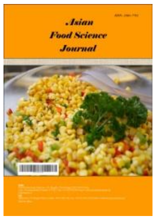

Asian Food Science Journal

18(4): 19-26, 2020; Article no.AFSJ.59072
ISSN: 2581-7752

Comparative Study of the Proximate and Dietary Fibre Compositions of Some Leafy Vegetables Commonly Consumed in the Niger Delta Region, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author CAO designed the study, performed the statistical analysis and wrote the protocol. Authors YEA and CIU managed the analyses of the study. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AFSJ/2020/v18i430224
Editor(s):
(1) Dr. Amjad Iqbal, Abdul Wali Khan University Mardan, Pakistan.
Reviewers:
(1) Subodh Kumar Tripathy, Anchal College, India.
(2) M. K. Poonia, Agriculture University Jodhpur, India.
Complete Peer review History: http://www.sdiarticle4.com/review-history/59072

Original Research Article

Received 20 May 2020
Accepted 25 July 2020
Published 07 November 2020

ABSTRACT

Objective: The objective of this study was to carry out a comparative proximate and dietary fibre analysis of some leafy vegetables commonly consumed in the Niger Delta region, Nigeria.
Methodology: The selected vegetables were Ugu leaf *(Telfairia occidentalis)*, Water leaf *(Talinum triangulare)*, Bitter leaf *(Vernonia amygdalina)*, *Scent leaf (Ocimum gratissimum)* and Green leaf *(Spinacia oleracea*). These leaves were harvested from the University school farms of University of Uyo, Akwa Ibom, Rivers State University and Delta State University to represent the Niger Delta region of Nigeria. The samples were analyzed for proximate composition and dietary fibres using standard methods.

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Results: Moisture, ash, fat, crude protein, crude fibre and carbohydrate contents of the leafy vegetables ranged from 70.95-92.11%, 1.90-5.18%, 0.07-1.47%, 1.54-8.78%, 1.90-7.89% and 1.42-10.54%, respectively. Total dietary and insoluble fibres of the vegetables grown in Niger Delta regions of Nigeria ranged from 4.10-23.12%. Dietary fibre of pumpkin leaves grown in Rivers and Akwa Ibom states as well as scent leaf from Rivers state were significantly ($p<0.05$) higher than vegetables from other states.

Conclusion: The result of this study therefore reveals that the proximate composition and dietary fibre content of the vegetables were significantly ($p<0.05$) affected by the locations in which they were harvested.

Keywords: Vegetables; proximate; dietary fibre; Niger Delta region.

1. INTRODUCTION

Leafy vegetables occupy an indispensible place in the human diet supplying the body with nutrients, vitamins and certain hormone precursors [1]. They are also cherished because of their colour, flavor and health benefits [2]. They are fresh agricultural produce with high moisture content which makes them highly perishable. They serve as rich sources of vitamins, minerals and vitamins and act as antioxidants in the body. Saidu and Jideobi [3] reported leafy vegetables to be typically low in calories and fat, and high in protein per calorie, dietary fibre, Vitamin C, pro-Vitamin A carotenoids, folate, manganese, and Vitamin K. Inyang [4] further added that the Vitamin K content of leafy vegetables is particularly high, since these are photosynthetic tissues and phylloquinone is involved in photosynthesis.

Most leafy vegetables often come from short-lived herbaceous plants, such as pumpkin, lettuce and spinach. The growing population of many tropical countries had led to awareness of the importance of vegetables as a source of essential nutrients which may not be available in other food sources. Leafy vegetables are usually consumed raw or as cooked complements to major staples such as cassava, plantain, rice and maize. They are also used in the preparation of soups and sauces in Africa.

The term ‘dietary fibre’ is referred to as plant cell wall materials or a class of plant-originated polysaccharides, which cannot be digested and absorbed in the gastrointestinal tract [5,6], however, part of it may be broken down by bacteria in the lower gut [7]. It is found in edible plant foods such as cereals, fruits, vegetables and grains amongst others [8]. It consists of non-starch polysaccharides and other plant components such as cellulose, resistant starch, resistant dextrins, inulin, lignins, chitins, pectins, betaglucans, and oligosaccharides [9]. Dietary fibre helps to keep the digestive systems healthy [10]. It is also important for digestive health and regular bowel movements [11]. Dietary fibre aids in lowering risk bowl cancer, diabetes and coronary heart disease as a result of its ability in stabilizing glucose and cholesterol levels.

Dietary fibre is classified into soluble and insoluble fibre [12]. Soluble fibre absorbs water, turning into a gel-like mush during digestion while insoluble fiber does not absorb water [13]. Soluble fibres are found in oat bran, barley, nuts, seeds, beans, lentils, peas, and some fruits and vegetables. The insoluble fibre is static to digestive enzymes in the upper gastrointestinal tract and is mostly found in foods such as leafy vegetables, wheat bran and whole grains [14]. They add bulk to the stool and also help food pass more quickly through the stomach and intestines [15].

Leafy vegetables are eaten based on the geographical location and the season in which these leaves grow [16]. The amount and kind of dietary fibre content of these vegetables depends on the species, climate, growing conditions, nature of soil and application of natural or artificial manure [17]. The Niger Delta Region of Nigeria is blessed with numerous species of leafy vegetables which are either grown in the forest or cultivated in the rural areas [4]. They include among others, scent leaf, spinach, pumpkin leaf, water leaf. Several researches have been carried out on the proximate, mineral and anti-nutrient composition of leafy vegetables in Niger Delta, Nigeria. Amos-Tautua and Onigbinde [18] evaluated the iron and zinc contents in some vegetables commonly consumed in Amassoma, Niger Delta. Inyang [4] also investigated the nutrient content of lesser known leafy vegetables consumed in Niger Delta while Agbaire and Emoyan [19] evaluated the nutritional and anti-nutritional levels of some local vegetable from

Delta State. However, no reports on the dietary fibre content of these leafy vegetables have been found. This study therefore sought to assess the dietary fibre content of some leafy vegetables commonly consumed in the Niger Delta region.

2. MATERIALS AND METHODS

2.1 Identification and Collection of Samples

Ugu leaf *(Telfairia occidentalis)*, Water leaf *(Talinum triangulare)*, Bitter leaf *(Vernonia amygdalina)*, *Scent leaf (Ocimum gratissimum)* and Green leaf *(Spinacia oleracea)* were harvested during the rainy season in May, 2019. The locations of harvest were: Rivers State University School farm; University of Uyo school farm, Akwa Ibom State and Delta State University school farm, Abraka to represent the Niger Delta region of Nigeria in May, 2019. Identification of the plant materials was done by a crop scientist in the department of Crop and Plant Science, Rivers State University, to ascertain that the right materials were used for the research. All chemicals used were of analytical grade.

2.2 Preliminary Preparation of the Leaves

The leaves were harvested from the school farms in the three states randomly picked to represent the Niger Delta region. They were wrapped with paper, bagged in polyethylene bags and transported to the Laboratory of Food Science and Technology, Rivers State University for analysis. They were stored at room temperature during the analysis.

2.3 Determination of Proximate Composition of Leaves

Moisture content, ash, crude protein, crude fat and crude fibre of each leaf sample was carried out using the AOAC [20] method. Carbohydrate content was determined by difference of moisture, protein, fat, ash and crude fibre from 100%.

2.4 Determination of Dietary Fibre Content of Leaves

Dietary fibre contents of each leaf sample were carried out according to standard methods of analysis [20]. The leaf sample components that were determined were insoluble, soluble and total dietary fibre.

2.4.1 Determination of residue and filtrate

One gram (1 g) of each sample was washed into two different beakers and 40 ml of buffer (pH 8.2) added to it. 0.1 ml of heat stable fungal and amylase was also added and incubated for 15 minutes at 95-100°C and then allowed to cool to 60°C. pH was adjusted to 7.5 using 0.1N NaoH. 0.1ml of protease (pepsin enzyme solution) was then added an incubated for 30mins at 60°c. The digest was then filtered into a pre-weighed filter paper and the residue washed twice with 10ml of water. Residue was used for insoluble fibre determination and filtrate + washings used for soluble fibre determination.

2.4.2 Determination of insoluble fibre content

Residue was washed with 10 ml of 95% ethanol twice and 10 ml of acetone twice. The washed residue was dried with filter paper in the oven at 105°C for 1 hour, then allowed to cool and filter paper + residue weighed. One of the residue was ashed (at 525°C for at least 1 hr or more and the weight of ash was noted). A blank of the filter paper was done while the residual protein on the other duplicate was determined and a blank also done. The insoluble fibre content was calculated.

$$\text{Insoluble fibre (\%)} = \frac{\frac{R1+R2}{2} - P - A - B}{(M1+M2)/2} \times 100$$

Where;

R_1=Residue from 1st duplicate (g), R_2=Residue from 2nd duplicate (g), P=Protein content (g), A=Ash content (g), M_1=Weight of sample that generated residue 1, M_2=Weight of sample that generated residue 2, B= Blank

2.4.3 Determination of soluble fibre content

Filtrate and washings were brought to 80 g with distilled water. 320 ml of 95% ethanol was added to it and preheated to 60°C. It was then allowed to stand for 1 hr at room temperature (37^{o}C) for precipitate formation. The precipitate was filtered and collected into a pre-weighed filter paper then washed (precipitate residue) with 20 ml 78% ethanol thrice and also washed with 10 ml 95% ethanol twice. The residue was then washed with 10 ml acetone twice and the residue oven dried. One of the duplicates was ashed and the weight of ash noted. The residual protein on the other duplicate was determined (N × 6.25) and the soluble fibre content was calculated

$$\text{Soluble fibre (\%)} = \frac{\frac{R1+R2}{2} - P - A}{(M1+M2)} \times 100$$

R_1=Residue from 1st duplicate (g), R_2=Residue from 2nd duplicate (g), P=Protein content (g), A=Ash content (g), M_1=Weight of sample that generated residue 1, M_2=Weight of sample that generated residue 2.

2.4.4 Determination of total dietary fibre content

Total dietary fibre content was determined by adding the soluble and insoluble fibre content.

Total dietary fibre=

$$\frac{\frac{R1+R2}{2} - P - A}{(M1+M2)} \times 100 + \frac{\frac{R1+R2}{2} - P - A - B}{(M1+M2)/2} \times 100$$

2.5 Statistical Analysis

The analysis was carried out in triplicate and data obtained were subjected to Analysis of Variance (ANOVA) using minitab®, version 16 software. Significant in mean values were calculated by Turkey's Test at 5% level of probability.

3. RESULTS AND DISCUSSION

3.1 Proximate Composition of the Leafy Vegetables

The proximate compositions of leafy vegetables are presented in Table 1. Moisture content of the vegetables ranged from 70.95% in pumpkin leaf grown in Delta state to 92.11% in water leaf grown in Delta state. Amongst the bitter leaves, moisture content of bitter leaf grown in Akwa Ibom (80.78%) and Delta states (82.20%) were significantly higher ($p<0.05$) than that grown in Rivers state (78.37%). Amongst green leaves from the three states, that grown in Akwa Ibom (83.23%) and Rivers states (83.58%) were significantly higher ($p<0.05$) than that grown in Delta state (79.02%). Pumpkin leaves grown in Akwa Ibom state (84.84%) was significantly ($p<0.05$) higher than that grown in Delta (70.95%) and Rivers states (77.03%). The moisture contents of the vegetables are comparable to those reported in Minna, Northern area of Nigeria, for *Talinum triangulare* (water leaf) and slightly higher than *Telferiria occidentalis* (91.6%) and bitter leaf (*Vernonia amygdalina*) (87.7%) as reported by Saidu and Jideobi [3]. Variation in the composition of the moisture is attributed to location, soil, variety, maturity and the cultural practices adopted during planting [10]. The relatively high moisture contents in these vegetables especially for water leaves from the three locations reveal that these vegetables need care for appropriate preservation as they would be prone to deterioration [9]. High moisture content may induce a greater activity of water soluble enzymes and co-enzymes involved in metabolic activities of these leafy vegetables [11].

Ash content of the vegetables ranged from 1.90% in water leaf grown in Akwa Ibom state to 5.18% in pumpkin leaf grown in Delta state. Amongst bitter and water leaves from the three states, those grown in Rivers state (4.14% and 2.48%, respectively) was significantly higher ($p<0.05$) than those grown in Akwa Ibom (2.23% and 1.90%) and Delta states (2.19% and 1.98%, respectively). For green and pumpkin leaves, those grown in Delta state (4.30% and 5.18%, respectively) was significantly higher ($p<0.05$) than those grown in Akwa Ibom (3.27% and 2.05%, respectively) and Rivers States (3.15% and 2.37%, respectively). For scent leaves, those grown in Delta state (3.22%) and Rivers State (2.82%) were significantly higher than that grown in Akwa Ibom State. The high ash content in some of these vegetables is of significance as the amount of ash shows the richness of food in terms of mineral composition. Ash values for the vegetables are however low as compared with those obtained by Saidu and Jideobi [3] for water leaf (*Talinum triangulare* as 1.6%), Fluted pumpkin (*Telferiria occidentalis* as 2.2%) and bitter leaf (*Vernonia amygdalina*as 2.5%). The factors responsible for the variation in ash content of the vegetables might be linked to growing conditions, nature of soil and application of natural or artificial manure.

Fat content of the vegetables ranged from 0.07% in green leaf grown in Akwa Ibom state to 1.47% in pumpkin leaf grown in Delta state. Bitter leaf grown in Delta state (0.94%) was significantly higher ($p<0.05$) than those grown in Akwa Ibom (0.07%) and Rivers states (0.08%). Green leaf grown in Delta state (0.69%) was significantly higher ($p<0.05$) than those grown in Akwa Ibom (0.06%) and Rivers state (0.17%). Amongst the pumpkin leaves grown in the three states, fat content of pumpkin grown in Delta state (1.47%)

Table 1. Proximate composition of the leafy vegetables

Samples	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Crude fibre (%)	Carbohydrate (%)
ASBL	80.78 ± 0.39^{def}	4.16 ± 0.04^{de}	0.07 ± 0.06^{d}	2.23 ± 0.05^{efg}	2.33 ± 0.03^{fg}	10.43 ± 0.38^{a}
ASGL	83.23 ± 0.20^{bcd}	4.61 ± 0.11^{d}	0.056 ± 0.02^{d}	3.27 ± 0.06^{c}	2.16 ± 0.12^{fg}	6.68 ± 0.50^{bcd}
ASPL	84.84 ± 1.85^{b}	5.68 ± 0.05^{c}	0.443 ± 0.10^{cd}	2.05 ± 0.01^{efg}	2.84 ± 0.28^{ef}	4.14 ± 1.49^{ef}
ASSL	80.92 ± 0.11^{de}	4.03 ± 0.03^{g}	0.29 ± 0.04^{cd}	2.31 ± 0.00^{efg}	1.91 ± 0.04^{fg}	10.54 ± 0.14^{a}
ASWL	93.17 ± 0.18^{a}	1.59 ± 0.04^{ef}	0.08 ± 0.01^{d}	1.90 ± 0.02^{g}	0.83 ± 0.08^{g}	2.44 ± 0.05^{fg}
DSBL	82.20 ± 0.59^{cd}	3.53 ± 0.33^{f}	0.94 ± 0.12^{b}	2.19 ± 0.22^{efg}	3.39 ± 0.63^{def}	7.76 ± 0.03^{bcd}
DSGL	79.02 ± 0.09^{efg}	5.55 ± 0.02^{c}	0.69 ± 0.10^{bc}	4.30 ± 0.06^{b}	4.89 ± 0.47^{bcd}	5.55 ± 0.37^{de}
DSPL	70.95 ± 1.43^{h}	8.78 ± 0.48^{a}	1.47 ± 0.58^{a}	5.18 ± 0.49^{a}	7.89 ± 1.92^{a}	5.73 ± 1.01^{cde}
DSSL	79.48 ± 0.04^{ef}	4.40 ± 0.21^{de}	0.70 ± 0.10^{bc}	3.22 ± 0.01^{c}	5.05 ± 0.58^{bcd}	7.15 ± 0.51^{bcd}
DSWL	92.11 ± 0.23^{a}	1.89 ± 0.02^{g}	0.44 ± 0.06^{cd}	1.98 ± 0.02^{fg}	1.47 ± 0.48^{fg}	2.12 ± 0.70^{fg}
RSBL	78.37 ± 0.55^{fg}	4.32 ± 0.08^{de}	0.08 ± 0.01^{d}	4.14 ± 0.08^{b}	4.46 ± 0.13^{cde}	8.64 ± 0.51^{ab}
RSGL	83.58 ± 0.68^{bc}	4.32 ± 0.25^{de}	0.169 ± 0.02^{d}	3.15 ± 0.12^{c}	2.92 ± 0.33^{ef}	5.86 ± 0.22^{cde}
RSPL	77.03 ± 1.73^{g}	7.47 ± 0.18^{b}	0.20 ± 0.03^{d}	2.37 ± 0.14^{def}	6.61 ± 0.20^{ab}	6.33 ± 1.63^{bcde}
RSSL	79.29 ± 0.35^{efg}	4.06 ± 0.03^{ef}	0.28 ± 0.07^{cd}	2.82 ± 0.01^{cd}	5.57 ± 0.96^{bc}	7.99 ± 1.34^{bc}
RSWL	92.49 ± 0.03^{a}	1.54 ± 0.00^{g}	0.17 ± 0.03^{d}	2.48 ± 0.13^{de}	1.90 ± 0.08^{fg}	1.42 ± 0.00^{g}

Values are means ± standard deviation of triplicate samples. Mean values bearing different superscripts in the same column differ significantly (p<0.05)

Key: ASBL = Akwa Ibom State Bitter Leaf; ASGL = Akwa Ibom State Green Leaf; ASPL = Akwa Ibom State Pumpkin Leaf; ASSL = Akwa Ibom State Scent Leaf; ASWL = Akwa Ibom State Water Leaf; DSBL = Delta State Bitter Leaf; DSGL = Delta State Green Leaf; DSPL = Delta State Pumpkin Leaf; DSSL = Delta State Scent Leaf; DSWL = Delta State Water Leaf; RSBL = Rivers State Bitter Leaf; RSGL = Rivers State Green Leaf; RSPL= Rivers State Pumpkin Leaf; RSSL= Rivers State Scent Leaf; RSWL= Rivers State water Leaf

was significantly higher ($p<0.05$) than that grown in Akwa Ibom (0.44%) and Rivers states (0.20%). Fat content of scent and water leaves from the three states were significantly ($p<0.05$) similar. The differences in fat content of the leafy vegetables grown in the three states could also be due to growing conditions, nature of soil and application of natural or artificial manure. The results obtained from this study for fat content of water leaf grown in Delta state agrees well with 0.4% for water leaf reported by Saidu and Jideobi [3] while fat content of water leaves grown in other states were low. Results from this study on fat content of pumpkin leaf grown in Delta state is higher than 0.3% obtained by Saidu and Jideobi [3]. They also reported 0.7% for bitter leaf which is close to the findings of this study for Delta state bitter leaf but lower for bitter leaves from other states. The low fat contents of some of these vegetables could be advantageous for individuals suffering from obesity and other related diseases. This result agrees with the report by Inyang [4] that leafy vegetables are low lipid containing food, and this may be an advantage for people suffering from obesity. Adeniyi et al. [21] stated that health disorders such as appendicitis, haemorrhoids, gallstones, heart diseases and constipation are either corrected or treated by copious consumption of vegetables because of the low fat contents.

Crude protein content of the vegetables from the three states ranged from 1.54% in water leaf grown in Rivers state to 8.78% in pumpkin leaf grown in Delta state. Bitter leaves grown in Akwa Ibom and Rivers states had protein contents (4.16% and 4.32%, respectively) significantly higher ($p<0.05$) than that grown in Delta state (3.53%). Green leaves grown in Rivers state (5.55%) was significantly higher ($p<0.05$) in protein than that grown in Akwa Ibom and Rivers states (4.61% and 4.32%, respectively). There was a significant difference in the protein content of pumpkin leaves grown in the three states with pumpkin leaf grown in Delta state (8.78%) showing significantly higher protein content than others. Scent leaves grown in Delta and Rivers state (4.40% and 4.06%, respectively) were significantly higher ($p<0.05$) higher than scent leaf grown in Akwa Ibom (4.03%). Protein content of water leaf grown in Delta state (1.89%) was significantly higher ($p<0.05$) than that grown in Rivers Ibom states (1.54% and 1.59%, respectively). These differences could be attributed to the type of soil, growing conditions of these vegetables and nature of manure type used during cultivation. Protein content of the bitter leaves and pumpkin leaves from this study is higher than 2.4% and 2.10%, respectively reported by Saidu and Jideobi [3] for bitter leaves grown in Minna and Environ of Nigeria. Protein content of water leaves from this study is however lower than 2.52% reported by Saidu and Jideobi [3] for water leaves grown in Minna, Northern part of Nigeria. Protein content of the vegetables (except for water leaf) is higher than *C. crepidioides* (3.22%) as reported by

Adeniyi et al. [21]. This suggests that the leafy vegetables (scent leaf, bitter leaf, pumpkin leaf and green vegetables) from the three states investigated are good sources of proteins and could play a significant role in providing cheap and available proteins for rural communities.

Crude fibre content of vegetables from the three states ranged from 1.90% in water leaf grown in Rivers state to 7.89% in pumpkin leaf grown in Delta state. Crude fibre content of bitter leaf grown in Rivers (4.45%) and Delta states (3.39%) was significantly higher than that grown in Akwa Ibom (2.327%). Crude fibre of green leaf grown in Delta state (4.89%) was significantly higher than those grown in Akwa Ibom (2.16%) and Rivers state (2.92%). Pumpkin and bitter leaves grown in Delta and Rivers states were significantly higher than that grown in Akwa Ibom state while no significant difference ($p>0.05$) was observed for water leaves grown in the three states. The crude fibre contents of the vegetables (except water leaf) were higher than 1.44% for *S. nigrum* and 1.68% in *S. biafrae* as reported by Adeniyi et al. [21]. The crude fibre content of the vegetables differed significantly ($p<0.05$) among the three locations of study and this could be linked to species, growing conditions and nature of soil. The high crude fibre content in scent leaf, pumpkin leaf and bitter leaf from Rivers and Delta states as well as well as green vegetable from Delta state may be employed in the management of diabetes, obesity, colon cancer and gastrointestinal disorder [4].

Carbohydrate content of the vegetables ranged from 1.42% in water leaf grown in Rivers state to 10.54% in scent leaf grown in Akwa Ibom state. Carbohydrate content of bitter leaf grown in Akwa Ibom and Rivers states (10.43% and 8.64%, respectively) were significantly higher ($p<0.05$) than that grown in Delta state (7.756%). Carbohydrate content of green, water and pumpkin leaves grown in the three states were significantly ($p<0.05$) similar while carbohydrate content of scent leaf grown in Akwa Ibom state (10.54%) was significantly higher ($p<0.05$) than those grown in Delta and Rivers state (7.15% and 7.99%, respectively). Carbohydrate content of water leaves grown in the three locations were lower than 4.3% reported by Saidu and Jideobi [3] for water leaf grown in Minna and Environs, Northern Nigeria. They also reported 4.3% for bitter leaf and 4.4% for pumpkin leaf of which it is lower than what is obtained from this study for all the locations. The carbohydrate content of the vegetables were low and this agrees with the statement of Adeniyi et al. [21] that low carbohydrate contents of the vegetables are a common phenomenon with leafy vegetables in Nigeria and West Africa. These vegetables contribute very little to the energy values of meals since they are also low in fat and protein contents, they contribute very little to the energy values of meals making them ideal for the obese and diabetics who can satisfy their appetites without consuming much carbohydrate and, at the same time, control their weight and health.

3.2 Dietary Fibre Content of the Leafy Vegetables

The dietary fibre content of the leafy vegetables is presented in Table 2. Total dietary and insoluble fibres of the vegetables grown in Niger Delta regions of Nigeria ranged from 4.10-23.12% with pumpkin leaves grown in Akwa Ibom showing the highest while that grown in Delta state was lowest. Total dietary fibre of pumpkin leaf grown in Akwa Ibom state was significantly higher ($p<0.05$) than all other vegetables except for pumpkin grown in Rivers state. Dietary fibre content of scent leaf grown in Rivers state (20.0%) was significantly higher ($p<0.05$) while those grown in Delta and Akwa Ibom states were significantly ($p<0.05$) similar. Among water leaves grown in the three states, insoluble and total dietary fibre of water leaf grown in Rivers state was higher, with significant differences ($p>0.05$) observed. Among bitter leaves grown in the three states, bitter leaf grown in Delta state had total dietary fibre significantly ($p<0.05$) higher than others.

Among green leaves grown in the three state, total dietary fibre of green leaf grown in Rivers state was higher, with significant ($p<0.05$) differences observed. Total dietary fibre of water leaves from this study was lower when compared with 63-79g/100g and 36-42g/100g dry weight for water leaf grown in rainy and dry season as reported by Nuri et al. [14]. The differences observed in the total dietary fibre of the vegetables from the three states is due to variation in the growing conditions, fertilizer used and environmental factors. Nuri et al. [14] reported that proportion of dietary fibre varies among many vegetables affected by some factors including level of maturation, part of plant to be consumed and cultivation practice. It is suggested that healthy adults should eat between 20 and 35 g of dietary food each day [22]. Dietary fibre of pumpkin leaf grown in Rivers and Akwa Ibom states as well as scent leaf from Rivers state may contribute a significant amount

Table 2. Dietary fibres of the leafy vegetables

Samples	Insoluble fibre (%)	Soluble fibre (%)	Total dietary fibre (%)
ASPL	23.12 ± 0.00^{a}	Nil	23.12 ± 0.00^{a}
RSPL	20.71 ± 0.51^{a}	Nil	20.71 ± 0.51^{a}
DSPL	11.73 ± 0.00^{bcd}	Nil	11.73 ± 0.00^{bcd}
ASGL	4.59 ± 0.09^{g}	Nil	4.59 ± 0.09^{bg}
RSGL	4.81 ± 0.04^{fg}	Nil	4.81 ± 0.04^{fg}
DSGL	4.10 ± 0.31^{g}	Nil	4.10 ± 0.31^{g}
ASBL	9.23 ± 1.66^{cde}	Nil	9.23 ± 1.66^{cde}
RSBL	11.21 ± 2.23^{bcd}	Nil	11.21 ± 2.23^{bcd}
DSBL	14.65 ± 0.00^{b}	Nil	14.65 ± 0.00^{b}
ASWL	8.30 ± 0.00^{def}	Nil	8.30 ± 0.00^{def}
RSWL	9.25 ± 1.03^{cde}	Nil	9.25 ± 1.03^{cde}
DSWL	7.08 ± 0.99^{efg}	Nil	7.08 ± 0.99^{efg}
ASSL	12.74 ± 0.00^{bc}	Nil	12.74 ± 0.00^{bc}
RSSL	20.00 ± 3.44^{a}	Nil	20.00 ± 3.44^{a}
DSSL	12.61 ± 0.32^{bc}	Nil	12.61 ± 0.32^{bc}

Values are means ± standard deviation of triplicate samples. Mean values bearing different superscripts in the same column differ significantly (P<0.05)

Key: ASBL = Akwa Ibom State Bitter Leaf; ASGL = Akwa Ibom State Green Leaf; ASPL = Akwa Ibom State Pumpkin Leaf; ASSL = Akwa Ibom State Scent Leaf; ASWL = Akwa Ibom State Water Leaf; DSBL = Delta State Bitter Leaf; DSGL = Delta State Green Leaf; DSPL = Delta State Pumpkin Leaf; DSSL = Delta State Scent Leaf; DSWL = Delta State Water Leaf; RSBL = Rivers State Bitter Leaf; RSGL = Rivers State Green Leaf; RSPL= Rivers State Pumpkin Leaf; RSSL= Rivers State Scent Leaf; RSWL= Rivers State water Leaf

of dietary fibre to the diet due to their significantly high total dietary fibre. Vegetable fibres and total fibre play very important roles in protecting against colorectal cancer [23]. Mahood [24] reported that women with take of vegetable fibres (12.6 g/day) had a 30% decreased risk of hospitalization compared to those with the lowest intake (4.1 g/day). They also reported that men who take 10.3 g/day of dietary fibre had a 32% decreased risk compared to those with a low intake (2.9 g/day).

4. CONCLUSION

The study has showed that the levels of protein, ash, crude fat and crude fibre varied significantly among the vegetables due to the growing conditions and nature of soil of the different states. Pumpkin leaf grown in Delta state contained significantly higher protein, fat, ash and crude fibre than other vegetables grown in Akwa Ibom and Rivers State. This suggests that pumpkin leaf grown in Delta state is a good source of proteins which could play a significant role in providing cheap and available proteins for rural communities in the Niger Delta region. Dietary fibre of pumpkin leaves grown in Rivers and Akwa Ibom states as well as scent leaf grown in Rivers state were significantly higher than vegetables grown in other states indicating that these vegetables from these states may contribute a significant amount of dietary fibre to the diet.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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