

**Development and Quality Assessment of Manathakkali and Agathi leaves  
incorporated recipes**

**K.GnanaDeepika**

**(14PFN003)**

**Thesis submitted to**

**Avinashilingam Institute for Home Science and Higher Education for Women,**

**Coimbatore – 641 043**

**In partial fulfilment of the Requirements for the  
Degree of Master of Science in Food Science and Nutrition**

**April, 2016**

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**Signature of the Supervisor**

  
**Signature of the Head of the Department**

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## INTRODUCTION

Vegetables comprise a large number of plants, mostly annual, of which different parts like leaves, stem, flowers, fruits, roots etc. are eaten. They are rich in nutrients and are essential items of a balanced diet. Among the vegetables, green leafy vegetables is a food group which is nutrient dense ([www.iosrjournals.org](http://www.iosrjournals.org)).

European black nightshade (*solanum nigrum*) or locally just black night shade also known as Duscle, garden nightshade, garden huckleberry, hound's berry, petty morel, wonder berry, smell-fruited black nightshade, or popolo is a species in the *solanum* genus, native to Eurasia and introduced in the Americas Australasia, and South Africa. Parts of this plant can be toxic to livestock and humans, and it is considered a weed. Nonetheless, ripe berries and cooked leaves of edible strains are used as food in some locales, and plant parts are used as a traditional medicine. A tendency exists in literature to incorrectly refer to many of the other "blacknightshade" species as "Solanum nigrum" (Moh-ud-dint khan, 2010)

*Solanum nigrum* has been recorded from deposits of the Paleolithic and Mesolithic era of ancient Britain and it is suggested by the botanist and ecologist Edward Salisbury that it was part of the native flora there before Neolithic agriculture emerged. The species was mentioned by Pliny the Elder in the first century AD and by the great herbalists, including Dioscorides. In 1753, Carl Linnaeus described six varieties of *solanum nigrum* in *species plantarum*.

*Solanum nigrum* (*solanaceae*) commonly known as "black nightshade berries". *Solanum nigrum* are locally called "manathakkali keerai" and is cultivated throughout India is rich in calcium, phosphorus, energy and moisture. Chemical constituents in this plant are alkaloids, saponins, flavonoids, and phytosterols (Vimala and Shoba, 2004).

It is a fairly common herb and has a number of medicinal properties. In India, it is a commonly used culinary ingredient and can be referred to as berry tomatoes. In Australia, it is also known as bush tomatoes. Each part of the manathakkali keerai has different properties and different uses in herbal medicine e.g. relief from coughs, colds and treatment of mouth ulcers, liver ailments ([thehindu@thehindu.co.in](mailto:thehindu@thehindu.co.in))

*Solanum nigrum* has been widely used as a food since early times, and the fruit was recorded as a famine food in 15<sup>th</sup> century. In Ghana, the unripe green berries are called kwaansusuaa or amber, and are used in preparing various soups and stews, including the popular palm nut soup commonly eaten with banku or fufu([www.nzma.org](http://www.nzma.org).)

In South Africa, the very ripe and hand-selected fruit known as nastergal in Afrikaans and umsobo in Zulu is cooked into a beautiful but quite runny purple jam(Venkateswarlu, 2001)

In Greece and Turkey, the leaves are called istifno, and in Crete known as stifno. They are one of the ingredients included in the salad of boiled greens known as horta(Irving, 2009)

*Solanum nigrum* is an important ingredient in traditional Indian medicines. Infusions are used in dysentery, stomach complaints, and fever. The juice of the plant is used on ulcers and other skin diseases. The fruits are used as a tonic, laxative, appetite stimulant, and for treating asthma and“Excessive thirst”. Traditionally the plant was used to treat tuberculosis. It is known as Peddakasha Pandla Kooru in the Telangana region. The leaves of the plant used to treat mouth ulcers that occur during winter periods in Tamil Nadu, India.(World Health Organization, 2002)

In Tamil Nadu it is popularly known as manathakkali keerai and kaage soppu in Karnataka, and apart from its use as a home remedy for mouth ulcers, is used in cooking like spinach. In North India, the boiled extracts of leaves and berries are also used to alleviate liver related ailments, including jaundice. In Assam,the juice from its roots is used against asthma and whooping cough.(Pei ,2001)

*Solanum nigrum* is a widely used plant in oriental medicine where it is considered to be antitumorigenic, antioxidant,anti-inflammatory,hepatoprotective, diuretic and antipyretic (Kumar, 2011).

*Sesbania grandiflora* also known as agathi belongs to the family Fabaceae. Agathi keerai in Tamil, (*Sesbania grandiflora*) and in English the spinach variety is called as august tree leaves or humming bird tree leaves.

It is a fast growing tree and is widely distributed in India, Indonesia, Myanmar, Philippines, and Thailand. The tree grows 5-15m tall and the leaves and flowers of this tree are eaten as nutrient source. The leaves are bitter in taste and rich in vitamin C, calcium, sterols, saponin, quercetin, myricetin, and kaempferol. The leaves of agathi are well known for their antiurolithiatic activity against calcium oxalate type stones. In a recent study, reported antimicrobial property of polyphenolic extract of *Sesbania grandiflora* on pathogenic bacteria, was reported (China et al, Karen, Shubha Gopal, and Vineeth 2012)

There are two varieties of agathi leaves. One variety has white flower and the other one has red flower called as red august tree leaves. The common variety is white flower august tree leaves. Taste of agathi leaves is bitter but has bunch of healthy values. The edible parts in this variety are flower and leaves of the tree. Leaves, stem, root and flower of august tree leaves are used for medicinal purposes. The agathi leaves can be consumed in the form of juice, cooked spinach or medicine. The thin stem is used as a ingredient for good health medicines in Siddha and Ayurveda. It is advisable to take agathi leaves two to three times in a month.

Strong bones are the main contribution of agathi leaves. The vitamins and calcium, iron content in this variety of spinach supplies more strength to bones. By taking some amount of agathi leaves daily prevent weak bones in order ages and arthritis. Agathi leaves strengthen the nerves of eyes. Agathi leaves are boiled fully and added to the mother of new born baby for healthy breast feeding. It has a power of throwing out the stomach worms and leaves your stomach happy for a long time. The high content of vitamin A and calcium is the reason behind this health benefit (Siddhuraju, and Mohan, 2002.)

The juice of agathi leaves reduces headache by applying agathi leaves juice on the forehead for few minutes and then take steam to get quick relief. The noticeable properties of agathi leaves are antidote, laxative, vermifuge and refrigerant. It reduces the unwanted bile in the body. It has a power of taking out the poisonous properties present in the food. Improves digestion and large intake of these leaves results in gastric trouble.

Hence, the present study is conducted with the following objectives

To

1. Incorporate manathakkali leaves in selected recipes
2. Incorporate agathi leaves in selected recipes
3. Evaluate the organoleptic properties of the manathakkali and agathi incorporated recipes
4. Analyse the phenolic constituents and the nutrient content of the acceptable recipes

## II .REVIEW OF LITERATURE

The review of literature pertaining to the study entitled ‘‘Development and Quality Assessment of Manathakkali and Agathi leaves incorporated recipies’’ has been discussed under the following heads;

A.Nutraceuticals- The bridge between food and medicine

B.Polyphenols-Potent nutraceuticals

C.Phytochemicals present in manathakkali and agathi leaves

D.Health benefits of manathakkali and agathi leaves

### **Nutraceuticals- The bridge between food and medicine**

Hippocrates highlighted around 2000 year ago ‘‘ Let food be your medicine and medicine be your food’’(Majaz and Khurshid, 2012).

Nutraceuticals are food or part of food that provides medical or health benefits including the prevention and treatment of a disease (Chauhan and Kumar,2013).

Nutraceutical is regarded as a bio active substance and the constituents are either of a known therapeutic activity or are chemically defined substance generally accepted to contribute substantially to the therapeutic activity of the drug.

Nutraceuticals are currently receiving recognition as being beneficial in coronary heart diseases, obesity,diabetes, cancer,osteoporosis and other chronic and degenerative diseases such as Parkinson’s and Alzheimers’ diseases.Mechanistic action of natural compounds involve a wide array of biological processes,including activation of antioxidant defenses, signal transduction pathways, cell survival-associated gene expression, cell proliferation and differentiation and prevention of mitochondrial integrity. It appears that these properties play a crucial role in the protection against the pathologies of numerous age –related or chronic diseases (Bhowmik and Gopinath,2013)

Rishi,(2006) have quoted in their study that, nutraceuticals may range from isolated nutrients , dietary supplements and specific diets to genetically engineered designer foods and herbal products(Pandey and Verma,2010)

The term nutraceutical was originally defined in 1989 by Dr. Stephen L.DeFelice, founder and chairman of the foundation of Innovation Medicine (FIM),Crawford, New Jersey. Since the term was coined by Dr.DeFelice, its meaning has been modified by Health Canada Which defines nutraceuticals as; a product isolated or purified from foods , and generally sold in medicinal forms not usually associated with food and demonstrated to have a physiological benefit or provide protection against chronic disease( Bhowmik and Gopinath, 2013).

Many nutraceuticals , functional foods and naturally occurring compounds have been investigated and report in various studies which revealed that these products are extremely active , have profound effect on cell metabolism and often have little adverse effect (Arya and Yadav ,2011).

Nutrients found in many foods, fruits and vegetables are responsible for the well documented health benefits. Because of these and other marked health benefits of these, it must be taken regularly and to reduce the risk factors like high cholesterol,high blood pressure and diabetes . With the rapidly increasing interest in the nutraceutical revolution , we need to establish a vibrant nutraceutical research community which is absolutely necessary to convert the majority of potential nutraceuticals to established ones there by truly delivering their enormous benefits to all of us . The list of nutraceuticals being studied is changing continually and reflects ongoing research , market developments and consumer interest( Bhowmik and Gopinath ,2013).

Consumers are deeply concerned about how their health is managed, administered and priced . The consumer is seeking complementary or alternative beneficial products and the red tape of managed care makes nutraceuticals particularly appealing. These have contributed to a favorable market condition for nutraceuticals industry in India. India has a lot of advantage like qualified human resources , world class R&D facilities and varied

raw material-aspects that give our country a leading edge. Nutraceuticals are found in a mosaic of products emerging from (a) the food industry,(b) the herbal and dietary supplement market (c) pharmaceutical industry, and (d) the newly merged pharmaceutical/agribusiness/ nutrition conglomerates (Majaz Khurshid 2012). It is shifting to positive approach for prevention of disease to stay healthy(Bhowmik and Gopinath,2013).

### **Polyphenols-Potent nutraceuticals**

Natural polyphenols are valuable compound possessing scavenging properties towards radical oxygen species, and complexing properties towards proteins. These abilities make polyphenols interesting for the treatment of various diseases like inflammation or cancer, but also for anti-ageing purposes in cosmetic formulations, or for nutraceutical application (Munin, and Edwards-Levy,2011)

Studies confirm that diet rich in foods with high content of phytochemicals, high total antioxidant capacity and polyphenolic compounds may be related to lower risk of diabetes and predisposing factors ( Bahadoran and Mirmiran,2013).Many authors have reported that the nature and content of phenolics varies dramatically among plants, which are mainly esterified or glycosylated . They possess beneficial properties, such as antioxidant, immune modulatory actions and anti-cancer and antibacterial activity. Studies evidence an improvement of wound healing by these phytochemicals. Besides their activity, reducing the risk of cardiovascular diseases, anti-proliferative action on tumor cells, atherosclerosis protection, radio-protective action, hair tonic, hormonal repository in natural menopause women and antimicrobial properties(Lima and Vianelli,2014).

Phenolics are widespread constituents of plant foods (fruits, vegetables, cereals, olive, legumes, chocolate,etc.)and beverages (tea, coffee,beer, wine,etc.) and partially responsible for the overall organoleptic properties of plant foods( Dai andMumper,2010).

Chemical substances derived from plants have been used to treat human diseases since the dawn of medicine. Roughly 50% of new chemical entities introduced during the past two decades are from natural products. Recent technological advances have renewed interest in natural products in drug discovery. Therefore, efforts should be directed towards isolation and characterization of the active principles and elucidation of the relationship between structure and activity. There are various medicinal plants and their extracts (containing active chemical constituents, e.g., tannins and flavonoids) that have significant antiulcer activity in in vivo experiments on animal models. Furthermore, detailed analysis of the active constituents of natural drugs should be directed towards clinical relevance. Standardization is indispensable to maintain reproducible quality in biological evaluation. Although the clinical efficacy of these preparations is reported by traditional practices, they have not been scientifically validated( Zapata-Colindres, 2006)

### **Phytochemicals Present In Manathakkali And Agathi Leaves**

Chemical Profile of manathakkali leaves are rich sources of riboflavin , niacin,  $\beta$ -carotene and citric acid .the leaf contains riboflavin , niacin,  $\beta$ -carotene, citric acid, vitamin C, along with minerals like calcium, phosphorus and iron. The chemical analysis of the leaf consists ,82.1percentage moisture, 5.9 percent protein, 2.1 percent minerals and 8.9 percent carbohydrates.

The minerals and vitamins present in include calcium , phosphorus, iron, riboflavin , niacin and vitamin C. Its calorific value is 68 (Asian online Recipes.com,2010) the plant and the fruit contain toxicalkaloid solanine and saponin(Despande,2010).

Agathi leaves are rich sources riboflavin , niacin,  $\beta$ -carotene, citric acid, vitamin C, along with minerals like calcium, phosphorus and iron.The leaf consists of 73 percentage of moisture,8 percentage of protein,3 percent of minerals and 12 percent carbohydrates,1130 percent calcium, 80 percent of iron respectively.

## **Health benefits of Manathakkali and Agathileaves**

Manathakkali leaves give strength to muscles and improve vision. It is the best medicine for headache and skin infections. The highlight of manathakkali leaves uses is to reduce urinary infections. It is the best medicine for constipation.( Lau, and Hill,2011)

The manathakkali leaves are high medicinal value and are a very good source for the removal and cure of stomach and mouth ulcers and also any indigestion problems. Manathakkali leaves paste is used to treat joint pain problems and it is used for treating pimples and acne.

Manathakkali leaves juice is used as a medicine for liver and pancreas infection . The juice is the best medicine for all types of skin infection and allergies.application of the juice over the whole body and leaving it for 2 to 3hours can reduce body pain.( [www.ethnobiomed.com](http://www.ethnobiomed.com) )

The small dark fruit which the plant bears is really good to taste and has immense medicinal value. The tiny berries turn from green to dark black and it has a shiny coat which glistens.These berries taste bland , they are neither sweet nor sour, but taste they make up in nutrient content.

Manathakkali leaves has high nutritional value, plenty of vitamins and minerals and is very safe to be taken during pregnancy.manathakkali keerai recipes taken during pregnancy improves digestion and reduces the vomiting sensation.

The black nightshade is used as an important ingredient in several Indian medicine .It is a valuable cardiac tonic. It corrects disordered processes of nutrition by which the organismingests, digests, absorbs, transports, utilizes and excretes food substances, and restores the normal function of the system. It also reduces excitement, irritation and pain. The leaves of the plant are mildly bitter, which becomesless pronounced after cooking. The plant is beneficial in the treatment of dropsy. It increases the secretion and discharge of urine. Either it can be used as decoction or as a vegetable in the treatment of this disease.

An extract of the leaves and stem, in doses of 6 to 8ml can also be taken. Manathakkali leaves are useful in fevers. A syrup of the vegetable can be given as a cooling drink. To induce copious perspiration, a hot infusion of 0.75 to 1.25 decigrams, of dried leaves can be used. The fruit soft heplant can also be given with beneficial result in fevers ([www.asianonlinerecipes.com](http://www.asianonlinerecipes.com))

The leaves are effective in the treatment of digestive disorders. The raw juice of the leaves can be used alone or mixed with other juices or liquids. It is used in stomach disorders like flatulence, peptic ulcers and colitis. An infusion of the plant is useful in dysentery and other stomach ailments. The plant helps in removing catarrhal matter and phlegm from the bronchial tubes in asthma patients. The fruits of the plant can also be used beneficially in treating asthma (Bakhru,2008).

The plant is useful in chronic skin diseases. The juice can also be applied locally on the affected parts such as acne, eczema and psoriasis. As a anodyne or pain reliever, decoction of the plant can be used for washing inflamed , irritated and painful parts of the body. A paste of the plant serves as a useful applicant over corrosive ulcers, pustules and suppurating syphilitic ulcers , severe burns, herpes and rheumatic joints.

Green fruits of the plant can be ground and applied locally on ringworms with gratifying results .A juice or poultice of leaves can be effectively applied on eruptive skin diseases, Whitlow and burns. leaves can be applied with gratifying results over swollen and painful scortum and testicels. A juice or poultice of the leaves is an efficacious application over rheumatic and gouty joints, corrosive ulcers and tumors. A decoction of the leaves can be used to wash tumours and inflamed, irritated and painful parts or the body (Devarkar,2011)

The plant is beneficial for the treatment of dropsy. It increases the secretion and discharge of urine. The leaves are effective in the treatment of digestive disorders and stomach disorder like flatulence, peptic ulcers and colitis. An infusion of the plant is often used in dysentery and other stomach ailments. The plant helps in expelling catarrhal matter and phlegm from the bronchial tubes, in asthma patients. A juice or poultice of the

leaves is an efficacious application over rheumatic and gouty joints, corrosive ulcers and tumors.

Manathakkali leaves regulate nitric oxide (NO) production, which is an antitumour molecule produced in activated macrophages. The total alkaloids from the medicinal herb manathakkali leaves inhibited the growth of human cervical carcinoma. It is used as a hepatoprotective and anti-inflammatory agent. The lipid-soluble extract of *Solanum nigrum* leaves possess antinociceptive, anti-inflammatory and anti-pyretic properties. Offers anti-ulcer activity by blocking acid secretion through inhibition of H<sup>+</sup>-K<sup>+</sup>-ATPase and decrease of gastrin secretion. These further suggest that it possesses anti-ulcerogenic as well as ulcer-healing properties, which might be due to its anti-secretory activity (Sathyanarayanan et al., 2009).

Culinary application of manathakkali leaves are popularly as a vegetable. The leaves blend well with other greens and pulses. The juice of the leaves can be mixed with medium like coconut water, coconut milk, butter-milk, cow's milk and fruit juice (Despande, 2010).

Both leaves and berries are mainly used in south Indian cooking to make stir-fry dish (varai) and gravy, curries (vathal kulambu). The leaves have medicinal properties, and make it as green curry for atypical Sri Lankan lunch, the berries are cooked in hot and sour gravies, leaves with pulses can be made into delicious dishes. The extract of the leaves can be consumed as a soup with the addition of mild spices (www.petitichef.com).

Agathi leaves are most protective when eaten raw or lightly cooked. It is extremely high in cancer-fighting activity. Like other vegetables, it also speeds up removal of Estrogen from the body, thus helping to suppress breast cancer. It is also rich in cholesterol-reducing fibers. (Raju 2005).

Agathi leaves are used as poultices. The principal medicinal effects are due to the tree's astringency; hence it is used against inflammation, venom and other poisons, bacterial infections and tumours.

The crushed leaves are applied to sprains and bruises of all kinds. A tea made from the leaves is believed to have antibiotic, anthelmintic, antitumor and contraceptive properties. Agathi is a super source of chromium that helps regulate insulin and blood sugar (Cheriyann2009). Along with diabetes, it is a complete package of versatile disease fighters. It is antiviral, anti-ulcer activity.

Agathi juices are used for poultices and the leaves are applied for rheumatism, swelling and bruises and itching for systemic disorders, decoction are taken internally leaves resin, mixed with honey is taken orally for phlegm and root juices are taken as an expectorant. Sinus congestion is reduced by taking leaves decoction.

The study to show potential anticancer and chemo preventive efficacy, in vitro and in vivo of a novel protein fraction from agathi and the study strongly support in vitro findings as administration increased the life span and decreased the tumor volume in mice bearing tumor (Laladhas, 2009). Agathi as cholesterol lowering agents is due to the presence of beta-glucans, a water-soluble dietary fibre present in this leafy vegetable. Beta-glucans, which are also present in barely, have also been shown to lower low density lipoprotein (LDL) cholesterol (Unnithan 2010)

### **III.METHODOLOGY**

The methodology of the study titled, ” Development and Quality Assessment of Manthakkali and Agathi leaves Incorporated Recipes, ” is presented under the following phases;

#### **Phase 1**

- A. Selection of food sample
- B. Processing of raw materials
- C. Selection of manathakkali and agathi leaves incorporation recipes.

#### **Phase II**

- A. Standardization and sensory evaluation of selected recipes
- B. Evaluation of overall acceptability of recipes

#### **Phase III**

- A. Analysis of nutrient content and phenolic constituents of the formulated recipes
- B. Statistical Analysis

## **PHASE I**

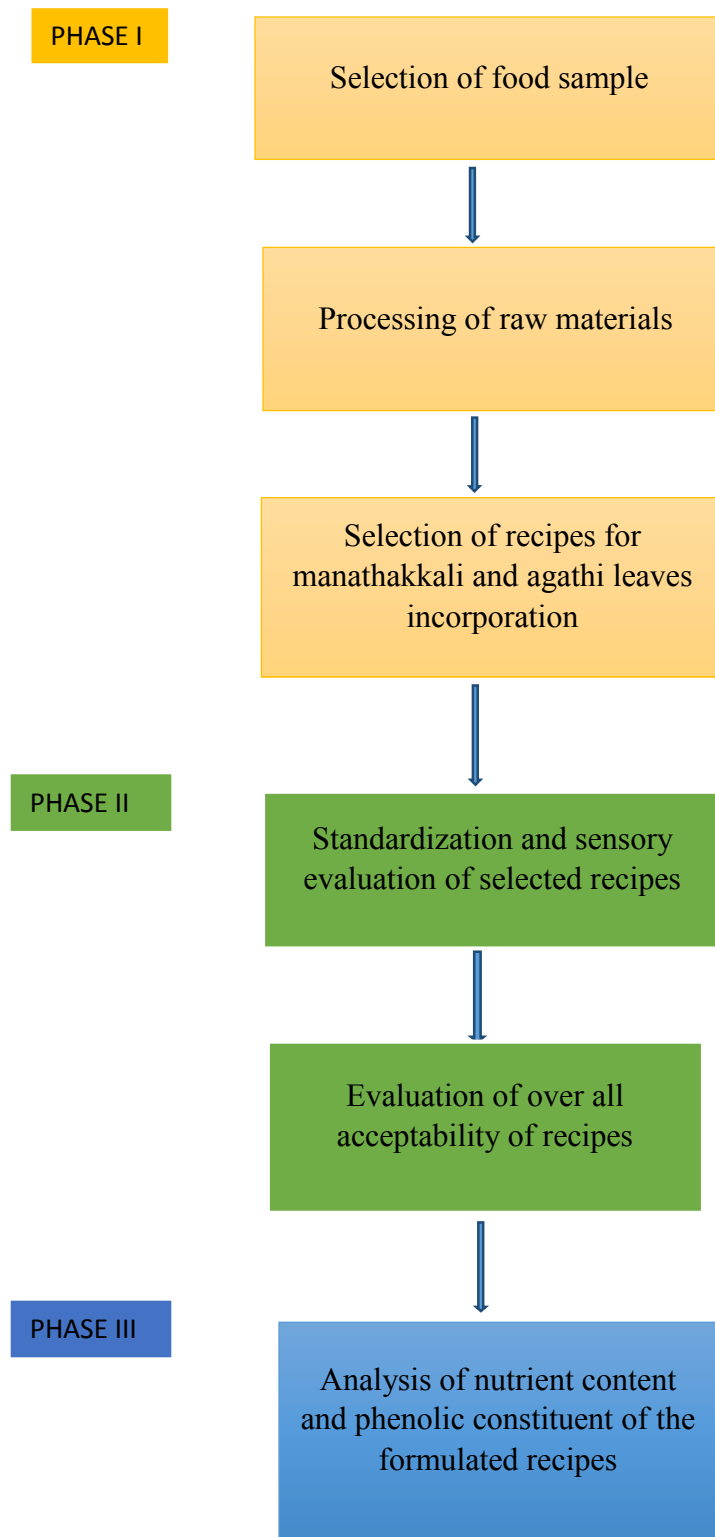
### **A. SELECTION OF FOOD SAMPLE**

In South India, manathakkali, agathi leaves and berries are routinely consumed as food after cooking with tamarind, onion, and cumin seeds. The berries are referred to as "fragrant tomato". Although not very popular across much of its growing region, the fruit and dish are common in Tamil Nadu.

In the indigenous system of medicine in India, the plant Agathi is claimed to be useful for various ailments and one such is for the treatment of renal calculi. Generally the green leaves of this variety is used for cooking similar to spinach but the flower, leaf and bark of Agathi tree has got a number of medicinal properties which is used in various ayurvedic and other traditional medicines. The simplest manner in which these leaves are used is by boiling the leaves with water to make a tea, which bears antibiotic, antihelminthic and antitumoral properties.

Hence, the investigator decided to incorporate commonly consumed recipes of South India with manathakkali and agathi leaves.

Four recipes which include breakfast items, and snacks namely Idly, Dosa, Kozukattai, chappathi and incorporated with Manathakkali and Agathi were selected randomly. The research design is presented in Figure 1.



**RESEARCH DESIGN**

**FIGURE 1**

## **B.PROCESSING OF RAW INGREDIENTS**

Manathakkali and Agathi leaves was purchased without any infestations and of good quality from local Market. Other ingredients, like mustard, refined oil, salt, curry leaves were directly purchased from market.

The required quantity of Manathakkali and Agathi leaves .

were thoroughly washed and ground for incorporation into recipes

The outer skin of onion was removed, green chilli were washed thoroughly and cut into small pieces.

## **C.SELECTION OF RECIPES FOR MANATHAKKALI AND AGATHI LEAVES INCORPORATION**

Four recipes suitable for Manathakkali and Agathi leaves incorporation were selected for the study. The recipes selected for incorporation were idli , dosa , kozhukattai and chappathi. Manathakkali and agathi leaves were incorporated separately in each recipe at varying proportion.

The images of recipes incorporated with manathakkali and agathi are presented in Plates Ia, and Ib

**Idli**



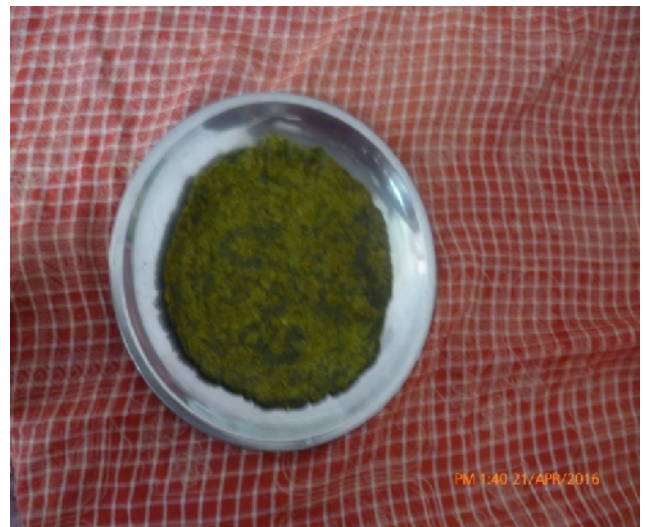
**Dosa**



**Kozhukattai**



**Chappathi**



**Recipes with Manathakkali Leaves**

**PLATE 1a**

**Idli**



**Dosa**



**Kozhukattai**



**Chappathi**



**Recipes with Aagathi Leaves**

**PLATE 1b**

## PHASE II

### A) STANDARDIZATION AND SENSORY EVALUATION OF SELECTED RECIPES

The Manathakkali and Agathi leaves recipes were incorporated at levels of 30,50, 75and 100 to the selected recipes to form four variations each namely A, B,C and D as mentioned in table I

**TABLE I**

PROPORTION OF INGREDIENTS IN THE INCORPORATED RECIPES OF MANATHAKKALI AND AGTHI LEAVES

Ingredients	Variation A	Variation B	Variation C	Variation D
Manathakkali leaves (g)	30	50	75	100
Agathi leaves(g)	30	50	75	100
Others(g)	100	100	100	100

Quality is a very important parameter for judging the edible nature of any food (Sharma, 2006). The process of setting generally uniform characteristics for a particular good service. ([WWW.businessdictionary.com/definition/product-standardization.html](http://WWW.businessdictionary.com/definition/product-standardization.html))

In order to standardize the recipes with manathakkali and agathi leaves, they were evaluated organoleptically in comparison with the respective standards recipes A score card prepared using the guidelines of numerical scoring method.

Sensory evaluation is a scientific tool that used the human senses, smell, sight, taste, touch and hearing to examine the properties with influence the quality of the products (Me .Dermoth and Murray, 2007).

Hence, sensory evaluation of the selected recipes were carried out by the following steps;

1. Selection of venue
2. Selection of panel members
3. Formulation of score card

#### 1. Selection of venue

The selection of evaluation room is an essential requisite for sensory evaluation. Foods Laboratory in the Department of Food science and Nutrition, Avinashilingam Institute for Home Science and Higher Education for Women , Coimbatore was selected as the venue for sensory evaluation .During evaluation , each panel member was given a score card . The recipes were displayed along with a spoon and a glass of water to rinse the mouth between tasting.

#### 2. Selection of panel members

Thirty semi-trained panel members were selected based on their health, co-operation, willingness and knowledge of quality characteristics and sensory analysis of foods. Research scholars, project associates and staff members of the Department of Food Science and Nutrition acted as panel members for the evaluation of the products.

#### 3. Formulation of score card

Score card is a tool which helps in evaluation through direction degree of judgment using suitable defined scores. Scoring is a form of rating of the preparation food items using a numerical scale where the numbers form an internal or ratio scale (Manay and Shadaksharaswamy, 2007).

Numerical scoring test for one or more samples are presented to each panellist in random order or according to a statistical each design. The panellish evaluates each sample on a specific scale for a particular characteristic indicating rating of the sample. The panellists are trained to follow the sensory characteristics corresponding to the agreed quality descriptions and scores.(Srilakshmi, 2010).

Numerical scoring test evaluation card ranging from a maximum score of five to minimum of one was used for the evaluation. The score card given is in Appendix I.

## **B.EVALUATION OF OVERALL ACCEPTTABILITY OF RECIPES**

Overall acceptability of all four selected recipes was determined from the sensory characteristics of the recipes such as appearance, texture, flavour and taste. The mean of overall acceptability was tabulated and analysed and the results were interpreted with statistical appraisal.

An evaluation sheet with allowed codes and details of the attributes and number of sample to be evaluated were prepared and given to each panel member. The scores obtained through sensory evaluation of the products by the panel members were recorded and the mean scores were calculated for each recipes .The overall acceptability and mean scores for each recipe were analysed and the recipes which obtained the highest total and mean score were considered to the best acceptable.

## **PHASE III**

### **A. ANALYSIS OF NUTRIENT CONTENT AND PHENOLIC CONSTITTUENTS OF THE MANATHAKKALI AND AGATHI INCORPORATED RECIPES**

#### **1. Nutrient content of manathakkali and agathi recipes**

All the four recipes formulated with manathakkali and agathi leaves respectively were analysed for its nutrient content (plate I). Moisture, ash and crude fibre were carried out by using association of analytical chemists International (AOAC) procedure.

Carbohydrates estimation was done by anthrone method. The amount of protein present was estimated by Macrokjeldhal's method. The iron content was estimated by colorimetric method and Vitamin -C Was estimated using dye method and Calcium by using titrimetric method.fat was estimated by Soxhelt extraction.(plate II)



PLATE II ANALYSIS OF NUTRIENT CONTENT

The energy content of the various recipes with calculated by multiplying the total amount of carbohydrates, fat and protein by their caloric value. The estimation procedure for nutrient content of recipes given in Appendix II.

## **ANALYSIS OF PHENOLIC CONSTITUENT IN MANATHAKKALI AND AGATHI RECIPES**

a. Qualitative analysis of phytochemical constituents of the manathakkali and agathi incorporated recipes was carried out. Preliminary phytochemical screening was performed for the presence of secondary metabolites like tannins, glycosides, alkaloids, steroids and flavonoids using standard qualitative assay (Arokiyaraj et al, 2009)

### **Sample Extraction**

Fifteen gram of manathakkkali and agathi leaves were initially soaked in 60 ml of petroleum ether in air tight conical flask for two days and then it was first filtered through double layered muslin cloth and then filtered through whatman no 1 filter paper and the filter was collected into sterile air tight bottle. Similar process was repeated twice with fresh petroleum ether and the filtrate was collected together. After all, petroleum ether was removed from the filtrate at 40 degree selcius using oven and the extract was stored at the refrigerator for further studies. Likewise, the above dried residue was used for sequential extraction of acetone, ethanol, methanol and water.

- 1) Test for Alkaloids :1 ml of 1% HCl was added to 3 ml of extract in a test tube and was treated with few drops of Meyer's reagent. A creamy white precipitate indicated the presence of alkaloids.
- 2) Test for terpenoids: 5 ml of extract was mixed with 2 ml of CHCL<sub>3</sub> in a test tube. 3 ml of concentrated H<sub>2</sub>SO<sub>4</sub> was carefully added to the mixer to form a layer. An interface with a reddish brown colouration was observed for the presence of terpenoids.
- 3) Test for saponins: 5ml of extract was shaken vigorously to obtain a stable persistent froth. The frothings was then mixed with 3 drops of olive oil and observed for the formation of emulsion, which indicated the presence of saponins.

- 4) Test for flavonoids: A few drops of 1% NH<sub>3</sub> solution was added to the extract in a test tube .A yellow coloration was observed for the presence of flavonoids.
- 5) Test for tannins: To 0.5ml of extract solution , 1ml of distilled water and one to two drops of of ferric chloride solution were added and observed for brownish green o a blue blach coloration .
- 6) Test for phenols: Ferric chloride Test: Extracts were treated with three to four drops of ferric chloride solution. Formation of bluish black colour indicates the presence of phenol.

## **B.STATISTICAL ANALYSIS**

The data obtained were analysed using the Statistical Package for the Social Sciences (SPSS) version 16 program. After confirming the normality of data and the homogeneity of the variance of the data , the significance of the difference between the means of the test and control studies was established by using t' test. The results were expressed as mean and standard error of the mean.

## **RESULTS AND DISCUSSION**

The results of the project entitled, “Development and Quality Assessment of Manathakkali and Agathi leaves Incorporated recipes” are presented as follows:

A. Sensory analysis of the manathakkali and agathi recipes.

B. Nutrient content of manathakkali and agathi recipes

C. Qualitative and quantitative assessment of phenolic constituents of manathakkali and agathi leaves extract and incorporated recipes.

A. Sensory analysis of the manathakkali and agathi recipes.

Recipes was prepared using the manathakkali and agathi leaves it was compared with the standard recipes in terms of their organoleptic properties. Both the recipes sample were prepared with 30,50,75 and 100 grams , and were subjected to sensory evaluation . Table I shows the mean scores of manathakkali and agathi leaves receipes.( plate II)

## SENSORY ATTRIBUTES OF MANATHAKKALI RECIPES

TABLE II

### SENSORY ATTRIBUTES OF MANATHAKKALI IDLI AND STANDARD IDLI

Attributes	30gm/100gm		50gm/100gm		75gm/100gm		100gm/100gm	
	MI	SI	MI	SI	MI	SI	MI	SI
Apperarance	4.9	4.8	4.7	4.7	3.8	3.9	2.2	2.0
Colour	4.8	4.6	4.6	4.1	3.6	3.8	2.0	1.7
Flavour	3.9	3.4	4.8	4.6	2.9	3.5	1.7	1.7
Taste	4.9	4.8	4.7	4.3	3.7	3.5	1.7	1.7
Texture	4.7	4.6	4.5	4.0	3.0	2.0	1.9	1.9
Total	23.2	22.2	23.3	21.7	17	16.7	9.5	9.2
Mean	4.6	4.4	4.6	4.3	3.4	3.3	1.9	1.8

MI-manathakkali idli , SI-standard idli

**TABLE III****SENSORY ATTRIBUTES OF MANATHAKKALI DOSA AND STANDARD  
DOSA**

Attributes	30gm/100gm		50gm/100gm		75gm/100gm		100gm/100gm	
	MD	SD	MD	SD	MD	SD	MD	SD
Apperarance	4.7	4.7	4.6	4.6	4.8	4.7	3.7	3.8
Colour	4.8	4.7	4.7	4.7	3.6	3.7	3.6	3.5
Flavour	4.4	4.4	3.6	4.8	4.6	4.7	3.7	3.6
Taste	4.7	4.7	4.7	4.5	4.6	4.8	3.7	3.4
Texture	4.1	4.6	4.7	4.7	4.7	4.7	4.6	4.1
Total	22.7	23.1	2.23	23.2	21.9	22.6	19.3	18.4
Mean	4.5	4.6	4.4	4.6	4.3	4.5	3.8	3.6

MD –manathakkali idli,SD- standard idli

**TABLE IV**

**SENSORY ATTRIBUTES OF MANATHAKKALI KOZHUKATTAI AND STANDARD KOZHUKATTAI**

Attributes	30gm/100gm		50gm/100gm		75gm/100gm		100gm/100gm	
	MK	SK	MK	SK	MK	SK	MK	SK
Apperarance	4.8	4.8	3.8	3.5	4.0	3.9	3.7	3.7
Colour	4.7	4.7	4.0	3.7	3.8	3.4	3.6	3.2
Flavour	4.9	4.7	3.6	3.5	3.6	3.9	3.5	3.4
Taste	4.6	4.7	4.0	3.5	3.9	3.3	3.8	3.1
Texture	4.9	4.7	3.9	3.7	3.8	3.3	3.5	3.4
Total	23.9	22.9	19.3	17.9	19.1	17.8	18.1	16.8
Mean	4.7	4.5	3.8	3.5	3.8	3.5	3.6	3.3

MK –manathakkali kozukattai,SK- standard kozhukattai

**TABLE V**  
**SENSORY ATTRIBUTES OF MANATHAKKALI CHAPPATHI AND**  
**STANDARD CHAPPATHI**

Attributes	30gm/100gm		50gm/100gm		75gm/100gm		100gm/100gm	
	MC	SC	MC	SC	MC	SC	MC	SC
Apperarance	4.5	4.6	3.9	4.0	3.1	3.7	3.4	3.9
Colour	4.4	4.3	3.8	3.4	3.4	3.9	3.5	3.0
Flavour	4.5	4.4	3.6	3.5	2.8	2.5	2.2	2.0
Taste	4.4	4.2	4.6	4.7	2.2	3.0	2.0	1.7
Texture	4.3	4.4	3.9	3.3	3.9	3.4	1.7	1.7
Total	22.1	21.9	19.8	18.9	15.4	16.5	12.8	12.3
Mean	4.4	4.3	3.9	3.7	3.0	3.3	2.5	2.4

MC –manathakkali chappathi ,SC- standard chappathi

**TABLE VI**

**SENSORY ATTRIBUTES OF AGATHI IDLI AND STANDARD IDLI**

Attributes	30gm/100gm		50gm/100gm		75gm/100gm		100gm/100gm	
	AI	SI	AI	SI	AI	SI	AI	SI
Apperarance	4.8	4.7	4.7	4.7	4.8	4.7	3.8	3.7
Colour	4.5	4.6	4.6	4.5	4.7	4.6	4.0	3.7
Flavour	4.7	4.6	4.7	4.6	4.8	4.8	3.5	3.5
Taste	4.7	4.7	4.4	4.7	4.6	4.7	4.0	3.6
Texture	4.6	3.5	4.3	4.7	4.5	3.6	3.9	3.5
Total	23.3	22.1	22.7	23.2	23.4	22.4	192	18
Mean	4.6	4.4	4.5	4.6	4.6	4.4	3.8	3.6

AI –agathi idli ,SI- standard idli

**TABLE VII**

**SENSORY ATTRIBUTES OF AGATHI DOSA AND STANDARD DOSA**

Attributes	30gm/100gm		50gm/100gm		75gm/100gm		100gm/100gm	
	AD	SD	AD	SD	AD	SD	AD	SD
Apperarance	4.7	4.7	4.8	4.7	4.6	4.6	4.6	4.5
Colour	4.6	4.6	3.6	3.7	4.7	4.7	3.6	3.2
Flavour	4.7	4.6	4.6	4.7	3.6	4.8	3.4	3.5
Taste	4.7	4.5	4.6	4.8	4.7	4.5	3.8	3.1
Texture	4.8	4.8	4.7	4.7	4.7	4.7	3.7	3.7
Total	23.5	23.2	22.3	22.6	22.3	23.3	19.1	18
Mean	4.7	4.6	4.4	4.5	4.4	4.6	3.82	3.6

AD – agathi dosa ,SD - standard dosa

**TABLE VIII**

**SENSORY ATTRIBUTES OF AGATHI KOZHUKATTAI AND STANDARD KOZHUKATTAI**

Attributes	30gm/100gm		50gm/100gm		75gm/100gm		100gm/100gm	
	AK	SK	AK	SK	AK	SK	AK	SK
Apperarance	4.9	4.8	4.7	4.7	4.8	4.7	4.8	4.5
Colour	4.8	4.6	4.6	4.1	4.5	4.6	3.8	3.5
Flavour	4.9	4.8	4.8	4.6	4.7	4.6	4.0	3.7
Taste	4.7	4.6	4.7	4.3	4.7	4.7	4.0	3.5
Texture	4.8	4.8	4.7	4.7	4.6	4.6	3.9	3.7
Total	24.1	23.6	23.5	22.4	23.3	23.2	20.5	18.9
Mean	4.8	4.7	4.7	4.4	4.6	4.6	4.1	3.7

AK – agathi kozhukattai ,SK - standard kozukattai

**TABLE IX**

**SENSORY ATTRIBUTES OF AGATHI CHAPPATHI AND STANDARD CHAPPATHI**

Attributes	30gm/100gm		50gm/100gm		75gm/100gm		100gm/100gm	
	AC	SC	AC	SC	AC	SC	AC	SC
Apperarance	4.0	3.9	4.7	4.7	3.9	3.7	3.7	3.7
Colour	4.0	3.5	4.6	4.6	4.8	3.1	3.8	3.4
Flavour	4.5	4.6	4.8	4.5	3.5	3.5	3.5	3.6
Taste	4.7	4.6	4.6	3.5	3.5	3.9	3.8	3.3
Texture	4.7	4.7	4.6	4.0	3.7	3.8	3.5	3.4
Total	21.9	21.3	22.3	21.3	15.9	18	18.3	17.4
Mean	4.3	4.2	4.6	4.2	3.1	3.6	3.6	3.4

AC – agathi chappathi ,SC - standard chappathi

Organoleptic evaluation is an important essential requirement to decide the acceptability of the product which will decide the shelf life of any product as it is subjective sensory evaluation mainly depending upon on the human liking the acceptability toward the various sensory attributes (Kumar et al,2012).

In this study, the over all acceptability and the mean scores obtained show that the average scores for all the parameters were higher for the manathakkali recipes compared to the agathi recipes

The sensory analysis also revealed that the samples containing thirty grams , fifty grams of manathakkali and agathi incorporated recipes was most accepted by the panel members followed by the samples containing fifty grams of manathakkali and agathi recipes. Table II to IX also Frrevealed that the sample samples containing, seventy five grams and hundred grams of manathakkali and agathi recipes was least accepted by the panel members .

The sensory scores presented in the table revealed that the colour of the manathakkali and agathi recipes was slightly acceptable are than the standard recipes. It is because the standard recipes was white in colour and manathakkali and agathi recipes had a green in colour . as such retention of the attributes such as shape, appearance, taste, nutrient, colour, flavour, texture and biological activity of the fresh sample.

The mean scores for appearance , texture, and taste presented the table reveals that the manathakkali recipes was highly acceptable compared to the agathi recipes . The sensory scores revealed that the manathakkali was accepted by the panellists compared to the agathi recipes .because agathi recipes was more bitter taste , Therefore it can be concluded that the texture and taste of the recipes was more acceptable compared to the agathi recipes.

Flavour is an impartant parameter when evaluating sensory attribute of foods . The product might be appealing but with out good flavour. It is slightly to be acceptable . The tables showed that the sensory scores for flavour was higher in the manathakkali recipes compared to the agathi recipes. This was due to the strong bitter flavour of the

agathi recipes which was slightly acceptable . Eventhough spices masked the bitterness, the manathakkali and agathi recipes was found to be more acceptable when compared to the agathi recipes.

The sensory scores for taste was higher in the manathakkali recipes when compared to the agathi recipes .The table shows the sample containing 30grams ,50 grams of both recipes was most accepted by the panel member followed by the sample containing 75 grams and 100 gram of manathakkali and agathi recipes was least accepted due to their bitter after taste.

In all the parameters the sample containing 30,50 ,75 and 100 gram of manathakkali and agathi recipes with added spices were found to be the most accepted sample by the panel members.

**NUTRIENT CONTENT OF MANATHAKKALI AND AGATHI RECIPIES  
LEAVES**

**TABLE X**

**NUTRIENT CONTENT OF MANATHAKKALI IDLI**

<b>S.NO</b>	<b>NUTRIENTS</b>	<b>PER 100g</b>
1	ENERGY(kcal)	261
2	CARBOHYDRATE(g)	60
3	PROTEIN (g)	9
4	FAT(g)	1.2
5	CALCIUM(g)	220
6	IRON(g)	6
7	MOISTURE (g)	27
8	CRUDE FIBRE(g)	4.6

From the above table , it was revealed that the amount of energy content of formulated manathakkali idli was found to be 261 kilocalories per 100g. The carbohydrates, protein and fat content were found to be 60g ,9g and 1.2g respectively. The calcium , iron and moisture content formulated with manathakkali idli was found to be 220mg,6mg, and 27 .The content of crude fibre was found to be 4.6 respectively.

**TABLE XI**

**NUTRIENT CONTENT OF MANATHAKKALI DOSA**

S.NO	NUTRIENTS	PER 100g
1	ENERGY(kcal)	309
2	CARBOHYDRATE(g)	49.5
3	PROTEIN (g)	7
4	FAT(g)	3
5	CALCIUM(g)	243
6	IRON(g)	5
7	MOISTURE (g)	22.5
8	CRUDE FIBRE(g)	3

From the above table , it was evident that the amount of energy content of formulated manathakkali dosa was found to be 309 kilocalories per 100g . The carbohydrates, protein and fat content were found to be 49.5g, 7g,and3g respectively. The calcium , iron ,and moisture was found to be 243mg,5mg,22.5mg . The content of crude fibre was found to be 3g respectively.

**TABLE XII**

**NUTRIENT CONTENT OF MANATHAKKALI KOZHUKATTAI**

S.NO	NUTRIENTS	PER 100g
1	ENERGY(kcal)	285
2	CARBOHYDRATE(g)	52
3	PROTEIN (g)	11.5
4	FAT(g)	2
5	CALCIUM(g)	208
6	IRON(g)	6
7	MOISTURE (g)	9
8	CRUDE FIBRE(g)	2

From the above table , it was clear that the amount of energy content of formulated manathakkali kozhukattai was found to be 285 kilocalories per 100g . The carbohydrates , protein and fat content were found to be 52g,11.5g,and2g respectively. The calcium , iron ,and moisture was found to be 208mg,6mg,9mg . The content of crude fibre was found to be 2g respectively.

**TABLE XIII**

**NUTRIENT CONTENT OF MANATHAKKALI CHAPPATHI**

<b>S.NO</b>	<b>NUTRIENTS</b>	<b>PER 100g</b>
1	ENERGY(kcal)	278
2	CARBOHYDRATE(g)	65
3	PROTEIN (g)	8
4	FAT(g)	3
5	CALCIUM(g)	138
6	IRON(g)	4.5
7	MOISTURE (g)	10
8	CRUDE FIBRE(g)	4

From the above table , it was revealed that the amount of energy content of formulated manathakkali chappathi was found to be 278 kilocalories per 100g . The carbohydrates , protein and fat content were found to be 65g,8g,and3g respectively. The calcium , iron ,and moisture was found to be 138mg,4.5mg,10mg . The content of crude fibre was found to be 4g respectively.

**TABLE XIV**

**NUTRIENT CONTENT OF AGATHI IDLI**

<b>S.NO</b>	<b>NUTRIENTS</b>	<b>PER 100g</b>
1	ENERGY(kcal)	352
2	CARBOHYDRATE(g)	45
3	PROTEIN (g)	7
4	FAT(g)	2.5
5	CALCIUM(g)	450
6	IRON(g)	5.1
7	MOISTURE (g)	21
8	CRUDE FIBRE(g)	1.7

From the above table , it was revealed that the amount of energy content of formulated agathi idli was found to be 352 kilocalories per 100g . The carbohydrates , protein and fat content were found to be 45g, 7g, and 2.5g respectively. The calcium, iron, and moisture was found to be 450mg, 5.1mg, 21mg . The content of crude fibre was found to be 1.7g respectively.

**TABLE XV**

**NUTRIENT CONTENT OF AGATHI DOSA**

<b>S.NO</b>	<b>NUTRIENTS</b>	<b>PER 100g</b>
1	ENERGY(kcal)	258
2	CARBOHYDRATE(g)	48
3	PROTEIN (g)	8.3
4	FAT(g)	4
5	CALCIUM(g)	375
6	IRON(g)	4
7	MOISTURE (g)	12
8	CRUDE FIBRE(g)	2

From the above table , it was revealed that the amount of energy content of formulated manathakkali chappathi was found to be 258 kilocalories per 100g . The carbohydrates , protein and fat content were found to be 48g, 8.3g respectively. The calcium , iron ,and moisture was found to be 375 mg, 4,mg, 12 mg . The content of crude fibre was found to be 2g respectively.

**TABLE XVI**

**NUTRIENT CONTENT OF AGATHI KOZHUKATTAI**

<b>S.NO</b>	<b>NUTRIENTS</b>	<b>PER 100g</b>
1	ENERGY(kcal)	275
2	CARBOHYDRATE(g)	54
3	PROTEIN (g)	11.2
4	FAT(g)	2
5	CALCIUM(g)	362
6	IRON(g)	6
7	MOISTURE (g)	10
8	CRUDE FIBRE(g)	1

From the above table , it was evident that the amount of energy content of formulated agathi kozhukattai was found to be 275 kilocalories per 100g . The carbohydrates , protein and fat content were found to be 54g,11.2g,and2g respectively. The calcium , iron ,and moisture was found to be 362mg,6mg,10mg . The content of crude fibre was found to be 1g respectively.

**TABLE XVII**

**NUTRIENT CONTENT OF AGATHI CHAPPATHI**

<b>S.NO</b>	<b>NUTRIENTS</b>	<b>PER 100g</b>
1	ENERGY(kcal)	249
2	CARBOHYDRATE(g)	50
3	PROTEIN (g)	8.8
4	FAT(g)	6
5	CALCIUM(g)	291
6	IRON(g)	3.8
7	MOISTURE (g)	14
8	CRUDE FIBRE(g)	3

From the above table , it was evident that the amount of energy content of formulated agathi chappathi was found to be 249 kilocalories per 100g . The carbohydrates , protein and fat content were found to be 50g,8.8g, and 6g respectively. The calcium , iron ,and moisture was found to be 291mg 3.8mg,14mg . The content of crude fibre was found to be 3g respectively.

C. Qualitative and quantitative assessment of phenolic constituents of manathakkali and agathi leaves extract and incorporated recipes.

1. Qualitative assessment of phenolic constituents of manathakkali leaves extract and agathi leaves extract

The qualitative analysis of phenolic constituents in the manathakkali and agathi leaves are presented in Table XVIII

Alkaloids are natural products that contains heterocyclic nitrogen atoms, are basic in character (Saxena and Saxena, 2013). The alkaloids were found to be present in aqueous extract of manathakkali leaves and it was found to be trace amounts in agathi leaves. In Methanol were found to be present in manathakkali leaves and absent agathi leaves. Ethanol were found to be absence in both leaves. Acetone were found to be presence of manathakkali leaves and absence of agathi leaves. Acetone was found to be present in manathakkali leaves and in moderate amount to be present in agathi leaves.

**TABLE XIX****QUALITATIVE ASSESSMENT OF PHENOLIC CONSTITUENTS IN MANATHAKKALI AND AGATHI LEAVES EXTRACT**

Phenol Constituents	Water		Methanol		Ethanol		Acetone	
	MTL	AL	MTL	AL	MTL	AL	MTL	AL
Alkaloids	-	+	+	-	-	-	+	++
Terpenoids	-	-	-	++	+	-	+	-
Saponins	+	-	+	++	-	+++	-	-
Flavonoids	+	-	+	++	-	+++	-	-
Phenols	+	+	+	+	+	+	+	+

Methanol , Alcohol are a class of natural products which have been derived from five carbon isoprene units(Saxena and Saxena, 2013).Terpenoids were absent in aqueous extract of manathakkali and agathi leaves.Methanol extract was absent of both leaves. Ethanol extract also it was absent formanathakkali leaves and present in agathi leaves. In Acetone extract it was present in manathakkali leaves and presence of agathi leaves.

saponins in aqueous extract were present in manathakkali leaves and moderately present in agathi leaves .Methanol were found to be manathakkali leaves and moderate level presence of agathi leaves. Ethanol were found to be presence of manathakkali leaves extract and absence of agathi leaves extract. Acetone were present in manathakkali leaves extract and absence of agathi leaves extract.

Flavonoids was found in presence of aqueous in manathakkali leaves extract and absence of agathi leaves. Methanol extract was in present in manathakkali extract and

moderate level of agathi leaves extract. Ethanol extract was in absent in manathakkali extract and moderate level present in agathi leaves extract. Acetone extract in absent in manathakkali and agathi leaves .

Phenols were present in all the extracts of the manathakkali and agathi leaves.

## 2. Quantitative analysis of phenolic constituents in manathakkali and agathi recipes

The quantitative assessment of phenolic constituents such as estimation of tannins , total phenolic content and total antioxidant capacity are presented in Table XX.

**TABLE XI****QUANTITATIVE ASSESSMENT OF PHENOLIC CONSTITUENTS IN MANATHAKKALI RECIPES**

Quantitative parameters	Manathakkalki Idli/100g	Manathakkali Dosa /100g	Manathakkali Kozhukattai/100g	Manathakkali Chappathi / 100g
Tannins(mg)	9.01	12.77	9.58	14.95
Total polyphenol content(mg)	39.78	32.11	27.30	51.35
Total antioxidant activity( $\mu$ g/g)	322.9	491.6	240.9	531.3

The findings of the study indicated that the tannin content was 9.01mg per 100 gm in the manathakkali idli ,12.77mg per 100 gm in the dosa , 9.58 mg per 100gm in the kozhukattai and 14. 95mg per 100 gm present in the chappathi.

Total polyphenol content was 39.78 mg per 100gm in the manathakkali idli,32.11 mg per100 in dosa,27.30 mg per 100 in kozukattai and 51.35 mg per 100 gm present in the chappathi.

Total antioxidant activity content was 322.9 mg per 100gm in the manathakkali idli, 491.6 mg per100 in dosa,240.9 mg per 100 in kozukattai and 531.3 mg per 100 gm present in the chappathi

**TABLE XXI**

**QUANTITATIVE ASSESSMENT OF PHENOLIC CONSTITUENTS IN AGATHI RECIPES**

Quantitative parameters	Agathi Idli/100g	Agathi Dosa/100g	Agathi kozhukattai/100g	Agathi Chappathi / 100g
Tannins(mg)	8.67	18.07	9.82	15.90
Total polyphenol content(mg)	50.38	68.97	39.69	70.19
Total antioxidant activity( $\mu$ g/g)	168.8	323.5	196.4	284.2

The findings of the study indicated that the tannin content was 8.67 mg per 100gm in the Agathi idli ,18.07 mg per 100 gm in the dosa , 9.82 mg per 100gm in the kozhukattai and 15.90 mg per 100 gm present in the chappathi.

Total polyphenol content was 50.38 mg per 100gm in the Agathi idli,68.97 mg per100 in dosa,39.69 mg per 100 in kozukattai and 70.19 mg per 100 gm present in the chappathi.

Total antioxidant activity content was 168.8 mg per 100gm in the agathi idli, 323.5 mg per100 in dosa,196.4mg per 100 in kozukattai and 284 mg per 100 gm present in the chappathi.

## V.SUMMARY AND CONCLUSION

Plants contain a huge range of active compounds with the most abundant being polyphenols, carotenoids, vitamin, and metals like zinc and selenium which form an integral part of antioxidant systems and reduce cellular damages. In addition fruits and vegetables are often low in fat and therefore dietary sources have been recognized as safe and effective antioxidants. In recent years considerable effort has been directed towards the search for safe antioxidants from natural sources in context to their efficiency and nontoxicity.

Nutraceuticals are natural bioactive , chemical compound that have health promoting , disease promoting or medicinal properties. In recent year, fruits and vegetables receive considerable interest depending on type , number, and mode of action of the different components , so called as “Phytochemicals” , for their presumed role in the prevention of various chronic disease including cancer and cardiovascular diseases .Plants are rich sources of functional dietary micronutrients, fibers and phytochemicals, such as ascorbic acid , carotenoids, and phenolic compounds , that individually , or in combination , may be beneficial for health since they demonstrate antioxidative activity. Polyphenols are the most abundant antioxidants in the diet and Widespread constituents of fruits , vegetables, cereals, dry legumes, chocolate , and beverages such as tea, coffee, or wine.

Among the manathakkali and agathi leaves have been analysed for their antioxidant activity, total polyphenols, and flavonoid content. From historical to modern times, different parts of manathakkali and agathi leaves have been used for different purposes. Manathakkali and agathi leaves are known for their high nutrient composition such as , vitamins A, B6, C, E, calcium , phosphorus , potassium .and oxalic acid.

With this in view, the study entitled “Development and Quality Assessment of Manathakkali and Agathi leaves Incorporated Recipes” was conducted to evaluate the efficacy and acceptance of manathakkali and agthi recipes as a product.

The sample was prepared using manathakkali and agathi leaves and the recipes were formulated and standardized. The most accepted formulation was prepared with spices was then subjected to sensory analysis by thirty semi trained panel members.

The manathakkali and agathi recipes were subjected to analysis phenolic constituents. The nutrient content of both sample were analysed to ascertain the nutrient value of the both samples.

Samples were subjected to qualitative analysis of phytochemical constituents in water, ethanol, methanol, and acetone extracts.

The total tannin content, polyphenolic constituents and antioxidant activity of the food samples were analysed.

### **Sailent finding of the study**

- Sensory analysis revealed that the mean scores for formulations prepared spicy added recipes was found to be higher for the manathakkali recipes when compared to the agathi recipes. The most accepted formulation prepared with spices. The recipes incorporate was 30gm ,50gm,75 gm and 100gm. The formulation containing 75 and 100 grams were also fairly accepted. Dosa, idli ,and chappathi using manathakkali and agathi recipes were also accepted.
- Manathakkali idli contained 261 kilocalories of energy, 60g of carbohydrates, 9g of protein and 1.2 of fat . Calcium,iron and moisture content of idli were 220mg,6 mg,and 27 mg respectively. The crude fiber in the formulated recipes was 4.6 percent.
- Manathakkali dosa contained 359 kilocalories of energy,49.5g of carbohydrates, 7g of protein and 3g of fat. . Calcium,iron and moisture content of dosa were 243mg,5mg,and 22.5 mg respectively. The crude fiber in the formulated recipes was 3 percent.
- Manathakkali kozhukattacontained 285 kilocalories of energy,52g of carbohydrates, 11.5g of protein and 2g of fat. Calcium,iron and moisture content

of kozhukattai were 208mg,6mg,and 9 mg respectively. The crude fiber in the formulated recipes was 2percent.

- Manathakkali chappathi contained 278 kilocalories of energy,65g of carbohydrates, 8 g of protein and 3g of fat. Calcium,iron and moisture content of chappathi were 138mg,6mg,and 9 mg respectively. The crude fiber in the formulated recipes was 2percent.
- Agathi idli contained 352 kilocalories of energy,45g of carbohydrates, 7 g of protein and 2.5g of fat. Calcium,iron and moisture content of idli were 450mg,5.1mg,and 21 mg respectively. The crude fiber in the formulated recipes was 1.7percent.
- Agathi dosa contained 258 kilocalories of energy,48g of carbohydrates, 8.3 g of protein and 4 of fat. Calcium,iron and moisture content of dosa were 375mg,4mg,and 12 mg respectively. The crude fiber in the formulated recipes was 2 percent.
- Agathi kozhukattai contained 275 kilocalories of energy,54g of carbohydrates, 11.2 g of protein and 2g of fat. Calcium,iron and moisture content of kozhukattai were 363mg ,6mg,and 10 mg respectively. The crude fiber in the formulated recipes was 1percent.
- Agathi chappathi contained 249 kilocalories of energy,50g of carbohydrates, 8.8 g of protein and 6g of fat. Calcium,iron and moisture content of kozhukattai were 291mg,3.8mg,and 14 mg respectively. The crude fiber in the formulated recipes was 3percent.
- The alkaloids were found to be present in aqueous extract of manathakkali leaves and it was found to be trace amounts in agathi leaves. In Methanol were found to be present in manathakkali leaves and absent agathi leaves. Ethanol were found to be absence in both leaves. Acetone were found to be presence of manathakkali leaves and absence of agathi leaves. Acetone was found to be present in manathakkali leaves and in moderate amount to be present in agathi leaves.
- Terpenoids were absent in aqueous extract of manathakkali and agathi leaves. Methanol extract was absent of both leaves. Ethanol extract also it was absent

for manathakkali leaves and present in agathi leaves. In Acetone extract it was present in manathakkali leaves and presence of agathi leaves.

- saponins in aqueous extract were present in manathakkali leaves and moderately present in agathi leaves. Methanol were found to be manathakkali leaves and moderate level presence of agathi leaves. Ethanol were found to be presence of manathakkali leaves extract and absence of agathi leaves extract. Acetone were present in manathakkali leaves extract and absence of agathi leaves extract.
- Flavonoids was found in presence of aqueous in manathakkali leaves extract and absence of agathi leaves. Methanol extract was in present in manathakkali extract and moderate level of agathi leaves extract. Ethanol extract was in absent in manathakkali extract and moderate level present in agathi leaves extract. Acetone extract in absent in manathakkali and agathi leaves .
- Phenols were present in all the extracts of the manathakkali and agathi leaves.
- Quantitative analysis revealed that the tannins content was 9.01mg per 100 gm in the manathgakkali idli ,12.77mg per 100 gm in the dosa , 9.58 mg per 100gm in the kozhukattai and 14. 95mg per 100 gm present in the chappathi.
- Total polyphenol content was 39.78 mg per 100gm in the manathakkali idli,32.11 mg per100 in dosa,27.30 mg per 100 in kozukattai and 51.35 mg per 100 gm present in the chappathi.
- Total antioxidant activity content was 322.9 mg per 100gm in the manathakkali idli, 491.6 mg per100 in dosa,240.9 mg per 100 in kozukattai and 531.3 mg per 100 gm present in the chappathi.
- the tannins content was 8.67 mg per 100gm in the Agathi idli ,18.07 mg per 100 gm in the dosa , 9.82 mg per 100gm in the kozhukattai and 15.90 mg per 100 gm present in the chappathi.
- Total polyphenol content was 50.38 mg per 100gm in the Agathi idli,68.97 mg per100 in dosa,39.69 mg per 100 in kozukattai and 70.19 mg per 100 gm present in the chappathi.
- Total antioxidant activity content was 168.8 mg per 100gm in the agathi idli, 323.5 mg per100 in dosa,196.4mg per 100 in kozukattai and 284 mg per 100 gm present in the chappathi.

## **Recommendations**

- Studies on the antioxidant components and its role in prevention of degenerative disease can be carried out.
- Value added products can be developed using manathakkali and agathi leaves.
- Formulated recipes can be used for supplementation and meal replacement .

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## APPENDIX I

### SCORE CARD FOR RECIPES WITH MANATHAKKALI AND AGATHI LEAVES

1.Score Card For Manathakkalli Idli, Dosa, Kozhukattai,Chappathi

NAME;

CLASS;

DATE;

- 9 Like extremely
- 8 Like very much
- 7 Like moderately
- 6 Like slightly
- 5 Neither like nor dislike
- 4 Dislike slightly
- 3 Dislike moderately
- 2 Dislike very much
- 1 Dislike extremely

VARIATION	APPEARENCE	COLOUR	FLAVOUR	TASTE	TEXTURE	OVER ALLACCEPTABILITY
S						
S1						
S2						
S3						
S4						

**SUGGESTION**

2. Score Card for Agathi Idli, Dosa, Kozhukattai,Chappathi

NAME;

CLASS;

DATE;

- 9 Like extremely
- 8 Like very much
- 7 Like moderately
- 6 Like slightly
- 5 Neither like nor dislike
- 4 Dislike slightly
- 3 Dislike moderately
- 2 Dislike very much
- 1 Dislike extremely

VARIATION	APPEARENCE	COLOUR	FLAVOUR	TASTE	TEXTURE	OVER ALLACCEPTABILITY
S						
S1						
S2						
S3						
S4						

**SUGGESTION**

## APPENDIX II

### ESTIMATION FOR NUTRIENT CONTENT OF RECIPES WITH MANATHAKKALI AND AGATHI LEAVES

- 1.) Moisture : Moisture content of the product was determined according to oven method .A sample of 3 mg was accurately weighed into a clean dry petridish and dried in an oven at 100C for 2-3 hrs and cooled in dessicator and weighed till consecutives weights were obtained.

$$\% \text{ Moisture content of the sample} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Sample weight}}$$

- 2.) Ash: Weigh accurately 5g of sample in a clean dry crucible . Complete the ignition by keeping in muffle furnace at 550 C until grey ash results (5-6 hrs).

$$\text{Ash content} = \text{Weight of ash} / \text{weight of the sample} * 100$$

- 3) 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).

- 4.) Protein –micro kjeldhal method

a. Digestion

Weigh 5g of sample and transfer to the digestion tube .Add 10-15 ml of conc.H<sub>2</sub>SO<sub>4</sub> and 5-7 g of digestion activator. Load the digestion tube to the digester and heat the digestion block . The sample turns colorless or light green color at the end of the digestion.

b. Distillation

During distillation the ammonium radical are converted to ammonia under excess alkali condition .After neutralization , acid in the digested sample with 40 % NaOH on heating , the digested sample are heated by passing steam and

ammonia liberated due to addition of 40 % NaOH is dissolved in 4 % in Boric acid .The boric acid containing of ammonia is taken for titration.

c. Titration

Titrate the solution of Boric acid and mixed indicator containing the liberated ammonia against 0.1 N HCl .Determine the titrate value of blank solution of boric acid and mixed indicator.

% of nitrogen present in sample =

$$\frac{(\text{Sample titer value} - \text{blank titer}) * \text{N of HCl} * 14}{\text{Sample weight}} * 100$$

5.) Carbohydrate :Weigh 100 mg of sample and place it in boiling test tube hydrolyze by keeping it in a boiling water bath for 3 hour with 5 ml of 2.5 N HCl and cool to room temperature .Neutralize it with solid Na<sub>2</sub>CO<sub>3</sub> until the effervescence ceases .Make up the volume to 100 ml and then centrifuge . collect the supernatant and take 0.5 ml and 1 ml aliquots. Prepare the standards by taking 0.2-1 ml and run blank simultaneously and make up the volume in all the tubes to 1ml with distilled water .Then add 4 ml of anthrone reagent and heat for 8 min in a boiling water bath .Cool the tubes under tap water and read the absorbance at 630 nm .Draw standard curve by plotting conc. Of standard on X axis and absorbance on Y axis .From the graph calculate the amount of carbohydrate present in the sample tube

$$\text{mg of glucose} = \frac{\text{OD of sample}}{\text{OD of standard}} * \text{concentration of standard}$$

$$\text{Amount of carbohydrate in 100 mg of sample} = \frac{\text{mg of glucose}}{\text{g of sample}} * 100$$

6.) Fat content (soxhlet apparatus)

2gm of powdered sample was weighed accurately into a dry thimble & extracted using petroleum ether ( 60 – 800 c boiling range) as solvent for 3 hours.The fat extract was collected in a previously weighed dry flat bottom

flask and separated from the solvent by evaporating over a hot water bath. The flask was dried in an oven at 80 – 1000 c and cooled till constant weight was obtained.

$$\% \text{ fat present} = \frac{\text{final weight of beaker} - \text{empty weight of beaker}}{\text{sample weight}} * 100$$

#### 7.) Iron

Iron content of samples was determined with ignition or oxidation .Iron as ferric iron reacts with ammonium thiocyanate or with potassium thiocyanate to give ferric thiocyanate which is red in color .The color which is a measure of the concentration is measured colorimetrically at 530-540  $\mu\text{m}$ . (AOAC 2004).

# INSTITUTIONAL HUMAN ETHICS COMMITTEE



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11<sup>th</sup> March 2016

To  
Ms. Gnanadeepika K  
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/15-16/FSN/02 entitled "Development and quality assessment of manathakkali and agathi leaves incorporated recipes" submitted for approval of the IHEC

The Institutional Human Ethics Committee of our University hereby grants approval to your research proposal No. IHEC/15-16/FSN/02 entitled "Development and quality assessment of manathakkali and agathi leaves incorporated recipes" submitted by you. The Approval number for the same is AUW/IHEC/FSN-15-16/XMT-02.

We wish you all the best in your research endeavours.

Regards,

  
Dr. P. R. Padma  
Member Secretary

