FORMULATION AND STANDARDISATION OF VALUE ADDED RECIPES INCORPORATED WITH MILLET MILK POWDERS

By

M.NITHYA

(13PFN011)

Thesis submitted to

Avinashilingam Institute for Home Science and Higher Education for Women

Coimbatore-641043

In Partial Fulfilment of the Requirement for the

Degree of Master of Science in Food Science and Nutrition

March, 2015

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I. INTRODUCTION

"Let food be your medicine be your food."- Hippocrates.

Nutrition is a basic human need and a perquisite to a healthy life. A proper diet is essential from the very early stages of life for proper growth, development and to remain active. Nutritional quality of food is a key element in maintaining human overall physical well-being is a sustainable force for health and development and maximization of human genetic potential (Vinitha *et.al,* 2014).

Food consumption, which largely depends on production and distribution, determines the health and nutritional status of the population. Since people consume food, it is essential to advocate nutrition in terms of foods, rather than nutrients. Emphasis has, therefore, been shifted from a nutrient orientation to the food based approaches for attaining optimal nutritional status (Singh and Raghuvanshi, 2012).

Urbanization and reduced physical activity, the transition from traditional diets to consisting of energy base industrialised food with sugar, salt and saturated fat content, increased consumption of animal products and reduced consumption of fruits and vegetables, have all contributed to imbalanced nutritional patterns in many countries. Furthermore globalization of trade and marketing of food products have changed the dietary habits in the directions of less healthy choices. If unhealthy diets and physical inactivity are modifiable, shared risk factor for NCDs which accumulate over the life course can be prevented (WHO Global status report on NCDs, 2010).

According to the World Health Organization (WHO, 2011), of the 57 million global deaths in 2008, 36 million, or 63% were due to Non Communicable Disease (NCDs) principally Cardio Vascular Diseases, diabetes, cancers and chronic respiratory diseases. Nearly 80 % of these deaths occur in low and middle income countries.

India is passing through the phase of economic transition and while the problem of under nutrition continues to be a major problem, especially in the urban areas. The prevalence of overweight and obesity is higher among the women (10.9%) compared to men (7.8%) in rural areas (Bella Shah *et.al,* 2005). According to NNMB (2010), the prevalence of Diabetes Mellitus and Coronary Heart Disease (CHD) is also higher in urban areas as compared to their rural counterparts. The incidence rate of cancer is comparatively higher among women (123 for 100,000) compared to men (113 for 100,000).

The nutritional status of a community has therefore recognized as an important indicator of national development. The demand for cereal grains will continue to increase as a consequence of the expanding human population. However, it is well known that cereals do not provide a nutritionally balanced source of protein. The deficiency of protein leads to Protein Energy Malnutrition (PEM) and several other disorders which affect the normal biological functions (Nirgude *et.al*, 2014).

Now people are accepting that "Health is a controllable gift", due to this multi grain and whole grain concept is becoming popular. The cereals and millet like barley, sorghum and pearl millet, rich in functional ingredients are gaining popularity amongst those who are accustomed to soft cereals like wheat and rice because of the presence of dietary fibre and its beneficial effect on various degenerative diseases. Whole grains are good sources of many phytochemicals, including phytoestrogens, phenolic compounds, phytic acid and Essential Amino Acids, which make them important for preventing various degenerative diseases (Mridula, 2014).

Among the cereals only three cereals such as rice, wheat and maize fulfil 90 % of the global food needs. Therefore, here is an urgent need for widening the food basket to ensure sustainable development. Minor millets play an important role in the food and nutritional security of the poor. However, their presence in the Indian food basket has been declining over the years. One reason for this decline is the increased availability of rice, wheat and maize (particularly rice and wheat under subsidized public distribution system). All these elements have collectively contributed to the neglect and underutilization of 20 minor millets in south Asia of these millets leading to their increased marginalization, accelerated loss of their genetic diversity and traditional food culture associated with them. Their cheaper price, compared to that of rice and wheat makes them more accessible to the poor people and those living in economically backward mountainous and semi-arid regions of South Asia (Saravanan *et.al*, 2010).

"Millets are one of the oldest foods known to humans and possibly the first cereal grain to be used domestic purposes" because of their important contribution to national food security and potential health benefits, millet grain is now receiving increasing interest from the Food Scientists, Technologists and Nutritionists (Pavithra, 2012).

Over the last few years, there is an increasing recognition of their favourable nutrient composition and benefits as healthy food, hence the protein content in these species is high to that of wheat, but in addition they are also rich in B- vitamins, especially niacin, pyridoxine, calcium, iron, potassium, magnesium and zinc. Minor millets do not contain gluten; hence they are appropriate food for those with celiac disease or other forms of allergies or wheat intolerance. Thus, apart from their continued strategies role as stable for the poor in marginal agriculture regions, they are also assuming a new role as a health food for the urban high income people (Vanithasri *et.al,* 2012).

India is considered as hub for these minor crops, according to the latest data, the world total production of millet grains at last count was 762,712 metric tonnes and the top producer was India with an annual production of 334,500 tonnes contributing 43.85% (FAO, http://faostat.fao.org/site/339/default.aspx).

According to Ranjita (2015), millet is an important food in many developing countries because of its ability to grow under diverse weather conditions such as limited rain fall. It is grown extensively in India although it is not utilized as major important food crop. In view of current life style and agricultural scenario with perspectives of modernization and global warming, there is need to revive these crops for multiple benefits.

Today millet ranks as the sixth most important grain in the world, sustain 1/3 of the world's population and is a significant part of the diet in northern China, Japan, Manchuria and various areas of the former Soviet Union, Africa, India and Egypt. It is often considered to be a "poor men's cereal" as it does not require fertilizers input. Indeed, it is one of the few special species that currently support the world's food supplies and have become a more mainstream supplement to the diet nowadays (Dubey and Verma, 2009).

Millet grains are nutritionally comparable and even superior to major cereal with respect to protein, energy, vitamins and minerals. Millets are valued for their high content of vitamin B, folic acids, phosphorus, iron and potassium. It is also the rich source of nutraceuticals and higher dietary fibres than rice or wheat and contains 9-14% protein, 70-80% carbohydrates. Finger millet contains 44.7% Essential Amino Acids of the total amino acids, which is higher than the 33.9% Essential Amino Acids

in FAO reference protein. The characterization of the proteins of millet grains shows that prolamine fraction constitutes the major storage protein of the grain and lysine is the most limiting amino acids followed by cysteine but millets are relatively high in methionine. The true digestibility and biological value of these millets ranges between 95.0 to 99.3 and 48.3 to 56.5 respectively. The lipid content is generally high (3-6%) for pearl millet, higher than for sorghum and most other common cereals. About 75% of the fatty acids in pearl millet are unsaturated and linoleic acid is particularly high (46.3%) (Jaybhaye*et.al*, 2014).

Many of the antioxidants found in millets, in addition to their beneficial impact on neutralizing free radicals, which can cause cancer, they can also clean up other toxins from the body, such as those in your kidney and liver. Quercetin, cur cumin, ellagic acid and various other beneficial catechins can help to rid our system of any foreign agents and toxins by promoting proper excretion and neutralizing enzymatic activity in those organs (http://www.organicfacts.net/health-benefits/cereal/health-benefits-of-millet.html).

Millet should be called as "Miracle Grains" because they are highly nutritious, non-glutinous. These millets are soothing and easy to digest, least allergenic and lowers the risk of diabetes. Compared to rice, especially polished rice, millets release lesser percentage of glucose and over a longer period of time (Miracle Grains, 2013).

India is a larger developing country with diverse people, region and diets. Over the last decade, economic transition in India has brought forth vast changes in lifestyle, which is primarily reflected in the nutritional transition (Radhapriya *et.al,* 2012). Almost whole of the finger millet produced in India is consumed in the form of various foods depending on the regions and their food habits. The amino acid profile of the finger millet is better than that of sorghum and maize and is comparable to wheat, barley and rice. Finger millet is also rich source of calcium (300-350 mg/100 g), phosphorus (280 mg/100 g) and iron (3.9 mg/ 100 g) (saikrishna *et.al,* 2011). The grains are also a good source of other micronutrient such as chromium, zinc, copper, magnesium etc. which is higher compared to other cereals like wheat and rice (Vikram Singh *et.al,* 2014).

Suma Pushparaj (2011) opines that, pearl millet a lesser known and underutilised crop can be grown at low maintenance cost, is relatively a cheaper source of nutrients and stable for population below poverty line for economic reasons. It has the distinct advantages of being a drought-resistant crop and hence acts as a principle source of energy, protein, fat and minerals for poor people living in these regions. It has well-balanced protein, with high concentration of threonine and tryptophan along with less (but adequate) leucine than other cereals. This millets is especially suitable for developing products for celiac which is a chronic mal-absorption disorder of the small intestine caused by exposure to gluten in the genetically predisposed individual (Balasubramanian *et.al,* 2014).

The millets have diversified high food value but the consumption of these millets has declined for want of standardised processing techniques to compete with fine cereals. Hence an effort was made to increase the utilization of small millets in popular foods which would find ready acceptability with the tag of 'HEALTH FOODS'. However these small sized grains are difficult to process as well as cook. The millet made in a convenient form, the nutritional and neutraceutical benefits of the millet could reach the different age group of people. Small millet based value added products including traditional recipes, bakery products, pasta products, flaked and popped products, instant food mixes were developed and standardised (shinoj *et.al,* 2006). The present study entitled "**FORMULATION AND STANDARIDISATION OF VALUE ADDED RECIPES INCORPORATED WITHMILLET MILK POWDERS**" was carried out under following objectives,

- Formulate and standardise recipes using millet milk powders.
- Analyse the nutrient content of the millet milk powders and
- Conduct sensory evaluation for the developed recipes.

II. REVIEW OF LITERATURE

Review of literature collected for the present study entitled "**FORMULATION AND STANDARIDISATION OF VALUE ADDED RECIPES INCORPORATED WITH MILLET MILK POWDERS**" is discussed under following headings,

A. Millets – An overview

1. Nutritional composition of millets
2. Millets as "Functional Foods"

B. Finger Millet

1. Nutritional composition of finger millet
2. Therapeutic properties of finger millet

C. Pearl Millet

1. Health benefits of pearl millet
2. Functional food components of pearl millet
3. Nutritional composition of pearl millet

D. Standardisation of Recipes

1. Need for standardisation of recipes
2. Acceptability of products

A. Millets – An overview

Millets are small seeded grasses grown for food, feed or forage and cultivated mostly in developing countries in poor soil and dry conditions. India is a largest producer of much kind of millets, which are often referred to as coarse cereals. Now, they have been gaining importance as nutri-cereal duo to their nutritional composition being superior or comparable to major cereals. Millet grains are attracting attention in developing countries in term of utilization as food and nutrition but some developed countries exploring their potential for manufacturing of bioethanol and biofilms (Manju Sharma *et.al,* 2014).

Reshmi (2013) opines that whole grain like millets have health promoting effects equal or even in higher amount than fruits and vegetables and have a protective effect against insulin resistance, heart disease, diabetes, ischemic stroke,

obesity, breast cancer, childhood asthma and premature death. Hence it can be used as functional foods and as neutraceuticals and also called as 'nutri-cereals'.

1. Nutritional composition of millets

Millets are nutritionally superior to major cereals such as rice or wheat due to the presence of all the required nutrients including protein, minerals and energy (Shinoj *et.al* 2006). Furthermore, the vitamin and essential amino acid contents of some of the common millet species are in most cases more than rice and wheat. Millet protein contains high quantity of essential amino acids especially the sulphur containing amino acids such as methionine and cysteine (Shobana*et.al*, 2010).

Fereidoon (2013) opines that nutritionally, millets are equivalent to other cereal grains. The major nutrients present are 60-70 percent carbohydrate, 7-11 percent proteins, 1.5-5 percent fat, 2-7 percent crude fiber, minerals and vitamins except finger millet, other millet types have higher fat content ranging from 3.5-5.5 percent compare to other cereals.

According to NIN (2010), reported that millets are good sources of components such as fat (2.78 g/ 100g) but George Amponsah Annor (2013), reported that millets have lipid content of 1.5 to 9.3 percent, with unsaturated fatty acids forming the bulk of its fatty acids. The main fatty acids found in millets are palmitic, oleic and linoleic acids.

The bran layer of millets are very good source of B- complex vitamins and minerals. They are also rich source of iron and phosphorus. Little millet and foxtail millet have a higher degree of iron. While finger millet contains 30 times more calcium than rice and wheat, other millet possesses at least two times more calcium than rice and wheat (Pushpa Devi *et.al*, 2013).

Basker (2013) opines that, millets contain more dietary fibre compared to rice and wheat. This enhances slow release of energy, thereby increasing physical efficiency. The foods characterised to be potential prebiotics can enhance the viability or functionality of probiotics with significant health benefits of Gastro Intestinal Tract. The insoluble fibre from millets helps in gall stones prevention.

According to Kang (2008), magnesium found in millets helps to relax blood vessels, enhances nutrient delivery by improving the blood flow and maintained the blood pressure thus further protects the Cardio Vascular system. Lignin present in

millets is converted to mammalian lignin by the healthy gut micro flora in our body which is thought to protect against breast cancer as well as heart diseases. Millets helps to lower blood glucose levels and improve insulin response. Besides the magnesium present in millets it act as co-factor in various enzymes involved in the secretion of insulin and metabolism of glucose in the body.

2. Millets as "Functional Foods"

Antioxidants are the substances that protect cells from damage caused by unstable molecules known as free radicals. Cellular damage or oxidation injury caused by these free radicals or reactive oxygen species which are generated through normal metabolisms of drugs, environmental chemicals and other xenobiotic as well as endogenous chemicals appears the fundamental mechanisms underlying a number of human diseases such as neurodegenerative disorders, diabetes mellitus, nephritis, rheumatisms, Alzheimer disease, cataract, Cardio Vascular Disease, acute liver toxicity, inflammation, viral infections, digestive system disorders and DNA damage that can lead to carcinogenesis (Odusola *et.al*, 2013).

Millets grains are rich in antioxidant and phenolic compounds however, it has been established that phytates, phenols and tannins can contribute to antioxidant activity important in health, ageing and metabolic syndrome. It has also been found that methanolic extracts from finger millet and kodo millet inhibit glycation and cross linking of collagen. Therefore, there is potential usefulness of millets in the protection against ageing (Ahmed Saleh, 2013).

Gupta (2012) opines that, research on the evaluation of nutraceutical properties and nutritional value of grains is now gaining momentum. Being non gluten crop the most millet are good food for people facing colon health problem. Four selected small millets such as finger millet, foxtail millet, proso millet and kodo millet have been examined for the presence of phenol, tannins, alkaloids, flavonoids and saponins. All these compounds have notable health benefits as immunity modulator, anticarcinogen, regulator of cell proliferation, delaying gastric emptying and supplying gastrointestinal bulk and free radicals scavengers along with control over cholesterol activity.

According to Shobana (2009), phenolic extract from millets have been reported to inhibit intestinal α-glucosidase and pancreatic α-amylase and may play a vital role in the management of postprandial hyperglycemia hence providing its hypoglycemic

potential. Lee Chung (2010), conducted studies on millets such as sorghum, finger millet, proso millet and foxtail millet are proved their hypoglycemic effect which may be attributable to various phytochemicals such as tannins, phenolic acids, anthocyannins, phytosterol and policosanols.

Millet contain phytes, polyphenols, tannins, trypsin inhibitors and dietary fibre which as "antinutrients" by chelating minerals. Tannins are naturally occurring polyphenolic compounds linked to reduce protein digestibility by forming complexes with protein and inhibiting enzymes. It has now been established that phytates, phenols and tannins present in cereals are also good sources of natural antioxidant. Phytic acid occurring in the grains acts as an antioxidant by the formation of chelates with pro-oxidant transition metals (Florence Suma Pushparaj, 2014).

Millets are rich in phytochemicals including phytic acid which is believed to lower cholesterol and triglycerides levels in the body. However, millets are also a mild thyroid peroxidase inhibitor and probably should not be consumed in great quantities by those with thyroid disease (Saikia, *et.al,* 2011). Thus millets are strategic in terms of their food, nutritional and livelihood security and their role in local agro eco-system (Joshi *et.al,* 2008).

B. Finger millet

Finger millet, also known as ragi, ranks fourth important crop in the world after sorghum, pearl millet and foxtail millet (Anil kumar *et.al,* 2014). It is a tetraploid crop belonging to the grass family Poaceae, subfamily Chloridoideae. The cropis adapted to a wide ranges of environments, can withstand significant levels of salinity, drought and is relatively resistant to water logging. Finger millet is grown mainly by subsistence farmers and serves as a food security crop because of its high nutritional value and excellent storage qualities.

1. Nutritional composition

According to vachanth (2010), finger millet grain has a carbohydrate content of 81.5 percent, protein 9.8 percent, crude fiber 4.3 percent and mineral 2.7 percent in comparison to other cereals like rice, wheat and maize. It's crude fiber and mineral content is remarkably higher than those of wheat (1.2 percent fiber and mineral 1.5 percent) and rice (fiber 0.2 percent and 0.6 percent mineral). Sangeeta Gupta (2014)

opines that ragi contain maximum amount 48.8 percent of oleic acid, it has low fat content and also rich in Poly Unsaturated Fatty Acids (PUFA).

Finger millet like any other cereal is a rich source of dietary carbohydrate but the proportion of dietary fiber in finger milet is relatively higher than many other cereals. Finger millet contain carbohydrate 72 percent comprises of starch as the main constitute and the Non-Starchy Polysaccharides (NSP) which amounts to 15-20 percent of seed matter as an unavailable carbohydrate which helps in constipation and lowering glucose in blood (Shrikant Baslingappa Swami *et.al*, 2013).

According to Nirmala (2000), the starch granules exhibit polygonal rhombic shape and about 80 to 85 percent of the finger millet starch is amylopectin and remaining 15 to 20 percent is amylose and non- starchy polysaccharides account for 20 to 30 percent of the total carbohydrates in finger millet.

According to NAAS (2013), the finger millet has a well-balanced amino acids profile and is good source of sulphur containing amino acids (cysteine and methionine), lysine, valine and threonine. These Essential Amino Acids are of special benefit of those who depend on plant food for their protein nourishment. The chemical score (percentage of the most limiting amino acid compared to a standard protein like egg protein) of finger millet is about 50 which is relatively better than other millets, jower (34) and pearl millet (43).

Finger millet is rich source of B vitamins especially niacin, folic acids and pyridoxine. It also contain high amount of mineral such as calcium, iron, phosphorus, magnesium and zinc. Finger millet has calcium contents 300 to 350 mg/ 100 g, phosphorus is 283mg/ 100 g and iron is 3.9 percent (Kumar *et.al*, 2014). Veenu verma (2013) opines that ragi contains more mineral and vitamin which are normally deficient in indian diet. Ragi is an extraordinary source has eight times more calcium than other cereals.

Dietary fibre, principally the non- starchy polysaccharides and lignin of the plant origin, is not digested by endogenous enzymes within the human intestinal tract, but is an important component of our diet. The health benefits associated with high fiber foods are delayed nutrient absorption, increased faecal bulk, lowering of blood lipids, prevention of colon cancer, barrier to digestion, mobility of intestinal contents, increased faecal transit time and ferment ability characteristics (Palanisamy Bruntha Devi, 2014).

2. Therapeutic purposeof finger millet

Finger millet and Cancer

Amir gull (2014) opines that, health benefits associated with finger millet are delayed nutrient absorption increased faecal bulk, lowering blood lipids, prevention of colon cancer, barrier to digestion, mobility of intestinal contents, increased faecal transit time and fermentability characteristics. Ragi also contain functional fibres fraction known as resistant starch, this escapes the enzymatic digestion, imparts beneficial effect by preventing several intestinal disorders. As it escapes digestion and provides fermentable carbohydrate for colonic bacteria. It also provides benefits such as the production of desirable metabolites, including short chain fatty acids in the colon, especially butyrate, which seems to stabilize colonic cell proliferation as preventive mechanisms for colon cancer.

Finger millet and Diabetes mellitus

Ragi provides highest level of calcium, antioxidant properties and phytochemicals which makes it easily and slowly digestible. Hence it helps to control blood glucose levels in diabetic patients very efficiently. The bulkiness of the fibers and the slower digestion rate makes us feel fuller on fewer calories and therefore may help to prevent us from eating excess calories. Therefore ragi is considered to be ideal food for diabetic individuals due to its low sugar content and slow release of glucose in the body. In the germination process, both starch and protein are partially degraded, important for better digestibility and some of the flatulent factors are also degraded (Anuratha Desai *et.al,* 2010).

According to Shailaja (2004), finger millet is also rich in proteins, sulphur containing amino acids and because of its low Glycemic Index and its high fibre, it is recommended for diabetic patients. It has proved to be very effective in controlling blood glucose levels of diabetics.

Finger millet helps to lower the blood glucose levels and improve the insulin response, besides, the magnesium present in millet is a cofactor in various enzymes involved in the secretion of insulin and metabolisms of glucose in the body. Whole grains improve insulin sensitivity by lowering Glycemic Index of the diet by increasing content of fibre, magnesium and vitamin-E. Since millet has low Glycemic

Index they increase satiety by decreasing hunger because it slows the rate of digestion (Shimelis Admassu *et.al*, 2009)

Finger millet and Post-menopause

Post-menopausal women with signs of cardiovascular disease like high blood pressure, increased cholesterol and obesity can benefit from eating whole grains especially millets by eating them in six diets in a week regularly (veenu verma *et.al* 2012).

Anti-bacterial activity of finger millet

Finger millet can be regarded as a functional food, to be taken as a part of the usual diets in order to have beneficial effects that go beyond basic nutritional function, thus helping to reduce the risk of obesity, malnutrition and premature ageing. An important factor of the functional food which is required to reduce the risk of chronic illnesses is proper intake and anti-bacterial activity. Germinated finger millet seeds extracts (12 hour) has a bactericidal property against Escherichia coli and can be consumed for management of infectious diarrhoea. However prolonged use of certain antibacteria can decrease the number of gut flora, which may have a negative impact on health (Ashwini *et.al*, 2014).

Prashant Hedge (2005) reveals that millet is used as a rich source of phenolic compound. Several other factors present in the millet that may have contributed to the accelerated wound healing in the treated rats include calcium and magnesium. They are reported to influence the process of wound healing. Calcium has an established role in the normal homeostasis of the mammalian skin and serves as a modular in keratinocyte proliferation and differentiation. In wound repair, calcium is predominately involves as factor IV in the haemotatic phase, but it is accepted to be required in epidermal cell migration and generation patterns in later stages of healing.

C. Pearl millet

The millets include species in several genera, mostely in the sub family panicoideae, of the grass family poaceae. The height of the pearl millet plant may range from 0.5 to 4 meters. The millet grains can be nearly white, pale yellow, brown, grey, stable blue or purple. The ovid grains of the pearl millet are about 3 to 4 mm long, much longer than those of other millets. The seeds usually weigh between 2.5 g and 1.4 g, with a typically mean of 0.8 g. the size of the millet kernel is about one

third that of sorghum. The relative proportion of germ to endosperm is higher in pearl than in sorghum (Odusola *et.al*, 2013).

It is a course cereal grain and has equivalent or even superior nutrient content to other cereals (Balasubramanian *et.al*, 2014). Pearl millet is a multipurpose crop, which is grown for food, feed and forage. As a coarse grain cereal for human foods, pearl millet is sustains the lives of many millions of people, particularly those of low income groups in several African and south Asian countries (Mohamed Eltayeb *et.al*, 2007).

1. Health Benefits of Pearl Millet

Pearl millet has been recommended for several therapeutic purposes, as it has been found to inhibit tumour development, control blood pressure and plasma Low Density Lipoprotein cholesterol levels and possess anti allergenic characteristics. Due to its high fiber content, pearl millet is also recommended for the treatment of constipation, several stomach ulcers and weight loss (Nambiar *et.al,* 2005).

Shubhashini (2014) opines that, the pearl millet is rich in fibre which provides bulk Gastro-Intestinal Tract contents and slows transit time of matter through the tract. Soluble fibres is also decreases the rate of starch digestion by pancreatic amylase in vivo, probably by delaying the interaction between enzymes and substrates. For healthy eating, particularly in persons with diabetes, obesity and insulin resistance, foods with low GI are recommended as they may help keep the euglycemia and the normal spectrum of lipoproteins. These effects result in decreased cardiovascular danger and probably also in reduced risk for colon and breast cancer.

Denial (2012) opines that, bajra is rich in oil and this adds to nutritive potential, the high amounts of oils (above 5%), rich in linoleic acid (45%) which is an omega 6 fatty acid, is highly significant because this acids is easily converted to n6 eicosanoids, n-6 prostagladins and n-6 leucotriene hormones. This provides targets for drug development in atherosclerosis, blood pressure, asthma, arthritis and immunity development. Linolenic acid, the third fatty acid present, is an essential fatty acid. This acid is useful in conditions of rheumatoid arthritis, cardiac arrhythmias, depression and reduces the risk of ischemic and thrombotic stroke.

The high fiber content in pearl millet is also known to reduce the risk of gall stone occurrence. The insoluble fibre content in pearl millet reduces the production of excessive bile in our system. Excessive amount of bile secretion in our intestine often leads to aggravate the condition of gall stones. The grain is very digestible as such and

has a very low probability of causing allergic reactions. Due to its hypo allergic property, it can be safely included in the diets of infants, lactating mothers, elderly and convalescent (http://www.theresearchpedia.com/health/superfoods/health-benefits-of-pearl -millet).

Pearl millet grains lack gluten, unlike most of the major cereals, thus enhancing its health value for those allergic to gluten. It is less prone to aflatoxin contamination than say sorghum and pearl millet d maize. It has been reported that eggs produced from layers fed on pearl millet based diets have lower levels of low density lipoprotein, thus providing for production of designer eggs for with high cholesterol (Kedar N Rai *et.al,* 2012).

2. Functional food components of pearl millet

Vanisha Nambiar (2012) opines that, pearl millet considered a poor man's cereal, may be repository of dietary antioxidant, especially flavonoids and phenolic acids, which provide bioactive mechanisms to reduce free radical induced oxidative stress and probably play a role in the prevention of ageing and various disease associated with oxidative stress such as Cancer and neurodegenerative diseases. Pearl millet grains are rich source of minerals and bioactive compound that may help to regain immune power and maintain various metabolic reactions inside the body to dominate over a wide range of stress generated due to free radicals (Sukhvinder Singh *et.al,* 2014).

Vanisha Nambiar (2014) opines that, the presence of flavonoids, such as tricin, acacetin and luteolin indicate the chemo preventive efficacy of pearl millet. They may be inversely related to mortality from coronary heart disease and to the incidence of heart attack in the pearl millet consuming belts of the world. Promotion of millets which are repository or flavonoids and fibre along with minerals and energy need to be promoted using effective communication skills for prevention and treatment of diabetes.

The availability of nutrients and bioactive components is likely to be influenced by processing methods. Several traditional house hold food processing methods (thermal processing, sprouting and fermentation) can be used to enhance the availability of micronutrients in plant based diets. These strategies could improve the physiochemical accessibility of nutrients from the food matrix and decrease the availability of antinutrients (Hotz and Gibson, 2007).

3. Nutritional composition of pearl millet

Antony Olusegun (2013) opines that similar amounts of total soluble sugar can be found in sorghum and pearl millet, 2.3 and 2.6% respectively; these free sugars include glucose, fructose, raffinose and xylose range in content from 1.2 to 2.5 %. The amount of sucrose found in pearl millet and sorghum is essentially the same. Pearl millet has higher arabinose content than sorghum, with the value of 0.71 % compared to 0.23 % found in sorghum.

According to Anthony Olusegun (2013), pearl millet has a fat content of approximately 5.1 %, which is higher than sorghum of 3.2 %. Unsaturated fatty acids, such as palmitoleic acid (16:1), oleic acid (18:1), lineoleic acid (18:2) and linolenic acid (18:3) account for approximately 75 % of the total fats. The saturated fatty acids, which include palmitic acid (16:0) and stearic acid (18:0), account for approximately 25 % of the total fats. The degree of unsaturation of fatty acids contributes to the development of objectionable odours and flavours after the grinding of pearl millet.

Pearl millet is often rich in fibre associated anti-nutrient namely phytate and oxalate which have a negative influence on bioavailability of minerals. The bioavailability of mineral from foods is defined as the proportion of the minerals that can be absorbed and utilised with in the body. It also contains tough fibrous seed coat which is rich in anti-nutrients like phytic acids, tannins and oxalate that form complexes with dietary mineral, such as calcium, zinc and iron leading to a marked reduction in its bioavailability and make them biologically unavailable to human organisms (Florence Suma, 2014).

D. Standardisation of Recipes

Sensory analysis can be considered to be an interdisciplinary science that uses human panellist sensory perception related to threshold of determination of attributes, the variance in individual sensory response experimental design to measure the sensory characteristics and the acceptability of food products, as well as many other materials. Since there is no one instrument that can replicate or replace the human psychological and emotion response, the sensory evaluation component of any food study is essential and the importance of good experimental design cannot be over emphasised in sensory experiments. Sensory analysis is applicable to a variety of areas such as inspection of raw materials, product development, product improvement, cost reduction, quality control, selection of packaging material, shelf

life or storage studies, establishing analytical/instrument/sensory relationship and process development (Dimple singh *et.al*, 2014).

Standardised recipes component

Standardised recipes components standardised for food service operation should always have certain components;

- Recipe title- name that adequately describes the recipes.
- Recipe category- recipe classification based on USDA or operation defined categories, eg, Main dishes, grains/ bread.
- Ingredients- products used in recipes.
- Weight and volume of each ingredient- the quantity of each ingredient listed in weight or volume.
- Cooking temperature and time- the cooking temperature and time, it should appropriate.
- Serving size- the amount of a single portion in volume and weight.
- Recipe yield- the amount of the product at the completion of production that is available for service.
- Equipment and utensils to be used- the cooking and serving equipment to be used in preparing and serving the recipe.
- Nutrient analysis- nutrient present per serving of food.
- Food safety guidelines- procedure designed to ensure the safe production and services of food. Hazard Analysis Critical Control Point (HACCP) information should be followed(http://www.nfsmi.org/documentlibraryfiles).

1. Need for standardisation of recipes

Recipe development and standardisation are important steps in quality development and the quality of the products. It ensures food product control and enables one to predict the quality, yield, portion size and cost of the finished products. Standardisation requires repeated using testing to ensure that the product meet the standards of quality and quantity that have been set. A recipe is regarded as standardised when the well-established formulation of quantities and proportion ingredients as well as the procedures of combing them constantly produces a highly acceptable product yield and given number of portion of a particular size (Spears and Gregoire, 2010).

The food should not be evaluated only on its safety and nutritional value but also on its technological value (Mular and Steinhart, 2007), convenience and cultural,

religious or ideological aspects without neglecting the economical aspect associated with the food quality (Gabriela Iordachescu *et.al,* 2013).

2. Acceptability of the products

Food acceptability is an experience or features characterised by a positive attitude when a food product is purchased or consumed. It is an indication of the attitude toward a degree of liking a food can be directly measured on a hedonic scale. It is the way that people show, through verbal and non-verbal behaviour, the degree of pleasure and displeasure, which they may be experiencing with a particular food product (Molly Thembi Malaza, 2012).

Health is another frequently mentioned as for food choices and emphasising the role of health is a growing trend. Unlike good taste, health related characteristics are typically not directly observable from the products; instead they need to be conveyed through information. Any piece of information has to be processed in consumer minds and received by any health related information varies structure. Therefore, the attention received by any health related attention information varies greatly depending on respondents earlier believes and motivational standpoints. Because of the strong cognitive component in health related message they tend to be weak motivators for choices in comparisons to taste benefits in food choices. The items in the scale refer closely to choosing options that are advocated in nutrition recommendation and high scores on this scale reflect willingness to comply with the nutritional guidelines (Klaus Grunert *et.al,* 2002).

Consumer acceptance, preference and hedonic (degree of liking) tests are used to determine the degree of consumer acceptance for a product. It is also considered to be consumer tests since they should be conducted using untrained consumer panels. Although panellists to indicate their degree of liking, preference and acceptance indirectly. Category scales, ranking tests and the paired comparison test can all used to assess product acceptance (Avsar *et.al,* 2004).

Validity of the results obtained with this approaches mainly depends on the uniformity of the preference criteria of the consumers surveyed. When the individual responses come from consumers with different preference criteria, the average value obtained from the whole population tested do not reflect the actual situation hypothesized that in the consumer population there exist a limited number of basic groups of people and each group exhibits a specified pattern of sensory preference and suggested that variations in product acceptance in different markets is the result of different distribution of these basic segments (Bayarri *et.al,* 2011).

III. METHODOLOGY

The methodology followed for the present study entitled **"FORMULATION AND STANDARDISATION OF VALUE ADDED RECIPES INCORPORATED WITH MILLET MILK POWDERS",** was carried out under the following headings:

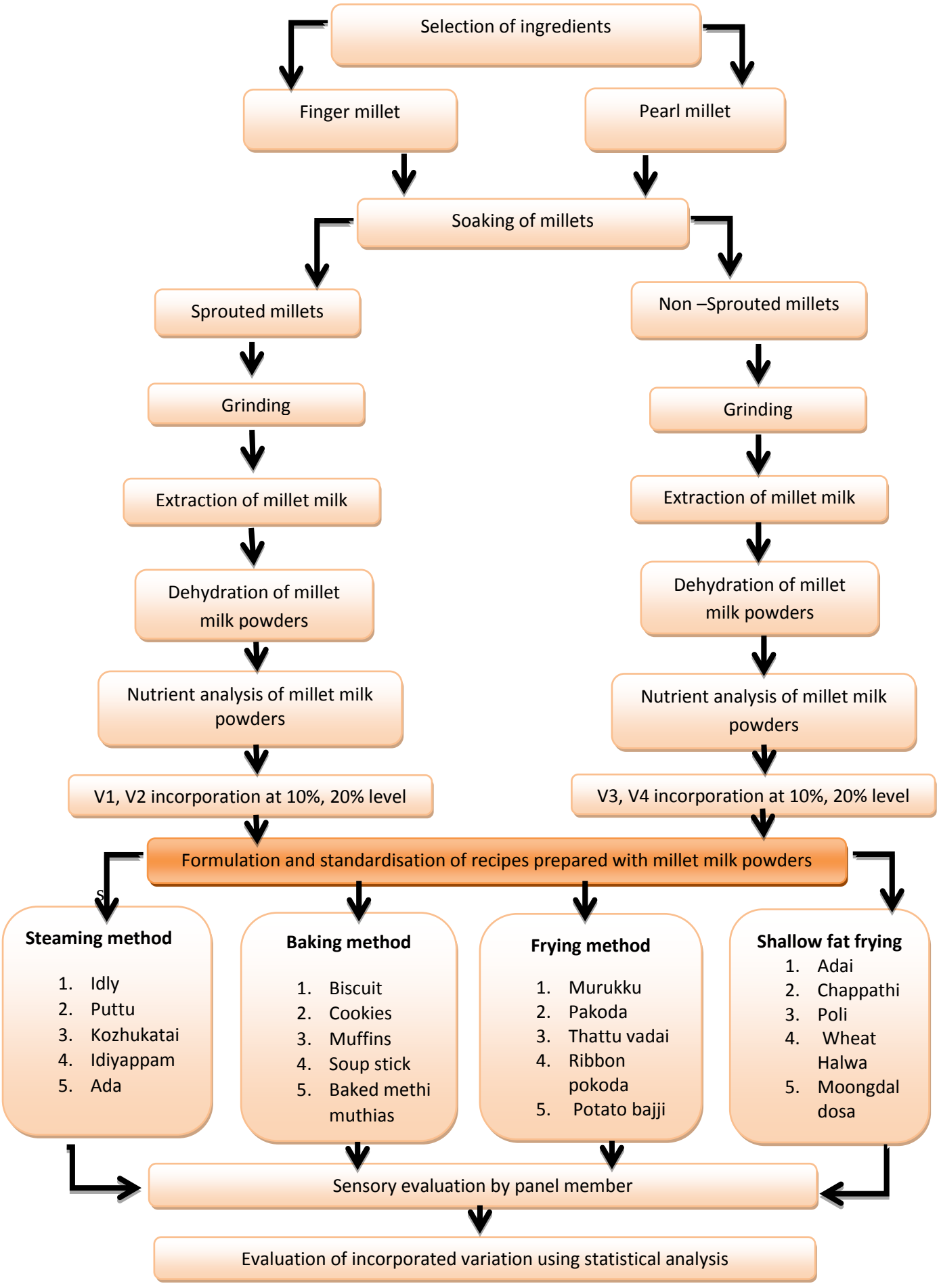
1. Selection of ingredients
2. Preparation of millet milk powders
3. Nutrient analysis of millet milk powders
4. Formulation and standardisation of recipes prepared with millet milk powders
5. Sensory evaluation of the formulated recipes

1. Selection of Ingredients

The name "millet" is applied to numerous small seeded grasses which originated in Asia and Africa. In developing countries, with the current rate of increase in population and with less than adequate irrigational facilities millet can adequately meet the demand for additional food supply (www.nsfmi.org/documentlibraryfiles).

According to Mamatha (2013), finger millet (Eleusine coracana) is grown mainly by subsistence farmers and serves as a food security crop because of its high nutritional value and excellent storage qualities (Nirgude *et.al,* 2014). It is nutritionally superior to wheat and rice with respect to protective nutrients such as dietary fiber, calcium and protein and has well balanced amino acid profile and a good source of methionine, cysteine and lysine.

Pearl millet (Pennisetum glaucum) is the sixth important cereal crop valued for its food, feed and fodder uses in various parts of the world and it is widely cultivated in Asia, Africa and USA. It is one of the important nutricereals and is a source of staple food for rural population. Pearl millet is a rich source of proteins, minerals and fibers (Durga Shankar Bunkar *et.al,* 2014). Hence finger and pearl millets were selected for development of value added products. Research design is presented in Figure-1.



Research Design
Figure - 1

In addition to their excellent nutritional properties, several potential health benefits such as preventing cancer and Cardiovascular Diseases, reducing tumour incidence, lowering blood pressure, reducing cholesterol level and rate of fat absorption, delaying gastric emptying and supplying gastrointestinal bulk have been reported for millet. Because of their high potential health importance and contribution to national food security millet grains are now receiving increasing interest from food scientists, technologists, and nutritionist (Ahzhari nour *et.al,* 2014).

2. Preparation of Millet Milk Powders

The millets were procured from the local market in bulk and manually cleaned to remove stones, grit, husk, chaff and other impurities. Soaking of millet is necessary before germination of seed, which by hydrating the reserve food material of seed initiates the metabolic activity responsible for growth of seedling (Sibian *et. al.,* 2013). The studies have shown that a long soaking period before fermentation or germination, leads to a reduction in phytate content and enhancement of mineral content (Lestienne *et al.,* 2005).

2.1 Sprouting of millets

Sprouting or germination of cereals has been used for centuries for softening the kernel structure, improving its nutritive value and reducing anti-nutritional factors. Several processing treatments have been evaluated to reduce these anti nutrient contents. There are reports that the phytic acid content decreased significantly by phytase activity during germination. The reduction was greatest in the first 2 days, after which it decreased at a lower rate from day 4 to day 6 of germination (Bolbol *et al*, 2012).

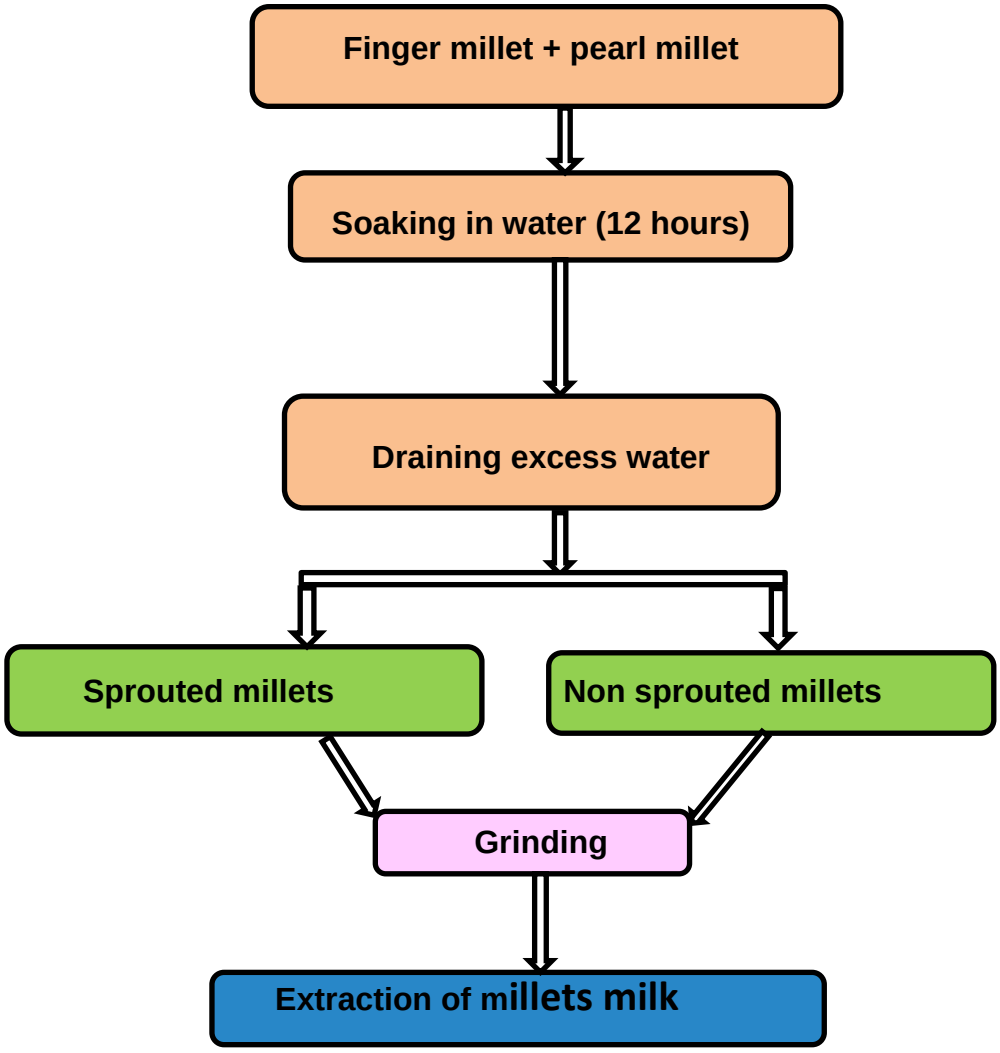
The millets were soaked separately overnight for a period of 12 hours in normal room temperature. One half of the millets were processed further for grinding and extraction of millets milk. The other half of the soaked millets, the water was drained and millets were dried in a loosely woven cotton cloth and hung for period of two days (48 hour) in normal room temperature.

Studies conducted by Inyang (2008), indicated that germination process reduced the phytic acid and flatulence causing oligosaccharides namely stachyose and arabinose, increased protein digestibility and improved sensory properties. When grain once soaked followed by drying, porosity of grain increased that further

facilitate the water absorption. Being porous in nature and with better digestibility of grain constituents, it is assumed that cooking time of grain may also reduce.

2.2 Extraction of millet milk powders

After preliminary processing of millets they were soaked separately overnight for a period of 12 hours. One half of the millets were processed further for grinding and extraction of milk. Other halves of the sprouted millets were processed for extraction of milk by same methods. The schematic representation of extraction of milk from millets are given in figure: 1,



Extraction of Millet Milk Powders

Figure: 2

2.3 Dehydration of millet milk

Drying is a thermo-physical and physico-chemical operation by which it removes water from food material at appropriate temperature and most suitable rate to retain maximum food value. Drying leads to reductions in water activity and the products become stable and from insects and pest attack or yeast and mould growth during further storage (Poongodi *et.al* 2011).

Sun-drying is a low cost technology which minimizes the post-harvest losses in developing countries. Sun-drying allows flavours to concentrate, prevents the loss of volatile compounds and unwanted caramelization of natural sugars against other drying methods. Sun-drying enhances better initial colour, texture, as well as translucency and shining (Imtiaz Hussain, 2015).

The extracted non sprouted millet milk was sun dried. The millet milk which was extracted from soaked and sprouted millets were dried in sun for 3 days at temperature first day 31^{o}C, second and third day 30^{o}C respectively (http://www.accuweather.com). The dried millet milk powders were ground in to a fine powder. The flour made was sieved manually using 40 mesh sieve and after that the prepared millets milk powder was packed in an air tight container and stored at room temperature until usedwhich is presented inFigure- 2. Finally acquired composite mix with the combination of finger millet milk powder (50 g) and pearl millet milk powder (50 g) was stored in suitable packaging material for further analysis. The prepared millet milk powders were incorporated at 10 %, 20 % level and coded as variation 1, 2, 3 and 4 (variation 1- sprouted millet milk powders at 10 %, variation 2- sprouted millet milk powders at 20 %, variation 3- Non-sprouted millet milk powders at 10 % and variations 4- Non sprouted millet milk powders at 20 %) levels for further standardisation of recipes.

Preparation of Millet Milk Powders
Figure-3

3. Nutrient Analysis of the Millet Milk Powders

Analysis of nutrient content is an important aspect in formulating and developing new product and evaluating new process for making food products and identifying the sources of problem with unacceptable problem (Nielson, 2006).

Adequate analytical methods for nutrients in foods, food ingredients and food products are the basis first step in determining the nutritional adequacy of a food supply. Whatever the ultimate use of nutrition data, i.e. consumer education via the food label, or databases for nutrient and deficiency diseases studies, the assay used to provide the data must determine the analyse of interest adequately (Jonathan, 2007).

The nutrients that were analysed in millet milk powders include all the proximate nutrients such as carbohydrate, protein, fat, calcium, iron and moisture. Plate-I gives the nutrient analysis of millet milk powders AOAC (The Association of Official Analytical Chemists) International Methods were used for determining the nutrient content of the millet milk powders and its procedures are given in Appendix- 2**.**

3.1 Estimation of moisture

The moisture content of the products was estimated using hot air oven method. Determining of the loss in mass on drying of a given material under specified condition gives measures of moisture present in food material. Most of the methods for the estimation of water in foods depend on the loss in weight on heating (Mealon, 2007).

3.2 Estimation of carbohydrate

Carbohydrate determination was done according to Hedge et al. It is hydrolyzed into simple sugars using dilute hydrochloric acid. Anthrone, 10 keto-9, 10- dihydro antheacene, a reduction product of anthroquinone reacts by condensing with carbohydrate furfural derivative to produce a green colour in a dilute solution and a blue colour in a solution colorimetrically at 630 nm. Glucose (1x10-2 g/ml) is used as standard.

3.3 Estimation of protein

For many years, the protein content of foods has been determined on the basis of total nitrogen content, while the kjeldahl method has been almost universally

applied to determine nitrogen content (AOAC, 2010). Nitrogen content is then multiplied by a factor to arrive at protein content. This approach is based on two assumptions: that dietary carbohydrate and fats do not contain nitrogen and that nearly all of the nitrogen in the diet is present as amino acids in proteins. On the basis of early determinations, the average nitrogen (N) content of proteins was found to be about 16 percent, which led to use of the calculation N× 6.25 (1/0.16= 6.25) to convert nitrogen content into protein content.

3.4 Estimation of fat

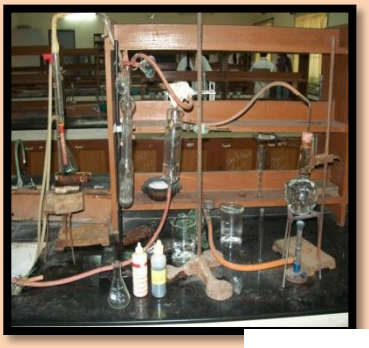
The crude fat content can be conveniently determined in foods extracting the dried and ground material with petroleum ether or diethyl ether in soxhlet extraction apparatus. Extraction of crude fat is carried out either with petroleum ether or diethyl ether in a soxhlet unit followed by volatilization of the solvent after extraction and determination of the mass of the residue.

3.5 Estimation of calcium

The method involves the separation of minerals from the food matrix by destruction of the organic matter of the sample through dry ashing or wet diagestion (Horwitz, 2000). The mineral content in diluted acid is then determined amount of calcium in millets milk powder by precipitating it as calcium oxalate and titration the oxalate solution in dilute sulphuric acids against potassium permanganate (KMnO4) AOAC 944.03.

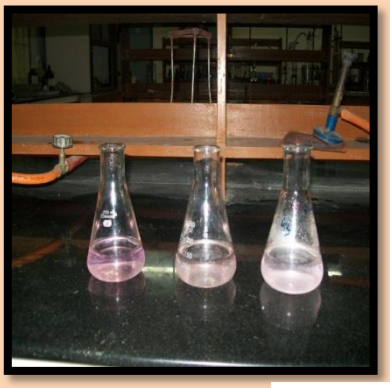
3.6 Estimation of iron

Iron as ferric iron reacts with ammonium thiocyanate or with potassium thiocyanate to give ferric thiocyanate which is red in colour. The clour which is a measured of the concentration is measured colorimetrically.



NITROGEN ESTIMATION

IRON ESTIMATION



CALCIUM ESTIMATION

Nutrient Analysis of Millet Milk Powders

Plate- 1

4 FORMULATION AND STANDARIDISATION OF RECIPES PREPARED WITH MILLET MILK POWDERS

Verma (2013) opines that among the food grains, millets are the cheapest and widely available source of energy and their intake is the highest among the poor income families. Millets can play very specific role in human nutrition because of their multiple qualities. Besides being stable foods, theses grains are also raw material in the production of various food and industrial products. Value addition in millets has great potential in increasing the availability.

According to Changmei Shadang (2014), a standardized recipes as one that has been tried, adapted and retrieved several times for use by a given food service operation and has been found to produce the same good results and yield every time when the exact procedures are used, with the same type of equipment and same quantity and quality of ingredients in the manual preparation.

Preserving nutritional content appears to vary with cooking methodology, food type and nutrient. Although there is no hard and fast rule, the consensus of the research indicates that microwave cooking, baking and steaming are the least destructive processes and preserve the greatest nutritional content of foods (Kevin Guest, 2009).

The recipes were selected based on the cooking methods with reference to minimum nutrient loss during cooking and popularity in south Indian cuisine which is presented in Figure-3. Steaming, Baking, Frying and shallow fat frying were the cooking methods with above mentioned factors. Hence based on the above mentioned methods recipes were developed using millet milk powders. Using each of these four different methods five different recipes werepreparedmaking up the total to twenty.

Steaming is a method of cooking food in steam generated from vigorously boiling water in a pan so that the food is completely surrounded by steam and not in contact with the water and temperature at 100^{o} C (212^{o} F). It is a method of cookery to preserve the nutritional content of the food. It also makes food easily digestible (Nelson Thornes, 2006). Using this cooking methodidly, kozhukattai, idiyappam, ada and puttu were prepared under which is given in Plate- 2.

Baking is a cooking method the food to be cooked in an oven or oven like appliance by dry heat. The methods of heat transfer involved are radiation from the source of heat to the metal wall at the base of the oven, by conductions from base to the other walls and by convections through the heated air currents set up in the oven to the food. The temperature range maintained in an oven is 120 ^{o} C to 260^{o} C (Sudhir Andrews, 2009). Biscuit, cookies, soup stick, baked methi muthia and muffins were prepared using this method which is presented in Plate-3.

Frying is a cooking method where the food is totally immersed in hot oil and cooked by convection currents and cooking is uniform on all sides of foods. Cooking can be rapidly completed in deep fat frying because the temperature used in 180-220^{o} C (Krishna Arora, 2008). Using this cooking method muruku, pakoda, thattu vadai, potato bajji and ribbon pokoda were prepared under which is given in Plate-4.

Shallow fat frying, food is cooked in fat or oil but not enough to cover it. Heat is transferred to the food partially by conduction by contact with the heated pan and partially by the convection currents of the food (Srilakshmi, 2010). Recipes like poli, adai, chappathi, wheat halwa and moong dal dosa were prepared using this method which is presented in Plate-5.

5 SENSORY EVALUATION OF MILLET MILK POWDERS BASED RECIPES

Quality is ultimately criterion of the desirability of any food product. When quality of a food product is assessed by the means of human sensory organs, the evaluation is said to sensory evaluation or organoleptic. Sensory evaluation is often described using the definition of institute of Food Technology – a scientific method used to evoke, measure, analyse and interpret those responses to products as perceived through the senses of sight, smell, tough, taste and hearing (Meilgard*et.al*, 2007).

According to Srilakshmi (2010), sensory evaluation is a combination of different senses of perception coming into play in choosing and eating a food. The effective characteristic is not the property of the food, but the subject reactions to the sensory qualities of foods. This reaction is highly conditioned by a variety of psychological and social factor and in the final analysis, plays a vital role in the acceptance and preference of foods.

Sensory evaluation a products are evaluated by a selected or trained panel. In subjective testing, the reactions of consumers to the sensory properties of products are measured. The powder of sensory evaluation is realised when these two elements are combined to reveals insights in to the way in which sensory properties drive consumer acceptance and emotional benefits. Linking sensory properties to physical, chemical, formulation and process variable then enables the product to be designed to deliver optimum or appropriate consumer benefits (Sarah *et.al*, 2009).

According to Shakuntala (2008), Sensory evaluation may be designed to reflect common preference to maintain the quality of food at a given standard for the assessment of process variation, cost reduction, product improvement, new market development and market analysis.

Sensory evaluation testing or "taste testing" consist of judging quality of food by panel judges (Stones and sidel, 2004). The ten panel judges of Food Science and Nutrition department, Avinashilingam University for women, Coimbatore were selected for the sensory evaluation. To avoid errors due to physical, psychological, environmental and individual characteristics, panels of evaluation were used rather than single assessors. The research design and the protocol used in this study were submitted for scrutinisation and approval to the Institutional ethical committee and ethical clearance, approval No. AUW/IHEC-14-15/XMT-01 was obtained. The ethical clearance chart was given by approval to the Institutional is given in Appendix 1.

The guide lines for ideal panel members according to Srilakshmi (2010) were followed. The panellist should be

- Be able to discriminate easily between the sample and should be able to distinguish appreciable differences in taste and smell.
- Have good health. If he/she suffering from cold his/her sensitive may be affected. A sick patient cannot judge the food correctly.
- Not be habituated to chewing pan or supari.
- Be experience in particular field.
- Have high personal integrity. They should not be prejudged. They should evaluate objectively.
- Willingness to spend time for the sensory evaluation work is required
- Have interest in sensory analysis of samples and intellectual curiosity.

- Have ability to concentrate and drive proper conclusion.
- Be available and willing to submit periotic test to get consistent results.

Score card is a tool which help in evaluation through direction and degree of judgement using suitable defined scores (Mannay and Shadaksharswamy, 2007).

A five point rating scale was used for the purpose of evaluation of the acceptance of colour, taste, texture, appearance and flavour of recipes based on millet milk powders. The score card is appended in Appendix 2.

Recipes were prepared according to the selected cooking methods. Standard recipes with two variations of sprouted and non-sprouted millet milk powders were prepared for each recipe and were subjected to sensory evaluation. The score cards of the sensory attributes were calculated to identify the best acceptability variation.

LIST OF RECIPES

Figure- 3

Plate -2

STEAMING RECIPES

Millet milk powders incorporated idiyappam

Plate – 2.a

Millet milk powders incorporated puttu

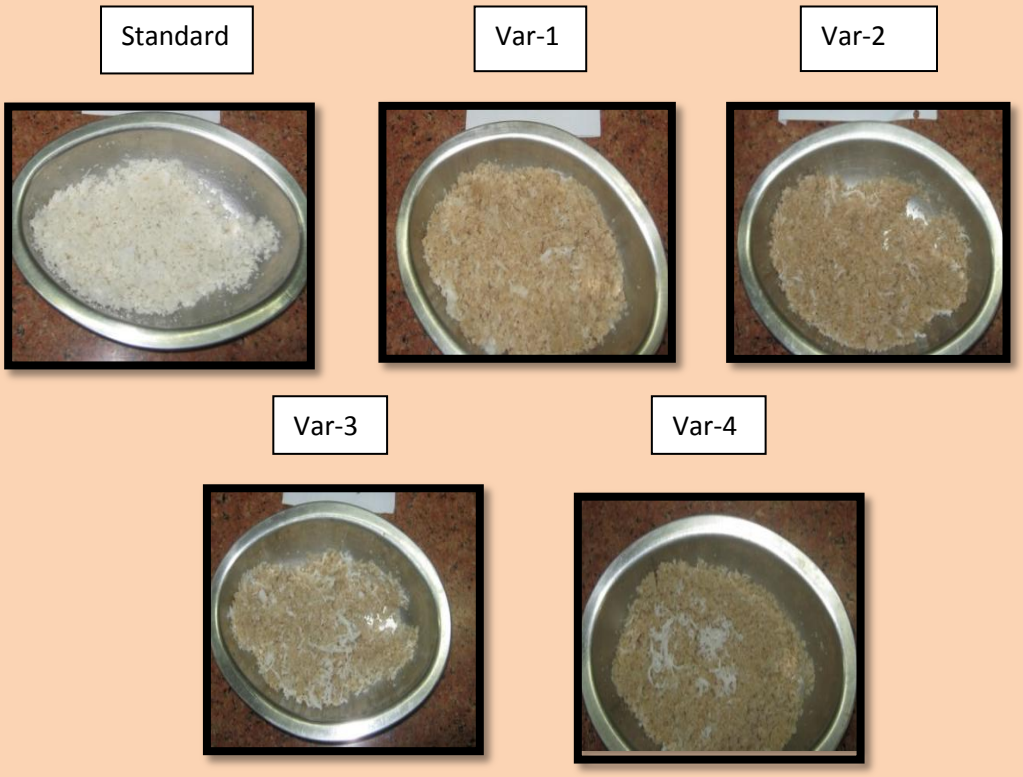


Plate – 2.b

Millet milk powders incorporated ada

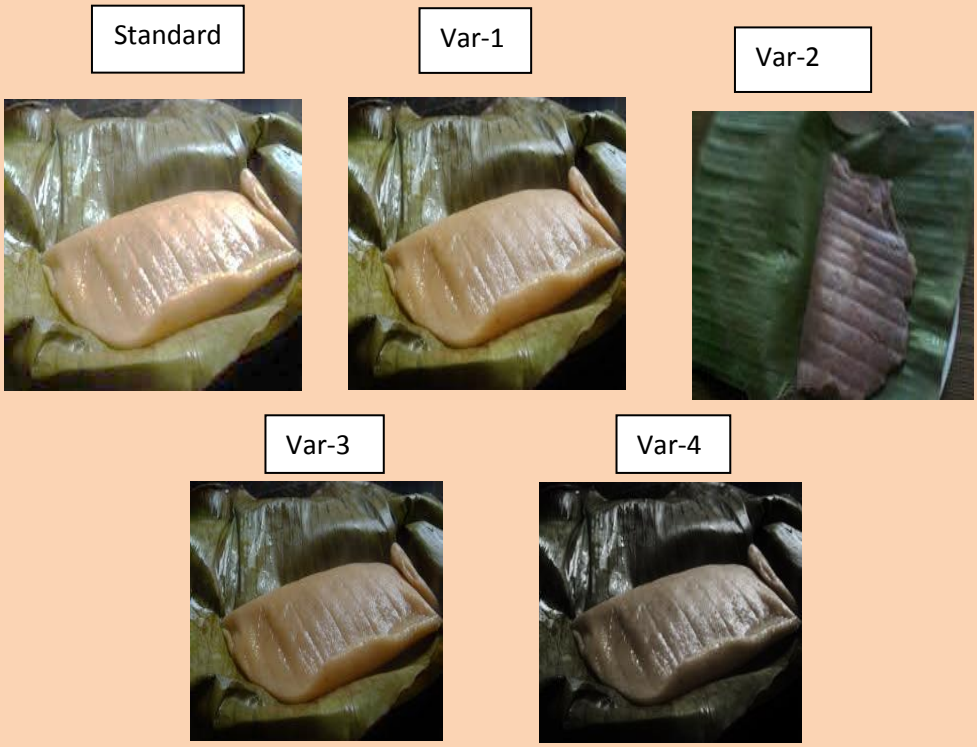


Plate – 2.c

Millet milk powders incorporated kozhukattai

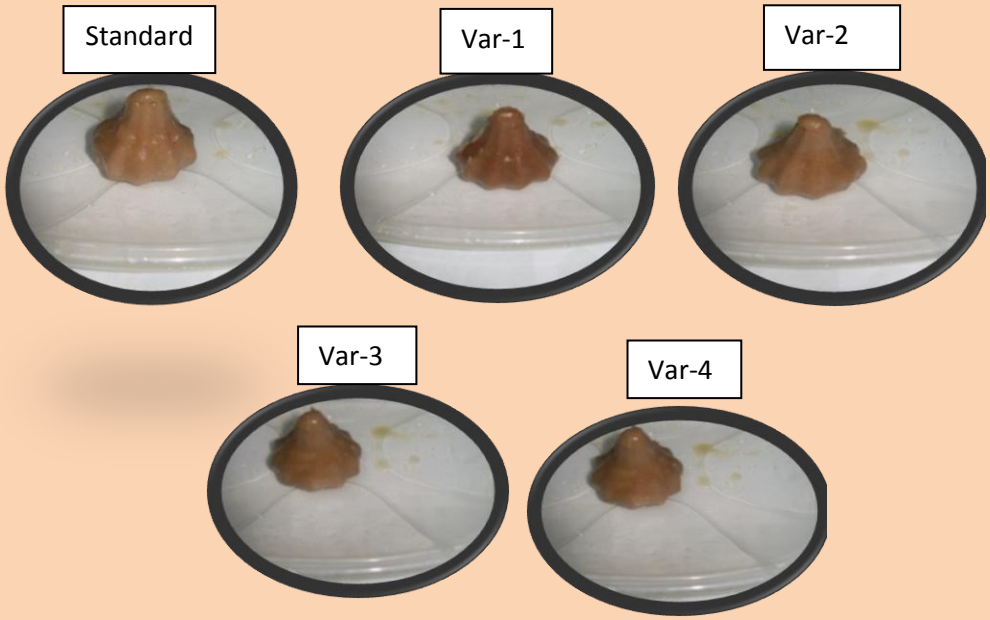


Plate – 2.d
Millet milk powders incorporated idly

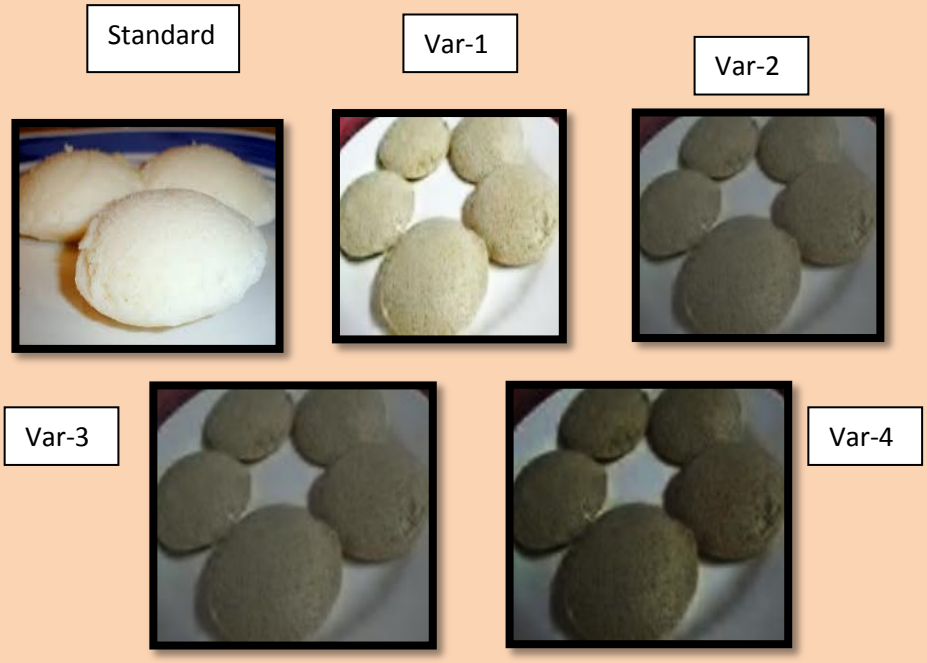


Plate – 3
FRYING RECIPES
Millet milk powders incorporated potato bajj

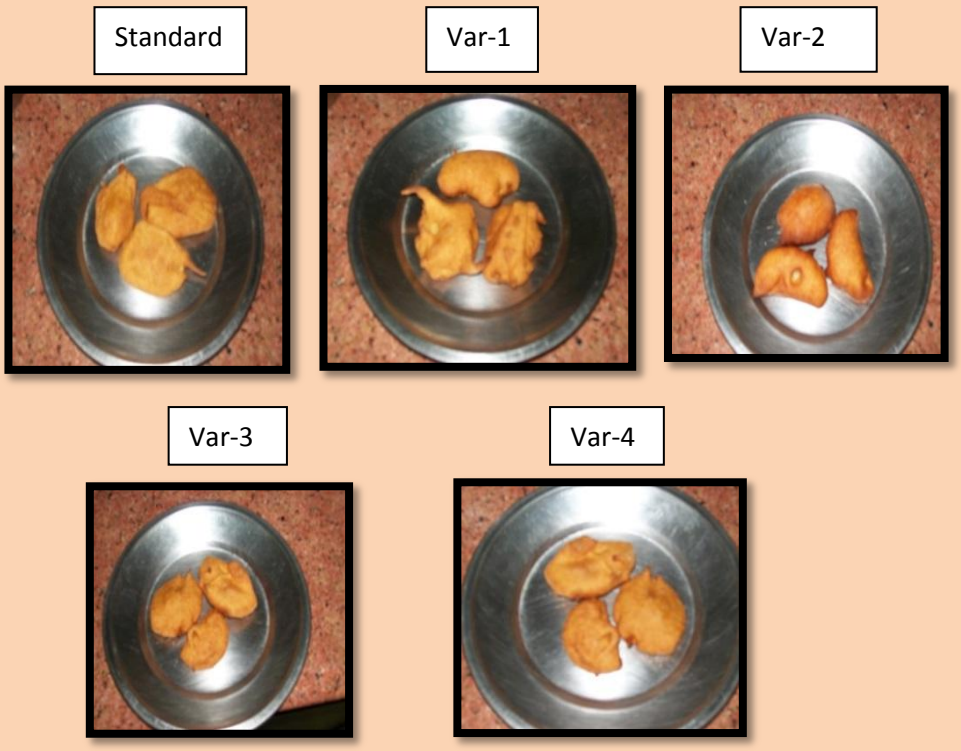


Plate – 3.a

Millet milk powders incorporated pakoda

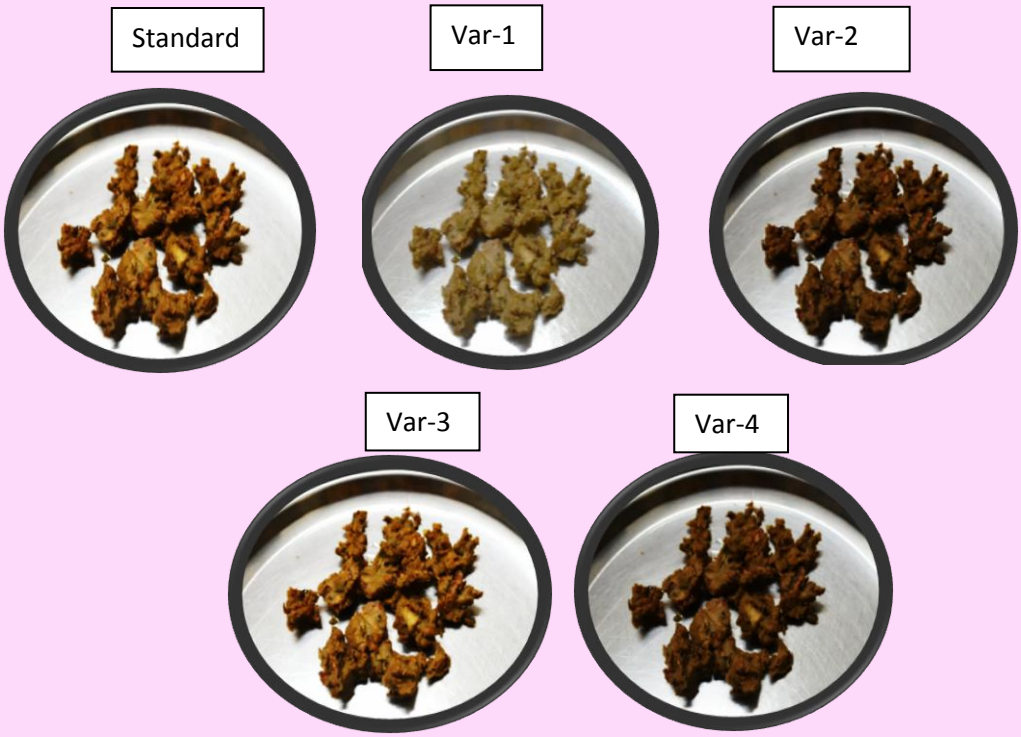


Plate-3.b

Millet milk powders incorporated ribbon pakoda

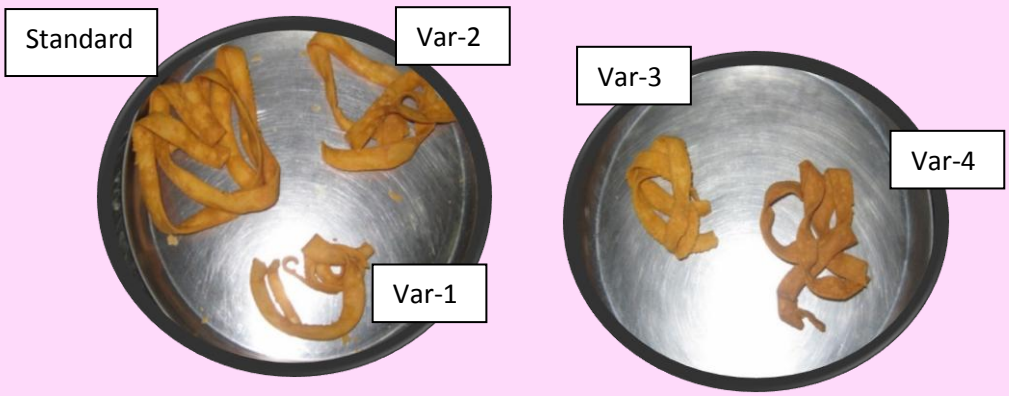


Plate – 3.c

Millet milk powders incorporated murruku

Standard

Var-1

Var-2

Var-3

Var-4

Plate –3.d

Millet milk powders incorporated thattu vadai

Standard

Var-1

Var-2

Var-3

Var-4

Plate – 4

SHALOW FAT FRYING

Millet milk powders incorporated poli

Standard

Var-1

Var-2

Var-3

Var-4

Plate – 4.a

Millet milk powders incorporated moong dal dosa

Standard

Var-1

Var-2

Var-3

Var-4

Plate-4.b

Millet milk powders incorporated adai

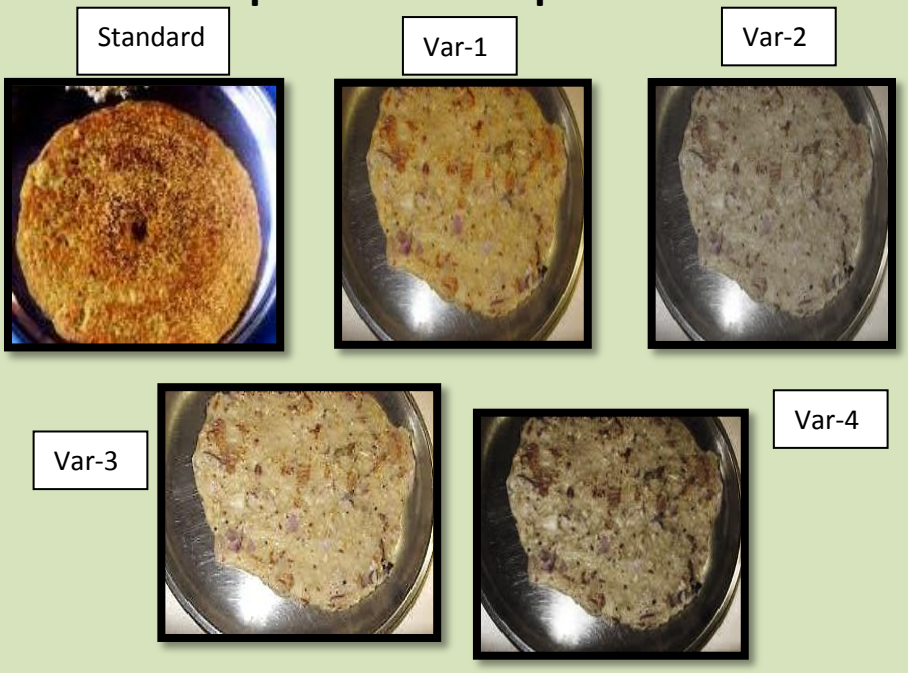


Plate- 4.c

Millet milk powders incorporated chapthi

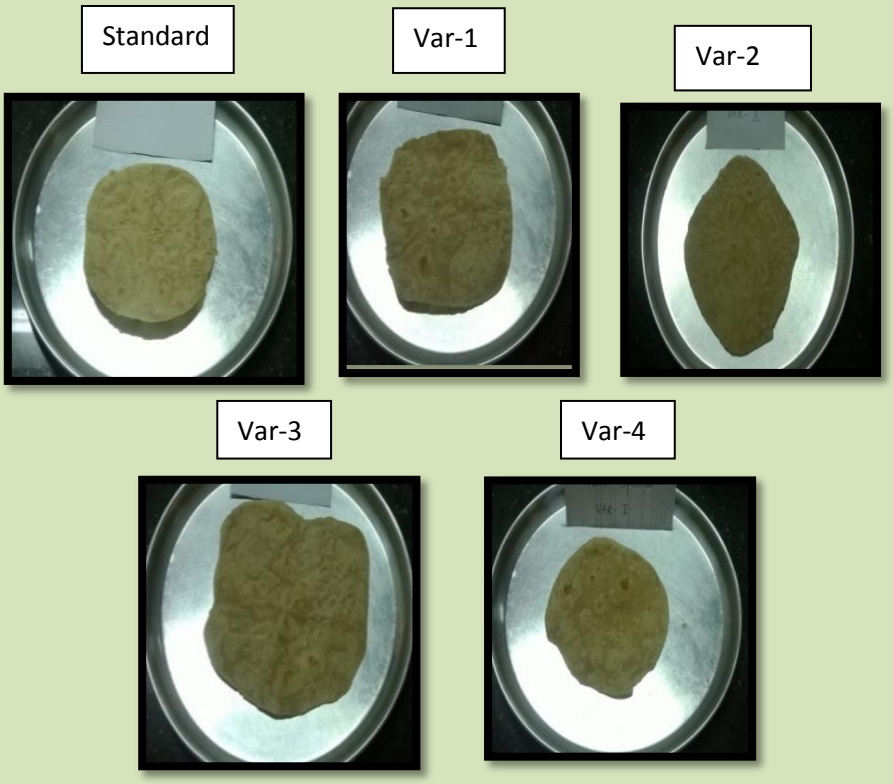


Plate – 4.d

Millet milk powders incorporated wheat halwa

Plate- 5

BAKING RECIPES

Millet milkpowders incorporated baked methi muthiya

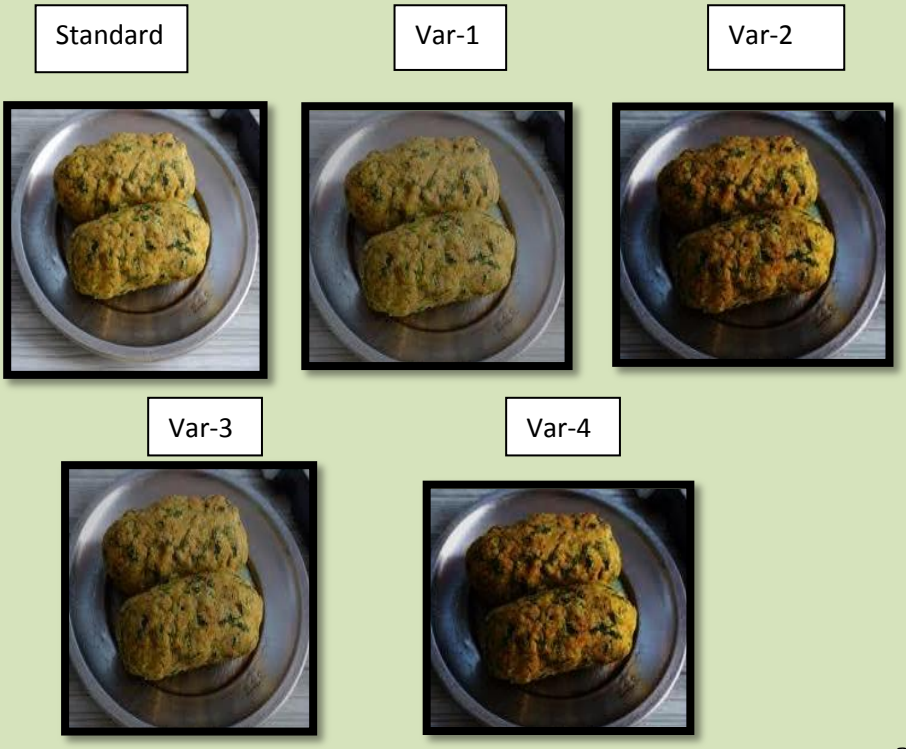


Plate – 5.a

BAKING METHOD

Millet milk powders incorporated biscuit

Standard

Var-1

Var-2

Var-3

Var-4

Plate – 5.b

Millet milk powders incorporated cookies

Standard

Var-1

Var-2

Var-3

Var-4

Plate – 5.c

Millet milk powders incorporated muffins

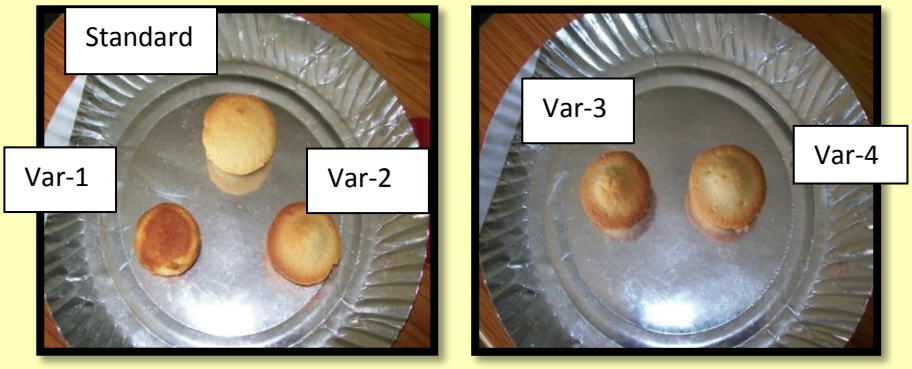
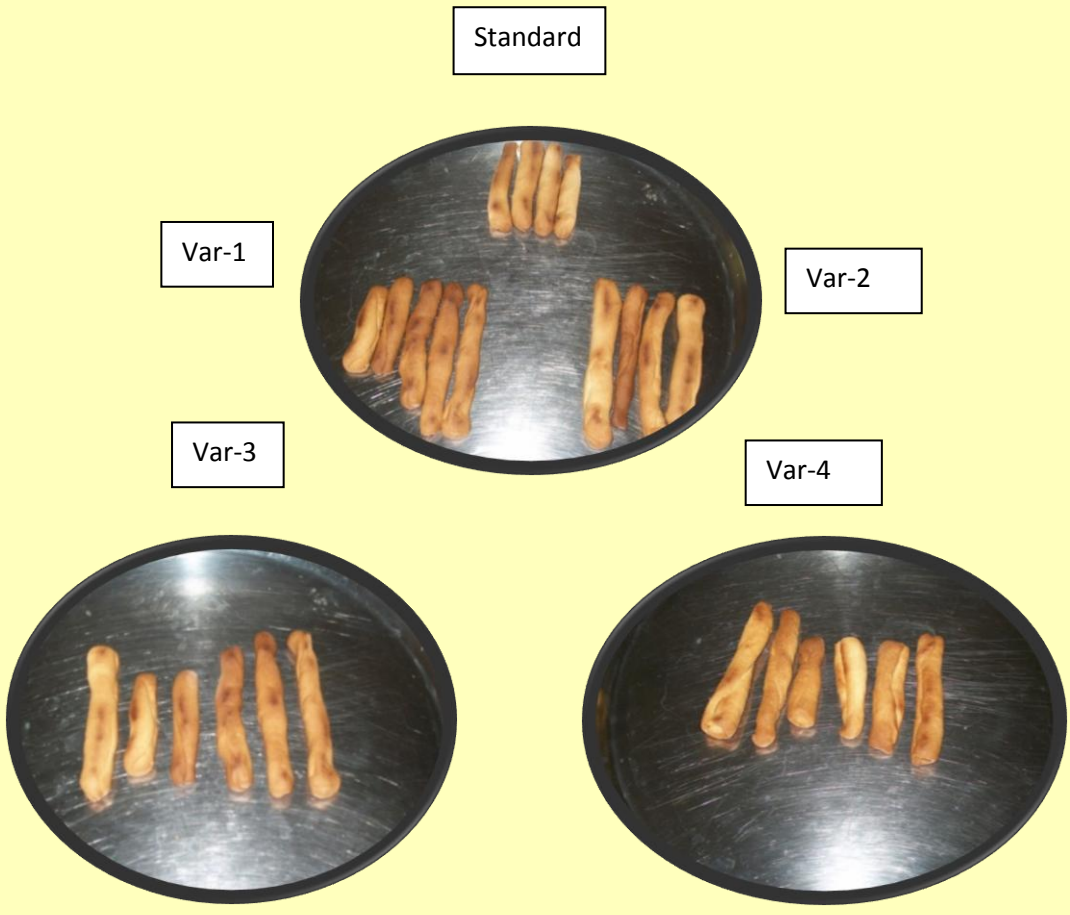


Plate – 5.d

Millet milk powders incorporated soup stick



IV. RESULTS AND DISCUSSION

The results and discussion pertaining to the topic entitled, "**Formulation and standardisation of value added recipes incorporated with millet milk powders**" is described under the following headings:

1. Nutritive value of millet milk powders
2. Acceptability of recipes incorporated with millet milk powders
   2.1. Recipes prepared by steaming method
   2.2. Recipes prepared by frying method
   2.3. Recipes prepared by shallow fat frying method
   2.4. Recipes prepared by baking method

1. NUTRITIVE VALUE OF MILLET MILK POWDERS

The nutrients that were analysed in millet milk powders include all the proximate nutrients such as carbohydrate, protein, fat, calcium, iron and moisture. AOAC (The Association of Official Analytical Chemists) International Methods were used for determine the nutrient content of the millet milk powders. Nutritive value of millet milk powders are given in Table-I.

TABLE-I

NUTRITIVE VALUE OF MILLET MILK POWDERS

NUTRIENTS	MILLET MILK POWDERS	
	SPROUTED	NON- SPROUTED
Moisture (%)	12.81%	12.50%
Protein (g)	20	17.2
Carbohydrate (g)	78.5	74.33
Fat (g)	4.88	3.05
Iron (mg)	10.25	8.95
Calcium (mg)	252	180

The moisture content of sprouted and non-sprouted millet milk powders were 12.81 per cent and 12.50 per cent, the results were comparable to the observation of Narayanasamy (2012) who reported that the moisture content of millet powder is 10.01 to 12.17 per cent. During germination and sprouting there is decrease in the moisture content of millets.

The protein content of millet milk powders in both sprouted and non-sprouted were 20 g, 17.2 g respectively. Malleshi and Hadimani (2003) stated that the protein content ranged between 8- 11 per cent of finger millet is comparable to other cereals. Khattak (2007) opines that, during germination seed proteins were degrade to increase the soluble protein content.

The fat content of sprouted millet milk powders and non-sprouted millet milk powders were 4.88 g and 3.05 g respectively. Similar finding was observed by Fasaai (2007), who reported that the low fat content recorded in fermented and germinated powder sample will help in increasing the shelf life of the samples by decreasing the changes of rancidity and will also contribute to the low energy value of the sample.

The decrease in carbohydrate content of germinated seed powder may be due to the utilization of some of the sugar during the growth metabolic activity reported by Fasasi (2007). The carbohydrate content of sprouted millet milk powders and non-sprouted millet milk powders were 78.5 g and 74.33 g respectively.

According to Gopalan (2004), the iron value ranged between 2.4- 6.4 mg for finger millet. The range of iron contents of sprouted and non-sprouted millet milk powders were 10.25 mg and 8.95 mg respectively. The calcium content of sprouted millet milk powders were (252 mg) and non-sprouted millet milk powders were (180 mg) respectively.

2) ACCEPTABILITY OF THE RECIPES INCORPORATED WITH MILLET MILK POWDERS

Food acceptability is an experience or features characterized by a positive attitude when a food product is purchased or consumed. It is an indication of the attitude toward a degree of liking a food can be directly measured on a hedonic scale. It is the way that people show, through verbal and nonverbal behaviour, the degree of pleasure and displeasure, which they may be experiencing with a particular food product (Molly Thembi Malaza, 2012).

An important point to consider is that consumer acceptance of a new healthy product is far from being unconditional and their benefits may provide added value to consumers but cannot outweigh the sensory properties of foods. The acceptance of a

product will depend on whether it responds to consumer needs and on the degree of satisfaction it is able to provide.

1.1 RECIPES PREPARED BY STEAMING METHOD

1.1.1. MEAN ACCEPTABILITY SCORES FOR PUTTU

The mean scores for puttu incorporated with millet milk powders cooked using steaming method are presented in Table- II and Figure- 5.

TABLE-II

MEAN ACCEPTABILITY SCORE FOR PUTTU

Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	4.3±0.69	3.6±0.67	4.2±0.66	3.8±0.63	4±0.63	3.8±0.60
Sprouted						
Var-1	4.4±0.78	4.2±0.69	4.3±0.67	4.3±0.67	4.7±0.82	4.4±0.69
Var-2	4.4±0.51	4.6±0.51	4.4±0.31	4.5±0.52	4.9±0.69	4.3±0.48
Non- sprouted						
Var-3	4.5±0.52	4.2±0.52	4.5±0.31	4.6±0.51	4.9±0.63	4.5±0.52
Var -4	4.4±0.63	4.2±0.51	4.6±0.48	4.1±0.73	4.7±0.51	4.3±0.67
t value Sprouted						
Std Vs var-1	4.30**	2.32*	3.85**	2.70*	3.80**	3.01**
Std Vs Var-2	2.44*	2.37*	2.33*	3.85**	3.63**	2.98**
Non sprouted						
Std Vs Var-3	1.15 ^{NS}	0.73^{NS}	3.85**	3.85**	2.01*	2.68*
Std Vs Var-4	1.54 ^{NS}	0.37 ^{NS}	2.68*	0.97 ^{NS}	2.01*	1.70 ^{NS}

Std – standard, Var-1 – Variation-1, Var-2 – Variation-2, Var-3 – variation-3 and Var-4 – variation -4
*significant at 5 % level, **significant at 1 % level, NS- Not Significant.

The mean scores for puttu prepared from sprouted millet milk powders in terms of colour, texture, taste, flavour, appearance and overall acceptability were (3.6, 4.2, 4.6), (4.2,4.3,4.4), (3.8,4.3,4.5), (4,4.7,4.9), (4.3,4.4,4.4) and (3.8,4.4,4.3) for standard, variations 1 and 2 respectively. The mean scores being statistically

significant at one percent level in comparing standard comparing with variation 1 for all the organoleptic parameters of puttu except five per cent significance for tasteprepared from sprouted millet milk powders similarly in comparing with variation 2 one per cent significance was observed in all the organoleptic parameters.

In the case of puttu prepared from non-sprouted millet milk powders the mean scores were (4.2, 4.2), (4.5, 4.6), (4.6, 4.1), (4.9, 4.7), (4.5, 4.4) and (4.5, 4.3) for variation 3 and variation 4 respectively, there were no significant differences between standard and both the variations in two parameters namely appearance and colour except for other organoleptic parameters were significant at one percent level compared with standard.

From the calculated results sprouted millet milk powders variation 1 propounds to be the best in all organoleptic parameters for puttu. Ten per cent of millet milk powders were incorporated in variation 1 and in case of variation 2 twenty per cent was used. Incorporation of ten per cent sprouted millet milk powders in puttu was better as it produced good flavour and taste whereas 20 per cent non-sprouted millet milk powders of incorporation was not acceptable.

1.1.2). MEAN ACCEPTABILITY SCORES FOR IDIYAPPAM

The mean acceptability scores for idiyappam are presented in Table- III and Figure-6.

TABLE-III

MEAN ACCEPTABILITY SCORES FOR IDIYAPPAM

Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	4±0.94	3.9±0.70	4.1±0.73	4.1±0.73	4±0.81	4.1±0.56
Sprouted						
Var-1	4.3±0.67	4.3±0.67	4.8±0.42	4.2±0.63	4±0.81	4.3±0.67
Var-2	4.4±0.69	4.3±0.82	4.6±0.51	4.3±0.67	4±0.81	4.4±0.51
Non- sprouted						
Var-3	4±0.94	4.3±0.82	4.6±0.69	3.9±0.99	4.1±0.87	4±0.94
Var -4	4±1.15	4.3±0.94	4.4±0.69	3.8±1.13	4.2±0.78	3.8±1.13
t value Sprouted						
Std Vs var-1	2.00*	2.26*	2.60*	2.32*	2.81*	2.71*
Std Vs Var-2	0.00 ^{NS}	1.14 ^{NS}	1.75 ^{NS}	0.63 ^{NS}	1.07 ^{NS}	1.23 ^{NS}
Non sprouted						
Std Vs Var-3	0.26 ^{NS}	1.14^{NS}	1.15 ^{NS}	0.51 ^{NS}	0.00 ^{NS}	0.28 ^{NS}
Std Vs Var-4	0.55 ^{NS}	1.14^{NS}	1.20 ^{NS}	0.49 ^{NS}	0.21 ^{NS}	0.46 ^{NS}

Std – standard, Var-1 – Variation-1, Var-2 – Variation-2, Var-3 – variation-3, Var-4 – variation -4
*significant at 5 % level, **significant at 1 % level, NS- Not Significant.

On considering the appearance, the mean scores of the idiyappam prepared from sprouted and non-sprouted millet milk powders were (4, 4.3, 4.4, 4 and 4) for standard, variations 1, 2, 3 and 4 respectively. The difference being statistically significant at five per cent level for variation1 compared with standard whereas there were no significant differences between the standard and non-sprouted variations.

The mean scores for idiyappam prepared from sprouted millet milk powders in terms of colour and texture were (3.9, 4.3, 4.3 and 4.1, 4.8,4.6) for standard, variations 1, 2respectively. The difference being statistically significant at five per cent level for both the organoleptic parameters of variation1 whereas no significant difference in comparison with standard and both parameters of variation 2 in case of

idiyappam prepared from sprouted millet milk powders. Similarly the mean scores for idiyappam prepared from non-sprouted millet milk powders were 4.3, 4.3 (variation 3) and 4.6, 4.4 (variation 4), whereas no significant difference in comparing standard comparing with variations in both the organoleptic parameters of idiyappam.

The scores for taste of the idiyappam prepared from sprouted and non-sprouted millet milk powders were 4.1,4.2,4.3,3.9 and 3.8 (Standard, variations1,2,3 and 4), the difference being statistically significance at five per cent level for variation1 and there were no significant differences between standard and non-sprouted millet milk powders in the case of idiyappam.

In terms of flavour, the mean scores for idiyappam prepared from sprouted millet milk powders were 4 for standard, variations 1 and 2 whereas idiyappam prepared from non-sprouted millet milk powders the same where found to be (4.1 and 4.2) for variation 3 and 4 respectively. Comparing the standard and variation1 of the idiyappam prepared from sprouted millet milk powders at five per cent level and there were no significant differences between both variations of idiyappam prepared from non-sprouted millet milk powders and standard.

The mean scores for overall acceptability of the idiyappam prepared from sprouted millet milk powders were 4.1 (standard), 4.3 (variation1) and 4.4 (variation 2) respectively, whereas idiyappam prepared from non-sprouted millet milk powders the mean scores were 4 (variation 3) and 3.8 (variation 4), the differencebeing statistically significant at five per cent level for variation 3 compared with standard.

From the calculated results sprouted millet milk powders variation1 propounds to be the best in all organoleptic parameters for idiyappam. Ten per cent of millet milk powders were incorporated in variation1 and in case of variation 2,20 per cent was used. Incorporation of ten per cent sprouted millet milk powders in idiyappam was better as it produced good flavour and taste whereas twenty per cent non-sprouted millet milk powders of incorporation was not acceptable.

1.1.3). MEAN ACCEPTABILITY SCORES FOR IDLY

The mean acceptability scores for idly are presented in Table- IV and Figure -7.

TABLE –IV

MEAN ACCEPTABILITY SCORES FOR IDLY

Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	3.9±0.67	4±0.56	3.4±0.63	3.8±0.63	4.2±0.51	4±0.47
Sprouted						
Var-1	4.4±0.56	4.1±0.51	3.9±0.51	4.3±0.48	4.6±0.56	4.3±0.48
Var-2	4.4±0.56	4.2±0.51	3.9±0.48	3.9±0.31	4.7±0.63	4.2±0.42
Non- sprouted						
Var-3	3.6±0.51	3.3±0.51	3.4±0.99	3.3±0.48	3.9±0.48	3.4±0.51
Var -4	3.4±0.51	4.2±0.51	4.1±0.63	4±0.42	4±0.56	3.9±0.51
t value						
Sprouted						
Std Vs var-1	2.71*	2.06*	2.54*	2.98*	2.88**	2.40*
Std Vs Var-2	3.71**	2.06*	2.08*	0.44 ^{NS}	3.09**	0.80 ^{NS}
Non sprouted						
Std Vs Var-3	1.11 ^{NS}	2.23*	0.80 ^{NS}	1.98 ^{NS}	0.44 ^{NS}	2.71*
Std Vs Var-4	2.15 ^{NS}	2.00*	1.41^{NS}	1.49^{NS}	1.23 ^{NS}	2.71*

Std – standard, Var-1 – Variation-1, Var-2 – Variation-2, Var-3 – variation-3 Var-4- variation- 4 *significant at 5 % level, **significant at 1 % level, NS- Not Significant.

In terms of colour, mean scores for standard, variations 1 and 2 for idly prepared from sprouted millet milk powders were 4, 4.1, 4.2 respectively and for idly prepared from non-sprouted millet milk powders were 3.3, 4.2 for variation 3 and 4 respectively. The difference between standard and both the variations 1 and 2being statistically significant at one per cent level and five per cent for standard compared with 3 and 4.

It was observed that, the mean scores of texture for idly prepared from sprouted and non-sprouted millet milk powders were 3.4, 3.9, 3.9, 3.4 and 4.1 respectively, the difference between standard and sprouted variations 1 and 2 at five per cent level and there were no significant differences between non-sprouted millet milk powders in the

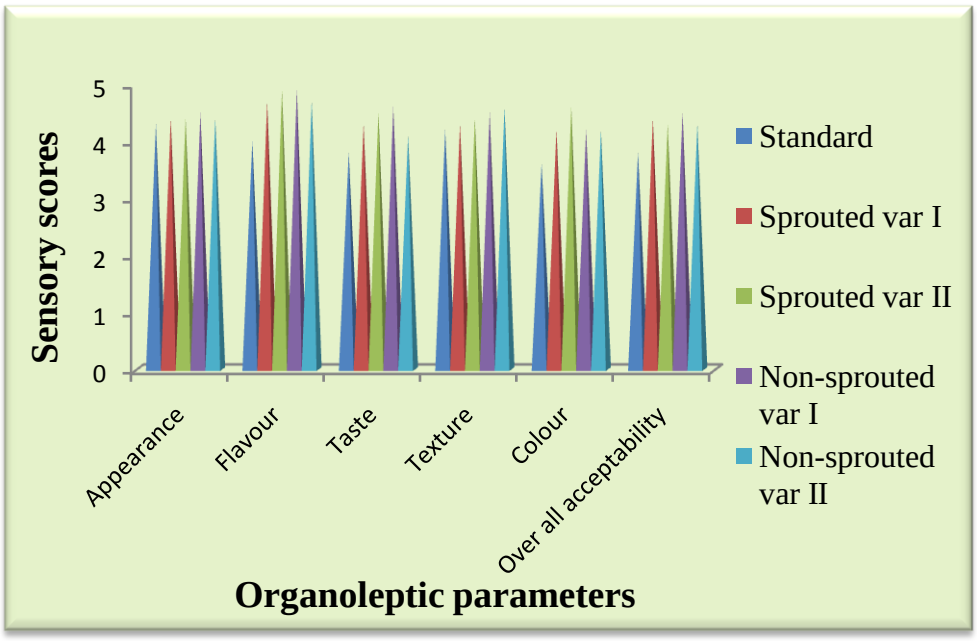
case of idly. According to Stone (2003), all the mechanical, geometrical and surface attributes of a product perceptible by means of mechanical, tactile and where appropriate, visual and auditory receptors.

Mean scores for taste of idly prepared from sprouted millet milk powders were 3.8, 4.3, 3.9 for standard, variations 1, 2and idly prepared from non-sprouted millet milk powders were 3.3, 4 for variation 3 and 4 respectively, the difference between the standard and variation1 for sprouted millet milk powder prepared from idly were statistically significant at five per cent level and there were no significant differences between the standard and both variations 3 and 4.

The mean scores for flavour and appearance for idly prepared from sprouted millet milk powders were 4.2, 4.6, 4.7 and 3.9, 4.4, 4.4 for standard, variation 1 and 2 respectively. The difference being statistically significant at one per cent level for both the organoleptic parameters compared with standard and variation 2. Similarly mean scores for idly prepared from non-sprouted millet milk powders variations 3 and 4 were 3.9, 4 for flavour and 3.6, 4.4 for appearance; there were no significant differences between the standard and non-sprouted variations in the case of idly.

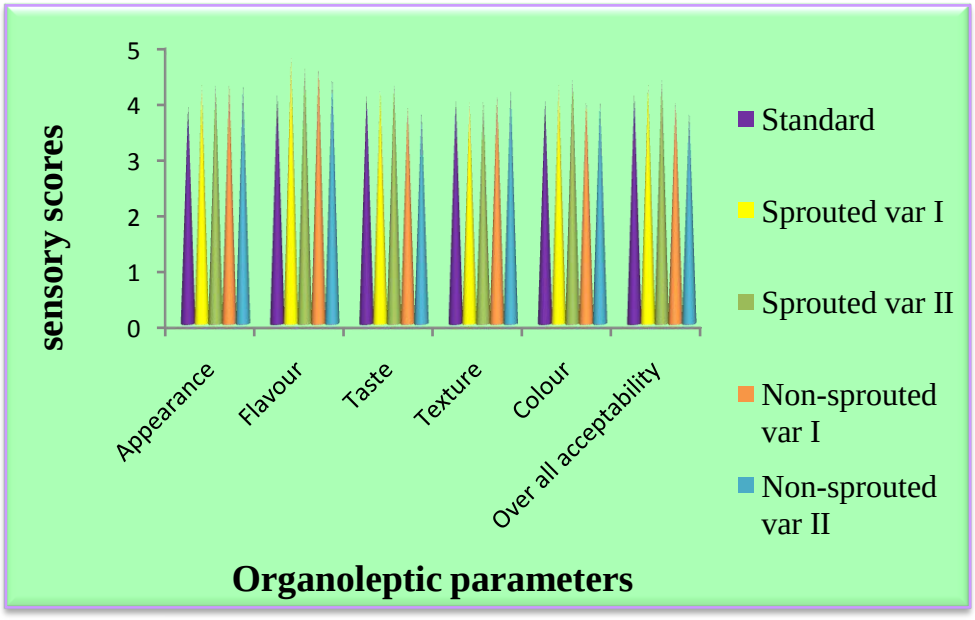
On considering the overall acceptability of the recipe sprouted and idly prepared from non-sprouted millet milk powders, the mean scores were 4, 4.3, 4.2, 3.4 and 3.9 for standard, variations 1,2,3 and 4 respectively. There were no significant differences between the standard and non-sprouted variations 3 and 4 except the sprouted variation1 at five per cent level being statistically significant.

From the calculated results sprouted millet milk powders variation1 propounds to be the best in all organoleptic parameters for idly. Ten per cent of millet milk powders were incorporated in variation1 and in case of variation 2 twenty per cent was used. Incorporation of ten per cent sprouted millet milk powders in idly was better as it produced good flavour and taste whereas twenty per cent non-sprouted millet milk powders of incorporation was not acceptable.



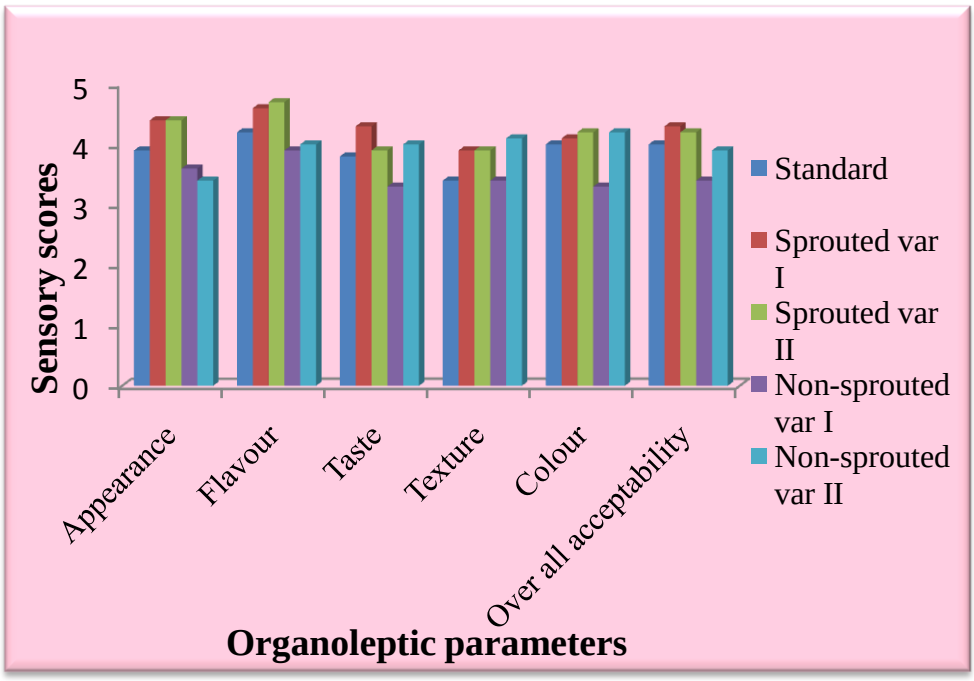
MEAN ACCEPTABILITY SCORES FOR PUTTU

Figure -5



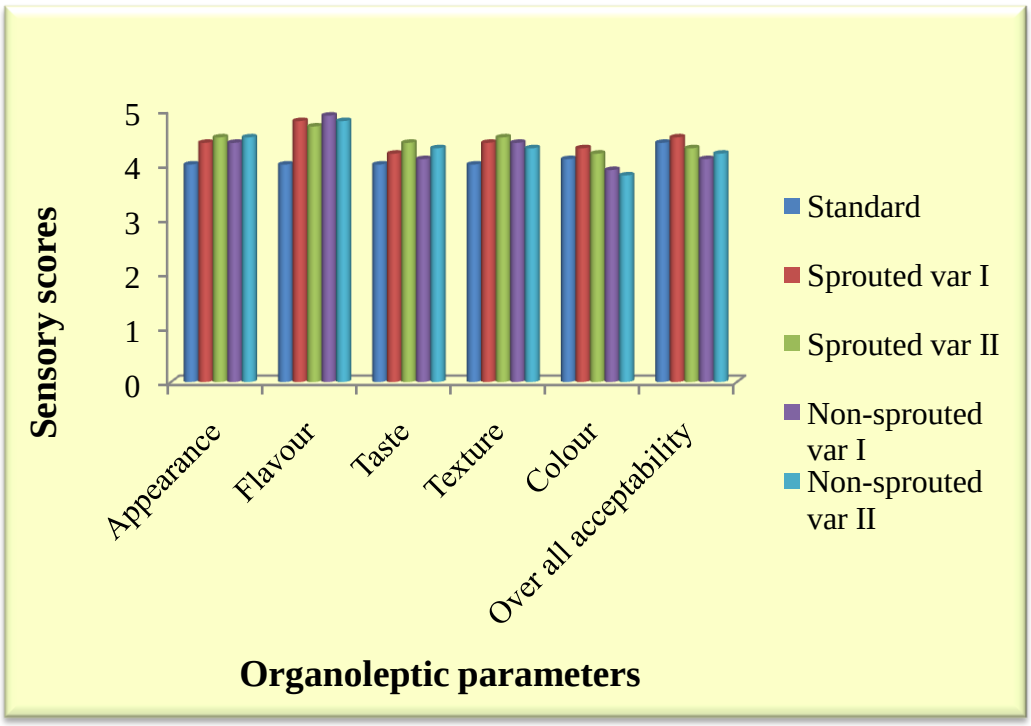
MEAN ACCEPTABILITY SCORES FOR IDIYAPPAM

Figure -6



MEAN ACCEPTABILITY SCORES FOR IDLY

Figure -7



MEAN ACCEPTABILITY SCORES FOR KOZHUKATTAI

Figure- 8

1.1.4). MEAN ACCEPTABILITY SCORES FOR KOZHUKATTAI

The acceptability scores for kozhukattai are presented in Table – V and Figure -8.

TABLE-V

MEAN ACCEPTABILITY SCORES FOR KOZHUKATTAI

Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	4±0.81	4±0.56	4±0.81	4±0.81	4±0.87	4.4±0.51
Sprouted						
Var-1	4.4±0.48	4.1±0.51	4.4±0.42	4.2±0.42	4.8±0.69	4.5±0.52
Var-2	4.5±0.63	4.2±0.51	4.5±0.48	4.4±0.51	4.7±0.52	4.3±0.48
Non- sprouted						
Var-3	4.4±0.73	3.3±0.51	4.4±0.31	4.1±0.56	4.9±0.48	4.1±0.73
Var -4	4.5±0.48	4.2±0.51	4.3±0.42	4.3±0.67	4.8±0.67	4.2±0.63
t value Sprouted						
Std Vs var-1	2.84*	2.30*	2.75**	2.68*	2.10*	2.42*
Std Vs Var-2	1.23 ^{NS}	1.62 ^{NS}	2.33*	1.30 ^{NS}	0.61 ^{NS}	0.44 ^{NS}
Non sprouted						
Std Vs Var-3	0.93 ^{NS}	1.30 ^{NS}	3.25**	0.31 ^{NS}	0.28 ^{NS}	1.05 ^{NS}
Std Vs Var-4	0.57 ^{NS}	1.62 ^{NS}	2.75**	0.89 ^{NS}	1.55 ^{NS}	0.77 ^{NS}

Std – standard, Var-1 – Variation-1, Var-2 – Variation-2, Var-3 – variation-3 Var-4 – variation 4
*significant at 5 % level, **significant at 1 % level, NS- Not Significant.

The mean scores for kozhukattai prepared from sprouted millet milk powders in terms of colour,texture,taste, appearance and flavour were(4,4.1,4.2),(4,4.4,4.5),(4,4.2,4.4),(4,4.4, 4.5) and (4,4.8,4.7) for standard, variation 1 and variation 2 respectively. The mean scores being statistically significant at one per cent level in comparing standard with variation 1, whereas variation 2 at five per cent level statistically significant compared to standard. Similarly the mean scores for murruku prepared from non-sprouted millet milk powders in terms of colour, texture,taste,appearance and flavour werefoundtobe(3.3,4.2),(4.4,4.3),(4.1,4.3),(4.4,4.5) and (4.9,4.8)for variations 3 and 4 respectively. There were no significant differences between standard and variation 3 and variation 4.

From the calculated results sprouted millet milk powders variation1 propounds to be the best in all organoleptic parameters for kozhukattai. Ten per cent of millet milk powders were incorporated in variation1 and in case of variation 2 twenty per cent was used. Incorporation of ten per cent sprouted millet milk powders in kozhukattai was better as it produced good flavour and taste whereas twenty per cent non-sprouted millet milk powders of incorporation was not acceptable.

1.1.5). MEAN ACCEPTABILITY SCORES FOR ADA

The acceptability scores for ada are presented in Table – VI and Figure -9.

TABLE-VI

MEAN ACCEPTABILITY SCORES FOR ADA

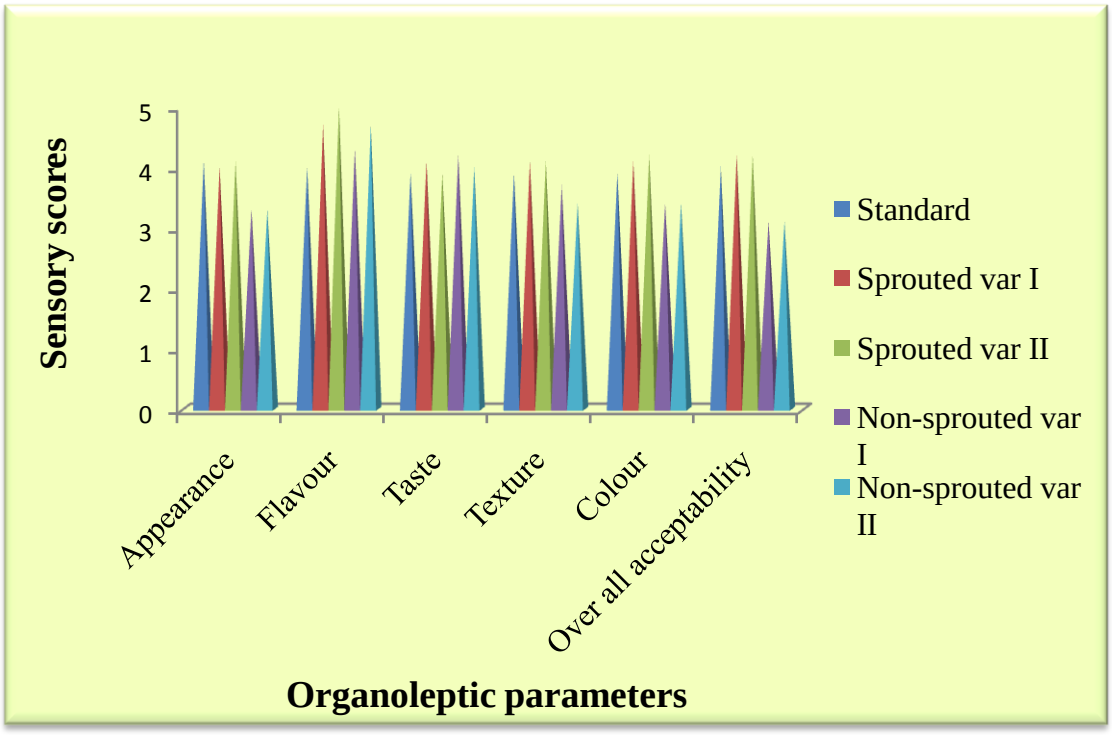
Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	4.1±0.87	3.9±0.73	3.9±0.81	3.9±0.81	4±0.87	4±0.81
Sprouted						
Var-1	4±0.31	4.1±0.31	4.1±0.48	4.1±0.31	4.7±0.42	4.2±0.31
Var-2	4.1±0.31	4.2±0.31	4.1±0.48	3.9±0.47	5±0.42	4.2±0.31
Non- sprouted						
Var-3	3.3±0.82	3.4±0.48	3.7±0.31	4.3±0.51	4.3±0.48	3.1±0.31
Var -4	3.3±0.69	3.4±0.48	3.4±0.48	4.7±0.69	4.8±0.67	3.1±0.31
t value						
Sprouted						
Std Vs var-1	1.71*	2.71*	2.33*	0.89 NS	0.89*	0.00*
Std Vs Var-2	0.28 NS	0.71 NS	1.96 NS	0.29 NS	0.28 NS	1.66 NS
Non sprouted						
Std Vs Var-1	0.28 NS	1.39 NS	3.25**	0.61 NS	0.28 NS	0.97 NS
Std Vs Var-2	0.55 NS	0.37 NS	0.89 NS	0.00 NS	0.00 NS	1.25 NS

Std – standard, Var-1 – Variation-1, Var-2 – Variation-2, Var-3 – variation-3, Var-4 – variation -4*significant at 5 % level, **significant at 1 % level, NS- Not Significant.

The mean scores for ada prepared from sprouted millet milk powders in terms of colour, texture, taste, flavour, appearance and overall acceptability were (3.9, 4.1, 4.2), (3.9, 4.1, 4.1), (3.9,4.1, 3.9), (4, 4.7, 5), (4.1, 4, 4.1) and (4, 4.2, 4.2) for standard, variation1 and variation 2 respectively. The mean scores being statistically significant at five per cent level in comparison with standard and comparison with variation1 for ada prepared from sprouted millet milk powders. In comparing with

variation 2 there were no significant difference between standard. Similarly the mean scores for ada prepared from non-sprouted millet milk powders were (3.4, 3.4), (3.7, 3.4), (4.3, 4.7), (4.3, 4.8), (3.3, 3.3) and (3.1, 3.1) for variation 3 and 4 respectively, the difference being statistically significant at five per cent level compared with standard for all the organoleptic parameters of ada prepared from non-sprouted millet milk powders.

The overall acceptability of standard was found to be very good. The 10 per cent sprouted millet milk powders incorporated ada was evaluated to be very good and 20 per cent millet milk powders incorporated ada scored lesser when compared to standard and variation1, non-sprouted millet milk powders both variations of incorporated recipes were not acceptable.



MEAN ACCEPTABILITY SCORES FOR ADA

Figure -9

1.2) RECIPES PREPARED BY FRYING METHOD

1.2.1) MEAN ACCEPTABILITY SCORES FOR MURUKKU

The mean acceptability scores for murruku incorporating millet milk powders cooked using frying method are presented in Table-VII and Figure -10.

TABLE-VI

MEAN ACCEPTABILITY SCORES FOR MURUKKU

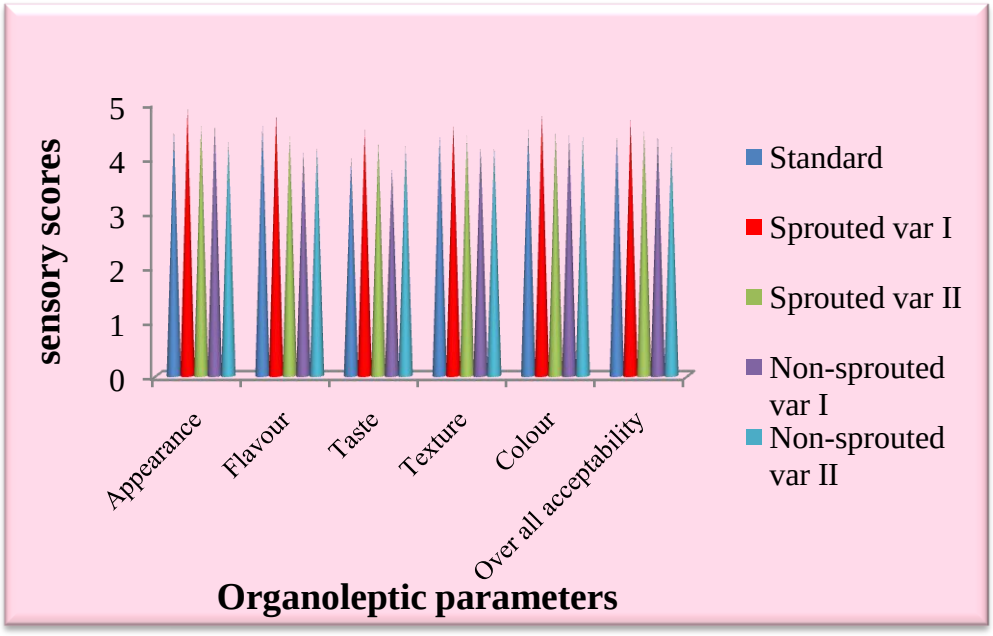
Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	4.5±0.67	4±0.73	3.7±0.73	4±0.66	3.9±0.66	3.6±0.81
Sprouted						
Var-1	4.7±0.59	4.4±0.48	4.4±0.48	4.5±0.51	4.8±0.31	4.4±0.51
Var-2	4.6±0.73	4.5±0.48	4.4±0.48	4.3±0.56	4.4±0.42	4.5±0.52
Non-sprouted	4.6±0.73	4.4±0.51	4.2±0.51	3.8±0.81	4.1±0.51	4.4±0.52
Var-3	4.3±0.81	4.8±0.48	4.2±0.51	4.2±0.48	5±0.01	4.4±0.52
Var -4						
t value						
Sprouted						
Std Vs var-1	3.60**	2.88*	2.92**	3.86**	4.30**	3.85**
Std Vs Var-2	2.60**	2.42*	2.55*	2.50*	2.86*	2.91**
Non sprouted						
Std Vs Var-3	1.52 ^{NS}	0.42^{NS}	0.60 ^{NS}	0.68^{NS}	1.50^{NS}	3.46**
Std Vs Var-4	3.20**	0.64^{NS}	4.71**	0.68^{NS}	3.20**	2.91**

Std – standard, Var-1 – Variation-1, Var-2 – Variation-2, Var-3 – variation-3, Var-4 – variation -4
*significant at 5 % level, **significant at 1 % level, NS- Not Significant.

The mean scores for murruku prepared from sprouted millet milk powders in terms of colour,texture,taste, appearance and flavour were(4,4.4,4.5),(3.7,4.4,4.4),(4,4.5,4.3),(4.5,4.7, 4.6) and (3.9,4.8,4.4) for standard,variation1 and variation 2 respectively. The mean scores being statistically significant at one per cent level in comparing standard with variation1, whereas variation 2 at five per cent level statistically significance compared to standard. Similarly the mean scores for murruku prepared from non-sprouted millet milk powders in terms of colour, texture,taste,appearance and flavour werefoundtobe(4.4,4.8),(4.2,4.2),(3.8,4.2),(4.1, 5) and (4.6,4.3)for variations 3 and 4

respectively. There were no significant differences between standard and variation 3 and variation 4.

From above calculated results variation1propounds to be the best in allorganoleptic parameter for murukku prepared from sprouted millet milk powders. Ten per cent of millet milk powders were incorporated in variation1 and variation 2,twenty per cent were used in recipes. Incorporation of sprouted millet milk powders at 10 per cent and 20 per cent better as it produced good flavour and taste whereas twenty per cent non-sprouted millet milk powders of incorporations was not acceptable.



MEAN ACCEPTABILITY SCORES FOR MURRUKU

Figure -10

1.2.2). MEAN ACCEPTABILITY SCORES FORTHATTU VADAI

The mean acceptability scores for Thattu vadai are presented in Table-VII and Figure- 11.

TABLE-VII

MEAN ACCEPTABILITY SCORES FORTHATTU VADAI

Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	4.1±0.87	3.9±0.73	4.1±0.81	3.8±0.63	3.7±0.67	3.9±0.73
Sprouted						
Var-1	4.7±0.31	4.7±0.48	4.6±0.42	4.6±0.51	4.8±0.42	4.6±0.51
Var-2	4.6±0.48	4.4±0.51	4.7±0.42	4.5±0.52	4.5±0.51	4.4±0.51
Non- sprouted						
Var-3	4.6±0.51	4.2±0.51	4.4±0.94	4.3±0.51	4±0.81	3.9±0.73
Var -4	4.4±0.48	4.3±0.69	4.6±0.63	3.8±0.78	4.2±0.73	4±0.87
t value Sprouted						
Std Vs var-1	2.75*	3.15*	4.37**	3.09**	2.86**	2.45*
Std Vs Var-2	3.15*	2.75*	2.95**	2.68**	2.75*	2.75*
Non sprouted						
Std Vs Var-3	1.05^{NS}	1.75^{NS}	0.81^{NS}	1.98^{NS}	1.11^{NS}	0.00^{NS}
Std Vs Var-4	2.15*	0.93^{NS}	1.70^{NS}	0.00^{NS}	1.25^{NS}	0.36^{NS}

Std – standard, Var-1 – Variation-1, Var-2 – Variation-2, Var-3 – variation-3, Var-4- variation 4 *significant at 5 % level, **significant at 1 % level, NS- Not Significant.

In thattu vadai prepared from sprouted millet milk powders, variation 1 received the scores were 4.7, 4.6, 4.6, 4.7 and 4.8 for various organoleptic parameters colour, texture, taste, appearance and flavour respectively. Similarly variation 2 received scores 4.4, 4.7, 4.5, 4.5 and 4.5 for various organoleptic parameters.The mean scores being statistically significant at five percent level compared with standardfor all organoleptic parameters. Kozhukattai prepared from non-sprouted millet milk powders the mean scores were (4.2, 4.3), (4.4, 4.6), (4.3, 3.8), (4.6, 4.4) and (4, 4.2) in terms of colour, texture, taste, flavour and appearance for variations 3 and 4 respectively and there were no significant differences in standard compared with both the variations for all organoleptic parameters.

The overall acceptability of standard was found to be very good. The 10 per cent sprouted millet milk powders incorporated thattu vadai was evaluated to be very good and 20 per cent millet milk powders incorporated thattu vadai scored lesser when compared to standard and variation1, non-sprouted millet milk powders both variations 3 and 4 incorporated thattu vadai were not acceptable.

1.2.3). MEAN ACCEPTABILITY SCORES FOR POTATO BAJJI

The mean acceptability scores for potato bajji are presented in Table- IX and Figure- 12.

TABLE-IX

MEAN ACCEPTABILITY SCORES FOR POTATO BAJJI

Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	3.9±0.51	3.6±0.73	3.9±0.63	3.8±0.78	3.9±0.51	4±0.66
Sprouted						
Var-1	4.7±0.31	4.9±0.48	4.3±0.42	4.4±0.52	4.8±0.67	4.6±0.52
Var-2	4.6±0.42	4.8±0.51	4.3±0.42	4.4±0.52	4.8±0.67	4.5±0.52
Non- sprouted						
Var-3	4.7±0.51	4.6±0.48	4.1±0.48	4.3±0.48	4.7±0.73	4.5±0.52
Var –4	4.7±0.48	4.7±0.48	4.1±0.51	4.2±0.42	4.6±0.73	4.5±0.52
t value						
Sprouted						
Std Vs var-1	1.26 ^{NS}	2.86*	4.16**	2.01*	6.78**	2.25*
Std Vs Var-2	1.26 ^{NS}	2.45*	4.16**	2.01*	5.96**	1.86 ^{NS}
Non sprouted						
Std Vs Var-3	0.60^{NS}	2.86*	3.57**	1.70^{NS}	1.33^{NS}	1.86 ^{NS}
Std Vs Var-4	0.60^{NS}	2.86*	3.09**	1.41^{NS}	1.91^{NS}	1.86 ^{NS}

Std – standard, Var-1 – Variation-1, Var-2 – Variation-2, Var-3 – variation-3, Var-4 – variation 4 *significant at 5 % level, **significant at 1 % level, NS- Not Significant.

The mean scores for appearance of bajji prepared from sprouted millet milk powders were (3.9, 4.7 and 4.6) for standard, variation1 and 2 respectively. Similarly the mean scores of the bajji prepared from non-sprouted millet milk powders were (4.7, 4.7) for variation3 and 4 respectively. There were no significant differences between the standard compared with variations 3 and 4 in the case of bajji.

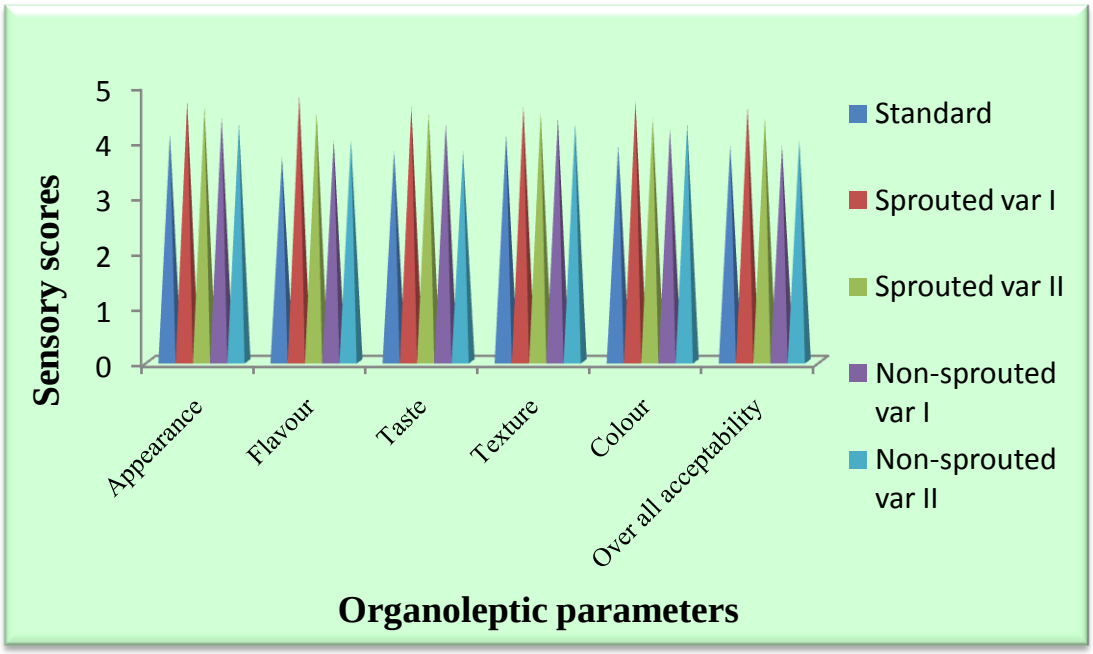
On considering colour, the mean scores for bajji incorporated with sprouted millet milk powders in standard was (3.6), variation1 was (4.9) and variation 2 was (4.8) respectively. It was observed that difference between the variations for colour were statistically significant at five percent level except variation1 at one percent level significance compared with standard. Similarly the mean scores for bajji prepared from non-sprouted millet milk powders were (4.6) variation 3, (4.7) for variation 4, the difference being statistically found to be at five percent level for both variations 3 and 4 compared with standard.

Mean scores of texture were 3.9 (standard), 4.3 (variation1) and 4.3 (variation 2) for bajji prepared from sprouted millet milk powders, the difference being statistically significant at one per cent level for standard compared with variations 1 and 2. Bajji prepared from non-sprouted millet milk powders scores for texture were (4.1) variation 3 and (4.1) variation 4 respectively. In case of bajji prepared from non-sprouted millet milk powders both variations were significant at one per cent level compared with standard.

In terms of taste, the difference being statistically significant at five per cent level for both variations 1 and 2 compared with standard; there were no significant differences between standard and both the variations 3 and 4 in case of bajji.The mean scores were 3.8, 4.4, 4.4, 4, 4.8 and 4.8 for standard, variation 1, 2, 3 and 4 respectively.

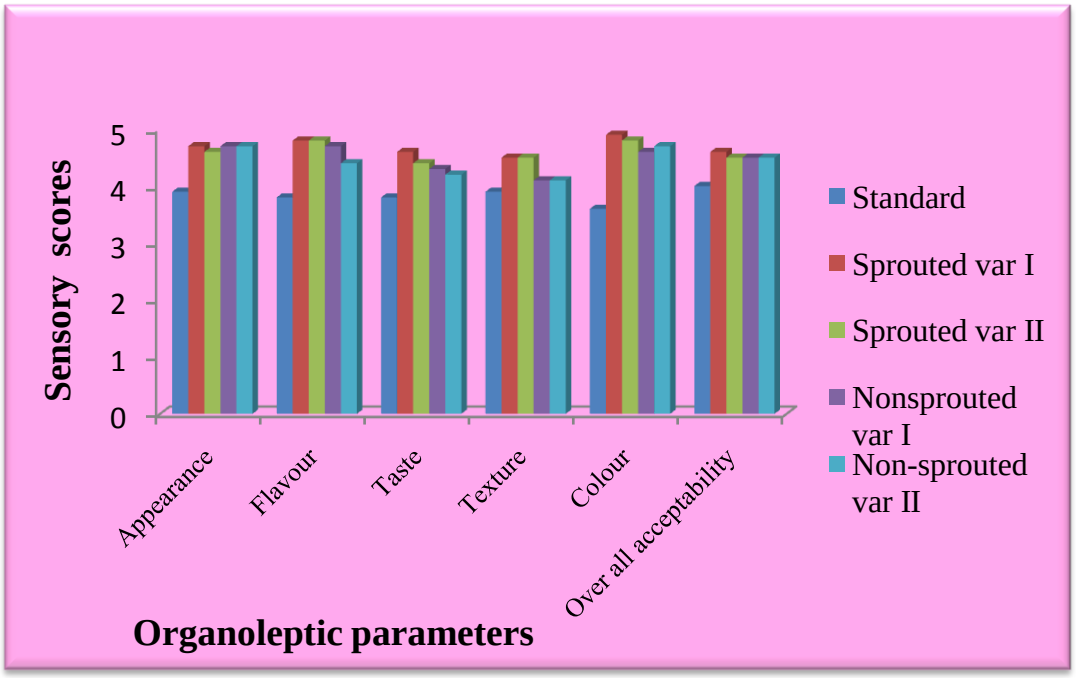
The scores for flavour of bajji prepared from sprouted millet milk powders were (3.9, 4.8 and 4.8) for standard, variation1 and 2 respectively. One per cent level significant difference between standard and both the variations 1 and 2 was noted. Similarly the mean scores for bajji prepared from non-sprouted millet milk powders were (4.7) and (4.6) for variations 3 and 4 respectively. There were no significant differences between the standard compared with variations 3 and 4.

From above calculated results variation1propounds to be the best in allorganolepticparameter for bajjiprepared from sprouted millet milk powders. Ten per cent of millet milk powders were incorporated in variation1 and in variation 2 twenty per cent were used. Incorporation of sprouted millet milk powders 10 per cent and 20 per cent were better as it produced good flavour and taste whereas twenty per cent non-sprouted millet milk powders of incorporations were not acceptable.



MEAN ACCEPTABILITY SCORES FOR THATTU VADAI

Figure- 11



MEAN ACCEPTABILITY SCORES FOR POTATO BAJJI

Figure -12

1.2.4). MEAN ACCEPTABILITY SCORES FOR PAKODA

The acceptability scores for pakoda are presented Table- X and Figure-13.

TABLE-X

MEAN ACCEPTABILITY SCORES FOR PAKODA

Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	3.9±0.81	4±0.56	4±0.66	4±0.66	4±0.66	3.9±0.56
Sprouted						
Var-1	4.8±0.51	4.5±0.42	4.4±0.48	4.8±0.51	4.7±0.63	4.4±0.69
Var-2	4.5±0.52	4.5±0.52	4.4±0.67	4.8±0.51	4.7±0.63	4.4±0.51
Non-sprouted						
Var-3	4.3±0.52	4.5±0.67	4.6±0.48	4.3±0.48	4.7±0.51	4.2±0.63
Var -4	4.3±0.52	4.8±0.67	4.3±0.82	4.2±0.82	4.3±0.67	4.6±0.51
t value Sprouted						
Std Vs var-1	0.61 ^{NS}	4.02**	2.68*	3.25**	2.50*	1.75 ^{NS}
Std Vs Var-2	1.71 ^{NS}	2.44*	2.33*	3.20**	2.86*	2.06*
Non sprouted						
Std Vs Var-3	1.96 ^{NS}	1.43^{NS}	2.68*	1.15^{NS}	1.86^{NS}	1.11
Std Vs Var-4	0.89 ^{NS}	1.63 ^{NS}	0.89 ^{NS}	0.68^{NS}	1.20^{NS}	2.06*

Std – standard, Var-1 – Variation-1, Var-2 – Variation-2, Var-3 – variation-3, Var-4 – variation -4*significant at 5 % level, **significant at 1 % level, NS- Not Significant.

Mean scores for appearance of pakoda prepared from sprouted millet milk powders were (3.9, 4.8 and 4.5) for standard, variation1 and 2 respectively. Similarly the mean scores of the pakoda prepared from non-sprouted millet milk powders were (4.3, 4.3) for variation 3 and 4 respectively. There were no significant differences between the standard with variations 3 and 4 in the case of pakoda.

On considering colour, the mean scores for pakoda prepared from sprouted millet milk powdersin standard was (4), variation1 was (4.5) and variation 2 was (4.5) for respectively. It was observed that difference between the variations for taste was statistically significant at one per cent level for variation1 except five per cent level significant in variation 2 compared with standard. Similarly the mean scores for pakoda prepared from non-sprouted millet milk powders were (4.5, 4.8) for variations

3 and 4, there were no significant differences between standard compared with both the variations.

Mean scores for texture were 4 (standard), 4.4 (variation1) and 4.4 (variation 2) respectively. The difference being statistically significant at five percent level for standard compared with variations 1 and 2. Pakoda prepared from non-sprouted millet milk powders scores for texture were (4.6) variation 3 and (4.3) variation 4 respectively, the difference being statistically not significant for standard comparing with variation 4 except variation 3 at five per cent level.

In terms of taste, the difference being statistically significant at five per cent level for both variations 1 and 2 compared with standard and variations and the mean scores were 4, 4.8 and 4.8 respectively. The mean scores for pakoda prepared from non-sprouted millet milk powders were 4.3 and 4.2 for variations 3 and 4 respectively.

The scores for flavour of pakoda prepared from sprouted millet milk powders were (4, 4.7 and 4.7) for standard, variations 1 and 2 respectively. Five percent level significant difference between standard compared with variations 1 and 2 was noted. The mean scores for pakoda prepared from non-sprouted millet milk powders were (4.7, 4.3) for variations 3 and 4 respectively. There were no significant differences between the standard compared with variations 3 and 4.

From above calculated results variation1propounds to be the best in allorganolepticparameter for pakoda prepared from sprouted millet milk powders. Ten per cent of millet milk powders were incorporated in variation1 and in variation 2, twenty per cent was used. Incorporation of sprouted millet milk powders at 10 per cent and 20 per cent were better as it produced good flavour and taste whereas twenty per cent non-sprouted millet milk powders of incorporations was not acceptable.

1.2.5). MEAN ACCEPTABILITY SCORES FOR RIBBON PAKODA

The acceptability scores for ribbon pakoda are presented Table- XI and Figure-14.

TABLE-XI

MEAN ACCEPTABILITY SCORES FOR RIBBON PAKODA

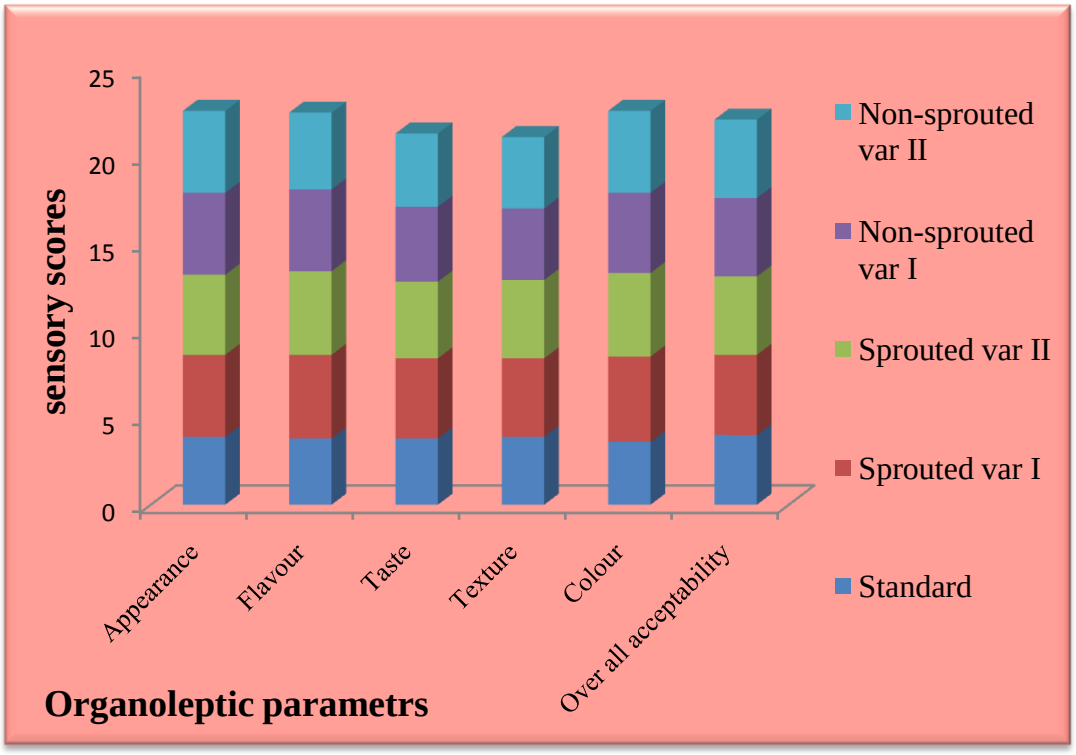
Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	4.4±0.87	3.9±0.73	3.9±0.63	4.2±0.78	3.8±0.73	4.1±0.87
Sprouted						
Var-1	4.8±0.51	4.8±0.31	4.5±0.52	4.5±0.51	4.1±0.63	4.4±0.87
Var-2	4.6±0.56	4.6±0.51	4.2±0.87	4.3±0.81	4.1±0.63	4.3±0.81
Non- sprouted						
Var-3	4.6±0.51	4.4±0.51	4.2±0.73	4.4±0.69	4.1±0.87	4.7±0.51
Var -4	4.8±0.31	4.4±0.42	4.3±0.56	4.4±0.69	4.1±0.87	4.5±0.52
t value						
Sprouted						
Std Vs var-1	2.09*	2.23*	2.87*	2.00*	2.92**	2.54*
Std Vs Var-2	0.97^{NS}	0.86^{NS}	0.87^{NS}	0.34^{NS}	2.17*	0.84^{NS}
Non sprouted						
Std Vs Var-3	0.97^{NS}	0.86^{NS}	0.97^{NS}	0.67^{NS}	1.55^{NS}	1.23^{NS}
Std Vs Var-4	1.43^{NS}	1.89^{NS}	1.11^{NS}	0.60^{NS}	1.55^{NS}	1.23^{NS}

Std – standard, Var-1 – Variation-1, Var-2 – Variation-2, Var-3 – variation-3, Var-4- variation -4 *significant at 5 % level, **significant at 1 % level, NS- Not Significant.

The mean scores for ribbon pakoda prepared from sprouted millet milk powders in terms of appearance,texture,taste, colour and flavour were(4.4,4.8,4.6),(3.9,4.5,4.2),(4.2,4.5,4,3),(3.9,4.8, 4.6) and (3.8,4.1,4.1) for standard, variation 1 and variation 2 respectively. The mean scores being statistically significant at five per cent level in variation 1 and no significance difference in variation 2 compared with standard for all the organoleptic parameters.Similarly the mean scores for murruku prepared from non-sprouted millet milk powders in terms of colour, texture,taste,appearance and flavour werefoundtobe(4.4,4.4),(4.2,4.3),(4.6,4.4),(4.4,4.8) and (4.1,4.1)for variations 3 and 4 respectively. There were no significant differences between standard and variations 3 and 4.

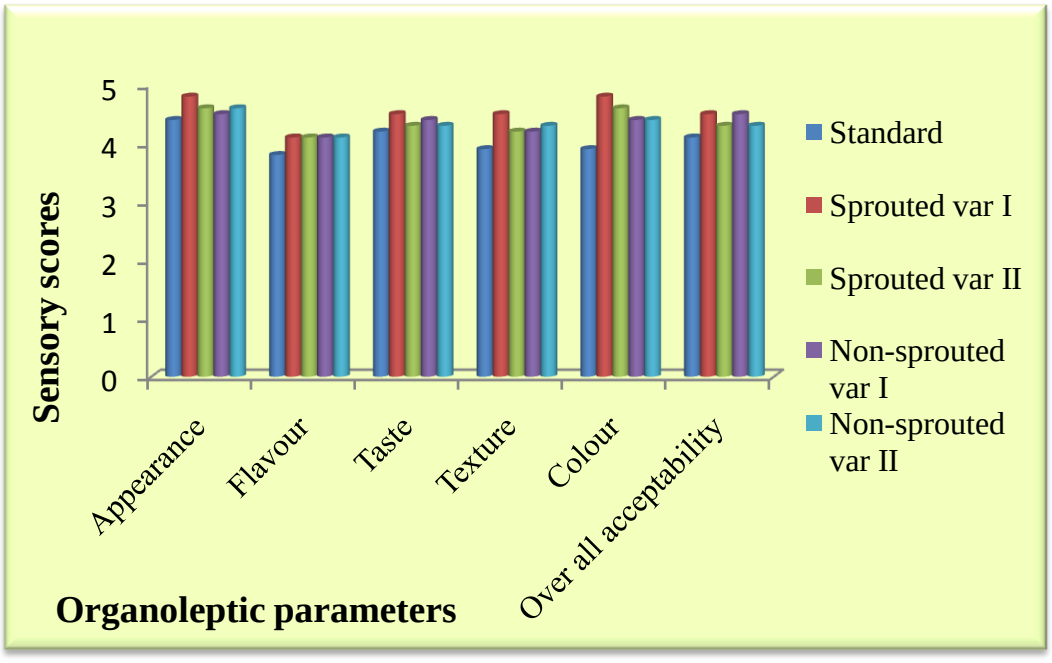
The overall acceptability of standard was found to be very good. The 10 percent sprouted millet milk powders incorporated ribbon pakoda was evaluated to very good and 20 percent millet milk powders incorporated ribbon pakoda scored lesser when

compared to standard and variation1, non- sprouted millet milk powders both variations 3 and 4 incorporated recipes were not acceptable.



MEAN ACCEPTABILITY SCORES FOR PAKODA

Figure -13



MEAN ACCEPTABILITY SCORES FOR RIBBON PAKODA

Figure -14

1.3). RECIPES PREPARED BY SHALLOW FAT FRYING

1.3.1). MEAN ACCEPTABILITY SCORES FOR ADAI

Themean acceptability scores for adai incorporating millet milk powders cooked using shallow fat frying method are presented Table – XII and Figure- 15.

TABLE-XII

MEAN ACCEPTABILITY SCORES FOR ADAI

Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	4±0.67	4.2±0.78	4.2±0.78	4.1±0.73	3.7±0.81	4.3±0.48
Sprouted						
Var-1	4.3±0.42	4.5±0.52	4.8±0.42	4.5±0.73	4.2±0.48	4.5±0.81
Var-2	4.2±0.42	4.2±0.42	4.6±0.42	4.3±0.48	3.8±0.78	4.2±0.78
Non- sprouted						
Var-3	4±0.67	3.9±0.47	4.7±0.48	3.5±0.56	3.5±0.73	3.7±0.82
Var -4	4±0.67	4±0.47	4.4±0.51	3.6±0.73	3.3±0.73	3.7±0.82
t value						
Sprouted						
Std Vs var-1	2.32*	2.43*	3.87**	3.33*	2.32*	2.92*
Std Vs Var-2	0.97 ^{NS}	1.43 ^{NS}	1.93 ^{NS}	0.00 ^{NS}	0.00 ^{NS}	0.82 ^{NS}
Non sprouted						
Std Vs Var-3	1.26 ^{NS}	1.39 ^{NS}	3.25**	1.95 ^{NS}	1.92 ^{NS}	1.98 ^{NS}
Std Vs Var-4	0.31^{NS}	1.15 ^{NS}	1.61 ^{NS}	1.95 ^{NS}	1.53 ^{NS}	1.98 ^{NS}

Std – standard, Var-1 – Variation-1, Var-2 – Variation-2,Var-3 – variation-3, and Var-4- variation -4
*significant at 5 % level, **significant at 1 % level, NS- Not Significant.

The adai prepared from sprouted millet milk powders obtained for the mean scores in terms of appearance, colour, texture, taste and flavour were (4, 4.3, 4.2), (4.2, 4.5, 4.2), (4.2, 4.8, 4.6), (4.1, 4.5, 4.3) and (3.7, 4.2, 3.8) for standard, variations 1,2,3 and 4 respectively, the difference begin statistically significant at five percent level in all organoleptic parameters except one per cent level significant difference in terms of texture. There were no significant differences between standard compared with variation 2 in all organoleptic parameters.

Adai prepared from non-sprouted millet milk powders obtained for the mean scores were (4, 4), (3.9, 4), (4.7, 4.4), 3.5, 3.6) and (3.5, 3.3) for variations 3 and 4respectively, there were no significant differences between standard compared with both variations 3 and 4 in all organoleptic parameters except one per cent level significant for variation 3 in terms of texture in case of adai.

The overall acceptability of standard was found to be very good. The 10 per cent sprouted millet milk powders incorporated adai was evaluated to very good and 20 per cent millet milk powders incorporated adai scored lesser when compared to standard and variation1, non-sprouted millet milk powders both variations of incorporated recipes were not acceptable.

b). MEAN ACCEPTABILITY SCORES FOR POLI

The mean acceptability scores for poli are presented in Table-XII and Figure-16.

TABLE-XII

MEAN ACCEPTABILITY SCORES FOR POLI

Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	4±0.73	4.1±0.66	3.9±0.87	4.1±0.56	4.1±0.73	3.8±0.81
Sprouted						
Var-1	4.9±0.31	4.8±0.31	4.4±0.69	4.7±0.48	5±0.01	4.7±0.48
Var-2	4.9±0.31	4.8±0.31	4.4±0.69	4.7±0.67	4.8±0.42	4.7±0.67
Non-sprouted						
Var-3	4.6±0.67	4.4±0.51	4.3±0.96	4.2±0.63	4.6±0.69	4.5±0.70
Var -4	4.6±0.67	4.4±0.51	4.2±0.63	4.2±0.63	4.8±0.62	4.4±0.69
t value						
Sprouted						
Std Vs var-1	2.71*	3.85**	3.25**	2.54*	2.60*	3.57**
Std Vs Var-2	2.17*	3.85**	3.25**	2.15*	2.60^{NS}	3.07**
Non sprouted						
Std Vs Var-3	1.26^{NS}	2.25*	2.27*	0.37^{NS}	0.93^{NS}	2.33*
Std Vs Var-4	0.87^{NS}	2.25*	2.27*	0.37^{NS}	0.93^{NS}	2.01*

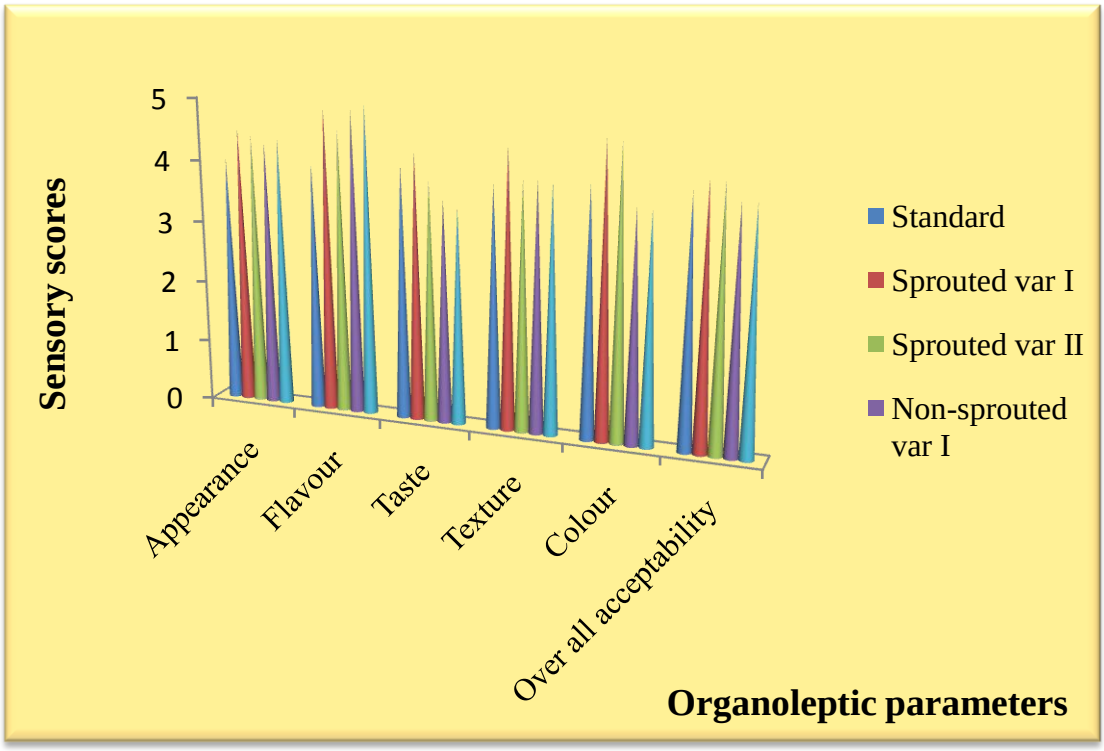
Std – standard, Var-1 – Variation-1, Var-2 – Variation-2, Var-3 – variation-3, Var-4 – variation -4
*significant at 5 % level, **significant at 1 % level, NS- Not Significant.

The mean scores for poli prepared from sprouted millet milk powders in terms of colour, texture, taste, flavour, appearance and overall acceptability were (4.1, 4.8,

4.8), (3.9, 4.4, 4.4), (4.1,4.7, 4.7), (4, 4.9, 4.9), (4.1, 5, 4.8) and (3.8,4.7, 4.7) for standard, variation 1 and 2 respectively. The mean scores being statistically significant at one percent level in comparing standard comparing with variations 1 and 2 for all the organoleptic parameters.

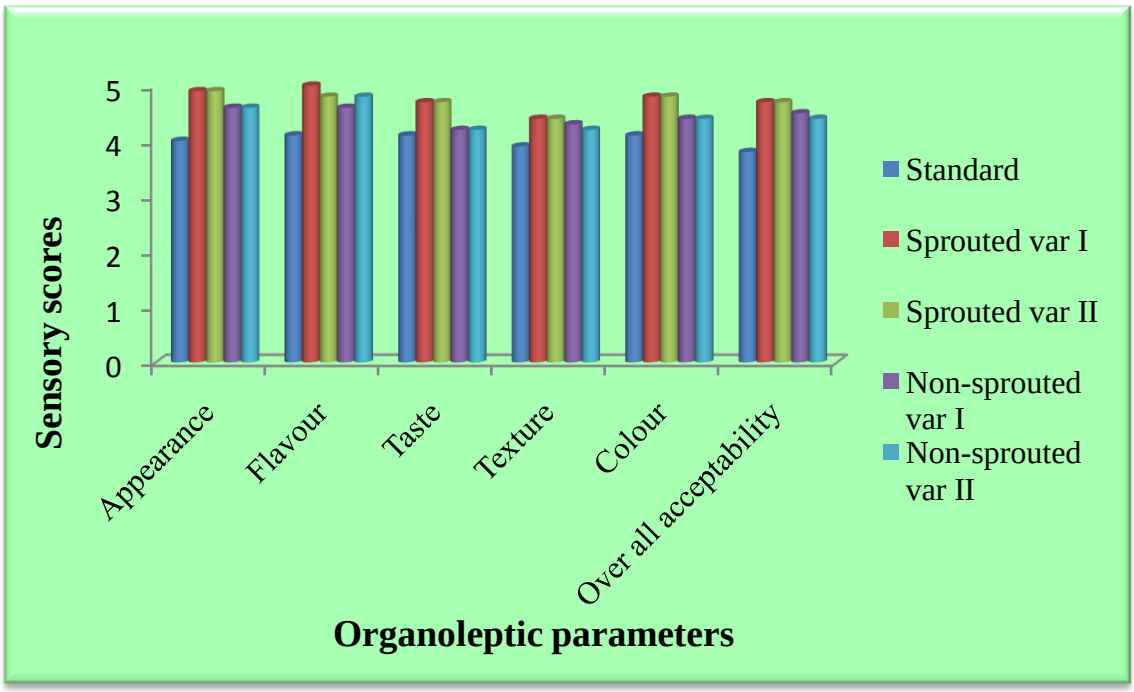
In the case of poli prepared from non-sprouted millet milk powders the mean scores were (4.4, 4.4), (4.3, 4.2), (4.2, 4.2), (4.6, 4.6), (4.6, 4.8) and (4.5, 4.4) for variation 3 and variation 4 respectively, there were no significant differences between standard compared with both the variations 3 and 4.

From above calculated result variation1propound to be the best in allorganolepticparameter for sprouted millets milk powder poli. Ten per cent of millet milk powders were incorporated in variation1 and variation 2. Incorporation of sprouted millet milk powders 10 per cent and 20 per cent better as it produced good flavour and taste whereas twenty per cent non-sprouted millet milk powders of incorporations was not acceptable.



MEAN ACCEPTABILITY SCORES FOR ADAI

Figure -15



MEAN ACCEPTABILITY SCORES FOR POLI

Figure -16

1.3.3). MEAN ACCEPTABILITY SCORES FORMOONG DAL DOSA

The acceptability scores for moong dal dosa are presented in Table- XIV and Figure- 17.

TABLE-XIV

MEAN ACCEPTABILITY SCORES FORMOONG DAL DOSA

Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	4.1±0.55	3.5±0.73	3.9±0.81	4±0.81	4.2±0.52	3.8±0.63
Sprouted						
Var-1	4.6±0.48	4.6±0.69	4.7±0.67	4.8±0.42	5±0.01	5±0.01
Var-2	4.5±0.70	4.5±0.84	4.5±0.84	4.5±0.70	4.9±0.11	4.7±0.67
Non- sprouted						
Var-3	4.6±0.69	4.3±0.51	4.4±0.42	4.5±0.70	4.3±0.67	4.6±0.84
Var –4	4.5±0.69	4.5±0.70	4.6±0.67	4.5±0.70	4.3±0.67	4.7±0.67
t value						
Sprouted						
Std Vs var-1	5.30**	2.34*	2.33*	3.34**	3.97**	4.16**
Std Vs Var-2	3.65**	2.22*	3.85**	1.85 ^{NS}	3.16**	3.07**
Non sprouted						
Std Vs Var-3	3.25**	1.54^{NS}	4.74**	1.86^{NS}	2.33*	2.40*
Std Vs Var-4	3.97**	1.00 ^{NS}	4.74**	1.55^{NS}	3.16**	3.07**

Std – standard, Var-1 – Variation-1, Var-2 – Variation-2, Var-3 – variation-3, Var-4- variation 4 *significant at 5 % level, **significant at 1 % level, NS- Not Significant.

The scores for colour for moong dal dosa prepared from sprouted millet milk powders were 3.5 (standard), 4.6 (variation1), 4.5 (variation 2) and for dosa prepared from non-sprouted millet milk powders, the mean scores 4.3, 4.5 for variations 3 and 4 respectively. The difference between the standard compared with both variations was significant at five per cent level significant and for moong dal dosa prepared from non-sprouted millet milk powders both variations were statistically not significant.

Mean scores for texture were (3.9) standard, 4.7 (variation1) and 4.5 (variation 2) for moong dal dosa prepared from sprouted millet milk powders, the difference being statistically five per cent level significance for standard compared with variation1. Moong dal dosa prepared from non-sprouted millet milk powders for

texture were 4.4, 4.6 for variation3 and 4, the difference being statistically significant at one percent level for standard compared with both the variations 3 and 4.

On considering taste, the mean scores for moong dal dosa prepared from sprouted and non-sprouted millet milk powders were 4 (standard), 4.8, 4.5, 4.5and 4.5 (variation 1,2,3 and 4) respectively. The difference between standard compared with variation1 at one per cent level and for moong dal dosa prepared from non-sprouted millet milk powders the difference were statistically not significant compared with standard.

In terms of flavour, the difference being statistically significant at one per cent level for both variations in terms of flavour both the comparisons namely standard compared with variation1 and standard compared with variation 2 and the mean scores were 4.5, 4.9 and 5,5 for standard, variation 1 and 2, whereas five per cent level significance was observed when compared with standard and moong dal dosa prepared from non-sprouted millet milk powders variation 3, one per cent significant change was noted for standard compared with variation 4.

The mean scores for appearance of the moong dal dosa prepared from sprouted millet milk powders were (4.1, 4.6 and 4.5) for standard, variation1 and 2 respectively, the difference being statistically significant at one per cent for both the variations compared with standard. Similarly moong dal dosa prepared from non-sprouted millet milk powders, the mean scores were (4.6, 4.5) for variation 3 and 4 respectively. One per cent level significant was seen in both variations of moong dal dosa prepared from non-sprouted millet milk powders compared with standard.

The overall acceptability of standard was found to be very good. The 10 percent sprouted millet milk powders incorporated moong dal dosa was evaluated to be very good and 20 percent millet milk powders incorporated moong dal dosa scored lesser when compared to standard and variation1. In case of non-sprouted millet milk powders both the variations of incorporated recipes were not acceptable.

1.3.4). MEAN ACCEPTABILITY SCORES FOR CHAPPATHI

The mean acceptability scores for chappathi are presented in Table – XV and Figure-18.

TABLE-XV

MEAN ACCEPTABILITY SCORES FOR CHAPPATHI

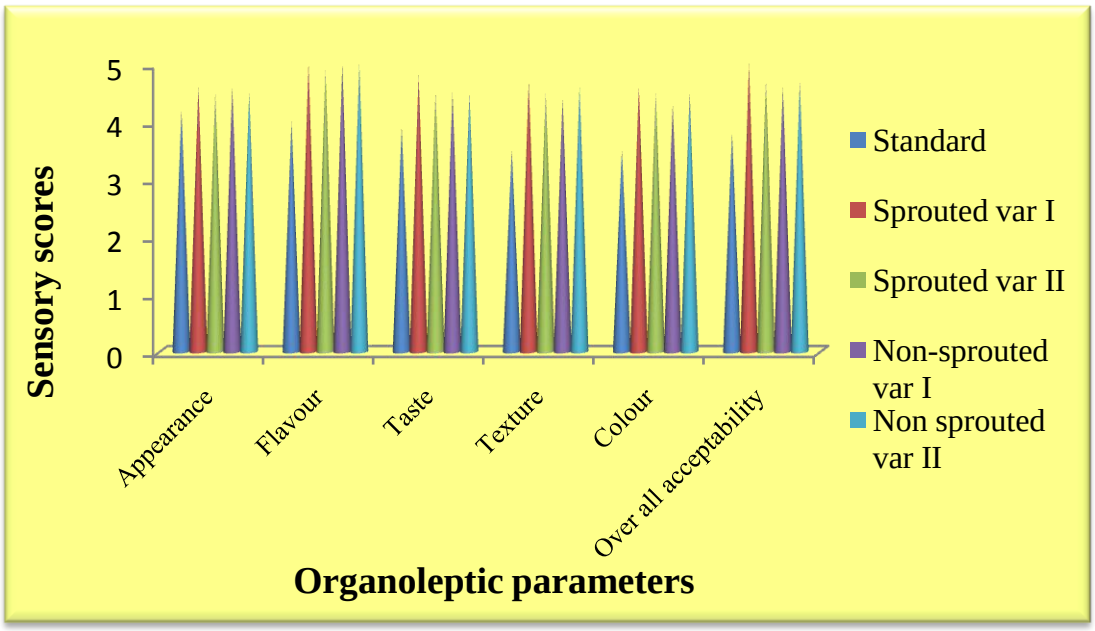
Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	4.1±0.81	4±0.73	4±0.81	4.2±0.78	4±0.87	4.2±0.63
Sprouted						
Var-1	4.3±0.67	4.3±0.48	4.2±0.48	4.5±0.70	4.7±0.69	4.2±0.63
Var-2	4.3±0.73	4.2±0.48	4.1±0.51	4.1±0.73	4.6±0.73	3.8±0.42
Non- sprouted						
Var-3	4.5±0.73	3.9±0.52	4.1±0.31	4±0.66	4.3±0.78	3.9±0.73
Var -4	4.2±0.66	4±0.42	4.2±0.67	4.3±0.67	4.3±0.78	3.8±0.78
t value						
Sprouted						
Std Vs var 1	2.84*	3.30**	2.75*	2.68*	2.00*	2.42*
Std Vs Var 2	1.23^{NS}	1.62^{NS}	2.33*	1.30^{NS}	0.61^{NS}	0.44^{NS}
Non sprouted						
Std Vs Var-3	0.93^{NS}	1.30^{NS}	3.25**	0.31^{NS}	0.28^{NS}	1.05^{NS}
Std Vs Var-4	0.57^{NS}	1.62^{NS}	2.75**	0.89^{NS}	0.55^{NS}	0.77^{NS}

Std – standard, Var-1 – Variation-1, Var-2 – Variation-2, Var-3 – variation-3, Var-4- variation -4 *significant at 5 % level, **significant at 1 % level, NS- Not Significant.

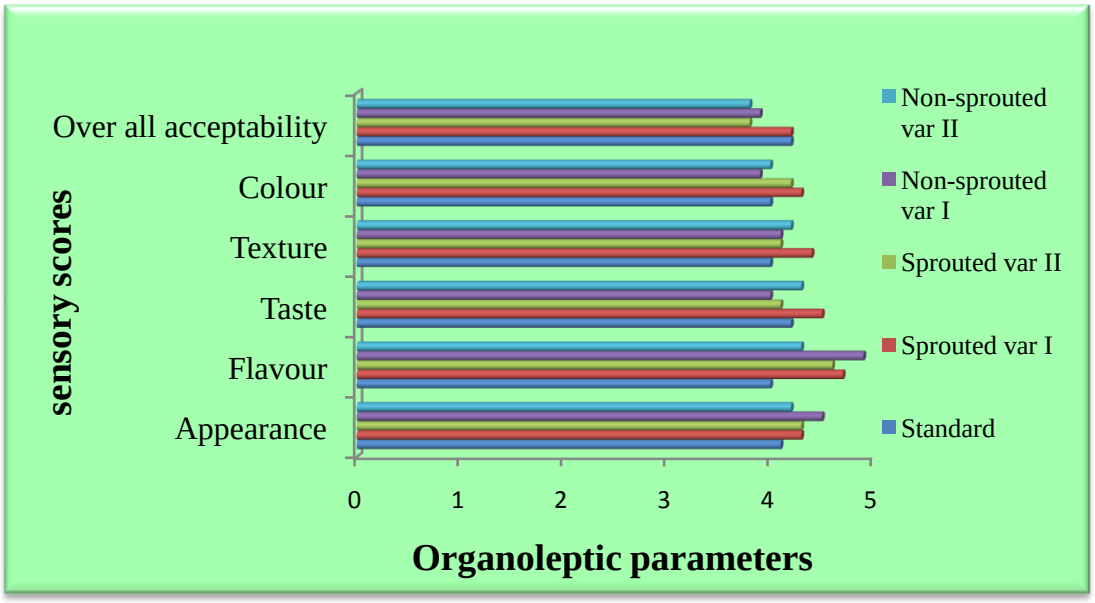
The mean scores for chapathi prepared from sprouted millet milk powders in terms of colour, texture, taste, flavour, appearance and overall acceptability were (4, 4.3, 4.2), (4, 4.2, 4.1), (4.2, 4.5, 4.1), (4, 4.7, 4.6), (4.1, 4.3, 4.3) and (4.2, 4.2, 3.8) for standard, variations 1 and 2 respectively. The mean scores being statistically significant at five per cent level for variation 1 compared with standard for all the organoleptic parameters.

In the case of cookies prepared from non-sprouted millet milk powders there were no significant differences between standard and all the organoleptic parameters of recipes in the terms of colour, texture, taste, flavour, appearance and overall acceptability the mean scores were (3.9, 4), (4.1, 4.2), (4, 4.3), (4.3, 4.3), (4.5, 4.2) and (3.9, 3.8) for variations 3 and 4 respectively.

Chappathi prepared using 10 per cent sprouted millet milk powders were evaluated to be very good and 20 per cent millet milk powders incorporated chappathi scored lesser when compared to standard and variation1. In case of non-sprouted millet milk powders the both the variations of incorporated recipes were not acceptable.



MEAN ACCEPTABILITY SCORES FOR MOONG DAL DOSA
Figure -17



MEAN ACCEPTABILITY SCORES FOR CHAPPATHI
Figure -18

1.3.5). MEAN ACCEPTABILITY SCORES FOR WHEAT HALWA

The mean acceptability scores for wheat halwa are presented in Table-XVI and Figure-19.

TABLE-XVI

MEAN ACCEPTABILITY SCORES FOR WHEAT HALWA

Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	4.1±0.87	4.2±0.73	4.1±0.63	4±0.66	4.2±0.73	4±0.66
Sprouted						
Var-1	4.9±0.31	4.9±0.31	4.7±0.31	4.9±0.31	4.9±0.42	4.9±0
Var-2	4.9±0.31	4.9±0.31	4.7±0.31	4.9±0.31	4.9±0.42	4.9±0.42
Non- sprouted						
Var-3						
Var -4	4.8±0.42	4.8±0.42	4.7±0.48	4.8±0.42	4.7±0.67	4.7±0.48
	4.8±0.42	4.7±0.42	4.6±0.31	4.7±0.48	4.9±0.42	4.8±0.42
t value						
Sprouted						
Std Vs var-1	3.55**	3.15**	3.13**	2.60*	2.12*	4.74**
Std Vs Var -2	3.55**	3.15**	3.85**	1.18 ^{NS}	2.12*	3.85**
Non sprouted						
Std Vs Var-3	1.98 ^{NS}	2.60*	3.18**	3.20**	2.12*	2.68**
Std Vs Var-4	1.41 ^{NS}	2.60*	3.13**	2.68*	1.70 ^{NS}	3.20**

Std – standard, Var-1 – Variation-1, Var-2 – Variation-2, Var-3 – variation-3, Var-4- variation -4 *significant at 5 % level, **significant at 1 % level, NS- Not Significant.

The mean scores for colour of wheat halwa prepared from sprouted and non-sprouted millet milk powders for standard, variation1,2,3 and 4 were found to be (4.2, 4.9, 4.9,4.8 and 4.7). Comparing the standard with both the variation of sprouted and non-sprouted millet milk powders at one percent level for variation 1 and 2, five per cent significance was observed in variation 3 and 4.

On considering texture, the mean scores for wheat halwa prepared from sprouted millet milk powders at standard was (4.1), variation1 was (4.7) and variation 2 was (4.7) whereas for wheat halwa prepared from non-sprouted millet milk powders at variation 3 and variation 4 were (4.7 and 4.6) respectively.

The scores for taste of wheat halwa prepared from sprouted millet milk powders were 4 (standard), 4.9 (variation1) and 4.9 (variation 2), the differences being statistically significant at five per cent level for standard comparing with variations 1 and 2. Mean scores for taste of wheat halwa prepared from non-sprouted millet milk powders were 4.8 (variation 3) and 4.7 (variation 4), the difference being statistically significant at one per cent level for standard compared with variations 3 and 4.

In terms of flavour, mean scores of wheat halwa prepared from sprouted and non-sprouted millet milk powders were (4.2, 4.9, 4.9, 4.7 and 4.9) for standard, variations1,2,3 and 4respectively, the difference being statistically significant at five per cent level forwheat halwa prepared from sprouted millet milk powders in both the comparisons and there were no significant difference between thevariation 4 in the case of non-sprouted millet milk powders.

Mean scores for appearance of wheat halwa prepared from sprouted and non-sprouted millet milk powders were (4.1, 4.9, 4.9, 4.8 and 4.8) for standard, variation1,2,3 and 4 respectively, the difference being statistically significant at one per cent level for standard and both the variations 1 and 2. There were no significant differences between the standard and variations 3 and 4.

Wheat halwa prepared using 10 per cent of sprouted millet milk powders were evaluated to be very good and 20 per cent of millet milk powders incorporated wheat halwa scored lesser when compared to standard and variation1. In case of non-sprouted millet milk powders both the variations of incorporated recipes were not acceptable.

1.4). RECIPES PREPARED BY BAKING METHOD

1.4.1). MEAN ACCEPTABILITY SCORES FOR BISCUIT

The mean acceptability scores for biscuit are presented in Table-XVII and Figure-20.

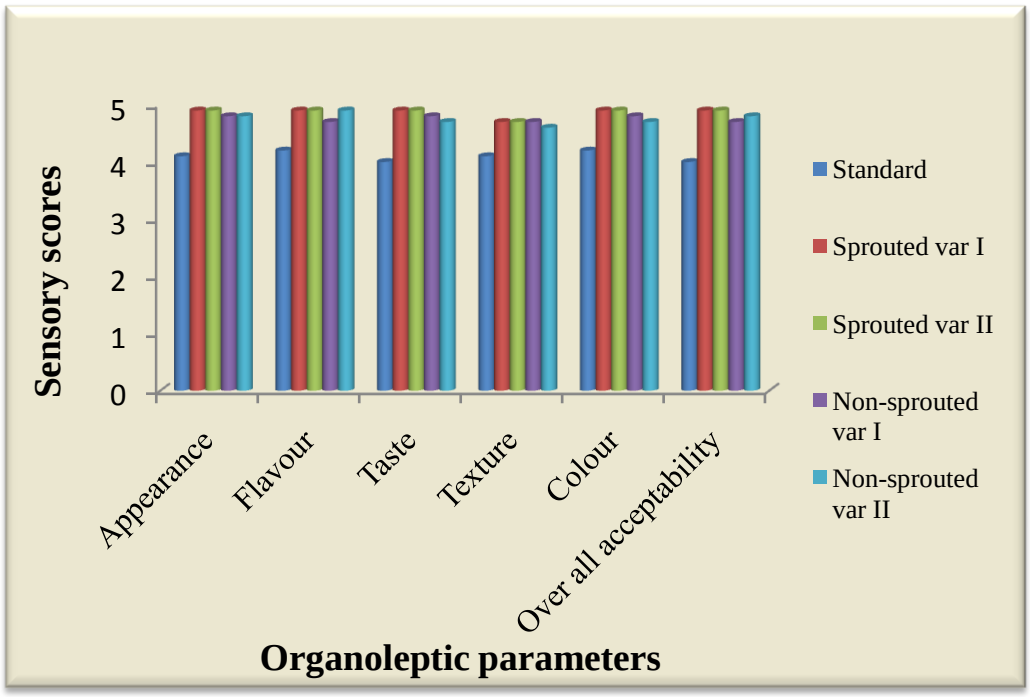
TABLE-XVII

MEAN ACCEPTABILITY SCORES FOR BISCUIT

Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	4.1±0.87	4.2±0.73	4.1±0.73	4±0.66	4.2±0.63	4.1±0.73
Sprouted						
Var-1	4.9±0.31	4.8±0.31	4.9±0.31	4.8±0.42	4.8±0.42	4.9±0.31
Var-2	4.5±0.48	4.3±0.84	4.6±0.70	4.2±0.63	4.5±0.51	4.6±0.51
Non- sprouted						
Var-3	4.8±0.51	4.3±0.48	4.6±0.48	4.5±0.52	4.7±0.48	4.7±0.51
Var -4	4.4±0.69	4.6±0.84	4.7±0.51	4.2±0.78	4.6±0.48	4.4±0.69
t value						
Sprouted						
Std Vs var 1	3.15**	3.15**	3.17*	3.20**	3.09*	3.15**
Std Vs Var 2	1.75 ^{NS}	1.12 ^{NS}	1.23 ^{NS}	0.68 ^{NS}	0.39 ^{NS}	1.75 ^{NS}
Non sprouted						
Std Vs Var-3	2.15*	2.60 ^{NS}	2.15*	0.61^{NS}	0.39^{NS}	2.00*
Std Vs Var-4	1.75 ^{NS}	0.84 ^{NS}	0.84 ^{N}	1.86^{NS}	1.54^{NS}	1.05 ^{NS}

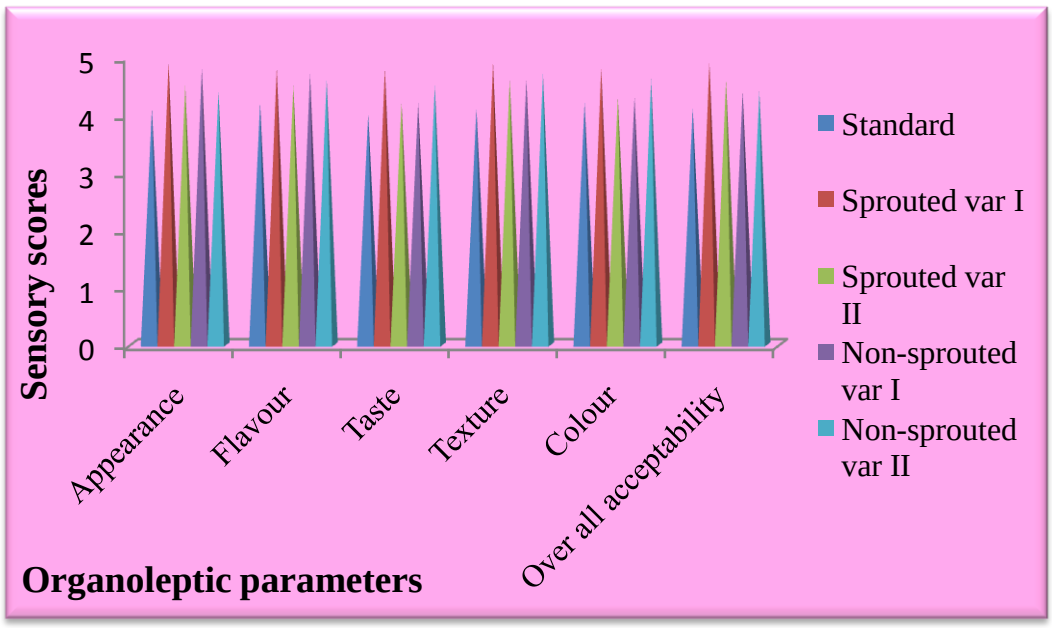
Std – standard, Var-1 – Variation-1, Var-2 – Variation-2, Var-3 – variation-3 Var-4 – variation-4 *significant at 5 % level, **significant at 1 % level, NS- Not Significant.

The mean scores for biscuit prepared from sprouted millet milk powders in terms of colour, texture, taste, flavour and appearance were (4.2,4.8,4.3), (4.1,4.9,4.6), (4,4.8,4.2), (4.2,4.8,4.9) and (4.1,4.9,4.5) for standard, variation1 and variation 2 respectively. The mean scores being statistically significant at one per cent level in comparing standard comparisons with variation1 for biscuit prepared from sprouted millet milk powders in all organoleptic parameters. In comparing with variation 2 there were no significant differences between standard. Similarly the mean scores for biscuit prepared from non-sprouted millet milk powders were (4.3,4.6), (4.6,4.7), (4.5,4.2), (4.7,4.6) and (4.8,4.4) for variations 3 and 4 respectively, the difference being statistically significant at five per cent level compared with standard for all the organoleptic parameters of biscuit prepared from non-sprouted millet milk powders.



MEAN ACCEPTABILITY SCORES FOR WHEAT HALWA

Figure -19



MEAN ACCEPTABILITY SCORES FOR BISCUIT

Figure -20

1.4.2). MEAN ACCEPTABILITY SCORES FOR MUFFINS

The mean acceptability scores for muffins are presented in Table- XVIII and Figure-21.

TABLE-XVIII
MEAN ACCEPTABILITY SCORES FOR MUFFINS

Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	4.2±0.87	3.9±0.73	4.1±0.66	3.9±0.73	4±0.87	4.4±0.51
Sprouted						
Var-1	4.8±0.52	4.8±0.48	4.5±0.48	4.8±0.70	4.7±0.42	4.7±0.48
Var-2	4.7±0.42	4.5±0.42	4.6±0.51	4.7±0.67	5±0.42	4.6±0.69
Non-sprouted						
Var-3	4.7±0.42	4.7±0.48	4.5±0.52	4.4±0.51	4.3±0.48	3.7±0.38
Var -4	4.9±0.48	4.8±0.49	4.6±0.54	4.8±0.69	4.8±0.67	3.7±0.38
t value Sprouted						
Std Vs var 1	4.95**	3.49**	3.20**	2.86*	2.92*	3.15*
Std Vs Var 2	3.28**	2.98*	3.20**	2.45*	2.85*	2.66*
Non sprouted						
Std Vs Var-3	1.68 ^{NS}	1.98 ^{NS}	3.85**	2.09*	2.53*	0.97 ^{NS}
Std Vs Var-4	0.55 ^{NS}	3.13**	3.20**	2.45*	2.92*	1.25 ^{NS}

Std – standard, Var-1 – Variation-1, Var-2 – Variation-2, Var-3 – variation-3,Var-4- variation4
*significant at 5 % level, **significant at 1 % level, NS- Not Significant.

The mean scores for muffins prepared from sprouted millet milk powders in terms of colour, texture, taste, flavour, appearance and overall acceptability were (3.9, 4.8, 4.5), (4.1,4.5,4.6), (3.9,4.8,4.7), (4,4.7,5), (4.2,4.8,4.7) and (4.4,4.7,4.6) for standard, variation1 and 2 respectively. The mean scores being statistically significant at one percent level in comparing standard comparisons with variation1 for all the organoleptic parameters of muffins prepared from sprouted millet milk powders and similarly in comparing with variation 2 one per cent significant was observed in all the parameters.

In the case of muffins prepared from non-sprouted millet milk powders the mean scores were (4.7, 4.8), (4.5, 4.6), (4.4, 4.8), (4.3, 4.8), (4.7, 4.9) and (3.7, 3.7) for variation 3 and variation 4 respectively, there were no significant

differencesbetween standard and both the variations 3 and 4 in two parameters namely appearance and overall acceptability except for other organoleptic parameters were significant at five percent level compared with standard.

From the calculated results sprouted millet milk powdersvariation1 propounds to be the best in all organoleptic parameters for muffins. Ten per cent of millet milk powders were incorporated in variation1 and in case of variation 2 twenty percent was used. Incorporation of ten per cent sprouted millet milk powders in recipe was better as it produced good flavour and taste whereas twenty per cent of non-sprouted millet milk powders of incorporation was not acceptable.

1.4.3). MEAN ACCEPTABILITY SCORES FOR BAKED METHI MUTHIYA

The acceptability scores for baked methi muthiya are presented in Table-XIX and Figure- 22.

TABLE-XIX
MEAN ACCEPTABILITY SCORES FOR BAKED METHI MUTHIYA

Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	4.2±0.73	4.1±0.78	4±0.73	4±0.81	3.9±0.81	4.2±0.63
Sprouted						
Var-	4.3±0.48	4.7±0.67	4.1±0.63	4.3±0.67	4.8±0.31	4.3±0.48
Var-2	4±0.56	4.1±0.47	3.9±0.63	3.4±0.51	4.2±0.31	3.9±0.31
Non-sprouted						
Var-I	3.7±0.51	3.7±0.48	3.7±0.31	4±0.42	4.9±0.40	3.9±0.31
Var -2	4.4±0.42	3.7±0.51	3.4±0.48	4±0.42	5±0.42	3.9±0.31
t value Sprouted						
Std Vs var I	2.36*	2.30*	2.92*	2.89*	2.15*	2.39*
Std Vs Var 2	0.36 NS	0.68 NS	0.97 NS	1.96 NS	0.00 NS	1.34 NS
Non sprouted						
Std Vs Var-I	0.36 NS	1.70 NS	1.11 NS	1.98 NS	1.75 NS	1.98 NS
Std Vs Var-2	0.68 NS	1.70 NS	1.11 NS	1.95 NS	1.55 NS	1.98 NS

Std – standard, Var-1 – Variation-1, Var-2 – Variation-2, Var-3 – variation-3, Var-4 – variation -4
*significant at 5 % level, **significant at 1 % level, NS- Not Significant.

The mean scores for baked methi muthiya prepared from sprouted millet milk powders in terms of colour, texture, taste, flavour and appearance were (4.1, 4.7, 4.1), (4, 4.1, 3.9), (4, 4.3, 3.4), (3.9, 4.8, 4.2) and (4.2, 4.3, 4) for standard, variation1 and 2 respectively, the difference being statistically significant at five per cent level in standard compared with variation1 for all the organoleptic parameters whereas there were no significant differences between standard and variation 2.

Baked methi muthiya prepared from non-sprouted millet milk powders the mean scores were (3.7, 3.7), (3.7, 3.4), (4, 4), (4.9, 5) and (3.7, 4.4) for variation 3 and 4 in the terms of colour, texture, taste, flavour and appearance whereas there were no significant differences between standard and both the variations in the case of non-sprouted millet milk powders baked methi muthiya. Baked methi muthiya prepared using 10 per cent of sprouted millet milk powders were evaluated to be very good and 20 per cent millet milk powders incorporated baked methi muthiya scored lesser when compared to standard and variation1. In case of non-sprouted millet milk powders both the variations of incorporated recipes were not acceptable.

1.4.4). MEAN ACCEPTABILITY SCORES FOR COOKIES

The mean acceptability scores for cookies are presented in Table – XX and Figure-23.

TABLE-XX
MEAN ACCEPTABILITY SCORES FOR COOKIES

Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	4.2±0.63	4±0.63	3.8±0.48	3.9±0.73	3.8±0.66	4±0.42
Sprouted						
Var-1	4.7±0.69	4.8±0.63	4.6±0.63	4.6±0.52	5±0.51	4.6±0.69
Var-2	4.8±0.51	4.8±0.51	4.5±0.69	4.6±0.51	5±0.51	4.6±0.69
Non- sprouted						
Var-3	4.8±0.78	4.4±0.51	4.1±0.41	4.2±0.63	4.9±0.50	4.3±0.51
Var -4	4.7±0.63	4.7±0.82	4.2±0.48	4.7±0.78	4.7±0.42	4.7±0.69
t value Sprouted						
Std Vs var -1	3.09**	2.49*	6.0**	2.85*	3.20**	3.28**
Std Vs Var- 2	2.68*	2.49*	6.0**	2.85*	3.20**	3.79**
Non sprouted						
Std Vs Var-3	1.98^{NS}	2.49*	1.08^{NS}	0.80^{NS}	1.30^{NS}	1.98^{NS}
Std Vs Var-4	1.98^{NS}	1.98^{NS}	1.08^{NS}	1.26^{NS}	1.30^{NS}	1.41^{NS}

The mean scores for cookies prepared from sprouted millet milk powders in terms of colour, texture, taste, flavour, appearance and overall acceptability were (4, 4.8, 4.8), (3.8, 4.6, 4.5), (3.9, 4.6, 4.6), (3.8, 5, 5), (4.2, 4.7, 4.8) and (4, 4.6, 4.6) for standard, variations 1 and 2 respectively. The mean scores being statistically significant at one per cent level compared with standard for all the organoleptic parameters and similarly variation 2 at one per cent level compared with standard.

In the case of cookies prepared from non-sprouted millet milk powders there were no significant differences between standard and all the organoleptic parameters of recipes in the terms of colour, texture, taste, flavour, appearance and overall acceptability the mean scores were (4.4, 4.7), (4.1, 4.2), (4.2, 4.7), (4.9, 4.7), (4.8,4.7) and (4.3, 4.7) for variations 3 and 4 respectively.

From the calculated results sprouted millet milk powders variation1 propounds to be the best in all organoleptic parameters for cookies. Ten per cent of millet milk powders were incorporated in variation1 and in case of variation 2 twenty per cent was used. Incorporation of ten percent sprouted millet milk powders in recipe was better as it produced good flavour and taste whereas twenty per cent non-sprouted millet milk powders of incorporation was not acceptable.

1.4.5). MEAN ACCEPTABILITY SCORES FOR SOUP STICK

The acceptability scores for soup stick are presented in Table- XXI and Figure- 24.

TABLE-XXI

MEAN ACCEPTABILITY SCORES FOR SOUP STICK

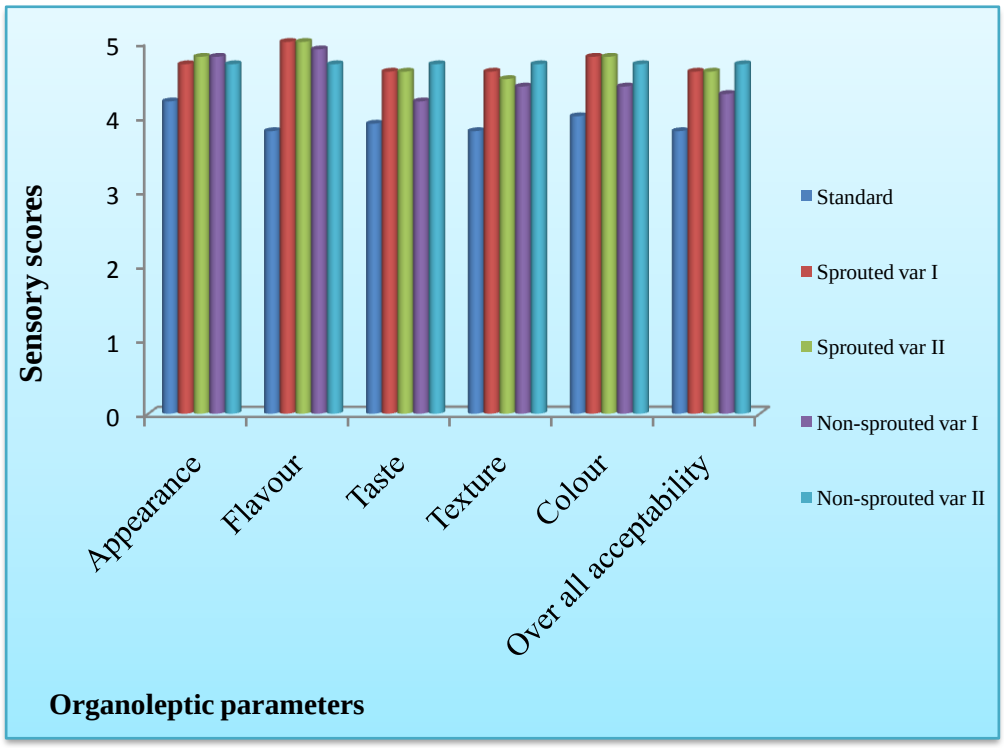
Variations	Appearance Mean ±SD	Colour Mean ±SD	Texture Mean ±SD	Taste Mean ±SD	Flavour Mean ±SD	Overall acceptability Mean ±SD
Standard	4±0.73	4±0.81	3.9±0.66	4.1±0.87	4±0.81	4±0.94
Sprouted						
Var-1	4.5±0.48	4.7±0.52	4.5±0.51	4.3±0.48	4.9±0.42	4.6±0.42
Var-2	4.4±0.63	4.4±0.41	4±0.62	3.9±0.31	4.6±0	4.2±0.31
Non- sprouted						
Var-3	4.3±0.67	3.7±0.48	4±0.31	3.6±0.69	3.8±0.42	3.9±0.31
Var -4	4.2±0.48	3.7±0.48	4±0.67	3.5±0.52	3.9±0.31	3.9±0.31
t valueSprouted						
Std Vs var -1	2.37*	2.62*	2.25*	2.63*	2.33*	2.61*
Std Vs Var -2	0.42 ^{NS}	1.30 ^{NS}	2.85*	0.67 ^{NS}	0.61 ^{NS}	0.55 ^{NS}
Non sprouted						
Std Vs Var-1	0.89 ^{NS}	1.00 ^{NS}	1.84 ^{NS}	1.41^{NS}	0.42^{NS}	031 ^{NS}
Std Vs Var-2	0.42 ^{NS}	1.30 ^{NS}	1.74 ^{NS}	1.85^{NS}	1.00^{NS}	0.31 ^{NS}

Std – standard, Var-1 – Variation-1, Var-2 – Variation-2, Var-3 – variation-3,Var-4, variation -4 *significant at 5 % level, **significant at 1 % level, NS- Not Significant.

In soup stick prepared from sprouted millet milk powders, variation1 received the scores were 4.7, 4.5, 4.3 and 4.9 for various organoleptic parameters colour, texture, taste, appearance and flavour respectively. Similarly variation 2 received scores 4.4, 4.4, 4, 3.9 and 4.6 for various organoleptic parameters. Soup stick prepared from non-sprouted millet milk powders the mean scores were (3.7, 3.7), (3.6, 3.7), (3.6, 3.5), (3.8, 3.9) and (4.3, 4.4) in terms of colour, texture, taste, flavour and appearance for variations 3 and 4 respectively and there were no significant differences in standard compared with both the variations in the case of non-sprouted millet milk powders soup stick.

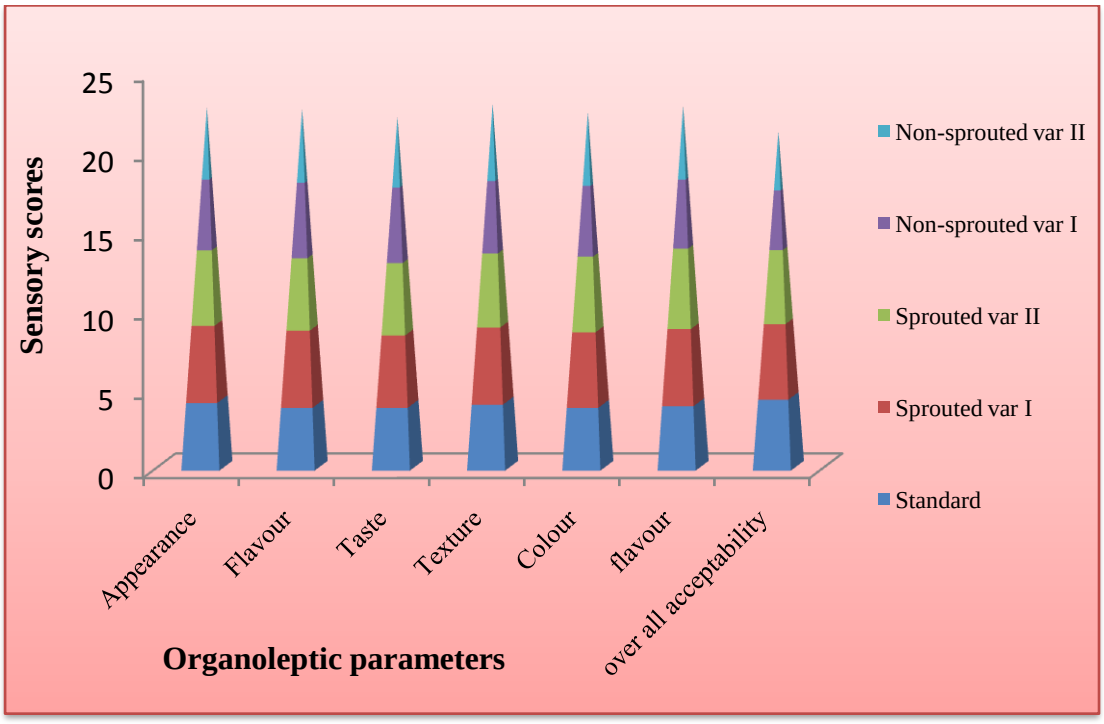
Soup stick prepared from non-sprouted millet milk powders the mean scores were (3.7, 3.7), (3.6, 3.7), (3.6, 3.5), (3.8, 3.9) and (4.3, 4.4) in terms of colour, texture, taste, flavour and appearance for standard, variations 3 and 4 respectively and there were no significant differences in standard compared with both the variations in the case of non-sprouted millet milk powders soup stick.

Soup stick prepared using 10 per cent sprouted millet milk powders were evaluated to be very good and 20 per cent millet milk powders incorporated soup stick scored lesser when compared to standard and variation 1. In case of non-sprouted millet milk powders both the variations of incorporated recipes were not acceptable.



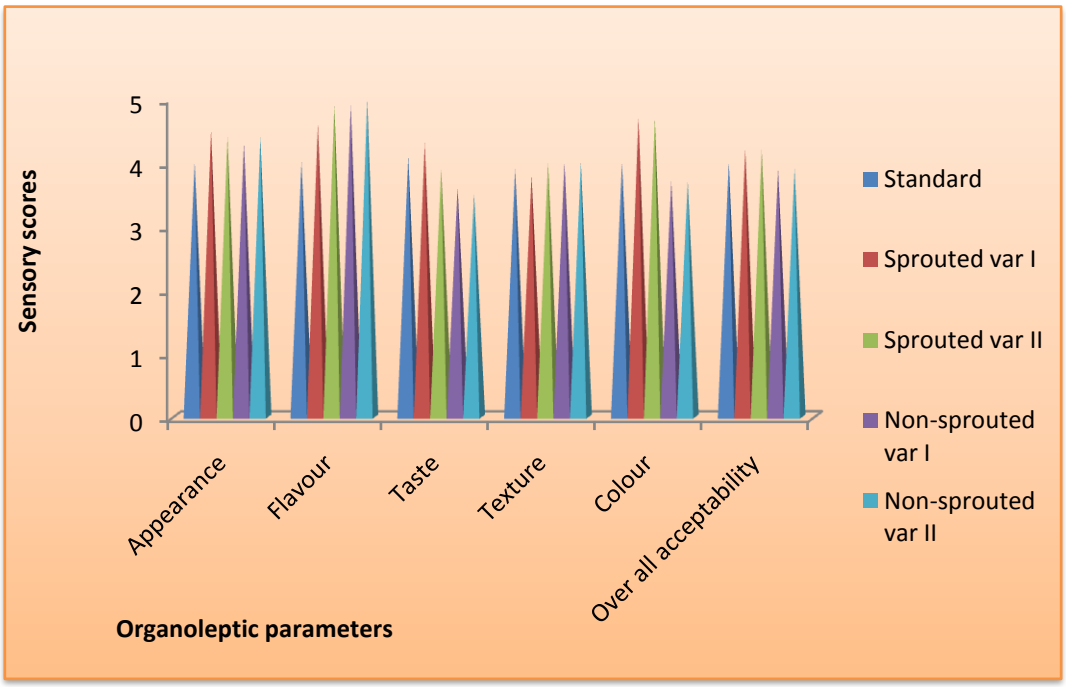
MEAN ACCEPTABILITY SCORES FOR COOKIES

Figure-21



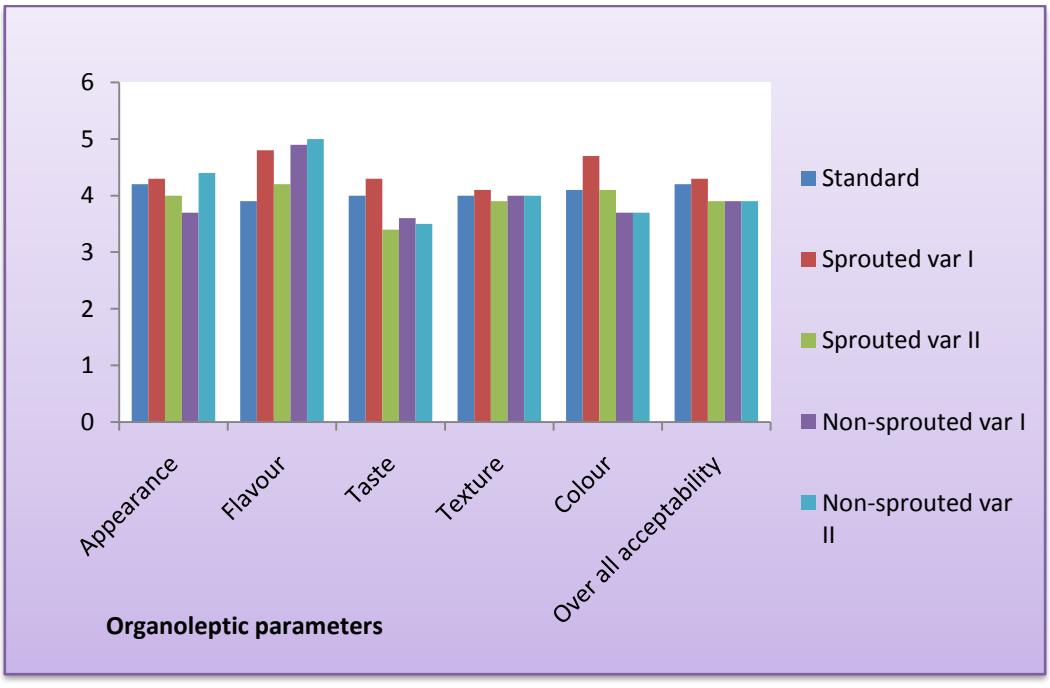
MEAN ACCEPTABILITY SCORES FOR MUFFINS

Figure-22



MEAN ACCEPTABILITY SCORES FOR BAKED METHI MUTHIYA

Figure-23



MEAN ACCEPTABILITY SCORES FOR SOUP STICK

Figure-24

V. SUMMARY AND CONCLUSION

Food consumption, which largely depends on production and distribution, determines the health and nutritional status of the population. Since people consume food, it is essential to advocate nutrition in terms of foods, rather than nutrients. Emphasis has, therefore, been shifted from a nutrient orientation to the food based approaches for attaining optimal nutritional status.

Millet is an important food in many developing countries because of its ability to grow under diverse weather conditions such as limited rain fall. It is grown extensively in India although it is not utilized as major important food crop. In view of current life style and agricultural scenario with perspectives of modernization and global warming, there is need to revive these crops for multiple benefits.Millets are also a rich source of non-nutritional components like phenols, tannins, phytates and flavonoids. These compounds serve as antioxidants and millets could also be used as a source of extremely beneficial phytochemicals in the pharmaceutical and food industry.

With this background the present study on "**FORMULATION AND STANDARDISATION OF VALUE ADDED RECIPES INCORPORATED WITH MILLET MILK POWDERS**" was undertaken with the following objectives toFormulate and standardise recipes using millet milk powders, analyse the nutrient content of the millet milk powdersand conduct sensory evaluation for developed recipes.

The methodology followed for the present study is as follows:

The millets were soaked separately overnight for a period of 12 hours in normal room temperature. One half of the millets were processed further for grinding and extraction of milk from millets. The other half of the soaked millets, were dried in a loosely woven cotton cloth and hung for period of two days (48 hour) in normal room temperature. One half of the millets were processed further for grinding and extraction of milk. Other halves of the sprouted millets were processed for extraction of milk by same methods. The extracted non sprouted millets milk was sun dried. The dried millet milk powders were ground in to a fine powder.

Based on the cooking methods with reference to minimum nutrient loss during cooking and popularity in south Indian cuisine various recipes were selected.Steaming, Baking, Frying and shallow fat frying were the cooking methods

which statistics the above mentioned factors. Hence based on the above mentioned methods recipes were developed using millets milk powder. Using each of these four different methods five different recipes were prepared making up the total to twenty.

All the recipes were standardised and evaluated for acceptability by a panel of 10 semi trained panellists. Numerical scoring method from excellent to not acceptable was used for each organoleptic parameter. The organoleptic parameters included colour, flavour, taste, texture, appearance and overall acceptability.

Mean and standard deviation was calculated for sensory score. Significance between the variations was evaluated on the basis of t- test. Analysis of nutrient content is an important aspect in standardizing and developing a new product and evaluating a new process for making food products. The millet milk powders both sprouted and non-sprouted were then analysed for nutrients like moisture, carbohydrate, protein, fat, calcium and iron using standardised procedures given by AOAC (2000).

The results are the present study was summarised as follows:

The sprouted and non-sprouted millet milk powders were high in protein and carbohydrate. Fat content of sprouted millet milk powders was low, with regard to other micronutrient of were rich in iron and calcium compared with non-sprouted millet milk powders.

Puttu prepared from sprouted millet milk powders scored more for their flavour and overall acceptability. Idiyappam incorporated with sprouted millet milk powders scored more for their flavour and the overall acceptability.

In case of idly, based on the mean scores of sprouted millet milk powders in variation 1, taste and overall acceptability parameters were found to highly significant on the basis of t- test.Sprouted millet milk powders incorporated in ada scored more for flavour and colour. The overall acceptability was high in ada incorporated at10 per cent level. In kozhukattai prepared with sprouted millet milk powders, variations 1 and 2 are the most acceptable on the basis of mean scores with respect all the organoleptic parameters. Differences between the variations were found to be five significant on the basis of t- test.

Murruku prepared from sprouted millet milk powders scored more for their flavour and colour. The overall acceptability was gained by 10 per cent and 20 per cent level of incorporation. Based on the mean scores, thattu vadai prepared from sprouted millet milk powders variation1 scored highest and was the most acceptable

amongst all the variations. A highly significant difference was found between the mean scores of variation with respect to all the parameters.

The investigator found that the sprouted millet milk powders incorporated in pakoda invariation1 scored the highest mean sensory scores for flavour, texture and taste. The overall acceptability was high at10 percent level of incorporation.

Based on the mean scores, variation1 in sprouted millet milk powders incorporated in ribbon pakoda to be the best among the all variation1 in terms of all sensory parameters. Difference between the mean scores of variation was significant at one per cent for colour and flavour.

Sprouted millet milk powders incorporated ada and poli scored more for their texture and taste. The overall acceptability was gained by 10 per cent level of incorporation. Differences between the variations were found to be significant at five per cent for flavour and colour on the basis of t- test.

Variation1of sprouted millet milk powders prepared from moong dal dosa scored the highest means score in texture and taste. The difference between the mean scores of variations was significant at one per cent level for texture and colour. Sprouted millet milk powders incorporated with chapathi scored more for their flavour and texture. The overall acceptability was highest for10 per cent level of incorporation.

In case of sprouted millet milk powders incorporated in wheat halwa, based on the mean score,variation1 was considered to be best among the three variations; taste and overall acceptability parameters were found to be highly significant based on the t- test value.

Sprouted millet milk powders incorporated in biscuit scored more for their texture and colour. Differences between the variations found to significance at one per cent level for flavour, texture and overall acceptability. Sprouted millet milk powders incorporated with muffins scored more for their taste and overall acceptability. The significance of difference between the mean scores of variation was observed at one percent for flavour and taste.

Variation1ofbaked methi muthiya scored the highest mean score, difference between the mean scores were found to be significant at five per cent level.Variation1 was consistent in all the sensory attributes. Hence it was considered the most acceptable. Based on the mean scores, sprouted millet milk powders variation1 incorporated with cookies scored the highest and was the most acceptable amongst all

the variations. The soup stick incorporated with sprouted millet milk powders scored more for their texture and colour. The overall acceptability was gained by 10 per cent level of incorporation.

Millet an ancient whole grain is counted on around the world to provide basic nutrition for many developing nations. Eating millet, a tiny yellow seed grain may improve our overall well-being by providing nutrients essential for maintainingbasic health as vegetarian protein source, packed with vitamins and minerals, antioxidants and gluten free food. Minor millets an integral part of food intake can lower the risk of life style related diseases. No wonder there is a sense of emergency that the change in life style and diet especially in urban population is need to be satisfied with best foods in terms of quality and quantity.

Hence the extraction of millet milk powders is one of the means of making the nutrients available in millets into a more concentrated source. Incorporation of millet milk powders in various recipes was a new idea to promote the intake of millets by all the age groups. The millets which are available at our door steps are packed with various essential nutrients are really a boon to the community when consumed correctly in right proportion.The immense potentialities that dehydrated millet milk powder possesses could be utilized in development of novel food products at therapeutic end.

Suggestion for Future studies

- Conduct long term feeding trails with milletsandits various by products.
- Formulate and develop new infant formulas as millets being a probiotics and
- Conduct research studies on phytochemicals and antioxidant properties of millet milk powders.

BILIOGRAPHY

- Ahmed, S.M. Saleh, Qing Zhang, Jing Chen and Qun Shen (2013). Millet Grains:Nutritional quality, processing and potential health benefits, Institute of Food Technologists, Vol.12, Pp:288-290.
- Amil Gull, Romee Jan, Gulzar Ahmed Nayik, Kamlesh Prased and Pradyuman Kumar, (2014). Significance of finger millet in Nutrition, Health and Value added products: A Review, Engineering and Technology, JECET, Vol.3 Issu.3, Pp: 1601-1603.
- Anil kumar, Vikram Singh Gaur., Anishita Goel., Atul kumar Gupta, (2014). De Novo assembly and characterization of developing spikes transcriptiome of finger millet (Elesine Coracana): A minor crop having neutraceutical properties, Plant molecular biology report, Pp: 487-489.
- Antony Olusegun Obilana, (2013). Nutritional, physiocochemical and sensory characteristics of a pearl millet- based instant beverage powder, Durban University of Technology, Durban, Pp: 227.
- Anuratha, D. Desai, Sharduli, S. Kulkarni, A.K., Sahoo, R.C., Ranveer and Dandge, P.B, (2010). Effect of supplementation of malted ragi flour on the nutritional and sensorial quality characteristics of cake, Advance Journal of Food Science and Technology, vol.2, issu.1, Pp: 67-71.
- AOAC official method 991.20, (2010). Nitrogen in milk, Kjeldhal method of analysis.
- Ashwini G. Rane, Jyothi D. Vor and Prinyanka Jadhav, (2014). A review on the Biochemical, Antimicrobial and Organoleptic studies on the germination profile of Finger millet (Elusine coracana), International Journal of Food Science, Nutrition and Dietetics (IJFS), vol.2, PP: 69.
- Avsar, Y.K., Karagul Yuceer, Y., Drake, M.A., Singh, T. K., Yoon, Y and Cadwallader, K.R, (2004). Characterization of nutty flavour in chedder cheese, Journal of Dairy Science, Vol. 87, Pp: 1999-2002.
- Awasthi, P and Yadav, M.C, (2000). Effect of incorporation of liquid dairy by products on chemical characteristics of soy fortified biscuit, Journal of Food Scince and Technology, 37(2), Pp: 158-161.
- Azhari, A. M Nour., Awad M.Sokrab., Isam A. M. Ahmed and Elfadil E. Babiker, (2014). Supplementation and cooking of pearl millet: changes in antinutrient and total minerals content extractability, Innovative Romanian Food Biotechnology, Vol. 15, Pp: 289-291.
- Balasubramanian, S., Deep N. Yadav and Tanupriya Anand, J., (2014). Development and shelf-life evaluation of pearl millet based upma dry mix, Food Science and Technology, 51(6), Pp: 1110-1117.
- Balasubramanian, S., Jaspreet Kaur and Deepak Singh, (2014). Optimization of extraction and the effect of pH on their stability, Food Chemistry, 105, Pp: 862-865.
- Baskar., Banumathi and Kanchana, (2013). Health benefit of small millets, National seminar on Recent Advances in processing, utilization and nutritional impact of small millet, Madurai Symposium, Thamukkam Grounds, TamilNadu Agricultural University, Coimbatore and DHAN Foundation, Madurai, Pp: 37.
- Bayarri, S., Carboneel, I., Barrios, E and Costel, (2011). Impact of sensory differences on consumer acceptability of yogurt and yogurt like product, International Dairy Journal, Vol.21, Pp: 111-115.
- Bela Shah and Prashant Mathur (2005). Risk factor surveillance for Non-Communicable Diseases (NCDs), the multi- site ICMR- WHO collaborated initiative, Forum 9, India, Pp: 59-61.
- Bolbol, R. R., Mohamed, H. S and Mohamed A.K (2012). Changes in total phenolic and DPPH scavenging activity during domestic processing in some cereal grains, Journal of food Science and technology, vol.13, issu.2, Pp: 190-196.
- Chandrasekara A., Naczk M and Shahidi. (2011), Effect of processing on the antioxidant activity of millet grains, Food Chemistry, 133, Pp: 1-9.
- Denial, M., Mammen Denni and Dipa Chauhan, (2012). Poluphenols, phospholipids and flexed oil composition of pearl millet (Pennisetum glaucum (L)), International Journal of Pharmaceutical and Life Science (IJPLS), vol.3, issu. 11, Pp: 2098-2102.

- Dimble Singh Ackbarali and Rohanie Maharaj, (2014). Sensory evaluation as a tool in determing acceptability of innovative products developed by undergraduate student in Food Science and Technology at university of Trinidad and Tobago, Journal of Curriculum and Technology, Vol.3, issu. 1, Pp: 449-552.
- Dubey, A and verma, A.K., (2009). Millets: Good neutraceutical source, Agrobedia vol.1, issu.1, Pp: 128-130.
- Durga Shankar Bunker., Alok Jha and Ankur Mahajan, (2014). Optimization of the formulation and technology of pearl millet based ready to reconstitute kheer mix powder, Journal of Food Science and Technology, vol.51, issu. 10, Pp: 2408-2410.
- Fasasi, O.S., Eleyinmi, A.F., Oyarekue, M.A, (2007). Effect of some traditional processing operation on the functional properties of African bread fruit seed (teculia Africana) flour. Journal of food science and technology 40: Pp.No; 513- 519.
- Fereidoon Shahidi and Marian Naczk. (2006), "Phenolics in Food and Nutraceuticals" CRC PRESS Washington, D.C. Pp.No:27 (book).
- Florence Suma, P and Asna Urooj, (2014). Influence of germination on bioaccesible iron and calcium in pearl millet (Pennisetum typhoideum), Journal of Food Science and Technology, vol. 51, issu. 5, Pp: 976-978.
- Food and Agricultural Organization, (2012). Economic and Social Department: the Statistical Division, Statistic Devision.
- Gabriela Iordachescu, Camelia Neagu, Tateana Costea, (2013). Sensory evaluation of functional bread obtained on rice and millet flour basis, Inside Food Symposium, Leuven, Belgium, Pp: 113-114.
- Georage Amponsah Annor (2013). Millet strarches: structural characteristics and glycemic attributes, Canada, Pp:69.
- Gopalan C, Ramasastri BV, Balasubramanian SC (2004) Nutritive value of Indian Foods. National Institute of Nutrition (NIN). Indian Council of Medical Research, Hyderabad, pp 59–67.
- Gupta, N. Srinivastava and Pandey, V. N, (2012). Biodiversity and nutraceutical quality of some Indian millet proceeding of the National Academy of Sciences, Indian section B: Biological Science, 82, Pp: 265-273.
- Horwitz, W (2000). Official method of analysis of AOAC International, AOAC International, Maryland, USA, 17 editions, Pp: 239-240.
- Hotz, C and Gibson, R, (2007). Traditional food processing and preparation practises to enhance the bioavailability of micronutrients in plant based diets, Journal of Nutrition, 137, Pp: 1097-1100.
- Imtiaz Hussain., Saeed Ahmed, Muhammad Amjad and Rashid Ahmed, J., (2015). Effect of modified sun drying techniques on fruit quality characters of dates harvested at rutab stage, Agric.Res, 52(3), Pp: 415-419.
- Inyang and Zakari, U.M (2008). Effect of germination and fermentation of pearl millet on proximate, chemical and sensory properties on instant Fura- A Nigerian cereal food. Pakistan Journal of Nutrition, vol.7, issu. 1, Pp: 9-12.
- Jaybhaye, R. V., Pardeshi, I.L., Vengaiah, P.C and Srivastav, P.P, (2014). Processing and technology for millet based food products: A review journal, Ready to eat food, Vol. 1, issu. 2, Pp: 32-48.
- Jonathan W. devries, (2007). AOAC International validated methods for nutrient analysis-method availability and method needs, Pp: 187-197.
- Joshi, A., Rawat K and Karki B, (2008). Millets as religious offering for nutritional, ecological and economical security-comprehensive Review, Food Science and Food Safety, vol.7, Pp: 369-372.
- Kang, R.K., Jain, R and Mridula, D., (2008). American Journal of Food Technology, Vol.3, issu.1, Pp: 50-55.
- Kedar N Rai, Mahalingam Govindaraj and Aluri S. Rao, (2012). Genetic enhancement of grain iron and zinc content in pearl millet, ICRISAT, Vol. 4, issu. 3, Pp: 119- 122.
- Kevin Guest, (2009). Nutrient Depletion of our foods, Macwilliam Communication Inc, Canada, Pp: 9-10.

- Khattak, A.B, Zeb, A., Khan, M., Bibi, N., Ihsanullah, I, (2007). Influence of germination techniques on sprouted yield, biosynthesis of ascorbic acid and cooking quality in chickpea (Cicer arietinum). Journal of Food chemistry 103, Pp: 115-120.
- Klaus Grunert, L2sa Lahteenma, Annika Astro, M and Anne Arvola, (2002). Acceptability of genetically modified cheese presented as real product alternative, Food Quality and Preference, 13, Pp: 523-533.
- Krishna Arora (2008). Theory of cookery. Frank Bros & co publishers Ltd, 6 th edition, Pp.No.89.
- Kumar, A., Mirza, N., Charan, T., Sharma, N and Gaur, V.S., (2014). Isolation, characterization and immunolocalization of a seed dominant cam from finger millet (Elesine Coracana L. Gartn) for studying its functional role in differential accumulation of calcium in developing grains, Applied Biochemistry Biotechnology, 14, Pp: 525-528.
- Lee, S.H. Chung., Cha, I.M., Park, Y.S., (2010). Millet consumption decrease serum concentration of triglyceride and C-reactive protein but not oxidative status in hyperlipidemic rats, Nutrition Research, 30(4), Pp: 290-296.
- Lestienne, I., Icard-Verniere, C., Mouquet, C., Picq, C and Treche, S (2005). Effect of soaking whole cereal and legume seed on iron, zinc and phytate contents, journal of Food Chemistry, 89, Pp: 421-425.
- Malleshi, N.G., Hiadimani, N.A, Riley K.W., Gupta, S.C., Seetharam, A and Mushonga, J.N., (1993). Nutritional and technological charcteristics of small millets and preparation of value added products from them, In Advances in Small Millets, Oxford and IBH Publishing: New Delhi, Pp: 270-271.
- Mamatha, H.S and mushtari Begum, (2014). Nutrient analysis and cooking quality of finger millet (Elesine Coracana) vermicelli with hypoglycemic foods, International Journal of Farm Sciences, Vol.3, issu. 2, Pp: 56-62.
- Maney, N.S., Shadaksharaswamy, M (2008). Foods Facts and principles, New Age International (P) Ltd, third edition, Pp: 197- 210.
- Manju sharma and Paul khurana S. M. (2014), Alternative healthy food crops, journal of nutrition and food Science Vol. 4, iss. 4, Pp: 241.
- Mealon, C. E., (2007). Food analysis: theory and practices, chapman and hall, third edition, Pp: 264-272.
- Meilagaar, M., Civille, C.V and Carr, B.T., (2007). Sensory evaluation techniques, fourth edition, CRC, Boca Raton, UK, Pp: 14.
- Miracle Grains, (2013). Know thy nature, Miracle Grains, I st edition, Pp: 11.
- Mirdula, D., Monica Sharma and Gupta, R. K., (2014). Development of quick cooking multi-grain dalia utilizing sprouted grains, Journal of Food Science and Technology, Pp: 11-13.
- Mohamed, M. Eltayeb., Amro, B. Hassn., Mashier, A. Sulieman and Elfadil, E. Babiker, (2007). Effect of processing followed by fermentation on Antinutritional factors content of pearl millet (Pennisetum glaucum L.) extracts, Journal of Food Chemistry, 126, Pp: 1643-1647.
- Molly Thembi Malaza, (2012). The development, standardisation and acceptability of the traditional Tsonga-shangaan dishes, Xigugu and Xiendla hi vomu for use in ethnic restaurants, University of Pretoria, Pp: 32-35.
- Muhimbula, S., Abdulsudilssa and Joyce Kinabo, (2011). Formulation and sensory evaluation of complementary foods from local, cheap and readily available cereals and legumes in Iringa, Tanzania, African Journal of Food Sciences, 5(1), Pp:26-31.
- Nambiar V.S., Mehta, R and Denial, M, (2005). Polyphenol content of three Indian Green leafy vegetables, Journal of Food Science and Technology, 42, Pp: 312- 315.
- NASS, (2013). Role of millet in nutritional security of India, National Academy of Agricultural Sciences, New Delhi, policy paper No. 66, Pp: 16.
- Nelson Thrones, (2006). Food preparation and cooking cookery units: student guide, Nelson thrones (P) Ltd, second edition, Pp: 61.
- Nirgude, M., Kalyana babu, B., Singh, U. M., Upadhayaya, H. D and Anil kumar, (2014). Development and molecular characterization of genic molecular markers for grain protein and

calcium content in finger millet (Eleusine Coracana (L) Gaetn), Molecular Biology Report, 411, Pp: 1189-1200.

- Nirmala, M., subba Rao and Muralikrishna G, (2000). Carbohydrates and their degrading enzymes from native and malted finger millet (Elusina coracana), Food Chemistry, 69, Pp: 175-180.
- NNMB Technical report No: 24, (2010). Diet and nutritional status of population and prevalence of Hypertension among adults in rural areas, NNMB, NIN, ICMR, Hyderabad.
- Odusola K B, Ilesanmi F F, Akinloye O.A "Assessment of nutritional composition and antioxidant ability of pearl millet (Pennisetum glaucum)" American Journal of Research Communication 2013: Vol 1(6) Pp No: 89-92.
- Palanisamy Bruntha Devi, Rajendran Vijayabharathi, Sathyaseelan Sathyabama, Nagappa Gurusiddappa Malleshi and Venkatesan Brindha Priyadarshini, (2014). Health benefits of finger millet (Elusine coracana L.) polyphenols and dietary fiber: A review, Journal Food Science Technology, Vol.51, issu.6, Pp: 1021-1040.
- Pavithra, R (2015). A survey on utilization of millets among homemakers, UGC sponsored International conference on Advances in Home Science studies, Tirupati, Andhra Pradesh, Pp: 28.
- Poongodi Vijayakumar, T and Jemima Berly Mohankumar (2011). Drying characteristics of pre-treated kodo and banyard millet, Indian Journal of Nutrition and Dietetics, 48, Pp: 162.
- Pradeep, S.R and Guha, M, (2010). Effect of processing methods on the nutraceutical and antioxidant properties of little millet (Panicum sumatrense) extract. Journal of Food Chemistry, 126, Pp: 1643-1647.
- Prashant Hedge., Anitha, B and Chandra, T. S, (2005). In vivo effect of whole grain flour of finger millet (Elusine coracana) and kodo millet (paspalum Scrobiculatum) on rat dermal wound healing, Indian Journal of Experimental Biology, Vol.43, Pp: 254-258.
- Pushpa Devi M and Narayanasamy sangeetha. (2013), Extraction and dehydration of millet milk powder for formulation of extruded product IOSR Journal of Environmental Science, Toxicology and Food Technology(IOSR- JESTFT), vol 7, iss.1, Pp No: 63-70.
- Radhapriya, D and Lakshmi, U. K., (2012). Hypoglycemic and Hypolipidimic effect of selected gourd vegetables of type 2 diabetics, Indian Journal of Nutrition and Dietetics, vol. 49, 509, Pp: 507-508.
- Reshmi R and Nandini P. V (2013), nutritional significance and therapeutic value of millets, National Seminar on Recent Advences in Processing , Utilization and nutritional impact of small millet., Madurai symposium, Thamukkam. Pp: 60.
- Saikai, D and Deka S., (2011). Cereals: from staple food to nutraceuticals, International Food Research Journal, vol.18, issu. 21, Pp: 25.
- Saikrishna, S., Sushma Rani, T and Jadhav, B. A., (2011). Development of nutritionally enriched banana cake with the incorporated of finger millet, Indian Journal of Nutrition and Dietetics, 48, 158, Pp: 158-159.
- Saleh, A. S., Zhank, Q., Chen, J and Shen, Q., (2013). Millet grain: nutritional quality, processing and potential health benefits. Comprehensive review in Food Science and Food Safety, 12, Pp: 281-295.
- Sangeeta Gupta, Santhose Kumar shrivastava, Manjul Shrivastava, (2014).fatty acid composition of new hybrid varieties of minor millets seed, 2OABJ, vol. 5, issu.1, Pp:15-18.
- Sarah, E. Kemp., Tracey Hollowood and Joanne Hort (2009). Sensory evaluation – A practical hand book, wiley- Blackwell A john wiles and sons (P) Ltd, Pp. 223.
- Saravanan, M and Soam, S. K., (2010). Exploitation of minor millets genetic resources for poverty alleviation in India, National Conference on Biodiversity, development poverty elevation, Uttar Pradesh state Biodiversity board, Pp: 105-107.
- Sari Edelstein, (2013). Food science: An Ecological Approch, Jones and Bartlett Publishers, Pp: 87.
- Shakuntala Manay, N and Shadakshraswamy, M (2008). Food Facts and Principles, New Age International (P) Ltd, Third revised edition, Pp.223.

- Shalaja Hittamani, (2004). Development of high yielding, disease resitent, drought tolerant finger millet (Elusine coracana Gaertn), University of Agricultural Sciences, Progress report of the Mc Knight Foundation funded Project, Pp: 46-49.
- Shimelis Admassu, Mulugeta Teamir, Dawit Alemu, (2009). Chemical composition of local and improved finger millet (Elusine coracana) varieties grown in Ethiopia. Pp: 79-81.
- Shinoj S., Viswanatha R., Sajeev M. S and Moorthy S. N. (2006), gelatinisation and rheological characteristics of minor millet flours. Bio sys Eng. 95 Pp: 51-59.
- Shobana, S., Harsha, M.R., Platel, K., srinivasan, K and Malleshi, N.G., (2010). Amelioration of hyperglycemia and its associated complications by finger millet (Eleusine Coracana L.) seed coat matter in streptozotocin-induced diabetic rats, Britis Journal of Nutrition, 104(12), Pp: 1787-1795.
- Shobana, S., Sreerama, Y and Malleshi, N, (2009). Composition and enzyme inhibitory properties of finger millet (Elesine coracana L.) seed coat phenolics: mode of inhibition of α-glucosidase and pancreatic amylase, Food Chemistry, 115, Pp: 1268-1273.
- Shrikant Baslingappa Swami., Thakor N.J and Malleshi, N, (2009). Effect of soaking and malting on finger millet (Elsina coracana L.) grain, Agricultural Engineering International: CIGR Journal, Vol. 15, iss. 1, Pp: 194.
- Shubhashini, V and Ushadevi, C, (2014). Estimation of glycemic index of pearl millet, International journal of Advance Research, Vol.2, issu.1, Pp: 922-929.
- Sibian, M.S., Saxena, D.C and Riar, C.S., (2013). Study of absorption behaviour, functional and pasting properties of pearl millet soaking under different chemical stresses, International Journal of Agriculture and Food Science and Technology, vol.4, issu.4, Pp: 347-350.
- Singh, P and Raghuvanshi, R. S., (2012). Finger millet for food and nutritional security, African Journal of Food Science, 6,4, Pp: 77-84.
- Spears and Gregoire, M.B, (2010). Food Service Organizations: A Managerial and system Approche, New Jersey, pearson,7 th edition, Pp: 669-670.
- Srilakshmi, B, (2010). Food Science and Nutrition, New Age International, New Delhi, Fifth edition, Pp: 292.
- Stones, H and Sidel, J. L (2004). Sensory evaluation practises, Academic press, third edition, Pp: 13-14.
- Sudhir Andrews, (2009). Food and beverage management study guide guide to accompany baking and pastry: mastering the Art and Craft. John wieley and son's culinary institute of America, 2 nd edition, Pp: 108.
- Sukhuvinder Singh Purewal, (2014). Phytochemicals analysis of the ethanolic extracts of different pearl millet (Pennisetum glaucum) variaties, Journal of National Production Plant Resource, vol.4, issu.5, Pp:19-23.
- Takhellambam Ranjita Devi, Bharathi Chimmad and Sunanda Itagi, (2015). Study on physic-chemical properties and nutrient composition of ready to cook (RTC) millets, UGC sponsored International conference on Advances in Home Science studies, Tirupati, Andhra Pradesh, Pp: 63.
- Tarkergari, K. Waghray and Gulla, S., (2013). Acceptability studies of value added products with Purslane (Portulaca oleracae), Pakistan Journal of Nutrition, 12(1), Pp: 155-156.
- Vachanth, M.C., Subbu Rathinam, K.M., Preethi, R and Loganathan, M, (2010).controlled atmospheric storage techniques for safe storage of processed little millet, Academic Journal of Entomol, vol.3.iss. 1, Pp: 13-16.
- Vanisha S Nambiar, Neha Sareen, Mammen Denial and Erick B Gallego, (2012). "Flavonoids and phenolic acids from pearl millet (Pennisetum glaucum) based foods and their functional implication" functional foods in health and Disease, vol.2, issu. 7, Pp: 251-255.
- Vanisha S. Nambiar and Tanvee Patwardhan, (2014). Millets in diabetes- Emic views, International Journal of Pure Applied Bio Science, vol.2, issu. 3, Pp: 94-97.
- Vanithasri, J., Kanchana, S., Hemalatha, G., Vanniarajan, C and Sahulhameeds, M., (2012). Role of millets and its importance in new millinium, International Journal of Food Science and Technology (IJFST), vol.2, issu.1, Pp: 35-37.
- Veenu verma and Patel, S., (2013). Value added products from nutri-cereals: finger millet (Elusine coracana), Emir.Journal. Food Agricultural, vol.25.issu. 3, Pp: 169-176.

- Verma, V and Patel, S (2013). Production enhancement, nutritional security and value added products of millets of Bastar region of Chhattisgarh, International Journal of Research in chemistry and environment, Vol.3, issu. 2, Pp: 162.
- Vinita thapaliyal and Karuna Singh., (2014). Nutrition Transition: A paradigm shift in Uttarkhand, Journal of Nutrition and Food Science, Vol.4, issu. 5, Pp. 3-4.
- WHO global status report on Non Communicable Diseases (NCDs), (2010). United Nation System standing committee on Nutrition 2010.
- World Health Statistics, (2011). Geneva, World Health Organization.

Website address:

- http://faostat.fao.org/site/339/default.aspx.
- http://www.accuweather.com
- http://www.nfsmi.org/documentlibraryfiles/PDF/20080215091404.pdf.
- http://www.nsfmi.org/documentlibraryfiles.
- http://www.theresearchpedia.com/health/superfoods/health-benefits-of-pearl -millet

APPENDIX-I

SENSORY EVALUATION OF BISCUIT

NAME:

CLASS DATE:

Std- Standard

S.NO	PARAMETER	SPORUTED			NON SPROUTED	
		Std	VAR –I	VAR-II	VAR-I	VAR –II
1	**COLOUR** Excellent Good Acceptability Poor Very Poor					
2	**TEXTURE** Soft Slightly hard Acceptability Hard Very hard					
3	**TASTE** Excellent Good Acceptability Poor Very poor					
4	**APPERANCE** Excellent Very good Good Poor Very poor					
5	**FLAVOUR** Highly acceptability Moderately acceptability Acceptable Disagreed Highly disagreed					
6	**OVER ALL ACCEPTABILITY** Excellent Very Good Good Poor					

Variation I- incorporated with 10% millets milk powder

Variation II- incorporated with 20% millets milk powder

Signature of candidate

DETERMINATION OF FAT CONTENT

AIM:

To determine the fat content of the given food sample.

PRINCIPLE:

Ether extraction of the crude fat in vegetable products is carried out in a continuous extractor that is an apparatus in which the ether, after dissolving a portion of the fat of the material and discharging into the extraction flask, is volatized, condensed and again followed to act on the material. The steps in the process are repeated continuously and automatically until the extraction is complete.

The soxhlet extraction used depends on the intermittent action a glass siphon. The ether gradually condenses into the extraction tube containing the material until it rises to the top when it is discharged into the extraction flask.

PROCEDURE:

The soxhlet flask was weighed to consecutive concordant weights. 2g of the moisture free sample was packed into an extraction thimble and placed in an extractor which was fixed into a soxhlet flask. Poured sufficient amount (150 ml) of petroleum ether so as to permit siphon action. The thimble and the contents were allowed to soak in ether for 24 hours. The entire set up was kept over an electric water bath and the extractor was connected to the condenser. The nozzle of the condenser was always plugged with moistened cotton. The temperature was maintained at 60°c. a steady stream of water in the condenser was maintained. The ether evaporated rose up but owing to the condenser arrangement; it fell back into the condenser extractor. When the extractor got filled with ether, it was siphoned back into the flask. This went on till the ether that got collected in the extractor was free from any yellow colour indicating the presence of fat. The soxhlet flask was then disconnected and ether was evaporated in a water bath maintained at 60°c. When the ether in the flask was evaporated, the flask was weighed again to get concordant values. From the difference in weight, the fat content was calculated.

RESULT:

DETERMINATION OF FAT CONTENT

Weight of Soxhlet flask		=
Weight of Soxhlet flask + fat		=
Weight of fat alone		=
2g of	contains	=
100g of	will contain	=

ESTIMATION OF CALCIUM

AIM:

To estimate the amount of calcium present in the given food sample.

PRINCIPLE:

Calcium is determined by precipitating it as calcium oxalate and titrating the oxalate solution in dilute sulphuric acid against standard potassium permanganate.

APPARATUS:

Beaker, burette, pipette, flask and standard flas

REAGENTS:

1. Ammonium oxalate: Ammonium oxalate was dissolved in 200 ml of water till it was saturated.
2. 0.01N Oxalic acid: 0.063g Oxalic acid crystals were weighed and dissolved in 100 ml of distilled water.
3. 0.01N Potassium permanganate: 0.316g of Potassium permanganate was dissolved in 1000 ml of distilled water.
4. Strong Ammonia
5. Glacial acetic acid.
6. 2N of sulphuric acid: 5.5 ml of sulphuric acid was dissolved in 94.5 ml of distilled water.

PROCEDURE;

Ash from the ignited sample was dissolved in hydrochloric acid and made upto the 100 ml. 10 ml of the ash solution was pipetted out in a conical flask and 90 ml of distilled water was added to it. Added 2 drops of methyl red indicator. It was made strongly alkaline by adding ammonia (colour-yellow) and kept for boiling for minutes. 20 ml of saturated ammonium oxalate was added to the solution, 10 ml of each time to ensure complete precipitation directly. When it was hot, a few drops of acetic acid was added to render the medium acidic (colour pink). The precipitate was allowed to settle overnight. The next morning the solution was filtered with Whatman No.40 filter paper. The precipitate was washed first with ammoniacal water and then with hot water several times until it was free from chloride. To test it 5 ml of the washing was collected, in a test tube and a drop of silver nitrate solution was added. The washing was continued till there was no precipitate with silver nitrate or calcium chloride solution. The filter paper was collected in a flask by making a hole in the filter paper. To this, 2 ml of 2N sulphuric acid was added. This solution was heated to 60-80°c and when still hot was titrated against N/100 potassium permanganate solution. From the volume of potassium permanganate solution used up the milligrams of calcium present in 100g of the sample was calculated

ESTIMATION OF CALCIUM

Standard Oxalic acid Vs Potassium permanganate

Volume of Oxalic acid (ml)	Volume of 2N H_2SO_4	Burette readings (ml)		Volume of $KMnO_4$ ml)	Indicator
		Initial	Final		
5.0 5.0	2.0 2.0				self

Volume of Oxalic acid = 5.0 ml

Normality of Oxalic acid = 0.01 N

Voulme of $KMnO_4$

(titration done at 60-80°c) =

Normality of $KMnO_4$ =

1 ml of 0.01N $KMnO_4$ = 0.2 mg calcium

Therefore, 1.0 ml of $KMnO_4$ =

STANDARD POTASSIUM PERMANGANATE VS SAMPLE

Volume of the sample (ml)	Burette readings (ml)		Volume of KMnO4 (ml)	Indicator
	Initial	Final		
Blank Sample I Sample 2				Self

The sample consumed = ml of Kmno4

Therefore, _____ ml of Potassium permanganate =

10ml of the Ash solution contains =

Therefore, 100ml of the Ash solution contains =

G of the sample was taken for ashing =

Therefore, g of the sample contains = mg of calcium

Therefore, 100g of the sample contains = mg of calcium

ESTIMATION OF IRON

AIM:

To estimate the amount of iron present in 100g of the given food sample.

PRINCIPLE:

The food sample is oxidized with ignition or oxidation. Iron as ferric iron reacts with ammonium thiocyanate or with potassium thiocyanate to give ferric thiocyanate which is red in colour. The colour which is a measure of the concentration is measured colorimetrically.

APPARATUS:

Volumetric flask,test tubes, klett, pipette.

REAGENTS:

1. Stock iron solution: Dissolved 0.0702 gm (70.2mg) of reagent grade crystalline ferrous ammonium sulphate (Mohr's salt)in 100 ml of water.

2. Working standard: Prepared a working standard solution in a 100ml volumetric flask by adding 10ml of the stock solution and diluted to the mark with distilled water.

3. Saturated potassium persulphate solution: Shook 7to8 g of reagent grade potassium per sulphate in 100ml of water in a glass stoppered flask. The undissolved crystals settled to the bottom and compensate the loss by decomposition.

4. 3N Potassium thiocyanate: Dissolved 146g of reagent grade potassium thiocyanate in water and diluted to 500 ml with water. Filtered if turbid. Added 20ml of pure acetone to improve the keeping quality. Deterioration will be evident from the rapid fermentation of a yellow colour in the blank. Stored in brown bottles.

PROCEDURE:

2g of the sample was ashed by ignition. When ashing had been completed 5 ml of hydrochloric acid was added and made up to 100 ml in a volumetric flask.

Took different aliquots of the standard solution (1 ml – 5ml) corresponding to 10-50 gamma in a series of test tubes. 2ml of the unknown solution was taken in the test tube. Added 1ml of 30% H_2SO_4, 1ml of potassium persulphate and 1.5ml of potassium thiocyanate to all the test tubes. This was made upto 10ml with water. A blank was prepared by adding the reagents except the standard or the unknown solution. Allowed the colour to develop for 20 minutes and the intensity was read at 530-540 μ filter in the colorimeter.

ESTIMATION OF IRON

Volume of the solution (ml)	Concentration (γ)	Volume of potassium persulphate (ml)	Volume of water (ml)	Volume of 30% H_2SO_4 (ml)	Volume of potassium thiocyanate (ml)	Klett reading OD
Blank		1.0	6.5	1.0	1.5	
standard						
1.0	10	1.0	5.5	1.0	1.5	
2.0	20	1.0	4.5	1.0	1.5	
3.0	30	1.0	3.5	1.0	1.5	
4.0	40	1.0	2.5	1.0	1.5	
5.0	50	1.0	1.5	1.0	1.5	
Unknown						
2.0		1.0	4.5	1.0	1.5	
2.0		1.0	4.5	1.0	1.5	

2 ml of the ash solution contains gamma of iron

Therefore 100 ml of the ash solution will contain :

100ml of the ash solution was made from g of

Therefore 5g of the contains :

Therefore 100 g of the will contain :

ESTIMATION OF NITROGEN

AIM:

To determine the amount of nitrogen present in the given food sample.

PRINCIPLE:

The given sample is digested with concentrated sulphuric acid in a macrokjeldahl flask when nitrogen gets converted to ammonium sulphate. Ammonia is liberated by the action of strong alkali in a macrokjeldahl steam distillation apparatus. This nitrogenous substance is converted to ammonium borate by absorbing 2% boric acid and is titrated against N/70 H_2SO_4. The volume of acid required to bring the test sample to the colour of the blank gives the acid equivalent to the ammonia.

REAGENTS:

1. N/70 Sulphuric acid
2. 40% Sodium Hydroxide
3. 2% Boric acid (in warm water)
4. Digestion mixture: A mixture of copper sulphate and potassium sulphate in the ratio of 2:98
5. Concentrated Sulphuric acid
6. Mozazaga indicator: A mixture of bromocresol green and methyl red indicator in 95% alcohol in the ratio of 4:1 (80mg and 20 mg in 100 ml alcohol).

PROCEDURE:

1. 0.5 g of the sample was taken into the digestion flask. To this added 15 ml of concentrated sulphuric acid and a pinch of digestion mixture as a catalyst. Kept at boiling gently over a heating mantle.
2. After digestion, the flask was cooled and the contents were transferred to a 100 ml standard flask and made upto the mark with distilled water.
3. The whole apparatus was washed with distilled water and allowed to back suck.
4. 10ml of boric acid was taken in a conical flask. A drop of indicator was added to it and kept under the condenser.
5. The tip of the condenser was well below the liquid.
6. 5 ml of the digested blank was added into the
7. Distillation chamber through the funnel. Then added 10ml of 40% NaOH. Washed the funnel with 2 to 3 ml of distilled water.
8. Closed the tap and steam was generated.
9. Steam entered the distillation chamber and drove all the ammonia which is inturn absorbed by boric acid.
10. Solution was pinkish white in colour, turned blue.
11. Steam was passed for 5 min and then the conical flask was lowered and the tip of the condenser washed.
12. The boric acid solution containing the liberated ammonia was titrated against N/70 H_2SO_4.
13. The end point was the appearance of pale permanent pink colour
14. Between each estimation, the apparatus was washed.
15. The experiment was repeated to get concordant values.

RESULT:

ESTIMATION OF NITROGEN

Ammoniacal Solution Vs N/70 Sulphuric acid

Sample	Burette Reading (ml)		Volume of N/70 H_2SO_4 (ml)
	Initial	Final	
Blank Sample I Sample 2			

1 ml of N/70 H_2SO_4 solution = 0.2 mg of Nitrogen
Therefore ml of N/70 H_2SO_4 =
5 ml of the digested solution contains =
Therefore 100ml of the digested solution will contain =
100ml was taken from of =
Therefore 100g of contains =

DETERMINATION OF MOISTURE CONTENT

AIM: To determine the moisture content of the given food sample and calculate the percentage of moisture content.

PRINCIPLE: Estimation of moisture is one of the most often performed determinations in food analysis. Moisture is lost when food is heated not much higher than the temperature of boiling water or by allowing to stand overnight over dehydrating agent or by heating over vacuum.

APPARATUS: Low flat-bottomed dishes, asbestos, analytical balance, weight box, tongs, dessicator and electric oven.

PROCEDURE: Heated a pair of weighing bottles at 100° c in oven and labeled A and B. Placed on an asbestos sheet for 2 minutes and then transferred them to a dessicator where they remained for half an hour. Recorded their weights in an analytical balance. Repeated this procedure till two successive weights obtained were constant (with maximum difference of 0.0002g).

Weighed definite amounts of food material (2g) in each dish and placed in an electric oven thermostatically controlled at 100-105°c. Heated for a stipulated time (2 hours), cooled in a desiccator for half an hour and weighed. This was also weighed till successive weighing showed no further loss.

PRECAUTIONS NEEDED:

1. Handle the bottle always with a clean pair of tongs.
2. Always keep the oven closed.
3. Do not expose the bottles to atmospheric air to avoid the chance of atmospheric moisture getting in.
4. Check for the appropriate placement of the lid of the desiccator.
5. Avoid placing a dish in a desiccator for more than half an hour.
6. Keep the door of the analytical balance shut.
7. Take care of the food sample for its purity. i.e. free from non-edible impurities.

The loss of weight equals the moisture present in the sample. The loss of weight divided by the weight of the original sample multiplied by 100 gives the percentage of moisture.

DETERMINATION OF MOISTURE CONTENT

Weight of the bottle and lid			=
Weight of the bottle, lid and flour			=
Weight of the bottle, lid and flour after heating			=
Loss in weight			=
g of	contains	=	g moisture
100 g of the	contains		=