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Original Article

Nature's Sugar Destroyer: Phytochemical Diversity And Free Radical Scavenging Efficacy Of *Gymnema Sylvestre* Sourced From Valsad, Gujarat

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ABSTRACT

Gymnema sylvestre (Asclepiadaceae), also referred to as Gurmar or the sugar destroyer. The current research was done to determine the phytochemical profile and antioxidant property of the entire plant (*panchang)* of *Gymnema sylvestre* growing at Village Marla, District Valsad, Gujarat, India. Plant extracts were made by cold maceration in three solvents namely, methanol, ethanol and water and were screened Qualitatively and Quantitatively by phytochemicals. Qualitative analysis showed the presence of alkaloids, tannins, flavonoids, phenolics, terpenoids, glycosides, saponins, proteins, and carbohydrates in the various solvent extracts. Water extract was found to contain the greatest Total Phenolic Content (0.78 mg GAE/g), Ethanol extract contained the greatest Total Flavonoid Content (11.324 mg QE/g), and Ethanol extract contained the greatest Total Tannin Content (19.094 mg TAE/g) by Quantitative estimation. The DPPH free radical scavenging assay was used to determine the Antioxidant activity, and the methanol extract exhibited the highest activity with an IC_{50} of 585.198 µg/ml, followed by water extract (612.986 µg/ml) and ethanol extract (652.944 µg/ml), as compared to the These findings substantiate that *Gymnema sylvestre* is a plentiful source of bioactive phytochemicals with significant antioxidant effects, which justify the use of this plant and its therapeutic potential.

Keywords: *Gymnema sylvestre*, Cold maceration, Phytochemical screening, DPPH assay, Quantitative analysis.

INTRODUCTION

Since the beginning of human history, Medicinal plants have been used for therapeutic purposes (James & alewo,2014). *Gymnema sylvestre* also referred to as "Meshasringi", is one such medicinal plant (khan *et al.,* 2020). About 40 species make up the genus with *G. sylvestre*, *G.montanum, G.yunnanense, G.inodorum*, being particularly valued for their medicinal properties (Tiwari *et al.,* 2020). *Gymnema sylvestre* is commonly known as "Gurmar" in local language. This herb is significant in India. It is widely found in Konkan, The Western Ghats, the deccan peninsula, and in Western and Northern India (Neel *et al.,* 2025).

Table 1: Taxonomical Classification (Srivastava *et al.*, 2019)

Kingdom	Plantae
Sub kingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Order	Gentianales
Family	Asclepiadaceae
Genus	*Gymnema*
Species	*sylvestre*

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Vernacular Names:

Sanskrit : Meshashringi, Madhunashini, Vishani-vishanika, Meshavalli, Tiktadugdha, Varttika, Cakshushya

Hindi : Medhaa singee OR Merasingi, Gudmaar ("gurmar" comes from 2 Hindi words- "gur", meaning sugar, and "mar", meaning to destroy. When combined "gurmar" literally means "the sugar killer".)

English: Periploca of the woods, Australian cow plant, Cow plant.

Gujarati: Mardashingi, Dhuleti

Marathi: Vakundi, Kavali, Kalikardori

Telugu: Podapatri

Tamil: Adigam, Cherukurinja

Kannada: Sannagerasehambu, Kadhasige

Malayalam: Cakkarakkolli, Madhunashini

Bengali: Mera-singi

Oriya: Gudmari (Triveni *et al.,* 2012); (Sagar *et al.,* 2015).

The word *Gymnema* comes from Greek where "gymnos" means naked and "nema" means thread. Then *sylvestre* is Latin means "of the forest" (Damor & Polaiah, 2022). *Gymnema sylvestre* is commonly known as the "destroyer of sugar" as a traditional name because by chewing it's leaves it will destroy the flavour of sweetness (Chowdhary & Rasool, 2010).

Gymnema sylvestre was put in consideration as one of the most significant botanicals to cure diabetes in the Ayurvedic. *Gymnema sylvestre* has been used in India to treat diabetes for over 2,000 years (Padmapriya *et al.,* 2010). Also is a part of Indian Pharmacopoeia as well as a system of medicine as an anti-diabetic plant. One of the ancient books on medicine, *Shushruta,* mentions *Gymnema sylvestre* as a curative agent in glycosuria and urinary disorder. It is a curing herb possessing several possibilities as stated by folk medicine, Ayurveda and Homeopathic Systems of medicine (Das *et al.,* 2022).

It is a natural plant that thrives in the open woodland of India, China, Indonesia, Japan, Malaysia, Sri Lanka, Vietnam, and South Africa (EI Shafey *et al.,* 2013). It is found in the forests of Madhya Pradesh, Andhra Pradesh, Kerela, Tamil Nadu, Uttar Pradesh, West Bengal, Bihar, and Chhattisgarh in India. The plant's high demand in Asia is causing it to become rare and be widely grown in southern Indian States, Particularly Tamil Nadu (Devi *et al.,* 2021)

It is a large woody climber that can grow between 100 and 1000 meters. The simple, green, oval, or elliptical leaves measure 2 to 6 cm long and 1 to 4 cm wide. They usually have a rounded or heart- shaped base, are petiolate, have a smooth edge, and are hairless on both surfaces. The leaves are opposite and have a pointed tip, with a network of veins. They also feature an astringent, slightly bitter taste and a distinct smell (Srivastava *et al.,* 2019).

The compound leaves are a distinctive light, bright green colour and have a feathery appearance. Each of their three- to five-centimetre-long leaves has two to four pairs of primary leaflets, or pinnae, which are further subdivided into one or two pairs of secondary leaflets, or pinnules. This makes them doubly pinnate (Hajare, 2018).

Flowers are greenish-yellow and arranged in spirals within lateral corymbose cymes. The calyx is covered in fine hair and is divided at the base. The corolla is bell-shaped. The corona has projections with a lying-down base. It is surrounded by two rows of short, stiff hairs, which are also fringed. The cymose gynostegium does not have a corona (Prakash, 2018)

The recent clinical trials have been performed in India and demonstrated that extract of *Gymnema sylvestre* can be used to control Blood Sugar. *Gymnema sylvestre* has found

popularity in the United States today as an adjunct therapy in diabetes (Srinivasan *et al.,* 2019). Additionally, it is used to treat snakebite, family planning, inflammations, eye problems, asthma, and cough. Furthermore, it has hepatoprotective, stomachic, diuretic, antimicrobial, anti-hypercholesteraemic, and anti-saccharine properties (Chowdhary & Rasool, 2010). It can be found in Ayurvedic formulations like *Mritasanjivani Sura, Nyagrodhadi Churna, Ayaskriti, and*

Mahavisagarbha Taila. Diabetes, inflammation, eye conditions, asthma, and dental cavities are all treated with these formulations.

In Japan, *Gymnema* teas and *Gymnema* chewing gum are made from *G. sylvestre* leaves. They are promoted as a natural way to control obesity, boost insulin secretion through the regeneration of pancreatic beta cells, and reduce sweet cravings on the tongue. The juice from the root is used to treat vomiting and dysentery. A paste made from the plant, combined with mother's milk, is applied to treat mouth ulcers. *Gymnema* preparations have shown anti-allergic activity (Chavda, 2015).

Many phytochemicals, including terpenoids, saponins, gymnemic acids, and gymnema saponins, are found in *G. sylvestre* leaves. Gymnemic acid, the active ingredient, was isolated from leaves and is frequently used as an anti-sweetener, anti-hypercholesterolemia, and antidiabetic (Entooru *et al.,* 2021). *sylvestre* stems contain a number of chemical components with therapeutic significance, such as stigmasterol and triterpenoid saponin. *Gymnema* root powder has also been used to treat liver diseases, constipation, stomach issues, snake bites, and water retention. In traditional medical systems, it is also used to treat infections (Saumendu, 2010). *Gymnema sylvestre* is a promising candidate for evaluating its anti-oxidant and anti-microbial properties, which may benefit diabetes patients (Gunasekaran *et al.,* 2019).

Also, there are various products, dietary supplements, and health food available in the market that are based on *Gymnema* in different parts of Asia, Europe and America (Damor & Polaiah, 2022).

(Table 2: Traditional uses in different states (Jamadagni *et al.*, 2021))

Sr. No	State	Folklore Claim
1	Uttar Pradesh	Paste made of fresh leaves is done on eyelid twice. In the Jhansi district of dailies to cure cataract.
2	Chhattisgarh	The entire plant has anti-inflammatory and anti-asthmatic properties, and the leaves have diuretic properties. This herb is utilized in the Jashpur District to treat dysentery and vomiting/ulcers.
3	Karnataka	Its roots are utilized as an anti-diabetic in Karnataka's Gulbarga district.
4	Andhra Pradesh	In the Gastric trouble in the Medak district of Andhra Pradesh, leaf powder is administered; and, in diabetes, as eye drops, the leaf juice is applied.
5	Tamil Nadu	In animals, Leaves of GS are crushed with pepper, garlic and 0.1g of common salt to cure temporary fever. Opacity of cornea is cured using leaf juice.
6	Kerala	Leaves of GS are crushed in water and the juice is consumed before a meal as a remedy to diabetes.
7	Pondicherry	Two to three grams of dried leaf powder are administered with water. For 15 days, seven fresh leaves are suggested every morning to treat diabetes.

MATERIALS AND METHODOLOGY

Plant Collection

The whole plant material *(panchang)* of *Gymnema sylvestre* (Asclepiadaceae) was collected from Village Marla of district Valsad, Gujarat, India. The collected material was washed thoroughly with tap water, after that the material was dried at room temperature for 6-7 days, after drying the dried plant material then mechanically ground into a fine powder using a mixer grinder. Approximately 150 gm of the homogeneous powder was packaged in an airtight zip-lock bag and stored under ambient condition to maintain stability until further use or analysis.

Plant Extract Preparation

The plant extract was prepared using the cold maceration method. Three different solvents were used for the extraction process which are Methanol, Ethanol and Water For each solvent, 10g of powdered plant material was soaked in 200 mL of the respective solvent. The mixture stood for 72 hours (3 days) at room temperature. During this time, the mixture was shaken gently 1 to 2 times a day to help with extraction. After 72 hours, the extract was filtered through Whatman filter paper. The liquid that passed through was collected into a petri dish and was allowed to evaporate completely under fan over a period of 2-3 days. Once fully dried, the petri plates were stored in laboratory refrigerator for the further process. The percentage yield was calculated by the standard formula-

$$\textbf{Yield (\%)} = \frac{\textit{Weight of dry extract}}{\textit{Weight of plant powder}} \times 100$$

Qualitative Analysis (Phytochemical Screening)

- **Test For Alkaloids**

1) Dragendroff's Test: Take 1ml extract and 2ml Dragendroff's reagent, the formation of orange Precipitate indicates the presence of alkaloids.

- **Test For Carbohydrate**

1) **Iodine Test:** Take 1 ml extract and add 2-3 drops of iodine solution, The formation of Blue-Black coloured complex indicates the presence of Carbohydrate.

- **Test For Glycosides**

1) Keller- Kelani Test: Take some amount of extract and add 1ml G.A.A., + 2% fecl3 solution (2drops) – pour into test tube with 1ml conc. H_2SO_4, 2 Layers formed Upper-red brown Lower-blue green indicates presence of Glycosides.

- **Test For Proteins**

1) **Millon's Test:** Take 1ml extract and add 1ml millions reagent. The formation of White precipitate indicates the presence of Proteins.

- **Test For Phenolics**

1) **Lead acetate Test:** Take 1ml extract add 5ml dis. Water then add 3ml 10% lead acetate. The formation of White ppt indicates the presence of Phenol.

- **Test For Flavonoids**

1) **Lead acetate Test:** Take 1ml extract add few drops of 10% lead acetate Solution. Yellow precipitates indicate the presence of Flavonoids

- **Test For Tannins**

1) **$FeCl_3$ Test:** Take 1ml extract and add 5% ferric chloride solution. Dark green or Blackish-blue colouration indicates the presence of Tannins

- **Test For Terpenoids**

1) **Salkowski's Test:** Take 1ml extract, add 2ml chloroform and 2ml con H_2SO_4, forms Reddish-brown colour ring indicates the presence of Terpenoids

- **Test For Saponins**

1) Foam Test: Take 1ml extract, add 3ml dist. Water & shake it vigorously the formation of Foam layers indicates the presence of Saponins

- **Test For Steroids**

1) **Salkowski's Test**: Take 1ml filtrate and add 2ml chloroform plus 2ml con. H_2SO_4 Reddish-brown/ rusty color formation indicates the presence of Steroids. (Sayma *et al.,* 2025) ;(Shaikh and Patil., 2020) ;(Dubale *et al.,* 2023).

Quantitative Analysis

The quantitative analysis of phytochemicals is done for the determination of exact amount of phytochemicals are present. For conducting quantitative analysis, the stock solution was prepared with a concentration of 1mg/ml in Methanol, Ethanol and Water solvent. 10mg dry extracts was dissolved in 10ml of Respective solvents to prepare the stock solution. Similarly, the standard solution was prepared with a concentration of 1 mg/ml.

DPPH ASSAY:

This is a popular and common method used to check the presence of free radical scavenging activity of a given plant material. 2, 2-diphenyl-1-picrylhydrazyl (DPPH) is a dark crystalline powder having stable free radical molecules. 4mg (0.004%) of DPPH was prepared by dissolving in 100 ml methanol. 3ml of prepared DPPH was added to various concentration of sample (200, 400, 600, 800, and 1000 µg/ml) and incubate for 30 minutes at room temperature in dark, the absorbance was read at 517 nm in triplicates for each concentration in spectrophotometer. The application of DPPH is important for antioxidant assay. The DPPH antioxidant assay is based on the ability of DPPH, a stable free radical, to decolorize in the presence of antioxidants, thus a low value corresponds to a good scavenging ability. Ascorbic acid solution of same concentration can be used as standard for the free radical scavenging assay. The result was expressed by IC_{50} value. Radical scavenging activity was compared with inhibition concentration (IC_{50} following formula was used for calculating DPPH scavenging activity: (Sayma *et al*., 2025).

DPPH scavenging activity (%) = [(absorbance of blank - absorbance of sample) / absorbance of blank)] × 100

Determination of Total Phenol Content:

The total phenolic content was determined by using Folin-Ciocalteau method with using gallic acid as a standard in different concentrations with modified series are formed. Standard solution is form with 10mg Galic acid powder with 10ml water as a solvent. Standard solution concentration series were 10mg/ml to 50mg/ml. Then add 0.5ml of 2N FC reagent and after that added 10ml of distil water and then added 1 ml 20% Sodium carbonate make volume up to 25ml. Put it for incubation for 30min. Than take OD at 765nm (Siddiqui *et al.,*2017). Similarly for plant extract, 1ml plant extract are taken with respective solvents in which add 0.5ml 2N FC reagents and then add 10ml water after that added 1ml 20% sodium carbonate than make volume up to 25ml for 30min keep it for incubation. Using UV Spectrophotometer, the absorbance is determined at 765nm. Quantification of total phenolic content was carried in micrograms of Galic acid equivalents per g of sample. Then determine the total phenolic content with using this formula (Siddiqui *et al.,*2017).

$C = C1 \times V/m$

Where C = total phenolic content in mg/ml, in GAE (gallic acid equivalent),

C1 = concentration of gallic acid established from the calibration curve in mg/ml,

V = Volume of extract in ml, and m = the weight of the plant extract in g (Siddiqui *et al.,*2017)

Determination of Total Flavonoid Content:

The flavonoids content was determined in different extracts by modified colorimetric method. First made a standard series with slight modification and used quercetin as standard. Standard solution of quercetin is formed by dissolving 10mg with 10ml methanol to make 1mg/ml then the solution used to make different concentrations series of 50mg/ml to 500mg/ml. To the series add 4ml water and then add 5% sodium nitrite and then, 0.3ml 10% aluminium chloride and after that, 2ml 1M Sodium hydroxide are added. Then make volume up to 10ml. after that take OD at 510nm.

Same as standard for solvents also plant extract, 1ml plant extract are taken in which 4ml water and then 0.3ml 5% sodium nitrite and then, 0.3ml 10% aluminium chloride and then, 2ml 1M sodium hydroxide are added. In both standard and extract final up to volume is 10ml. Using UV Spectrophotometer, the absorbance is determined at 510nm. The flavonoid content was calculated from standard curve of quercetin is determined and expressed as mgQEg-^{1} (quercetin equivalent) using the formula: QE = C × V/M (Kaviya *et al.,*2024).

Determination of Total Tannin Content:

This phytochemical is produced by the plant as a defence mechanism, offering protection through its strong taste. To determine the total tannin content, the potassium iodate method was employed. Tannic acid was used as the standard, and a concentration series ranging from 100mg/mL to 500mg/mL was prepared. The solution was then placed in a cold water bath for 5 minutes. Afterward, 5 mL of 2.5% potassium iodate (KIO_3) was added, and the mixture was incubated in

a test tube for 25 to 30 minutes. The optical density was measured at 550 nm (Willis and Allen.,1998).

For the plant extract, 1 mL of the extract, along with the respective solvent, was used, and the same procedure was followed. The tannin content was calculated from the standard curve of tannic acid and expressed as milligrams of tannic acid equivalent per gram (mg TE/g). The calculation was done using the formula:

TE = C × V/M.

RESULTS

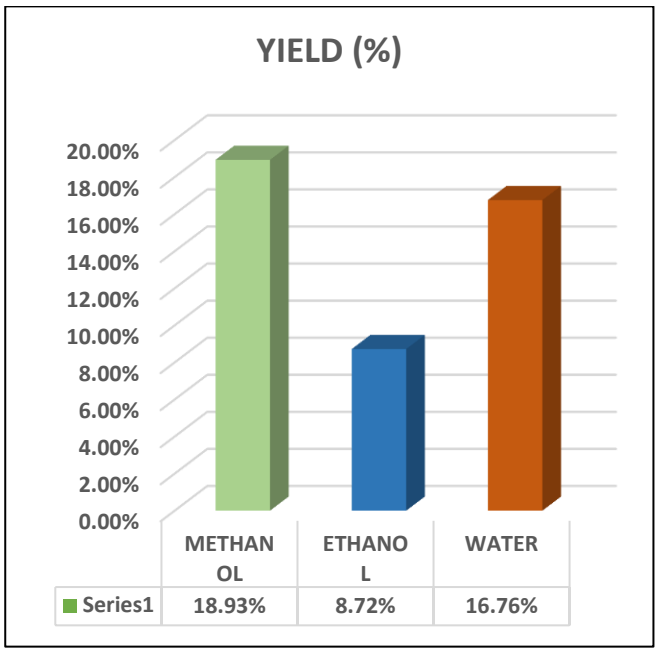
Plant Extract Yield (%) value

Standard formula for Yield (%):

Yield (%) = (Weight of Dry Extract ÷ Weight of Plant Powder Taken) × 100

Calculations:

1. Yield (%) for Methanolic Extract = (1.893 ÷10) ×100 = 18.93%
2. Yield (%) for Ethanolic Extract = (0.872÷10) × 100 = 8.72%
3. Yield (%) for Water Extract = (1.676 ÷10) ×100 = 16.76%



(Graph 1: Yield of Different Extracts)

Qualitative analysis

Table 1: Phytochemical Screening

Sr. No.	Phytochemicals	Test name	Methanol	Ethanol	Water
1	Alkaloids	Dragendroff's Test	+	++	+
2	Tannin	Ferric chloride Test	+	++	+
3	Glycoside	Keller-Kelani Test	-	+	+
4	Flavonoids	Lead acetate Test	+	+	+
5	Phenol	Lead acetate Test	+	+	+
6	Saponin	Frothing Test	+	-	++
7	Protein	Millon's Test	-	++	++
8	Terpenoids	Salkowski's Test	++	++	++
9	Carbohydrate	Iodine Test	+	+	-

(The table represents the results of the phytochemical tests performed. '++' sign indicates sign indicates – Highly Present, '+' sign indicates – Moderately present, the '-' sign indicates absence of the respective phytochemicals)

Quantitative Analysis

Quantitative Estimation of Total Phenol Content (TPC)

The process of finding out sample's overall phenolic content is known as the Total Phenolic content (TPC). The extraction solvent has a direct impact on the yields. Here, Gallic acid was used as a reference to measure TPC of the Whole plant of *Gymnema sylvestre*. The substances found in the plant sample also exhibit antioxidant qualities.

(Graph 2 : Gallic acid standard Curve)

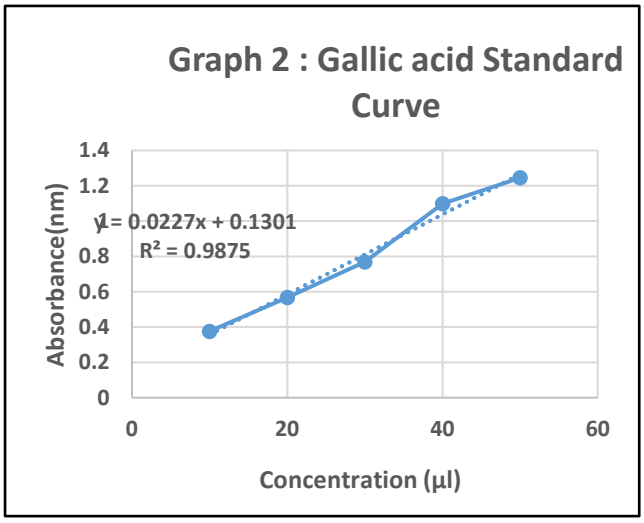


Table 2: Standard reading of Total Phenol Content

Concentration(µl)	Absorbance(765nm)
10	0.369±0.0098
20	0.571±0.0063
30	0.783±0.0212
40	1.111±0.0183
50	1.257±0.0176

Graph 3: The Phenol Content In different extracts of *Gymnema sylvestre*.

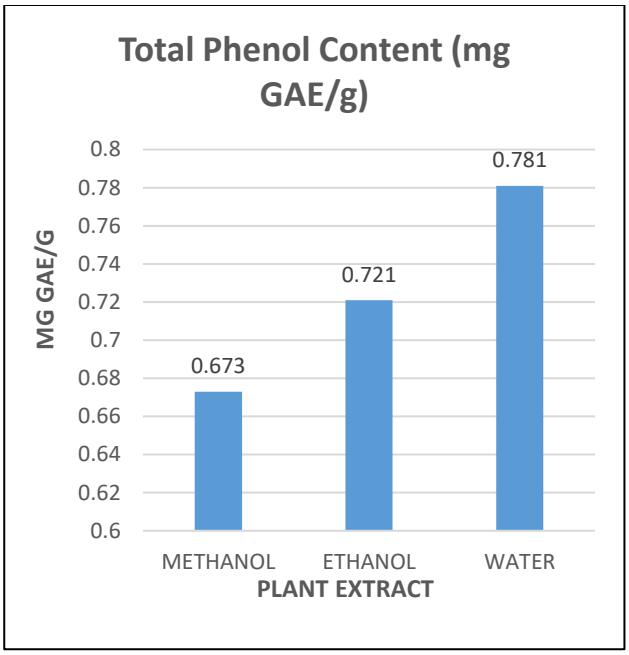


Table 3: Total Phenolic Content (TPC) In different extracts of *Gymnema sylvestre.*

Solvent	Concentration(µl)	Absorbance(765nm)	Total Phenolic Content (mg GAE/g)
Methanol	1000	0.894±0.01202	0.67
Ethanol	1000	0.949±0.0091	0.72
Water	1000	1.017±0.0268	0.78

Quantitative Estimation of Total Flavonoid Content (TFC)

The process of finding out sample's overall Flavonoids content is known as the Total Flavonoid content (TFC). The extraction solvent has a direct impact on the yields. Here, Quercetin was used as a reference to measure TFC of the Whole plant of *Gymnema sylvestre*. The substances found in the plant sample also exhibit antioxidant qualities.

(Graph 4 : Quercetin Standard Curve)

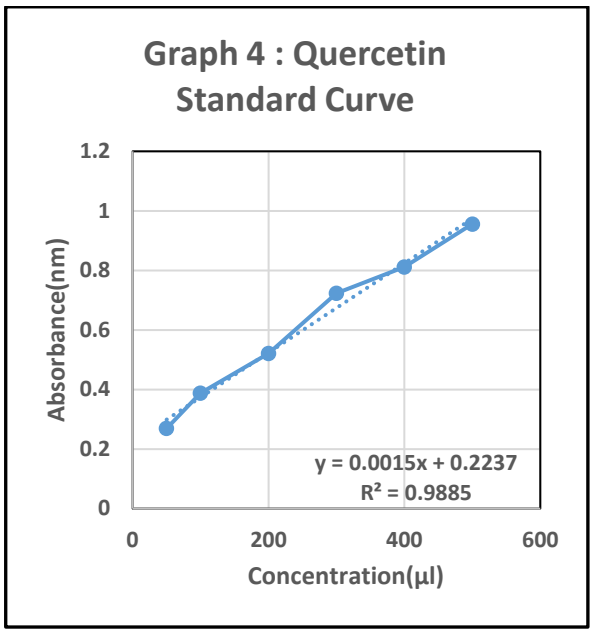


Table 4: Standard Reading of Total Flavonoid Content

Concentration(µl)	Absorbance(nm)
50	0.271±0.002828
100	0.389±0.00212
200	0.524 ±0.00495
300	0.728 ±0.00707
400	0.817± 0.00919
500	0.971± 0.02121

Graph 5 : Total Flavonoid Content In different extracts of *Gymnema sylvestre*

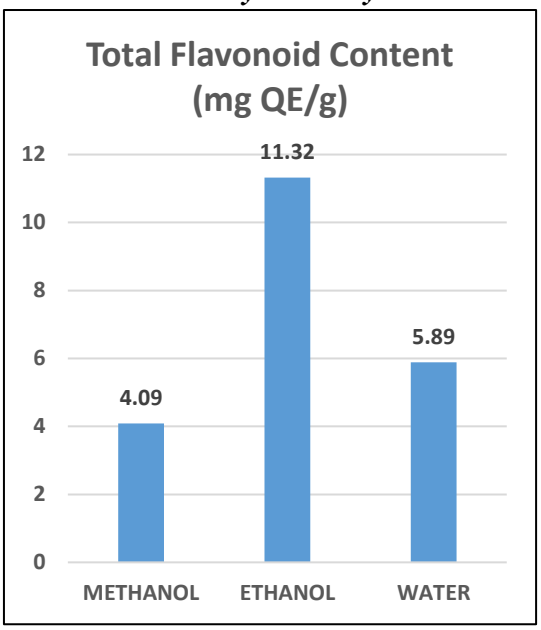


Table 5: Total Flavonoid Content (TFC) In different extracts of *Gymnema sylvestre.*

Solvent	Concentration(µl)	Absorbance(510nm)	Total Flavonoids Content (mg QE/g)
Methanol	1000	0.5305±0.020506	4.090667
Ethanol	1000	1.073±0.274357	11.324
Water	1000	0.666±0.008485	5.897333

Quantitative Estimation of Total Tannin Content (TTC)

The process of finding out sample's overall Flavonoids content is known as the Total Tannin content (TTC). The extraction solvent has a direct impact on the yields. The tannin content in the whole plant of *Gymnema sylvestre* was quantified by using Tannin acid as a standard. The substances found in the plant sample also exhibit antioxidant qualities.

Graph 6 : Tanic acid Standard Curve

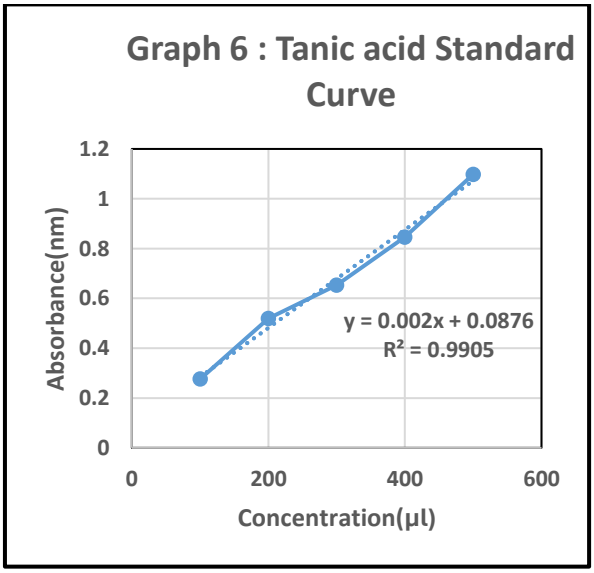
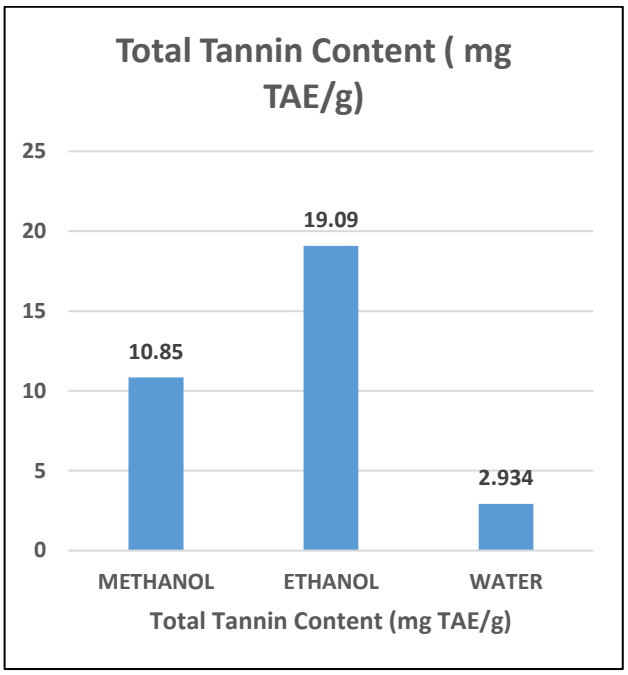


Table 6: Standard Reading of Total Tannin Content

Concentration(µl)	Absorbance(550nm)
100	0.2725±0.00495
200	0.5275± 0.010607
300	0.6575± 0.006364
400	0.8605±0.020506
500	1.105 ±0.009899



Graph 7 : Total Tannin Content In different extracts of *Gymnema sylvestre*

Solvent	Concentration(µl)	Absorbance(550nm)	Total Tannin Content (mg TAE/g)
Methanol	1000	1.173 1.088944	10.854
Ethanol	1000	1.997 0.019799	19.094
Water	1000	0.381 0.002828	2.934

Table 7: Total Tannin Content (TTC) In different extracts of *Gymnema sylvestre*

Antioxidant Activity

Estimation of DPPH Assay:

Free radicals are unpaired electrons in uncharged compounds. It is poisonous and can cause oxidative stress, which harms living cell or tissue. Here DPPH Assay was performed for the different solvents in the plant *Gymnema sylvestre*. Ascorbic acid used as the standard for DPPH Assay, and the inhibitory activity was computed using the OD of the sample extracts.

Table 8: Inhibitory Activity of Ascorbic Acid

Sr. No.	Concentration(µl)	Ascorbic acid
1	200	31.695±0.89803
2	400	44.565±1.68999
3	600	55.03±0.28284
4	800	63.955±1.25158
5	1000	79.76±1.25158
6	IC_{50}(µg/ml)	513.062µg/ml

Graph 8 : Ascorbic Acid Standard

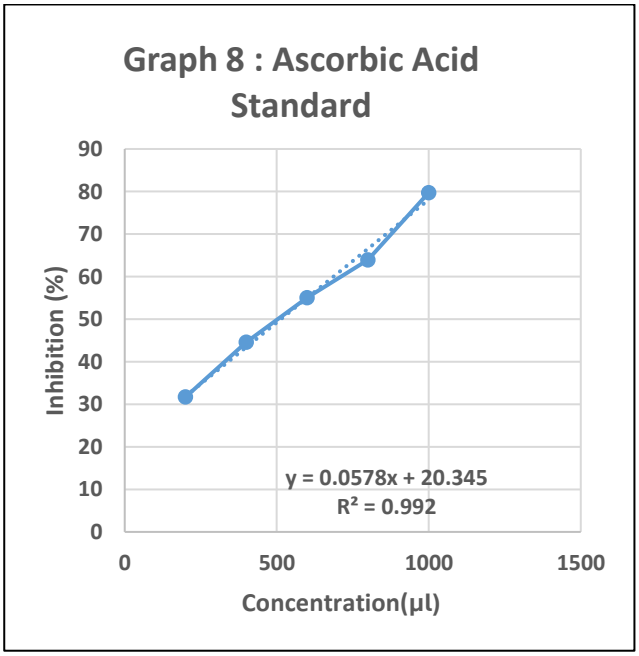
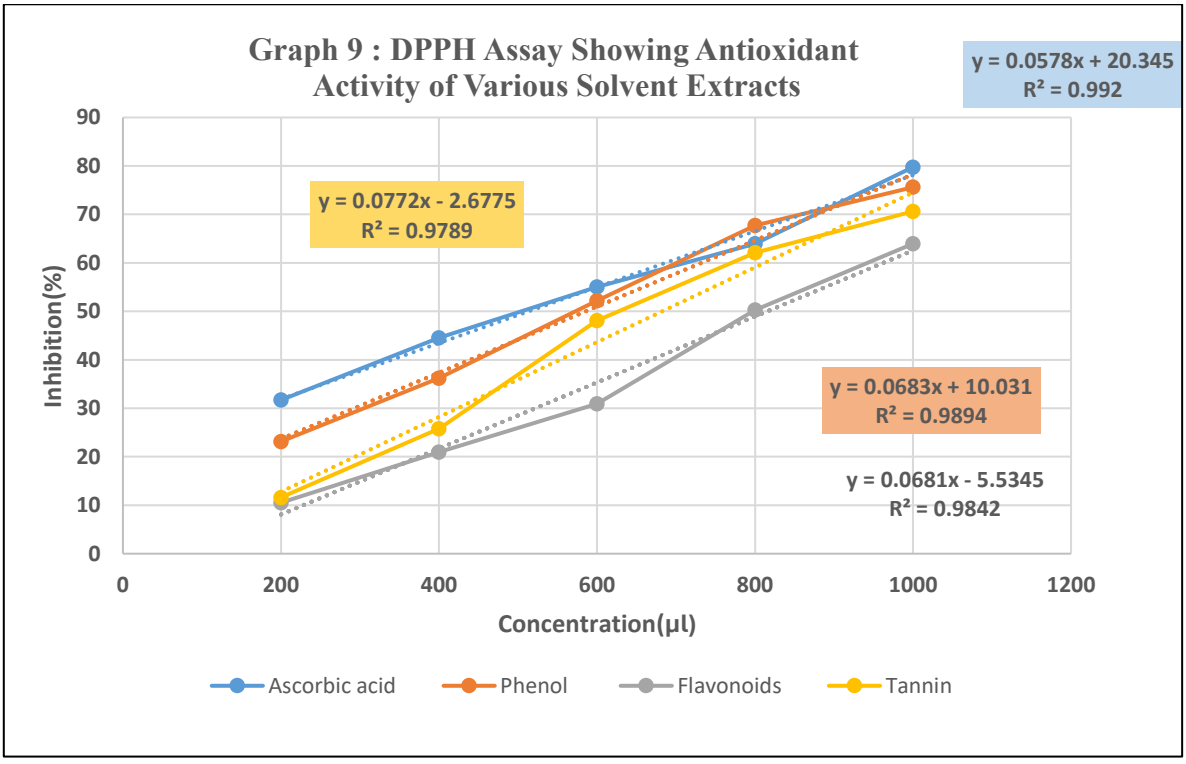


Table 9: Depicting for the results for DPPH Assay for Plant *Gymnema sylvestre*

Sr. No	Concentration(µl)	Methanol	Ethanol	Water
1.	200	23.13±3.2739	10.51±0.43134	11.60±1.57685
2.	400	36.2±1.4283	20.96±1.43543	25.75±1.59099
3.	600	52.21±2.1566	30.9± 0.35355	48.11±2.58801
4.	800	67.74±1.209	50.29±0.65054	62.09±1.18794
5.	1000	75.61±1.2657	63.95±0.32527	70.63±0.91924
6.	IC_{50}(µl)	585.198 µg/ml	652.944µg/ml	612.986 µg/ml

Graph 9 : Various Solvent Extracts Inhibition Against Standard Inhibition



DISCUSSION

The current research undertaking a thorough phytochemical and antioxidant analysis of the entire plant (panchang) of *Gymnema sylvestre* using methanol, ethanol and water as extraction solvents through the cold maceration technique. The percentages of yield which were obtained (18.93% of methanol, 16.76% of water, and 8.72% of ethanol) demonstrate that methanol and water can be used as more efficient extraction solvents of this plant material. The high polarities of the polar solvents are in line with the generally polar character of the phytochemicals that have been reported in *Gymnema sylvestre*, such as the gymnemic acids, saponins and flavonoids. The screening of the phytochemical qualitatively identified the presence of a variety of secondary metabolites. All three solvent extracts contained alkaloids, tannins, flavonoids, phenolics and terpenoids, with the latter having strongly positive results (++) in methanol, ethanol and water extracts. These results are similar to the previously established phytochemical composition of *Gymnema sylvestre*, comprising of gymnemic acids

(triterpenoid saponins), stigmasterol, and numerous flavonoids. The glycosides did not appear in the methanol extract, and were found in ethanol and water extracts, indicating that solvent polarity contributes to the extraction of glycosides. Saponins were highly positive in water but negative in ethanol whereas proteins were negative in methanol but positive in ethanol and water extracts. These differences highlight that solvent choice in phytochemical research is vital. Folin-Ciocalteau method with gallic acid as the standard was used to quantitatively analyse the total phenolic content (TPC) of water, ethanol, and methanol extracts; the results showed that water extract (0.78 mg GAE/g) had the highest phenolic content, followed by ethanol (0.72 mg GAE/g) and methanol (0.6 The high yield of phenolic compounds of the water extract confirms the fact that polar solvents are effective in extracting polar phenolic compounds. Antioxidant, anti-inflammatory and antimicrobial effects are considered to be among the most common phenolic compounds and these properties are attributed to the numerous therapeutic uses of *Gymnema sylvestre* in traditional medicine. The colorimetric method was used to determine the total flavonoid content (TFC) with quercetin as standard. Ethanol extract had a significantly higher TFC (11.324 mg QE/g) than water extract (5.897 mg QE/g) and methanol extract (4.091 mg QE/g). This observation indicates that ethanol is a better extracting solvent in extraction of flavonoids in *Gymnema sylvestre*. Flavonoids have been known to play a significant role in antioxidant capacity of plant extracts and have also been linked with antidiabetic, anti-inflammatory and hepatoprotective activity, all of which would be in line with traditional applications of this plant. The highest concentration of tannin (TTC) estimated with the use of tannic acid as a reference was in the ethanol extract (19.094 mg TAE/g) then methanol (10.854 mg TAE/g) and water extract (2.934 mg TAE/g). Tannins have been known to have astringent, antimicrobial and antioxidant activity and the fact that ethanol extracts contain large amounts of tannins, further justifies the use of ethanolic preparations of the *Gymnema sylvestre* in traditional preparations. The fact that the tannin content is significantly less in the aqueous extract also shows that tannins in this plant are more likely to be aqueous soluble. The antioxidant activity has been determined using DPPH (2,2-diphenyl-1-picrylhydrazyl) free radical scavenging assay using ascorbic acid as a reference standard. The IC_{50} of ascorbic acid was 513.062 µg/ml. Methanol extract was used because it had the highest antioxidant capacity and lowest IC_{50} value of 585.198 µg/ml compared to water extract (612.986 µg/ml) and ethanol extract (652.944 µg/ml). The fact that the IC_{50} values of all three extracts are relatively close shows that *Gymnema sylvestre* has moderate and general-based antioxidant activity irrespective of the solvent used in the extraction. It is plausible that the antioxidant activity is a result of the synergistic performance of phenolics, flavonoids, tannins and terpenoids found in the extracts. It is known that free radicals can result in oxidative stress in living cells and the capacity of extracts of *Gymnema sylvestre* to scavenge DPPH radicals justifies the potential of this plant in antioxidative stress-related diseases like diabetes and inflammation. The general trend followed, that is, high TPC in water, high TFC and TTC in ethanol, and greatest antioxidant activity in methanol, indicates the multidimensional character of the solvent polarity and phytochemical extractability. These results confirm the high level of phytochemical composition of *Gymnema sylvestre* and the ancient use of this plant in Ayurvedic and folk medicine in various Indian states. The fact that all three extracts have different bioactive compounds is a sign of the strength of this plant as a source of medicine.

CONCLUSION

The current research was able to conduct Qualitative and Quantitative Phytochemical screening, and Antioxidant assays of the whole plant (panchang) of *Gymnema sylvestre* using methanol, ethanol and aqueous cold maceration extracts. The Qualitative screening established the occurrence of significant secondary metabolites such as alkaloids, tannins, flavonoids, phenolics, terpenoids, glycosides, saponins, proteins, and carbohydrates with the variability across the solvent systems indicating the effect of polarity on phytochemical extraction. The Quantitative analysis indicated that the water extract contained the greatest total phenolic content (0.78 mg GAE/g), the ethanol extract contained the greatest total flavonoid content (11.324 mg QE/g) and the total tannin content (19.094 mg TAE/g). The DPPH free radical scavenging assay showed that, the methanol extract had the highest antioxidant activity (IC_{50} =

585.198 µg/ml), followed by water (IC_{50} = 612.986 µg/ml) and ethanol (IC_{50} = 652.944 µg/ml) extracts, these findings all demonstrate that *Gymnema sylvestre* is a valuable source of bioactive phytochemicals with great antioxidant properties. The identified diversity and abundance of secondary metabolites in this study offers a solid scientific foundation to the traditional application of this plant in Ayurvedic medicine to treat diabetes, inflammation, gastric disorders, and others in different states of India. The results indicate that *Gymnema sylvestre* whole plant extracts, especially in ethanol and methanol, should be studied further to isolate particular bioactive compounds and assess their pharmacological action, in particular, antidiabetic, antimicrobial, and anti-inflammatory effects. This work will add to the existing literature that confirms the therapeutic potential of *Gymnema sylvestre* and justify its presence in further pharmacognosy as a source of medicine plant

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