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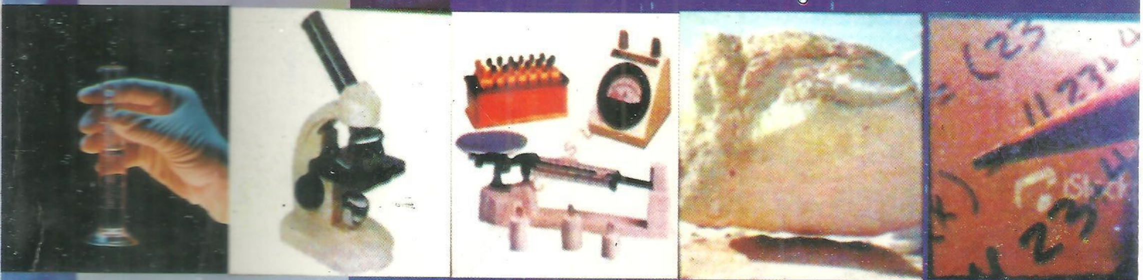

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The nutritive value of *Lactuca sativa*

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Abstract

Lactuca sativa was analyzed for its proximate and mineral composition using standard methods of food analysis. On dry weight basis, the leaves had the following proximate composition: Ash (13.8 ± 0.01%), Crude protein (11.17 ± 0.02%), Crude lipid (8.13 ± 0.03%) and available carbohydrate (20.25 ± 0.01%). *Lactuca sativa* had high moisture content (91.11 ± 0.02% wet weight) with appreciable calorific value of 167.60 ± 0.03 kcal/100g. The mineral composition in mg/100g dry weight are K (2563.15 ± 0.02), Na (55.17 ± 0.01), Ca (43.13 ± 0.03), P (10.19 ± 0.02), Mg (78.53 ± 0.12), Cu (12.54 ± 0.03), Fe (11.64 ± 0.01), Mn (1.19 ± 0.02) and Zn (10.43 ± 0.04). When the minerals detected were compared with US Recommended Dietary Allowances, K and Cu were found to be adequate for all categories of people while Fe was adequate for adult male and children (7 – 10 years) respectively.
Keywords: *Lactuca sativa,* proximate composition, mineral element, leafy vegetable.

Introduction

Lactuca sativa with common name as lettuce is a temperate annual or biennial plant of the daisy family *Asteraceae.* Both the English name and the Latin name of the genus are ultimately derived from *lac,* the Latin word for "Milk", referring to the plant's milky juice. It is most often grown as a leafy vegetable. The favourable condition for the Cultivation of *Lactuca sativa* is humus rich, moist soil. It hates dry conditions, which can cause the plants to go to seed (known as bolting). It is normally grown by early and late sowing in sunny positions, or summer crops in shade. It is considered fairly easy to grow and a suitable crop for beginners. The *Lactuca sativa* plant has a short stem initially (a rosette growth habit), but when it blooms, the stem lengthens, branches, and produces many flower heads that look like those of dandelions, but smaller. This is referred to as bolting. When grown to eat, *Lactuca sativa* is harvested before it bolts. It is also used as a food plant by the larvae of some lepidoptera. In many countries, *Lactuca sativa* is typically eaten cold, raw, in salads, sandwiches, hamburgers, tacos, and in many other dishes. In some places, including china, *Lactuca sativa* is typically eaten cooked and use of the stem is as important as use of the leaf. Mild in flavour, it has been described over the centuries as a cooling counterbalance to other ingredients in a salad (lettuce, 2009).

In this paper, analyses were carried out to evaluate the nutritional content of *Lactuca sativa* with a view of being incorporated into the food basket of the country.

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Materials and methods

Sample collection and sample treatment

The sample of *Lactuca sativa* used in this study was collected from a farm site at Chanchaga in Minna town, Niger state, Nigeria. The chemicals used were manufactured by M & B and BDH chemicals of England.

Prior to analysis, the leaves were separated from the stalk and washed with distilled water. The residual moisture was evaporated at room temperature thereafter the leaves were wrapped in large paper envelopes and oven dried at 60^0C until constant weight was obtained (Fasakin, 2004). The dried leaves were then ground in porcelain mortar, sieved through 2 mm mesh sieve and stored in plastic container (Umar *et al.*,2007). The powdered sample was used for both proximate and mineral analysis. Moisture content was however, evaluated using fresh leaves.

Proximate analysis

The moisture content of the leaves were determined by drying 5 g of the leaves (in triplicate) in a Gallenkamp oven at 105^0C until constant weight was attained (AOAC, 1990). Ash content was determined according to the method described by Ceirwyn (1998) and among others involved dry ashing in Lenton muffle furnace at 600^0C until grayish white ash was obtained. Crude protein content was calculated by multiplying the value obtained from Kjeldahl's nitrogen by a protein factor of 5.3, a factor recommended for vegetable analysis (Bernice and Merril, 1975). Crude lipid was quantified by the method describe by AOAC (1990) using the soxhlet apparatus and n-hexane as a solvent. Available carbohydrate was determined by Clegg Anthrone method using Jenway 6100 spectrophotometer at 625 nm with glucose and maltose as the standard (Idris *et al.*,2009). The sample calorific value was estimated (in Kcal) according to the formula: Energy = (g crude protein x 2.44) + (g crude lipid x 8.37) + (g available carbohydrate x 3.57) (Asibey – Berko and Taiye, 1999).

Samples preparation

Six (6) gram of the powdered sample was weighed into a crucible and gently heated over a Bunsen burner until it charred. The charred sample with the crucible was transferred into a Lento muffle furnace at about 600^0C and content ashed until grayish white ash was obtained. It was cooled first at room temperature and then in a desiccator. 5 cm^3 of concentrated HCl was added and heated for 5 minutes on a hot plate in a fume cupboard. The mixture was then transfer into a beaker and the crucible washed several times with distilled water. The mixture was made up to 40 cm^3 and boiled for 10 minutes over a bunsen burner. This mixture was then cooled, filtered into a 100 $cm^3$of volumetric flask and distilled water was used to rinse the beaker into the volumetric flask and solution made up the volume to 100 cm^3 (Ceirwyn,1998). The solution where prepared in triplicates.

Mineral quantification

Sodium (Na) and Potassium (K) were analysed by flame atomic emission spectrophotometer with NaCl and KCl used to prepare the standards. Phosphorus (P) was determined with Jenway 6100 spectrophotometer at 420 nm using vanadium phosphomolybdate (vanadate) colorimetric method with KH_2P0_4 as the standard (Ceirwyn, 1998). The concentrations of calcium (Ca), magnesium (Mg), copper (Cu), Iron (Fe), Manganese (Mn) and Zinc (Zn) in the solutions were determined with a Unicam 969 model atomic absorption spectrophotometer, with standard air – acetylene flame (AOAC, 1990). $CaCl_2$, Mg metal, Cu metal, Fe granules, $MnCl_2.4H_20$ and Zn metal were used to prepare the standards.

Data Analysis

Data were generated in triplicates and the mean standard deviation determined according to Steel and Torrie (1980).

Results and discussion

Proximate composition

As shown in Table 1 the leaves moisture content (91.11 ± 0.02%) was high compared to 58.0 – 90.64% reported in some Nigerian green leafy vegetables (Ladan *et al.,* 1996; Tomori and obijole, 2000) and 85.75 ± 3.28% found in Nightshade *(Solanum americanum* L.) leaves (Lawal and Kabiru, 2008). This value agreed with 91% indicated in

Vietnamese water spinach (*Ipomoea aquatica)* leaves (Ogle *et al.,* 2001). The ash content, which is an index of mineral contents, for *Lacutca sativa* the value of 13.8 ± 0.01% dry weight was low compared to the values reported for other edible leaves such as, Nightshade *(Solanum americanum* L.) leaves with 17.40 ± 1.27% dry weight (Lawal and Kabiru,2008) and 14.44% dry weight in *Ipomoea aquatica* leaves grown in Vietnam (Ogle *et al.,* 2001).

Table 1: Proximate composition of *Lactuca sativa*

Parameter	Concentration (% Dry weight)[a]
Moisture content[b]	91.11 ± 0.02
Ash	13.8 ± 0.01
Crude protein	11.17 ± 0.02
Crude lipid	8.13 ± 0.03
Available carbohydrate	20.25 ± 0.01
Calorific value (kcal/100g)	167.60 ± 0.03

[a]mean ± standard deviation (SD)of three replicates, [b]Value expressed as % wet weight.

The crude protein content (11.17 ± 0.02%) was high compared to 0.5 – 5.0% reported for fresh vegetables (Lintas, 1992) but low compared to 17.2 ± 0.1 – 27.03% dry weight indicated in some Nigerian leafy vegetables (Ifon and Bassir, 1980). However, despite the low protein content of this plant leaves, it can still make significant contribution to dietary intake. The crude lipid content of *Lactuca sativa* was 8.13 ± 0.03% dry weight. This value is low compared to 8.5 -27.0% found in some wild green leafy vegetables of Nigeria and Republic of Niger (Ifon and Bassir, 1980; Sena *et al.,* 1998) but higher than 11.00 ± 0.50% in water spinach (*Ipomoea aquatica* Forsk) leaves (Umar *et al.,* 2007). The result indicated that *Lactuca sativa* is a poor source of plant lipid, which is in agreement with general observation that leafy vegetables are low lipid containing food, thus advantageous healthwise in avoiding overweighting (Lintas, 1992). The available carbohydrate content (20.25 ± 0.01%) in *Lactuca sativa* was found to be higher than that for *Senna obtusifolia* leaves (20%) (Faruq *et al.,* 2002). This value is lower than 31.82 ± 1.37% in Nightshade *(Solanum americanum* L.) leaves (Lawal and Kabiru, 2008). Main function of carbohydrate in the body is for energy supply. According to Ifon and Bassir (1980), leafy vegetables may not be important source of carbohydrate as they are eaten along with other carbohydrate rich food such as cereals.

The calorific values of most vegetables are low (30 – 50 kcal/100g) (Umar *et al.,* 2007). The result obtained in *Lactuca sativa* was substantial (167.60 ± 0.03 kcal/100g dry weight), which is lower than 300.94 ± 5.31 kcal/100g in water spinach (*Ipomoea aquatica* Forsk) leaves (Umar *et al.,* 2007) and 288.3 kcal/100g indicated in *Ipomoea batatas* leaves (Asibey – Berko and Taiye, 1999).

Mineral content

Table 2 shows the results of the mineral concentrations of *Lactuca sativa.* The concentration of Potassium in *Lactuca sativa* was 2563.15 ± 0.02 mg/100g dry matter. This value is lower than the amount reported in some Nigerian leafy vegetables such as *Talinum trianglare* (8,000 mg/100g) and 6,500 mg/100g in *Crassocephalum biafrae* (Smith,1983). The result indicated that *Lactuca sativa* is a useful potassium sources. According to Yoshimura *et al.* (1991), increase of K/Na ratio in the diet assist in the prevention of hypertension and arterioscherosis, and for normal retention of protein during growth stage, K/Na ratio should be within the range of 3 – 4 (Guil – Guerrero *et al.,* 1998). The K/Na in *Lactuca sativa* was (46.46) which is above the range reported by Guil – Guerrero *et al.*(1998). However, addition of common salt during cooking should bring this ratio within the range. The sodium concentration in *Lactuca sativa* was 55.17 ± 0.01 mg/100g. This values falls within the range of 2 – 150 mg/100g for vegetables (Lintas, 1992). The low sodium content of *Lactuca sativa* make it a good food source for hypertensive patients (Levin, 1998). Sodium, in combination with potassium in the body are involved in maintaining proper acid – base balance and during nerve transmissions (Setiawan, 1996).

Table 2: Mineral composition of *Lactuca sativa*

Mineral element	Concentration (mg/100g dry matter)[a]
K	2563.15 ± 0.02
Na	55.17 ± 0.01
Ca	43.13 ± 0.03
P	10.19 ± 0.02
Mg	78.53 ± 0.12
Cu	12.54 ± 0.03
Fe	11.64 ± 0.01
Mn	1.19 ± 0.02
Zn	10.43 ± 0.04
K/Na	46.46
Ca/P	4.23

[a]*mean value ± standard deviation (SD) of three replicates.*

Calcium and phosphorous are associated with each other for development and proper functioning of bones, teeth and muscles (Dosunmu, 1997; Turan *et al.,* 2003). The calcium content in *Lactuca sativa* was 43.13 ± 0.03 mg/100g which was low compared to 142.00 ± 3.2 mg/100g in *Tribulus terrestris* leaves (Hassan *et al.,* 2005) and 416.70 ± 5.77 mg/100g in water spinach (*Ipomoea aquatica* Forsk) leaves (Umar *et al.,* 2007). The phosphorous content on the other hand was 10.19 ± 0.02 mg/100g. This value was low compared to 12 – 125 mg/100g found in vegetables (Lintas, 1992) and 109.29 ± 0.55 mg/100g in water spinach (*Ipomoea aquatica* Forsk) leaves (Umar *et al.,* 2007). According to Guil – Guerrero *et al.* (1998), for good calcium and phosphorus intestinal utilization, Ca/P ratio must be close to unity. *Lactuca sativa* had a high ratio (4.23). This showed that *Lactuca sativa* is a good source of Ca over that of P., consequently the diet based on this leafy vegetable required to be supplemented with other food material rich in phosphorous.

Lactuca sativa contain 78.53 ± 0.12 mg/100g of magnesium. This value is high compared to 30.00 ± 0.6 mg/100g in *Tribulus terrestris* leaves (Hassan *et al.,* 2005) but lower than 79 – 107 mg/100g found in *Ipomoea batatas* leaves (Ishida *et al.,* 2000). Magnesium is essential for energy production, protein formation and cellular replication (e.g. DNA, RNA).

The concentration of copper (12.54 ± 0.03 mg/100g) in this sample was high compared to 0.36 ± 0.01 mg/100g in water spinach (*Ipomoea aquatica* Forsk) leaves (Umar *et al.,* 2007), 3.34 – 3.95 mg/100g found in *Ipomoea batatas* leaves (Ishida *et al.,* 2000) and 1.28 mg/100g revealed in *Tribulus terrestris* leaves (Hassan *et al.,* 2005). From our result, *Lactuca sativa* had appreciable amount of copper relative to the recommended dietary allowance (RDA) of 1.5 – 3 mg/day for adult male and female, pregnant and lactating mothers and 1 – 3 mg/day for children (7 – 10 years) set by the United State of America National Research Council, NRC (1989).

The iron content in *Lactuca sativa* was 11.64 ± 0.01mg/100g. This value is high compared to 2.80 ± 0.7 mg/100g in *Tribulus terrestris* leaves (Hassan *et al.,* 2005) but lower than 110 – 325 mg/100g in some green leafy vegetables consumed in Sokoto (Ladan *et al.,* 1996). Iron is essential for metabolism, DNA synthesis, growth, healing, immune function, reproduction and as a cofactor in many enzyme reactions. *Lactuca sativa* is a good source of iron compared to the RDA for iron which is 10 – 15 mg/day (NRC, 1989).

Manganese acts as activator of many enzymes. The Mn content of 1.19 ± 0.02 mg/100g in *Lactuca sativa* was low compared to 2.14 ± 0.22 mg/100g in water spinach (*Ipomoea aquatica* Forsk) leaves (Umar *et al.,* 2007) and 9.68 ± 0.57 mg/100g found in *Melochia corchorifolia* leaves (Umar *et al.,* 2007). Our result clearly indicated that *Lactuca sativa* is a moderate source of manganese compared to the RDA for Mn which are 2 – 5 mg/day for adult male and female, pregnant and lactating mother, 2 – 3 mg/day for children (7 – 10 years) (NRC, 1989).

Zinc is involved in normal function of immune system. Our results show that the Zinc content of 10.43 ± 0.04 mg/100g in *Lactuca sativa* fell within the range of 6.3 – 25.5 mg/100g indicated in some non–conventional vegetables grown in Yola, Nigeria (Barminas *et al.,* 1998). From our result, *Lactuca sativa* is a moderate source of Zinc compared to the RDA value of 12 – 15 mg/day for Zn (NRC, 1989). Thus, adequate consumption of this plant leaves may help in preventing adverse effects of dietary deficiencies of these micronutrients. Inadequate intake of micronutrient is recognized as an important contributor to the global burden of disease (Black, 2003).

The contribution of *Lactuca sativa* to the dietary intake of essential elements was evaluated as described by Hassan *et al.,* 2005. This was presented in Table 3. *Lactuca sativa* is a rich source of potassium, copper, and iron, moderate source of manganese, zinc and magnesium and poor source of sodium, calcium and phosphorous when compared with their respective recommended dietary allowances. This revealed that *Lactuca sativa* supplement other dietary sources of potassium, copper, iron, zinc, manganese and magnesium.

Table 3: Contribution to the dietary intake to some mineral element by *Lactuca sativa* Minerals

	RDA (mg)	Contribution to RDA(%)
K	2000	128
Na	500	11
Ca	1200	4
P	1200	1
Mg	350	22
Cu	1.5 – 3	418 – 836
Fe	10 – 15	78 – 116
Mn	2 – 5	24 – 60
Zn	12 - 19	55 - 87

Conclusion

Based on these findings, it can be seen that *Lactuca sativa* could be used as protein supplement and sources of available carbohydrate. *Lactuca sativa* is a good source of potassium, copper, Iron, zinc, manganese and magnesium. Thus, optimal utilization of the plant will help toward realizing a better nutritional standard of the inhabitants who eat the plant. Furthermore, as potassium depresses blood pressure while sodium enhances, based on our result, the plant could be recommended for hypertensive patients.

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