1. Introduction

Reactive oxygen species are produced in body during various metabolic processes such as mitochondrial respiration (Uttara, Singh, Zamboni & Mahajan, 2009). Under, altered pathological conditions, ROS production subverses the endogenous antioxidant capacity and results in development of various disorders (Liguori et al., 2018). Therefore, oxidative stress is considered as a crucial player in the pathogenesis of wide array of diseases. Hence, reduction of oxidative stress seems to be a viable approach for managing various ailments.

Herbal drugs have been a great source of drugs as drugs of natural origin are being employed clinically (Veeresham, 2012). Literature has shown that various phytochemicals such as phenol, alkaloids, steroids, terpenoids, flavonoids etc exhibit strong antioxidant potential and thus are capable of managing cancer, diabetes, hypertension, neurodegeneration etc (Szymanska, Pospisil & Kruk, 2016; Unuofin & Lebelo, 2020). Therefore, exploring natural products for compounds exhibiting antioxidant properties has attracted attention of researchers.

Glycyrrhiza glabra (GG) is one such natural product plant which has been reported to have neuroprotective, antidiabetic, anti-inflammatory, anti-ulcer, expectorant, antimicrobial and hepatoprotective effects (Pastorino et al., 2018). However, the antioxidant effect of GG in different assays has not been systematically investigated. Therefore, the present study is designed to evaluate GG for antioxidant activity using various in-vitro assays.
2.2. Reducing Potential

The reducing potential of prepared extracts was determined in terms of ferric reducing capacity. The extracts were dissolved in methanol and its 10 – 70 µg/ml concentrations were prepared. Each concentration was allowed to react with potassium ferricyanide in presence of trichloroacetic acid as described by Singh et al., (2016). Ascorbic acid was used as standard drug (Ahmed, Khan & Saeed, 2015).

2.3. Nitric Oxide Inhibitory Potential

The nitric oxide inhibitory effect of prepared extracts (10-70 µg/ml) was determined by Griess reagent as described by Basu & Hazra, (2006). Ascorbic acid was used as positive control.

3. Results and Discussion

Free radicals are very reactive molecules that are formed during interaction of oxygen or nitrogen with certain biomolecules. Based on the capacity of free radicals to accept or donate electron, they are called as oxidant and reductant, respectively. These reactive radicals (oxygen or nitrogen) have capacity to interact with various cellular molecules and shows deleterious effects such as DNA damage, apoptosis, mitochondrial dysfunction etc and thus, play significant role in the progression of various age and non-age related disorders (Liguori et al., 2018; Pizzino et al., 2017). Nitric oxide is released by neurons, macrophages and endothelial cells and causes inflammatory pathways (Lubos, Handy & Loscalzo, 2008). Therefore, to prevent and manage health disorders, it is necessary to develop drugs that can counteract the action of these energetic radicals.

In the present study, GG roots were tested whether it has free radical scavenging properties using in-vitro assays. In-vitro DPPH, ferric reducing antioxidant potential (FRAP) and nitric oxide inhibitory assays are widely used methods to screen drugs for antioxidant effects. These assays are easy to perform, accurate and give reproducible results. Furthermore, these methods depict the different antioxidant mechanisms. Therefore, these methods are selected in the present study to evaluate radical scavenging, reducing potential and nitric oxide inhibitory effects of GG extracts.

The gradient extraction of GG roots showed varied percentage yield of extracts. Since, methanol extract showed highest percentage yield, it is likely that GG roots contained high content of polar compounds (Table 1). The percentage yield and physical properties of prepared extract are given in Table 1. The phytochemical screening showed the presence of phenols in all the prepared extracts while carbohydrates were found to be present in aqueous extract only. Quantitative analysis of phenols in extracts showed that ethylacetate extract had highest amount (Table 2, Figure 2).

![Figure 1: Extraction scheme.](image-url)
Table 1: Percentage yield and physical properties of prepared extracts.

| Extract            | Colour           | Consistency | Percentage yield (% w/w, air dried material) |
|--------------------|------------------|-------------|---------------------------------------------|
| Petroleum ether    | Yellowish green  | Semi-solid  | 1.02                                        |
| Ethylacetate       | Brown            | Semi-solid  | 2.76                                        |
| Methanol           | Brown            | Semi-solid  | 4.28                                        |
| Aqueous            | Yellowish brown  | Semi-solid  | 3.11                                        |

Table 2: Phytochemical screening and total phenol content of prepared extracts.

| Extract            | Phytochemical screening | Total phenol content (mg/g of dried extract) |
|--------------------|-------------------------|----------------------------------------------|
| Petroleum ether    | Steroids, terpenoids    | Not determined                               |
| Ethylacetate       | Terpenoids, phenols     | 2.4                                          |
| Methanol           | Phenols, flavonoids, carbohydrates | 1.8                                     |
| Aqueous            | Phenols, flavonoids, carbohydrates | 1.4                                     |

Figure 2: Standard plot for total phenol content.

In *in-vitro* antioxidant analysis, all the extracts exhibited antioxidant effects. However, ethylacetate extract showed marked antioxidant potential in all the three methods employed (Figure 3-5).

Phenols are well established antioxidant compounds and are reported to be beneficial in various diseases including, cancer, diabetes, neurodegenerative, kidney, liver, hypertension, cardiovascular disorders (Pandey & Rizvi, 2009; Dzialo et al., 2016). Keeping in view the beneficial effects of phenols, it is possible that higher phenol content in ethylacetate extract contribute to its antioxidant effects. However, these results warrant further studies including isolation of antioxidant compound and *in-vivo* investigations.

Figure 3: DPPH scavenging effects of extracts.

Figure 4: Ferric reducing potential of extracts.

Figure 5: Nitric oxide inhibitory effects of extracts.

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Conflict of Interest

There is no conflict of interest.

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