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Differentiation between two Spices: *Zingiber officinale* (Ginger) and *Curcuma longa* (Tumeric); their Proximate, Mineral and Vitamin Contents.

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Abstract:
This present study was conducted to assess the difference between two spices;Zingiber officinale (Ginger) and Curcuma longa (Turmeric) using their Proximate, Mineral and Vitamin analysis. The proximate analysis was conducted using AOAC standard and the result revealed that Ginger is higher in Carbohydrate (50.87%), Protein (11.37%), Fibre (8.75%) as against Turmeric, with Carbohydrate (37.33%), Protein (8.72%), Fibre (5.00%). Hence indicating that ginger is a good source of carbohydrate, protein, and fibre. Also, turmeric is higher in moisture content (36.33%), fat (7.11%) and ash (5.510%) as against ginger with moisture content (19.62%), fat (5.89%) and ash (3.504%), thus indicating that turmeric will take a longer time to be dried than ginger if both are subjected to the same temperature condition and will be difficult to be preserved fresh because of its high moisture content, which will lead to its deteriorationby the microbial attack. The mineral analysis showed that ginger is higher in potassium content (62.48%), followed by sodium (25.15%) as against turmeric with potassium content (40.44%) and sodium (12.99%). This implies that constant consumption of ginger, which is rich in potassium, will help in reducing blood pressure and will also play a role in controlling skeletal muscle contraction and nerve impulse transmission. Furthermore, the result showed that turmeric is higher in calcium content (38.73%), followed by magnesium (4.90%), and phosphorous (2.94%) against ginger with calcium content (8.51%), magnesium (2.87%) and phosphorous (0.99%). Hence, turmeric can be used as a good source of calcium, which is a major factor for sustaining strong bones and plays a dominant role in muscle contraction and relaxation, blood clotting cascade reaction and absorption of vitamin B_{12}. Finally from the Vitamin analysis, ginger is higher in Vitamin A (4.814), Niacin (2.179), Riboflavin (0.250) and Thiamin (0.121) as compared to turmeric with vitamin A (2.484), Niacin (1.702), Riboflavin (0.114), and Thiamin (0.006). Also,vitamin C is higher in ginger than in turmeric. Hence the presence of these vitamins which are more in turmeric implies that constant feeding on turmeric could be important in sustaining strong bone, muscle contraction and relaxation, blood clotting, reduce blood pressure, and help in hemoglobin formation. Hence the result suggests that Ginger has high food value content and is also rich in vitamin while turmeric is rich in mineral composition.

Keywords: Proximate analysis, Mineral composition, Vitamin analysis

Introduction:

Spices are aromatic substances of vegetable origin used as preservative and food flavors. They are obtained from the various plant material and sometimes chemically synthesized in the laboratory. Spices are used in food preparation, beverages, cosmetics, and confectionaries. In the case of ginger and turmeric, their rhizome is the economic part [1,2,3]. These spices have originated in the tropics and subtropics and have been used for their aroma, flavor, and colour. The essential oil and oleoresin that impart their quality are well documented [4] and their ingredients are often extracted and exported.

Turmeric (*Curcuma aromatics*) belonging to the family *Zingiberaceae* is a medicinal and aromatic plant with multiples uses. Turmeric is known as the 'golden spices' as well as the 'spices of life'. It has been used as a medicinal plant and held sacred from time immemorial [5]. Turmeric has strong associations with the socio cultural life of the people of Indian subcontinent. This earthy herb of the sun with the orange yellow rhizome was regarded as the 'herb of the sun' by some people of the Vedic period. No wonder, the ancient regarded turmeric as the oushadhi, the healing herb, the most outstanding herb, the one herb above all others [6]. Turmeric has at least 6000 years of documented history of its use as medicine and in many socio religious practices. Turmeric is probably a native of south East Asia where many related spices of curcuma occur wildly, though turmeric itself is not known to occur wildly. Turmeric is cultivated most extensively in Indian, followed by Bangladesh, China, Thailand, Cambodia, Malaysia, Indonesia, and Philippines. On a small scale, it is grown in most tropical regions in African, America and Pacific Ocean Island [7]. Indian is the largest producer, consumer and exporter of turmeric. Several commercially produced cosmetics contain turmeric. Skin care is the major domain of application of this aromatic plant. The rhizome of turmeric is used in medicine and recently as a health food in Japan [8]. The wild turmeric is called Curcuma aromatica and its domestic species is called Curcuma longer. Due to lack of a compressive taxonomic review, there is little consensus on the number of species that should be recognized. Recent species may vary from 80-503 [9]. Their number will probably increase in the near future due to ongoing detailed botanical exploration of India and south Asia [10]. Ginger is a well-known spice and flavoring agent which has been used in traditional medicine in many countries. This large seasonal plant is cultivated in South East Asia and China, India and some part of African. Ginger is a source of valuable phytonutrients, characterized as having aromatic odor and a pungent smell. The part of ginger used is its root which is botanically the rhizome. The flat surface of the rhizome is removed leaving the remains of the underground stem. Ginger is a special monocotyledon and herbaceous perennial species belonging to the order Scitamineae and family Zingiberaceae as turmeric. It is the oldest rhizome widely domesticated as a spice. The cultivation of ginger commenced in Nigeria in 1927 and the location includes southern Zaria, Jemma federated districts and neighboring parts of Plateau but today ginger is cultivated nationwide [11]. National Crop Research Institute [12] confirmed that ginger grows well in the rainforest region of the country where rainfall is above 2000mm and altitude ranging from 0-800 metres above sea level within the temperature range of 25^0C – 35^0C. Nigeria's production in 2004 was 117000 tones [13], 10% which is locally consumed as fresh ginger and 90% dried primarily for export markets. Ginger is popular for its distinct sharp and hot flavor due to an oily substance called gingerol. Due to its properties, it is used as primary health care aid among 80% of the world's population in the form of plant extracts of their active components [14]. [4]

reported that the processing of ginger in Nigeria has not been standardized consequently upon, low-quality ginger which falls short of importer's specifications are produced.

Material and Methods:

Collection and Preparation of Samples:

Fresh and healthy ginger (*Zingiber officinale*) and turmeric (*Curcuma longa*)weighing 50g were bought from the Ekeonuwa market in Owerri, Imo state. Their barks were washed gently in a tap running water and scrapped gently with a clean kitchen knife and later air-dried for three days. They were crushed by pounding to powder using mortar and pestle and finally sent to the laboratory for analysis.

Proximate Analysis of Ginger and Turmeric Sample:

Moisture content were determined at 105^0C. Ash content was determined at 550^0C. Crude protein, lipid, and fibre were carried out essentially according to the standard AOAC methods (AOAC, 1990).

Determination of Moisture Content:

Moisture content was determined by the oven drying method. 2g of the well-mixed sample was accurately weighed in cleaned, dried crucible and recorded as W_1. The crucible was placed in an oven at 105^0C for 2hours until a constant weight was obtained and then placedagain in a desiccator for 30min to cool. After cooling it was weighed again and recorded as W_2. The percent moisture was calculated using the formula below:

$$\% \text{ Moisture content} = \frac{W1-W2}{Wt.\ of\ Sample} \times 100$$

Where;

W_1 = Initial weight of crucible + Sample

W_2 = Final weight of crucible + Sample

W = Mass of container

Determination of Ash Content:

For the determination of ash, a clean empty crucible was placed in a muffle furnace at 600^0C for an hour and cooled in a desiccator and then the weight of empty crucible was noted as W_1. 2g each of the samples wasadded to the crucible and its new weight was recorded as W_2. The sample was ignited over a burner with the help of blowpipe, until it is charred. Then the crucible was placed in a muffle furnace at 575^0C for 2-4 h. and the appearances of gray-white ash indicates complete oxidation of all organic matter present in the sample. After ashing, the furnace was switched off and the crucible was cooled and weighed and recorded as W_3. Percentage of ash content was calculated by the formula stated below:

$$\% \text{ Ash Content} = \frac{W3-W2}{W2-W1} \times 100$$

Where;

W_1 = weight of crucible

W_2 = weight of crucible + sample before ignition

W_3 = weight of crucible + sample after ignition

$W_2 – W_1$ = Weight of sample taken for ignition

Determination of crude fibre:
In determining the crude fibre of the samples, 2g each of the samples was weighed and placed separately in a hot 200ml of 1.25% H_2SO_4 and boiled for 30mins and then filtered through a bunker funnel equipped with a muslin cloth and held firm with an elastic band. The residue was washed with boiling water to remove acid from it. It was then returned to 200ml of 1.25% NaOH and boiled for 30mins. It was filtered and progressively washed with boiling water and 1% HCL to remove acid from it. The residue was washed twice with alcohol and three times with petroleum ether using small quantities. It was then drained and completely transferred to a porcelain crucible and dried in an oven to a constant mass and incinerated at 600^0C for 2hours in a muffle furnace. The crucible and the content were weighed after cooling in the desiccator. The loss of incineration is the mass of crude fiber. Percentage of crude fiber wascalculated by using the formula below:

$$\% \text{ crude fibre} = \frac{M3-M4}{M2-M1} \times 100$$

Where
M_1 = Mass of crucible
M_2 = Mass of sample + crucible
M_3 = Mass of crucible + residue after drying
M_4 = Mass of crucible + ash after incineration

Determination of Crude Fat (Ether Extract):
In determination of crude fat, 2g each of the samples was weighed into a filter paper and carefully wrapped and tied with thread. The filter paper and contents were placed in the Soxhlet extractor column and extracted for about 6 hours. When the solvent was clear in the column, the fat must have been extracted. The defatted sample was carefully removed and the solvent was removed. The flask and oil were oven-dried until all the solvent is gone. The flask and its content were reweighed. The percentage of crude fat is calculated using the formula below;

$$\% \text{ crude fat} = \frac{M2-M1}{M3} \times 100$$

Where
M_1 = Mass of the flask
M_2 = Mass of flask + fat
M_3 = Mass of sample

Determination of Crude Protein:
Crude protein was determined by Kjeldahl Method. 2g each of the sample was weighed and put in a crucible flask. 20mls of HCl and two tablets of Kjedahl catalyst were added to increase the heat of the reaction. It was heated with heating mantle in a fume cupboard till it becomes clear, then allowed to cool for five minutes and a little amount of distilled water was added. Heat again for 5mins, bring down and allow to cool. Using a filter paper, it was filtered into a 100ml volumetric flask and made up to 100mls using distilled water. 10mls of boric acid were measured into another 100mls volumetric flask and 2 drops of mixed indicator made up of methyl red and bromocrysol were added. 10mls of the sample was poured into a round-bottomed flask and placed on a heating mantle and connected to Markham distillation apparatus with the flask containing the boric acid and indicator at the other end of the Markham distillation apparatus. The samples were allowed to reach 25mls then the Markham distillation apparatus was turned

off. Using 0.1m HCl titrate the sample + boric acid + indicator mixtures until it returns to its original colour which is pinkish-red then stop.

$$\% \text{ protein} = \frac{TV \times Nacid \times 0.014 \times V1 \times}{C1 \times V2} \times 100$$

Where
TV = Titre value of acid – titre vale of blank
Nacid = Normality of acid
V1 = Volume of aliquot
V2 = Volume of aliquot taken
C_1 = Initial weight of sample used

Mineral Analysis:
Determination of potassium and sodium using flame photometry:
A crucible was washed and dried in an oven at 105^0C for 30mins. It was cooled in the desiccator. 2g each of the sample was weighed into the crucible and then placed in the heart of the furnace and incinerated for 6-8hours at 575^0C. 5ml of $NHNO_3$ was added and evaporated to dryness using a hot plate. The crucible and content were returned to the furnace and incinerated for 10-15 minutes. 10ml of NHCl was added and filtered into a 50ml volumetric flask with filter paper and funnel. The residue was rinsed on the filter paper with 0.1M HCl and made up to mark with 0.1M HCl.

Determination of phosphorous by Spectrophotometry:
This has the same procedures as that of sodium and potassium. A standard solution of 0.4397g of KH_2PO_4 and dissolved in $1dm^3$volumetric flask with distilled water.

Determination of calcium by complexiometric method using EDTA (Ethylenediaminetetraacetic acid):
This was done by preparing a reference point of 5ml of NaOH with 5 drops of calcium and diluted to 100ml with water. Then titrate the resultant with EDTA solution. 5ml aliquot of the sample waspipetted into a clean conical flask, 100ml of water was added, 5ml of NaOH, 5 drops of indicator (Eriochrome Black T), and 15ml of buffer solution. Finally, titrate with EDTA solution to obtain the endpoint which was indicated by the matching of the colour of the solution to the reference point.

Determination of calcium + magnesium by EDTA:
5ml each of the sample solutions were pipetted into a conical flask and diluted to 100ml with water, 15ml of buffer solution, 10 drops of indicator (Eriochrome Black T), and 2ml of triethanolamine were added. It was then titrated with EDTA solution from red to a clear blue solution.

Vitamin Analysis:
Vitamin A Determination:
Vitamin A was determined by the method of the Association of vitamin chemicals (Kirk and Sawyer, 1998). 5g of each the sample was dispersed in 30ml of absolute ethanol, 3ml of 50% potassium hydroxide was added to it and boiled under reflux for 30min, after cooling rapidly in running water, 30ml of distilled water were added to it and the mixture was added transferred to

a separation funnel. Three portion 50mls of ether was used to wash the mixture, thus extracting vitamin A. the lower layer (i.e. the aqueous layer was discarded while the vitamin A was washed with 50ml of distilled water, taking care to avoid formation of emulsion). The vitamin A extract was evaporated to dryness and then dissolved in 10mls isopropyl alcohol. Meanwhile, a standard vitamin A was prepared and filtered to the desired concentration using isopropyl alcohol. The absorbance of both the extract and the standard was measured in a spectrophotometer at 325nm, the vitamin A content was calculated by the formula below;

$$\text{Vitamin A (mg/100g)} = \frac{100}{W} \times \frac{au}{as} \times \text{C}$$

Where
au = absorbance of sample extract
as = absorbance of standard vitamin A
C = concentration of standard vitamin A solution
w = weight of sample

Determination of Thiamin (Vitamin B_1):
5g each of the sample was homogenized in 50ml of 114 ethanoic sodium hydroxide solution. The homogenate was filtered through Whatman No. 42 filter paper into a 100ml volumetric flask. The filtrate was washed with more ethanoicNaOH until 100ml filtrate was obtained. 10ml of the filtrate dispersed into a conical flask. Meanwhile, standard thiamin was prepared and diluted to the desired concentration. 10ml of a standard and equal volume of distilled water was dispersed into separate flasks (as the standard and blank respectively). The content of each flask was treated with 10ml of potassium dichromate solution. The absorbance of each was measured in a spectrophotometer at a wavelength of 360nm with the blank at zero. Thus thiamin content were calculated using the formula below;

$$\text{Thiamin (mg/100g)} = \frac{100}{W} \times \frac{au}{as} \times \text{C}$$

Where
au = absorbance of sample extract
as = absorbance of standard thiamin
C = concentration of standard thiamin solution
w = weight of sample

Determination of Riboflavin (Viatmin B_2):
5g each of the sample was mixed 100ml of 55% ethanol solution and shaken for 1hour. The mixtures were filtered through filter paper and the filtrates obtained was used for the analysis. 10ml portion of extracts was mixed with an equal volume of 5% $KMnO_4$ solution in a 50ml volume flask and 10ml of 30% H_2O_2 was added to it. The mixtures was allowed to stand over a water bath (100^0C) for 30min, 2ml of 40% Na_2SO_4 solution was added. Meanwhile the standard was prepared and diluted to the desired concentration. 10ml of the solution was mixed with 10ml of 5% $KMnO_4$ and 10ml 30% H_2O_2 and heated over a water bath for 30min. then 2mls of 40% Na_2SO_4 was added to it. The same was done for the blank. Theabsorbance of both the standard and the test samples was read in the spectrophotometer at a wavelength of 510nm with the reagent blank at zero. The content of riboflavin was calculated thus;

$$\text{Riboflavin (mg/100g)} = \frac{100}{W} \times \frac{au}{as} \times C$$

Where
au = absorbance of sample extract
as = absorbance of standard riboflavin
C = concentration of standard riboflavin solution
w = weight of sample

Determination of Niacin (Nicotinic acid) Vitamin B_3:
2.5g each of the samples was mixed with 50mls of H_2SO_4 solution and shaken for 30mins at room temperature. 3 drops of concentrated NH_3 was added to it, shaken and filtered. The filtrates were ready for the spectrophometric assay. Standard Nicotinic acid was prepared and diluted to the desired concentration. 10mls of standard and 10mls of distilled water was dispersed into separate flasks to serve as the standard and blank respectively. Then 5mls of 0.1n potassium solution was added to each of the flask followed by 5mls of 0.02n and allowed to stand for 10mins at room temperature before the absorbance was measured in a spectrophotometer at a wavelength of 4.0nm. the reagent blank was usedto calibrate the instrument and Niacin content was calculated using the formula below;

$$\text{Niacin (mg/100g)} = \frac{100}{W} \times \frac{au}{as} \times C \times D$$

Where
au = absorbance of sample extract
as = absorbance of standard Niacin
C = concentration of standard Niacin solution
w = weight of sample
D = Dilution factor where applicable.

Determination of Vitamin C (Ascorbic acid) by Virtual titration method:
2g each of the sample was weighed and 2mls of 1% oxalic acid was added from 20% stock solution and titrated with the dye solution to a faint pink colour that persists for 15seconds. The content of ascorbic acid is gotten by the formula below;

$$\text{Ascorbic acid (mg/100g)} = \frac{2}{T1} \times \frac{T}{1} \times \frac{100}{W}$$

Where
T = Titre value of the sample
T_1 = Titre value for standard ascorbic acid
W = mass of sample used

Results:

Table 1: Proximate Content of Ginger and Turmeric

PROXIMATE COMPOSITIONS (%)	GINGER	TURMERIC
Moisture content	19.62	36.33
Ash content	3.50	5.51
Fat content	5.89	7.11
Protein content	11.37	8.72
Fibre content	8.75	5.00
Carbohydrates	50.87	37.33

Table 1 above showed that carbohydrate content, protein content and fibre content were higher in ginger than turmeric, while moisture content, fat content, and ash content are more in turmeric than ginger.

Table 2: Mineral Content of Ginger and Turmeric

MINERAL COMPOSITIONS	GINGER (%)	TURMERIC (%)
Calcium	0.086 (8.51)	0.316 (38.73)
Phosphorous	0.010 (0.99)	0.024 (2.94)
Magnesium	0.029 (2.87)	0.040 (4.90)
Potassium	0.631 (62.48)	0.330 (40.44)
Sodium	0.254 (25.15)	0.106 (12.99)
TOTAL	**1.01 (100)**	**0.816 (100)**

From table 2 above, ginger is higher in potassium and sodium than turmeric but turmeric is also contain more calcilum, magnesium, and phosphorous than ginger.

Table 3: Vitamin Content of ginger and turmeric

VITAMIN COMPOSITIONS (mg/100g)	GINGER	TURMERIC
Niacin	1.702	2.179
Vitamin A	2.484	4.814
Riboflavin	0.114	0.250
Thiamin	0.006	0.121
Vitamin C	8.20	2.31

Table 3 above also revealed that ginger is richer in Vitamin C, while turmeric is richer in Niacin, Vitamin A, Riboflavin, and Thiamine.

Discussion:

The result of this present study showed that from the proximate analysis of Ginger (*Zingiber officinale*) and Turmeric (*Curcuma longa*) as shown in table 1, ginger is higher in Carbohydrate (50.87%), Protein (11.37%), Fibre (8.75%) as against Turmeric, with Carbohydrate (37.33%), Protein (8.72%), Fibre (5.00%). Hence indicating that ginger is a good source of carbohydrate, protein and fibre. This result does not compare favorably with the work of Taoheed, *et al*., (2017) on Phytochemical Properties, Proximate and Mineral Composition of *Curcuma longa* Linn. And *Zingiber officinale* Rosc.: A Comparative Studyas there was no significance difference in their carbohydrate, protein and fiber content. Also, the result revealed that turmeric is higher in moisture content (36.33%), fat (7.11%) and ash (5.510%) as against ginger with moisture content (19.62%), fat (5.89%) and ash (3.504%), thus indicating that turmeric will take a longer time to be dried than ginger if both are subjected to the same temperature condition and it will be difficult to preserve it when fresh because it will easily be attacked by microbes like fungi and bacteria. This result compared well with the work of [4,7] on Determination of Proximate and Minerals Content of Turmeric (*Curcuma longa* Linn) Leaves and Rhizomes.

Mineral composition analysis (table 2) showed that ginger is higher in potassium content (62.48%), followed by sodium (25.15%) as against turmeric with potassium content (40.44%) and sodium (12.99%). Thus the result of this present findings indicatedthat ginger is rich in potassium, which is in agreement with the work of [9] on Comparative analysis of the chemical composition of three spices *Allium sativum* L. *Zingiber officinale* Rosc. and *Capsicum frutescens* L. commonly consumed in Nigeria, which shows that ginger is rich in sodium content and not potassium.Furthermore, the result showed that turmeric is higher in calcium content (38.73%), followed by magnesium (4.90%), and phosphorous (2.94%) as against ginger with calcium content (8.51%), magnesium (2.87%) and phosphorous (0.99%). Hence, suggesting that turmeric can be used as a good source of calcium, since calcium is known for sustaining strongbones and also plays a dominant role in muscle contraction and relaxation, blood clotting cascade reaction and absorption of vitamin B12. This result is contrary to the work of [2] as there was no significance in all the mineral content assayed.

Vitamin analysis as shown in table 3, revealed that ginger is higher in Vitamin A (4.814), Niacin (2.179), Riboflavin (0.250) and Thiamin (0.121) as compared to turmeric with vitamin A (2.484), Niacin (1.702), Riboflavin (0.114), and Thiamin (0.006). Also Vitamin C is higher in ginger than in turmeric. Hence the presence of these vitamins which are more in turmeric

suggests that constant feeding on turmeric could be of great important in sustaining strong bone, muscle contraction and relaxation, blood clothing, reduce blood pressure, and also help in haemoglobin formation. Thus, the result of this present finding on vitamin compared well with the work of [6] on Nutritional and Biochemical Compositions of Turmeric (*Curcuma longa* Linn) Rhizomepowder – A Promising Animal feed additive.

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