Short-Communication

Green Synthesis of Copper Nanoparticles Using Aqueous Solution of Flowers of Capparis Decidua from Cholistan Desert

Farrukh Jaleel¹,²*, Kanwal Irshad¹, Areesha Shahid¹, Maliha Akhtar¹ and Shahid Mehboob²

¹Department of Chemistry, Khwaja Fareed University, Pakistan
²Islamia University of Bahawalpur, Pakistan

*Corresponding author: Farrukh Jaleel, Assistant Professor, Department of Chemistry, Khwaja Fareed University of Engineering and Information Technology, Rahimyar Khan, 64200, Pakistan.

To Cite This Article: Farrukh Jaleel, Kanwal Irshad, Areesha Shahid, Maliha Akhtar, Green Synthesis of Copper Nanoparticles Using Aqueous Solution of Flowers of Capparis Decidua from Cholistan Desert. 2020 - 10(5). AJBSR.MS.ID.001557. DOI: 10.34297/AJBSR.2020.10.001557.

Received: October 19, 2020; Published: October 30, 2020

Abstract

The undeniable impact of nanotechnology in biomedicines science is further explored by the rapid green synthesis of Cu nanoparticles (NPs) from flower extract of a deserted region species, Capparis decidua which is proven to be an important pharmacological medicine. The extract of Capparis decidua exhibits potential against diseases like paralysis, diabetes, cough, asthma, enlarged spleen. Synthesized NPs were characterized by UV-vis, FTIR, SEM, and EDX spectroscopy, and results declare the conformation of these NPs which can enhance extracts effectiveness against diseases.

Keywords: Cu Nanoparticles (NPs), Flower Extract, Green synthesis, Pharmacological Medicine

Introduction

Herbal medicines constitute natural compounds isolated from plant sources [1] which 90-95% are obtained from natural sources [2,3]. Besides having a less toxic and more therapeutic nature their drug delivery system is the main area of concern for scientists and pharmacologists. “Herbal remedies” term is referred to the 90-95% plant extract-based NPs [4] due to effective drug delivery action with less toxic side reactions. A statistical data of 1981-2007 shows 50% of drugs are plant-based NPs while new drugs in the era of 1981-2007 specifies that almost 50% of drugs are synthesized utilizing NPs obtained from plant sources because of compact size and effective drug action [5]. Desert plant shows exceptions as the herbal drugs, being rich in metabolites used both traditionally and pharmacologically. Present studies emphasize on reporting Cholistan desert species, covers around 26,000 Km² area located south of Punjab, Pakistan accounts for 154 plant species belong to 106 genera and 38 families [6].

Phytochemical composition indicates terpenes, steroids, phenolics, flavonoids, quinones, anthocyanidins, saponins, antioxidants etc. Researchers recently showed immense interest in Cholistan desert flora to advance their importance with the help of nanotechnology. Very few species have been reported for synthesizing NPs of metals like Ag, Au, CuO, and ZnO and found that these NPs possess a wide range of biological activities including anti-microbial, antidiabetic, anti-analgesic, anti-plague [7]. Capparis decidua is commonly termed as Delha, Kari, Caper, Kabra, Karyal, Handbag, Karil, Kair, Ker, Teens, Della, and Nepti in different regions [8,9] about which important information are presented in the table. So far being neglected, the very first time encyclopedic presented matter of concern is to utilize this flora as a source of biomedicinal treasure that not only serves suffering humanity but also play an important part in the country’s economy.

Materials and Method

Materials

Flowers of Capparis decidua plant were collected from the Cholistan Desert. The copper salt (CuSO4.5H2O) was purchased from Sigma Aldrich.
Preparation of Extract

The flowers were washed properly with distilled water and parched in shelter for 4-5 days. The dried flowers were then crushed by a grinder followed by the preparation of broth by boiling 10g powder in 100mL of distilled water at 60°C for 40 minutes. The resulted infusion was allowed to cool down to room temperature and filtered.

Synthesis of Metal NPs

80mL of plant extract was added in 100mL followed by the addition of 2g of metallic salt and stirred at 60°C for 1 hour. The reduction of metallic ions takes place. The production of NPs was observed by color changing from light brown to dark brown in this case. This methodology is presented in illusion form in Figure 1.

Results and Discussion

The Cu NPs were periodically examined by UV-Visible spectroscopy in the wavelength ranging from 200-800nm at room temperature. To identify the possible functional groups, present in the NPs they were subjected to the FTIR spectroscopy. To identify the shape of NPs SEM spectroscopy was used. Then scanning electron microscopy was used to investigate the size and shape of the NPs. EDAX was used to do elemental analysis of biogenic copper NPs.

UV-Visible Spectroscopy

![UV-Visible Spectra of Cu NPs](image-url)
UV visible spectroscopy is the first characterization technique that confirms the synthesis of Cu NPs. Cu NPs were analyzed by UV visible spectroscopy via Shimadzu UV-2450 spectrophotometer to confirmation the synthesis of NPs. Absorbance of synthesized of NPs was measured in solution form. The graph shows an absorbance peak at 390 nm confirming the synthesis of Cu NPs as indicated in spectral (Figure 2).

**FTIR Spectroscopy**

![FTIR of Cu NPs](image)

Fourier transform spectroscopy describes the presence of functional groups attached to Cu NPs. Relative frequencies describe the bond bending, bond stretching, and the presence of functional groups in the compound. The Fourier transform spectroscopy of Cu NPs was performed to confirm the presence of functional groups attached to the NPs. The FTIR analysis was done by Shanghai Jiao tong University of China as illustrated in spectral (Figure 3). The frequency ranges from 3400-3500 cm⁻¹ showed the presence of aliphatic primary amines and Alcohols.

The frequency range 1500-1700cm⁻¹ reported the presence of Nitro-compounds, Alpha beta-unsaturated ketones, Secondary and tertiary amide, Conjugated alkenes, Amines, alkenes, cyclic alkenes, oximes, conjugated aldehydes, and carboxylic acids. The frequency range at 1600cm⁻¹ confirmed the presence of Aromatic compounds and C-H bending. The frequency ranges from 1300-1500cm⁻¹ showed the presence of Isopropyl group and di-ketones. The frequency range at 1200 cm⁻¹ reported the presence of Ester and carbonyl compounds. While the frequency range at 600 cm⁻¹ confirmed the presence of Halo compounds and C-I single bond. The simple representation is done by illustration Table 1.

**Table 1: FTIR Frequency range and functional groups table.**

| Frequency Range (Cm⁻¹) | Functional Group                                                                 |
|------------------------|----------------------------------------------------------------------------------|
| 3400-3500              | Aliphatic primary amines, Alcohols                                               |
| 1500-1700              | Nitro-compounds, Alpha beta-unsaturated ketones, Secondary and tertiary amide, Conjugated alkenes, Amines, alkenes, cyclic alkenes, oximes, conjugated aldehydes, carboxylic acids. |
| 1600                   | Aromatic compounds, C-H bending.                                                  |
| 1300-1500              | Isopropyl group, di-ketones.                                                      |
| 1200                   | Ester, carbonyl compounds                                                        |
| 600                    | Halogen compounds, C-I single bond.                                                |

**SEM Spectroscopy**

The morphology of the NPs is shown in Figure 4. This image reveals that the synthesized particles are highly agglomerated in nature. Some of the large particles are also present due to aggregation or overlapping of the smaller particles. The shape of the NPs is no so well defined. They are somewhat spherical to irregular in appearance.
EDX Spectroscopy

The EDX spectroscopy shown in Figure 5, was done by Shanghai Jiao tong University of China. The EDX spectra showed that the crystalline Cu is present in the Cu NPs. While Au, Mg, and O are the main impurities present in the Cu NPs but they are small in amount. The Au and Mg contents may be present in the flower extract of the Capparis decidua and the O contents might be added during the process of synthesis of NPs. But the highest peak is of Cu which confirms the presence of crystalline Cu.

Conclusion

Desert plants of the Cholistan region are being glorified under this study as a novel source of the Nanomedicine system. Phytochemical investigation of species of Cholistan desert pave new pathways for the synthesis of a new diversified range of NPs involved in curing many fatal ailments. Synthesized flower extract-based Cu NPs of Capparis decidua characterize under the UV-vis, FTIR, SEM, and EDX spectroscopy shows great agreement with the theoretical values from the literature. UV-Visible confirms the formation of Cu nanoparticle; FTIR elaborates the detailed in-

look of different functional groups present in these NPs. The SEM spectroscopy results showed that NPs are highly aggregated and show irregular to spherical shape. The EDX spectra confirm the presence of crystalline Cu is present in the Cu NPs. These metal-based NPs of the Cholistan desert can be future explored in diverse applications along with the herbal medicine basis in the future. Multidisciplinary applications involve sensors, optical probes, catalysis, electronics, and disease diagnosis as future prospects. Thus, the present situation demands to utilize the source of natural medicine which has been wasted every year due to ignorance and non-exploration.
References

1. Paules CI, Marston HD, Fauci AS (2020) Coronavirus infections—more than just the common cold. Jama 323(8): 707-708.

2. Meng L, Qiu W, Wan L, Ai Y, Xue Z, et al. (2020) Intubation, and ventilation amid the COVID-19 outbreak: Wuhan’s experience. Anesthesiology 132(6): 1317-1332.

3. Yang X, Yu Y, Xu J, Shu H, Liu H, et al. (2020) Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. Lancet Respir Med 8(5): 475-481.

4. Wang D, Hu B, Hu C, Zhu F, Liu X, et al. (2020) Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. Jama 323(11): 1061-1069.

5. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, et al. (2020) Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med 382(18): 1708-1720.

6. Huang C, Wang Y, Li X, Ren L, Zhao J, et al. (2020) Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 395(10223): 497-506.

7. Chen N, Zhou M, Dong X, Qu J, Gong F, et al. (2020) Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet 395(10223): 507-513.

8. Mao L, Wang M, Chen S, He Q, Chang J, et al. (2020) Neurological manifestations of hospitalized patients with COVID-19 in Wuhan, China. Jama Neurol 77(6): 1-9.

9. Zuo M, Huang Y, Ma W, Xue Z, Zhang J, et al. (2020) Expert Recommendations for Tracheal Intubation in Critically Ill Patients with Novel Coronavirus Disease 2019. Chin Med Sci 35(2): 105-109.

10. Chen N, Zhou M, Dong X, Qu J, Gong F, et al. (2020) Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet 395(10223): 507-513.

11. Liu WJ, Zhao M, Liu K, Xu K, Wong G, et al. (2017) T-cell immunity of SARS-CoV: Implications for vaccine development against MERS-CoV. Antiviral Res 137: 82-92.

12. Fan E, Brodie D, Shute AS (2018) Acute respiratory distress syndrome: advances in diagnosis and treatment. Jama 319(7): 699-710.

13. Matthey MA, Zemans RL, Zimmerman GA, Arabi YM, Beilker JR, et al. (2019) Acute respiratory distress syndrome. Nature reviews Disease primers 5(1): 1-22.

14. Badawi A, Ryoo SG (2016) Prevalence of comorbidities in the Middle East respiratory syndrome coronavirus (MERS-CoV): a systematic review and meta-analysis. Int J Infect Dis 49: 129-33.

15. Channappanavar R, Fett C, Mack M, Ten Eyck PP, Meyerholz DK, et al. (2017) Sex-based differences in susceptibility to severe acute respiratory syndrome coronavirus infection. J Immunol 198(10): 4046-4053.

16. Jaillon S, Berthelon K, Garlanda C (2019) Sexual dimorphism in innate immunity. Clin Rev Allergy Immunol 1: 1-4.

17. Dryden M, Baguenid M, Eckmann C, Corman S, Stephens J, et al. (2015) Pathophysiology and burden of infection in patients with diabetes mellitus and peripheral vascular disease: focus on skin and soft-tissue infections. Clin Microbiol Infect 21: 27-32.

18. Hu B, Zeng LP, Yang XL, Ge XY, Zhang W, et al. (2017) Discovery of a rich gene pool of bat SARS-related coronaviruses provides new insights into the origin of SARS coronavirus. PLoS pathogens 13(11): e1006698.

19. Song HD, Tu CC, Zhang GW, Wang SY, Zheng K, et al. (2005) Cross-host evolution of severe acute respiratory syndrome coronavirus in palm civet and human. Proc Natl Acad Sci 102(7): 2430-2435.

20. Yin Y, Wunderink RG (2018) MERS, SARS, and other coronaviruses as causes of pneumonia. Respir Med 23(2): 130-137.

21. Song Z, Xu Y, Bao L, Zhang L, Yu P, et al. (2019) From SARS to MERS, thrusting coronaviruses into the spotlight. Viruses 11(1): 59.

22. Li LQ, Huang T, Wang YQ, Wang ZP, Liang Y, et al. (2020) COVID-19 patients’ clinical characteristics, discharge rate, and fatality rate of meta-analysis. J med Virol 92(6): 577-583.

23. Chen L, Liu HG, Liu W, Liu J, Liu K, et al. (2020) Analysis of clinical features of 29 patients with 2019 novel coronavirus pneumonia. Zhonghua Jie He He Hu Xi Za Zhi 43(0): 005.

24. Zhou F, Yu T, Du R, Fan G, Liu Y, et al. (2020) Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet 395(10229): 1054-1062.

25. Singer M, Deutschman CS, Seymour CW, Shankar HM, Annane D, et al. (2015) The third international consensus definitions for sepsis and septic shock (Sepsis-3). JAMA 315(8): 1754-1757.

26. Ferreira FL, Bota DP, Bross A, Mélot C, Vincent JL (2001) Serial evaluation of the SOFA score to predict outcome in critically ill patients. Jama 286(14): 1754-1757.

27. Wang J, Zhou M, Liu F (2020) Reasons for healthcare workers becoming infected with novel coronavirus disease 2019 (COVID-19) in China. J Infect 105(1): 100-101.

28. Yang M, Ng MH, Li CK (2005) Thrombocytopenia in patients with severe acute respiratory syndrome. Hematology 10(2): 101-105.

29. Jolicoeur P, Lamontagne L (1995) Impairment of bone marrow pre-B and B cells in MHV3 chronically infected mice. Adv Exp Med Biol 380: 193-195.

30. Han Y, Zhang H, Mu S, Wei W, Jin C, et al. (2020) Lactate dehydrogenase, a risk factor of severe COVID-19 patients. MedRxiv.

31. Zhang, Hu, Luo, Fang, Chen, et al. (2020) Clinical features and outcomes of 221 patients with COVID-19 in Wuhan, China. MedRxiv 127: 104364.

32. Zhao J, Yang Y, Huang HP, Li D, Gu DF, et al. (2020) Relationship between the ABO Blood Group and the COVID-19 Susceptibility. MedRxiv.

33. Miller A, Reandelar MJ, Fasciglione K, Roumenova V, Li Y, et al. (2020) Correlation between universal BCG vaccination policy and reduced morbidity and mortality for COVID-19: an epidemiological study. MedRxiv.

34. Hegarty PK, Kamat AM, Zafrirakis H, Dinardo A (2020) BCG vaccination may be protective against Covid-19. Indian J Tuberc.

35. Bilan N, Dastranj A, Behbahani AG (2015) Comparison of the spo2/fio2 ratio and the pao2/fio2 ratio in patients with acute lung injury or acute respiratory distress syndrome. J Cardiovasc Thorac Res 7(1): 28-31.

36. Yamada T, Wakabayashi M, Yamaji T, Chopra N, Mikami T, et al. (2020) Value of leukocytosis and elevated C-reactive protein in predicting disease severity of COVID-19: a descriptive and predictive analysis. Clinica Chimica Acta 509: 235-243.

37. Li YX, Wu W, Yang T, Zhou W, Fu YM, et al. (2020) Characteristics of peripheral blood leukocyte differential counts in patients with COVID-19. Zhonghua Nei Ke Za Zhi 59: E003.

38. Mastaglio S, Ruggeri A, Ristano AM, Angelillo P, Yancopoulou D, et al. (2020) The first case of COVID-19 treated with the complement C3 inhibitor AMY-101. Clin Immunol 215: 108450.

39. Tan I, Wang Q, Zhang D, Ding J, Huang Q, et al. (2020) Lymphopenia predicts disease severity of COVID-19: a descriptive and predictive study. Signal Transduct Target Ther 5(1): 33.

40. Guo T, Fan Y, Chen M, Wu X, Zhang L, et al. (2020) Cardiovascular implications of fatal outcomes of patients with coronavirus disease 2019 (COVID-19). JAMA cardiology 5(7): 1-8.

41. Terpou E, Ntanning SI, Elalamy I, Kastriotis E, Sergentakis TN, et al. (2020) Hematological findings and complications of COVID-19. Am J Hematol 95(7): 834-847.
42. Lippi G, Plebani M, Henry BM (2020) Thrombocytopenia is associated with severe coronavirus disease 2019 (COVID-19) infections: A meta-analysis. Clin Chim Acta 506: 145-148.

43. Zulfiqar AA, Lorenzo VN, Hassler P, Andrès E et al. (2020) Immune thrombocytopenic purpura in a patient with Covid-19. N Engl J Med 382(18): e43.

44. Yang X, Yang Q, Wang Y, Wu Y, Xu J, et al. (2020) Thrombocytopenia and its association with mortality in patients with COVID-19. J Thromb Haemost 18(6): 1460-1472.

45. Ling W (2020) C-reactive protein levels in the early stage of COVID-19. Med Mal Infect 50(4): 332-334.

46. Tan C, Huang Y, Shi F, Tan K, Ma Q, et al. (2020) C-reactive protein correlates with computed tomographic findings and predicts severe COVID-19 early. J Med Virol 92(7): 856-862.

47. Zheng Z, Peng F, Xu B, Zhao J, Liu H, et al. (2020) Risk factors of critical & mortal COVID-19 cases: A systematic literature review and meta-analysis. J Infect 81(2): 16-25.

48. Liu F, Li L, Xu M, Wu J, Luo D, et al. (2020) Prognostic value of interleukin-6, C-reactive protein, and procalcitonin in patients with COVID-19. J Clin Virol 112: 104370.

49. Yuan J, Zou R, Zeng L, Kou S, Lan J, et al. (2020) The correlation between viral clearance and biochemical outcomes of 94 COVID-19 infected discharged patients. Inflamm Res 69(6): 599-606.

50. Zhao D, Yao F, Wang L, Zheng L, Gao Y, et al. (2020) A comparative study on the clinical features of COVID-19 pneumonia to other pneumonias. Clin Infec Dis 71(15): 756-761.

51. L’OEniLL LA, Netaa MG (2020) BCG-induced trained immunity: can it offer protection against COVID-19? Nat Rev Immunol 20(6): 335-337.

52. Escobar LE, Molina CA, Barillas MC (2020) BCG vaccine protection from severe coronavirus disease 2019 (COVID-19). Proc Natl Acad Sci U S A 117(30): 17720-17726.

53. Urashima M, Toyoda S, Nakano T, Matsuda S, Kobayashi N, et al. (1992) BIUN/Cr ratio as an index of gastrointestinal bleeding mass in children. J Pediatr Gastroenterol Nutr 15(1): 89-92.

54. Zhu N, Zhang L, Zhang H, Fengru X, Feng T (2017) Clinical Significance of Serum Bun, Cr, Cys C and RBP Combined Detection for Early Diagnosis of Renal Damage in Patients with Lupus Nephritis. J Med Lab Med 32(2): 114-116.

55. Yang J, Zheng Y, Gou X, Pu K, Chen Z, et al. (2020) Prevalence of comorbidities in the novel Wuhan coronavirus (COVID-19) infection: a systematic review and meta-analysis. Inter J Infect Dis.

56. Guan WJ, LiangWH, Zhao Y, LiangHR, Chen ZS, et al. (2020) Comorbidity and its impact on 1590 patients with Covid-19 in China: A Nationwide Analysis. Eur Respir J 55(5): 2000547.

57. Homan TD, Cichowski E (2019) Physiology, pulse pressure. InStatPearls [Internet].

58. Johnson P (2016) Practical Assessment of Volume Status in Daily Practice. Top Companion Anim Med 31(3): 86-93.

59. Zhao Q, Meng M, Kumar R, Wu Y, Huang J, et al. (2020) Lymphopenia is associated with severe coronavirus disease 2019 (COVID-19) infections: A systematic review and meta-analysis. Int J Infect Dis 96: 131-135.

60. Bermejo JR, Martín FM, López MC, Duque P, Almansa R (2018) Shared features of endothelial dysfunction between sepsis and its preceding risk factors (aging and chronic disease). J Clin Med 7(11): 400.

61. Huang C, Wang Y, Li X, Ren L, Zhao J, et al. (2020) Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 395(10223): 497-506.

62. Li J, Wang X, Chen J, Zuo X, Zhang H, et al. (2020) COVID-19 infection may cause ketosis and ketoacidosis. Diabetes Obes Metab 1-7.