

## Moringa Leaves with Beneficial Secondary Metabolites

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### Abstract

**Background:** Moringa originally belongs to India and later on it is taken up to different parts of the world. *Moringa oleifera* is well known ethnobotanical plant belongs to Moringaceae family of plants which is highly significant in Indian food. The immature pods, leaves are eaten as nutritious plant parts. Nowadays, this plant is of high importance in Indian market because of its medicinal and economical importance. Moringa is cultivated on large scale not only in India, but also all over the globe especially in warm countries.

**Methods:** In this study, it was found that this plant contains secondary metabolites which are present in all parts of the plants. The analysis of secondary metabolites has been done on shade dried leaves using soxhlet method with chloroform and water as the solvent of extraction.

**Results:** In the qualitative estimations of these extracts, we observed presence of secondary metabolites such as alkaloids, tannins, carbohydrate, cardiac glycosides, phenols, protein, amino acids, flavonoids, saponins, resins, terpenoids, coumarins, and quinons. During the quantitative estimation, we observed that plant contains optimum concentrations of alkaloids, flavonoids, and tannins in leaves. The higher amount of secondary metabolites indicates that this plant has anti-oxidative activity around 86.62 % with absorbance 0.13.

**Conclusion:** The plant Moringa contains numerous necessary components for the growth of human being such as nutrients, vitamins, and necessary elements. It can be a desired component of human diet.

**Keywords:** Moringa; Secondary metabolites; Antioxidant.

### Introduction

Moringa (*Moringa oleifera*) is very common plant of India and pods of it used as the important food material and known by several names like drumstick, horsh radish tree, etc. belongs to family moringaceae [1].

It is originally belongs to Himalayan tracts of north India and having shoot height around 5-10 meter [2, 3]. The plant parts such as leaves, flowers, and pods are rich source of nutrients. Hence, it has a special place in Indian vegetables [4-6]. The majorly it contains the nutrients and elements such as  $\beta$ -

carotene, protein, vitamin C, calcium, and potassium [7, 8].

It also has therapeutic potential and used in the treatment of chronic diseases such as cancers, etc. and contains more than 40 sorts of natural anti-oxidants as well as higher amount of phenolic compounds hence, its crude extracts showing potent anti-oxidative properties [9]. It is an important ethnobotanical plant with bioactive potential such as antitumor, antipyretic, antiepileptic, anti-inflammatory, antiulcer, anti-diabetic, antioxidant, antifungal, and antibacterial properties [10]. It is to be reported that Moringa contains the bruceantin and maytansine with higher anticancer potential that can be used in conjugation of monoclonal antibodies for targeting tumor cells especially on pancreatic tumor cells [11].

Moringa is also rich source of  $\beta$ -sitosterol which helps to maintain cholesterol level in the blood serum and having greater anti-ulcer potential (1).

In this study, it was found that this plant contains secondary metabolites which are present in all parts of the plants. The analysis of secondary metabolites has been done on shade dried leaves by using soxhlet method with chloroform and water as the solvent of extraction. In the qualitative estimations of these extracts, we observed presence of secondary metabolites such as alkaloids, tannins, carbohydrate, cardiac glycosides, phenols, protein, amino acids, flavonoids, saponins, resins, terpenoids, coumarins, and quinons.

During the quantitative estimation, we observed that plant contains optimum concentrations of alkaloids, flavonoids, and tannins in leaves. The higher amount of secondary metabolites indicates that this plant is having anti-oxidative activity around 86.62 % with absorbance 0.13.

## Materials and Methods

The plant material was obtained from local market and required chemicals were purchased from reputed chemical suppliers. The collected leaves of Moringa were shade dried and powdered by grinder. Fine powdered sample was further subjected soxhletion for the extraction of secondary metabolites using water and chloroform as the solvent. The obtained extracts were filtered and dried in rotary evaporator and stored in refrigerator till further use. The obtained aqueous and chloroform extract were subjected to qualitative and quantitative estimations of secondary metabolites with their respective standards protocols. The presumptive metabolites are tested for qualitative estimations as per the protocol suggested by Kancherla *et al.* (2019) [9].

The test is conducted for alkaloids, tannins, carbohydrate, cardiac glycosides, phenols, protein, amino acids, flavonoids, saponins, resins, terpenoids, coumarins, and quinons. Furthermore, aqueous and chloroform extracts were screened for estimating flavonoids (colorimetric method), phenols (Folin-reagent method), total tannins content [12], and antioxidant activity of crude extracts were measured by DPPH assay [13].

The quantitative estimations have been done of flavonoids [14], phenolics [15], and tannins [10].

## 3. Results and Discussion

The crude extract obtained after the soxhletion were screened for the presence of secondary metabolites by qualitative estimation method and we observed in aqueous extract of Moringa leaves contains higher amount of alkaloids while chloroform extract rich in alkaloids, carbohydrates, and cardiac glycosides.

The presence of flavonoids, phenols, amino acids, and saponins were detected in aqueous extracts and absent in chloroform extract. While chloroform extract rich in tannins, and also shows

the presence of terpenoids, quinols, and resins which aqueous extract contains higher amount of coumarins (See Table 1 and Figure 1).

**Table 1** Qualitative analysis of Moringa leaves in chloroform and aqueous extracts

Sr. No.	Compound	Aqueous Extract	Chloroform extract
1	Alkaloid	Highly positive	Highly positive
2	Carbohydrate	Negative	Highly positive
3	Cardic glycosidase	Slightly positive	Highly positive
4	Flavonoid	Positive	Negative
5	Phenol	Positive	Negative
6	Amino acid	Positive	Negative
7	Saponin	Positive	Negative
8	Tannin	Negative	Highly positive
9	Terpenoids	Negative	Negative
10	Quinols	Negative	Negative
11	Resins	Negative	Positive
12	Coumarins	Positive	Negative

The crude extract obtained after the soxhletion were screened for the presence of secondary metabolites by qualitative estimation method and we observed in aqueous extract of Moringa leaves contains higher amount of subjected to thin layer chromatography and silica column chromatography. In the present study, we estimated the concentrations of secondary metabolites

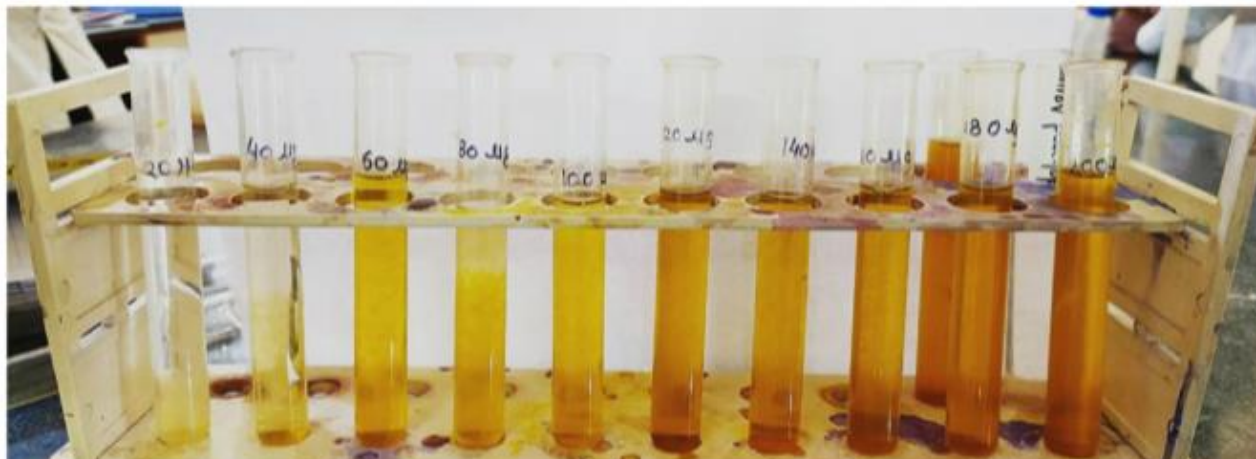
of aqueous extract and observed that the flavonoid concentrations is around 26.66 µg/ml, phenols 11.30 µg/ml, and tannins are around 23.25 µg/ml (See Table 2 and Figures 2-7). DPPH activity is observed to around 86.62 % with absorbance 0.13. As the plant is having higher amount of secondary metabolites such as phenolics and alkaloids responsible for higher anti-oxidative potential.



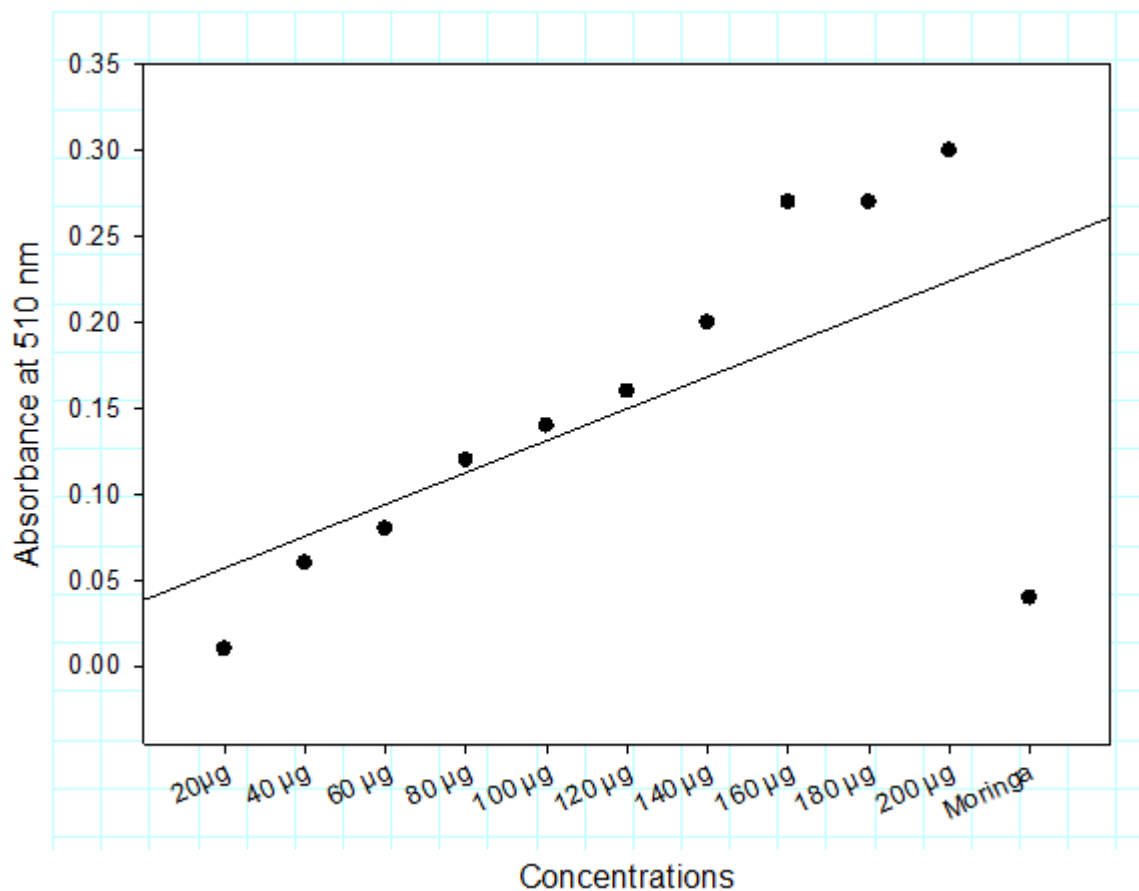
**Figure 1** Qualitative analysis of aqueous extract of Moringa leaves

**Table 2** Quantitative analysis of aqueous extract of Moringa leaves

Sr. No.	Compound	Concentration
1	Flavonoid	26.66 $\mu\text{g/ml}$
2	Phenols	11.30 $\mu\text{g/ml}$
3	Tannins	23.25 $\mu\text{g/ml}$



**Figure 2** Estimation of flavonoid by comparing the standard compounds



**Figure 3** The standard graph of flavonoid for estimating unknown concentration in Moringa

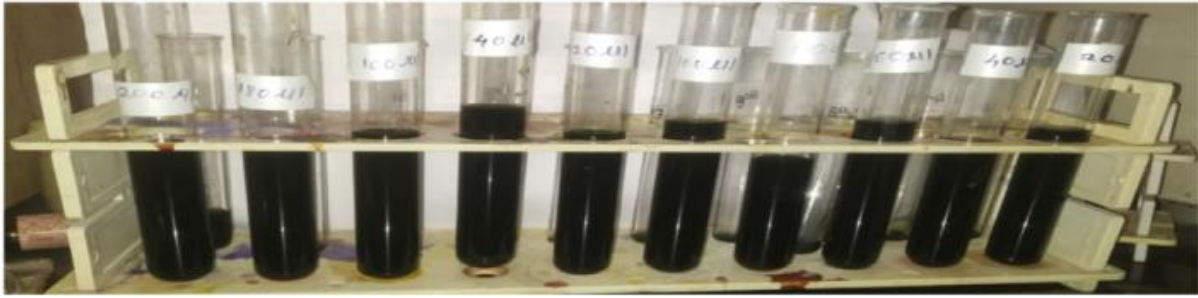


Figure 4 Estimation of phenol by comparing the standard compounds

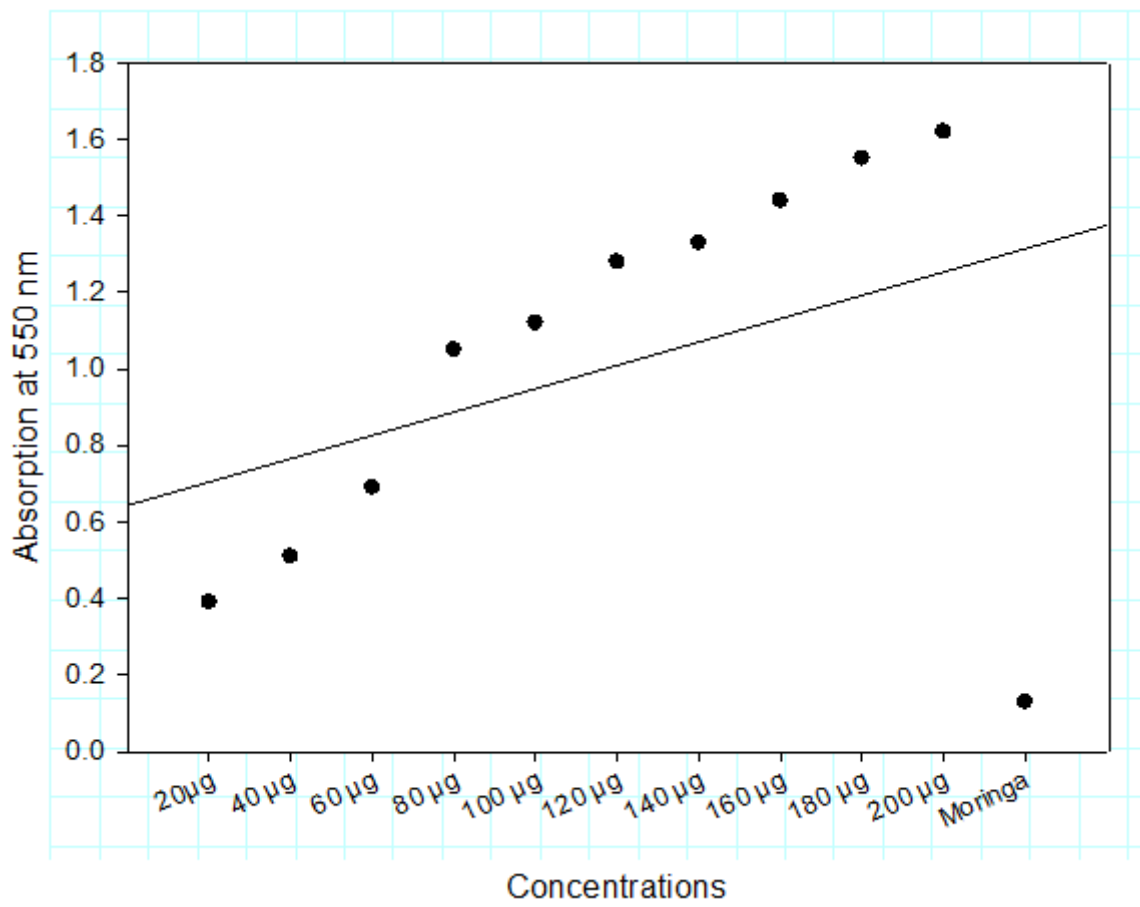


Figure 5 The standard graph of phenols for estimating unknown concentrations in Moringa

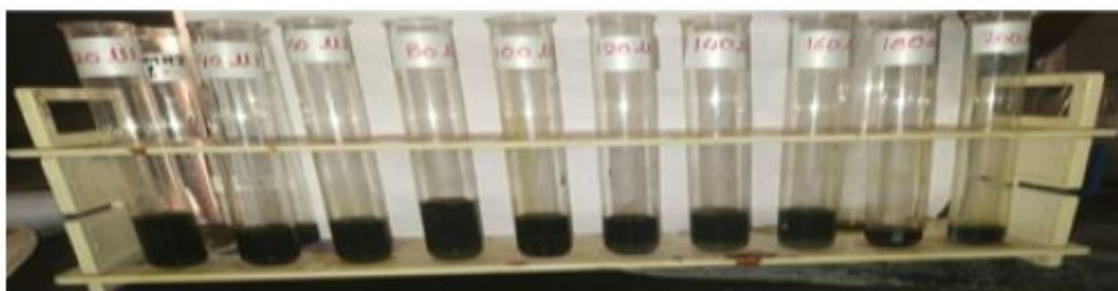
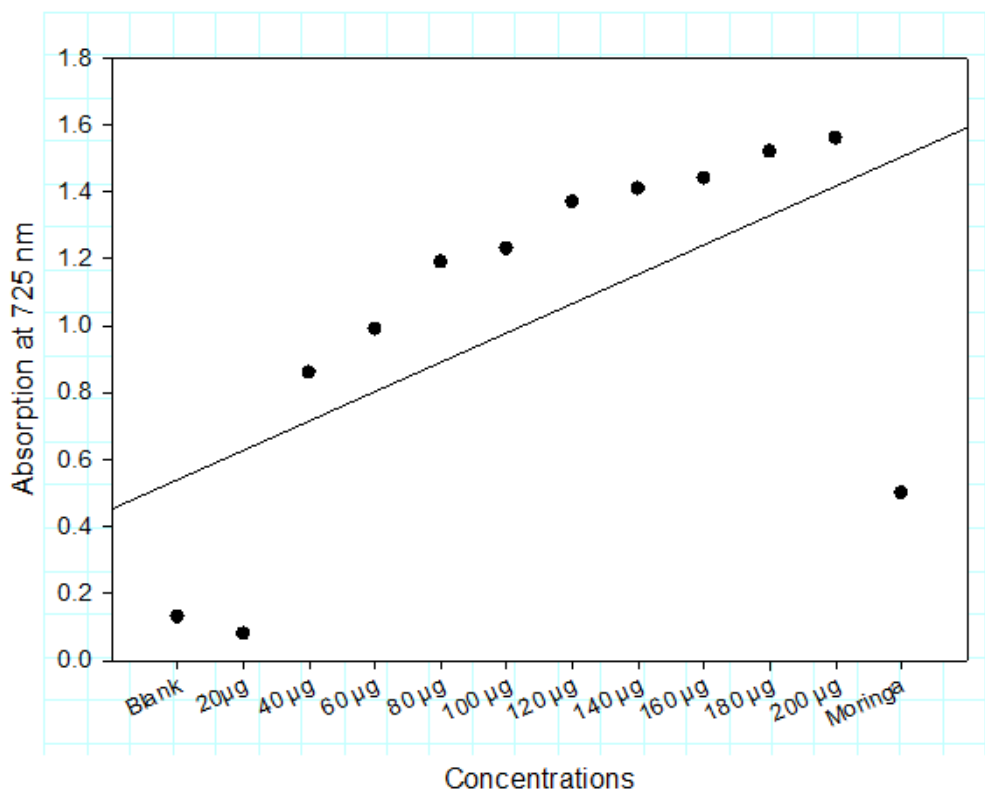


Figure 6 Estimations of tannins by comparing the standard compounds



**Figure 7** The standard graph of Tannins for the estimation of unknown concentrations in Moringa

## Conclusion

*Moringa oleifera* is well known for its medicinal properties since ancient times, and also it is one of the nutritious vegetable. This plant is rich source of enormous amounts of minerals, elements, and especially secondary metabolites such as  $\beta$ -sitosterols. The major nutrients and elements belongs to this plants are  $\beta$ -carotene, protein, vitamin C, calcium, and potassium. This plant is also prominent for its anti-cancerous properties and the compounds bruceantin and maytansine are the potential anti-cancerous agents. It can be conjugated with monoclonal antibodies to target cancerous cells such as pancreatic tumor cells.

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## Authors' contributions

All authors contributed to data analysis, drafting, and revising of the paper and agreed to be responsible for all the aspects of this work.

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