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Studies on Extraction of Quercetin Flavonoid from Combination of Different Parts of *Acanthus ilicifolius* (Indian Mangrove)

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Abstract

Medicinal plants constitute an essential natural resource for the treatment of chronic illness. It is possible to treat the same illness using various medicinal plants; the decision is frequently influenced by the nation in which the disorder is most frequent. Acanthus ilicifolius is an Indian mangrove and belongs to Acanthaccae family and grows in the coastal zone. It comprises of a wide range of phytochemicals and exhibits numerous biological characteristics. In this study, the quercetin flavonoid was extracted by combining different parts (root, stem, and leaf) of Acanthus ilicifolius. The extraction process, when further optimized, involved various physicochemical parameters that influenced the yield of quercetin. These parameters were different solvents and their varying concentration, extraction time, pH, and particle mesh size. The optimal conditions for extracting quercetin from this plant combination were found to be methanol as the solvent with 80% concentration, 24 hrs extraction time at pH-6, and having a particle size of 100 mesh. As a result, the concentration of the quercetin of this plant extract was found to be 43.0 µg/ml.

Keywords: *Acanthus ilicifolius*, mangrove, extraction, quercetin, methanol.

INTRODUCTION

Acanthus ilicifolius is the botanical name for this member of the *Acanthaccae* family names for the species Indian mangrove [1]. The coastal plant species *Acanthus ilicifolius* also called sea holly or holly-leaved acanthus. Originating in tropical and subtropical parts of Asia, which include nations like India, Sri Lanka, and Southeast Asia, it flourishes in estuaries with high salinity levels, mangrove environments, and coastal mudflats. This little tree or shrub can reach a height of three meters and is distinguished by its holly-like leathery, spiky leaves. *Acanthus ilicifolius* is prized for both its therapeutic qualities and its ecological function in preserving coastal environments [2]. Because of their anti-inflammatory, antibacterial, and antioxidant properties, the plant's roots, leaves, and stems have all been utilized in traditional medicine. According to phytochemical research, it contains bioactive substances such alkaloids, phenolic compounds, and flavonoids, including quercetin, which enhance its potential as a medicine. Specifically, quercetin's capacity to counteract inflammation and oxidative stress has been investigated [3]. The plant is also of interest for possible therapies of infections and other medical disorders because it has shown antibacterial qualities. Although it continues to play a significant role in coastal ecosystems, *Acanthus ilicifolius* is threatened by coastal development. In addition to being a safe substitute for artificial food coloring, *Acanthus ilicifolius* is a useful ingredient with possible health advantages when used as a natural

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colorant because it also has antioxidant qualities. Customers' desire for cleaner, more natural food options free of artificial ingredients has led to a rise in the use of natural colorants made from plants like these. The pigments from the plant must still be stabilized and extracted for reliable usage in food products, though. *Acanthus ilicifolius* has promise as a natural food coloring despite these obstacles, providing a possible answer to the food industry's increasing need for eco-friendly, health-conscious substitutes [4, 5].

MATERIALS AND METHODS

Collection of Plant Materials

Acanthus ilicifolius specimens were collected from seashore area of Visakhapatnam city in Andhra Pradesh, India. The leaves, stems, and roots were thoroughly cleaned with water followed by drying in the sun [6]. To make a powder, they were subsequently treated independently.

Chemicals

Methanol, Potassium acetate, Aluminum chloride, Distilled water.

Plant Extraction

One gram of powdered sample was placed in a conical flask. To it, 25 mL of organic solvent, i.e., methanol was added. After a couple of hours, the mixture was filtered through a funnel using Whatman filter paper No. 1 [7]. The organic solvent (Methanol) in the filtered extract was allowed to evaporate at a specific temperature using heat (at 65°C). Finally, the plant extract was prepared for the determination of quercetin flavonoid content.

Determination of Quercetin

A milliliter extract and 1.5 milliliters of methanol were mixed in a test tube. 0.1 ml of potassium acetate, 2.8 ml of distilled water, and 0.1 ml of Aluminum chloride (1% in water) was added to this mixture. The test tube was left to incubate for half an hour at room temperature. Then, using a colorimeter, the reaction mixture was observed at 415 nm [8]. Using a calibration curve, the amount of quercetin was ascertained.

RESULTS AND DISCUSSION

Effect of Different Solvents

Methanol was shown to be the best solvent in this investigation for obtaining the maximum concentration of quercetin from a variety of *Acanthus ilicifolius* root, stem, and leaf sections. It was found that the concentration of quercetin was 9.0 µg/ml. The efficacy of methanol was attributed to its greater polarity [9, 10]. Table 1 and Figure 1 present the findings.

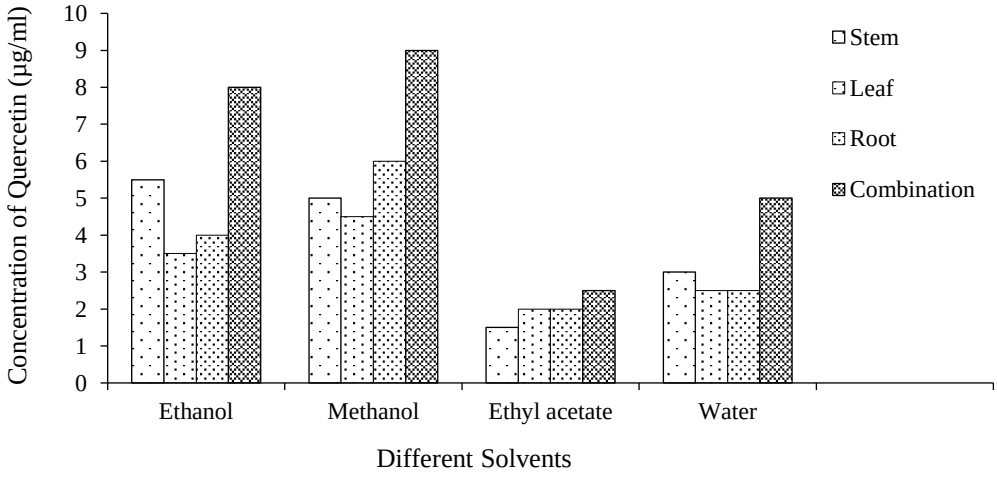

Figure 1. Effect different solvents for extraction of quercetin.

Table 1. Effect different solvents for extraction of quercetin.

S.N.	Different Solvent	Quercetin (µg/ml)			
		Stem (S)	*Leaf (L)*	*Root (R)*	*Combination (S+L+R)*
1.	Ethanol	5.5	3.5	4	8.0
2.	Methanol	5.0	4.5	6	9.0
3.	Ethyl acetate	1.5	2.0	2	2.5
4.	Water	3.0	2.5	2.5	5.0

Effect of Percentage Solvents

This study found that the best solvent concentration for obtaining the greatest concentration of quercetin from *Acanthus ilicifolius* was 80% methanol. A quercetin content of 10.5 µg/mL was determined. The extraction efficiency was improved by the 80% methanol's increased polarity [11]. Figure 2 and Table 2 exhibit the findings.

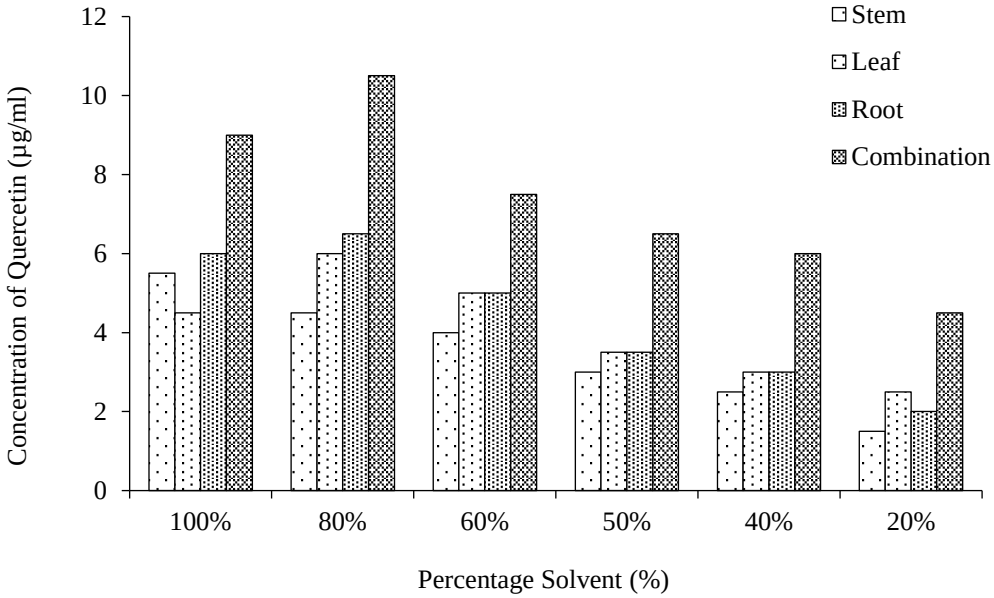

Figure 2. Effect of percentage of solvents for extraction of quercetin.

Table 2. Effect of percentage of solvents for extraction of quercetin.

S.N.	Percentage of Solvent	Quercetin (µg/ml)			
		Stem (S)	*Leaf (L)*	*Root (R)*	*Combination (S+L+R)*
1.	100% (25 ml solvent + 0 ml water)	5.5	4.5	6.0	9.0
2.	80% (20 ml solvent + 5 ml water)	4.5	6.0	6.5	10.5
3.	60% (15 ml solvent + 10 ml water)	4.0	5.0	5.0	7.5
4.	50% (12.5 ml solvent + 12.5 ml water)	3.0	3.5	3.5	6.5
5.	40% (10 ml solvent + 15 ml water)	2.5	3.0	3.0	6.0
6.	20% (5 ml solvent + 20 ml water)	1.5	2.5	2.0	4.5

Effect of Extraction Time (hrs)

The combination of *Acanthus ilicifolius* was shown to extract the maximum quantity of quercetin after a 24-hour soaking period. The measured concentration of quercetin was 18.0 µg/ml. The combination's best extraction efficiency for quercetin was shown at this 24-hour soaking period [12]. The findings are displayed in Figure 3 and Table 3.

Table 3. Effect of extraction time for extraction of quercetin.

S.N.	Extraction Time (hrs)	Quercetin (µg/ml)			
		Stem (S)	*Leaf (L)*	*Root (R)*	*Combination (S+L+R)*
1.	12	12.5	8.5	9.5	11.5
2.	24	10.5	11.0	14.5	18.0
3.	36	9.0	9.5	11.0	13.5
4.	48	7.0	7.5	8.0	10.0

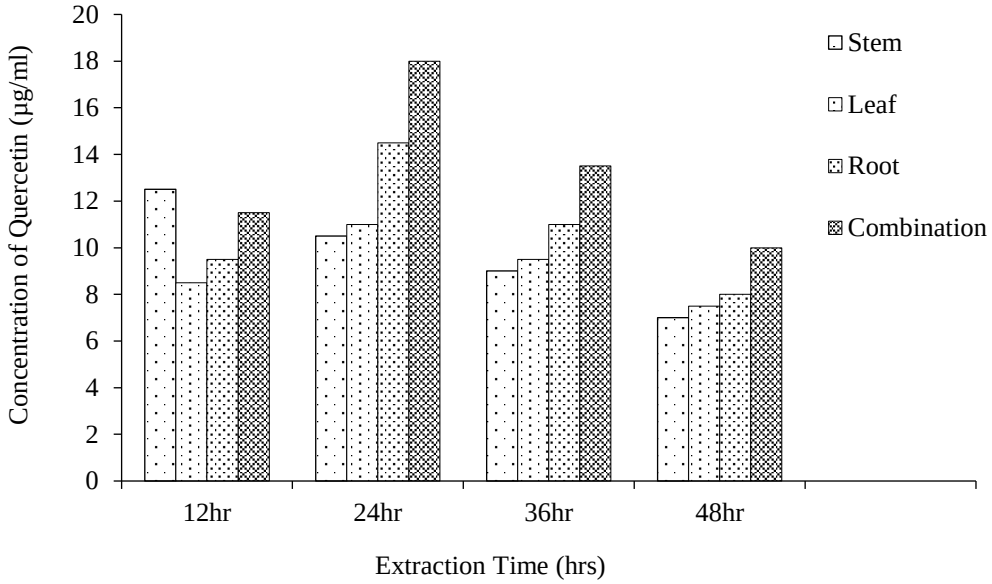

Figure 3. Effect of extraction time for extraction of quercetin.

Effect of pH

The concentration of quercetin at this acidic pH was 20.0 µg/ml, pH 6 was determined to be the ideal pH for obtaining the greatest quercetin concentration when combining *Acanthus ilicifolius* [13]. Figure 4 and Table 4 exhibit the findings.

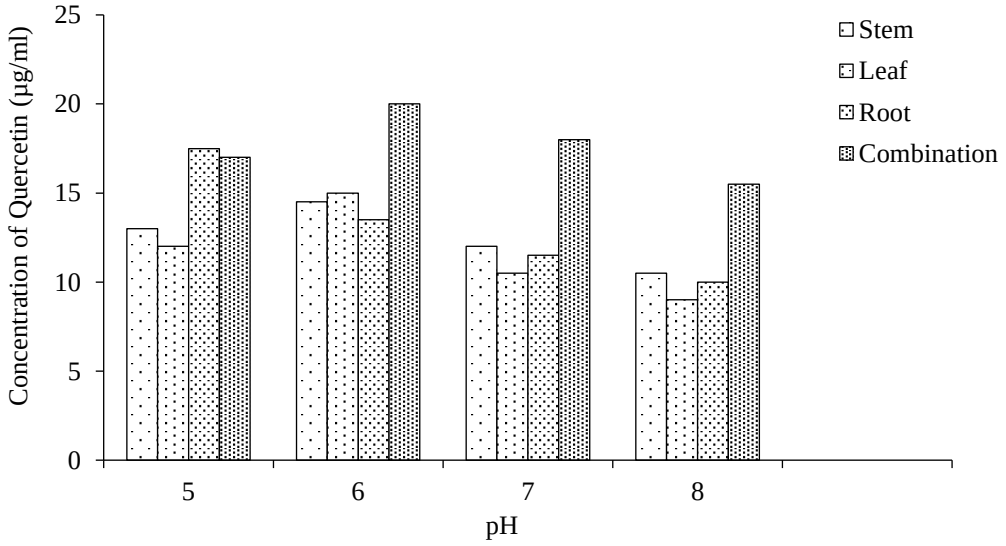

Figure 4. Effect of pH for extraction of quercetin.

Table 4. Effect of pH for extraction of quercetin.

S.N.	pH	Quercetin (µg/ml)			
		Stem (S)	*Leaf (L)*	*Root(R)*	*Combination (S+L+R)*
1.	5	13.0	12.0	17.5	17.0
2.	6	14.5	15.0	13.5	20.0
3.	7	12.0	10.5	11.5	18.0
4.	8	10.5	9.0	10.0	15.5

Particle Mesh Size

It was discovered that the combination of *Acanthus ilicifolius* yielded the maximum quercetin concentration (42.5 µg/ml) when the particle mesh size was 100 (149 µm). Because of its greater surface area, the 100-mesh particle size demonstrated a higher extraction efficiency [14, 15]. Figure 5 and Table 5 exhibit the findings.

Table 5. Effect of particle mesh size for extraction of quercetin.

S.N.	Particle Mesh Size (µm)	Quercetin (µg/ml)			
		Stem (S)	*Leaf (L)*	*Root (R)*	*Combination (S+L+R)*
1.	54 mesh (297)	15.5	18.0	20.5	26.5
2.	72 mesh (210)	20.0	22.0	24.5	32.5
3.	85 mesh (177)	23.5	26.5	28.0	36.5
4.	100 mesh (149)	27.0	34.0	30.5	43.0

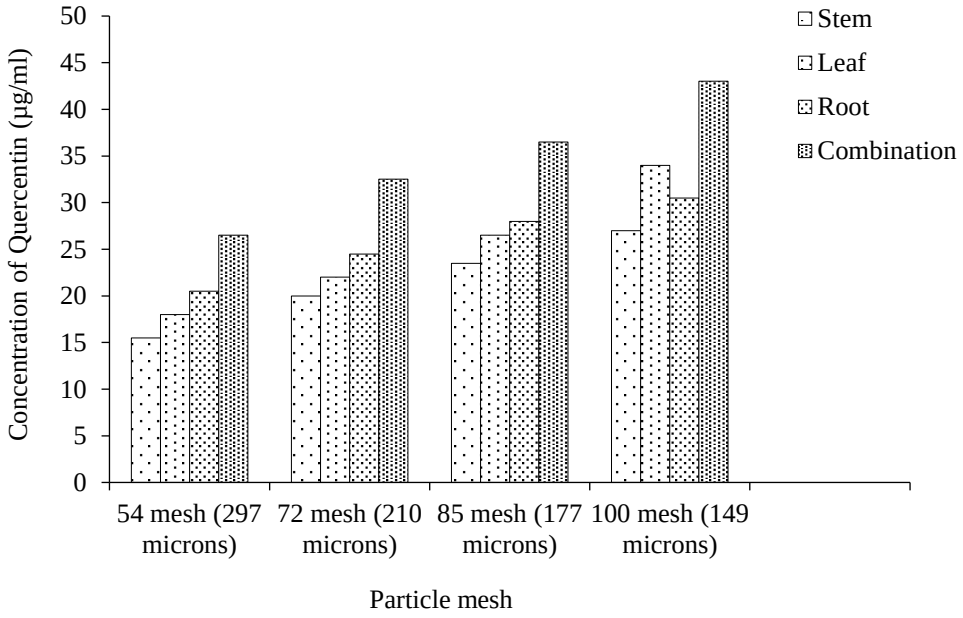

Figure 5. Effect of particle mesh size for extraction of quercetin.

CONCLUSIONS

The combination of the root, stem, and leaf of *Acanthus ilicifolius* increased the quercetin flavonoid content in this investigation. Several physicochemical characteristics were important in the extraction (optimization process) of quercetin. The effects of various solvents, solvent percentages, extraction durations, pH values, and particle mesh sizes on the extraction of quercetin were examined. Methanol as the solvent, an 80% solvent concentration, a 24-hour extraction period, pH 6, and a 100-mesh size were determined to be the ideal conditions for this combination. In these circumstances, the plant extract's quercetin content was 43.0 µg/ml.

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