**Momordica charantia**: A natural medicinal plant

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**Abstract**

Natural products play an important role in the treatment of several diseases inflicted on mankind and in drug discovery procedures. Drugs synthesized from naturally available products are usually safe, cheap in cost, easily available and more effective than pure synthetic drugs in the treatment of several diseases. Bitter melon containing numerous bioactive compounds like saponins, alkaloids, polypeptides, minerals, vitamins, with the ability to fight against several disorders, i.e. diabetes mellitus, abdominal pain, tumor proliferation, cancer, kidney (stone), scabies and fever. The key constituent of BM called charantin, which is steroidal saponins, act like peptides and certain alkaloids that control sugar levels in blood. The medicinal properties of *M. charantia* are beneficial in regulating blood cholesterol to minimise cardiovascular disorders like atherosclerosis. There are several classes of secondary metabolites, such as tannins, flavonoids, and alkaloids in the fresh and dried leaves extracts of Bitter melon with antimicrobial activity. This phytochemical composition of both the leaves reported antimicrobial activity against different bacteria, like *Salmonella, E. coli, Pseudomonas aeruginosa, Bacillus* and *Streptococcus*.

**Keywords**: *Momordica charantia*, bitter melon, antidiabetic, wound healing, antimicrobial, anticancer ...

1. Introduction

*Momordica charantia* is commonly known as Bitter melon, bitter guard and used as a food and natural medicine. The scientific name, *Momordica* means “to bite,” in Latin which is refers to the jagged edges of the leaves. Including fruits, all parts of the plant, contains a bitter compound, momordicinso and very bitter in taste. The plant grows in tropical regions such as India, China, America Malaya, Bangladesh, tropical Africa, Thailand, Middle East. *Momordica charantia* contains a different biologically active phytochemicals, which includes proteins, triterpens, saponins, flavonoids, steroids, alkaloids, and acids. The plant is beneficial for its anti-tumorous, anti-fungal, anti-parasitic, anti-cancer, antiviral, anti-fertility, anti-bacterial and hypoglycaemic properties due to the presence of numerous phytochemicals. In traditional medication, fruits and leaves are used to cure several diseases like: gout, rheumatism, colic, worms, illness of liver and spleen. *Momordica* contains alkaloids and peptides which resemble like insulin and charantin, a collection of steroidal sapogenins due to which it has hypoglycaemic property.
2. Botanical Information

*Momordica* is a slender, climbing monoecious plant with yellow colored separate male and female flowers, arises in the leaf axils and long-stalked leaves, belongs to family Cucurbitaceae. Leaves are simple/alternate of 4–10 cm with 3–6 deeply separate lobes, tendrils unbranched or 2 branched. Fruit is in ovoidal shape, like small cucumber, ellipsoidal, or spindle in shape, filled with flat seeds in pulp and usually with ridged surface, and dehiscent irregularly as a fleshy capsule or indehiscent. The fruits in young stage are in green color and changes to orange to yellow color when ripened. The fruit splits into three irregular valves and curls backwards to release numerous reddish-brown or white seeds which are enveloped in scarlet arils. In unripen fruits seeds and pith are in white color, and red in ripening fruits.

Flowers: Flowers are solitary with hypanthenium shallow, 5 lobed calyx, 5 petals, yellow in color, 1-3 with incurved scales at base, usually 3 stamens inserted towards the base of hypanthenium, broad filaments, anthers are distinct or coherent, and of which 2, are dithecal, the other monothecal, cells curved or flexuous; pistillate flowers usually solitary on a bracteate scape. Hypanthenium is ovoidal to spindle in shape, perianth usually smaller than in staminate flowers, ovules numerous, horizontal, stigmata 3, 2 lobed, staminodes absent or 3. Seeds are few to numerous, ovate and usually sculptured.

3. Active Constituents

Bitter melon is an edible vegetable and natural medicinal plant with 91.8% water, 1.4% fiber, 0.20% fat, 4.2% carbohydrates. The proteins composition is, 49.3% albumin, globulin 29.3, and glutelin 3.1% [1]. The seeds contain 3.3% of MUFA (monounsaturated fatty acid) and 36.71% of SFA (saturated fatty acids) which is indicated by fatty acid profile and 35% to 40% of oil from seeds. Bitter guard contains maximum amount (60%) of PUFA (polyunsaturated fatty acids). Main constituents of fruits are Charantin, momordicoside L, momordin, stigmasta-5, momordicin, 25-dien3-β-O-glucoside, momordicoside G, β-sitosterol-β-D-glucoside, momordicoside F1, momordicoside F2, momordicoside I, momordicoside K, [3]; A conjugated linolenic acid, α-eleostearic acid (54%) has remarkable importance in PUFA[4,5]. BM contains minerals like potassium, sodium, calcium, phosphorous and magnesium, in maximum amounts in fruit and leaves. Seeds are naturally the best sources of chromium i.e. 5.65 and zinc 45.45 mg/100g.

A variety of compounds are present in *Momordica*, which are biologically active and that includes two classes of saponins, oleanane and cucurbitane-type triterpenoids [6]. Nearly 20 – 25 phytochemical constituents which exhibit 91% of the oil administered. Main components present in the oil are trans-nerolidol apiole, germacrene, and cis-dihydrocarveol [7,8]. Alphaeleostearic acid with strong blood fat lowering properties, is abundant in oil, anticancer by suppressing the multiplication of tumour cell and anti-inflammatory in action. Minerals particularly Cr and Zn with strong effect on polysaccharides or proteins, and form an anticipation of hyperglycaemia, cholesterol, and hyperlipidaemia [9]. Leaves, fruits and seeds are rich in variety of phytochemicals like steroidal saponins resins, vitamins, polypeptides, minerals, alkaloids, and aromatic volatile oil which are health promoting. Charantin as steroidal saponin, momordicine alkaloid, and p-insulin which is polypeptides in nature, are standard constituents [10]. Fruit pulp
of bitter melon contains soluble pectin and no free pectic acid. BM comprises charantin, steroidal saponin glucosides, mineral matters, alkaloids, ascorbic acid, carbohydrates and momordium etc. Phenolic components, epicatechin, catechin, gentisic acid, chlorogenic acid and gallic acid are present in Momordica extract [11].

4. Medicinal Uses of Momordica charantia

In Momordica, nutrients like betacarotene, foliate, thiamine, riboflavin and minerals like potassium, calcium, manganese, magnesium, zinc iron, phosphorus, and dietary fiber are abundant. The high antioxidant properties of Momordica is due to phenols, anthroquinones, flavonoids, terpenes, isoflavones, and glucosinolates, all together are responsible for bitter taste [12]. Regular use of bitter gourd juice prevents chronic fatigue by increasing body stamina and the beta-carotene content reduces eye disorders and enhances eyesight.

- Bitter melon promotes secretion of acid and treats dyspepsia by stimulating digestive system [13].
- Bitter melon juice keeps insulin under check and lower blood sugar levels. The phytochemicals charantin, alkaloids and insulin-like peptides, all together responsible for hypoglycaemic property of bitter guard and enhances glucose tolerance without increasing blood insulin levels. These bioactive constituents activate AMPK protein, regulate fuel metabolism and facilitates glucose uptake and all other activities impaired due to diabetics. Bitter melon increases the beta cell number in the pancreas that secretes insulin. Numerous studies have reported the anticancer, anti-inflammatory and anti-diabetic properties of bitter gourd, and several pharmaceutical companies included them in their formulations [14].
- Bitter gourd juice strengthens liver and prevent jaundice. Bitter melon juice detoxifies and nourishes liver and helpful in the hangover treatment [15].
- Hypothetically bitter melon is an immune modulator, can enhance immune cell function in cancer patient. It is also used in the treatment for malaria, cold and flu, fever, tumors, high cholesterol, psoriasis and cancer [16].
- Fresh juice of bitter guard leaves was an effective medicine for diarrhoea and used in early stages of cholera.

4.1. Antidiabetic Activity

Momordica charantia contains phytochemicals like, charantin, polypeptide-p, the plant insulin, vicine, karavilosides and glycosides. These compounds increase glucose uptake and synthesis of glycogen in the liver, muscles and fat cells by which regulates blood sugar and act as hypoglycaemic agents [17]. Fruits and seeds, has a polypeptide, TP-Insulin is which lowers and normalizes the blood sugar level in treated rats. Lectin with insulin like activity is a bioactive compound present in bitter melon. It links the two insulin receptors together and acts like insulin. Lectin act with insulin like activity, on peripheral tissues and lowers blood glucose concentrations. Lectin plays important role in hypoglycaemic effect which generates after consuming bitter guard. Alcoholic extract of charantin, composed of mixed steroids, is a potent hypoglycaemic agent which is used to lower the sugar levels in blood and in the diabetic treatment. The bitter melon fruit increases the glucose uptake of cells by promoting insulin release to enhance the insulin effect. In diabetic rats, extract of fresh and dried fruit lowered the blood sugar. In alloxan-induced diabetic rats, bitter gourd extracts have hypoglycaemic, anti-diabetic, hypolipidemic and hepato-renal protective effects. Bitter melon regulates microvascular dysfunction, a common diabetic complication by reducing capillary permeability at arteriolar and capillary level. One of the hypoglycaemic compounds, charantin, belongs to steroidal saponins consisting of a mixture of (1:1) sitosteryl glucoside and stigmasteryl glucoside, Charantin produces hypoglycaemic effects in rabbits when administered orally or intravenously [18]. P- insulin is a polypeptide consists of 166 amino acids with molecular weight of about 11,000 Da is another hypoglycaemic agent of bitter guard. Clinical studies revealed that blood sugar lowering effect is produced by polypeptide-pZnCl2. Pyrimidine nucleoside, vicine present in seeds and fruits, can induce hypoglycaemia in rats, when treated intraperitonially. In type-2 diabetic patients, Momordica extracts rich in charantin increases insulin-sensitivity [19].

4.2. Anti-Microbial Activity

The chemical composition of fresh leaf extracts M. charantia has various secondary metabolites with different therapeutic applications. The secondary metabolites like, tannins (antiviral, antimicrobial, antitumoral and moluscidial); flavonoids (anticarcinogenic, antioxidant antiviral, and antinemorrhagic). BM leaves with antibacterial action against Escherichia coli, Pseudomonas aeruginosa, Salmonella, Streptococcus, Bacillus [20]. Different extractions of fresh leaves were effective against different strains of Escherichia coli, S. aureus, B. cereus. Many secondary metabolites of various classes occur in both the fresh and dried leaves extracts, i.e. tannins, alkaloids and flavonoids, with many biological actions, including antimicrobial. The seed extracts of bitter melon possess antimicrobial activity and controls growth and infection of several viruses and gram-positive and gram-negative bacteria, including Shigella, Staphylococcus, Pseudomonas, Salmonella, H. pylori Escherichia coli, Streptococcus, Streptobacillus, and parasitic
organisms *Plasmodium falciparum* & *Entamoeba histolytica*. The bioactive molecules of bitter melon are potential candidates as chemotherapeutics against leishmaniasis [21].

### 4.3. Anti-Malarial Activity

*Momordica charantia* is a natural medicinal plant for preventing against and used in treatment of malaria. Bitter guard is traditionally regarded as anti-malarial by Asians, Colombians, and Panamanians. Tea prepared with leaves boiled in water used in malaria treatment. Laboratory studies also confirmed the antimalarial activity of various species of *Momordica* [22].

### 4.4. Antioxidant Activity

Antioxidants are substances which can reduce or prevent the damage to cells caused by free radicals. The ethanolic extracts of bitter melon contain high antioxidant activities, like phenolic compounds [23,24]. Bitter guard increases the catalase activity and reduce the glutathione level by which inhibits stress-induced lipid peroxidation. The phenolic compounds extracted from bitter melon have antioxidant activity. *Momordica charantia* seeds having antioxidant properties effectively normalize the impaired antioxidant status in diabetic rats induced with Streptozotocin [25].

### 4.5. Anti-Tumor Properties

Bitter gourd is anti-carcinogenic and prevents tumor cell proliferation. BM contains anti-carcinogens or chemo preventive agent. Water extract of bitter guard can block the prostate carcinoma growth in rat model study. Hot water extract of entire plant in mice inhibited tumor cell development in mammary glands. Various in vitro studies in numerous cell lines reported the anti-leukemic and anti-cancerous activity of bitter melon including human leukemia, liver cancer or hepatic carcinoma, solid sarcomas, melanoma [26,27]. Bitter gourd is an effective immunomodulator, improves immune cell function in cancer patients. Fruit and seed extracts of bitter melon inhibit the proliferation of numerous cancer cell lines, including human colon cancer, prostate adenocarcinoma, and metastatic breast cancer cell line MDAMB 23140-41 in In vitro studies.

### 4.6. Hypo-cholesterolemic activity

*Momordica charantia* has hypo-cholesterolemic effects when studied in normal and diabetic animals. Octadecatrienoic fatty acid isolated from *Momordica charantia* seeds fed to rats which were fed with sunflower for 4 weeks. After 4 weeks, these rats showed lowering of the plasma lipid peroxidation and erythrocyte membrane lipid peroxidation as well as nonenzymatic liver tissue lipid peroxidation. The levels of triglyceride and cholesterol were normalized after treating with bitter gourd fruit and/or seeds for about 21 days in diabetic rats. The bitter gourd oil (BGO) has its effects on the blood and liver lipids of rats [28].

### 4.7. Anti-Viral Properties

In-vitro studies on anti-viral activity of Bitter gourd have reported against numerous viruses, including Epstein-Barr, herpes and HIV viruses [29]. The leaf extract of Bitter melon has immunostimulant effect in animals, increase natural killer cell activity interferon production and increases resistance to viral infections. The anti-viral constituents of bitter gourd are of protein or glycoprotein in nature. Bitter gourd may not reduce the multiplication of virus in people infected HIV due to the poor absorption by oral administration. However oral administration of Momordica offset the negative effects of anti-HIV drugs. Various leaf extracts of Bitter guard have anti-bacterial activities against *Pseudomonas, Escherichia coli, Staphylococcus, Streptobacillus, Streptococcus and Salmonella*. Antiprotozoal activity against *Entamoeba histolytica* can be seen in entire plant extract [31]. The fruit and fruit juice have antibacterial properties and activity against *Helicobacter pylori*, the stomach ulcer-causing bacteria.

### 4.8. Larvicidal Activity

The Phytochemicals present in bitter guard has larvicidal potential. Numerous studies had been conducted against two mosquito vectors such as C. quinquefasciatus and Anopheles stephens [32]

### 4.9. Anti-genotoxic activity

*Momordica charantia* has antigenotoxic activity decreases chromosome breakage by decreasing genotoxic effects of methanesulfonate tetracycline and methylnitrosamine [33].
4.10. Anti-helmintic activity

Extracts of *M. charantia* leaf, fruit, and seeds found to be pharmacologically active against helminths. The treatment of *Ascaridia galli* is more effective with aqueous extracts of *Momordica*. Saponins are anthelmintic agents and inhibit the enzyme acetylcholinesterase activity, hence the worm paralysis, and lead to death.

4.11. Wound healing activity

Fruit powder ointment of *Momordica charantia* is more effective in wound contracting, wound closure time, epithelisation period, tensile strength of the wound and tissue regeneration at wound site when compared to the control group, and also comparable with a reference drug povidone iodine ointment in rat model [34]. Bitter melon has high capacity for wound healing property. Charnatin and other phytochemicals present in the bitter melon stimulates the production of growth factors, induces the proliferation of fibroblasts, and accelerates the oxygenation and capillary circulation of the wound. The antioxidant and antimicrobial effects of phytochemical substances such as flavonoids and glycosides increase the process of healing. *Momordica* effects the rate of wound healing positively, increases the wound to contract, reduces the time for the wound to close, accelerates the epithelisation process, and the tension of the wound.

5. Conclusion

*M. charantia* is naturally available dietary supplements and used as ethnomedicine throughout centuries for different health issues like diabetes, cancer, inflammation etc. *M. charantia* studied worldwide for its natural medicinal properties like antidiabetic, anticancer, antimicrobial, antimalarial, antioxidant etc. Bitter guard is a versatile plant with medicinal properties to treat almost many diseases. The plant possesses various medicinal constituents, which act all together or separately to exert their medicinal properties. The phytochemicals i.e. charantin, insulin-like peptide and alkaloid-like extracts possess hypoglycaemic properties in relation to diabetes, similar to the plant itself or its crude extracts. The different compounds present in different plant extracts are beneficial in regulating several mechanisms to control and treat diabetes mellitus. *M. charantia* is a naturally available and feasible option for those who have a higher chance of diabetes.

Compliance with ethical standards

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Disclosure of conflict of interest

The author states no conflict of interest.

References

[1] Farhan S, Muhammad A, Bushra N, Muhammad UA, Tabussam T, Muhammad BH and Ahsan J. Bitter melon (*Momordica charantia*): a natural healthy vegetable.

[2] Patience OO, Estella UO and Philip FU. Natural Products as Potential Sources of Antidiabetic Drug.

[3] Nirupama KV, J Adlin Jino Nesalin and T Tamizh M. Extraction, Isolation and Characterization of charantin From *Momordica charantia* Fruit.

[4] Grossmann ME, Mizuno NK, Dammen ML, Schuster T, Ray A and Cleary MP. Eleostearic Acid Inhibits Breast Cancer Proliferation by Means of an Oxidation-Dependent Mechanism. Cancer Prevention Research.

[5] Liu XR, Deng ZY, Fan YW, Li J and Liu ZH. Mineral Elements Analysis of *Momordica charantia* Seeds by ICP-AES and Fatty Acid Profile Identification of Seed Oil by GC-MS. Guang Pu Xue Yu Guang Pu Fen Xi.

[6] Popovich DG, Li L and Zhang W. Bitter Melon (*Momordica charantia*) Triterpenoid Extract Reduces Preadipocyte Viability, Lipid Accumulation and Adiponectin Expression in 3T3-L1 Cells. Food and Chemical Toxicology.
[7] Mesia GK, Tona GL, Nanga TH, Cimanga RK, Apers S, Cos P, Maes L, Pieters L and Vlie tinck AJ. Antiprotozoal and Cytotoxic Screening of 45 Plant Extracts from Democratic Republic of Congo. Journal of Ethnopharmacology.

[8] Ahmad Z, Zamhuri KF, Yaacob A, Siong CH, Selvarajah M, Nazrul IA and Hakim M. In Vitro AntiDiabetic Activities and Chemical Analysis of Polypeptide-K and Oil Isolated from Seeds of Momordica charantia (Bitter Gourd).

[9] Hsu C, Hsieh CL, Kuo YH and Huang CJ. Isolation and Identification of Cucurbitane-Type Triterpenoids with Partial Agonist/Antagonist Potential for Estrogen Receptors from Momordica charantia. Journal of Agricultural and Food Chemistry.

[10] Tan SP, Stathopoulos C, Parks S and Roach P. An Optimised Aqueous Extract of Phenolic Compounds from Bitter Melon with High Antioxidant Capacity. Antioxidants (Basel).

[11] Horax R, Hettiarachchy N, Over K, Chen P and Gbur E. Extraction, Fractionation and Characterization of Bitter Melon Seed Proteins. Journal of Agricultural and Food Chemistry.

[12] Snee LS, Nerurkar VR, Dooley DA, Efird JT, Shovic AC and Nerurkar PV. Strategies to improve palatability and increase consumption intentions for Momordica charantia (bitter melon): A vegetable commonly used for diabetes management.

[13] Ahmad N, Hassan MR, Halder H, et al. Effect of Momordica charantia (Karolla) extracts on fasting and postprandial serum glucose levels in NIDDM patients.

[14] Jayasooriya AP, Sakono M, Yukizaki C, et al. Effects of Momordica charantia powder on serum glucose levels and various lipid parameters in rats fed with cholesterol-free and cholesterol-enriched diets.

[15] Murray MT. The Healing Power of Herbs: The Enlightened Person’s Guide to the Wonders of Medicinal Plants.

[16] Leatherdale BA, Panesar RK, Singh G, et al. Improvement in glucose tolerance due to Momordica charantia. Linn.

[17] Madhu Guptha. Momordica charantia: Nature's silent healer.

[18] Lolitkar MM, et al. Pharmacology of a hypoglycaemic principle isolated from the fruits of Momordica charantia. Linn.

[19] Anti-diabetic Activity of Momordica charantia or Bitter Melon: A Review Ranabir Chanda1, Asim Samadder2 and Jannmajoy Banerjee.

[20] Brandao DO, Guimaraes GP, Santos RL, Junior FJ, Da Silva KM, De Souza FS and Macedo RO. Model Analytical Development for Physical, Chemical, and Biological Characterization of Momordica charantia Vegetable Drug.

[21] Gupta S, Raychaudhuri B, Banerjee S, Das B, Mukhopadhaya S and Datta SC. Momordicatin Purified from Fruits of Momordica charantia Is Effective to Act as a Potent Antileishmania Agent

[22] Olasehinde GI, Ojurongbe O, Adeyeba AO, FAGade OE, Valecha N, Ayanda IA, Ajayi AA and Egwari LO. In Vitro Studies on the Sensitivity Pattern of Plasmodium Falciparum to Anti-Malarial Drugs and Local Herbal Extracts.

[23] Aljohi A, Matou-Nasri S and Ahmed N. Antiglycation and Antioxidant Properties of Momordica charantia.

[24] Qader SW, Abdulla MA, Chua LS, Najim N, Zain MM and Hamdan S. Antioxidant, Total Phenolic Content and Cytotoxicity Evaluation of Selected Malaysian Plants. Molecules.

[25] Sathishsekhar D and Subramanian S. Antioxidant properties of Momordica charantia (bitter gourd) seeds on Streptozotocin induced diabetic rats.

[26] Fang EF, Zhang CZY, Wong JH, Shen JY, Li CH and Ng TB. The MAP30 protein from bitter gourd Momordica charantia seeds promotes apoptosis in liver cancer cells in vitro and in vivo.

[27] Grover JK and Yadav SP. Pharmacological actions and potential uses of Momordica charantia: A review.

[28] Nutritional, pharmacological and medicinal properties of Momordica charantia Kandangath Raghvan Anilakumar, Garlapati Phani Kumar, Nallamuthu Ilaiyaraja.

[29] Bourinbaiar AS and Lee-Huang S. Potentiation of anti-HIV activity of the anti-inflammatory drugs dexamethasone and indomethacin by MAP30, the antiviral agent from bitter melon.

[30] Zhang QC. Preliminary report on the use of Momordica charantia extract by HIV patients.

[31] Gupta S, Raychaudhuri B, Banerjee S, Das B, Mukhopadhaya S and Datta SC. Momordicatin purified from fruits of Momordica charantia is effective to act as a potent antileishmania agent.
[32] Balboa JG and Lim-Sylianco CY. Antigenotoxic effects of drug preparations Akapulko and Ampalaya.

[33] Hussan F, Teoh SL, Muhamad N, Mazlan M and Latiff AA. *Momordica charantia* Ointment Accelerates Diabetic Wound Healing and Enhances Transforming Growth factor-β Expression.

[34] Subhashchandra P, Tushar P, Kaushal P, Yagnesh B, Yogesh P and Dr. NM Patel. Isolation, Characterization and antimicrobial activity of charantin from *Momordica charantia* fruit.

[35] Singh MP, Sarangdevot Y.S. and Sisodia S.S. "Wound Healing Activity of the whole plant of *Momordica charantia* in Rats.

[36] Sonal Desai, Pratima Tatke. Charantin: An important lead compound from *Momordica charantia* for the treatment of diabetes.

[37] Rajaram P, Natarajan M and Ganesan VS. Wound healing property of aqueous extract of seed and outer layer of *Momordica charantia*.

[38] Nal Ae Y, Ju yeong P, Ji yeon L, Joo YJ, Hak SL, In GH, Gu SR, Hyun JK, Gyeong JC, Wan SC, Dong HL and Sang SK. Anti-diabetic Effects of Ethanol Extract from Bitter Melon in Mice Fed a High-fat Diet.

[39] Soon YY and Tan BKH. Evaluation of the hypoglycaemic and anti-oxidant activities of Morinda officinalis in streptozotocin-induced diabetic rats. Singapore Med J.

[40] Powers AC. Diabetes mellitus. In Kasper DL, Fauci AS, Longo DL, Braunwald E, Hauser SL, Jameson JL (eds.), Harrison’s Principles of Internal Medicine, 26th Edition, McGraw-Hill Medical Publishing Division: New York.

[41] Guo S and Di Pietro LA. Factors Affecting Wound Healing, J. Dent. Res.

[42] Nam sa ND, Mandal M, Tangiang S and Mandal SC. Ethnobotany of the Monpa Ethnic Group at Arunachal Pradesh, India. Journal of Ethnobiology and Ethnomedicine.

[43] Puri R, Sud R, Khaliq A, Kumar M and Jain S. Gastrointestinal Toxicity Due to Bitter Bottle Gourd (*Lagenaria Siceraria*)–A Report of 15 Cases. Indian Journal of Gastroenterology.

[44] Sabourian R, Karimpour-Razkenari E, Saeedi M, Bagheri MS, Khanavi M, Sadati N, Akbarzadeh T and Ardekani MR. Medicinal Plants Used in Iranian Traditional Medicine (ITM) as Contraceptive Agents. Current Trends Biotechnology Pharmacy.

[45] KP Sampath Kumar. Debjit Bhowmik: Traditional medicinal uses and therapeutic benefits of *Momordica charantia* Linn.

[46] Baby J and D Jini. Antidiabetic effects of *Momordica charantia* (bitter melon) and its medicinal potency.

[47] Monirul I, Md. Saiful I, Shaheda Z, Golam S and Mamunur R. *Momordica charantia* (Bitter melon) in Combination with Metformin Potentiates Hypoglycaemic and Hypolipidemic Effects in Alloxan-induced Diabetic Rats.