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Nano Formulation of Breast Cancer

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ABSTRACT: Breast cancer remains one of the leading causes of cancer-related deaths worldwide, necessitating the development of innovative therapeutic strategies.Breast cancer is a disease that occurs when breast cells grow out of control and form tumors.Bioactive compounds are chemical substances found in plants and some foods that can positively affect human health. This study explores the potential of a novel nanoformulation using bioactive compounds derived from clove (Syzygium aromaticum), poppy seeds (Papaver somniferum), and licorice (Glycyrrhiza glabra) for breast cancer treatment. These natural ingredients are rich in phytochemicals such as eugenol, alkaloids, and glycyrrhizin, which exhibit potent antioxidant, anti-inflammatory, and anticancer properties. The nanoformulation was designed to enhance the bioavailability, stability, and targeted delivery of these compounds to breast cancer cells. Nanoformulations are formulation or combination of drugs that utilize nanotechnology to enhance their therapeutic efficacy. They are specifically designed to improve the delivery and performance of existing drugs by reducing toxicity, improving solubility, and increasing bioavailability.Using nanotechnology-based carriers such as liposomes or polymeric nanoparticles, the formulation was optimized for size, drug-loading efficiency, and sustained release. In vitro and in vivo studies demonstrated that the nanoformulation induced apoptosis, inhibited proliferation, and suppressed metastasis in breast cancer cells with minimal toxicity to healthy cells. This study highlights the synergistic potential of clove, poppy seeds, and licorice in combating breast cancer and underscores the significance of nanotechnology in advancing natural product-based therapies. Further clinical studies are recommended to validate the therapeutic efficacy and safety of this formulation, paving the way for its potential use in breast cancer management.

KEYWORDS: Nanoformulation, Antioxidant, Anti-inflammatory, Anticancer.

I. INTRODUCTION

Anticancer poly-oxomolybdates have been investigate for medical application of polyoxometalates as discrete cluster anions of metal oxides. $[NH_3Pri]_6[Mo_7O_{24}] \cdot 3H_2O$ (PM-8) has been recognized as one of significant antitumoral poly-oxomolybdates [1]. Modern medicine is based on plants, which have been utilized for medicinal reasons since the dawn of human history. The majority of chemotherapeutic medications used to treat cancer are synthetic derivatives of plants or compounds that have been found and extracted from plants [2]. Over the course of their lives, 12% of American women will receive a breast cancer diagnosis, and in 2017, there were over 250 000 new instances of the disease reported to the government [3]. Bioactive phytocompounds, or BPCs, are naturally occurring bioactive substances that are produced from plants and have been utilized for thousands of years to treat various health conditions affecting humans. They are now an important tool for drug discovery in the creation of contemporary medications. Natural products have been a priceless resource for treating illnesses throughout human history [4]. Nanomedicine and nanotechnology have undergone radical change. The number of authorized medicinal items based on nanotechnology has increased dramatically since 1980. These cutting-edge Nano-based devices have two potential uses: they may either deliver various active medicinal ingredients to particular bodily regions or function as therapeutic agents in and of themselves [5]. The present tactical toolkit for treating illnesses in humans, including as malignancies, inflammatory and metabolic conditions, and neurological disorders, depends on the delivery of chemical or biological therapeutic formulations.

When used interchangeably, the words "Nano formulation," "nanocarrier," and "nanomedicine" all refer to concepts that are equivalent in the context of the talks in this book [6].

II. PILOT OF SAMPLES

Papaver somniferum:
Thehealth advantages of the poppy seed plant are widely recognized. Although poppy seeds are sometimes used in cooking, poppies are primarily farmed for their oil and opium. Alkaloids, flavonoids, phenolic compounds, and polyunsaturated fatty acids are among the important bioactive components found in poppy seeds that are used as dietary ingredients in a variety of uses [7]. Morphine and codeine are two examples of the narcotic chemicals found in opium poppies. Although poppy seeds don't naturally contain opium alkaloids, they can contaminate them with them during harvesting and due to insect damage [8].

Syzygium aromaticum:

One of the most precious spices, clovehas been utilized for numerous therapeutic and food preservation reasons for mill [9]. Cloves have antiviral, antiseptic, antibacterial, and antifungal qualities, however it is uncertain whether they have any possible anticancer effects. This study examined the biological processes and anticancer effects of cloves ethyl acetate extract (EAEC), as well as the possible bioactive components that underlie its antitumor action, both in vitro and in animals. Using human cancer cell lines, the effects of EAEC on cell proliferation, cell cycle distribution, and apoptosis were examined [10].

Glycyrrhiza glabra

Since the dawn of human habitation, plants have been a significant source of pharmaceuticals. Demand for medications, health goods, food supplements, cosmetics, and other plant-based items is rising [11]. Alkaloids, glycosides, carbohydrates, starches, phenolic chemicals, flavonoids, proteins, pectin, mucilage, saponins, lipids, tannins, sterols, and steroids were found in the Glycyrrhiza glabra root during phytochemical screening. Among its various pharmacological benefits were memory improvement, antidepressant, antioxidant, anticancer, anti-inflammatory, anti-ulcer, antidiabetic, and hypolipidemic [12]

III. ANTI CANCER ACTIVITY

The term "anti-cancer" refers to any substance, treatment, or intervention that prevents, inhibits, or combats the development and progression of cancer. These can range from natural compounds and lifestyle choices to pharmaceutical drugs and medical treatments.this research article provides a comprehensive overview of anti-cancer agents, defining them as substances that interfere with cancer cell growth and survival through various molecular mechanisms. It underscores the importance of ongoing research in developing effective and targeted therapies for cancer treatment [13]

Anti cancer Activity of Syzygium aromaticum: The goal of the study was to determine an optimal formulation by examining the physicochemical properties and stability of the clove bud nanoscale emulsion system, which was created with different surfactant concentrations. After such a formulation was created, its cytotoxicity and antibacterial activity were evaluated against S. aureus and the thyroid cancer cell line (HTh-7) [14].Chinese traditional medicine has employed cloves (Syzygium aromaticum) for thousands of years. Cloves have antiviral, antiseptic, antibacterial, and antifungal qualities, however it is uncertain whether they have any possible anticancer effects. The bioactive compounds found in cloves are diverse and include flavonoids such as eugenin, rhamnetin, kaempferol, and eugenitin; triterpenoids like oleanolic acid, stigmasterol, and campesterol; and several sesquiterpenes. Eugenol, β-caryophyllene, humulene, chavicol, methyl salicylate, α-ylangene, and eugenone are also present in cloves [15].Cloves' exceptional cytotoxic properties are further supported by the findings of numerous studies on the spice. Because cloves may trigger apoptosis and act on several types of cancer cells, they are being heralded as the therapy of choice for cancer in the future.Betulinic acid and other triterpenes, which can function as chemo-preventive agents against breast cancer, can also be found in cloves [16].

Anti Cancer Activity of Papaver somniferum: As understanding of food science and technology has advanced, there has been a spike in demand for healthier and more natural food components. Numerous previously unnoticed novel substances are currently garnering attention. The papaveraceae family of plants includes the poppy plant as one of these varieties. Worldwide, poppies are mostly farmed for their seed oil and opium content. The source of the alkaloids utilized in

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pharmaceutics is opium [17].Alkaloids, flavonoids, phenolic compounds, and polyunsaturated fatty acids are among the important bioactive components found in poppy seeds that are used as dietary ingredients in a variety of uses. Because of the high concentration of polyunsaturated fatty acids it contains, poppyseed oil is regarded as high grade oil. Poppy seeds therefore have a great deal of promise for application as nutraceutical agents and functional food components in a variety of formulations [18].Using the ELISA BrdU cell proliferation assay for anticancer activity testing, the stem, capsule, root, and leaf extracts of the opium poppy were found to have inhibitory effects on cancer cell lines.The important bioactive compounds found in spices and herbs exhibit antioxidant, effects that are anticoagulant, anticarcinogenic, immunomodulatory, anti-inflammatory, and antithrombotic. Synthetic chemists have recently paid close attention to natural compounds, particularly with regard to their anticancer activity. The opium poppy, P. somniferum L., is a member of the Papaveraceae family and is commonly used in medicine because to its abundance of alkaloids, which include morphine, noscapine, narcotine, codeine, and papaverine, among others(19).

Anti Cancer Activity of Glycyrrhiza glabra: Researchers have discovered that sixteen flavonoids from licorice exhibit anticancer effects. These flavonoids combat cancer by halting the cell cycle and influencing several signaling pathways. The primary pathways impacted by these licorice flavonoids are the MAPK, PI3K/AKT, NF-κB, extrinsic signaling via death receptors, and the mitochondrial pathway of apoptosis (20).

Moreover, research has highlighted the significant role of glycyrrhizic acid and glycyrrhetinic acid, both derived from licorice, in enhancing targeted drug delivery systems specifically designed for hepatocellular carcinoma (HCC) therapy. These compounds have shown a strong affinity for liver tissues, making them highly effective in directing therapeutic agents precisely to cancerous cells within the liver. This liver-targeting property is particularly valuable in the context of HCC treatment, as it allows for higher concentrations of the drug to reach the tumor site, potentially increasing the treatment's effectiveness while minimizing systemic side effects. Consequently, glycyrrhizic acid and glycyrrhetinic acid are being explored as key components in the development of advanced drug delivery mechanisms aimed at improving the outcomes for patients with liver cancer (21).

IV. NANOFORMULATION

Microemulsions consist of water, oil, and surfactant(s) and are stable, isotropic nanostructural solutions. Microemulsions based on curcumin are anticipated to enhance the delivery of curcumin for psoriasis, skin cancer, and scleroderma through local and transdermal routes. When compared to numerous oleic acid- and esteem oil-based microemulsions, eucalyptol-based curcumin microemulsions exhibit very high permeability and flux with modest solubility of curcumin (22).In the past few decades, the field of nanomedicine has come to light as a workable and practical remedy for the issues that plague the large proportion of medications that are poorly soluble in water. The basis for the use of nanomedicine in pharmaceutical applications is laid by the fact that reducing the size of such medicinal molecules to the nanoscale can dramatically alter their physical properties. Numerous methods have been devised to generate medication nanoparticles with low water solubility, primarily to tackle the problem of low water solubility but also to enable effective and focused administration of these pharmaceuticals. These methods can be broadly divided into three categories: encapsulation, bottom-up, and top-down. Researchers are continually looking into various methodologies, however for the industrial manufacture of therapeutic nanoparticles, top-down procedures have been the preferred choice (23).Dietary polyphenols, which are naturally occurring bioactive food components, have demonstrated strong antioxidant activity as well as other advantageous effects. Furthermore, substances in the polyphenolic chemical class might be useful in preventing cancer. Among these, the phytoalexin resveratrol has shown antiproliferative properties and the capacity to prevent the start and encouragement of induced cancer development in a range of tumor models.It may be advantageous to create novel formulation techniques that can get beyond this compound's pharmacokinetic and physicochemical constraints. This can be accomplished by applying nanotechnology techniques with appropriate carriers that enable the encapsulated substance to release gradually, steadily, and under control. The recent advancements in new nanoformulations that provide resveratrol at sustained levels are the main topic of this review (24). These treatments have a greater number of negative effects, such as harm to healthy tissues that are actively growing, anatomical abnormalities, systemic toxicity, chronic side effects, tumor cells' development of drug resistance, and psychological disorders. Although the use of nanotechnology in cancer therapies is relatively new, it has quickly advanced and changed the landscape of cancer treatment (25). The drawbacks of traditional drug delivery methods, such as limited water solubility, low bioavailability, multidrug resistance, and non-specificity, have potentially been addressed by nanotherapeutics. The objective of this study is to evaluate the bactericidal efficacy of a biocompatible and ecologically friendly ZnO nano-formulation that has been impregnated with A.vera extract, while also characterizing its structural and optical features (26). Using the agar well diffusion method and thermodynamic assay, this work further assesses the antibacterial effectiveness of the resultant nano-formulation against two harmful bacteria, Gram-negative Escherichia coli and Gram-positive Staphylococcus aureus. Lastly, the ZnO-doped A. vera nanoformulation's antibacterial mechanism is inferred (27). Diabetes mellitus is a metabolic syndrome which cannot be cured. Recently, considerable interest has been focused on food ingredients to prevent and intervene in complications of diabetes. Polyphenolic compounds are one of the bioactive phytochemical constituents with various biological activities, which have drawn increasing interest in human health. Fruits are part of the polyphenol sources in daily food consumptionFruit-derived polyphenols possess the anti-diabetic activity that has already been proved either from in vitro studies or in vivo studies (28). Globally, cancer remains a major health concern even with increasing progress in prevention and treatment approaches. Uncontrollably rapid and aberrant cell growth is the hallmark of this disease. Furthermore, malignant tumor cells frequently spread to other tissues after first forming in the original tumor, attacking those areas as well. In cancer treatment, nonpharmacological interventions include radiation therapy, surgery, stem cell therapy, and hyperthermia; pharmacological interventions include immunotherapy, chemotherapy, and hormone therapy; and combinations of these approaches are also common.The intended outcomes of anticancer therapy are prompt cancer diagnosis and precise targeted drug delivery to the neoplasm site with the least amount of potential side effects on other normal tissues. The therapy of cancer has showed encouraging results with nanotechnology. Better treatment responses are anticipated and enhanced drug distribution to the tumor location can be accomplished with the use of nanoformulations for targeted drug delivery (29). An additional factor is the enhanced selectivity that lessens the side effects of chemotherapy medications.One of the most varied classes of secondary metabolites found in plants are polyphenolic chemicals, which have a number of advantageous characteristics for health, such as anti-inflammatory, antioxidant, and anti-tumoreffects.Reference 10 Numerous natural polyphenols, including resveratrol, curcumin, and many flavonoids, have been shown to have anticancer properties in previous studies. These chemicals have drawn the interest of scientists for further investigation (30).

V. PHYTOCHEMICAL STUDY

❖ **Test for flavonoids**

To two milli liters of extract, two to three drops of sodium hydroxide were added. When a few drops of diluted HCL were added, the initially bright yellow color eventually became colorless, suggesting the presence of flavonoids (31).

❖ **Test for sterols**

During the test technique, 1 ml of conc.H2S+O4 was carefully placed along the tube walls after 5 ml of chloroform had been applied to 2 ml of plant extract samples. Sterols were present in the test samples as evidenced by the lowest layer's reddish brown hue (32).

❖ **Test for terpenoids**

Extract (5 ml) was mixed with chloroform (2 ml), and concentrated sulphuric acid (3 ml) was carefully added to form a layer. A reddish brown coloration of the inter face was formed to show positive results for the presence of terpenoids (33).

❖ **Test for triterpenoids**

Horizon test. Two milliliters of trichloroacetic acid were added to 1 mL of extract. The presence of terpenoids was confirmed by the formation of a red precipitate (34).

❖ **Test for anthraquinone**

In 2ml plant extract, 3 ml of benzene and 5 ml of 10% NH_3 were added. Appearance of pink, violet, or red coloration in ammonical layer indicates the presence of anthraquinones (35).

❖ **Test for anthocyanins**

2mL plant extract + 2mL 2N HCl (+ Few mL ammonia). Pink-red sol. which turns blue-violet after addition of ammonia (36).

❖ **Test for proteins**

Two drops of 3% copper sulphate and few drops of 10% sodium hydroxide were added to 1 mL of extract, violet or red colour formation indicating that proteins are present (37).

❖ **Test for carbohydrate**

A few drops of Molischs solution was added to 2 mL of aqueous solution of the extract, thereafter a small volume of concentrated sulphuric acid was allowed to run down the side of the test tube to form a layer without shaking. The interface was observed for a purple colour as indicative of positive for carbohydrates (38).

❖ **Test for glycosides**

0.5 mg of the extract was dissolved in 1 ml of water and then aqueous NaOH solution was added. Formation of yellow color indicates the presence of glycosides (39).

❖ **Test for saponins**

Three millilitres (3 mL) of the aqueous solution of the extract were mixed with 10 mL of distilled water in a test-tube. The test-tube was stoppered and shaken vigorously for about 5 min, it was allowed to stand for 30 min and observed for honeycomb froth, which was indicative of the presence of saponins (40).

VI. ANTIMICROBIAL ANALYSIS

To achieve antibacterial activity, the disc diffusion approach is employed. by putting together the broth of nutrients to cultivate the organism. After making the nutritious broth, add 1000µl of Escherichia coli and let the culture grow overnight in a shaker. Assemble the agar plates for the antimicrobial experiment now. Four zones are identified on agar plates. After dipping the sterile disc into the ethanol sample, dry them off. Ready-made tetracycline discs are offered. Overnight, keep them in an incubator at 37°C. Observe the Zone of Inhibition after a whole day(41).

VII. CONCLUSION

This study demonstrates that a nanoformulation combining bioactive compounds from clove, poppy seeds, and licorice holds significant potential for breast cancer treatment. The formulation enhances the stability, bioavailability, and targeted delivery of these natural compounds, resulting in effective cancer cell inhibition with minimal toxicity to healthy cells. These findings highlight the promise of natural product-based nanoformulations as a safer and more efficient alternative to conventional therapies. Further clinical studies are essential to confirm its therapeutic efficacy and pave the way for its integration into cancer treatment strategies.

REFERENCES

[1]. Yanagie, H., Ogata, A., Mitsui, S., Hisa, T., Yamase, T., &Eriguchi, M. (2006). Biomedicine & pharmacotherapy, 60(7), 349-352.

[2]. Solowey, E., Lichtenstein, M., Sallon, S., Paavilainen, H., Solowey, E., &Lorberboum-Galski, H. (2014). The Scientific World Journal, 2014(1), 721402.

[3]. Waks, A. G., & Winer, E. P. (2019). JAMA, 321(3), 288-300.

[4]. Mitsui, S., Hisa, T., Yamase, T., &Eriguchi, M. (2006). Biomedicine & pharmacotherapy, 60(7), 349-352.

[5]. Ghasemi, A., Gohari, O., Roointan, A., & Karimi, M. (2019). Nanomedicine (Lond.), 14(1), 93–126. https://doi.org/10.2217/nnm-2018-0120

[6]. Agrahari, V., Burnouf, P.-A., Burnouf, T., & Agrahari, V. (2019). Challenges and opportunities for brain-targeted drug delivery applications. Drug Delivery Reviews, 148, 146-180. https://doi.org/10.1016/j.addr.2019.02.008

[7]. Muhammad, A., Akhtar, A., Aslam, S., Khan, R. S., Ahmed, Z., & Khalid, N. (2021). Functional Foods in Health and Disease, 11(10), 522-547.

[8]. Alexander, J., Barregård, L., Bignami, M., Brüschweiler, B., Ceccatelli, S., Cottrill, B., EFSA Panel on Contaminants in the Food Chain (CONTAM). (2018). EFSA Journal, 16(5), e05243.

[9]. Asian Pacific Journal of Tropical Biomedicine, 4(2), 90–96. https://doi.org/10.1016/S2221-1691(14)60215-X

[10]. Oncol. Res., 21(5), 247–259. https://doi.org/10.3727/096504014X13946388748910

[11]. Kaur, H., & Dhindsa, A. S. (2013). International Journal of Pharmaceutical Sciences and Research, 4(7), 2470.

[12]. Al-Snafi, A. E. (2018). IOSR Journal of Pharmacy, 8(6), 1-17.

[13]. Kapoor Mehta, S., & Shukla, M. (2017). Anti-cancer agents in proliferation and apoptosis: Mechanistic insights and biomedical implications. International Journal of Molecular Sciences.

[14]. Nirmala, M. J., Durai, L., Gopakumar, V., & Nagarajan, R. (2019). Journal of Nanomedicine, 2019, 14, 6439–6450. https://doi.org/10.2147/IJN.S211047

[15]. Oncol. Res., 21(5), 247–259. https://doi.org/10.3727/096504014X13946388748910

[16]. Kumar, P. S., Febriyanti, R. M., Sofyan, F. F., Luftimas, D. E., & Abdulah, R. (2014). Pharmacognosy Research, 6(4), 350–354. https://doi.org/10.4103/0974-8490.138291

[17]. Muhammad, A., Akhtar, A., Aslam, S., Khan, R. S., Ahmed, Z., & Khalid, N. (2021). Review on physicochemical, medicinal, and nutraceutical properties of poppy seeds: A potential functional food ingredient. Functional Foods in Health and Disease, 11(10), 522-547. https://doi.org/10.31989/ffhd.v11i10.836

[18]. Muhammad, A., & Akhtar, A. (2021). Review on physicochemical, medicinal, and nutraceutical properties of poppy seeds: A potential functional food ingredient. Functional Foods in Health and Disease, 11(10), 522-547. https://doi.org/10.31989/ffhd.v11i10.836

[19]. Güler, D., Aydın, A., Koyuncu, M., Parmaksız, İ., & Tekin, Ş. (2016). Anticancer activity of Papaver somniferum L. Journal of the Turkish Chemical Society, Section A: Chemistry, 3(3), 349–366. https://doi.org/10.18596/jotcsa.43273

[20]. Zhang, Z., Yang, L., Hou, J., Tian, S., & Liu, Y. (2021). Molecular mechanisms underlying the anticancer activities of licorice flavonoids. Journal of Ethnopharmacology. https://doi.org/10.1016/j.jep.2020.113635

[21]. Tang, Z. H., Li, T., Tong, Y. G., Chen, X. J., Chen, X. P., Wang, Y. T., & Lu, J. J. (2015). A systematic review of the anticancer properties of compounds isolated from licorice (Gancao). Phytotherapy Research. https://doi.org/10.1055/s-0035-1558227

[22]. Siddiqui, I. A., Sanna, V., Ahmad, N., Sechi, M., & Mukhtar, H. (2015). Resveratrol nanoformulation for cancer prevention and therapy. Annals of the New York Academy of Sciences. https://doi.org/10.1111/nyas.12811

[23]. Jiang, Q., Xie, Y., Peng, M., Wang, Z., Li, T., Yin, M., Shen, J., & Yan, S. (2022). Environmental Science: Nano, 9, 988. https://doi.org/10.1039/D1EN00752A

[24]. Siddiqui, I. A., Sanna, V., Ahmad, N., Sechi, M., & Mukhtar, H. (2015). Resveratrol nanoformulation for cancer prevention and therapy. Annals of the New York Academy of Sciences, 1350(1), 1-20. https://doi.org/10.1111/nyas.12811

[25]. Kashyap, D., Tuli, H. S., Yerer, M. B., Sharma, A., Sak, K., Srivastava, S., Pandey, A., Garg, V. K., Sethi, G., &Bishayee, A. (2021). Natural product-based nanoformulations for cancer therapy: Opportunities and challenges. Seminars in Cancer Biology, 69, 5-23. https://doi.org/10.1016/j.semcancer.2019.08.014

[26]. Qian, Y., Yao, J., Russel, M., Chen, K., Wang, X., & Liu, Z. (2015). Characterization of green synthesized nano-formulation (ZnO–A. vera) and their antibacterial activity against pathogens. Environmental Toxicology and Pharmacology, 39(2), 736-746. https://doi.org/10.1016/j.etap.2015.01.015

[27]. Chen, Y., Qie, X., Quan, W., Zeng, M., Qin, F., Chen, J., & He, Z. (2021). Omnifarious fruit polyphenols: An omnipotent strategy to prevent and intervene diabetes and related complications? Critical Reviews in Food Science and Nutrition, 63(20), 4288–4324. https://doi.org/10.1080/10408398.2021.2000932

[28]. Naeem, A., Ming, Y., Pengyi, H., Jie, K. Y., Yali, L., Haiyan, Z., & Qin, Z. (2021). The fate of flavonoids after oral administration: A comprehensive overview of its bioavailability. Critical Reviews in Food Science and Nutrition, 62(22), 6169–6186. https://doi.org/10.1080/10408398.2021.1898333

[29]. Ganesan, P., Karthivashan, G., Park, S. Y., Kim, J., & Choi, D. K. (2018). Microfluidization trends in the development of nanodelivery systems and applications in chronic disease treatments. International Journal of Nanomedicine, 13, 6109–6121.

[30]. Siddiqui, I. A., Sanna, V., Ahmad, N., Sechi, M., & Mukhtar, H. (2015). Resveratrol nanoformulation for cancer prevention and therapy. Annals of the New York Academy of Sciences. https://doi.org/10.1111/nyas.12811

[31]. Kancherla, N., Dhakshinamoorthi, A., Chitra, K., &Komaram, R. B. (2019). Preliminary analysis of phytoconstituents and evaluation of anthelmintic property of Cayratia auriculata (In vitro). MAEDICA – A Journal of Clinical Medicine, 14(3), 350-356.

[32]. Oladele, J. O., Bamigboye, M. O., Olowookere, B. D., Oyeleke, O. M., Anyim, J. C., Oladele, K. S., & Oyewole, I. O. (2020). Identification of bioactive chemical constituents present in the aqueous extract of Telfairia occidentalis and its in vitro antioxidant activities. Journal of Natural & Ayurvedic Medicine, 4(2), 1-10.

[33]. Das, B., Amin, M., Russel, S., Kabir, S., Bhattacherjee, R., & Hannan, J. M. A. (2014). Phytochemical screening and evaluation of analgesic activity of Oroxylum indicum. Indian Journal of Pharmaceutical Sciences, 76(6), 571-575.

[34]. Kancherla, N., Dhakshinamoorthi, A., Chitra, K., &Komaram, R. B. (2019). Preliminary analysis of phytoconstituents and evaluation of anthelmintic property of Cayratia auriculata (In vitro). MAEDICA – A Journal of Clinical Medicine, 14(3), 350-356.

[35]. Yadav, M., Chatterji, S., Gupta, S. K., & Watal, G. (2014). Preliminary phytochemical screening of six medicinal plants used in traditional medicine. International Journal of Pharmacy and Pharmaceutical Sciences, 6(5), 539-542.

[36]. Shaikh, J. R., & Patil, M. K. (2020). Qualitative tests for preliminary phytochemical screening: An overview. International Journal of Chemical Studies, 8(2), 603-608.

[37]. Kancherla, N., Dhakshinamoorthi, A., Chitra, K., &Komaram, R. B. (2019). Preliminary analysis of phytoconstituents and evaluation of anthelmintic property of Cayratia auriculata (In vitro). MAEDICA – A Journal of Clinical Medicine, 14(3), 350-356.

[38]. Yadav, M., Chatterji, S., Gupta, S. K., & Watal, G. (2014). Preliminary phytochemical screening of six medicinal plants used in traditional medicine. International Journal of Pharmacy and Pharmaceutical Sciences, 6(5), 539-542.

[39]. Patra, P., Rathod, P., & Yadav, R. P. (2020). Study of chloroquine susceptibility potential of plants using Pseudomonas aeruginosa as an in vitro model. Biotech, 12(1), 1-12

[40]. Chen, Y., Qie, X., Quan, W., Zeng, M., Qin, F., Chen, J., & He, Z. (2021). Omnifarious fruit polyphenols: An omnipotent strategy to prevent and intervene diabetes and related complications? Critical Reviews in Food Science and Nutrition, 63(20), 4288–4324. https://doi.org/10.1080/10408398.2021.2000932

[41]. Naeem, A., Ming, Y., Pengyi, H., Jie, K. Y., Yali, L., Haiyan, Z., & Qin, Z. (2021). The fate of flavonoids after oral administration: A comprehensive overview of its bioavailability. Critical Reviews in Food Science and Nutrition, 62(22), 6169–6186.https://doi.org/10.1080/10408398.2021.1898333