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Bitter gourd (*Momordica charantia*) antioxygenic activity in various in-vitro models and bioactive compounds used in nutraceutical formulations

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Abstract

Gourd vegetables have been utilized to treat diseases by humans all across the world since ancient times. For millennia, the bitter gourd (*Momordica charantia* L.) has played a significant culinary and therapeutic role in human humans. It has been cultivated since ancient times and is mostly used as a spice and flavoring agent. It has been employed in both ancient and modern cultures due to its potential benefits in preventive and curative medicine. The therapeutic use of bitter gourd is widespread and growing rapidly in today's world as well. Charantin, vicine, polypeptide-p, and other bioactive components such as antioxidants are responsible for *M. charantia*'s anti-diabetic properties. *M. charantia* is used to treat worms and parasites in wounds using a topical internal or exterior treatment. The oxidative breakdown of lipids, which generates off-flavors, is a major concern in the shelf life of foods. For the stabilization of lipid-containing meals, there has been an increasing interest in using natural additions rather than synthetic substances in recent years. Infections are thought to be responsible for 20% of all human cancers. Patients with bronchogenic carcinomas were found to have active tuberculosis at a higher rate than the overall population. We can say that bitter gourd has a lot of flavonoid and phenolic compounds, which are good sources of antioxidants. The therapeutic advantages and bioactive ingredients of bitter gourd fruit need further exploration, given its potential use in traditional medicine.

Keywords: bitter gourd, *Momordica charantia*, medicinal, use, bioactive, in-vitro, etc.

1. Introduction

Many vegetable gourds are found in the Cucurbitaceae family, including ash gourd [*Benincasa hispida* (Thunb.) Cogn.], bottle gourd [*Lagenaria siceraria* (Mol.) Standl.], bitter gourd (*Momordica charantia* L.), ivy gourd [*Coccinia grandis* (L.)], pointed gourd (*Trichosanthes dioica* Cucurbits) abundant in India, which is thought to be the primary and secondary origins of species including the pointed gourd, snake gourd, and bitter gourd. These gourds can be eaten raw or cooked (bitter gourd, bottle gourd, pointed gourd), boiled for vegetable curries (ash gourd, snake gourd, pointed gourd), pickled (ash gourd, pointed gourd), or candied (ash gourd, pointed gourd) (ash gourd, pointed gourd). The extensive use of gourd vegetables as folk medicine and a functional food element prompted the creation of a comprehensive assessment of these vegetables' traditional uses, nutritional and therapeutic properties, and phytochemicals.

✓ Nutritional profile

Nutritional characteristics are vital in determining a food's medicinal quality. Moisture content is quite high, accounting for more than 92 percent of the edible weight section of gourd vegetables, according to the nutritional makeup of the edible portion (pulp). Protein and ash content range from 0.2 to 1.6 percent and 0.4 to 0.8 percent, respectively. Fat content is minimal, accounting for less than 0.3 percent of the edible portion's weight. Vitamins and minerals are necessary nutrients that the body needs to function normally, and they can be gained through daily dietary consumption. Thiamine concentration ranged from 0.03 to 0.07 mg per 100 gm of gourd vegetables, riboflavin from 0.01 to 0.09 mg, niacin from 0.2 to 0.5 mg, and vitamin C from 1 to 88 mg per 100 gm.

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Bitter gourd has the greatest concentration of vitamin C. *Calcium* was the most common mineral found in gourd vegetables, with values ranging from 20 to 30 mg/100 gm.

✓ **Traditional uses and medicinal values**

Gourd vegetables have been utilised to treat diseases by humans all across the world since ancient times. Many plant extracts include a varied array of secondary metabolites, most of which have antioxidant properties, in addition to minerals and primary metabolites. Diabetes mellitus, diuresis diseases, urinary infection, chronic inflammatory disorders, epilepsy, cough, fever, heart conditions, liver disorders, peptic ulcer, and internal organ haemorrhages, as well as an antibiotic and purgative vermifuge, have all been treated with ash gourd. Triterpenes, phenolics, sterols, glycosides, and soluble dietary fibre are among the bioactives and therapies found in it. The immature and mature fruits of the ash gourd are both grown. It is widely used in curries in India, and it is offered to Gods in religious rites. The ripe fruits have a bland taste and a rich greenish-white flesh. The elder fruits' hard flesh can also be candied with sugar and dried for later use. Fruits are frequently packed with meat, shrimp, and veggies in China and then cooked in a pot. The researchers used irradiation to stabilise ash gourd juice and ash gourd mint-blended juice, and found that the generated juices were stable for up to eight months, had a high acceptance score, and were microbiologically safe. Aseptic processing was used to prepare and preserve the ash gourd juice, which was stable for up to eight months under ambient settings. Another beverage made from ash gourd and mint that was aseptically processed, sterilised at 95°C, and packed in a tetra pack (six-layered) had an eight-month shelf life. The therapeutic properties of ash gourd fruits include antipyretic, nootropic, antidepressant, anorectic, anxiolytic, antiinflammatory, analgesic, diuretic, antioxidant, antihistamine, antidiarrheal, angiotensin-converting enzyme inhibition, renal, and gastroprotective actions.

✓ **Bitter gourd as a possible antioxidant source**

For millennia, the bitter gourd (*Momordica charantia* L.) has played a significant culinary and therapeutic role in human humans. It has been cultivated since ancient times and is mostly used as a spice and flavouring agent. It has been employed in both ancient and modern cultures due to its potential benefits in preventive and curative medicine. The therapeutic use of bitter gourd is widespread and growing rapidly in today's world as well. Epidemiological, clinical, and preclinical research have found a link between dietary habits, such as bitter gourd consumption, and the development of disease. Based on its potential and diverse benefits, bitter gourd is regarded as one of the top disease-prevention foods. There is data that suggests that eating more fruits and vegetables lowers the risk of cancer. Antioxidants found in fruits and vegetables are responsible for this. Bitter melon's antioxidants may aid in the detection and destruction of free radicals that can cause diseases (including cancer), but this isn't the fruit's only cancer-fighting advantage.

2. Antioxidant properties of two bitter gourd (*Momordica charantia*) varieties

Momordica charantia L. Cucurbitaceae, often known as bitter gourd, bitter melon, or balsam pear, belongs to the

Cucurbitaceae family. It belongs to the cucurbit family and is widely grown in tropical and subtropical regions. Fruits with a diameter less than 5cm, known as var. minima, and fruits with a diameter greater than 5cm, known as var. maxima, are the two types of farmed *M. charantia*. In Africa, Asia, and South America, especially the Caribbean, *M. charantia* is planted for its edible fruit. *M. charantia*'s immature fruits can be served in a variety of ways, with the seeds and pith being eliminated before cooking. They can be dehydrated, pickled, or canned in addition to frying and cooking. To lessen the bitterness, pre-treatments like as blanching or soaking in salt water are used. Flavorings can be made from the fruits, flowers, and new shoots. *M. charantia*'s entire fruit (including the seeds and pith) can be used to make a health drink. Vitamin C, as well as vitamins A and B, phosphorus, calcium, potassium, and iron, are abundant in the fruits.

M. charantia has a higher mineral and vitamin concentration than other Cucurbitaceae pear species. Anti-diabetic, anti-tumor, anti-cancer, anti-inflammatory, antiviral, and cholesterol-lowering properties are all found in *M. charantia*. Charantin, vicine, polypeptide-p, and other bioactive components such as antioxidants are responsible for *M. charantia*'s anti-diabetic properties. *M. charantia* is used to treat worms and parasites in wounds using a topical internal or exterior treatment. The impact of different processing methods on total antioxidant content and activity is scientifically significant since it has a direct impact on dietary nutrition. Blanching is a method of inactivating enzymes such polyphenol oxidase, catalase, peroxidase, lipogenase, and chlorophyllase in vegetables. Blanching also acts as a surface disinfectant, killing bacteria and removing dirt from vegetables. It makes veggies more compact, brighter in colour, and prevents nutrient loss. Boiling, on the other hand, softens vegetables by breaking down their cell walls, allowing them to be consumed.

2.1 Effect of Cooking Methods on Bitter Gourd

Bioactive substances such as phenolic and polyphenolic chemicals are abundant in fruits and vegetables. These chemicals have antioxidant properties, which means they protect cell components including proteins, DNA, and lipids from oxidative damage produced by free radicals by delaying or preventing oxidation. Polyphenols, which can be found in fruits and vegetables, are the most powerful antioxidants. They can be found in nearly every section of the plant. *Momordica charantia* (bitter gourd) is a Cucurbitaceae family. Glycosides, saponins, alkaloids, fixed oils, triterpenes, proteins, and steroids are the principal biological components of bitter gourd. In addition, bitter gourd contains vitamins C and A, as well as other health-promoting compounds like charantin and vicine (hypoglycaemic), momorcharin and momordicoside A and B (tumour growth inhibitors), and phenolic compounds such gallic acid, epicatechin, chlorogenic acid, and carotenoids.

3. *Momordica charantia* and fractions antioxidant activity in various *in vitro* models

The oxidative breakdown of lipids, which generates off-flavors, is a major concern in the shelf life of foods. For the stabilization of lipid-containing meals, there has been an increasing interest in using natural additions rather than synthetic substances in recent years. Because synthetic antioxidants like butylated hydroxyanisole (BHA) and

butylated hydroxytoluene (BHT) have been linked to acute toxicity and chronic illnesses in animals, their use in food has been prohibited. As a result of the growing sensitivity of consumers to synthetic additives, the current trend in food processing is to employ natural ingredients. Natural antioxidants have been discovered in large quantities in spices, herbs, and grains. Rosemary and vitamin E are two of them that have commercial value. The pulp and seed of bitter melon, a traditional Indian vegetable, were independently extracted with several solvents in the current study, and the relative antioxidant properties of these extracts were assessed using various assays.

3.1 In-vitro antioxidant activity, phenolic content of bitter melon leaf stem and fruit fraction extracts

In recent years, research into the association between antioxidants and the prevention of non-communicable diseases such as cardiovascular disease, cancer, and diabetes has exploded. Free radicals are thought to play a major role in human health by producing serious diseases including cancer and cardiovascular disease through cell degradation. These free radicals are produced naturally in the body and can also be obtained from the environment. Oxygen radicals have been linked to cellular and metabolic damage, as well as accelerated ageing, cancer, cardiovascular disease, neurological disease, and inflammation. Dietary antioxidants may be able to prevent or reduce oxidative damage. The most widely used synthetic antioxidants, such as butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT), are banned in food and are suspected of causing liver damage and cancer. Food containing phytochemicals with antioxidants has been shown in epidemiological and *in vitro* studies to have potential protective effects against a variety of diseases, including cancer, diabetes, and cardiovascular disease.

Fruit and vegetable consumption has aided in the prevention of oxidative stress-induced degenerative processes. Fruits, vegetables, and grains, among other foods, are said to contain a wide range of antioxidant components, including phytochemicals. Phytochemicals, such as phenolic compounds, are thought to be beneficial to human health because they reduce oxidative stress and limit macromolecular oxidation, lowering the risk of degenerative illnesses. These chemicals have been found to have a strong relationship with antioxidant activity. Bitter melon (*Momordica charantia* L.) has been used as a food and medicinal for thousands of years. Because it grows in tropical regions such as India, Malaysia, China, tropical Africa, the Middle East, America, and Thailand, bitter melon is known by a variety of names. It has been found to have antilipolytic, analgesic, abortifacient, antiviral, cytotoxic, hypoglycemic, and antimutagenic properties as a medicinal plant. According to the findings, extract powder of fresh and dried bitter melon fruit decreased blood sugar in diabetic rats. In alloxan-induced diabetic rats, bitter melon extracts had anti-diabetic, hepato-renal protecting, and hypolipidemic effects.

4. The seed oil of *Momordica charantia* L. Bioactive compounds used in nutraceutical formulations

Plant-derived nutraceuticals have received a lot of attention in nutrition and dietary supplement research over the last decade. Functional food components and sources of unusual phytochemicals, such as new plant species, cultivars, and

agro-industrial byproducts, have piqued researchers' interest as low-cost dietary supplements with possible disease prevention properties. Fats and oils are vital industrial raw materials as well as being crucial in the human diet. The majority of oils are currently produced from plants, and demand for edible oils is steadily increasing. As a result, wild plants have recently been looked into as potential sources of unique seed oils. *Momordica charantia*, often known as bitter melon, bitter melon, or karela, is a Cucurbitaceae family gourd that grows in humid and subtropical climates around the world. Bitter melon vines are native to Asia, but due to the nutritional value of both unripe and ripe fruits, they are now widely planted across the world, notably in tropical nations such as Brazil, China, Taiwan, and India. They may grow in a variety of conditions, but they prefer warm weather. It's a game-changing plant with numerous uses in the food business and in medicine. Bitter melon is a rich source of conjugated ω -linolenic acids, according to numerous research (CLnA). As a result, it's been utilised in traditional folk medicine (mostly in Asia) to treat a variety of ailments, including diabetes and atherosclerosis. Bitter melon is one of the few edible fruits that contains conjugated linolenic acid, a result of its metabolism, in its seeds. Because of the significant presence of polyunsaturated fatty acids (PUFAs) and other bioactive substances in seed oils, their lipid profiles have gotten a lot of attention. Eleostearic acid (EA; C18:3 9c11t13t), a long-chain PUFA (ω -5) with conjugated double bonds, makes up 30–60% of bitter melon seed oil (BSO). CLnAs are a group of octadecadienoic fatty acid isomers with two Trans and one cis double bonds that are positional and geometrically similar. CLnAs' chemical and physiological properties, as well as their numerous prospective health benefits, such as antioxidant, anti-inflammatory, anti-atherosclerotic, anti-tumor, and serum lipid-lowering effects *in vitro* and *in vivo*, have piqued scientists' attention. BSO has been found to include various bioactive substances such as tocopherols and polyphenolic compounds, in addition to a high concentration of CLnA. The existence and quantification of phytosterols, on the other hand, are quite limited. There is presently no information available about these types of research projects on Brazilian-grown cultivars of this plant. Furthermore, changes in chemical and phytochemical makeup across cultivars have yet to be determined. Improved soil and climatic conditions in the production area may improve fat content and functional properties. This project intends to raise awareness of underutilised agricultural products in Brazil and, as a result, contribute to preventing waste disposal issues to improve the bitter melon seeds' economic value as a source of edible oil with nutraceutical potential.

5. Bitter melon fruit extracts antibacterial, and anticancer activities at three different farming stages

Antibiotics are the most common weapons used to combat bacterial infections. The choice of antibiotics, on the other hand, has shrunk as a result of the resistance factor, which has increased the risk of serious effects. Infections are thought to be responsible for 20% of all human cancers. Patients with bronchogenic carcinomas were found to have active tuberculosis at a higher rate than the overall population. The activation of inflammation and the creation of mutagenic chemicals by bacterial metabolism are the two major explanations, notwithstanding the direct influence of

pathogenic organisms, which is most likely a blunder. Noncardia gastric carcinoma and colon carcinoma are two prevalent malignancies caused by bacteria. Bacterial infection is responsible for around 1.2 million cancer cases each year. In the global emergence of bacterial resistance and growing incidence of oxidative stress illnesses situation, natural products and phytochemicals are attracting attention. Phytomedicines have a number of advantages over infectious and malignant chemotherapeutic medications, including less side effects and a lack of bacterial resistance. Plants have long been studied in the hopes of discovering novel medicinal compounds. Medicinal plant-based therapy is used by about 80% of the world's population and 90% of the African population. Similarly, between 1981 and 2002, the pharmaceutical sector generated around 61% new natural product-based medications that were highly successful against infectious and malignant disorders. According to WHO, medicinal plants are the best and cheapest source of anti-infection and anti-cancer agents. As a result, one of the key focuses is screening the flora for natural products and phytochemicals to suppress and eliminate infection and malignant diseases. Bitter gourd (BG) is a wild form of *Momordica charantia* in the Cucurbitaceae family that is used as a vegetable as well as a folk remedy. Phenolics, steroidal glucosides, alkaloids, conjugated linolenic acid isomers, lysophosphatidylcholines, organosulfur compounds, and cucurbitane-type triterpenoids are only a few of the biologically active substances discovered in the Cucurbitaceae family. Diabetes, hypoglycemia, heart illness, HIV (human immunodeficiency virus), cancer, and microbial infections have all been studied to see if phytochemical fractions and chemicals extracted from the gourd family can help cure them.

✓ **Bitter gourd's health benefits (*Momordica charantia* L.)**

Bitter gourd (*Momordica charantia* L.) has been used as a culinary and medicinal herb for centuries. It's a nutrient-dense, strong plant with a diverse variety of helpful chemicals. Phytochemicals, vitamins, minerals, and antioxidants are among them, and they all contribute to its extraordinary adaptability in healing a variety of ailments. Vitamin C, vitamin A, vitamin E, vitamins B1, B2, and B3, as well as vitamin B9, are abundant in the fruits (folate). Bitter melon's medicinal usefulness has been attributed to its high antioxidant properties, which are attributable in part to phenols, flavonoids, isoflavones, terpenes, anthraquinones, and glucosinolates, which all impart a bitter flavour. Vitamin C, vitamin E, phenolic acid, and flavonide are all antioxidants found in plants. Due to their protective properties against a variety of chronic and cardiovascular diseases, phytochemicals, particularly antioxidants from natural sources such as fruits, vegetables, and herbs, have gained prominence in recent years. Plant phenols and polyphenolic compounds, which are a wide class of chemical compounds with the ability to act as chain breaking antioxidants and proposed to protect against free radical damage to DNA, cell membranes, and cell components, are the primary natural antioxidants in bitter gourd. These polyphenols have gotten a lot of attention among plant-derived natural compounds because of their potent antioxidant, antimicrobial, and antiviral properties, as well as their ability to inhibit cancer cell proliferation,

protect neurons from oxidative stress, simulate vasodilation, reduce vascularization, and improve insulin secretion.

✓ **The advantages of antioxidants**

Antioxidants are commonly mentioned in discussions about good health and illness prevention. Antioxidants are substances that protect the body from the harmful effects of oxygen, such as those caused by free radicals. Antioxidants include enzymes and other compounds that can counteract the detrimental effects of oxidation, such as vitamin C, vitamin E, and beta carotene. Antioxidants may help to lower cancer risk and decrease the course of age-related macular degeneration. These strong chemicals, which are usually found in the fresh fruits and vegetables we consume, inhibit (and in some cases completely block) another molecule in the body from oxidising. Antioxidants are extremely beneficial to one's health because free radicals can cause serious health problems if left unchecked. They have the potential to cause a variety of illnesses and chronic diseases.

✓ **Antioxidant vs. Free Radicals**

Most people are unaware that oxygen is both a blessing and a burden. Humans require oxygen to survive, but simply breathing in oxygen causes the production of extremely reactive molecules known as free radicals. Free radicals produce oxidative damage when they interact with other molecules in the body, which can lead to a variety of illnesses and disorders. Free radicals are produced naturally in the human body, and antioxidants are produced to combat their harmful effects. In most situations, however, free radicals overwhelm naturally occurring antioxidants. Antioxidants benefit the body by neutralising and removing free radicals from the blood stream; and removing free radical. The phrase 'free radical' is used in biomedical and scientific literature to refer to a wide range of reactive species, including 'excited states' that lead to free radical generation, species that arise from free radical creation, and species that result from free radical reaction.

Antioxidants are added as Red-ox systems, which have a larger oxidative potential than the medicine they're supposed to protect, or as chain inhibitors of radical induction breakdown. Antioxidants work by supplying a hydrogen atom or an electron to the free radical and receiving the extra energy held by the activated molecule to break up the chains established during the propagation phase. It has been proposed that fruits, vegetables, and natural plants contain a wide range of substances known as phytochemicals, which are found in plants and are the primary source of antioxidants in the diet, potentially reducing the stress caused by reactive oxygen species. Free-radical scavengers, reducing agents, potential complexes of pro-oxidant metals, singlet oxygen quenchers, and other natural antioxidants may be present. By interacting with free radicals, antioxidants can disrupt the oxidation process. The search for naturally occurring antioxidants for usage in foods or medical materials has sparked a lot of attention recently.

6. Conclusion

We can say that Gourd vegetables include a variety of new and biologically active phytochemicals, such as triterpenes, proteins, and steroids, suggesting that they could be used to protect the human body from a variety of illnesses. Ridge gourd, snake gourd, ivy gourd, and spiny gourd are among

the gourds that have not been well studied, thus there is need for more research. Because the health advantages of ash gourd, bitter gourd, and bottle gourd have been well documented, it can be inferred that gourd vegetables have a lot of promise as functional food and nutraceutical ingredients. Antioxidants, which are naturally formed in the body and can be obtained from various herbs, vegetables, and fruits, can protect the body from the damage caused by free radicals at varying degrees. Several research on the anti-oxidant capacity of bitter gourd extract and juice show of vitamin C. Calcium was the most common mineral found in gourd vegetables, with values ranging from 20 to 30 mg/100 gm.

✓ **Traditional uses and medicinal values**

Gourd vegetables have been utilised to treat diseases by humans all across the world since ancient times. Many plant extracts include a varied array of secondary metabolites, most of which have antioxidant properties, in addition to minerals and primary metabolites. Diabetes mellitus, diuresis diseases, urinary infection, chronic inflammatory disorders, epilepsy, cough, fever, heart conditions, liver disorders, peptic ulcer, and internal organ haemorrhages, as well as an antibiotic and purgative vermifuge, have all been treated with ash gourd. Triterpenes, phenolics, sterols, glycosides, and soluble dietary fibre are among the bioactives and therapies found in it. The immature and mature fruits of the ash gourd are both grown. It is widely used in curries in India, and it is offered to Gods in religious rites. The ripe fruits have a bland taste and a rich greenish-white flesh. The elder fruits' hard flesh can also be candied with sugar and dried for later use. Fruits are frequently packed with meat, shrimp, and veggies in China and then cooked in a pot. The researchers used irradiation to stabilise ash gourd juice and ash gourd mint-blended juice, and found that the generated juices were stable for up to eight months, had a high acceptance score, and were microbiologically safe. Aseptic processing was used to prepare and preserve the ash gourd juice, which was stable for up to eight months under ambient settings. Another beverage made from ash gourd and mint that was aseptically processed, sterilised at 95°C, and packed in a tetra pack (six-layered) had an eight-month shelf life. The therapeutic properties of ash gourd fruits include antipyretic, nootropic, antidepressant, anorectic, anxiolytic, antiinflammatory, analgesic, diuretic, antioxidant, antihistamine, antidiarrheal, angiotensin-converting enzyme inhibition, renal, and gastroprotective actions.

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Antioxidants found in fruits and vegetables are responsible for this. Bitter melon's antioxidants may aid in the detection and destruction of free radicals that can cause diseases (including cancer), but this isn't the fruit's only cancer-fighting advantage.

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3. *Momordica charantia* and fractions antioxygenic activity in various *in vitro* models

The oxidative breakdown of lipids, which generates off-flavors, is a major concern in the shelf life of foods. For the stabilization of lipid-containing meals, there has been an increasing interest in using natural additions rather than synthetic substances in recent years. Because synthetic antioxidants like butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) have been linked to acute toxicity and chronic illnesses in animals, their use in food has been prohibited. As a result of the growing sensitivity of consumers to synthetic additives, the current trend in food processing is to employ natural ingredients. Natural antioxidants have been discovered in large quantities in spices, herbs, and grains. Rosemary and vitamin E are two of them that have commercial value. The pulp and seed of bitter melon, a traditional Indian vegetable, were independently extracted with several solvents in the current study, and the relative antioxygenic properties of these extracts were assessed using various assays.

3.1 *In-vitro* antioxidant activity, phenolic content of bitter melon leaf stem and fruit fraction extracts

In recent years, research into the association between antioxidants and the prevention of noncommunicable diseases such as cardiovascular disease, cancer, and diabetes has exploded. Free radicals are thought to play a major role in human health by producing serious diseases including cancer and cardiovascular disease through cell degradation. These free radicals are produced naturally in the body and can also be obtained from the environment. Oxygen radicals have been linked to cellular and metabolic damage, as well as accelerated ageing, cancer, cardiovascular disease, neurological disease, and inflammation. Dietary antioxidants may be able to prevent or reduce oxidative damage. The most widely used synthetic antioxidants, such as butylated hydroxy anisole (BHA) and butylated hydroxy toluene (BHT), are banned in food and are suspected of causing liver damage and cancer. Food containing phytochemicals with antioxidants has been shown in epidemiological and *in vitro* studies to have potential protective effects against a variety of diseases, including cancer, diabetes, and cardiovascular disease.

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4. The seed oil of *Momordica charantia* I. Bioactive compounds used in nutraceutical formulations

Plant-derived nutraceuticals have received a lot of attention in nutrition and dietary supplement research over the last decade. Functional food components and sources of unusual phytochemicals, such as new plant species, cultivars, and agro-industrial byproducts, have piqued researchers' interest as low-cost dietary supplements with possible disease prevention properties. Fats and oils are vital industrial raw materials as well as being crucial in the human diet. The majority of oils are currently produced from plants, and demand for edible oils is steadily increasing. As a result, wild plants have recently been looked into as potential sources of unique seed oils. *Momordica charantia*, often known as bitter melon, bitter melon, or karela, is a Cucurbitaceae family that grows in humid and subtropical climates around the world. Bitter melon vines are native to Asia, but due to the nutritional value of both unripe and ripe fruits, they are now widely planted across the world, notably in tropical nations such as Brazil, China, Taiwan, and India. They may grow in a variety of conditions, but they prefer warm weather. It's a game-changing plant with numerous uses in the food business and in medicine. Bitter melon is a rich source of conjugated ω -linolenic acids, according to numerous research (CLnA). As a result, it's been utilised in traditional folk medicine (mostly in Asia) to treat a variety of ailments, including diabetes and atherosclerosis. Bitter melon is one of the few edible fruits that contains conjugated linolenic acid, a result of its metabolism, in its seeds. Because of the significant presence of polyunsaturated fatty acids (PUFAs) and other bioactive substances in seed oils, their lipid profiles have gotten a lot of attention.

Eleostearic acid (EA; C18:3 9c11t13t), a long-chain PUFA (ω -5) with conjugated double bonds, makes up 30–60% of bitter melon seed oil (BSO). CLnAs are a group of octadecadienoic fatty acid isomers with two Trans and one cis double bonds that are positional and geometrically similar. CLnAs' chemical and physiological properties, as well as their numerous prospective health benefits, such as antioxidant, anti-inflammatory, anti-atherosclerotic, anti-tumor, and serum lipid-lowering effects *in vitro* and *in vivo*, have piqued scientists' attention. BSO has been found to include various bioactive substances such as tocopherols and polyphenolic compounds, in addition to a high concentration of CLnA. The existence and quantification of phytosterols, on the other hand, are quite limited. There is presently no information available about these types of research projects on Brazilian-grown cultivars of this plant. Furthermore, changes in chemical and phytochemical makeup across cultivars have yet to be determined. Improved soil and climatic conditions in the production area may improve fat content and functional properties. This project intends to raise awareness of under utilised agricultural products in Brazil and, as a result, contribute to preventing waste disposal issues to improve the bitter melon seeds' economic value as a source of edible oil with nutraceutical potential.

5. Bitter gourd fruit extracts antibacterial, and anticancer activities at three different farming stages

Antibiotics are the most common weapons used to combat bacterial infections. The choice of antibiotics, on the other hand, has shrunk as a result of the resistance factor, which has increased the risk of serious effects. Infections are thought to be responsible for 20% of all human cancers. Patients with bronchogenic carcinomas were found to have active tuberculosis at a higher rate than the overall population. The activation of inflammation and the creation of mutagenic chemicals by bacterial metabolism are the two major explanations, notwithstanding the direct influence of pathogenic organisms, which is most likely a blunder. Noncardia gastric carcinoma and colon carcinoma are two prevalent malignancies caused by bacteria. Bacterial infection is responsible for around 1.2 million cancer cases each year. In the global emergence of bacterial resistance and growing incidence of oxidative stress illnesses situation, natural products and phytochemicals are attracting attention. Phytomedicines have a number of advantages over infectious and malignant chemotherapeutic medications, including less side effects and a lack of bacterial resistance. Plants have long been studied in the hopes of discovering novel medicinal compounds. Medicinal plant-based therapy is used by about 80% of the world's population and 90% of the African population. Similarly, between 1981 and 2002, the pharmaceutical sector generated around 61% new natural product-based medications that were highly successful against infectious and malignant disorders. According to WHO, medicinal plants are the best and cheapest source of anti-infection and anti-cancer agents. As a result, one of the key focuses is screening the flora for natural products and phytochemicals to suppress and eliminate infection and malignant diseases. Bitter gourd (BG) is a wild form of *Momordica charantia* in the Cucurbitaceae family that is used as a vegetable as well as a folk remedy. Phenolics, steroidal glucosides, alkaloids, conjugated linolenic acid isomers, lysophosphatidylcholines, organosulfur compounds, and cucurbitane-type triterpenoids are only a few of the biologically active substances discovered in the Cucurbitaceae family. Diabetes, hypoglycemia, heart illness, HIV (human immunodeficiency virus), cancer, and microbial infections have all been studied to see if phytochemical fractions and chemicals extracted from the gourd family can help cure them.

✓ Bitter gourd's health benefits (*Momordica charantia* L.)

Bitter gourd (*Momordica charantia* L.) has been used as a culinary and medicinal herb for centuries. It's a nutrient-dense, strong plant with a diverse variety of helpful chemicals. Phytochemicals, vitamins, minerals, and antioxidants are among them, and they all contribute to its extraordinary adaptability in healing a variety of ailments. Vitamin C, vitamin A, vitamin E, vitamins B1, B2, and B3, as well as vitamin B9, are abundant in the fruits (folate). Bitter melon's medicinal usefulness has been attributed to its high antioxidant properties, which are attributable in part to phenols, flavonoids, isoflavones, terpenes, anthraquinones, and glucosinolates, which all impart a bitter flavour. Vitamin C, vitamin E, phenolic acid, and flavonoid are all antioxidants found in plants. Due to their protective properties against a variety of chronic and cardiovascular diseases, phytochemicals, particularly antioxidants from

natural sources such as fruits, vegetables, and herbs, have gained prominence in recent years. Plant phenols and polyphenolic compounds, which are a wide class of chemical compounds with the ability to act as chain breaking antioxidants and proposed to protect against free radical damage to DNA, cell membranes, and cell components, are the primary natural antioxidants in bitter gourd. These polyphenols have gotten a lot of attention among plant-derived natural compounds because of their potent antioxidant, antimicrobial, and antiviral properties, as well as their ability to inhibit cancer cell proliferation, protect neurons from oxidative stress, simulate vasodilation, reduce vascularization, and improve insulin secretion.

✓ The advantages of antioxidants

Antioxidants are commonly mentioned in discussions about good health and illness prevention. Antioxidants are substances that protect the body from the harmful effects of oxygen, such as those caused by free radicals. Antioxidants include enzymes and other compounds that can counteract the detrimental effects of oxidation, such as vitamin C, vitamin E, and beta carotene. Antioxidants may help to lower cancer risk and decrease the course of age-related macular degeneration. These strong chemicals, which are usually found in the fresh fruits and vegetables we consume, inhibit (and in some cases completely block) another molecule in the body from oxidising. Antioxidants are extremely beneficial to one's health because free radicals can cause serious health problems if left unchecked. They have the potential to cause a variety of illnesses and chronic diseases.

✓ Antioxidant vs. Free Radicals

Most people are unaware that oxygen is both a blessing and a burden. Humans require oxygen to survive, but simply breathing in oxygen causes the production of extremely reactive molecules known as free radicals. Free radicals produce oxidative damage when they interact with other molecules in the body, which can lead to a variety of illnesses and disorders. Free radicals are produced naturally in the human body, and antioxidants are produced to combat their harmful effects. In most situations, however, free radicals overwhelm naturally occurring antioxidants. Antioxidants benefit the body by neutralising and removing free radicals from the blood stream; and removing free radical. The phrase 'free radical' is used in biomedical and scientific literature to refer to a wide range of reactive species, including 'excited states' that lead to free radical generation, species that arise from free radical creation, and species that result from free radical reaction.

Antioxidants are added as Red-ox systems, which have a larger oxidative potential than the medicine they're supposed to protect, or as chain inhibitors of radical induction breakdown. Antioxidants work by supplying a hydrogen atom or an electron to the free radical and receiving the extra energy held by the activated molecule to break up the chains established during the propagation phase. It has been proposed that fruits, vegetables, and natural plants contain a wide range of substances known as phytochemicals, which are found in plants and are the primary source of antioxidants in the diet, potentially reducing the stress caused by reactive oxygen species. Free-radical scavengers, reducing agents, potential complexes of pro-oxidant metals, singlet oxygen quenchers, and other natural antioxidants may

be present. By interacting with free radicals, antioxidants can disrupt the oxidation process. The search for naturally occurring antioxidants for usage in foods or medical materials has sparked a lot of attention recently.

6. Conclusion

We can say that Gourd vegetables include a variety of new and biologically active phytochemicals, such as triterpenes, proteins, and steroids, suggesting that they could be used to protect the human body from a variety of illnesses. Ridge gourd, snake gourd, ivy gourd, and spiny gourd are among the gourds that have not been well studied, thus there is need for more research. Because the health advantages of ash gourd, bitter gourd, and bottle gourd have been well documented, it can be inferred that gourd vegetables have a lot of promise as functional food and nutraceutical ingredients. Antioxidants, which are naturally formed in the body and can be obtained from various herbs, vegetables, and fruits, can protect the body from the damage caused by free radicals at varying degrees. Several research on the anti-oxidant capacity of bitter gourd extract and juice show that the whole fruit, peel, and seed of *M. Charantia* contain anti-oxidant properties because it is high in biological substances such as ascorbic acid, phenolic compound, and flavonoid. Bitter gourd has a lot of flavonoid and phenolic compounds, which are good sources of antioxidants. The therapeutic advantages and bioactive ingredients of bitter gourd fruit need further exploration, given its potential use in traditional medicine.

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