external environment. It enhances the product's appeal, affordability, and consumer-friendliness**.**

Fig IX- Label of the Developed Instant Smoothie Mix

IV. RESULTS AND DISCUSSION

The results and discussion of the study titled "Development and evaluation of herbs infused wholesome smoothie mix" is discussed under the following headings

I. Development of herbs infused smoothie mix and standardization.

II. Quality analysis of the developed smoothie mix.

I. Development of herbs infused smoothie mix and standardization

Smoothie mix was developed with different combination of ingredients in different proportions and various trials were conducted to standardise the mix for a serving size of 100ml of milk.

TABLE III

VARIATIONS WITH COMPOSITION OF INGREDIENTS

S.no	Variations	I (Smoothie mix +0.25g of herbs mixture)	II (Smoothie mix + 0.5g of herbs mixture)	III (Smoothie mix + 0.75g of herbs mixture)	IV (Smoothie mix + 1g of herbs mixture)
1	Ragi milk powder	4g	4g	4g	4g
2	Sprouted green gram powder	4g	4g	4g	4g
3	Roasted Poha powder	10g	10g	10g	10g
4	Banana powder	12g	12g	12g	12g
5	Cardamom powder	0.5g	0.5g	0.5g	0.5g
6	Herb mixture (Pirandai,Vallarai Mudakathan)	0.25g	0.5g	0.75g	1g

In table III various ingredients used and its compositions are projected. In all the 4 variations ingredients such as ragi milk powder, sprouted green gram powder, rice flakes powder, banana powder were used in same quantity only the herbs mixture was used in the proportion of 0.25g,0.5g,0.75,1g for variation I ,II, III and IV respectively. Then all the four variations were subjected to organoleptic evaluation to determine the preferable combination of the developed smoothie mix.

Sensory Analysis of the Developed Smoothie Mix

The organoleptic evaluation of the developed smoothie mix was conducted by a panel of semi-trained members (20 students) of the age group 18-24 years from Avinashilingam Institute for Home Science and Higher Education for Women. The sensory qualities of each varaitions in the parameters appearance, colour, flavour, taste, texture, and overall acceptability) were scored using the hedonic scale of 1 to 9.

TABLE IV

SENSORY EVALUATION OF THE DEVELOPED SMOOTHIE MIX

Table IV shows the results of the sensory parameters for all the 4 variations of the developed smoothie mix.

S.No	Variation	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
1	**A** (Smoothie mix +0.25g of herbs mixture)	8.3± 0.73	8 ±0.64	7.8± 0.5	8.1±0.9	8± 0.85	7.9 ± 0.6
2	**B** (Smoothie mix +0.5g of herbs mixture)	8.4 ± 0.6	8.1± 0.7	8.3± 0.7	8.2±0.8	7.8 ± 0.5	8.2 ± 0.69
3	**C** (Smoothie mix +0.75g of herbs mixture)	8.5± 0.6	8 ± 0.6	8.2± 0.6	8.2±0.6	8.4 ± 0.59	8.3 ± 0.85
4	**D** (Smoothie mix +0.1g of herbs mixture)	8.4± 0.7	8.1± 0.8	8.1±0.6	8.1±0.6	8.1 ± 0.81	8.2± 0.56

(9- like extremely,8- like very much,7- like moderately,6- like slightly,5- neither like nor dislike,4- dislike slightly,3- dislike moderately,2- dislike very much,1- dislike extremely)

Variation C scored high in appearance,texture, taste and overall acceptability.Hence the variation C (smoothie mix +0.75g herbs mixture)was selected as the final standardized product.

The study is in line with the development of a millet based instant health mix by Geetha *et al* (2021) and evaluation of sensory parameters. The evaluation was conducted on 9 point hedonic scale. The appearance and taste scored 8.5 and 8.3 respectively. The taste of the developed wholesome smoothie mix scored 8.4 which is higher than the health mix score.

The study is also in line with the research conducted by Haripriya (2019) in the development a cereal based health powder and evaluated the sensory parameters on 5 point hedonic scale. The appearance and texture scored high in the evaluation. But the developed smoothie mix scored high in all parameters of the evaluation.

II. Quality analysis of the developed smoothie mix

To determine the quality of the developed smoothie mix powder, nutrient analysis, pH, total solid substances (TSS), microbial analysis, phytochemical analysis, presence of antioxidant, toxic elements was done.

A. Nutrient analysis

The nutrients of the developed smoothie mix was analysed and the results are projected in Table V

TABLE V

NUTRIENT COMPOSITION OF THE DEVELOPED SMOOTHIE MIX

Nutrient	Value per 100g of the developed smoothie mix
Energy	810 Kcal
Carbohydrate	76g
Total sugar	1.15g
Protein	12g
Total fat	1.2g
Dietary Fibre	4g
Vitamin A	12.1 mg
Vitamin B1	0.37 mg

Vitamin C	16 mg
Sodium	1283 mg
Calcium	184 mg
Iron	4.87 mg
Zinc	2.07 mg
Magnesium	120.3 mg
Moisture	7.02 %
Ash	3.57 %

Table V projects the nutrient composition of the developed herbs infused wholesome smoothie mix powder.100g of the developed smoothie mix contains 810 Kcal of calories, 76g of carbohydrate, 1.15g of total sugar. The developed smoothie mix yields 12g of protein, 4g of fibre. The minerals present in the 100g of smoothie mix developed is 4.8 mg of iron and 184 mg of calcium. The moisture and ash contents of the developed smoothie mix is 7.02%, 3.57% respectively. The smoothie mix of 25g for serving size for 100 ml of milk was standardised.

The study results are in line with study done by Dilrukshi*et al* (2021) where in freeze-dried instant green smoothie powder was developed and the properties were evaluated . The developed powder nutritionally contributed 271 Kcal 2.6g protein,1g fat. Though the caloric contribution of the developed wholesome smoothie is slightly less when compared to the freeze-dried the protein and fibre are high and the fat is more or less the same.

The study results are also in line with study done by Priyakshi*et al* (2016) were a value added herbal health mix was developed specifically to treat hypolipidemia. The major ingredients added were parboiled rice and green gram dhal . The 100g of health mix contained 74.75g of carbohydrates, 12.92g of protein 1.07g of fat and 7.13g of dietary fibre. The developed wholesome smoothie nutritive yield per 100g is also in par with the value added hypolipdemic health mix.

The commercial product choco dates smoothie(Little moppet foods-FSSAI Approved) has a nutrient contribution per serving of 49 Kcal, protein of 1.7g, carbohydrate of 4.9g, sugar of 4.32 g and very trace amount of Sodium, iron, potassium and dietary fibre. The developed wholesome smoothie mix contributed more than the commercial smoothie mix. The

developed smoothie mix is a chemical and preservative free and better choice when compared to the commercial smoothie mixes available in the market.

B. pH Analysis

The pH analysis is a quality indicator for the developed product .The pH analysis for the developed product was studied to ensure that the developed food product have an appropriate acidity level and are suitable for consumption.

TABLE VI

PH ANALYSIS OF THE DEVELOPED WHOLESOME SMOOTHIE MIX

Product	**pH value**
Smoothie mix powder	5± 0.22

Table VI projects the results of the pH analysis of the developed smoothie mix. The pH level of the developed smoothie mix is less acidic and suitable for human consumption. Even if the product is consumed along with milk it does not become acidic and cause any side effects like acid reflux reaction in the body.

The pH has a significant impact on pigments.The ability of the food to hold moisture has a significant impact on pH as well.The pH value has an impact on a variety of phenomena and processes, including the denaturing, gelling property, and enzymatic activities of proteins, microorganism growth and death, bacterial spore germination or inactivation, and chemical reactions including the Maillard reaction. Producing safe, high-quality, and value-added goods thus requires knowledge of pH effects and its regulation throughout processing. (Andrés-Bello *et al* 2013)

The study results are in line with study done by Dilruksh *et al* (2021) where in freeze-dried instant green smoothie powder was developed and the properties were evaluated .The pH of the freeze-dried smoothie mix was 4.22. But the developed wholesome smoothie mix is 5. The freeze-dried smoothie mix is more acidic than the wholesome smoothie mix developed.

C. Total Soluble Substance (TSS)

The total solid substance(TSS) is used mainly to determine the percentage of sugar concentration in the product. It also indicated the quality of the fruit added to the product. The TSS analysis of the developed wholesome smoothie mix is listed in Table VII

TABLE VII

TOTAL SOLID SUBSTANCES ANALYSIS OF THE DEVELOPED SMOOTHIE MIX

Product	TSS value	Normal range
Smoothie mix powder	3	0-10 Low concentration of sugar. 11-20 Medium concentration of sugar. 21-30 High concentration of sugar.

According to the Table VII the TSS of the developed smoothie mix is 3 Brix. It shows that the total amount of sugar present in the smoothie is very low. Hence it cannot aid in fermentation process or spoilage when it is stored in powder form or as milk blend form.

Based on the instant smoothie mix developed by Dilrukshi *et al* (2021) the TSS value is 12.33 which is medium concentration of sugar. The concentration of sugar plays a vital role in the shelf life of the product. The concentration and shelf life are inversely proportional. Lower concentration of sugar can aid in increased shelf life period.(Islam, 2013)

Vennila *et al* (2020) developed muskmelon fruit powder and incorporated it to develop various products such as instant – drink mix, milkshake powder, ice cream powder and health mix powder. Difference in the nutrient content of fresh fruit and fruit powder developed was compared. The TSS of the fresh fruit is 5.58, and powder is 25. The study is in line with the developed of smoothie mix where the TSS was analysed to be 3 which is low.

D. Anti Oxidant Analysis

TABLE VIII

ANTIOXIDANT ANALYSIS OF THE DEVELOPED WHOLESOME SMOOTHIE MIX (Standard)

Concentration(µl)	Inhibition Percentage
3	62.30
6	70.30
9	83.61
12	90.16
15	95.90

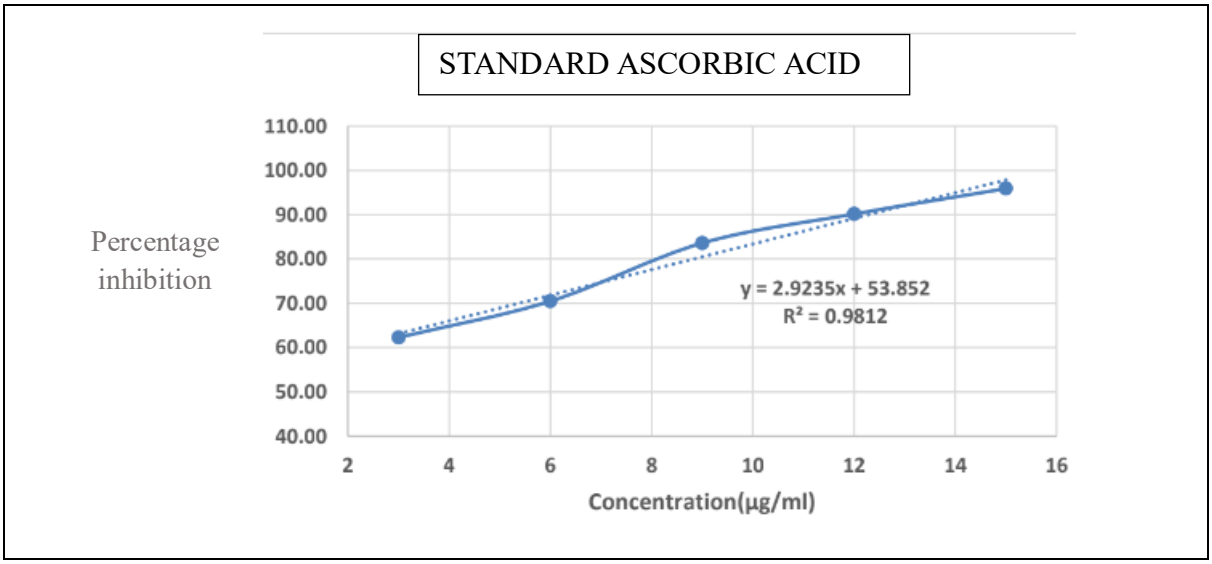


Fig X-Concentration of the Standard Ascorbic Acid

TABLE IX

ANTIOXIDANT ANALYSIS OF THE DEVELOPED WHOLESOME SMOOTHIE MIX

Table IX contains the antioxidant concentration of the developed wholesome smoothie mix developed

Concentration (µl)	Inhibition Percentage
10	49.18
50	50.82
150	54.10
250	55.74
350	72.13
500	73.77
750	75.41

The antioxidant content of the of the developed wholesome smoothie mix was analysed by DPPH method with ascorbic acid as standard . Table VIII and IX projects the concentration values of the standard and smoothie mix powder respectively . The smoothie mix powder was taken in the concentration of 2.01mg/mL in water (H_2O)as solvent. Since the sample was not completely soluble only the soluble portions were used for analysis.

The DPPH (2,2-diphenyl-1-picrylhydrazyl) method was used for the assessment of free radical scavenging activityof the developed smoothie mix . Ascorbic acid is used as standard because it is a well-known antioxidant and free radical scavenger. It is a medium-strength DPPH radical dot scavenger, but compared to other scavenging molecules, such polyphenols, mallic acid etc.When ascorbic acid is present in a considerable amount, it has been shown to have a correlation with the measured DPPH radical scavenging abilities of the food product. The ability of the food to scavenge free radical is expressed as inhibition percentage (Scalzo,2008).

Form the table IX it is evident that the inhibition percentage increases strikingly with the increase in concentration of the sample. The sample also shows high absorbance ability which is also an indicator of high level of antioxidant contents present in the developed smoothie mix

E. Phytochemical Analysis

TABLE X

PHYTOCHEMICAL ANALYSIS OF THE DEVELOPED WHOLESOME SMOOTHIE MIX POWDER

S.No.	Metabolite	Test performed	Observation	Results	Figure
1.	Alkaloids	+Mayer's reagent	Absence of Cream coloured precipitate	-	
		+ Dragendorff's reagent	Presence of reddish brown precipitate	+	**1**
2.	Flavonoids	Alkaline test	Intense yellow colouration with dil. NaOH turning colourless on adding dil.HCl	+	**2**
		$+H_2SO_4$	Absence of reddish Orange colour	-	

		+lead acetate	Absence of white Precipitate	-	
		Shinoda test	Absence of crimson Pink colour	-	
3.	Sterols (Libermann test)	+$CHCl_3$+ Acetic anhydride +Conc.H_2SO_4	Presence of reddish brown ring	+	**3**
4.	Terpenoids (Libermann test)	+ $CHCl_3$+ Acetic anhydride + Conc. H_2SO_4	Absence of green colour	-	
5.	Anthraquinone (Borntrager's test)	+ $FeCl_3$ + Conc.HCl+diethyl ether +Ammonia	Presence of reddish orange colour	+	**4**
6.	Anthocyanin	HCl Test	No Colour change	-	
7.	Proteins	+2%Ninhydrin reagent	Presence of Purple colour	+	**5**
		+2%$CuSO_4$+ 95%ethanol+KOHpellet	Absence of blue colour	-	
		+conc. HNO_3	Presence of Yellow Colouration	+	**6**
8.	Phenolic compounds	+5% neutral $FeCl_3$	Absence of bluish green coloured solution	-	

		Gelatin test	Absence of white precipitate	-	

		Ellagic acid test	Absence of nigger brown precipitate	-	
9.	Quinones	Conc.HCl	Absence of yellow precipitate	-	
		Alcoholic KOH	Absence of reddish solution	-	
10.	Carbohydrates	Molisch's test	Presence of Violet ring	+	**7**
		Fehling's test	Presence of Red precipitate	+	**8**
11.	Tannin	Braymer's test	Absence of bluish green colour	-	
		+Gelatin test	Absence of white precipitate	-	
		10% NaOH test	Absence of emulsion	-	
12.	Saponins	Shaken with water	Absence of foam	-	
13.	Cardiac glycosides	+Baljet reagent	Absence of yellow orange colour	-	
		Bromine water test	Absence of yellow precipitate	-	
		Keller-killani test	Absence of brown ring	-	
14.	Glycoside's test	Borntrager's test	Absence of pink coloured solution	-	
		Aq.NaOH test	Absence of yellow coloured solution	-	
15.	Lignin	+Gallic acid	Absence of olive-green	-	

			colour		
16.	Coumarins	Fluorescence test	No yellow fluorescence	-	
		+10%NaOH + $CHCl_3$	Absence of yellow colour	-	
17.	Volatile oils	Fluorescence test	No fluorescence	-	

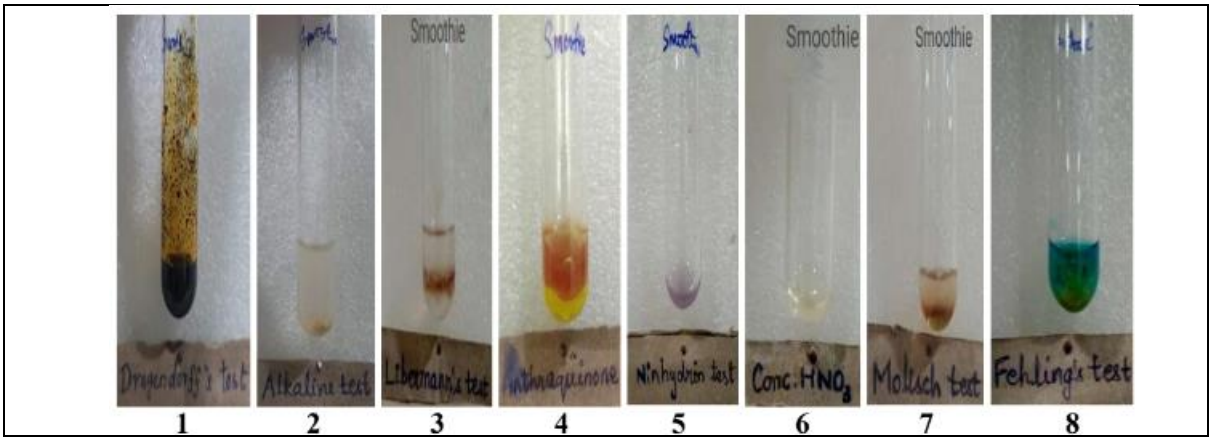


Fig XI Phytochemical screening of the developed wholesome smoothie mix

The phytochemicals present in the developed herbs infused wholesome smoothie mix was analysed and highlighted in Table X.The qualitative analysis of phytochemicals in the developed smoothie mix ,the presence of alkaloids, flavonoids, sterols, anthraquinone, plant based protein and carbohydrates were identified.

Alkaloids- The presence of alkaloids were indicated by testing the sample with Dragendorff's reagent(reddish brown precipitate Fig XI[1]). Alkaloids have proven to be neuroprotective against neurodegenerative disorders in old age(Hussain *et al* 2018).

Flavonoids-The flavonoids were identified by the alkaline test (Fig XI [2]). The flavonoids is known for its cardioprotective,antidiabetic and anti inflammatory properties which is proven to be beneficial in old age.(Fan *et al* 2022).

Sterols-The presence of sterols were confirmed by Libermann test (reddish brown ring formation Fig XI [3]). Sterols has potential effects that includes antioxidant, anti inflammatory, anti atherogenic property which aids in the management of old age health condition.(Rudkowska,2010).

Anthraquinone-The reddish orange colour in Borntrager's test (Fig XI [4]) proved the presence of anthraquinone which has many therapeutic effects anti carcinogenic propertiesand laxative properties.(Malik *et al* 2021).

Futherthe presence plant based protein and carbohydrates were also identified.

The study is in line with the study conducted by Malavika and Rajinder(2015).The phytochemical parameters of the developed ready to eat infant mix was analysed. The presence of phenolic content of 16.71Aμg GAE / mg and flavonoid of 85.26 Aμg CE / mg extract was identified

F. Toxicity Analysis

TABLE XI

TOXICITY ANALYSIS OF THE DEVELOPED WHOLESOME SMOOTHIE MIX

S. No	Sample Code	Concentration (μg/ml)	Mortality of Brine shrimp (no. of shrimps dead) (h)					
			1	2	4	6	24	% Mortality (at 24h)
1.	Smoothie Mix Powder	100	0	0	0	0	1	3
		250	0	0	0	0	2	7
		500	0	0	0	2	2	7
		1000	0	0	0	1	2	7
		1500	0	0	0	2	2	7
2.	**Control $K_2Cr_2O_7$**	**1 (mg/ml)**	**30**	**-**	**-**	**-**	**-**	**100**
3.	**Blank**	**Saline water**	0	0	0	0	0	0

The toxicity analysis was conducted by Brine shrimp lethality assay. The saline water was used as blank solution and the potassium dichromate as positive control solution. The sample (Smoothie Mix Powder) is comparatively not toxic than K2Cr2O7 which shows maximum lethality of shrimps at higher concentration. The sample (Smoothie Mix Powder) are found to be non-toxic in lower (100 µg/ml) as well as in higher concentration (1500 µg/ml).

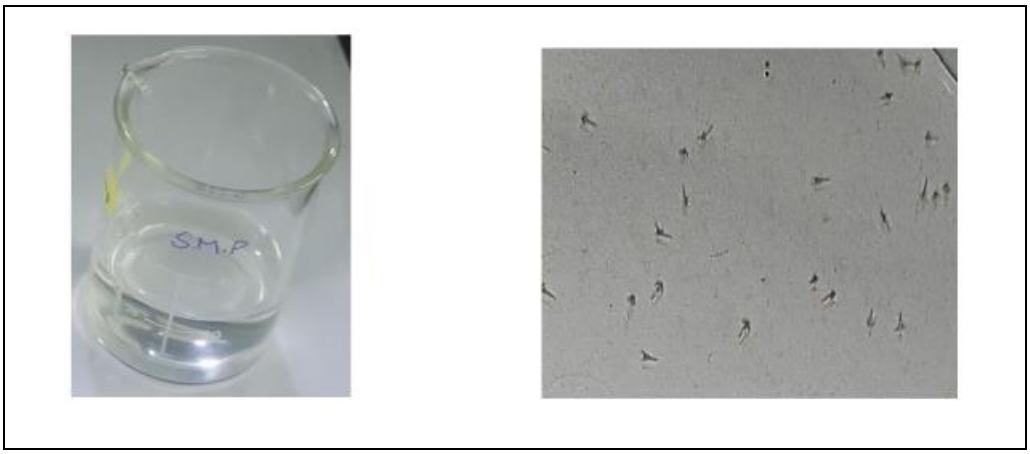


Fig XII Shrimps Present in the Developed Smoothie Mix

G. Shelf Life Analysis

TABLE XII

SHELF LIFE ANALYSIS- APPEARANCE AND TEXTURE OF THE DEVELOPED WHOLESOME SMOOTHIE MIX

Appearance and texture	**Stainless steel container**	**Glass container**	**Plastic container**	**Zip-lock container**
WEEK 1	Fine Powder	Fine Powder	Fine Powder	Fine Powder
WEEK 2	Fine Powder	Fine Powder	Fine Powder	Fine Powder
WEEK 3	Fine Powder	Fine Powder	Fine Powder	Fine Powder
WEEK 4	Fine Powder	Fine Powder	Fine Powder	Dusty
WEEK 5	Dusty	Dusty	Dusty	Dusty
WEEK 6	Dusty	Floury	Floury	Dusty
WEEK 7	Dusty	Floury	Floury	Granular
WEEK 8	Dusty	Crumbling	Lumpy	Granular

FigXIII–Lumps Formation in the Developed Smoothie Mix

The powder stored in all the container (stainless steel , glass, plastic and zip-lock cover) was fine in appearance and texture up to 4 weeks. From the week 5 the slight chances in texture were observed. In the week 5 the powder started to appear dusty to floury. By the end of week 8 lumps were also formed and powder appeared to be granular.

TABLE XIII

SHELF LIFE ANALYSIS- TASTE AND FLAVOUR OF THE DEVELOPED WHOLESOME SMOOTHIE MIX

Taste and flavour	**Stainless steel container**	**Glass container**	**Plastic container**	**Zip-lock container**
WEEK 1 to 5	Edible and pleasant	Edible and pleasant	Edible and pleasant	Edible and pleasant
WEEK 6	Edible and pleasant	Edible and pleasant	Edible and pleasant	Slight off flavour
WEEK 7 to 8	Slight off flavour and edible	Slight off flavour and edible	Slight off flavour and edible	Slight off flavour and edible

The powder stored in all the container (stainless steel , glass, plastic and zip-lock cover) was fine, the taste and flavour was edible up to 6 weeks. From the week 7 the slight chances in taste and flavour were observed. In the week 7 and 8 the powder started to have slight off flavour due the herbs added but the taste of the product was good .

H. Microbial Analysis

The microbial status of the developed herbs infused smoothie mix was analysed. The change in appearance and texture was visible from the week 4 of shelf life study, hence the microbial analysis was conducted for Day 1 and Day 30 samples.The samples were analysed for total plate count and yeast and mould count. `The values are projected in Table XIV and Table XV

TABLE XIV

MICROBIAL ANALYSIS OF THE DEVELOPED SMOOTHIE MIX – DAY 1

Table XIV highlights the TPC (total plate count) and yeast and mould count on day 1 of the developed smoothie mix.

S.NO	PARAMETERS	NORMAL RANGE	RESULT
1	Total plate count	<50,000/g	243 CFU/g
2	Yeast and mould count	<10/g	<10 CFU/g

TABLE XV

MICROBIAL ANALYSIS OF THE DEVELOPED SMOOTHIE MIX – DAY 30

Table XV highlights the TPC (total plate count)and yeast and mould count on day 30 of the developed smoothie mix.

S.NO	PARAMETERS	NORMAL RANGE	RESULT
1	Total plate count	<50,000/g	960 CFU/g
2	Yeast and mould count	<10/g	<10 CFU/g

Table XIV and XV highlights the total plate count , yeast and mould count of the day 1 and day 30 of the developed smoothie mix. The result values obtained from the analysis are with in the limit of preferable and acceptable range as per FSSAI guidelines 2006.

The Total Plate Count of the developed smoothie mix on day 1 was 243/g and on day 30 was 960/g and the yeast and mould count was <10 CFU/g which is in the acceptable range as per FSSAI guidelines. Though the TPC (total plate count) value has increased from day 1 to day 30, the value is within the limit as per the norms of FSSAI.

The results of the study is in line with the study conducted by Indirani *et al* (2022) in the development of health mix powder by incorporating carrot powder. In the microbial analysis of the day 1 is 100cfu/g and day 30 is 7580cfu/g. The value is in acceptable range based on the guidelines of the FSSAI. But the developed smoothie mix value is lesser than the value added health mix powder.

V SUMMARY AND CONCLUSION

Old age is the last phase of the life cycle. It is a process of gradual and natural changes that takes place physically, physiologically, psychologically, sociologically and biologically. The impact of these changes affects the lifestyle quality of old age population. There is significant increase in the old age population percentage globally. It is necessary to have a better understanding of age-oriented changes in older age to help in proper management.

The age-related changes are natural and gradual process of the old age. These changes include decrease in brain functioning ability and physical, physiological, and sensory functioning capacity leading to frailty. The natural loss of muscle tone is also observed in old age but neglecting it can lead to malnutrition which is contributing factor for many age related chronic disease and disorders. Some of the common chronic disease prevalent among the old age population are diabetes mellitus, hypertension, cardiac related diseases, gastrointestinal disorder.

The food preference, choices and nutritional requirement are altered with aging. Nutrition always plays a significant role in the old age population health management. The benefits of choosing healthy foods for the elderly population are beneficial for effective ageing.Many foods prepared exclusively for the elderly population are available in the commercial market. Similar to other food categories, such as infant foods, meals for the elderly should be created to meet their specific nutritional requirements.

A variety of foods in the forms of "Ready to Cook" and “Ready to Eat” are available in the commercial market. Commercial products include ready-to-eat health mixes, biscuits, cookies etc. Despite the abundance of commercial goods, none of them are necessarily healthier due to their high calorie content and significant processing. Products having functional qualities can be used as healthy replacements are highly advised for the elderly.

Hence the study was conducted on “Development and Quality Evaluation of Herb Infused Wholesome Smoothie Mix for Elderly People”. Smoothies are very convenient food that can be easily prepared in short period of time. Initially a pilot study was conducted to select the milk as base for the smoothie. A trial with black rice milk was conducted. Later it was rejected due to its quality and quantity of milk yield. Since millets are low in GI and nutritional substitute for rice, millet based milk was selected.

Similar to commercial smoothie mix available in the market, a nutritional substitute as chemical binding agent was identified. The trial was conducted with chia seeds, sago powder, and oats to analyse their ability of binding. Based on the trials, rice flakes was selected for its better ability of binding, than the other ingredients selected for the trials.

The ingredients such as finger millet (*Eleusine coracana*), sprouted green gram (*Vigna radiata)* , rice flakes (*Oryza sativa L*)binder, banana (*Musa paradisiaca)* and herbs like pirandai(*Cissus quadrangularis)*, Vallarai (*Centella asiatica*), Modakathan (*Cardiospermum Halicacabum)* were selected for the development of herbs infused wholesome smoothie mix. Cardamom was also added as flavouring agent to the smoothie mix developed. The herbs were processed by shade drying process and all the major ingredients were processed by solar drying process. Several combination of ingredients quantity were tried out to standardise the smoothie mix for a serving size of 100ml. Four variations were created by varying the herb mixture quantity (0.25g to 1g).

- Sensory evaluation was conducted for all the four variations by a panel of 20 semi trained members to determine the preferrable combination of the smoothie mix developed. Based on the organoleptic evaluation, 0.75g of herb mixture added to the smoothie mix scored high in all the sensory parameters. Hence it was finalised and was proceeded for quality analysis.
- The developed smoothie was evaluated for its nutrient qualities. Based on the analysis 100g of the developed smoothie mix contains 810 kcal of calories, 76g of carbohydrate, 1.15g of total sugar,12g of protein, 4g of fibre, 4.8 mg of iron ,184 mg of calcium 7.02% of moisture and 3.57% of ash
- The smoothie mix developed was assessed for its pH and Total soluble substances (TSS). The pH of the product ranged 5$\pm$ 0.22 which is is less acidic and suitable for human consumption. The TSS value was 3 which shows that the total amount of sugar present in the smoothie is very low.
- The antioxidant present in the smoothie mix was analysed by DPPH method. The ascorbic acid was used as standard for the analysis due to its better scavenging ability. The significant rise in the inhibition percentage of the sample was observed. This indicated high antioxidant activity of the developed smoothie mix.
- The phytochemical parameters were tested to identify the presence of phytochemicals. The presence of alkaloids, flavonoids, sterols, anthraquinone, plant based protein and

carbohydrates were identified. Presence of all these phytochemicals are beneficial to the elderly population to combat age related diseases and disorders.

- The shelf life study was conducted for the product by storing one serving of the developed smoothie mix in 4 types of storage materials like stainless steel container, glass container, plastic container and a zip-lock cover. The significant changes in the texture was observed after 4 weeks of storage. Hence microbial analysis for total plate count and yeast and mould count was also evaluated for the product for 30 days (4 weeks). The total plate count for day 1 and day 30 was 243 CFU/g and 960 CFU/g respectively. The yeast and mould colonies was <10 CFU/g. The values obtained were within the limit as per the norms of FSSAI.
- The sample was further analysed for the presence of toxic elements by Brine shrimp lethality assay. From the analysis, the developed smoothie mix developed was found to be non toxic and safe for human consumption. Thus the product developed is an instant and convenient drink for the elderly people. It is a healthy and better choicefor consumption when compared to other products available in the commercial market.

CONCLUSION

With ageing comes several physiological changes that affect people's desire to prepare extravagant meals lessens. This affects the quality and quantity of food consumed ,leading to micro and macro nutrient deficiencies. An effort was made to design a healthy smoothie mix that is instant and convenient for the elderly people. The developed smoothie mix is a nutritional replacement for the other commercially available products which are loaded with calories and sugars. Thus the developed smoothie mix can be taken up as a small scale venture to promote the healthy foods among the elderly people to improve the health status.

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ANNEXURE I

INSTITUTIONAL HUMAN ETHICS COMMITTEE

Avinashilingam

Institute for Home Science and Higher Education for Women
(Deemed to be university under Category 'A' by MHRD, Estd. u/s 3 of UGC Act 1956) Re-accredited with 'A^{+++}' Grade by NAAC.
Recognised by UGC Under Section 12 B
Coimbatore- 641043, Tamil Nadu, India

05.01.2023

To
Ms. Vishalakshi, S.
Department of Food Service Management and Dietetics
Avinashilingam Institute for Home Science and
Higher Education for Women
Coimbatore- 641043

Dear Vishalakshi,

Ref: Your proposal No. IHEC/22-23/FSMD-24 entitled "Development and Quality Evaluation of Herbs Infused Wholesome Smoothie Mix for Elderly People" submitted for approval of IHEC 21.11.2022

The Institutional Human ethics Committee of our University hereby grants approval to your research proposal No. IHEC/22-23/ FSMD-24 entitled "Development and Quality Evaluation of Herbs Infused Wholesome Smoothie Mix for Elderly People" submitted by you. The Approval number for the same is AUW/IHEC/FSMD- 22-23/XPD-24.

We wish you all the best in your research endeavours.

Regards

5.1.23

Dr. A Thirumani Devi
Member Secretary

Institutional Human Ethics Committee

ANNEXURE II

SCORE CARD FOR SENSORY EVALUATION OF THE DEVELOPED SMOOTHIE MIX

Name:

Class: Date:

Attributes	Variation I (Smoothie mix +0.25g of herbal mixture)	Variation II (Smoothie mix + 0.5g of herbal mixture)	Variation III (Smoothie mix + 0.75g of herbal mixture)	Variation IV (Smoothie mix + 1g of herbal mixture)
Appearance				
Colour				
Flavour				
Texture				
Taste				
Overall acceptability				
Total Score				

9- Like extremely

8- Like very much

7- Like moderately

6- Like slightly

5- Neither like nor dislike

4- Dislike slightly

3- Dislike moderately

2- Dislike very much

1- Dislike extremely

ANNEXURE III

Greenlink Analytical and Research Laboratory (India) Private Ltd.
S.F. No. 414/1, Tex Park Road, Opp. Good Luck Syndicate,
Civil Aerodrome Post, Coimbatore - 641 014. Tamilnadu, INDIA.
Tel : +91 422 2901999 | Mob : +91 95245 81999, +91 95249 81999
Email : enquiry@greenlinklabs.com, info@greenlink.in

NABL ISO / IEC 17025:2017 ISO 9001:2015

TEST REPORT

Report No.	GLARL/TRE/1485	**Date**	20.03.2023

Details of Customer	
Customer Name and Address	Ms. S. Vishalakshi Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore.
Customer Reference	-

Details of Sample			
Sample Received Date	14.03.2023	**Sample-By**	Customer
Nature of the sample	Food Product	**Description**	Health Mix Powder
Sample Code	GLARL/F/03/23/1485	**Received condition**	Good
Analysis Started on	15.03.2023	**Analysis Completed on**	18.03.2023

Result of Analysis

S.No	Characteristic	Test Method	Unit	Results
1.	Energy	FSSAI/IS/AOAC	Kcal	810
2.	Dietary Fibre		g/100g	3.63
3.	Total Sugar		g/100g	1.15
4.	Protein		g/100g	12.39
5.	Total Fat		g/100g	1.287
6.	Sodium		mg/100g	1283
7.	Calcium		mg/100g	184
8.	Iron		mg/100g	4.87
9.	Zinc		mg/100g	2.07
10.	Magnesium		mg/100g	120.3
11.	Vitamin A		mcg	12.1
12.	Vitamin B1		mg/100g	0.37
13.	Vitamin C		mg/100g	15.94
14.	Moisture		%	7.02
15.	Ash content		%	3.57
16.	Carbohydrate		g/100g	75.72

******End of Report******

Green Analytical And Research Laboratory (India) Pvt Ltd CBE - 14

Authorized Signatory
(M.Amsaveni)
Technical Manager
GREENLINK

ANNEXURE IV

TAMIL NADU AGRICULTURAL UNIVERSITY
FOOD QUALITY TESTING LABORATORY
Post Harvest Technology Centre
Coimbatore – 641 003

Date: 14.03.2023

TEST REPORT

Name & Address of the customer: **M/S. S.Vishalakshmi** Avinashilingam Institute for Home Science and Higher education for women, Coimbatore.	Name of the product : Smoothie mix Sample ID : 2729 No. of samples : 1 Quantity received : 50 g Packaging condition : Ziplock cover Date of Receipt : 16.02.2023 Date of Testing : 03.03.2023 Date of Completion : 03.03.2023 Sampling : Sampling not conducted by us

S. No	Parameters	Results	Method of Analysis
1.	TSS (°Brix)	3	Refractometer
2.	PH	5.22	Biochemical methods, 2nd Edn. 1996

----------End of Report----------

14/3/23

(Dr.S. Karthikeyan)
Authorized signatory

ANNEXURE V

Avinashilingam Institute for Home Science and Higher Education for Women
(Deemed to be University *Estd.u/s* 3 of UGC Act 1956, Category A by MHRD)
Re-accredited with 'A++' Grade by NAAC. Recognised by UGC Under Section 12
B Coimbatore-641 043, TamilNadu, India

Bharat Ratna Prof.C.N.R Rao Research Centre

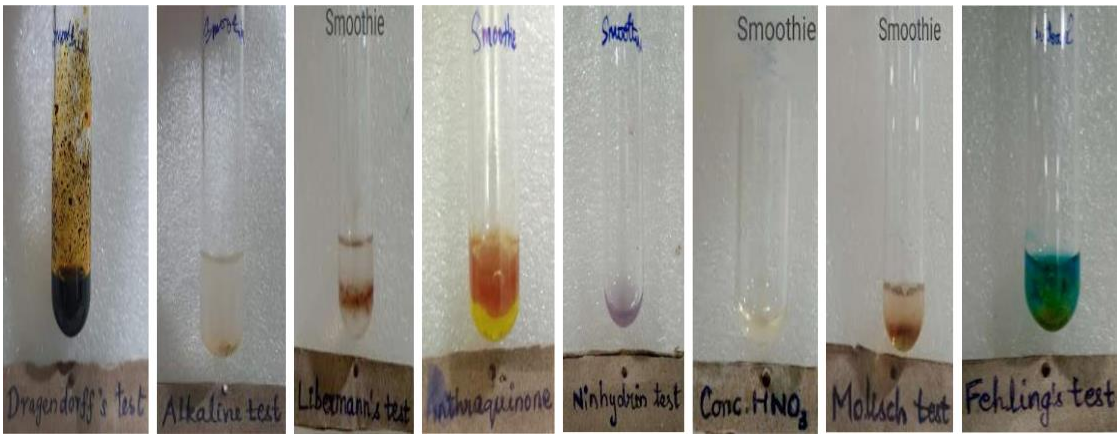
Results of Phytochemical Screening of samples

Sample code: Smoothie min Powder

S.No.	Metabolite	Test performed	Observation	Results	Figure No.
1.	Alkaloids	+Mayer's reagent	Absence of Cream coloured precipitate	-	
		+ Dragendorff's reagent	Presence of reddish brown precipitate	+	1
2.	Flavonoids	Alkaline test	Intense yellow colouration with dil. NaOH turning colourless on adding dil.HCl	+	2
		+H_2SO_4	Absence of reddish Orange colour	-	
		+lead acetate	Absence of white Precipitate	-	
		Shinoda test	Absence of crimson Pink colour	-	
3.	Sterols (Libermann test)	+$CHCl_3$+ Acetic anhydride +Conc.H_2SO_4	Presence of reddish brown ring	+	3
4.	Terpenoids (Libermann test)	+ $CHCl_3$+ Acetic anhydride + Conc. H_2SO_4	Absence of green colour	-	
5.	Anthraquinone (Borntrager's test)	+ $FeCl_3$ + Conc.HCl+diethyl ether +Ammonia	Presence of reddish orange colour	+	4
6.	Anthocyanin	HCl Test	No Colour change	-	
7.	Proteins	+2%Ninhydrin reagent	Presence of Purple colour	+	5
		+2%$CuSO_4$+ 95%ethanol+KOHpellet	Absence of blue colour	-	
		+conc. HNO_3	Presence of Yellow Colouration	+	6
8.	Phenolic compounds	+5% neutral $FeCl_3$	Absence of bluish green coloured solution	-	

		Gelatin test	Absence of white precipitate	-	
		Ellagic acid test	Absence of nigger brown precipitate	-	
9.	Quinones	Conc.HCl	Absence of yellow precipitate	-	
		Alcoholic KOH	Absence of reddish solution	-	
10.	Carbohydrates	Molisch's test	Presence of Violet ring	+	**7**
		Fehling's test	Presence of Red precipitate	+	**8**
11.	Tannin	Braymer's test	Absence of bluish green colour	-	
		+Gelatin test	Absence of white precipitate	-	
		10% NaOH test	Absence of emulsion	-	
12.	Saponins	Shaken with water	Absence of foam	-	
13.	Cardiac glycosides	+Baljet reagent	Absence of yellow orange colour	-	
		Bromine water test	Absence of yellow precipitate	-	
		Keller-killani test	Absence of brown ring	-	
14.	Glycoside's test	Borntrager's test	Absence of pink coloured solution	-	
		Aq.NaOH test	Absence of yellow coloured solution	-	
15.	Lignin	+Gallic acid	Absence of olive-green colour	-	
16.	Coumarins	Fluorescence test	No yellow fluorescence	-	
		+10%NaOH + $CHCl_3$	Absence of yellow colour	-	
17.	Volatile oils	Fluorescence test	No fluorescence	-	

Figures



1 **2** **3** **4** **5** **6** **7** **8**

The results of Phytochemical Screening of sample submitted by S. Vishalakshi, II M.Sc FSMD of our institution are given in the above table and photographs.

Attested by

14/4/2023

Bharat Ratna Prof.C.N.R Rao Research Centre
Avinashilingam Institute for Home Science and
Higher Education for Women,
Coimbatore-641043

Dr.P.Lalitha
Professor of Chemistry,
Director R&D Cell i/c & Co-ordinator,
Bharat Ratna Prof. CNR Rao Research Centre.

ANNEXURE VI

Avinashilingam Institute for Home Science and Higher Education for Women
(Deemed to be University Estd. u/s 3 of UGC Act 1956, Category A by MHRD)
Re-accredited with A++ Grade by NAAC. CGPA 3.65/4, Category I by UGC
Coimbatore - 641 043, Tamil Nadu, India

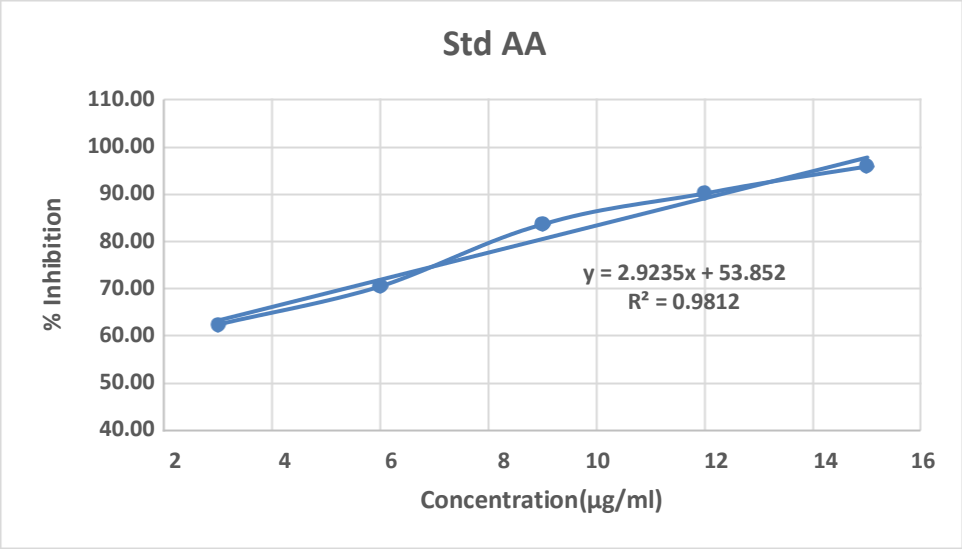
Bharat Ratna Prof.CNR Rao Research Centre

Results of Antioxidant Assay of samples

Method: DPPH Assay

Standard: Ascorbic acid

Concentration (µg/ml)	% Inhibition
3	62.30
6	70.49
9	83.61
12	90.16
15	95.90



Sample Code – Smoothie mix powder
Concentration: 2.01mg/mL H2O

Concentration (µl)	% Inhibition
10	49.18
50	50.82
150	54.10
250	55.74
350	72.13
500	73.77
750	75.41

NOTE: SAMPLE WAS NOT SOLUBLE COMPLETELY, ONLY SOLUBLE PORTIONS WERE USED FOR THIS STUDY

The results of Antioxidant assay of samples submitted by Ms.S Vishalakshi, M.Sc.FSMD of our Institution are given in the above Table and Photographs.

Attested by

Bharat Ratna Prof.C.N.R Rao Research Centre
Avinashilingam Institute for Home Science and Higher Education for Women,
Coimbatore-641043

Dr.P.Lalitha
Professor of Chemistry
Dean i/c, Research and Development Cell

ANNEXURE VII

Avinashilingam Institute for HomeScience and Higher Education for Women
(Deemed to be University Estd. u/s 3 of UGC Act 1956, Category 'A' by MHRD
Re-accredited with A++ Grade by NAAC. CGPA 3.65/4, Category I by UGC)
Coimbatore - 641 043, Tamil Nadu, India

Bharat Ratna Prof.CNR Rao Research Centre

Results of Brine Shrimp Lethality Assay

Number of Samples submitted: 1

Sample Code – Smoothie Mix Powder

Preparation of Samples

The given sample (Smoothie Mix Powder) is weighed and diluted to prepare 1mg/ml stock solution. The samples (Smoothie Mix Powder) of different volume 100, 250, 500, 1000, 1500µl are added to each beaker containing saline solution respectively.

Procedure

30 shrimps ⟹ Introduced into the solution mixture of saline (25ml) and sample solution of various concentration.

The movement of shrimp is monitored at intervals of 1, 2, 4, 6, 24 hours.

Blank solution : 30 shrimps in Brine solution

Positive control : Potassium dichromate (1mg/ml).

- The mortality of shrimp is calculated after 24 hours for Sample solution as well as Blank and Positive control.

S. No	Sample Code	Concentration (µg/ml)	Mortality of Brine shrimp (no. of shrimps dead) (h)					
			1	2	4	6	24	% Mortality (at 24h)
1.	Smoothie Mix Powder	100	0	0	0	0	1	3
		250	0	0	0	0	2	7
		500	0	0	0	2	2	7
		1000	0	0	0	1	2	7
		1500	0	0	0	2	2	7
2.	**Control $K_2Cr_2O_7$**	**1 (mg/ml)**	**30**	**-**	**-**	**-**	**-**	**100**
3.	**Blank**	**Saline water**	0	0	0	0	0	0

N= 30.

Attached are the images of sample (Smoothie Mix Powder) and the shrimps present in it respectively.

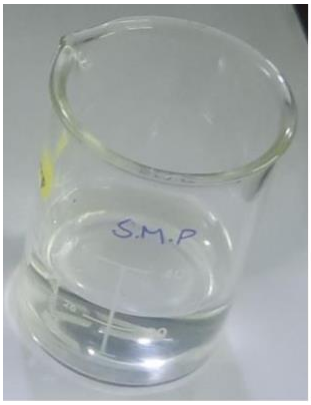


Fig. 1

Fig. 1a

- The sample (Smoothie Mix Powder) is comparatively not toxic than $K_2Cr_2O_7$ which shows maximum lethality of shrimps at higher concentration.
- The shrimps in the sample (Smoothie Mix Powder) are found to be non-toxic in lower concentration as well as in higher concentration.
- After 24h, only two shrimps are found to be mortal at highest concentration.

The results of Brine Shrimp Lethality Assay of sample submitted by Ms. S. Vishalakshi, II MSc FSMD of our institute is given in the above table and photographs.

Attested by

Bharat Ratna Prof.C.N.R Rao Research Centre
Avinashilingam Institute for Home Science and
Higher Education for Women,
Coimbatore-641043

Dr.P.Lalitha
Professor of Chemistry,
Dean i/c, R&D
& Co-ordinator, Bharat Ratna Prof.CNR Rao Research Centre

ANNEXURE VIII

SRI SHAKTHI
FOOD TESTING LABORATORY

43-B, Nethupalayam Road, Vellakinar Pirivu, Thudiyalur, Coimbatore - 641 034. Tamil Nadu, INDIA.
Mob : +91 72220 96666, +91 89030 26999, E-mail : srishakthiftl@gmail.com

Accredited by NABL Through Certificate Number TC-10001 dated 18.10.2021 as per ISO / IEC 17025 : 2017

Sponsored by Ministry of Food Processing Industries, Government of India.

TEST REPORT

Test Report No:2023/02/21/SSFTL/22-23/NN-556/001	Issue Date:02.03.2023	Page 1 of 1

CUSTOMER DETAILS	
Customer Name & Address	Miss.Visalakshi Avinashilingam College Coimbatore
Customer Reference	Test Request dt 21.02.2023

SAMPLE DETAILS			
Product Category	Food and Agricultural Products	Sample Code	SSFTL/22-23/NN-556-001
Sample Name	Smoothie Mix Powder	Sample Conditions at Receipt	Good
Sample Description	Received in Zip lock cover	Sample Received on	21.02.2023
Sample Quantity	100 g (Approx.)	Test Commenced on	22.02.2023.
Sampled by	Drawn by customer	Test Completed on	27.02.2023
Sampling Procedure	-----	Testing performed at	Sri Shakthi Food Testing Laboratory, Coimbatore

TEST RESULTS –BIOLOGICAL PARAMETERS

Sl. No.	PARAMETERS	TEST METHOD	UNIT	RESULTS
1	Total Plate Count	IS 5402 (Part 1) : 2021	CFU/g	243
2	Yeast and Mould	IS 5403 : 1999	CFU/g	<10

Remarks:

- Result Related Only to the Sample Tested.

End of the Report

Checked by
Name : Mrs.S.Nithiya
Designation : Junior Microbiologist

Sri Shakthi Food Testing Laboratory Coimbatore

Authorized Signatory
Name : M.Karthikeyan
Designation : Senior Microbiologist

SRI SHAKTHI
FOOD TESTING LABORATORY

43-B, Mettupalayam Road, Vellakinar Pirivu, Thudiyalur, Coimbatore - 641 034. Tamil Nadu, INDIA.
Mob : +91 72220 96666, +91 89030 26999, E-mail : srishakthiftl@gmail.com

Accredited by NABL Through Certificate Number TC-10001 dated 18.10.2021 as per ISO / IEC 17025 : 2017

Sponsored by Ministry of Food Processing Industries, Government of India.

TEST REPORT

Test Report No:2023/03/21/SSFTL/22-23/NN-610/002	Issue Date:04.04.2023	Page 1 of 1

CUSTOMER DETAILS	
Customer Name & Address	Miss.Visalakshi Avinashilingam College Coimbatore
Customer Reference	Test Request dt 21.03.2023

SAMPLE DETAILS			
Product Category	Food and Agricultural Products	Sample Code	SSFTL/22-23/NN-610-002
Sample Name	Smoothie Mix Powder	Sample Conditions at Receipt	Good
Sample Description	Received in Sterile Pack	Sample Received on	21.03.2023
Sample Quantity	100 g (Approx.)	Test Commenced on	21.03.2023
Sampled by	Drawn by customer	Test Completed on	26.03.2023
Sampling Procedure	-----	Testing performed at	Sri Shakthi Food Testing Laboratory, Coimbatore

TEST RESULTS –BIOLOGICAL PARAMETERS

Sl. No.	PARAMETERS	TEST METHOD	UNIT	RESULTS
1	Total Plate Count	IS 5402 (Part 1) : 2021	CFU/g	960
2	Yeast and Mould	IS 5403 : 1999	CFU/g	<10

Remarks:

- Result Related Only to the Sample Tested.

End of the Report

Checked by
Name : Mrs.M.Rathidevi
Designation : Microbiologist

Sri Shakthi Food Testing Laboratory Coimbatore

M. Karthikeyan 4.4.23
Authorized Signatory
Name : M.Karthikeyan
Designation : Senior Microbiologist