COMPARATIVE NUTRITIONAL STUDY AND MINIMAL PROCESSING OF DARK GREEN LEAFY VEGETABLES FOUND IN BATTICALOA DISTRICT

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ABSTRACT

The study dealt with the relationship between consumption patterns and the method of minimal processing of dark green leafy vegetables. Ten indigenous varieties of Dark Green Leafy Vegetables (DGLV) were analyzed in ten villages of the Batticaloa district. The study showed clear differences in consumption pattern of the DGLV among the tested individuals. *Alternanthera sessili, Dregea volubilis* and *Moringa pterygota* widely consumed in all the ten villages. *A. sessili, D. volubilis, Solanum trilobatum* and *Sesbania grandiflora* were available throughout the year. Other six leafy vegetables are mostly available during the rainy seasons of the year.

There was a wide spread awareness of basic nutrition principles associated with preparation of various categories of people sampled. There was a clear preferential pattern to some DGLVs which was not related to any variables. All ten DGLVs that are consumed in the local villages were analyzed for nutritional composition, minerals, β- carotene and ascorbic acid content. The protein ranged from 1.90 – 3.86%, fat from 0.16 – 2.6%, fiber from 9.4 – 19.7% and minerals from 1.1 – 3.8%. The moisture content of the DGLVs ranged from 75.6 – 87.6%, ascorbic acid ranged from 4.6 – 12.5 mg/100g and β- carotene from 3440 – 7174 µg/100g. Minimal processing and shelf life of DGLVs were analyzed with sensory evaluation and were found to be suitable for minimal processing with no significant difference in nutritional and sensory qualities during processing and storage.

Key words : Dark green leafy vegetables, Minimal processing, Nutritional quality, Packaging, Sensory evaluation

INTRODUCTION

Good nutrition is the key to health whilst malnutrition causes ill health or disease. Malnutrition is associated with under nutrition or overeating (FAO, 2004). Under nutrition lowers resistance of the body to disease. This is common in developing countries. Malnutrition has been one of the major nutritional problems in the less developed countries including Sri Lanka (Waterlow and Puyne, 2007). The rural population of the tropical and sub tropical countries depend on plant derived food. Vegetables grown in the home garden can make an important contribution to improve nutrients in developing countries (Suhumaran and Premkumar, 1997). They introduce more variety into their daily diet and enrich it with vitamins and minerals. The regular consumption of green leafy vegetable can help to prevent vitamin A, vitamin C deficiencies and chronic anemia. Green leafy vegetable contains relatively large amount of qualitatively high grade protein (Burberries and Clausletzmann, 2003).

In Sri Lanka, as in most part of the South Asian countries green leafy vegetable is consumed daily in their staple diet. They can be grouped into pale green leafy vegetable and dark green leafy vegetable. Cabbage (*Brassica oleracea*) and lettuce (*Lettuca sativa*) belong to the pale green leafy vegetables and these are widely consumed in all parts of Sri Lanka (Kailasapathy and Illeperuma, 1985). Dark green leafy vegetables have been consumed by the village communities for hundreds of years as the source of vitamins and minerals. Leafy vegetables are good sources of carotene, folic acid, vitamin C, iron and calcium (Wickramanayake, 2005). The predominant dark green leafy vegetables (DGLV's) consumed in Batticaloa are *Amaranthus paniculatus, Dregea volubilis*, *Centella asiatica*, *Alternanthera sessili*, *Ipomea aquatica*, *Sesbania grandiflora* and *Moringa pterygota*

Methods of preparation could alter the nutritive value of raw green leafy vegetables. The extent of nutritional losses depends on the methods of cooking, length of time and the temperature of the treatments (Fulfils and Baser, 2006). Dark green leafy vegetables which are widely available in Sri Lanka are also a good source of dietary fiber. Dietary fiber is a complex mixture of indigestible compounds derived mainly from plant cell

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walls. It consists mainly of polysaccharides, particularly cellulose fibers. Its bulk stimulates the movement of food through the gut. There is evidence that fiber helps to reduce blood cholesterol levels and the risk of intestinal cancer and gall stones formation (Armstrong *et al.,* 2006). Upto 60% of cancers in women are due to dietary factors and nutritional deficiencies (Bayer and Gragam,2004).

The objective of this research is to assess the:

1. Nutritional value of dark green leafy vegetables
2. Changes in nutritional value of the dark green leafy vegetables during processing and storage.
3. Evaluate the sensory qualities of the dark green leafy vegetable prior to and following minimal processing.

METHODOLOGY

A survey was conducted in 10 villages in the Batticaloa district. The villages were Valaichenai, Oddamavady, Sittandi, Kiran, Vanntharumoolai, Chenkaladi, Eravur, Puliyanthivu, Kallady and Kattankudy. Hundred and fifty houses were randomly selected from these villages and a questionnaire was used to collect data in type, amount of indigenous dark green leafy vegetable consumed, source, preference and methods of preparation. The descriptive, statistic and frequency distribution of socio – economic features and consumption patterns were obtained. The minimal processing of the dark green leafy vegetables (Figure: 1) was done as follows :

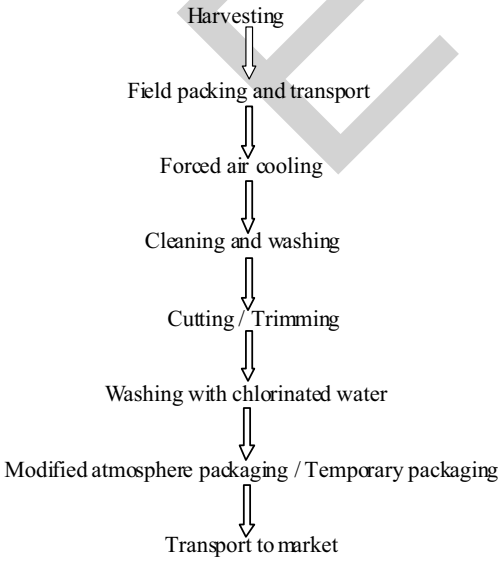

Figure 1 : Minimal Processing of Dark Green Leafy vegetables

Sample Collection

Ten indigenous dark green leafy vegetables (Table: 1) were collected from home gardens, fields and markets of the villages.

NUTRITIONAL ANALYSIS

Sample Preparation

Leaves were quickly brought to the laboratory and washed with tap water to get rid of the sand and other impurities.

Nutritional Analysis

Analysis of moisture, fat, protein, fiber, minerals and β-carotene were determined by standard AOAC (2000) methods. The ascorbic acid content was determined using titration sodium salt of 2, 6-dichlorophenol indophenol dye method. Complete randomized design was used to analyze the nutrient contents of the dark green leafy vegetables. The readings were subjected to analysis of variance (ANOVA) and the means were compared using Duncan's Multiple Range Test. Suitable environmental friendly packaging materials were analyzed with shelf life and sensorial parameters green leafy vegetables and their suitability for domestic and industrial purpose was also evaluated. Polyethylene, banana leaves and newspapers were tested at 1, 2, 3ºC and room temperature for shelf life evaluation. The suitability of these packaging materials for domestic and commercial purpose was also evaluated.

RESULTS AND DISCUSSION

Consumption Pattern of Dark Green Leafy Vegetables

In an average, all families daily consume green leafy vegetables with their main meals. Table 2 shows the clear preferential patterns to the tested dark green leafy vegetables. People from Sittandy, Kiran and Valaichenai consume more dark green leafy vegetables than those from Kattankudy and Eravur while the majority from Eravur and Kattankudy consume more amounts of *Moringa pterygota*, *Dregea volubilis* and *Alternanthera sessili*, the others prefer to consume all ten types of vegetables.

According to this study in ten villages, 56% of the sampled population was consuming 100 – 150 g of *Alternanthera sessili* and *Moringa pterygota* in a week. Leafy vegetable such as *Alternanthera sessili* and *Moringa pterygota* are used for cooking purposes as an accompaniment with rice for lunch. These two are

Table 1: Botanical Characteristics of the Dark Green Leafy Vegetables

Botanical name	Family	Vernacular / Common name	
		Tamil	English
Alternanthera sessili	Amaranthaceae	Ponnankanni	Alligator weed /Sessile joyweed
Amaranthus paniculatus	Amaranthaceae	Keerai	African spinach/ Blood amaranth
Centella asiatica	Umbelliferae	Vallarai	Coin wort / Asiatica coinwort
Dregea volubilis	Asclepiadaceae	Kurinja	Sneez wort
Ipomea aquatica	Convulvulaceae	Kankun	Water spinach
Mollugo pentaphylla	Aizoaceae	Thirai	Carpet weed, African chickweed
Moringa pterygota	Moringaceae	Murunga	Drumstick
Mukia maderaspatana	Curcurbitaceae	Musumusukai	Rough bryony
Sesbania grandiflora	Leguminosae	Akathi	Corkwood tree /West Indian pea
Solanum trilobatum	Solanaceae	Thuthuvalai	Purple-Fruited Pea Eggplant

Table 2 : Consumption Preferences of Dark Green Leafy Vegetables in the Batticaloa District

Dark Green Leafy Vegetables	No of Households	Consumption Preference (%)
Alternanthera sessili,	198	99
Moringa pterygota	196	98
Dregea valubilis	194	97
Solanum trilobutum	180	90
Sesbania grandiflora	170	85
Ameranthus peniculatus	166	83
Mollugo pentuphylla	150	75
Mukia maderaspatana	142	71
Centrella asiatica	130	65
Ipomea aquatica	110	55

favored by most of the children in the sampled families. According to Suhumaran and Premkumar (1997), 40.7% of the sampled population consumed 11 – 15 bundles of *Alternanthera sessili* per week. This was used for cooking and medicinal purposes. The nutritional compositions of the tested dark green leafy vegetables are presented in the Table: 3.

The nutritional values of the green leafy vegetables vary widely and depend on the type of the leafy vegetable, maturity, sampling, growing environment and so on. The moisture, protein and fibre content of the dark green leafy vegetables ranged from 75.6-87.6%, 1.9-3.86% and 9.4-19.7% respectively. Similar results were reported by Suhumar and Premakumar (1997) for the nutritional contents of the leafy vegetables available in the Batticaloa district. DGLV's are rich in fibre, β-carotene, vitamin A and minerals but their energy value and fat content are low compared to other vegetables. The ascorbic acid and β-carotene content range from 4.6-12.5 mg/100g and 3440-7174 µg/100g, respectively. Our results are supported by Fulfils and Baser (2006).

Table3 : Nutritional Composition of the tested Dark Green Leafy Vegetables (DGLV)

Common Name	Moisture (%)	Protein (%)	Fibre (%)	Fat (%)	Minerals (%)	Ascorbic Acid (mg/100g)	β-carotene (µg/100g)
Alternanthera sessili	79.6	2.62	19.7	2.04	3.80	11.5	6733
Moringa pterygota	77.1	2.49	17.6	1.86	3.14	4.6	5853
Dregea valubilis	78.4	2.91	11.4	1.47	2.26	5.4	5960
Solanum trilobatum	81.7	2.09	10.1	1.09	2.94	4.7	4121
Sesbania grandiflora	76.2	3.86	13.1	2.60	3.74	11.5	6346
Ameranthus peniculatus	82.1	2.17	16.7	1.42	1.76	11.3	7174
Mukia maderaspatana	80.7	3.46	14.1	2.10	2.84	12.4	6430
Centrella asiatica	75.6	3.32	18.2	2.44	3.39	6.3	3440
Ipomea aquatica	87.6	1.90	11.6	0.16	1.10	12.5	3712
Mollugo pentaphylla	84.4	2.71	9.4	1.70	1.42	7.7	4314

Green leafy vegetables are rich in Vitamin A. Consumption of DGLV would prevent the eye diseases and disorders.

Changes in Nutritional Composition of Dark Green Leafy vegetables during Storage

The moisture content and shelf life of the *Alternanthera sessili* were assessed after the storage of 1, 2, 3 days packed in different materials (Table: 4). Comparing the moisture content of the leafy vegetables during 1, 2, and 3 days, there was no significant difference during day 1 and 2 however there was significant difference on day 3 but in banana leaf packed *Alternanthera sessili*, there was no significant difference in all 3 days.

Table 4: The Moisture content (%) of *Alternanthera sessili* packed in different materials

Packaging Materials	Initial	Day 1	Day 2	Day 3
Polyethelene	79.6	76.2 a	71.9 a	66.2 b
Paper	79.6	72.1 ab	68.2 ab	61.1 c
Banana leaf	79.6	74.8 a	72.2 a	69.0 a

Table 5: Changes in Fiber Content (%) of *Alternanthera sessili* stored in different materials

Packaging Materials	Initial	Day 1	Day 2	Day 3
Polythene	19.7	20.5 a	22.2 ab	23.8 b
Paper	19.7	21.6 a	23.5 a	25.4 a
Banana Leaf	19.7	20.1 a	21.5 b	22.4 bc

There was no significant difference in moisture content between *Ameranthus peniculatus*, *Mollugo pentaphylla* but there was significant difference between *Mukia maderaspatana* and *Centrella asiatica* types during the storage of 3 days at room temperature. The fibre content of the leafy vegetables was increased during storage at different packaging materials. This may be due to loss of moisture during storage increased the dry matter content. The fibre in fruits and vegetables are composed of cellulose, hemicellulose, lignin and other insoluble polysaccharides in plants (Tayler, 2002). There were no significant differences were found in fibre content for the leafy vegetables packed in polyethylene and banana leaf after 1 and 2 days. However, the differences were significant after 3 days of storage in all the tested materials (Table 5).

Ascorbic acid content of DGLVs ranged from 4.6 – 12.5 mg/100g. There were significant diffrence between different species of green leafy vagetables during storage. The study revealed that there was no significant difference in vitamin C content between Day 1 and Day 2 shelf life with all 3 types of packaging materials such as polythene, banana leaf and paper. The sensory evaluation showed no significant difference among the packaging material following day 1 and 2 but there was significant differences following day 3 in the paper and polythene packs. The leafy vegetables packed in banana leaf remain in fresh and are acceptable by the panalists for all the sensory characteristics.

CONCLUSION

This study showed that DGLV's are extensively used in the villages of Sittandy, Vantharumoolai, Kallady and Kattankudy in the Batticaloa district. The people from Sittandy, Kommathurai and Chenkalady grow most of the dark green vegetables in their home garden and people from Eravur and Kattankudy buy them from market. The widely used cooking method is with grated coconut for *Dregea volubilis* and *Mollugo pentaphylla* and with coconut milk for *Alternanthera sessili* and *Moringa pterygota*. Many of the dark green leafy vegetables are good sources of vitamin A, C, protein, sodium and fiber content. Almost all the leafy vegetables have high amount of fiber and some particularly *Ipomea aquatica*, *Mukia maderaspatana*, *Alternanthera sessili*, *Sesbania grandiflora* and *Ameranthus peniculatus* are sources of ascorbic acid. Protein content is high in *Centrella asiatica*, *Sesbania grandiflora* and *Mukia maderaspatana*. Fat content is low in all leafy vegetables. Polythene paper and banana leaf were better packaging materials in maintaining the nutritional and sensory qualities compared to the leaves without any packing. The storage of leafy vegetables for 1, 2 and 3 did not affect their nutritional content significantly. *Alternanthera sessili* is more suitable in banana leaf packaging for 3 days at room temperature of 30ºC at the RH of 85-90% without any singificant changes in the nutritional and organoleptic qualities.

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