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# EXPLORING THE NUTRITIONAL AND ANTIOXIDANT POTENTIALS OF CINNAMON AND TURMERIC

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## Abstract
The aim of the current study was to examine the physicochemical, nutritional, and antioxidant characteristics of Cinnamon and Turmeric Powders. The spices were thoroughly examined using a multidisciplinary approach that involved analytical chemistry, nutritional analysis, and antioxidant assessments. The nutritional analysis consisted of determining the proximate composition, mineral content, and antioxidant capability. The primary bioactive compounds, namely Cinnamaldehyde, cinnamyl acetate, β-caryophyllene, and coumarin in cinnamon, as well as curcumin, demethoxycurcumin, and bisdemethoxycurcumin in turmeric, were evaluated using the GC-MS technique. The investigation of the proximate composition of cinnamon and turmeric revealed distinct nutritional profiles for each spice, indicating potential health advantages linked to their use. Cinnamon contains bioactive components such as cinnamaldehyde, cinnamyl acetate, β-caryophyllene, and coumarin in concentrations of 61.47±2.15, 2.01±0.48, 1.38±0.05, and 1.01±0.01 µg/g, respectively. Turmeric contains curcumin, demethoxycurcumin, and bisdemethoxycurcumin in concentrations of 4321±21, 1024±17, and 412±14 µg/g, respectively. This research rallies insight of these spices and their use in food, pharmaceutical, and nutraceutical products, making them easier to incorporate into healthy diets.

**Keywords:** Cinnamon, Turmeric, Proximate, Antioxidant, Minerals.

## Introduction
Scientists have momentously concentrated on the health-promoting properties of nutraceuticals and functional foods that support human well-being during the last millennium. The bioactive molecules in these functional meals help with the medical treatment of certain potentially fatal diseases, such as metabolic syndrome (Gibson *et al*., 2004). Among many other dietary components employed in diet-based interventional treatments, phytochemicals obtained from plants are crucial since they not only enhance health and wellbeing but also function as a factor reducing health risks (Shahidi, 2009).
Different useful foods possess these plant-based phytochemicals, which are particularly present in spices. Spices are a great source of Phyto-chemicals, essential oils, minerals, vitamins, and antioxidants that are needed to fight many ailments in addition to developing our taste buds (Mishra

and Behal, 2011). While the active constituents in spices and herbs may be significantly lower compared to those found in commercial drugs, their high bioavailability and little adverse effects validate their utilization in the field of medicine (Balsano and Alisi, 2009).

Among the main spices, turmeric (Curcuma longa) is widely used as a food additive and coloring agent with biological and therapeutic effects (Abou-Elkhair *et al*., 2014). Comprising 2 to 8% of the spice, curcumin is the primary and active phenolic compound and has been shown to have antibacterial and antioxidant properties (Negi *et al*., 1999). Similar well-documented benefits of cinnamon include its antioxidant, anti-inflammatory, and antibacterial properties (Vinitha and Ballal, 2008). Cinnamaldehyde, eugenol, camphor, and polyphenols are a few of the substances in cinnamon that are in charge of these advantageous effects (Rafehi *et al*., 2012).

Though numerous research has utilized different species of turmeric and cinnamon or preparations for different animal models, the spices have the ability to cure metabolic disorders (Kannapan *et al*., 2006; Shen *et al*., 2010; Mishra *et al*., 2010; El-Desoky *et al*., 2012). Still, the combined effect of these spices in controlling blood glucose responses is not clearly assessed (Rafehi *et al*., 2012; Allen *et al*., 2013). The current study was therefore carried out to characterize locally grown turmeric (Curcuma longa) and cinnamon (Cinnamomum cassia) through proximate, nutritional and antioxidant parameters to further investigate their potential to manage and treat PCOS through rat model, especially when used synergistically, considering the health claims of these plants. The objectives of the current study were to explore the nutritional, and antioxidant potential of cinnamon and turmeric powders.

## 2. Materials and Methods

### 2.1. Procurement and preparation of raw materials

The cinnamon barks and turmeric roots of excellent quality were obtained from the local market in District Faisalabad, Pakistan. The cinnamon and turmeric were processed into a powdered consistency following the steps of washing and grinding. The mill ground the cinnamon and turmeric to a size that could pass through screens with a mesh size of 30-40. The powdered cinnamon barks and turmeric were subjected to additional drying at a temperature of 60°C for a duration of 48 hours. They were then stored at a temperature of -18°C until they were ready to be used. High-quality chemicals were acquired from Sigma-Aldrich (Sigma-Aldrich Tokyo, Japan), Merck (Merck KGaA, Darmstadt, Germany), and other reputable suppliers.

### 2.2. Raw Material Analysis

The proximate composition of the powdered cinnamon and turmeric was analyzed using the standard protocols specified by AOAC (2016). The mineral contents were determined by using the method described in AOAC (2016), and the bioactive compounds were identified using GC-MS (Hameed *et al.,* 2016).

### 2.3. Analysis of the Chemical Composition of Cinnamon and Turmeric Powders

Cinnamon and Turmeric powders were analyzed for their proximate parameters (moisture, ash, fibre, fat, protein, and nitrogen-free extract) using the standard procedures outlined by AOAC (2016). These analyses were carried out in the Food Analytical Laboratory of Department of Food Science and Technology at GCWUF.

The moisture content of both samples was determined by using method No. 44-15 (AOAC, 2016). The moisture content was determined by drying the sample at a temperature of 105±5°C in an oven with forced air circulation for a duration of 24 hours, using the formula provided below: The moisture content, expressed as a percentage, can be calculated using the formula: (Weight of the sample minus the weight of the dried sample) divided by the weight of the sample, multiplied by 100.

The Kjeldahl method was employed to determine the nitrogen content, following the guidelines of AOAC (2016; method No. 46-10). The nitrogen contents were quantified using the following formula: The percentage of nitrogen can be calculated using the formula: Nitrogen (%) = (Quantity of 0.1 N $H_2SO_4$ utilized × 0.0014 × 250) / (Weight of sample × volume of aliquot sample) × 100.

To calculate the total protein content, multiply the percentage of nitrogen by a factor of 6.25.
The crude fibre contents were assessed using the method specified in AOAC (2016). The total fibre contents were determined using the following equation: The formula for calculating crude fibre content is as follows: Crude fibre (%) = Weight loss on igniting/Weight of sample × 100.
The ash contents were determined using the methodology outlined in AOAC (2016), and the ash contents were calculated using the following formula. The ash content is calculated by dividing the weight of the residue by the sample weight, and then multiplying the result by 100.
The caloric content of carbohydrates, known as NFE, was calculated using the difference method. This involved subtracting the moisture, crude fiber, fat, protein, and ash contents from 100. The caloric values were then obtained using the Attwater coefficients (Schmidt-Hebbel *et al*., 1992). The caloric carbohydrate percentage can be calculated by subtracting the sum of the moisture percentage, ash percentage, protein percentage, fat percentage, and fiber percentage from 100.

### 2.3. Mineral identification

The levels of major and minor minerals including magnesium (Mg), potassium (K), phosphorus (P), calcium (Ca), sodium (Na), manganese (Mn), chromium (Cr), zinc (Zn), and iron (Fe) in cinnamon and turmeric powder were measured using an atomic absorption spectrophotometer (Perkin Elmer), following the procedure outlined in AACC (2016).
The mineral profile of the samples was determined through the utilization of a wet digestion method. The processed samples were transferred to a 100mL volumetric flask and the volume was adjusted using distilled water before being filtered. The sample solution, which had been filtered, was analyzed using an Atomic Absorption Spectrophotometer (AA240 Varian K, Australia). Initially, samples with established strength were tested for each mineral in order to establish a standard curve. The mineral contents of the samples were analyzed using specific standard curves generated for each element, following the guidelines provided by AACC (2016). The sodium (Na) contents were measured using a flame photometer, as detailed in the relevant method outlined in AACC (2016).

### 2.4. Test for Antioxidant Capacity

The assessment of overall antioxidant capability was conducted by employing diphenyl-picrylhidrazyl (DPPH) and vitamin C as the reference standard for comparison. The total antioxidant capacity test was conducted using a spectrophotometer, as described by Blois (1958).
The bioactive chemicals cinnamaldehyde, cinnamyl acetate, β-caryophyllene, and coumarin were identified and quantified using gas chromatographic-mass spectrophotometric (GC-MS) analysis. This approach was specifically designed to extract and analyze the components of cinnamon and turmeric (Friedman *et al*., 2000).
The analysis was conducted utilizing a GC-MS system comprising of an HP 5890 series II gas chromatograph, HP 5972 mass detector, and Agilent 6890 series auto-sampler (Agilent Technologies, USA). The experiment utilized a Supelco MDN-5S capillary column with dimensions of 30 m in length and 0.25 mm in internal diameter, with a film thickness of 0.5 µm. Helium was employed as the carrier gas, flowing at a rate of 1 ml/min. The GC oven temperature was set to 40°C initially for 5 minutes, then increased to 140°C at a rate of 5°C per minute and maintained at 140°C for 5 minutes. Subsequently, it was further increased to 280°C at a rate of 10°C per minute and kept for an additional 5 minutes. The temperatures of the injector and detector were set at 250°C. An automated injection was performed using a diluted sample (1/100, v/v in heptane) of 1.0 µl. The mass spectrometry analysis was conducted using the electron impact mode (EI) with an energy of 70 electron volts (eV). The components were identified by comparing their GC retention durations, interpreting their mass spectra, and confirming the results by a search in the National Institute of Standards and Technology (NIST) database utilizing mass spectral library search (Friedman *et al*., 2000; Adams, 2007).
The gas chromatographic-mass spectrophotometric (GC-MS) technique was employed to quantify the bioactive components (curcumin, demethoxycurcumin, bisdemethoxycurcumin) present in turmeric. A sample of 1 microliter was introduced into the UPLC-MS system and separated using an Acquity UPLC Beh C18 column (1.7 micrometres, 2.1 × 150 millimetres; Waters) at a temperature of 40

degrees Celsius. The analytical mobile phase consisted of acetonitrile with 0.1% (v/v) formic acid (solvent A) and water with 0.1% (v/v) formic acid (solvent B). The study of curcuminoids involved an elution gradient starting at 5% A, which was then increased to 50% A at 1.0 min, 70% A at 5.0 min, and 100% A at 6.5 min. This was followed by a reduction to 5% A at 7.1 min and a hold at that level until 12.0 min for equilibrium. The flow rate used was 0.3 min $mL^{-1}$. The positive electrospray ionization (ESI) was regulated using selected ion monitoring (SIM) with certain mass-to-charge ratios (m/z). The mass-to-charge ratios used were 369.27 for curcumin, 339.22 for demethoxycurcumin, and 309.19 for bisdemethoxycurcumin. The capillary energy and cone voltage employed to evaluate curcuminoids were 1.3 kV and 10 V, respectively. A calibration curve was generated by utilizing a range of curcuminoid concentrations, specifically ranging from 0.02 to 2 μg $mL^{-1}$.

### 2.5. Statistical analysis

The obtained data was subjected to Statistix 8.1 for data analysis. The results were presented as means±S.D.

## 3. Results and Discussion

### 3.1. Analysis of Cinnamon Bark and Turmeric Root Powder

The proximate composition, mineral content, and bioactive compounds of Turmeric root and cinnamon bark powders were analyzed.

### 3.2. Proximate analysis

The proximate composition of a substance can be determined through the examination of its various components, such as moisture, ash, protein, fat, fiber, and carbohydrates, using the technique of approximate analysis. An examination of the proximate properties of cinnamon, an extensively utilized spice derived from the bark of numerous trees belonging to the Cinnamomum genus, provides valuable insights into its nutritional attributes and possible beneficial effects on health. Turmeric is a widely employed spice and botanical remedy that is esteemed for its distinctive yellow coloration and possible therapeutic properties (Sana *et al*., 2019).

Table 1 presents the results of the proximate analysis conducted on cinnamon and turmeric powders. The cinnamon powder was found to have a moisture content of 5.30±0.06%. The lipid content was determined to be 3.81±0.02%, whereas the protein content was 3.24±0.04%. The ash and fiber contents were ascertained to be 2.12±0.10% and 31.00±0.17%, respectively. In conclusion, the calculated non-fiber extract (NFE) concentration was 54.531.45%. Moisture content of 7.45±0.01%, protein content of 8.91±0.14%, lipid content of 5.98±0.04%, ash content of 3.01±0.02%, fiber content of 44.44±0.03%, and NFE content of 30.21±0.97% were all characteristics of the turmeric powder.

**Table 1: Proximate analysis of Cinnamon and Turmeric powder**

| Proximate | Cinnamon | Turmeric |
|---|---|---|
| | Composition (%) | |
| **Moisture** | 5.30±0.06 | 7.45±0.01 |
| **Crude Protein** | 3.24±0.04 | 8.91±0.14 |
| **Ash** | 2.12±0.1 | 3.01±0.02 |
| **Crude Fat** | 3.81±0.02 | 5.98±0.04 |
| **Crude Fiber** | 31.00±0.17 | 44.44±0.03 |
| **NFE** | 54.53±1.45 | 30.21±0.97 |

An examination of the proximate composition of Turmeric and Cinnamon unveiled unique nutritional profiles for each ingredient, suggesting the possibility of health benefits associated with their application. Due to its comparatively low moisture content, cinnamon can be utilized in a variety of cooking situations and stored for an extended period of time (Sana *et al*., 2019). Cinnamon's composition also revealed acceptable concentrations of crude protein, crude ash, and crude fat,

indicating that it contributes essential nutrients to the diet albeit in comparatively minute amounts. Cinnamon, in particular, demonstrated a substantial amount of crude fiber, which is consistent with previous studies that have highlighted its elevated fiber content. There are numerous health benefits associated with dietary fiber, including improved digestive health, weight management, and reduced vulnerability to chronic diseases such as diabetes and cardiovascular disease (Kaczmarczyk *et al.*, 2012). The moisture content exceeds the values reported by other scientists Shumaila & Mahpara (2009). The ash content, crude fiber, and nitrogen free extract closely align with the values. The fat content is higher compared to the values. The energy content is somewhat lower than the amounts documented by Shumaila & Mahpara (2009).

Odimegwu *et al.* (2011) examined the composition of various herbs including turmeric and found the that turmeric has a higher carbohydrate content of 68.54%. However, Turmeric has lower levels of crude fiber, crude protein, and ash at 4.60%, 9.40%, and 2.85% respectively. This suggests that turmeric also has a higher energy content. The ash level of turmeric, which is 2.85%, indicates that turmeric contains a significant quantity of minerals. The 4.60% fiber content in turmeric aids in purging the digestive system of potential cancer-causing substances and inhibits the excessive absorption of cholesterol. Fiber contributes to the volume of meals and helps avoid excessive consumption of starchy foods. As a result, it may protect against metabolic diseases such as hypercholesterolemia and diabetes mellitus (Odimegwu *et al.*, 2011).

### 3.2. Mineral analysis

Perusing the mineral composition of cinnamon and turmeric allows us to get insight into the significant minerals present in these spices, thereby improving their nutritional worth and potential health benefits. Cinnamon, derived from the bark of trees belonging to the Cinnamomum genus, contains many components that improve its nutritional profile and potential health advantages. Cinnamon generally contains minerals, however the exact composition can vary greatly depending on factors such as the species of cinnamon and the conditions in which it is grown.

Table 2 shows that Cinnamon is rich in many minerals such as iron, zinc, chromium, manganese, calcium, magnesium, potassium, sodium, and phosphorus. Table 2 presents the results on the mineral makeup of cinnamon and turmeric powder. Table 2 displays the mean values for mineral content. The cinnamon powder has been discovered to contain a variety of minerals, with the most abundant being Potassium (K) with a concentration of 122.04±1.78 mg/g. The content of Calcium (Ca) is 85.12±1.45 mg/g, followed by Magnesium (Mg) at 79.18±1.11 mg/g, Phosphorus (P) at 39.14±0.45 mg/g, Manganese (Mn) at 19.47±0.47 mg/g, Iron (Fe) at 6.89±0.45 mg/g, Zinc (Zn) at 3.21±0.14 mg/g, and traces of Chromium (Cr) at 0.54±0.07 mg/g. The spice Cinnamon has the most elevated potassium content and the least amount of salt concentration compared to all other spices.

Table 2 shows that Turmeric is rich in minerals such as iron, calcium, potassium, sodium, and phosphorus. The Turmeric powder has been shown to possess the highest concentration of Phosphorus (P) at 7.01±0.07 mg/g. Next in the sequence is Iron (Fe) with a concentration of 4.50±0.11 mg/g, followed by Potassium (K) at 3.92±0.09 mg/g, Calcium (Ca) at 3.20±0.12 mg/g, and little amounts of Sodium (Na) at 0.95±0.04 mg/g.

**Table 2: Mineral analysis of Cinnamon and Turmeric powder.**

| Minerals (mg/g) | Cinnamon | Turmeric |
|---|---|---|
| Iron (Fe) | 6.89±0.45 | 4.50±0.11 |
| Zinc (Zn) | 3.21±0.14 | - |
| Calcium (Ca) | 85.12±1.45 | 3.20±0.12 |
| Chromium (Cr) | 0.54±0.07 | - |
| Manganese (Mn) | 19.47±0.47 | - |
| Magnesium (Mg) | 79.18±1.11 | - |
| Potassium (K) | 122.04±1.78 | 3.92±0.09 |
| Phosphorus (P) | 39.14±0.45 | 7.01±0.07 |
| Sodium (Na) | - | 0.95±0.04 |

Calcium is essential for maintaining strong bones and is involved in muscle contraction and relaxation, blood coagulation, and the absorption of vitamin B12. Potassium and magnesium have been shown to lower blood pressure. Potassium is involved in regulating skeletal muscle contraction and the transmission of nerve impulses. Individuals with osteoporosis are typically prescribed a diet rich in calcium and potassium (Kubmarawa *et al.*, 2007). The presence of iron can aid in the production of haemoglobin, making it a recommended treatment for iron deficient anaemia. Additionally, many biochemical reactions in the body rely on various minerals as co-enzymes, highlighting the plant's significance in metabolic processes (Ikpeama *et al.*, 2014).

Cinnamon, obtained from the bark of different Cinnamomum species, is renowned for its abundant taste and fragrance. An examination of the proximate composition has shown that cinnamon includes substantial quantities of important elements, such as iron (Fe), zinc (Zn), calcium (Ca), chromium (Cr), manganese (Mn), magnesium (Mg), potassium (K), phosphorus (P), and small amounts of sodium (Na). Out of these minerals, cinnamon stands out due to its significant levels of calcium, manganese, magnesium, and potassium. These minerals are crucial for a range of physiological activities, including maintaining bone health, facilitating enzyme reactions, and balancing electrolytes (Muhammad & Iyaka, 2021).

The available research on the mineral composition of Turmeric is sparse. According to the data at hand, Turmeric has lesser amounts of iron, calcium, potassium, phosphorus, and salt compared to cinnamon. Turmeric is notably abundant in phosphorus and potassium, both of which are crucial for cellular function and cardiovascular health (Muhammad & Iyaka, 2021).

### 3.3. Antioxidant Capacity Test and Bioactive compounds:

The data given shows a clear association between the concentration of cinnamon and turmeric powder and the percentage of inhibition, as observed in Tables 3 and 4. By increasing the concentration of the extract from 10 µg/mL to 60 µg/mL, there is a notable rise in the inhibition percentage, indicating a clear correlation between the dosage and the observed impact. This pattern demonstrates the efficacy of the extract in hindering the target's functionality, with higher doses leading to more potent inhibition. Despite a decrease of around 40% at a dose of 10 µg/mL, correctly establishing the IC50 value, which indicates the concentration required for 50% inhibition, is challenging due to the lack of data points beyond 10 µg/mL. From the observed increase in inhibition percentages, it can be inferred that the IC50 value falls within the range of 10 µg/mL and 20 µg/mL. To achieve a more accurate IC50 value, it is necessary to gather more data points or employ interpolation techniques. To summarize, the findings suggest that cinnamon bark extract has promising suppressing characteristics, which warrants additional investigation into its potential medicinal applications. Similar findings were seen regarding the total antioxidant capacity of turmeric.

Cinnamon is highly regarded not just for its pleasant aroma but also for its significant health advantages, mostly due to its abundant assortment of bioactive substances. The therapeutic benefits of Cinnamon are attributed to several substances, which have been extensively studied (Sana *et al.*, 2019). Turmeric is well-known for its vivid yellow hue and powerful therapeutic characteristics, mostly due to its abundant concentration of bioactive chemicals. The presence of these chemicals in turmeric accounts for its wide array of health advantages, rendering it a sought-after component in both ancient medicinal practices and contemporary scientific investigations (Liu *et al.*, 2022).

**Table 3: Antioxidant capacity of cinnamon bark.**

| Cinnamon extract concentration (µg/mL) | Inhibition (%) | IC 50 (µg/mL) |
|---|---|---|
| 10 | 12,57 | 40,54 |
| 20 | 26,85 | |
| 30 | 35,85 | |
| 40 | 46,75 | |
| 50 | 54,85 | |
| 60 | 67,24 | |

**Table 4: Antioxidant capacity of turmeric root.**

| Turmeric extract concentration (µg/mL) | Inhibition (%) | IC 50 (µg/mL) |
|---|---|---|
| 10 | 13,54 | 41,67 |
| 20 | 25,75 | |
| 30 | 36,75 | |
| 40 | 45,75 | |
| 50 | 55,75 | |
| 60 | 68,75 | |

The compounds cinnamaldehyde, cinnamyl acetate, β-caryophyllene, coumarin, curcumin, demethoxycurcumin, and bisdemethoxycurcumin were identified and quantified using gas chromatographic-mass spectrophotometric (GC-MS) analysis (Figure 1). This approach was specifically designed for the extraction and analysis of the components found in cinnamon and curcumin. The gas chromatographic-mass spectrophotometric (GC-MS) technique was employed to detect the bioactive components of cinnamon, namely cinnamaldehyde, cinnamyl acetate, β-caryophyllene, and coumarin. The results of this analysis are provided in Table 5.

Table 5 indicates that cinnamon contains bioactive components such as cinnamaldehyde, cinnamyl acetate, β-caryophyllene, and coumarin. The concentrations of these compounds were found to be 61.47±2.15, 2.01±0.48, 1.38±0.05, and 1.01±0.01 µg/g, respectively. Cinnamon had the highest concentration of cinnamaldehyde and the lowest concentration of coumarin among the bioactive chemicals. The gas chromatographic-mass spectrophotometric (GC-MS) technique was employed to measure the levels of curcumin, demethoxycurcumin, and bisdemethoxycurcumin in turmeric.

The data presented in Table 6 indicates that turmeric contains bioactive chemicals (Figure 2), namely curcumin, demethoxycurcumin, and bisdemethoxycurcumin, in concentrations of 4321±21, 1024±17, and 412±14 µg/g, respectively. Cinnamon has the highest concentration of curcumin among the bioactive chemicals, as well as the lowest concentration of bisdemethoxycurcumin.

**Table 5: Bioactive compounds of Cinnamon.**

| Bioactive Compounds (µg/g) | Cinnamon |
|---|---|
| Cinnamaldehyde | 61.47±2.15 |
| cinnamyl acetate | 2.01±0.48 |
| β-caryophyllene | 1.38±0.05 |
| Coumarin | 1.01±0.01 |

**Table 6: Bioactive compounds of Turmeric.**

| Bioactive Compounds (µg/g) | Turmeric |
|---|---|
| Curcumin | 4321±21 |
| Demethoxycurcumin | 1024±17 |
| Bisdemethoxycurcumin | 412±14 |

Current studies have prioritized the task of discovering and describing the bioactive substances that are accountable for the therapeutic effects of cinnamon. Cinnamaldehyde, cinnamyl acetate, β-caryophyllene, and coumarin are the main bioactive ingredients among these substances. In a study conducted by Kim *et al*. (2015), the levels of bioactive chemicals in cinnamon were investigated. The substances assessed were cinnamaldehyde, cinnamyl acetate, β-caryophyllene, and coumarin, with respective values of 65, 1.50, 1.30, and 1.

Several studies have been conducted thus far to assess the bioactivity of cinnamon components against various diseases. Cinnamon contains a high concentration of cinnamic acid, cinnamic aldehyde, cinnamyl acetate, α-thujene, terpineol, α-cubebene, eugenol, and coumarin. These chemicals possess potent antibacterial and anti-inflammatory capabilities and exert an influence on biological processes within the human body (Mohamed *et al.*, 2020).

A literature search found that cinnamaldehyde, are the primary components of cinnamon. Similarly, cinnamyl acetate, β-caryophyllene, and coumarin are the main constituents of cinnamon. These findings were reported by Kaul *et al*. (2003), Pauli (2008), Singh *et al*. (2008), and Wang *et al*. (2009). However, our current data shows that the quantities of several key components, as determined through a quantitative analysis, fall outside the typical range reported in earlier studies (Vernin and Parkanyi, 1994; Raina *et al*., 2001; Singh *et al*., 2007). In the study conducted by Singh *et al*. (2007), it was discovered that cinnamon leaf oil has a significant amount of eugenol, making up more than 85% of the oil. However, trans-cinnamaldehyde was not detected in the oil. In the study conducted by Singh *et al*. (2008), curcumin was shown to be the predominant component in turmeric, comprising 25.9% of the total composition.

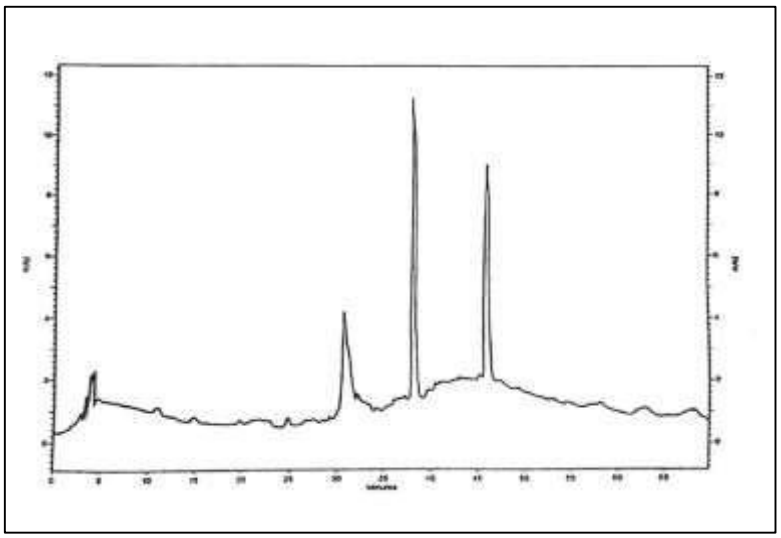

**Figure 1: Bioactive compounds identified and quantified using gas chromatographic-mass spectrophotometric (GC-MS) in cinnamon.**

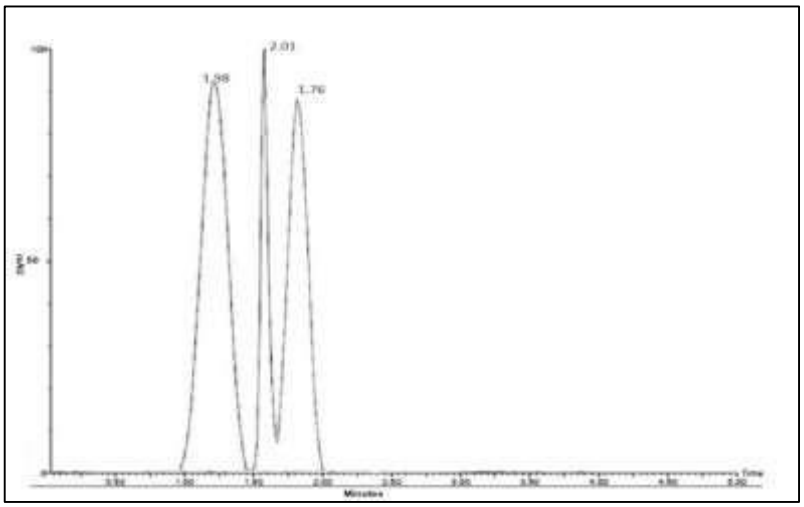


**Figure 2: Bioactive compounds identified and quantified using gas chromatographic-mass spectrophotometric (GC-MS) in Turmeric.**

The chemical composition of cinnamon and turmeric can vary significantly due to different subspecies, as well as various agroclimatic conditions (such as climate, season, and geography) in different regions. Other factors that can contribute to these variations include the stage of maturity of the plants, their adaptive metabolism, distillation conditions, and the specific plant part being analyzed. Several studies have explored these factors (Anwar *et al*., 2009; Abd El Baky and El Baroty, 2008; Singh *et al*., 2008; Wang *et al*., 2009).

## Conclusion

This research paper provides a thorough assessment of the physical and chemical characteristics, nutritional makeup, and antioxidant capacity of two commonly used spices, cinnamon and turmeric. By conducting thorough examination, researchers have obtained valuable knowledge about the various characteristics of these spices, highlighting their potential advantages for health and practical uses. The physicochemical characterization revealed crucial factors, including moisture content, ash content, and fibre, which serve as a basis for comprehending their inherent features. Moreover, the nutritional study demonstrated the abundant nutrient compositions of cinnamon and turmeric, emphasizing their significance as providers of vital minerals, and dietary fibers. Significantly, the evaluation of antioxidant activity using several tests revealed the impressive intrinsic antioxidant capacity in these spices, which could have a crucial impact in fighting against diseases caused by oxidative stress. In summary, the results emphasize the significance of cinnamon and turmeric as functional foods that have potential health benefits. This supports the idea that they should be included in various cooking and healing activities to improve human health and well-being.

## References:


1. Abd El-Hack, M. E., El-Saadony, M. T., Swelum, A. A., Arif, M., Abo Ghanima, M. M., Shukry, M., ... & El-Tarabily, K. A. 2021. Curcumin, the active substance of turmeric: its effects on health and ways to improve its bioavailability. Journal of the Science of Food and Agriculture, 101(14), 5747-5762.
2. Abou-Elkhair R, Ahmed HA, Selim S. 2014. Effects of Black Pepper (Piper Nigrum), Turmeric Powder (Curcuma Longa) and Coriander Seeds (Coriandrum Sativum) and Their Combinations as Feed Additives on Growth Performance, Carcass Traits, Some Blood Parameters and Humoral Immune. Asian-Australasian journal of animal sciences 27(6), 847-854.
3. Allen RW, Schwartzman E, Baker WL Coleman CI, Phung OJ. 2013. Cinnamon use in type 2 diabetes: an updated systematic review and meta-analysis. The Annals of Family Medicine 11, 452-459.
4. Anwar F, Ali M, Hussain AI, Shahid M. 2009. Antioxidant and antimicrobial activities of essential oil and extracts of fennel (Foeniculum vulgare Mill.) seeds from Pakistan. Flav. Frag. J., 24: 170-176.
5. AOAC, 2016. Official methods of analysis of the association of official's analytical chemists, 17th ed. Association of official analytical chemists, Arlington, Virginia.
6. Balsano C, Alisi A. 2009. Antioxidant effects of natural bioactive compounds. Current Pharmaceutical Design 15, 3063–73.
7. Blois MS, (1958). Antioxidant determinations by the use of a stable free radical. Nature, 181(4617):1199-1200. doi: 10.1038/1811199a0
8. El-Desoky GE, Aboul-Soud MAM, Al-Numair KS. 2012. Antidiabetic and hypolipidemic effects of Ceylon cinnamon (Cinnamomumverum) in alloxan diabetic rats. Journal of Medicinal Plants and Research 6(9), 1685-1691.
9. Friedman M, Kozukue N, and Harden LA, 2000. Cinnamaldehyde content in foods determined by gas chromatography-mass spectrometry. Journal of Agricultural and Food Chemistry, 48(11):5702-5709.
10. Gibson GR, Probert HM, Van Loo J, Rastall RA, Roberfroid M. 2004. Dietary modulation of the human colonic microbiota: updating the concept of prebiotics. Nutrition Research Reviews 17, 259-75.
11. Ikpeama, A., Onwuka, G. I., & Nwankwo, C. 2014. Nutritional composition of Tumeric (Curcuma longa) and its antimicrobial properties. International Journal of Scientific and Engineering Research, 5(10), 1085-1089.
12. Iniaghe, O. M., Malomo S.O. and Adebayo, J.O. 2009. Proximate composition and phytochemical constituents of leaves of some acalypha species. Pakistan Journal of Nutrition 8: 256- 258.

13. Kaczmarczyk, M. M., Miller, M. J., & Freund, G. G. (2012). The health benefits of dietary fiber: beyond the usual suspects of type 2 diabetes mellitus, cardiovascular disease and colon cancer. Metabolism, 61(8), 1058-1066.
14. Kannapan S, Jayaraman T, Rajasekar R, Ravichandran M, Anuradha C. 2006. Cinnamon bark extract improves glucose metabolism and lipid profile in the fructose fed rat. Singapore Medical Journal 47, 858-863.
15. Kaul PN, Bhattacharya AK, Rao BRR, Syamasundar KV, Ramesh S. 2003. Volatile constituents of essential oils isolated from different parts of cinnamon (Cinnamomum zeylanicum Blume). Journal of the Sci. Food Agric., 83: 53-55.
16. Kubmarawa, D., Ajoku, G. A., Enwerem, N. M., & Okorie, D. A. 2007. Preliminary phytochemical and antimicrobial screening of 50 medicinal plants from Nigeria. African Journal of Biotechnology, 6(14).
17. Liu, J., Li, K., Chen, Y., Ding, H., Wu, H., Gao, Y., ... & Hu, Y. (2022). Active and smart biomass film containing cinnamon oil and curcumin for meat preservation and freshness indicator. Food Hydrocolloids, 133, 107979.
18. Mishra A, Bhatti R, Singh A, Singh-Ishar MP. 2010. Ameliorative effect of the cinnamon oil from Cinnamomumzeylanicumupon early-stage diabetic nephropathy. Planta Medica 76(5), 412–417.
19. Mishra N, Behal KK. 2011. Chemopreventive activity of some spices against selected cell line. Der Pharmacia Sinica 2(1), 31-33.
20. Mishra, N., & Srivastava, R. (2022). Therapeutic and pharmaceutical potential of cinnamon. In Research Anthology on Recent Advancements in Ethnopharmacology and Nutraceuticals (pp. 698-710). IGI Global.
21. Mohamed, A. E., Abdur, R., & MM, S. A. 2020. Cinnamon bark as antibacterial agent: A mini-review. GSC Biological and Pharmaceutical Sciences, 10(1), 103-108.
22. Muhammad, H. I., & Iyaka, Y. A. 2021. Dietary assessment of some essential trace elements in nigerian fruits, vegetables and spices: A review. Lapai Journal of Science and Technology, 7(1), 133-157.
23. Negi PS, Jayaprakasha GK, Jagan MRL. Sakariah KK. 1999. Antibacterial activity of turmeric oil: a byproduct from curcumin manufacture. Journal of Agricultural and Food Chemistry 47(10), 4297-4300.
24. Odimegwu, N. E., Ubbaonu, C. N., Ofoedu, C. E., Akajiaku, L. O., Njoku, N. E., Agunwah, I. M., ... & Iwuh, G. E. 2019. Comparative study on the proximate composition, functional and sensory properties of turmeric (Curcuma longa) and Pawpaw (Carica papaya) custard products. Current Journal of Applied Science and Technology, 33(4), 1-11.
25. Pauli A. 2008. Relationship between lipophilicity and toxicity of essential oils. Int. J. Essential Oil Therapeut., 2: 60-68.
26. Rafehi H, Ververis K, Karagiannis TC. 2012. Controversies surrounding the clinical potential of cinnamon for the management of diabetes. Diabetes, Obesity and Metabolism 14(6), 493-499.
27. Rao PV, Gan SH. Cinnamon: A Multifaceted Medicinal Plant. Evid Based Complement Alternat Med. 2014;2014:642942. doi:10.1155/2014/642942
28. Sana, S., Arshad, M. U., Farhan, S., Ahmad, R., Ali, I., & Tabussam, T. (2019). Nutritional characterization of cinnamon and turmeric with special reference to their antioxidant profile. Int. J. Biosci, 15(4), 178-187.
29. Shahidi F. 2009. Nutraceuticals and functional foods: Whole versus processed foods. Trends in Food Science and Technology 20(9), 376-387.
30. Shen Y, Fukushima M, Ito Y, Muraki E, Hosono T, Seki T, Ariga T. 2010.Verification of the antidiabetic effects of cinnamon Cinnamomumzeylanicum, using insulin-uncontrolled type 1 diabetic rats and cultured adipocytes. Bioscience, Biotechnology, and Biochemistry 74, 2418-25.
31. Shumaila G, Mahpara S. 2009. Proximate composition and mineral analysis of cinnamon. Pakistan journal of nutrition. 8: 1456-1460

32. Singh G, Kapoor IS, Singh P, Heluani CS, Lampasona MP, Catalan CAN. 2008. Chemistry, antioxidant and antimicrobial investigation on essential oil and oleoresine of Zingiber officinale. Food Chem. Toxicol., 46: 3295-3302.
33. Singh G, Maurya S, DeLampasona MP, Catalan CAN. 2007. A comparison of chemical, antioxidant and antimicrobial studies of cinnamon leaf and bark volatile oils, oleoresins and their constituents. Food Chem. Toxicol., 45: 1650-1661.
34. Vinitha M, Ballal M. 2008. In vitro anticandidal activity of Cinnamomumverum. Journal of Medical Sciences 8, 425-428.
35. Wang R, Ruijiang W, Bao Y. 2009. Extraction of essential oils from five cinnamon leaves and identification of their volatile compound compositions. Innovative Food Sci. Emerging Technol., 10: 289–292.