

COMPARATIVE ANALYSIS OF ANTIOXIDANT ACTIVITY AND PHYTOCHEMICAL SCREENING OF SOME INDIAN MEDICINAL PLANTS

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ABSTRACT

Indian medicinal plants (*Casia fistula*, *Cinnamomum cassia*, *Acacia catechu* and *Citrus limon*) were analyzed for their antioxidant activity, phytochemical composition and vitamins content. Methanolic extracts of the bark of these plant species showed high antioxidant activity and *Casia fistula* possessed the highest percent inhibition of DPPH (91.66%) amongst all studied plants. The results also revealed the presence of substantial amount of bioactive constituents comprising alkaloids (1.31 to 1.64 mg/100g DW), flavonoids (36.2 to 76.2 mg/100g DW), saponins (0.883 to 2.251 mg/100g DW), tannins (0.45 to 0.85 mg/100g DW) and total phenol content (110 to 210.2 mg/100g DW) where *Casia fistula* was observed comparatively richer source of these phytochemicals. The medicinal plants had the erratic concentrations of vitamins and contained carotenoids (104 to 135 mg/100g DW), ascorbic acid (18.05 to 55.04 mg/100g DW), thiamine (0.12 to 0.28 mg/100g DW), riboflavin (0.11 to 0.42 mg/100g DW) and niacin (0.02 to 0.08 mg/100g DW). The results provided the evidence that the studied medicinal plants are to be potent source of natural antioxidant and medicinally important compounds.

Keywords: Antioxidant activity, Bioactive compounds, Ethnomedicine, Medicinal plants, Vitamins.

INTRODUCTION

Nature has been a source of medicinal agents for thousands of years and an impressive number of modern drugs have been isolated from natural sources, many based on their use in traditional medicine. Medicinal plants typically contain mixtures of different chemical compounds that may act individually, additively or in synergy to improve health. The main objective of this study is, to search for some Indian plants with strong antioxidant activity which could serve as good candidates for the development of standardized phytomedicine.

Oxidative stress is one of the most important routes for producing free radicals in food, drugs and even living systems. Environmental pollutants e.g. radiation, chemicals, toxins, deep fried and spicy foods as well as physical stress, cause depletion of immune system antioxidants, change in gene expression and induce abnormal proteins. Free radicals contribute to more than one hundred disorders in human beings including atherosclerosis, arthritis, ischemia, central nervous system injury, gastritis, cancer and AIDS¹. Antioxidants can be effective in preventing free radical formation by scavenging them or promoting their decomposition and up pressing such disorders². Currently, there is a growing interest toward natural antioxidants of herbal resources. Epidemiological and *in vitro* studies on medicinal plants and vegetables strongly supported this idea that plant constituents with antioxidant activity are capable of exerting protective effects against oxidative stress in biological systems³.

Acacia catechu is a sacred plant that belongs to the family Mimosaceae. It contains a number of chemical constituent that interact in a complex way to elicit their pharmacodynamic responses. It is highly effective in a wide spectrum of diseases and reported to possess antibacterial, antifungal, anti-inflammatory and antioxidant properties⁴. It also helps in clotting of blood in case of any injuries.

Cassia fistula Linn. (Family- Leguminosae) is of great therapeutic value in treating diseases such as liver disorder, gout, dysentery, leprosy and diabetes. It also helps in shrinking engorged veins and has a powerful antioxidant and anti-inflammatory effect⁵. It has the

right balance of lipids, proteins and carbohydrate hence it is very much effective in providing strength to the body.

Cinnamomum cassia (Family- Lauraceae) bark is attributed with numerous medicinal uses such as diaphoretic, antipyretic and analgesic. It is used as a carminative, cardiac stimulant, antioxidant, refrigerant and diuretic⁶. It stimulates the nervous system of our body. It works as good appetizer and improves digestion. It also stimulates liver for proper functioning and it is also very effective treatment in tuberculosis due to presence of sinemic acid.

Citrus limon (Family- Rutaceae) its therapeutic effects have been attributed to its vitamin C rich fruit pulp. The seeds and bark are used in the treatment of asthma, bronchitis, scurvy, rheumatism, dysentery and diarrhea, it also possesses bactericidal and antioxidant properties. It improves circulation of the blood and is helpful in condition like atherosclerosis.

In particular, despite widespread use of aromatic plants as medicines in India, the literature contains few reports of antioxidant activity and chemical composition of these plants. In present study, we carried out a systematic record of the relative free radical scavenging activity in selected Indian medicinal plant species.

MATERIAL AND METHODS

Chemicals

1,1-Diphenyl-2-picryl hydrazyl (DPPH) and quercetin were purchased from Sigma Chemical Co. (St. Louis, USA). Gallic acid, tert-butyl-4-hydroxy toluene (BHT), Folin Ciocalteu reagent, and methanol were purchased from Merck Co. (Germany).

Plant materials

The four medicinal plants studied were collected from Auraon Research Center (an authenticated research center recognized by Central Scientific and Industrial Research, India), Botanical garden of National Botanical Research Institute, Lucknow. The plant materials were cleaned and powdered. The botanical names, family names, English names and parts used are presented in Table 1.

Table 1: Brief introduction of medicinal plants

Botanical Name used	English Name	Part	Family	Medicinal use
<i>Acacia catechu</i> L. antifungal	Mimosa catechu	Bark	Fabaceae	Antibacterial,
<i>Cassia fistula</i> L. tree inflammatory	Golden shower	Bark	Fabaceae	Antioxidant, anti-
<i>Cinammomum cassia</i> L. antipyretic, analgesic	Chinese cinnamon	Bark	Lauraceae	Diaphoretic,
<i>Citrus limon</i> L. antioxidant	Lemon	Bark	Rutaceae	Bactericidal,

Extraction

The plant materials presented in Table 1 were air-dried in shed at room temperature (26°C) for 2 weeks, after which it was grinded to a uniform powder. Methanol extracts were prepared by soaking 100 g each of the dry powdered plant materials in 1 litre of methanol at room temperature for 48 h. The extracts were filtered first through a Whatmann filter paper No. 42 (125 mm) and then through cotton wool. The extracts were concentrated using a rotary evaporator with the hot water bath set at 40°C. The percentage yield of extracts ranged from 5 - 20% (w/w).

Antioxidant activity (DPPH free radical scavenging activity) determination

The antioxidant activity of the plant extracts was examined on the basis of the scavenging effect on the stable DPPH free radical activity by the method given by Yen and Duh⁷. Ethanolic solution of DPPH (0.05 mM) (300 µl) was added to 40 µl of extract solution with different concentrations (0.02 - 2 mg/ml). DPPH solution was freshly prepared and kept in the dark at 4°C. Ethanol 96% (2.7 ml) was added and the mixture was shaken vigorously. The mixture was left to stand for 5 min and absorbance was measured spectrophotometrically at 517 nm. Ethanol was used to set the absorbance zero. A blank sample containing the same amount of ethanol and DPPH was also prepared. All determinations were performed in triplicate. BHT and quercetin were used as standard controls. IC₅₀ values denote the concentration of sample, which is required to scavenge 50% of DPPH free radicals. The radical scavenging activities of the tested samples, expressed as percentage of inhibition were calculated according to the following equation.

$$\text{Percent (\%)} \text{ inhibition of DPPH activity} = \left[\frac{AB - AA}{AB} \right] \times 100$$

Where AA and AB are the absorbance values of the test and of the blank samples respectively. A percent inhibition versus concentration curve was plotted and the concentration of sample required for 50% inhibition was determined and represented as IC₅₀ value for each of the test solutions.

Determination of alkaloids

5 g of the sample were weighed into a 250 ml beaker and 200 ml of 20% acetic acid in ethanol was added and covered to stand for 4 h. This was filtered and the extract was concentrated using a water bath to one-quarter of the original volume. Concentrated ammonium hydroxide was added drop wise to the extract until the precipitation was complete. The whole solution was allowed to settle and the precipitate was collected by filtration and weighed⁸.

Determination of Flavonoid

10 g of the plant samples were extracted repeatedly with 100 ml of 80% aqueous methanol at room temperature. The whole solution was filtered through Whatman filter paper no. 42 (125 mm). The filtrate was later transferred into a crucible and evaporated to dryness over a water bath and weighed⁹.

Determination of Saponin

20 g of each plant samples were dispersed in 200 ml of 20% ethanol. The suspension was heated over a hot water bath for 4 h with continuous stirring at about 55°C. The mixture was filtered and the residue re-extracted with another 200 ml of 20% ethanol. The combined extracts were reduced to 40 ml over water bath at about 90°C. The concentrate was transferred into a 250 ml separator funnel and 20 ml of diethyl ether was added and shaken vigorously. The aqueous layer was recovered while the ether layer was discarded. The purification process was repeated. 60 ml of n-butanol was added. The combined n-butanol extracts were washed twice with 10 ml of 5% aqueous sodium chloride. The remaining solution was heated in a water bath. After evaporation, the samples were dried in the oven to a constant weight⁸.

Determination of Tannins

Weigh 0.5 g of powdered material and transfer to a 250ml of conical flask. Add 75ml of distilled water. Heat the flask gently and boil for 30 min. centrifuge at 2000rpm for 20 min and collect the supernatant in

100 ml of volumetric flask and make up the volume. Transfer 1 ml of the sample extract to a 100 ml volumetric flask containing 75 ml distilled water add 5 ml of Folin-Denis reagent, 10 ml of Na₂CO₃ and dilute to 100 ml with distilled water. Shake well and read the absorbance at 700 nm after 30 min. Prepare a blank with water instead of sample. Prepare the standard graph by using standard tannic acid¹⁰.

Determination of total phenol

Total phenols were determined by Folin Ciocalteu reagent¹¹. A dilute extract of each plant extract (0.5 ml of 1:10 g ml⁻¹) or gallic acid (standard phenolic compound) was mixed with Folin Ciocalteu reagent (5 ml, 1:10 diluted with distilled water) and aqueous Na₂CO₃ (4 ml, 1 M). The mixtures were allowed to stand for 15 min and the total phenols were determined by colorimetry at 765 nm. The standard curve was prepared using 0, 50, 100, 150, 200, 250 mg L⁻¹ solutions of gallic acid in methanol: water (50:50, v/v). Total phenol values are expressed in terms of gallic acid equivalent (mg g⁻¹ of dry weight), which is a common reference compound.

Determination of carotenoids

Total carotenoids were determined by the method of Jensen¹². One gram sample was extracted with 100 ml of 80% methanol solution and centrifuged at 4000 rpm for 30 min. The supernatant was concentrated to dryness. The residue was dissolved in 15 ml of diethyl ether and after addition of 15 ml of 10% methanolic KOH the mixture was washed with 5% ice-cold saline water to remove alkali. The free ether extract was dried over anhydrous sodium sulphate for 2 h. The ether extracts were filtered and its absorbance was measured at 450 nm by using ether as blank.

Determination of ascorbic acid

The ascorbic acid was determined according to Cakmak and Marschner¹³ with some modification. Each plant extract (0.5 ml of 1:10 g/ml) in methanol was separately mixed with 5 ml of 5% metaphosphoric acid, and centrifuged at 4000 rpm for 30 min. The reaction mixture contained 0.2 ml aliquot of the 4000 rpm supernatant, 0.5 ml 150 mM phosphate buffer (pH 7.4) containing 5 mM EDTA, 0.1 ml (10 mM) DTT (1,4-dithiothreitol) and 0.1 ml (0.5%, w/v) N-ethylmaleimide (NEM) to remove excess DTT. The color was developed after addition of the following reagents in the reaction mixture: 0.4 ml (10%) trichloroacetic acid (TCA), 0.4 ml (44%) ortho-phosphoric acid, 0.4 ml (4%) 2, 2-bipyridine in 70% ethyl alcohol, and 0.2 ml (3%) FeCl₃. The mixture was then incubated at 40°C for 40 min, and the absorbance was measured at 525 nm. Ascorbic acid was used as a standard in the range of 0 to 100 µg/ml.

Determination of thiamine

5 g of the sample were homogenized with ethanolic sodium hydroxide (50 ml). It was filtered into a 100 ml flask. 10 ml of the filtrate was pipette and the colour developed by addition of 10 ml of potassium dichromate and read at 360 nm. A blank sample was prepared and the color also developed and read at the same wavelength¹⁴.

Determination of riboflavin

5 g of the sample was extracted with 100 ml of 50% ethanol solution and shaken for 1 h. This was filtered into a 100 ml flask; 10 ml of the extract was pipette into 50 ml volumetric flask. 10 ml of 5% potassium permanganate and 10 ml of 30% H₂O₂ were added and allowed to stand over a hot water bath for about 30 min. 2 ml of 40% sodium sulphate was added. This was made up to 50 ml mark and the absorbance measured at 510 nm in a spectrophotometer¹⁵.

Determination of niacin

5 g of the sample was treated with 50 ml of 1 N sulphuric acid and shaken for 30 min. 3 drops of ammonia solution were added to the sample and filtered. 10 ml of the filtrate was pipette into a 50 ml volumetric flask and 5 ml potassium cyanide was added. This was acidified with 5 ml of 0.02 N H₂SO₄ and absorbance measured in the spectrophotometer at 470 nm wavelengths¹⁶.

RESULTS

Preliminary phytochemical screening of the studied plants (*Cassia fistula*, *Cinnamomum cassia*, *Acacia catechu*, and *Citrus limon*) revealed the presence of phytochemicals: alkaloids, saponins, flavonoids, tannins, total phenol, carotenoids, ascorbic acid, thiamine, riboflavin and niacin.

Among all four medicinal plants used in the study, the maximum antioxidant activity 91.66 ± 4.33 (DPPH percentage inhibition) was observed in *Cassia fistula* followed by *Cinnamomum cassia* (86.6 ± 4.33 mg/100g DW), *Acacia catechu* (76 ± 1.66 mg/100g DW) and the least activity was noted in *Citrus limon* (67.33 ± 3.33 mg/100g DW) (Table 2).

Table 2: Antioxidant activity of *Cassia fistula*, *Acacia catechu*, *Cinnamomum cassia*, and *Citrus limon*.

Plants name	Antioxidant activity (%DW)
<i>Cassia fistula</i>	91.66 ± 4.33
<i>Acacia catechu</i>	76 ± 1.66
<i>Cinnamomum cassia</i>	86.66 ± 4.33
<i>Citrus limon</i>	67.33 ± 3.33

All values are mean \pm standard deviation (n = 3). Means with different letters within a column are significantly different (P < 0.05).

The variable concentrations of alkaloids were observed in the bark of studied plants. The *Cinnamomum cassia* showed highest value (1.64 ± 0.22 mg/100g DW) as compared to other three medicinal

plants and lowest source was examined to be *Citrus limon* (1.31 ± 0.16 mg/100g DW). *Citrus limon* and *Acacia catechu* both had almost similar concentrations of alkaloid but *Cassia fistula* possessed some higher content and reported to be 1.54 ± 0.15 mg/ 100g DW. Analysis of bark samples showed *Cassia fistula* is the richest source of flavonoids (76.2 ± 4.5 mg/100g DW) which was found almost two fold higher than *Acacia catechu* (36.2 ± 1.2 mg/100g DW). *Cinnamomum cassia* and *Citrus limon* had better content of flavonoids than *Acacia catechu* and possessed 59.4 ± 5.4 and 48.3 ± 1.3 mg/100g DW respectively (Table 3). Similarly, Saponins content was seen significantly elevated in *Cassia fistula* (2.251 ± 0.020 mg/100g DW) while *Citrus limon* (0.883 ± 0.004 mg/100g DW) was recorded to be poorest source in the studied plants. *Acacia catechu* contained a bit higher concentration of saponins (1.605 ± 0.012 mg/100g DW) than *Cinnamomum cassia* (1.115 ± 0.014 mg/100g DW) but contained double amount than *Citrus limon*.

Tannins were present in trace amount with their highest concentration (0.85 ± 0.26 mg/1000g DW) found in *Cinnamomum cassia*, near about same content was obtained from *Cassia fistula* (0.78 ± 0.20 mg/100g DW). *Acacia catechu* (0.52 ± 0.15 mg/100g DW) had more tannins than *Citrus limon* (0.45 ± 0.22 mg/100g DW) which had the least amount. Total phenol was found as the major constituent of these medicinal plants. Values recorded in the table-3 reveals that *Cassia fistula* and *Cinnamomum cassia* possessed significantly higher total phenol and contained 210.2 ± 3.2 and 198.0 ± 4.2 mg/100g DW respectively. The bark of *Acacia catechu* (156.3 ± 2.8 mg/100g DW) was also seen to be better storage of total phenol while its minimum concentration was obtained from *Citrus limon* (110.0 ± 3.1 mg/100g DW) (Table 3).

Table 3: Phytochemical constituent of Indian medicinal plants expressed as mg/100g dry weight (DW).

Plant name	Flavanoid(mg/100g DW)	Total phenol (mg/100g DW)	Alkaloids (mg/100g DW)	Tannins (mg/100g DW)	Saponin (mg/100g DW)
<i>Cassia fistula</i>	76.2 ± 4.5	210.2 ± 3.2	1.54 ± 0.15	0.78 ± 0.20	2.251 ± 0.02
<i>Acacia catechu</i>	36.2 ± 1.2	156.3 ± 2.8	1.36 ± 0.11	0.52 ± 0.15	1.605 ± 0.012
<i>Cinnamomum cassia</i>	59.4 ± 5.4	198 ± 4.2	1.64 ± 0.22	0.85 ± 0.26	1.115 ± 0.014
<i>Citrus limon</i>	48.3 ± 1.3	110 ± 3.1	1.31 ± 0.16	0.45 ± 0.22	0.883 ± 0.004

All values are mean \pm standard deviation (n = 3). Means with different letters within a column are significantly different (P < 0.05).

Results of analysis of *Cassia fistula*, *Acacia catechu*, *Cinnamomum cassia* and *Citrus limon* showed that these plants are also a rich source of vitamins. The concentration of carotenoids was recorded maximum in *Cassia fistula* (135 ± 15 mg/ 100g DW) and minimum in *Citrus limon* (104 ± 1.66 mg/100g DW) whereas *Acacia catechu* had more carotenoids as compared to *Cinnamomum cassia* (Table 4). Among all the four plants, *Citrus limon* (55.04 ± 0.23 mg/ 100g DW) was found to be the prosperous source of ascorbic acid and contained two and half folds more ascorbic acid than *Cinnamomum cassia* whereas three folds than *Acacia catechu*. Concentration of ascorbic acid in *Cassia fistula*, *Cinnamomum cassia* and *Acacia catechu* was reported to be 40.05 ± 0.18 , 22.51 ± 0.28 and 18.05 ± 0.32 mg/100g DW respectively. A significantly highest concentration of thiamine (0.28 ± 0.42 mg/ 100 g DW) was obtained in *Cinnamomum*

cassia while lowest (0.12 ± 0.26 mg/ 100 g DW) in *Citrus limon*. Its concentration was 0.22 ± 0.38 mg/ 100 g DW in *Cassia fistula* and 0.14 ± 0.20 mg/ 100g DW in *Acacia catechu* (Table 4).

Maximum riboflavin concentration (0.42 ± 0.10 mg/ 100g DW) was detected in *Cassia fistula*. Next to it was *Cinnamomum cassia* (0.21 ± 0.09 mg/100g DW) and *Acacia catechu* (0.18 ± 0.14 mg/100g DW) whereas least amount was obtained from *Citrus limon* (0.11 ± 0.22 mg/100g DW). Concentration of niacin was found maximum in medicinal plant *Cinnamomum cassia* (0.07 ± 0.14 mg/100g DW) very much close to *Cassia fistula* (0.08 ± 0.12 mg/100g DW), also *Citrus limon* (0.04 ± 0.20 mg/100g DW) had about similar concentration to *Acacia catechu* (0.02 ± 0.11 mg/100g DW) that had least niacin content (Table 4).

Table 4: Vitamins composition of Indian medicinal plants expressed as mg/100g dry weight (DW).

Plant name	Ascorbic acid(mg/100g DW)	Riboflavin (mg/100g DW)	Thiamine (mg/100g DW)	Niacin (mg/100g DW)	Carotenoids (mg/100g DW)
<i>Cassia fistula</i>	40.05 ± 0.18	0.42 ± 0.10	0.22 ± 0.38	0.08 ± 0.12	135 ± 15
<i>Acacia catechu</i>	18.05 ± 0.32	0.18 ± 0.14	0.14 ± 0.20	0.02 ± 0.11	123.6 ± 4.33
<i>Cinnamomum cassia</i>	22.51 ± 0.28	0.21 ± 0.09	0.28 ± 0.42	0.07 ± 0.14	118 ± 0.66
<i>Citrus limon</i>	55.04 ± 0.23	0.11 ± 0.22	0.12 ± 0.26	0.04 ± 0.20	104 ± 1.66

All values are mean \pm standard deviation (n = 3). Means with different letters within a column are significantly different (P < 0.05).

DISCUSSION

Medicinal plants constitute an effective source of both traditional and modern medicines, herbal medicine has been shown to have genuine utility and about 80% of rural population depends on it as primary health care¹⁷.

Free radicals are involved in many disorders like neurodegenerative diseases, cancer and AIDS. Antioxidants through their scavenging power are useful for the management of those diseases. DPPH stable free radical method is an easy, rapid and sensitive way to survey the antioxidant activity of a specific compound or plant extracts¹⁸. A strong correlation has been observed between the phenols and

antioxidant activity. Also strong relationship between total phenolics content and antioxidant activity has been reported by Kahkonen et al.¹⁹. In contrast, relationship was not observed between the flavonoids content and antioxidant activity. The results of the present study are in agreement with that of Miliuskas et al. and Gracia-Alonso et al.^{20,21}.

The secondary metabolite constituents of *Cassia fistula*, *Acacia catechu*, *Cinnamomum cassia* and *Citrus limon* detected include the alkaloids, flavonoids, saponins and tannins. Pure isolated alkaloids and their synthetic derivatives are used as basic medicinal agents for their analgesic, antispasmodic and bactericidal effects²². The presence of alkaloids in these plants is also used for hypertension treatment²³. Flavonoids, are potent water-soluble antioxidants and free radical scavengers²⁴, which prevent oxidative cell damage, have strong anticancer activity²⁵. Flavonoids in intestinal tract lower the risk of heart disease. As antioxidants, flavonoids from these plants provide anti-inflammatory activity²⁵.

The high saponin content of *Cassia fistula*, *Acacia catechu*, *Cinnamomum cassia* and *Citrus limon* justifies the use of the extracts from these plants to stop bleeding and in treating wounds. Saponin has the property of precipitating and coagulating red blood cells. Some of the characteristics of saponins include formation of foams in aqueous solutions, hemolytic activity, cholesterol binding properties and bitterness^{25, 26}. Saponins prevent the excessive intestinal absorption of this cholesterol and thus reduce the risk of cardiovascular diseases such as hypertension²⁷. Tannins have stringent properties, hasten the healing of wounds and inflamed mucous membranes²⁸. Recent studies have shown that, many polyphenol compounds contribute significantly to the total antioxidant activity of many plants²⁹. The total phenols contain good antioxidant, antimutagenic and anticancer properties³⁰. *Cassia fistula* and *Cinnamomum cassia* had high total phenol content while the highest concentration of total phenols responsible for the antioxidant activity.

Carotenoids play an important role in plant reproduction: along with phenolics they are responsible for bright colors. This chemical class acts as antioxidants, with functions that include protection of membranes against damage by free radicals and retardation of ageing processes³¹. It act as photo protective agents and may reduce the risk of sunburns, photo-allergy and even some types of skin cancer³². The examined result shows that *C. fistula* and *A. catechu* are strong source of carotenoids and it can be a promising plant for use in pharmacological products designed for antioxidant activity.

Ascorbic acid is a powerful reducing agent capable of rapidly scavenging a number of reactive oxygen species. L-Ascorbate (Vitamin C) is considered as the strong reducing agent carrying out the reducing function which may reduce the risk of chronic diseases such as cancer, cardiovascular and helps make collagen, a tissue needed for gums and blood vessels³³. As a result of the availability of ascorbic acid in *C. fistula*, *A. catechu*, *C. cassia* and *C. limon* these plants are used in herbal medicine for the treatment of common cold and other diseases like prostate cancer²⁵. The most important role of thiamin is to treat beri beri and Wernicke-Korsakoff syndrome, it is a brain disorder caused by thiamine deficiency³⁴. Thiamin, Riboflavin and Niacin also play most important role in Cataract³⁵, Heart failure³⁶ and Alzheimer's disease³⁷. *Cassia fistula* and *Acacia catechu* use as an herbal medicine and further drug formulation for heart failure and Alzheimer's disease.

CONCLUSION

This present study has revealed that the antioxidant activity, phytochemicals and vitamins composition of *Cassia fistula*, *Acacia catechu*, *Cinnamomum cassia* and *Citrus limon* in bark extracts. This study showed the antioxidant properties of medicinal plants playing part significantly in anti-inflammatory, heart failure and carbohydrate metabolism disorders. The investigation supports the traditional use of these plants in postpartum care. Some medicinal plants are potent antioxidants and may be efficient as preventive agents in many diseases. This partly shows the use of phytochemicals, coupled with the presence of the essential vitamins. These plants can be seen as a potential source of useful food and

drugs. Further studies have to be carried out to isolate, characterize and elucidate the structure of the bioactive compounds from the plants for the industrial drug formulation.

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