INTRODUCTION

Nanoscience research shows exponential growth, especially with potential applications in biomedical science and technology. Currently, metallic nanoparticles such as silver, gold, and platinum are focused much for specific optical, mechanical, and chemical properties than bulk metal [1]. Among these metal nanoparticles, silver plays a key role in fabric and pharmaceutical industries [2]. A wide spectrum of methods to synthesize AgNPs is well documented. For example, distinct electrochemical method, sono-chemical, radiation, microwave assisted method, opposite micelles technique, segment transfer procedure, photochemical synthesis, organic strategies [3-10]. These methods involve the use of toxic substance and pose serious environmental and health problem. In recent years, metal nanoparticles protected by bioorganic ligand are involved in a great deal due to their widespread applications [11].

In current years, the facile synthesis of AgNPs with the aid of biologically active compounds has been extensively explored due to its easy availability and eco-friendliness [12]. Biosynthesized silver nanoparticles (AgNP) using Eucalyptus chapmaniana [13], Terminalia bellirica [14], Acalypha indica [15], and Cynodon dactylon [16] plant extracts has been acknowledged, and the applications of AgNPs in the detection of cancer, combating of microbes, bio-labeling, and drug transport are reported [17]. Biosynthesized nanoparticles are used in water filters, textile, and food industries due to their antimicrobial activities [18].

In the past few years, gas chromatography-mass spectrometry (GC-MS) has become a versatile tool for secondary metabolite profiling in both plant and non-plant species [19,20]. GC-MS analysis provides accurate results of analyte even at low concentrations. GC-MS analyses are extensively utilized in forensic science, elemental analysis, and pollution research [21]. In recent times, the bioactive additives tagged with non-polar, volatile substances, alkaloids, phenols, long chain and branched-chain hydrocarbons, alcohols, acids, esters, and different biologically energetic additives are being separated using GC-MS [22,23]. AgNPs prepared using green gram sprout extract (GGSE) (Leguminosae family) and characterized by UV-spectrum, X-ray diffraction, Fourier-transform infrared, standard error of the mean, and tested on antimicrobial activity using some microbes were published by our research group [24]. In this work, the author reported the phytochemical analysis, GC-MS, and antioxidant activity of AgNPs.

METHODS

Preparation of GGSE

Quality seeds of Vigna radiata (green gram) obtained from the agro seed shop were washed and covered in a smooth moist cloth. The seeds began to sprout after germination time of 1–2 days. The sprouts were gathered and dried in the shade at room temperature (30°C). Electric blender was used to powder the dried sprouts. Cloth sieve is used to collect the fine powder of GGSE and is collected in airtight container for further studies.

Chemicals and reagents

Ascorbic acid, methanol, silver nitrate (AgNO₃), and 2,2-diphenyl-1-picrylhydrazyl (DPPH) have been bought from Sigma-Aldrich. All reagents were of analytical grade.
RESULTS AND DISCUSSION

Biosynthesis of AgNPs and the usage of GGSE

The GGSE was blended with the aqueous extract of synthesized AgNO₃ at room temperature. The various stages of AgNP formation are shown in Fig. 1. After 30 min, the initial color change was observed and a brownish red coloration was obtained after 2 h as shown in Fig. 2. The final color change indicates the completion of AgNP synthesis process. The change in color from watery to brownish red color indicates the formation of AgNPs and this variation is attributed due to surface plasmon resonance of AgNPs within the reaction samples [29,30].

**Qualitative phytochemical screening**

The qualitative phytochemical screening of methanolic GGSE is shown in Table 1. Phytochemical screening showed the presence of...

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**Table 1: Phytochemicals screening results of green gram sprout extracts**

| S. No. | Phytochemical | Results (qualitative) |
|-------|--------------|-----------------------|
| 1     | Tannin       | -         |
| 2     | Saponin      | -         |
| 3     | Flavonoids   | ++        |
| 4     | Steroids     | ++        |
| 5     | Terpenoids   | ++        |
| 6     | Alkaloids    | ++        |
| 7     | Amino acids  | +++       |
| 8     | Polyphenol   | +++       |
| 9     | Glycoside    | +++       |
| 10    | Protein      | ++        |

- : Absence, + : Presence, ++, +++: Indicates intensity of color
flavonoids, steroids, terpenoids, alkaloids, amino acids, polyphenol, glycoside, and protein. It is reported that the leaves of *D. montana* have steroids, flavonoids, and phenols [31]. Biologically active compounds might play a large role in forming, capping, and stabilization of AgNPs [32].

**GC-MS analysis**

The outcomes of the GC-MS evaluation confirmed that 24 compounds (Fig. 3) have been present in GGSE. These compounds have been diagnosed using GC-MS. The mass spectra of these compounds matched with the ones found within the NIST/NBS spectral database and the information are given in Table 2. The important compounds of GGSE (retention time 30.027) were found to be stigmast-5-en-3-ol, (3-beta), stigmasterol, pregnane, silane derivative trimethylsilyl ester of tetracosanoic acid, 9-octadecenoic acid (z), n-hexadecanoic acid, mome inositol, and ethyl alpha-d-glucopyranoside stated to own antioxidant, antibacterial, anticancer, hepatoprotective, anti-inflammatory, and antimicrobial and inhibition of parasitic increase [33].

**Antioxidant activity**

The free radical scavenging capabilities of biosynthesized AgNPs and GGSE were made using the DPPH assay. In DPPH assay, the antioxidant activities of AgNPs and the GGSE were found increased as the concentration of samples used for assay changed from 20 to 100 μg/mL (Fig. 4). In general, GGSE-mediated biosynthesized AgNPs have the good antioxidant capacity as that of the standard (ascorbic acid). This is due to the presence of phytocompounds that might have radical scavenging activity, particularly polyphenols which are a potential hydrogen atom donor [34]. The presence of antioxidant outcomes indicated that free radical scavenging activity of AgNPs has increased concentration-dependent way.

**Antibacterial activity**

Antibacterial activity of synthesized AgNPs showed positive results toward the Gram-positive and Gram-negative microorganism. The antibacterial activity was found to be maximum for *K. aerogenes*, followed by *E. coli*, *B. subtilis*, and *S. aureus* (Fig. 5). From the results, it is obvious that the inhibition activity of AgNPs toward Gram-negative bacterial traces was higher than toward the Gram-positive bacteria.

### Table 2: Peak report derived from the chromatogram of the green gram sprout

| Peak | R. Time | Area       | Area % | Name                                    |
|------|---------|------------|--------|-----------------------------------------|
| 1    | 3.257   | 598627     | 0.69   | 1-Butanamine, 2-methyl-N-(2-methylbutylidene) |
| 2    | 3.781   | 564406     | 0.67   | Cyclopentane, 1-acetyl-1,2-epoxy-         |
| 3    | 4.650   | 5036211    | 5.94   | 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl |
| 4    | 5.485   | 2425030    | 2.86   | 1-Deoxy-d-arabitol                        |
| 5    | 6.460   | 388872     | 0.46   | 2-Ethylhexyl pentenoate                   |
| 6    | 6.883   | 231882     | 0.27   | 1-Heptanol, 2-propyl                      |
| 7    | 7.752   | 295200     | 0.35   | 3-(4-Aminobutyl) piperidine               |
| 8    | 8.249   | 493866     | 0.58   | Unknown                                  |
| 9    | 10.349  | 144343     | 0.17   | 1H-Pyrole, 2-(2,4,6-cycloheptatrienyl)     |
| 10   | 11.212  | 9582380    | 11.31  | Ethyl alpha-d-glucopyranoside             |
| 11   | 12.714  | 2613752    | 30.83  | Mome inositol                            |
| 12   | 13.413  | 7436423    | 8.77   | Caffeine                                 |
| 13   | 13.708  | 895705     | 1.06   | 1H-Purine, 2,6-dione, 3,7-dihydro-3,7-dimethyl |
| 14   | 13.908  | 335443     | 0.40   | Hexadecanoic acid, methyl ester           |
| 15   | 14.350  | 12096730   | 14.27  | n-Hexadecanoic acid                      |
| 16   | 14.943  | 9915501    | 11.70  | Unknown                                  |
| 17   | 16.198  | 3239788    | 3.82   | Octadecanoic acid                        |
| 18   | 17.915  | 308432     | 0.36   | 9-Octadecenoic acid (Z)                  |
| 19   | 18.839  | 197121     | 0.23   | Trimethylsilyl ester of tetracosanoic acid|
| 20   | 18.967  | 200867     | 0.24   | Pregnan, silane derivative               |
| 21   | 19.150  | 896508     | 1.06   | Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester |
| 22   | 27.907  | 488264     | 0.58   | Cholest-5-en-3-ol (3-beta), carbonochloridate |
| 23   | 28.676  | 979558     | 1.16   | Stigmasterol                             |
| 24   | 30.027  | 1886587    | 2.23   | Stigmast-5-en-3-ol (3-beta)              |
| Total|         | 8476171    | 100.00 |                                         |
could be attributed to the fact that the Gram-negative microorganisms have a thin peptidoglycan layer; but the Gram-positive microorganisms have a thick peptidoglycan layer [35].

CONCLUSION
The GGSE-assisted biosynthesis of AgNPs was found to be a convenient green route and cost-effective method. Phytochemicals present in the sprout extract act as a strong reducing and capping agent for the formation of AgNPs. The GGSE-assisted biosynthesis of AgNPs has shown potential antibacterial and antioxidant activity and proved to be an effective antibacterial material.

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AUTHOR’S CONTRIBUTIONS
The idea is mine, I have designed the work, experiments were carried out by me, and the paper is also written by me.

CONFLICTS OF INTEREST
There are no conflicts of interest in this article.

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Fig. 5: Zone of inhibitions of silver nanoparticles against Gram-positive and Gram-negative bacteria through continuous culture method
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