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FLAVONOID COMPOSITION OF TURMERIC (*CURCUMA LONGA*) PLANT CULTIVATED IN EBONYI STATE, NIGERIA.

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ABSTRACT

Turmeric is one of the powerful gift of nature to man to treat diseases. The therapeutic and pharmacological uses of different bioactive components of turmeric are been slowly revealed. Flavonoid belongs to the human diet's phenolic phytochemical compounds found in nature. This study analyzed the flavonoid composition of turmeric using standard method to reveal the presence and percentage composition of different flavonoids found in turmeric cultivated in Ebonyi State. The results revealed the presence of gallic acid (4.028), p-coumaric acid (1.464), ferrulic acid (7.949), rutin (5.88), quercetin (14.322) and kampferol (10.812 ppm). The high quantity of flavonoid in turmeric renders it a good plant in herbal medicine. This may account for the folkloric use of turmeric plant by miners in Ebonyi State.

Key words: *flavonoid, turmeric, quercetin, kampferol, bio-active, catechin.*

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1 INTRODUCTION

Plants contain an array of bio-active constituents that, may, merge or fuse to give the plant its medicinal value. Parts of the plant such as the leaves, roots, back, or even the flowers or any other part of the plant may have the capacity to hold some of the bioactive constituents. The use of traditional medicine as an alternative form of health care in Africa and all over the world is gaining momentum due to the high cost of medication and side effect observed among patients in some years now. Africa and South east Nigeria have rich plant diversity of which many cultivated, planted or in the wild posses medicinal properties.

Turmeric (*Curcuma longa*) widely used as a spice is a rhizomatous, perennial crop belonging to Zingaberaceae family. The plant is native to Southeast Asia and Indian subcontinent were it thrives with high rainfall. Turmeric is commonly grown in Bangladesh, Bengal, China, Pakistan, West Indies, Taiwan, Sri Lanka, Java, Peru, and Australia [1, 2]. Turmeric are used in treatment of many disease conditions such as inflammations, cancerous cells, digestive problems, anorexia, cough, infectious diseases, diabetic wounds, rheumatism etc [1-3].

Flavonoids occur naturally in plants and are polyphenolic compounds with a benzo-γ-pyrone structure. Flavonoids are synthesized by phenylpropanoid pathway or through shikimic acid pathway of plants [4, 5]. Generally flavonoids have a 15-Carbon skeleton with two benzene rings (A and B) which are bonded with a heterocyclic pyrane ring C [4].

Flavonoids hunt reactive oxygen species (ROS), reactive chlorine species (RCS) and reactive nitrogen species (RNS) that chelates transition-metal ions [6, 7]. Auxin a growth factor in plants are regulated by flavonoids [8]. The mechanism of action of flavonoids lies in the number and position of hydroxyl groups, conjugations and substitutions of functional groups, structural class, degree of polymerization and configuration [5]. The chelation ability and radical scavenging of metals by flavonoids as an antioxidant depends on total number of hydroxyl groups, arrangement, substitution and or configuration of functional groups in the structure [9]. Other pharmacological activities of flavonoids includes Anti-ulcer [10], anti-inflammatory [11, 12, 13], anti-depressant [14], anti-hypetensive [15], anti-diabetic [16, 17], anti-cancer [18], Antiallergic [19], anti-bacterial agents [20], anti-asthmatic effect [21].

2 MATERIALS AND METHODS

2.1 Sample Collection

The turmeric plant were planted and harvested from a

Figure 1 – Cultivated turmeric in sandy loamy soil in Ugwulangwu Ohaozara LGA Ebonyi State: A – Planted turmeric plant with the leaves that has grown and mature for harvest while, B – showed harvested turmeric tuber with the soil before taken to the laboratory for analysis.

farm in Ugwulangwu Ohaozara L.G. A of Ebonyi State and identified in the Department of Applied Biology, Ebonyi State University (Figure 1).

2.2 Sample preparation

Fresh harvested turmeric were sorted and washed with running clean water from a tap to remove sands and other unwanted materials. However, after the washing, the turmeric samples were air dried in a room for 4 months before it were blended into powder.

2.3 Quantification of flavonoids

Quantification of flavonoids in *Curcuma longa* extract was performed by Shimadzu LC-20AD HPLC system (Shimadzu company, Japan) with a delivery system constituting of binary solvent (LC-20AD), an injector of Rheodyne type possessing 10 µL sample loop and DAD detector (SPD-M 20 A). Through the mechanism of reverse phase column chromatographic separation was carried out (Capcell Pack C-18, MGII, 5 µm, 250 mm × 4.6 mm) with an extended guard column. The mobile phase consisted of methanol–acetonitrile water (40:15:45, v/v/v) containing 1.0% acetic acid with isocratic elution for 30 min. Shimadzu LC solution software was applied for acquiring the data and processing. The range of the Diode array detector was kept between 240 to 280 nm. The rate of flow was 1 mL/min and the volume of samples and standard solutions were taken as 10 µL. By keeping track of retention time and analyzing UV spectra the peaks were identified by comparing them with reference standards, confirming them by running the samples with a small amount of the standards. The standard sample was introduced in triplicate and average detector response was measured. The *Curcuma longa* extract were determined in triplicate and peak areas corresponding to flavonoids were compare with the calibration curve and quantity of flavonoids was determined and means deviation used.

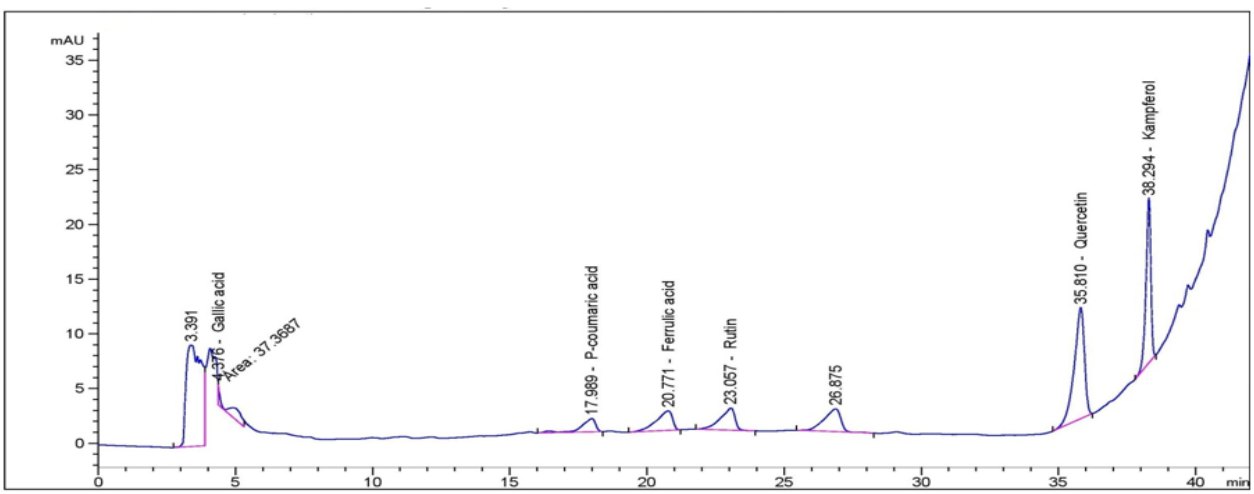

Figure 2 – HPLC concentrations of flavonoid composition of turmeric planted in Ebonyi State.

Table 1 – Flavonoid composition of turmeric planted in Ebonyi State

	Retention time (min)	Amount in (ppm)	Flavonoids
1	4.376	4.028	Gallic acid
2	13.220	-	Catechin
3	17.989	1.464	p-coumaric acid
4	20.77	7.949	Ferrulic acid
5	23.057	5.88	Rutin
6	30.194	-	Apigenin
7	35.810	14.322	Quercetin
8	38.294	10.812	Kampferol

2.4 Statistical Analysis

Statistical processing of experimental data was performed using standard descriptive statistical methods in Microsoft Excel.

3 RESULTS

Results of HPLC analysis of turmeric plant cultivated in Ebonyi State are presented below. The identified bioactive compounds were done through comparative assessment of retention time and fragmentation pattern. Eight peaks were identified from the chromatogram figure 2.

These peaks (1-8) showed the presence of compounds in the plant. Compound 1 was gallic acid (Table 1) with retention time of 4.37and 4.028 ppm. Kamferol and quercetin have 10.81 ppm and 14.32 ppm with retention time of 38.29 and 35.81 respectively. Catechin and apigenin was not detected but have a retention time of 13.20 and 30.19, respectively.

Six flavonoid compounds gallic acid, p-coumaric acid, rutin, ferrulic acid, kampfeerol and quercetin was identified in parts per million (ppm) with their retention time. Data software unit were used for the analysis.

The chromatogram showing the peaks revealed the presence of quercetin, kamferol, ferrulic acid, rutin, gallic acid and p-coumaric acid whereas catechin and apigenin was not detected in ppm

4 DISCUSSION

The pharmacological properties of turmeric as a medicinal plant are linked to presence of flavonoids which are secondary metabolites. Therefore, the presence of various flavonoids in turmeric includes gallic acid, p-coumaric acid, ferrulic acid , rutin , quercetin and kampferol (figure 2) indicates that turmeric (*Curcuma longa*) possess therapeutic importance.

Data from this study showed that quercetin, kampferol and ferrulic acid has the highest amount of flavonoid in the planted turmeric. Flavonoid biosynthesis occurs via phenylpropanoid pathway. The aromatic amino acid phenylalanine, gets converted into 4-coumaroyl-CoA. malonyl-CoA conjugates with 4-coumaroyl-CoA to produce chalcones giving rise two phenyl rings. Chalcones ring-closure of conjugates produces flavonoids. Other enzymatic modifications of this pathway produce anthocyanins, flavanones, flavonols, dihydroflavonols, and other poly-phenolics [4].

kampferol and quercetin are the most abundant flavonoids observed in turmeric plant planted in Ebonyi State. Quercetin are primarily made up of three benzene rings and five hydroxyl groups and abundantly found in capers, rocket, dill, coriander, fennel, juniper berries, corn poppy, bee pollen, and okra anti-asthmatic [21].

Quercetin posses anti-ulcer activity by inhibiting histidine decarboxylase that leads to reduced production of histamine in the gastric mucosa, which energizes parietal cells and pepsinogen that secrets hydrochloric acid and pepsin respectively [22, 23,24, 25, 26]. Quercetin a flavonoid act as anti-cancer agent by arresting cell death and mediated apoptosis via p53 [18].

According to Liu et al. [27] quercetin interferes with the production of inflammatory factors and stimulation of the NLRP3 inflammasome while elevating the generation of Interleukin 10 (IL-10) and Heme oxygenase (HO-1). Zhu et al. [28] found that quercetin and kaempferol can be used in asthma and chronic bronchitis treatment. The anti-cancer activity of kampferol was observed by Qin et al. [29] where it lowered vascular endothelial growth factor (VEGF) that leads to increased vascular proliferation and permeability. However, kampferol and quercetin act as anti-inflammatory agent by inhibiting proinflammatory enzymes [11, 30]. Apigenin, quercetin and myricetin, improves diabetes mellitus by hindering Na+ dependent glucose transporter-1 [31]. Demonty et al. [32] also reported the hypoglycemic activity of Rutin and Quercetin while Oboh et al. [33] reported the anti-diabetic effect of quercetin.

Turmeric plant cultivated in Ugwulangwu possess high levels of kampferol and quercetin while catechin and apigenin was not found. However, the turmeric was best grown in sandy loamy soil (Figure 1A and B). The principal aromatic phenolic compound synthesized from L-Phe and L-Tyr and cinnamic acids and esters, coumarins, phenylpropenes, chromones, chalcones, isoflavonoids, neoflavonoids and their dimmers and trimers [34].

5 CONCLUSION

Turmeric is store house of many bioactive flavonoids, which are responsible for a variety of pharmacological and therapeutic properties. Turmeric planted in Ebonyi State possesses high concentrations of quercetin, kamferol and ferrulic acid which may serve as antioxidants to miners who mine lead on mining sites.

AUTHOR CONTRIBUTIONS

O.C.O.: conceptualization, study design, collection of bio-

logical material, laboratory experiments, data validation, writing – original draft preparation and final approval of the manuscript.

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CONFLICT OF INTEREST

The author declare no conflict of interest

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СОСТАВ ФЛАВОНОИДОВ РАСТЕНИЯ КУРКУМЫ (*CURCUMA LONGA*), ВЫРАЩИВАЕМОГО В ШТАТЕ ЭБОНИ, НИГЕРИЯ.

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АННОТАЦИЯ

Куркума – один из мощных даров природы человеку для лечения болезней. Медленно раскрываются терапевтические и фармакологические применения различных биоактивных компонентов куркумы. Флавоноид относится к фенольным фитохимическим соединениям человеческого рациона, встречающимся в природе. В этом исследовании был проанализирован флавоноидный состав куркумы с использованием стандартного метода для выявления наличия и процентного состава различных флавоноидов, обнаруженных в куркуме, выращенной в штате Эбони. Результаты показали наличие галловой кислоты (4,028), п-кумаровой кислоты (1,464), феруловой кислоты (7,949), рутина (5,88), кверцетина (14,322) и кампферола (10,812 частей на миллион). Высокое количество флавоноида в куркуме делает ее хорошим растением в фитотерапии. Это может объяснять фольклорное использование растения куркумы шахтерами в штате Эбони.

Ключевые слова: *флавоноид, куркума, кверцетин, кемпферол, биоактивный, катехин.*

НИГЕРИЯ ЭБОНИ ШТАТЫНДА ӨСІРІЛГЕН КУРКУМА (*CURCUMA LONGA*) ӨСІМДІГІНІҢ ФЛАВОНОИДТЫҚ ҚҰРАМЫ

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АҢДАТПА

Куркума – ауруларды емдеуге арналған табиғаттың адамға берген қуатты сыйларының бірі. Куркуманың әртүрлі биоактивті компоненттерінің терапевтік және фармакологиялық қолданулары баяу ашылады. Флавоноид адамның рационында табиғи түрде кездесетін фенолды фитохимиялық заттарға жатады. Бұл зерттеуде Эбони штатында өсірілген куркумадағы әртүрлі флавоноидтардың болуын және пайыздық құрамын анықтау үшін стандартты әдісті қолдану арқылы куркуманың флавоноидтық құрамы талданды. Нәтижелер галл қышқылының (4,028), п-кумар қышқылының (1,464), ферул қышқылының (7,949), рутиннің (5,88), кверцетиннің (14,322) және кемпферолдың (10,812) бар екенін көрсетті. Куркумадағы флавоноидтардың жоғары мөлшері оны фитотерапияда жақсы шөп етеді. Бұл Эбони штатындағы кеншілердің куркума зауытын фольклорлық пайдалануын түсіндіруі мүмкін.

Негізгі сөздер: *флавоноид, куркума, кверцетин, кемпферол, биоактивті, катехин.*