Effect of Cephalandra indica against advanced glycation end products, sorbitol accumulation and aldose reductase activity in homoeopathic formulation

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Abstract

Background: Extreme generation of free radicals leads to oxidative stress which has been apprehensive in several disease processes such as diabetic complications and vascular and neurodegenerative diseases. Objective: The present study was designed to evaluate the potential of homoeopathic preparations of Cephalandra indica L. against oxidative stress. Materials and Methods: Potencies of Cephalandra indica (mother tincture, 6C and 30C) were procured from Dr. Willmar Schwabe India Pvt. Ltd. The antioxidant activity of Cephalandra indica was evaluated by employing various in vitro antioxidant methods. Results: The total phenol content was found to be 1905, 849 and 495 mg/g gallic acid equivalents in mother tincture, 6C and 30C of Cephalandra indica and total antioxidant capacity was found to be 2710, 759 and 510 μM/g ascorbic acid equivalents, respectively. Mother tincture, 6C and 30C of Cephalandra indica was found to have strong reducing power, 2,2-diphenyl-1-picrylhydrazyl radical, hydrogen peroxide, nitric oxide and superoxide radical scavenging activity. Percentage inhibition of AGEs formation by mother tincture, 6C and 30C of Cephalandra indica (10–50 μl) was found to be 30.34%–91.77%, 29.98%–65.71% and 33.05%–57.75%, respectively. Mother tincture, 6C and 30C of Cephalandra indica showed inhibitory effect against sorbitol accumulation with IC₅₀ value of 26.12 μl, 203.10 μl and 897.3 μl, respectively, whereas, in aldose reductase inhibition assay, the IC₅₀ value was 32.54 μl, 175.02 μl and 834.34 μl, respectively. Conclusion: The results revealed that homoeopathic preparations of Cephalandra indica exhibit protective effect against oxidative stress.

Keywords: Advanced glycation end products, Aldose reductase inhibition, Cephalandra indica, diabetic complications, Homoeopathic preparations, Oxidative stress, Sorbitol accumulation

INTRODUCTION

Generation of free radicals and reactive oxygen species (ROS) leads to the oxidative damage to cellular biomolecules such as proteins, lipids and DNA which is considered to play an important role in the prevalence of several chronic diseases.[1,2] Cephalandra indica belongs to family Cucurbitaceae, also known as Kundru in Hindi and Ivy Gourd in English, is a creeper vegetable that grows wild and in abundance in major parts of India. It is a perennial climbing herb with tuberous roots, fruiting throughout the year. The plant has been used since ancient times for treating Diabetes Mellitus in the Indian system of medicine known as Ayurveda. As it was significantly effective in diabetes treatment, Cephalandra indica was described by some as 'Indian Substitute for Insulin'.[3] The plant also gained many reported scientific values as antidiabetic medicine.[4,5] Fresh juice of roots is used to treat diabetes; tincture of leaves is used to treat gonorrhoea and paste of leaves is applied to the skin diseases. Dried bark is a good cathartic. Leaves and stem are antispasmodic and expectorant. The fleshy green fruit is very bitter. Green fruit is chewed to cure sores on the tongue.[6,7]

In the present study, in vitro antioxidative potential of mother tincture, 6C and 30C potencies of Cephalandra indica was evaluated using 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging assay; 2-thiobarbituric acid (TBARS) assay; 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging assay; 2-thiobarbituric acid (TBARS) assay; and 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical scavenging assay. The results revealed that homoeopathic preparations of Cephalandra indica exhibit protective effect against oxidative stress.

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radical scavenging assay, nitric oxide (NO) scavenging assay, hydrogen peroxide scavenging assay, reducing power, superoxide radical scavenging activity, total phenolic content by Folin-Ciocalteu method and total antioxidant activity by phosphomolybdenum method.

**MATERIALS AND METHODS**

**Materials and reagents**

Potencies (Mother tincture, 6C and 30C) of *Cephalandra indica* L. were procured from Dr. Willmar Schwabe India Pvt. Ltd. DPPH and NADPH were purchased from Sigma Chemical Co. (St. Louis, MO, USA). Gallic acid, bovine serum albumin (BSA), nitroblue tetrazolium (NBT), Folin–Ciocalteu reagent and N-(1-Naphthyl) ethylenediamine dihydrochloride were purchased from Molychem Pvt. Ltd., India. All other chemicals and reagents used were of analytical grade. Study protocol was approved and conducted in MMCP, Maharishi Markandeshwar University, Mullana, Ambala, Haryana, India.

**In vitro antioxidant activity**

**Determination of total phenol content**

Total phenolic content in the mother tincture, 6C and 30C of *Cephalandra indica* was determined with Folin–Ciocalteu reagent using gallic acid as a standard phenolic compound. Sample was diluted appropriately to obtain absorbance in the range of calibration curve. An aliquot of 1 ml of sample solution was mixed with 1 ml of Folin–Ciocalteu reagent. Three minutes later, 3.0 ml of 2% sodium carbonate was added, and the mixture was allowed to stand for 3 h with intermittent shaking. The absorbance of the blue colour that developed was measured at 760 nm (UV-VIS spectrophotometer - 1800, Shimadzu, Japan). The concentration of total phenolic compounds in the sample was obtained as milligrams of gallic acid equivalent (GAE) per gram dry weight.\(^9\)

**Total antioxidant capacity**

An aliquot of 0.3 ml of mother tincture, 6C and 30C of *Cephalandra indica* was mixed with 3 ml of the reagent solution (0.6 M sulphuric acid, 28 mM sodium phosphate and 4 mM ammonium molybdate). In case of blank, 0.3 ml of water was used instead of sample. The tubes were capped with aluminium foil and incubated in boiling water bath at 95°C for 90 min. After the samples had cooled to room temperature, the absorbance was measured at 695 nm against a blank. Ascorbic acid was used as a standard. Total antioxidant capacity was expressed as equivalents of ascorbic acid (μmol/g).\(^9\)

**2,2-diphenyl-1-picrylhydrazyl scavenging activity**

The DPPH radical scavenging ability of mother tincture, 6C and 30C of *Cephalandra indica* was evaluated according to the method given in literature with slight modification.\(^10\) The different concentrations in each reaction set were mixed with 1.0 ml of 0.1 mM of DPPH in ethanol. The mixture was incubated in the dark for 30 min at room temperature. Degree of inhibition of DPPH by monitoring the decrease in absorbance measured at 517 nm. Ascorbic acid was used as positive control. Radical scavenging activity was expressed as inhibition percentage of free radical by the sample and was calculated using the following formula:

\[
\text{% Inhibition} = \left(1 - \frac{A_o - A_i}{A_o}\right) \times 100
\]

Where \(A_o\) was the absorbance of control (blank without sample) and \(A_i\) was the absorbance in presence of sample. All the tests were performed in triplicate and graph was plotted with mean values.

**Hydrogen peroxide scavenging activity**

The hydrogen peroxide scavenging activity was evaluated as described previously.\(^11\) An aliquot of 40 mM H\(_2\)O\(_2\) solution (0.6 ml) was mixed with various concentrations of mother tincture, 6C and 30C of *Cephalandra indica*. To the mixture, 2.4 ml of phosphate buffer (0.1 M, pH 7.4) was added and the mixture was shaken vigorously and incubated at room temperature for 10 min. Then, the absorbance of the reaction mixture was determined at 230 nm. Ascorbic acid was used as positive control. The H\(_2\)O\(_2\) scavenging activity was calculated as follows:

\[
\text{% Inhibition} = 1 - \frac{A_o - A_i}{A_o} \times 100
\]

Where \(A_o\) is the absorbance of the control (water instead of sample), \(A_i\) is the absorbance of the sample and \(A_s\) is the absorbance of the sample only (phosphate buffer instead of H\(_2\)O\(_2\) solution). The IC\(_{50}\) value represented the concentration of the compounds that caused 50% inhibition of H\(_2\)O\(_2\).

**Reducing power assay**

The Fe\(^{3+}\)-reducing power of mother tincture, 6C and 30C of *Cephalandra indica* was determined according to the method described in literature.\(^12\) Different concentrations of samples (2.5 ml) were mixed with 2.5 ml of 0.2 M sodium phosphate buffer (pH 6.6) and 2.5 ml of 1% potassium ferricyanide and incubated at 50°C for 20 min. After incubation, 2.5 ml of 10% trichloroacetic acid (w/v) was added and the mixture centrifuged at 1000 rpm for 8 min. The supernatant (5 ml) was mixed with 5 ml of distilled water and 1 ml of 0.1% of ferric chloride, and the absorbance was measured spectrophotometrically at 700 nm. The assay was carried out in triplicate and the results expressed as mean values ± standard deviations. Ascorbic acid was used as positive control. The sample concentration providing 0.5 of absorbance (EC\(_{50}\)) was calculated from the graph plotted between absorbance at 700 nm against sample concentration.

**Nitric oxide scavenging activity**

At physiological pH, aqueous solution of sodium nitroprusside spontaneously generates NO\(^{13}\) which interacts with oxygen to produce nitric ions that can be estimated using Griess reagent. Scavengers of NO compete with oxygen, leading to reduce the production of NO. The reaction mixture of 5 mM sodium nitroprusside in phosphate buffer saline (PBS) and 3.0 ml of different concentrations of the mother tincture, 6C and 30C of *Cephalandra indica* were incubated in the dark for 30 min at room temperature.
indica was incubated at 25°C for 150 min. After incubation, the samples were added to Greiss reagent (1% sulphanilamide, 2% H₃PO₄, and 0.1% naphthyl ethylenediamine dihydrochloride). The pink chromophore generated during the diazotisation of nitrite with sulphanilamide and subsequent coupling with naphthyl ethylenediamine was measured at 546 nm. Ascorbic acid was used as a positive control. The percentage of inhibition was measured by the following formula:

% Inhibition = \( \frac{A_0 - A_t}{A_0} \times 100 \)

Where A₀ was the absorbance of the control (blank, without sample) and Aₜ was the absorbance in the presence of the sample. All the tests were performed in triplicate and the graph was plotted with the mean values.

**Superoxide radical scavenging activity**

The activity was measured by the reduction of NBT reagent method as described by Shukla et al., 2009. The method is based on the generation of superoxide radical (O₂⁻) by auto-oxidation of hydroxylamine hydrochloride in the presence of NBT, which gets reduced to nitrite. Nitrite in the presence of ethylenediaminetetraacetic acid (EDTA) gives a colour that was measured at 560 nm. Different concentrations of mother tincture, 6C and 30C of Cephalandra indica were taken in a test tube. To this, reaction mixture consisting of 1 ml of (50 mM) sodium carbonate, 0.4 ml of (24 mM) NBT and 0.2 ml of 0.1 mM EDTA solutions were added to the test tube and immediate reading was taken at 560 nm. After incubating the reaction mixture at 25°C for 15 min, about 0.4 ml of (1 mM) of hydroxylamine hydrochloride was added to initiate the reaction and reduction of NBT was measured at 560 nm. Ascorbic acid was used as the positive control. Decreased absorbance of the reaction mixture indicates increased superoxide anion scavenging activity. The percentage of inhibition was calculated according to the following equation:

% Inhibition = \( \frac{A_0 - A_t}{A_0} \times 100 \)

Where A₀ was the absorbance of the control (blank, without sample) and Aₜ was the absorbance in the presence of the samples. All the tests were performed in triplicate and the graph was plotted with the mean values.

**Antiglycation activity**

*In vitro* antiglycation activity of mother tincture, 6C and 30C of Cephalandra indica was examined by testing their ability to inhibit the fluorescence of BSA in accordance with a previous method. The reaction mixture of BSA (10 mg/ml), 1.1 M fructose in 0.1 M PBS and pH 7.4 containing 0.02% sodium azide with or without sample (Mother tincture, 6C and 30C of Cephalandra indica dissolved in PBS) was incubated in darkness at 37°C for 1, 2, 3 and 4 weeks. AGE formation was measured by fluorescent intensity at an excitation wavelength 355 nm and emission wavelength 460 nm using Elico-SLI74 spectrofluorometer fitted with Xenon Lamp (Elico, India). Aminoguanidine (AG; 500 µg/ml) was used as a positive control for this study.

**Erythrocyte sorbitol accumulation inhibition**

Five millilitres of heparinised blood was collected from overnight fasted healthy male Wistar rats and erythrocytes were separated from the plasma by centrifugation at 3000 g for 30 min. The cells were washed three times with isotonic saline at 4°C, and in the final washing, the cells were centrifuged at 1500 g for 15 min to obtain a consistently packed cell preparation. The packed cells (1 mL) were then incubated in Krebs-Ringer bicarbonate buffer (pH 7.4) (4 mL) containing 55 mM glucose in the presence or absence of samples (Mother tincture, 6C and 30C of Cephalandra indica) at 37°C for 3 h. The erythrocytes were washed with cold saline by centrifugation at 2000 g for 5 min, precipitated by adding 6% of cold perchloric acid (3 mL) and centrifuged again at 2000 g for 10 min. The supernatant was neutralised with 2.5 M K₂CO₃ at 4°C and used for sorbitol determination. The relative fluorescence due to NADH was measured by a fluorescence spectrometer (Elco-SLI74 spectrofluorometer fitted with Xenon Lamp, Elico, India) at an excitation wavelength of 366 nm and an emission wavelength of 452 nm. The experiments were performed in triplicates.

**Aldose reductase enzyme inhibition**

Partial purification of aldose reductase (ALR1) from rat kidney (IAEC Protocol No: MMCP/IAEC/13/07) was carried out following the previously described methods. Isolated kidney was homogenised in 3 volumes of 10 mM sodium phosphate buffer, pH 7.2 containing 0.25 M sucrose, 2.0 mM EDTA and 2.5 mM 2-mercaptoethanol. The homogenate was centrifuged at 10,000 g for 20 min and the supernatant was subjected to ammonium sulphate precipitation. Precipitate obtained between 45% and 75% saturation was dissolved in the above buffer. The supernatant was used as the source of ALR1. The activity of ALR1 was measured spectrophotometrically by monitoring the oxidation of NADPH at 340 nm as a function of time at 37°C using glyceraldehyde as substrate. The assay mixture in 1 ml contained 50 mM sodium phosphate buffer of pH 7.2, 0.2 M ammonium sulphate, 10 mM DL-glyceraldehyde, 5 mM β-mercaptoethanol and 0.1 mM NADPH. Various concentrations of mother tincture, 6C and 30C of Cephalandra indica were added to assay mixtures of ALR1 and incubated for 5 min before initiating the reaction by NADPH as described above. The percentage inhibition was calculated considering the activity in the absence of mother tincture, 6C and 30C of Cephalandra indica as 100%. The IC₅₀ values were determined by linear regression analysis of the plot of percentage inhibition versus inhibitor concentration.

**Results and Discussion**

**Total phenol content**

Phenols and polyphenols are the main class of natural antioxidants found in plants whose functions is to strengthen
the oxidative stability of foods and human systems due to their redox properties, which plays significant role in neutralising free radicals, quenching singlet oxygen or decomposing hydroperoxides. Total phenol content in homoeopathic preparations of Cephalandra indica was determined by Folin–Ciocalteu reagent. The total phenol content was found to be 1905, 849 and 495 mg/g GAEs in mother tincture, 6C and 30C of Cephalandra indica, respectively.

**Total antioxidant capacity**

The total antioxidant capacity is used for the evaluation of both water- and fat-soluble antioxidants. The phosphomolybdenum method used for measuring total antioxidant capacity is based on the formation of green phosphate/reduced Mo (V) complex at acidic pH. Total antioxidant capacity of mother tincture, 6C and 30C of Cephalandra indica was found to be 2710, 759 and 501 μg/g ascorbic acid equivalent, respectively.

**2,2-diphenyl-1-picrylhydrazyl scavenging activity**

Assay based on the use of DPPH radicals is the most popular spectrophotometric methods for the determination of the antioxidant capacity of plant extracts, foods, beverages and vegetable extracts because the radical compounds can directly react with antioxidants. The IC\textsubscript{50} value of mother tincture, 6C and 30C of Cephalandra indica was apparently good free radical scavengers. The IC\textsubscript{50} value of ascorbic acid was found to be 1.43 μg/ml.

**Hydrogen peroxide scavenging activity**

H\textsubscript{2}O\textsubscript{2} is considered as one of the main inducers of cellular ageing and could strike many cellular energy-producing systems. H\textsubscript{2}O\textsubscript{2} is an uncharged species and is not very reactive itself. It penetrates in cellular membrane and leads to formation of hydroxyl radical which the capability of damaging almost every molecule found in the living cells. The IC\textsubscript{50} value of mother tincture, 6C and 30C of Cephalandra indica was found to be 32.23, 155.14 and 923.02 μl respectively [Figure 1] and that of ascorbic acid was found to be 1.43 μg/ml.

**Reducing power assay**

The electron donating capacity reflects the reducing power of bioactive compounds and is associated with antioxidant activity. Antioxidants can be reductants, and inactivation of oxidants by reductants can be described as redox reactions in which one reaction species is reduced at the expense of the oxidation of the other. The presence of reductants, such as antioxidant substances in the samples, causes the reduction of the Fe\textsuperscript{3+}/ferricyanide complex to the ferrous form. The formation of ferrous ion complex was observed and EC\textsubscript{50} (effective concentration at which the absorbance is 0.5) was calculated [Figure 3]. EC\textsubscript{50} was found to be 37 μl, 250 μl and 989 μl for mother tincture, 6C and 30C of Cephalandra indica, respectively, and 21.42 μg/ml for ascorbic acid.

**Nitric oxide scavenging activity**

NO is generated from amino acid L-arginine by vascular endothelial cells, phagocytes and certain cells of the brain. NO is classified as a free radical because of its unpaired electron and displays important reactivity with certain types of proteins and other free radicals. The toxicity of NO becomes adverse when it reacts with superoxide radical, forming a highly reactive peroxynitrite anion. The various concentrations of mother tincture, 6C and 30C of Cephalandra indica showed significant inhibition against NO radical in a dose-dependent manner. The concentration of mother tincture, 6C and 30C of Cephalandra indica required for 50% inhibition (IC\textsubscript{50}) was found to be 42.13 μl, 207.05 μl and 999 μl, respectively [Figure 4]. IC\textsubscript{50} of ascorbic acid was found to be 63.55 μg/ml.
Superoxide scavenging activity
Superoxide anion radicals are formed due to electron leakage from electron transport chain in aerobic cells and acts as a precursor for ROS that contributes to tissue damage and various other pathological conditions.\(^{26}\) Mother tincture, 6C and 30C of *Cephalandra indica*, had significant activity against superoxide radicals in a dose-dependent manner [Figure 5]. IC\(_{50}\) of ascorbic acid was found to be 27.96 \(\mu\)g/ml and that of mother tincture, 6C and 30C of *Cephalandra indica* was found to be 33.65 \(\mu\)l, 223 \(\mu\)l and 987 \(\mu\)l, respectively.

AGEs inhibition activity
Hyperglycaemia leads to the production of AGEs and their receptors. AGEs are responsible for production of ROS and thus results to oxidative stress, the major element for onset of diabetic complications.\(^{27}\) In the present study, the formation of AGEs was monitored weekly by measuring fluorescence intensity of the BSA-fructose solutions for 4 weeks and mother tincture, 6C and 30C, potencies of *Cephalandra indica* were found to have inhibitory effect against the formation of AGEs. A significant inhibition of AGEs formation (93.37\%) was observed in fructose-induced glycated BSA plus AG (500 \(\mu\)g/ml). At 4\(^{th}\) week of incubation, the percentage inhibitions of AGEs formation by *Cephalandra indica* mother tincture (10–50 \(\mu\)l) were 30.34\%–91.77\%, respectively; 6C (50–250 \(\mu\)l) was 29.98\%–65.71\% and for 30C (200–1000 \(\mu\)l) was found to be 33.05\%–57.75\%, respectively [Figures 6-8].

Erythrocyte sorbitol accumulation inhibition
The excessive formation and accumulation of sorbitol during chronic hyperglycaemia lead to increased oxidative stress and ultimately to diabetic complications.\(^{28}\) The increased activity of this pathway leads to excess formation of sorbitol.\(^{28}\) The enzyme ALR1 was obtained from kidney of Wistar rat and the activity of ALR1 was measured spectrophotometrically by monitoring the oxidation of NADPH at 340 nm. IC\(_{50}\) of quercetin (standard) was found to be 5.30 \(\mu\)g/ml and that of mother tincture, 6C and 30C of *Cephalandra indica* was found to be 32.19 \(\mu\)l, 175.01 \(\mu\)l and 834 \(\mu\)l, respectively [Figure 10].

Conclusion
Free radicals produced from different physiological and non-physiological processes are one of the bases of...
Figure 8: The effects of Cephalandra indica 30C on the formation of fluorescent advanced glycation end products incubated with fructose. Values are mean ± standard deviation for n = 3. AG: Aminoguanidine

Figure 9: Effect of Cephalandra indica on erythrocyte sorbitol accumulation inhibition assay in homeopathic formulation. Values are mean ± standard deviation for n = 3

Figure 10: Effect of Cephalandra indica on aldose reductase inhibitory assay in homeopathic formulation. Values are mean ± standard deviation for n = 3

several diseases. Therefore, there is an urge of safe and potent antioxidants to overthrow the free radicals. The results from the present study revealed the presence of phenols in homeopathic preparation of Cephalandra indica which plays a significant role in the reduction of oxidative stress. Cephalandra indica was found to scavenge different radicals such as in DPPH, H$_2$O$_2$, NO and SOD. Cephalandra indica was also found to inhibit the formation of AGEs and sorbitol accumulation, major culprits for onset of diabetic complications. These defensive effects of homeopathic preparation of Cephalandra indica may suggest its use for the attenuation of oxidative stress and diabetic complications.

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Conflicts of interest
There are no conflicts of interest.

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Wirkung von Cephalandra indica gegen fortgeschrittene Akkumulation und Aldosereduktaseaktivität in homöopathischer Formulierung.

**Abstrakt**

**Hintergrund:** Extreme Bildung von freien Radikalen führt zu oxidativem Stress, der bei verschiedenen Krankheitsprozessen, wie diabetischen Komplikationen und vaskulären und neurodegenerativen Erkrankungen, befürchtet wurde.

**Zielsetzung:** Die vorliegende Studie wurde entworfen, um das Potenzial von homöopathischen Präparaten von Cephalandra indica L. gegen oxidativen Stress zu bewerten.

**Material und Methoden:** Potenzen von Cephalandra indica (Urtinktur, 6C und 30C) wurden von Dr. Willmar Schwabe India Pvt. Die antioxidative Aktivität von Cephalandra indica wurde unter Verwendung verschiedener in vitro-Antioxidationsmethoden bewertet.

**Ergebnisse:** Es wurde gefunden, dass der Gesamtphenolgehalt 1905, 849 und 495 mg / g Gallussäureäquivalente in der Urtinktur, 6C und 30C Cephalandra indica betrug und dass die gesamte antioxidative Kapazität 2710, 759 und 510 uM / g Ascorbinsäureäquivalente betrug, beziehungsweise. Es wurde gefunden, dass die Urtinktur, 6C und 30C von Cephalandra indica starke Reduktionskraft, 2,2-Diphenyl-1-picrylhydrazyl-Radikal, Wasserstoffperoxid, Stickoxid und Superoxid-Radikalfängeraktivität aufwiesen. Die prozentuale Hemmung der Bildung von AGEs durch Urtinktur, 6C und 30C Cephalandra indica (10–50 & mgr; l) betrug 30,34% -91,77%, 29,98% -65,71% bzw. 33,05% -57,75%. Die Urtinktur, 6C und 30C von Cephalandra indica zeigten eine inhibitorische Wirkung gegen die Sorbitakkumulation mit einem IC 50 -Wert von 26,12 & mgr; l, 203,8 & mgr; l bzw. 897,3 & mgr; l, während der IC50-Wert im Aldosereduktase-Inhibitionstest 32,54 & mgr; l, 175,02 & mgr; l und 834,34 & mgr; l bezogen wurden.

**Fazit:** Die Ergebnisse zeigten, dass homöopathische Zubereitungen von Cephalandra indica eine schützende Wirkung gegen oxidativen Stress zeigen.

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**Efecto de la formulación homeopática de Cephalandra indica frente alos productos finales de la glicación avanzada, la acumulación de sorbitol y la actividad de la aldosareductasa**

**Resumen**

**Fundamento:** La generación de radicales libres da lugar a un estrés oxidativo que ha sido problemático en varios procesos patológicos como las complicaciones de la diabetes y las enfermedades vasculares y neurodegenerativas.

**Objetivos:** El presente estudio se diseñó para evaluar el potencial de los preparados homeopáticos de *Cephalandra indica* L. frente al estrés oxidativo.

**Materiales y métodos:** El laboratorio Dr. Willmar Schwabe India Pvt. Ltd. suministró las potencias de *Cephalandra indica* (tintura madre, 6C y 30C). La actividad antioxidante de *Cephalandra indica* evaluó empleando diferentes métodos antioxidantes *in vitro*.

**Resultados:** En la tintura madre y las potencias de 6C y 30C de *Cephalandra indica*, se determinó el contenido total de fenoles en 1.905, 849 y 495 mg/g de equivalentes del ácido gálico y la capacidad antioxidante total, en 2.710, 759 y 510 µM/g de equivalentes del ácido ascórbico, respectivamente. Se constató que la tintura madre y las potencias de 6C y 30C de *Cephalandra indica* poseen un gran poder de reducción y una actividad scavengerpotente contra el radical 2,2-difenil-1-picrilhidrazil, el peróxido de hидrógeno, el óxido nítrico y los radicales superóxido. La inhibición porcentual de la formación de AGE (productos finales de glicación avanzada),que ejercen la tintura madre y las potencias de 6C y 30C de *Cephalandra indica* (10–50 µl), se situó en el 30,34%–91,77%, el 29,98%–65,71% y el 33,05%–57,75%, respectivamente. Las tinturas madre y las potencias de 6C y 30C de *Cephalandra indica* mostraron un efecto inhibitor frente a la acumulación de sorbitol con un valor CI50 de 26,12 µl, 203,10 µl y 897,3 µl, respectivamente, mientras que, en el ensayo de inhibición de la aldoseduactasa, el valor CI50 fue de 32,54 µl, 175,02 µl y 834,34 µl, respectivamente.

**Conclusiones:** Los resultados revelaron que los preparados homeopáticos de *Cephalandra indica* exhiben un efecto protector frente al estrés oxidativo.
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Effets du Cephalandra indica contre les produits finaux de glycation avancée, l’accumulation de sorbitol et l’activité inhibitrice d’aldose réductase dans la formulation homéopathique.

Résumé

Contexte: L’extrême production de radicaux libres entraîne un stress oxydatif appréhendé dans de nombreux processus de maladies comme dans le cas des complications du diabète et des maladies vasculaires et neuro-dégénératives. Objectif: Cette étude a été élaborée pour évaluer le potentiel des préparations homéopathiques de Cephalandra indica L. dans le traitement du stress oxydatif.

Matériels et méthodes: Les dilutions du Cephalandra indica (la teinture mère, 6C et 30C) ont été obtenues auprès de la société Dr Willmar Schwabe India Pvt. Ltd. L’activité antioxydante du Cephalandra indica a été évaluée en utilisant diverses méthodes antioxydantes in vitro.

Résultats: La teneur totale en phénol était de 1905, 849 et 495 mg/g d’équivalents en acide gallique dans la teinture mère 6C et 30C de Cephalandra indica et la capacité totale antioxydante était de 2710, 759 et 510 µM/g d’équivalents en acide ascorbique respectivement. La teinture mère, 6C et 30C de Cephalandra indica semble avoir un fort pouvoir réducteur et une activité piégeage du radical 2,2-diphenyl-1-picrylhydrazyl, du peroxyde d’hydrogène, de l’oxyde nitrique et du radical de superoxyde. Le pourcentage d’inhibition de la formation des AGE par la teinture mère 6C et 30C de Cephalandra indica (10–50 µl) se trouvait entre 30,34 % et 91,77 %, 29,98 % et 65,71 % et entre 33,05 % et 57,75 % respectivement. La teinture mère 6C et 30C de Cephalandra indica a montré un effet inhibiteur contre l’accumulation de sorbitol avec une valeur IC50 de 26,12 µl, 203,10 µl et de 897,3 µl, respectivement tandis que dans l’analyse de l’inhibiteur d’aldose réductase, la valeur IC50 était de 32,54 µl, 175,02 µl et de 834,34 µl respectivement.

Conclusion: Les résultats montrent que les préparations homéopathiques de Cephalandra indica ont un effet protecteur contre le stress oxydatif.