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RESEARCH ARTICLE

Standardization and organoleptic evaluation of agathi (*Sesbania grandiflora*) leaves incorporated traditional weaning recipes

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ABSTRACT

For every individual, nutrition is very important to prevent the nutrient deficiencies and to help good growth of infants. To make the availability of nutrient rich food even in lower income families the present study was undertaken to formulate nutrient dense complementary foods for infants with the use of locally available green leafy vegetable which is rich in calcium and iron. In present study fresh agathi leaves was taken cleaned, shade dried and pulverized. Incorporating the agathi leaves powder, 3 different variations of rajma kitchidi, urad dhal kitchidi and sathumavu kanji was made V1(5 gm agathi leaves powder), V2(10 gm agathi leaves powder), V3 (15 gm agathi leaves powder). Sensory quality evaluation was done using 9 point hedonic rating score by a panel of 10 judges. From 3 variations of all 3 recipes the variation - I recorded the highest hedonic value. Acclerated shelf life analysis found product to be microiologically safe for 48 hours in room temperature and 72 hours safe at refrigerated temperature respectively. The study concluded addition of agathi leaves into standard recipe increased the nutrient composition especially calcium and iron content and can also recommended for adult and elderly people to meet their requirements.

Keywords: *Sesbania grandiflora*, Agathi, 9 point hedonic rating scale, sensory analysis, shelf life

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INTRODUCTION

Sesbania grandiflora, referred to as vegetable humming bird or august leaves small loosely branching tree. It is tree which grows during a hot humid climate and thus the tree is usually native to India, Philippines, Malaysia, Indonesia and also widely grown in Mexico, South West USA .The tree survives under full exposure to sunshine and is extremely sensitive (Ramasubramania and Haranadha, 2019). Among the vegetables, green leafy vegetables are a food group which is nutrient rich. Among them, sesbania grandiflora, often described as “A green leaf with curative benefits”, is a relatively unknown plant which is not easily available outside tropical countries. Although agathi trees are mostly distributed in India, it is not so popular among the people. It is cultivated in states like Assam, Bengal, Punjab, Andhra Pradesh and Tamil Nadu (Samja and Aparna, 2013).

Agathi leaves acts as anti-oxidants. All the leaves and whole plant has bunch of medicinal values. If agathi leaves are mixed with the foods it increases the nutrient value which is very useful. Foods enriched with these leaves and the

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chemicals derived from the leaves were found to posess antibacterial, activity. Agathi contains natural antioxidants, which helps in delay or prevention of spoilage of food (Sumana and Aruna, 2017). It is advisable to consume agathi leaves 2 to 3 times in a month (Sinthiya et al., 2017). The phytochemical active ingredients of sesbania leaves have alkaloid, flavanoids, glycosides, tannins, steroids, proteins, carbohydrates, Saponins, amino glycoside, vit. A, C & B complex, Glycoside, coumarines. Both agathi flowers and leaves are filled with lots of vitamins and nutrients including protein, minerals. Sesbania grandiflora are an incredible source of vitamin A, folate, thiamin, niacin, and vitamin C. According to the USDA nutrient database, 100g of agathi leaves contains 12g of carbohydrate, 8g of protein, 1g of fat, 2g of fiber, 1130mg of calcium, 80mg of phosphorus, 4mg of iron, 93 kcal of energy (Karmakar et al., 2016).

Certainly, the leaves are great source of calcium and iron. These nutrients are the main reason for its reputation as a bone strengthener (Gowri and Vasantha, 2010).There are two types of agathi leaves. One variety is white flower and thus the another one has red flower called as red august tree leaves. The most known variety is white flower august tree leaves (Sinthiya et al., 2017).

The agathi taste bitter but it has many health benefits (Ramasubramania and Haranadha, 2019). The flowers are also bitter but the white are less so than the red. It's possible to remove the bitterness by eliminating stamen. The flower's texture is lightly crunchy and fibrous.

Agathi are often classified in to 4 distinct groups, which are sita has white colored flower strain, peeta has yellow colored flower strain, neela which is blue colored flower strain, lohita is rich red colored flower strain. Red and white groups are used as vegetables, while blue and yellow are used in the drugs. Red group is highly nutritious than white which contains higher phenolics compound. White flowers are preferred to red ones as they're less bitter than the red ones (Karmakar et al., 2016).

Different parts of scarlet wisteria are taken in Siddha system of Indian traditional medicine for treatment of ailments including anemia, bronchitis, fever, headache, ophthalmia, nasal catarrh, inflammation, leprosy, gout and rheumatism (Wagh et al., 2009)

These agathi leaves have special benefits due to their impact on physical and cognitive development of the children by formulation of complementary foods by using low cost easily available ingredients. Agathi leaves are the best sources of vitamin A, calcium, iron and phosphorus among all the green leafy vegetables. Agathi is also rich in folate, and vitamin c. Flowers also render ample amounts of magnesium, potassium, and selenium (Janani and Aruna, 2017).

Sesbania grandiflora usually contains high content of total oxalates, tannins and dietary fibers, which disturbs and decrease calcium bioavilability (Amalraj and Anitha, 2014). Leaves are chewed to disinfect the screw cap vials mouth and throat (Kanitta and Wannee, 2015). The primary objective of this study is to determine analytically the amount of nutrients present in the agathi leaves and to formulate the recipes using the agathi leaves powder included in this to prevent the nutritional deficiency in the children.

MATERIALS AND METHODS

Procurement of ingredients

The agathi leaves were brought from local market of nellore .The ingredients selected and used were of high grade and made into powder by shade drying. the other raw ingredients which are needed for creating the recipes are procured from the grocery in needed quantities for creating the recipe. The ingredients were standardized by using measuring cups and

spoons according to the recipe needs. The leaves are cleaned thoroughly under normal running water to make leaves free from dirt &insects. Then cleaned leaves are kept for drying under shade dry to urge obviate moisture present within the leaves. The dried leaves are pulverized employing a mixer jar untill the leaves gets into powder form and stored during a air tight container. 5, 10, and 15 grams of fresh agathi leaves powder are getting to be incorporated into basic recipes identified.

Figure 1. Flow of work

Recipe formulation

Basic local recipes were identified .These recipes was formulated and agathi leaves powder are getting to be added to the essential identified recipes. Three recipes were developed for the weaning group children.

To make sathumavu kanji take 3 table spoon of healthy mix during a sauce pan. Add a glass of water and cook the kanji till it gets thick keep stirring continuously to avoid forming any lumps. Add water if required so as that the kanji gets cooked. When the kanji is cooked, add a cup of milk and convey the kanji to boil. Add sugar or jaggery according to the taste and preference and serve the Kanji hot or cold. For urad dhal kitchidi Wash and soak the dhal into water for overnight or 8 hours. Drain and keep aside. Wash and soak the rice in to water for quarter-hour . Drain and keep aside. Add the ghee during a autoclave add cumin seeds, asafoetida, red chillies, green chillies and ginger. Saute few seconds. Add Rice, dal and salt and blend well. Saute few seconds. Add water and canopy with lid. Cook in autoclave until 3-4 whistles or till it's mashed. Transfer into serving platter and serve hot. for creating of Rajma kitchidi Soak rajma for six hours. during a

autoclave heat oil on medium flame, add cumin seeds, turmeric powder, ginger strips and asofaetida and fry for 1 min. Add whole broken red chilli. Add rajma, salt and a couple of of cups of water and pressure Cook for 5-6 whistles. Then open lid and add rice. Add required water and blend . Close the lid and cook for a further 2-3 whistles until it's mashed. Open the lid and pour melted desi ghee and serve hot.

Sensory evaluation of formulated recipes by consumers

The sensory evaluation was done using the 9-point hedonic scale score card. The rating scale contains nine points and these points are given word description ranging from dislike extremely to like extremely. Three recipes of three different combinations (V1, V2, V3) each mixture was provided for the evaluation. Ten normal healthy individuals also evaluated the sensory attributes for assessing the customer acceptance. The scores for every quality were totalled and averaged

Nutrient analysis of formulated recipes

The finalized product, which scored high in sensory evaluation attributes was subjected to nutrient analysis at labs at Samples was packed in polythene bags and was analyzed for its Energy (Kcal), Carbohydrate (g), Fat (g) Protein (g), and Calcium (mg) fiber (g) iron (g)content. Each of the ingredients was analyzed for its micro and macro nutrient contents and thus the prepared products were stored during a glass container and kept for period of time study in both room and refrigerated temperature for time of 1month for any colour change or microbial detoriation.

Cost analysis

The cost analysis was finished individual ingredient and thus the ultimate product. the worth of each ingredient was analyzed according to the local market. Overall cost of the merchandise was calculated supported the number of ingredients taken for the preparation of recipe.

Statistical analysis

Descriptive analysis was conducted to calculate Mean and variance values for sensory attributes. ANOVA and Kruskal Wallis test was conducted to hunt out significant difference of taste, texture, appearance, flavor, colour, over all acceptability sensory attributes and compared with the variations of the recipes. The values of all the three recipes of three variations which was calculated and compared against each variation in which variation I showed maximum score in every attribute shown and it is significant at $p<0.01$ which is highly significant level at 1%

Inferential statistics

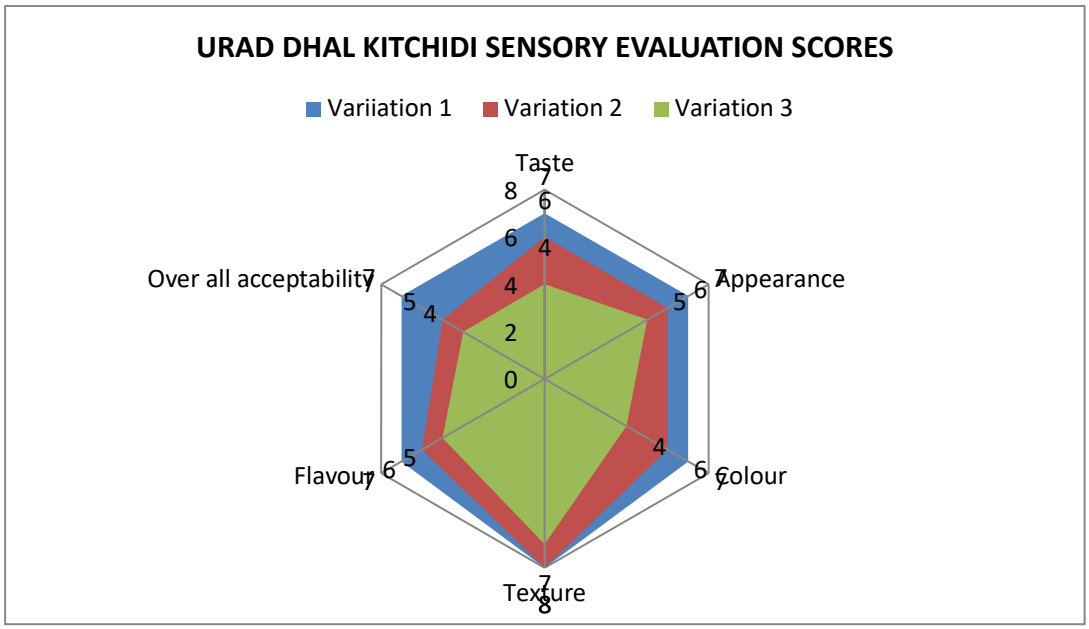
The analysis of the individual attributes of sensory evaluation such as taste, colour and appearance, body, texture and flavor is been listed in the table below

RESULTS AND DISCUSSION

Sensory evaluation studies

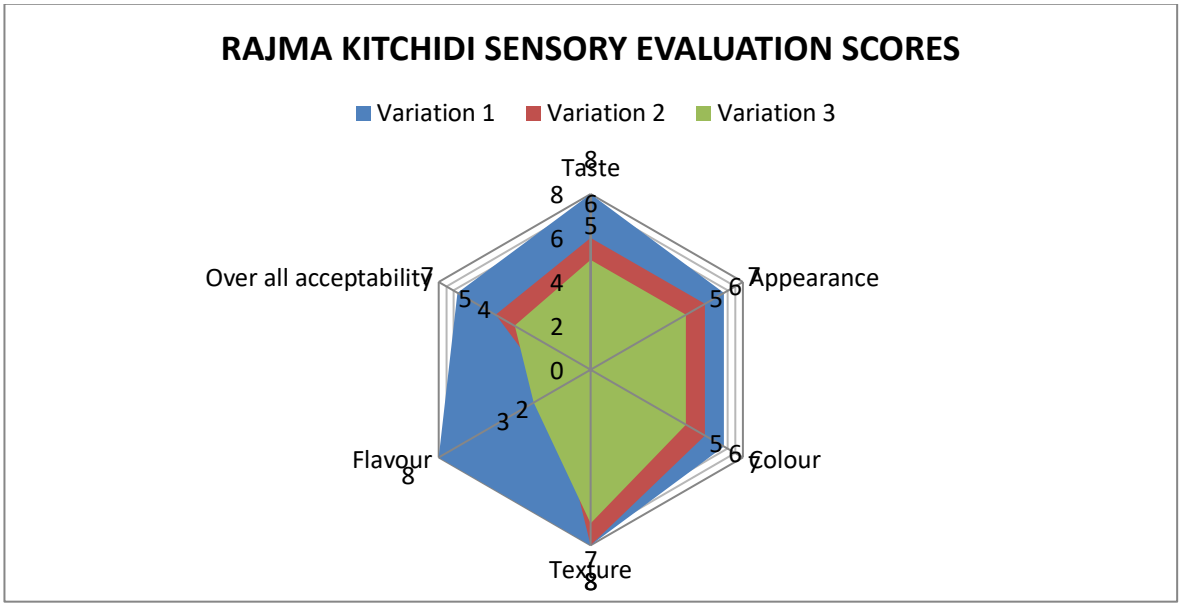
Sensory evaluation was one by using 9 point hedonic scale with a panel of 10 judges and scores of the all the three recipes variation I, II and III has been evaluated and variation I has scored higher in the terms of taste, appearance, colour, flavor, texture and over all acceptability.

Figure 2. Sensory evaluation characteristics of the agathi leaves incorporated urad dhal kitchidi with all three variations



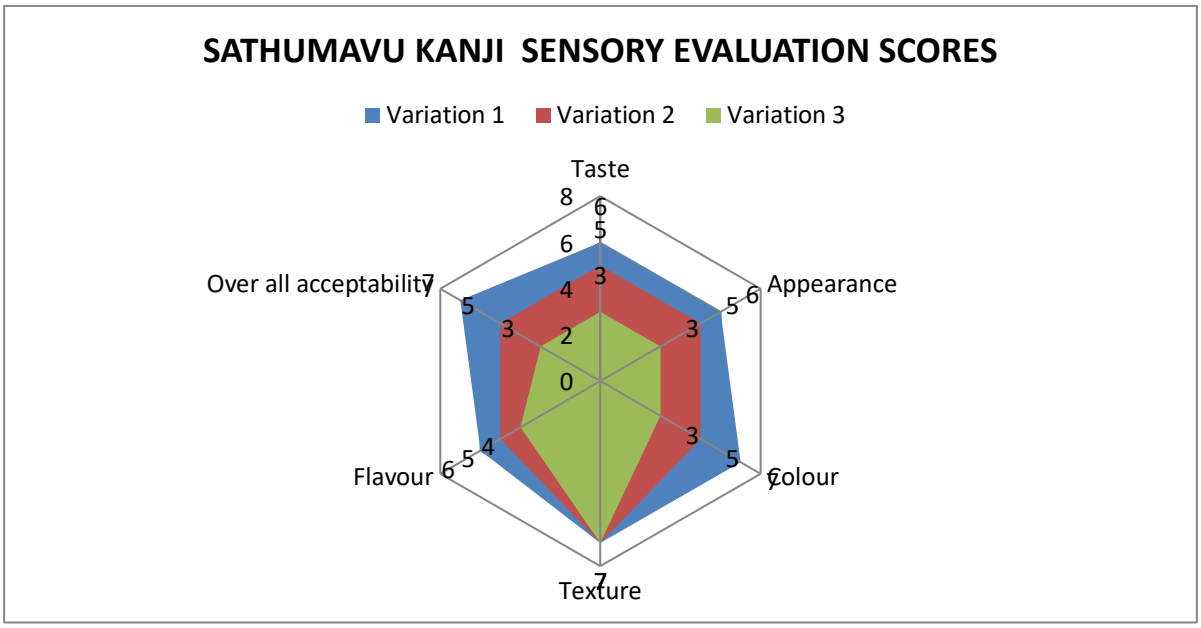
The Figure 2 sensory evaluation scores of the urad dhal kitchidi variation I, II and III has been evaluated and variation I has scored higher in the terms of taste, appearance, colour, flavor, texture and over all acceptability.

Figure 3. Sensory evaluation characteristics of the agathi leaves incorporated rajma kitchidi with all three variations



The Figure 3 sensory evaluation scores of the rajma kitchidi variation I, II and III has been evaluated and variation I has scored higher in the terms of taste, appearance, colour, flavor, texture and over all acceptability.

Figure 4. Sensory evaluation characteristics of the agathi leaves incorporated sathumavu kanji with all three variations



The Figure 4 sensory evaluation scores of the sathumavu kanji variation I, II and III has been evaluated and variation I has scored higher in the terms of taste, appearance, colour, flavor, texture and over all acceptability.

The variation I with 5 grams of agathi leaves powder incorporated into all three basic recipes was finalized scored high in sensory evaluation attributes was subjected to nutrient analysis sample was carefully and hygienically packed in polythene bags and was analyzed for its Energy (Kcal), Carbohydrate (g), Fat (g) Protein (g), and Calcium (mg) fiber (g) iron (g)content.

Table 1 represents the nutrient analysis of the recipes before and after addition of agathi leaves powder incorporated into the recipes. Nutrient analysis of the agathi leaves incorporated recipes showed that there is an increase in energy, protein, carbohydrate, fat, calcium and iron.

Table 1. Nutrient analysis of agathi Leaves incorporated into the recipes

NUTRIENT (Per 100gm)	Sathumavu kanji		Rajma kitchidi		Urad dhal kitchidi	
	Original Recipe nutritive value	Agathi leaves incorporated recipe	Original Recipe nutritive value	Agathi leaves incorporated recipe	Original Recipe nutritive value	Agathi leaves incorporated recipe
Energy (K.Cal)	380	414	230	261	146	196
Carbohydrate (g)	41.5	53.9	30.3	42.3	22.1	24.1
Fat (g)	1.9	3.0	5.67	5.75	4.8	5.4
Protein (g)	0.9	3.1	0.9	1.4	0.86	2.0
Calcium (mg)	79	167.0	45.1	66.8	6	13.0
Iron (mg)	0.36	0.51	2.5	2.8	4.5	5.0
Fiber (g)	8.0	11.0	6.64	7.1	7.14	7.4

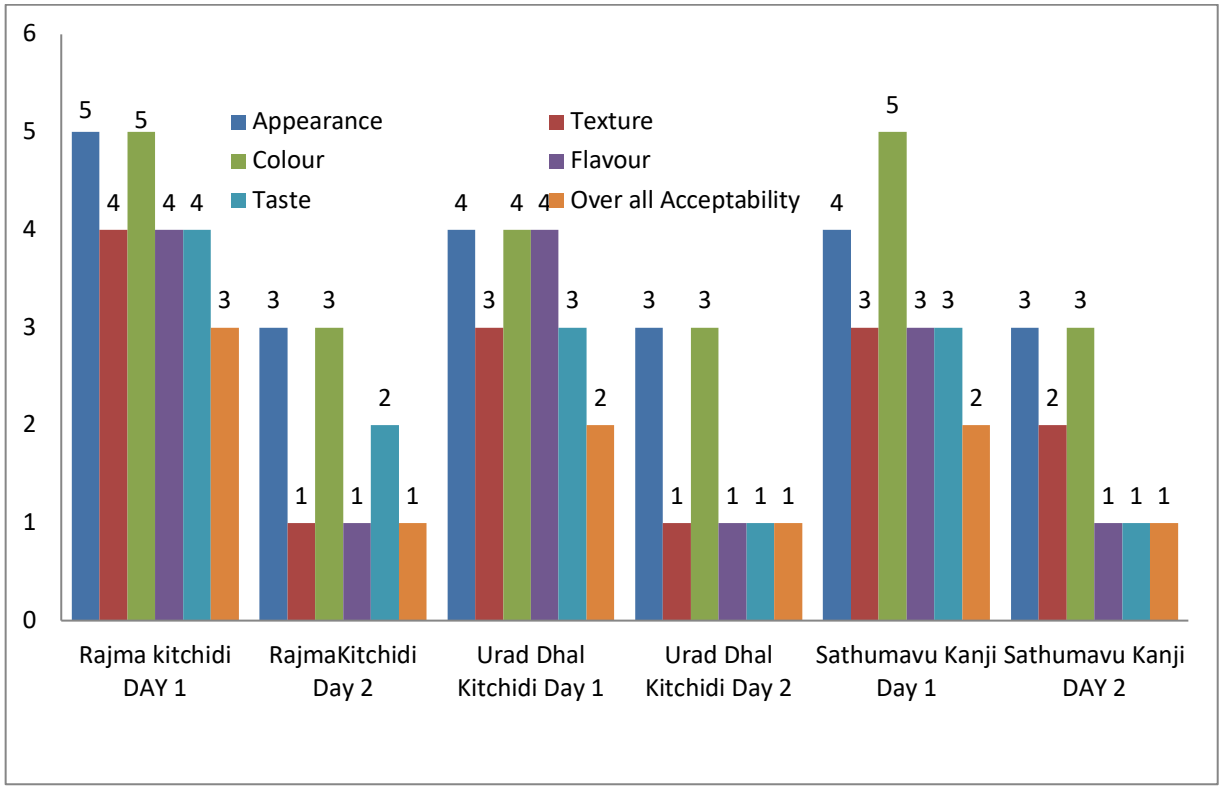
The above table 1 shows that urad dhal kitchidi recipe were analysed for its nutrient content and nutritional composition of agathi leaves powder incorporated urad dhal kitchidi and original recipe was compared where calcium had 7mg, protein had 2gm, iron had 1.14mg and energy had 50kcal, fiber had 0.5g, carbohydrate had 2g and fat had 0.6 gm. increase when compared to original recipe. Rajma kitchidi has compared with original recipe and the agathi leaves incorporated recipe the values were compared where increase of calcium had 21.7mg, protein had 0.43gm, iron had 0.5 mg and energy had 31kcal fiber had 0.3g, carbohydrate had 12g and fat had 0.08 gm.

Sathumavu kanji has compared with original recipe and the agathi leaves incorporated recipe of agathi leaves powder incorporated urad dhal kitchidi and original recipe was compared where calcium had 88mg, protein had 3gm, iron had 1.14mg and energy had 34kcal,fiber had 0.15g, carbohydrate had 12.4g and fat had 1.1 gm increase when compared to original recipe.

SHELF LIFE ANALYSIS OF AGATHI LEAVES INCORPORATED RECIPES

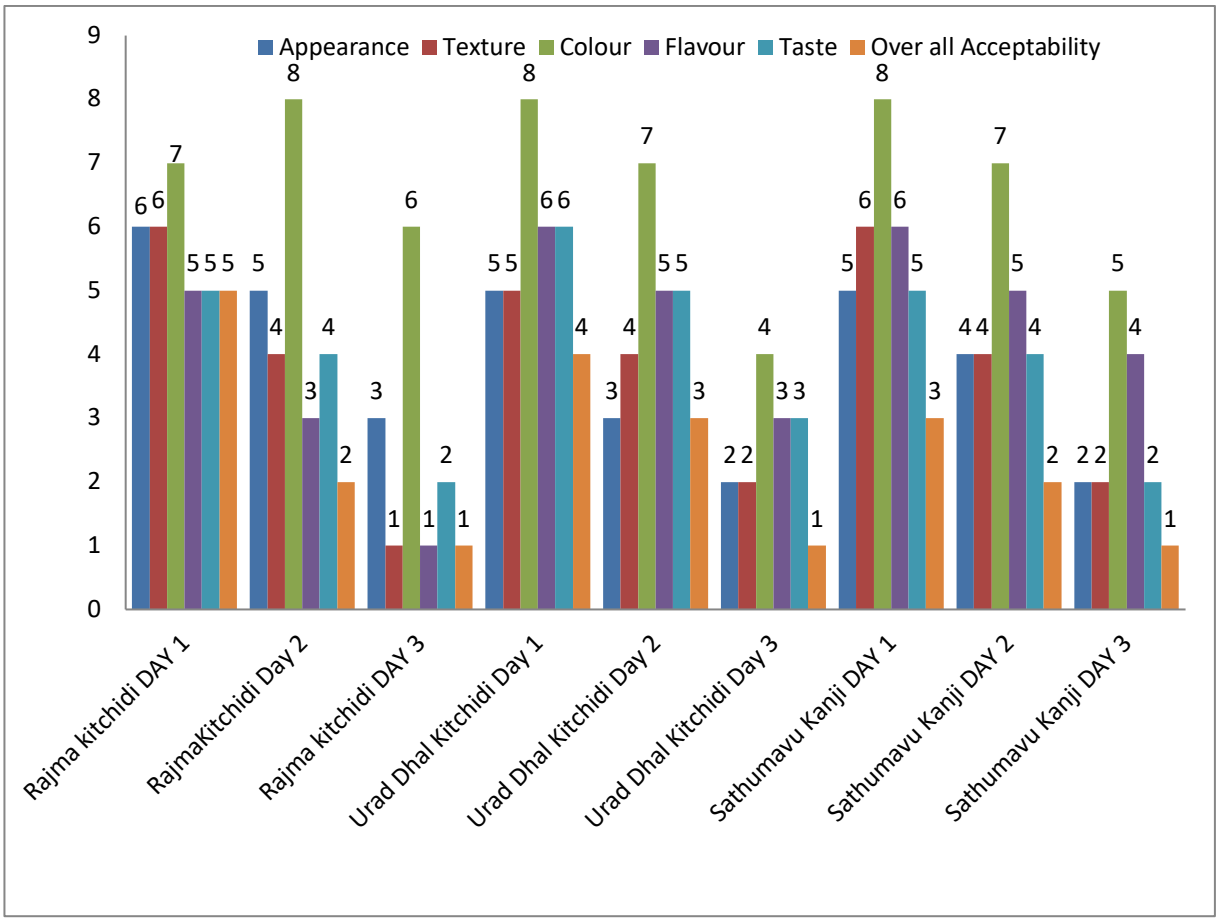
All formulated recipes was kept for the shelf life analysis at room temperature and refrigerated temperature for 1 month of time and changes and the shelf time will be observed.

Figure 5. Shelf Life Analysis of All Formulated Recipes At The room temperature



According to the results of the shelf life analysis, the Figure 5 data showed that the shelf life evaluation of the recipe attributes such as appearance, taste, flavour, texture, odour has decreased in the shelf life. Comparing with the day 1 of the shelf life the day 2 graph depicts that there was a fall in the scores in the each attributes which depicts that the recipes shelf life was 48 hours at room temperature

Figure 6. Shelf Life Analysis of All Formulated Recipes At The Refrigerated Temperature



The Figure 6 shows the graph of shelf life analysis depicts that shelf life evaluation of the refrigerated temperature recipes attributes such as appearance, taste, flavour, texture, odour has decreased in the shelf life. When the results are compared with the day 1 and day 2 the day 3 scores has been fallen notably in the each attributes which depicts that the recipes shelf life was 72 hours

COST ANALYSIS

Cost analysis was done for the product based on the cost of the raw ingredients available in the local markets.

Table 2. Cost Analysis of The Recipes

RECIPES	Total Cost (Rs)
Urad Dhal Kitchidi	25.1 Rupees
Rajma Kitchidi	29.6 Rupees
Sathumavu Kitchidi	13.6 Rupees

The table 2 shows that cost analysis was done to know how expensive or non expensive to make the particular nutrient rich recipe at the home and according on the prices in the local market each and every single ingredient added to prepare each recipe is calculated on the basis of the amount taken or needed for preparation of 100g of the recipe. Sathumavu kanji recipe has been resulted as the lowest price which is very budget friendly to every individuals and also nutritional rich recipe with low cost can be done in home itself and also rich in nutrients and also the cost than compared to ready made or ready to make foods available in the market. The rajma kitchidi has resulted as the high cost recipe in the all three recipes made. Even though the cost is little expensive its more nutritious and it is very healthy to babies.

CONCLUSION

From the above study it can be concluded that agathi leaves have been reported to have high contents of calcium and iron also exhibit many health benefits. The agathi leaves incorporated weaning recipes were nutritionally rich with good sensory attributes and overall acceptability. In addition, the results of this study indicate agathi can be considered as a potential ingredient for food products, increasing their content of calcium, iron and fiber content to an extent respectively. Hence, development and utilization of such ingredients can be used to improve the nutritional status of the child as well as to overcome nutritional deficiencies and non-communicable diseases.

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