Original Article

Studies On Optimization Of Parameters For Extraction Of Total Phenolic Content From Terminalia Arjuna

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Abstract

Terminalia arjuna is commonly known as Arjun tree and belongs to Combretaceae family. It has a high phytochemical content and functions as an antioxidant. It exhibits a variety of pharmacological effects, including those against cancer, free radicals, ulcers, diabetes, and helminths. In this study, the total phenolic content (TPC) of Terminalia arjuna's leaves and bark was extracted by optimising physico-chemical parameters such as the impacts of various solvents, solvent percentages, pH, extraction time, and particle mesh size. The best extraction conditions for TPC from bark were determined to be ethanol solvent, 60% solvent, 48 hours of extraction duration, pH 6, 72 mesh size, and a concentration of 25.0 g/ml. Additionally, methanol solvent, 100% solvent, 48 hours of extraction time, pH 8, 72 mesh size, and a concentration of 21.5 g/ml were shown to produce the best results for the extraction of TPC from leaves. The best extraction conditions for TPC were determined to be methanol solvent, 80% solvent, 24 hours of extraction duration, pH 6, 72 mesh size, and a concentration of 27.0 g/ml.

Keywords: *Terminalia arjuna*, Leaf, Bark, Phenolic content, Extraction.

INTRODUCTION

Arjuna, also known as *Terminalia arjuna* sp. of the Combretaceae family, is a sizable evergreen deciduous tree [1]. Typically growing to a height of 60 to 80 metres, the tree has a spreading crown and an evergreen appearance. The flowers have short supplementary spikes and are pale yellow in colour. The T. arjuna plant has simple leaves that resemble guava leaves and are borne opposite with a tip that is either slightly acute or obtuse. The bark is soft and thick, with a grey exterior and a crimson interior. It can be found in large quantities in India, Burma, and Sri Lanka [2]. The many plant components of Terminalia arjuna, including as the roots, stems, leaves, seeds, and fruits, contain a variety of active biomolecules referred to as Phytochemicals [3]. Each plant portion has a special relevance since it contains these phytoconstituents, which have important medical applications and a range of pharmacological qualities. Various illnesses and problems have been treated using various *Terminalia arjuna* plant components [4]. Anemia, heart failure, cardiomyopathy, atherosclerosis, ischemia [5], myocardium necrosis, venereal and viral problems have all been treated using this plants bark. Arjuna's chemical components have the potential to be antimutagenic and anti-cancerous; they do this by trapping the electrophile of carcinogens through nucleophilic chemical reactions to produce safe byproducts [6]. Additionally, it has been shown to have hypocholesterolemic, antibacterial [7], antimicrobial, anticancer, antioxidant, antiallergic and antifeedant, antifertility, and anti-HIV actions.

Materials and Methods

Chemicals

Ethanol, Methanol, Ethyl acetate, Distilled water, FC reagent, Sodium carbonate.

Collection of Plant Material

The leaves and bark samples of *Terminalia arjuna* were collected from a tree of Arjuna, flourishing near the entrance of Meerut Institute of Engineering and Technology, Meerut, U.P., India. The leaves and bark were cleaned, rinsed in distilled water, sun dried and grounded into a fine powder.

Plant Extraction

1.0 g powder of plant parts (leaf/bark/leaf+bark) were weighed and taken separately in conical flasks. To each of the conical flask, 25 ml of the respective solvent is added. The samples were soaked for upto different time intervals [8]. After soaking, the extracts were filtered using Whatman paper grade No.1 through funnel. These filtered extracted samples were slightly heated upto boiling for the evaporation of organic solvents. Finally, these extracts samples were cooled to room temperature and used for the determination of Total Phenolic Content (TPC).

Determination of TPC

In this research, the estimation of Total Phenolic Content (TPC) was done by using Folin Ciocalteus reagent method.1ml sample each of leaf, bark and their combined extract was withdrawn in separate test tubes. Each tube received 0.5ml of the Folin-Ciocalteu reagent and 1ml of sodium carbonate before being filled with distilled water to a volume of 10ml. For incubation, the mixture was left to stand for 30 minutes at room temperature. [9]. Using a colorimeter, the reaction mixture's absorbance was determined at 680 nm. Here, TPC was stated as Gallic acid equivalence (GAE).

RESULTS AND DISCUSSION

Optimization of Parameters for Extraction of TPC

a. Effect of Solvent:

The effect of aqueous (water) and different organic solvents on the concentration of Total Phenolic Content (TPC) was analyzed. Various organic solvents were used to extract the optimum yield of Total phenolic content (TPC) from the leaf, bark and the combination of leaf and stem of *Terminalia arjuna sp.* Ethanol was found to be optimum for the extraction of TPC [10] from the bark yielding a concentration of 10.0 µg/ml. Methanol was found to be optimum for the extraction of TPC from the leaf and leaf+bark combination yielding TPC concentrations of 14.0 µg/ml and 17.5 µg/ml respectively. The results were shown in fig 1.

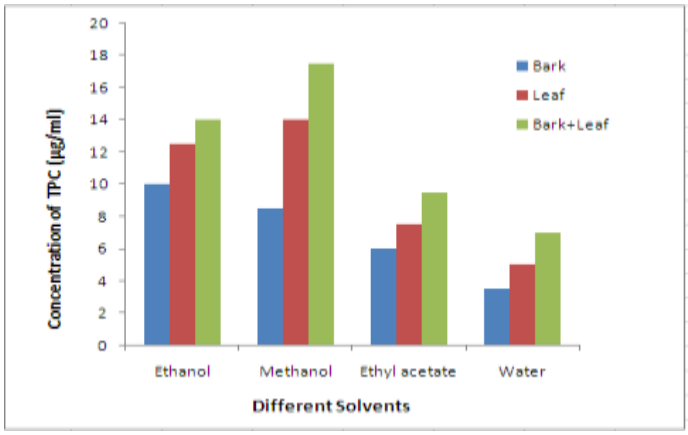

Fig.1: Effect of Solvent

b. Effect of Percentage Solvent:

The effect of different percentage concentrations of aqueous (water) and different organic solvents on the concentration of Total Phenolic Content (TPC) was analyzed. It was found that 60% of ethanol as solvent is optimum for the extraction of TPC from bark and yields a concentration of 15.5µg/ml. It was found that 100% of ethanol as solvent is optimum [11] for the extraction of TPC from leaf and yields a concentration of 14.0µg/ml. It was found that 80% of methanol as solvent is optimum for the extraction of TPC from the combination of bark and leaf and yields a concentration of 17.5µg/ml. The results were shown in fig 2.

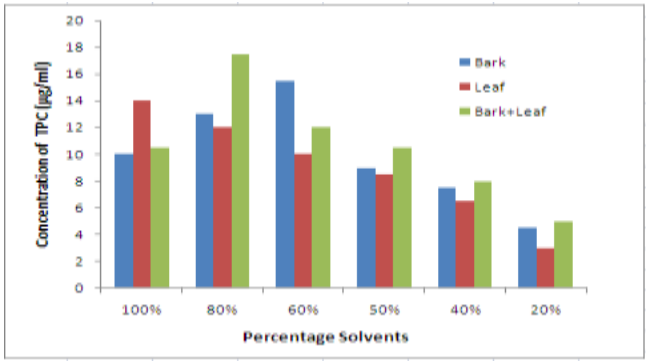

Fig.2: Effect of Percentage Solvent

c. Effect of Extraction Time

The effect of time taken for extraction on the concentrations of Total Phenolic Content (TPC) was analyzed. In this study, the plant samples were soaked in the respective solvent systems for different intervals of time ranging from 12hrs to 72hrs and were simultaneously analyzed for studying the effect of extraction time on the concentrations of Total Phenolic Content (TPC). In this extraction process, the TPC concentration yielded from the bark extract was found to be 18 µg/ml at 48hrsand hence, is optimum for the extraction from the bark of *Terminalia arjuna*. In this extraction process, the TPC concentration yielded from the leaf extract was found to be 16.5 µg/ml at 48hrs and hence, is optimum for the extraction from the leaf of *Terminalia arjuna* [12]. In this extraction process, the TPC concentration yielded from the combined bark+leaf extract was found to be 20.5µg/ml at 24hrsand hence, is optimum for the extraction. The results were shown in fig 3.

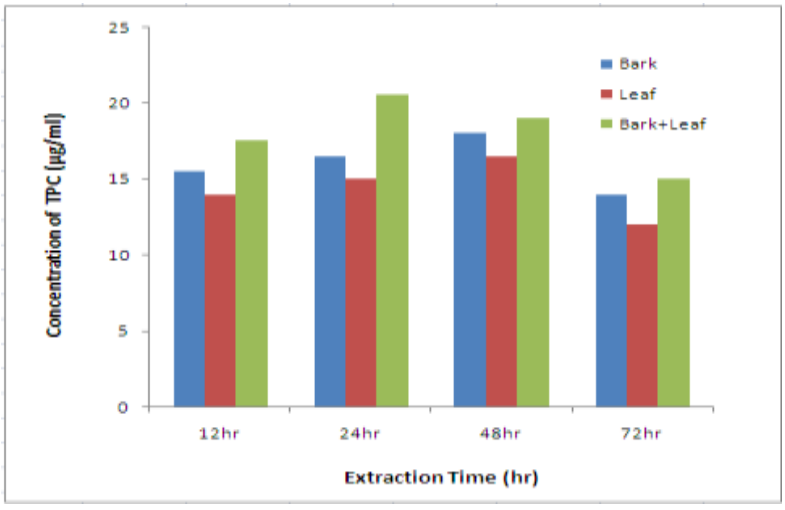

Fig.3: Effect of Extraction Time

d. Effect of pH

The effect of pH maintained during the extraction period on the concentrations of Total Phenolic Content (TPC) was analyzed. In this study, the plant samples were soaked in the optimum percentage concentration of solvent systems for optimum duration at different pH conditions ranging from pH 5.0 to 9.0 were analyzed for studying the effect of pH on the concentrations of Total Phenolic Content [13]. In this extraction process, the concentration of TPC yielded from the bark extract was found to be 22µg/ml at pH 6. Here, at pH 6 is optimum for extraction of TPC from the bark of *Terminalia arjuna.* In this extraction process, the concentration of TPC yielded from the bark extract was found to be 18.5 µg/ml at pH 8. Here, at pH 8 is optimum for extraction of TPC from the bark of *Terminalia arjuna.* In this extraction process, the concentration of TPC yielded from the bark extract was found to be 24.0 µg/ml at pH 6. Here, at pH 6 is optimum for extraction of TPC from the bark of *Terminalia arjuna* [14]. The results were shown in fig 4.

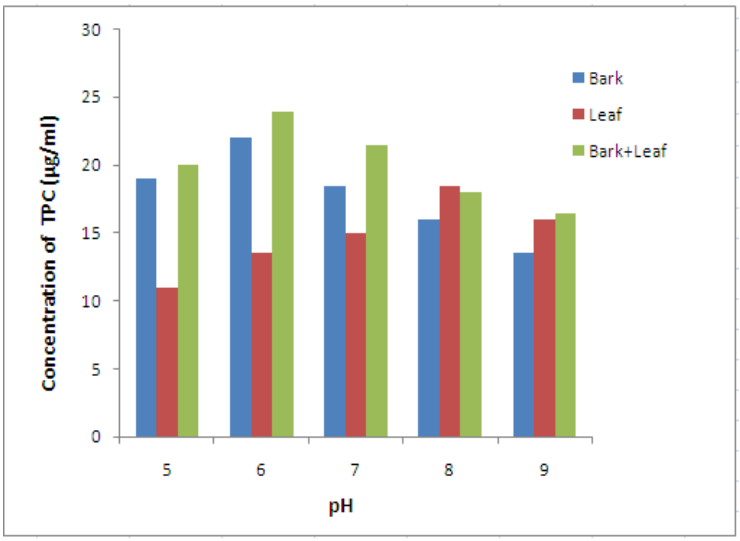

Fig.4: Effect of pH

e. Effect of Particle Mesh Size:

The effect of Particle Mesh Size of the plant sample on the concentrations of Total Phenolic Content (TPC) was analyzed. In this study, the finely powdered plant samples were sieved using different mesh sizes ranging from 48-72, soaked in the optimum percentage concentration of solvent systems for optimum duration of time at optimum pH and were analyzed for studying the effect of pH on the concentrations of Total Phenolic Content (TPC). In this extraction process, 72 particle mesh size wasfound to be optimum for TPC extraction. The TPC concentration yielded was 25.0 µg/ml from bark of *Terminalia arjuna.* In this extraction process, 72 particle mesh size wasfound to be optimum for TPC extraction. The TPC concentration yielded was 21.5 µg/ml from leaf of *Terminalia arjuna.* In this extraction process, 72 particle mesh size was found to be optimum for TPC extraction [15]. The TPC concentration yielded was 27.0 µg/ml from bark+leaf combination of *Terminalia arjuna.* The results were shown in fig 5.

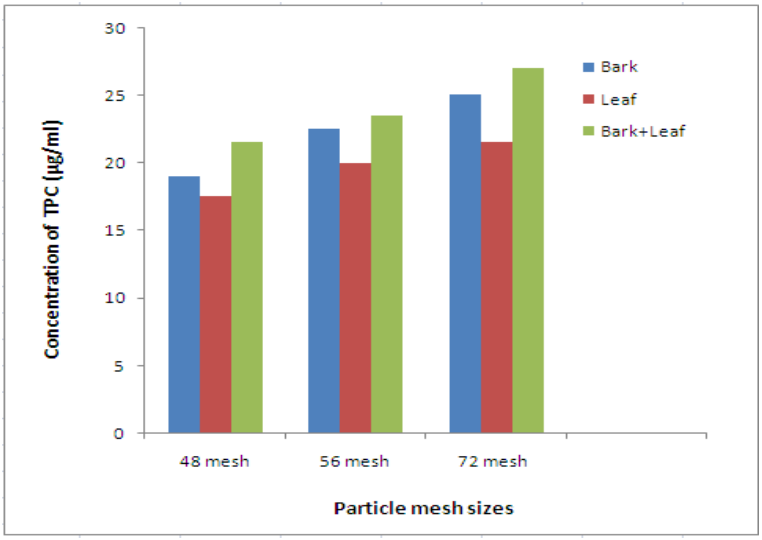

Fig.5: Effect of Particle Mesh Size

CONCLUSION

The total phenolic content (TPC) of *Terminalia arjuna's* leaves and bark was extracted using this research's optimization of physico-chemical parameters, including the impacts of various solvents, solvent percentages, pH, extraction time, and particle mesh size. The best conditions for extracting TPC from bark were ethanol solvent, 60% solvent, 48 hours of extraction time, pH 6, 72 mesh size, and a concentration of 25.0 g/ml. Additionally, methanol solvent, 100% solvent, 48 hours of extraction time, pH 8, 72 mesh size, and a concentration of 21.5 g/ml were shown to produce the best results for the extraction of TPC from leaves. The best extraction conditions for TPC were determined to be methanol solvent, 80% solvent, 24 hours of extraction duration, pH 6, 72 mesh size, and a concentration of 27.0 g/ml.

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