Comparative Analysis of the Nutrient and Mineral Elements Composition of Spinacia Oleracea (spinach) and Hibiscus sabdariffa (roselle) leaves

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Abstract

This study was focused on determining the amount of nutrient which include; crude protein, crude fiber, crude lipid, ash content and moisture content. As well as mineral elements that include Sodium (Na), Potassium (k), Calcium (Ca), Phosphorus (P), Iron (Fe) and Zinc (Zn) content of Spinach (Alayyahu) and Roselle (Yakuwa) leaves were collected around Yobe State area in a randomized sampling approach. The analysis showed that the leaves examined have moderate content of protein and ash with low fat and crude fiber, and good mineral abundance in them especially Sodium, Potassium, Phosphorus and Zinc while they were low in term of Copper, Calcium and Iron. Concisely, the leaves examined have moderate level of crude protein with low fat and crude fiber the ash content is moderate, the vegetables also contained high amount of some minerals.

Keywords: Spinach, Roselle, Leaves, Nutrients, mineral, element, crude, content, composition, vegetables.

1. Introduction

Spinach (*S. oleracea*) is the bulk vegetable that has high vital dietary, enrich with many required nutriments as well as healthy elevating composite (Shi et al., 2016). Moreover, spinach is flora which conduct and gather heavy metals along with nitrate genuinely despite the minor level in loam (Kawazu et al., 2003). Moreover, spinach additionally is dicarboxylic acid assemble flora with large level of dicarboxylic acid than many vegetables, which is the main source of developing kidney stones (Mou, 2008). However, quantification of co-low conductors supplies a chance to minimize human wellness threats. Spinach is an enrich fountain of fiber along with elements, plus selenium, iron, as well as additional nutriments. Spinach can hold a lot of Selenium, initially within the radicle and leave cells (Zhu et al., 2004). Many findings have taken into account several constructive uses of Selenium on flora growing and production (Xue et al, 2001; Turakainen et al., 2004; Smits et al., 2099). Increase in size of flora boost alongside Selenium might be further well-organized method of producing Selenium reached nourishment to improve human wellness.

Spinach is profitably vital greenery crop across the world that has estimated yearly price of 11.8 b US dollars. USA is the second biggest grower of spinach besides China with excess of 550,000 tons yield, priced at excess of 300 M US dollars yearly as of 2009 (Correll et al., 2011; NASS., 2011). Additionally, its profit significance, spinach is among the rise up greenly harvest in the unite state when it's come to per capita utilization then is regarded as wellness greenly for humans since it is origin of nourishment and essential nutriments, along with many wellness-elevating plants-based chemicals (Decoteau, 2011; Morelock & Correll, 2008). Nutrients arise in the world may not be produce by biotic creatures (Higdon, 2003). Metal nutrients exist in various configuration in universe as well as certain metals required by body to accomplish several purposes (Prashanth et al., 2015). Almost all of them interfered with important biological chemical responses through serving as a delegate or stimulus of several organic catalysts. They otherwise turn as core of building optimizing edifices like organic catalysts and amino acid sequence. The five main nutrients in human system are calcium (Ca), phosphorus (P), potassium (K), sodium (Na), and magnesium (Mg) (Prashanth et al., 2015; Berdanier et al., 2013).

Zobo leaves otherwise called Roselle leaf is the sepals of the okra flora *Hibiscus sabdariffa* (Da-Costa-Rocha et al., 2014). The okra flora is a glowing woody plant which is native to hot areas of Africa as well as Asia and is part of the *Malvaceae* lineage (Nwaiwu et al., 2020). Zobo leaves are usually utilize in conventional medicine along with culinary applications in several regions, Nigeria is inclusive, Mexico, and Thailand (Akujobi et al., 2019). They are famous in their different test and are generally utilize to prepare tea or mixtures. Roselle leaves have a tart, tangy flavor and are usually relate to cranberries in place of test (Ojulari et al., 2019). They are a enrich source of antioxidants, flavonoids, and phenolic mixtures, that are consider to bestow their capability of wellness uses (Ojulari et al., 2019). They additionally possess a series of nourishment, inclusive of vitamin C, iron, and calcium. Furthermore, Roselle leaves are moderate in calories as well as

increased in food fiber, rendering them a nutritious increment to all food (Edo et al., 2023b). Moreover, in medicine, Zobo leaves are been applied to cure large series of ailments, inclusive of hypertension, blood sugar, hepatic infection, along with bacterium diseases (Onabanjo and Airaodion, 2022). Roselle leaves has additionally been applying to increase the general wellness as well as health-being, along with a treatment of gastrointestinal system problems including diuretic (Montalvo-Gonz´alez et al., 2022).

2. Materials and Methods

2.1 Sample collection

Fresh spinach and Roselle leaves are obtained from four distinct farmland in a randomized approach, the collected leaves were washed with clean water, and transported to the laboratory, proximate analysis (moisture, ash content) were carried out on the fresh leaves before drying in a closed room away from direct sunlight. The dried leaves were crush in to smaller pieces prior to further analysis.

2.2 Preparations of reagents / solution.

Preparation of 40% sodium hydroxide: Dissolve 40 gram of NaOH in 60ml deionized water. The mixture is transferred into volumetric flask, the volume was adjusted to 100ml with distilled water.

Preparation of 2% boric acid: 2g of boric acid is dissolved in 100ml deionized water.

Preparation of 0.0lM hydrochloric acid: 0.086µl of concentrated HCL was measured and diluted in100ml distilled water in a conical flask.

Preparation of 0.25m Sulphuric acid Solution: 6.8cm³ of sulphuric acid was diluted in 500ml distilled water.

Preparation of 0.321M Na0H Solution: 6.2g of sodium hydroxide flask was weighed and dissolved in 500ml distilled water.

Preparation of 0.5% NaCl standard (Sodium Chloride): 0.5g of sodium chloride is dissolved in 100ml distilled water.

Preparation of 0.5% KCl standard (potassium chloride): 0.5g of potassium chloride was dissolved in 100ml distilled water.

2.3 Sample Digestion

0.5 gram of each dried sample added into respective digestion vessels, 6ml of Nitric acid is added to both the four tubes along with 3ml of Hydrogen peroxide by drop wise in 2:1 ratio. The samples are digested in microware digester at 180°c for 50 minutes. Digested samples were transferred to plastic sample bottles and adjust the volume to 50ml with distilled water. The samples were further analyzed for mineral elements compositions by atomic absorption spectrometry (AAS) method.

2.4 Determination of moisture content

Association of official analytical chemists (AOAC) 2000 technique was adopted. Empty dishes and lids were washed and dried in oven at 105°C up to 180 minutes and allowed to cool in desiccators; 1.0g of both the samples were added to the respective empty dishes (for all the 3 samples), and covered with lids, the dishes containing the samples were kept in an oven and dried up to 180 minutes at 105^0c. The samples are then transferred to desiccators in order to cool, finally the dried samples were weighed again.

Percentage (%) of moisture

W1 represent sample weighted prior to drying, W2 represent sample weighted after drying

2.4.1 Determination of ash content

A.O.A.C (2000) standard procedure was adopted for the determination. Vessels along with lids are kept in a furnace and heated to 550^0_C for 180 minutes to make sure that contaminants on the top of the crucibles are blaze away. The crucibles are allowed to cool in evaporators for 30 minutes before weighing. 5 grams of each of the sample were placed in respective crucibles. The crucibles are warmed up in the boiler at 550°c for 300 minutes, after the heating is completed, the boilers are allowed to cool in the vessels before weighing the crucibles containing the ash again.

2.4.2. Determination of crude lipid

A.O.A.C (2000) standard method was adopted for the determination. The containers along with covers are kept in oven at 105°c to make sure the heaviness of the container is static. 5 grams of individual sample (spinach and Zobo) are measured on a filter paper and kept for extraction, the containers are full with 250 ml petroleum either and then taken to the heating mantle. The Soxhlet equipment is attached and water is revolved on to chill them prior to samples heating up to 10 hours, the dissolvent are kept at 80-90°c until dissolvent is entirely vaporize, subsequently the containers are allowed to cool and then weight again.

2.4.3 Determination of crude protein

The technique elucidated by A.O.A.C (2000) was adopted; 1grams of each sample (spinach and Roselle) are weighed into kjeldahl flask, two tablets were added to the flask. 10ml of concentrated H2S04 (Sulfuric acid) were added and digested at 420°c for 180 minutes. After cooling 10ml of distilled water was added to both the tubes and 50ml 40% Na0H was added, then placed on heating section of the distillation chamber. 30 milliliter 0f Boric acid, Bromocresol green and methyl orange indicator was add on in the conical flask and then kept below the distillation section for accumulatio of NH_3 as well as the final stage is attained which shown by a color interchanged from green to pink.

Protein (%)

Where;

A Capacity of acid (milliliter) applied in sample titration

B Volume of acid (milliliter) applied in blank titration

N Regularity of acid

W Heaviness (grams) of sample

14.007 Atomic Heaviness of nitrogen

2.4.5 Determination of crude fiber

Technique developed by A.O.A.C (2000) was adopted; 2g of each of the sample were placed in conical flask, $200cm^3$ of 0.25M Sulfuric acid solution is add on to both the samples. The mixtures were heated beneath the reflux up to 30 minutes. The warm solutions were immediately filtered. Then undissolved matters were treated many times with warm water until there are no more acid. They transpired into the beaker and 100cm3 of hot 0.31M NaOH mixture were add on to each sample, they are heated beneath reflux up to 30 minutes and filter. The residue was washed in boiling water until both residues were base free, it was confirmed by litmus paper test and dried in an oven at 100°c. It was cooled in desiccator. The samples were also incinerated in a mute boiler at 550^0c up to 120 minutes, it was cooled in desiccator and weighed again.

Fiber (%)

Where; M1 weight of crucibles before Ashing

M2 weight of crucibles after Ashing

M0 weight of sample

2.4.6 Determinations of calcium (ca), Iron (Fe,) and copper (Cu).

Levels of Calcium, Iron, and, Copper in the sample were determined using atomic absorption spectrophotometer equipped with an air-acetylene burner. Blanks and standard solutions for device calibration were used, the samples were aspirated and absorbance were recorded and converted to concentration.

2.4.7 Determination of sodium (Na) and potassium (K)

Blaze light meter is applied in quantifying the level of Na as well as K in the samples. The machine was switched on and allowed to warm for 10 minutes, then calibrated using blank (distilled water) and standard (0.5g NaCl and 0.5g KCl standards), the samples were aspirated and results were recorded.

2.4.8 Determination of Zinc (Zn) and phosphorus (P)

The Levels of zn along with P were quantify by colorimeter, blanks (distilled water) are used as well, the analysis is carried out using procedures provided in the operating manual for all the elements.

3. Results and discussion

3.1 Results

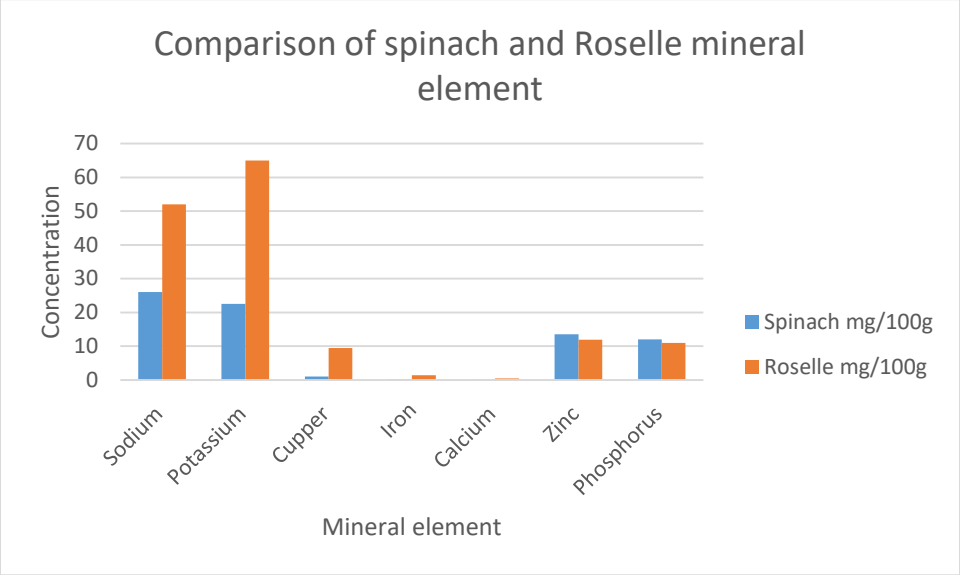
Table: 1: Proximate composition of spinach leaves

S/N	**Nutrient tested**	**Composition (%)**	**Reference value**
1	Moisture content	80.75	36.8
2	Ash content	12.71	6.96
3	Crude lipid	2.05	3.45
4	Crude fiber	8.0	21.38
5	Crude protein	4.40	11.10

Reference value: (Kavitha & Saradha, 2013).

Reference value: (Mahadevan et al, 2009).

Figure: 1; Mineral elements constituents of Spinach and Roselle leaves



3.2.1. Proximate composition

It has been observed that water content otherwise referred to as moisture content in spinach is (80.70%), which is significantly higher than moisture content in spinach reported by Kavitha & Saradha, 2013, 36.8%). While in Roselle leaves, moisture content is (72.69%) which is lower than the value reported by (Mahadevan et al, 2009, (82.6%). Roselle leaves have higher moisture content compared to spinach leaves, which is lower. The moisture contents of vegetables make them to help digestion of food and facilitate bacterial action resulting into spoilage (Kavitha & Saradha, 2013).

3.2.1.2 Ash content

The ash content as the total organic residue remaining after either ignition or complete oxidation of organic matter in a sample shows spinach leaves having higher ash content (12.71%), compared to (6.96%) reported by (Kavitha & Saradha, 2013). While Roselle leaves, (6.53%) is significantly higher than (1.0%) reported by (Mahadevan et al, 2009), and lower in ash content compared to spinach leaves.

3.2.1.3 Crude fiber

The fiber content percentage was found to be lower in Roselle leaves (7.55%) compared to (10.0%) reported by (Mahadevan et al, 2009). while Spinach leaves (8.0%) is significantly lower (21.38%) reported by (Kavitha & Saradha, 2013). The analysis shows spinach leaves having a higher fiber content compared to Roselle leaves. Leafy vegetables are particularly rich in dietary fiber contents together with low carbohydrate contents found in these leaves are good in management of diabetes mellitus. Fiber can also help to keep blood sugar levels under control (Ensminger & Esminge, 1996).

4.2.1.4 Crude lipid

The fat content in spinach leaves was lower (2.05%) compared to (4.92%) as reported by (Kavitha & Saradha, 2013), while lipid content in Roselle leaves (4.92%) is higher than (1.0%) reported by (Mahadevan et al, 2009). Due to the general low levels of crude fat in vegetables leaves, their consumption in large amounts would be beneficial to individuals suffering from obesity and would constitute a good dietary habit.

3.2.1.5 Crude protein

Percent of protein content is lower in spinach leaves (4.40%) compared to (11.10%) reported by (Kavitha & Saradha, 2013), while protein content in Roselle leaves is found to be 4.55% is higher than 3.2% as reported by (Mahadevan et al, 2009). The analysis shows Roselle leaves slightly higher in crude protein content compared to spinach leaves. Their protein content makes them suitable for consumption as a necessity for body development, when rightly combined with other foods can be of high biological value and adequately meet protein needs of malnourished children and adults (Ejoh et al, 2007).

4.2.2 MINERAL COMPOSITION

4.2.2.1 Sodium (na)

The analysis shows sodium concentration in spinach leaves 26mg/100g, is lower compared to 50mg/100 reported by (Abbas et al 2011). While in Roselle leaves 5.2mg/100g, is significantly lower compared to 46mg/100g reported by (Asaolu et al 2012), and was found to be lower compared to spinach leaves. Sodium is the major cations of extracellular fluids which are needed to maintain normal fluid and electrolyte balance (Skou, 2006).

3.2.2.2 Potassium (k)

The level of potassium was lower (22.5mg/100g) in spinach leaves compared to 50mg/100g reported by (Abbas et al 2011). While potassium level in Roselle leaves, (6.5mg/100g) was significantly also lower compared to 84mg/100g reported by (Asaolu et al 2012). The analysis shows spinach leaves having higher potassium concentration than Roselle leaves. Potassium is very important in cellular biochemical reactions and energy metabolism; it participates in the synthesis of protein and amino acids in the cell (Ganong, 1991).

3.2.2.3 copper (cu)

Copper level in spinach leaves was found to be lower (1.01mg/100g) compared to 29mg/100 reported by (Abbas et al 2011). While in Roselle leaves 0.943mg/100 is also lower compared to 3.14mg/100g reported by (Asaolu et al 2012). Copper level is slightly lower in Roselle leaves compared to spinach leave. Copper is necessary in human nutrition for normal Iron metabolism and formation of red blood cells (Rosalind, 2005).

3.2.2.4 Iron (fe)

The concentration of Iron in spinach was significantly lower (0.175mg/100g) compared to 10mg/100g reported by (Tewani et al 2016). While in Roselle leaves 0.143mg/100g, is also lower compared to 21.84 reported by (Asaolu et al 2012). Iron is required in production of red blood cells, and ensures its function as an Oxygen carrier (Latunde-Dada, 2009).

3.2.2.5 Calcium (ca)

Calcium is essential for maintaining total body health. The body needs calcium to keep bones and teeth strong and ensure proper muscle function (Kanis & Passmore, 1989). The analysis shows spinach leaves having lower concentration of calcium (0.042mg/100g) compared to73mg/100g reported by (Tewani et al 2016). Roselle leaves also, having the same concentration with spinach leaves, is significantly lower compared to 110.16mg/100g reported by Asaolu et al (2012).

3.2.2.6 Zinc (zn) & phosphorus (p)

Zinc is an essential component of more than 300 metalloenzymes participating in the synthesis and degradation of carbohydrate, lipid, protein, and nucleic acids as well as metabolism of other micronutrients (King et al, 2003). The analysis shows spinach leaves having higher zinc

concentration (13.50ppm) compared to Roselle leaves (12.87ppm). Also higher in phosphorus 12.0ppm compared to 11.0ppm found in Roselle leaves.

Conclusion

The current finding has indicated that vegetable leaves studied has average level of crude protein with small fat content as well as crude fiber, additionally the ash level is of moderate value, the vegetables also possessed excess number of certain minerals like Sodium (Na), Potassium (k), Zinc (Zn) along with Phosphorus (p) while it possessed small Copper (Cu), Calcium (Ca), and Iron (Fe) content.

The outcomes of this investigation indicated that the vegetables examined when consumed in high quantity would assist largely towards attaining human nutritional benefits required for normal growth as well as effective prevention from diseases emerge from nutrient along with mineral elements insufficiency.

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