Nutrient and Phytochemical Determination of Two Under-Utilized Green Leafy Vegetables *Cassia tora* and *Sesamum indicum* with Medicinal Potentials in Mubi Adamawa State of Nigeria

By

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**ABSTRACT**

**Objective:** The study investigated the nutrient and phytochemical compositions of two under-utilized green leafy vegetables (*Cassia tora* and *Sesamum indicum*) in Mubi town, Adamawa state Nigeria and their medicinal potentials.

**Materials and methods:** One kilogramme each of fresh *Cassia tora* and *Sesamum indicum* leaves was separately plucked, cleaned and pulverized using galekamp mixer kenwood. Standard methods (AOAC, 2000) were used to determine the proximate, some minerals, vitamins and phytochemical compositions of the leaves in triplicates. Means and standard error of the means of the triplicate determinations were calculated with Statistical package for social sciences (SPSS) version 20.

**Results:** The proximate principles revealed that *Cassia tora* and *Sesamum indicum* leaves contained high moisture (82.38% and 95.09%), low protein (1.64% and 1.62%), an appreciable amount of fibre (2.16% and 1.90%), carbohydrates (13.71% and 1.04%) and ash (0.36% and 0.33%). The two vegetables had low levels of fat (0.05% and 0.06%) respectively. Mineral values were calcium (4.97mg and 0.63mg), phosphorus (197.63mg and 172.50mg), iron (0.59mg and 0.26mg), potassium (2.67mg and 0.87mg), zinc (0.59mg and 0.51mg) respectively. Vitamins were β-carotene (19.65 µg and 11.57 µg), ascorbate (18.96mg and 15.60mg), vitamin B₁ (1.53mg and 1.157mg), B₂ (2.13mg and 1.87mg), niacin (1.45mg and 0.74mg) and vitamin E (28.79mg and 25.89mg) respectively. Phytochemicals present in the leaves include alkaloids (0.15% and 0.03%), glycosides (0.01% and 0.01%) tannins (0.41% and 0.40%), saponins (0.12% and 0.06%), flavonoids (0.02% and 0.01%) respectively.

**Conclusion:** *Cassia tora* had higher levels of β-carotene (19.65 µg), ascorbate (18.96mg), vitamin E (28.96mg), calcium (4.94mg), potassium (2.61mg), phosphorus (197.63mg) and most of the phytochemicals than *Sesamum indicum*. The vegetables contained significant quantities of fibre, β-carotene, vitamin C and E, calcium, phosphorus, iron, potassium, alkaloids, glycosides and saponins which have medicinal benefits. The medicinal potentials of the vegetables could be attributed to their rich nutrient and phytochemical constituents. More studies are needed to standardize the portion sizes of the vegetables for dietary management of diet related diseases based on their nutrients and health promoting constituents.

**Key words:** *Cassia tora*, *Sesamum indicum*, nutrients, phytochemicals, medicinal potentials.

**INTRODUCTION**

Vegetables are indispensible part of human diet. They are important protective foods highly beneficial for the maintenance of good health and prevention of diseases (kubmarawa, 2009). Phytochemicals found in vegetables are responsible for this protective effect. Phytochemicals are natural bio-active non-nutrient substances found in plants (Nnam, 2011). Phytochemicals give plants natural defense against diseases and they perform a similar function for humans (Starvic, 2004). The level of consumption of green leafy vegetables in the diet of most Nigerians (Nnam, 2010) is low, this often leads to prevalence of micronutrient deficiency diseases. The feeding habit of the people have also deteriorated leading to high consumption of fatty foods and refined carbohydrates which leads to increase
incidence of obesity, diabetes, cardiovascular diseases, high blood pressure and cancer. These problems are more prevalent in urban areas where there is increased preference for a few exotic foods. Many species of African traditional vegetables are poorly known and used only locally. Wild and weedy species that were commonly used as vegetables in the past are disappearing. There is a need to identify such vegetables and put them into proper use. In Nigeria and Mubi in particular, there are many underutilized vegetables such as Cassia tora and sesamum indicum leaves. The concepts of health promotions using vegetable has become part of health care system www.healthy.eating.and.nutrition.co. Lack of information on the specific nutrients in a large number of locally consumed vegetables is partly responsible for their under exploitation and utilization in areas beyond their traditional locality. Nnam et al. 2012 reported that some vegetables have medicinal properties and can be used for the sick and convalescences. Cassia tora and sesamum indicum are some leafy vegetables that have been claimed to have nutritional and medicinal properties (Mishara 2010). They are underutilized, being used only for soup by few individuals. Cassia tora ("tabsa") is a legume belonging to the caesalpiniaeae family. It grows wild mostly in the tropics and is considered a weed in many places (Kubmarawa, Magomija, Yebjoella & Adebayos, 2011). Cassia tora is an edible wild vegetable. The leaves are used as pot herb. Sesamum indicum, also known as sesame, is a flowering plant in the genus sesamum and family pedaliaceae (Raphav et al., 1990). It is widely naturalized in tropical regions around the world and cultivated for its edible seeds which grow in pods and leaves. The leaves of Sesamum indicum are consumed in Adamawa state of Nigeria largely by the rural communities where it is known as “karkashi" and claimed to have medicinal properties (Kubamarawa, 2009). The medicinal potentials of Cassia tora and Sesamum indicum leaves have not been given adequate scientific bases. Not much work has been done to fully document the nutrients and natural bioactive health promoting ingredients (phytochemicals) in these leafy vegetables. There is need to identify and quantify the phytochemical constituents of the vegetables. This will provide baseline information for using the vegetables in diet formulation for prevention and treatment of diet related non-communicable diseases. The trust of this study was to determine the nutrient composition and phytochemical constituents of Cassia tora and Sesamum indicum leaves, so as to incorporate them in the dietary management of diet related diseases.

MATERIALS AND METHODS

Sourcing of Vegetables

The vegetables for this study were obtained from various farms in Mubi town and identified at the Department of Agriculture Modibbo Adama University of Technology Yola, Nigeria. The collection was done in June, 2013

Preparation of Materials

One kilogramme each of fresh cassia tora and sesamum indicum leaves was separately cleaned and pulverized using a gallen Kemp mixer. The fresh samples were subjected to chemical analyses in triplicates.

Chemical Analyses

Proximate compositions in the leaves were determined by standard AOAC (2000) methods. Moisture was determined by oven drying method, ash by incineration using muffle furnace, crude protein by micro Kjeldahl method (digestion of sample, distillation and titration) and crude fibre was determined by filtering with Gooch filter crucible, drying in the oven and incineration; carbohydrate was by difference (that is the fraction of the percentage remaining after all the other proximate compositions were subtracted from 100% as shown below;

% Carbohydrate = 100% - % (protein + fat + ash + crude fibre + moisture).

For mineral determination, the fresh samples were wet digested with concentrated nitric and per chloric acids. The minerals Calcium (Ca), zinc (zn) and Iron (fe), were determined by atomic absorption spectrophotometer-VGP210. Potassium (K) was analyzed using Air-Acetylene flame integrated method. Phosphorus (P) was determined calorimetrically with spectrophotometer using phospho-vanadomolydate method.

For vitamins, Provitamin A (beta carotene) was determined using the method adopted from IVACG (1992). The samples were washed with volatile organic solvents (chloroform). The absorbance of the filtrate was measured with UV spectrophotometer at 328nm. Ascorbic acid and vitamin E were determined using AOAC (2000). The extraction method was used for the phytochemical analysis. About 100g each of the fresh vegetables were carefully soaked in liquid containing 70% ethanol and 30% distilled water for 72 hours. The extracting liquid was recovered from the extract by filtration. The extract was subjected to phytochemical tests using Evans and Trease (1983) and Harbourne (1983) methods to test for saponins, alkaloids, flavonoids, glycosides, tannins, phytosterols.
Statistical Analysis

Data collected were entered into the computer and the analysis ran with statistical package for Social sciences (SPSS) version 20. The result of the triplicate was pooled and analyzed using descriptive statistics (mean, standard deviation) and Post Hoc.

RESULTS AND DISCUSSION

Proximate composition

The moisture contents of the vegetables were high (95.09% %, and 82.38%). The result is similar to that reported by Olaia and Adebisi (2010) (75.0 - 91.5%) in ten leafy vegetables studied. Oloyede, Obuotor and Ibronke (2011) also reported moisture values of 80.50% - 90.57% in a study of five underutilized fresh green leafy vegetables in south western Nigeria. The high moisture content makes vegetables aid the digestion of food, however, shelf life is very short because the high moisture facilitates bacterial action resulting into spoilage. The high water content shows that the more the vegetables consumed, the more water intake that flushes out waste products from the body (www.healthy-eating.and. nutrition.co).

The protein values were low (1.64, and 1.62% ) but they are similar to literature reports of Sheela et al. (2004) who observed protein values of 0.80% – 3.60% per 100g fresh vegetables. The low protein levels of the vegetables were in line with literature reports which classified vegetables as poor sources of protein especially for fresh samples (Oguntana, 1998; Nnam, 2012). The low fat contents of the vegetables (0.05% - 0.06%) were lower than the values (0.20 – 2.60 %) reported by Sheela et al. (2004) on some leafy vegetables. The fat level was the least in the proximate components. This is in line with the observation of Nnam et al. (2012) that among the proximate components, fat content represents the lowest in vegetables. Oguntana (1998) also noted that fat values for green leafy vegetables scarcely exceed 1.0%. The vegetables would be of immense importance in the preparation of low fat diets. Green leafy vegetables are known to be poor sources of fat (en.wikipedia.org/wiki/leaf. Veg.). However, dark green leafy vegetables contain omega 3 fatty acids. Omega 3 fatty acids are called essential fatty acids because the body cannot manufacture the acids from other nutrients. The fatty acids must be obtained from the diet by consumption of such vegetables. The omega 3 fatty acids give important health benefits to the body. They may help to prevent breast and colon cancer, high blood pressure and can reduce the risk of suffering a stroke among other benefits.

The crude fibre contents of the vegetable (2.16%  and 1.90%) were similar with the findings of Olaia and Adebisi (2010) who reported fibre contents of 0.8g/100g – 9.5g/100g for ten green leafy vegetables in south-western Nigeria. Fibre is useful for providing bulk, and increasing intestinal peristalsis by surface extension of food in the intestinal tract (Mathenge, 1997). The vegetables could help in preventing constipation, bowel problems and piles when consumed in large quantities. Consumption of the vegetables in large amounts could be useful in the treatment of diseases such as obesity, diabetes, cancer and gastrointestinal disorder. Fibre has beneficial effect on blood cholesterol. In diabetics, fibre improves glucose tolerance (Ashaye, 2010). The high fibre content of Cassia tora leaves (2.16%) is of interest. Cho et al. (2009), in their study on the effect of Cassia tora fibre supplement on serum lipids in Korean diabetic patients concluded that Cassia tora leaf fibre supplement can help improve serum lipid status in type 2 diabetic patients without any serious adverse side effect. The use of the vegetables could therefore be very useful in the management of diabetics when properly incorporated into the dietary regimen for diabetics. The ash values obtained in this study (0. 36%, 0.33%) were comparable to ash values reported for fresh underutilized green leafy vegetables Celosia trigyna (0.87%) (Oloyede et al., 2011). The higher ash values obtained for Cassia tora leaves (0.36)% than Sesamum indicum (0.33)% leaves suggests that the vegetable is richer in organic matter.

The lower carbohydrate content in sesamun indicum (1.04%) is not surprising considering its high moisture content of 95.09%. The carbohydrate values of 1.04% in fresh Sesamum indicum is comparable to the values reported for an underutilized leafy vegetable Celosia trigyna (1.09%) (Oloyede et al., 2011). The low levels of carbohydrates in the vegetables are in line with literature reports that fresh leafy vegetables are not good sources of carbohydrates. The little carbohydrate contents in the vegetables could supply part of the daily requirements for carbohydrates for the individual. The end product of carbohydrate digestion (glucose) provides energy to cells in the body particularly the central nervous system (Effiong, et al. 2009). The carbohydrate level of Cassia tora (13.41%) is higher than that of Sesamum indicum (1.04 %). The values for carbohydrates of these vegetables were not a surprise because fresh vegetables are known not to be good sources of carbohydrates. (Sheela et al., 2004). The low carbohydrate levels of the vegetables could be of help in planning of low calorie diets.
Table 1 presents the proximate composition of *Cassia tora* (tabsa) and *Sesamum indicum* (karkashi) leaves on wet weight basis.

<table>
<thead>
<tr>
<th>NUTRIENTS %</th>
<th>Cassia tora</th>
<th>Sesamum indicum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>82.38 ± 0.69</td>
<td>95.09±0.05</td>
</tr>
<tr>
<td>Crude Protein</td>
<td>1.64 ± 0.37</td>
<td>1.62 ± 0.39</td>
</tr>
<tr>
<td>Fat</td>
<td>0.05 ± 0.03</td>
<td>0.06 ± 0.03</td>
</tr>
<tr>
<td>Ash</td>
<td>0.06 ± 0.04</td>
<td>1.33 ± 0.03</td>
</tr>
<tr>
<td>Fibre</td>
<td>2.16 ± 0.19</td>
<td>1.90 ± 0.19</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>13.71 ± 0.50</td>
<td>1.04 ± 0.33</td>
</tr>
</tbody>
</table>

Mean ±SD, N=3

Mineral Composition

The result of the study showed that the fresh vegetables are good sources of some minerals as shown in table 2. The results showed that *Cassia tora* had appreciable amount of calcium and phosphorus (4.97mg and 197.63mg /100g) respectively. This shows that consumption of this vegetable could support good bone health. *Sesamum indicum* also had appreciable amount of phosphorus (172.50mg/100g). The high potassium level of *Cassia tora* (2.67mg/100g) and appreciable phosphorus level of *Sesamum indicum* (0.87mg / 100g) further enhances the health benefits of the vegetables. Potassium is essential for normal functioning of the nerves, muscles and heart, sugar metabolism, acid-base balance and oxygen metabolism in the brain (Tantilo, 2009). Calcium levels (4.94mg / 100g and 0.63 mg / 100g) of the vegetables were comparable to the levels (1.10mg/100g - 5.60mg/100g) reported by Olayiwa and Adebisi (2010). The high calcium levels found in the fresh leaves of *Cassia tora* (4.97mg/100g) relative to the other vegetable suggests that consumption of *Cassia tora* leaves could be more effective than *Sesamum indicum* leaves in bone and teeth formation and in the proper functioning of the nervous system. It has long been reported that commonly consumed leafy vegetables are a superior source of calcium to milk (Oke, 1966). Dark green vegetables are known to be good sources of calcium but the time of harvesting (June 2013) of the vegetables in this study might have affected the concentration of the minerals. This is because the month of June is the beginning of the rains in the North Eastern part of Nigeria and most of the vegetables are in their early stage. At this stage some minerals are not yet fully established and may not be fully deposited in the leaf (Bamishaiye *et al.*, 2011).

The moderate values (197.63mg / 100g and 172.50 mg / 100g fresh vegetables) of phosphorus were not surprising because literatures report that phosphorus is widely distributed in both plant and animal foods and is very high in leafy vegetables. The values of phosphorus obtained for the vegetables are similar to those reported by Nnam *et al.* (2012) (99.36 - 409.75g/100g) for four leafy vegetables. Consumption of 100g of the vegetables will supply the RNI of phosphorus (250mg/day) for a child. Phosphorus is important in the energy transfer of nucleic acids. It is essential component of bone mineral. A balance proportion of calcium and phosphorus is needed in the body for healthy bones. Consumption of large quantity of the vegetables will be very helpful in the body as phosphorus aid in metabolic reactions as component of DNA and RNA, ADP, ATP and TPP. The levels of zinc (0.59 mg and 0.51mg/100g) respectively in the vegetables were lower than the values reported by Nnam and Ngwa (2010) (3.00 - 23.00mg/100g) on indigenous vegetables. The values were however comparable with the levels observed by Nnam *et al.* (2012) for *Vernonia amagdalina* (0.61mg/100g). Zn protects the skin and improves resistance to infectious diseases, inflammation and allergies (Nnam *et al.* 2009). Zn is an essential micronutrient for human growth and immune functions (Black, 2003). It plays a structural role in the storage of insulin and a catalytic role in enzymes. However, zinc contents of the vegetables is in line with literature reports that most vegetables contain a small amount of zinc (Akindahusi *et al.*, 2006).

Table 2 some mineral composition of fresh *cassia tora* and *sesamum indicum* leaves on wet weight basis.

<table>
<thead>
<tr>
<th>Nutrient mg/100g</th>
<th>Cassia tora</th>
<th>Sesamum indicum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>4.94 ± 0.04</td>
<td>0.63 ± 0.07</td>
</tr>
<tr>
<td>Potassium</td>
<td>2.61 ± 0.83</td>
<td>0.86 ± 0.87</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>197.63 ± 0.02</td>
<td>172.48 ± 3.79</td>
</tr>
<tr>
<td>Iron</td>
<td>0.58 ± 0.13</td>
<td>0.26 ± 0.03</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.59 ± 0.03</td>
<td>0.51 ±0.02</td>
</tr>
</tbody>
</table>

Mean ±SD, N=3
Vitamins compositions

The beta-carotene (pro-vitamin A) levels of the leaves (19.65μg/100g and 11.57μg/100g) are significant. Beta carotene is a precursor of vitamin A, which is important in strengthening and boosting the immune system to fight infection. Carotenoid is a component of rhodopsin, the visual pigment in the mammalian eye; as such the consumption of large quantities of the vegetables would be beneficial for good vision. Beta carotene is a precursor of vitamin A, which is important in strengthening and boosting the immune system to fight infection.

The vitamin C levels (18.96mg/100g and 15.60mg/100g) of the vegetables were similar to those of Ocimum gratissimum (18.64mg/100g) and Gnetum africanum (21.07mg/100g) leaves (Nnam et al., 2012). The human body cannot produce vitamin C so it must be obtained entirely through the diet. The vegetables could serve as good dietary sources of the vitamin. Vitamin C is essential for the healthy formation of bones and teeth. Beta-carotene and Vitamin C are very powerful antioxidants. This suggests that consumption of large quantities of the vegetables could provide health benefits. Antioxidants are known to protect the cells by reacting with oxidizing factors and neutralizing their effects (Nnam, 2011). They help protect the body from cell damage caused by free radicals and peroxides. Consumption of the vegetables with their high beta-carotene and Vitamin C contents could be effective in preventing cancer and other degenerative diseases. The high levels of beta-carotene and ascorbate in the vegetables will synergistically facilitate the absorption of iron in the leaves. Beta-carotene and ascorbate enhances iron absorption and utilization. The enhancing effect of ascorbate has been attributed to its reducing and chelating properties during the digestion of food (Hurrel and Egli, 2007). Ascorbate also enhances iron absorption by reducing the iron III ions to ferrous (Fe²⁺) state, a form in which iron is absorbed. Inclusion of the vegetables as dietary components would improve absorption of iron particularly the non-haem iron from plant foods which is poorly absorbed.

The thiamin (1.58mg and 2.12mg / 100g), riboflavin (2.13mg and 1.87mg/100g) and niacin (1.45mg and 0.74mg/100g) values were higher than the values reported by Olaiya and Adebisi (2010) for thiamin (0.03 - 0.16mg/100g), riboflavin (0.04 - 0.03mg/100g) and niacin (0.10 - 0.90mg/100g) for ten leafy vegetables in south western Nigeria. The micronutrients thiamin, riboflavin and niacin play very important roles in nutrient metabolism. Niacin has the ability to lower blood lipids and is sometimes used in treating hyperlipidaemia (Olaiya and Adebisi, 2010). Thiamin is intricately involved with metabolism of glucose in the body while riboflavin is required to release energy from proteins, carbohydrates and fat. The significant amount of the micronutrients (B₁, B₂ and niacin) in the vegetables studied further enhance their health benefits. The micronutrients play significant role in the metabolism of proteins, carbohydrates and fat.

Consumption of 100g of the vegetables could provide about 90% of the RNI of vitamin E for adults. Vitamin E is a powerful fat soluble antioxidant vitamin. Vitamin E is the most effective non enzymatic antioxidant for terminating the chain reactions of lipid peroxidation in cell membranes. It is especially effective in protecting low density lipoproteins (LDL) from oxidation. It corroborates with vitamin C to slow progression of cardiovascular diseases and protects the double bonds of beta carotene from oxidation and thus exhibits a sparing effect. Consumption of the vegetables with the high content of vitamin C and E will help prevent cardiovascular diseases (Salomen et al. (1995) established that vitamin E status has a strong independent inverse association with the risk of diabetes. This suggests that consumption of large quantities of the vegetables could help prevent the risk of diabetes. One of the mechanisms that form the basis of both western approaches and traditional medicine approaches to lower blood glucose is to clear free radicals, resist lipid peroxidation and correct the lipid and protein metabolic disorder. The high Vitamin E, C, B₁, B₂, niacin and beta-carotene contents of the vegetables studied suggest that the vegetables could be very useful in the management of diabetes and other NCDs.

Table 3 presents beta carotene, vitamin B₁, B₂, C, niacin and vitamin E composition of Cassia tora and Sesamum indicum leaves on wet weight bases.

<table>
<thead>
<tr>
<th>Nutrient mg/100g</th>
<th>Cassia tora</th>
<th>Sesamum indicum</th>
</tr>
</thead>
<tbody>
<tr>
<td>β carotene μg/100g</td>
<td>19.65 ± 0.07</td>
<td>11.57 ± 0.03</td>
</tr>
<tr>
<td>Vitamin B₁</td>
<td>1.53 ± 0.45</td>
<td>2.12 ± 0.05</td>
</tr>
<tr>
<td>Vitamin B₂</td>
<td>2.13 ± 0.05</td>
<td>1.87 ± 0.18</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>18.96 ± 0.90</td>
<td>15.60 ± 21</td>
</tr>
<tr>
<td>Niacin</td>
<td>1.45 ± 0.10</td>
<td>0.74 ± 0.16</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>28.79 ± 0.27</td>
<td>25.89 ± 0.09</td>
</tr>
</tbody>
</table>

Mean ±SD, N=3
Phytochemicals composition

The results of the study showed that the phytochemicals (table 4) were generally present in the vegetables in small quantities relative to the nutrients. The low levels of phytochemicals (Saponins 0.12mg and 0.06mg, flavonoid 0.02mg and 0.01mg, alkaloids 0.15 and 0.03mg, glycosides 0.01 and 0.01mg, terpenes 0.21mg and 0.16mg, phytosterols 0.16 and 0.12mg) per 100g in the fresh vegetables were important and in line with literature reports that phytochemicals occur in small quantities in plant foods (Nnam, 2011). Saponins contents of Cassia tora (0.12mg/100g) leaves in the study was comparable to saponin value of Vernonia amagdalina (0.13mg/100g) reported by Nnam et al. (2012). The phytosterols levels of the vegetables were comparable to those reported by Nnam et al. (2012) for Ocimum gratissimum (0.08mg/100g) and Gnetum africanum (0.12mg/100g). The low levels of saponins and phytosterols in the fresh vegetables have the potential to lower cholesterol levels in humans due to their hypercholesteralmic effect (Nnam, 2011). Phytoesters are plant counterparts of cholesterol and thus inhibit its absorption. It lowers cholesterol level by blocking the uptake of cholesterol. The cholesterol is thus excreted from the body. This help to prevent heart diseases. Saponins form complexes with cholesterol to reduce plasma cholesterol levels. Whitney and Relfe (2005) reported that saponins have the capability to lower serum cholesterol and also fight cancer in low concentrations in the body. The low levels of saponins in the vegetables are of interest and will boast the phytochemical properties of the vegetables. However saponins are bitter and could reduce the palatability of food when present in large amounts in foods. Simple food preparation methods could reduce the bitterness in the vegetables.

The flavonoid levels of the vegetables (0.02mg and 0.01mg) are comparable to those of Vernonia amagdalina (0.04mg/100g), Ocimum gratissimum (0.08mg/100g) (Nnam et al., 2012). The presence of flavonoids in the vegetables are desirable. Flavonoids have antioxidant properties to protect the body against cardiovascular diseases and some forms of cancer (Nnam, 2011). They protect the cells against the breakdown of arachidonic acid, an unsaturated fatty acid that keeps cell membrane healthy and permeable. Flavonoids lower high blood pressures as well as cholesterol in animal studies and have strong anti-inflammatory properties (Nnam, 2011). They also inhibit low density lipoprotein (LDL) oxidation by free radicals (Verena et al., 2006). Based on these reports, consumption of the vegetables as constituents of human diet could be of health benefits because their flavonoids contents.

The alkaloid levels in the fresh leaves (0.15mg/100g and 0.03mg,) were lower than the values reported by Nnam et al. (2012) for some leafy vegetables such as Vernonia amagdalina (1.78mg/100g), Ocimum gratissimum (0.95mg/100g). Bamishaiye et al. (2011) reported the presence of alkaloids in methanol extract of leafy vegetable Moringa oleifera but did not quantify the values. Alkaloids are nitrogen – containing naturally occurring compounds. They are commonly found to have antimicrobial properties due to their ability to intercalate with DNA of the microorganisms (Kasolo et al., 2010). This could be responsible for their much acclaimed medicinal values though the exact mode of action is poorly understood. Stray (1998) reported that pure isolated alkaloids are used as basic medicinal agents because of their analgesic, antispasmodic and bacterial properties. The high concentration of alkaloids in the fresh cassia tora leaves (0.15mg/100g) in the study supports the use of Cassia tora leaves as the most popular ingredient in Ayurvedic formulations (www.academia.edu/239988/Medicinal). This might be because of its high content of alkaloids which has been claimed as a basic medicinal agent. The leaves of Cassia tora have been widely claimed to cure different diseases by rural and traditional practitioners of Septura region of Madhya Pradesh (Mishara, 2010). Based on these facts, consumption of the vegetables especially Cassia tora with the high content of alkaloids would be of great importance in the management of different diseases as an analgesic, antispasmodic and antibiotic.

The terpenes values in the fresh leaves (0.21mg and 0.16 per 100gm) were comparable to values of 0.02 – 0.38mg/100g of terpenes reported by Nnam et al. (2012) for some leafy vegetables. Glycosides were also present in the vegetables (0.01mg and 0.01mg / 100g). Alkoids, Terpenes and Glycosides present in the leaves are known to protect the body by decreasing the risk of heart diseases, stroke and certain types of cancers (Nnam 2011). Terpenes seem to battle against cancers and heart diseases due to their antioxidant effect and their action in increasing the activities of the enzyme that detoxify carcinogens (Nnam, 2011). Several studies have reported beneficial effects of a therapy with antioxidant phytochemicals against cardiovascular system consequence of diabetes (Ruhe, 2001; Dav, 2005; Vassort, 2010). Consumption of the vegetables with their concentrations of alkaloids, terpenes, and glycoside could be beneficial in the management of diabetes.
Table 4: shows the phytochemical constituents of Cassia tora and Sesamum indicum leaves on wet weight bases.

<table>
<thead>
<tr>
<th>Nutrients mg/100g</th>
<th>Cassia tora</th>
<th>Sesamum indicum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavonoids</td>
<td>0.02 ± 0.01</td>
<td>0.01 ± 0.01</td>
</tr>
<tr>
<td>Alkaloids</td>
<td>0.15 ± 0.02</td>
<td>0.03 ± 0.01</td>
</tr>
<tr>
<td>Saponins</td>
<td>0.12 ± 0.02</td>
<td>0.06 ± 0.02</td>
</tr>
<tr>
<td>Terpenes</td>
<td>0.21 ± 0.02</td>
<td>0.16 ± 0.30</td>
</tr>
<tr>
<td>Glycosides</td>
<td>0.01 ± 0.01</td>
<td>0.01 ± 0.01</td>
</tr>
</tbody>
</table>

Mean ±SD, N=3

CONCLUSION AND RECOMMENDATION

Cassia tora and Sesamum indicum leaves obtained in Mubi town contained appreciable quantities of nutrients with health promoting benefits. The vegetables contained significant quantities of fibre, important minerals (calcium, phosphorus, iron, potassium and zinc) and vitamins (beta carotene, vitamin B₁, B₂, C and niacin) which have medicinal benefits. The phytochemicals identified include: alkaloids, saponins, glycosides, phytosterols, terpenes and flavonoids. These phytochemicals could help in protecting the body from nutrition related diseases. The result of this study has shed some light on the nutrients and phytochemicals that are responsible for the claimed medicinal potentials of these vegetables. The vegetables could be used in preparation of diets for management of diabetes and some other diet related non-communicable diseases because of their rich nutrient and antioxidant phytochemical constituents. Further studies are needed to standardize the portion sizes of the vegetables for dietary management of diet related diseases based on their nutrients and health promoting constituents. Animal studies are also required to identify the specific diseases for which each vegetable could be used. It is necessary to popularize the use of these vegetables (Cassia tora and Sesamum indicum) in other parts of the country where they are not known.

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