Ethnobotanical uses, phytochemical and pharmacological profiles, and cultural value of *Momordica charantia* Linn.: An overview

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ABSTRACT

**Background:** Traditional medicine plays a crucial role in the developing countries as it provides primary health care needs for a large majority of their populations. *Momordica charantia* is among the plants popularly used in the traditional medicine with a proved effectiveness. **Objective:** This article aims to provide a comprehensive review on ethnobotanical uses, phytochemical and pharmacological profiles, and cultural value of *Momordica charantia* Linn. **Results:** In the folkloric medicine, this plant is particularly involved in the treatment of cancers, diabetes, and to fight viruses; cardiac, liver and kidney diseases, and gynaecological problems. Pharmacological tests carried out on this plant for its antioxidant, antimalarial, hypolipidemic, antidiabetic, hypoglycemic and anti-diabetic, cardiovascular, wound healing, body weight decrease, antifeedant, anti-inflammatory and analgesic, antiviral, anti-genotoxic, anti-tumour and anticancer, anti-hepatitis B virus, abortifacient, antimicrobial and antibacterial, hypoglycemic and anti-diabetic, cardiovascular, wound healing, body weight decrease, anti-feedant, antineuroprotective, antipyretic, anti-diarrhoeal, larvicidal, antifertility, anti-gout activities; its effect on haemoglobin concentration and on diabetic complications revealed positive results. Some bioactive constituents such alkaloids, tannins, flavonoids, saponins, glycosides, sterols, mucilages and oleomeric acids significantly present in the plant extracts support its numerous properties and uses in traditional medicine, while its rich content in moisture, ash, crude lipid, crude fibre, crude protein, carbohydrates, minerals and vitamins validate its high nutritional value. Moreover, this plant has powerful medico-spiritual properties, providing protection against curses, diseases, evil spirits, spells and madness. **Conclusion:** It is now obvious that *Momordica charantia* can help as a natural source product in the treatment process of many diseases and in particular diabetes, cancers, cardiac, liver and kidney problems. Even more interesting, many scientific studies have proved that this plants extract can be consumed without a risk of toxicity. However pregnant women should not eat bitter melon or take this plant extracts as it stimulates the uterus and may cause premature birth. We sincerely hope that we have provided a data base for proper evaluation of *Momordica charantia* extracts which could lead to the discovery of new and more effective drugs.

**Key words:** *Momordica charantia*, Ethnobotanical, pharmacological, toxicity

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**Received 3 October 2016; accepted 16 December 2016; published 26 December 2016**

INTRODUCTION

Medicinal plants have recently become a focus of interest because they may play key roles in treating a majority of diseases with minimal or no side effects. *Momordica charantia* is one of those popularly known plants for its numerous medicinal virtues. This plant is a member of the cucurbitaceae family. It grows in tropical areas of the Amazon, Africa, Asia, India, South America, and the Caribbean and is used traditionally as...
both food and medicine (Perumal et al., 2015). The plant is a climbing perennial with elongated fruit that resembles a warty gourd or cucumber. The unripe fruit is white or green in colour and has a bitter taste that becomes more pronounced as the fruit ripens (Langner et al., 1998). 

Momordica charantia is a flowering vine cultivated its intensely bitter fruits that are commonly used in cooking and as a natural remedy for treating antioxidant, diabetes like disorders (Abascal and Yarnell, 2005). This herbaceous, tendril-bearing vine grows to 5 meters. It bears simple, alternate leaves 4-12 cm across, with 3-7 deeply separated lobes. Each plant bears separate yellow male and female flowers. In the Northern Hemisphere, flowering occurs during June to July and fruiting during September to November. As the fruit ripens, the flesh becomes tougher, bitterer, and too distasteful to eat. On the other hand, the pith becomes sweet and intensely red; it can be eaten uncooked in this state and is a popular ingredient in some Southeast Asian salads. When the fruit is fully ripe it turns orange and mushy, and splits into segments which curl back dramatically to expose seeds covered in bright red pulp (Md. Alamgir et al., 2012). Male flower stalks slender with bract midway or toward base; peduncle 2-5 cm long, bract reniform, 5-11 mm diameter, green, pedicel 2-6 cm long; receptacle-tube cupshap, 2-4 mm long and 2-3 men wide; sepals ovate-elliptic, 4-6x2-3 mm, pale green; petals obovate, 10-20x7-15 mm, mucronate at apex, scales 2; filaments 1.5-2 mm long, inserted in the throat of the receptacle tube: Anthers coherent. Female flower peduncle 1-6 cm long; bract 1-9 mm diameter; pedicel 1-8 cm long; Sepals narrow, oblong lanceolate, 2-5 mm long; petals smaller than or equal to that in male, 7-10 mm long; ovary fusiform, narrowly rostrate, 5-11x2-3 mm, mucinate, tuberculate or longitudinally ridged; style 2 rare long (Aparna et al., 2015). Pendulous, stalk 2-8 cm long; fruit discoid, ovoid, ellipsoid to longitudinally ridged; style 2 rare long (Aparna et al., 2015). Pendulous, stalk 2-8 cm long; fruit discoid, ovoid, ellipsoid to oblong or blocky, often narrowed at ends; sometimes finely rostrate, 3-20x2-5 mm, white or green turning orange on maturity, soft tuberculate with 8-10 broken or continuous ridges, splitting from base in to 3 irregular valves (Aparna et al., 2015). The Seed, 5-30, squarish rectangular, ends subtridentate, faces compressed, scupltured, 5-9x3-6 rare, margins grooved; testa brown or black (Aparna et al., 2015). Momordica charantia is commonly known as either bitter melon or bitter gourd but there is other synonyms which include: Momordica chinenus, Momordica elegans, Momordica indica, Momordica operculata, Momordica sinenums and Silyos fauriei, and its common names bitter Melon, papaila, melado sao caetano, bittergourd, balsam apple, balsam pear, karela or corilla, ku kua karela, kor-kuly, ku gua, para-aki, salsamino, Soru, Sorossis borossieb, pare, peria La at, peria. Bitter melon as fondly called has been implicated experimentally to achieve a positive sugar regulatory effect by suppressing the neural response to sweet taste stimuli and also keep the body functions operating normally (Bakari et al., 2010). It is one of the most promising antioxidant plant (Ghosh et al., 2014; Rezaeizadeh et al., 2011), and can therefore serve in the prevention and treatment of oxidative stress relating diseases such as malaria, diabetes, etc. All parts of the plant, including the fruit, taste very bitter. This plant is used in the treatment of many diseases, but diabetes, cancers, cardiac, liver and kidney problems are the most cited. Momordicin, Chlarantin, Vicine, Kuguacin J, EMCDO, Cucurbitacin are the most important purified bioactive constituents isolated from this plants which justify its multiple pharmacological activities.

### Scientific Classification

| Kingdom: | Plantae |
| Class: | Dicotyledonae |
| Order: | Cucurbitales |
| Family: | Cucurbitaceae |
| Genus: | Momordica |
| Species: | Momordica charantia |

### Scientific name: **Momordica charantia** Linn.

#### Traditional Uses:

Extracts of various parts of *Momordica charantia* are used extensively in traditional African medicine. Clinical conditions for which *Momordica charantia* extracts (primarily from the fruit) are currently being used include diabetes, dyslipidemia, microbial infections, and as a cytotoxic agent for certain types of cancer (Chrubasik et al., 2007; Oishi et al., 2007; Chaturvedi et al., 2004; Ahmed et al., 2001). The seeds, fruit, leaves, and root of the plant have been used in traditional medicine for microbial infections, sluggish digestion and intestinal gas, menstrual stimulation, wound healing, inflammation, fever reduction, hypertension, and as a laxative and emetic (Leung, 1984). In Guyana traditional medicine, a leaf tea is used for diabetes, to expel intestinal gas, to promote menstruation, and as an antiviral for measles, hepatitis, and feverish conditions. It is used topically for sores, wounds and infections, internally and externally for worms and parasites (Jagessar et al., 2008). Leaves of *Momordica charantia* (Karela) are effective in bilious affections as emetic and purgative. Leaves are administered internally in leprosy, piles, jaundice. It is active as galactagogue, it is also applied round the eye orbit for night blindness. Leaf juice is rubbed to soles in burning of the feet, and used in liver complaint of childrens. In Cambodia and in Gold coast, leaves are also considered to be antipyretic (Nadkarni

#### Plant and fruits images
and Nadkarni, 1998). Leaves are used in treatment of menstrual troubles, burning sensation, constipation, fever (malaria), colic, infections, worms and parasites, as an emmenagogue, measles, hepatitis and helminthiases (Kumar et al., 2010). Fruits of Momordica charantia are used in asthma, burning sensation, colic, constipation, cough, diabetes, fever (malaria), gout, helminthiases, inflammation, leprosy, skin diseases, ulcer and wound. It has also been shown to have hypoglycaemic properties (antidiabetic) in animal as well as human studies. Juice of the plant leaves used to treat piles completely. It is used as a blood purifier due to its bitter tonic properties. It can heal boils and other blood related problems that show up on the skin. Juice of karela is also beneficial in treating and preventing the liver damage (Agharkar, 1953; Garau et al., 2003). While the root decoctions have abortifacient properties, leaf and stem decoctions are used in treatment of dysentery, rheumatism and gout (Subratty et al., 2005). Roots are used in the treatment of syphilis, rheumatism, boils, ulcer, septic swellings, ophthelmia, and in Prolapsus vageneae (Agharkar, 1953; Jadhav, 2008). In addition, juice of Momordica charantia drawn directly from fruit has traditionally been used for medicinal purposes worldwide. Likewise, the extracted juice from leaf, fruit and even whole plant are routinely used for treatment of wounds, infections, parasites (e.g., worms), measles, hepatitis and fevers (Behera et al., 2008). In Uganda, an infusion of the leaf and roots is used as an abortifacient and ecbolic (Chhabra et al., 1989) and in Tanzania the fruit pulp is regarded as being poisonous to weevils, moths and ants and is used as a repellant (Bryant, 1909). In India, Momordica charantia is used by tribal people for abortions, birth control, increasing milk flow, menstrual disorders, vaginal discharge, constipation, food, diabetes, hyperglycemia, jaundice, stones, kidney, liver, fever (malaria), gout, eczema, fat loss, hemorrhoids, hydrophobia, intestinal parasites, skin, leprosy, psoriasis, rheumatism, scabies, snakebite, vegetables, piles, tonic, anthelminthic, purgative (Grover and Yadav, 2004). However, it is commonly consumed as vegetable (Grover and Yadav, 2004). Momordica charantia has been used by indigenous people to treat diabetes, urethra discharge, dysentery, colitis, wounds, infections, hepatitis, rheumatism, gout and mild purgative for children (Lotikar et al., 1996; Plattel and Srinivasan, 1997). Momordica charantia is used by traditional healers in Togo for gastrointestinal, childhood viral diseases, skin problems, malaria and food uses. However, gynecological aid, fevers, and diabetes are three uses much more commonly cited by the healers [Beloin et al., 2005]. In Cameroon, Momordica charantia juice is claimed to reduce the problem of Pyorrhoea. This plant decoction is used for the treatment of diabetes, viruses, cancer, tumors, high cholesterol and psoriasis, rheumatism, typhoid fever, malaria, fever, worms, ulcer and hepatitis. This plant’s leaves are squeeze and drink to clear fallopian tube blockage.

Reported Phytoconstituents:
The nutritional and chemical compositions of Momordica chlorantia were investigated using standard analytical methods (Bakare et al., 2010). The proximate analysis showed the percentage moisture, ash, crude lipid, crude fibre, crude protein, carbohydrates content of the material plants. The calorific values for leaf, fruit and seed were 213.26, 241.66 and 176.61 Kcal/100g respectively. The elemental analysis of this plant leaf revealed the presence of potassium (255ppm), manganese (156ppm), zinc (120ppm), iron (98ppm) and copper (32ppm). Vitamin A (0.03ppm), vitamin E (800ppm), folic acid (206000ppm), cyanocobalamin (5355ppm), and ascorbic acid (66000ppm) were present. Trace amount of some other vitamin such as vitamin B3, vitamin B6, vitaminD, and vitamin K were also found in the methanol and pet-ether leaf extract of Momordica chlorantia. Phytochemicals like alkaloids, tannins, flavonoids, saponins, glycosides, sterols, mucilages and oleanolic acids (Bakare et al., 2010; Harinantenaina et al., 2006; Venkat et al., 2011) were also found present. The study conducted by Bakare et al. (Bakare et al., 2010) also indicates the presence of nutritional and chemical compounds that are beneficial in addition to numerous medicinal values of the plants. Researches indicate the Active purified constituents responsible for the properties of Momordica. They are charantin (insulin-like peptide or plant-insulin) (Harinantenaina et al., 2006), Momordicin I, Momordicin IV, Aglycone of Momordicose I, Aglycone of Momordicoside L and Karavilagenin D (Wen et al., 2015), kuguacin J (3,7,23-trihydroxycucurbit-5,24-dien-19-al) , a Triterpenoid from Momordica charantia (Pitchakarn et al., 2012), 3β,7β,25-trihydroxycucurbita-5,23(E)-diene-19-ol (TCD), another triterpenoid, EMDCO 5β,19-epoxy-25-methoxycucurbita-6,23(E)-diene-3β-ol) (Chang et al., 2015), Vicine (Dutta et al., 1981), momordin, stigmasta-5, 25-dien-3β-O-glucoside, β-sitosterol-β-D-glucoside, momordicose G, momordicoside F1, momordicoside F2, momordicoside I, momordicoside K, momordicoside L (Wu and Ng, 2008; Kokate et al., 2008; Chatterjee and Prakash, 1995). Some structures of these actives constituents are given below. Charantin can be used as substitute to insulin (Cunnick and Takemoto, 1993). Momordin may have anticancer properties (Leung, 1984). Flavonoids have been shown to have diuretic, laxative, antispasmodic, anti-hypertensive and anti-inflammatory actions (Okuda 1962), and antimalarial activity (Konziase, 2015). Isolated pure form of alkaloids and their synthetic derivatives are used as basic medicinal agents for their analgesic and bacterial effects (Blytt et al., 1988), antivirus, antiarrhythmic, antimalarial and anti-cancer activities [Wink et al., 1998]. Tannin rich medicinal plants are used to heal a lot of illneses; such as leucorhoea, rhinorhoea and
diarrhea. More recently, tannins have gained medical interest, because of the high prevalence of deadly ailments such as AIDS and numerous cancers (Ibikunle and Ogbadoyi, 2011).

Chemical structures of some purified bioactive constituents extracted from *Momordica charantia*:

**Pharmacological Profiles:**

Scientific investigations on *Momordica charantia* demonstrated the tremendous pharmacological and nutritional values of this plant which support its various traditional uses for the management of health problems. The most important are:

**Antioxidant activity:**

A study aimed to determine and compare the antioxidant activity of methanol and chloroform extracts of *Momordica charantia* fruit was carried out by Rezaeizadeh et al (Rezaeizadeh et al., 2011). In this study, the total antioxidant and free radical scavenging activities in methanol and chloroform extracts were measured by ferric thiocyanate (FTC), Thiobarbituric acid (TBA) and 1,1-diphenyl-2-picryl-hydrazyl(DPPH) methods. Total phenol and flavonoid contents of the plant’s extracts were also evaluated. The total antioxidant activity results indicated that, the inhibition percent of methanol extract was significantly higher than the inhibition percent of chloroform extract in the FTC and TBA methods. Methanol extract exhibited a higher IC50 value for free radical scavenging, a higher concentration of total phenols and flavonoids and was found to contain more potent antioxidant and high polyphenol compounds when compared with chloroform extract. The results also confirmed that, the type of solvent has an important role in detecting plant compounds. In another study, the antioxidant activity of *Momordica charantia* was studied in some in-vitro antioxidant models like DPPH radical scavenging activity, Superoxide radical scavenging activity, Ferric reducing power and Hydrogen peroxide scavenging activity (Ghosh et al., 2014). The plant’s extract showed antioxidant activity by inhibiting DPPH, scavenging superoxide and hydrogen peroxide. It also showed reducing power ability in ferric reducing model. Total antioxidant capacity was found to be 19.22 mg/gm expressed as L-Ascorbic acid. Significant antioxidant activity of Water extract of this plant was found and might be due to the presence of Acidic compounds, Flavonoids, Phenols, Saponins, Tannins and Triterpenoids present in the plant. This plant can be used as an accessible source of natural antioxidants and to cure some diseases associated with oxidative stress like malaria.

**Antimalarial activity:** The anti-malarial activity of *Momordica charantia* has been reported (Mothena et al., 2009; Jayapal et al., 2012; Munoz et al., 2000). A study conducted by Munoz et al showed moderate in vivo activity of the this plant’s extract against rodent malaria *Plasmodium vinckei petteri* and an excellent antimalarial activity in vitro on *Plasmodium falciparum* (Munoz et al., 2000). This plant’s extract, a bacterial insecticide also has good larvicidal and pupicidal properties against potent malarial vector, Anopheles stephensi and can be recommended as a potent bio-pesticide (Jayapal et al., 2012).

**Hypocholesterolemic activity:** Experiments carried out in normal as well diabetic animals have shown hypo-cholesterolemic effects by *Momordica charantia* (Dhar et al., 1999). In a study conducted by Dhar et al, sunflower fed rats were fed with conjugated octadecatrienoic fatty acid isolated from *Momordica charantia* seeds for 4 weeks. After 4 weeks, these rats showed significant lowering of the plasma lipid peroxidation and erythrocyte membrane lipid peroxidation as well as non enzymatic liver tissue lipid peroxidation (Dhar et al., 1999).
Trypanocidal activity:

The effective concentration of ethanolic extract of *Momordica charantia* leaves, capable of killing 50% of *Trypanosoma cruzi* parasites (IC50) was 46.06 μg/mL. The Minimum Inhibitory Concentration (MIC) was ≤1024 μg/mL. Metronidazole showed a potentiation of its antifungal effect when combined with an extract of *Momordica charantia* (Santos et al., 2012).

Food preservative:

A study was carried out systematically to isolate and characterize peptides having antibacterial activity from different parts of *Momordica charantia* (Jabeen and Khanum, 2014). Crude aqueous extracts of seeds, pulp and skin were prepared in phosphate buffer saline (PBS) and antibacterial activity was checked on Luria Bertani (LB) broth agarplates against a number of bacteria such as *Escherichia coli*, *Staphylococcus aureus*, *Salmonella typhi* and *Pseudomonas aeruginosa*. The results of this study suggested that antibacterial peptide obtained from seeds the plant may be used as an alternative natural bio-preservative source for minced meat products.

Hepatocurative and Hepatoprotective activity:

An analysis of different serum enzymes including ALT, AST, ALP and LDH was carried out to evaluate the hepatoprotective and hepatocurative effects of *Momordica charantia* (Zahra et al., 2012). The study was divided in two phases. In first the phase, liver toxicity was induced in rabbits with administration of acetaminophen, and then Momordica extract was given and hepatocurative effects were observed. The results indicated significant decrease in the elevated concentrations of these enzymes in acetaminophen-intoxicated rabbits. In the second phase, the extract of Momordica was given to the rabbits orally for 10 and 15 days respectively. Then, the animals were administered with acetaminophen and hepatoprotective effects of Momordica were observed. The hepatoprotective effects of Momordica extract was found to be more effective after 15 days as there was less elevation of the serum enzymes after liver damage. Chaudhari et al (Chaudhari et al., 2009) also demonstrated the hepatoprotective activity of hydroalcoholic extract of *Momordica charantia* leaves against carbon tetrachloride induced hepatotoxicity in albino wistar rats (Chaudhari et al., 2009). This plant can then be used as a protective and/or therapeutic remedy against liver diseases.

Gastroprotective potential of alcoholic and aqueous fruit extracts of *Momordica charantia* against pylorus ligation, aspirin and stress induced ulcer in rats has been evaluated (Venkat et al., 2011). Both aqueous and alcoholic fruit extracts of this plant were used at three different doses (100, 200 and 400 mg/kg). Results of the study demonstrated the dose dependent antulcer activity of *Momordica charantia*. There was a significant decrease in ulcer score, ulcer area, total acid output and gastric volume in plant extract treated groups. Phytochemical analysis of plant extracts showed the presence of active constituents including glycosides, saponins, alkaloids, sterols, steroidal saponins and mucilages which might participate in gastroprotective potential of the plant. In another study (Alam et al., 2009) methanol extract of *Momordica charantia* fruit increases healing of gastric ulcer and also prevents development of gastric ulcers and duodenal ulcers in rats.

Effect on diabetic complications: Complications are frequently encountered in diabetes and these are associated with irreversible functional and structural changes in various organs particularly the kidneys, eyes, nerves, blood vessels and insulin resistance (American Diabetes Association 1998). *Momordica charantia* has shown promising effects in prevention as well as delay in progression of these complications in experimental animals (Grover et al., 2001; Rathi et al., 2002; Vikrant et al., 2001). In a study aimed to evaluate the effect of this plant on diabetic neuropathy, its aqueous extract (200 mg/kg) was given to diabetic animals for 50 days. The treatment caused reduction in tail flick latency by 43.6% in comparison to diabetic control animals where it increased by 73.6% compared to normal animals (Grover et al., 2002). In another experiments, *Momordica charantia* treatment (aqueous extract 200 mg/kg) of alloxan diabetic rats inhibited development of cataract (observed up to 120 days) that (Rathi et al., 2002). With a view to assessing the effect of Momordica charantia treatment on development of nephronephropy in diabetic animals, certain renal functions parameters were measured by Grover et al (Grover et al., 2001). STZ diabetic mice had several times higher mean values of serum creatinine (50.0mol/l), urinary albumin (14113g/24 h), urine volume (31.9 ml/24 h) and renal weight (0.59 gm) compared to normal mice. However, in parallel, these values were significantly less (47.5mol/L, 1072g/24 h, 20.0 ml/24 h and 0.51 g, respectively) in *Momordica charantia* treated animals (Grover et al., 2001). Bhaskar Sharma et al also proved that Momordica charantia exhibited significant rejuvenating capacity of kidney tissues activities in alloxan-induced diabetic mice (Sharma et al., 2014). These results are very important since diabetic patients are 17 times more prone to kidney disease as compared to healthy patients. Komolafe et al investigated the effects of *Momordica charantia* on histological changes of the left ventricle of the heart in streptozotocin-induced diabetic Wistar rats (Komolafe et al., 2012). *Momordica charantia* and glipizide (a standard drug) attenuated the morphological alterations and reduced the glycogen deposits (Komolafe et al., 2012). All these evidences suggest cardio-protective effects of this plant against anatomaical derangements observed in the
diabetic rats. This later result showed the usefulness of *Momordica charantia* to diabetic patients who are particularly prone to cardiovascular diseases including hypertension, atherosclerosis, diabetic cardiomyopathy, congestive heart failure and cardiac autonomic neuropathy (Komolafe et al., 2012).

Anthelmintic study: Preparations from *Momordica charantia* exhibited in vitro anthelmintic activity against *Ascaridia galli* worms and shown to be more effective than piperazine hexahydrate, a conventional drug used against helminths (Lal et al., 1976). In another work the anthelmintic property of *Momordica charantia* seeds extracts against Indian adult earthworm *Pheretima posthuma* was evaluated, while Albendazole was used as the standard drug (Vedamurthy et al., 2015). Petroleum ether, chloroform, ethanol and aqueous extracts at concentration of 20 mg/mL each were evaluated for anthelmintic activity. The time taken for each worm for paralysis and death were determined. Among all the extracts chloroform extract showed best anthelmintic activity by inducing paralysis within 3 min and death within 8 min. The extracts even showed better result when compared to the standard drug Albendazole. Thus, this plant extracts can be used for the treatment of worms.

Immunomodulatory activity: Studies have shown immunosuppressive as well as immunostimulatory effect of *Momordica charantia* components (Leung et al., 1987; Spreafico et al., 1983; Zheng et al., 1999; Huang et al., 1990; Oladele et al., 2009). During an in vivo study, Leung et al. (Leung et al., 1987) observed that microgram injections of *Momordica charantia* inhibitory protein (MCI) to mice delayed H2-incompatible skin allograft rejection, splenocyte responsiveness to concanavalin A (ConA) and phytohemoglobin (PHA). It also abrogated PFC response to T-dependent (SRBC) antigen but completely spared response to a T-independent (S III) stimulus. There was reduction in NK cell activity but increased macrophage-mediated spontaneous cytotoxicity. In vitro, MCI inhibited lymphoid cell responsiveness to PHA and ConA, but not to LPS and markedly enhanced macrophage-dependent cytotoxicity (Spreafico et al., 1983). Intraperitoneal administration of alpha-momorcharin and beta-momorcharin (50g weekly for 5 weeks) to BALB/cAn or C57BL/6N mice resulted in high levels of IgE production (PCA titer), while no cross-immunological reactivity among these proteins was found (Leung et al., 1987; Spreafico et al., 1983; Zheng et al., 1999). In another in vivo study, a leaf extract demonstrated the ability to increase resistance to viral infections as well as to provide an immunostimulant effect in humans and animals (increasing interferon production and natural killer cell activity) (Oladele et al., 2009).

**Anti-inflammatory and analgesic activity:**

Many scientific studies have revealed the anti-inflammatory activity of *Momordica charantia* (Oladele et al., 2009; Leelaprakash et al., 2012; Che-Yi et al., 2014). The in vitro anti-inflammatory activity of Momordica charantia was studied by inhibiting the action of lipoxygenase (LOX) enzymes, involved in the mechanism of inflammation (Leelaprakash et al., 2012). A protein free Momordica charantia extract was also used to characterise the chemical component which is responsible for inhibition of lipoxygenase activity. It was observed that the plant extract had anti-inflammatory activity as it inhibited the activity of lipoxygenase. The study also showed that the activity of LOX in the presence of plant extract was less when compare to control. Thus the plant extract was responsible for the inhibition of LOX activity. Moreover, the study gave a clear picture that a protein is not responsible for the activity as removal of protein from the extract also gave the same result. Another study reports the anti-inflammatory and analgesic properties of aqueous leaf extracts of *Momordica charantia* in rats and mice in a carrageenan-induced rat paw oedema (Oladele et al., 2009). The result of the study revealed that the leaf extract of the plant possesses anti-inflammatory property as they were found to significantly (p<0.05) inhibit oedema induced by carrageenan in the rat paws. The leaf extract of *Momordica charantia* was also found to significantly (p<0.05) increase the reaction time of the mice in hot plate test method, while the number of writhing movement of the mice was also significantly(p<0.05) reduced in dose-dependent manner. The results of the study suggest the anti-inflammatory and analgesic effects of the aqueous leaf extract of the plant. Che-Yi Chao et al also indicate that this plant in diets promoted lipid metabolism, reducing fat accumulation, and improving low blood glucose in sepsis (Che-Yi et al., 2014).

**Antiviral activity:**

Momordica charantia is active against viruses. In fact, its extract can inhibit transcription and transactivation, and can also inhibit viral integrase (Lee-Huang et al., 1990). MAP 30 (Momordica Anti HIV Protein) present in seed and fruit extracts; Alpha and beta momorcharin from seeds, fruits and leaf extracts, all have Anti-HIV (Human Immunodeficiency Virus) activity (Lee-Huang et al. 1990; Au et al. 2000). In fact, in a study HIV-infected cells treated with alpha- and beta-momorcharin showed a nearly complete loss of viral antigen while healthy cells were largely unaffected (Lee-Huang et al., 1990), and in 1996 the inventors of the chemical protein along MAP-30 filed a U.S. patent, stating it was “useful for treating tumors and HIV infections. He added that in treating HIV infection, the protein is administered alone or in conjunction with conventional AIDS therapies (Lifson et al., 1989).This plant’s extract is also effective against polio virus as it inhibits polio virus replication by inhibiting protein synthesis (Schreiber et al., 1999). In a study conducted by Prasero et al (Prasero et al., 1997), the in vitro activity of Momordica charantia against herpes simplex virus
type 2 (HSV2) was evaluated by standard method of plaque reduction assay. The result showed that the total inhibition of plaque formation on HSV2-infected Vero cell line was achieved at concentration of 8% v/v of crude extract, whereas the concentration of 1% v/v was capable of reducing the number of plaques by approximately 50% (inhibitory dose 50 = ID50). This result is very interesting as even with only small amount of crude extract, they got ID 50. We can then use Momordica charantia extract to treat genital organ infection caused by HSV2. Recently, the new antiviral activity of the protein extracted from Momordica charantia seed was determined with different subtypes of influenza A by Pongthanapisith et al. (Pongthanapisith et al., 2013). Using 5, 25, and 100 TCID50 of influenza A/New Caledonia/20/99H1N1, A/Fujian/411/01 H3N2 and A/Thailand/1(KAN-1)/2004 H5N1, the IC50 was calculated to be 100, 150, and 200; 75, 175, and 300; and 40, 75, and 200µg/mL, respectively. The present finding indicated that the plant protein inhibited not only H1N1 and H3N2 but also H5N1 subtype. As a result of the broad spectrum of its antiviral activity, this plant protein holds a great promise to be developed as a potent therapeutic against various and even new emerging subtypes of influenza A such as H7N9, which is now pandemic in China.

**Anti-Genotoxic Activity:**
Balboa and Lim-Sylianco have reported that *Momordica charantia* decreases the genotoxic activity of methylnitrosamine, methanesulfonate and tetracycline, as shown by the decrease in chromosome breakage (Balboa et al., 1992).

**Anti-tumour and anticancer activities:**
Plants are an invaluable source of potential new anti-cancer drugs. Early examples of anticancer agents developed from higher plants are the antileukemic alkaloids (vinblastine and vincristine), which were both obtained from the Madagascar periwinkle (Catharanthus roseus) (Voss et al., 2005). Momordica charantia is one of these plants with both edible and medical value and reported to exhibit anticancer activity. Many scientific studies have proved the effectiveness of this plant’s extracts against almost all types of cancer cells. Its crude extract inhibits tumor formation in CBA/1 mouse cancer cell line of mice (Jilka et al., 1983). MAP 30 extracted from Momordica charantia is effective against lymphoid leukemia, lymphoma, squamous carcinoma of tongue, larynx, human bladder carcinoma, Hodgkin’s disease (Licastro et al., 1980; Ng et al., 1994; Battelli et al., 1996; Basch et al., 2003; Soudararajan et al., 2012). This plant’s extract is also effective against colon cancer cells (Kohno et al., 2002), human nasopharyngeal carcinoma CNE-1 and CNE-2 cells (Fang et al., 2012) in inhibiting breast cancer cell growth (Li-Yuan et al., 2016; Ray et al., 2010; Shobha et al., 2015) and prostate cancer progression in vitro and in vivo (Ru et al., 2011; Pitchakarn et al., 2011). Fruit and seed extract activates natural killer cells in mice (Cunnick et al., 1990). To explore the potential effectiveness of Momordica charantia, its methanol extract was used to evaluate the cytotoxic activity on four human cancer cell lines: Hone-1 nasopharyngeal carcinoma cells, AGS gastric adenocarcinoma cells, HCT-116 colorectal carcinoma cells, and CL1-0 lung adenocarcinoma cells (Chia-Jung et al., 2012). This extract showed cytotoxic activity towards all cancer cells tested; with the approximate IC50 ranging from 0.25 to 0.35 mg/mL at 24 h. The extract induced cell death was found to be time-dependent in these cells. Apoptosis was demonstrated by DAPI staining and DNA fragmentation analysis using agarose gel electrophoresis. The same extract also activated caspase-3 and enhanced the cleavage of downstream DFF45 and PARP, subsequently leading to DNA fragmentation and nuclear condensation. The apoptogenic protein, Bax, was increased, whereas Bcl-2 was decreased after treating for 24 h in all cancer cells, indicating the involvement of mitochondrial pathway in extract-induced cell death. These findings indicate that, ethanol extract of this plant has cytotoxic effects on human cancer cells and exhibits promising anti-cancer activity by triggering apoptosis through the regulation of caspases and mitochondria. Another study investigated the anti-cancer effect of an active water-soluble extract (s) of Momordica charantia on cell viability and its cellular mechanism(s) of action in inducing cell death (Manoharan et al., 2014). The results show that the crude water soluble extract of this plant can evoke both time-couse (800 µg/ml) and dose-dependent (200µg/ml -800 µg/ml) decreases in cell viability (cell death) with maximal increases in cell death employing 800 µg/ml over a period of 24 hours following incubation. The results of this study have also shown that the crude water-soluble extract of the plant (800 µg/ml) can elicit marked and significant (p < 0.05) increases in the activities of caspase -3 and caspase -9 in all the cell lines. The crude water soluble extract of Momordica charantia can stimulate the release of cytochrome-c and elevated intracellular free calcium concentrations [Ca2+] in the different cancer cell lines compared to untreated cell lines. These results clearly show that Momordica charantia is exerting its anti-cancer effect via an insult to the mitochondria resulting in apoptosis, calcium overloading and subsequently, cell death. More recently, Mohammed conducted a study focused on the in vitro effect of crude methanol extract of Momordica charantia on liver cancer (HepG2), Human colon cancer (HCT116) and breast cancer (MCF-7) (Alshehri et al., 2016). The results showed that the effect of this plant’s extract was highly significant in HepG2 cells (IC50: 0.77 µ g/ml) and HCT116 cell (IC50: 0.81 µ g/ml) than MCF-7 (IC50: 1.35µ g/ml). Thus the methanol extract of this plant has a potential effect to decrease the proliferation rate of different cancer cells specially HepG2 liver cancer and HCT116 Human.
colon cancer. The study suggested that the mechanism of action of Momordica charantia plant extract is due to its chemical contents like triterpenoid, which is confirmed as anti-proliferative ingredient (Akihisa et al., 2007). Also, the in vivo antitumor activity of a crude extract from the bitter melon (Momordica charantia) was determined (Jilka et al., 1983). The extract inhibited tumor formation in CBA/H mice which had been given i.p. injections of 1.0 x105 CBA/DI tumor cells (77% of the untreated mice with tumors versus 33% of the treated mice with tumors after 6 weeks). The extract also inhibited tumor formation in DBA/2 mice which had been given i.p. injections of either 1x105 P388 tumor cells (0% of untreated mice survived after 30 days versus 40% survival of the treated mice) or 1x105 L1210 tumor cells (0% survival of untreated mice versus 100% of treated mice after 30days). The in vivo antitumor effect required both the prior exposure of tumor cells to the extract (2hr) in vitro and i.p., biweekly injections of the extract into the mice. The optimum dose for tumor inhibition (8 μg protein, biweekly) was not toxic to mice for at least 45 days of treatment. Nylon wool-purified spleen cells from these same bitter melon-treated mice exhibited an enhanced mixed lymphocyte reaction when exposed to irradiated P388 stimulator cells (186% of the untreated control mice). These data indicate that in vivo enhancement of immune functions may contribute to the antitumor effects of the bitter melon extract. This antitumor activity was later confirmed by Li-Yuan Bai et al (Li-Yuan et al., 2016). They investigated the antitumor activity of 3β, 7β, 25-trihydroxycucurbita-5, 23(E)-dien-19-al (TCD), a triterpenoid isolated from wild bitter gourd, in breast cancer cells. TCD suppressed the proliferation of MCF-7 and MDA-MB-231 breast cancer cells with IC50 values at 72 h of 19 and 23 μM, respectively, via a PPARγ-independent manner. TCD induced cell apoptosis accompanied with pleiotropic biological modulations including down-regulation of Akt-NF-κB signaling, up-regulation of p38 mitogen-activated protein kinase and p53, increased reactive oxygen species generation, inhibition of histone deacetylases protein expression, and cytoprotective autophagy. Together, these findings provided the translational value of TCD and wild bitter gourd as an antitumor agent for patients with breast cancer. Kuguacin J, another Triterpenoid from Momordica charantia have shown potent anticancer capabilities to induce apoptosis/cell cycle arrest in pre-initiated/initiated tumor cells, while in more advanced tumors, this compound could block resistance to anticancer drugs, tumor progression and metastasis, especially against human prostate cancer (Pitchakarn et al., 2012; Pitchakarn et al., 2011). These findings provide evidence of the anticancer effects of kuguacin J and suggest the strong possibility that this purified compound from natural product can be developed for cancer chemoprevention and chemotherapy. It is henceforth evident that, Momordica charantia is effective against many types of cancer and gains very high attention to be one of the strong candidates for the elaboration of potent anticancer drugs.

**Anti-hepatitis B virus activity:** EMCDO (5β,19-epoxy-25-methoxycucurbita-6,23(E)-dien-3β-ol), a purified compound isolated from Momordica charantia extract exhibited the most efficient effect in terms of reducing HBV surface antigen, e antigen and viral DNA levels in HBV particles or surface antigen-producing cells 2.2.15 and PLC/PRF/5, respectively (Chang et al., 2015). Tumor suppressor p53 played a significant role in EMCDO-mediated anti-HBV effects. Pretreatment with EMCDO prevented 2.2.15 cells-induced tumor formation in a nude mice subcutaneous xenograft model. The anti-HBV and anti-tumor activities of EMCDO were better than those of oltipraz, an inhibitor of HBV transcription. In fact, the EC50 of HBV DNA suppression was 4.58 µg/ml for oltipraz and 1.31 µg/ml for EMCDO. EMCDO also reduced the pro-inflammatory cytokines and mediates in LPS-treated RAW264.7 cells in a dose-dependent manner. Thus, EMCDO have potential beneficial effects against HBV and inflammation response, subsequently preventing hepatocellular carcinoma development.

**Abortifacient activity:**
Alpha and beta momorcharin in seeds extract Induces mid term abortion in mice (Yeung et al., 1986).

**Anti-typhoid fever:** Adeyi et al investigated the antimicrobial potency of methanol extract of Momordica charantia leaves on Salmonella typhi in male albino rats (Sprague dawley) and the effects of treatment on liver function (Adeyi et al., 2013). There were 5 groups of 10 rats each. 1ml aliquot of the 4th dilution of Salmonella typhi was administered orally to rats in four of the groups to be infected with typhoid, while the last group served as the control. Infected groups were thereafter treated with 100 and 200mg/kg of M. charantia and 10mg/kg of chloramphenicol, respectively for seven days, while the remaining group was not treated after infection. The effect of treatment on infection level, body weight and liver enzymes were thereafter investigated. Marked reduction in infection level was observed in all treated rats. Rats treated with 200mg/kg of the plant extract had total clearance by the sixth day, while significantly lower (p<0.05) infection level was recorded in rats treated with the plant extract than those treated with the standard drug. Mean body weight of all treated rat groups increased during treatment. Concentrations of total and direct bilirubin, alanine aminotransferase (ALT), alkaline phosphatase (ALP), aspartate aminotransferase (AST) and gamma glutamyl transferase (GGT) were higher (p<0.05) in untreated rats than the treated rats. These results suggest that leaf extract of Momordica
charantia is a potent antimicrobial drug against Salmonella typhi with hepato-ameliorative potentials. This result is of great importance since typhoid fever is a disease prevalent in the tropics. In fact, despite the availability of antibiotics, treatment of patients with the disease has been quite challenging in the face of resistance to those drugs.

**Antimicrobial and antibacterial activity:**

The antibacterial and antifungal activities of Momordica charantia, was investigated against Staphylococcus aureus (gram+ve), Escherichia coli (gram-ve) and Candida albicans (fungi) using the Stokes disc diffusion, the pour plate, well diffusion and streak plate methods (Jagessar et al., 2008). The solvent type extracts were obtained by three extractions with hexane, dichloromethane, ethyl acetate and ethanol respectively. Solvents were removed in vacuo to yield viscous oils and paste which were made up to a concentration of 0.03g in 10 mL of the respective solvents. These were tested in varying volumes of 100-600μL/plate (i.e. concentrations of 0.03-0.18mg/10mL agar). The solvents were used as control whereas ampicillin and nystatin were used as references for bacteria and fungal species respectively. The solvents had no effect on the microorganisms whereas ampicillin and nystatin inhibited microbial growth. Momordica Charantia showed antimicrobial inhibitory activity at 0.18mg/10mL plate of medium with activity most prominent with the ethanol extracts and negligible with the hexane. This study suggests that the ethanol extracts of Momordica Charantia, can be used in the control of theses micro-organisms-induced diseases. In another study, this plant’s extracts also appeared to inhibit the growth of numerous gram-negative and gram-positive bacteria including Escherichia coli, Salmonella typhi, Shigella dysenteriae, Staphylococcus aureus, Pseudomonas aeruginosa, Streptobacillus moniliformis, Streptococcus pneumoniae, Helicobacter pylori, and parasitic organisms Entamoeba histolytica and Plasmodium falciparum (Anonymous, 2007).

**Hypoglycemic and anti-diabetic activity:**

Over 1000 herbal products have been used by various cultures to lower blood glucose and treat diabetes. Among them, Momordica charantia is the most popular herbal resource (Marles and Farnsworth, 1995). A study was conducted in order to evaluate changes in urinary metabolite profile of the normal, streptozotocin-induced type 1 diabetes and Momordica charantia extract (100 and 200 mg/kg body weight) treated diabetic rats, using proton nuclear magnetic resonance (1H-NMR) -based metabolomics profiling, for one week (Perumal et al., 2015). Blood glucose level after administration was measured to examine hypoglycemic effect of the extract. The results obtained indicated that Momordica charantia was effective in lowering blood glucose level of the diabetic rats. Administration of the plant’s extract was found to be able to regulate the altered metabolic processes. Thus, it could be potentially used to treat the diabetic patients. Charantin isolated from fruits of Momordica charantia was also tested for its hypoglycemic activity. In fasting rabbits, it gradually lowered blood sugar within one to four hours and recovered slowly to initial level. At an oral dose of 50 mg/kg, blood sugar level was declined by 42% at the 4th hour. The average blood sugar fall during 5 hours was 28%. Charantin was found to be more potent than tolbutamide however both compounds produced similar pattern of blood sugar change. The hypoglycemic activity of charantin in depancreatized cats was less, but abolished, indicating a pancreatic as well as extra-pancreatic action (Desai and Tatke, 2015). The possible modes of the hypoglycemic actions are insulin secretagogue effect, stimulation of skeletal and peripheral muscle glucose utilization, inhibition of glucose intake and hexokinase activity, inhibition of key gluconeogenic enzymes, glucose-6-phosphatase and fructose-1,6-bisphosphate dehydrogenase (due to the depressed activity of these enzymes, the glucose synthesis would decrease and as a result blood glucose level would be reduced), stimulation of key enzyme of HMP pathway (The increased activity of this regulatory enzyme reflects an increased glucose oxidation through this pathway and thus contributes partially to the overall blood glucose decreasing), preservation of islet β cells and their functions or prevention of insulin resistance (Md. Alamgir et al., 2012; Bailey and Day, 1989; Meir and Yaniv, 1995; Yang et al., 2015).

**Cardiovascular effects:**

Effect of charantin (a pure chemical from Momordica charantia) was studied on cardiovascular system (Desai and Tatke, 2015). At the dose of 800 mg/kg, 5-10% of blood pressure lowering of anaesthetized cat was observed. In another study aimed at evaluating possible cardio-protective properties of Momordica charantia by determining its effect on blood cholesterol levels in albino rats was carried out by Sheriff and Yusuf (Sheriff et al. 2013). Results indicated that the plant’s extract significantly reduced low density lipoprotein (LDL) levels (P<0.05) in the experimental group A (80mg/kg), when compared to the control group. Together, these studies showed that Momordica charantia plant extract has cardio-protective properties by its dose-dependent effects on blood cholesterol and blood pressure. However, there is an indication that higher doses should be discouraged, since it is rather increase low density lipoprotein (LDL) levels in the blood.
Wound healing activity:
Researchers (Sankaranarayanan et al., 1993) found that Momordica charantia fruit powder, in the form of an ointment (10% w/w dried powder in simple ointment base), showed a statistically significant response (P < 0.01), in terms of wound-contracting ability, wound closure time, period of epithelization, tensile strength of the wound and regeneration of tissues at wound site when compared with the control group, and these results were comparable to those of a reference drug povidone iodine ointment in an excision, incision and dead space wound model in rats.

Body weight decrease activity:
In a study, Farhat Bano et al administered orally the aqueous extract of Momordica charantia fruit to overweight rats in order to assess the effect of this extract on body weight of the rats (Farhat Bano et al., 2011). Five weeks treatment not only showed significant decrease in body weight of rats but there was also significant decrease in blood glucose, total cholesterol, triglyceride and LDL-cholesterol. Moreover, there was increase in HDL-cholesterol levels in serum. This result clearly showed a decrease in body weight with many other advantages. Hence, this plant’s extract can be used against obesity, which not only increases the risk of cardiovascular diseases but is also responsible of certain types of cancer and osteoarthritis.

Antifeedant activity:
Yaqui (Yaqui, 2002) demonstrated that methanolic extract of M. charantia leaves inhibited feeding of two armyworm larvae, Spodoptera litura and Pseudaletia seperata. Momordin II, a triterpene monoglucoside from the plant extract was identified as an antifeedant compound.

Neuroprotective effect:
Momordica charantia possesses neuroprotective effects on High-Fat Diet-associated blood brain barrier disruption, stress and neuro-inflammatory cytokines [Nerurkar et al. 2011]. In fact, Malik et al. (Malik et al., 2011) showed that cerebral oxidative stress and damage, and neurological deficits were dose dependently attenuated by pre-treatment with the lyophilized this pant’s juice (200-800 mg/kg).

Antipyretic effect:
The ethanolic extracts (500 mg/ kg) of Momordica charantia fruit showed antipyretic effect in a study which was carried out using yeast-induced pyrexia in rats. The authors stated that the antipyretic activity of Momordica charantia may be due to the individual or combined action of bioactive constituents present in it (Patel et al., 2010).

Anti-diarrheal activity:
The anti-diarrheal activity of aqueous leaf extract of Momordica chlorantia was evaluated on castor oil-induced diarrhea, gastro-intestinal transit, intestinal fluid accumulation and gastric emptying in rats (Bakare et al., 2011). The aqueous extract of the plant showed inhibitory activity against castor oil-induced diarrhea. A significant reduction (p<0.05) in the gastro-intestinal mobility in charcoal meal test in rats was observed. The extract decreased the volume of intestinal secretion induced by castor oil with a significant effect (p<0.05) on the gastric emptying of the test animals compared to the control rats. Inhibition of the gastro-intestinal propulsion and fluid by the extract suggest it might exert its anti-diarrheal activity by anti-secretory mechanism.

Larvicidal activity:
Bioassays with crude extract of Momordica charantia against larvae of Anopheles stephensi, Culex quinquefasciatus and Aedes aegypti revealed the LC50 values of 0.50, 1.29 and 1.45%, respectively (Singh et al., 2006). Further, in bioassays hexane extract showed more potent larvicidal activity than the crude extract, indicating the non-polar characteristics of larvicidal components (Singh et al. 2006). The LC50 values of hexane extract against larvae of Anopheles stephensi, Culex quinquefasciatus and Aedes aegypti were 66.05, 96.11 and 122.45 ppm, respectively. The results revealed that the larvae of Anopheles stephensi were more susceptible in comparison to the larvae of Culex quinquefasciatus and Aedes aegypti. However, further studies to identify the larvicidal components are needed. Hence the larvicidal action of the fruits extract of this plant could be exploited for use in potable waters against mosquito larvae. This plant’s activity against Anopheles stephensi has recently been confirmed by Jayapal et al (Jayapal et al., 2012).

Antifertility effects:
Tumkiratiwong et al investigated the antifertility effect of Momordica charantia ethanol seed extracts on reproductive male Wistar rats (Tumkiratiwong et al., 2014). Their data showed that high dose of this plant seed extracts caused infertility in male rats. They said that the interruption in the fertility is probably attributed to the direct toxic to seminiferous tubules, epididymis and the lowered testosterone level which might impact on sperm

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parameters. This plant has also shown to have potent male antifertility effects when ethanol seed extracts were administered to dogs (Dixit et al., 1978) and guinea pigs (Udoh et al., 2001). The plant extract also has antifertility effect on female animals. In fact in an experiment aimed at determining the effect of graded doses of aqueous leaf extracts of Momordica charantia on fertility hormones of female albino rats (Adewale et al., 2014). Twenty adult, healthy, female Wistar rats were divided into four groups: low dose (LD), moderate dose (MD) and high dose (HD) groups which received 12.5 g, 25.0 g, 50.0 g of the leaf extract respectively and control group that was given with water ad libitum. The result showed reduction of estrogen levels by 6.40 nmol/L, 10.80 nmol/L and 28.00 nmol/L in the LD, MD and HD groups respectively, while plasma progesterone of rats in the LD, MD and HD groups reduced by 24.20 nmol/L, 40.8 nmol/L and 59.20 nmol/L respectively. This study has shown the antifertility effect of Momordica charantia, achieved in a dose dependent manner. Stepka et al also demonstrated an in vivo antifertility effect of fruit and leaf of bitter melon in female animals (Stepka et al., 1974). Hence, cautious use of such medication should be advocated especially seed extract at high doses, when managing couples for infertility.

**Anti-gout:**

Intisar Reehem et al carried out a study, in order to screen some plant species growing wild with respect to their xanthine oxidase inhibition activity which may be potentially useful for the treatment of gout or other xanthine oxidase - induced diseases (Alsultanee et al., 2014). Their aqueous extracts, prepared from used parts, were tested in vitro, at 100 μg/mL concentrations, for their inhibition potencies expressed as % inhibition of xanthine oxidase activity. Two of the test plants were found inhibition % activity of xanthine oxidase, namely Zingiber officinalis (81.56±3.76) and Momordica charantia (96.5±2.17). Total Phenolic of Momordica charantia (0.83±0.30) was more than Zingiber officinat(62.18±0.65). Fraction of Momordica charantia (coumarin) was achieved the highest activity (inhibition activity of xanthine oxidase 97%) based on analysis HPLC. Data showed that coumarin (0.5 mg/kg) treatment cause significant reduction in the serum uric acid level of hyperuricemia in normal mice. These finding suggest that Momordica charantia extracts possess prominent medicinal properties and can be exploited as natural drug to treat gout and other diseases associated with inflammation, free radical formation, oxidative stress, xanthine oxidase activity and hyperuricemia.

**Effect on Haemoglobin Concentration:**

A research work was carried out to investigate the effect of the aqueous extract of Momordica charantia on hemoglobin concentration in albino rats (Adedeji et al., 2014). The aqueous extract of the plant’s leaves was prepared and given orally at doses of 80, 100, 120 and 140 mg/kg body weight daily to the experimental animals. Hemoglobin concentration was then determined after two weeks of administration. The results of the work showed a significant (p<0.05) decrease in mean hemoglobin concentration in test animals, in comparison with the control. Hence, oral administration of aqueous extract of Momordica charantia causes a decrease in hemoglobin concentration which can lead to anemia.

**Cultural values:**

Many healers in Togo indicated that the plant has powerful medico-spiritual properties, providing protection against curses, diseases, evil spirits, spells and madness (Beloin et al., 2005). It is also claimed to aid in obtaining favors. It is claimed to be a purifying plant that is used before the manipulation of sacred objects. Many original details concerning the ritual and historical aspects of Momordica charantia were recounted by some healers from Southern Togo. The plant is used in traditional ceremonies linking the living to the ancestors, particularly among the Guin tribe of coastal Togo. The ancestors of the Guin lived on the coast of Ghana near what is today the area of Elabadi in Accra. In mid-1600, they fled intertribal warfare fueled by the slave trade and moved to the east into what is now Togo [Cornevin, 1969]. According to oral tradition, they wore a necklace of Momordica vines which repelled their enemies and allowed the tribe to journey in safety to their new home at Glidji-Kpodji on the northern side of Lake Togo. The plant is considered a powerful charm to this day and is worn as a necklace, wrist or ankle bracelet or crown at traditional ceremonies. Its name in Mina, the dialect language of the Guin, is ‘guinsika’ (gold of the Guin) or ‘guingbe’ (plant of the Guin). The plant is widely used in traditional ceremonies, including the famous consultation of the oracle named Epe-Ektep or Ekpossoso, during which a sacred stone is uncovered to predict the fortunes of the coming year (Piriaux, 1977). The king of the Guin, which is also the fetish priest of the sacred forest of Glidji-Kpodji, and his male attendants (vodussi) at the ceremony wear Momordica vine for its purification properties. The ritual ceremonial importance of the plant is accompanied by its considerable reputation as a medicinal plant for the treatment of disease.

**Reported toxicity:**

A work aimed to assess the acute oral toxicity effects of Momordica charantia in Sprague Dawley rats was conducted by Husna et al (Husna et al., 2013). The extract was administered orally at two different doses of 300 mg/kg and 2000 mg/kg of body weight. The toxicity signs were recorded within the first 24 hours after forced
feeding. Both of the treated groups showed dizziness and depression during the first 30 minutes. However, no significant difference of feeding patterns which included water, food intake and body weight gain were observed. Haematological evaluations did not show significant differences in white blood cells count, mean corpuscular volume and mean corpuscular haemoglobin concentration levels. However, red blood cells count and packed cell volume percentage was significantly lower in rats that received 2000 mg/kg than those of the other two groups. Meanwhile, haemoglobin count and the relative liver weight of rats received 2000 mg/kg body weight of extract decreased significantly (p<0.05) as compared with the control group. This result was previously found by two studies which proved that Momordica chlarantia is safe (no signs of nephrotoxicity and hepatotoxicity and any adverse influence on the food intake, growth organ weights and hematological parameters) in experimental animals when ingested in low doses up to 2 months (Platel et al., 1993; Virdi et al., 2003). Thus, these studies are expected to be beneficial for clinical and traditional applications, for safe consumption and to utilize Momordica charantia as a remedy at a recommended dosage.

Conclusion:
More than 80% of the population in developing continues to use folkloric medicine in their primary medical problems. Therefore, researches have been focused on scientific evaluation of traditional drugs of plant origin for the development of new and more potent drugs. Momordica charantia is among those plants currently involved in the treatment of various diseases, and particularly diabetes and cancers. In the traditional medicine, Momordica charantia is involved in the treatment of almost all the diseases of the human body and sometime to cure animal and plants infections. The cases where it is most involved include the treatment of cancers, diabetes, and to fight viruses; the treatment of cardiac, liver and kidney diseases, as well as gynaecological problems. Many traditional practitioners consider it as a powerful medico-spiritual plant since it is said to provide protection against curses, diseases, evil spirits, spells and madness. It is also claimed to aid in obtaining favors or to be a purifying plant that is used before the manipulation of sacred objects. Pharmacological tests carried out on this plant for its antioxidant, antimalarial, hypcholesterolemic, trypanocidal, hepatocurative and hepatoprotective, gastroprotective and anti-ulcer, anthelmintic, immunomodulatory, anti-inflammatory and analgesic, antiviral, anti-genotoxic, anti-tumour and anticancer, anti-hepatitis b virus, abortifacient, antimicrobial and antibacterial, hypoglycemic and anti-diabetic, cardiovascular, wound healing, body weight decrease, antifeedant, neuroprotective, antipyretic, anti-diarrheal, larvicidal, antifertility, anti-gout activities; its effect on haemoglobin concentration and on diabetic complications revealed positive results without significant adverse side effects. Some bioactive constituents such alkaldoids, tannins, flavonoids, saponins, glycosides, sterols, mucilages and oleanolic acids significantly present in the plant extracts support its numerous properties and uses in traditional medicine, while its rich content in moisture, ash, crude lipid, crude fibre, crude protein, carbohydrates, minerals and vitamins validate its high nutritional value. Momordicin, Chlarantin, Vicine, Kuguacin J, EMCDO, Cucurbitacin figure among the most important purified bioactive constituents isolated from this plants which support its traditional use for the treatment of various diseases and justify its multiple pharmacological activities. It is however notable that, pregnant women should not eat bitter melon or consume this plant’s extracts as it stimulates the uterus and may cause premature birth. We do not pretend to have examined all the studies related to this medicinal plant. However, we sincerely hope that we have provided a data base for proper evaluation of Momordica charantia extracts which could lead to the discovery of new and more effective drugs.

ACKNOWLEDGEMENTS
Authors sincerely thank their respective families’ members and friends for their kind encouragements.

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