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Red tea and ginger formulation mediated silver nanoparticles and its antioxidant activity.

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Abstract
Background: Poor solubility and bioavailability of herbal drugs, which are a barrier to their effective administration, can be resolved with the use of appropriate nanomaterials that will improve their pharmacokinetics.Aim:The aim of the current study is to analyse the synthesis of silver nanoparticles from red tea and ginger extract and to determine the antioxidant potential of it.Materials and Methods: DPPH free radical scavenging assay and hydroxyl radical scavenging assay was performed to determine the antioxidant potential of red tea and ginger formulation mediated silver nanoparticles. The percentage inhibition of DPPH radical scavenging activity and hydroxyl radical scavenging activity was calculated. The data was analysed statistically and the level of significance was considered at the level of $p<0.05$.Results: There is a dose-dependent increase in the percentage of inhibition of DPPH free radical and hydroxyl free radical by red tea and ginger formulation mediated silver nanoparticles. The percentage of inhibition increases with increase in the concentration of the extract. Conclusion: The study concludes that red tea and ginger formulation mediated silver nanoparticles have potent antioxidant properties and can be used as an herbal antidote for the treatment of various diseases due to oxidative stress.

Keywords: Antioxidants, Ginger , oxidative stress, Red tea, silver nanoparticles.

Introduction

Nanotechnology is the synthesis, characterisation, manufacture, and manipulation of structures, devices, or materials with particle sizes ranging from 1 to 100 nm, or the handling of materials at the nanoscale. Particle sizes below this limit, produce materials whose physical and chemical characteristics are very different from those of macroscale materials made of the same constituent (1,2). A growing demand to create environmentally acceptable material synthesis methods, has drawn attention to the biosynthesis of nanoparticles. Poor solubility and bioavailability of herbal drugs, which limit their distribution, can be overcome with the use of appropriate nanomaterials that improve the pharmacokinetics and effectiveness of the drugs(3). Due to weak solubility, poor permeability, low bioavailability, instability in biological milieu, etc., the administration of plant/herbal medicinal compounds as drugs is challenging. By attaching or encapsulating herbal medications with appropriate nanomaterials, which can considerably increase pharmacokinetics and performance, it is possible to get around these limits of herbal medications(4).Silver nanoparticles (AgNPs) are of great importance due to the ease in preparation process and unique optical, electrical, and thermal properties which enhances electrical conductivity, near infrared absorption, and effective charge separation(5). It is widely used to treat cancer, degenerative Alzheimer's disease, and other oxidative stress-related illnesses because of its great antioxidant potential(6). inger is also a very popular plant with worldwide acceptance. It has found various uses as spices, nutraceutical and pleasure drinks. The health benefits of ginger are attributed to their polyphenols(7). Gingerols, shogaols, and catechins are among the polyphenols found in ginger. It has been determined that ginger is a medicinal herb with pharmacological effects. Ginger has antioxidant, antihypertensive, and anti-atherogenic effects .(8–10).Red tea, or Rooibos tea, is distinct because it is primarily grown in Africa and contains polyphenols like aspalathin that are not present in other foods (11). It possess high antioxidant and anti-inflammatory properties (12). RedTea has been shown to possess several health benefits which could be attributed to its content of polyphenols(13) . Tea polyphenols include catechins, myricetin, and quercetin. Tea catechins are efficient free radical scavengers due to their one-electron reduction potential(14). Catechins have antioxidative, anticarcinogenic, antimicrobial, antiviral, anti-inflammatory, and antidiabetic properties (15–19).The current study is done to determine the antioxidant property of red tea and ginger formulation mediated silver nanoparticles.

Materials and Methods

ANTIOXIDANT ACTIVITY:

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1.DPPH METHOD
Antioxidant activity
DPPH assay was used to test the antioxidant activity of biogenic synthesised silver nanoparticles. Diverse concentrations (10µL,20µL,30µL,40µL,50µL) of Red tea and ginger interceded silver nanoparticle was mixed with 1 ml of 0.1 mM DPPH in methanol and 450 µl of 50 mM Tris HCl buffer (pH 7.4) and incubated for 30 minutes. Later, the reduction in the quantity of DPPH free radicals was assessed dependent on the absorbance at 517 nm. Ascorbic acid was used as standard. The percentage of inhibition was determined from the following equation,
% inhibition= Absorbance of control- Absorbance of test sample ×100 Absorbance of control

2.HYDROXYL RADICAL SCAVENGING ASSAY:
All solutions were prepared freshly.1.0mL of the reaction mixture contained 100µL of 28mM of 2-deoxy-2-ribose (dissolved in phosphate buffer,pH 7.4), 500µL solution of various concentrations of the red tea and ginger (10µL,20µL,30µL,40µL,50µL, 200µL) of 200µM Fecl3 and 1.04mM EDTA (1:1 v/v),100µL H2O2(1.0mM) and 100µL ascorbic acid(1.0mM).After an incubation period of 1 hour at 37°C the extent of deoxyribose degradation at about 532nm against the blank solution . Vitamin E was used as a positive control.

Statistical analysis
The data was statistically analysed using one way analysis of variance (ONE-WAY ANOVA). Duncan Multiple range test was used to analyse the statistical significance between groups. The levels of significance was at the levels of $p<0.05$.

Results
The results show that there is a dose-dependent increase in the percentage of inhibition of DPPH free radicals and hydroxyl free radicals by the red tea and ginger formulation mediated silver nanoparticle extract, with an increase in concentration ranging from 10µL to 50µL of the extract. The percentage of inhibition increases with increase in the concentration of the extract. The antioxidant activity of red tea and ginger formulation mediated silver nanoparticles was similar to that of the standard.

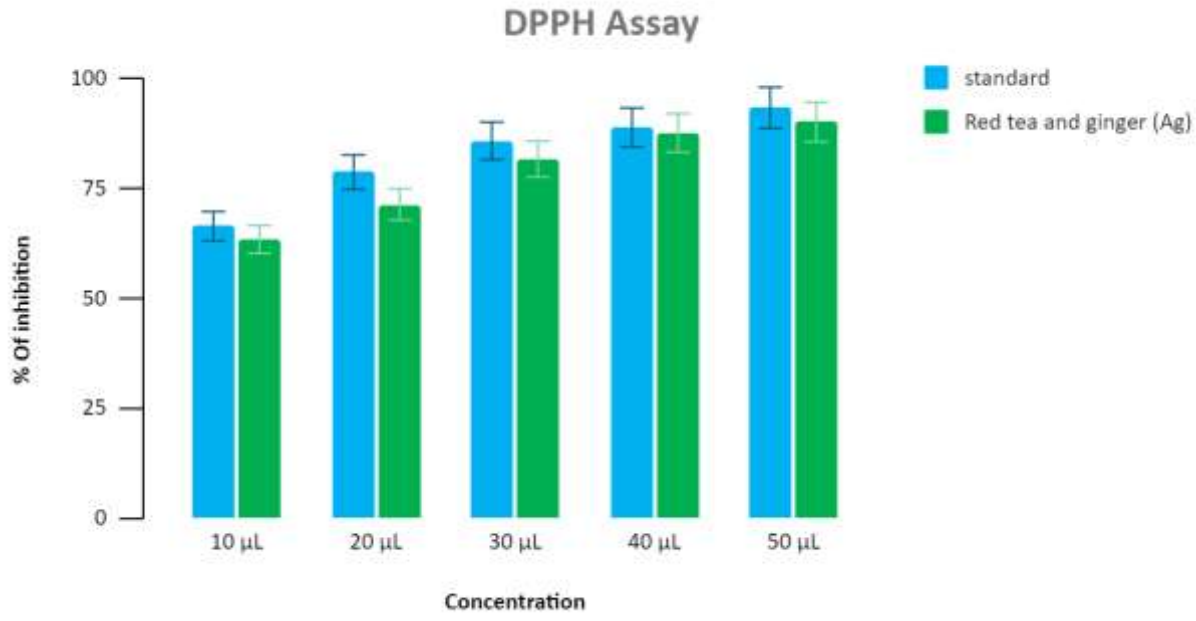

Figure 1: Represents bar graph showing DPPH inhibitory activity of red tea and ginger formulation mediated silver nanoparticle extract. Blue colour bar represents the percentage of inhibition of DPPH by the standard drug (Ascorbic acid) and the green colour bar represents the percentage of inhibition of DPPH by red tea and ginger silver nanoparticle extract. Each bar represents the mean ± SD of 5 observations. Significance at the levels of $p< 0.05$.

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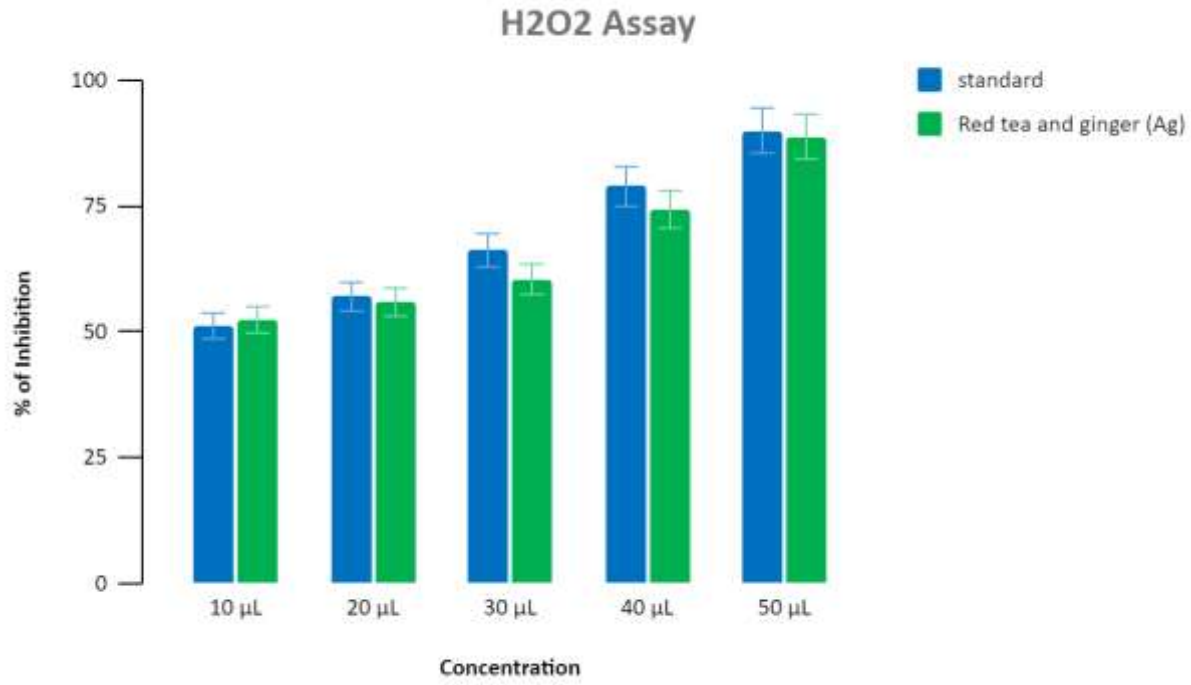

Figure 2: Represents bar graph depicting H2O2 inhibitory activity of red tea and ginger formulation mediated silver nanoparticle extract. Blue colour bar represents the percentage of inhibition of H2O2 by the standard (Vitamine E) and the green colour represents the percentage of inhibition of H2O2 by red tea and ginger silver nanoparticle extract. Each bar represents the mean ± SD of 5 observations. Significance at the levels of $p< 0.05$.

Discussion

Free radicals are molecules with an unpaired electron in their outermost orbital that are capable of independent existence. Because of the unpaired electrons, it is unstable and extremely reactive (20). To achieve stability, they either strive to provide or take an electron. The hydroxyl radical, superoxide radical, anion radical, hydrogen peroxide, oxygen singlet, hypochlorite, nitric oxide radical, and peroxynitrite radical are a few examples of free radicals generated in the body(21). These extremely reactive chemicals destroy biologically important components including DNA, protein, carbohydrates, and lipids (22). They are produced as metabolic byproducts in the cell nucleus and membranes.The use of antioxidants can lower the chance of developing illnesses caused due to oxidative stress. Antioxidants are chemicals that shield the cell from free radicals and are also known as "free radical scavengers." By preventing the chain reaction, it neutralises the free radical. Antioxidants come from both organic and artificial sources. Exogenous dietary sources including vegetables, fruits, and other synthetic sources are among the sources of antioxidants in addition to endogenous antioxidants found naturally in the body. Vitamins A, C, E, beta-carotene, lycopene, lutein, selenium, manganese, and zeaxanthin are a few examples of antioxidants that originate from outside the body(23). The majority of antioxidants, including flavonoids, flavones, catechins, polyphenol, and phytoestrogen, are found in plant-based meals. Natural antioxidants are typically chosen over synthetic ones due to their natural origin, relative lack of adverse effects or complete absence of them, and cost effectiveness. Poor solubility and bioavailability of herbal drugs, which are a barrier to their effective administration, can be resolved with the use of appropriate nanomaterials that will improve their pharmacokinetics(24) .The present study focused on the green synthesis of silver nanoparticles (AgNPs) from red tea and ginger extract and evaluated the antioxidant potential using DPPH assay and H2O2 assay. The results showed that there is a significant increase in the antioxidant potential of the extract with the increase in the concentration of the extract. Previous studies done on the phytochemical screening of ginger and red tea, determined the presence of polyphenols in red tea and ginger. The polyphenol aspalathin, was unique to red tea(12,25). The antioxidant property of these plant extracts are due to the presence of these phytochemicals.

Conclusions

The study concludes that red tea and ginger formulation mediated silver nanoparticles have potent antioxidant properties and can be used as an herbal antidote for the treatment of various diseases due to oxidative stress.

Reference

1. Duncan TV. Applications of nanotechnology in food packaging and food safety: barrier materials, antimicrobials and sensors. J Colloid Interface Sci. 2011 Nov 1;363(1):1–24.
2. Egbuna C, Jeevanandam J, Patrick-Iwuanyanwu KC, Onyeike EN. Application of Nanotechnology in Food Science, Processing and Packaging. Springer Nature; 2022. 266 p.
3. Cioffi N, Rai M. Nano-Antimicrobials: Progress and Prospects. Springer Science & Business Media; 2012. 563 p.
4. Prasad R. Fungal Nanotechnology: Applications in Agriculture, Industry, and Medicine. Springer; 2017. 295 p.
5. Alarcon EI, Griffith M, Udekwu KI. Silver Nanoparticle Applications: In the Fabrication and Design of Medical and Biosensing Devices. Springer; 2015. 146 p.
6. Firdhouse MJ, Jannathul Firdhouse M, Lalitha P. Biogenic silver nanoparticles – Synthesis, characterization and its potential against cancer inducing bacteria [Internet]. Vol. 222, Journal of Molecular Liquids. 2016. p. 1041–50. Available from: http://dx.doi.org/10.1016/j.molliq.2016.07.141
7. Jeena K, Liju VB, Kuttan R. Antioxidant, anti-inflammatory and antinociceptive activities of essential oil from ginger. Indian J Physiol Pharmacol. 2013 Jan;57(1):51–62.
8. Kulkarni RA, Deshpande AR. Anti-inflammatory and antioxidant effect of ginger in tuberculosis. J Complement Integr Med. 2016 Jun 1;13(2):201–6.
9. Ghlissi Z, Atheymen R, Boujbiha MA, Sahnoun Z, Makni Ayedi F, Zeghal K, et al. Antioxidant and androgenic effects of dietary ginger on reproductive function of male diabetic rats. Int J Food Sci Nutr. 2013 Dec;64(8):974–8.
10. Wang H. Ginger Cultivation and Its Antimicrobial and Pharmacological Potentials. BoD – Books on Demand; 2020. 164 p.
11. Piek H, Venter I, Rautenbach F, Marnewick JL. Rooibos herbal tea: An optimal cup and its consumers. Health Saf Code Annot State Calif Adopt April 7 1939 Calif. 2019 Feb 21;24:1090.
12. Joubert E, Beelders T, de Beer D, Malherbe CJ, de Villiers AJ, Sigge GO. Variation in Phenolic Content and Antioxidant Activity of Fermented Rooibos Herbal Tea Infusions: Role of Production Season and Quality Grade [Internet]. Vol. 60, Journal of Agricultural and Food Chemistry. 2012. p. 9171–9. Available from: http://dx.doi.org/10.1021/jf302583r
13. Lawal AO, Davids LM, Marnewick JL. Rooibos (Aspalathus linearis) and honeybush (Cyclopia species) modulate the oxidative stress associated injury of diesel exhaust particles in human umbilical vein endothelial cells [Internet]. Vol. 59, Phytomedicine. 2019. p. 152898. Available from: http://dx.doi.org/10.1016/j.phymed.2019.152898
14. Akinfenwa AO, Abdul NS, Marnewick JL, Hussein AA. Protective Effects of Linearthin and Other Chalcone Derivatives from Aspalathus linearis (Rooibos) against UVB Induced Oxidative Stress and Toxicity in Human Skin Cells [Internet]. Vol. 10, Plants. 2021. p. 1936. Available from: http://dx.doi.org/10.3390/plants10091936
15. Marnewick JL, Rautenbach F, Venter I, Neethling H, Blackhurst DM, Wolmarans P, et al. Effects of rooibos (Aspalathus linearis) on oxidative stress and biochemical parameters in adults at risk for cardiovascular disease [Internet]. Vol. 133, Journal of Ethnopharmacology. 2011. p. 46–52. Available from: http://dx.doi.org/10.1016/j.jep.2010.08.061
16. Marnewick JL, Venter I, Rautenbach F, Neethling H, Kotze M. Rooibos: Effect on Iron Status of South African Adults at Risk for Coronary Heart Disease [Internet]. Vol. 53, Free Radical Biology and Medicine. 2012. p. S85. Available from: http://dx.doi.org/10.1016/j.freeradbiomed.2012.10.340
17. Marnewick JL, Venter I, Rautenbach F, Neethling H, Kotze M. Rooibos: Effect on Iron Status in South African Adults at Risk for Coronary Heart Disease [Internet]. ACS Symposium Series. 2013. p. 103–14. Available from: http://dx.doi.org/10.1021/bk-2013-1127.ch008
18. Obasa Z, van Vuuren MA, Huisamen B, Windvogel SL. The modulating effects of green rooibos (Aspalathuslinearis) extract on vascular function and antioxidantstatus in obese Wistar rats [Internet]. Vol. 32, Cardiovascular Journal of Africa. 2021. p. 33–43. Available from: http://dx.doi.org/10.5830/cvja-2020-048
19. Canda BD, Oguntibeju OO, Marnewick JL. Effects of Consumption of Rooibos (*Aspalathus linearis*) and a Rooibos-Derived Commercial Supplement on Hepatic Tissue Injury by*tert*-Butyl Hydroperoxide in Wistar Rats [Internet]. Vol. 2014, Oxidative Medicine and Cellular Longevity. 2014. p. 1–9. Available from: http://dx.doi.org/10.1155/2014/716832
20. Rahman MM, Islam MB, Biswas M, Khurshid Alam AHM. In vitro antioxidant and free radical scavenging activity of different parts of Tabebuia pallida growing in Bangladesh. BMC Res Notes. 2015 Oct 30;8:621.
21. Gowder SJT. Basic Principles and Clinical Significance of Oxidative Stress. BoD – Books on Demand; 2015. 330 p.
22. Gadoth N, Göbel HH. Oxidative Stress and Free Radical Damage in Neurology. Springer Science & Business Media; 2010. 323 p.
23. Joshy R, Sridevi G, Selvaraj J, Preetha S. In vitro Antioxidant Properties of Various Extracts of Andrographis Echioides [Internet]. Journal of Pharmaceutical Research International. 2021. p. 404–11. Available from: http://dx.doi.org/10.9734/jpri/2021/v33i61a35677
24. Firdhouse MJ, Jannathul Firdhouse M, Lalitha P. Biosynthesis of Silver Nanoparticles and Its Applications [Internet]. Vol. 2015, Journal of Nanotechnology. 2015. p. 1–18. Available from: http://dx.doi.org/10.1155/2015/829526

25. Joubert E, Jolley B, Koch IS, Muller M, Van der Rijst M, de Beer D. Major production areas of rooibos (Aspalathus linearis) deliver herbal tea of similar phenolic and phenylpropenoic acid glucoside content [Internet]. Vol. 103, South African Journal of Botany. 2016. p. 162–9. Available from: http://dx.doi.org/10.1016/j.sajb.2015.08.015