Development of Bakery Product Incorporating Sunflower Seed, Cottonseed and Value Addition with Arugampul

Mubina M. Syed

(13PFN008)

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

Development of Bakery Product Incorporating Sunflower Seed, Cottonseed and Value Addition with Arugampul

Mubina M. Syed

(13PFN008)

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

Signature of the
Supervisor

31/3/15
Signature of the
Head of Department

ACKNOWLEDGEMENT

The investigator expresses her deep sense of gratitude to **GOD ALMIGHTY** for his blessings and grace bestowed on her throughout the period of study.

The investigator wishes to record her gratitude to **Dr. T. S. K. Meenakshisundaram, M.A., M.Phil., Ph.D.,** Chancellor Avinashilingam Institute for Home science and Higher Education For Women, Coimbatore for providing the opportunity to conduct the research in this esteemed university.

The investigator owes her heartfelt thanks to **Dr. (Mrs.) Sheela Ramachandran, M.Sc., PG.Dip., Ph.D.,(Avinashilingam)** Vice chancellor. Avinashilingam Institute for Home science and Higher Education for Women, Coimbatore for the amenities provided for the successful completion of the study.

The investigator wishes to express her respectful regards and sincere thanks to **Dr. (Mrs.) A. Venmathi, M.Sc., Dip.,Ed, M.Phil., Ph.D.,** Registrar(I/C) Avinashilingam Institute for Home science and Higher Education For Women, Coimbatore for providing all the facilities to carry out the studies.

The investigator wishes to express her respectful regards and sincere thanks to **Dr. (Mrs.). N. Vasugi Raaja, M.Sc., M.Phil., Ph.D.,** Dean,Faculty of Home Science, Avinashilingam Institute for Home science and Higher Education For Women, Coimbatore, for her inspiration, encouragement and support.

The investigator wishes to express her respectful regards and sincere thanks to **Dr. (Mrs.) M. Amirthaveni M.Sc., Dip. Ed., M.Phil., Ph.D.,** Professor and Head of Department(In-charge), Department of Food Science and Nutrition, Avinashilingam Institute for Home science and Higher Education For Women, Coimbatore, for her inspiration, encouragement and support.

The investigator is indebted and expresses her deep sense of whole hearted gratitude to her guide, **Dr.(Mrs). S.Thilakavathy, M.Sc., M.Phil., Ph.D., (Avinashilingam),** Asst. Professor (Senior scale), Department of Food science and Nutrition, Avinashilingam Institute for Home science and Higher Education For Women, Coimbatore, for the stimulating support, constructive suggestions, inspiring guidance and encouragement throughout the research period and documenting the thesis.

The investigator takes this opportunity to extend her thanks to all the **Faculty members of Department of Food Science and Nutrition** for their support, and concern throughout the endeavour and their continuing encouragement and support for this research study.

The investigator is very thankful to her beloved parents and dear brother, other family members, friends and all unseen hands for their prayers, moral support and help rendered in carrying out and completing the research effectively.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICS

INTRODUCTION

"There are people in the world so hungry, that God cannot appear to them except in the form of bread."

\- Mahatma Gandhi

Man's basic drive is for food to satisfy his hunger. Food is intimately woven into physical, economical, physiological, intellectual and social life of man, and it is a more basic need of man than shelter and clothing.

The food scenario in our country is changing drastically, as more and more novel food products are being dumped in the market and are becoming popular to a greater extent and each and everyone is eager to know the quality, nutritional value of the food and ill effects of the food they are consuming (Nambiar, 2004).

Baking is a term commonly applied for preparing a wide range of food products including, breads, cakes, pastries and crackers. The transition from raw material to baked products is often referred as being a change from foam to a sponge (James, 2011).

The art of baking was developed early during the Roman Empire. It was a highly famous art as roman citizens loved baked goods and demanded them for important occasions such as feasts and weddings etc. Due to the fame and desire that the art of baking received, around 300 BC, baking was introduced as an occupation and respectable profession for Romans. The bakers began to prepare bread at home in an oven, using mills to grind grain into the flour for their breads. This appeal for baked goods promoted baking all throughout Europe and expanded into eastern part of Asia (Rogers, 2000).

Bread had been an important food since Stone Age farmers created the first flat bread. A rough porridge was mixed together and spread thinly over hot stones to form a soft pan-cake like bread. It is an amazing feast, that the connection was made between wheat, water and sunshine to give us the most enduring of foods, the bread (Scarlett, 2000).

By the 17th century, the haze had lifted and Europe was familiar with most of the key ingredients for modern cake making in particular with cocoa, chocolate, sugar and

vanilla. The chemical raising agent bicarbonate of soda made a grand entrance in the early 1800s and was closely followed by baking powder. This powder replaced yeast but still maintained excellent leavening powder. A ready supply of white flour, granulated sugar and shortening made the whole cake-baking experience much simpler. Another important development at this time was ovens with reliable temperature control.

Cakes are chemically leavened batter-based products. The variety and diversity of cake product is large, with formulation varying substantially across the globe. The definition of cake varies, but the term refers to products that are characterized by formulation based on wheat flour, sugar, whole eggs, and other liquids, to which fat or oil may be added (Cauvin, 2003).

Many ingredients are used to make bakery products and each have a specific purpose that provides concrete function, such as building structures, adding flavor, giving texture, or color and the "invisible" function of providing nutritional value which can no longer be ignored. Bakery can be healthy foods as well as delicious and attractive (Maureen, 2002).

According to Sudhar *et al.,* (2007), bakery products can be used as a vehicle for incorporation of different nutritionally rich ingredients. Confectionary industry had been increasingly engaged in production of fiber enriched biscuits with the aim to offer such products as a valuable constituent of good nutrition and dietetic functional food intended for risky population.

Bakery industry has an important role to play in the economic development of the country in fuller utilization of its wheat resources, and in building up the health of its people. The demand of bakery products is increasing at the rate of 10.07 percent per annum. India is a developing country with large segment of population depending on wheat as staple foods and 25 percent of wheat is used in the preparation of baked foods. Due to changing life style the people have started demanding ready to cook or ready to serve convenience foods. More and more women are seeking employment to supplement the family income and they find less time for cooking and therefore demand ready to serve

foods. Baked products are considered as convenient foods and also an excellent vehicle for fortification, value addition and feeding at mass scale (Hans *et al.*, 2006).

There are several advantages of bakery products, such as consumption without heat treatment, no danger of overheating and eating without limitation, to get satiety (Abrol, 2007).

Bakery products are considered to be important for a balanced and nutritious diet since they are rich in carbohydrate, which offer the essential energy and several important B complex vitamins, vitamin E, minerals (calcium and phosphorus) and dietary fiber for human body function (Da-Wen Sun, 2012).

The nutritive value of baked products varies according to the type and amount of ingredients used in the formulation. The primary ingredients of many baked products are flour. However, there may be a significant amount of fat or sugar (Vickie, 2008).

Oil seeds and nuts are rich in protein particularly the amino acids, arginine and in addition they contain a high level of fat. They are thus source of protein and concentrated source of energy. They do not contain an appreciable amount of carbohydrate but contain high amount of B vitamins. Oil seeds produced in the country are mostly used for oil extraction. The meal obtained from the seed is richer in protein than the seed itself. Oil meals are used along with cereals for product development for child feeding and as weaning foods (Gopalan *et.al.,* 2004).

Oil seeds provide the essential fatty acid linoleic acids which is required for human health. Oil seeds are also rich in protein and oil seed cake obtained after the extraction of oils from seeds can be processed to produce protein rich foods. Such foods are in the market and have helped solve the protein deficiency of vulnerable section of our population, such as infants, children and pregnant mothers (Manay *et.al.,* 2005).

The cultivation of sunflower seed has significantly increased in recent years, mainly due to quality of its oil, which is useful for the human consumption. In addition, due to its large capacity of adaptation to different climatic conditions, sunflower is an excellent option for crop rotation and succession systems for several regions (Carvalho*et.al.,*2003).

Sunflower (*Helianthus annuus* L.) is an important oil seed crop of the world and it ranks third in production next to groundnut and soybean (Byrareddy, 2008; Satish and Shrivastava, 2012). The importance of sunflower as source of edible oil and high quality protein is continuously increasing. Sunflower plays an important role in human nutrition. Seeds of sunflower are mainly used for their oil content, which accounts for 80 percent of the value of the sunflower crop. At the same time, there is an increasing interest in the use of sunflower protein in human nutrition (Zilic*et al*., 2010).

Sunflower kernel and its defatted meal have several advantages over other oilseed meal as human protein food, because of the absence of anti nutritional or toxic factors, flavor and of its high digestibility and biological value. Sunflower seeds are excellent source of dietary fiber, protein, vitamin E, B vitamins, and minerals such as potassium, magnesium, iron, phosphorus, selenium, calcium and zinc. (Sahebeh Jafari *et al*., 2011).

Sunflower seed contains an appreciable amount of vitamin E – 37.8 mg/100 g unlike linseed, sesame seed and soy that contain less than 3 mg/ 100 g while peanut is estimated to contain 10.1 mg/100 g (Food Standards Agency Institute of Food Research, 2002). Tocols (tocopherols and tocotrienols) that possess vitamin E activities are recognized as the most important tissue antioxidants, having a role in preventing or controlling non-specific reactions from various oxidizing species produced in normal metabolism.

Mainly due to its superior nutritional quality and the relatively low amount of anti-nutritional factors, sunflower seed has great potential to be, not only as a protein source, but also a valuable supplement in human diet, providing considerable amounts of antioxidants, minerals and unsaturated fatty acids. Sensorially acceptable and nutritionally improved bread can be made with as much as 16 percent of sunflower seed on flour basis (Skrbic and Filipcev, 2008).

Cottonseed contains hull and kernel. The hull produces fiber and linters. The kernel contains oil, protein, carbohydrate and other constituents such as vitamins, minerals, lecithin, sterols etc. cottonseed oil is extracted from cottonseed kernel. Cottonseed oil, also

termed as “Heart Oil” is among the most unsaturated edible oils (Agarwal and Chakrabarty, 2003).

Cottonseed is processed into four major by-products: oil, meal, hulls and linters, of which the oil and linters are typically used as human food. Oil is the main derived product used for human consumption and, for example, in the first half of the 20th century, cottonseed oil was the major vegetable oil consumed in the United States (O'Brien, 2008).

Food products from cottonseed are limited to highly processed products because of the presence of natural toxicants (gossypol) and anti-nutrients (cyclopropenoid fatty acids) in the unprocessed seed. Cottonseed meal is the second most valuable product of cottonseed, usually accounting for over one-third of total product value. It may be sold in the form of meal, cake, flakes, or pellets. Cottonseed meal is used principally as feed for livestock and is usually sold at 41percent protein level. Its major value is as a protein concentrated.

Cottonseed oil finds application in the production of biscuits, crackers, doughnuts and potato chips and the preparation of ice cream substitutes (mellorines), in which process the oil replaces butter fat (Encyclopaedia Americana, 2001).

Cottonseed meal encounters a similar degree of competition from other protein concentrates like peanut meal and sunflower meal but especially soybean meal. Cottonseed meal is normally used as a supplement to feed-grains. However, if meal becomes high-priced relative to grains, feeders will increase grain use and reduce meal (www.cottonseed.com).

Medicinal plants are the source of many potent and powerful drugs. They present healthier and safer alternate to the synthetic drugs (Rai *et al.,* 2007).

Herbs constitute an effective source for maintaining health in South India. Literally meaning the “science for soul and longevity” in olden Tamil, in the oldest healing system of India, based on way of life, diet and herbs (Ramkumar *et al.,* 2014). *Cynodon dactylon* commonly referred to as Arugampul, is a valuable medicinal plant and is used as a curative

for various aliments. This medicinal herb has a renowned position in Indian system of medicine.

Arugampul has many medicinal properties mainly it's in glycemic potential and contains more than 65 percent of Chlorophyll which helps in increasing the number of Red blood cell in our body and also contains protein, calcium, fiber, phosphorus and potassium. It helps in maintaining the alkalinity of blood as it reduces acidity, improves digestion cures stomach ailments (Uma and Missiriya, 2013).

Cynodon is a weed and has been found to possess various potential medicinal properties (Singh *et al*., 2009). The plant is traditionally used as an agent to control diabetes in India especially the extract of *C. dactylon* leaf (Singh *et al*., 2007, 2008, Rai *et al.,* 2010).

Sensory evaluation is defined by the Institute of Food Technology as a scientific method used to evoke, measure, analyze and interpret those responses to products as perceived through the senses of sight, smell, touch, taste and hearing. Sensory evaluation can be divided into two categories of testing: objective and subjective. In objective testing, the sensory attributes of a product are evaluated by a selected or trained panel. In subjective testing, the reactions of consumers to the sensory properties of products are measured. Linking sensory properties to physical, chemical, formulation and/or process variables then enables the product to be designed to deliver optimum or appropriate consumer benefits. The role of sensory evaluation has changed considerably over the years. Initially, it was a service provider supplying data, but now its role is, in partnership with research and development and marketing, to provide insights to help guide development and commercial strategy. In the early stages of product development, consumer and sensory testing can help identify the important sensory attributes driving acceptability across a product category. It can identify sensory-based target consumer segments, analyze competitor products and evaluate new concepts (Sarah, 2009).

Product developers make use of many tools like chemical tests, microbiological procedures and the use of physical equipment to determine elasticity, hardness, viscosity, color intensity and more in the development of a product (Dimple, 2014).

The choice of packaging for foods produced is very much on the nature of food. The composition varies in each food and gives the food its major characteristics. The composition of each food determines how well it withstands attack by bacteria, moulds, viruses. Chemicals such as oxygen in the air and humidity affect deterioration.

The oil seeds and herbs selected are rich in nutrients. It is easily affordable and locally available and from ancient days it is used as food. Hence a trial was made to incorporate oil seeds and herbs in bakery products. These products can be consumed by all age groups from children to old people as these snacks because of its nutritional importance. The product developed by incorporating cottonseed and sunflower seed with arugampul powders was evaluated based on sensory evaluation of the product. The study was undertaken with the following objectives

- Incorporate sunflower seed, cottonseed and arugampul powder at various levels in selected bakery products,
- Evaluate the acceptability of these baked products on basis of organoleptic parameters
- Standardize the baked products with the most acceptable level of incorporation of sunflower seed, cottonseed and arugampul powder.
- To evaluate the nutrients present in sunflower seed, cottonseed and arugampul powder
- To evaluate the shelf life study of powders using different packaging material.

II REVIEW OF LITERATURE

The literature pertaining to the title "**Development of Bakery Products Incorporating Sunflower Seed, Cottonseed and Value Addition with Arugampul**" was reviewed under the following headings:

A. Standardization of bakery products
   1. Standardization of recipes
   2. Need for incorporation
   3. Acceptability of the product

B. Value addition of bakery products using different unexploited food items

C. Nutritional importance of sunflower seed, cottonseed and arugampul
   1. Nutritional importance of sunflower seed
   2. Nutritional importance of cottonseed
   3. Nutritional importance of arugampul

A. Standardization of bakery product

1. Standardization of recipes

A standardized recipe is one that has been tried, adopted and retried 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 same type of equipment and the same quantity and quality of ingredients (Mohan, 2005).

The term food usually refers to a single food item belonging to a mixed/composite food, while diet usually indicates the pattern of food consumption and meal is the combination of various food courses served at a particular time. The term dish either refers to a specific type of food or is used to describe the serving utensil or bowl rather than the food itself (Perveen, Nasir and Faqir, 2009).

Composite food was referred to as a mixture of one or more products of animal origin and other edible material intended for human consumption and may and may not be cooked or processed e.g. cookies dough, cake mixes etc. It refers to mixed food as ethnic or modified ethnic food associated with the traditional dietary practices of immigrates in the light of their cultural background and religious beliefs that are different from the host

country (Hamid and Sarwar, 2004).The standardized recipe is an important tool for the kitchen staff. Use of standardized recipe assures quality and consistency of menu items, and it helps with cost control and menu pricing.

Some of the advantages of using standardized recipes are to ensure product consistency, to improve cost control by controlling portion size, to lists item cost, which makes it easy to access and use this information for pricing and help make the kitchen run smoother and more efficiently, to create inventory and purchasing lists, and help with employee training.

Standard recipe guidelines

Standard recipes will have the following:

- Name of the item – Recipe number / identification within file system.
- Yield – The total quantity the recipe will prepare.
- Portion size – This may be listed by weight or number of pieces.
- Garnish – Specific and every plate goes out looking the same which includes plate setup.
- Ingredients – List in order, list quantities of ingredient used, and the abbreviation used for quantities standard. If “oz” is used for ounce in one recipe, use it in all recipes.
- Preparation Instructions – Include any preheating instructions. Use the correct terms for instructions. This also should include pan sizes and preparation, cooking temperature, cooking time, how to test for doneness, and instructions for portioning.
- Finishing – Describe any finish the product needs, such as brushing with oil or melted chocolate drizzled on top.
- Cost - Total the cost of each ingredient for total price cost. This can then be divided by the number of portions.
- Photo of Finished Dish – Photos are not always included on recipes, but are an excellent reference to quickly determine garnish and furnishing (Lora, 2005).

2. Need for incorporation

To improve the nutritional status of all strata of people, it is necessary to augment the diet with the locally available nutritionally valued ingredient and formulate diversity recipes to include in our day to day life. Understanding the impact of trends in both dining customs and eating patterns in today's society centers around healthy dining menus that are both interesting and healthy (Nancy, 2000)

Value addition to the existing product can be an effective way of improving nutrition security along with other factors underlying food security. Moreover people are working forward, for a more complete diet formulation, with addition of one or two ingredients that may benefit many disorders like cancer of bone, cardiovascular diseases, under nourishment and also to enhance immune system (Faulker, 2002).

Even though our daily diets increasingly consist of processed convenience foods, the ideal for naturalness still prevails, for many ' natural' (i.e) unprocessed, environmentally benign, additive free or local foods stand for good, proper and healthy food (Lien, 2003).

The studies conducted where enriching bakery products with selected ingredients with pro-health properties and simultaneous estimation of their effect on the physical (weight loss, the proper weight of the crumb the proportion of crust to crumb) and sensory properties of bakery products. The analysis showed the effect of the kind ingredient and its weight share on the characteristics of the test baking. Independently of the kind of bakery product, its freezing did not influence the studied physical properties. The identified weight losses depend on and are effect of the manner of thawing. Thawing in a microwave oven caused much greater weight losses than in the case of thawing in the air and it did not cause any significant change in the examined properties. However , changes were found in the proper weight of the crumb, the proportion of crust to crumb; besides, the elasticity of the crumb and the hardness of the crust were decreased, which had an effect on the value of organoleptic evaluation (Kozlowicz *et al.*, 2008).

CFTRI (CFTRI.com) has developed bakery products (bread and biscuits using different flavors and spices such as onion, garlic, ginger, cardamom, cumin seeds, vermicelli etc.,) based on composite flours from oil seeds such as defatted soya flour and

ground nut flour, non-wheat cereals such as maize and sorgam and millets such as bajra and ragi as well as tuber flour from potato and tapioca.

3. Acceptability of the product

Acceptability is connected to views on technology in food production and the naturalness of food (Conky and Giese, 2000).

In a study by Laureati *et al*. (2006), considering the influence of tradition in sensory acceptability aspects should be followed by familiarity and tradition linked with the consumption of meal. Human beings eat foods because of the pleasure and enjoyment of eating as well the necessity of obtaining energy and nutrients. The main contributions to human's enjoyment of eating foods are the three sensory factors perceived and appreciated by human senses-appearance, flavor and aroma and texture (Bourne, 2002).

Barylko and Matuszewska (2000) obtained that food acceptability and choice depends on sensory properties of the food which are perceived during chewing and swallowing. Overall sensory quality of the product can be evaluated using quantitative descriptive analysis.

Lawlessit and Fleymann (2000) states that size and shape of particles within the food and of the entire sample, are important in the evaluation of food texture. Flavors can be among the most valuable ingredients in any food formula. Flavor plays an important role in consumption of foods (Taylor *et al.,* 2004).

Subjective tests evaluate food quality by relying on the sensory characteristics and personal preferences of selected individuals in taste panels, consisting of either randomly chosen members of the population or experts trained in tasting a particular product(Wadsworth, 2000).

B. Value addition of bakery products using different unexploited food items

Addition of chickpea flour to sponge and layer cakes reported that whole Bengal gram flour posed more problems than dehulled Bengal gram flour. It was observed that pulse flour affected the cake volume, firmness, cohesiveness and gumminess; therefore, attention needs to be paid to substitution levels and other flour attributes (Gomez *et al.,* 2008).

In a study conducted by Shakuntala (2008) wheat biscuits were prepared by incorporating Bengal gram flour at 10, 15, 20 and 25% levels along with modification in water, fat, and baking powder to improve the nutritional and textural quality of biscuits. Incorporation upto 20 percent level improved the dough texture and sensory parameters in the final product. Biscuits can be easily fortified with protein rich flours to provide convenient foods in order to supplement protein in the diet (Mishra, 2004)

Tyagei (2006) opine that incorporation of Bengal gram flour at 15- 20% level added with optimum fat, water and baking powder improved the physical characteristics of biscuits. Addition of whey protein powder instead of egg enhanced the nutritive value without altering the sensory and physic chemical properties of biscuits to any remarkable extent (Seetha, 2010)

Mridula (2008) quote that biscuits incorporated with beetroot powder were hard and breaking strength was increased with increased levels of beetroot powder. Supplementation of flaxseeds and green gram incorporated cookies improved the nutritional status of children (Devaki, 2009).

Incorporation of 100 per cent Rajkeera seed flour in masala biscuit and coconut cookies had enhanced the level of protein, iron, and calcium and also found organoleptically acceptable (Salve, 2010)

Functional and organoleptic contribution by soy flour to bakery products improved texture, moisture holding to create cake richness, imparting better, more authentic colour, adding nutrition, especially as a lysine fortifier, improving desired bite, whether hard or soft (Thomas, 2001).

Olaoye *et al.* (2006) substituted wheat flour with soy flour and plantain flour from 0-15% for bread production; substitution of wheat flour with 10percent plantain flour resulted in bread similar to control in all the sensory aspects. Overall, plantain flour substituted bread with control bread was comparable, in sensory and nutritional qualities.

Arshad *et al.* (2007) prepared cookies by replacing wheat flour with defatted wheat germ (DFWG) at 0–25percent. It was observed that 15percent substitution of wheat flour with DFWG produced acceptable cookies similar to 100percent white flour cookies.

Three varieties of weaning biscuits were developed using the proportion of potato flour (Variety I) maize flour (Variety II) green gram flour (Variety III) with soya flour and wheat flour in the ratio of 70:20:10 with the addition of sugar and fat. The developed biscuits were analyzed for its nutritive value with reference to calories, protein, fat, carbohydrates, crude fiber and total ash using the standard procedures. Among the three variation green gram biscuits obtained that highest score biscuits for appearance but for flavor attributes it obtained least score (Chauhan, 2000).

Replacing five and 10percent of the wheat flour with green gram flour improved the mixing properties of dough and produced good acceptable bread. However, the addition of 15percent green gram flour weakened the dough and lowered the quality of bread (Mesallam, 2008).

Sindhuja *et al*. (2005) carried out studies on composite flour cookies by incorporating amaranth seed (*Amaranthus gangeticus*) flour, on the basis of color, taste, flavor, surface appearance of the cookies, 25percent incorporation of amaranth flour was found to be highly acceptable.

Dhull *et al.* (2005) studied the effect of replacing wheat flour with dried pea and red gram flours on the nutritional and sensory quality of biscuits. The protein content increased from 5.1 to 8.2 and 9.0percent with replacement of 3.0percent of wheat flour with dried pea and red gram flours, respectively

Soy fortified biscuits with addition of 20percent defatted soy flour in the recipe increased the protein, ash, crude fiber, calcium, phosphorus, iron, sugar and available lysine contents of biscuits (Singh *et al.,* 2000).

Effects of substituting five, 10 and 15percent field pea or defatted soy flour for wheat flour in a chemically leavened quick bread on physical characteristics of batters and sensory characteristics of bread was studied. Significant differences were observed for batter spread, consistency, loaf volume, darkness and yellowness value of bread crumbs. Results indicated that defatted soy flour could be successfully substituted for wheat flour in quick breads at levels upto 15percent, whereas at the same substitution levels, field pea flour had adverse effects on both physical and sensory characteristics (Raidl and Klein, 2003).

Khan *et al* (2005) compared baking properties of bread containing three experimental peanut protein concentrates. The volumes of loaves produced from flour with concentrations of peanut protein higher than 10percent were significantly lower than those of loaves made from flour containing other protein supplements.

Debashis (2006) studied the effect of incorporation of full fat soyflour for making various bakery products have shown that 5-25 percent soy flour can be used in preparation of bread, cakes and cookies, doughnuts, and other snack foods, without any loss of physical characteristics but substantial improvement in the nutritional value of the products.

Schober *et al* (2003) produced gluten free short – dough type biscuits from a range of gluten – free flours. It was found that the combination of rice, corn, potato, and soya with a high fat powder produced biscuit which were sheetable, and the baked biscuits were of comparable quality to wheat biscuits.

C. Nutritional importance of sunflower seed, cottonseed and arugampul

1. Nutritional importance of sunflower seed

Adequacy in nutrient intake in terms of quantity and quality are one of the major determinants of health of a nation. India is undergoing nutrition transition and is facing the dual burden of malnutrition such as problem of under nutrition and micro nutrient deficiencies. Sunflower seeds are the one among that can address this problem unswervingly.

Sunflower seeds are dried or roasted and used as a medicine in South America. Sunflower oil has cleansing properties: it is both a diuretic and an expectorant. Sunflower seeds are very rich in protein and in essential fatty acids. These nutrients are essential for the good health of the nerves, brain and eyes and for the general health. More than half of sunflower seed is made up of the valuable and highly nutritive Sunflower oil Amjad, 2012).

The sunflower is a plant in which every part can be beneficial: roots (recycling of nutrients and organic matter soil), stems (used of fodder),leaves (green manure, together with the stems), flowers (honey extraction) and seeds (oil production or food products). The sunflower seed has a high content of nutrients such as protein, dietary fiber, vitamins and minerals. It is also known that this seed is a good source of phytochemicals such as

tocopherols, choline, betaine, lignan, phenolicacids and arginine. For this reason it is also considered a functional food. It is capable of preventing several diseases such as hypercholesterolemia, arterial hypertension, obesity and cancer due to its antioxidant capacity (Maria, 2011).

The cereal and legumes seeds have always had an outstanding place in human nutrition. It is known that about 70percent of the entire human food consumption is represented by seeds that comprise about 50percent and 70percent respectively of the total intake of proteins and calories by humans. Among the seeds most commonly consumed by humans are rice, wheat, barley, rye and beans. Nevertheless, other seeds may be incorporated as a supplement to the eating habit to enrich the nutritional value of the diet (Agriculture and Agri- food Canada, 2003).

New nutrient data shows that sunflower seeds contain a good amount of beneficial plant chemicals, thought tobe advantageous to health. Sunflowers have been cultivated and harvested by many cultures for at least 4,500 years. They have been used for a variety of purposes that range from culinary to medicinal. Sunflower seeds are not only recommended for their low saturated, zero trans and high polyunsaturated and monounsaturated fat content but also they provide protein, fiber, vitamins, minerals.

Sunflower meal is a by-product of industrial oil extraction of whole or dehulled seed (Stringhini *et al.,* 2000).It can be used as an ingredient in feed production since it has high protein content. However, it also has a high insoluble fiber content which reduces digestible energy and low lysine content (Silva *et al.,* 2002).

Sunflower seeds are incredible sources of folic acid. Hundred grams of seed contains 227µg of folic acid which is about 37percent of recommended daily intake. Folic acid is essential for DNA synthesis. When given in anticipant mothers during peri-conceptional period, it may prevent neural tube effect in the body.

The seeds are incredibly rich source of many essential minerals, calcium, iron, magnesium, zinc; selenium and copper are especially concentrated in sunflower seeds. Many of these mineral play a vital role in bone mineralization, red blood cell production, enzyme secretion, hormone production, as well as in the regulation of cardiac and skeletal muscle activites (www.nutrition-and-you.com).

Thomas and Gebhardt (2008) studied that Sunflower Seed Butter and Almond Butter as Nutrient-Rich Alternatives to Peanut Butter. Most sunflower seed butter had been reformulated using mid-oleic sunflower seed, making it significantly higher in monounsaturated fat (MUFA) than peanut or almond butter. Compared to peanut butter and sunflower seed butter are also good or excellent sources of protein, magnesium, phosphorus, manganese and vitamin E. sunflower seed butter had the highest amount of many minerals whereas almond butter in the only good sources of fiber and calcium.

Catherine (2005), state that sunflower seeds are an excellent source of B vitamins, particularly niacin and folate, and contain magnesium, phosphorous, potassium and zinc with smaller amounts of iron and calcium. They contain good amounts of fibre and are important for their vitamin E which is around half of the recommended daily intake. Vitamin E is a well-studied antioxidant that is under study for its ability to protect oxidation of the bad LDL-cholesterol. It also keeps our blood free-flowing, by making blood cells less likely to clump and form clots.

2. Nutritional importance of cottonseed

Cottonseed produces more food for man and feed for animal than fiber. All elements of cottonseed as it is often considered as "Golden Goose" linters, kernels and hulls are used in various consumer products, delicious food and nutritious feed (Dinesh, Singh, Chakrabarty, Shaikh, Gayal, 2003).

Crude cottonseed oil, derived mainly from the seeds of *Gossypium hirsutum* (American) or *Gossypium barbadense* (Egyptian) varieties of cotton, has a strong, characteristic flavor and a dark, reddish-brown color from the presence of highly colored material extracted from the seed. It is a member of a particularly useful group of vegetable oils, whose fatty acids consist substantially of C16and C18 fatty acids containing no more than two double bonds. Cottonseed is stable in the β- crystal form which is desirable in most 'solid' products because it promotes a smooth workable consistency, usually referred to as plasticity. The reverted flavor of deodorized cottonseed is usually described as nutty or nut-like, which is more acceptable at higher degrees of oxidation than other vegetable oils. Its characteristics make it highly desirable food oil for use in salad and cooking oils, shortenings, margarines, and specialty fats and oils products (O' Brien, 2001).

Cotton should rank high among crop production priorities since it provides fiber, a renewable resource for garment manufacturing, as well as edible oil and protein for human consumption and animal feed. However, it contains gossypol, a natural phenolic aldehyde that permeates cells and acts as an inhibitor for several dehydrogenase enzymes, it can cause negative effects on growth and reproductive performance, and it can also result in intestinal and internal organ abnormalities. Glandless cottonseed flour could potentially be used as raw material for the production of texturized protein products. This is achieved by genetically eliminating the toxic compound gossypol from the cottonseed (Reyes, 2012).

Cottonseed is rich in tocopherols which inhibits rancidity development and thus contribute to its stability resulting in a longer shelf life for the product. Cottonseed oil is naturally hydrogenated oil and is suitable for heart due to the presence of palmtic, stearic, mysteric, oleic, linoleic and linoleinic fatty acids in sufficient quantities. Cottonseed oil has also gained importance in food preparations due to its higher smoke point (about 232^{o}C) compared to other cooking oils and is good for frying food (Brien *et al*., 2005).

Modern medical science has found that parts of the cotton plant may have potential use in the treatment of HIV and cancer. It has been found in one study to have the ability to inhibit cancerous growths in head and neck cancers (Oliver, 2004).

3. Nutritional importance of arugampul (*cynodon dacylon*)

Cynodon dactylon is a perennial grass that has a variety of medicinal properties. It is cultivated throughout the tropics and subtropics. Whole herb or its root & stalk are used for medicinal purpose. It is reported to have important properties like anabolic, antiseptic, astringent, cyanogenetic, demulcent, depurative, laxative, diuretic and emollient.

C. dactylon is used by traditional healers for purifying the blood, anuria, biliousness, conjuctivitis, diarrhoea, gonorrhoea, itches and stomachache. A decoction of the root is used as a diuretic in the treatment of dropsy and secondary syphilis.

An infusion of the root is used to stop bleeding from piles. The expressed juice of plant act as astringent and is applied to bleeding cuts and wounds to stop. Leaf, root and rhizome of the plant have been used in folk medicine of different countries, in Ayurveda, *Cynodon dactylon* shows many pharmacological activities like antidiabetic, antioxidant,

antidiarrheal, hepatoprotective, anti-ulcer, immune modulator, CNS depressant, antimicrobial and germicidalas, antihysteria, antipsychotic, antigonorrheal infection, anti-viral, as well as hypolipidemic, hypoglycemic agent (Zabin, 2014).

Singh *et. al.* (2008), worked for the, Assessment of antidiabatic potential of *Cynodon dactylon* extract in streptozotocin diabetic rats. The effect of repeated oral administration of aqueous extract on serum lipid profile was also examined. It lowers blood glucose level around 31percent after 4hour. The same dose of 500 mg/kg body weight produced a fall of 23percent in glucose level with in 1hour. During glucose tolerance test (GTT). This dose has almost similar effect as that of standard drug tolbutamide (250 mg/kg bw).

The plant extract checks uterine bleeding strengthens the uterus and augments fetal growth. The species is also used in traditional cultures for toothache and amibiosis. Decoction of *C.dactylon* can be used to treat kidney stones. Extract of the whole plant shows antiviral activity against vaccine virus, white spot syndrome virus (Datta, 2012).

Singh (2007),a research by showed that the aqueous extract of *cynodon dactylon* has high antidiabetic potential along with significant hypoglycemic and hypolipidemic effect

Paranjpe (2001) studied that the plant contains crude proteins, carbohydrates, mineral constituents, oxides of magnesium, phosphorus, calcium, sodium and potassium. The whole plant affords β- sitosterol, flavanoids, alkaloids, glycosides and triterpenoids. Other compounds like vitamin c, carotene, fat, palmitic acid etc. green grass contains 10.47 percent crude protein, 28.17 percent fiber and 11.75percent of total ash.

The concentration of 0.625 mg/ml of the ethanolic extract of *C. dactylon* on HT-29 human colon cancer cell line showed 52.6percent potent anticancer activity (Kanimozhi and Ratha Bai, 2013). Saroja and Annapoorani (2012) evaluated antitumor activity of methanolic extracts of leaves of *C. dactylon* against ascitic lymphoma (ELA) and tumor was induced by intraperitoneal injection. The result revealed that methanolic extract of *C. dactylon* was found to possess significant antitumor and hepatoprotective effect.

Ramesh *et,al*(2009)stated that Arugampul chooranam capsules are prepared from dried Arugampul which is powdered and concentrated with fresh Arugampul juice. The minimum dose of a 500gm capsule contains a good concentration of the essence of Arugampul. This capsule is used to control Diabetes mellitus.

The ethanolic extract of *C. dactylon* leaves contains a range of active pharmacological agents as analyzed by GC-MS, includes alkaloids, steroids and tannins are known to reduce blood glucose level in diabetic condition.Those are frequently implicated as having antidiabetic effects. It is known that certain alkaloids and flavonoids exhibit hypoglycemic activity and is also known for their ability of beta cell regeneration in pancreas. Tannins have also shown to decrease blood sugar level in patients. Thus, the significant antidiabetic effect of ethanolic extract of *C. dactylon* leaves may be due to the presence of more than one antihyperglycemic principle and/or their synergistic effects.

The ethanolic extract exhibited strong hypoglycemic activity in addition to hypolipidemic activity in diabetic patients. This has clinical implications that the relatively nontoxic *C. dactylon* extract, if used as a hypoglycemic agent, may also reverse dyslipidemia associated with diabetes and prevent the cardio vascular complications that are very prevalent in diabetic patients. The present investigation has also opened avenues for further research especially with reference to the development of potent phytomedicine for diabetes mellitus from *C. dactylon* leaves (Karthik and Ravikumar, 2006).

Antibacterial and antipyretic efficacy shown by *cynodon dactylon* provides a scientific basis and thus, validates their traditional uses as homemade remedies. Isolation and purification of different phytochemicals may further yield significant antibacterial agents. The plant widely available all over the world could be a prominent source of medicinally important natural compounds (Zabin *et al.*, 2014).

Antioxidant potential of oral feeding of aqueous extract of *C. dactylon* was evaluated on diabetes-induced oxidative stress of diabetic rats and the results showed that elevated level of lipid peroxide (LPO) came down significantly and decreased the activities of antioxidant enzymes in diabetic rats (Rai *et al.*, 2010).

III METHODOLOGY

The methodology followed for the present study, "**DEVELOPMENT OF BAKERY PRODUCT INCORPORATING SUNFLOWER SEED, COTTONSEED AND VALUE ADDITION OF ARUGAAMPUL**" was carried out under the following headings:

1. Selection of recipes
2. Selection of ingredients
3. Incorporation of sunflower seed, cottonseed and arugampul powders in selected bakery products
4. Organoleptic evaluation of the developed baked products
5. Nutrient analysis of the powders
6. Shelf life of powders using different packaging material

1. Selection of recipes

Baking is a term commonly applied to the practice of making a wide range of food products including cakes, breads, pastries, cookies and crackers. The transition from raw materials to baked product is more often referred as being a change from foam to a sponge (James, 2011).

Bakery industry in India today has an important place in the industrial map of the country. Bakery products are items of mass consumption in view of its low price, high nutritive value and changing food habits of people and hence they have gained popularity among masses. The bakery industry has achieved third position in generating revenue among the processed food sector. The market size for the industry in pegged at U.S $ 4.7 billion in 2010 and is expected to reach U.S $ 7.6 billion by 2015. The percapita consumption of bakery product in India is one to two kg per annum, which is comparatively lower than the advanced countries where consumption is between 10-50 kg per annum. The growth rate of bakery products has been tremendous in the both urban and rural areas. The sector has indicated promising growth prospects and has been making rapid progress (www.marketresearch.com, 2012).

Bakery products include bread, rolls, cookies, pies, pastries, and muffins. They are usually prepared from flour or meal derived from some form of grain and cooked by dry heat process in oven. Bakery products are used relatively soon after production, thus having better vitamin retention and lesser sensory changes (Madhavan, 2011).

Among the different age group, children like baked products because of their delicious taste and texture. Though they are very tasty, their nutritional value is very low. To overcome this problem this study was taken to improve the nutritional value of bakery products by incorporating sunflower seed powder, cottonseed powder and value addition of arugampul powder. These powders are rich in nutrients and are generally thrown away. Hence using it gives value addition to bakery products.

Cakes are chemically leavened batter-based products. The variety and diversity of cake products is large with formulations varying substantially across the globe. The definition of cake varies, but essentially the term refers to products that are characterized by formulation based on wheat flour, sugar, whole egg and other liquids to which fat or oil may be added (Cauvin, 2003).

Biscuits and cookies are popular products all over the world and their combinations of texture and taste give them a universal appeal. Many different types of biscuits exist. However regardless of the category they belong to, certain rheological requirements must be present for all biscuits, i.e. the dough must be adequately cohesive for molding/ forming without excessive stickiness and the dough must have a short, soft texture (Oritz, 2004).

Pizza is distinguished as a traditional bakery product in European countries, with growing popularity in American countries, such as the United States, Brazil and Asian countries primarily as snack (Bezerra *et al.,* 2013; Ford *et al.,* 2013).

Just as with traditional bread, pizza has very pleasant aroma and flavor, is easily prepared and is of relatively low cost, this certainly contributes to its increased consumption. Despite its popularity, pizza dough's present low nutrient densities and bioactive compounds since they are prepared from refined wheat flour (Schmiele *et al.,* 2011).

The increase of functional ingredients is a good alternative to produce health foods, but the modification of the sensory characteristics should be considered to ensure the consumption of these products. The reduction of wheat flour and the addition of flours with high content of dietary fiber and absence of gluten decrease the capacity of air incorporation in the dough, increasing the texture of the same (Gomez, *et al.*, 2010).

Baking was done by bakers using individual raw materials like flour, water, sugar, eggs, fat, salt and other minor ingredients to enhance products. Although baked products have longer shelf life than other cooked foods, there are problems one faces time and again. The problem is solved by large commercial companies offering pre-blended mixes like bread, cakes, cupcakes, doughnut, creams, frosting, filling, and toppings. These premixes cover a variety of products, help in reducing labor time, result in lower storage, lower inventory, more variants, easy working, consistent quality and reduction of specialized manpower (www.thebakerynetwork.com).

According to Sudha *et al. (2007),* bakery products are sometimes used as a vehicle for incorporation of different nutritionally rich ingredients. Confectionary industry has been increasingly engaged in production of fiber enriched biscuits with the aim to offer such product as a valuable constituent of good nutrition and dietetic functional food intended for risky population.

In the present scenario more number of women is working, they have no sufficient time for preparing snacks for their children and hence they prefer to buy ready- to-eat snacks which are readily available in the market. Hence these types of bakery products will be of great help to them and to give an additional nutrient in it.

Different varieties of baked products are available in the market and for the present study plain sponge cake, muffin, cookies, pizza base and rusk are chosen for incorporation of the different powders.

The research design and the protocols used in the study were submitted for scrutinisation and approval to the Institutional Ethical Committee and ethical clearance approval No. IHEC/14-15/FSN/06 was obtained. The ethical clearance certificate was given by the Institutional Ethical Committee is given in Appendices I.

2. Selection of ingredients

One of the essential ingredients for the preparation of bakery product is refined flour. It is a good source of energy and carbohydrate but lacks other essential nutrients like protein and fiber. Hence to enrich with nutrients and introduce variety in the bakery product different oil seeds and herb were incorporated in the form of powder along with flour. Oil seeds like sunflower seed, cottonseed and herb like arugampul (*cynodon dacylon*) were selected and incorporated separately along with the basic ingredients of bakery products.

Different bakery products are created by varying the ingredients and combining them in a certain way to form the structure of the product. The possibilities are endless, but the basic ingredients like fat, sugar, eggs, flour, liquid, and leavening agent are the common factors. Depending on how these ingredients are combined, product will turn out delicious and for achieving desired texture the main requirement is the measurement of ingredients accurately.

Shortening, butter, margarine, and oil are all considered as fats and can be used in cakes depending on the desired texture. Besides adding flavor and moisture, fat combines with sugar during "creaming" to add lightness by trapping air that expands during baking.

Sugar adds sweetness and flavor but also aids in browning, tenderizing, maintaining moistness, and preserving the shelf life of the product. Sugar acts as a tenderizer by absorbing water, inhibiting gluten development, and incorporating air into shortening during the creaming process. It caramelizes under heat, providing cakes with a pleasing color and aroma.

Eggs provide the structure for cakes and help bind the ingredients together and act as an emulsifier. By surrounding small particles of fat, the egg helps make the cake batter smoother, contributing to volume and texture. In addition, when eggs are beaten, they incorporate tiny air bubbles that expand with heat in the oven, contributing to volume. Eggs should be at room temperature before use, for better incorporation of air during mixing. Eggs also add moisture, color, flavor, and nutritional value.

Although the structure of cakes is affected by the flour used in recipe, a more tender cake is made when little gluten development occurs. Now the recipes are prepared by using all-purpose flour. A self-rising flour may also be used in recipes, but because it has added baking powder and salt, these ingredients must be eliminated from the original recipe.

Baking powder is a mixture of baking soda plus an acid. It contains a fast-acting baking powder that reacts with the moisture in the recipe and a slow-acting baking powder that reacts with the addition of heat. If moisture is present, the acid reacts, causing the release of carbon dioxide, which causes the cake to rise. (Sandra, 2010).

Oil seeds enhance nutritional value to the diet due to high quality protein and vegetable oil with fat soluble vitamin A (Gunstone, 2002). Oil seeds contain energy for the sprouting embryo mainly as oil, compared with cereals, which contain the energy in the form of starch (Mc Kevith, 2005). Sunflower is an important oil seed crop. Sunflower oil is comparable to olive oil; it is rich in linoleic acid (essential fatty acid) hence is a valuable cooking oil (Iqtidar and Amanullah, 2005).

Sunflower kernel and its defatted meal have several advantages over other oilseed meal as human protein food, because of the absence of anti nutritional or toxic factors, flavor and of its high digestibility and biological value. Sunflower seeds are excellent source of dietary fiber, protein, vitamin E, B vitamins, and minerals such as potassium, magnesium, iron, phosphorus, selenium, calcium and zinc (Sahebeh *et al.*, 2011).

Sunflower is classified as either an oil type or a confection (non-oil) type, each with its own distinct market. Seeds from oil types are processed into vegetable oil or as meal in livestock feed (Lee, 2014).

Cottonseed meal is a product of oil extraction. Solvent extracted meal has about 50 percent protein (Shaikh, 2007).

Cottonseed is touted as a good cooking and salad oil, and is finding its way into a variety of foodstuffs as it ‘enhances’ the flavor of fried foods. It is also claimed to be healthy oil, as cottonseed doesn’t have any cholesterol www.herbstreatandtaste.blogspot.in)

Cynodon dacylon commonly known as arugampul, is a perennial grass, forming thick mats by means of stolen and rhizomes. It is an important medicinal plant which is

used for treatment of various ailments in Ayuvedic system of medicine (Saroja *et.al.,* 2012).

From ancient times, arugampul have been used for curing several ailments of mankind and pet animals. Even today with advancement of allopathic medicine, tribal people and rural population are still dependent on the arugampul (Rameshkumar, 2013).

Indigenous medicine is now recognized by WHO (2002) as an important healthcare resource due to its effectiveness and affordable cost. But traditional use of arugampul is continuously decreasing with the easy availability of the modern medicines and unavailability of information of local flora of medicinal importance. (Azaizeh *et al.*, 2003).

3. Incorporation of sunflower seed, cottonseed and arugampul powders in bakery products

The raw materials for the incorporation were purchased from the local market. The raw materials that were required for the present study include sunflower seed, cottonseed and arugampul. The selected raw materials were powdered by the following processes.

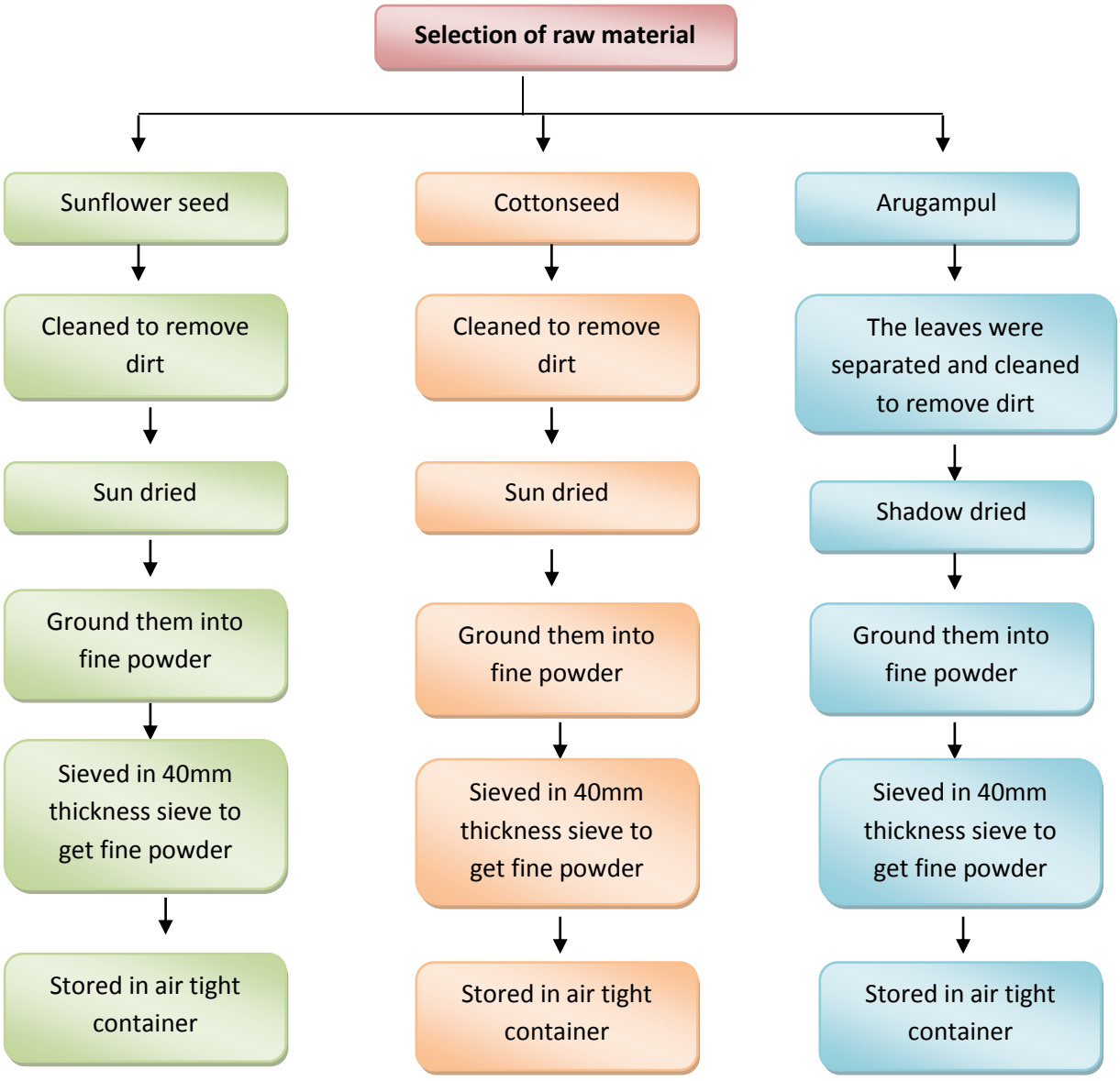


Figure I

Processing of raw material

Drying is one of the oldest methods of food preservation. Drying preserves foods by removing enough moisture from food to prevent decay and spoilage (Kendall *et.al*, 2004).

The following tables represent the composition of the ingredients used for preparation of bakery product.

TABLE I

COMPOSITION OF SUNFLOWER SEED POWDER, COTTONSEED POWDER AND ARUGAMPUL POWDER INCORPORATED IN CAKES

Ingredients (g)	**Standard**	**Sunflower seed**			**Cotton seed**		
		S1 (10%)	**S2 (15%)**	**S3 (20%)**	**C1 (10%)**	**C2 (15%)**	**C3 (20%)**
Maida flour	100	80	75	70	80	75	70
Sunflower seed/cottonseed	-	10	15	20	10	15	20
Baking powder	1	1	1	1	1	1	1
Sugar	80	80	80	80	80	80	80
Salt	2	2	2	2	2	2	2
Egg	2	2	2	2	2	2	2
Shortening	100	100	100	100	100	100	100
Arugampul powder	-	10	10	10	10	10	10

TABLE II

COMPOSITION OF SUNFLOWER SEED POWDER, COTTONSEED POWDER AND ARUGAMPUL POWDER INCORPORATED IN COOKIES

Ingredients (g)	Standard	Sunflower seed			Cotton seed		
		S1 (10%)	S2 (15%)	S3 (20%)	C1 (10%)	C2 (15%)	C3 (20%)
Maida flour	100	80	75	70	80	75	70
Sunflower seed/cottonseed	-	10	15	20	10	15	20
Baking powder	1	1	1	1	1	1	1
Sugar	50	50	50	50	50	50	50
Salt	2	2	2	2	2	2	2
Milk (ml)	10	10	10	10	10	10	10
Shortening	50	50	50	50	50	50	50
Arugampul powder	-	10	10	10	10	10	10

TABLE III

COMPOSITION OF SUNFLOWER SEED POWDER, COTTONSEED POWDER AND ARUGAMPUL POWDER INCORPORATED IN PIZZA

Ingredients (g)	Standard	Sunflower seed			Cotton seed		
		S1 (10%)	S2 (15%)	S3 (20%)	C1 (10%)	C2 (15%)	C3 (20%)
Maida flour	100	80	75	70	80	75	70
Sunflower seed/cottonseed	-	10	15	20	10	15	20
Dry yeast	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Sugar	5	5	5	5	5	5	5
Salt	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Warm water/ Warm milk	As required	As required	As required	As required	As required	As required	As required
Shortening	30	30	30	30	30	30	30
Arugampul powder	-	10	10	10	10	10	10

TABLE IV

COMPOSITION OF SUNFLOWER SEED POWDER, COTTONSEED POWDER AND ARUGAMPUL POWDER INCORPORATED IN RUSK

Ingredients (g)	Standard	Sunflower seed			Cotton seed		
		S1 (10%)	S2 (15%)	S3 (20%)	C1 (10%)	C2 (15%)	C3 (20%)
Maida flour	100	80	75	70	80	75	70
Sunflower seed/cottonseed	-	10	15	20	10	15	20
Dry yeast	5	5	5	5	5	5	5
Sugar	15	15	15	15	15	15	15
Oil	5	5	5	5	5	5	5
Milk (ml)	To brush	To brush	To brush	To brush	To brush	To brush	To brush
Lukewarm water	As required	As required	As required	As required	As required	As required	As required
Arugampul powder	-	10	10	10	10	10	10

4. Organoleptic evaluation of the developed baked product

Organoleptic evaluation is a scientific discipline that applies principles of experimental design and statistical analysis to the use of human senses (sight, taste, touch and hearing) for the purpose of evaluating consumer products. Organoleptic evaluation is done to estimate the acceptability of the prepared seed powder incorporated bakery products. The Numerical score card rating was used to sense the parameters like Appearance, Color, Flavor, Texture and Taste.

The Institute of Food Technologies (IFT) defines sensory evaluation as “The Scientific disciple used to evoke measure, analyze and interpret human reactions to those characteristics of foods and beverages as they are perceived by the senses of sight, smell, taste, touch and healing (Murano, 2003).

Semi trained (taste) panel members were selected for the evaluation and the panelists were asked to assess the degree of linking for each sample and the scores obtained were tabulated.

Surface characteristics of food products contribute to the appearance. The quality of food item may simply be judged from its appearance when it is placed in front of a consumer (Sivasankar, 2005).

The term 'Flavors' includes taste, smell and feeling on the tongue. The sense of taste is limited to three characteristics namely sweet, salty and bitter (Swaminathan, 2004).

Bakery products were evaluated based on physical factors such as softness, hardness, firmness, juiciness, grittiness or chewiness felt by the consumer. When the food is handled with fingers (hand feel) or with tongue, teeth or palate (mouth feel), any deviation from the expected texture is said to be a quality defect

Taste may be defined as the sensation derived from food as interpreted through the tongue to brain sensory system. The four primary taste sensations are sweet, salt, sour, bitter and fifth sensation is delicious (Murano, 2003).

Baked products can be tested for moisture level by conducting a test for wettability. For this test, the sample is weighed before being placed for 5 seconds in a dish of water. Immediately at the end of the lapsed time, the sample is removed from the water and weighed again to determine the weight gain. High moisture retention is synonymous with good wettability, a sign that a cake probably will be considered to be appropriately moist when judged subjectively (Srilakshmi, 2007)

Texture based analysis of baked food items to determine their baked quality. As the consumers are becoming more sophisticated and the demand for healthy food is increasing, food texture is becoming a very important issue for food processors. (Kaur, 2012).

The physical parameters of the biscuits were evaluated in terms of diameter (D), thickness (T) and spread ratio (D/T) values. Average weight of biscuits was recorded. Baking loss was determined by comparing weight of dough of biscuits before baking against total weight of baked biscuits. After cooling of the biscuits for 30 minutes diameter,

thickness measure were taken using a calibrated ruler. Diameter of biscuits was measured by laying six biscuits edge to edge with the help of a scale measuring the diameter of six biscuits (cm) and then taking average values. Thickness was measured by stacking six biscuits on top of each other and taking average thickness (cm).

$$\text{Spread ratio} = \frac{\text{Average value of diameter}}{\text{Average value of thickness}}$$

$$\text{\% spread} = \frac{\text{Spread ratio of experimental biscuits}}{\text{Spread ratio of control biscuits}} * 100$$

5. Nutrient analysis of the powders

Analysis of nutrient content is an important aspect in standardizing and developing a new product and evaluating a new process for making food products and identifying the sources of problem with unacceptable problem.

Adequate analytical methods for nutrients in foods, food ingredients, and food products are the basic first step in determining the nutritional adequacy of a food supply. Consumer education via food labels, database of nutrient and deficiency disease studies, and the assay used to provide the data must determine the analysis of interest adequately (Jonathan, 2006)

Nutrient analysis was carried out for the sunflower seed, cottonseed and argampul powders. The nutrients that were analyzed in these samples include the entire proximate nutrient such as Carbohydrate, Energy, Protein, Fat, and the micronutrients Calcium, Phosphorus, Iron, Thiamine and Riboflavin.

Determination of energy

Bomb calorimeter is based on the fact that a known weight of the sample completely burnt in the apparatus permits the heat developed by the combustion to be absorbed by a definite weight of water. By determining the rise in temperature, it is possible to calculate within close limits, the number of heat units liberated (AOAC, 2004).

Determination of carbohydrate

Carbohydrates are hydrolyzed into sample sugar using dilute hydrochloric acid. In hot acidic medium glucose is dehydrated to hydroxyl methyl furfural. This compound forms with anthrone, a green color with an absorption maximum at 630nm (AOAC, 2004)

Determination of protein

The most widely used method for protein determination is by Kjeldhal method for nitrogen determination. Since nitrogen is the characteristic element in protein, by its accurate determination, protein concentration can be calculated. This method involves two steps. In the first step protein is digested using sulphuric acid in the presence of a catalyst. In this step ll the organic material is oxidized except nitrogen, the reduced form of which is retained in digest as ammonium sulphate. Then ammonia is distilled and collected in boric acid and titrated against standard acid (FSSAI, 2012)

Determination of fat

Fat content of the sample were determined by soxhlet extraction method. The extraction of the crude fat is carried out using petroleum ether in a soxhelt unit followed by volatilization of solvent after extraction and determination of mass of the residue (James, 2006).

Estimation of minerals

Iron determination in the food sample is oxidized with ignition or oxidation. Iron as ferric iron reacts with ammonium thiocyanate or with potassium thiocyanate to give ferric thiocyanatewhich is red in color. The color which is a measure of the concentration is measured calorimetrically (AOAC, 2004)

Phosphorus determination which is treated with ammonium molybdate, phosphomolybdic acid is formed. Phosphomoly acid is reduced by the addition of 1, 2, 4 amino napthol sulphonic acid reagent to produce a blue color which is apparently a mixture of oxides of molybdenum. The color which is a measure of the concentration is measured calorimetrically (AOAC, 2004)

Calcium is determined by precipitating it as calcium oxalate and titrating the oxalate solution in dilute sulphuric acid against standard potassium permanganate (AOAC, 2004).

Determination of riboflavin

Riboflavin in the food sample is estimated fluorimetrically. Fluorimetric procedure for the determination of riboflavin depends on the extraction of vitamin with diluted acid, reaction with potassium peroxide to destroy interfering pigment and measurement of fluorescence. The vitamin content of the extract is evaluated by means of internal standard (AOAC, 2004).

Determination of thiamine

Thiamine estimation is based on the oxidation of thiamine to thiochrome in ultra violet light under standard conditions and in the absence of other fluorescent substances, the fluorescence produce directly proportional to the thiochrome present (AOAC, 2004)

6. Shelf life study of incorporating powders using different packaging material

Microbial analysis was carried for the sunflower seed, cottonseed and arugampul powders. These powders were stored in zip lock covers. The microbial content of the sample was estimated for the first week, second week and the third week.

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

Food microbiology focuses on the general biology of micro organisms which are found in foods including their growth, characteristic, identification and pathogenesis (Singh, 2009)

Shelf life is most influenced by several factors: exposure to light and heat, transmission of gasses, humidity, mechanical stress, and contamination by microorganism. Microbiological analysis is important to determine the safety and quality of food.

Cost analysis

Current cost at the time of preparation of the raw ingredients in the wholesale commercial market was considered as basic cost. Fifty per cent of basic cost was added as overhead charges to this and considered to be the total cost, the production cost and the cost of all the standardized and prepared products were calculated.

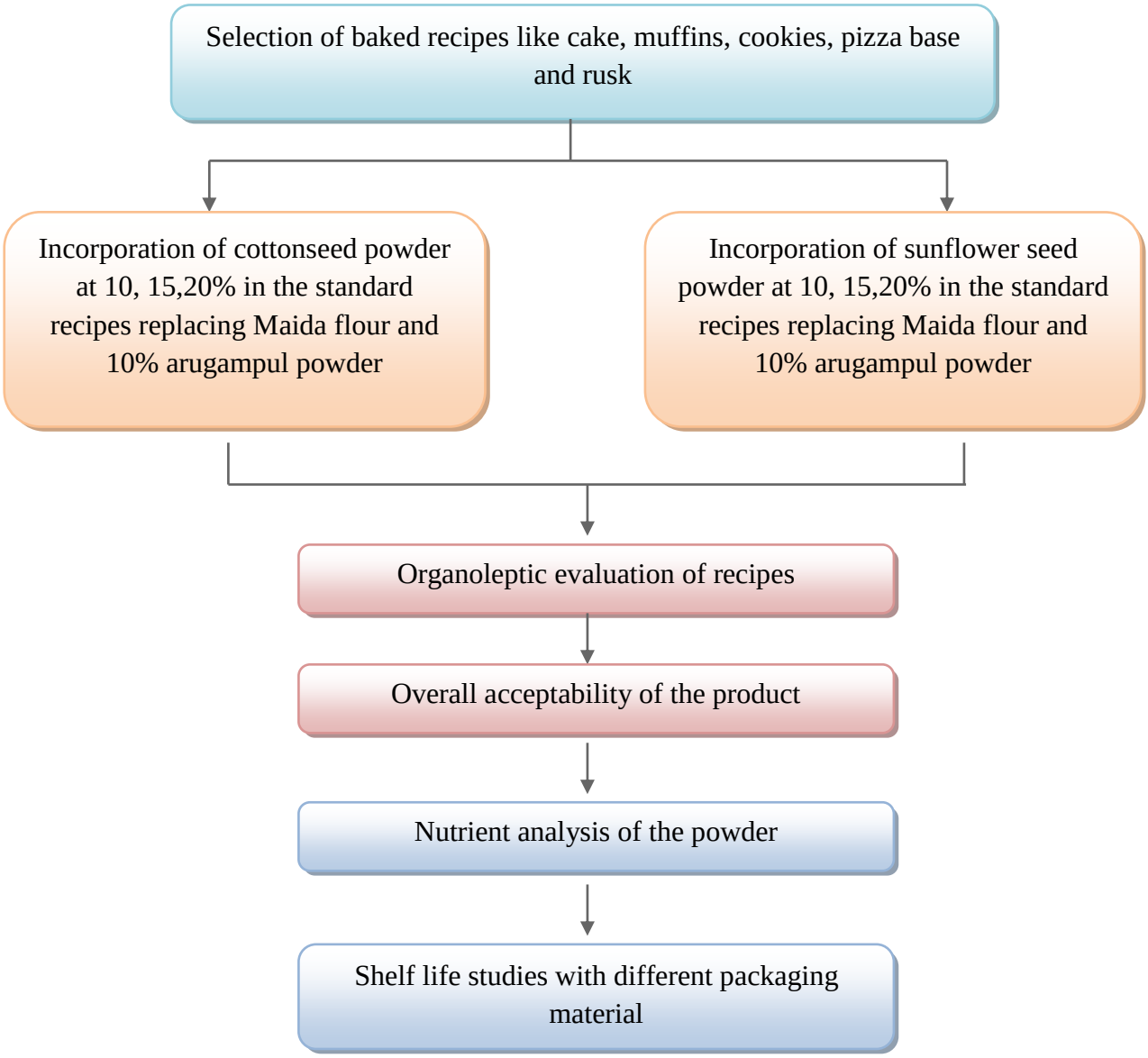
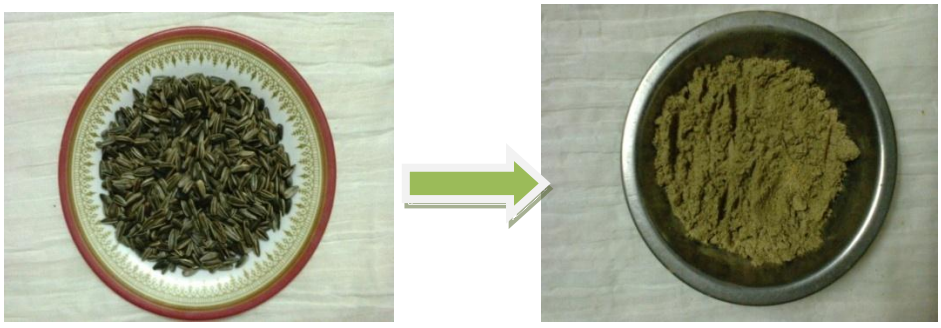


FIGURE II

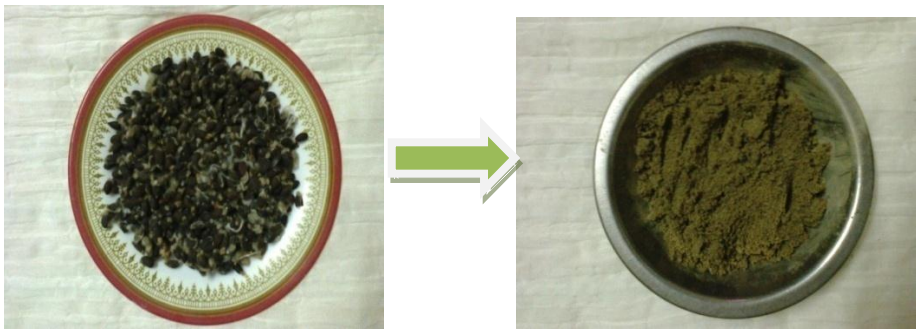
RESEARCH DESIGN

PLATE I

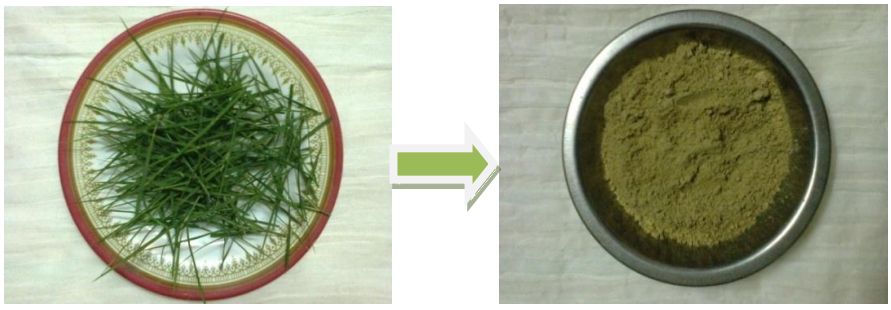
INCORPORATING POWDERS (SUNFLOWER SEED, COTTONSEED AND ARUGAMPUL)



Sunflower seed **Sunflower seed powder**



Cottonseed **Cotton seed powder**



Arugampul **Arugampul powder**

PLATE II

SUNFLOWER SEED AND ARUGMPUL POWDER INCORPORATED CAKE

Standard

S1 (10%)

S2 (15%)

S3 (20%)

PLATE III

COTTONSEED AND ARUGAMPUL POWDER INCORPORATED CAKE

Standard

C1 (10%)

C2 (15%)

C3 (20%)

PLATE IV

SUNFLOWER SEED AND ARUGAMPUL INCORPORATED COOKIES

Standard

S1 (10%)

S2 (15%)

S3 (20%)

Plate V

Cottonseed and arugampul powder incorporated cookies

Standard

C1 (10%)

C2 (15%)

C3 (20%)

PLATE VI

SUNFLOWER SEED AND ARUGAMPUL INCORPORATED RUSK

Standard

S1 (10%)

S2 (15%)

S3 (20%)

PLATE VII

COTTONSEED AND ARUGAMPUL POWDER INCORPORATED RUSK

Standard

C1 (10%)

C2 (15%)

C3 (20%)

PLATE VIII

SUNFLOWER SEED AND ARUGAMPUL INCORPORATED PIZZA

Standard

S1 (10%)

S2 (15%)

S3 (20%)

PLATE IX

COTTONSEED AND ARUGAAMPUL POWDER INCORPORATED PIZZA

Standard

C1 (10%)

C2 (15%)

C3 (20%)

IV RESULTS AND DISCUSSION

The Results and Discussion pertaining to the topic, "**Development of Bakery Product Incorporating Sunflower Seed, Cottonseed and Value Addition with Arugampul**", is presented under the following headings:

A. Selection of recipes and sensory evaluation of the developed bakery products
B. Sensory evaluation and acceptability of cakes prepared by incorporating sunflower seed, cottonseed and arugampul powder
C. Sensory evaluation and acceptability of cookies prepared by incorporating sunflower seed, cottonseed and arugampul powder
D. Sensory evaluation and acceptability of rusk prepared by incorporating sunflower seed, cottonseed and arugampul powder
E. Sensory evaluation and acceptability of pizza prepared by incorporating sunflower seed, cottonseed and arugampul powder
F. Nutrient analysis of powder
G. Shelf life study of powders using different packaging material

A. Selection of recipes and sensory evaluation of the developed bakery products

Among the different age group, children like baked products because of their delicious taste and texture. Though they are very tasty, their nutritional value is very low. To overcome this problem this study was undertaken to improve the nutritional value of bakery products by incorporating sunflower seed powder, cottonseed powder and enriching the product with arugampul powder. These powders are rich in nutrients and are generally thrown away. Hence using it gives value addition by improving the micronutrients.

Sensory evaluation is an important aspect for development, product improvement and optimization of the product. Baking conditions as well as raw material properties affects the sensory characteristics of product developed. Among the variety of bakery products cakes, cookies, rusk and pizza were selected to carry out the acceptability trials by incorporating the prepared powders. After the sensory evaluation highly acceptable cake, cookies, rusk and pizza in each of the four forms were selected to carry out statistical

analysis. The mean acceptability scores of the four forms of cake, cookies, rusk and pizza are discussed in the following pages.

Cakes, Cookies, Rusk and Pizza were prepared by incorporating sunflower seed/cottonseed powder at 10 percent, 15 percent and 20 percent levels and along with these seed powder arugampul powder was also incorporated at 10 percent levels. The standard cakes, cookies, rusk and pizza were labeled as S and the cakes, cookies, rusk and pizzaprepared incorporating 10percent, 15 percent and 20 percent of sunflower seed and arugampul powder were labeled as S_1, S_2, and S_3 respectively. The cakes, cookies, rusk and pizza incorporating 10percent, 20 percent and 30 percent of cottonseed and arugampul powder were labeled as C_1, C_2, and C_3 respectively.

B. Sensory evaluation and acceptability of cakes prepared by incorporating sunflower seed, cottonseed and arugampul powder

The mean scores for cakes prepared incorporating sunflower seed and arugampul powder is presented in Table V and Figure III.

TABLE V

MEAN ACCEPTABILITY SCORES OF SUNFLOWER SEED AND ARUGAMPUL POWDER INCORPORATED CAKE

Variation	Appearance Mean±SD	Flavour Mean±SD	Taste Mean±SD	Texture Mean±SD	Colour Mean±SD	Over all Acceptability Mean±SD
Standard	4.8±0.4	4.9±0.3	4.9±0.3	4.6±0.6	5±0	4.9±0.3
S1	3.6±0.8	4.3±0.6	4.4±0.6	4.1±0.5	3.2±0.4	4.2±0.6
S2	3.9±0.5	4.1±0.7	4.2±0.7	4.2±0.4	3.1±0.3	4.2±0.4
S3	3.9±0.5	4.2±0.6	4.6±0.5	4.6±0.5	3.1±0.7	4.1±0.3
t value						
SvsS1	4.0*	2.5*	2.0*	1.7*	13.5*	3.1*
SvsS2	4.0*	3.1*	2.6*	1.5**	19*	4.2*
SvsS3	4.0*	3.1*	1.5**	0^{NS}	8.1*	5.6*

S-Standard, S1-10% Incorporation ,S2-15% Incorporation, S3-20% Incorporation.
*- Significant at 1% level,**- significant at 5% level, NS- not significant.

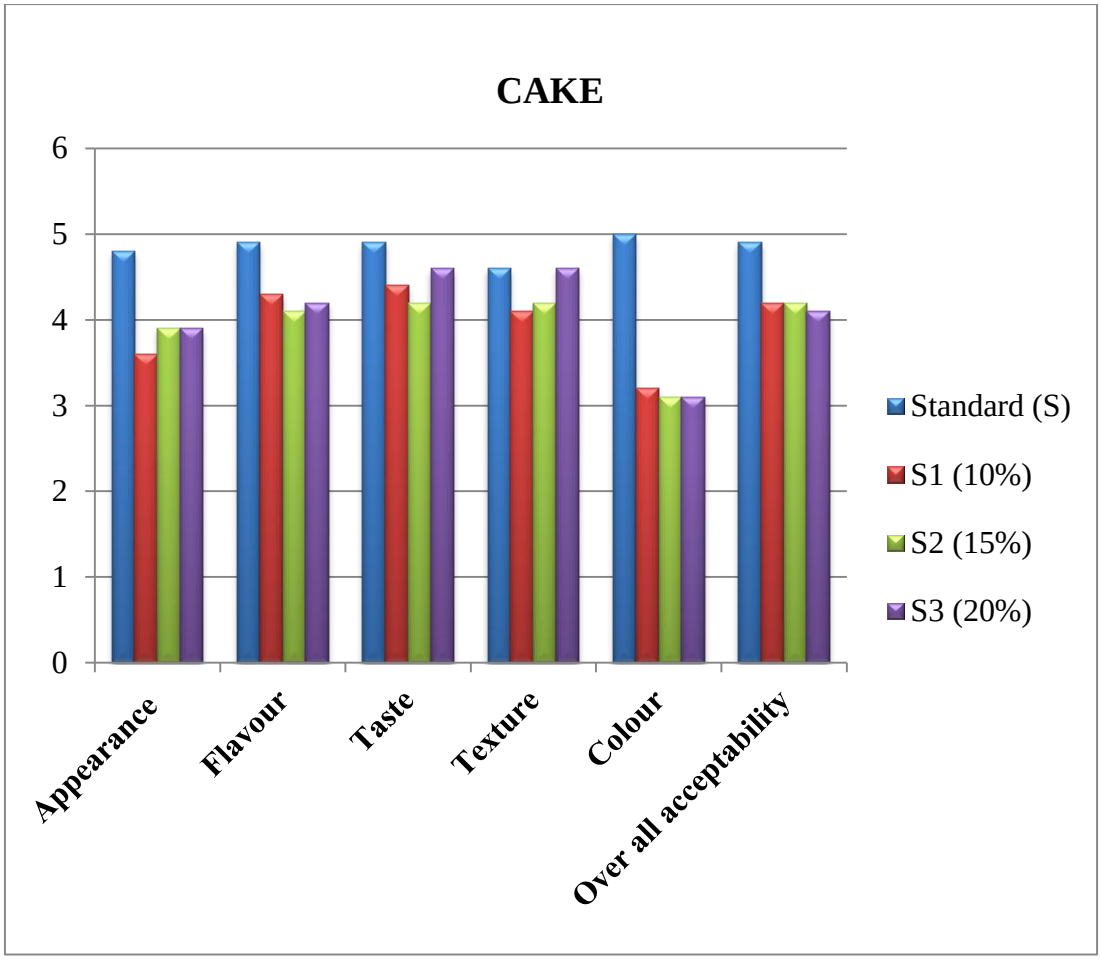


FIGURE III

MEAN ACCEPTABILITY SCORES OF SUNFLOWER SEED AND ARUGAMPUL POWDER INCORPORATED CAKE

From the table V and Figure III it is evident that the mean scores of the cakes decreased as the level of incorporation of the sunflower seed and arugampul powder increased.

After incorporating sunflower seed and arugampul powders in the cake the appearance was not highly acceptable. Majority of the panel members stated that icing was necessary for good appearance. The mean score obtained for appearance of cake was 3.6±0.8, 3.9±0.5, 3.9±0.5 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%), S2 (15%) and S3 (20%).

The flavor of the cake increased with each successive incorporation of the powders. The cake had a very strong flavor of the sunflower seed and arugampul powders. Mean scores obtained for flavor, for cake was 4.3±0.6, 4.1±0.7, 4.2±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%), S2 (15%) and S3 (20%).

After incorporating sunflower seed and arugampul powders the taste of the cake was not highly acceptable. It gave a bitter taste when incorporation of sunflower seed and arugampul powder was increased. The mean score for taste was 4.4±0.6, 4.2±0.7, 4.6±0.5 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%) and S2 (15%) but the difference was significant at five percent ($p<0.05$) between standard (S) and S3 (20%).

Incorporating sunflower seed and arugampul powder in the cake, texture was not very soft. The mean score for texture of cake was 4.1±0.5, 4.2±0.4, 4.6±0.5 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%). The difference was significant at five percent ($p<0.05$) between standard (S) and S2 (15%) but there was no significant difference between standard (S) and S3 (20%).

The intensity of the color of the cake increased as the level of incorporation of the sunflower seed and arugampul powder increased. The mean score for the color of the cake was 3.2±0.4, 3.1±0.3, 3.1±0.7 for 10%, 15% and 20% level incorporation respectively. The

difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%), S2 (15%) and S3 (20%).

The overall acceptability of standard cake and S1 and S2 (i.e.) 10% and 15% level incorporated cake were found to be very good. The S3 (i.e.) 20% level of incorporation were found to be good. The mean score for cake was 4.2±0.6, 4.2±0.4, 4.1±0.3 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%), S2 (15%) and S3 (20%).

The mean scores for cakes incorporating cottonseed and arugampul powder is presented in Table VI and Figure IV.

TABLE VI

MEAN ACCEPTABILITY SCORES OF COTTONSEED AND ARUGAMPUL POWDER INCORPORATED CAKE

Variation	Appearance Mean±SD	Flavour Mean±SD	Taste Mean±SD	Texture Mean±SD	Colour Mean±SD	Over all Acceptability Mean±SD
Standard	4.8±0.4	4.9±0.3	4.9±0.3	4.6±0.6	5±0	4.9±0.3
C1	4.3±0.6	4.4±0.6	4.6±0.5	4.4±0.5	3.2±0.4	4.3±0.4
C2	4.3±0.8	4.7±0.4	4.4±0.5	4.4±0.5	3.5±0.5	4.2±0.6
C3	4.3±0.8	4.4±0.6	4.4±0.6	4.4±0.5	3.5±0.5	4±0.6
t value						
SvsC1	1.9*	2.0*	1.5**	0.7**	13.5*	3.2*
SvsC2	1.7**	1.0**	2.6*	0.7**	9*	3.1*
SvsC3	1.7**	2.0*	2.0*	0.7**	9*	3.8*

S-Standard, C1-10% Incorporation ,C2-15% Incorporation, C3-20% Incorporation.
*- Significant at 1% level,**- significant at 5% level

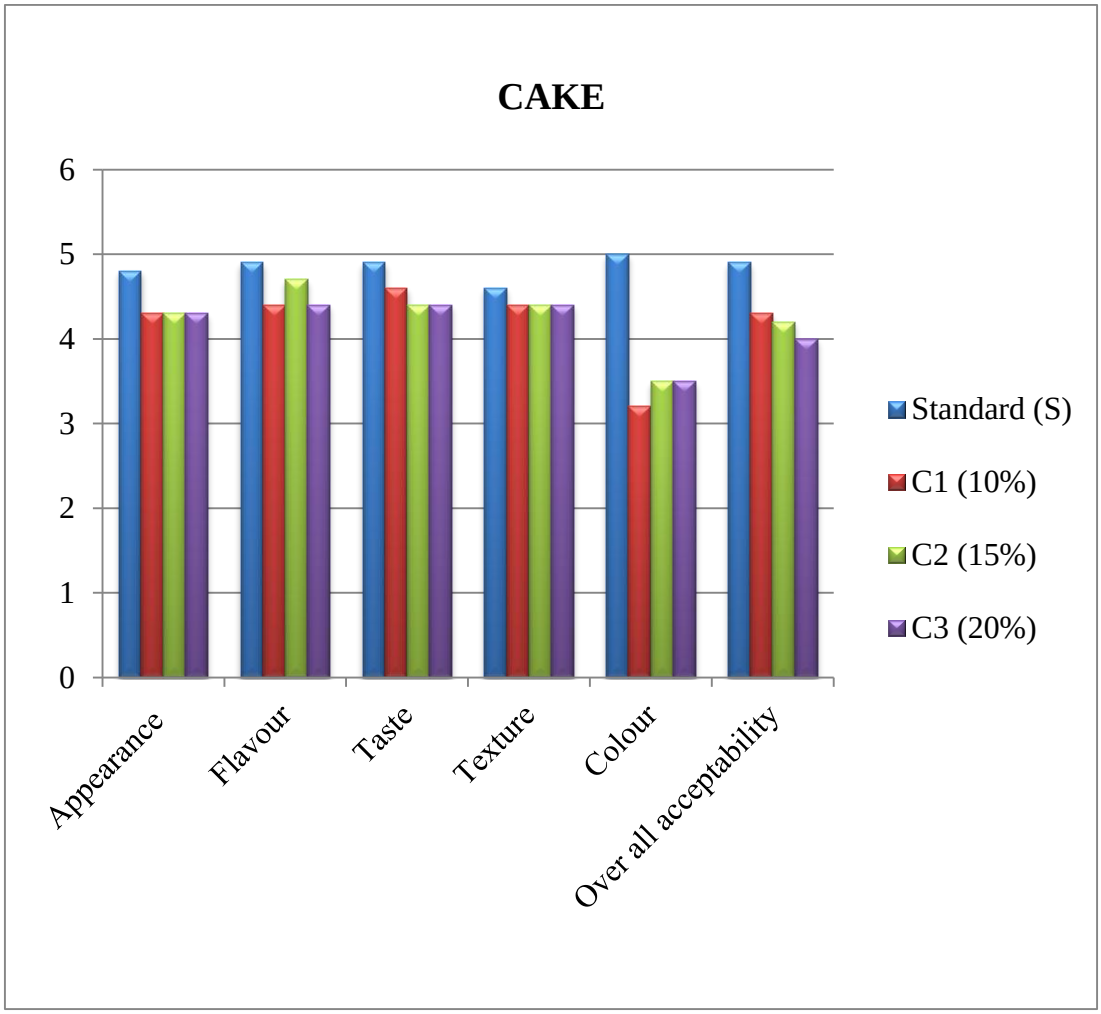


FIGURE IV

MEAN ACCEPTABILITY SCORES OF COTTONSEED AND ARUGAMPUL POWDER INCORPORATED CAKE

From the table VI and Figure IV it is evident that the mean scores of the cakes decreased as the level of incorporation of the cottonseed and arugampul powder increased.

After incorporating cottonseed and arugampul powders in the cake the appearance was not highly acceptable. The mean score obtained for appearance of cake was 4.3±0.6, 4.3±0.8, 4.3±0.8 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C1 (10%) but the difference was significant at five percent ($p<0.05$) between standard (S) and C2 (15%) and C3 (20%).

The flavor of the cake increased with each successive incorporation of the powders. The cake had a very strong flavor of the cottonseed and arugampul powders. Mean scores obtained for flavor for cake was 4.4±0.6, 4.7±0.4, 4.4±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C1 (10%) and C3 (20%). The difference was significant at five percent ($p<0.05$) between standard and C2 (15%)

Incorporating cottonseed and arugampul powders the taste of the cake was not highly acceptable. It gave a bitter taste when incorporation of cottonseed and arugampul powder was increased. The mean score for taste was 4.6±0.5, 4.4±0.5, 4.4±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C2 (15%) and C3 (20%) but the difference was significant at five percent ($p<0.05$) between standard (S) and C1 (10%).

Incorporation of cottonseed and arugampul powder in the cake, texture was not up to the standard of the cake. The mean score for texture of cake was 4.4±0.5, 4.4±0.5, 4.4±0.5 for 10%, 15% and 20% level incorporation respectively. The difference was significant at five percent ($p<0.05$) between standard (S) andC1 (10%), C2 (15%) and C3 (20%).

The intensity of the color of the cake increased and the cake had darker color as the level of incorporation of the cottonseed and arugampul powder increased. The mean score for the color of the cake was 3.2±0.4, 3.5±0.5, 3.5±0.5 for 10%, 15% and 20% level

incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C1 (10%), C2 (15%) and C3 (20%).

The overall acceptability of standard cake and C1 and C2 (i.e.) 10% and 15% level incorporated cake were found to be very good. The C3 (i.e.) 20% level of incorporation were found to be good. The mean score for cake was 4.3±0.4, 4.2±0.6, 4±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C1 (10%), C2 (15%) and C3 (20%).

C. Sensory evaluation and acceptability of cookies prepared by incorporating sunflower seed, cottonseed and arugampul powder

The mean scores for cookies prepared incorporating sunflower seed and arugampul powder is presented in Table VII and Figure V.

TABLE VII

MEAN ACCEPTABILITY SCORES OF SUNFLOWER SEED AND ARUGAMPUL POWDER INCORPORATED COOKIES

Variation	Appearance Mean±SD	Flavour Mean±SD	Taste Mean±SD	Texture Mean±SD	Colour Mean±SD	Over all Acceptability Mean±SD
Standard	4.8±0.4	5±0	4.8±0.4	4.9±0.3	5±0	5±0
S1	4.1±0.5	4.4±0.5	4.3±0.6	4.4±0.6	3.8±0.6	4.3±0.6
S2	4.4±0.6	4.5±0.7	4.4±0.6	4.4±0.5	3.6±0.5	4.7±0.4
S3	4±0.8	4.6±0.6	4.7±0.4	4.3±0.4	3.5±0.7	4.6±0.5
t value						
SvsS1	3.1*	3.6*	1.9*	2.0*	6*	3.2*
SvsS2	1.5**	2.2*	1.5*	2.6*	8.5*	1.9*
SvsS3	2.7*	1.8*	0.4^{NS}	3.2*	6.7*	2.4*

S-Standard, S1-10% Incorporation, S2-15% Incorporation, S3-20% Incorporation.
*- Significant at 1% level,**- significant at 5% level, NS- not significant.

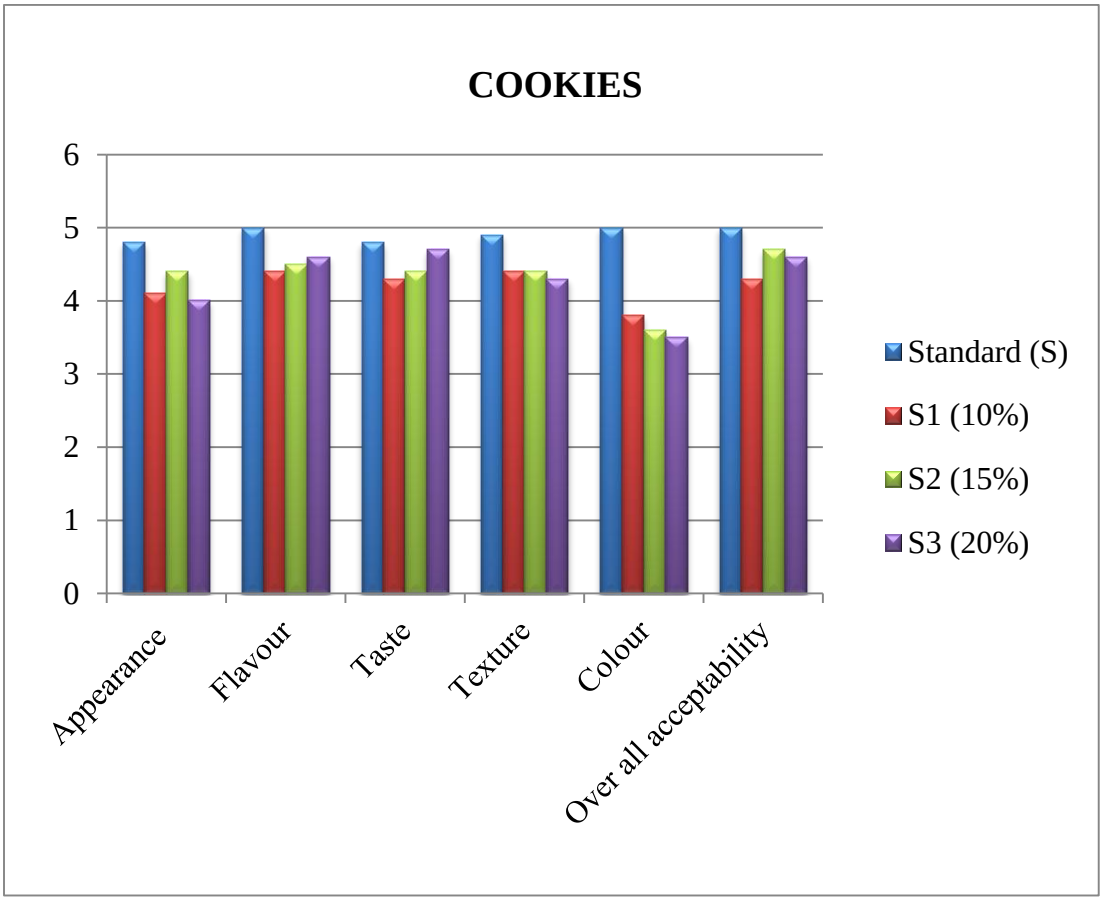


FIGURE V

MEAN ACCEPTABILITY SCORES OF SUNFLOWER SEED AND ARUGAMPUL POWDER INCORPORATED COOKIES

From the table VII and Figure V it is evident that the mean scores of the cookies decreased as the level of incorporation of the sunflower seed and arugampul powder increased.

After incorporating sunflower seed and arugampul powders in the cookies the appearance was slightly acceptable. The mean score obtained for appearance of cookies was 4.1±0.5, 4.4±0.6, 4±0.8 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%) and S3 (20%) but the difference was significant at five percent ($p<0.05$) between standard (S) and S2 (15%).

The flavor of the cookies increased with each successive incorporation of the powders. Mean scores obtained for flavor for cookies was 4.4±0.5, 4.5±0.7, 4.6±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%), S2 (15%) and S3 (20%).

After incorporating sunflower seed and arugampul powders the taste of the cookies was slightly acceptable. It gave a bitter taste when incorporation of sunflower seed and arugampul powder was increased. The mean score for taste was 4.3±0.6, 4.4±0.6, 4.7±0.4 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%) and S2 (15%) but the difference was not significant between standard (S) and S3 (20%).

After incorporation of sunflower seed and arugampul powder in the cookies texture was not highly acceptable. The mean score for texture of cookies was 4.4±0.6, 4.4±0.5, 4.3±0.4 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%), S2 (15%) and S3 (20%).

The intensity of the color of the cookies increased as the level of incorporation of the sunflower seed and arugampul powder increased. The mean score for the color of the cookies was 3.8±0.6, 3.6±0.5, 3.5±0.7 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%), S2 (15%) and S3 (20%).

The overall acceptability of standard cookies and S2 and S3 (i.e.) 15% and 20% level incorporated cookies were found to be very good. The S1 (i.e.) 10% level of incorporation were found to be good. The mean score for cookies was 4.3±0.6, 4.7±0.4, 4.6±0.5 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%), S2 (15%) and S3 (20%).

The mean scores for cookies incorporating cottonseed and arugampul powder is presented in Table VIII and Figure VI.

TABLE VIII

MEAN ACCEPTABILITY SCORES OF COTTONSEED AND ARUGAMPUL POWDER INCORPORATED COOKIES

Variation	Appearance Mean±SD	Flavour Mean±SD	Taste Mean±SD	Texture Mean±SD	Colour Mean±SD	Over all Acceptability Mean±SD
Standard	4.8±0.4	5±0	4.8±0.4	4.9±0.3	5±0	5±0
C1	4±0.4	4.4±0.8	4.1±0.7	4.1±0.5	3.9±0.7	4.2±0.4
C2	4.4±0.5	4.1±0.8	3.8±0.7	4.1±0.7	3.7±0.8	4.3±0.6
C3	4.4±0.5	4.6±0.6	4.1±0.5	4.2±0.4	3.8±0.7	4.5±0.7
t value						
SvsC1	4*	2.2*	2.6*	3.8*	4.7*	6*
SvsC2	1.8*	3.2*	3.5*	3.1*	4.9*	3.2*
SvsC3	1.8*	1.8*	3.1*	4.2*	4.8*	2.2*

S-Standard, C1-10% Incorporation ,C2-15% Incorporation, C3-20% Incorporation.
*- Significant at 1% level,**- significant at 5% level

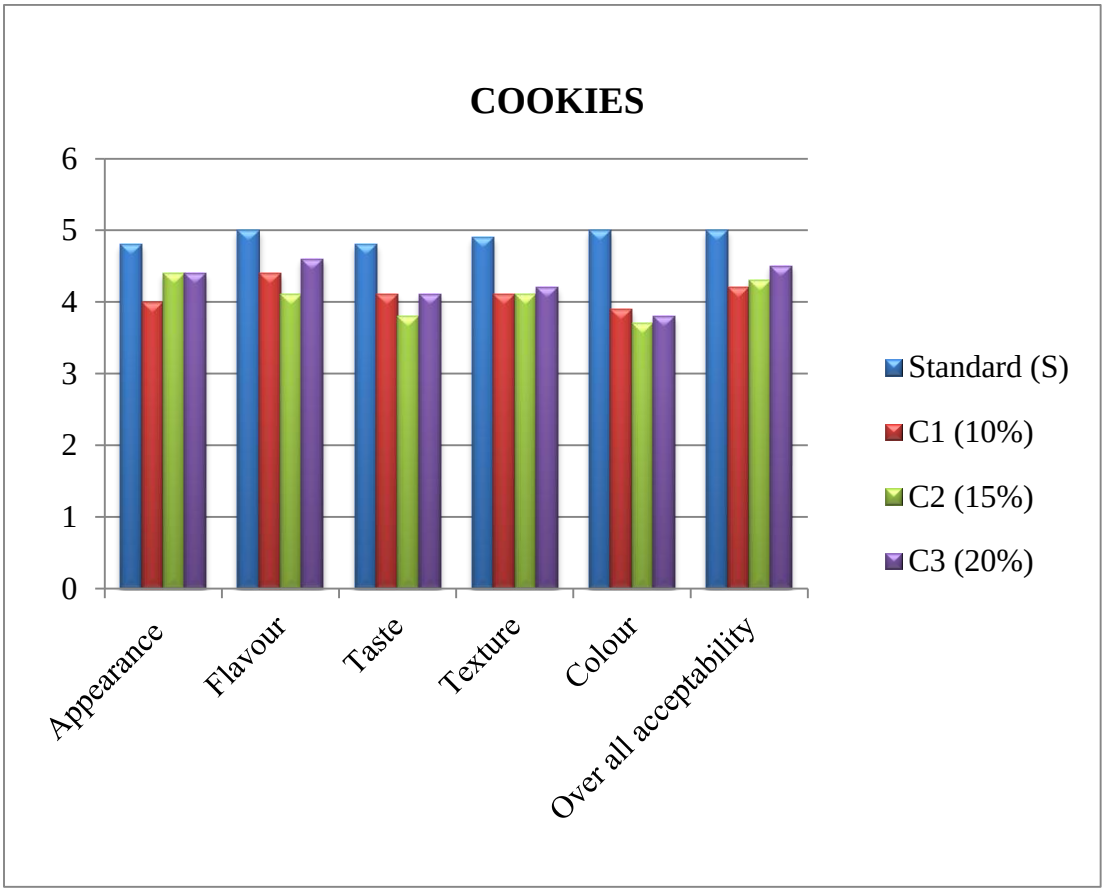


FIGURE VI

MEAN ACCEPTABILITY SCORES OF COTTONSEED AND ARUGAMPUL POWDER INCORPORATED COOKIES

From the table VIII Figure VI it is evident that the mean scores of the cookies decreased as the level of incorporation of the cottonseed and arugampul powder increased.

After incorporating cottonseed and arugampul powders in the cookies the appearance was not highly acceptable. The mean score obtained for appearance of cookies was 4±0.4, 4.4±0.5, 4.4±0.5 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C1 (10%), C2 (15%) and C3 (20%).

The flavor of the cookies increased with each successive incorporation of the powders. Mean scores obtained for flavor for cookies was 4.4±0.8, 4.1±0.8, 4.6±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C1 (10%),C2 (15%) and C3 (20%).

After incorporating cottonseed and arugampul powders the taste of the cookies was slightly acceptable. It gave a bitter taste when incorporation of cottonseed and arugampul powder was increased. The mean score for taste was 4.1±0.7, 3.8±0.7, 4.1±0.5 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C1 (10%), C2 (15%) and C3 (20%).

After incorporation of cottonseed and arugampul powder in the cookies texture was slightly acceptable. The mean score for texture of cookies was 4.1±0.5, 4.1±0.7, 4.2±0.4 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) andC1 (10%), C2 (15%) and C3 (20%).

The intensity of the color of the cookies increased as the level of incorporation of the cottonseed and arugampul powder increased. The mean score for the color of the cookies was 3.9±0.7, 3.7±0.8, 3.8±0.7 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C1 (10%), C2 (15%) and C3 (20%).

The overall acceptability of standard cookies and C2 and C3 (i.e.) 15% and 20% level incorporated cookies were found to be very good. The C1 (i.e.) 10% level of

incorporation were found to be good. The mean score for cookies was 4.2±0.4, 4.3±0.6, 4.5±0.7 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C1 (10%), C2 (15%) and C3 (20%).

Spread ratio of cookies prepared by incorporating sunflower seed, cottonseed and arugampul powder

The data pertaining to physical parameters of sunflower seed, cottonseed and arugampul powder incorporated cookies is presented in Table IX

TABLE IX

PHYSICAL PROPERTIES OF COOKIES

Cookies sample	Weight (g)	Diameter (cm)	Thickness (cm)	Spread ratio	% spread as compared to standard
Sunflower seed and arugampul	10	4.2	0.7	6	100
S	11.5	4.3	0.8	5.3	88.3
S1	11.6	4.2	0.7	6	100
S2	10.8	4.2	0.7	6	100
S3					
Cottonseed and arugampul					
S	10	4.2	0.7	6	100
C1	11	4.3	0.8	5.3	88.3
C2	11.5	4.2	0.7	6	100
C3	11.8	4.2	0.7	6	100

It was observed that the weight of cookies increased with the addition of sunflower seed and arugampul powder from 10g in standard (S) to 11.5g, 11.6g, 10.8g in sample S1, S2, S3 and in cottonseed and arugampul from 10g in standard (S) to 11g, 11.5g, 11.8 in sample C1, C2 and C3. Diameters of incorporated sample were recorded and it is almost equal to that of standard (S). The thickness of cookies increased from 0.7cm in standard (S) to 0.8 in S1 and C1, while S2, S3 and C2, C3 had the same thickness as that of standard (S). The changes in thickness and diameter were reflected in spread ratio and percent spread of cookies. The spread ratio and percent spread of standard (S) cookies were 6 and 100 respectively. Spread factor is the ratio that depends on the values of the thickness and

diameter of the cookies. Experimental cookies S2, S3 and C2, C3 showed similar spread ratio and percent spread values as that of standard (S).

D. Sensory evaluation and acceptability of rusk prepared by incorporating sunflower seed, cottonseed and arugampul powder

The mean scores for rusk incorporating sunflower seed and arugampul powder is presented in Table X and Figure VII.

TABLE X

MEAN ACCEPTABILITY SCORES OF SUNFLOWER SEED AND ARUGAMPUL POWDER INCORPORATED RUSK

Variation	Appearance Mean±SD	Flavour Mean±SD	Taste Mean±SD	Texture Mean±SD	Colour Mean±SD	Over all Acceptability Mean±SD
Standard	4.9±0.3	5±0	5±0	4.8±0.6	4.8±0.6	4.8±0.4
S1	4.4±0.5	4.4±0.5	4.3±0.6	4.8±0.4	4.4±0.6	4.5±0.5
S2	4.4±0.5	4.4±0.5	4.1±0.5	4.5±0.5	4±0.4	4.1±0.5
S3	4.3±0.6	4.3±0.6	3.8±0.9	4.2±0.7	4±0.4	4±0.6
t value						
SvsS1	2.6*	3.6*	3.2*	0^{NS}	1.3**	1.4**
SvsS2	2.6*	3.6*	5.0*	1.1**	3.2*	3.1*
SvsS3	2.5*	3.2*	4.1*	1.8*	3.2*	3.2*

S-Standard, S1-10% Incorporation ,S2-15% Incorporation, S3-20% Incorporation.
*- Significant at 1% level,**- significant at 5% level, NS- not significant.

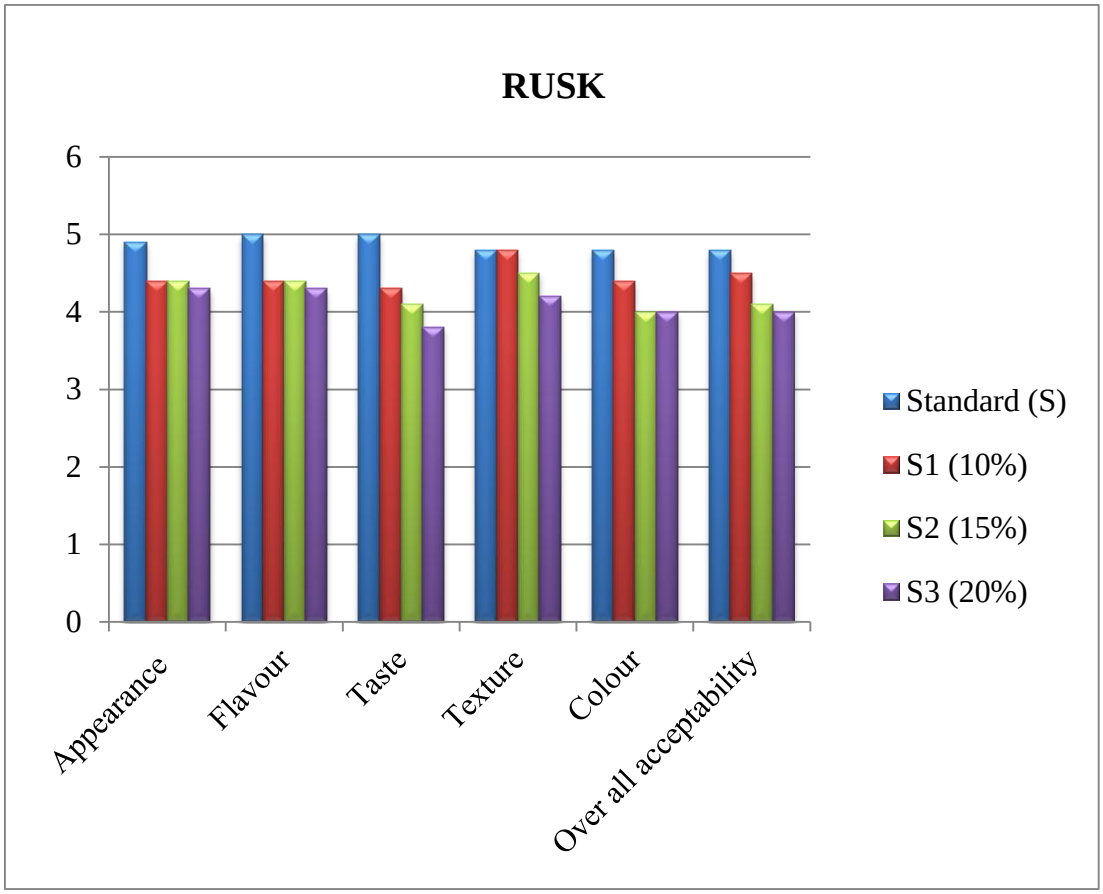


FIGURE VII

MEAN ACCEPTABILITY SCORES OF SUNFLOWER SEED AND ARUGAMPUL POWDER INCORPORATED RUSK

From the table X and Figure VII it is evident that the mean scores of the rusk decreased as the level of incorporation of the sunflower seed and arugampul powder increased.

After incorporating sunflower seed and arugampul powders in the rusk the appearance was slightly acceptable. The mean score obtained for appearance of rusk was 4.4±0.5, 4.4±0.5, 4.3±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%), S2 (15%) and S3 (20%).

The flavor of the rusk increased with each successive incorporation of the powders. Mean scores obtained for flavor for rusk was 4.4±0.5, 4.4±0.5, 4.3±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%), S2 (15%) and S3 (20%).

After incorporating sunflower seed and arugampul powders the taste of the rusk was slightly acceptable. It gave a bitter taste when incorporation of sunflower seed and arugampul powder was increased. The mean score for taste was 4.3±0.6, 4.1±0.5, 3.8±0.9 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%), S2 (15%) and S3 (20%).

After incorporating sunflower seed and arugampul powder in the rusk texture was slightly acceptable. The mean score for texture of rusk was 4.8±0.4, 4.5±0.5, 4.2±0.7 for 10%, 15% and 20% level incorporation respectively. There was no significant between standard (S) and S1 (10%). The difference was significant at five percent ($p<0.05$) between standard and S2 (15%). The difference was significant at one percent ($p<0.01$) between standard (S) and S3 (20%).

The intensity of the color of the rusk increased as the level of incorporation of the sunflower seed and arugampul powder increased. The mean score for the color of the rusk was 4.4±0.6, 4±0.4, 4±0.4 for 10%, 15% and 20% level incorporation respectively. The difference was significant at five percent ($p<0.05$) between standard (S) and S1 (10%). The difference was significant at one percent ($p<0.01$) between standard (S) and S2 (15%) and S3 (20%).

The overall acceptability of standard rusk and S1 (i.e.) 10% level incorporated rusk were found to be very good. The S2 and S3 (i.e.) 15% and 20% level of incorporation were found to be good. The mean score for rusk was 4.5±0.5, 4.1±0.5, 4±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at five percent ($p<0.05$) between standard (S) and S1 (10%). The difference was significant at one percent ($p<0.01$) between standard (S) and S2 (15%) and S3 (20%).

The mean scores for rusk incorporating cottonseed and arugampul powder is presented in Table XI and Figure VIII.

TABLE XI

MEAN ACCEPTABILITY SCORES OF COTTONSEED AND ARUGAMPUL POWDER INCORPORATED RUSK

Variation	**Appearance Mean±SD**	**Flavour Mean±SD**	**Taste Mean±SD**	**Texture Mean±SD**	**Colour Mean±SD**	**Over all Acceptability Mean±SD**
Standard	4.9±0.3	5±0	5±0	4.8±0.6	4.8±0.6	4.8±0.4
C1	4.3±0.4	3.8±0.7	3.4±0.8	4.4±0.5	4.3±0.8	3.7±0.6
C2	3.9±0.7	3.7±0.9	3.7±0.9	4.6±0.5	4±0.8	3.7±0.8
C3	4±0.6	4.1±0.8	3.8±0.7	4.6±0.6	4±0.8	4.2±0.6
t value						
SvsC1	3.2*	4.8*	6*	1.5**	1.5**	4.3*
SvsC2	3.0*	4.3*	4.3*	0.7**	2.4*	3.7*
SvsC3	3.8*	3.2*	4.8*	0.6^{NS}	2.4*	2.4*

S-Standard, C1-10% Incorporation ,C2-15% Incorporation, C3-20% Incorporation.
*- Significant at 1% level,**- significant at 5% level, NS- not significant.

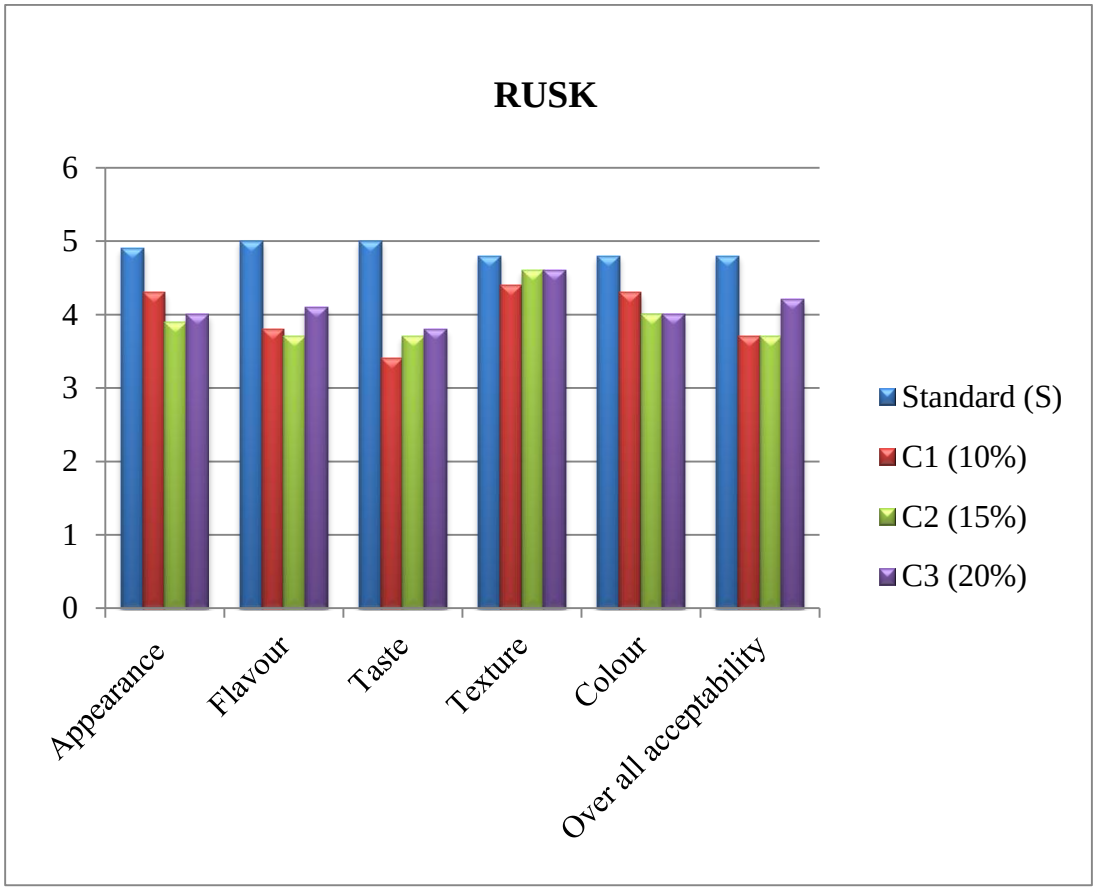


FIGURE VIII

MEAN ACCEPTABILITY SCORES OF COTTONSEED AND ARUGAMPUL POWDER INCORPORATED RUSK

From the table XI and Figure VIII it is evident that the mean scores of the rusk decreased as the level of incorporation of the cottonseed and arugampul powder increased.

After incorporating cottonseed and arugampul powders in the rusk the appearance was slightly acceptable. The mean score obtained for appearance of rusk was 4.3±0.4, 3.9±0.7, 4±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C1 (10%), C2 (15%) and C3 (20%).

The flavor of the rusk increased with each successive incorporation of the powders. Mean scores obtained for flavor for rusk was 3.8±0.7, 3.7±0.9, 4.1±0.8 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C1 (10%),C2 (15%) and C3 (20%).

After incorporating cottonseed and arugampul powders the taste of the rusk was slightly acceptable. It gave a bitter taste when incorporation of cottonseed and arugampul powder was increased. The mean score for taste was 3.4±0.8, 3.7±0.9, 3.8±0.7 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C1 (10%), C2 (15%) and C3 (20%).

After incorporation cottonseed and arugampul powder in the rusk texture was slightly acceptable. The mean score for texture of rusk was 4.4±0.5, 4.6±0.5, 4.6±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at five percent ($p<0.05$) between standard (S) andC1 (10%), C2 (15%) but there was no significant between standard (S) and C3 (20%).

The intensity of the color of the rusk increased as the level of incorporation of the cottonseed and arugampul powder increased. The mean score for the color of the rusk was 4.3±0.8, 4±0.8, 4±0.8 for 10%, 15% and 20% level incorporation respectively. The difference was significant at five percent ($p<0.05$) between standard (S) andC1 (10%). The difference was significant at one percent ($p<0.01$) between standard (S) and C2 (15%) and C3 (20%).

The overall acceptability of standard rusk and C3 (i.e.) 20% level incorporated cookies were found to be very good. The C1and C2 (i.e.) 10% and 20% level of incorporation were found to be good. The mean score for cookies was 3.7±0.6, 3.7±0.8, 4.2±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C1 (10%), C2 (15%) and C3 (20%).

E. Sensory evaluation and acceptability of pizza prepared by incorporating sunflower seed, cottonseed and arugampul powder

The mean scores for pizza incorporating sunflower seed and arugampul powder is presented in Table XII and Figure IX

TABLE XII

MEAN ACCEPTABILITY SCORES OF SUNFLOWER SEED AND ARUGAMPUL POWDER INCORPORATED PIZZA

Variation	Appearance Mean±SD	Flavour Mean±SD	Taste Mean±SD	Texture Mean±SD	Colour Mean±SD	Over all Acceptability Mean±SD
Standard	4.8±0.6	4.9±0.3	4.9±0.3	5±0	4.8±0.4	4.9±0.3
S1	4.4±0.6	4.3±0.8	4.1±0.7	4.7±0.4	4.1±0.7	4.2±0.7
S2	4±0.9	4.2±0.7	3.8±1.0	4.5±0.4	4.3±0.8	4±0.6
S3	3.7±0.6	4±0.7	3.8±0.7	4.4±0.8	4.3±0.8	3.7±0.6
t value						
SvsS1	1.3**	2.1*	3.1*	1.9*	2.6*	2.6*
SvsS2	2.2*	2.6*	3.2*	1.8*	1.7**	3.8*
SvsS3	3.7*	3.8*	4.0*	2.7*	1.7**	5.0*

S-Standard, S1-10% Incorporation ,S2-15% Incorporation, S3-20% Incorporation.
*- Significant at 1% level,**- significant at 5% level

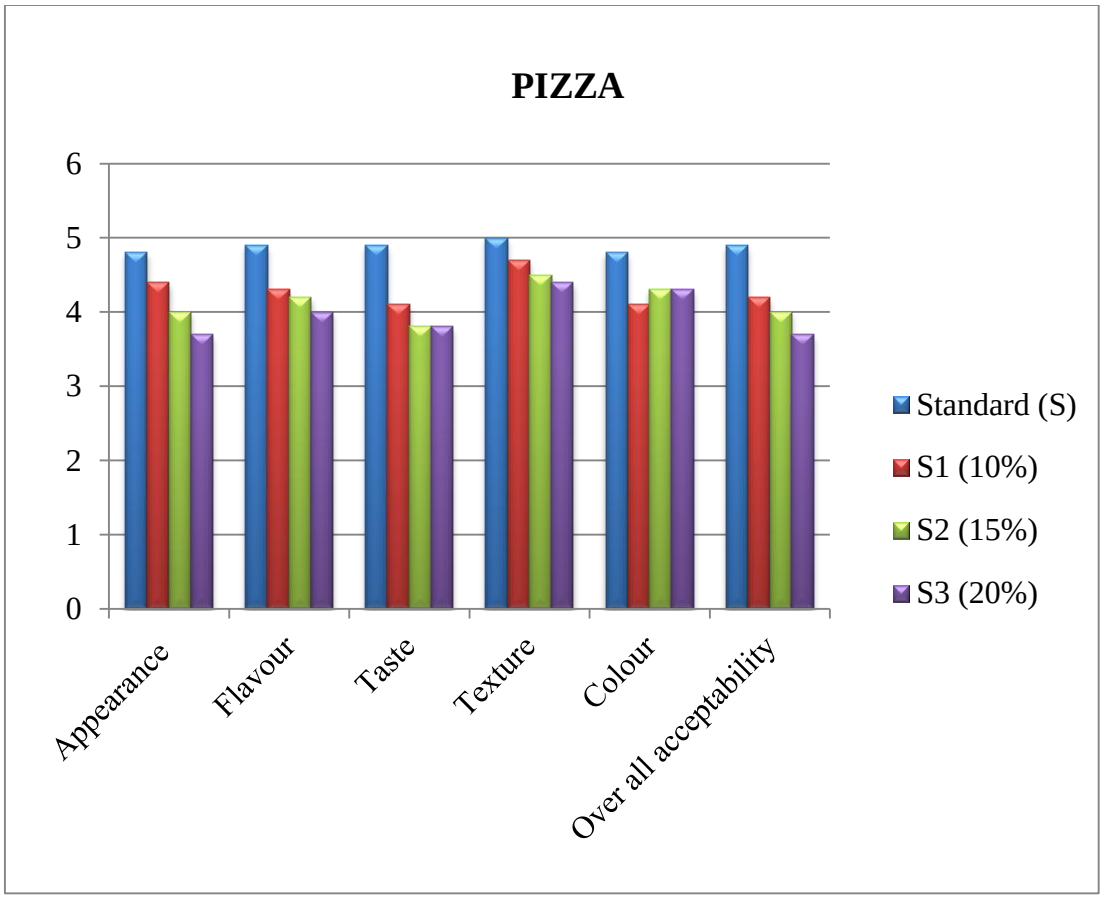


FIGURE IX

MEAN ACCEPTABILITY SCORES OF SUNFLOWER SEED AND ARUGAMPUL POWDER INCORPORATED PIZZA

From the table XII and Figure IX it is evident that the mean scores of the pizza decreased as the level of incorporation of the sunflower seed and arugampul powder increased.

After incorporating sunflower seed and arugampul powders in the pizza the appearance was not highly acceptable. The mean score obtained for appearance of pizza was 4.4±0.6, 4±0.9, 3.7±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at five percent ($p<0.05$) between standard (S) and S1 (10%). The difference was significant at one percent ($p<0.01$) between standard (S) and S2 (15%) and S3 (20%).

The flavor of the pizza increased with each successive incorporation of the powders. The pizza had a very strong flavor of the sunflower seed and arugampul powders. Mean scores obtained for flavor for pizza was 4.3±0.8, 4.2±0.7, 4±0.7 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%), S2 (15%) and S3 (20%).

After incorporating sunflower seed and arugampul powders the taste of the pizza was not highly acceptable. It gave a bitter taste when incorporation of sunflower seed and arugampul powder was increased. The mean score for taste was 4.1±0.7, 3.8±1.0, 3.8±0.7 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%) and S2 (15%) and S3 (20%).

After incorporation sunflower seed and arugampul powder in the pizza texture was very soft. The mean score for texture of pizza was 4.7±0.4, 4.5±0.4, 4.4±0.8 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%), S2 (15%) and S3 (20%).

The intensity of the color of the pizza increased as the level of incorporation of the sunflower seed and arugampul powder increased. The mean score for the color of the pizza was 4.1±0.7, 4.3±0.8, 4.3±0.8 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%). The difference was significant at five percent ($p<0.05$) between standard (S) and S2 (15%) and S3 (20%).

The overall acceptability of standard pizza and S1 and S2 (i.e.) 10% and 15% level incorporated pizza were found to be very good. The S3 (i.e.) 20% level of incorporation was found to be good. The mean score for pizza was 4.2±0.7, 4±0.6, 3.7±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S1 (10%), S2 (15%) and S3 (20%).

The mean scores for pizza incorporating cottonseed and arugampul powder is presented in Table XIII and Figure X

TABLE XIII

MEAN ACCEPTABILITY SCORES OF COTTONSEED AND ARUGAMPUL POWDER INCORPORATED PIZZA

Variation	Appearance Mean±SD	Flavour Mean±SD	Taste Mean±SD	Texture Mean±SD	Colour Mean±SD	Over all Acceptability Mean±SD
Standard	4.8±0.6	4.9±0.3	4.9±0.3	5±0	4.8±0.4	4.9±0.3
C1	4.4±0.6	4±0.9	4.2±0.7	4.6±0.5	4.1±0.8	4.4±0.5
C2	4.3±0.8	4.1±0.7	4.3±0.6	4.5±0.8	4.4±0.8	4.2±0.6
C3	3.8±0.6	4.4±0.6	4.1±1.7	4.4±0.8	4.1±0.7	4.6±0.5
t value						
SvsC1	1.3**	2.8**	2.6*	2.4*	2.2*	2.6*
SvsC2	1.5**	3.1*	2.5*	2.2*	1.3**	3.1*
SvsC3	3.5*	2.0*	3.8*	2.2*	2.6*	1.5**

S-Standard, S1-10% Incorporation ,S2-15% Incorporation, S3-20% Incorporation.
*- Significant at 1% level,**- significant at 5% level

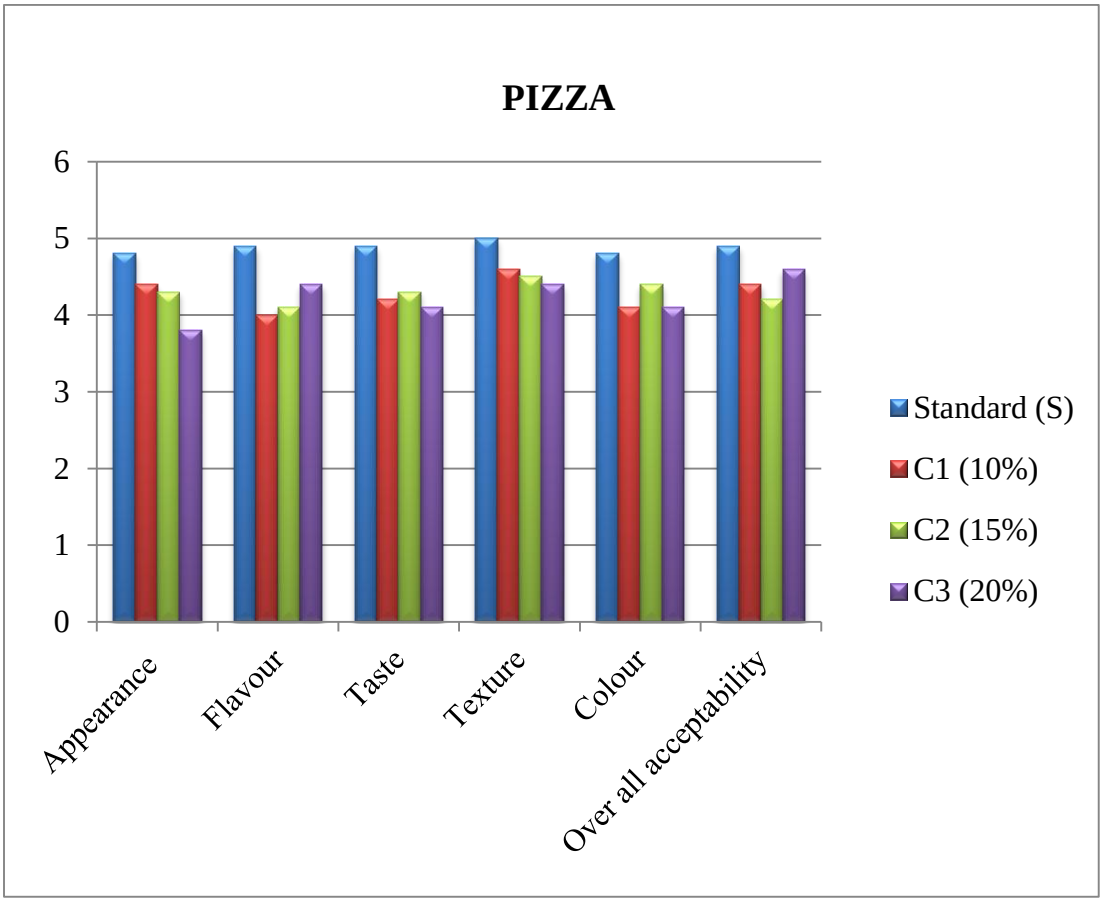


FIGURE X

MEAN ACCEPTABILITY SCORES OF COTTONSEED AND ARUGAMPUL POWDER INCORPORATED PIZZA

From the table XIII Figure X it is evident that the mean scores of the pizza decreased as the level of incorporation of the cottonseed and arugampul powder increased.

After incorporating cottonseed and arugampul powders in the pizza the appearance was not highly acceptable. The mean score obtained for appearance of pizza was 4.4±0.6, 4.3±0.8, 3.8±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at five percent ($p<0.05$) between standard (S) and C1 (10%) and C2 (15%). The difference was significant at one percent ($p<0.01$) between standard (S) and C3 (20%).

The flavor of the pizza increased with each successive incorporation of the powders. The pizza had a very strong flavor of the cottonseed and arugampul powders. Mean scores obtained for flavor for pizza was 4±0.9, 4.1±0.7, 4.4±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at five percent ($p<0.05$) between standard (S) and C1 (10%). The difference was significant at one percent ($p<0.01$) between standard (S) and C2 (15%) and C3 (20%).

After incorporating cottonseed and arugampul powders the taste of the pizza was not highly acceptable. It gave a bitter taste when incorporation of cottonseed and arugampul powder was increased. The mean score for taste was 4.2±0.7, 4.3±0.6, 4.1±1.7 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) andC1 (10%), C2 (15%) and C3 (20%).

After incorporation cottonseed and arugampul powder in the pizza texture was very soft. The mean score for texture of pizza was 4.6±0.5, 4.5±0.8, 4.4±0.8 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) andC1 (10%), C2 (15%) and C3 (20%).

The intensity of the color of the pizza increased as the level of incorporation of the cottonseed and arugampul powder increased. The mean score for the color of the pizza was 4.1±0.8, 4.4±0.8, 4.1±0.7 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C1 (10%) and C3 (20%). The difference was significant at five percent between standard (S) and C2 (15%).

The overall acceptability of standard pizza and C1 and C3 (i.e.) 10% and 20% level incorporated cake were found to be very good. The mean score for pizza was 4.4±0.5, 4.2±0.6, 4.6±0.5 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C1 (10%), C2 (15%). The difference was significant at five percent ($p<0.05$) between standard (S) and C3 (20%).

F. Nutrient analysis of powders

Analysis of nutrient content is an important aspect in standardizing and developing a new product and evaluating a new process for making food products and identifying the sources of problem with unacceptable problem. Adequate analytical methods for nutrients in foods, food ingredients, and food products are the basic first step in determining the nutritional adequacy of a food supply.

Nutrients present in sunflower seed, cottonseed and arugampul powder are presented in Table XIV.

TABLE XIV

NUTRIENTS PRESENT IN SUNFLOWER SEED, COTTONSEED AND ARUGAMPUL POWDERS

S. No	Nutrients	Sunflower seed	Cottonseed	Arugampul
1.	Carbohydrate (gm)	45.14	56.63	60.29
2.	Energy (Kcal)	439.29	406.40	396.26
3.	Protein (gm)	44.66	28.98	24.88
4.	Fat (gm)	0.20	1.11	0.90
5.	Calcium (mg)	120.0	688.0	386.0
6.	Phosphorus (mg)	689.0	1988.0	680.0
7.	Iron (mg)	6.0	16.66	80.0
8	Thiamine (mg)	2.88	2.80	30.0
9	Riboflavin (mg)	0.20	0.88	12.0

When the energy and protein value of all the three powders were compared. Sunflower seed powder was rich in calories and protein with 439 Kcal and 44gm of protein followed by cottonseed 406 Kcal and 28gm of protein, arugampul 396 Kcal and 24gm of protein. With regard to fat sunflower seed powder is a poor source with only 0.20gm/100g of seed powder. With regard to other micronutrients cottonseed is a good source of calcium, phosphorus and iron with 688gm, 1988gm, and 16mg respectively. Arugampul is a good source of calcium and phosphorus with 386mg and 680mg respectively.

G. Shelf life of powders using different packaging material

Microbial analysis of the powder presented in Table XV

TABLE XV

MICROBIAL ANALYSIS OF SUNFLOWER SEED, COTTONSEED AND ARUGAMPUL POWDER

S. No	Sample name	Microbial plate count (cfu/ml)		
		Week I	Week II	Week III
1.	Sunflower seed powder	$31*10^3$	$43*10^3$	$58*10^3$
2.	Cottonseed powder	$2.9*10^3$	$6.5*10^3$	$8.6*10^3$
3.	Arugampul powder	$14.2*10^3$	$17.5*10^3$	$24*10^3$

The sunflower seed, cottonseed and arugampul powders (100gm) were packed in zip lock cover for three weeks and kept at room temperature. Every sample was evaluated for the microbial plate count (cfu/ml). All the samples were found to be acceptable during the first, second and third week. These powders were found to be acceptable while storing in the zip lock covers it showed low microbial plate count.

V SUMMARY AND CONCLUSION

The present study on "**Development of Bakery Product Incorporating Sunflower Seed, Cottonseed and Value Addition with Arugampul"** was undertaken to incorporate sunflower seed, cottonseed and arugampul powders in cakes, cookies, rusk and pizza.

Bakery industry in India has an important place in the industrial map of the country. Bakery products are items of mass consumption in view of its low price, high nutritive value and changing eating habits of people and hence they have gained popularity among masses. The bakery industry has achieved third position in generating revenue among the processed food sector. Bakery products include bread, rolls, cookies, pies, pastries and muffins. They are usually prepared from flour or meal derived from some form of grains and cooked by dry heat process in oven. Bakery products are used immediately after production, thus having better vitamin retention and lesser sensory changes.

There are several advantages of bakery products, such as consumption without heat treatment, no danger of overheating and eating without limitation to get satiety. The nutritive value of baked products varies according to the type and amount of ingredients used in the formulation. The primary ingredients of many baked products are flour. However, there may be a significant amount of fat and sugar.

Oil seeds and nuts are rich in protein particularly the amino acids, arginine and in addition they contain a high level of fat. They are source of protein and concentrated source of energy. They do not contain an appreciable amount of carbohydrate but contain high amount of B vitamins. Oil seeds produced in the country are mostly used for oil extraction. The meal obtained from the seed is richer in protein than the seed itself.

Due to its superior nutritional quality and the relatively low amount of anti-nutritional factors, sunflower seed and cottonseed has great potential to be, not only as a protein source, but also a valuable supplement in human diet, providing considerable amounts of antioxidants, minerals and unsaturated fatty acids.

Cynodon dactylon commonly referred to as Arugampul, is a valuable medicinal plant and is used as a curative for various ailments. This medicinal herb has a renowned

position in Indian system of medicine. Medicinal plants are the source of many potent and powerful drugs. They present healthier and safer alternate to the synthetic drugs.

The oil seeds sunflower and cottonseed and herb *cynodon dactylon* were selected for incorporation in the selected baked products and they are rich in nutrients. It is easily affordable and locally available and from ancient days it is used as food. Hence a trial was made to incorporate oil seeds and herbs in bakery products. These products can be consumed by all age groups from children to old people as snacks because of its nutritional importance. The product developed by incorporating cottonseed and sunflower seed with arugampul powders was evaluated based on sensory evaluation of the product. The study was undertaken with the following objectives

- Incorporate sunflower seed, cottonseed and arugampul powder at various levels in selected bakery products,
- Evaluate the acceptability of these baked products on basis of organoleptic parameters
- Standardize the baked products with the most acceptable level of incorporation of sunflower seed, cottonseed and arugampul powder.
- To evaluate the nutrients present in sunflower seed, cottonseed and arugampul powder
- To evaluate the shelf life of powders using different packaging material.

The sunflower seed, cottonseed and arugampul were selected for the preparation of cakes, cookies, rusk and pizza. The sunflower seed, cottonseed and arugampul powders were prepared by cleaning, drying in sun, ground them into fine powder and then sieved. Cakes, cookies, rusk and pizza were prepared by incorporating sunflower seed/cottonseed powder at 10 percent, 15 percent and 20 percent levels and along with these seed powder arugampul powder was also incorporated at 10 percent level. The sensory evaluation of the cakes, cookies, rusk and pizza was conducted and the product which obtained the highest acceptability scores wereselected as the acceptability level of incorporation.

The overall acceptability of standard cake and sunflower seed powder and arugampul powder incorporated cake S_1 and S_2 (i.e.) 10% and 15% level incorporated cake

were found to be very good and highly acceptable. The S_3 (i.e.) 20% level of incorporation were found to be good. The mean score for cake was 4.2±0.6, 4.2±0.4, 4.1±0.3 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S_1 (10%), S_2 (15%) and S3 (20%).

The overall acceptability of standard cookies and sunflower seed powder and arugampul powder incorporated cookies S_2 and S_3 (i.e.) 15% and 20% level incorporated cookies were found to be very good. The S_1 (i.e.) 10% level of incorporation were found to be good. The mean score for cookies was 4.3±0.6, 4.7±0.4, 4.6±0.5 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S_1 (10%), S_2 (15%) and S_3 (20%).

The overall acceptability of standard rusk and sunflower seed powder and arugampul powder incorporated rusk S_1 (i.e.) 10% level incorporated rusk were found to be very good. The S_2 and S_3 (i.e.) 15% and 20% level of incorporation were found to be good. The mean score for rusk was 4.5±0.5, 4.1±0.5, 4±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at five percent ($p<0.05$) between standard (S) and S_1 (10%). The difference was significant at one percent ($p<0.01$) between standard (S) and S_2 (15%) and S_3 (20%).

The overall acceptability of standard pizza and sunflower seed powder and arugampul powder incorporated pizza S_1 and S_2 (i.e.) 10% and 15% level incorporated pizza were found to be very good. The S_3 (i.e.) 20% level of incorporation was found to be good. The mean score for pizza was 4.2±0.7, 4±0.6, 3.7±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and S_1 (10%), S_2 (15%) and S_3 (20%).

The overall acceptability of standard cake and cottonseed powder and arugampul powder incorporated cake C_1 and C_2 (i.e.) 10% and 15% level incorporated cake were found to be very good. The C_3 (i.e.) 20% level of incorporation was found to be good. The mean score for cake was 4.3±0.4, 4.2±0.6, 4±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C_1 (10%), C_2 (15%) and C_3 (20%).

The overall acceptability of standard cookies and cottonseed powder and arugampul powder incorporated cookies C_2 and C_3 (i.e.) 15% and 20% level incorporated cookies were found to be very good. The C_1 (i.e.) 10% level of incorporation was found to be good. The mean score for cookies was 4.2±0.4, 4.3±0.6, 4.5±0.7 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C_1 (10%), C_2 (15%) and C_3 (20%).

The overall acceptability of standard rusk and cottonseed powder and arugampul powder incorporated rusk C_3 (i.e.) 20% level incorporated cookies was found to be very good. The C_1 and C_2 (i.e.) 10% and 20% level of incorporation were found to be good. The mean score for cookies was 3.7±0.6, 3.7±0.8, 4.2±0.6 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C_1 (10%), C_2 (15%) and C_3 (20%).

The overall acceptability of standard pizza and cottonseed powder and arugampul powder incorporated pizza C_1 and C_3 (i.e.) 10% and 20% level incorporated cake were found to be very good. The mean score for pizza was 4.4±0.5, 4.2±0.6, 4.6±0.5 for 10%, 15% and 20% level incorporation respectively. The difference was significant at one percent ($p<0.01$) between standard (S) and C_1 (10%), C_2 (15%). The difference was significant at five percent ($p<0.05$) between standard (S) and C_3 (20%).

Analysis of nutrient content is an important aspect in standardizing, developing and evaluating a new product. The nutrient content of sunflower seed, cottonseed and arugampul powders were analyzed. When the energy and protein value of all the three powders were compared, sunflower seed powder was rich in calories and protein with 439 Kcal and 44gm of protein followed by cottonseed 406 Kcal and 28gm of protein. Arugampul powder 396 Kcal and 24gm of protein was present. With regard to fat sunflower seed powder is a poor source with only 0.20gm/100g of seed powder. With regard to other micronutrients cottonseed is a good source of calcium, phosphorus and iron with 688gm, 1988gm, and 16mg respectively. Arugampul is a good source of calcium and phosphorus with 386mg and 680mg respectively.

Microbial analysis is important to determine the safety and quality of food. The sunflower seed, cottonseed and arugampul powders were analyzed for microbial plate count. These powders were packed in zip lock cover and every sample was evaluated at the end of first week, second week and third week. These three powders were acceptable at the end of the third week also.

Conclusion

Due to changing life style the people have started demanding ready to cook or ready to serve convenience foods. More and more women are seeking employment to supplement the family income and they find less time for cooking and therefore demand ready to serve foods. Baked products are considered as convenient foods and also an excellent vehicle for fortification, value addition and feeding at mass scale. Hence, being consumed daily by large population, development and production of novelty bakery product needs to be exploited commercially.

BIBILIOGRAPHY

Abrol.Y.P, 2007, Agricultural Nitrogen use and its environmental implications, Bangalore, pg: 354.

Agriculture and Agri- food Canada, Sunflower seed: Situation & outlook, Bulletin, 2003, pg: 38

Akbar S, 2008, Processed food industry, may 2008, pg: 46

AOAC, 2004, AOAC official method, pg: 935

Byrareddy, K., Uppar, D.S., Vyakaranahal, B.S., Hiremath, S.M., Ravi H., Nadaf, H.L., 2008. Effect of integrated nutrient management on sunflower hybrid (KBSH-1) seed production. Karnataka J. Agri. Sci. 21**,** pg: 171-175.

Catharine, 2005, Nutritional Benefits of Sunflower Products, Australian oilseed federation.pg: 57

Cauvin,S.P, 2003, Cakes:Nature of cakes, In: Encyclopedia of food sciences and nutrition, London, pg:756-759.

Chauhan GS, Kumari, S. Evaluation of wheat-defatted soy flour blends for chapatti making quality. Beverage Food World. 2000, pg: 17(1); 40-2.

Damian Reyes-Jaquez, 2012, The Effect of Glandless Cottonseed Meal Content and Process Parameters on the Functional Properties of Snacks during Extrusion Cooking, *Food and Nutrition Sciences*, pg: 388

Data K Animesh, 2012, An updated overview on *cynodon dactylon* (L.) PERS.ijrap, pg: 380

Debashus Basu B Francis kulirani, 2006, Agriculture, Food Security Nutrition and Health in North East India, pg:305.

Dimple singh-Ackbarali and Rohanie Maharaj, 2014, sensory evaluation as a tool in determining acceptability of innovative products developed by undergraduate students in food science and technology at the university of Trinidad and tobogo. Journal of curriculum and teaching. Vol.3 no 1, pg: 56

Dinesh K. agarwal, Phudan sinhg, Mukta chakrabarthy, A J sheikh, S G Gayal, 2003, Cottonseed oil quality utilization and processing, CICR technical bulletin no 25, pg: 177

Dinesh K. Agarwal, Phundan Singh, Mukta Chakrabarty A J Shaikh, S G Gayal, 2003, cottonseed oil quality, utilization and processing. Vol 3, pg: 63

Encyclopaedia Americana International Edition vol-20, 2001

FSSAI, 2012, manual method of analysis of foods, pg: 57

Gomes, J.C. et al. analise the aliments, 2.ed. rev e at. Viçosa: FUNARBE, 2010, pg: 153.

Gupta, H.O. and N.N. Singh, 2005. Preparation of wheat and quality protein maize based biscuits and their storage, protein quality and sensory evaluation. J. Food Sci. Technol., Vol 42, pg: 43-46.

Hamid, F. and T. Sarwar, 2004. Nutrition: A Multicultural Pack. Brent NHS Teaching Primary Trust, London. National Food Based Dietary, fifth edition, pg: 480

Hans,G.B, W. Steller, W.Feldhelm, 2006, Dietary fiber and bread: Intake, enrichment, determination and influence on colonic function, cereal food world, second edition, pg:306-310.

Iqtidar and amanullah, 2005, cropping technology, NBF publisher Islamabad, Pakistan, Vol 21, pg: 247-248

Jonathan W. De Vries, AOAC International Validation Methods for Nutrient Analysis-Method Availability and Method Needs, 2006, Vol 50, pg: 53

Juliet Rogers, Key Scarlett, Wendy sstephen, 2000, the essential baking work book, thunder bay presss sundiego, California, first edition, pg: 35

Kanimozhi D, Ratha BV (2013). *In vitro* anticancer activity of ethanolic extract of *Cynodon dactylon* against HT-29 cell line. Int. J. Curr. Sci.Vol 5, pg:74-81.

Karthik D and Ravikumar S, 2006, A Study on the Protective Effect of *Cynodon dactylon* Leaves Extract in Diabetic Rats, *PRIST University, Thanjavur*, Vol 34, pg: 23

Kendall P Dipersio and J sofos, 2004, Drying vegetables facts sheet no 9.308, food and nutrition series Colorado state university co-operative extension, Vol 10, pg: 48

Lora Arduser and Douglas Robert, 2005, companion CDROM includes The encyclopedia of Restaurant Training. A complete ready to use Training program for all positions in the food service industry. Pg: 368.

Maria de Lourdes Reis Giada, 2011, Development and Sensory Evaluation of Sunflower Seeds, Research Paper, pg: 89

Maureen Egan, 2002, Healthful Quantity Baking, second edition, pg: 57.

McCance and Widdowson's, 2002, Food Standards Agency and Institute of Food Research (2002). The Compositionof Foods, sixth. Summary Edition, Royal Society of Chemistry, Cambridge, pg: 289

Nambiar, V. 2004, A text book on food contamination and saftey, Anmol publishers (p) ltd, pg: 71, 79.

Nechaev, A. P., 2007. Food Chemistry. *GIORD*, St.Petersburg, pg.349-464 (Ru).

O`Brien. R. D and Wan P. J, 2001, cottonseed oil: processing conference and exhibition on oil seed processing and utilization (ed R. Wilson), AOCS press, champaign, IL, pg:16

O'Brien, R.D. (2008) *Fats and Oils: Formulating and Processing for Applications*. 3rd ed, CRC Press, pg:77

Oritz, D.E, 2004, Cakes, pastries, muffins and bogels. In: Encyclopedia of grain science, pg-134-140.

Paranjpe. P, 2001. Durva. In Indian medicinal plants: forgotten healers 1st Edn, chaukhamba Sanskrit pratishthan, Delhi, pg: 75-76

Perveen Liaqat, Mahnaz Nasir Khan and Faqir Mohammad, 2009, Consumer Acceptance of Standardized Mixed/Composite Foods for Optimal Accuracy in Nutrient Estimation, P. J. Nutri. Vol 15, pg: 56

Prajakta J nande, 2013, physical properties, sensory characteristics and nutritional quality of biscuits prepared using nut butter, Indian journal of nutrition and dietetics, vol 51, no 1, pg: 53

R. Ramesh, Shivakumar, Balamurugan, R. Manjula, 2009, DIABETES:the sneaking unwelcome companion, volume 2, issue 3, pg: 47

R. Thomas and S. Gebhardt, 2008, Sunflower Seed Butter and almond Butter as Nutrient-Rich Alternatives to Peanut Butter, Beltsville Human Nutrition Research Center, ARS/USDA, Beltsville, pg: 98

Rai PK, Jaiswal D, Rai DK, Sharma B, Watal G, 2010. Antioxidant potential of oral feeding of *cynodon dactylon* extract on diabetes-induced oxidative stress. J. Food Biochem. Vol 34, pg:78-92.

Rai PK, Jaiswal D, Rai DK, Sharma B, Watal, G. Antioxidant potential of oral feeding of *Cynodon dactylon* extract on diabetes-induced oxidative stress. J Food Biochem 2010; vol 34, pg: 78-92.

Rai, P. K, N.K Rai, A K Rai, g watal, 2007, Role of LIBS in elemental analysis of P.*guajava* responsible for glycemic potential Inst. Sci. Tech., vol 35, pg: 507-522

Sahebeh, J., Javad, K., Akbar, A., Jafar, M., Khoshtaghaza, M.H. 2011. Study on mechanical properties of sunflower seeds. Electronic Journal of Polish Agricultural Universities vol 14, pg:1.

Sarah E Kemp, Tracey Hollowood and Joanne Hort, 2009, sensory evaluation, a practical handbook, first edition, pg: 88

Saroja M, Santhi R, Annapoorani S (2012). Antioxidant potential of ethyl acetate fraction of *Cynodon dactylon* against ELA implanted Swiss albino mice. Int. J. Pharm. Biol. Sci. vol 3(2), pg:415-419.

Satish, I., Shrivastava, S.K., 2012. Chemical studies of new varieties of sunflower (*Helianthus annuus*) LSF-11 and LSF-8 seeds. Agric. Biol. J. N. Am.vol 2, pg: 1171-1181.

SCHMIELE, M. et al. Infl uência da adição de farinha integral de aveia, fl ocos de aveia e isolado proteico de soja na qualidade tecnológica de bolo inglês. Boletim do Centro de Pesquisa de Processamento de Alimentos, v.29, n.1, pg:71-82, 2011.

Schober,T.J.,O'Brien,2003,Influence of gluten free flour mixes and fat powders on the quality of gluten free biscuits, Eur.Food.Res.Tech.,pg:210.

Silva et al., 2002, Stringhini et al., 2000, Sunflower Meal Incorporated Ready to Eat Food Products, pg:245

Sindhuja, A., M.L. Sudha and A. Rahim, 2005. Effect of incorporation of amaranth flour on the quality of cookies. Eur. Food Res. Technol., vol 221, pg: 597-601.

Singh S K, P K Rai, D Jaiswal and G Watal, 2008, Evidence- based critical evaluation of glycemic potential of cynodon dactylon, Evid. Based complement. Alternat Med.vol 5, pg: 415-420

Singh S K, P K Rai, S Mehta, R K Gupta, and G watal, 2009, curative effects of cynodon dactylon against STZ induced hepatic injury i diabetic rats, Ind. J. Clin. Biochem., vol 24, pg: 410-413

Singh S. K, A. N Kesari, R. K Gupta, D. Jaiswal and G. Watal, 2007, assessment of antidiabetic potential of cynodon dactylon extract in streptozotocin diabetic rats, J. Ethnophamacol, vol 114, pg: 174-179.

Singh SK, Kesari AN, Gupta RK, Jaiswal D and Watal G, Assessment of antidiabetic potential of *Cynodon dactylon* extract in streptozotocin diabetic rats.J. Ethnopharmacol, vol 114, pg: 174-179 (2007).

Singh SK. et. al., studied the, Protective effect of *Cynodon dactylon* against STZ induced hepatic injury in rats- J. Ecophysiol. Occup. Hlth., Vol. 8, pg: 195 – 199, 2008.

Singh, R, 2009, Food microbiology and food processing, ALP books, p-1

Singh, R., G. Singh and G.S. Chauhan, 2000. Nutritional evaluation of soy fortified biscuits. J. Food Sci. Technol., vol 37, pg: 162-164.

Singh, S. K, A N Kesari, R K Gupta, D Jaiswal and G Watal, 2007. Assessment of antidiabetic potential of cynodon dactylon extract in streptozotocin diabetic rats. J. Ethnophamacol., vol 114, pg: 174-179

Skrib B and B Filipcev, 2008. Nutritional and sensory evaluation of wheat breads supplements with oleic rich sunflower seed. Food chemistry,vol 108, pg:119-129

Srilakshmi, 2007 Food Science, fourth edition, new agee international publisher, pg: 308

Sudha, M L Vetrimani, R and Leelavathi, K. 2007, Influence of fiber from different cereals on the rheological characteristic of wheat flour dough and on biscuit quality. Food chemistry, vol 100, pg: 1365-1370

Uma Rajesh and Sahbanathul Missiriya, effect oral herbal extract on diabetes mellitus, global research analysis, vol-2, pg: 467

Vickie A.Vaclavik, 2008, Essentials of Food science, 3rd edition, pg: 351, 375.

Wallis TE., Text Book of Pharmacognosy, 5th edition, CBS Publishers and Distributors, New Delhi, 2004, pg: 250

Zabin K. Bagewadi, Siddanagouda R.S and Praveen G. Baligar, 2014, phytoconstituents investigation by lc-ms and evaluation of anti-microbial and anti-pyretic properties of *cynodon dactylon ijpsr*,vol. 5(7), pg: 2874-2889.

Zabin K. Bagewadi, 2014, phytoconstituents investigation by lc-ms and evaluation of anti-microbial and anti-pyretic properties of *cynodon dactylon, ijpsr,* vol 58, pg: 589

Zilic S., Barac, M., Pesic, M., Crevar, M., Stanojevic, S., Nisavic, A., Saratlic, G., Tolimir, M., 2010. Characterization of sunflower seed and kernel proteins. Helia, vol *52, pg*: 103-114.

Web reference

- www.nutrition-and-you.com
- www.cftri.com
- www.marketresearch.com
- www.thebakerynetwork.com
- www.herbs-treatandtaste.blogspot.in
- www.cottonseed.com

APPENDIX I

ETHICAL COMMITTEE CERTIFICATE

INSTITUTIONAL HUMAN ETHICS COMMITTEE

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

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

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

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

9th March 2015

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

Dear Madam,

Ref : Your proposal No. IHEC/14-15/FSN/06 entitled "Development of bakery product incorporating sunflower seed, cottonseed and value addition with arugampul" submitted for approval of the IHEC on 3rd January 2015.

The Institutional Human Ethics Committee of our University hereby grants approval to your research proposal No. IHEC/14-15/FSN/06 entitled "Development of bakery product incorporating sunflower seed, cottonseed and value addition with arugampul" submitted by you. The Approval number for the same is AUW/IHEC-14-15/XMT-05.

We wish you all the best in your research endeavours.

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

Institutional Human Ethics Committee

APPENDIX II

SENSORY EVALUATION FOR THE CAKES, COOKIES, RUSK AND PIZZA USING SUNFLOWER SEED, COTTONSEED AND ARUGAMPUL POWDERS

Sensory evaluation	Sunflower seed powder and arugampul powder			Cottonseed powder and arugampul powder		
Variations	**S1**	**S2**	**S3**	**C1**	**C2**	**C3**
Appearance Excellent Very good Good Poor Very poor						
Flavour Highly acceptable Moderately acceptable Acceptable Disagreed Highly disagreed						
Taste Highly acceptable Moderately acceptable Acceptable Disagreed Highly disagreed						
Texture Highly acceptable Moderately acceptable Acceptable Disagreed Highly disagreed						
Color Highly acceptable Moderately acceptable Acceptable Disagreed Highly disagreed						
Over all acceptability Excellent Very good Good Poor Very poor						

Comments: **Signature**

APPENDIX III

PREPARATION OF CAKES

CAKE MAKING:

Ingredients:

- Maida- 100g
- Sugar-100g
- Fat -100g
- Egg -2.no
- Baking powder- 1/2tsp
- Essence – few drops
- Milk- 2tsp

Preparation:

1. Preheat oven to 350°F. Grease and dust flour 2 9-inch cake pans.
2. In bowl, cream fat and sugar till light and fluffy.
3. Beat egg and sugar till bright and add essence if needed. Add well beaten egg little by little, creaming all at a time.
4. Sieve the flour with baking powder.
5. Add flour to the cream and mix well. Add milk if needed, bring the mixture to the dropping consistency. Put the cake batter into a greased cake tin. Bake at 180ºc-200 ºc for 20min.

APPENDIX IV

PREPARATION OF COOKIES

COOKIES:

Ingredients:

- Maida- 100g
- Sugar-50g
- Fat -50g
- Milk -10 ml
- Baking powder- 1/2tsp
- Essence- few drops
- Salt- 1tsp

Preparation

1. Preheat oven to 450 degrees F (230 degrees C).
2. In a large mixing bowl sift together flour, baking powder and salt. Cream the shortening and add sugar little by little.
3. Add the sieved mixture and mix well.
4. Pour milk into flour mixture while mixing. Mix in milk until dough is soft, moist and pulls away from the side of the bowl.
5. Turn dough out onto a lightly floured surface and toss with flour until no longer sticky. Roll dough out into a 1/2 inch thick sheet and cut with a floured biscuit or cookie cutter. Press together unused dough and repeat rolling and cutting procedure.
6. Place biscuits on ungreased baking sheets and bake in preheated oven until golden brown, about 15 minutes.

APPENDIX V

PREPARATION OF RUSK

RUSK

Ingredients:

- Maida- 100g
- Sugar- 15g
- Dry yeast- 5g
- Oil- 5ml
- Milk- to brush
- Lukewarm water- as required

Preparation

1. Oven temperature 204°c
2. Dissolve sugar in ½ cup lukewarm water and sprinkle yeast over it. Leave in a draught free place to froth
3. When frothy, add salt, oil and yeast to flour and knead to a soft dough with the likewarm water and leave to rise in a draught free place covered with cling film or wet cloth
4. When it rises, punch and knead again and leave to rise again
5. When it rises, for the second time knead a bit and shape to fit into a greased baking tin (not more than half filled) and leave to risr for ½ an hour
6. Brush with the milk and bake in a pre-heated oven for 30-40 minutestake the tin out of the oven and when cool remove the loaf of bread
7. The bread has to be absolutely room temperature, in fact it is better if it is a day old
8. Slice into ¼ inch thick slice and bake in an oven 150°c, till light brown and crisp

APPENDIX VI

PREPARATION OF PIZZA

PIZZA

Ingredients:

- Maida- 100g
- Dry yeast- 2.5g
- Sugar-5g
- Salt- 2.5g
- Warm water/warm milk- as required
- Shortening- 30g

Preparation

1. Pour ¾ cup warm water into small bowl, stir in yeast. Let stand until yeast dissolves, about 5 minutes
2. In a bowl mix flour, yeast, salt and sugar. Mix well
3. Add milk little by little till it is consumed and knead the flour mixture to form dough
4. Add little warm water if more liquid is required to form diugh
5. Finally add butter to this dough and punch well. This dough might be slightly sticky but do not worry it will be fine later
6. Now cover this dough with lid or damp cloth and leave it aside for 1-1 ½ hours
7. It will be double in size. Now apply little oil to your hand and punch the dough
8. Spread it evenly on a baking tray to form a nice pizza base
9. Spread the pizza sauce on this dough
10. Add toppings of your choice and bake it to make a yummy pizza