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EFFECT OF DIFFERENT DRYING METHODS ON THE QUALITY OF STEM BARK OF *TERMINALIA ARJUNA* ROXB.

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ABSTRACT
The effects of Ayurvedic medicine by different drying conditions were studied. Stem bark of *Terminalia arjuna* was chosen and dried by shade, sun and oven. The dried samples were characterized by means of microscopic study, preliminary physiochemical & phytochemical studies and Thin Layer Chromatography (TLC) study. The aim of this study was therefore to develop an understanding of suitable conditions for the processing of stem bark of *T. arjuna*. The objectives of this study were to investigate the effect of drying techniques i.e. shade, sun and oven drying, on the physicochemical, phytochemical and TLC studies of stem bark of *T. arjuna*. The results of physicochemical parameters i.e. loss on drying, total ash, acid insoluble ash, alcohol soluble extractive and water soluble extractive values of shade dried sample showed lower values when compared with sun dried and oven dried samples. Preliminary phytochemical analysis of all samples revealed the presence of Alkaloids, Glycosides, Flavonoids, Steroids, Triterpenoids, Saponins, Tanins and Carbohydrates. Thin layer chromatogram of the methanolic extract of shade dried sample after derivatisation with anisaldehyde sulphuric acid reagent showed nine major spots, where as sun and oven dried samples showed eight spots.
Keywords: Arjuna, *Terminalia arjuna*, stem bark, microscopic study, preliminary physiochemical study, Preliminary phytochemical analysis, TLC study.

INTRODUCTION

The medicinal plants *Terminalia arjuna* (Roxb, Wight Arn) is a large evergreen tree with butteressed trunk. It belongs to *Combretaceae* family, is an important cardiotonic plant described in the Ayurveda[1]. The bark is useful as an anti-ischaemic and cardioprotective agent in hypertension and ischaemic heart disease, especially in disturbed cardiac rhythm, angina or myocardial infarction[2]. *Terminalia arjuna* has been shown to be beneficial for coronary artery disease, heart failure, and possibly for high cholesterol levels[3]. It has also been found to be antibacterial and antimutagenic[4]. It helps in promoting proper gastrointestinal function to regulate gastrointestinal pH, while improving gastrointestinal motility, increasing stool specific gravity and reducing the populations of certain fecal micro-organisms, including yeast [*Candida albicans*][5]. This might have significant advantages to some individuals by promoting proper dietary protein digestion and absorption and reducing bowel putrefactive processes in the colon[6]. It also improves the cardiac muscle function and subsequent improved pumping activity of the heart[7]. A decoction of its bark with cane sugar and boiled cow's milk is highly recommended for endocarditis, pericarditis and angina[8]. Chemical constituents of different classes such as hydrolysable tannins[9], triterpenoid acids and their glycosides[10,11], flavonoids[12], Phenolics[13], phytosterol[14], were reported from stem bark portion of *Terminalia arjuna* species. Additionally, Arjunglucoside I-III, aujunic acid, arjunetin, arjunolic acid, and terminoic acid also form group of important constituents of the bark[15]. A number of previously published papers report the therapeutic properties for *Terminalia arjuna*[16-19]. According to Kumar and Jain, people living in the south Surguja district of Madhya Pradesh uses the bark of *T. arjuna* in the treatment of fever and high blood pressure[20]. People living in the Malkangiri district of Orissa, chew the fresh bark of *T. arjuna* and the juice is used as antacid[21]. Decoction of the bark is used as ulcer wash, while bark ash is used in the treatment of the snake bite and scorpion sting[22].

The kinetics of the drying process can define the final quality properties of the dried material. Artificial drying has been one of the most important processes in preprocessing of agricultural products, aiming to achieve the phytotherapy product needs of the pharmaceutical industry, which does not have infra-structure to use fresh plants in the quantities required for industrial production[23].

The post-harvesting process of medicinal plants has great importance in the production chain, because of its direct influence on the quality and quantity of the active principles in the product sold[24]. For this reason, adequate dryers are needed, using temperature, velocity and humidity values for drying air that provides a rapid reduction in the moisture content without affecting the quality of the active principles of medicinal plants. The drying process may also contribute to regular supply and facilitate the marketing of plants, because it facilitates the transport and storage[24].

Specific processing methods are often required, to reduce drying time, to detoxify the inherent toxic constituents, to reduce side effects or to enhance therapeutic effects. For example, the methods and temperatures used for drying may have a considerable impact on the quality of the resulting medicinal plant materials. Shade drying is the preferred method for drying plant material since it can maintain or minimize loss of color of leaves and flowers; and the lower temperatures can prevent the loss of volatile substances in the plant materials[25,26]. Taking into account of this wide use bark of *T. arjuna* present study aimed to

evaluate the effect of different drying methods on the quality.

MATERIAL AND METHODS

Plant material

The stem bark of *Terminalia arjuna* were collected from Raipur in March 2009. A voucher specimen was kept at the Department of Dravyaguna, Govt. Ayurvedic College, Raipur, after identification of the plant. The stem bark was subjected to three different drying conditions namely, shade, sun and microwave oven dry, however for all the three strategies, approximately five hundred grams of the fresh plant material was washed, drained and used. For shade dry, the pre washed and drained plant material was placed on a filter paper (90x60 cm) at room temperature (27± 1°C) for 3 days. For sun dry, the fresh material was placed in to the greenhouse for 3 days. For microwave oven drying, the plant material was placed in the middle of the turntable of a commercial microwave oven (SAMSUNG Model CE1031LFB; 900W) for 4 min. Once, the drying process was over, the dry weights were powdered using a laboratory blender and stored for further work.

Macroscopic study

Macroscopy is the study of the form of an object, where the material is known to occur in a particular form. Macroscopic and organoleptic features viz. color, odour, taste, shape, sizes etc. of the stem bark were observed[27,28].

Microscopic study

The shade dried stem barks were powdered and passed through a sieve no 85 to obtain the fine powder and then subjected for microscopic examination. About few mg of the powder was warmed with chloral hydrate solution, stained with safrarin, mounted with glycerin and observed under suitable magnification[27,28].

Physicochemical parameters study

The physicochemical parameters viz. loss on drying, total ash**,** acid-insoluble ash**,** alcohol-soluble extractive and water-soluble extractive were determined for the stem bark of *T. arjuna*[28]. The results are presented in Table1.

Preliminary Phytochemical Analysis

The methanolic and aqueous extracts were subjected to preliminary phytochemical analysis. The various quantitative chemical tests performed on the extracts were for alkaloids, glycosides, flavonoids, steroids, triterpenes, tannins, carbohydrates, proteins and amino acids[29-31]. The results are presented in Table 2.

Table 1: Physicochemical parameters studies of stem bark of *Terminalia arjuna*

NO.	Physico-Chemical Test	Shade drying	Sun drying	Oven drying
1.	Loss on drying at 105^{0}C	5.12	6.28	7.32
2.	Total ash	12	18	16
3.	Acid-insoluble ash	1.2	1.4	1.6
4.	Alcohol soluble extractive	12.02	14.63	16.05
5.	Water soluble extractive	17.45	21.30	19.22

Table 2: Preliminary phytochemical screening test of stem bark of *Terminalia arjuna*

S.No	Chemical test	Shade drying samples		Sun drying samples		Oven drying samples	
		Methanolic extract	Aqueous extract	Methanolic extract	Aqueous extract	Methanolic extract	Aqueous extract
1.	Alkaloids	+	-	+	-	+	-
2.	Glycosides	+	+	+	+	+	+
3.	Flavonoids	+	+	+	+	+	+
4.	Steroids	+	+	+	+	+	+
5.	Triterpenoids	+	+	+	+	+	+
6.	Saponin	+	+	+	+	+	+
7.	Tanins	+	+	+	+	+	+
8.	Carbohydrates	+	+	+	+	+	+
9.	Proteins	-	-	-	-	-	-
10.	Amino acids	-	-	-	-	-	-

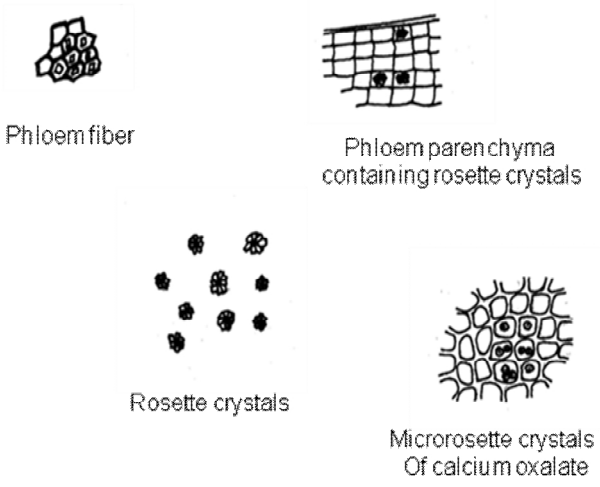

Figure 1: Microscopic study of stem bark of *Terminalia arjuna*

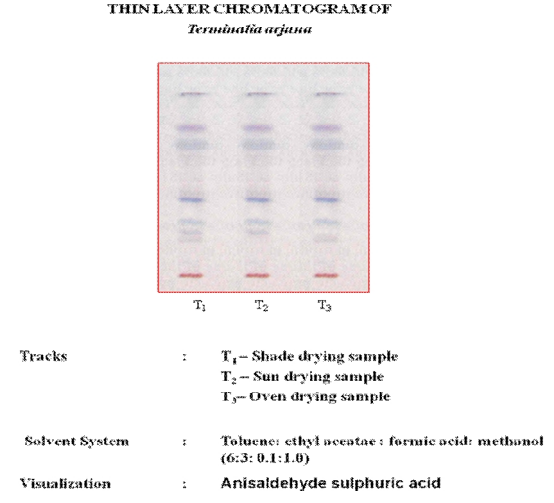

Figure 2: Thin Layer Chromatographic study of stem bark of *Terminalia arjuna*

Thin layer chromatographic study

TLC studies[32] of the methanolic extract was carried out on aluminium plates precoated with silica gel 60 F_{254} of 0.2 mm thickness using Toluene: ethyl aceatae : formic acid: methanol (6:3: 0.1:1.0) as mobile phase and observed under visible light after derivatisation with anisaldehyde sulphuric acid (5%) followed by heating the plate at 110°C. The colour and R_f values of the resolved spots were noted.

RESULTS AND DISCUSSION

Macroscopic characters

All samples are flat or slightly curved. Outer surface smooth, pale greenish yellow, inner surface finely longitudinally striated and pinkish in colour, bitter taste and characteristic odour.

Microscopic characters (Powder)

Microscopic analysis of all the samples shows the presence of identifying diagnostic characters, that are phloem fiber, phloem parenchyma containing rosette crystals, rosette crystals and micro rosette crystals of calcium oxalate (Figure 1).

Physicochemical parameters study

Physicochemical parameters of *T. arjuna* are tabulated in Table 1. Loss on drying at 105^0C is one of the major factors responsible for the deterioration of the drugs and formulations. Low moisture content is always desirable for higher stability of drugs. A high ash value is indicative of contamination, substitution, adulteration, or carelessness in preparing the drug or drug combinations for marketing. Water-soluble and alcohol soluble extractive value plays an important role in evaluation of crude drugs. Less extractive value indicates addition of exhausted material, adulteration or incorrect processing during drying or storage or formulating. The physicochemical parameters of barks of *T. arjuna* were determined as per the standard protocol. The results of loss on drying, total ash, acid insoluble ash, alcohol soluble extractive and water soluble extractive values of shade dried stem showed lower results when compared with sun dried and oven dried stem.

Thin Layer Chromatographic Study

Thin layer chromatogram of the methanolic extract of all samples developed after derivatisation with anisaldehyde sulphuric acid reagent. The shade drying sample showed nine major spots major spots at R_f 0.08(grey), 0.19 (pinkish blue), 0.23 (dark blue), 0.32 (blue),0.42 (Dark blue), 0.45 (grey), 0.65 (grey), 0.71 (grayish blue) and 0.80 (dark pink), where as sun and oven drying samples showed eight spots. The spot at R_f 0.08 (grey) was absent on sun drying samples and the spot at R_f 0.19 (grey) was absent on oven drying samples (Figure 2).

CONCLUSION

Drying of plant material can be achieved by several processes, including shade, sun and oven drying. Overall results showed that drying methods determine the chemical quality of stem bark of *Terminalia arjuna*. The results of physicochemical parameters i.e. loss on drying, total ash, acid insoluble ash, alcohol soluble extractive and water soluble extractive values of shade dried sample showed lower values when compared with sun dried and oven dried samples. Preliminary phytochemical analysis of all samples revealed the presence of Alkaloids, Glycosides, Flavonoids, Steroids, Triterpenoids, Saponins, Tanins and Carbohydrates. Thin layer chromatogram of the methanolic extract of shade drying sample after derivatisation with anisaldehyde sulphuric acid reagent showed nine major spots major spots, where as sun and oven drying samples showed eight spots. It concluded that shade drying of plant materials more suitable and is recommended as drying process showed a high potential in improving quantity and quality of medicinal plants.

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