Antioxidant activity of leaf and root extracts of *Baccaurea courtallensis* (Wight) Muell.-Arg., Euphorbiaceae.

Blessy Sharon Babu[*1] and K.Surekha[2]
[1] Research Scholar, Department of Biochemistry, Kongunadu Arts and Science College (Autonomous), Coimbatore-641029, Tamil Nadu.
[2]Associate professor, Department of Biochemistry, Kongunadu Arts and Science College (Autonomous), Coimbatore-641029, Tamil Nadu.

***Abstract*- The purpose of this study was to evaluate the antioxidant radical scavenging property of leaf and root crude aqueous extracts of *Baccaurea courtallensis* (Wight) Muell.-Arg., an endemic tree. The antioxidant activities of the leaf and root extracts of *B. courtallensis* were determined by using five *in vitro* radical scavenging assay; DPPH, Nitric oxide, ABTS, FRAP and Hydroxyl radical scavenging activity. The results showed statistically significant difference for DPPH and FRAP where the IC_{50} value for DPPH; LE is 1.5 µg/ml and RE is 1.0 µg/ml. The IC_{50} value for FRAP; LE is 201.24 µg/ml and RE is 383.1 µg/ml. The present study revealed that leaf and root extracts of *B. courtallensis* had antioxidant activity that protects against oxidative damage.**

***Keywords*- *In vitro* antioxidant activity, Oxidative stress, ROS, Leaf, Root and *B. courtallensis*.**

I. INTRODUCTION

Plant-based antioxidants, which are believed to be beneficial to human health is a kind of phytonutrient that helps to prevent various diseases. Nowadays, people face so many health issues due to the changes in life style, food habits, psychological stress etc. When free radicals interact with nucleic acids of mitochondria and nucleus of the cell it causes mutation in the DNA strands [1]-[2]. Reactive oxygen species (ROS) generated in the body through a process called oxidation which is a biochemical reaction that can produce free radicals. Presence of free radicals in the body could lead to chain reactions by damaging cells metabolism. To neutralize this oxidative state, plant-based antioxidant compounds are used to terminate these chain reactions by inhibiting oxidation process [3]. High metabolic activity takes place in the brain which is sensitive to oxidative stress [4].

Over years, 7000 different types of flavonoids are discovered by scientists around the world. Flavonoids can be used to prevent many diseases such as cardiovascular diseases, cancer and have other biological activities such as anti-aging, anti-mutagenic action etc [5]. Flavonoids [6], L-ascorbic acid also known as vitamin C, tocopherol also well known as vitamin E, alkaloids, phenols, tannins, saponins etc are different types of plant based anti-oxidants found in different parts of plant in different concentrations. Phenolic compounds have a scavenging property that is by donating an electron it can neutralize free radicals [7]-[8]. Also compounds like ascorbic acid, tocopherol, carotenes, polyphenols, phytoestrogens and flavonoids are antioxidants present in plants which have ability to trap free radicals such as peroxide, hydroperoxide or lipid peroxyl by inhibiting the oxidative mechanisms that lead to degenerative chronic diseases [9].

Baccaurea courtallensis (Wight) Muell.-Arg. (Euphorbiaceae) commonly known as moottil palam, or onapalam are mostly seen in semi evergreen and evergreen forests. Well this tree is an endemic found in the Western Ghats and fruits are edible . In a survey conducted by Remesh *et al*., in 2016 conservation status of this tree is at lower risk and are mostly used among the elderly tribal people of Palakkad District, Kerala, India. Depth study of this endemic tree are lacking [10]. In malayalam, its commonly called moottilthoori, moottilpazham and some tribal community call this plant as keranda. The phytochemical screening of *Baccaurea courtallensis* (Wight) Muell.-Arg. showed presence of useful bioactive compounds [11].

Due to the lack of scientific documentation of its potential pharmacological properties, the objective of our study was to evaluate the antioxidant activity of leaf and root crude aqueous extracts of *Baccaurea courtallensis* (Wight) Muell.-Arg. through direct *in-vitro* free radical scavenging methods.

II. MATERIALS AND METHODS

A. PLANT COLLECTION AND AUTHENTICATION

Baccaurea courtallensis (Wight) Muell.-Arg. (= *Pierardia courtallensis* Wight) plant specimen (leaf and root) were collected from the Western Ghats of Wayanad district, Kerala (India). The plant was identified and authenticated by Botanical Survey of India, Coimbatore; No: BSI/SRC/5/23/2017/Tech/1276.

B. SAMPLE PREPARATION

Plant samples (leaf and root) collected were cleaned using tap water to remove the soil and then rinsed with deionised water. Plant samples were shade dried for 4-5 weeks at room temperature. These samples were then grounded to a fine powder and were stored in air tight containers for further analysis.

C. EXTRACTION PROCEDURE

Leaf and root crude aqueous extraction of *Baccaurea courtallensis* (Wight) Muell.-Arg. was done using water bath at 75-90° Celsius for 8-12 hours. The extracts were filtered using Whatsmann No. 1 filter paper and evaporated to dryness which was then stored in sterile containers in the refrigerator till further analysis.

D. *IN VITRO STUDIES: ANTIOXIDANT SCAVENGING ACTIVITY*

DPPH (2,2-diphenyl-1-picrylhydrazyl), ABTS·+ (2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid)) are brought from Sigma-Aldrich. L-ascorbic acid, rutin and butylated hydroxyl toluene were obtained from Hi-media Laboratories Pvt. Ltd, Mumbai, India. All other reagents and chemicals used in the antioxidant scavenging experiments were of analytical grade.

1) DPPH (2,2-diphenyl-1-picrylhydrazyl) scavenging assay:

The antioxidant activity method was developed by Blois (1958). Various concentration of the leaf and root extracts were taken in different test tubes which was made up to 2 ml of DPPH solution (0.2 mM of DPPH diluted in 80% of methanol). All test tubes was shaken well. L-ascorbic acid was used as the standard for comparison. After incubation for 30 minutes in dark at room temperature, absorbance was recorded at 517 nm. DPPH alone serves as the blank. The percent DPPH radical scavenging was calculated with the equation:

$$\text{Inhibition } \% \quad = \frac{(Absorbance\ control - Absorbance\ \ sample/standard)}{(Absorbance\ control)} * 100$$

where, *Absorbance control* is the absorbance of the blank, *Absorbance sample/standard* is the absorbance of the leaf/root extracts or standard (L-ascorbic acid) [12],[13]-[14]. Calibration curve was plotted with % DPPH scavenged versus concentration of standard (L-ascorbic acid).

2) Nitric oxide scavenging activity assay:

Sodium nitroprusside breaks down to release nitric oxide (NO), which interacts with oxygen to form reactive nitrogen species (RNS) which is a free radical, which can be estimated by the use of Griess Illosvoy reaction by Garrat, 1964. The nitric oxide scavenging activity was evaluated according to the modified method of Sreejayan and Rao (1997). Various concentrations of extract was prepared. 2 ml of sodium nitroprusside (10 mM) and 0.5 ml of phosphate buffered saline (0.1M of PBS, pH-7.4) was added to extract prepared (1gm/30ml) in tubes of different concentrations. The reaction mixture was incubated at 25°C for 150 min. After incubation, 0.5 ml aliquot was removed and 0.5 ml of Griess reagent: (1% (w/v) sulphanilamide, 2% (v/v) H_3PO_4 and 0.1% (w/v) naphthyl ethylene diamine hydrochloride) was added. Pink color were developed and absorbance were read at 546 nm in

uv-visible spectrophotometer [15]. Rutin (1mg/ml) was used as reference standard. Sodium nitroprusside in PBS (2 ml) was used as control. The nitric oxide radicals scavenging activity of the extracts and rutin was calculated according to the following equation:

$$\text{Inhibition } \% \quad = \frac{(Absorbance\ control - Absorbance\ \ sample/standard)}{(Absorbance\ control)} * 100$$

where, *Absorbance control* is the absorbance of the blank, *Absorbance sample/standard* is the absorbance of the leaf/root extracts or rutin as standard.

3) ABTS·+ (2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid)) radical scavenging activity:

Assay was conducted based on the method of Re *et al*., 1999. The ABTS·+ aqueous solution (7 mM) was oxidized with potassium persulfate (2.45 mM) in distilled water for 12-24 hours in the dark at room temperature. The ABTS·+ solution was diluted with 50 % ethanol to an absorbance of 0.70 (± 0.05) at 734 nm. An aliquot (200-1000 µl) of each sample (100 µg/ml) was made up to 2000 µl ABTS·+ solution and the absorbance was read at 734 nm after 2 and 10 minutes using uv-visible spectrophotometer. L-ascorbic acid was used as a reference standard. Percentage ABTS·+ radical scavenging was calculated with the following equation:

$$\text{Inhibition } \% \quad = \frac{(Absorbance\ control - Absorbance\ \ sample/standard)}{(Absorbance\ control)} * 100$$

where, *Absorbance control* is the absorbance of the blank, *Absorbance sample/standard* is the absorbance of the leaf/root extracts or L-ascorbic acid as standard [16]-[17].

4) FRAP (ferric reducing-antioxidant power) assay:

Ferric reducing-antioxidant power was determined according to the method of Oyaizu, 1986. Aqueous plant extracts were mixed with 2.5 ml of 0.2M sodium phosphate buffer (pH 6.6) and 2.5 ml of 1% potassium ferricyanide. The mixture was incubated at 50 °C for 20 min. After 2.5 ml of 10% TCA (trichloroacetic acid) (w/v) were added, the mixture was centrifuged at 3000 rpm for 10 min. Supernatant (2.5 ml) were mixed with 2.5 ml deionised water and 0.5 ml of ferric chloride (0.1%), were incubated for 10 minutes and the absorbance was read at 700 nm using uv-visible spectrophotometer. Increase of absorbance indicates higher reducing power in the sample. The results are expressed as mean ± standard deviation. BHT (1mg/ml) were used as standards [18]-[19]. Calibration curve was plotted with mean of absorbance of FRAP versus concentration of standard Butylated Hydroxyl Toluene (BHT).

5) Hydroxyl radical scavenging activity:

The hydroxyl radical scavenging activity was measured by the method of Rajeshwar *et al*., 2005 with little modifications by Balakrishnan *et al*., 2018. 5.0 ml of reaction mixture volume contained, 1.0 ml of 1.5 mM $FeSO_4$, 0.7 ml of 6 mM hydrogen peroxide, 0.3 ml of 20 mM sodium salicylate and 3.0 ml of different concentrations (50-250 µg) of sample were mixed well and incubated for 1 h at 37 °C. Absorbance of the hydroxylated salicylate complex was measured at 562 nm. L-ascorbic acid was used as reference standard. Percentage of inhibition were determined by comparison of L-ascorbic acid standard [20]-[21].

The percentage of scavenging potential [15] was calculated as,

$$\text{Inhibition } \% \quad = \frac{(Absorbance\ control - Absorbance\ \ sample/standard)}{(Absorbance\ control)} * 100$$

where, *Absorbance control* is the absorbance of the blank, *Absorbance sample/standard* is the absorbance of the leaf/root extracts or L-ascorbic acid as standard.

E. *STATISTICAL ANALYSIS*

Data were subjected to a mean ± standard deviation of the triplet value obtained. Statistical analysis was performed by One-Way Analysis of Variance (ANOVA) in IBM SPSS statistic 20. A significant difference was considered statistically significant by least significance difference (LSD) at $p \leq 0.05$.

III. RESULTS AND DISCUSSION

Oxidative modification of cellular molecules caused by ROS played a major role in a variety of common diseases and also in age-related degenerative problems [22]. There is indeed a growing interest in free-radical biology and a lack of effective therapies for various chronic diseases. A study of the efficacy of antioxidants in the protection against these disease outbreaks is very much required and these antioxidants are nothing but chemical substances that could help in reducing or preventing the oxidation [23]. Five in-vitro scavenging assays are used in this study to assess potential antioxidant activity of leaf and root crude aqueous extracts of *Baccaurea courtallensis* (Wight) Muell.-Arg., an endemic tree.

1) Effects of BCE on DPPH scavenging activity:

The DPPH (2,2-diphenyl-1-picrylhydrazyl) method is preferred as it is fast, easy and reliable and requires no special reaction and device. DPPH is a stable, synthetic radical not disintegrating in to the water, methanol, or ethanol. The free radical scavenging of extracts depends on the ability of antioxidant compounds to lose hydrogen. DPPH free radical can easily receive an electron or hydrogen from antioxidant molecules to become a stable molecule [24]. The most useful standard for preparation of calibration graph is L-ascorbic acid (Vitamin C) [25]. The results is shown in **Fig. 1**, BCE (leaf and root extracts of *B. courtallensis*), LE is leaf extract and RE is root extract. The leaf extracts (LE) of BCE exhibited 10.52 %, 13.68 %, 15.48 %, 20.73 % and 23.19 % of scavenging activity at 10, 20, 30, 40 and 50 µg/ml concentrations respectively. Whereas root extracts (RE) of BCE exhibited 8.73 %, 14.19 %, 16.49 %, 22.37 % and 25.50 % with the same concentrations. On the other hand, L-ascorbic acid standard showed 19.59 %, 24.61 %, 25.94 %, 27.84 % and 33.30 % of activity with the same concentrations. L-ascorbic acid is showing higher percentage of inhibition than the results obtained by LE and RE. The IC_{50} values of LE and RE crude aqueous extracts of BCE are 1.5 µg/ml and 1 µg/ml respectively (Table 1). The lower IC_{50} value indicates higher antioxidant activity and vice versa. These reductions probably are result of the certain oxidation of the antioxidants present in the leaf and root extracts of *B.courtallensis* (BCE). There is a statistically significant difference ($p<0.05$) observed in DPPH scavenging activity.

TABLE I
Percentage of inhibition and IC_{50} values of DPPH scavenging effect of *B.courtallensis* extracts (µg/ml)

Sample	Concentration (µg/ml)					IC_{50} (µg/ml)
	10	20	30	40	50	
Leaf Extract (LE)	10.52 ± 1.30	13.68 ±1.29	15.48 ± 1.10	20.73 ± 2.20	23.19 ± 1.86	1.5^{C}
Root Extract (RE)	8.73 ± 1.36	14.19 ± 1.60	16.49 ± 1.14	22.37 ± 1.28	25.5 ± 2.33	1^{B}
Standard (L-ascorbic acid)	19.59 ± 3.60	24.61 ± 1.35	25.94 ± 1.69	27.84 ± 1.76	33.3 ± 2.09	0.5^{A}

Values are expressed as mean ± standard deviation, (n=3); IC_{50}- Inhibition coefficient by 50%;
Superscript letters (A-C) are increasing order of IC_{50} values. Statistical comparison: Standard is compared with LE and RE.

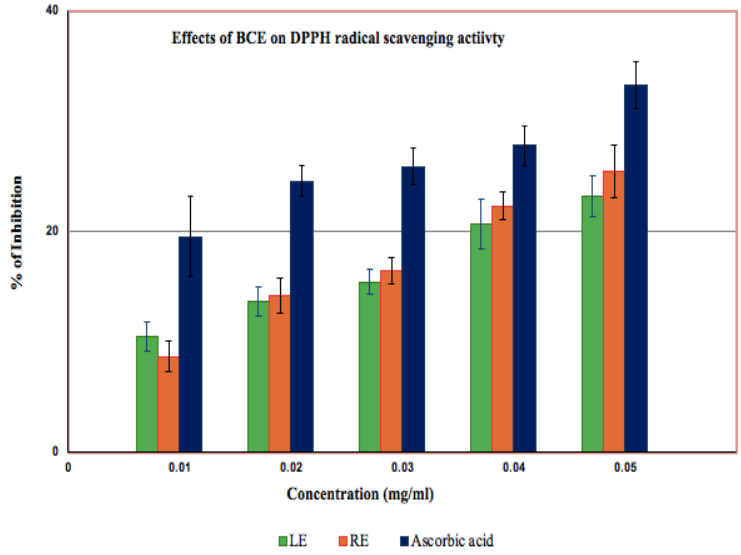

Figure: 1, Graphical presentation of DPPH scavenging activity of BCE (leaf and root extracts of *Baccaurea courtallensis*) where LE is leaf extract and RE is root extract. Statistical comparison: Standard is compared with LE and RE.

The efficacy of BCE on DPPH scavenging was found to be dose dependent. There was enhancement in DPPH scavenging with increase in the concentration of BCE and L-ascorbic acid standard. Comparison to our study, reports of DPPH radical scavenging activity of leaf and root parts of *H.radicata,* aqueous leaf extract had higher IC_{50} value (595.23 µg/mL) which indicated its poor scavenging activity [26].

2) *Effects of BCE on Nitric oxide scavenging activity*

Nitric oxide is a free radical and excess production of these radicals contributes to certain inflammatory disease conditions [27]. The results obtained are shown in **Fig 2.** BCE (leaf and root extracts of *B. courtallensis*), LE is leaf extract and RE is root extract. The leaf extracts (LE) of BCE exhibited 8.20 %, 28.61 %, 40.83 %, 57.89 % and 66.03 % of scavenging activity at 500, 1000, 1500, 2000 and 2500 µg/ml concentrations respectively. Whereas root extracts (RE) exhibited 21.00%, 28.61%, 40.89 %, 53.40 % and 80.90 % with the same concentrations. On the other hand, rutin standard showed 8.53 %, 17.77 %, 32.94 %, 39.07 % and 49.09 % of activity with the same concentrations. The IC_{50} values of LE and RE crude aqueous extracts are 1834 µg/ml and 1676 µg/ml respectively (Table 2). In nitric oxide scavenging activity, there is no statistically significant difference ($p<0.05$) observed.

TABLE II
Percentage of inhibition and IC_{50} values of NO scavenging effect of *B.courtallensis* extracts (µg/ml)

Sample	Concentration (µg/ml)					IC_{50} (µg/ml)
	500	1000	1500	2000	2500	
Leaf Extract (LE)	8.2 ± 0.20	28.61 ± 0.6	40.83 ± 0.25	57.89 ± 0.96	66.03 ± 0.81	1834^{B}
Root Extract (RE)	21 ± 0.79	28.61 ± 0.37	40.89 ± 0.32	53.4 ± 0.32	80.9 ± 2.89	1676^{A}
Standard (Rutin)	8.53 ± 0.12	17.77 ± 0.57	32.94 ± 0.6	39.07 ± 0.58	49.09 ± 0.95	2514^{C}

Values are expressed as mean ± standard deviation, (n=3); IC_{50}- Inhibition coefficient by 50%;
Superscript letters (A-C) are increasing order of IC_{50} values. Statistical comparison: Standard is compared with LE and RE.

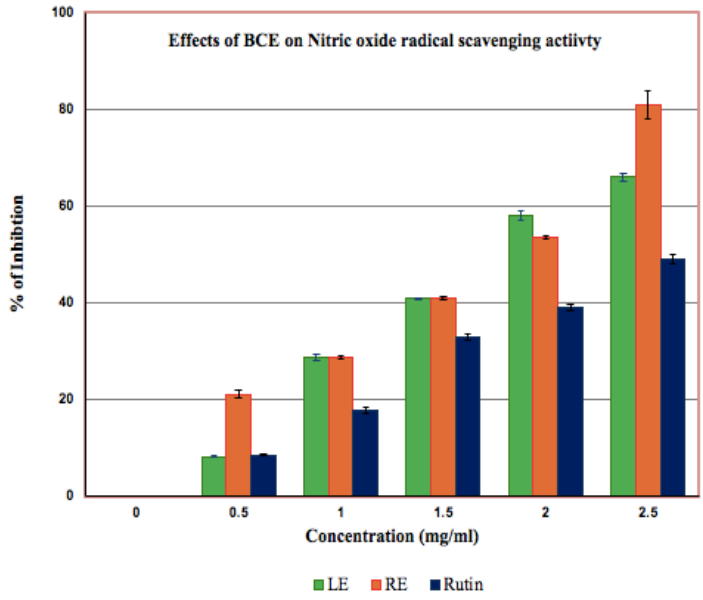

Figure: 2, Graphical presentation of nitric oxide scavenging activity of BCE (leaf and root extracts of *Baccaurea courtallensis*) at different concentrations where LE is leaf extract and RE is root extract. Statistical comparison: Standard is compared with LE and RE.

Chipiti *et al.*, reported the lower results of IC_{50} value of nitric oxide scavenging activity of aqueous root extracts than the aqueous leaf extracts of *A. antunesiana* comparison to our result. This difference can be explained by the way in which the radicals of nitric oxide are produced and the different physical and chemical properties of the antioxidants present in the extracts [28].

3) *Effects of BCE on ABTS·+ scavenging activity*

ABTS·+ scavenging activity assay is an indirect method which merely measures the ABTS·+ activity to abstract a hydrogen atom or electron from the compounds being studied. The method's simplicity has made it very popular and suitable for assessing compounds' ability to act as donors of hydrogen / electron and evaluating their antioxidant activity. ABTS·+, a cation-free radical soluble in both water and organic media, is produced by the potassium persulfate reaction of ABTS solution [29]. The results is shown in **Fig 3**., BCE (leaf and root extracts of *B. courtallensis*), LE is leaf extract and RE is root extract. The leaf extracts (LE) of BCE exhibited 13.10 %, 61.24 %, 77.69 %, 82.37 % and 83.64 % of scavenging activity at 20, 40, 60, 80 and 100 µg/ml concentrations respectively. Whereas root extracts (RE) exhibited 2.59 %, 22.77 %, 40.49 %, 71.48 % and 82.50 % with the same concentrations. On the other hand, L-ascorbic acid standard showed 12.12 %, 49.81%, 63.16 %, 73.74 % and 85.65 % of activity with the same concentrations. The IC_{50} values of LE and RE crude aqueous extracts are 46.73 µg/ml and 64.69 µg/ml respectively (Table 3). In ABTS·+ scavenging activity, there is no statistically significant difference ($p<0.05$) observed between the groups.

TABLE III
Percentage of inhibition and IC_{50} values of ABTS scavenging effect of *B.courtallensis* extracts (µg/ml)

Sample	Concentration (µg/ml)					IC_{50} (µg/ml)
	20	40	60	80	100	
Leaf Extract (LE)	13.1 ± 3.76	61.24 ± 1.08	77.69 ± 3.76	82.37 ± 0.16	83.64 ± 1.24	46.73^{A}
Root Extract (RE)	2.59 ± 0.72	22.77 ± 1.52	40.49 ± 1.68	71.48 ± 2.48	82.5 ± 1.58	64.69^{C}
Standard (L-ascorbic acid)	12.12 ± 4.03	49.81 ± 0.95	63.16 ± 2.9	73.74 ± 4.35	85.65 ± 2.08	52.89^{B}

Values are expressed as mean ± standard deviation, (n=3); IC_{50}- Inhibition coefficient by 50%;
Superscript letters (A-C) are increasing order of IC_{50} values. Statistical comparison: Standard is compared with LE and RE.

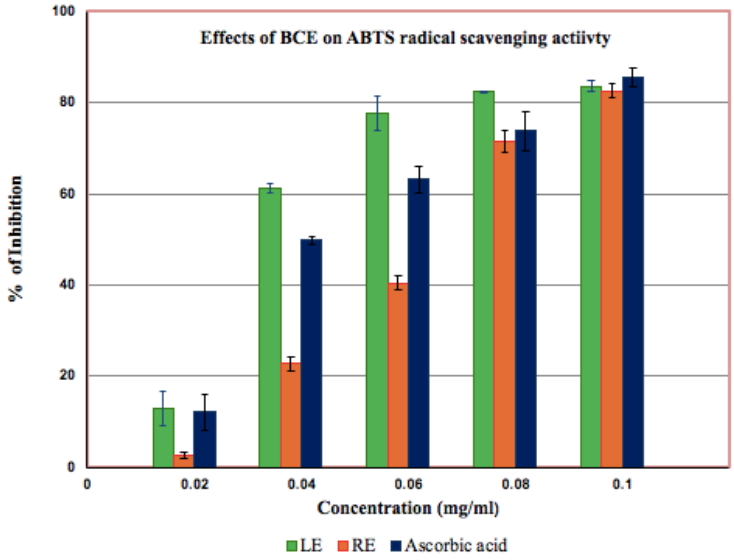

Figure: 3, Graphical presentation of ABTS·+ scavenging activity of BCE (leaf and root extracts of *Baccaurea courtallensis*) where LE is leaf extract and RE is root extract. Statistical comparison: Standard is compared with LE and RE.

Ethyl acetate leaf extracts of *A. indicum* exhibited lower IC_{50} value that of the root extracts of *A. indicum* which is similar to our study [30]. As indicated in the literature, the ability to scavenge free radicals against ABTS or DPPH was correlated with the concentration, chemical structures and degree of polymerization of antioxidant compounds [31].

4) Effects of BCE on FRAP scavenging activity

FRAP is simple, fast and can be used with semi-automatic or automated protocols. The mechanism of the FRAP is based on transferring electron rather than hydrogen atom. FRAP assessment is based on pH ability to reduce Fe^{3+} to Fe^{2+} [32]. The results are shown in **Fig 4**., BCE (leaf and root extracts of *B. courtallensis*), LE is leaf extract and RE is root extract. The absorbance (Optical density) was read at 700 nm. The leaf extracts (LE) of BCE exhibited 0.908, 1.584, 2.931, 3.217 and 3.370 of reducing power activity at 500, 1000, 1500, 2000 and 2500 µg/ml concentrations respectively. Whereas root extracts (RE) exhibited 0.713, 1.048, 1.922, 2.801 and 2.8 with the same concentrations. On the other hand, butylated hydroxyl toluene (BHT) standard showed 0.286, 0.448, 0.67, 0.829 and 0.960 of activity with the same concentrations. Increase of absorbance indicated increase of reducing power in the sample [33]. The IC_{50} values of LE and RE crude aqueous extracts of BCE are 201.24 µg/ml and 383.1 µg/ml respectively (Table 4). There is a statistically significant difference ($p<0.05$) observed in FRAP scavenging activity between groups.

TABLE IV
Absorbance at 700 nm and IC_{50} values of FRAP scavenging effect of *B. courtallensis* extracts (µg/ml)

Sample	Concentration (µg/ml)					IC_{50} (µg/ml)
	500	1000	1500	2000	2500	
Leaf Extract (LE)	0.91 ± 0.009	1.58 ± 0.098	2.93 ± 0.06	3.22 ± 0.005	3.37 ± 0.263	201.2^{A}
Root Extract (RE)	0.71 ± 0.007	1.05 ± 0.017	1.92 ± 0.039	2.80 ± 0.163	2.8 ± 0.18	383.1^{B}
Standard (BHT)	0.29 ± 0.005	0.45 ± 0.010	0.67 ± 0.009	0.83 ± 0.016	0.96 ± 0.034	1165.3^{C}

Values are expressed as mean ± standard deviation, (n=3); IC_{50}- Inhibition coefficient by 50%;
Superscript letters (A-C) are increasing order of IC_{50} values. Statistical comparison: Standard is compared with LE and RE.

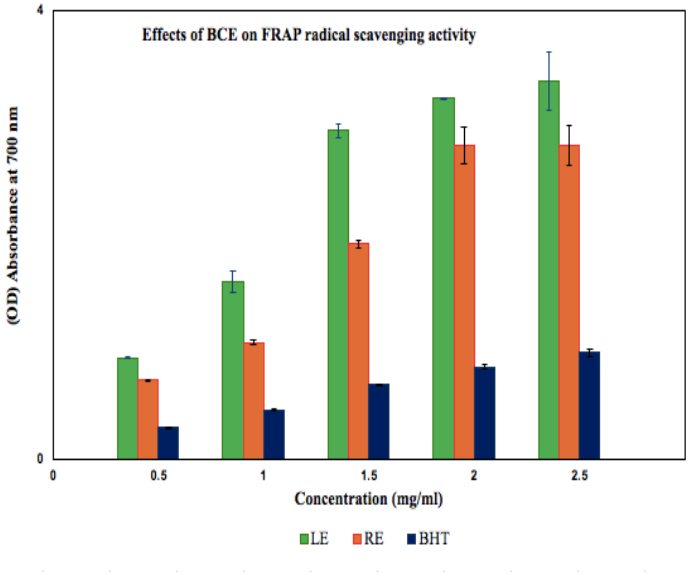

Figure: 4, Graphical presentation of FRAP scavenging activity of BCE (leaf and root extracts of *Baccaurea courtallensis*) where LE is leaf extract and RE is root extract. Statistical comparison: Standard is compared with LE and RE.

Comparison to our results, a similar reports of FRAP scavenging activity was observed in the leaf extract of *T. subulata* that had the highest antioxidant capacities compared with extracts of other plant parts [34].

5) Effects of BCE on hydroxyl radical scavenging activity

Hydrogen peroxide is gradually decomposed into oxygen and water, leading to the production of hydroxyl radicals (OH·) capable of initiating lipid peroxidation and causing DNA damage. Hydroxyl radicals are scavenged by antioxidants [35]. The results are shown in **Fig 5**., BCE (leaf and root extracts of *B. courtallensis*), LE is leaf extract and RE is root extract. The leaf extracts (LE) of BCE exhibited 47.21%, 62.29 %, 65.44 %, 78.03 % and 87.31% of scavenging activity at 50, 100, 150, 200 and 250 µg/ml concentrations respectively. Whereas, Root extracts (RE) exhibited 40.76 %, 57.11 %, 78.16 %, 81.07 % and 94.08 % with the same concentrations. On the other hand, L-ascorbic acid standard showed 80.47 %, 86.39 %, 89.64 %, 93.02 % and 95.88 % of activity with the same concentrations. The IC_{50} values of LE and RE crude aqueous extracts of BCE are 102.93 µg/ml and 100.63 µg/ml respectively. Hydroxyl radical scavenging activity of LE, RE and standard compounds with low to higher IC_{50} value followed the order, L-ascorbic acid > RE > LE (Table 5). In hydroxyl radical scavenging activity, there is no statistically significant difference ($p<0.05$) observed.

TABLE V
Percentage of inhibition and IC_{50} values of Hydroxyl scavenging effect of *B. courtallensis* extracts (µg/ml)

Sample	Concentration (µg/ml)					IC_{50} (µg/ml)
	50	100	150	200	250	
Leaf Extract (LE)	47.21 ± 1.06	62.29 ± 1.12	65.44 ± 0.68	78.03 ±0.997	87.31 ± 0.977	102.93^{C}
Root Extract (RE)	40.76 ± 0.474	57.11 ± 0.90	78.16 ± 0.98	81.07 ± 1.01	94.08 ± 0.87	100.63^{B}
Standard (L-ascorbic acid)	80.47 ± 1.292	86.39 ± 0.98	89.64 ± 1.063	93.02 ± 1.77	95.88 ± 0.32	43.50^{A}

Values are expressed as mean ± standard deviation, (n=3); IC_{50}- Inhibition coefficient by 50%;
Superscript letters (A-C) are increasing order of IC_{50} values. Statistical comparison: Standard is compared with LE and RE.

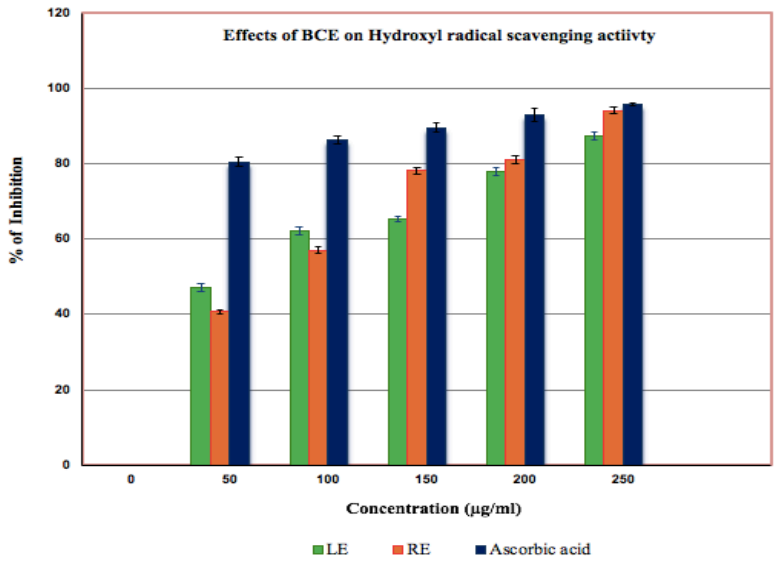

Figure: 5, Graphical presentation of hydroxyl radical scavenging activity of BCE (leaf and root extracts of *Baccaurea courtallensis*) where LE is leaf extract and RE is root extract. Statistical comparison: Standard is compared with LE and RE.

Approximately 80% of the world's population, including in both developed and developing countries, use the active chemical compounds of different plants as their traditional therapies, and these medicinal compounds are reported to reduce the more side effects than synthetic drugs [36]. Antioxidants are compounds that can delay or inhibit lipid, protein or other molecules' oxidation reactions by inhibiting free radical reaction. Two types of antioxidants are available in the market one is synthetic antioxidants such as butylated hydroxyanisole, butylated hydroxytoluene, propyl gallate, L-ascorbic acid, rutin and other one is natural antioxidants derived from leaves, roots, barks, fruits and vegetables. Synthetic antioxidants could be toxic to the body or cause mutagenic effects. Due to consumer concerns about the safety of synthetic antioxidants, demand for natural antioxidants had increased. The potential of plants and other bioresources as potential natural antioxidants to replace the synthetic ones is being studied in numerous research projects [37].

IV. CONCLUSION

In conclusion, the results of the scavenging activity of *Baccaurea courtallensis* plant specimen observed in the study, showed that the LE and RE had antioxidant activity. These reductions probably are result of the certain oxidation of the antioxidants present in the leaf and root crude aqueous extracts of *B. courtallensis*. Probably this could be due to the better extraction of the substances, which possessed antioxidant properties. Differences in antioxidant activity were associated with different contents of bioactive compounds present in the plant specimen. As to our knowledge this is the first report of antioxidant activity of crude aqueous leaf and root extracts of *B. courtallensis* plant parts collected from Wayanad district, Kerala. Further studies are considered necessary to identify the bioactive constituent(s) responsible for the observed activities and to elucidate the detailed mechanism of action at the biomolecular level.

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DECLARATION OF CONFLICTING INTERESTS

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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