

Research Article

Formulation, Standardization and Nutritional Analysis of Beverage and Chutney recipes using *Cassia auriculata*

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Abstract— In this study, the effects of *Cassia auriculata*, a herb, on the formation, standardization, and nutritional analysis (Macro and Micro nutrients) of beverage and chutney recipes were investigated. The flowers, buds, and leaves of the herb exhibited the highest antioxidant activity due to their elevated phenolic and flavonoids content. The aqueous shade-dried powder from the leaves, flowers, and buds was used in the preparation of the beverage mix and chutney mix, which were formulated and standardized using natural preservatives. The edible flowers, buds, and leaves were found to be non-toxic and innocuous, with potential health benefits when consumed in the human diet. The prepared beverage mix and chutney mix were subjected to nutritional analysis, and the organoleptic evaluation by a panel of semi-trained participants showed encouraging acceptability for up to 120 days of storage at room temperature. This study demonstrates the feasibility of utilizing *Cassia auriculata* as a natural ingredient in the development of shelf-stable and nutritionally-rich beverage and chutney mixes, without the addition of artificial preservatives or flavours. This diversity in formulations also opens avenues for innovative culinary applications and commercial product development, potentially expanding the plant's consumption. Incorporating this ethno medicinal herb into your regular diet, either as a drink or in a recipe, may help to revitalize your body's overall system.

Keywords —*Cassia auriculata*, formulation, beverage and chutney recipes, nutrition analysis and organoleptic evaluation

1. Introduction

Cassia auriculata, also known as "Tanners Senna" or "Avarampoo" in Tamil, is a traditional medicinal plant that has been utilized to manage various health conditions, such as diabetes, skin ailments, dysentery, asthma, rheumatism, and metabolic disorders [1]. The nutraceuticals present in medicinal plants offer a range of health benefits when consumed as part of the human diet. Plant-based nutraceuticals have gained increasing attention and awareness worldwide due to their preventative and immunomodulatory properties, in addition to their therapeutic and medical uses [2].

The purpose of the current study is to investigate the potential health advantages of the nutrients provided by *Cassia auriculata* and to develop dietary formulations that can be easily incorporated into regular recipes. The aim is to create formulations that can improve the overall nutritional content of food products while also appealing to a broader demographic. Specifically, this study evaluates the nutritional analysis (Macro and Micro nutrients) of food products, such as beverage mixes and chutney mixes, made from the leaves, buds, and flowers of *Cassia auriculata*.

The motivation for this study stems from the growing interest in plant-based nutraceuticals and the potential of *Cassia auriculata* to offer various health benefits. Previous research has highlighted the medicinal properties of this herb, but there is a need to explore its potential in developing functional food products [1,3,4,5&6]. The current study aims to address this research gap by formulating, standardizing, and analysing the nutritional characteristics of *Cassia auriculata*-based beverage and chutney mixes.

The necessity of the proposed work lies in the potential to provide consumers with a convenient and accessible way to incorporate the health-promoting properties of *Cassia auriculata* into their regular diet. By developing shelf-stable and nutritionally-rich food products, this study can contribute to the growing trend of incorporating ethno medicinal herbs and plant-based nutraceuticals into everyday foods and beverages [7,8,9&10].

2. Related works

Objectives:

- To formulate and standardize the indigenous ethno medicinal plant, *Cassia auriculata* into special dietary

formulations like beverage powder, and chutney mix recipes using the *Cassia auriculata* powder and evaluate the nutritive values (Macro & Micro nutrients) of the prepared products.

- To record the organoleptic evaluation and consumer feedback survey for both uncooked formulations and the cooked recipes.

Review of Literature

There are numerous health benefits of *C.auriculata* especially it is widely used for its antidiabetic/antihyperglycemic effect. Based on the available literature all the plant parts of *C.auriculata* possess components of health promotion and disease prevention. It is included in diet for this reason in different forms.

Study by Jayasekara *et al*, standardized a porridge formulation of *C.auriculata*. This porridge mixture was made from the leaves of *C.auriculata* which were dehydrated to attain 6% of moisture content. It was then ground and sifted and the powder was prepared into 2 types of porridge mixture, with and without coconut powder. The study revealed that instant *C.auriculata* porridge mixture possessed acceptable organoleptic and antidiabetic property [11].

Another formulation of beverage powder using the flowers of *C.auriculata* was made. Blanched flowers were strained and cabinet dried and powdered later. The flower powder was mixed with other ingredients like tulasi powder, dried ginger, ellaichi, cinnamon, jaggery and lemon to prepare the beverage powder. Beverage powder with each ingredient was prepared in 3 different ratios (1:1, 2:1 and 3:1) of the flower powder with the ingredient. Out of these 18 formulations, beverage powder prepared in 1:1 ratio was reported to be superior Organoleptic scores than others and also commercially available green beverage [12].

The herbal buttermilk using *C.auriculata* leaves, flowers and seeds was formulated. The mentioned parts were taken in equal quantity and powdered which was then soaked in distilled water (1:10). The solution was then centrifuged to obtain the aqueous extract of the herb. The herbal extract was mixed with buttermilk in three different percentages (1%, 3% & 5%) for further physicochemical analysis and organoleptic evaluation [13].

Another interesting study of incorporating *C.auriculata* plant extract in palmyrah jaggery was done. Palmyrah jaggery is a natural sweetener that has low glycemic index and can be used by diabetic patients. Various parts of the *C.auriculata* plants were collected (leaves, bark, root, flower, fruit) shade and oven dried and then ground to coarse powder to make decoction from the same. The aqueous extract was mixed with palmyrah sap in two different quantities (10mL and 30mL). Jaggery incorporated with 30ml decoction exhibited significantly phenolic content, flavonoid, catechin content contributing to the antioxidant property. The study suggested that jaggery incorporated with *C.auriculata* extract can be used by diabetic patients as natural sweeteners [14].

This study focus to incorporate *Cassia auriculata* leaves, flowers and buds as a major ingredient to formulate and standardize the indigenous ethno medicinal plant, *Cassia auriculata* into special dietary formulations like beverage powder, and chutney mix recipes and evaluate the nutritive values (Macro & Micro nutrients) of the prepared products and then record the Organoleptic evaluation for both uncooked formulations and the cooked recipes. Including this ethno medicinal herb in your daily diet, as a beverage or as a recipe, can help your body's systems function more efficiently.

3. Material and Methods

Cassia auriculata leaves, buds, and flowers were harvested from a disease and pest-free location in Urmelalagian village, Tenkasi, Tamil Nadu. After washing and draining, the raw materials were weighed in a 70:30 ratio (leaves to buds & flowers were showed in figure 1) and shade-dried in a controlled environment (25°C-28°C, 40% humidity) within a designated room. Finally, the dried samples were ground into a fine powder using a stainless-steel mixer and sieved for uniformity. The shade dried *Cassia auriculata* powder were used for recipes preparation.



Figure 1. *Cassia auriculata*

3.1 Preparation of standardized special diet formulation products

3.1.1 Preparation of standardised special diet products

The special dietary products prepared from the shade dried *Cassia auriculata* powder were beverage mix, and chutney mix.

The proportion of the *Cassia auriculata* powder with other ingredients that were used to prepare the dietary products is listed in the following table and the method of preparing the products are elaborated.

3.2 Formulation & Standardization of beverage mix:

The *Cassia auriculata* beverage powder boasts a synergistic blend of beneficial components. The ingredients and measurements used for *Cassia auriculata* beverage preparation was showed in the table 1. Holy basil and neem leaves undergo a thorough cleaning process using a 2% saltwater solution to remove impurities. Following air drying for a week at room temperature, all three ingredients – holy basil, neem, and *Cassia auriculata* – are individually ground

into a fine powder. These powders are then meticulously combined in a specific 1:2:7 ratio (neem:holy basil:*Cassia auriculata*), ensuring a consistent mixture through mixing with a dry spoon. Finally, the powder is sealed in an airtight container to preserve freshness and prevent moisture absorption.

Table 1. Ingredients for *Cassia auriculata* beverage mix

S. No.	Ingredients	Quantity
1	<i>Cassia auriculata</i> – flowers, buds and leaves dry powder	70 g
2	<i>Ocimum tenuifloru</i> (Holy basil) dry powder - Flavouring agent	20 g
3	<i>Azadirachta indica</i> (Neem leaves) dry powder – Natural Preservative	10 g

3.2.1 Preparation of beverage powder:

- Holy basil leaves and neem leaves were washed thoroughly in 2% of salt water.
- It was drained and allowed to dry in room temperature for 7 days.
- The dried cassia powder was taken 70g, holy basil leaves and neem leaves were pulverized separately (20g) and 10g respectively.
- The *Cassia auriculata* powder (70g), holy basil leaves and neem leaves powder were mixed thoroughly using dry spoon and stored in an air tight container.

3.3 Formulation & Standardization of chutney mix:

The ingredients and measurements used for *Cassia auriculata* chutney preparation was showed in the table 2. This flavourful chutney mix is prepared by dry-roasting ginger, chilli, urad dal, mint, and coriander leaves separately for ten minutes in a skillet. Once cooled, all ingredients are ground with tamarind in a mixer jar for a fine consistency. Salt and cassia powder are then added and thoroughly mixed with a dry spoon before storing in an airtight container for optimal freshness.

Table 2. Ingredients for *Cassia auriculata* Chutney Mix

S.No.	Ingredients	Quantities
1	Dried Cassia flower, buds & leaves powder	60 g
2	Urad dal	5 g
3	Dry Chillies	5 g
4	Salt	5 g
5	Ginger	4 g
6	Oil	3 g
7	Mustard seeds	1 g
8	Asafoetida	1 g
9	Curry leaves	1 g
10	Mint leaves	2 g
11	Coriander leaves	2 g
12	Tamarind	10 g

3.3.1 Preparation of chutney:

- Ginger (4g), dry chilly (5g), urad dal (5g), mint leaves (2g), coriander leaves (2g) and Cassia powder were roasted in a vessel with oil.
- The roasted ingredients with tamarind (10g) and salt were pulverized in the mixer jar.

- The mustard seeds, curry leaves and asafoetida were added in a vessel with oil and then the ground paste was added to it and cooked for 10 mins.

3.4 Nutritional analysis (Macro & Micro nutrient) of the special dietary products (instant mix)

The 100-gram samples of *Cassia auriculata* beverage mix (T1) and chutney mix (T2) were packaged in labeled polythene pouches for nutritional analysis. The samples, designated for special diets, underwent macronutrient and micronutrient testing at the Food Quality Testing Laboratory, Tamil Nadu Agricultural University, Coimbatore.

3.5 Cooked recipes using the specially formulated products

3.5.1 *Cassia auriculata* beverage: Take water of 200ml and allow to boil, then 3grams of *Cassia auriculata* beverage mix was added and all to boil for 5-7 minutes. The beverage was then drained and served after adding 4 drops of lime juice in it. The cooked *Cassia auriculata* beverage was shown in Figure 2.



Figure 2. Cooked *Cassia auriculata* beverage

3.5.2 *Cassia auriculata* Chutney:

Add oil to the vessel, then mustard seeds and curry leaves were seasoned in oil for flavour in a pan to which 15 grams of chutney mix powder was added along with 5 ml of water and cook it for 5 mins. It can be used as a side dish for main food like idly, rice, chapatti, dosa, etc. The cooked *Cassia auriculata* chutney was shown in Figure 3.



Figure 3. Cooked *Cassia auriculata* Chutney

4. Results and Discussion

4.1 Nutritional analysis of *Cassia auriculata* dietary products:

4.1.1 Macronutrient analysis of *Cassia auriculata* dietary products

Table 3. Macronutrient analysis of *Cassia auriculata* dietary products

S.No	Parameter	Dietary Product		Method of Analysis
		Beverage Mix T1	Chutney Mix T2	
1	Protein (%)	27.22	10.92	Kjeldahl method
2	Fat (%)	2.05	2.01	Soxhlet method
3	Crude Fiber %	14.15	12.24	Fibra plus method
4	Calorific value (kcal/100g)	353.09	324.81	DGHS method
5	Tannins (mg/100g)	2167	1834.64	Biochemical method 2nd Edn. 1996
6	Ash (%)	6.22	11.72	AOAC, 21st Edition 2019, Method 923.03

The macronutrient analysis of the *Cassia auriculata*-based dietary products, namely the beverage mix (T1) and chutney mix (T2), revealed interesting findings. As shown in Table 3, the beverage mix had a higher protein content of 27.22% compared to the chutney mix, which had 10.92% protein. The Kjeldahl method was employed to determine the protein content in both formulations.

The fat content in the beverage mix and chutney mix was found to be 2.05% and 2.01%, respectively, as analysed using the Soxhlet method. The crude fiber content was also evaluated, with the beverage mix having 14.15% and the chutney mix containing 12.24% crude fiber, as determined by the Fibra plus method. The calorific value of the beverage mix was higher at 353.09 kcal/100g compared to the chutney mix, which had a calorific value of 324.81 kcal/100g, as per the DGHS method. Interestingly, the tannin content was significantly higher in the beverage mix (2167 mg/100g) compared to the chutney mix (1834.64 mg/100g), as analysed using the biochemical method. The ash content, which is an indicator of the mineral content, was found to be 6.22% in the beverage mix and 11.72% in the chutney mix, as determined by the AOAC method. These findings suggest that the *Cassia auriculata*-based dietary products, particularly the beverage mix, are rich in macronutrients, including protein, fiber, and tannins. The higher protein and tannin content in the beverage mix may be attributed to the specific processing and formulation techniques employed.

The variations in the macronutrient profiles between the beverage mix and chutney mix can be attributed to the different processing methods and the ratio of the plant parts (leaves, buds, and flowers) used in each formulation. The results of this study indicate the potential of *Cassia auriculata* as a valuable source of nutraceuticals and its ability to

enhance the nutritional profile of food products. The development of these dietary formulations provides consumers with a convenient way to incorporate the health-promoting properties of this medicinal herb into their regular diet.

4.1.2 Micronutrient analysis of *Cassia auriculata* dietary products

Table 4. Micronutrient analysis of *Cassia auriculata* dietary products

S.No	Parameter	Dietary Product		Method of Analysis
		Beverage Mix T1	Chutney Mix T2	
1	Calcium (mg/kg)	2210.99	1691.23	ICP-OES Method
2	Iron (mg/kg)	159.67	115.17	
3	Sodium (mg/kg)	692.60	33913.83	
4	Potassium (mg/kg)	8670.19	7722.16	
5	Zinc (mg/kg)	17.74	16.06	
6	Lead (mg/kg)	0.73	1.15	
7	Manganese (mg/kg)	57.27	42.72	
8	Nickel (mg/kg)	2.40	2.30	
9	Copper (mg/kg)	7.09	7.05	
10	Molybdenum (mg/kg)	0.15	0.13	
11	Magnesium (mg/kg)	1596.25	2219.25	
12	Boron (mg/kg)	27.36	22.75	
13	Chromium (mg/kg)	1.31	1.77	

The in-depth analysis of the micronutrient nutrient of the *Cassia auriculata*-based dietary products, namely the beverage mix (T1) and chutney mix (T2), provided valuable insights. As shown in Table 4, the micro nutrient analysis revealed significant differences between the two formulations. The beverage mix exhibited a higher calcium content of 2210.99 mg/kg compared to the chutney mix, which had 1691.23 mg/kg. Similarly, the iron content was also higher in the beverage mix (159.67 mg/kg) than in the chutney mix (115.17 mg/kg). These findings suggest that the beverage mix may be a more potent source of these essential minerals. Interestingly, the sodium content was dramatically higher in the chutney mix (33913.83 mg/kg) compared to the beverage mix (692.60 mg/kg). This can be attributed to the addition of salt as a key ingredient in the chutney mix formulation. In contrast, the potassium content was higher in the beverage mix (8670.19 mg/kg) than in the chutney mix (7722.16 mg/kg). The zinc content was also higher in the beverage mix (17.74 mg/kg) compared to the chutney mix (16.06 mg/kg). However, the lead content was slightly higher in the chutney mix (1.15 mg/kg) than in the beverage mix (0.73 mg/kg), though both values were within the acceptable limits.

Regarding other trace minerals, the beverage mix showed higher levels of manganese (57.27 mg/kg), nickel (2.40 mg/kg), and boron (27.36 mg/kg), while the chutney mix had higher levels of magnesium (2219.25 mg/kg) and chromium (1.77 mg/kg). These findings suggest that the *Cassia auriculata*-based dietary products, particularly the beverage mix, are rich in a diverse array of essential minerals. The variations in the mineral profiles between the beverage mix and chutney mix can be attributed to the differences in the processing methods, the ratio of plant parts used, and the addition of other ingredients in the respective formulations.

The high mineral content, especially the elevated levels of calcium, iron, and potassium, in the *Cassia auriculata*-based dietary products highlights their potential to contribute to the overall nutritional well-being of consumers. These results further reinforce the versatility of this ethno medicinal herb and its ability to enhance the nutritional value of food products.

4.2 Sensory Evaluation of Uncooked and Cooked recipes:

The 9-point hedonic scale is a widely used method in organoleptic evaluation to assess and quantify individuals' subjective responses to a product's overall liking or preference. It allows consumers to express their feelings toward a particular item, often a food product, on a scale ranging from 1 to 9. Each point on the scale represents a specific level of liking or disliking, and the scale is typically anchored with verbal descriptors to guide the participants in their evaluation. Minimum score '1' is intensely disliked, and there may be a strong aversion to its Organoleptic characteristics. Maximum score of '9' is liked intensely, and there is a strong preference for its Organoleptic attributes. This score represents the highest level of liking. Other similar studies have used hedonic scale as a standard for Organoleptic evaluation [15].

4.2.1 Sensory Evaluation Score of Uncooked Recipe:

Table 5: Sensory Evaluation Score of Uncooked Recipe

25 Samples	Beverage overall score	Chutney overall score
Mean	7.13	7.04
Non parametric test - Freidman test (Equivalent to one-way ANOVA); p-value= 0.5613		

In Table 5 & Figure 4, from the 25 semi trained panellists organoleptic evaluation scores shows the overall scores of two different food mix samples namely beverage mix and chutney mix.

The mean scores indicate the average perception of each sample. The beverage mix has an average score of 7.13, and the chutney score 7.04.

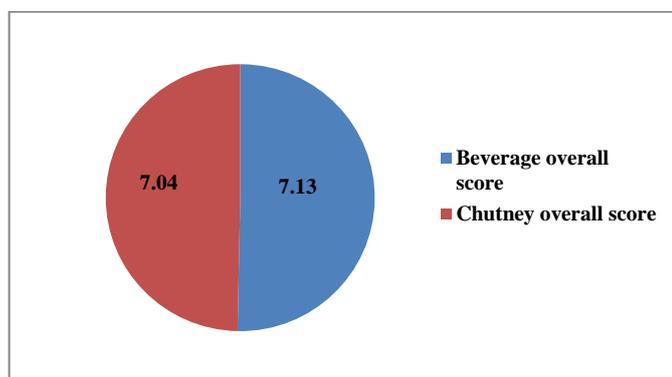


Figure 4. Mean Sensory Evaluation Score of Uncooked Recipe

To assess the statistical significance of the differences in scores among the samples, a non-parametric Freidman test was conducted. The analysis proves that the participants' preferences for beverage mix, and chutney mix were not

significantly different (p-value = 0.5613). This showed that the acceptance of two recipes were similar.

In summary, the statistical analysis indicates that the observed differences in scores are not statistically significant. It's important to consider that individual preferences and variations may exist within the sample population, and the results highlight a degree of similarity in the overall liking of the two different food samples.

3.2.2 Sensory Evaluation Score of Cooked Recipe:

The table 6 and Figure 5, presents from the 25 semi trained panellists organoleptic overall evaluation scores of two different cooked recipes (beverage, and chutney). The mean score of beverage mix and chutney mix are 8.14 and 8.4 respectively.

Table 6: Sensory Evaluation Score of Cooked Recipe

25 Samples	Beverage overall score	Chutney overall score
Mean	8.14	8.4
Non parametric test - Freidman test (Equivalent to one way ANOVA); p-value = 0.8140		

These mean scores suggest that, on average, the participants rated chutney the highest, followed closely by beverage mix. To assess the statistical significance of the differences in scores among the samples, a non-parametric Friedman test was conducted. The p-value obtained from the test is 0.8140 is substantially greater than the significance value of 0.05.

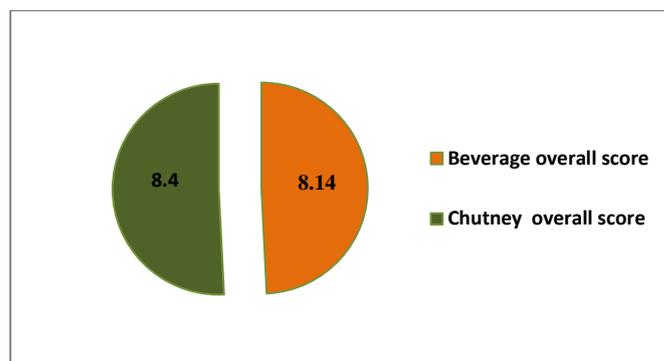


Figure 5. Mean Sensory Evaluation Score of Cooked Recipe

5. Conclusion

This study demonstrates the potential of *Cassia auriculata*, a traditional medicinal herb, in the development of value-added food products. The beverage mix (T1) and chutney mix (T2) formulated from the leaves, buds, and flowers of *Cassia auriculata* were found used as a major ingredient and safe for consumption without the addition of any chemical preservatives for up to 120 days of storage.

The comprehensive nutritional analysis revealed that the beverage mix (T1) stands out for its high protein (27.22%) and crude fiber (14.15%) content, while the chutney mix (T2) boasts a rich mineral profile. The elevated levels of essential minerals, such as calcium, iron, and potassium, in these *Cassia auriculata*-based products highlight their ability to contribute to the overall nutritional well-being of consumers.

These results underline the importance of evaluating the mineral compositions of food combinations when making informed dietary choices.

Notably, the sensory evaluation by semi-trained panellists confirmed the acceptability of these products for up to 120 days, indicating their potential for long-term shelf stability. Furthermore, these *Cassia auriculata*-based food products are affordable and accessible, making them suitable for various socioeconomic groups, including those with non-communicable diseases. The development of these nutritionally-dense and shelf-stable formulations can provide consumers with a convenient way to incorporate the health-promoting properties of this medicinal herb into their regular diet, thereby contributing to improved overall health and well-being.

The Organoleptic evaluation underscored the palatability of *Cassia auriculata* based products, a key factor influencing their potential adoption into regular diets. The products prepared from *Cassia auriculata* based recipes in two forms namely beverage mix and chutney mix can help in increasing the overall consumption of *Cassia auriculata* for health benefits. This diversity in formulations also opens avenues for innovative culinary applications and commercial product development, potentially expanding the plant's consumption. Encourage policies that promote the consumption of traditional foods like *Cassia auriculata*, emphasizing their nutritional richness. Support awareness programs highlighting the health benefits of incorporating such foods into daily diets.

Declarations

The authors accept the transfer of rights for worldwide publication of the research article.

Data Availability

The datasets and materials used in this study are available upon request to the corresponding author.

Conflicts of Interest

The authors declare that they have no conflicts of interest or competing interests that could have influenced the conduct or reporting of this research.

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The authors did not receive any financial support.

Authors' Contributions

Author-1 Conceptualization, methodology, and data curation. Designed the study, collected and analysed the data, conducted experiments, created figures, visualized the data, and contributed to the interpretation of the results.

Author-2 Writing – revised and editing. Revised the manuscript for important intellectual content, grammar, and formatting. All authors reviewed the manuscript.

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Served in Association for Integrated Rural Development (AIRD) as Nutrition and Health Educator from 2nd June 2011 to 3rd December 2013 (2 years) in Valliyoor, Tirunelveli District, Tamilnadu. Acted as a Project Coordinator in Pondicherry Science Forum (Non Govt. Organisation) from July 2004 to June 2009, as a Dietician, Health Educator & Social Worker in two Projects and furthermore served in Aravind Eye Hospital, Thavalakuppam, Puducherry as a Nutritionist cum Medical Social Worker from June 2004 to June 2005 (1 year). The Project named INDEYE, which is on Age related Macular Degeneration of the Eye for the Elderly population (60+ years).

Published ten research publications in National and International journals with NAAS rated and UGC care listed. Authored five books/chapters with ISBN numbers and delivered two research papers at National & International seminars and conferences. Five food product recipes were submitted to the Indian Patent Office in an application for patent. Published more than thirty well-received articles in newspapers and publications. Given a door interview with Door Darshan Pothigai and a live cooking demonstration for Makkal TV and Sun TV on wholesome cuisine, food processing, and value-adding as a means of generating revenue for the farming community. Awarded as "Singapen" and "Arumthamizh Tharagai" for Outstanding Nutrition Educator, Gifted Individual, and Social Worker.

Dr. V. Raji Sugumar, PhD., Currently working as a Principal of Bharathidasan Govt. College for Women, Puducherry. Worked as a Associate Professor & Head in PG & Research Dept. of Home Science. Has 35 years of Teaching and Research Experiences. Areas of specialization / interest are Extension Education, Inter-disciplinary Studies- Community health & Nutrition, Social Psychology, Ethnographic Studies, Gender Studies, Consumerism. Published more than 40 research papers in reputed journals, paper presented 6 research papers in International and National seminar/conference.



Served as a member of Board of Studies/ examinership for UG & PG courses in Home Science –Pondicherry University, Thiruvalluvar University, contributed towards redesigning curriculum suitable for contemporary days. M.Sc. in Clinical Nutrition- BoS member in MG College of Medicine-Sri Balaji Vidyapeeth.

Adjudication member for evaluating PhD thesis – Behrampur University, Orissa; Kerala University, Trivandrum; Gandhigram University, TN; Bharathidasan University, Coimbatore; Madras University, Chennai. Member of Advisory Board, FoodSci: Indian Journal of Research in Food Science and Nutrition- 2018. Member of various college level forum like Examination, Autonomous, NAAC, Research Committee, Member Secretary of Academic Council etc., College nodal officer for the All India Survey on Higher Education, (AISHE) MHRD, New Delhi ; Project implementation committee member- RUSA-College level (From 2014-19). As Principal in-charge at AGCW, Karaikal for a month (1st Dec 2017-31st Dec. 2017).