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Variation of Antioxidant Properties of African Basil (*Ocimum gratissimum*) Leaves with respect to Various Drying and Solvents Extraction Methods

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Abstract

The cleaned leaves of African Basil (*Ocimum gratissimum*) were dried initially using various drying processes such as sun dry, shade dry, hot air oven dry and microwave dry. Dried samples were then extracted in three different solvents; water (Cold and Hot), methanol and butanol using maceration process. Various antioxidant activities of all the extracts were then evaluated both qualitatively and quantitatively to find out the best drying method and extraction of solvent for preserving the activity of bioactive compounds in the dry leaves of African basil. The result revealed that the hot water extract of microwave dried African Basil was rich in total polyphenolic content and the butanol extract of sun-dried African Basil was rich in total flavonoid content. In case of DPPH (2,2-diphenyl-1-picrylhydrazyl) assay, lowest IC_{50} value was observed in the cold water extract of shade dried African Basil. Finally, in FRAP (Ferric Reducing Antioxidant Power) assay, maximum ferric reducing activity was observed in the hot water extract of microwave dried African Basil. After analyzing the overall data, it was revealed that the organic extract of sun-dried African Basil content high polyphenolics and flavonoids, and hence had strong antioxidant potential.

Keywords: Antioxidant activity; African Basil; *Ocimum gratissimum*; Phytochemical screening; TPC; TFC; DPPH; FRAP

1. Introduction

African Basil (*Ocimum gratissimum*) is one of the essential, aromatic, tender-growing annual herbs native to West Africa and extensively cultivated also in India [1]. It's strong, spicy aroma makes it useful not only in food preparation but also for therapeutic reasons because it contains various types of antioxidants, anti-inflammatory, and antibacterial agents [2].

Reactive oxygen species (ROS) are produced in human body by various physiological processes, including the production of energy in mitochondria, control over cell growth, phagocytosis, intracellular signaling, and detoxification of xenobiotics [3]. In addition, our body produce excessive amount of ROS as a result of exposure to several environmental factors such as pollutants, chemicals, organic solvents, UV light, tobacco smoke, and pesticides [4]. Stress brought on by modern living is a significant contributor to tissue damage, excess production of free radicals, and a rising number of health problems [5]. Excessive and prolonged stress can also lead to the development of various pathological disorders, such as cancer, ischemia, arthritis, and atherosclerosis [6]. Research on natural antioxidants and their applications is crucial, as synthetic antioxidants have been found to have number negative impacts, including the ability to cause cancer and other health problems [7].

In response to environmental stress, plants produce secondary metabolites known as polyphenols which can effectively stop the progression of oxidative stress-related illnesses and protect the biological system from severe oxidative stress by acting as antioxidants [8]. Flavonoids, another class of polyphenolics, also have anti-inflammatory properties, can

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lower blood sugar and fat levels, block oxidative and hydrolytic enzymes, scavenge free radicals, and increase immunity [9].

Numerous bioactive chemicals, including beta-caryophyllene, eugenol derivatives, vanillin, rosmarinic acid, ursolic acid, gallic acid, and vanillic acid, have been found to be abundant in the leaves of *Ocimum gratissimum*, often known as African basil [10]; although there is still work to be done in terms of identifying and extracting active polyphenols and flavonoids and correlating them to antioxidant properties. The polarity of the solvent has a major impact on the extraction of phytochemicals and their antioxidant qualities. A few information's had been attributed regarding extraction of various components from this herb's leaves [8].

The quality of the finished product is also significantly influenced by technological processes. When technological methods are used, some bioactive chemicals may become unstable, reducing the product's biological value. Drying is a frequently used preservation strategy because it inhibits microbial proliferation and prevents enzymatic breakdown [11]. Different drying techniques have an impact on the chemical composition and properties of bioactive substances. Variations in the leaf composition during drying have been documented in a number of research publications; nevertheless, the antioxidant capacity and related quality criteria in connection to various drying techniques are less established [12].

The aim of this study is to get maximum extraction of polyphenols, flavonoids and other antioxidants from the leaves of *Ocimum gratissimum* with respect to different drying procedures and extraction solvents and to determine the most effective drying procedure as well as extraction solvent which preserve the maximum antioxidant properties of the Basil leaves.

2. Material and methods

2.1. Chemicals

Distilled water, Methanol, Butanol, Ferric chloride, Sodium hydroxide, Hydrochloric acid, Folin-Ciocalteu reagent, Sodium bicarbonate, Gallic acid, Aluminium chloride, Sodium nitrite, Quercetin, DPPH (2,2-diphenyl-1-picrylhydrazyl), Ascorbic acid, Sodium acetate, Glacial acetic acid, and TPTZ (2,4,6-Tripyridyl-S-triazine) of either AR or GR grade of E Mark, HIMEDIA, SRL etc. were used in this study.

2.2. Collection and Processing of Plant Material

Leaves of African Basil (*Ocimum gratissimum*) were collected in the month of January 2024 from the local area of Hadia, On Basanti Highway, North 24 Parganas, West Bengal, India. The fresh leaves of African Basil (*Ocimum gratissimum*) were washed under running tap water for several times to remove dirt and finally with distilled water. The leave samples were then completely dried using various drying process as shown in **Table 1**. After that, the dried samples were crushed into powder with mesh size 60 using a mixer grinder and stored in airtight polythene zip lock bags for further studies.

Table 1 Various drying methods of leaves of African Basil [2]

Method of Drying	Temperature	Time
Sun drying	-	14 days
Shade drying	-	30 days
Hot air oven drying	55^0C	4 hrs. 40 minutes
Microwave drying	900 watts	2 minutes

2.3. Preparation of Leave Extract

0.5g of each type of leave powder was extracted with 10ml of different solvents such as methanol, butanol, hot (55^0C) and cold (4^0C) distilled water by using maceration process. Finally, the extracts were filtered and the clear liquid extracts were stored in refrigerator (4^oC) for future analysis.

2.4. Qualitative Analysis of Phytochemicals (Polyphenols and Flavonoids)

The procedure for qualitative analysis of Phytochemicals is given in **Table 2**.

Table 2 Qualitative analysis of Phytochemicals of dried leaves of African Basil

Name of Phytochemicals	Protocol	Reagents
Polyphenols	1ml of plant extract + 3-4 drops of 5% ferric chloride solution → Bluish-black coloration [13]	Ferric chloride solution (5%): 2.5g of ferric chloride ($FeCl_3$) dissolved in 50ml of distilled water.
Flavonoids (Alkaline Reagent Test)	1ml of plant extract + few drops of 1% sodium hydroxide solution →Intense yellow coloration → add few drops of dilute hydrochloric acid (1N) → Solution becomes colorless [14]	Sodium hydroxide solution (1%): 0.2g of sodium hydroxide (NaOH) dissolved in 20ml of distilled water. Dilute hydrochloric acid (1N): 4.2ml of hydrochloric acid (HCl) (12N) dissolved in 45.8ml of distilled water.

2.5. Quantitative Analysis of Phytochemicals

2.5.1. Preparation of Stock Solution of dried leaves of African Basil (1000 µg/ml)

20µl of leave extract was dissolved in 980µl of specific solvent (used for extraction). This dilution was used as a stock solution of leave extract to perform the analysis of various antioxidants contents.

2.5.2. Estimation of Total Polyphenol Content (TPC)

The total polyphenol content in plant extracts were determined by Folin-Ciocalteu method with little modification [15, 22]. In this method, 18µl of different concentrations of plant extracts (31.25-1000µg/ml) were taken into a 96 well plate; then 90µl of 10% Folin-Ciocalteu reagent and 90µl of 7.5% sodium bicarbonate solution were added to it. After that, the plate was incubated in dark at 45^0C for 45 mins and the absorbance was measured at 765 nm in triplicate. Gallic acid (31.25-1000µg/ml) was used for calibration of standard curve. The results were expressed as milligram Gallic acid equivalent per gram of dried plant material (mg GAE/g).

2.5.3. Estimation of Total Flavonoid Content (TFC)

The total flavonoid content in plant extracts was estimated by aluminium chloride spectrophotometric method [15, 22]. In this method, 100µl of different concentrations of plant extracts (31.25-1000µg/ml) were taken into a 96 well plate; then 10µl of 5% sodium nitrite solution, 10µl of 10% aluminum chloride solution and 50µl of 4% sodium hydroxide solution were added to it and mixed well. After that, the absorbance was measured at 518 nm in triplicate. Quercetin (31.25-1000µg/ml) was used for calibration of standard curve. The results were expressed as milligram quercetin equivalent per gram of dried plant material (mg Q/g).

2.5.4. DPPH (2,2-diphenyl-1-picrylhydrazyl) Radical Scavenging Activity

The free radical scavenging capacity of the plant extracts was determined using DPPH assay [16, 22]. In this method, 100µl of different concentrations of plant extracts (31.25-1000µg/ml) were taken into a 96 well plate; then 100µl of 100µM DPPH solution was added to it and the plate was incubated in dark at room temperature for 30mins. After that, absorbance was measured at 517 nm in triplicate. Control sample containing 100µl of methanol and DPPH without any extract was prepared and ascorbic acid (31.25-1000µg/ml) was used for calibration of standard curve. The antioxidant activity of the extracts, expressed as inhibition percentage of DPPH free radicals, was calculated using

$$\text{Scavenging effect (\%)} = [(\text{Abs of control} - \text{Abs of sample}) / \text{Abs of control}] \times 100$$

The radical scavenging effect (%) vs. the extract concentration (µg/ml) was plotted as a graph, and the obtained regression equation was used to calculate the IC_{50} value (the concentration of extract or standard that can inhibit 50% of the DPPH). Lower the IC_{50} value, higher the antioxidant capacity.

2.5.5. Ferric Reducing Antioxidant Power (FRAP) Assay

The ferric reducing activity of each sample was determined using the FRAP assay, as described by Benzie and Strain with some modifications [17, 22]. In this method, 15µl of different concentrations of plant extracts (31.25-1000µg/ml) were taken into a 96 well plate; then 135µl of freshly prepared FRAP reagent was added to it and the plate was incubated in dark at room temperature for 30mins. After that, absorbance was measured at 593 nm in triplicate using acetate buffer as the blank. Ascorbic acid (31.25-1000µg/ml) was used for calibration of standard curve. The results were expressed as milligram ascorbic acid equivalent per gram of dried plant material (mg AAE/g).

2.6. Statistical Analysis

All the experimental measurements were carried out in triplicate and are expressed as an average of the three analyses. The IC_{50} value was calculated using linear regression analysis.

3. Result and Discussion

3.1. Qualitative Screening of Phytochemicals (Polyphenols and Flavonoids)

The initial screening of phytochemical of the aqueous and organic extracts of the dried leaves of *Ocimum gratissimum* was performed to investigate and identify the common bioactive compounds (polyphenols and flavonoids etc.) which were present in the sample which are mainly responsible for its antioxidant activity. The results of qualitative analysis of various phytochemicals present in the samples were given in **Table 3**. It was concluded from the results that the hot water extract of sun dried and microwave dried samples, cold water extract of shade dried and hot air oven dried samples, methanol extract of both shade dried and microwave dried samples, and butanol extract of both sun dried and hot air oven dried samples of African Basil contain fairly good amount of phytochemicals (mainly polyphenols and flavonoids). Hence these samples were selected for qualitative analysis of various antioxidants as well as total antioxidant activity test.

Table 3 Phytochemical screening of various extracts of dried leaves of African Basil

Sample Type	**Qualitative Assay**							
	Polyphenol Test				***Flavonoid Test***			
	Aqueous Extract		***Organic Extract***		***Aqueous Extract***		***Organic Extract***	
	Hot Water	***Cold Water***	***Methanol***	***Butanol***	***Hot Water***	***Cold Water***	***Methanol***	***Butanol***
Sun Dried	+	-	-	+	++	+	+	++
Shade Dried	+	++	++	+	+	++	+	-
Hot Air Oven Dried	-	+	-	+	+	++	+	++
Microwave Dried	++	+	++	+	++	+	++	+

++ = Very good detection, + = Good detection, - = Not detected

3.2. Quantitative Analysis of Phytochemicals

3.2.1. Estimation of Total Polyphenol Content (TPC)

The results of total polyphenol content (TPC) in various dried samples with respect to various solvents were given in **Table 4**. The total polyphenol content was expressed as Gallic acid equivalent (GAE) per g of dried sample. From **Table 4**, it was observed that the maximum amount of total polyphenol content was present in the hot water extract of microwave dried sample; measured 17.48 ± 0.89 mg GAE/g of dried sample. In butanol extract of hot air oven dried sample, it was measured to be 10.55 ± 0.84 mg GAE/g of dry weight, which was second highest in compare to other samples. In methanol extract of microwave dried and shade dried sample, the total polyphenol content were 8.74 ± 0.73 mg GAE/g and 6.01 ± 0.65 mg GAE/g of dried sample respectively. In cold water extract of shade dried sample, it was 4.80 ± 0.55 mg GAE/g of dried sample, which was quite low in compare to other samples. The total polyphenol content (TPC) of the hot water extract of sun-dried sample was 1.93 ± 0.32 mg GAE/g of dried sample, which was least in compare to other samples.

Table 4 Total polyphenol content in various extracts of African Basil

Sample Type	**TPC Content (mg GAE/g of dried sample)**			
	Aqueous Extract		***Organic Extract***	
	Hot Water Extract	***Cold Water Extract***	***Methanol Extract***	***Butanol Extract***
Sun Dried	1.93 ± 0.32			5.88 ± 0.53
Shade Dried		4.80 ± 0.55	6.01 ± 0.65	
Hot Air Oven Dried		5.96 ± 0.49		10.55 ± 0.84
Microwave Dried	17.48 ± 0.89		8.74 ± 0.73	

According to the report published by Igbinosa et al., [18]; total polyphenol content of the methanol extract of *Ocimum gratissimum* (19.21 ± 1.25 mg TAE/g DW) was found to be higher in compare to the acetone (10.21 ± 2.20 mg TAE/g DW) and aqueous extract (12.02 ± 2.05 mg TAE/g DW) [18]. Acetone provided the maximum yield of polyphenol (127-900 mg GAE/g DW) in all *Ocimum* species, followed by methanol (102–800 mg GAE/g DW), ethanol (184–700 mg GAE/g DW), and water (60–500 mg GAE/g DW) as reported by Sharma et al., [19]. Kpètèhoto et al., [20] reported that the total polyphenol content of the ethanol extract of *Ocimum gratissimum* was found to be 56.59 mg GAE/100 g of sample. From the previously estimated data of total polyphenol content of the leaf extracts of *Ocimum gratissimum,* it was observed that our results were within the expected range and we observed that the hot water extract of microwave dried sample and butanol extract of hot air oven dried sample contain relatively higher total polyphenol in compare to other drying methods and solvent extraction respectively.

3.2.2. Estimation of Total Flavonoid Content (TFC)

The results of total flavonoid content (TFC) in various dried samples with respect to various solvents were given in **Table 5**. The quantification of total flavonoid content was expressed as quercetin equivalent (QE) per g of dried sample. From the **Table 5**, it was observed that the highest amount of total flavonoid content was present in the butanol extract of sun-dried sample, which was estimated to be 652.59 ± 3.58 mg QE/g of dried sample, whereas in the same solvent extract of hot air oven dried sample, it was observed to be 610.72 ± 3.71 mg QE/g of dry weight. It was second highest in compare to other samples. In hot water extract of microwave dried and sun-dried sample, the total flavonoid content were observed to be 536.33 ± 3.54 mg QE/ g and 261.73 ± 2.34 mg QE/ g of dried sample respectively. In cold water extract of shade dried sample, it was 115.89 ± 2.09 mg QE/g of dried sample, which was quite low in compare to other samples. The total flavonoid content of the methanol extract of microwave dried sample was 100.63 ± 1.84 mg QE/g of dried sample which was least in compare to other samples.

Table 5 Total flavonoid content in various extracts of African Basil

Sample Type	**TFC Content (mg QE/g of dried sample)**			
	Aqueous Extract		***Organic Extract***	
	Hot Water Extract	***Cold Water Extract***	***Methanol Extract***	***Butanol Extract***
Sun Dried	261.73 ± 2.34			652.59 ± 3.58
Shade Dried		115.89 ± 2.09	129.73 ± 2.07	
Hot Air Oven Dried		159.01 ± 1.98		610.72 ± 3.71
Microwave Dried	536.33 ± 3.54		100.63 ± 1.84	

Total flavonoid content of the methanol extract of *Ocimum gratissimum* (15.57 ± 0.56 mg QE/g DW) was found to be higher in compare to acetone (12.03 ± 2.52 mg QE/g DW) and aqueous extract (11.50 ± 2.51 mg QE/g DW) as reported by Igbinosa et al., [18]. Acetone provided the maximum yield of flavonoids (9 - 319 mg RU/g DW) in all *Ocimum* species, followed by ethanol (13 – 225 mg RU/g DW), methanol (13 – 176 mg RU/g DW), and water (4 – 98 mg RU/g DW) as reported by Sharma et al., [19]. Kpètèhoto et al., [20] also reported that the total flavonoid content of the ethanol extract of *Ocimum gratissimum* was found to be 13.71 mg QE/100 g of sample. From the above reported estimated data of total flavonoid content of the leaf extracts of *Ocimum gratissimum,* it was observed that our results were within the expected

range and our observation concluded that the butanol extract of sun dried and hot air oven dried sample contain relatively higher total flavonoid content in compare to samples prepared and extracted by other drying methods and solvent extraction respectively.

3.2.3. DPPH (2, 2-diphenyl-1-picrylhydrazyl) Radical Scavenging Activity:

The free radical scavenging activity of the aqueous and organic extracts of dried African Basil (*Ocimum gratissimum)* was measured by DPPH assay. The quantification of free radical scavenging activity was expressed as half-maximal inhibitory concentration or IC_{50} value (µg/ml). The results of % free radical scavenging effects were given in **Table 6**. From **Table 6**, the highest free radical scavenging effect (16.44%) as well as the lowest IC_{50} value (95.03 ± 1.43 µg/ml) was observed in the cold water extract of shade dried sample. This observation indicates its highest antioxidant potential. The cold water extract of hot air oven dried sample and methanol extract of shade dried sample showing second highest (15.04%) and third highest (14.89%) free radical scavenging activity, and showing 103.91 ± 2.08 µg/ml, 104.90 ± 1.78 µg/ml IC_{50} value respectively. In the butanol and hot water extract of sun-dried sample, the percentage of free radical scavenging effect were 14.58% when the IC_{50} value was 107.19 ± 1.53 µg/ml and 14.24% when the IC_{50} value was 109.71 ± 1.78 µg/ml respectively. In the hot water extract of microwave dried sample, the percentage of free radical scavenging effect was observed as 9.41%, which was quite low and it's IC_{50} value was reported as 165.99 ± 2.78 µg/ml, which was comparatively high with respect to other samples. The lowest free radical scavenging activity (2.10%) and highest IC_{50} value (742.44 ± 3.27 µg/ml) were observed in the butanol extract of hot air oven dried sample, indicating its lowest antioxidant potential in compare to other samples.

Table 6 DPPH radical scavenging activity of various extracts of African Basil

Sample Type	**Half-maximal Inhibitory Concentration or IC_{50} Value (µg/ml) & % inhibition of DPPH**			
	Aqueous Extract		***Organic Extract***	
	Hot Water Extract	***Cold Water Extract***	***Methanol Extract***	***Butanol Extract***
Sun Dried	109.71 ± 1.78 (14.24%)			107.19 ± 1.53 (14.58%)
Shade Dried		95.03 ± 1.43 (16.44%)	104.90 ± 1.78 (14.89%)	
Hot Air Oven Dried		103.91 ± 2.08 (15.04%)		742.44 ± 3.27 (2.10%)
Microwave Dried	165.99 ± 2.78 (9.41%)		127.34 ± 2.03 (12.27%)	

According to the observation of Igbinosa et al., [18] the methanol extract of *Ocimum gratissimum* possess highest DPPH radical scavenging activity (85.45%), followed by the acetone (80.5%) and aqueous extract (78.5%). The IC_{50} values of the ethanol, ethyl acetate and aqueous extracts of *Ocimum gratissimum* for DPPH radical scavenging activity were 2.47 mg/ml, 1.58 mg/ml and 5.29 mg/ml respectively as reported by Ojo et al., [21]. Kpètèhoto et al., [20] also reported that the ethanol extract of *Ocimum gratissimum* shows highest DPPH radical scavenging activity (20-75%) in the concentration range from 12.5µg/ml to 500µg/ml. Hence from the previously estimated data of DPPH radical scavenging activity of the leaf extracts of *Ocimum gratissimum,* it was observed that our results were within the previous reported range and we concluded that the cold water extract of shade dried and hot air oven dried sample exhibited relatively higher free radical scavenging effect and lower IC_{50} values in compare to samples prepared and extracted by other drying methods and solvent extraction respectively.

3.2.4. Ferric Reducing Antioxidant Power (FRAP) Assay:

The results of ferric reducing antioxidant power assay of various dried samples with respect to various solvents was expressed as ascorbic acid equivalent (AAE) per g of dried sample and shown in **Table 7**. From **Table 7**, it was observed that the hot water extract of microwave dried sample possess highest ferric reducing activity (57.34 ± 1.89 mg AAE/g of dried sample) which indicates it's high antioxidant capacity, followed by the methanol extract of microwave dried (54.01 ± 1.93 mg AAE/g of dried sample) and shade dried sample (39.49 ± 1.53 mg AAE/g of dried sample) respectively. In the hot water extract of sun dried and cold water extract of shade dried sample, the ferric reducing activity were 36.29 ± 0.67 mg and 34.23 ± 1.03 mg AAE/g of dried sample respectively. In case of butanol extract of hot air oven dried sample, the ferric reducing activity was reported as 23.55 ± 0.87 mg AAE/g of dried sample, which was quite low in compare to other samples. The ferric reducing activity was 17.12 ± 0.43 mg AAE/g of dried sample in the butanol extract of sun-dried sample which was found to be least with respect to other samples.

Table 7 Ferric reducing activity of various extracts of Holy Basil

Sample Type	**Ferric Reducing Activity (mg AAE/g of dried sample)**			
	Aqueous Extract		***Organic Extract***	
	Hot Water Extract	***Cold Water Extract***	***Methanol Extract***	***Butanol Extract***
Sun Dried	36.29 ± 0.67			17.12 ± 0.43
Shade Dried		34.23 ± 1.03	39.49 ± 1.53	
Hot Air Oven Dried		34.20 ± 0.58		23.55 ± 0.87
Microwave Dried	57.34 ± 1.89		54.01 ± 1.93	

Ferric reducing activity of the methanol extract of *Ocimum gratissimum* was found to possess highest ferric reducing activity (508.19 ± 5.98 µmole Fe (II) /g DW), followed by the acetone (346.51 ± 8.54 µmole Fe (II) /g DW) and aqueous extract (159.83 ± 3.64 µmole Fe (II) /g DW) as reported by Igbinosa et al., [18]. Kpètèhoto et al., [20] also reported that the ferric reducing activity of the different concentrations of ethanol extract of *Ocimum gratissimum* was observed to lie in the range of 78.92 - 106.25 mMol AAE/g DW. From the previously estimated data of ferric reducing activity of the leaf extracts of *Ocimum gratissimum,* it was observed that our results were within the expected range and our observation is that the hot water extract and methanol extract of microwave dried sample exhibited relatively higher ferric reducing activity in compare to samples prepared and extracted by other drying methods and solvent extraction respectively.

3.2.5. Comparison of Individual and Total Antioxidant activity:

The results of TPC, TFC and total antioxidant activity (DPPH and FRAP) of various dried samples of African Basil (*Ocimum gratissimum*) with respect to aqueous extract (the maximum antioxidant activity observed among the hot and cold water extract of dried samples) and organic solvents (the maximum antioxidant activity, observed among the methanol and butanol extract of dried sample) were given in **Table 8** and **Figure 1**. From the results, it could be stated that the aqueous extract of microwave dried African Basil had been observed to show highest amount of TPC (17.48 ± 0.89 mg GAE/g dried sample), TFC (536.33 ± 3.54 mg QE/g of dried sample), and FRAP (57.34 ± 1.89 mg AAE/g of dried sample) but fourth highest amount of DPPH activity (165.99 ± 2.78 µg/ml) in compare to other dried samples. It was also observed that the organic solvent extract of sun-dried African Basil had shown highest amount of TFC (652.59 ± 3.58 mg GAE/g dried sample), second highest amount of DPPH (107.19 ± 1.53 mg QE/g of dried sample) but fourth highest amount of TPC (5.88 ± 0.53 mg GAE/g dried sample) and FRAP (17.12 ± 0.43 mg AAE/g of dried sample) in compare to other dried samples. Hence considering all the results presented in **Table 8** and **Figure 1** and comparing the presence of various individual level of TPC, TFC and total antioxidant activity (DPPH and FRAP) of various dried samples of African Basil, it may be concluded that the microwave dried leaves of African Basil have shown relatively higher antioxidant activity in aqueous extract and sun dried sample in organic solvent in compare to all other sample which was also found in the previous report of Sharma et al [12]. In shade drying method, prolonged time period to remove moisture as well as long time exposure to aerobic oxygen may be some of the reasons for the reduced overall antioxidant activity of the respective samples, whereas in hot air oven drying process, both temperature and time factors may reduce the overall antioxidant activity of the sample [21]. During microwave and sun drying process, quick removal of moisture and relatively short processing time [22] may be the reasons for preservation of the antioxidant components [23] present in the leaves of African basil. Hence, the present investigations showed that microwave and sun drying methods are the most effective process to retain the quality of the leaves of African Basil [24] and it also requires shorter drying period as compared to shade drying and hot air oven drying process.

Table 8 Individual and Total antioxidant content of various extracts of African Basil

Sample Type	**Antioxidant Content**							
	Aqueous Extract				**Organic Extract**			
	TPC (mg/g)	**TFC (mg/g)**	**DPPH (µg/ml)**	**FRAP (mg/g)**	**TPC (mg/g)**	**TFC (mg/g)**	**DPPH (µg/ml)**	**FRAP (mg/g)**
Sun Dried	1.93 ± 0.32	261.73 ± 2.34	109.71 ± 1.78	36.29 ± 0.67	5.88 ± 0.53	652.59 ± 3.58	107.19 ± 1.53	17.12 ± 0.43

Shade Dried	4.80 ± 0.55	115.89 ± 2.09	95.03 ± 1.43	34.23 ± 1.03	6.01 ± 0.65	129.73 ± 2.07	104.90 ± 1.78	39.49 ± 1.53
Hot Air Oven Dried	5.96 ± 0.49	159.01 ± 1.98	103.91 ± 2.08	34.20 ± 0.58	10.55 ± 0.84	610.72 ± 3.71	742.44 ± 3.27	23.55 ± 0.87
Microwave Dried	17.48 ± 0.89	536.33 ± 3.54	165.99 ± 2.78	57.34 ± 1.89	8.74 ± 0.73	100.63 ± 1.84	127.34 ± 2.03	54.01 ± 1.93

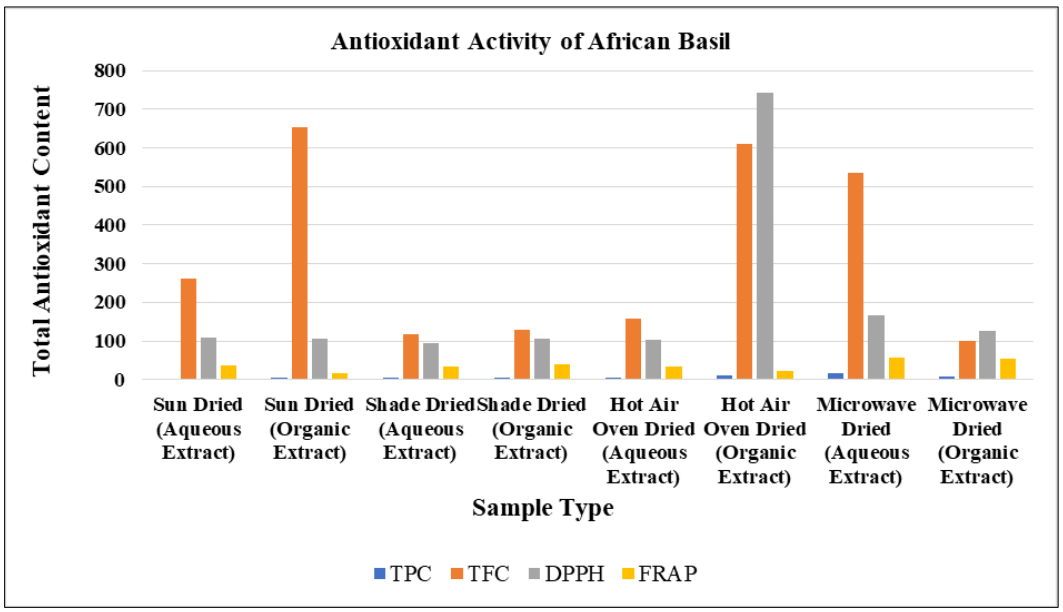

Figure 1 Individual and Total antioxidant content of various extracts of African Basil

4. Conclusion

Our investigations on various solvent extracts of dried leaves of African Basil (*Ocimum gratissimum)* revealed that the organic solvent extract of sun dried and aqueous extract of microwave dried leaves of African Basil could extract large amount of phenolic and flavonoid compounds and had strong antioxidant potential in compare to shade dried and hot air oven dried sample. Therefore, therapeutic and nutraceutical applications of the aqueous extract of microwave dried and organic solvent extract of sundried leaves of African Basil may be explored to incorporate the herbal antioxidants for implications in foods, nutrition and human health.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

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