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Nutritional Importance of Some Leafy Vegetables Available in Bangladesh

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Abstract: Fifteen different kinds of leafy vegetables were investigated for the content of moisture, ash, protein, fat, carbohydrate and dietary fiber. Among all leafy vegetables the lowest value of moisture content in Jute leaves (*Corchorus olitorius* L.) 76.52 g 100 g^{-1} and the highest value Pui leaves (*Basella alba* L.) 92.44 g 100 g^{-1}, respectively. Ash content in leafy vegetables varied between 0.9 to 1.8 g 100 g^{-1}. Among leafy vegetables the lowest value of fibre content in Bengal germ leaves (*Cicer arietinum* L.) 5.57 g 100 g^{-1} and the highest value Jute leaves 10.8 g 100 g^{-1}, respectively. From the present results protein, fat and carbohydrate contents in different leafy vegetables varies from 1.67 to 6.5, 0.09 to 1.5 and 3.3 to 12.57 g 100 g^{-1}, respectively. Highest protein, fat and carbohydrate content leafy vegetable is Bengal germ leaves 6.5 g 100 g^{-1}, Drumstick leaves (*Moringa oleifera* L.) 1.5 g 100 g^{-1} and Jute leaves 12.57 g 100 g^{-1}, respectively. Among all studied leafy vegetables the highest amount of Neutral Detergent Fiber (47.50 g 100 g^{-1}) was estimated in Radish leaves (*Raphanus sativus* L.) and the lowest amount of NDF (24.98 g 100 g^{-1}) was contained by Napa leaves (*Malva verticillata* L.). Cellulose content varied between highest Jute leaves 11.09 g 100 g^{-1} to lowest Lettuce leaves 4.05 g 100 g^{-1}, hemicellulose content varied between highest Radish leaves 33.90 g 100 g^{-1} to lowest Napa leaves 15.12 g 100 g^{-1} and lignin varied between Jute leaves highest 6.01 g 100 g^{-1} to lowest Radish leaves 0.87 g 100 g^{-1}.

Key words: Leafy vegetables, nutrients, dietary fiber

INTRODUCTION

Bangladesh has thirty broad and distinct agro-ecological zones with specific soil and other agricultural characteristics[1]. These diverse agro-ecological regions are the sources of different kind of vegetation. As a result, a huge number of indigenous varieties of vegetables are available in Bangladesh through out the year. Here all categories of peoples eat leafy vegetables cocked form and some are fresh as a salad.

Vegetables and their products are usually valued for their nutrient content but they are now also regarded as rich sources of non-glycemic carbohydrates, collectively referred to as dietary fiber. Leafy vegetables composed primarily of the polysaccharides cellulose, hemicelluloses, pectin, gum and mucilage and non-carbohydrate components lignins. All forms of dietary fiber come from plants are not digested in human stomach or intestine[2]. Leafy vegetable are rich source of dietary fiber has demonstrated benefit for health maintenance, disease prevention and as a component of medical nutrition therapy. It is now well known that the main physiological effects of dietary fiber are improved bowel function[3-5] and improved carbohydrate and lipid metabolism[6-9]. Many studies have reported that dietary fiber of leafy vegetables was effective for counteracting obesity, diabetes, hyperlipidemia, colon disease and constipation[10,11]. Recently Khan *et al.* [12] observed cholesterol-lowering effect of Bangla gram in hypertensive patients. Some selected vegetables and fruits have revealed that these indigenous vegetables contained moderate amount of non-dietary fiber[13,14].

Though, it is now clearly established that the fiber component of the leafy vegetables (diet) is nutritionally important but whether the quantity or the quality or both are more important is unknown and a subject of intensive study in recent period of time. The important to determine nutrients content and the content of dietary fiber in our leafy vegetables food draw attention of the researchers in the field. The present study was to investigate the nutritive values such as moisture; ash, protein, fat, carbohydrate and die try fiber component of the leafy vegetables low coast and available in Bangladesh.

MATERIALS AND METHODS

Collection of samples: Fifteen leafy vegetables samples were collected from local market of Rajshahi as well as

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from fields of the farmer between October and January 2002. These are Pui leaves (*Basella alba* L.), Jute leaves (*Corchorus olitorius* L.), Lettuce leaves (*Laetuca sativa* L.), Ipomoea leaves (*I. reptans* Poir.), Napa leaves (*Malva verticillata* L.), Amaranthus leaves red (*Amaranthus tricolor* L.), Spinach (*Spinacea olerace* L.), Amaranthus leaves (*Amaranthus tricolor* L.), Radish leaves (*Raphanus sativus* L.), Bottle gourd leaves (*Lageneria siceraria)*, Carrot leaves (Daucus carota), Cabbage leaves (*Brassica oleracea* var.), Drumstick leaves (*Moringa oleifera* L.), Khesari leaves (*Lathyrus sativus* L.) and Bengal germ leaves (*Cicer arietinum* L.). Nine samples (Pui leaves, Ipomoea leaves, Lettuce leaves, Napa leaves, Amaranthus leaves red, Spinach, Bottle gourd leaves, Amaranthus leaves, Carrot leaves) were collected form Nawhata Agricultural farm, Rajshahi, Bangladesh and six (Jute leaves, radish leaves, Cabbage leaves Drumstick leaves, Khesari leaves, Bengal germ leaves.) from local Shaheb Bazzar market. They are selected at random from the stock lot of the farmer and seller. Samples were collected during the pick season. After collection the samples, washed with tap water, shorted mature one and cut into small pieces and then dried in air for 2 h and then dried at 105°C in an oven for 8-10 h. The dried samples were then blended in a grinder machine (Jamboo, India) and filter through a 40 mm sieve. The samples powdered were then stored in desiccators with plastic packets.

Analytical procedures: Samples of each variety were chemically analyzed to find their proximate values (moisture, ash, protein, fat, carbohydrate and dietary fibre). The edible portions of fresh vegetables (5.0 g) were taken in a crucible and the moisture content was determined by weight loss of the sample on drying at 105°C for 8 h[15]. The sample was charred and ashes to a constant weight, the residue being quantified as ash by AOAC official method 942.05[16] and crude fibre content was determined by ICMR[26]. Using N x 6.25 calculated protein content from total nitrogen after determination of the total nitrogen by semi-micro Kjeldhal method[16]. Total lipid content was determined through Evaporating Method describe by Bligh and Dyer[17]. The nitrogen free extracts (NFE) were considered as total carbohydrate and was calculated by the following equation:

$$\text{Carbohydrate (g 100 g}^{-1}\text{)} = 100\text{-(moisture+protein+lipid+fiber+ash) g 100 g}^{-1}$$

Dietary fiber was determined by estimation of Neutral Detergent Fiber and Acid Detergent Fiber by the method of Van Soest[18], Van Soest and Wing[19].

The Neutral Detergent Fiber method depends on the extraction of the food with hot neutral solution of a detergent, Sodium Lauryl Sulfate.

The Acid Detergent Fiber method of Van Soest[18] was adopted in the present study with minor modification [addition of dicahydtophthalen (decalin) in the refluxing procedure has been omitted].

RESULTS AND DISCUSSION

Table 1 represents the local and botanical name of selected leafy vegetables used for this research work. The proximate composition of moisture content of the leafy vegetables studied was found to range between 76.52 to 92.44 g 100 g^{-1} (Table 2). Among leafy vegetables the lowest value of moisture in Jute leaves (*Corchorus olitorius* L.) 76.52 g 100 g^{-1} and the highest value Pui leaves (*Basella alba* L.) 92.44 g 100 g^{-1}, respectively. Table 2 also show the ash and fibre content of different varieties of leafy vegetables studied. Ash content in leafy vegetables varied between 0.9 to 1.8 g 100 g^{-1}. Ash content in Ipomoea leaves (*I. reptans* Poir.) is the lowest (0.9 g 100 g^{-1}) and the highest amount in Jute leaves (1.8 g 100 g^{-1}). The fibre content in the leafy vegetables sample analyzed was found to range between 5.57 to 10.8 g 100 g^{-1}. Among leafy vegetables the lowest value of fibre in Bengal germ leaves (*Cicer arietinum* L.) 5.57 g 100 g^{-1} and the highest value Jute leaves (*Corchorus olitorius* L.) 10.8 g 100 g^{-1}, respectively.

It is generally believed that leafy vegetables are not rich in nutrients. Vegetables and fruits have a high water content and low protein, carbohydrate, fat content leading to low energy density[20].

From the present studied protein, fat and carbohydrate contents in different leafy vegetables varies from 1.67 to 6.5, 0.09 to 1.5 and 3.3 to 12.57 g 100 g^{-1},

Table 1: Local and botanical name of selected leafy vegetables

Leafy vegetables	Local name	Botanical name
Pui leaves	Pui shak	*Basella alba* L.(Basellaceae)
Jute leaves	Pat Shak	*Corchorus olitorius* L. (Tiliaceae)
		Corchorus capsularis L. (Tiliaceae)
Lettuce leaves	Lettuce shak	*Laetuca sativa* L.
Ipomoea leaves	Kalmi shak	Ipomoea aquatica Forsk (convol.)
		(*I. reptans* Poir.)
Napa leaves	Napa shak	*Malva verticillata* L. (Malvaceae)
Amaranthus leaves red	Lal shak	*Amaranthus tricolor* L. (Amaranth)
Spinach	Palong shak	*Spinacea olerace* L. (Chenopodiaceae)
Amaranthus leaves	Data shak	*Amaranthus tricolor* L.
Radish leaves	Mula shak	*Raphanus sativus* L. (Ranunculaceae)
Bottle gourd leaves	Lau shak	*Lageneria siceraria* (Mol.)
		(*L. vulgaris* Ser.) (legum)
Carrot leaves	Ghazor shak	Daucus carota
Cabbage leaves	Pata-kopi	*Brassica oleracea* var. (gemmifera)
Drumstick leaves	Kachu shak	*Moringa oleifera* L.
Khesari leaves	Kashari shak	*Lathyrus sativus* L.
Bengal germ leaves	Motor shak	*Cicer arietinum* L.

Table 2: Mean ± SD of moisture, ash and fiber content of leafy vegetables

Leafy vegetables	Local name	Moisture (g 100 g^{-1} dry sample)	Ash (g 100 g^{-1} dry sample)	*Fiber (g 100 g^{-1} dry sample)
Pui leaves	Pui shak	92.44±2.50	1.1	6.90±0.15
Jute leaves	Pat Shak	76.52±1.89	1.8	10.80±1.05
Lettuce leaves	Lettuce shak	92.23±1.24	1.2	9.92±0.12
Ipomoea leaves	Kalmi shak	90.23±1.55	0.9	8.00±0.99
Napa leaves	Napa shak	86.97±2.05	1.02	7.98±0.79
Spinach	Palong shak	90.98±2.15	0.98	6.87±0.99
Amaranthus leaves	Data shak	85.86±2.55	1.0	8.12±0.75
Amaranthus leaves red	Lal shak	87.03±2.05	1.1	7.12±0.66
Radish leaves	Mula shak	89.90±0.98	0.92	7.54±0.40
Bottle gourd leaves	Lau shak	87.92±1.21	0.97	8.95±0.45
Carrot leaves	Ghazor shak	86.54±0.77	1.2	7.83±0.25
Cabbage leaves	Pata-kopi shak	90.32±1.07	0.91	8.90±0.89
Drumstick leaves	Kachu shak	76.54±0.99	1.3	5.98±0.86
Khesari leaves	Kashari shak	84.50±1.45	1.0	7.90±0.42
Bengal germ leaves	Motor shak	77.25±2.10	1.2	5.57±0.85

*Acid detergent fiber (ADF) content

Table 3: Mean ± SD of nutrients content of leafy vegetables

Leafy vegetables	Local name	Protein (g 100 g^{-1} dry sample)	Carbohydrate (g 100 g^{-1} dry sample)	Fat (g 100 g^{-1} dry sample)
Pui leaves	Pui shak	2.23±0.8	4.22±0.9	0.15±0.09
Jute leaves	Pat Shak	2.56±0.5	12.57±1.2	0.19±0.07
Lettuce leaves	Lettuce shak	2.10±0.4	3.80±0.54	0.35±0.09
Ipomoea leaves	Kalmi shak	2.78±0.8	9.44±0.96	0.92±0.10
Lettuce leaves	Lettuce shak	2.10±0.5	5.50±0.8	1.00±0.9
Spinach	Palong shak	3.32±0.5	3.95±0.45	0.09±0.06
Amaranthus leaves	Data shak	1.76±0.7	3.30±0.32	0.19±0.02
Amaranthus leaves red	Lal shak	5.34±1.2	4.96±0.3	0.14±0.02
Radish leaves	Mula shak	1.67±0.9	3.95±0.6	0.90±0.05
Bottle gourd leaves	Lau shak	2.30±0.54	6.10±0.85	0.70±0.04
Carrot leaves	Ghazor shak	5.10±0.66	6.40±0.54	0.60±0.02
Cabbage leaves	Pata-kopi shak	1.80±0.7	6.30±0.45	0.21±0.08
Drumstick leaves	Kachu shak	6.20±0.88	11.80±1.4	1.50±0.9
Khesari leaves	Kashari shak	6.10±0.68	5.40±0.96	1.00±0.55
Bengal germ leaves	Motor shak	6.50±0.92	9.20±1.12	1.30±0.06

Table 4: Mean ± SD of dietary fiber content of leafy vegetables

Leafy vegetables	Neutral detergent fiber* (g 100 g^{-1} dry sample)	Hemicellulose (g 100 g^{-1} dry sample)	Cellulose (g 100 g^{-1} dry sample)	Lignin (g 100 g^{-1} dry sample)
Pui leaves	25.53±0.75	15.98±0.57	6.12±0.12	3.35±0.11
Jute leaves	39.98±1.30	22.76±1.02	11.09±0.45	6.01±0.24
Lettuce leaves	35.78±0.99	29.90±1.12	4.05±0.55	2.98±0.35
Ipomoea leaves	31.54±0.89	19.40±0.95	9.45±0.43	3.12±0.10
Napa leaves	24.98±1.00	15.12±0.75	9.05±0.33	1.09±0.05
Spinach	42.12±1.02	32.24±0.88	7.96±0.25	2.46±0.08
Amaranthus leaves	32.55±0.98	21.80±0.98	9.32±0.46	1.25±0.09
Amaranthus leaves red	25.78±1.02	17.26±0.45	7.55±0.35	1.87±0.07
Radish leaves	47.50±2.25	33.90±0.75	9.12±0.24	0.87±0.02
Bottle gourd leaves	37.90±0.89	29.89±0.95	7.77±0.54	1.89±0.08
Carrot leaves	40.54±1.25	30.25±1.02	7.98±0.14	1.78±0.05
Cabbage leaves	37.43±0.67	19.50±0.45	9.59±0.44	3.19±0.66
Drumstick leaves	40.25±0.79	23.50±0.75	5.65±0.32	2.58±0.34
Kashari leaves	41.09±0.88	30.25±0.65	6.89±0.12	2.06±0.09
Bengal germ leaves	41.23±0.99	29.55±0.75	7.12±0.24	1.80±0.05

*Neutral detergent fiber (NDF) content

respectively. Highest protein content leafy vegetable is Bengal germ leaves 6.5 g 100 g^{-1} and lowest is Radish leaves 1.67 g 100 g^{-1}. Among leafy vegetables the lowest value of fat in Spinach (*Spinacea olerace* L.) 0.09 g 100 g^{-1} and the highest value Drumstick leaves (*Moringa oleifera* L.) 1.5 g 100 g^{-1}, respectively. Carbohydrate content in Amaranthus leaves (*Amaranthus tricolor* L.) is the lowest (3.3 g 100 g^{-1}) and the highest amount in Jute leaves (*Corchorus olitorius* L.) (12.57 g 100 g^{-1}). The result obtained from the studied are more or less consistent with that of previous studies[21].

Among all studied leafy vegetables the highest amount of Neutral Detergent Fiber (47.50 g 100 g^{-1}) was estimated in Radish leaves. While lowest amount of Neutral Detergent Fiber (24.98 g 100 g^{-1}) was contained by Napa shak. From the resulted data the dietary fiber content of all leafy vegetables were considerably higher than the values reported for crude fiber[25,21]. Spinach

leaves has been reported to content 29.05% NDF on dry weight basis, 3.34% NDF on fresh weight basis and 40.67% NDF on boiled form[22]. Our estimation showed a very high amount of DF (43.9% of dry matter) in plank shak.

Mohmod[13] reported that on dry weight basis NDF contents of Lal shak and Lau shak were 25.47% and 20.0%, respectively (calculated from fresh weight). Our finding was similar to Lal shak (25.78%) and Lau (37.9%). This may be due to difference in the variety or cultivars between the studies.

Factors such as plant species, stage of plant maturity and parts of plant have a strong influence on the chemical composition of food fiber. The proportion of various dietary fiber components as well as their individual chemical composition varies considerably from food to food[23]. It has been reported that cellulose is high in vegetables and some fruits, while proportion of lignin is highest in fruits[23]. Cellulose content varied between highest Jute leaves 11.09 g 100 g^{-1} to lowest Bathua leaves 4.05 g 100 g^{-1}, hemicellulose content varied between highest Radish leaves 33.90 g 100 g^{-1} to lowest Napa leaves 15.12 g 100 g^{-1} and lignin varied between Jute leaves highest 6.01 g 100 g^{-1} to lowest Radish leaves 0.87 g 100 g^{-1}. The cellulose, hemicellulose and lignin contents of the leafy vegetables when examined with respect to other reported values indicated that spinach contained ADF (11.67%), cellulose (8.56%) and lignin (3.11 %)[24] which are similar to the estimated values in the present study (ADF 10.59%, cellulose 8.23% and lignin 2.54%, respectively). Hemi cellulose content was estimated to 33.9%, which is much more higher than the reported value (15.83%)[22].

This present study was conducted to analyze the important nutrients content and composition of dietary fiber of some Bangladeshi common and chiefly leafy vegetables. Present finding in this regard may be helpful for health professional, dietitians and nutrition planners of our country.

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