

## Determination of Phenolic and Flavonoid Content in *Ziziphus Jujuba* Mill. Fruit Collected from Farah Province, Afghanistan

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### ABSTRACT

The fruit of jujube (*Ziziphus jujuba* Mill.), a member of the Rhamnaceae family, is a valuable exporting dry fruit of Afghanistan. The plant is found in some provinces of the country, but Farah province produces it more. The purposes of this study were to standardize the jujube fruit collected from Farah Province and to determine the amount of its phenolic and flavonoid contents. Jujube fruit (JFs22) was collected from medicinal plant sellers in Kabul. After identification and pharmacogenetic evaluation of JFs22, the amount of phenolic and flavonoid content in the fruit was determined using UV-Vis spectroscopy. The test sample was *Ziziphus jujuba*. The JFs22 had  $10.27 \pm 0.532\%$  foreign matter,  $4.58 \pm 0.33\%$  moisture,  $1.97 \pm 0.09\%$  total ash,  $0.26 \pm 0.04\%$  acid insoluble ash,  $50.69 \pm 0.30\%$  water soluble extractive content, and  $24.93 \pm 0.59\%$  methanolic extractive value. The JFs22 had flavonoids, alkaloids, tannins, phenolic substances, saponin, and mucilage as its active ingredients. The total phenolic (TPC) and total flavonoid (TFC) contents of the methanolic extract of JFs22 were  $9.84 \pm 1.65$  mg gallic acid equivalent (GAE) and  $0.55 \pm 0.04$  mg rutin equivalent (RE) in 3 grams of dry fruit weight, respectively. Although in most of the cases, the values obtained from the pharmacogenetic evaluation of JFs22 were lower than the standard, nevertheless, they are within the standard range available in pharmacopeias, and this may be considered a good quality of tested jujube fruit and notice for paying much attention for its processing. The determination of TPC and TFC of JFs22 showed that the Farah province jujube fruit has many polyphenols.

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## Introduction

Afghanistan exports a significant portion of its dry fruits and medicinal plants (MPs). Understanding this field's careers and employment opportunities could help the country's industry take a valuable position in domestic and foreign markets. Since Afghanistan is a mountainous country with various climate zones, it has a rich plant flora, including the jujube (red gold of Farah), whose fruit is one of the country's principal export goods.

Jujube, also known as *Ziziphus jujuba* Mill. is a thorny plant belonging to the Rhamnaceae family that may reach altitudes of up to 2000 meters. Southwest Europe, China, India, the Middle East, Russia, and Iran are all major cultivators of this plant. The genus *Ziziphus* has five species: *Z. spina-Christi*, *Z. nummularia*, *Z. jujuba*, *Z. oxyphylla*, and *Z. aucheri*, identified and reported in *Flora Iranica* (Rechinger, 1977).

Jujube is one of the plants in the eastern, central, and western regions of Afghanistan, mainly used for nutrition. Onab is the name of jujube in Afghanistan. Jujube is a plant that grows in Afghanistan in the provinces of Farah, Herat, Badghis, Faryab, Panjshir, Badakhshan, and Ghor; however, Farah is where the majority of the plant is grown (Breckle & Rafiqpoor, 2013). This plant is widely cultivated in Farah and Herat provinces (Breckle & Rafiqpoor, 2013). However, mistakes are sometimes made in identifying the fruit of the plant due to its similarity with the fruit of other plants of the Rhamnaceae family. In order to avoid possible mistakes, jujube fruit should be separated from different fruits in terms of appearance, type, color, and taste. The fruit of *Z. Jujuba* has a red date color, but the fruit of *Z mauritiana* (Indian jujube) is yellow-green and has a larger size. In addition, the jujube fruit is an oval or spherical green fruit that turns dark red (jujube) when it reaches maturity. Moreover, the mentioned fruit is often confused with the fruit of elderberry (*Elaeagnus angustifolia*), which has a light brown color. However, considering the characteristics such as color, taste, and hardness of the fruit of these plants, they can be easily distinguished (Breckle & Rafiqpoor, 2013).

Jujube fruit is rich in nutrients, including carbohydrates, minerals (magnesium, phosphorus, potassium, sodium, and zinc), vitamins (alpha-tocopherol, beta-carotene, and vitamin C), and amino acids (Zhang, et al., 2020). The most significant biologically active compounds found in jujube include phenolic acids, terpenic acids, flavonoids, saponins, and alkaloids (Pareek, 2013; Ji et al., 2017; Rashwan et al., 2020; Tepe et al., 2022).

The important secondary metabolites, phenolic compounds, and flavonoids have a wide range of biological activities, such as anti-aging, hypnotic, sedative, hypolipidemic, hypotensive, hepatoprotective, and protective effects on the cardiovascular and cerebrovascular systems. These bioactive compounds are some of the most essential functional nutrients in the jujube's fruit, buds, leaves, and kernels (Xue, et al., 2021). Moreover, the color of the fruit skin is closely correlated with the level and type of polyphenols, including phenolic acids, anthocyanins, flavonoids, and proanthocyanidins (tannins) (Xie, You, Huang, & Zhang, 2017).

Jujube fruit is regarded as a laxative and expectorant in traditional medicine. It eases cough, shortness of breath, and chest pain, as well as hoarseness, throat stiffness, and chest tightness (Ahmed, 2016; Ghobadi et al., 2019). Jujube is a medication that forms blood since it purifies and generates blood. According to Chen & Tsim (2020), jujube reduces inflammation, thirst, and pain in the liver, kidneys, and bladder.

Based on pharmacological investigations, Jujuba fruit has antioxidant, anti-inflammatory, anti-cancer, hypotensive, hypolipidemic, and soothing properties (Sweety, Ravindra, & Dattaprasad, 2022). According to Chen et al. (2013) and Bai et al. (2015), it helps treat cardiovascular disease in older people and jaundice in youngsters.

Jujube is consumed with evening tea in Britain, either dried or as flavored candy. The syrup from the delicious jujube fruit is utilized in Taiwan, China, and Korea. In certain places, jujube is used to manufacture vinegar; in Africa, it's used to make cakes. Although jujube is also used in tea and cans worldwide, it is most commonly used in dried form in Iran, Pakistan, and India. Its fresh fruit is utilized in many world regions and has a superb taste (Vafaei & Abdollahzadeh, 2015).

In many ways, MPs, including endemic ones, are essential to the country's self-sufficiency. As a developing country, Afghanistan's economy mainly rests on its exports of agricultural goods, which make up 12% of the country's gross domestic product (GDP). However, these products' ability to be successfully marketed domestically and globally is closely correlated with their quality. Standardization and identification of the MPs' bioactive phytoconstituents, which are extracted from their primary resources, help to improve post-harvesting treatment standards, optimize processing conditions, and increase the quality of desired products and their acceptance rate as export goods in both domestic and international markets. Regretfully, though, some of the MPs collected from various provinces across the country are not only not standardized but are also illegally exported to nearby countries where they undergo some processing before being marketed as their export goods. In addition, due to the lack of available data regarding the quality of domestic products, most people prefer to consume imported items, which may strengthen the country's economic dependency on other nations. Therefore, it's critical to assess the quality of the plants, as mentioned above, harvested from Afghanistan's primary resources and, if feasible, enhance the harvesting process to prevent the current situation from occurring.

It was decided to conduct research into the standardization of the quality and determination of the bioactive compounds of the jujube fruit collected from one of Afghanistan's most crucial producer provinces. Fortunately, we started as the first researchers in this field, considering the importance of jujube fruit in medical, nutritional, and export and its widespread use in the country's traditional medicine. Moreover, the phenolic and flavonoids of the jujube fruit are regarded as essential for the plant's bioactivity and the fruit's color, which influences the market acceptability rate of the jujube fruit as an export good. So, in this study, the jujube fruit collected from Farah province of Afghanistan was standardized, and its phenolic and flavonoid content were determined. It is intended that the

findings of this research would increase the nation's production, exports, and domestic use of this MP. To be more precise, the aims of this article are as follows:

1. To standardize the jujube fruit (JFs22) collected from Farah province of Afghanistan.
2. To determine the total phenolic (TPC) and flavonoid (TFC) contents of JFs22 collected from Farah province of Afghanistan.

## **Materials and Methods**

### ***Collection of Jujube Fruit***

Ten samples of the jujube dried fruit (JFs22) under the local names of Red jujube and Zarafshani jujube were randomly collected from the sellers of MPs in Kabul, Afghanistan, on 24.09.2022. The collected samples were red jujubes from Farah province.

### ***Identification of JFs22***

Since the proper identification of the test sample is a crucial and significant component of a pharmacogenetic evaluation, the collected samples were identified following the existing references (written documents and the certified jujube fruits by Export Development Department of Raisins, Fruits, Vegetables and Medical Plants of Afghanistan (ARFVPA)), with a portion of them being retained after labeling for storage in the laboratory.

### ***Pharmacogenetic Evaluation of Jfs22***

To rule out the presence of potential pollutants, the collected samples were evaluated pharmacokinetically. The test sample was investigated and examined for this aim using organoleptic, macroscopic, microscopic, and preliminary phytochemistry investigations.

### ***Standardization of JFs22***

Standardization is regarded as an essential stage in processing herbal drugs after drying. Herbal drugs are "standardized" when their quality and quantity are established following standards, such as pharmacopeias, codex, and national and international standards. In essence, prepared drugs must meet precise standards that adhere to acknowledged scientific and professional norms. Jujube samples were standardized using numerical criteria for the amount of foreign matter, ash value, moisture content, swelling index, and extractive value using various solvents.

**Determination of Foreign Matter in Jfs22.** Using a 6X lens, 100 grams of the test sample were examined for potential organic and inorganic foreign material types. Following separation, the test sample's impurity was weighed to calculate the amount of foreign matter in JFs22 (Dehkordi, 2003; Jalil et al., 2021).

**Determination of moisture content of JFs22.** The Petri dishes containing 2 grams of JFs22 were heated to 105°C in a hot air oven and left there for 5 hours. The petri dishes containing samples were then put inside the desiccator to cool. The samples were weighed again after cooling, and their weight was recorded (keeping in mind that it was not in touch

with open air). The test samples were once more heated in the oven for an hour before being weighed. The moisture was measured after repeating this procedure to set the sample's weight (Dehkordi, 2003; Jali et al., 2021).

**Determination of Total Ash Content of Jfs22.** Initially, the crucibles were heated for one hour at 500°C, cooled, and then precisely weighed. In a muffle furnace, a crucible containing 3 grams of JFs22 was heated at 700°C for over 4 hours (until no carbon was detected in the ash). The ash-containing crucible was then moved to the desiccator and weighed. The total ash value of JFs22 was then determined based on the amount of ash obtained. This process was continued until the ash weight was fixed (Dehkordi, 2003; Jalil et al., 2021).

**Determination of Acid Insoluble Ash Value of Jfs22.** The abovementioned procedure was used to obtain JFs22 ash, which was then put into an Erlenmeyer and given 25 ml of hydrochloric acid. After 5 minutes of boiling, the insoluble material was filtered. The leftover debris was thoroughly cleaned with warm water, followed by drying of the filter paper. A dry, accurately weighted crucible containing the dried filter paper was then placed in a muffle and heated to 500°C for three hours (until all carbon was destroyed and transformed into ash). The formula below determined the percentage of acid-insoluble ash in JFs22 (Dehkordi, 2003; Jalil et al., 2021). Percentage of acid-insoluble ash =  $100 \times \frac{\text{ash treated with acid}}{\text{sample weight}}$ .

#### **Determination of Extractive Value of Jfs22.**

**Extraction.** By macerating JFs22, several extracts (aqueous and methanolic) were prepared. To do this, JFs22 was thoroughly crushed using a mortar and pestle before being combined with the solvent. Next, 5 grams of fruit powder were mixed with 30 ml of the solvent (methanol and water) and left to macerate. The resultant mixture was shaken for two hours. The mixture was then run through filter paper to get the first extract. This procedure was repeated by adding 10 ml of solvent to the remaining components.

**Determination of Methanolic Extractive Value of Jfs22.** The above procedure was used to extract 5 grams of JFs22 from methanol. The extract was heated in a water bath at 100°C until 75% of the solvent evaporated, and it was then heated at 76°C on a hot plate to finish drying. The dried extract was weighed precisely after cooling in a desiccator. According to the dry weight of the extract, the methanolic extractive value of JFs22 was estimated (Dehkordi, 2003; Jalil et al., 2021).

**Determination of Aqueous Extractive Value of Jfs22.** As mentioned, the technique was used to extract 5 grams of JFs22 from distilled water. The extract was heated in a water bath at 100°C until 75% of the solvent evaporated, and it was then heated at 90°C on a hot plate to finish drying. The dried extract was weighed precisely after cooling in a desiccator. According to the dry weight of the extract, the aqueous extractive value of JFs22 was estimated (Dehkordi, 2003; Jalil et al., 2021).

### Determination of Total Phenolic and Flavonoid Content of Jfs22.

**Preparation of Stock Solution of Gallic Acid.** 200 mg of standard gallic acid was dissolved in 200 ml of distilled water to prepare the stock solution. Then, using the following formula, various concentrations of gallic acid were prepared (Table 1):

$$N_1 * V_1 = N_2 * V_2$$

Table 1: Different concentrations of gallic acid stock solution

Solution Concentration (%)	10	20	30	40	50	60	70	80	90	100
Distilled water Volume (mL)	90	80	70	60	50	40	30	20	10	0
Standard Gallic acid Stock Volume(mL)	10	20	30	40	50	60	70	80	90	100

**Preparation of stock solution of rutin.** 200 mg of standard rutin was dissolved in 200 ml of distilled water to prepare the stock solution. Following that, various rutin concentrations were prepared using the formula below (Table 2):

$$N_1 * V_1 = N_2 * V_2$$

Table 2: Different concentrations of rutin stock solution

Solution Concentration(%)	10	20	40	60	80	100
Distilled Water Volume (mL)	90	80	60	40	20	0
Standard Rutin Stock Volume (mL)	10	20	40	60	80	100

**Determination of total phenolic content (TPC) of JFs22.** The Folin-Ciocalteu reagent and distilled water were combined with 1 ml of JFs22 extracts (aqueous and methanolic) to determine TPC. The mixture was then incubated for eight minutes. Then, 10 ml of sodium carbonate solution at 7% (w/v) was added to it. At a wavelength of 750 nm, the mixture's absorption was read after two hours using a spectrophotometer (Shimadzu UV mini-1240). The TPC of test samples was calculated to be equivalent to the standard curve of mg/mL of gallic acid (Xue et al., 2021; Ersoy et al., 2018).

**Determination of Total Flavonoid Content (TFC) of Jfs22.** The TFC of JFs22 was determined by aluminum chloride assay. For this purpose, 1 ml of methanolic, aqueous extracts of JFs22, and 1 ml of aluminum chloride in 5% acetic acid solution in methanol was added. After 10 minutes, the absorption of the samples was read at a wavelength of 430 nm against the control sample using a spectrophotometer (Shimadzu UV mini-1240). The results were read as milligrams equivalent to the standard curve of mg/ mL of rutin (Shraim et al., 2021).

**Analysis of Collected Data.** The experiments were repeated in triplicates, and the results were recorded as mean±SD. The processed jujube fruits (SJFs22) certified by the ARFVPA were used as standard. Microsoft Excel 2010 was used in data analysis. Microsoft Excel 2010 tool-pack was used to calculate mean and standard deviations.

## Results

### Identification of JFs22

The collected JFs22 were examined using the available resources (written documents and the certified jujube fruits by ARFVPA), and it was found that the test sample was *Ziziphus jujuba*.

### Pharmacogenetic Evaluation of Jfs22

For the better identification of possible pollutants in the composition of JFs22, organoleptic (Table 3), macroscopic (Table 3 and Figure 1), microscopic (Figure 1), and preliminary phytochemical analysis (Table 4) were conducted, and the results are stated briefly.

Table 3: Organoleptic and Macroscopic characteristics of JFs22.

Color	Odor	Taste	Shape	Size (cm)	Presence of Seed
Reddish brown	Odorless to Caramel-like	Mildly sweet	Round-Oval	1.7	Hard stone seed is present

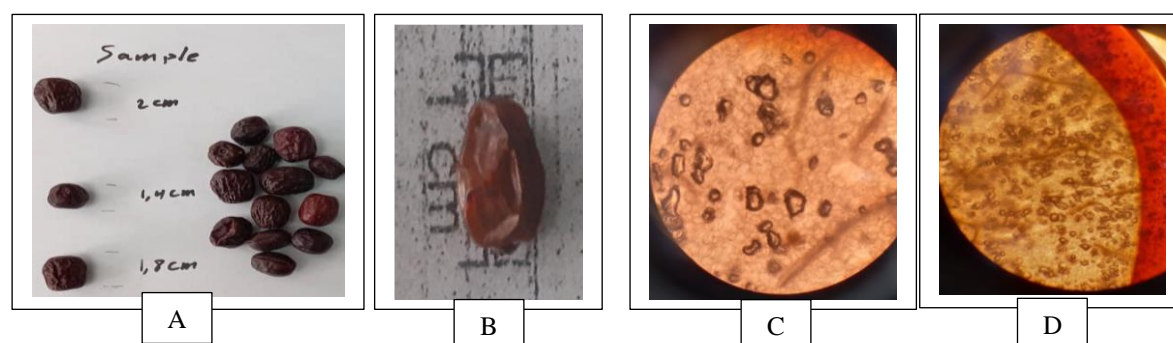


Figure 1 Macroscopic (A & B) and Microscopic (C & D) characteristics of JFs22.

Table 4 Preliminary phytochemical studies of JFs22.

No.	Type of Secondary Metabolite	Type of Extract	Test	Result
1	Flavonoids	Methanolic	Ammonia test	Yellow color
			Shinoda test	Light red color
			Vanillin HCL	Light red color
2	Alkaloids	Methanolic	Dragendorff's test	Orange-red precipitate
			FeCl <sub>3</sub>	Bluish or black color
3	Tannins and Phenolics	Aqueous	Vanillin HCL	Pink color
			Froth test	Foam production
4	Saponins	Aqueous	Fontan_ Kendal	Foam stability difference
			Swelling index	0.26 —→ 0.66 (swelling)

### Standardization of JFs22

**Determination of Foreign Matter in Jfs22.** After evaluation of collected JFs22, it was found that the percentage of organic and inorganic foreign matter in JFs22 and SJFs22 were  $10.27 \pm 0.53\%$  and  $10.57 \pm 0.45\%$ , respectively (Table 5).

**Determination of Moisture Content of Jfs22.** The evaluation of test and standard samples showed that JFs22 and SJFs22 contained  $4.58 \pm 0.33\%$  and  $5.77 \pm 0.21\%$  of moisture, respectively (Table 5).

**Determination of Total Ash Content of Jfs22.** As a result of the standardization process, it was found that JFs22 and SJFs22 contained  $1.97 \pm 0.09\%$  and  $1.77 \pm 0.09\%$  of total ash, respectively (Table 5).

**Determination of Acid Insoluble Ash Value of Jfs22.** As a result of the standardization process, it was found that JFs22 and SJFs22 contained  $0.26 \pm 0.04\%$  and  $0.23 \pm 0.03\%$  of acid-insoluble ash, respectively (Table 5).

**Determination of Extractive Value of Jfs22: Extraction:** Several extracts of JFs22 were prepared and then used to determine the aqueous and methanolic extractive values and TPC and TFC of test samples.

**Determination of Methanolic Extractive Value of Jfs22.** After determining the methanolic extractive value of JFs22 and SJFs22, it was found that the test and standard samples had  $24.93 \pm 0.59\%$  and  $26.72 \pm 1.07\%$  dry extract, respectively (Table 5).

**Determination of aqueous extractive value of JFs22.** As a result of the determination of the aqueous extractive value of JFs22 and SJFs22, it was found that the test and standard samples had  $50.69 \pm 0.30\%$  and  $60.38 \pm 0.83\%$  dry extract (Table 5).

Table 5 Various numerical values of JFs22 obtained after standardization.

Numerical values (%)						
Test Sample	Foreign matter	Water soluble extractive	Methanolic extractive	Acid-insoluble ash	Total ash	Moisture
JFs22	$10.27 \pm 0.53\%$	$50.69 \pm 0.30\%$	$24.93 \pm 0.59\%$	$0.26 \pm 0.04\%$	$1.97 \pm 0.09\%$	$4.58 \pm 0.33\%$
SJFs22	$10.57 \pm 0.45\%$	$60.38 \pm 0.83\%$	$26.72 \pm 1.07\%$	$0.23 \pm 0.03\%$	$1.77 \pm 0.09\%$	$5.77 \pm 0.21\%$

**Determination of Total Phenolic and Flavonoid Content of Jfs22: Standard Curve of Gallic Acid.** The standard curve of gallic acid using different dilutions of its stock solutions was plotted. The equation obtained  $y = 0.0062x + 0.0011$  ( $R^2 = 0.9846$ ) was then used to calculate the TPC of JFs22 (Figure 2).

**Standard Curve of Rutin.** The standard curve of rutin using different dilutions of its stock solutions was plotted. The equation obtained  $y = 0.4493x - 0.0349$  ( $R^2 = 0.9944$ ) was then used to calculate the TFC of JFs22 (Figure 3).



**Determination of Total Phenolic Content (TPC) of Jfs22.** The TPC in the aqueous and methanolic extracts of JFs22 was  $9.74 \pm 1.04$  mg gallic acid equivalent (GAE) and  $9.84 \pm 1.65$  mg GAE in 3 grams of JFs22 dry weight, respectively (Table 6).

**Determination of total Flavonoid Content (TFC) of JFs22.** The TFC of JFs22 in aqueous and methanolic extracts was  $0.22 \pm 0.38$  mg rutin equivalent (RE) and  $0.55 \pm 0.04$  mg RE in 3 grams of JFs22 dry weight, respectively (Table 6).

Table 6: TPC and TFC of JFs22.

Type of extract (JFs22)	TPC (mg/3g DFE)	TFC (mg/3g DFE)
Aqueous	$9.74 \pm 1.04$ mg	$0.22 \pm 0.38$ mg
Methanolic	$9.84 \pm 1.65$ mg	$0.55 \pm 0.04$ mg

n= 3, mean $\pm$  SD; JFs22: Jujube Fruits 2022; DE: dried fruit extract

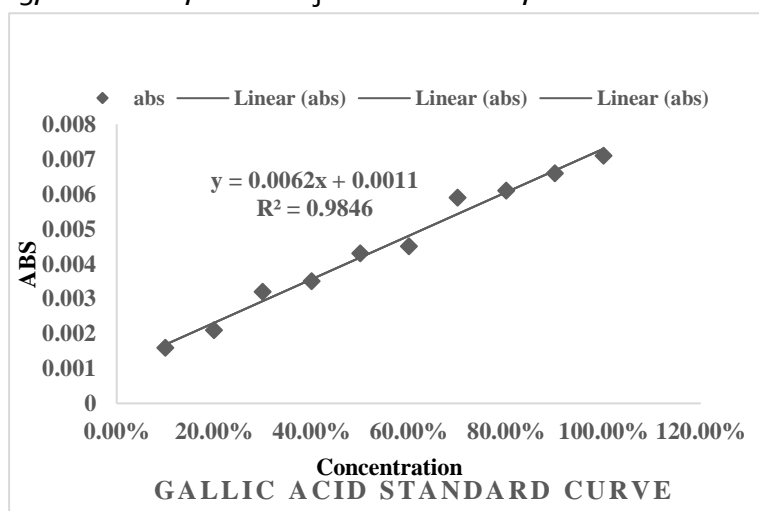


Figure 2: Standard curve of gallic acid

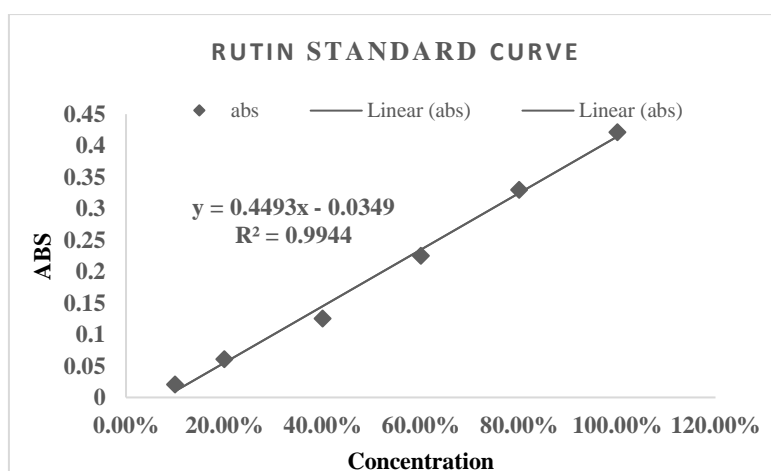


Figure 3: Standard curve of rutin

## Discussion

The results obtained from this research showed that the percentage of foreign matter in JFs22 ( $10.27 \pm 0.532\%$ ) was higher, which may indicate the failure to comply with standard conditions during sample collection. The moisture content of JFs22 ( $4.58 \pm 0.33\%$ ) was lower than that mentioned in the Iranian Pharmacopoeia (20.4%), but it is still within the standard range. This drastic difference in the amount of moisture may be due to the storage condition or the lack of sufficient moisture in the environment before collecting the fruit. The ash value in JFs22 ( $1.97 \pm 0.09\%$ ) had a slight difference compared to the value mentioned in the Iranian pharmacopoeia (maximum 3%), which shows the similarity of the geographical conditions of the test sample with the standard. The acid-insoluble ash value of JFs22 ( $0.26 \pm 0.04\%$ ) was lower than that mentioned in the Iranian pharmacopoeia (maximum 0.7%), but it is still within the standard range.

The methanolic and aqueous extractive values of JFs22 ( $24.93 \pm 0.59$  and  $50.69 \pm 0.30\%$ , respectively) were less, which may indicate the low quality of the test sample due to not observing the appropriate time of collection, post-harvest treatment, type of solvent used, or the place where the plant grows. The findings of the study by Delfanian, Kenari, and Sahari (2016) recorded the extractive value of Indian jujube fruit (*Z. mauritiana*) using different solvents in about 17.56-45.71% and the best solvent system for extracting the active compounds of the fruit a mixture of ethanol and water (1:1).

The results of this research made it clear that the total phenolic and flavonoid contents of JFs22 aqueous and methanolic extracts were about  $9.74 \pm 1.04$  GAE,  $0.22 \pm 0.38$  RE, and  $9.84 \pm 1.65$  GAE,  $0.55 \pm 0.04$  RE mg per 3 grams of dry fruit weight, respectively. These figures are partially following the results of other studies conducted in similar cases. According to the research conducted by Choi et al. (2011), TPC and TFC of jujube fruit were reported to be about 1.1-2.4 and 0.7-1.8 grams per 100 grams of dry fruit weight, respectively. In another study conducted by Cosmulescu et al. (2017), the TPC of the methanolic extract of jujube fruit was recorded as 1.634-4.724 grams per 100 grams of GAE and its TFC was 0.199-0.485 grams per 100 grams of quercetin equivalent (QE). The findings of Xue et al. (2021) have proven that the TPC and TFC of selected jujube varieties grown in Korea were around 0.359-1.041 mg per gram of fruit weight. In another study conducted on different accessions of jujube from the Tookean area in Lorestan province of Iran, the TPC ranged from 1.69- 14.05 mg GAE/g fresh weight, and the TFC varied from 0.25- 2.01 mg QE/g fresh weight (Khadiji & Beigi, 2022). In the study conducted to determine the TPC and TFC of eight Iranian jujube populations and imported jujube, the highest TPC and TFC were 32.902 mg GAE/g and 3.064 mg QE/g, respectively (Ghani et al., 2022) Azizi and Pirbodaghi (2016) have investigated the variations in TPC and TFC of fruit extracts among 29 jujube accessions originating from seven provinces of Iran. As a result, the TPC values ranged from 5.80 mg GAE/g dry weight to 9.24 mg GAE/g fresh weight, and the TFC values ranged from 0.054 mg QE/g dry weight to 0.140 mg QE/g dry weight. Kamiloglu et al. (2009) determined the TPC of methanolic extracts from fifteen selected jujube genotypes endogenous to the Mediterranean region of Turkey. The highest

TPC was between 42- 40 mg GAE/ g dry weight, and the lowest values ranged from 28- 25 mg GAE/g dry weight in tested genotypes. The similarities and the differences between the TPC and TFC values obtained in our study and the previously reported literature may consider the affectability of the amount of jujube fruit bioactive compounds from ecoclimatic zones, type of solvent systems used for the extraction, storage condition, genotypic variabilities, collection stage, etc. Despite this, the jujube fruit collected from the Farah province has many polyphenols compared to some of the abovementioned species. In some cases, this amount is not sufficient.

## **Conclusion**

Jujube is an endemic plant in Afghanistan that grows in the country's eastern, central, and western regions. This plant is unique in traditional medicine, as a food item, and a valuable export item of the country. Farah province is one of the significant producers of jujube in Afghanistan. Standardizing herbal drugs is crucial to national and international market acceptability of domestic exported items, as it directly reveals their quality. Furthermore, optimization of the processing conditions of herbal drugs highlighted by experimental research helps to prevent the illegal export of the country's natural treasures, which are sold for the benefit of third parties. As per the findings obtained from this research, although in most of the cases, the values obtained from the pharmacogenetic evaluation of JFs22 were not similar to the figures recorded in the existing works, nevertheless, the mentioned values were within the range of the standard available in the pharmacopeias, and this may consider as good quality of tested JFs22 and a notice for paying much attention for its processing. The determination of TPC and TFC of JFs22 showed the jujube fruit of the Farah province has a good amount of polyphenols, which may replace the usage of imported alternatives to some extent and introduce the importance of Afghanistan's domestic herbal products in the region's market and consequently improves the country self-sufficiency.

## **Recommendations**

Since the percentage of foreign matter in jujube fruit was higher than the standard value, the appropriate collection condition should be considered. According to this research, different solvents and/or solvent systems are recommended to determine the extractive value of jujube fruit. It is better to use the Soxhlet apparatus for the extraction to obtain a clear chemical profile of the jujube fruit. It is advised to determine the moisture content of jujube fruit using ventilated ovens.

## **Conflict of interest**

The author declares that they have no conflict of interest.

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