COMMERCIALISATION OF CINNAMON GROWN IN INDIA

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Cinnamon, a spice, more valuable than gold has been used as a folk medicine from the ancient era due to its numerous health benefits, both in Ayurveda and traditional Chinese medicine. From chronicles, cinnamon was worn as a symbol of sovereignty and respect and was a prestigious gift to Gods and Monarchs. Ayurveda revealed that cinnamon is a medicine for treating various diseases such as malaria, diabetes, menopausal problems, digestive disorders, impotence, anaemia, sinus congestion, dyspepsia, blood circulation, scabies, intestinal infections and gynaecological problems (used even as a natural birth-control aid) as well as it possesses many beneficial activities such as anti-oxidant, anti-malarial, antimicrobial, and anti-inflammatory properties which were commonly faced from the Vedic period to modern times. The chief bioactive component responsible for the favourable and therapeutical properties of cinnamon is due to the presence of Cinnamaldehyde, Eugenol, and Linalool, α-pinene, γ-terpinene, phenols, saponin, tannins and flavonoid. The main focus of the paper is to emphasise the use of cinnamon grown in India to its journey to the global market as a bark or leaf along with its beneficial studies.

Keywords: Phytochemical Activities, Antioxidant, TPC, TFC and Antimicrobial Activity

Introduction

The genus *Cinnamomum* belongs to Lauraceae family is considered as one of the oldest known spices in the world, which comprises approximately 250–350 species (Annegowda *et al.*, 2011), distributed in tropical and subtropical regions of South East Asia, Australia, North America, Central America and South America (Mabberley, 1987). In India, the genus is represented by 26 species, out of which some species have medicinal and spice value and are commercially used (Hooker, 1885).

A number of species of the genus *Cinnamomum* such *as Cinnamomum zeylanicum syn. C. verum, C. cassia, C. burmannii, C. loureiroi* are being cultivated commercially in different areas of the world for the production of leaf and bark and are commercially known as Cinnamon, because these species produce bark, which is often sold as commercial spice product "Cinnamon" in the global market (Vangalapati *et al.*, 2012).

In Ayurveda (*Charaka Samhita* along with *Sushruta Samhita*) revealed that cinnamon is used as a medicine for treating various diseases such as malaria, diabetes,

digestive disorders, blood circulation and gynaecological problems as well as it possesses many beneficial properties such as anti-oxidant, anti-malarial, anti-diabetic and antimicrobial, which were commonly faced from Vedic period to modern times (Abeysekera *et al.*, 2013; Cheng *et al.*, 2004; Kim *et al.*, 2006; Mazimba *et al.*, 2015).

Phytochemical constituents such as polyphenols (flavanols, anthocyanins, phenolic acids, etc.) are the secondary metabolites which are used in human therapy, veterinary, agriculture, scientific research and drug development (Jyothiprabha, 2016). Plant polyphenols, a group of phenolic compounds have an ideal structural chemistry for free radical scavenging activity.

The present study focuses on phytochemical activity, TPC, TFC, Antioxidant activity and antimicrobial activity of cinnamon bark using methanol and acetone extracts.

Material and Methods

Plant material: The bark sample (500 g) was obtained from Cinnamomum tamala tree, grown in the premises of Centre for Aromatic Plants (CAP), Selaqui, Dehradun. The bark was carefully peeled from the tree trunk and shade dried for one week at room temperature and then powdered for further investigation. The bark samples are shown in Fig 2.

Preparation of extracts: 50 g of the powdered sample was extracted by Soxhlet extractor using 250 mL of two different solvents, methanol and acetone. The extract was concentrated using a rotary evaporator to dryness and the extracts were stored at 4˚C for further analysis.

Qualitative analysis of phytochemicals: Phytochemical screening was carried on Cinnamon bark extracts. The following tests were performed to detect various phytochemical constituents present in them. (Ramaswamy *et al.*, 2017; Mazimba *et al.*, 2015).

Alkaloids (Wagner's test): To 2 ml of extract was added to a few drops of Wagner's reagent. The formation of brownish-red precipitate indicated the presence of alkaloid.

Flavonoid (Lead acetate test): The extract (2 mL) was treated with 2 mL of 10 per cent lead acetate solution. The appearance of yellowish-green color indicated that flavonoid was present in the sample.

Carbohydrates (Benedict test): To extract (1 mL), Benedict's reagent was added, and then water bath, appearance of green solution indicated the presence of reducing sugar.

Phenols (Ferric Chloride test): The extract (0.5 mL) was added with few drops of neutral (0.5 per cent) ferric chloride solution. Formation of dark green color signifies the presence of the phenolic compounds.

Quinones: (0.5 mL) of extract was treated with a few drops of concentrated hydrochloric acid along the sides of the test tube. Formation of yellow precipitate or coloration indicated the presence of Quinones.

Oxalate: The extract (2 mL) was treated with a few drops of glacial acetic acid. A greenish black coloration indicated the presence of oxalate.

Saponins (Foam test): 5 mL distilled water was added to 2 mg of the extracts and shaken for the formation of froth, which confirmed the presence of saponins.

Tannins (Ferric chloride test): To extract (1 mL), 5 mL of distilled water was added and kept for boiling in hot water bath. After cooling of the sample, 0.1 per cent ferric chloride solution was added to it. The appearance of blue-black or brownish-green colour confirmed the availability of tannins.

In-Vitro Antioxidant Activity DPPH (2, 2-diphenyl-1-picrylhydrazyl) free radical scavenging method: The free radical scavenging activity of the extracts was performed using established method (Brand Williams *et al.*, 1995). DPPH solution was prepared in methanol at a concentration of 0.004 per cent and kept in dark. The working solution of extracts was prepared at different concentrations (500, 250, 125, 62.5, 31.25 µg/ml) by serial dilution from stock solution 1mg/mL. 2.7 mL of DPPH solution was added in each test tubes and incubated in the dark for 30 min. The absorbance was measured at 517 nm against methanol as a blank by using UV spectrophotometer. Ascorbic acid was used as a standard antioxidant. DPPH solution without extract or standard served as a control. All the measurements were done in triplicates.

The percentage (per cent) of scavenging of the DPPH free radical was calculated by using the following equation: $[(A_0-A_1)/ A_0] \times 100$

Where, A_0= absorbance of the control;
A_1 = absorbance of the extract/ standard

The IC50 values were calculated from the regression equation, prepared from the graph plotted against concentration and percentage inhibition of the samples.

Total phenolic content: The method followed was reported by Mazimba *et al*. (2015). Briefly, Test sample, 0.5 mL (standard, 0.01-0.05 mg/mL or extract, 1 mg/mL) and Folin-Ciocalteu reagent, 0.5 ml was shaken (5 min.) with 1 ml of 20 per cent Na_2CO_3 solution and allowed to stand for 2 hours. Finally, methanol (80 per cent, 5 mL) was added and the absorbance of the supernatant solution was recorded at 725 nm. The total phenolic content was expressed in milligrams of gallic acid equivalent (GAE) per gram of samples from the standard gallic acid plot.

Total flavonoid content: The total Flavonoids content (TFC) of cinnamon bark extracts were determined by the aluminium chloride method (Siddhuraju and Becker, 2003). 10 0µl of 2 per cent aluminium chloride in methanol solution was added to 100 µl of 0.25 mg/mL bark extract of cinnamon in methanol. The mixture was incubated at room temperature (25 ± 2 °C) for 10 min and the absorbance was recorded at 367 nm. Six different concentrations of quercetin (125, 62.5, 31.25, 15.62 and 7.81 mg/mL) were used to construct the calibration curve. The TFC of cinnamon bark extracts were expressed as mg quercetin equivalents per gram of dry weight cinnamon leaf or bark. (3 per cent plagiarism)

Antimicrobial activity testing using agar well method: The selected strains of bacteria were inoculated into 2 mL of sterile nutrient broth, and incubated at 37° C for 16–18 hours. Using a sterile cotton swab, the nutrient broth cultures were washed on the surface of sterile Mueller- Hinton Agar plates and left to dry for a few minutes at room temperature. Agar wells were prepared with the help of sterilised cork borer. Different volume of Cinnamon extracts (50 µl, 100 µl, 150 µl, 200 µl) was added to different wells in the plate. The plates were incubated in upright position at 37°C for 24 hours. The diameter of inhibition zones was measured in mm and the results were recorded (Venkatachalam and Jyothiprabha, 2016).

Result and discussion: Phytochemical analysis of the cinnamon bark shows the presence of alkaloid, carbohydrates, phenol, quinone, saponin and tannin in both the extract whereas oxalate and flavonoid were absent (Table 1). Similar result was also investigated by Mazimba *et al.* (2015) in the bark of C. verum. Inhibition of DPPH radical by methanolic extract was found to be higher than the acetone extract with IC50 value 111.05 µg/mL and 845.56 µg/mL. IC50 value of ascorbic acid was 57.97 µg/mL shown in Fig. 1. A similar result has been reported by Sudan *et al.* (2013) in methanolic extract of *C. verum* with IC50 value of 111.5±0.62 µg/mL by using DPPH assay. Lower IC50 value is associated with a higher antioxidant activity. The methanolic extract contained more phenolic compound as well as antioxidant activity than acetone extract. Stronger antioxidant activity of bark is mainly due to the presence of phenols and flavonoids. The phenolic content in the bark of cinnamon methanol extract was found to be the maximum and higher than its acetone extract. Similar result was also obtained in case of flavonoid content. The detailed value of TPC and TFC were provided in Table 2. Mazimba and co-workers investigated the TPC in C. verum and reported the phenol content to be 220.5±0.53 GAEmg/g, which was similar to the result obtained by us. Antimicrobial assay revealed that the methanol extract of the cinnamon bark has higher activity than acetone extract with zone of inhibition in *Escherichia coli and Staphylococcus aureus.* The analogous study on *E. coli* and *S. aureus* by Bharath *et al.* (2016) and Usha *et al.* (2012) has reported that the methanol extract of *C. cassia* and *C. zeylanicum* had subsequent activity than acetone extract.

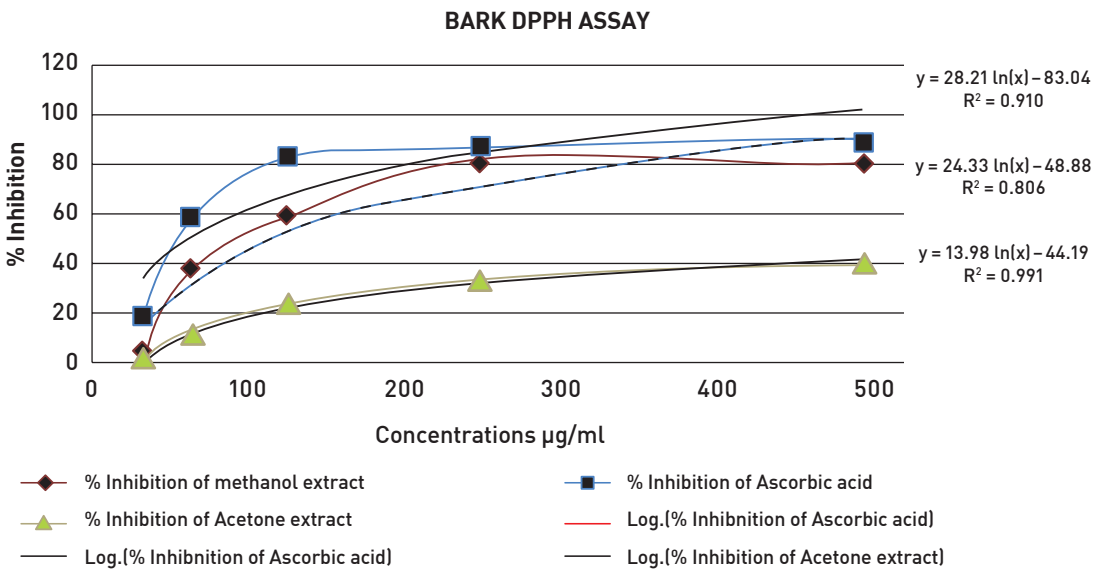

Fig. 1. DPPH free radical scavenging activity of Cinnamomum tamala bark (methanolic extract and ascorbic acid, per cent inhibition vs. concentration)

Fig. 2. Bark of Cinnamomum tamala

Table 1: Phytochemical Analysis of Methanol and Acetone Extract of Cinnamon Bark

Phytochemical Constituents	Methanol	Acetone
Alkaloids	+	+
Carbohydrates	+	+
Phenols	+	+
Tannins	+	+
Saponin	+	+
Quinone	+	+
Flavonoids	-	-
Oxalate	-	-

(-)= Absence; (+) = Presence

Table 2: Antioxidant Activity, TPC, TFC and Antimicrobial Activity of Cinnamon Bark Extracts

Cinnamon extract	TPC (GAE mg/g)	TFC (mg Quercetin/g)	DPPH (IC50 value in µg/mL)	Zone of Inhibition (mm)	
				E. coli	S. aureus
Methanol	198±0.35	43±0.57	111.05	8+0.97	7.9+1.23
Acetone	110±0.12	23±1.25	845.56	7+0.03	-

(-)= No zone of inhibition

Conclusion

The study concluded that all the experiments which were performed on the bark extract of cinnamon have confirmed the presence of phytochemical, total phenolic content, total flavonoids content, antioxidant activity and antimicrobial activity. The availability of saponins, quinones, alkaloids, tannins, carbohydrates, phenols, oxalate and flavonoids have proved that the bark possesses potent medicinal property which is beneficial for health. The plant can be further monitored against various diseases in order to find out its unknown efficacy and can be a potential source of biologically eminent drug candidates.

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References

Abeysekera, W.P.K.M., G.A.S. Premakumara and W.D. Ratnasooriya. 2013. In Vitro Antioxidant Properties of Leaf and Bark Extracts of Ceylon Cinnamon (*Cinnamomum zeylanicum* Blume). *Tropical Agriculture Research*. Vol. 24, No. 2. pp. 128–138.

Annegowda, H.V., T.S. Gooi, S.H.H. Awang, N.A. Alias, M.N. Mordi, S. Ramanathan and S.M. Mansor. 2011. Evaluation of Analgesic and Antioxidant Potency of Various Extracts of *Cinnamomum* iners Bark. *International Journal of Pharmacology*. Vol. 8, No. 3. pp. 198–203.

Bharath, M.R., M.A. Azeem, S. Basha and H.V. Keerthan. 2016. Antimicrobial Activity of Cinnamon Extracts Against Foodborne Pathogens *E. Coli*, *S. Tyhimurium*, *S. Aureus* and *L. Monocytogens*. *IOSR Journal of Pharmacy and Biological Sciences* (IOSR-JPBS). Vol. 11, No. 6. pp. 66–72.

Brand-Williams W, ME. Cuvelier and C. Berset. 1995. Use of Free Radical Method to Evaluate Antioxidant activity. *Journal of Food Science and Technology*. Vol. 28. pp 25–30.

Cheng, S.S., J.-Y. Liu, , K.-H. Tsai, W.-J. Chen, S.-T Chang. 2004. Chemical Composition and Mosquito Larvicidal Activity of Essential Oils from leaves of different *Cinnamomum osmophloeum* provenances. *Journal of Agricultural and Food Chemistry*. Vol. 52, pp. 4395–4400.

Hooker, J.D. 1885. Flora of British India, Bishen Singh Mahendra Pal Singh, Dehradun. Vol. 5, pp. 128–136.

Jyothiprabha, V., P. Venkatachalam. 2016. Preliminary Phytochemistry Screening of Different Solvent Extracts of Selected Indian Spices. *International Journal of Currant Microbiology and Applied Sciences*. Vol. 5, No. 2. pp. 116–122.

Kim, S.H., S.H. Hyun, S.Y. Choung. 2006. Anti-diabetic Effect of Cinnamon Extract on Blood Glucose in db/db Mice. *Journal of Ethnopharmacology*. Vol. 104, No. 1–2. pp. 119–123.

Mabberley, D.J. 1987. *The Plant Book*, The Cambridge University Press, Cambridge.

Mazimba, O., K. Wale, TE. Kwape, SO. Mihigo, BM. Kokengo. 2015. *Cinnamomum verum* Ethylacetate and Methanol Extracts Antioxidant and Antimicrobial Activity. *Journal of Medicinal Plants Studies*. Vol. 3, No. 3. pp. 28–32.

Ramaswamy L, SRM. Shankar, G. Thilagavathi 2017. Analysis of Consortium of Spices: Ginger, Cinnamon, and Ajwain on their Phytochemical Content and Anticancerous Effect on Lung Cancer Cell Lines. *Journal of Pharmacognosy and Phytochemistry*. Vol. 6, No. 1.pp. 83–88.

Siddhuraju, P. and K. Becker. 2003. Antioxidant Properties of Various Solvent Extracts of Total Phenolic Constituents from three Different Agroclimatic Origins of Drumstick Tree (Moringa Oleifera Lam.) Leaves. *Journal of Agricultural and Food Chemesitry*. Vol. 51, pp. 2144–2155.

Sudan, R., M. Bhagat, S. Gupta, T. Devi. 2013. Comparative Analysis of Cytotoxic and Antioxidant Potential of Edible *Cinnamomum verum* (bark) and *Cinnamomum tamala* (Indian bay leaf). Free Radicals and Antioxidants. Vol. 3. pp S70–S73.

Usha, M., S. Ragini and S.M.A. Naqvi. 2012. Antibacterial Activity of Acetone and Ethanol Extracts of Cinnamon (*Cinnamomum zeylanicum*) and Ajowan (*Trachyspermum ammi*) on four Food Spoilage Bacteria. *International Research Journal of Biological Sciences*. Vol. 1. pp. 4, pp. 7–11.

Vangalapati, M., N. Sree Satya, D. Surya Prakash and S. Avanigadda, 2012. A review of pharmacological activities and clinical effects of cinnamon species. *Research Journal of Pharmaceutical Biological and Chemical Sciences*. Vol. 3, No. 1. pp. 653–663.

Venkatachalam, P. and V. Jyothiprabha. 2016. Phytochemical Screening and Antibacterial Activities of Cinnamon against Vancomycin Resistant Enterococcus. *International Journal of Scientific Research.* Vol. 5, No. 9. pp 309–312.