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Phytochemical Analysis of the Ayurvedic Formulation, '*Triphala*' and its Constituents

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ABSTRACT

'*Triphala'* is a traditional Ayurvedic herbal formulation, consisting of equal parts of three medicinal fruits namely, *Emblica officinalis* Gaertn., *Terminalia bellerica* Roxb and *Terminalia chebula* Retz. In India, it is considered the most versatile of all herbal formulations. '*Triphala'* is found to be very effective in helping to control weight gain, chronic constipation, chronic degenerative conditions, conjunctivitis and progressive myopia. It also cures early stages of glaucoma and cataracts. In the present study, the aqueous and methanolic extracts of dried fruits and leaves of the constituent plants, individually and in equiproportional combinations were subjected to preliminary phytochemical studies. Phytochemical analysis revealed the presence of steroids, flavonoids, coumarins, alkaloids, proteins, sugars and phenolic compounds. Combination extracts gave better results than individual aqueous and methanol extracts. Leaf extracts (individual and combination) were found to be equally effective as fruit extracts. Considering the availability and cost factor, leaves may be a cheaper substitute in favor of fruits.

KEYWORDS: *Triphala, fruit and leaf combination extracts, aqueous and methanol extracts, Emblica officinalis, Terminalia bellerica, Terminalia chebula, phytochemical analysis*

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INTRODUCTION

Plants are known to contain innumerable biologically active compounds. The ability of herbal medicine to affect body systems depends on the constituents that it contains (Chevellier, 1996., Wink, 2015). These constituents can be elucidated by conducting chemical and pharmacological screening of the crude plant extracts as well as the active fractions of plants followed by the tests for specific activities such as antiallergic, anti-inflammatory, antibacterial, antifungal, antimitotic and antitumour (Gupta, 1994). Plant based phtochemicals are effective in the treatment of infectious diseases while mitigating many of the side effects, often associated with synthetic antimicrobials (Iwu *et al*., 1999, Elizabeth, 2005, AlSheikh *et al*., 2020).

'*Triphala*' (Tri=three, phala=fruit), fruit combination of *Emblica officinalis* Gaertn., *Terminalia bellerica* Roxb. and *Terminalia chebula* Retz., is a well established popular Ayurvedic drug. '*Triphala*' exhibits a number of health benefits, including antioxidant activity, lowering cholesterol levels, normalization of blood pressure, inhibition of HIV, reduction of tumours in animals, and protection and improvement of liver function. Some of the scientific research and practical experience of people using it down through the ages has demonstrated that '*Triphala*' is an effective blood purifier that stimulates bile secretion as it detoxifies the liver, helps digestion and assimilation, and significantly reduces serum cholesterol and lipid levels throughout the body. As a result, it is regarded as a kind of universal panacea and is the most commonly prescribed herbal formulation.

The fruits of *E. officinalis*, *T. bellerica* and *T. chebula* are widely used in the Indian traditional system of medicine. The half ripe fruit of *T. bellerica* and the pericarp of *T. chebula* fruit were reported to be purgative (Chopra *et al*., 1956). The fruit of *T. chebula* was traditionally used to cure asthma, urinary disorders, heart disease and it has cardiotonic activity (Reddy *et al*., 1990; Kumar *et al*., 2013). The fruit of *E. officinalis* has a beneficial role in cancer, diabetes, liver treatment, heart trouble,

ulcer, anemia and various other diseases. Similarly, it has applications as an antioxidant, immunomodulatory, antipyretic, analgesic, cytoprotective, antitussive and gastroprotective. Additionally, it is useful in memory enhancing, ophthalmic disorders and lowering of the cholesterol level. It is also helpful in neutralizing snake venom and is used as an antimicrobial (Khan, 2009). It is a rich source of vitamin C, a well-known antioxidant (Halliwell and Gutteridge, 1985) and is reported to counteract the hepatotoxic and renotoxic effects of metals (Roy *et al*., 1991).

Perusal of literature shows that most of the studies have focused on the effects activities of fruits of the constituent plants of '*Triphala*', but reports on phytochemical studies of the leaves individually or in combination have not yet been published. Therefore, the aim of the present study was to collect data on phytochemical compositions of leaves and fruits of '*Triphala*' and its constituent plant samples.

MATERIALS AND METHODS

The leaves of *Emblica officinalis*, *Terminalia bellerica* and *Terminalia chebula* were collected from Regional Drug Research Institute (RRI), Thiruvananthapuram and the fruits were collected from the local herbal medicine suppliers.

Extraction

For the preparation of aqueous extracts of leaves of each species, 15 gms of leaves were separately ground with 100 ml distilled water and heated for 2 hrs at 60^0C using Liebig condenser and reduced to half in a rotary vacuum evaporator at 60^0C. For the preparation of the aqueous combination extract, the same process was repeated with 5 gms each of the three leaves, making a total 15gms.

For the preparation of aqueous extracts of fruits, 8 grams of the powdered fruit of each plant was mixed with 250 ml distilled water and heated for 2 hrs at 60-70°C by continuous hot extraction using Liebig condenser. The extract was evaporated to dryness in a rotary evaporator at 40-50°C. For the preparation of combination extract of fruits, the same procedure was repeated with approximately 2.67 gms each of the three fruits, making a total 8gms.

For the preparation of methanol extracts of each species, 15 gms of powdered leaves and fruits were extracted separately with 250ml of methanol for 10 hrs in a Soxhlet apparatus and evaporated to dryness in a rotary vacuum evaporator. For the preparation of the aqueous combination extract, the same process was repeated with 5 gms each of the three leaves and fruits, making a total 15gms (Harborne, 1998; Zhang *et al*., 2018)

PHYTOCHEMICAL STUDIES

The extracts were evaluated for the presence of steroids, terpenoids, flavonoids, coumarins, alkaloids, proteins, suberins, sugars, phenolic compounds and quinones using standard procedures (Harborne, 1984; Trease and Evans 1983 and Brindha and Parvathy, 2005).

RESULTS AND DISCUSSION

Humans have a long history of using plants not only as food, but also to improve health, known as functional food. Such foods containing bioactive components are also the source of modern drugs (Weli *et al*., 2018). In the present phytochemical studies on leaves and fruits of *Emblica officinalis*, *Terminalia bellerica* and *Terminalia chebula* were positive for steroids, flavonoids, coumarins, alkaloids, proteins, suberins, sugars and phenolic compounds (Table I-III) and support previous observations (Vani *et al*., 1997). Many of the reported beneficial effects of '*Triphala*' and its constituent plants, such as anti-inflammatory, antioxidant and antimicrobial activities, are due to the presence of these active compounds (Belapurkar *et al*., 2014; Kumar *et al*., 2016; Tarasiuk *et al*., 2018; Yan *et al*., 2022) .

Interestingly, terpenoids were found to be absent in the aqueous extract of the leaves of *E. officinalis* and the methanolic extract of the leaves of *T. bellerica*. The cyclized structures and groups of Terpenoid makes the extraction procedure more complex to optimize the full recovery (Jiang, *et al*., 2018). Quinones were absent in all the extracts (Table I-III). According to Devi and Mehendal, H. M. (2014), quinones are toxicological intermediate compounds with toxic reactions that irritate the skin, eye and respiratory tract. Moreover, its acute and chronic exposure leads to corneal ulcers and opacity respectively. Besides, its neurotoxin effects causes visual disturbances. This fact reiterates the points mentioned at the outset and supports the fact that '*Triphala*' is very effective in curing glaucoma and cataracts and can be safely included in eye care products such as eye wash. The present study also supports this as all the extracts of '*Triphala*' were found to be quinone negative.

CONCLUSION

In terms of the presence of phytochemicals, the results of the present study justifies the utility of the herbal formulation, '*Triphala*' the combination of three fruits, *Emblica officinalis*, *Terminalia bellerica* and *Terminalia chebula*. The study also highlights the effectiveness of leaf extracts and the use of combinations of leaf extracts is suggested as a suitable alternative to fruit extracts after thorough clinical trials.

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TABLE I. Phytochemical analysis of Aqueous extracts of *Emblica officinalis*, *Terminalia bellerica* and *Terminalia chebula*

Tests for	Leaf			Fruit		
	E.officinalis	*T.bellerica*	*T.chebula*	*E.officinalis*	*T.bellerica*	*T.chebula*
Terpenoids	-	+	+	+	+	+
Steroids	+	+	+	+	+	+
Flavonoids	+	+	+	+	+	+
Coumarins	+	+	+	+	+	+
Alkaloids	+	+	+	+	+	+
Proteins	+	+	+	+	+	+
Suberins	+	+	+	+	+	+
Sugars	+	+	+	+	+	+
Phenolic contents	+	+	+	+	+	+
Quinones	-	-	-	-	-	-

TABLE II. Phytochemical analysis of Methanolic extracts of *Emblica officinalis*, *Terminalia bellerica* and *Terminalia chebula*

Tests for	Leaf			Fruit		
	E.officinalis	*T.bellerica*	*T.chebula*	*E.officinalis*	*T.bellerica*	*T.chebula*
Terpenoids	+	-	+	+	+	+
Steroids	+	+	+	+	+	+
Flavonoids	+	+	+	+	+	+
Coumarins	+	+	+	+	+	+
Alkaloids	+	+	+	+	+	+
Proteins	+	+	+	+	+	+
Suberins	+	+	+	+	+	+
Sugars	+	+	+	+	+	+
Phenolic contents	+	+	+	+	+	+
Quinones	-	-	-	-	-	-

Table III. Phytochemical analysis of Combination ('Triphala') extracts

Tests for	Aqueous Extract		Methanolic extract	
	Leaf	Fruit	Leaf	Fruit
Terpenoids	+	+	+	+
Steroids	+	+	+	+
Flavonoids	+	+	+	+
Coumarins	+	+	+	+
Alkaloids	+	+	+	+
Proteins	+	+	+	+
Suberins	+	+	+	+
Sugars	+	+	+	+
Phenolic contents	+	+	+	+
Quinones	-	-	-	-