

Enhancing leafy foods' intake for optimal nutrition and human security in the South Pacific⁺

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Abstract

In the Pacific Island countries (PICs) major nutritional problems are under-nutrition and micronutrient deficiencies due to low dietary intake of leafy foods. Edible leaves of food crops are some of the inexpensive abundant sources of protein, carbohydrate, minerals, vitamins and fibres. In high natural calamity-prone areas, such as PICs, people frequently remain cut-off from the external sources of food for many days and they mainly survive on leafy food material available in their surroundings. This study investigated about what leafy foods are available in Fiji, which of these are commonly consumed by people and which of these are not used. This study is based on primary data obtained by a household sample survey on a structured questionnaire by personal interview method. The study revealed that a rich variety of leafy foods are available and known to people in Fiji. However, out of twenty six leafy foods listed only ten are regularly consumed by majority of the people. A small proportion of households have used up to five leafy foods i.e. underutilization. However, there are several known leafy foods (eleven) which no one has tried i.e. such leafy foods have not been utilized. The respondents reported many constraints in improving their intakes of leafy foods: (i) higher prices of leafy foods in the market; (ii) lack of space to grow own leafy foods in their backyards; (iii) lack of knowledge about how to prepare delicious dishes out of many leafy foods material; (iv) lack of information about the nutritional value of some of the leafy crops. Hence, to popularize the consumption of underutilized or not-utilized local leafy food crops, there is a need to generate more information on nutritional aspects of those leafy food crops and disseminate it to the people.

Keywords: Leafy food crops, Leafy vegetables, Nutrition and food security, Disaster prone people

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1. Introduction

Nutrition related diseases such as under nutrition and malnutrition is of growing concern in the Pacific Islands countries (PICs). The focus on nutrition studies in the PICs has traditionally been on problems of under nutrition i.e. insufficient micronutrients to meet human health (Hone, 2004). Contact with Europeans and people of other ethnicities throughout the past couple of centuries had a great impact on the traditional food system (Schultz, 2009). Therefore, Fiji food systems have also changed consequently. The shift from traditional to modern lifestyles has greatly affected the health of the indigenous people making them vulnerable to nutrition related diseases (Schultz, 2009). It is well known that minerals, protein and carotenoids are of prime importance to health, yet it is still deficient in many people's diet in the developing countries (Lako *et al.*, 2006). Australian Center for International Agricultural Research (ACIAR) survey on food preferences reveals that the Indo-Fijian families lived on predominantly rice and flour based foods while Fijian families generally consumed foods like taro, cassava, rice, yams, kumala, green vudi, etc (Owen *et*

al., 2002; Hone, 2004). However, there has not been any survey report on the consumption of indigenous leafy food crops in Fiji.

Indigenous leafy food crops are vegetables of locality which originated from an area and may or may not be confined to that particular region (Vorster, 2007). Indigenous leafy vegetables account for about 10% of the world's higher plants often regarded as weed (Nnamani *et al.*, 2009). The traditional plant food crops i.e. leafy vegetables are notably the most important group of wild plants consumed by people in different parts of the world which constitute the cheapest sources of macronutrients and micronutrients, especially providing vitamins (A, B and C), minerals (calcium, iron, fluorine, magnesium, phosphorus, potassium, sodium and zinc), dietary fibre and protein (Orech *et al.*, 2007; Hanif *et al.*, 2006; Aregheore, 2012). In the most recent review, the world health organization (WHO) has continuously emphasized to improve the nutritional quality of the food supply to provide a public health benefit with minimal health risk (Tulchinsky, 2010).

Increasing intake of fruits and vegetables can

readily aid in quenching free radicals (Lako *et al.*, 2008) that is present in the body which can cause several chronic diseases (Rao and Rao, 2007; Tiwari and Cummins, 2011). Other important nutrients such as minerals, proteins and carotenoids can also be obtained from consumption of fruits and vegetables. Green leafy vegetables such as kale and spinach provide carotenoids such as lutein, zeaxanthin, α -carotene and β -carotene which aid in prevention of age-related cataracts and macular degeneration (Belanger *et al.*, 2010). Lutein and zeaxanthin are dominant carotenoids found in human retina (Khachik *et al.*, 1997; Perry *et al.*, 2009; Ribaya-Mercado and Blumberg, 2004). Thus green leafy vegetables, being rich source of provitamin A, β -carotene, with any bioavailability issues, can contribute substantially in fighting against retinal diseases (Belanger *et al.*, 2010). This mechanism (prevention of age-related cataracts and macular degeneration) is known as blue light filters and/or antioxidants by which lutein and zeaxanthin provide protection to the eye (Perry *et al.*, 2009). Numerous studies have also supported that higher intake of fruits and vegetables reduced risk of cancer, protect against non-communicable diseases, heart disease and diabetes (Englberger *et al.*, 2014; Khachik *et al.*, 2002; Oliver and Palou, 2000). Hence, to enhance the consumption of leafy food crops, there is a need to generate comprehensive and informative data on the nutritional aspect of leafy food crops that are underutilized or not-utilized. To achieve this objective it was extremely essential first to determine the leafy crops whose leaves are commonly utilized (consumed), underutilized and not utilized and was achieved through household sample survey on a structured questionnaire by personal interview method and the findings are reported in the present paper.

2. Methodology

Household questionnaire survey using a structured questionnaire sheet was used to identify the various components such as the familiar/known leafy vegetable and what leafy food crops are mostly consumed in the family. A total of 230 households were interviewed personally in the three divisions (Central, Northern and Western) in Fiji. In the Northern and Western division 159 households were interviewed while in the Central division a total of 71 households were interviewed. The questionnaire survey for the Central division was conducted between September to December 2012 while the Northern and Western division questionnaire survey was conducted in January 2013 and February 2013 respectively. While surveying, the households were classified as large and small households based on the number of members in a family (family member ≤ 5 : small family and ≥ 6 : large family). The households were also classified based on the household head

education background (HHEB) as primary, secondary and tertiary. The data was then statistically analyzed using Microsoft Excel 2010 and SPSS statistical analysis software Version 19.

3. Results

3.1 Awareness of Leafy Food Crops

Based on the questionnaire survey in three divisions (Central, Northern and Western) of Fiji, the ranking of various food crops as per their consumption is presented in Table 1, where known leafy foods have been arranged in descending order according to their quantities consumed by the households. The most commonly known and edible leafy vegetables were listed in the questionnaire and the respondents were asked whether or not these leafy vegetables were known to them. The vegetables such as amaranth, bele, English cabbage and Chinese cabbage were known by all (100 %) the respondents while lettuce, taro, chilly leaves, cassava leaves, cowpea leaves, papaya shoots, drumstick leaves, sweet potato leaves, mustard leaves, pumpkin leaves, fenugreek leaves, roselle, winged bean leaves, bottle gourd leaves, kangkong, Indian mulberry (archi), fern and watercress were known by more than 80 % of the respondents, except for nightshade leaves, creeping spinach, jointfir leaves and fig leaves which were known by 71.7 %, 63.0 %, 29.1 % and 17.4 % respondents respectively. Based on average quantity consumed, Table 1 clearly reveals that the most commonly consumed leafy vegetables were taro leaves, pumpkin leaves, lettuce, amaranth, bele, fern, creeping spinach, roselle, kangkong and Chinese cabbage.

3.2 Quantity of Consumption and Constraints

Quantity of consumption is dependent on the leafy food crops consumed in a household. Based on the survey, the data related to commonly utilized, underutilized and not-utilized leafy food crops is presented in Table 1, where those utilized more than 40 kg/year is taken as the commonly utilized while less than 40 kg/year is taken as underutilized. Some of the commonly consumed leafy food crops identified were taro, pumpkin, lettuce, amaranth, bele, fern, creeping spinach, roselle, kangkong and Chinese cabbage. In some cases the quantity of consumption is high compared to the percentage of people consuming that particular leafy vegetable (Table 1). For example, pumpkin leaves are consumed at a rate of 101 kg/year while only 21.7 % of people are consuming this leafy vegetable. On the other hand, Chinese cabbage is consumed at a rate of 40 kg/year by 92.2 % respondents (*cf.* Table 1). Hence, in such circumstances, one can emphasize on increasing the quantity of consumption or can emphasize the on intake of a particular leafy vegetable.

Table 1. Leafy food crops known to the household categorized as commonly utilized, underutilized and not-utilized by people.

Leafy food crops (Botanical name is in parenthesis)	Awareness of leafy vegetable (%)	Leafy foods consumed by people (%)	Average quantity consumed (kg/household/year)
Commonly utilized			
Taro (<i>Colocasia esculenta</i>) leaves	99.1	81.3	124.0
Pumpkin (<i>Cucurbita moschata</i>) leaves	93.9	21.7	101.0
Lettuce (<i>Lactuca sativa</i>)	99.6	44.3	98.0
Amaranth (<i>Amaranthus</i>)	100.0	76.5	78.0
Bele (<i>Abelmoschus manihot</i>)	100.0	76.1	78.0
Fern (<i>Athyrium esculentum</i>)	88.3	30.0	71.0
Creeping spinach (<i>Basella alba</i>)	63.0	0.9	52.0
Roselle (<i>Hibiscus sabdariffa</i>)	92.6	22.2	49.0
Kangkong (<i>Ipomoea aquatica</i>)	89.6	23.5	47.0
Chinese cabbage (<i>Brassica chinensis</i>)	100.0	92.2	40.0
Underutilized			
Watercress (<i>Nasturtium officinale</i>)	82.6	13.9	38.0
Drumstick (<i>Moringa oleifera</i>) leaves	97.4	52.6	37.0
Fenugreek (<i>Trigonella foenum-graecum</i>) leaves	92.6	7.4	29.0
Mustard (<i>Brassica nigra</i> Koch) leaves	95.2	28.3	21.0
English cabbage (<i>Brassica oleracea</i>)	100	52.2	20.0
Not-utilized			
Papaya shoots (<i>Carica papaya</i>)	97.8	0.0	0.0
Nightshade (<i>Solanum nigrum</i>) leaves	71.7	0.0	0.0
Cassava (<i>Manihot esculenta</i>) leaves	98.3	0.0	0.0
Sweet potato (<i>Ipomoea batatas</i>) leaves	97.4	0.0	0.0
Bottle gourd (<i>Lagenaria siceraria</i>) leaves	91.3	0.0	0.0
Chilly (<i>Capsicum frutescens</i>) leaves	98.7	0.0	0.0
Cowpea (<i>Vigna unguiculata</i>) leaves	98.3	0.0	0.0
Fig (<i>Ficus species</i>) leaves	17.4	0.0	0.0
Indian mulberry/archi (<i>Morinda citrifolia</i>) leaves	92.6	0.0	0.0
Jointfir (<i>Gnetum gnemon</i>) leaves	29.1	0.0	0.0
Winged bean (<i>Psophocarpus tetragonolobus</i>) leaves	92.6	0.0	0.0

Most respondents prefer consuming those leafy vegetables that are easy to produce and readily available in the local markets and home gardens such as Chinese cabbage, English cabbage (depends on the cost in the market), bele, taro leaves (mostly sold at lower/affordable prices in the market), lettuce (mostly consumed raw as salads) and roselle (can be fried and preserved). The cost and availability of leafy vegetables in the market influences their consumption at home.

Increase in food price has also led to an increase in the prices of locally produced leafy food crops in the local markets which makes consumers to give more preference to canned foods and meat over vegetables sold in the local markets. A lot of households in Western and Northern divisions produce leafy food crops for sales in the local market however their consumption is not directly proportional to what they produce. This is also due to the fact that to most

households, who produce leafy food crops for sale, daily consumption of same leafy vegetables is not feasible.

Finding from sentinel monitoring 2009-2010 also reported that due to increase in food prices, majority of respondents face difficulty in meeting daily expenditures and face serious financial difficulties compared to previous year in 2008 (Miskelly *et al.*, 2011). In Fiji, the respondents/ families have also commented on the change in the type and quantity of food consumed as well as the cooking methods (Miskelly *et al.*, 2011).

Therefore, the study concluded that there are leafy vegetables like taro leaves, pumpkin leaves, lettuce, amaranth, bele, fern, creeping spinach, roselle, kangkong and Chinese cabbage are commonly consumed while leafy vegetables such as watercress, drumstick leaves, fenugreek leaves, mustard and English cabbage are less commonly utilized. However, there are many other leafy vegetables such as papaya shoots, nightshade leaves, cassava leaves, sweet potato leaves, bottle gourd leaves, chilly leaves, cowpea leaves, fig leaves, Indian mulberry, jointfir and winged bean leaves are known to the people in Fiji but are not generally consumed by the people i.e. they are not utilized at all (*cf.* Table 1: Not-utilized).

3.3 Educational Background

An attempt was made to compare the consumption of leafy food crops with the educational background of the households. The educational background of respondents from the Central, Northern and Western divisions is seen to be conflicting i.e. no regular pattern

was observed. In Central division, the highest percentage of HHEB is tertiary followed by Western division and least in the Northern division. It is apparent that those respondents living in the Central division are modernized, have attained high tertiary qualification and are in highly paid jobs. In contrast to the Central division, the Northern division respondents were mostly high school dropouts who have engaged themselves in subsistence agriculture. A study conducted by the United Nations Children's Fund (UNICEF) also supports that the children are being pulled out from secondary schools as parents cannot afford to pay fees or because they need the older sibling to help support the family financially (Miskelly *et al.*, 2011). In addition, since the Northern division is still developing in comparison to Central division, most people holding tertiary qualification move up to the main city for job preference thus increasing the percentage tertiary qualification of the Central division. However, most people in Western division are holding secondary and tertiary qualification. Since Western division has developed centers and this can cater jobs for both secondary and tertiary qualified people.

The consumption pattern of the fifteen leafy food crops with respect to the household head educational background is presented in Figure 1 which clearly indicates that the families with secondary HHEB uses highest amount of the leafy food crops. However, no clear difference in the consumption pattern with the HHEB having primary and tertiary was observed rather the consumption pattern is almost same but with the exception of watercress, tertiary HHEB consume the least leafy vegetables (Figure 1).

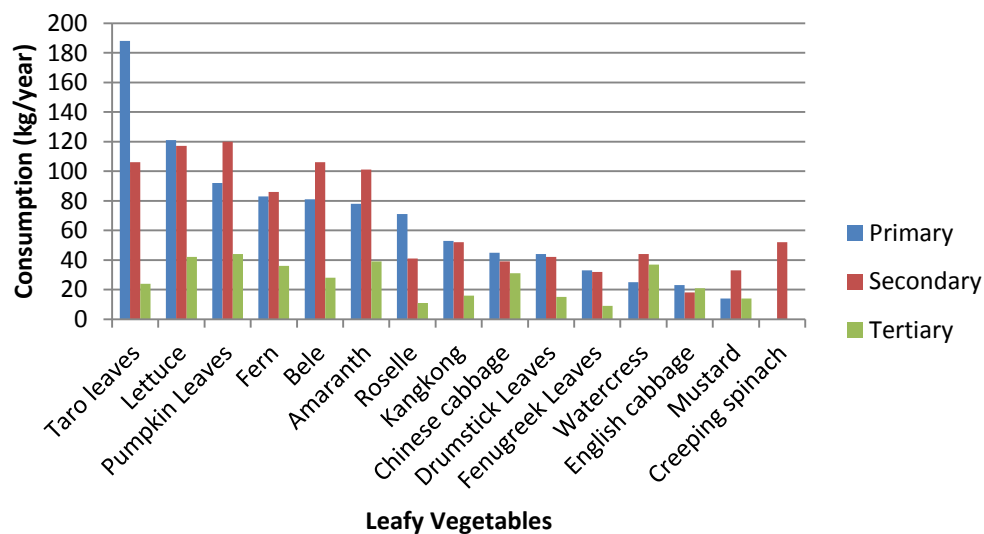


Figure 1. Consumption pattern of the fifteen leafy food crops with respect to HHEB.

3.4 Constraints in Producing Leafy Food Crops

Most people practice subsistence agriculture due to various reasons such as lesser land availability, higher cost of pesticides and most imported seeds are not adverse environmental tolerant. Respondents are highly depended on buying vegetables from the market which is further compounded by their incapability to access and utilize natural resources to produce their own leafy food crops. Accessibility to lands for producing leafy food crops is very limited to people living in Central divisions as well as town/urban centers in Western and Northern divisions. Higher cost of fence is another factor affecting farmers at village sites for producing leafy food crops. Improper fencing of cropping gardens/fields leads to crops being damaged by free moving cattles, goats, pigs and chickens, hence makes farmers practice subsistence agriculture. The constraints in producing leafy food crops are further enhanced by lack of available market where, if farmers tend to produce leafy food crops in larger quantities, they could easily transport for sales. Thus, transporting the leafy food crops to the local market is very expensive, and in doing so crops get damaged especially leafy food crops such as cabbage, amaranthus, etc.

4. Discussion

At a national level, food security means having adequate food to meet food needs for all citizens. Household food security is the application of this conception at a household level and at individual level, this relates to nutrition status and anything that threatens adequate nutrition (Norshazila *et al.*, 2012). Hence, there is a need to first carry out a comprehensive nutritional profile of leafy food crops. Reliable data on nutritional values of all underutilized and not-utilized are needed which are also important to food and pharmaceutical industry (Norshazila *et al.*, 2012).

In high natural calamity-prone areas, i.e. PICs people frequently remain cut-off from the external sources of food for many days and they mainly survive on leafy food material available in their surroundings. Hence for the benefit of the poor people in the highly natural calamity prone areas, searching for additional alternative leafy foods will help in formulating strategies of food and nutrition security as adaptation to the threat of climate change and global warming and natural disasters. The use of wild edible plants in agriculture as food supplements and as means of survival during famine and drought has been underestimated (Addis *et al.*, 2005). Although the diets are mainly based on local vegetables such as bele, tomatoes, green bean and greens of taro, vegetable production is insignificant and of low priority in the Pacific Islands. The transition of the people to more processed and refined food makes vegetable

consumption even scarcer.

Leafy food crop production should aim to increase the usage of underutilized traditional food crops. After conducting this survey on the consumption and production of underutilized leafy food crops in Fiji, the study concluded that out of various leafy food crops present/available, production of leafy food crops is dependent on availability of land, seeds, fertilizers, pesticides (to control pests), etc. while consumption is more depended on cost, availability in the markets and taste to lesser extent. People mostly rely on processed food/canned foods for daily consumption. This is due to the fact that there have been significant lifestyle changes in the Pacific Island countries, including urbanization, increasing reliance on imported foods and neglect of traditional foods of the Pacific Islands (Englberger *et al.*, 2014).

The exploitation of leafy foods can help attenuate malnutrition and starvation. Therefore, raising awareness on the use of underutilized and not-utilized leafy foods as a source of nourishment will also contribute to a healthy diet as well as promoting for agriculture can help many people who periodically struggle against starvation (Moodley *et al.*, 2013). As the leafy foods usually contain adequate nutrition which is essential for optimal growth and development will also add to food security and thus human security (Moodley *et al.*, 2013).

After conducting this survey, various loopholes were identified with regards to underutilized and not-utilized leafy food crops that are available for immediate use. Less availability of the underutilized and not-utilized leafy food crops in the local markets was identified to be one of the leading factors affecting their consumption. Only ten leafy food crops are commonly consumed by the people living in Central, Northern and Western divisions in Fiji. Other factors which affect consumption are poor taste, cooking techniques and unawareness of the nutritional value of such vegetables.

5. Conclusion

To enhance the consumption of leafy food crops that are locally available, there is an urgent need to carry out community based education at different locations which could provide awareness about the nutritional value of eating those leafy food crops that are underutilized and not-utilized at all. Various recipes should be given on how to process those leafy food crops as good nutrition is highly dependent on the way the food is being cooked. Continuous consumption will make people get used to the taste and hence could be handy during famines and drought when the usual food crops are damaged during disasters or out of season. This understanding will help contribute to change households' nutrition deficiency, food insecurity and thus human security.

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