DEVELOPMENT AND EVALUATION OF VALUE ADDED FOOD PRODUCTS USING TENDER LEAVES AND SEED KERNEL OF TAMARIND (Tamarindus indicaL.)

Shaza Fathima[1], Dr. Annie Ninan[2]

Abstract

Tamarind (Tamarindus indica.L) is an important multipurpose tropical fruit tree found in most of the tropical regions. The medicinal value of tamarind is remarkable besides the nutritional values. The fruit pulp extract, leaf extract and seed kernels have high antioxidant activity and phenolic content. The fruit pulp is locally used in dishes whereas the seeds and leaves are wasted mostly. The present study was undertaken to conserve the potential health benefits of tamarind seed kernel and leaves by the development of value added products. A soup mix incorporating dried tamarind leaves and cookies from tamarind seed kernel were developed from different variations of the same product. The raw materials were collected and processed to prepare the kernel and leaf powder. Value added products were developed and evaluated. Organoleptic evaluation, nutrient analysis and shelf life evaluation were carried out. The result indicates that tamarind seed kernel cookies and soup mix had a higher content of protein in comparison to the controlled cookie. The sensory examination shows that the soup mix could be stored for two months without any change. The products formed were palatable and easy to prepare and could add variety to the menu besides its nutritional and medicinal benefits. Therefore incorporation of tamarind and its products in food and their consumption can be encouraged among people since the raw materials are widely available. Thus it has also great potential to be exploited in the food processing industries.

Key Words: *Tamarind, Seed, kernel, nutrients, processed.*

Introduction

Food innovation is the developmental and production process of new food products.These provide variety and produce more nutritious food products. Innovative food products are also being considered as an alternative for certain food products. The combination of new ingredients and new methods of production give access to new flavour profiles and with better storage those flavours can be preserved.

Tamarindus (Tamarindus indica L) belongs to the family Leguminosae, commonly known as Tamarind Tree, is one of the fruit tree species that is used as traditional medicine. Tamarind is a tropical fruit used in many dishes around the world. Tamarind has played an important role in traditional medicine. Different parts of tamarind are recognized for their various medicinal properties.. The seed, leaf fruit pulp and skin extracts of tamarind possess high phenolic content and antioxidant activities. Leaves are a fair source of vitamin C, beta-carotene, and minerals like potassium, phosphorous, calcium and magnesium. Tamarind seed and kernels are rich in protein (13-20%) with good balance of essential amino acids except for threonine and tryptophan which are the limiting amino acids.

Tamarind fruit pulp is commonly used in local dishes but, the seed and leaves are not widely used. The seed kernel and leaves can be dried and stored and can be incorporated in several dishes. The seeds can be ground to flour and can be used along with other flours to make enriched recipes. Dried leaves can also be mixed to enhance flavour to certain recipes, thus enhancing the nutritive value.

Objectives

- Prepare value added products like cookies from tamarind seed kernel.
- Prepare value added products like soup mix incorporating tamarind leaves.
- Evaluate the organoleptic quality of the products.
- Find the nutritive value of selected developed products
- Estimate the shelf life of the tamarind kernel powder.
- Estimate the shelf life of selected products prepared from tamarind dried leaves.

➢ Relevance of the Study

Tamarind is an economically important fruit of India. It is mostly used in south areas including Kerala which is found in large amount. The pulp of the fruit is used in many recipes whereas seed and leaves as edible source is not of great significance among commoners. The production of value added products in an effective way helps to preserve the contents of the fruit. Tamarind seed which is discarded from the tamarind pulp industry has a great potential to be used. Moreover it has been shown that Tamarind indica seed extract has dose dependent protection on ulcer induced by alcohol and ibuprofen. The protective effect of the seed comes from its phenolic compounds .These compounds have an antioxidant effect and a high protective role against free radicals. T leaves are known to contain fibre, potassium, iron and even calcium. It is also rich in ascorbic acid and tartaric acid that help in building body immunity.

Methodology

Tamarind incorporated cookie and soup mix were developed using tamarind seed kernel and dried tender leaves powder.

1. **Prepraration of Tamarind Kernel Powder (Tkp)**

The seeds were collected from ripe tamarind fruit and were washed and drained. The seeds were then roasted in a pan to separate the seed coats from the endosperm. Care was taken during roasting to prevent charring of seeds. The endosperm was then ground and sieved to produce the tamarind kernel powder (TKP).

2. **Development of (Tkp) Cookies**

Various blends of the cookies were made by using ingredients like TKP and maida in the various ratios of (100:0, 70:30, 60:40, and 50:50). Set of 3 variations (K1, K2 and K3) along with a control recipe C0 were prepared. The standardisation of variations is given in Table No 1. Preparation of TKP cookies included preparing dough by combining the TKP along with maida flour indifferent various variations along with other ingredients like butter, sugar, baking powder, egg, salt and vanilla essence. The cookies were prepared by pressing the dough into sheets and then cutting into different shapes and were baked at 180°C for 20 minutes. Figure 1 and Figure 2 show the powdered TKP and selected cookies respectively.

Fig. 1. Powdered TKP

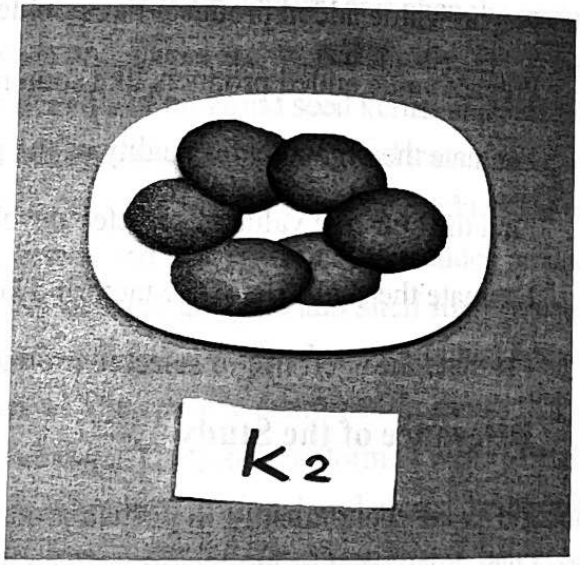

Fig 2. Selected Cookies

Table–1 The Ingredients Used for the Preparation of Tkp Cookies

S No.	INGREDIENTS(g)	K0	K1	K2	K3
1	Seed kernel flour	0	70	60	50
2	Maida	100	30	40	50
3	Sugar	75	75	75	75

Preparation of Tamarind Dried Tender Leaves Powder

The tender leaves were collected and sorted. Fresh, green, un-damaged leaves were taken. The leaves were separated from the stalk and washed thoroughly in running water and left to drain. The

tender leaves were sun dried under shade. The dried leaves were then powdered in a mixer.

Development of Tamarind Leaf Soup Mix

The soup mix was prepared using the dried leaf powder. Three different variations were made as U1, U2 and U3 along with a control recipe U0. Table No.2 gives the standardized variation of the ingredients used. The soup mix was prepared using tamarind leaf powder, corn starch, carrot flakes (sun dried), garlic powder, onion powder, pepper and salt. All the ingredients were mixed well and stored in airtight container. Figure 3 shows the dried tamarind tender leaves powder and Figure 4 shows selected soup mix.

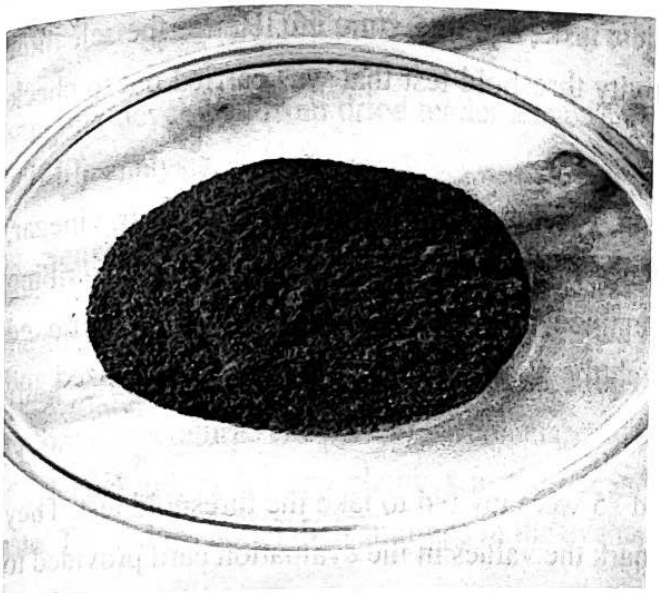

Fig 3. Dried Tamarind Tender Leaves Powder

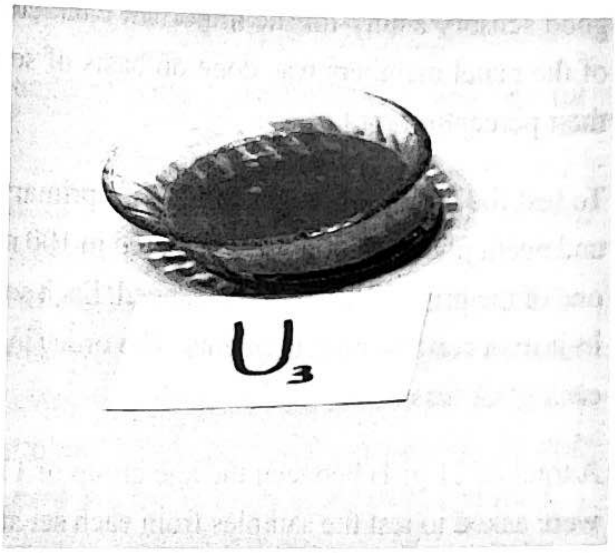

Fig 4. Selected Soup Mix

Table 2 – Ingriedients Used for the Preparation of Tamarind Leaves Soup Mixes.

S No.	INGREDIENTS(g)	U0	U1	U2	U3
1	Tamarind leaves	0	30	35	25
2	Corn starch	10	10	10	15
3	Carrot flakes	15	5	5	10
4	Garlic powder	25	15	10	15
5	Onion powder	25	15	15	10
6	Pepper	5	5	5	5
7	Salt	10	10	10	10
8	Butter	10	10	10	10

- **Organoleptic Evaluation**

Quality is the ultimate criterion of the desirability of any food product. When the quality of a food product is assessed by means of human sensory organs, the evaluation is said to be sensory or organoleptic. Sensory quality is a combination of different senses of perception coming into play

choosing and eating food. Appearance, colour, flavour, texture, and mouth feel decide the acceptance of the food.

Therefore, the acceptability of value-added products of tamarind indica incorporating its seed kernel and leaves prepared in three variations along with a control recipe was evaluated using sensory evaluation. For this, a panel of judges were selected.

- **Selection of Panel of Judges**

Sensitivity threshold test are done to measure the ability of an individual to smell, taste, or feel specific characteristics in food or beverages Panel members are selected based on having average to good sensory acuity for the important characteristics; taste, smell, texture etc. Hence the selection of the panel members was done on basis of sensitivity threshold test that was carried out to check their perception for taste.

To test the ability of judges to identify primary taste, varying concentration of salt, sugar, vinegar, and neem juice solution were prepared in 100 ml water. Four sets of five glasses, each set describing one of the primary tastes was arranged. Each set contained a glass of plain water with solution mixed in it in according measurements. The order in which the glasses were placed was randomized and each glass was labelled with a code.

A total of 21 girls between the age group of 17 and 25 were invited to take the threshold test. They were asked to test the samples from each set and mark the values in the evaluation card provided to them. The score card had threshold values that were expressed in numerical values as 5-very strong, 4-strong, 3-medium, 2-weak, and 1-weak. For each correct identification a score of 5 was given. The highest score panel members were selected for sensory evaluation. Hence, a total of 10 members were selected for testing the acceptability of the prepared products of tamarind.

Sensory Evaluation of Developed Products

The most widely used scale for measuring food acceptability is the 9-point hedonic scale. The original 'words only' 9-point hedonic scale is a scale of liking. Consumers are required to assess a product and report how much they like it. It can be inferred from this 'words only' scale that if food 'A' is 'liked extremely' and food 'B' is 'liked very much' or 'liked moderately', then food 'A' is liked more or is preferred to food 'B'. Used in this way, the scale becomes one of preference. Thus, assigning numbers 1–9 to the verbal responses on the 'words only' hedonic scale would be assigning at least an ordinal measure of preference to the products in question . The selected judges were asked to evaluate the taste, appearance, flavour, texture and overall acceptability of the prepared foods. The completed score cards were collected and consolidated. The average score obtained for each product was calculated and compared. From each recipe, the most accepted variation with highest average score was selected.

- **Evaluation of Nutrient Content**

The nutrient content of the selected value-added products developed from the dried tender leaves powder and seed kernel powder of Tamarindus indica. L was estimated. Nutrients like carbohydrate, protein and fat were evaluated. The crude fibre of cookie was also calculated. Potassium and phosphate of soup mix were calculated.

- **Shelf-Life Estimation**

The shelf life of a food is defined as the time taken for a product to decline to an unacceptable level of consumption. The actual length of the shelf life of any product will depend on several factors such as moisture content of the product, processing method, packaging, and storage conditions.

Soup mix developed from dried tender leaves and the tamarind kernel powder as flour was kept for shelf life analysis.

- **Sensory Tests**

The shelf life stability of the soup mix developed from tender leaves and the TKP was evaluated for a time period of two months. Samples of the soup mix and kernel flour were kept in airtight container at room temperature. The samples were analysed after every two week for two months by the panel of selected judges for any changes in their sensory attribute like appearance, texture, smell, and taste. The judges noted their findings in the evaluation card and their observations were recorded.

Microbial Analysis

Microbial analysis is the use of biological, biochemical, molecular or chemical methods for the detection, identification or enumeration of microorganisms in a material. After two months of storage in airtight containers at room temperature, the soup mix and tamarind kernel powder were analysed. Microorganisms such as yeast and mould count were analysed.

- **Compilation and Interpretation of Data**

The obtained data were consolidated, tabulated and analysed using statistical tools. Kendall's W value of concordance was calculated for assessing agreement among the judges in the sensory evaluation of the tamarind products and interpreted.

- **Results & Discussion**

The results of the study are presented and discussed under the sensory evaluation, nutrient analysis and shelf life estimation.

- **Sensory Evaluation**

Product of Tamarind Kernel Powder

The score obtained in the sensory evaluation of the three variations of TKP cookies and its control recipe is given in Table 3.

Table 3 – Sensory Evaluation Scores of Cookies

S No.	Variations and proportions	Appearance	Flavour	Colour	Texture	Taste	Overall acceptability	Average score
1.	K0	8.6 (3.25)	6.4 (2.30)	8.0 (3.30)	7.0 (2.15)	6. 9(2.40)	7.5(2.70)	7.4
2.	K1	7.1 (1.80)	6.6 (2.10)	6.2 (1.75)	6.7 (2.45)	6.4 (1.85)	6.7 (1.90)	6.6
3.	K2	7.7 (2.65)	7.7 (2.75)	6.7 (2.40)	7.5 (3.00)	7.6 (2.75)	8.0 (2.65)	7.5
4.	K3	7.1 (2.30)	7.0 (2.85)	6.9 (2.55)	6.4 (2.40)	7.5 (3.00)	7.8 (2.75)	7.1
Kendall's value		NS 0.251	NS 0.87	NS 0.273	NS 0.092	NS 0.162	NS 0.107	

Figures in the parenthesis are mean rank score

NS = non-significant, ** = Significant

From Table3 reveals that the variation K2 is the most acceptable (8.0) with an average means score of (7.5) and K1 has the lowest average score (6.6). K2 had the highest score in appearance (7.7), flavour K2 (7.7), texture,(7.5), and taste (7.6).

Product of Dried Tender Leaves Powder

The score obtained in the sensory evaluation of the three variations of soup mix using tamarind leaves powder and its control recipe is given in Table 4.

Table 4 - Sensory Evaluation Scores of Soup Mix

S No.	Variations and proportions	Appearance	Flavour	Colour	Texture	Taste	Overall acceptability	Average score
1.	U0	8.2 (2.95)	8.0 (3.35)	8.0 (3.00)	7.7 (2.60)	8.6 (3.45)	8.5 (3.25)	8.2

2.	U1	7.0 (1.55)	6.3 (1.80)	7.2 (2.20)	6.9 (2.15)	6.8 (1.90)	6.8 (2.05)	6.8
3.	U2	8.0 (2.80)	6.9 (2.55)	7.2 (2.05)	7.8 (2.85)	6.8 (2.20)	7.4 (2.65)	7.3
4.	U3	8.1 (2.70)	6.8 (2.30)	8.0 (2.75)	7.2 (2.40)	7.4 (2.45)	7.4 (2.05)	7.5
Kendall's value		NS 0.309	** 0.289	NS 0.146	NS 0.074	NS 0.352	NS 0.248	

Figures in the parenthesis are mean rank score
NS = non-significant, ** = Significant

In the soup mix variations in terms of appearance U3 has highest value of (8.1) after control recipe with a score of (8.2). U2 tends to have more score (6.9). The control recipe and U3 has the highest in colour (8.0). U1 had the least scored in texture and the rest of the variation had an average of (7.2) to (7.8). The highest score for taste was obtained by U3 (7.4).

The sensory evaluation of the prepared products showed acceptance close to or more than the control recipe. The cookies (K2) variation made from TKP excelled than that of their control recipes. The selected soup mix prepared from tamarind dried leaves powder is U3.

- **Nutrient Analysis**

A. **Nutrient Content of Selected Products from Tamarind Kernel Powder**

The amount of nutrient present in the selected variation of TKP cookies and its control recipe are given in Table 5.

Table 5. Nutrient Content of Cookie

S No.	Nutrients	Control K0	Selected Cookie K2
1	Carbohydrate (g)	51.84	52.66
2	Total protein (g)	4.7	6.61
3	Total fat (g)	36.27	30.6
4	Crude fibre (g)	1.19	1.33

In the TKP cookie recipe, content of carbohydrate has risen slightly in K2 (52.66g) than the control recipe. In terms of total protein, the variation has more content (6.61g). Fat is reduced in the variation recipe (30.6g) and crude fibre is increased in slightly (1.33g) than control recipe.

B. Nutrient Content of Selected Tamarind Leaves Powder Products

The amount of nutrient present in the selected variation of tamarind leaves powder soup and its control recipe are given in Table 6.

Table 6 - Nutrient Content of Soup Mix

S No.	Nutrients	Control U0	Soup Mix U3
1.	Carbohydrate (g)	63.97	62.87
2.	Total protein (g)	3.51	6.17
3.	Total fat (g)	1.58	2.91
4.	Phosphate (mg)	22.5	23
5.	Potassium (mg)	780	1290

The carbohydrate content of the soup mix recipe is almost same in both the control recipe (63.97g) and U3 (62.87g). Here, it is noted that in U3, the protein was double (6.17g) than that of the control recipe (3.51g). Total fat content has also increased in U3 (2.91g). Phosphate seems to be almost similar in both recipes (22.5mg and 23mg). The potassium level has increased in U3 to (1290mg).

1.1 Shelf Life Study

The sensory test and microbial analysis results in the shelf life evaluation of prepared TKP and products made of tamarind pulp and dried leaves are given below.

Sensory Assessment in TKP

The result of shelf-life study of TKP by sensory test is given in Table 7.

Table 7- Changes Observed in the Prepared TKP During Storage

Sensory Attributes	Storage Period			
	2weeks	1 month	1 month & 2 weeks	2 months
Appearance	Nil	Nil	Nil	Nil
Texture	Nil	Nil	Nil	Nil
Taste	Nil	Nil	Nil	Nil
Smell	Nil	Nil	Nil	Nil

It is clear that after two months of storage, there was no change in appearance, texture, taste and smell.

Sensory Assessment of Tamarind Leaves Soup Mix

The result of shelf-life study of tamarind leaves soup mix by sensory test is given in Table 8.

Table 8 - Changes Observed in the Tamarind Leaves Soup Mix During Storage

Sensory Attributes	Storage Period			
	2weeks	1 month	1 month & 2 weeks	2 months
Appearance	Nil	Nil	Nil	Nil
Texture	Nil	Nil	Nil	Nil
Taste	Nil	Nil	Nil	Nil
Smell	Nil	Nil	Nil	Slight change

It is noted that in the sensory test of tamarind leaf soup mix for two months there has been no change in appearance, texture and taste. A slight change in the smell is observed in the end of second month. There was no change after two weeks and during the first month.

- **Microbial Analysis of Tamarind Kernel Powder**

The result of microbial analysis of tamarind kernel powder done is given in Table 9.

Table 9 - Microbial Count in Tamarind Kernel Powder

S No.	Micro-Biological Parameter	Count	Desirable limit (FSSAI standards)
1.	Yeast and mould cfu/g	<10	≤10

The microbial analysis of the tamarind kernel powder stored for two months revealed that there was no yeast and mould count exceeding the desirable limit.

Microbial Analysis of Tamarind Leaves Powder Product (Soup Mix)

The result of microbial analysis of tamarind leaves soup mix is given in Table 10.

Table 10 - Microbial Count in Soup

S No.	Micro-Biological Parameter	Count (cfu/g)	Desirable limit (FSSAI stds)
1.	Yeast and mould cfu/g	64	≤10

The microbial analysis of the soup mix stored for two months shows a presence of yeast and mould count exceeding the desirable limit of ≤ 10. The count is 64 cfu/g.

- **Summary & Conclusion**

Tamarind indica is an exotic fruit packed with many nutrients and health benefits. The present study was carried out with an objective to develop value added products from seed kernel and dried tender

leaves by incorporating them in simple recipes.

The raw materials were collected and processed individually to obtain the raw ingredients.

Cookies were made from the processed tamarind kernel flour in 3 variations (K1, K2, K3 respectively) along with a control recipe (K0) without the incorporation of TKP were prepared. Using the tamarind dried tender leaves powder a soup mix was developed in 3 variations (U1, U2, U3) each along with a control recipe. These recipes, each with their variations and control recipe were evaluated for their sensory quality by a selected panel of 10 judges. In each recipe the variation obtained highest average score was selected as the best product. The nutrient content of the selected products and their respective control were calculated. Tamarind kernel powder and the soup mix made from tamarind dried leaves were kept in airtight container for two months to analyse shelf -life. The shelf life of the prepared products was tested by the judges and also for its microbial analysis.

The TKP bonded well with the batter of cookie due to its high binding capacity and presence of gum. The variation K2 made from tamarind kernel powder was selected as it scored best in overall acceptability and had a higher average score (8.0) and (7.5) respectively. In the nutrient analysis of the cookie(K2) made of tamarind kernel powder had higher amount of carbohydrate (52.66g), protein (6.61g), fat (30.6g) and crude fiber (1.3g). The sensory assessment during the shelf life period of the tamarind kernel powder were analysed and no change was observed in sensory quality The microbial analysis including count of yeast and mould was observed to be under desirable count ≤10 in tamarind kernel powder.

Soup mix prepared form tamarind dried tender leaves, the variation U3 was selected best since it had higher average score of (7.5).The nutrient content of soup mix (U3) had more amount of carbohydrate (62.87g), protein (6.17g) and potassium (1290mg).In the sensory test of shelf life it showed a slight change in the smell in the end of second month. The microbial analysis of soup mix had elevated count of yeast and mould 64cfu/g

Thus innovative food products can be convenient and add variety to the menu. They also enhance the nutritional value of the products.

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1. *Student (MSc. Nutrition and Dietetics), Korambayil Ahamed Haji Memorial Unity Women's College, Manjeri.Kerala.*
2. *Associate Professor, Dept. of Home Science, Korambayil Ahamed Haji Memorial Unity Women's College, Manjeri Kerala.*

Innovation and Incubation Opportunities through Home Science

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DR SITHARA BALAN V
Asst Professor, PG Dept & Research Centre of Home Science, Govt College for Women, Thiruvananthapuram, Kerala

DR SUSAN CHERIAN
Associate Professor & Head, Dept of Home Science, St.Teresa's College (Autonomous), Kochi, Kerala

DR BHAGYA D
Assistant Professor, Dept of Home Science, St.Joseph's College for Women, Alappuzha, Kerala

DR ANNIE NINAN
Associate Professor, Dept of Home Science, Korambayil Ahamed Haji Memorial Unity Women's College, Manjeri, Malappuram

DR NISHA VIKRAMAN
Assistant Professor, Dept of Home Science, St.Teresa's College (Autonomous), Kochi, Kerala

Ms. SHIFA J
Research Scholar & Former Asst Professor, PG Dept & Research Centre of Home Science, Govt College for Women, Thiruvananthapuram, Kerala

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