International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 01 Jan. 2025, pp: 404-415 www.ijaem.net ISSN: 2395-5252

Phytochemical and Nutritive Evaluation of Bitter Gourd Leaf (Momordicalcharantia) and Scent Leaf (Occimumgratissimum) Found in Southwestern Nigeria.

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Date of Submission: 20-01-2025 Date of Acceptance: 30-01-2025

ABSTRACT
Momordicacharantia (Bitter gourd) and Ocimumgratissimum (Scent leaf) have been used to make herbs either singly or in combination to cure several ailments, thus making them potential sources of phytochemicals that can be developed into useful drugs. Using their leaves to manage ailments without considering their chemical constituents has attracted the need for investigation. These plants were analysed for proximate, mineral, vitamin, and phytochemical compositions. Standard analytical methods were used in this research work.The proximate analysis results revealed that both plants (leaves) contained nutrients at varying levels. O. gratissimumleaf extract exhibits higher nitrogen-free extract (58.55%) and ash content (10.02%) while M. charantia has higher crude protein (24.95%) and crude fiber (6.01%). Mineral analysis shows that M. charantia had higher values of potassium (9.127 mg/kg), magnesium (6.517 mg/kg), and iron (4.571mg/kg) while O. gratissimum has a significantly higher calcium value of 12.826 mg/kg. Vitamin analysis shows that M. charantia has considerably higher levels of riboflavin (8.389 mg/kg), niacin (2375.5 mg/kg), ascorbic acid (352.8 mg/kg), and retinol (3.847 mg/kg) while O. gratissimum contains a higher level of tocopherol (183.9 mg/kg) and folic acid (1134.5 mg/kg). The secondary metabolites analysis (quantitative analysis) revealed significant amounts of glycosides, terpenoids, and saponins concentrations, with O. gratissimum having higher quantities (31.43 mg/kg, 23.75 mg/kg, and 16.59 mg/kg) respectively. The leaves of M. charantia and O. gratissimum are sources of essential nutrients that could be used in diets to supplement daily nutrient needs in humans and animals.
Keywords: Momordicacharantia, Ocimumgratissimum, proximate, phytochemical

I. INTRODUCTION

Momordicacharantia(L)iscommonly known as Bitter gourd, Bitter melon or Karela, Ejirin (Yoruba), Daddasu (Hausa), Gara-

International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 01 Jan. 2025, pp: 404-415 www.ijaem.net ISSN: 2395-5252

Fini(Nupe), and Okwunuolo (Igbo). The plant belongs to the family of Cucubitaceae and the genus Momordica. It is a plant species frequently utilized in traditional medicine due to its numerous therapeutic properties. The fruits, flowers, and young shoots are used as flavouring agents in various Asian dishes. Fruits are cooked with other vegetables, especially in soups for the slightly bitter taste.However, in Indian cuisines, the fruits are mainly used after blanching parboiling or soaking in salt water to reduce bitterness [31]. The Fruits can also be canned pickle or dehydrated in addition to cooking or deep frying. It is considered widely as a folklore medicine against diabetes amongst the indigenous population of Asia, South America, India,and East Africa [20]. Apart from the fruits, the roots, leaves, and vines are used as suppressants for toothache, diarrhoea, and furuncle. Various products of Bitter gourd like bitter gourd tea, which is known as Gohyah or herbal tea made from dried slices of bitter gourd, are gaining popularity as herbal medicine [19].Other potential medicinal uses of bitter gourd include its anti-cancer and anti-obesity effects. The fruit contains various bioactive compounds that have been found to inhibit the growth and proliferation of cancer cells and promote apoptosis [32]. It may also help with weight loss by reducing appetite, improving digestion, and increasing metabolism.

The second plant is botanically calledOcimumgratissimum(L) (Scent-Leaf) also referred to as Efinrin (Yoruba), Daidoya (Hausa), Tamwotswagi (Nupe), and Nchanwa (Igbo), belongs to the family Lamiaceae and are found mostly in the tropical countries including; Nigeria, India, North and South America, Mexico and Brazil. It is a fully developed flowering plant with roots, stems, and leaf systems [28]. It prefers moist and fertile soils during growth but can tolerate drought after flowering. It is naturally and traditionally used to relieve pains and in the treatment of rheumatism, diarrhoea, high fever, convulsions, diabetes, eczema, piles, skin infections, gastroenteritis, stomach-ache, cuts, wounds, inflammation, and diuretic as a repellent [17].Ocimumgratissimum(L.) has found usage in food and medicine. Its application in food includes being used as flavourings and nutraceuticals. In Nigeria, the leaf is used as a condiment in the preparation of dishes such as pepper soup, jollof rice, and vegetable soups. The extract from the leaves of O. gratissimum(L.) possesses good antioxidant potential, which may be attributed to its phytochemical constituents [34]. Ocimumgratissimum(L.) is also used in traditional medicine for the treatment of several ailments such as urinary tract, wound, skin, and gastrointestinal infections, and this practice continues to exist in developing nations [25]. Traditionally, in Nigeria, fresh leaves are usually harvested, rinsed, and squeezed in cold water for 3 to 5 min. The squeezing in cold water is repeated three times, and the extracts are collected and served for drinking immediately.This research work aims to comparatively analyse the chemical constituents of ethanolic crude extracts of the leaves of Bitter gourd M. charantia(L) and Scent Leaf O. gratissimum(L) involving a well-detailed evaluation of their nutritional properties, phytochemical screening (secondary metabolites) and bioactive compounds, to ascertain which of the leaves exhibit a greater potency in therapeutic application.A lot has been carried out on the herb, O. gratissimum(L.). This plant is used by herbalists to treat a variety of maladies, from bacterial infections and diabetes to pain and liver damage. Several studies have been performed that lend credence to herbalist'suse of this plant for treating diarrhoea and other gastrointestinal infections [13]. In folk medicine, O. gratissimum(L) is extensively used throughout West Africa as a febrifuge, anti-malarial and anti-convulsant. In the coastal area of Nigeria, the plant is used in the treatment of epilepsy, high fever, and diarrhoea. While in the savannah areas decoctions of the leaves are used to treat mental illness [11]. The use of natural means of treating infectious diseases was the future of pharmacology in the development of effective drugs with low or no toxicity to the recipient. Scent leaf has been used traditionally for the treatment of gastrointestinal disorders, dysentery, diarrhoea, and candidiasis caused by various gastrointestinal inhabiting microorganisms. Direct oral administration of raw scent leaf juice has been used for a long time in many tribes to treat gastrointestinal disorders, dysentery, diarrhoea, and candidiasis of varying degrees. Traditional medicine is more accessible to most populations in the world than orthodox medicine. It is reported that 60-80% of the population of every country of developing country has to rely on traditional or indigenous forms of medicine [24].

Traditional Uses and Health Benefits of the Plants

1. **Digestive disorderliness**

Traditionally,both plants are used to treat various digestive disorders, such as; constipation,

International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 01 Jan. 2025, pp: 404-415 www.ijaem.net ISSN: 2395-5252

indigestion, and diarrhea. The plants contain a high amount of dietary fiber, which helps to regulate bowel movements and promote digestive health [21].

2. Skin Disorders:

Both plantshave been used for the treatment of various skin problems, such as;psoriasis, acne, and eczema. The plants containseveral compounds that have anti-inflammatory and anti-microbial activities [23].

3. Respiratory Disorders:

Both plants have been traditionally used to treat respiratory disorders, such as asthma, cough, and bronchitis [15, 35]. The leaf decoction of M. charantia (L) is also used for the treatment of high blood pressure, malaria, dysentery,and worm infections. It is also used for the treatment of rheumatism[29].

This study focused on the nutritive and phytochemical (secondary metabolites) compositions of both plants to ascertain their possible utilization as food and in the formulation of drugs.

(A)

Plate 1: Bitter Gourd Plant

(B)

Plate 2: Bitter Gourd Plant with Fruit

International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 01 Jan. 2025, pp: 404-415 www.ijaem.net ISSN: 2395-5252

(C)
Plate 3: Scent leaf plant

II.

III. MATERIALS AND METHODS

Collection of Plant Samples

The fresh leaf samples were collected on a farmland at Elekoyangan area of Oke-Ose, Jebba Road, Ilorin, Kwara State, Nigeria.

Identification of Leaves Samples

The samples were identified at the Herbarium, Department of Plant Biology, Faculty of Life Sciences, University of Ilorin, Ilorin, Kwara State, Nigeria by the Herbarium Officer and samples were assigned the following voucher No UILH/001/963/2023 and UILH/002/984/2023.

Preparation of Plant Samples

The two plant leaf samples were treated separately, samples were rinsed with deionized water and air-dried at room temperature (25^{o}C) in

(C) **Scent Leaf Plant** *(D)*

with 0.5 mm pore size to obtain fine powder. The powdered samples were stored separately in airtight containers and properly labelledbefore analysis. The leaf powder samples were analysed separately in triplic

Scent Leaf Leaves

Solvent Purification

Solvents were purified by distillation method using a simple distillation setup. Ethanol was distilled at 78.5 ^{0}C.

Preparation of Plant Extracts

The samples were extracted with static maceration by weighing 500 g of each plant sample and soaked in 2.5 L of ethanol separately at room temperature in a closed container (to prevent evaporation of solvent). The mixture was allowed to stand for 72 h at room temperature (25^{o}C). The mixture was filtered using what man filter paper in a glass funnel. The remaining solvent in the plant particles of the mixture was extracted using a mechanical press. The extracts obtained were concentrated under reduced pressure using a rotary evaporator and were stored in labelled sample bottles until ready for use.

Instrumentation

Copper, iron and zinc were dete
Ato
dete
sodium; a flame photometer (Jenway, U.K model) was used. Each instrument was calibrated with analytical grade standard metal solutions.

Proximate analysis

Moisture content was determined by drying to constant weight in the air, ash content by ignition at 550^{0}C in a muffle furnace, oil content by soxhlet extraction with hexane (8h), protein by the

International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 01 Jan. 2025, pp: 404-415 www.ijaem.net ISSN: 2395-5252

kjeldahl method, crude fibre by the acid and alkaline digestion methods, and the carbohydrate content were estimated bydifference, all described by AOAC [4].

Mineral analysis

The mineral composition was determined by the wet acid digestion method. 1.00 g each of dried samples weighed into a conical flask and 10 mL conc. HNO_3 was added to each of the flasks with a lid and placed in a fume cupboard for three days. Thereafter, the content was then heated on a hot plate with conc. $HNO_3$was added intermittently, as the content was reducing, to avoid being dry until the sample solution changed to colourless. It was then cooled and transferred into a 50 mL volumetric flask, made up to mark with distilled water, and kept for AAS and flame photometric analysis [7].

Vitamin analysis

The vitamins were determined according to the method outlined by Okwu [26].

Phytochemical analysis

Phytochemical screening was done on the samples using methods described by Ayoolaet al., [9] and standard methods described by Sofowara[33] were used for the determination of Alkaloid, saponin, tannin, flavonoid, cardiac glycosides, terpenoids and phenolic.

Statistical Analysis

The descriptive statistics (mean, standard deviation, range) were conducted while statistical differences ($p<0.05$) were established using two-way analysis of variance (ANOVA) with SPSS VERSION 20 and post-hoc test (to separate the means) was conducted using Duncan Multiple Range Test.

IV. RESULTS AND DISCUSSION

The **proximate composition results of the leaves of** M. charantia (L.) and O. gratissimum(L.)were reported inFigure 1.The moisture content values for the leaves were not significantly different. Both leaves have relatively low moisture content. They contain (9.16% and 9.08%) respectively. High moisture content is an index to spoilage. The lower the moisture content, the longer the expected shelf-life [16] .The ash content values of the leaves of M. charantia(L.) and O. gratissimum(L.) (8.59 % and 10.02%) respectively are still favourable but lower in comparison to the values reported for M. charantia(L.) leaf (15.42%) by Bakareet al.,[10] and O. gratissimum(L.) leaf of (10.50%) by Olumideet al.,[28]. However, the result of the O. gratissmum(L.) leaf in this study was higher than that of Adewole [1]which is 2.45%. This suggests a potentially higher mineral content that could contribute to its therapeutic effects related to mineral supplementation and bone health. However, lower (14.71%) for M. charantia(L.) as reported by Ayeniet al.[6]. The percentage of ash is an indication of the level of inorganic content where mineral content could be obtained.The crude fat content of M. charantia(L.) (4.52%) was significantly higher than O. gratissimum(L) of (2.30%) but comparably low to the value obtained by Olumideet al.[28] for O.gratissimum (L.) of (4.20%) and Ayeniet al.[6] as reported for M. charantia(L.) of (5.83%). The low-fat content of both leaves suggested that the leaves cannot serve as oil vegetables but may be useful for individuals on weight-reducing diets [12] and can impact both energy levels and potentially influence blood sugar regulation. The leaves of the two plants investigated contained appreciable amounts of crude fibre of (6.01% and 5.16%) for M. charantia(L.) and O. gratissmum(L.) respectively. These values were lower than O. gratissimum(L.) reported byOlamideet al.[28]at (7.60%) and M. charantia(L.) reported by Amina and Mohammed, [3]at (25.31%). The differences in values obtained could be due to geographical location or soil type. The crude fibre quantity in these leaves is desirable with M. charantia(L.) having a higher value than O. gratissimum(L) and this indicates that these leaves can be included in diets without any deleterious effects, as adequate consumption of dietary can benefit digestion health, lower blood cholesterol and blood sugar. Fibre softens stools and therefore prevents constipation [8]. The protein content values of the M. charantia(L.) leaves were significantly higher than that of O. gratissimum(L.) leaves which may indicate better nutritional support and potentially better metabolic benefits and this makes it a more favourable vegetable and can be ranked as a potential source of plant protein, important for cell structure and function, therefore can serve as a protein supplement in the diet. However, the values recorded for both plant leaves were found to be lower than the value reported by Adewole [1] for O. gratissimum(L.) (16.51%) but comparable to the value (14.35%) obtained by Olumideet al.[28]. The crude protein obtained in this study for M. charantia(L.) (24.95%) was in the

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Volume 7, Issue 01 Jan. 2025, pp: 404-415 www.ijaem.net ISSN: 2395-5252

range of (27.46%) obtained by Bakareet al.[10].The values of nitrogen-free extract content for O. gratissimum(L.) and M. charantia(L.) have the highest value among the proximate parameters investigated indicating higher carbohydrate availability which might impact blood sugar levels and this may be attributed to the starchy nature of the plants with O. gratissimum(L.) having the higher value of (58.55%). This may influence its energy-providing properties and overall metabolic effects. These carbohydrate sources are not generally used because most of them remain undigested. The difference observed may be due to the physiological state of the plant before harvesting.Both plants have similar dry matter content, suggesting that most of the solid content in their extracts can be used for therapeutic purposes after moisture removal. However, from the results, O. gratissimum(L) exhibits higher ash content and nitrogen-free extract, potentially indicating stronger mineral and carbohydrate-related therapeutic effects, which is an indication of the presence of more glucose, which might influence blood sugar levels differently Likewise, M. charantia(L) has higher crude protein, crude fiber and crude lipid content, suggesting it may be more beneficial for protein-based nutritional therapies in most developing country such as Nigeria, where people can hardly afford high proteins' food because of their costs. M. charantia may be preferable for boosting overall nutritional health, beneficial for overall metabolic processes, potentially affecting digestive health, and also may have implications for blood sugar control.

The mineral analysis results are reported in Figure 2. Both leaves contained essential minerals necessary for various physiological functions. The amount of Calciumpresent inboth O. gratissimum(L) and M. charantia(L) was 12.826 mg/kg and 11.542 mg/kg respectively. Calcium helps in the regulation of muscle concentrations, transmits nerve impulses, and is beneficial for bone formation [18]. Calcium is necessary for the coagulation of blood, the proper functioning of the heart and nervous system, and the normal contraction of muscles, its most important function is to aid in the formation of bones and teeth [14]. The recommended dietary allowance (RDA) for calcium is 800 mg/day.

Magnesium content for both extracts of the leaveswas not significantly different with M. charantia(L.) having (6.517 mg/kg) as against O. gratissimum(L.) of (6.453 mg/kg), which is crucial in glucose metabolism and insulin action, also for relaxing muscles along the airway to the lung thus allowing asthma patients to breathe easier, it plays fundamental roles in the most reaction involving phosphate transfer, believed to be essential absorption while deficiency of magnesium in man is responsible for severe diarrhea, migraines, hypertension, cardiomyopathy atherio sclerosis, and stroke [5]. The recommended dietary allowance for magnesium is 320 mg/day. The **Potassium** content of M. charantia(L.) (9.127mg/kg) is significantly not different in values to O. gratissimum(L.)(9.092mg/kg). Potassium is important for cardiovascular health, responsible for nerve action and some osmoregulation in the body fluid.The **Sodium** content of O. gratissimum(L.) (2.469 mg/kg) is higher but not significantly different from the content ofM. charantia(L.)(2.468 mg/kg).A moderate quantity could be useful in lowering blood pressure. Sodium and potassium found in the intracellular and extracellular fluidshelp to maintain electrolyte balance and membrane fluidity [2]. **The Iron** content inboth M. charantia(L) and O. gratissimumwas 4.571 mg/kg and 2.25 mg/kg respectively. The high iron content in M. charantia(L.) could make it preferable for treating iron-deficiency anemia and beneficial for overall health. Iron is an essential trace element for hemoglobin formation, the normal functioning of the central nervous system, and in oxidation of carbohydrates.**Zinc** content inM. charantia(L.) (0.655 mg/kg) was higher in concentration than O. gratissimum (0.445 mg/kg). The presence of Zinc could mean that the leaves can be used in the management of diabetes, which results from insulin malfunctioning. Zinc is essential for the production of insulin, a hormone, and carbonic anhydrase, an enzyme in the body [27]. **Copper (Cu)** ranged between 0.046 mg/kg and 0.063 mg/kg withM. charantia(L.) higher than O. gratissimum(L.). Deficiencies of copper have been reported to cause cardiovascular disorders as well as anemia and disorders of the bone and nervous systems [22]. According to Reddy and Love [30], these essential elements are needed for growth, and production of bones, teeth, hair, blood, nerves, skin, vitamins, enzymes, and hormones.

The vitamin compositions of the ethanolic crude extracts of both leaves were reported in Figure 3.M. charantia(L) (3.84745 mg/kg) has more vitamin A compared to O. gratissimum(L) (2.40755 mg/kg), though these values are relatively low compared to others but could have mild anti-inflammatory properties due to their role in immune function and vision. Both plantleaf

International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 01 Jan. 2025, pp: 404-415 www.ijaem.net ISSN: 2395-5252

samples have a substantial amount of vitamin B, but M. charantia(L.) generally has significantly higher levels, especially in vitamins B2 and B3 indicating stronger antioxidant activity, a potential benefit in blood sugar control, benefit for digestive disorders and energy metabolism which can help in reducing inflammation and improving circulation. M. charantia(L) (352.75 mg/kg) was significantly higher in vitamin C content than O. gratissimum(L) (203.25 mg/kg), which is vital for immune function, skin health and suggests stronger antioxidant and anti-inflammatory potential, while O. gratissimum(L) (197.735 mg/kg) has higher vitamin E content than M. charantia(L) (183.905 mg/kg)which may indicate good antioxidant protection and skin health. However, M. charantia(L) generally shows higher levels of vitamins B2, B3, C, and A compared to O. gratissimum(L.). These vitamins are crucial for various metabolic processes and immune functions, indicating potential broader therapeutic applications for M. charantia(L.).

Theresults of the phytochemical analysis were reported in Figure 4. The results of the amount of the phytochemicals (secondary metabolites) revealed that O. gratissimum(L.) has higher saponins (16.59 mg/kg), glycosides (31.43 mg/kg), and terpenoids (23.75 mg/kg) compared to M. charantia(L.)(16.46 mg/kg, 31.18 mg/kg, and 21.28 mg/kg respectively) while phenolics, steroids, flavonoids, triterpenoids, alkaloids, and tannins are higher in M. charantia(L.) compared to O. gratissimum(L.). Glycosides have a higher concentration in both samples O. gratissimum(L)and M. charantia(L), suggesting they might have a significant impact on both anti-inflammatory and blood sugar regulation.Terpenoids also have a relatively high concentration in both samples, indicating strong therapeutic potential effects. Likewise, saponins were present in significant amounts in both samples, which could contribute to their therapeutic potential.Saponins are known for their immune-boosting and anti-inflammatory properties. O. gratissimum(L.) has higher saponin content, which could be an indication of a better potential for its therapeutic effects.

V. CONCLUSION

The study provides insight into the presenceof useful components in the ethanolic crude extracts of the leaves of M. charantia(L.) and O. gratissimum(L.) as a good source of nutrients and chemical constituents with potential health benefits due to their nutritive constituents as determined by proximate, mineral and vitamin analysis likewise as sources of drugs due to the presence of phytochemicals.

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Volume 7, Issue 01 Jan. 2025, pp: 404-415 www.ijaem.net ISSN: 2395-5252

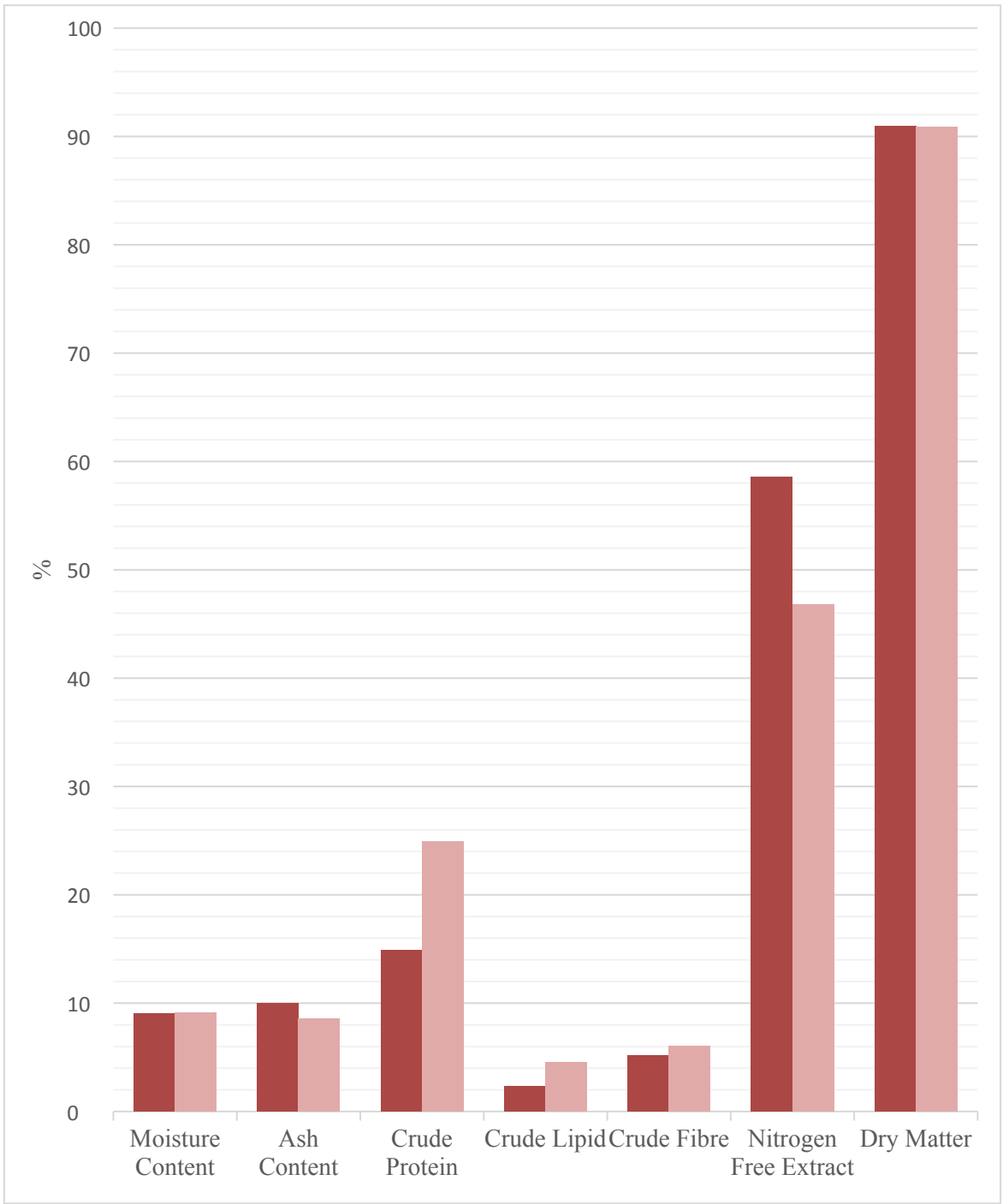

Figure 1: Proximate Composition (Nutritional Value).

Key:

A = O. gratissimum(L.)
B = M. charantia(L.)

International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 01 Jan. 2025, pp: 404-415 www.ijaem.net ISSN: 2395-5252

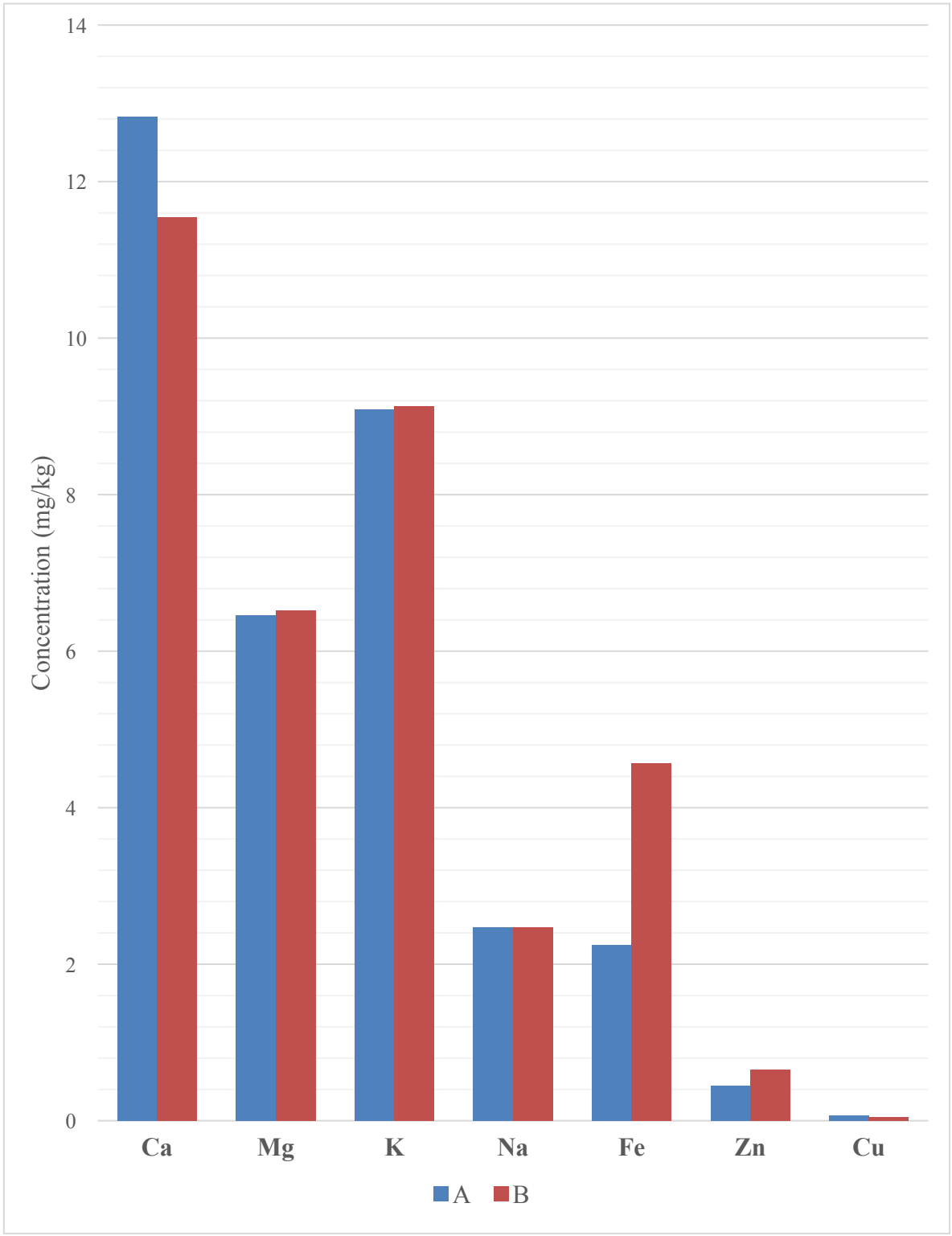

Figure 2: Mineral Estimation of the Ethanolic Crude Extract

Key:
O. gratissimum(L.)
M. charantia(L.)

International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 01 Jan. 2025, pp: 404-415 www.ijaem.net ISSN: 2395-5252

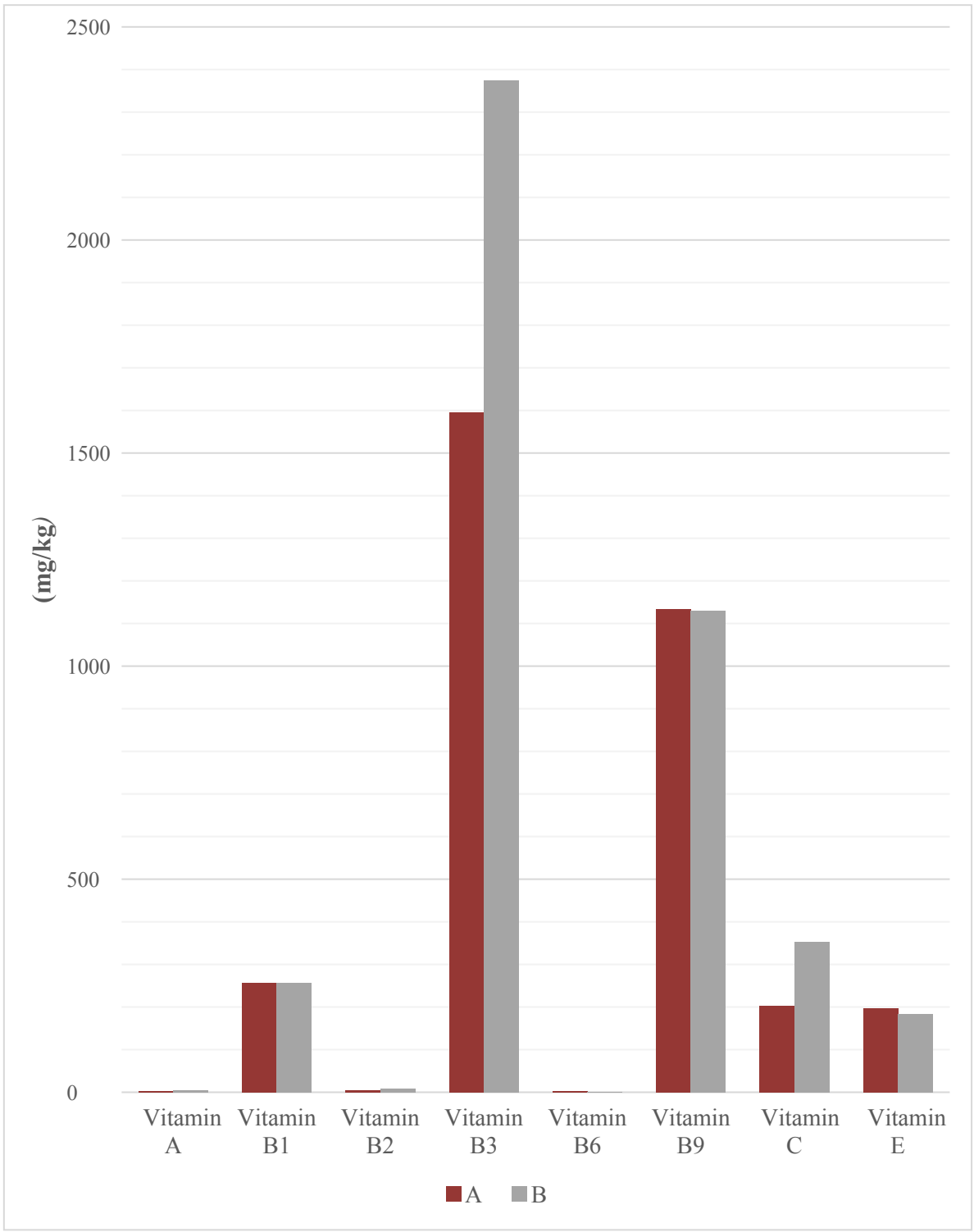

Figure 3: Vitamin Compositionof the Ethanolic Crude Extract
Key:
A= O.gratissimum(L.)
B = M.charantia(L.)

International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 01 Jan. 2025, pp: 404-415 www.ijaem.net ISSN: 2395-5252

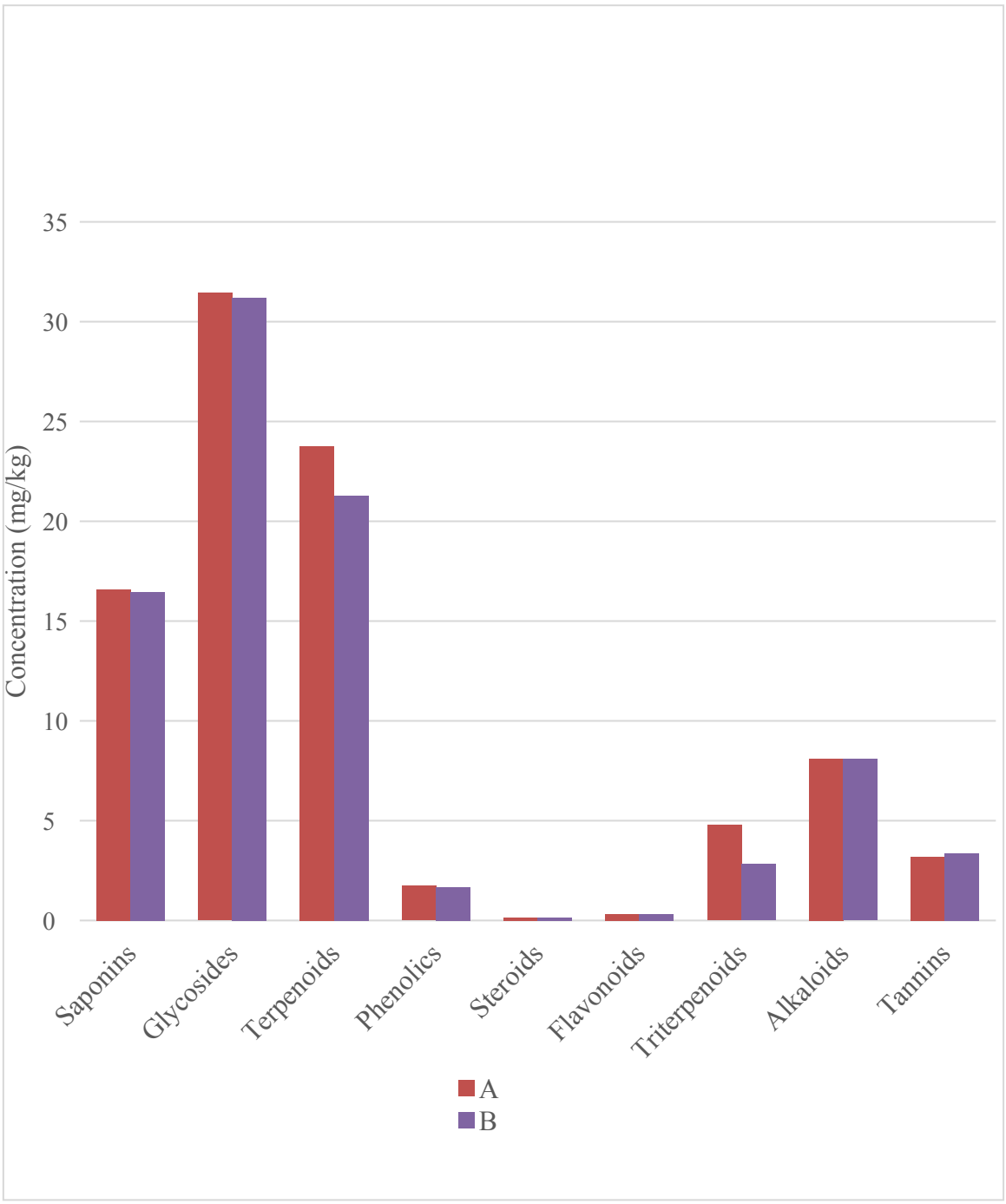

Figure 4: Quantitative Estimation of Secondary Metabolites.

Key:
= O. gratissimum L.
= M.charantia L.

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International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 01 Jan. 2025, pp: 404-415 www.ijaem.net ISSN: 2395-5252

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