PHYTOCHEMICAL SCREENING AND CHEMICAL ANALYSIS OF METHANOLIC EXTRACTS OF THE LEAVES OF THREE *Momordica* SPECIES

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Abstract: The results of the phytochemical screening revealed the presence of saponin, tannin, phenols, alkaloids, terpenoids, steroids, flavonoids, cardiac glycosides, glycosides and reducing sugar. Saponin, tannin, phenols, alkaloids, steroids and cardiac glycosides were present in all the samples. Terpenoids and reducing sugar were absent in *Momordicacharantia,* flavonoids and glycosides were absent in *Momordicafoetida* while only reducing sugar was found to be absent in *Momordica cissoids.* The mineral analysis result showed that calcium is most abundant, (781.0 mg/100g) in *M. charantia*, (902.0 mg/100g) in *M. foetida* and (753.2 mg/100mg) in *M. cissoides.* The heavy metal lead was detected at low levels in the three samples; (0.07 mg/100g) in *M. charantia*, (0.06 mg/100g) in *M.foetida* and (0.08 mg/100g) in *M. cissoides.* The findings suggest that the three *momordica* species are very good sources of phytochemicals, with essential nutritional, medicinal and chemoprotective prospect.

Keywords: Minerals,*Momordicacharantia*,*Momordica cissoids*,*Momordicafoetida*, phytochemicals

Introduction

Bioactive plants are commonly used by traditional healers or in folklore medicines for the relief of pain or some alignments. This act of medication has made some plant families popular (Odeleye and Oyedeji, 2008).The acceptance of traditional medicine as an alternative form of health care has assisted scientists in enriching these claims, by studying the chemical composition and biological potentials of the plants (Odeleye and Oyedeji, 2008). This has led to the advent of new drugs in the market.

Momordicacharantia (bitter melon or bitter gourd) is a flowering vine in the family Cucurbitaceae. It is a tropical plant that is widely cultivated in Asia, India, East Africa, and South America for its intensely bitter fruits that are commonly used in cooking and as a natural remedy for treating diabetes (Abascal and Yarnell, 2005; Joseph and Jini, 2013). It is a climbing perennial that usually grows up to 5 m, and bears elongated fruits with a knobble surface. It is a useful medicinal and vegetable plant for human health and one of the most promising plants for diabetes (Lee *et al.,* 2009). Bitter melon is a powerful nutrient-dense plant composed of a complex array of beneficial compounds. These include bioactive chemicals, vitamins, minerals and antioxidants which all contribute to its remarkable versatility in treating a wide range of illnesses. The fruits contain high amounts of vitamin C, vitamin A, vitamin E, vitamins B1, B2 and B3, as well as vitamin B9 (folate). The caloric values for leaf, fruit and seed were 213.26, 241.66 and 176.61 Kcal/100 g respectively (Bakare*et al.,* 2010). The fruit is also rich in minerals including potassium, calcium, zinc, magnesium, phosphorus and iron, and is a good source of dietary fiber. Medicinal value of bitter melon has been attributed to its high antioxidant properties due in part to phenols, flavonoids, isoflavones, terpenes, anthroquinones, and glucosinolates, all of which confer a bitter taste (Snee*et al.,* 2011).

Momordicafoetida occurs in forest clearings and at outskirts of villages. *M. foetida* is widespread in tropical Africa and in West Africa. It occurs also in margins of swamps and on disturbed ground as a weed and colonizer, up to 2400 m altitude. In Ghana, the mashed leaves of the plant are mixed with water, native black soap and heated in the sun for two or three hours. This preparation is used as a bath for fever and parched leaves are administered to pregnant women in Southern Nigeria (Dokosi, 1998). For joint pains; a decoction of the leaves is prepared and used as a steam bath. A person under treatment for fever or pains in the joints drinks an infusion of the plants (Jackson, 1990). The roots are said to be poisonous. Crushed seeds are used in East Africa to cure constipation. The fruit pulp is said to be poisonous to weevils, moths and ants, and is used as an insect repellent in Tanzania. The Karamajong (Uganda) use the whole plant on their cattle as an oxpecker repellent. In Gabon, the leaves are soaked, dried in the sun and used to stuff cushions. Roots are used with *Strophanthus species* in arrow poisons by the Benin people (Burkill, 1985; Watt and Breyer-Brandwijk, 1962). *M. foetida* is a plant with potential strong antinicotinic and antimuscarinic action. Foetidin which was isolated from the plant was reported to lower the blood glucose level in fasting rat up to 18 h. This effect was comparable to that produced by insulin (Marquis *et al.,* 1977). Foetidin also has hypotensive activity (Odeleye, 2010). Leaf extracts of *M. foetida* showed antitrichomonas activity against *Trichomonasvaginalis* (Burkill, 1985).

Momordocin have been found to be insecticidal; while foetidin has slight antispasmodic and anticholinergic effects (Marquis *et al.,* 1977). In vivo studies with water extracts showed that *M. foetida* given orally in different doses, prolonged the survival of *Plasmodium berghei* infected mice (Waako*et al*., 2005). Froelich*et al*. (2007) reported that the ethyl acetate extract of *M. foetida* showed about 88% inhibition of heme degradation, which is very similar to chloroquine (84%) patent drug. The plant has also been reported for its antioxidant activity (Acquaviva*et al*., 2013; Molehin and Adefegha, 2014).

Momordicacissoides is a tendrilous climber with compound leaves and flowers held in large green bracts. *M. cissoides* stem has a single cell layered epidermal cells, around the ridges five to six layer of sclerenchyma cell around the furrows directly below the epidermis, eight to ten layers of collenchymas, two to three layers of sclerenchyma and single layer of parenchymaous cells surrounding twelve bicollateral vascular bundle (Aguoru and Okoli, 2008). The plant is sometimes gathered from the wild for local use as food and medicine. The plant is used in the treatment of fevers and is an ingredient for treating malaria. The anticonvulsant and in vitro antioxidant activity of *M. cissoides*has recently been reported (Ojong*et al*., 2016).

This research therefore presents the comparative phytochemical and chemical analysis of *M. foetida, M. charantia and M. cissoides*to ascertain their ethnomedicinal use in alleviating diseases and to check the nutritional compositions since they are used as local foods.

Materials and Methods

Collection/sample preparation

The leaves of the three *Momordica species* (*Momordicacharantia, Momordicafoetida and Momordicacissoides*) were obtained from the Sawmill area, Ikere road, Ado- Ekiti, Ekiti State, Nigeria. The plants were identified at the Herbarium section of the Department of Plant Science by Mr. Omotayo. The leaves samples were air dried for three weeks at room temperature under shade and ground into powder using an electric blender. The resultant powder were soaked in methanol for 72 h, filtered and concentrated at 40^{o}C using rotary evaporator. The methanolic extracts were stored in airtight containers at- 4^{o}C pending analysis.

Phytochemical analysis

The phytochemical analyses were by the methods described by De *et al*. (2010); Yadav and Agarwala (2011).

Mineral analysis

The minerals were determined using appropriate methods as illustrated by AOAC, 2005. 5g of individually sample was dry-ashed in an electric furnace at 550^{o}C for 24 h. The resulting ash was cooled in a desiccator and weighed. The ash was dissolved with 2 ml of concentrated HCl and few drops of concentrated HNO_3 were added. The solution was placed in boiling water bath and evaporated almost to dryness. The content was then transferred to 100 ml volumetric flask and diluted to volume with deionized water. Appropriate dilutions were made for each element before analysis which was determined by Atomic Absorption Spectrophotometry (Pye, UnicanSP9, Cambridge, UK).

Results and Discussion

The results of the phytochemical screening revealed the presence of saponin, tannin, phenols, alkaloids, terpenoids, steroids, flavonoids, cardiac glycosides, glycosides and reducing sugar (Table 1). Tannin, phenols, alkaloids, steroids and cardiac glycosides were found to be present in all the samples. Cardiac glycoside was present in abundance in *M. foetida* so also terpenoids and steroids were moderately present. Saponin was moderately present in *M. charantia* and *M.cissoides*, tannin and phenols were also moderately present in *M.cissoides* while cardiac glycoside was moderately present in *M. charantia*. Reducing sugar was absent in both *M. charantia* and *M. cissoides* but found present in *M.foetida*. Flavonoids and glycosides were present in both *M.charantia* and *M.cissoides* and absent in *M.foetida*.

Flavonoids are biologically active phytochemicals whose functions includes; anti-inflammatory, anti-tumour and antiallergic agents (Eze and Ernest, 2014). They also prevent platelet aggregation and ulcers. Some flavonoids e.g. isoflavones relief hay fever, eczema, sinusitis and asthma, and also helps in reducing blood cholesterol and can also prevent osteoporosis as well as ease menopause symptoms (Eze and Ernest, 2014). The presence of flavonoids in the leaves of *M. charantia* and *M.cissoides* respectively supports its ethnomedicinal and pharmacological uses. Flavonoids also show antimicrobials properties (Cushnie and Lamb, 2009) and anti-cancer properties (Paul *et al.*, 2012). Alkaloids are very important as medicine; they constitute most of the valuable drugs used in medicine and ethnomedicine to treat malaria and diabetes (Arif*et al*., 2014; Oliveira *et al*., 2009; Ye and Dyke, 2015). The presence of alkaloids in the leaves of *M. foetida, M. charantia* and *M. cissoides* respectively support their ethnomedicinal uses in treating diabetes mellitus and malaria.

Saponins are responsible for the haemolytic properties of plant parts. Saponins also prevent cancer by preventing DNA from damage. They also may be cardio protective through their ability to lower cholesterol level when they bind on them (Giovanmucci, 1998). The presence of saponins in the three *Momordica* species supports their use in ethnomedicine. Tannins have been reported to possess antibacterial activity (Banso and Adeyemo, 2007; Funatogawa*et al*., 2004). The tannin content in the leaves of the three *Momordica* species supports the use in treating wounds, various ulcers, snake bites and burns in herbal medicine because of its antibacterial effect.

Steroids and their metabolites often function as signaling molecules (the most notable examples are steroid hormones), and steroids and phospholipids are components of cell membranes. Steroids such as cholesterol decrease membrane fluidity (Sadava*et al*., 2011). Steroids also include testosterone which is responsible for development of sex hormones and also progesterone steroid hormone involved in the female menstrual cycle, pregnancy and embryogenesis (Paula Yurkanis, 2001). The presence of steroids in leaves of *Momordica species* shows its usefulness in pharmaceuticals. Abundance of cardiac glycosides in *Momordica species* shows its usefulness in the treatment of heart diseases, e.g. congestive heart failure and arrhythmia.

Table 1: Phytochemical screening of leaves of *Momordica species*

Plants metabolites	*M.charantia*	*M. foetida*	*M. cissoides*
Saponin	++	+	++
Tannin	+	+	++
Phenols	+	+	++
Alkaloids	+	+	+
Terpenoids	-	++	+
Steroids	+	++	+
Flavonoids	+	-	+
Cardiac glycosides	++	+++	+
Glycosides	+	-	+
Reducing sugar	-	+	-

+++ Present in abundance, ++ Moderately present, + Present, - Absent

Table 2: Mineral composition of extract of *Momordica species* (mg/100g dry weight)

Minerals	*M. charantia*	*M. foetida*	*M. cissoides*
Sodium	256.00	348.00	201.00
Calcium	781.00	902.00	753.20
Potassium	503.00	706.00	482.00
Iron	26.50	31.18	20.10
Zinc	9.60	13.50	8.80
Copper	5.32	6.64	4.90
Manganese	8.20	10.72	7.50
Magnesium	84.40	102.50	70.80
Lead	0.07	0.06	0.08
Chromium	0.10	0.21	0.10

The mineral compositions of *Momordica* species are presented in Table 2. The result showed that calcium is most abundant, (781.0 mg/100g) in *M. charantia*, (902.0 mg/100g) in *M. foetida* and (753.2 mg/100mg) in *M.cissoides* this is followed by potassium having (503.0mg/100g) in *M. charantia*, (706.0 mg/100mg) in *M.foetida* and (482.0 mg/100g) in *M.cissoides*. Sodium (Na) and Magnesium (Mg) are moderately present followed by Iron (Fe), Zinc (Zn), Maganese (Mn), Copper (Cu) and Chromium (Cr). Lead had the lowest content (0.07 mg/100g) in *M. charantia*, (0.06 mg/100g) in *M.foetida* and (0.08 mg/100g) in *M. cissoides.*

The results of the mineral compositions of the three *Momordica* plant shows that the leaves contains appreciable amount of minerals which are micronutrients; those required by the body in small quantity. The presence of potassium and calcium as the major element in the plant leaves correlates with earlier report on leaves of *Moringaoleifera* (Yameogo*et al*., 2011). Sodium was detected in high amount in leaves of the plant. However, zinc, manganese and copper were detected as trace elements in the three analyzed sample. Zinc helps to form the large number of enzymes, many of which

functions in energy metabolism and in wound healing (Faleye and Akinwunmi, 2016). Manganese is a trace mineral involved in bone formation, immune function and carbohydrate metabolism. Its deficiency may result in paralysis and convulsion (Zhaojun*et al*., 2013).

Conclusion

This research has shown that the leaves of *Momordica* species are important sources of some phytochemicals. The result of mineral compositions also reveals high content of minerals such as calcium, sodium and potassium indicating their relevance and indispensable roles in solving many mineral related problems.

References

Abascal K &Yarnell E 2005.Using bitter melon to treat diabetes.*Alternative Complement Med.*, 11(4): 179-184.

Acquaviva R, Di Giacomo C, Vanella L, Santangelo R, Sorrenti V, Barbagallo I, Genovese C, Mastrojeni S, Ragusa S &Iauk L 2013. Antioxidant activity of extracts of *Momordicafoetida*Schumach.etThonn. *Molecules*, 18(3): 3241-3249.

Aguoru CU &Okoli BE 2008. Seed Coat Anatomy of *Momordica L.* (Cucurbitaceae) in arts of tropical Western Africa.*Int. J. Trop. Agric. Food Syst*., 2(1): 29-33.

AOAC 2005.*Official methods of Analysis of Association of Analytical Chemists*. AOAC International, 18th edn. Horrowitz, W.(ed) Volume 1 & 2, AOAC International Maryland, USA, pp. 774-784.

Arif T, Sharma B, Gahlaut A Kumar V &Dabur R 2014. Anti-diabetic agents from medicinal plants: A review. *Chem. Biol. Lett.*, 1(1): 1-13.

Bakare RI, Magbagbeola OA, Akinwande AI &OkunowoOW 2010.Nutritional and chemical evaluation of *Momordicacharantia*.*JMPR*, 4(21): 2189-2193.

Banso A &Adeye O 2007. Evaluation of antibacterial properties of tannins isolated from *Dichrostachyscinerea*. *Afr. J. Biotechnol*., 6(15): 1785-1787.

Burkill HM 1985. *The useful plants of West Tropical Africa*2nd edn. Volume 1, Families A–D. Royal Botanic Gardens, Kew, Richmond, United Kingdom, p. 960.

CushnieTPT& Lamb AJ 2009.Antimicrobial activity of flavonoids.*Int. J. Antimicrob. Agents*, 26(5): 343-356.

De S, Dey Y &Ghosh A 2010.Phytochemical investigation and chromatographic evaluation of the different extracts of tuber of Amorphaphalluspaeoniifolius (Araceae). *Int. J. Pharm. Bio. Res.*, 1(5): 150–157.

Dokosi OB 1998. *Herbs of Ghana*, published for Council of Scientist and Industrial Research Ghana by Ghana university press, Accra, xviii, p. 746.

Eze SO & Ernest O 2014. Phytochemical and nutrient evaluation of the leaves and fruits of *Nauclealatifolia* (Uvuru-ilu). *Communications in Appl. Sci.*, 2(1): 8-24.

FaleyeFJ&Akinwunmi OA 2016. Comparative nutritional compositions of the leaves, bark and root of *Nauclealatifolia*. *JMBSR*, 2(7): 127-130.

Funatogawa K, Hayashi S, Shimomura H Yoshida T Hatano T Ito H & Hirai Y 2004. Antibacterial activity of hydrolyzable tannins derived from medicinal plants against Helicobacter pylori. *Microbiol and Immunol*.,48(4): 251-261.

Froelich S, Onegi B, Kakooko A Siems K Schubert C &Jeneth-Siems, K 2007. Plants traditionally used against malaria: Phytochemical and Pharmacological investigation of *Momordicafoetida*. *Braz. J. Pharmacog.*, 17(1): 1-7.

Giovannucci E 1998. Plant bioactive components.Phytochemistry, *Biols Res*., 33: 159-165.

Jackson WPU 1990. *Origins and meanings of names of South African plant genera*. Part 1: Pteridophytes, gymnosperms and monocotyledonous angiosperms. Part 2: Dicotyledons. *Rondebosch: Ecolab, c/o Botany Department*, University of Cape Town,South Africa, iv, p. 189.

Joseph B &Jini D 2013.Antidiabetic effects of *Momordicacharantia* (bitter melon) and its medicinal potency. *Asian Pac J Trop Dis*, 3(2): 93-102.

Lee SY, EomSH, Kim YK Park NI & Park SU 2009.Cucurbitane type triterpenoid in *Momordicachaarantia*Linn.*J. Medicinal Plants Res*., 3(13): 1264-1269.

Marquis VO Adanlawo TA &Olaniyi AA 1977. The effect of foetidin from *Momordicafoetida*on blood glucose level of albino rats. *PlantaMedica*, 31(4): 367-74.

Molehin OR &Adefegha SA 2014.Comparative study of the aqueous and ethanolic extract of Momordicafoetida on the phenolic content and antioxidant properties.*Int. Food Res. J*.,21(1):401-405.

Odeleye OM&Oyedeji AO 2008. Antibacterial activity of crude and fractions of *Momordicafoetida* leaf extracts. *Int. J. Biomed.&Pharmac. Sci*., 2(2):75-78.

Odeleye OM 2010.Investigation of Chemical Constituents, Antimicrobial and Antioxidant Activities; and Pharmacognostic Characters of the Leaves of *Momordicafoetida* and *Berkheyabergiana* (Doctoral dissertation, University of Zululand).

Oliveira AB, Dolabela MF, Braga FC JácomeRLVarotti FP &Póvoa MM 2009. Plant-derived antimalarial agents: new leads and efficient phythomedicines. Part I. Alkaloids.*Anais da Academia Brasileira de Ciencias*, 81(4): 715-740.

OjongLJ, Abdou JP, KavayeKandeda A, YayaAJ, Tchamgoue AD, TchokouahaLR, Nkantchoua NG, Agbor G, Agbor RS & Ngo EB2016. Anticonvulsant and in vitro antioxidant activities of *Momordicacissoides* L.(Cucurbitaceae). *J. Appl. Pharmac. Sci.*, 6(4): 117-123.

Paula Yurkanis B 2001. *Organic Chemistry* 3rd edn.PrenticeHall Inc. Pearson Education, Upper Saddle river, New Jersey 07458, pp. 1055-1060.

Paul K, Jourma K, Harri H Ritva J Reunaner MA Timo H &Arpo A 2012. Flavanoids intake and risk of chronic diseases.*Am. J. Clin. Nutr*., 76(3): 560-568.

Sadava D, HillisDM, Heller HC &BerenbaumMR 2011. Life: The science of biology, 9th edn. San Francisco: Freeman,pp 105-114.

SneeLS, Nerurkar VR, Dooley DA, Efird JT, Shovic AC &Nerurkar PV 2011. Strategies to improve palatability and increase consumption intentions for *Momordicacharantia* (bitter melon): A vegetable commonly used for diabetes management. *Nutr J*. 10(1):78.

WaakoPJ, Gumede B, Smith P &Folb PI 2005. The in vitro and in vivo antimalarial activity of *Cardiospermumhalicacabum*L. and *Momordicafoetida*SchumachetThonn. *J. Ethnopharmacol.*, 99(1): 137-143.

Watt JM&Breyer-Brandwijk MG 1962.*Medicinal and poisonous plants of Southern and Eastern Africa*, 2nd edn, E&S Livingstone, pp. 989-1009.

YadavR &Agarwala M 2011. Phytochemical analysis of some medicinal plants.*J. Phytol*., 3(12):10–14.

YameogoCW, Bengaly MD, Savadogo A Nikiema PA, &Traore SA 2011. Determination of chemical composition and nutritional values of Moringaoleifera leaves. *Pak .J .Nutr*.,10(3): 264-268.

Ye Z & Dyke KV 2015.Antimalarial activity of various bisbenzylisoquinoline and aporphine-benzylisoquinoline alkaloids and their structure-activity relationships against chloroquine – sensitive and resistant *Plasmodium falciparum* Malaria *in vitro*.*Malaria Contr Elimination*, 5(1): 137-143.

Zhaojun W, Lin W, Zhenyong W Jian W & Ran L 2013. Effects of manganese deficiency on serum hormones and biochemical markers of bone metabolism in chicks.*J. Bone & Mineral Metabolism*,31(3): 285-292.