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Unveiling Antioxidant Properties of *Fagonia Arabica* L Grown in Kufa City, Southwest, Iraq

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Abstract
In this study, the antioxidant property of the ethanolic extraction of Dhamaso, botanically known as a *Fagonia arabica* L. (Prajapati *et al*., 2020) [17] has been investigated. F. arabica falls under Zygophyllaceae, and flowering dicot (angiosperms), is considered a vital curative plant (Khasim *et al*., 2020) [14]. It has a wide spectrum of medical traditional uses in sore mouth, smallpox, endocrinological, hematological, neurological, cooling agent in stomatitis, and inflammatory (Iftikhar *et al*., 2021) [12]. It is a rich source comprising various glycosides, flavonoids, terpenoids, saponins, and alkaloids, besides significant properties like cytotoxic and anti-cancer activities (Alamami *et al*., 2022) [3]. This is certainly very beneficial, because the side effect of chemical drugs can be reduced, and resistance can be avoided too (Bhagya *et al*., 2020) [7]. Combination therapy is a significant approach to cancer treatment (Huang *et al*., 2020) [11]. Objective: This study has evaluated the antioxidant activities of *F. arabica* L ethanolic extract. The antioxidant activity of F. arabica extract was evaluated via the DPPH assay. IC_{50} % was 12.88 µg/ml for vitamin C, compared to the IC_{50}% was 17.19 µg/ml for FAE. The extract has Moderate anticancer properties on HepG2 cells, MFC7, and weak on normal cell lines, IC_{50} is 88.46 ± 5.16 µg/mL, 78.87649 ±3.60 and 271.40 ± 3.21 µg/mL, respectively for FAE which described being (Moderate), while it was weak against normal cell lines after a 24-hour incubation period.

Keywords: Bioactive Substances, Phenol, Tannins, Alkaloids, Saponins, Minerals, Antioxidants, Cytotoxicity, Fagonia Arabica L Extract

1. Introduction
Conventional chemotherapy involves a single drug at several dose levels for a limited time. Although conventional therapy is effective, it gives a serious inclusion of drug resistance (Altalhi *et al*., 2023) [4]. A combination of therapy of anti-tumor drugs has been employed for quite a long time now, as it improves drug efficacy. Moreover, it can precisely target many pathways and not only a single drug that might later be exposed to resistance (Gunasekaran *et al*., 2023) [10]. WHO, by many reports, indicated that 80 % of the population over the globe, prefers nonconventional treatments and therapies, particularly herbal products in their primary healthcare (Zafar *et al*., 2023) [23]. Humans today enjoy a higher level of health thanks to medicinal plants. The different plants continually make natural secondary phytochemicals that proved to have anticancer benefits reflected in the improvement of new plant-derived drugs (Pawar *et al*., 2018) [16]. Bioactive phytochemicals' suppression of cancer cell development is commonly accompanied by a disruption of redox homeostasis (Aggarwal *et al*., 2019) [2]. Reactive oxygen species (ROS) control cell growth and phytochemicals with antioxidant activity may prevent cell proliferation by scavenging ROS (Nayak *et al*., 2022) [15]. Numerous antioxidants found in food, such as phenolics, flavonoids, carotenoids, etc., are also known to have powerful antioxidant effects that have anticancer features. Additionally, plant extracts or isolated bioactive substances may be used with chemotherapy medications (Ginovyan *et al*., 2023) [9].

2. Methods
2.1 Collection and Preparation of the plant
The utilized samples of the herb have been collected locally from the territories around the campus of Kufa, southwest Iraq. The plant is taxonomized at the University of Kufa, department of Sciences.
Arial parts of the plant were taken and cleaned up from the dust and any other strange materials, dried in an oven at 40° C and crashed via the mechanical grinder into a fine powder, and kept in a refrigerator at 4C (Shu *et al*., 2022) [21]. Then, the powder has extracted directly by the Soxhlet apparatus. 100 gm of the plant powder and placed into an extraction thimble, extracted

with 750 ml ethanol (98%±2 percent concentrate), and the extraction was left at room temperature for 24 hours. The extract was filtered through gauze and then through filter paper (Wattman No.1), and then evaporated for dryness 45° C under depressed pressure in a rotary evaporator.

2.2 Prepare (1 mg/mL) of FAE solution and vitamin C concentrations

To evaluate the antioxidant activity, 1 mg of FAE was weighed and diluted in 1 ml of distilled water (DW). Then, the following concentrations were made (50, 40, 30, 20, 10, 5µg/ml) of FAE and placed in an ultrasonic water bath for 10 min. The same concentrations were taken from Vit C and added to the microplate of 96 wells.

2.3 Preparation of (DPPH)

The antioxidant mechanism of the active compounds is established along with the use of the DPPH assay (R & AVaishnav, 2022) [18]. 100 ml of 82% methanol was used to dissolve 3.2 milligrams of DPPH to create the DPPH solution then it is kept in a dark place until use (R & AVaishnav, 2022) [18].

2.4 Antioxidant assay using (DPPH) radical scavenging

10 mg of DPPH was transferred to a 10 mL amber-colored flask, then 5 mL methanol has added when the flask was placed in an ultrasonic water bath for 10 min. After that, the mix was stored at 4o C in the refrigerator.

By a multichannel pipette, from raw 1 to raw 2, uptake 200 µL from columns 2 to 10 and carry them into the matching wells. The mixing of the contents 4-5 times using a pipette tip. Then, transfer 100 µL to the third row and do the process again until the last one, disregarding the last 200 µL. Each one of the wells contains 100 µL of the solution after 8 double dilutions in columns 2-12. Such away, 100 µL DPPH is then added to each well in the microplate. Lastly, incubation of the plates for 20 minutes at 37° C. Scanning of the microplate using a microplate scanner at wavelength 517 nm (R & AVaishnav, 2022) [18]. And the formula is as follows (Afify & Hassan, 2016) [1]:

$$\text{DPPH scavenging (\%)} = \frac{\text{(Absorbance of control} - \text{Absorbance of reaction mixture)}}{\text{Absorbance of control}} \text{x100 \%}$$

3. Results and Discussion

3.1 The Antioxidant Activity of FAE

In this study, the antioxidant activity of F. arabica extract was assessed using a methanol solution of DPPH assay and using vitamin C as standard. The antioxidant activity of FAE was compared with the one of vitamin C, the results possess a slight decrease, where the IC_{50} % was (17.19±0.1 µg/ml) for the extract while the IC_{50} % of vitamin C was equal to (12.88±0.1 µg/ml) as shown in the following Table 1.

Table 1: DPPH scavenging activity (IC_{50}%) of plant extract and vitamin C, sample Linear equation and coefficient of regression (R2)

Sample	Linear equation	R^2	IC_{50}% µg/ml
FAE	y = 1.3034x + 27.584	R^2 = 0.8944	***17.19809728***
Vit C	y = 1.1558x + 35.102	R^2 = 0.8831	12.88977332

The phenolics and flavonoids were the two main functional phytochemicals of the FAE, which showed the most promising plant extract against breast cancer (Walbi *et al*., 2023) [22], this was supportive of the outcomes of this study. Marzieh agreed that phenols are well-known for their antioxidant capacity, as they are extracted from FAE and their activities through donating hydrogen atoms or single electron transfer (Shojaee *et al*., 2022) [20].

(Iftikhar *et al*., 2022) [13] Another study abstracted *F. arabica* has been studied for its wide scale of biological activities, like antioxidant, antimicrobial, and anticoagulant as a result of the bioactive constituents, including flavonoids, terpenoids, and alkaloids. Further studies referred to the belief that the antioxidant property of phenolic compounds belongs to redox properties, which enable them to represent reducing agents, and hydrogen donors, and they have metal-chelating potentials, F. arabica shows a considerable quantity of phenolic content and this reflects antioxidant activities (Satpute *et al*., 2012) [19] (Benchikha *et al*., 2022) [6].

3.2 Cytotoxic activity of FAE toward certain cancer and normal cells *in vitro*

We examined the cytotoxic capacities of FAE. The results showed that the extract was cytotoxic against all the tested cell lines (breast, liver, and normal cell lines). MCF10A cell line (normal cell line), MCF7 cell line (Breast cancer), and HepG2 cell line (liver cancer) were used in the current study.

First treatment whereas the inhibition concentration of 50% of cells (IC_{50}%) on the liver cancer cell line resulted in 88.46 ± 1.48 µg/ml. The second was the cell line of Breast cancer, where the IC_{50}% was 78.87649±1.43 µg/ml. Thirdly, the same concentrations of the plant extract were examined on the normal cell line of epithelial cells of the human mammary gland. The IC_{50}% was 343.364±2.73 µg/ml. The fourth treatment was for the concentrations of the FAE which were applied on the normal cell line (L929) and the results showed IC_{50}% was 271.40±5.02 µg/ml. The National Cancer Institute, and particularly the Geran Protocol illustrated the standard scale of the cytotoxic effects as three major categories (Atun *et al*., 2010) [5]:

Strong: which is IC_{50} < 21µg/ml,
Moderate: which is IC_{50} of 21–200 µg/ml,
Weak: which is IC_{50} 201 – 500 µg/ml;
Non-cytotoxic: which is IC_{50} > 501µg/ml.

Hence, clearly can conclude that the FAE has moderate cytotoxicity effects on MCF7 and HepG2 cell lines and weak effects on MCF10A and L929 normal cell lines.

4. Conclusions

FAE showed antioxidant properties, and it was lower than vitamin C.

FAE showed antiproliferative activity against normal and cancer cell lines.

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