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DIETARY CONTRIBUTION OF OLERICULTURE AS A COMPONENT OF INTEGRATED FARMING

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ABSTRACT

The samples of five leafy vegetables were collected from Wunti vegetable market in Bauchi State and tested for proximate composition following the instructions of AOAC (2020) at National Veterinary Research Institute Jos, Plateau state- Nigeria. The results indicated a percentage moisture content range of 5.2-18.85% forLettuce *(Lactuca sativa)* and Amaranth (*Amaranthus hybridus*) respectively. Cabbage *(*Brassica *oleifecea) recorded the* highest crude protein (6.21%). This was closely followed by *Sorrel (Rumex* acetosa*)* (5.31%) and Lettuce *(*Lactuca *sativa)* (4.41%) had the least value for Crude protein. The study also reveals that the highest crude fibre of 38.41% was recorded for *Brassica oleifecea* while *Lattuce sativa* had the least value for the same. However, *Moringa oleifera*

Introduction

Background of the study

Vegetables are generally plants that are valued for their leaves, stems, young shoots, fruits or a combination of these plant parts, which may be used to fulfill human needs (Ogwu *et al*., 2016). Vegetables may be annual,biannual or perennial with variable biological, chemical and physiological requirements for growth and development depending on the environmental conditions, species, and the geographical origin and distribution (Ali and Tsou, 1997). The number of plants exploited as

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had the highest value for Fat (5.72) followed by *Amaranthus hybridus* (5.65%) with *Amaranthus hybridus* (11.80%) containing the highest amount of ash. *Brassica oleifecea* recorded the highest quantity of Calcium *(*4.17%*) and this was followed by Moringa oleifera (3.41%).* The highest Phosphorous content of 3.00% was recorded for *Moringa oleifera* followed by *Rumex acetosa* (2.14%) and *Amaranthus hybridus* recorded the least quantity of Phosphorous content. Considering the dietary contribution of Olericultural practices, vegetable farmers should be supported through provision of soft loan and packaging facilities that will add value to their products. The training and posting of Extension Agents to rural areas for enhanced vegetable production and provision of subsidies Agricultural inputs at the right time were also recommended.

Key words: Olericulture – Vegetables - Proximate Composition - Dietary

Vegetable globally is unknown but it is estimated that over one (1) billion tonnes of vegetables are gathered each year with China and India accounting for the production of a bulk of that amount as the world largest producers of vegetables. Even though certain vegetables are not easily available in some parts of the world, most are accessible and affordable (CDC, 2018). Based on availability and nutritional composition tomato, curcubits, alliums and chillies are considered the most important vegetables in the world (Schreinemachus et al., 2018). Although the information on some indigenous vegetables consumed in a few countries or restricted to third world countries is hard to come by and often not put in a global perspective for the sake of comparison.

The importance of vegetables remain the major interest of many researches and public health nutrition education because, in all societies and ethnic groups, vegetables are consumed irrespective of socio-economic status (Thompson et al., 2011).

Low consumption of vegetables may cause disability, lower lifespan and death. Whole or parts of mature or immature vegetable may be eaten raw (fresh or dried), cooked or in other processed forms (e.g. as oil) and used as a part of other

food for different purposes including as a source of energy, nutrition, flavour, colouring or medicine. In part of sub-Saharan Africa, vegetables are a cheap and reliable source of proteins, vitamins, zinc and iron as well as a source of income for the mostly female farmers (Busari et.al, 2012). Due to insufficient consumption, some countries have developed dietary recommendations with respect to vegetable consumption as a way to promote healthy living and disease prevention (CDC, 2018, Ajayi et al.,2016, FAO, 2021). The report of Alberta Health Services (Albert, 2014) suggests that poor people or people with lower household income consume more vegetables. Socio-cultural and economic activities related to vegetables have evolved over time in many parts of the world. According to Sinha et al., 2011, the impacts of the food industry on the global economy relies upon the increased consumption and processing of fresh and processed vegetables. Moreover, (Schreinemachers et.al., 2018) proposed a greater value for vegetable production than all cereals combined despite a relatively low level of support from private,
national and international donors compared to staple and oil crops. At the national level, many countries continue to earn huge foreign exchange from vegetable related activities.

The aim of this study is to evaluate the dietary contribution of Olericulture by examining proximate composition of some selected leafy vegetables obtained from vegetable market in Bauchi under the following specific objectives:

1. The moisture content of the leafy vegetables under consideration at the time of the analysis.
2. The crude fat present in the leaves of the vegetables under consideration
3. The ash content in the leaves of the vegetables under consideration
4. The crude fibre of the leaves of the vegetables under consideration
5. The protein content of the leaves of the vegetables under consideration
6. The calcium content of the leaves of the vegetables under consideration
7. The carbohydrate content of the leaves of the vegetables under consideration
8. The phosphorus content of the leaves of the vegetables under consideration

MATERIALS AND METHODS

Specimen collection

The leafy vegetable specimens were collected from Wunti market in Bauchi State, Nigeria (($9^{o}30^{1}$ and $12^{o}30^{1}$ N and $8^{o}50^{1}$ and 11^{o}E) and investigated for Dry matter (DM), ash, Moisture Content, Crude Fibre (CF), Calcium (Ca), Fat, Crude Protein(CP), and Phosphorous. The specimens were cut into pieces with secateurs and kept in the specimen poly-bag. Each bag housed a particular species specimen. To determine the dry matter content of the specimens, the specimens were oven dried at 105°C for eight hours until uniform (constant) weight was obtained.

Determination of Moisture content

The apparatus used for this test were an electric oven (DHD 1901), digital weighing balance, wet and dry bulb thermometers. The wood sample was introduced in to an oven maintained at 105°C for one to four hours until uniform weight was attained (ASTM-D143-82). The moisture was determined using an equation, thus,

$$MC = \frac{A-B}{B} * 100$$

Where MC = Moisture content

A = Original mass of sample

B = Oven dry mass of sample

Determination of Ash

The instruction of AOAC (2020) was adhered to in the running of this analysis. Crucibles were rinsed and dried in hot air oven (SM9053) maintained for 30minutes at 105°C. These were cooled in desiccators and weighed. 2.5g of the sample was burnt on a heater inside a fume cupboard to get rid of smoke. The samples were moved to pre-heated muffle furnace (SM9080) maintained at 550°C until such a time when a light grey ash was noticed. The crucibles were cooled in a desiccators and weighed. The ash content was calculated as:

$$\%Ash = \frac{(\text{weight of crucible} + \text{Ash}) - \text{weight of empty crucible}}{\text{Weight of sample}} \times 100$$

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Determination of Crude Fiber (CF)

The crude fiber of the sample was determined according to AOAC (2020). 2g of the sample was defatted with petroleum ether and then boil under reflux for 30minutes with 200mlof a solution containing 1.25g of H_2SO_4 per 100ml of solution. The solution was then filtered through linen on a fluted funnel. It is then washed with boiling water until the washings are no longer acid. The residue was then transferred to a beaker and boils for 30minutes with 200ml of a solution containing 1.25g of carbonate free NaOH per 100ml. the final residue was then filtered through a thin but close pad of washed and ignited asbestos in a Gooch crucible and dried in an electric oven and weigh. It was then incinerated, cooled and weighed. The percentage crude fiber was calculated as:

%CF = Loss of weight after incineration x 100

Determination of Calcium

An empty crucible was weighed and record of the sample was added and weighed. It was then ashed in a furnace at 600^0C for 2-4 hours. It was removed weighed and transferred in 100ml beaker quantitatively and crucible was rinsed with distilled water and poured into the beaker 8.5ml of 75% HCL and 3 drops of concentrated nitric acid was added. The solution was boiled for 10 minutes on a hot plate at about 70^0C and allowed to cool, after which it was filtered into 100ml volumetric flask and made up to mark with distilled water. About 50ml of the solutions was transferred into a container, 4ml of sample was transferred into a test tube on a hot plate at 70^0C for 10 minutes and allowed to cool. It was centrifuged at 3000 revolutions per minute for 5 minutes. The supernatant was decanted 2% ammonium hydroxide about 3ml was added centrifuged and decanted, 2ml of sulphuric acid was added and boiled, 10mls of 0.1N potassium per-manganite ($KMN0_4$)was pipette into 100ml measuring cylinder and was made up and marked with distilled water into water to give 0.01N KMN04. The boiling sample was then titrated with the 0.01N $KMN0_4$used was recorded and was multiplied by 0.25 (calcium factor) to give calcium volume of the sample.

Determination of Crude Fat

The fat contents were determined using Fat extractor with automated control unit (FOSS Soxtec 2055) according to AOAC (2020). The equipment has six

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extraction units with each unit carrying a thimble which accommodate the samples and aluminum cups for collection of the extracted fat. These units enable six samples to be analyzed within 75minutes. Percentage of fat is the differences between weight of the pre-weighed cups and after extraction. One gram of the samples was weighed into the thimble and its mouth plugged with defatted cotton wool, after which it was inserted in to the extraction unit. 80ml of petroleum ether were dropped in to each cup and maintained at 135^{o}C. Each cup was aligned with its corresponding thimble. The extraction and rinsing were done for 30minutes each, after which the sample was aerated for 15minutes and crude fat calculated as:

$$\%Fat = \frac{W_3 - W_2}{W_1} \times 100$$

Where
w_1 = weight of sample, W_2 = weight of empty cup and W_3 = weight of cup with the extracted oil

Determination of Crude Protein (CP)
This analysis was conducted with an aid of micro Kjedhal system in accordance with AOAC (2020). A small quantity of the sample (Approximately 1g) was introduced in to the digestion tube (Kjeltec 2200 FOSS) and, a catalyst (2 tablets of 5gK_2SO_4 and 5g of Se) and 12ml of concentrated tetra oxosulphate VI acid (H_2SO_4) were added. The digestion was run for one hour at 420^{o}C. 80ml and 40ml of water and sodium hydroxide (NaOH) respectfully were used in the distillation using 2200 FOSS distillation unit and the distillate was collected in 4% Boric acid. Percentage Nitrogen was calculated thus:

$$\%N = \frac{(\text{Titre- Blank}) \times 14.007 \times 0.1 \times 100}{1000 \times \text{sample weight (mg)}}$$

$$\%CP = \%N \times 6.25$$

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Determination of Phosphorous

RESULTS AND DISCUSSION

Table1: Proximate Composition of Some Selected leafy Vegetable leaves

SAMPLES	ASH	MC	CF	Ca	FAT	PR	P
AMARANTH (Amarantus hybridus)	11.8	18.85	41.21	2.41	5.65	5.27	1.11
SORREL (Rumex acetosa)	10.41	8.64	40.21	2.44	4.34	5.31	2.14
DRUMSTICK (Moringa oleifera)	10.59	9.34	38.01	3.21	5.72	5.17	3.00
CABBAGE (Brassica oleifecea)	11.42	7.42	38.41	4.17	5.14	6.21	2.01
LETTUCE (lactuca sativa)	9.29	5.24	28.11	2.90	4.41	4.41	2.11

Ash Content

The mineral content of the sample is represented by ash content which is said to be remaining part of food constituents after the removal of moisture and organic materials such as fat, proteins, carbohydrates, vitamin and organic acid among others. The minerals content of the leafy vegetables samples ranged from 9.24 percent to 11.42 percent (9.24% - 11.42%). The sample with the highest mineral content was found to be Cabbage (Brassica oleracea) which recorded 11.42 percent and was closely followed by Amaranth(Amaranthus hybridus) with mineral value of 11.18 percent. Drumstick (Moringa oleifera) recorded 10.59 percent then followed by Sorrel (Rumex acetosa) with ash value 10.41 percent.

Lettuce (Lactuca sativa), according to the laboratory analysis give the least value 9.29 percent of Ash. The higher the value of Ash, the higher the mineral contents of a sample and therefore Cabbage (Brassica oleracea) contains more minerals than other sample of the leafy vegetables as evident in table 1. Ash value obtained in this research as compared with ash content of Auberine (*Pterocarpus santatinoides*) leaves 16.32% and Wild Cassava (*Manihot pentaphylla*) 12.49% Ikpeama(2013) and Hofman et al., (2002), are higher than Ash content value of this study. The variation could be due to type of species and plant part used for the study. According to Ndukwe,(2013) reported

Ash content value 9.46% for African padauk (Pterocarpus soyauxii) was in agreement with the ash content value range 9.29% - 11.42% of this study. However, Wakili, (2024) reported that the ash content of baobab leaves 0.030% turned out to be lower than ash content value range 9.29% -11.42% of this study. The variation may be as result of different plant species or plant part used and different climatic factors in different localities.

Moisture Content

The moisture value for this study was found to fall within a range 5.24 percent to 18.85 percent (5.24% - 18.85%). The sample with the highest value was found to be Amaranth (Amaranthus hybridus) with moisture value of 18.85 percent. This followed by Drumstick (Moringa oleifera) which is recorded a moisture value of 9.34 percent, then Sorrel(Rumex acetosa) with a moisture value of 8.64 percents followed by Cabbage(Brassica oleifecea) with moisture value of 7.42 percent and the least moisture value of 5.24 percent was recorded for Lettuce(Lactuca sativa).

Moisture content is an indicator as whether a sample may be stored for long period of time or Otherwise. This is because the higher the moisture content, the easier it is to be degraded by biodegraders.. Ajayi et al., (2000) agrees with the findings of this study by reporting 6.1% and 5.02% moisture content of Amaranth (Amaranthus hybrids) and Baobab seed(Adansonia digitata) respectively.

Moisture content is an indicator as whether a sample may be stored for long period of time orotherwise. This is because the higher the moisture content, the easier it is to be degraded by biodegraders.

The findings of Wakili et al., (2015) show moisture value of some commonly used horticultural plants in northern Nigeria: Orange (*Citrus senensis*) 87.12%, Pineapple (*Ananas comosus*) 80.10% Eggplant(*Solanun melongena*) 78.95% and Coconut(*Cocos nucifera*) 42.92%. These values were higher than the values of this study. The variation may be attributed to the plant part used. Wakili et al., (2015) uses fruits which mainly content water and the collected fruits experimental material and which were not subjected to were not to sundry for long period of the time. In this work the experimental materials were collected and subjected to sundry process for a period of five days. The work of Ekumankama, (2008), reported high moisture content of some leafy vegetables: African Teak (Pterocarpus angolensis) (oha) 83.75% and Andaman Redwood (Pterocarpus santalinoide) (Nturukpa) 83.75%. These results were much higher than the results of this research. This may be as result of variation in ecological zones, of two of samples Ekumankama, (2008), uses leafy vegetables of rain forest ecological zone as against the dry savannah zone leafy vegetables used in this research.

Crude Fibre

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Crude fibre which is made largely of cellulose together with a little lignin represents the organic residue behind after the material has been treated under standardized condition. The crude fibre content of the samples was found to have ranged from 28.11 percent to 41.21 percent (28.11% - 41.21%). The sample with the highest value was Amaranth (*Amaranthus hybridus*) 4.12 percent and this was followed by Sorrel (Rumex acetosa) with 40.21 percent crude fibre value. Cabbage (*Brassica sativa*) recorded 35.41 percent as crude fibre value and was followed by Drumstick (Moringa oleifera) 38.01percent the least crude fibre value of 28.11 percent was recorded for Lettuce (Lactuca sativa). Therefore, the sample with more fibre content value is more health benefits of reducing the risk of heart and type II diabetes.

Crude fibre content value for all leafy vegetables of this study have a moderate dietary fiber content and these values are comparatively much higher than the leafy vegetables in red tarweed (Pentachlaena latifolia) 15.30%, Balloon vine (*Cardiospermum halicacabum*) 7.88% and Amaranth (*Amaranthus virdis*) 1.93%. (Nisha et.al, 2012) and (Gotruvalli et.al, 2016). The variation may be as a result of plant species used and different climatic factors in different localities. According to the findings of Wakili et al., (2015), crude fiber of Coconut (Cocos nucifera) 14%, Pineapple (*Ananas comosus*) 7%, Orange (*Citrus sinensis*) 2.82%, Carrot (*Daucus carota*) 2.39% and Aubergine (*Solanum melongena*) are lower crude fibre values thanthe findings of this study. The variation could be due to the mode of dying and different in geographical location, this work is subjected to five day drying before carrying out the laboratory analysis.

Calcium

The calcium content of the species under consideration was found to falls within the range, 2.41 percent to 4.17 percent (2.41% - 4.17%). The highest value of 4.17 percent was recorded for Cabbage (Brassica oleraecea) and this followed by Drumstick (Moringa oleifera) with calcium value of 3.21 percent, then Lettuce(Lactuca sativa) with calcium value 2.90 percent. Sorrel (Rumex acetosa) had 2.44 percent as calcium value and Amaranth (Amaranthus hybride) recorded the least value 2.41 percent. Calcium is essential in human nutrition and its concentration varies from species to species. Calcium occurs in high concentration in dairy and dairy products, cereal, nuts, fish, eggs and many vegetables (James, 1996; Jimoh and Oladiji, 2015).

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These values were higher than the calcium values reported by Danbature et al., (2014) and Wakili, (2024) who gave 1.2% and 0.14% as calcium figures for Baobab seed and Baobab leaves respectively. The variation could be attributed to differences in plant part used for the research.

This study uses leafy vegetables while Danbature et al., (2014) and Wakili, (2024) uses seeds and leaves of Baobab (Adansonia digitata) respectively for their work. According to (James 1996) reported Calcium value for Amaranth 6.62% is higher than calcium values of this study.

The difference in minerals levels in the same variety may be due to climatic, maturity stage of the plant, genetic factors, soil conditions and fertilizers used by farmers (Nuez,2017).

Fat

Fat content value for this study was found to fall within a range from 4.34 percent to 5.72 percent (4.34% - 5.72%). The sample with the highest value was found to be Drumstick (Moringa oleifera) with fat value of 5.72percent. This was followed by Amaranth (Amaranthus hybrids) with recorded fat content value of 5.65 percent, then Cabbage (Brassica oleracea) with fat value of 5.14 percent, followed by Lettuce (Lactuca sativa) with fat value of 4.41 percent and the least fat value of 4.34 percent was recorded for Sorrel (Rumex acetosa).

The result of the analysis indicated that the value of leafy vegetable examine ranged from 4.34% - 5.72%. this range was found to be lower compared to the value of Waterleaf(Talinium triangulae) 7.34% reported by Osman,(2004), Ajayi et al., (2006) reported fat value for Baobab seeds to be 12.25%. This value is also higher than the value discovered by this study and the variation may be due to differences in experimental materials. According to the findings of Akindanunsi and Salawu (2005), that fat content of Waterleaf (Talinium triangulae) leaves 5.90% and Amaranth (Amaranthus hybridus) 4.80% were in agreements with the report of this study, probably due to similarity of the experimental materials.

Protein Content

As evident in table 1, the protein value of the samples under study ranged from 5.17 percent to 7.11 percent (5.17% - 7.11%). The species with the highest protein value 7.11 was found to be Lettuce (Lactuca sativa) and this was followed by Cabbage (Brassica sativa) with protein value 6.21 percent. Sorrel (Rumex acetosa) recorded 5.31 percent as protein value and Amaranth (Amaranthus hybrides) recorded 5.27 percent as protein value. Drumstick (Moringa oleifera) gave the least protein value of 5.17 percent. Protein is responsible for body building and repairs and therefore the species with high protein value have high potentials in body building and repairs.

The protein content observed in this study was lower (5.17% - 7.11%) compared to the findings of Ogunlade et al., (2011), who reported protein value of 10.38% for Guinea peanut (Pachira glabra) for the desert date leaves 17.06%, Andama redwood Var (*Pteracarpus santalinoides*) leaves (16.32%) and Andama redwood (*Pterocarpus marsupium*) (19.4%).

Wakili et al., (2015) reported the protein value of 18.48% for Auberine (Solanum melongen), 12.81% for Carrot (Darcus carota), 9.38% for Orange (Citrus sinensis) and 8.32% for Coconut (Cocas nucifera). The value obtained by Wakili et al., (2015), is much higher than the value obtained in the study. The variation may be due to part of plant used for the study. Wakili et al., (2015) carried out research on fruit, while this study uses the leaves of selected leafy vegetables (Amaranth, Sorrel, Drumstick, Cabbage and Lettuce) as the experiment materials. Oni et al., (2015) reported protein value of 7.67 for Guinea peanut (Pachra glabra) which is also higher than the value of protein range (5.17% to 7.11%) for this experiment. However, Wakili, (2024) reported 0.15% protein value for Baobab leaves. In term of comparison, the protein content of baobab leaves (*Adonsonia giditata*), was lower than the protein content in this study. The variation may be as a result of plant part used for the experiment. Wakili (2024) uses leaves of a tree which were sundried for five days before subjected to laboratory analysis.

Phosphorus

Phosphorus is a chemical element with the symbol (P) and atomic number 15. Phosphorus helps in formation of bones and teeth. Phosphorus plays an important role on how the body uses carbohydrates and fat. It also helps body to make protein for the growth, maintenance and repair of cells and tissues. Table 1, shows the content of the leafy vegetables under study and accordingly, the values ranged from 1.11 percent to 3.00 percent. The highest value of 3.00 percent was recorded for Drumstick (Moringa oleifera) and which was followed by phosphorus value of 2.14 percent for Sorrel (Rumex acetosa). 2.11 percent was recorded for

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lettuce (lactuca sativa) and followed by Cabbage (Brassica sativa) with phosphorus value of 2.01, and Amaranth (Amaranthus hybridus) had the least phosphorus value of 1.11 percent.

Asaolu et.al., (2012) worked on Proximate and Mineral Composition of some Nigeria's leafy vegetables, the reported phosphorus content of bitter leaf as 71.52%, Indian spinach 15.38%, Bush bush as 29.42%, Scent leaf 21.65%, Amarantus hybridus 32.63%, Hibiscus sabdarifla 39.91% and Talfaria accidetalsi as 26.19%. All these values were higher than that of this study.

The variation could be attributed to different plant species used.

RECOMMENDATIONS

Considering the great significantly dietary contributions of the selected leafy vegetables in addition to its ecological and industrial values, the following are here recommended:

- There should be a massive effort toward production and distribution of the selected leafy vegetables.
- There should also be a massive awareness on the nutritive and health benefits of these leafy Vegetables.

Processing and packaging of the leaves product will go along way in promoting food security and add value to the products.-

Extension Agents be trained on cultivation of leafy vegetables and be posted to rural areas for enhanced production of same by rural farmers.

- Agricultural inputs be subsidies and made available to rural areas at ease and at the right time.
- Soft loan be made available to vegetables growers at ease for enhanced vegetables production most especially to rural areas where majority of the farmers resides.
- More research should be done on other leafy vegetables leaves.

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