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A REVIEW OF THE EFFICIENCY OF *OCIMUM GRATISSIMUM* AS A VEGETABLE CONDIMENT

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ABSTRACT: *People from various socioeconomic backgrounds use and consume a vast variety of condiments on a regular basis. Therefore, condiments could be used as dietary transporters for micronutrients to counteract deficits in micronutrients, which is a problem in many nations, including Nigeria. Vegetables are a vital component of a balanced diet and a good source of minerals, antioxidants, and bioactive compounds, among other nutrients. Ocimum gratissimum, or scent leaf as it is affectionately known in Nigeria, is a common vegetable that is widely cultivated. This article reviewed O. gratissimum as a condiment vegetable, its unique flavor, ability to preserve food, taste, scent, ability to compliment other foods, and therapeutic benefits. The article emphasized the bioactive compounds found in O. gratissimum that have the potential to both prevent disease and maintain good health. It also brought to fore the widely acknowledged fact among researchers that condiment vegetables possess various medicinal properties that are contingent upon specific bioactive compounds. These bioactive compounds are thought to exert an influence on human physiology, hence the inclusion of O. gratissimum in diet is recommended.*

KEYWORDS: Condiments, Micronutrient, Ocimum gratissimum, Vegetable.

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INTRODUCTION

Ocimum gratissimum (*O. gratissimum*) is a herbaceous plant, a member of the Lamiaceae family and is sometimes referred to as smell leaf, vana tulsi, African basil, camphor basil, basil leaf, or ram tulsi (Kalita et al., 2023). This particular species of tropical plant is commonly known as "scent leaf," a term that Nigerians find particularly endearing. It is known as Nchanwu leaf in Igbo, Daidoya in Hausa, and Efirin in Yoruba in native Nigeria (Zaku et al., 2015; Imosesmi, 2020). It is a small to average-sized plant with leaves that is comparable to cloves-like flavor and aroma, making it a significant herb in various cuisines (Puneet & Monika, 2022). In West Africa, the plant is commonly grown for both culinary and medicinal reasons (Kalita et al., 2023), usually in gardens around community huts. *O. gratissimum* is used as a culinary ingredient in salads, soups, pastas, vinegars, and jellies in many parts of the world.

Strong-smelling leaves are widely used throughout the southeast of Nigeria and beyond to add flavor to soups, especially "pepper soup," and other meals (Edo et al., 2023; Sharma et al., 2021; Ojewumi et al., 2021; Adefolalu et al., 2015). Thus, in order to address micronutrient shortages in many nations, particularly in South America and Asia, they could also be used as food (Chavasit & Photi, 2018).

Description of *O. gratissimum*

The plant is a small, upright plum that is covered in many barnacles that are frequently no more than a meter tall. *O. gratissimum* is a fragrant, evergreen plant that grows to a height of 1-3 meters. Its stem is upright, circular-quadrangular, heavily branched, glabrous or pubescent, woody at the base, and frequently has peeling epidermis. It is a *gratissimum* specie and a member of the *Labiatea* family (Table 2) (Imosemi, 2020). The plant's leaves (Figure 1) have flowering tips and are either dark green or yellowish green in color (Srivastava et al., 2018). The leaves of *O. gratissimum* range in size from very small (0.5 cm wide) to extremely large (6.5 cm wide) and are hairy on both sides, elliptic, oblong-obtuse, and minutely gland-dotted (Sarang & Ameeta, 2013; Pingale, 2010).

Chemical Constituents of *O. gratissimum*

Numerous studies have examined O. *gratissimum's* chemical makeup. Compounds such as eugenol, flavone, caryophyllene, oleic acid, phytol, octadecanoic acid, clohexene-1-methanol4-[1-methylethenyl]-acetate, artemisinin, phenol, 3,5-bis [1,1-dimethylethyl]-, and methyl-α-ionone were found to be present when GC-MS analysis was performed (Selvaraju et al., 2021). Along with ocimene, caryophyllene, and germacrene, another investigation determined that eugenol was the primary component of *O. gratissimum* essential oil (Dung et al., 2022). Major chemicals found in *O. gratissimum* include citral, methyl eugenol, camphor, and linalool (Digambar & Tai, 2022). Along with other substances typical of the *Ocimum* genus, it was discovered that the volatile fraction of *O. gratissimum* from Madagascar has a methyl cinnamate chemotype (Laure & Silvain, 2023). *O. gratissimum's* chemical makeup indicates that it may have applications as a condiment because it contains a variety of aromatic and tasty chemicals.

Mineral Constituents of *O. gratissimum*

The location and properties of the soil affect the mineral content of *O. gratissimum* leaves. Important minerals like potassium, calcium, magnesium, iron, manganese, zinc, copper, and

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sodium required by the body are reported to be present in the leaves of *O. gratissimum* (Etukudo & Ukpe, 2021; Adebola, 2017; Priscilla et al., 2016).

Potassium

The potassium content in the leaves is particularly high, making it a good source of this mineral (Ishola et al., 2017). *O. gratissimum* leaves and stems are rich in potassium, providing a good source for hypertensive patients, and are also good sources of Cu, Fe, Mn, and Zn. Potassium is crucial to heart and smooth muscle contraction, making it important for normal digestive and muscular function (Adebola, 2017). The mineral content of *O. gratissimum* leaves was studied and found to have high potassium content of 81.63±0.05mg/100g (Adebola, 2017). Another study also confirmed that the leaves of *O. gratissimum* have a high potassium content, with 1479.88 ± 0.01 mg/100g for the leaves (Idris et al., 2011). These findings suggest that *O. gratissimum* leaves can be a good source of potassium when used as a condiment (Bilanda et al., 2022; Etukudo & Ukpe, 2021).

Calcium

According to Adebola (2017), calcium is a mineral that is required continuously to maintain the blood level of calcium and to grow bone. In separate studies, Adebola (2017) and Kiendrebeogo et al. (2016) reported the concentrations of calcium in *O. gratissimum* leaves as 60.12±0.43 mg/100g and 4523 mg/100g respectively As a result, condiments prepared with *O. gratissimum* leaves are good sources of calcium.

Sodium

When making condiments, sodium is a key component. Because of its capacity to lower water activity values, it functions as an antibacterial and preservative. The primary sodium source in condiments, sodium chloride, also improves flavor through influencing enzyme activity and biochemical pathways. Due to its inexpensive cost and numerous uses, salt is widely employed in the food sector (Dipika et al., 2022). Nonetheless, the detrimental impacts of consuming too much sodium, like elevated risk of cardiovascular disease and hypertension, are becoming more widely recognized (Gregory et al., 2015). Consequently, a tendency has emerged in condiments towards reducing or substituting salt with alternatives such as phosphorus or potassium chloride, and also towards enhancing the physical form of salt (William et al., 2011). This lowers the amount of sodium consumed while still delivering flavor.

Iron

O. gratissimum leaves have a noteworthy iron concentration (mg/100g, 18.03) considering that they are used as a condiment vegetable. According to Ishola et al. (2017), the iron level in *O. gratissimum* leaves varied depending on the sampling location. The iron content of *O. gratissimum* leaves was also verified by Priscilla Alexander's subsequent investigation (Etukudo & Ukpe, 2021). According to the previously cited author, the iron content of the *O. gratissimum* leaf is 0.312 ± 0.067 mg/kg. This implies that *O. gratissimum* leaves contain iron, which is necessary for the organism to produce red blood cells and transfer oxygen. Consequently, when used as a condiment vegetable, the iron concentration of *O. gratissimum* leaves makes them a great addition to boost the nutritional value of foods.

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Zinc

Zinc is a vital micronutrient that is present in food and is necessary for the development of all living things. It is also used in fertilizers and the handling of metals to prevent oxidation, and a deficiency in zinc can result in disease onset, reduced crop yield and restricted plant development (Patil et al., 2023; Saurav, 2023; Saper & Rash, 2009). Zinc can cause hair loss, memory loss, sores on the skin that takes a long time to heal and physical weakness. Zinc is also essential for strengthening the human immune system (Ozturk et al., 2023; Al-Khafaji et al., 2022). In vegetable condiments, zinc serves a number of purposes. In order to minimize caking and offer a nutritional zinc supplement for human consumption, it is applied as a coating to condiments, such as sodium chloride (Ahmad et al., 2017). About 8% of plant proteins have a zinc-binding activity, demonstrating the importance of zinc for a variety of biochemical processes in plants (Stanton et al., 2022). It is necessary for all cellular compartments and contributes to the control and activity of enzymes (Gao & Song, 2017). Zinc can lower superoxide dismutase activity while increasing the activities of antioxidant enzymes in plants, such as catalase and peroxidase (Ozturk et al., 2023). Furthermore, zinc helps lessen cadmium buildup in fruits and plants, which is crucial for food safety (Wang et al., 2013).

Zinc extracted from *O. gratissimum* is very important because of its many uses and characteristics. Studies reveal that leaf extracts from *O. gratissimum* have been employed in the production of Zinc Oxide (ZnO) nanoparticles, which exhibit antibacterial properties against *Staphylococcus aureus* and *Escherichia coli* (Saka et al., 2022; Rebecca et al., 2020). Furthermore, it has been discovered that the plant extract effectively inhibits the corrosion of zinc-aluminum alloy, indicating the possibility of its use as a non-toxic corrosion inhibitor (Mamta et al., 2019). Moreover, Ayurvedic literature on *O. gratissimum* states that it contains trace levels of zinc in addition to other vital elements like iron, copper, and manganese, all of which may contribute to its medicinal qualities (Jaya, 2008). These results demonstrate the value of zinc obtained from *O. gratissimum* in a variety of industries, including nanotechnology and medical applications. In general, zinc is essential for the development of vegetable condiments by supplying nutritional support, controlling the action of enzymes, and lowering the buildup of toxic compounds.

Medicinal Value of *O. gratissimum*

Plant compounds have been reported to be abundant in the leaves (Ishola et al., 2017). The therapeutic property and health benefits of *O. gratissimum* have been reported (Ishola et al., 2017). It is a well-known herb that is utilized in the Indian medical system and has been used traditionally for the treatment of different health conditions, including headache, fever, diarrhea, and pneumonia (Jahanger et al., 2022). The leaves are also used to treat bronchitis, diarrhea, conjunctivitis, and skin infections. Their antibacterial, anti-inflammatory, antioxidant and neuroprotective properties has been documented (Jahanger et al., 2022; Arun et al., 2022; Selvaraju et al., 2021; Confidence et al., 2020; Ma, 2016; Kirti et al., 2009).

Many bioactive substances found in the plant, including phenolic acids, flavonoids, terpenes, and essential oils, are utilized as food additives, medications, insecticides, and fragrances (Julissa, 2022). These compounds also contribute to the plant's medicinal qualities (Bilander et al., 2022). Significant antibacterial action against both Gram-positive and Gram-negative bacteria has been demonstrated by extracts from *O. gratissimum* (Gbemisola et al., 2022). The plant also possesses a wide range of medicinal applications; it may be used to treat diabetes

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due to its antidiabetic activity, as well as its chemopreventive, anticarcinogenic, free radical scavenging, and radio defensive qualities (Ma, 2016).

Moreover, research has indicated that the plant may have neuroprotective properties since it shields the brain from ischemic stroke-induced brain damage and prevents hepatic fibrosis while shielding the liver from oxidative stress (Chaudhary et al., 2018). Going forward, the extraction and use of secondary metabolites from *O. gratissimum* have been investigated using biotechnology methods including plant cell culture (Yung et al., 2014). Overall, *O. gratissimum* is a promising plant for additional study and the creation of innovative medications due to its wide spectrum of medicinal, ethnobotanical, pharmacological, biological, and therapeutic potential.

Vegetable Condiment

O. gratissimum is a condiment vegetable that can be used in cuisine as a sauce or spice to improve its flavor (Julissa, 2022). *O. gratissimum's* chemical makeup satisfies daily nutritional needs, and its sufficient mineral content balances out the human diet (Ransit et al., 2019). *O. gratissimum* leaves are a common condiment in the area and a good source of essential elements like calcium, magnesium, and potassium (Adebola, 2017). *O. gratissimum* has also been added to traditional dishes as a condiment. *O. gratissimum* extracts have potential uses in food, pharmaceutical, and medical sectors when extracted properly.

O. gratissimum is a condiment with flavor-enhancing qualities, therapeutic value, and a chemical makeup that fulfills daily nutritional needs. It is frequently used as a spice and in food seasoning, and it has been categorized as a condiment vegetable (Confidence et al., 2020). *O. gratissimum* leaves can be used to improve the flavor of food because of their clove-like flavor (Ishola et al., 2017). The plant also has bioactive components that are used in medicines, food additives, and colorants (Chaudhary et al., 2018). Eugenol, limonene, ocimene, and rosmarinic acid are among the phytochemicals that make up *O. gratissimum*, and they all add to the plant's flavor (Akeem et al., 2013).

Given that the leaves contain these minerals, *O. gratissimum* may be used as a condiment vegetable to add flavor and essential nutrients to food (Guessan et al., 2016). Furthermore, it has been discovered that *O. gratissimum* leaves contain bioactive secondary metabolites that may be used therapeutically, such as in the management of diabetes. Thus, adding *O. gratissimum* leaves to food can enhance its flavor and help ensure that it is a diet high in nutrients. Additionally, the plant's antibacterial, anti-inflammatory, and antioxidant qualities lend credence to its usage as a condiment.

Bioactive compounds in *O. gratissimum* and their uses

Perarah et al. (2019) have isolated bioactive chemicals from *O. gratissimum* that may find use in the manufacture of condiments. It has been reported that *O. gratissimum* contains chemicals which include eugenol, limonene, ocimene, and rosmarinic acid (Salvaraju et al., 2021). *O. gratissimum's* herb and spice flavors are a result of these chemicals, which also confer culinary and condiment uses (Jodi et al., 2019). According to Confidence and Doga (2020), *O. gratissimum* plant extracts have also been shown to exhibit antibacterial activity against Salmonella species. According to Chaudhary et al. (2018), the extracts also show anticarcinogenic, chemopreventive, and free radical scavenging properties, which lends

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credence to their prospective application in the making of condiments. Thus, the bioactive chemicals found in *O. gratissimum* can be used in condiment recipes to improve flavor and offer health benefits.

Furthermore, *O. gratissimum* possesses useful qualities that make it an excellent vegetable condiment. Phytochemicals found in the plant include volatile oils, flavonoids, alkaloids, and saponins (Chaudhary et al., 2018; Ishola et al., 2017). When added to food as a condiment, these phytochemicals enhance the flavor and aroma of the food (Justina and Solomon, 2018). With crude protein levels of 15.075 %, *O. gratissimum* likewise has a high protein content (Ransit et al., 2019). Because it gives the body the necessary amino acids, it becomes a nutrient-dense complement to meals (Jodi et al., 2019). Furthermore, the plant has a high fiber content (17.365% crude fiber). This can support a healthy digestive system and help with digestion. The phytochemicals, protein, and fiber combination of *O. gratissimum* makes it a useful and adaptable vegetable condiment.

Different portions of *O. gratissimum* are utilized to treat different diseases, such as fever, asthma, headaches, and other conditions (Edo et al., 2023; Taur & Patil, 2011). Numerous nutrients and minerals found in the leaf give the plant numerous health advantages (Nakamura et al., 1999). According to reports of Ojewumi et al. (2021) and Awah et al. (2010), fresh *O. gratissimum* leaves contain protein, magnesium, anatol, boron compounds, eugenol, tryptophan, stigmasterol, zinc, tannin, and cinnamic acid. It is widely used as a condiment vegetable and has been found to have medicinal value, phytochemicals, minerals, and functional properties that meet daily nutrient requirements and complement the human diet (Ishola et al., 2017; Odebisi-Omokanye et al., 2017).

Importance of Vegetable Condiments

The unique flavor and distinct perfume of condiment plants, which add flavor and nutrients to food, make them a common and widely accepted part of daily life. They are more significant in food since they contain functional properties in addition to organoleptic ones (Izidoro et al., 2021). Vegetable condiments complement meals and intensify their flavor, making eating them more pleasurable (Ishola et al., 2017).

Vegetable condiments can be used to make a variety of dishes. For example, soy sauce can be used as a flavoring bag for packaged goods and prepared dishes, or it can be used for rapid cooking in catering businesses (An, 2016). Certain condiments made from vegetables have particular effects on the body; for example, they can warm the stomach and spleen and protect against colds (Qian, 2017). Plus, umami-rich soups and dishes can be made with vegetable condiments (Izidoro et al., 2021). Vegetable condiments are generally useful additives that enhance a range of meals with taste, nutrition, and health advantages.

Processing of *O. gratissimum* into Condiment

There is a special way to make *O. gratissimum* into a vegetable condiment. The leaves are destalked, separated, cleaned, allowed to air dry, and ground into a powder. Important food minerals including potassium, calcium, and magnesium can be added to diets by using the resulting powder as a condiment (Ibeh et al., 2017).

Alternatively, a way to turn vegetables into condiments is provided by the development of a fermented condiment vegetable liquid and powder. Activating yeast, adding it to condiment

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vegetables, controlling sugar levels, and fermenting for a few weeks are the steps involved in this process to produce the fermented condiment vegetable liquid (Mauricion, 2023). The final fermented condiment vegetable liquid is obtained by sterilizing the liquid, inoculating it with lactobacillus and acetic acid bacteria, and then fermenting it once more (Qian, 2017). To create the fermented condiment vegetable powder, the fiber residues and fermented condiment vegetable liquid are spray-dried (Liu et al., 2018). To improve flavor and aroma, this technique uses a mixed fermentation strategy with brewer's yeast and non-brewer's yeast (Huang et al., 2018). Rich vegetable flavor and natural, nutritious, and healthful qualities characterize the resultant condiment (Li & Zeng, 2017). It works well in a variety of soups and meals.

CONCLUSION

O. gratissimum has a wide range of applications in various fields such as food, ethnomedicine and pharmaceuticals, making it an attractive plant for additional research and the development of novel industrial applications. It is a useful condiment in the food, pharmaceutical, and medical industries due to its flavor-enhancing properties and medicinal benefits. *Oryza gratissimum* can be considered as a multipurpose herb that enhances food flavor while also offering health and nutritional advantages. As a good source of nutrients and phytochemicals, *O. gratissimum* can be recommended for inclusion in diet and pharmaceuticals for the improvement of human health.

Figure

Figure 1: Leaves of *O. gratissimum*

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TABLES

Table 1: Common Names of *O. gratissimum* across the globe (Julissa, Rojas-Sandoval.2022)

Countries	Local Name
Brazil	alfavaca brava
Dominican Republic	albahaca vacaatiyayo
Cambodia	ling leak kranam
India	Ajeka, doshakleshi, elumichai tulasi, elumichanthulasi, kattuthrithavu, mali-thulasi, perumthulasi, ram tulsi
Cuba	albahaca de clavo, canela, clavo, clavo mondonguero, laurel, cimarron, orégano cimarron
Jamaica	African tea bush
Netherlands	Antilles: anis; yerba di hole blanku
Lesser Antilles	Basilic, frond bazin, mint
Malaysia	ruku-ruku, hitam; selaseh besar
Haiti	basilic à petites fleurs, basilic grandes feuilles, folle basin, fombasin, gran basilique, grand basilique, grand fombasin
Panama	origanum de castilla
Indonesia	kemangi hutan ruku-ruku rimbaselaseh mekah
Vietnam	é lá lớnhương nhu trắng
Thailand	horapha-chang kaphrao-chang yira

Table 2: Taxonomy classification of *O. gratissimum* (Julissa, Rojas-Sandoval.2022)

DOMAIN	**EUKARYOTA**
KINGDOM	Plantae
SUBKINGDOM:	Tracheobionta
SUPER DIVISION:	Spermatophyta
DIVISION:	Magnoliophyta
CLASS:	Magnoliopsida
SUBCLASS:	Asteridae
ORDER:	Lamiales
FAMILY:	Lamiaceae
GENUS:	Ocimum L
SPECIES:	Gratissimum

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