Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.47750/jptcp.2023.30.07.048

Bio Reduction Of Zinc Oxide Nanoparticles Using Ipomoea Batatas & Its Antidiabetic Activity

Sriraj Gannamaneni[1], Suganya Panneer Selvam[2]*, Rajeshkumar Shanmugam[3], Ramya Ramadoss[4], Sandhya Sundar[5], Pratibha Ramani[6]

[1]Undergraduate Student, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai-600077

[2]Assistant Professor, Department of Oral Biology, Saveetha Dental College and Hospital, Saveetha Institute of Medical and Technical Sciences, Chennai - 600077

[3]Senior Lecturer, Department of Pharmacology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Science, Saveetha University, Chennai-600077

[4]Professor & Head, Department of Oral Biology, Saveetha Dental College and Hospital, Saveetha Institute of Medical and Technical Sciences, Chennai - 600077

[5]Assistant Professor, Department of Oral Biology, Saveetha Dental College and Hospital, Saveetha Institute of Medical and Technical Sciences, Chennai - 600077

[6]Professor & Head, Department of Oral Pathology & Microbiology, Saveetha Dental College and Hospital, Saveetha Institute of Medical and Technical Sciences, Chennai - 600077

***Corresponding author:** Suganya Panneer Selvam, Assistant Professor, Department of Oral Biology, Saveetha Dental College and Hospital, Saveetha Institute of Medical and Technical Sciences, Chennai - 600077

Submitted: 26 February 2023; Accepted: 14 March 2023; Published: 01 April 2023

ABSTRACT

Introduction: Ipomea batatas (sweet potato) have high fiber content, good choice for diabetes, lower blood sugar that does nothing but control blood sugar. This attempt was done by a photochemical study of the extract which revealed the presence of glycosides, glucosinolates, and alkaloids, a pre medicine for type 2 diabetes mellitus. This study is to analyze the efficacy of anti-diabetic activity of Ipomea batatas with synthesized zinc oxide nanoparticles.

Materials And Methods: Ipomea batatas weighing 10g added with 0.574g of zinc oxide nanoparticles & 100 ml of NaOH. The mixture is then subjected to heating or condensation for 5 minutes in a water bath. It is repeated and the mixture is allowed to condense to 5 ml & used for the alpha amylase test and glucosidase test. Ipomea batatas with zinc oxide nanoparticles have shown more activity against diabetes compared with standard.

Results Conclusion: Our results showed that Ipomea batatas with silver nanoparticles have good anti-diabetic activity when compared to the standard.

Conclusion: In future, this can be considered in the pharmaceutical companies & used as an adjuvant rather than promoting higher doses of insulin and oral drugs.

Keywords: *Diabetes, Potato, Metabolism, Insulin, Pancreas, Inhibition*

INTRODUCTION

Ipomea batatas (sweet potato) is a traditional crop in Tropical countries.IPomea batatas are extremely grown in many countries ,especially in China and in Southeast Asia. Ipomea batatas leaf, by-product of Ipomea batatas, possesses accelerating metabolism,preventing arteriosclerosis,protecting eyesight and anti mutation activities (Kumar, Hari Kumar, and Patnaik 2018)

Diabetes mellitus is a clinical syndrome due to relative or absolute deficiency of insulin or resistance to the action of insulin at the cellular level; as a result hyperglycaemia or glycosuria occurs .most common manifestations of diabetes are weight loss,polydipsia is and dyslipidemia. Similar common complications caused by diabetes are cardiovascular diseases,neuropathy,retinopathy and nephropathy (Feather, Randall, and Waterhouse 2020).

Diabetes is managed by proper exercise,avoiding the carbohydrate rich diet and increasing protein diet. Oral hypoglycemic agents maintain the blood glucose concentration at a certain level (Gougeon et al. 2000)

Several biochemical parameters play a momentous function in diabetes mellitus .These parameters include glucose, protein, cholesterol,HDL cholesterol, LDL cholesterol, AST and ALT (Gougeon et al. 2000; "Fig. 1. Features of Treatment to Reduce the Risk of Complications of Cardiovascular Disease in Patients with Diabetes Mellitus: SS - Cardiovascular; HDL Cholesterol - High Density Lipoprotein Cholesterol; LDL Cholesterol - Low Density Lipoprotein Cholesterol; PCSK-9 - Subtilizine / Kexin Type 9 Protein Convertase; TG - Triglycerides; OH - Total Cholesterol," n.d.)

Diabetes mellitus is a persistent metabolic syndrome which is characterized by irregular increase in blood sugar leve;L prolonged hyperglycemia leads to elevated risk of vascular complications and long term malfunction and damage of different organs(Kumar, Hari Kumar, and Patnaik 2018). Our team has extensive knowledge and research experience that has translate into high quality publications(Samuel et al. 2021; Gowhari Shabgah et al. 2021; Muthukrishnan 2021; Kanniah et al. 2020; Ramesh Kumar et al. 2011; Ganapathy et al. 2022; Anita et al. 2020; PradeepKumar et al. 2021; Barabadi et al. 2021). Our aim was to evaluate the anti-diabetic activity of the zinc oxide nanoparticles using Ipomea batatas.

MATERIALS AND METHODS

The inhibition of alpha amylase was carried out by the method described by Malik and SIngh.Breifly the reaction was initiated by the addition of 490,470,450 µl buffer to different volumes(10,30 and 50 µl) of 30 mg/ml synthesized zinc nanoparticles,stored (at room temperature)at 37°C and 4°C and calcined (300°C,500°C and 700°C)GAgNPs samples respectively to make the total volume of 500µl alpha amylase was added followed by the addition of 1000µl of starch to the reaction vessels.Then the reaction vessels were incubated incubated in a water bath for 5 minutes at 100°C.Next to this strep 500µl of NaoH is added.The reaction was completed by the addition of 500µl of DNS, and then the reaction vessels were again incubated for 5 minutes by putting them in a beaker with hot water.The color change from yellow to orange indicated alpha amylase inhibition activity. For the preparation of blank, 30µl of garlic extract was added into 1500µl buffer, and all the steps were repeated conducted in the same sequence as mentioned earlier except the addition of amylase and starch.the tubes were left to cool and the absorbable was measured at 540 nm.The percentage inhibition of alpha amylase was calculated as [(Ao-Ai)/Ao]*100. Where Ao was the absorbance of the standard and Ai was the absorbance of test samples.

The %inhibition was calculated using the formulae- % inhibition =C-T/C*100 Where, C=control, T=test sample.

To conduct the glucosidase assay, add 50 µL of the enzyme solution to 50 µL of the sample solution or standard drug solution in a 96-well microplate. Incubate the mixture for 10 minutes at 37°C. Then, add 100 µL of the substrate solution to each well, and incubate the plate for another 10 minutes at 37°C. Finally, stop the reaction by adding 50 µL of 0.1 M Na_2CO_3 solution to each well. Measure the absorbance of the reaction mixture at 405 nm using a microplate reader.Calculation of glucosidase inhibition: Calculate the percentage of glucosidase inhibition using the following formula:

% inhibition = [(Abs_control - Abs_sample or drug) / Abs_control] x 100

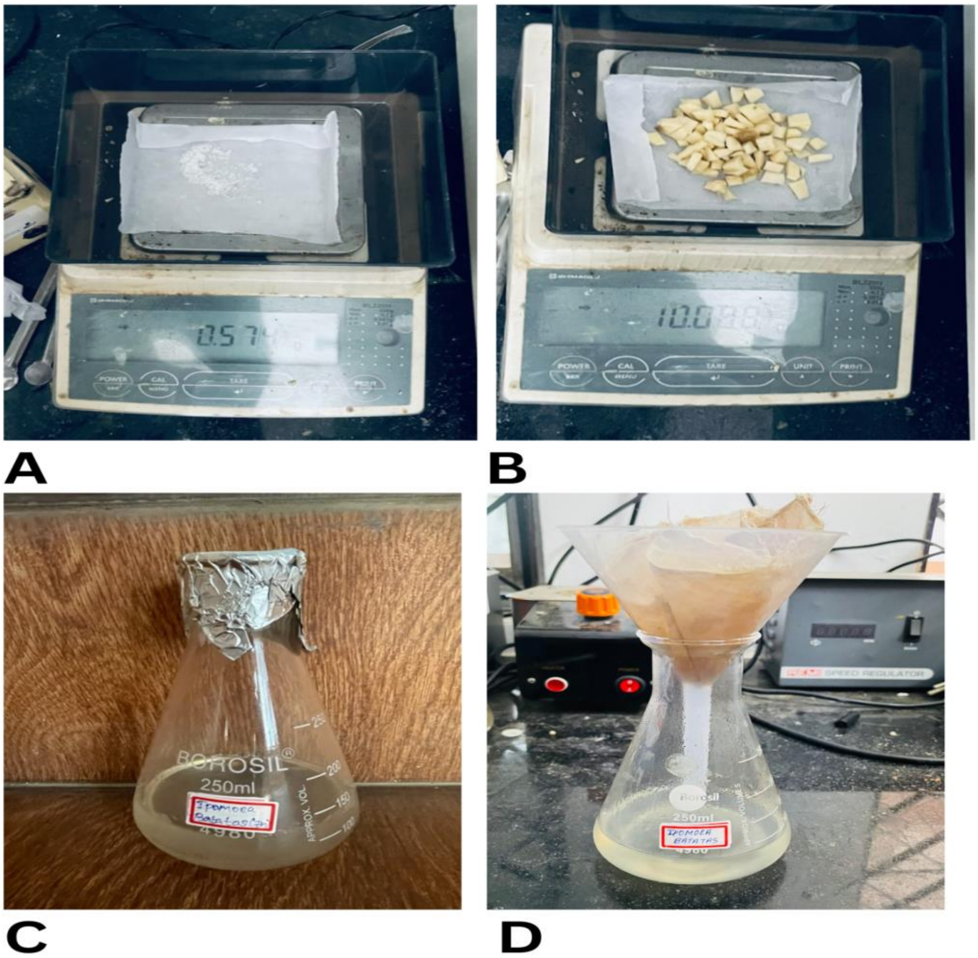
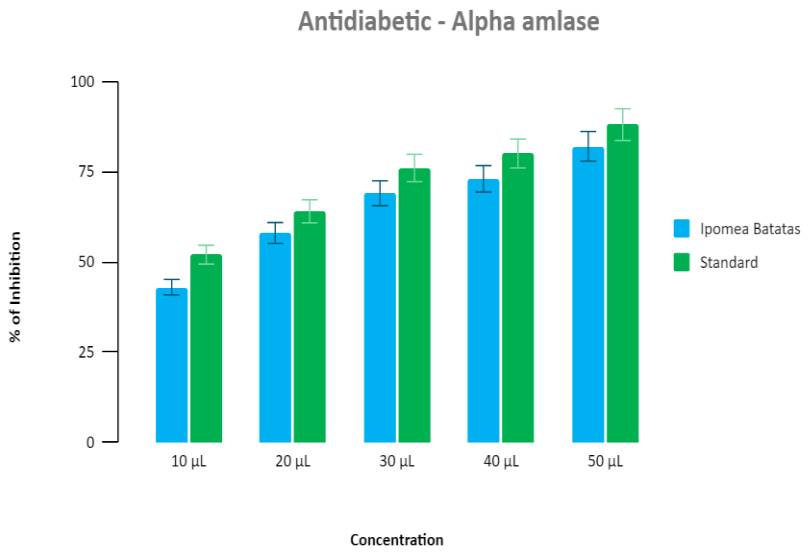


FIGURE A,B,C,D: Weighing, Filtering and Preparation of Ipomea batatas extract.

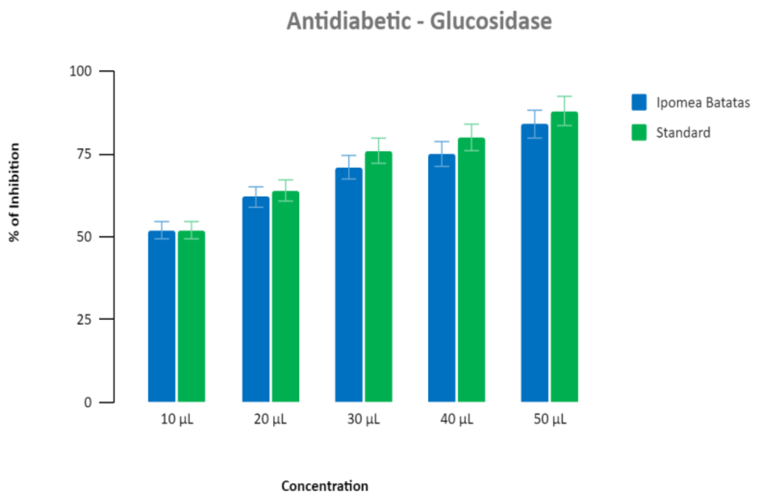
RESULTS AND DISCUSSION

For the α-amylase inhibition test, the graph was plotted with x-axis as concentration of extract prepared and y-axis as % of inhibitions. It was compared to the standard drug, acarbose. We had a positive confirmatory test as the standard showed more inhibition than extracted drug. With concentration of extract increasing, inhibition increased and was better than acarbose. For all concentrations ranging from 10μl to 50μl, inhibition was more than 50% & peaked at 90% inhibition. From the alpha amylase test by checking the anti diabetic activity. It is shown that combination of zinc oxide nanoparticles with Ipomea batatas has shown less inhibition with increased concentration comparatively with standard Ipomea batatas (Graph 1).

For the glucosidase test, the graph was plotted with x-axis as concentration of extract prepared and y-axis as % of inhibitions. It was compared to the standard drug, acarbose. We had a positive confirmatory test as the standard showed more inhibition than extracted drug. With concentration of extract increasing, inhibition increased and was better than acarbose. For all concentrations ranging from 10μl to 50μl, inhibition was more than 50% & peaked at 90% inhibition. From glucosidase test checking the anti-diabetic activity it is shown that combination of zinc oxide nanoparticles with IPomea batatas has shown less inhibition comparatively with standard Ipomea batatas (Graph 2).



GRAPH 1



GRAPH 2

A collection of illnesses known as diabetes mellitus are characterized by hyperglycemia, altered lipid, carbohydrate, and protein metabolism, and a higher risk of vascular disease complications. Insulin secretion is abnormal in type 2 diabetes mellitus, and the peripheral tissues are unable to react to insulin. None of the several animal models for Type 2 diabetes mellitus, including those that are genetically and chemically produced, can accurately represent human Type 2 diabetes mellitus. (Faruqui 2017)

Hyperglycemia or glucosuria is a symptom of diabetes mellitus, a clinical disease caused by a relative or absolute lack of insulin or by cellular resistance to insulin action. Weight loss, polydipsia, polyphagia, and polyuria are the most typical signs and symptoms of diabetes because of hyperglycemia, hypoinsulinemia, and dyslipidemia. Cardiovascular conditions, neuropathy, retinopathy, and nephropathy are also often occurring consequences of diabetes (Vaidya, Vaidya, and Nabar 2014). To manage diabetes and its consequences, a variety of treatments are utilized, such as dietary supplements, natural or plant-derived medicines, and synthetic drugs..(Gupta, Das, and Imran 2019)

Reactive oxygen species are prevented from forming and type 2 Diabetes mellitus consequences are lessened by a drop in glucagon levels.Diabetes changes the metabolism of lipids or lipoproteins, which results in increased atherosclerosis. Our research suggests that higher glucose metabolism may be the cause of higher cholesterol, triglycerides, and LDL-cholesterol levels (Xu, Wang, and Song 2022). With diabetes mellitus, there are changes in the way that protein, fat, and glucose are metabolised.Achieving the ideal level of glycosylated proteins may help to reduce complications like retinopathy, nephropathy, and neuropathy.Insulin shortage or ineffective insulin activity is the cause of abnormal management of dietary proteins. Reduced ATP production results in less protein being formed, and diabetes also contributed to the catabolic reaction by causing structural proteins to be destroyed (Díaz-Gerevini et al. 2019)

Ipomea batatas have a special ability to retain a lot of starch in their roots, which makes them a fantastic source of dietary energy. In addition to their high carbohydrate content, sweet potatoes are also a good source of potassium, calcium, iron, and the vitamins A and C.Studies have demonstrated that sweet potato can improve insulin sensitivity, glucose tolerance, and reduce blood glucose levels in animal models of diabetes. This effect has been attributed to the presence of bioactive compounds such as phenolic acids, flavonoids, and anthocyanins, which have been shown to enhance insulin secretion and reduce insulin resistance(Abidin et al. 2015)

In addition to its effects on glycemic control, sweet potato has been shown to improve lipid profile by reducing total cholesterol, triglycerides, and LDL cholesterol levels, while increasing HDL cholesterol levels. This effect has been attributed to the presence of antioxidants and polyphenols, which can protect against oxidative stress and inflammation, both of which are implicated in the development of metabolic disorders such as diabetes.(Campos and Ortiz 2019)

Ipomoea batatas' effects on lipid profile, insulin sensitivity, and glycemic control have all been proven to have anti-diabetic action. Bioactive substances like phenolic acids, flavonoids, and anthocyanins as well as dietary fibers like pectin and resistant starch have been linked to these effects. People with diabetes or those who are at risk for developing it may find it helpful to include sweet potatoes in their diet (Habtemariam 2019). Our study propose the anti-diabetic activity of the natural element; Ipomoea batatas which will change the future perspective of the pharmacotherapy.

CONCLUSION

These results show that the white skinned sweet potato is useful in prevention and improvement of diabetic symptoms by stimulating human immunity & should be used in many pharmaceutical companies as an adjuvant to improve the quality of life of patients from the adverse effects of long term anti-diabetic drugs.

CONFLICT OF INTEREST

No conflict of interest

REFERENCES

1. Begum JS, Manjunath K, Pratibha S, Dhananjaya N, Sahu P, Kashaw S. Bioreduction synthesis of zinc oxide nanoparticles using Delonix regia leaf extract (Gul Mohar) and its agro medicinal applications. Journal of Science: Advanced Materials and Devices. 2020 Dec 1;5(4):468-75.
2. Begum,J.S Manjunath,K.Pratibha ,s.Dhanajaya 'Bioreduction synthesis of zinc oxide nanoparticles using Delonix renal leaf extract and agro medicinal applications',2020.
3. Tahir IM, Akhter N, Parveen A, Mehboob H, Saleem S, Munir N, Ali Shah SM, Zaheer J, Khan FS, Sultana S, Akram M. Effects of methanolic and aqueous extracts of Ipomoea batatas L on mineral contents level (calcium and magnesium) in alloxan-induced diabetic rats. Pakistan Journal of Pharmaceutical Sciences. 2018 Sep 2.
4. Akhtar N, Akram M, Daniyal M, Ahmad S. Evaluation of antidiabetic activity of Ipomoea batatas L. extract in alloxan-induced diabetic rats. International journal of immunopathology and pharmacology. 2018 Nov;32:2058738418814678
5. Kamal S, Akhter N, Khan SG, Kiran S, Farooq T, Akram M, Shah SM, Tahir IM, Akhlaq M, Said F, Zaheer J. Anti-diabetic activity of aqueous extract of Ipomoea batatas L. in alloxan induced diabetic Wistar rats and its effects on biochemical parameters in diabetic rats. Pakistan Journal of Pharmaceutical Sciences. 2018 Jul 2;31.
6. Li F, Li Q, Gao D, Peng Y. The optimal extraction parameters and anti-diabetic activity of flavonoids from Ipomoea batatas leaf. African

Journal of Traditional, Complementary and Alternative Medicines. 2009;6(2).
7. Kusano S, Abe H, Tamura H. Isolation of antidiabetic components from white-skinned sweet potato (Ipomoea batatas L.). Bioscience, biotechnology, and biochemistry. 2001 Jan 1;65(1):109-14.
8. Panda V, Sonkamble M. Phytochemical constituents and pharmacological activities of Ipomoea batatas l.(Lam)–A review. International Journal of Research in Phytochemistry and Pharmacology. 2012 Feb 29;2(1):25-34.
9. Wang P, Su Z, Yuan W, Deng G, Li S. Phytochemical constituents and pharmacological activities of Eryngium L.(Apiaceae).
10. Khalafi T, Buazar F, Ghanemi K. Psychosynthesis and enhanced photocatalytic activity of zinc oxide nanoparticles toward organosulfur pollutants. Scientific reports. 2019 May 3;9(1):1-0.
11. Abidin, P. E., E. Dery, F. Kweku Amagloh, K. Asare, and E. E. Crey. 2015. Training of Trainers' Module for Orange-Fleshed Sweetpotato (OFSP).: Utilization and Processing. International Potato Center.
12. Anita, Ramesh, Arumugam Paramasivam, Jayaseelan Vijayashree Priyadharsini, and Srinivasan Chitra. 2020. "The m6A Readers YTHDF1 and YTHDF3 Aberrations Associated with Metastasis and Predict Poor Prognosis in Breast Cancer Patients." American Journal of Cancer Research 10 (8): 2546–54.
13. Barabadi, Hamed, Faraz Mojab, Hossein Vahidi, Boshra Marashi, Niloufar Talank, Omid Hosseini, and Muthupandian Saravanan. 2021. "Green Synthesis, Characterization, Antibacterial and Biofilm Inhibitory Activity of Silver Nanoparticles Compared to Commercial Silver Nanoparticles." Inorganic Chemistry Communications. https://doi.org/10.1016/j.inoche.2021.108647.
14. Campos, Hugo, and Oscar Ortiz. 2019. The Potato Crop: Its Agricultural, Nutritional and Social Contribution to Humankind. Springer Nature.
15. Díaz-Gerevini, Gustavo Tomás, Alejandro Daín, María Eugenia Pasqualini, Cristina B. López, Aldo R. Eynard, and Gastón Repossi. 2019. "Diabetic Encephalopathy: Beneficial Effects of Supplementation with Fatty Acids ω3 and Nordihydroguaiaretic Acid in a Spontaneous Diabetes Rat Model." Lipids in Health and Disease 18 (1): 43.
16. Faruqui, Arif. 2017. "Post Prandial Hyperglycemia: A Real Threat for Patients with Type 2 Diabetes Mellitus." Advances in Diabetes and Metabolism. https://doi.org/10.13189/adm.2017.050302.
17. Feather, Adam, David Randall, and Mona Waterhouse. 2020. Kumar and Clark's Clinical Medicine. Elsevier."Fig. 1. Features of Treatment to Reduce the Risk of Complications of Cardiovascular Disease in Patients with Diabetes Mellitus: SS - Cardiovascular; HDL Cholesterol - High Density Lipoprotein Cholesterol; LDL Cholesterol - Low Density Lipoprotein Cholesterol; PCSK-9 - Subtilizine / Kexin Type 9 Protein Convertase; TG - Triglycerides; OH - Total Cholesterol." n.d. https://doi.org/10.14341/dm10351-5216.
18. Ganapathy, Dhanraj, Ramya Ramadoss, Monal Yuwanati, and Murthykumar Karthikeyan. 2022. "Rarity of Mucormycosis in Oral Squamous Cell Carcinoma: A Clinical Paradox?" Oral Oncology 125 (February): 105725.
19. Gougeon, R., K. Styhler, J. A. Morais, P. J. Jones, and E. B. Marliss. 2000. "Effects of Oral Hypoglycemic Agents and Diet on Protein Metabolism in Type 2 Diabetes." Diabetes Care. https://doi.org/10.2337/diacare.23.1.1.
20. Gowhari Shabgah, Arezoo, Azwar Amir, Zhanna R. Gardanova, Angelina Olegovna Zekiy, Lakshmi Thangavelu, Maryam Ebrahimi Nik, Majid Ahmadi, and Jamshid Gholizadeh Navashenaq. 2021. "Interleukin-25: New Perspective and State-of-the-Art in Cancer Prognosis and Treatment Approaches." Cancer Medicine 10 (15): 5191–5202.
21. Gupta, Twinkle, Nilanjan Das, and Sabiha Imran. 2019. "The Prevention and Therapy of Osteoporosis: A Review on Emerging Trends from Hormonal Therapy to Synthetic Drugs to Plant-Based Bioactives." Journal of Dietary Supplements. https://doi.org/10.1080/19390211.2018.1472715.
22. Habtemariam, Solomon. 2019. Medicinal Foods as Potential Therapies for Type-2 Diabetes and Associated Diseases: The Chemical and Pharmacological Basis of Their Action. Academic Press.
23. Kanniah, Paulkumar, Jila Radhamani, Parvathiraja Chelliah, Natarajan Muthusamy, Emmanuel Joshua Jebasingh Sathiya Balasingh, Jesi Reeta Thangapandi, Subburathinam Balakrishnan, and Rajeshkumar Shanmugam. 2020. "Green Synthesis of Multifaceted Silver Nanoparticles Using the Flower Extract of Aerva Lanata and Evaluation of Its Biological and Environmental Applications." ChemistrySelect 5 (7): 2322–31.
24. Kumar, K. V. S. Hari, K. V. Hari Kumar, and S. K. Patnaik. 2018. "A Long Term Follow-up Study from India Assessing the Risk of Diabetes Mellitus in Service Population." Diabetes & Metabolic Syndrome: Clinical Research & Reviews. https://doi.org/10.1016/j.dsx.2017.09.002.
25. Muthukrishnan, Lakshmipathy. 2021. "Multidrug Resistant Tuberculosis - Diagnostic Challenges and Its Conquering by Nanotechnology Approach

- An Overview." Chemico-Biological Interactions 337 (March): 109397.
26. PradeepKumar, Angambakkam Rajasekharan, Hagay Shemesh, Malli Sureshbabu Nivedhitha, M. Mohamed Jubair Hashir, Selva Arockiam, Tirupambaram Natarajasundaram Uma Maheswari, and Velmurugan Natanasabapathy. 2021. "Diagnosis of Vertical Root Fractures by Cone-Beam Computed Tomography in Root-Filled Teeth with Confirmation by Direct Visualization: A Systematic Review and Meta-Analysis." Journal of Endodontia 47 (8): 1198–1214.
27. Ramesh Kumar, K. R., K. K. Shanta Sundari, A. Venkatesan, and Shymalaa Chandrasekar. 2011. "Depth of Resin Penetration into Enamel with 3 Types of Enamel Conditioning Methods: A Confocal Microscopic Study." American Journal of Orthodontics and Dentofacial Orthopedics: Official Publication of the American Association of Orthodontists, Its Constituent Societies, and the American Board of Orthodontics 140 (4): 479–85.
28. Samuel, Srinivasan Raj, Syed Kuduruthullah, Al Moutassem Billah Khair, Maher Al Shayeb, Abed Elkaseh, Sudhir Rama Varma, Gulrez Nadeem, Issameldin Abdalla Elkhader, and Awad Ashekhi. 2021. "Impact of Pain, Psychological-Distress, SARS-CoV2 Fear on Adults' OHRQOL during COVID-19 Pandemic." Saudi Journal of Biological Sciences 28 (1): 492–94.
29. Vaidya, Ashok, Rama Vaidya, and Nutan Nabar. 2014. "Current Status of Indigenous Drugs and Alternative Medicine in the Management of Diabetes Mellitus." RSSDI Textbook of Diabetes Mellitus. https://doi.org/10.5005/jp/books/12626_46.
30. Xu, Linlin, Wei Wang, and Wei Song. 2022. "A Combination of Metformin and Insulin Improve Cardiovascular and Cerebrovascular Risk Factors in Individuals with Type 1 Diabetes Mellitus." Diabetes Research and Clinical Practice 191 (September): 110073.