

1 **NUTRITIONAL COMPOSITIONS OF SELECTED**
2 **GREEN LEAFY VEGETABLES IN OYO STATE,**
3 **NIGERIA**

6 **ABSTRACT**

7 The nutritional compositions of selected green leafy vegetables obtained from major towns in
8 Oyo State, Nigeria, (March and April) were determined using standard analytical methods for
9 proximate analysis. The following nutrients in percentage were determined; moisture
10 contents, ash, fat, crude fibre and crude protein. The green leafy vegetable used are *Talium*
11 *triangulare*, *Amaranthus hybridus*, *Launaena taraxacifolia* *Ocimum gratissimum*, *Celosia*
12 *argentea*, *Cucuribita maxima*, *Abelimoschus esculentus*, *Solanum macrocarpon*, *Vernonia*
13 *amygdalina* and *Sesamum indicum*. All nutrients were present in appreciable quantities.
14 Moisture contents ranged from $5.33 \pm 0.06\%$ - $8.33 \pm 0.06\%$, ash ($23.07 \pm 0.06\%$ - $61.27 \pm$
15 0.06%), fat ($1.13 \pm 0.06\%$ - $3.37 \pm 0.06\%$), crude fibre ($2.43 \pm 0.12\%$ - $22.03 \pm 0.06\%$), and
16 crude protein ($18.50 \pm 0.10\%$ - $55.23 \pm 0.06\%$). The functional properties of vegetables were
17 close in term of high protein level indicating that they are more nutritious. Also, the level of
18 their ash content showed that the vegetables are very rich in essential minerals for healthy life
19 when compared with one another and recommended dietary allowance (RDA). Thus, there is
20 a need for farmers in the area to engage in dry season vegetable production so as to ensure
21 availability of leafy vegetables throughout the year.

22 Keywords: Oyo state, proximate, nutritional composition, green leafy vegetables.

24 **INTRODUCTION**

25 Vegetables are the fresh and edible portions of herbaceous plants, which can be eaten raw, or
26 cooked^{1,2}. They contain valuable food ingredients which can be successfully utilized to build

27 up and repair the body. Vegetables are valuable in maintaining alkaline reserve of the body.
28 Vegetables can be grouped into edible roots, stems, leaves, fruits or seed. Each group
29 contributes to diet in its own way². Leafy vegetables are regular ingredient in the diet of
30 average Nigerian with their level of consumption; they can provide appreciable amounts of
31 nutritive minerals³. *Amarathus hybridus*, *Celusia argentea*, *Abelmoschus esculentus*, *Talinum*
32 *triangulare*, *Vernonia amygdalina* and *corchorus olitorious* are popular edible vegetables in
33 Nigeria. *Corchorus olitorius* is usually recommended for pregnant women and nursing
34 mothers because it is believed to be rich in iron⁴.

35 Most developing countries depend on starch-based food as the main staple food for the
36 supply of both energy and protein. This account in part for protein deficiency which prevails
37 among the populace as recognized by Food and Agricultural Organization;⁵.

38 Apart from the variety which they add to the menu^{6, 7}, they are valuable sources of nutrients
39 especially in rural areas where they contribute substantially to protein, minerals, vitamins,
40 fibers and other nutrients which are usually in short supply in daily diets⁸. It is worthwhile to
41 note that consumption of numerous types of edible plants as sources of food could be
42 beneficial to nutritionally marginal population especially in developing countries where
43 poverty and climate is causing havoc to the rural populace⁹. African indigenous leafy
44 vegetables (ALVs) are the cheapest and most readily available sources of important proteins,
45 vitamins, especially the pro-vitamin A⁹ and essential amino acids. Vegetables rank higher in
46 production than all other crops; they are known to provide 80% of the vitamin A in diet¹⁰.

47 Indigenous vegetables are reported to play a very important role in income generation and
48 subsistency¹¹. They are important commodities for poor households because their prices are
49 relatively affordable when compared to other food items. Vegetables provide very important
50 sources of employment for those outside the formal sector in urban areas because of their
51 generally short, labour intensive production systems, low levels of investment and high

52 yield¹¹. A large number of African indigenous leafy vegetables have long been known and
53 reported to have health protecting properties and uses¹². It is reported that the roots, leaves
54 and twigs, as well as the bark of the tree of Moringa plants (*Moringa oleifera*) are used in
55 traditional medicine¹³.

56 The WHO recommended a minimum daily intake of 400g of fruits and vegetables¹⁴.
57 However, it is not clear from the report what proportion of this total daily intake should go to
58 vegetables. Nevertheless, according to the Kobe framework document and an FAO report, the
59 recommended total daily intake is equivalent to five (5) servings of 80g each of fruits and
60 vegetables^{15, 16}. Vegetables are full of water, especially when eaten raw, and when eaten, the
61 body does not need to use some of its own water to digest them. This means less pressure is
62 put on the digestive systems¹⁷. Green leafy vegetables like cabbage, lettuce, dandelion, and
63 Moringa may be eaten raw, boiled or dried. Perhaps the most common use in all parts of the
64 world is boiled vegetable leaves. This process eliminates potential pathogens, sometimes
65 poisonous or irritating substances are neutralized and spoilage is brought to a halt¹⁸.

66 In Nigeria, as in most other tropical countries of Africa where the daily diet is dominated by
67 starchy staple foods, vegetables are the cheapest and most readily available sources of
68 important proteins, vitamins minerals and essential amino acids². Vegetables also act as
69 buffering agents for acidic substances produced during the digestion process².

70 Traditional African leafy vegetables are better adapted to the environment than the introduced
71 exotic vegetables and also provide low-cost quality nutrition for large parts of the population
72 in both rural and urban areas¹⁹. Inadequate information on these vegetable species is causing
73 gradual neglect of some of the useful ones that have been used for food over the years.

74 Vegetables are a vital constituent of West African diet, and traditional vegetable species are
75 highly important yet, many species are poorly known, being used only locally²⁰. The
76 objective of this study is to evaluate the nutritional value of some leafy vegetables consumed

77 in Oyo State South West of Nigeria to give more information that are lacking on the
78 importance of these vegetables on the nutrient they supply.

79 **MATERIALS AND METHODS**

80 Eleven leafy vegetables were collected from different locations within the study area (Ibadan,
81 Ogbomoso, Oyo, Igboora, Iseyin, and Saki all in Oyo State) between months of March and
82 April 2016. Vegetable collected includes *Talium triangulare*, *Amaranthus hybridus*,
83 *Launaena taraxacifolia* *Ocimum gratissimum*, *Celosia argentea*, *Cucuribita maxima*,
84 *Abelimoschus esculentus*, *Solanum macrocarpon*, *Vernonia amygdalina* and *Sesamum*
85 *indicum* (English/Common and Local name shown in Table 1). They were identified and
86 authenticated at department of Botany, University of Ibadan, Nigeria. The vegetables were
87 air-dried at room temperature (25°C) and ground to fine powder, using a laboratory mill and
88 stored in air-tight containers for laboratory analysis. The nutritional compositions in terms of
89 proximate analysis were carried out to determine Moisture contents, crude protein, crude
90 fibre, fat, and ash. All analysis was carried out in triplicates.

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93 **NUTRITIONAL ANALYSIS**

94 The moisture content of the vegetable samples was determined after drying at 105 °C in an
95 electric oven (model: UNISCOPE5M9053) until a constant weight was attained²¹. The
96 micro-Kjeldahl method was employed to determine the total nitrogen and the crude protein
97 (N×5.95)²¹. A dry ashing method was used to determine the ash content²¹. The samples were
98 ashed in a furnace (model: SXL) at 550 °C. Crude fat was determined by Soxhlet extraction
99 and crude fiber by incineration method after acid and base digestion.

100 **STATISTICAL ANALYSIS**

101 Three determinations were carried out for each analysis. The mean value and standard
 102 deviation were calculated using statistical software.

103 **RESULTS AND DISCUSSION**

104 Table: 1. Botanical, English/Common and Local name of the vegetable samples

Botanical name	English name	Local name
<i>Amaranthus hybridus</i>	Smooth amaranth	Tete
<i>Talinum triangulare</i>	Water leaf	Gure
<i>Launaena taraxacifolia</i>	Wild lettuce	Yanrin
<i>Ocimum gratissimum</i>	African basil	Efinrin
<i>Cucurbita maxima</i>	Winter squash	Gboro
<i>Ocimum canum</i>	African mint	Marugbo
<i>Celosia argentea</i>	Cocks comb	Soko
<i>Solanum macrocarpon</i>	African eggplant	Igbo/Gbagba
<i>Abelmoschus esculentus</i>	Okro leave	Ilasa
<i>Vernonia amygdalina</i>	Bitter leaf	Ewuro
<i>Sesamum indicum</i>	Sesame	Ekuuku/Morogbo

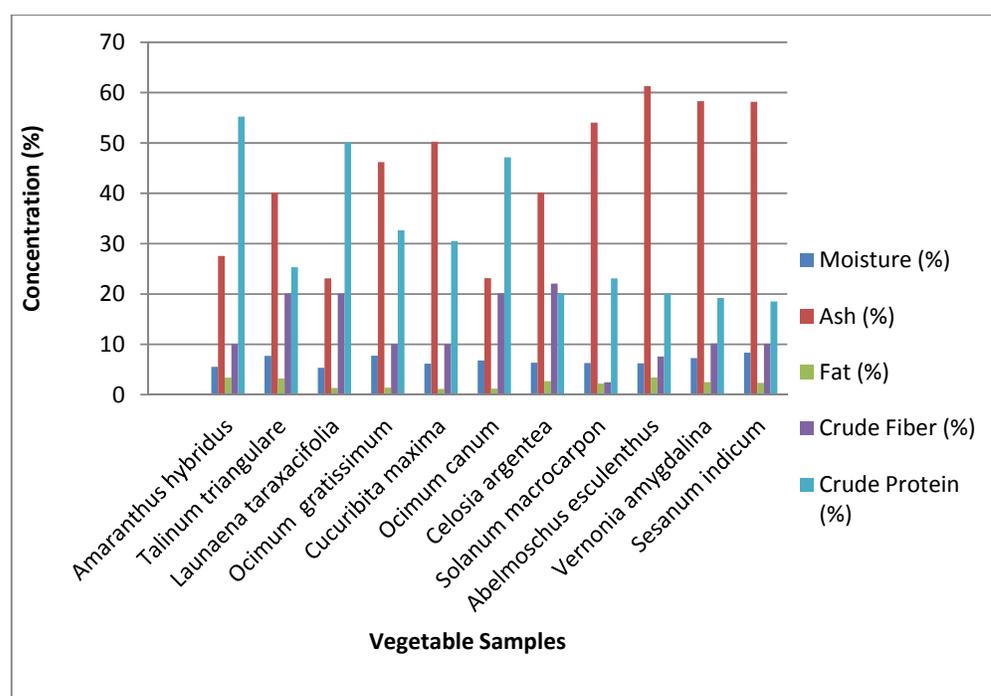
105 Aiyeloja and Bello²²

106 Table: 2. Proximate Composition of green leafy Vegetable Samples

Leafy Vegetables	Moisture (%)	Ash (%)	Fat (%)	Crude Fiber (%)	Crude Protein (%)
<i>Amaranthus hybridus</i>	5.50 ± 0.10 ^b	27.53 ± 0.06 ^a	3.37 ± 0.06 ^a	10.07 ± 0.06 ^a	55.23 ± 0.06 ^a
<i>Talinum triangulare</i>	7.70 ± 0.10 ^b	40.10 ± 0.10 ^b	3.23 ± 0.06 ^a	20.07 ± 0.12 ^b	25.30 ± 0.10 ^b
<i>Launaena taraxacifolia</i>	5.33 ± 0.06 ^a	23.07 ± 0.06 ^a	1.30 ± 0.00 ^a	20.10 ± 0.10 ^a	50.10 ± 0.10 ^b
<i>Ocimum gratissimum</i>	7.73 ± 0.06 ^a	46.2 ± 0.00 ^c	1.37 ± 0.06 ^a	10.10 ± 0.10 ^b	32.63 ± 0.06 ^a
<i>Cucurbita maxima</i>	6.17 ± 0.06 ^a	50.27 ± 0.06 ^a	1.13 ± 0.06 ^a	10.07 ± 0.12 ^a	30.47 ± 0.06 ^a
<i>Ocimum canum</i>	6.77 ± 0.06 ^a	23.13 ± 0.06 ^a	1.20 ± 0.00 ^a	20.13 ± 0.12 ^a	47.13 ± 0.12 ^b

<i>Celosia argentea</i>	6.33 ± 0.06 ^a	40.13 ± 0.06 ^a	2.67 ± 0.06 ^a	22.03 ± 0.06 ^a	20.20 ± 0.17 ^c
<i>Solanum macrocarpon</i>	6.27 ± 0.06 ^a	54.03 ± 0.06 ^a	2.20 ± 0.10 ^b	2.43 ± 0.12 ^b	23.10 ± 0.10 ^b
<i>Abelmoschus esculentus</i>	6.23 ± 0.06 ^a	61.27 ± 0.06 ^a	3.40 ± 0.10 ^b	7.60 ± 0.10 ^b	20.10 ± 0.00 ^c
<i>Vernonia amygdalina</i>	7.27 ± 0.06 ^a	58.33 ± 0.15 ^c	2.47 ± 0.06 ^a	10.17 ± 0.06 ^a	19.20 ± 0.17 ^b
<i>Sesamum indicum</i>	8.33 ± 0.06 ^a	58.17 ± 0.06 ^a	2.33 ± 0.06 ^a	10.13 ± 0.06 ^a	18.50 ± 0.10 ^a

107 Mean values ± Standard deviation values. Values carrying different letter within a column are
 108 significantly different at P>0.05.
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113 Figure: 1. Graphical comparison of vegetables nutritional composition in percentage.

114 The proximate composition of the eleven green leafy vegetables and Graphical comparison of
 115 vegetables nutritional composition in percentage are shown in the table 2 and figure 1
 116 respectively and Botanical, English/Common and Local name in table 1.

117 The eleven leafy vegetables showed moisture content ranges from 5.33% to 8.33% (Table 2
 118 and fig.1). The results obtained were close to that reported for *Basella alba* (11.57%) and
 119 *Amaranthus hybridus* (10.00%) by Asaolu *et al.*²³, *Cleome gynandra* (15.90%) reported by
 120 Clement¹⁹ and 15.6% for *Celosia argentea* by Onwordi *et al.*². In this study, it was observed

121 that a closer relationship occurred between the moisture content of the leafy vegetables under
122 study, but a great difference was observed when compared with the one reported by Idris *et*
123 *al.*²⁴ for *Abelimoschus esculentus* (82.53%) and 79.98% reported for *Corchorus olitorius* by
124 Adeniyi *et al.*²⁵. Also, as it has been reported in the work of Kwenin *et al.*¹⁷ that leafy
125 vegetables have high moisture content ranging from 72.93% to 91.83%, the significant
126 difference observed now may be due to the cultivation conditions that influence the water
127 level of vegetables²⁶. George²⁷ stated that moisture content makes an important contribution
128 on the texture of the leaves and helps in maintaining the protoplasmic content of the cells; it
129 also makes them perishable and susceptible to spoilage by microorganisms.

130 The highest result was recorded for *A. esculentus* (61.27%) while *Launaena taraxacifolia* had
131 the least value of 23.07%. Ash, according to Mc Clement²⁸ is the inorganic residue which
132 provides a measure of the total amount of minerals present in food. There were significant
133 interactions among the samples used in this study and a great difference was obtained when
134 compared with the ash content range of 10.0% - 12.5% recorded for *Cleome gynandra* by
135 Clement¹⁹.

136 Therefore the small difference observed when these vegetables are compared with one
137 another, and the immense difference observed when compared with the vegetables studied by
138 another scientist above may be of the fact that, there is different concentration of minerals in
139 the soil onto which they were planted. Crude fibre ranged from 2.43% (*S. macrocarpon*) to
140 22.03% (*Celosia argentea*) (Table 2 and fig1), this fell within the range (8.50% - 20.90%)
141 reported by Isong and Idiong²⁹ for some Nigerian vegetables. Dietary fibre helps to prevent
142 constipation, bowel problems and piles. High crude fibre in the vegetable according to
143 CFW³⁰ could also help in blood cholesterol attenuation, as well as blood glucose attenuation
144 when consumed. The fibre content recorded in this study were in line with 6.0g/ 100g to
145 6.33g/100g reported by Hassan *et al.*³¹ and also in line with the result obtained for crude fibre

146 content of Asaolu *et al.*²² which ranges from 8.05% to 12.08%. Therefore, *Celosia argentea*,
147 *Launaena taraxacifolia*, *Talinum triangulare* and *Ocimum canum* are good source of crude
148 fibre as suggested by this study which could be of immense health benefit to their consumer
149 which follows Clement¹⁹ reports that an increased intake of dietary fibre appears to be useful
150 in treatment of both obesity and diabetics.

151 The crude fat content in this study ranges from 1.20% to 3.40% (Table 2 and fig 1), where
152 high values were observed for *Abelmoschus esculentus*, *Amaranthus hybridus* and *Talinum*
153 *triangulare*. Asaolu *et al.*²² study, reported 3.51% to 14.02% range for crude fat in
154 *Amaranthus hybridus*, *Indian spinach* and *Telfaira occidentalis*. Vegetables with high
155 Dietary fats represent the most compact chemical energy available to man³².

156 The protein content of the vegetables ranged from 18.50% to 55.23% with *Amaranthus*
157 *hybridus* showing the highest value followed by *Launaena taraxacifolia* and *Ocimum canum*
158 among others (Table 2 and fig. 1). It is also in accordance to the result reported by Asaolu *et*
159 *al.*²² which ranges from 46.56% to 66.60%. Plant foods that provide more than 12% of their
160 calorific value from protein have been shown to be good source of protein³³. This shows that
161 all the leafy vegetables investigated are all good sources of protein. Protein help in building
162 and maintaining all tissue in the body forms an important part of enzymes, fluid and
163 hormones of the body and also helps form antibodies to fight against inaction and supplies
164 energy³⁴. Proteins help in building and maintaining all tissues, forms an important part of
165 enzymes, fluids, hormones of the body and form antibodies (immunoglobulin) that fight
166 against infections and supplies energy¹⁹. The protein content of vegetables in this study was
167 high, showing that they are more nutritious.

168 The level of protein in the vegetables generally indicates that they are very important for
169 human health and are good supplements for people living below the poverty level, especially
170 in the rural areas.

171 **CONCLUSION**

172 The result of this research work showed that all the vegetables used in this study are more
173 nutritious because they are very good source of protein. Also, their fibre contents were a bit
174 low but when consumed, could correct body abnormalities such as obesity and diabetes. Also,
175 their low fat content level indicated that, they are good for human health because they will
176 not easily provide additional calories to the body when ingested. High ash contents indicate
177 that, they are vital source of minerals (Na, K, Fe, Zn, Cu, Ca and P), particularly Ca could be
178 helpful in building up strong teeth and bones, and also prevent haemophilia in blood.

179 Farmers should continue engaging in vegetable production and marketing. The farmers
180 should be motivated by the government, especially the local government with provision of
181 effective measures that could guide against any factor which may hinder the productivity of
182 the vegetables. In addition, for sustenance of poor people in some rural areas, leafy green
183 vegetables are very important and should therefore be an effective and efficient means of
184 transportation to other parts of the country where productivity is low.

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