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Evaluation of the Antinutrient Composition of the Component Herbs of a Traditional Antidiabetic Formulation

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ABSTRACT: Compound or substances which act to reduce nutrient intake digestion, absorption and utilization and may produce other adverse effect are referred to as anti-nutrient factors. The anti-nutrients in six plants herb; *Mormodica charantia, Acanthus montanus, Asystasia gangetica, Hibiscus rosa-sinensis, Vernonia amygdalina,* and *Emilia coccinea* were studied using standard methods. Anti-nutrients studied include: oxalate, phytate, tannins and trypsin inhibitors. The result showed that *Hibiscus rosa-sinensis,* has the highest oxalate content (23.20mg/100g), followed by *Mormodica charantia* (21.20mg/100g) and *Acanthus montanus* (18.80mg/100g). *Asystasia gangetica, Vernonia amygdalina,* and *Emilia coccinea* showed oxalate contents of 13.84mg/100g, 16.80mg/100g, and 12.80mg/100g respectively. Phytate contents of 11.69mg/100g, 67.52mg/100g, 41.15mg/100g, 52.53mg/100g, 39.45mg/100g and 22.15mg/100g were obtained for *Mormodica charantia, Acanthus montanus, Asystasia gangetica, Hibiscus rosa-sinensis, Vernonia amygdalina,* and *Emilia coccinea* respectively. The determination of tannins revealed that *Asystasia gangetica, Mormodica charantia* and *Hibiscus rosa-sinensis* have higher concentrations of tannins (1.48, 1.31 and 1.26mg/100g respectively) than *Acanthus montanus, Vernonia amygdalina,* and *Emilia coccinea* (0.77, 0.66 and 0.99mg/100g respectively). The herbs are rich sources of trypsin inhibitors as they contained 90mg/100ml, 84mg/100ml, 70mg/100ml, 69mg/100ml, 71mg/100ml, and 59mg/100ml of trypsin inhibitors in *Mormodica charantia, Acanthus montanus, Asystasia gangetica, Hibiscus rosa-sinensis, Vernonia amygdalina,* and *Emilia coccinea* respectively.

Keywords: Anti-nutrients, antidiabetic formulation, herbs, *Mormodica charantia, Acanthus montanus, Asystasia gangetica, Hibiscus rosa-sinensis, Vernonia amygdalina,* and *Emilia coccinea.*

Introduction

Anti-nutritional factors are those substances found in most food substances which are poisonous to humans or in some ways limit the nutrient availability to the body. Plants evolved these substances to protect themselves and to prevent them from being eaten. However, if the diet is not varied, some of these toxins build up in the body to harmful levels (Norman and Potter, 1987). Anti-nutritional factors are present in different food substances in varying amounts, depending on the kind of food, mode of its propagation, chemicals used in growing the crops as well as those chemicals used in storage and preservation of the food substances (Kabagambo, *et al.,* 2005). Being an anti-nutritional factor is not an intrinsic characteristic of a compound but depends upon the digestive process of the ingesting animal. Trypsin inhibitors, which are anti-nutritional factors for monogastric animals do not exert adverse effect in ruminants because they are degraded in the rumen of ruminants (Abulude, 2007). The importance and awareness of nutrition in public health issues has resulted in the increased demand of knowledge of the nutrients of food. Green leafy vegetables occupy an important place among the food crops as they provide adequate amounts of many vitamins and minerals for humans. They are rich sources of carotene, ascorbic acid, riboflavin, folic acid and minerals like calcium, iron and phosphorus (Fasuyi, 2006). In addition, they contain anti-nutritients, which reduce their bioactivity. (Akindabunsi and Salaivu, 2005). Aletor and Adeogun, (1995) reported that some anti-nutritional phytochemicals exhibit protective effects, thus making them to serve a dual purpose of reducing some essential nutrients and protecting the body against a number of biochemical, physiological and metabolic disorders.

Herbal medicines are the oldest remedies known to mankind. Herbs had been used by all cultures throughout history but India has one of the oldest, richest and most diverse cultural living traditions associated with the use of medicinal plants. In the present scenario, the demand for herbal products is growing exponentially throughout the world and major pharmaceutical companies are currently conducting extensive research on plant materials for their potential medicinal value. Many plant components have potential to precipitate adverse effects on the productivity of farm livestock. These compounds are present in the foliage and seed of virtually every plant that is used in practical feeding (Alobo, 2003; Apori, *et al.,* 2000). Plants are an essential component of the universe. Human beings have used plants as medicine from the very beginning of time. After various observations and experimentation, medicinal plants were identified as a source of important medicine; therefore, treatment through those medicinal plants began in the early stages of human civilization. In Islam, diseases are cured in two ways, first, the cure through prayers and second, the cure of ailments through medicines (Basu, *et al., 2007*). Several phytochemical surveys have been published, including the random sampling approach which involved some plant accession collected from all parts of the world. The importance of the nutritional status of vegetables by Nigerians has resulted in the increased demand of knowledge of the nutrients of food.Green leafy vegetables are important components of the dietary regime of humans because they provide the necessary vitamins, and minerals (Fasuyi, 2006). They however also contain anti-nutrients which reduce the bioavailability or these nutrients (Akindahunsi and Salawu, 2005). Aletor and Adeogun, (1995), however reported that some anti-nutrients exhibit protective effects thus making them serve dual purpose. Oxalate bind to calcium to form calcium oxalate crystals; these prevent the absorption and utilization of calcium by the body thereby causing diseases such as ricket and osteomalacia (Sauage, 2002).

Despite the fact that these vegetables are widely used medicinally, this study is hereby taken to evaluate the Anti-nutrient Compositions of components herbs of a Traditional Anti-diabetic Formulation. Vegetables play significant role in human nutrition especially as a source of vitamins (C, A, B, and E), minerals and dietary fiber (Aletor and Adeogun, 1995). Vegetables contain compounds that are valuable antioxidants and protectants. The main protective action of vegetable has been attributed to the presence of ascorbic acid (Amic, *et al.,* 2002). In Nigeria, unlike the Western world where green leafy vegetables are usually consumed in their unprocessed forms, green leafy vegetables are usually subjected to various post-harvest treatment, such as blanching, soaking, abrasion with salt (AWS) or abrasion without salt (AWOS) (Oboh, *et al.,* 2005), in order to improve their palatability and to remove the bitter taste and some of the acids present in the vegetables. The various processing techniques have been reported to alter both the nutrients, anti-nutrients and anti-oxidant properties of some commonly consumed plant foods in Nigeria (Oboh and Akindahunsi, 2004; Oboh, *et al.,* 2005). These constituents are essential for normal physiological well-being and help in maintaining healthy state through development of resistance against pathogens (Bal, 1997). Although the wild vegetables are delicious and nutritious, much consumption of such vegetables may be toxic to our body. Therefore, there is a need to ascertain the anti-nutritional composition (such as tannin, oxalate, phytate, trypsin inhibitors) of such vegetables (Liener, *et al.,* 1980). Oxalic acid and its content have deleterious effects on human nutrition and health, mainly by decreasing calcium absorption and aiding the formation of kidney stones (Sauage, 2002). The formation of oxalate crystal is said to take place in the digestive track (Thompson and Yoon, 1984). Phytate is a major component of the plant material (Heldt, 1997). Tannin forms complexes with protein and reduce their digestibility and palatability (Eka, 1985). Plants are essential component of the universe. Human beings have used them as medicine from the very beginning of time. Compounds or substances which act to reduce nutrients intake, digestion, absorption and utilization and may produce other adverse effects are referred to as anti-nutrients or anti-nutritional factors.

This work will use quantitative techniques to determine the anti-nutrients and the concentration in which they are present in *Momordica charantia, Vernonia amygdalina, Acanthus monthanus, Hibiscus rosa-sinensis, Asystasia gangetica.*

Materials and Method

Sample collection and preparation

Two (*Momordica charantia* and *Acanthus montanus*) out of the six samples analysed were obtained from Umueze village in Osisioma Ngwa Local Government of Abia state, while the other four were vegetables were collected from Egbelu Umungasi in Aba North local Government of Abia state, all in Nigeria. The samples were properly identified, washed under a running tap water and then air-dried for four days. The dried samples were then grinded and stored in an air-tight container till further analysis.

Sample Analysis

Determination of phytate

The phytate concentration was determined by titrimetric method as described by Lucas and Markaka (1975), oxalate concentration of the samples was determined following the method as described by Munro and Bassir (1969), trypsin inhibitor and tannic acid concentrations of the samples were determined by methods of AOAC (2010,1984) respectively.

Results

The results of the antinutritional composition of the leaves of *Momordica charantia, Acanthus montanus, Asystasia gangetica. Hibicus rosa-sinesis, Verononia amygdalina and Emilia coccinea* are shown in figures 1-4. Figures 1-4 shows the oxalate composition, phytate composition, tannin composition and trypsin composition respectively of the different vegetable analyzed. The results showed that the vegetables contain appreciable quantities of antinutrients . The vegetables were found to have low tannin content compared to other antinutrients. However, there was a significant difference in the trypsin inhibitor composition of all the vegetables. The data obtained was analyzed using ANOVA.

Table 1: Concentration of the anti-nutritional factors in different vegetables.

Common name	Botanical name	Oxalate(mg/100g)	Tannin(mg/100g)	Phytate(mg/100g)	Trypsin inhibitors(mg/100ml)
Bitter melon	*Momordica charantia*	21.20	1.31	11.69	90
Bears breach	*Acanthus montanus*	18.80	0.77	67.52	84
Chinese violet	*Asystasia gangetica*	13.84	1.46	41.35	70
Rose mallow	*Hibiscus rosa-sinensis*	23.20	1.26	52.53	69
Bitter leaf	*Vernonia amygdalina*	16.80	0.66	39.45	71
Tassel flower	*Emilia coccinea*	12.80	0.99	22.15	59

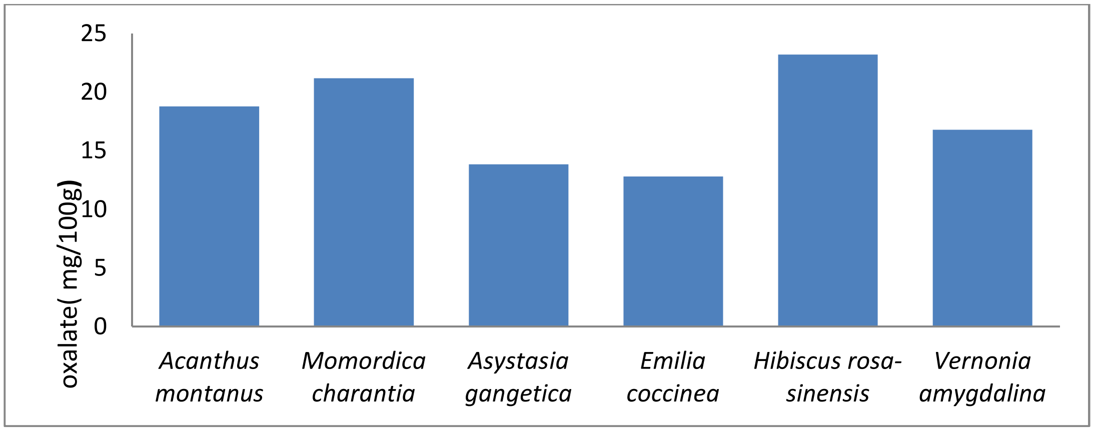

Fig. 1: Oxalate composition in different vegetables

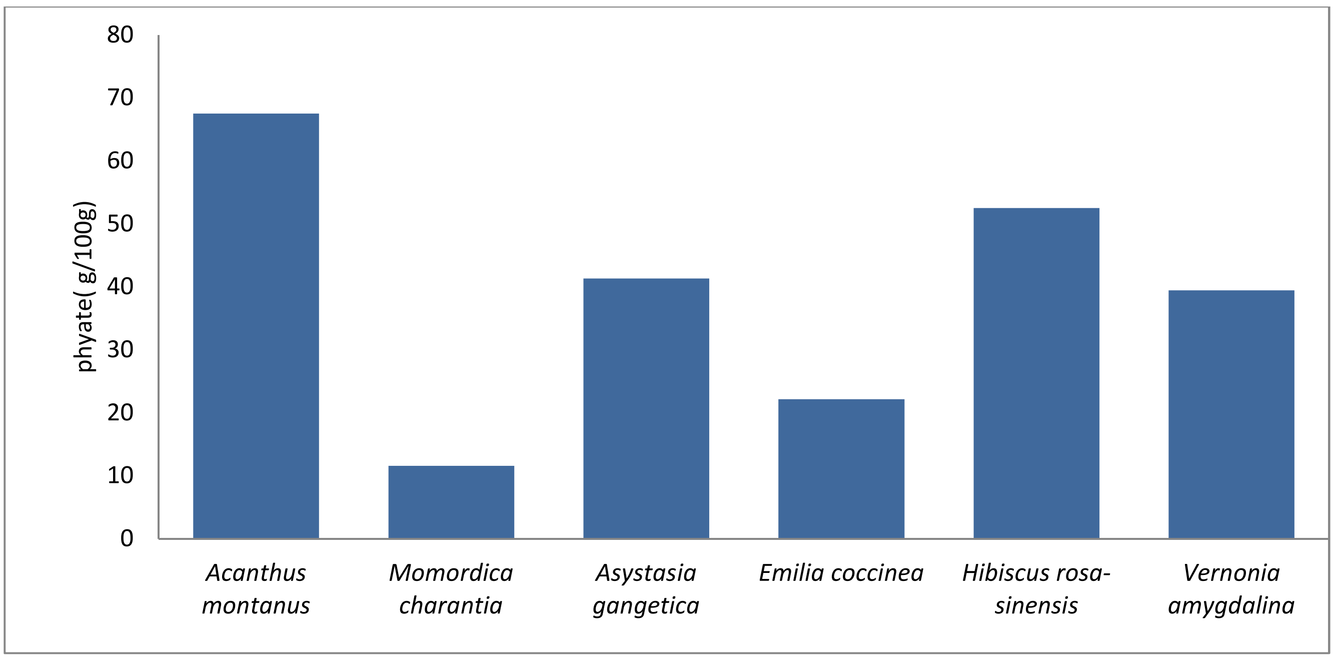

Fig. 2: Phytate composition of different vegetables

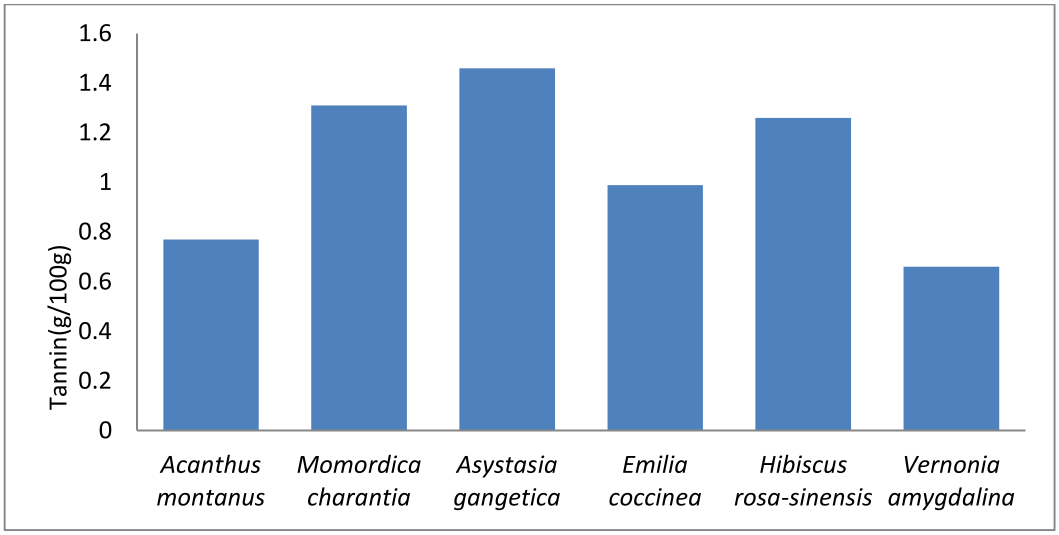

Fig. 3: Tannin composition of different vegetables

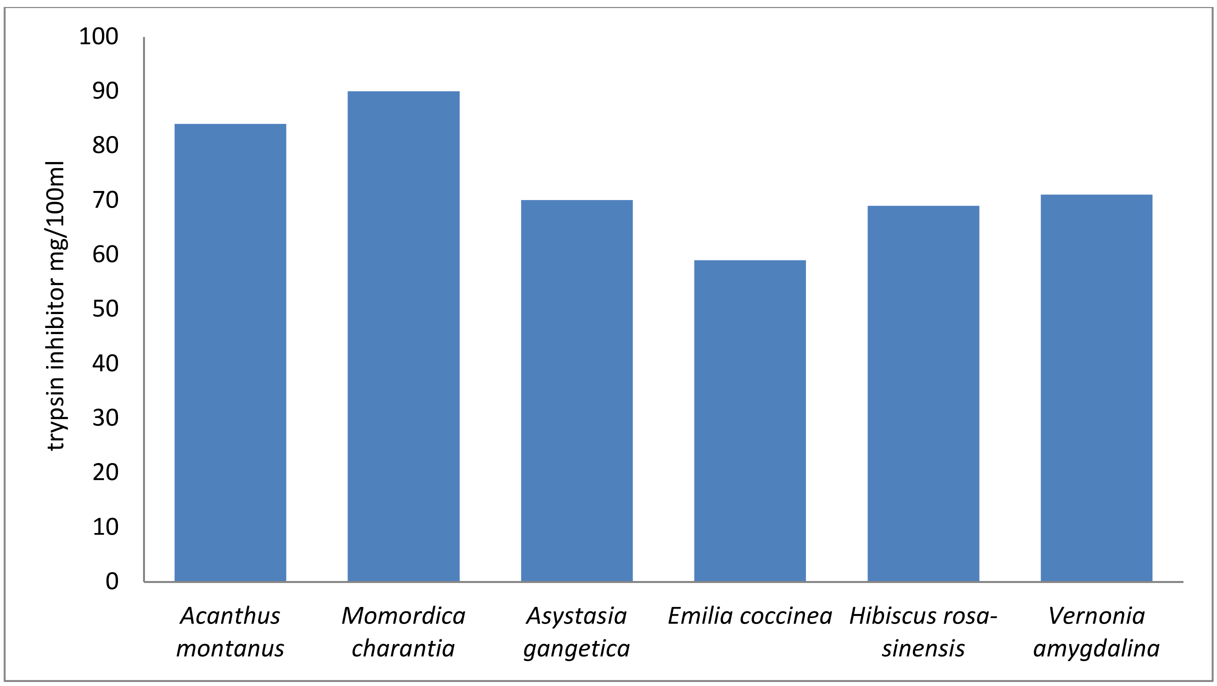

Fig.4: Trypsin inhibitors composition of different vegetables

Discussion

The results of the anti-nutritional composition of the leaves of *Momordica charantia, Acanthus montanus, Asystasia gangetica, Hibiscus rosa-sinensis, Vernonia amygdalina, and Emilia coccinea* are shown in table 1. The antinutrients considered in this work include oxalate, phytate, trypsin inhibitors, and tannin.
The concentration of oxalate was highest in *Hibiscus rosa-sinensis* (23.20mg/100g) followed by that of *Momordica charantia* (21.20mg/100g) and *Acanthus montanus* (18.80mg/100g). *Asystasia gangetica, Vernonia maygdalina and*

Emilia coccinea showed lower concentrations of oxalate (13.84mg/100g, 16.80mg/100g, and 12.80mg/100g respectively) compared to the others (figure 1).

Oxalate has been reported to form complexes with the most essential trace elements (like calcium and magnesium), therefore making them unavailable for enzymatic activities and other metabolic activities (Ayivor, *et al*., 2011). Oxalic acid is known to interfere with calcium absorption by forming insoluble salts of calcium. Previous studies have also suggested that oxalate complex with calcium, magnesium and iron leading to the formation of insoluble oxalate salts and formation of oxalate stone (Owuamanam, *et al*., 2013). Consumption of large doses of oxalic acid causes corrosive gastroenteritis, shock, convulsive symptoms, low plasma calcium, high plasma oxalates and renal damage (Ene-Obong, 2011). The lethal dose of oxalate has been reported to be 3-5g for man (Edet, 2005).

The tannin content of the plants indicated that *Asystasia gangetica, Momordica charantia and Hibiscus rosa-sinensis* had higher concentrations of tannin (1.4mg/100g, 1.31mg/100g, and 1.26mg/100g respectively) than *Emilia coccinea, Acanthus montanus,* and *Vernonia amygdalina* whose tannin concentrations were 0.99mg/100g, 0.77mg/100g, and 0.66mg/100g respectively (figure 3). Tannins are dietary antinutrients that are responsible for the astringent taste of food and drinks. Tannins bind to both proteins and carbohydrates, with several implications for vegetables containing tannins. The presence can cause browning and other pigmentation problems in both fresh foods and processed products. Tannins can complex with and thus, precipitate protein in the gut, reducing the digestibility or inhibiting the digestive enzymes and microorganisms.They can inhibit the activities of some enzymes such as trypsin, chemotrypsin, amylase and lipase (Griffiths, 1979) and also interfere with dietary iron absorption (Raw and Desothal, 1998).

Results of phytate determination showed that *Acanthus montanus* had the highest concentration of phytate (67.52mg/100g) followed by *Hibiscus rosa-sinensis* and *Asystasia gangetica* with phytate concentrations of 52.53mg/100g and 41.35 mg/100g respectively. *Vernonia amygdalina* and *Emilia coccinea* showed phytate concentration of 39.45 mg/100g and 22.15 mg/100g respectively while *Momordica charantia* showed the lowest concentration of phytate (11.60 mg/100g), figure 2.

Phytic acid, a hexophosphate derivative of inositol is an important storage form of phosphorous in plants. It is soluble and cannot be absorbed in the human intestine. Phytic acid has 12 replaceable hydrogen atoms with which it could form insuloble salts with minerals like calcium, iron, magnesium and zinc. The binding of phytate with these minerals inhibit minerals absorption (Norhaizan and Norfaizadatul, 2009). The presence of phytate in foods has been associated with mineral absorption due to the structure of the phytate which has high density negatively charged phosphate groups which form very stable complexes with mineral ions causing unavailability for intestinal absorption (Walter *et al*., 2001).

High values of trypsin inhibitors with significant differences were observed in the plants. *Momordica charantia* showed the highest concentrations of trypsin inhibitors (90mg/100ml) while *Emilia coccinea* showed the least concentration of trypsin inhibitors (59mg/100ml), figure 4. *Acanthus montanus, Asystasia gangetica, Hibiscus rosa-sinensis, and Vernonia amygdalina* showed trypsin inhibitors concentrations of 84mg/100ml, 70 mg/100ml, 69 mg/100ml and 71 mg/100ml respectively. The presence of trypsin inhibitors in the diet leads to the formation of irreversible condition known as enzyme-trypsin complex. The causes a drop in intestine trypsin and a decrease in protein digestibility, leading to slower animal growth (Bolhius, 2003).

Conclusion

The presence of anti-nutrients in vegetables is a major constraint that reduces their full utilization. The vegetables studied contained varying concentration of anti-nutrients which may affects mineral bioavailability when ingested by humans and animals. The leaves contain high concentration of trypsin inhibitors, phytate and oxalate but are low in tannin composition. Since these anti-nutrients can cause adverse effects to human health, adequate processing techniques should be developed to help reduce the concentration of these anti-nutrients.

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