

# Effect of MLR, Temperature and Solvent on the Extraction of Colourant from Arjuna (*Terminalia Arjuna*) Bark

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**Abstract**—Growing concern to save environment from industrial waste has led the industrialists to make processes eco-friendly. Natural dyes have attracted a lot of interest of researchers to make the textile industry sustainable. Extracts from plants which have been used in Ayurveda since ages because of their inherent medicinal properties have potential to be used as natural dyes for colouration of textiles. *Terminalia Arjuna* generally called as Arjuna is one such tree which contains large amount of bio actives in its bark. Extract of Arjuna bark can act as colouring matter to textiles having additional medicinal properties.

Present work focuses on the effect of extraction parameters on the extraction of colourant from bark of Arjuna. MLR (Material to Liquor Ratio) and temperature were varied to check the effect on colour strength. Colour strength of the liquid was checked on computer colour matching software. Effect of solvents was also examined by calculating the colour yield %. In the study it was observed that these parameters have significant effect on the extraction efficiency. The optimised extraction conditions were MLR 1:30 and temperature 100°C, while water as solvent gave maximum colour yield %. The extract obtained has potential to be used as natural dye for colouration of textiles.

**Keywords:** Arjuna bark, Colour extraction, Natural dye, Textiles

## 1. INTRODUCTION

Natural dyes are in great demand these days because of the increasing awareness among people about the sustainability issues. Natural dyes have many limitations but due to their eco- friendly nature they are gaining popularity [1]. Most of the natural dyes are extracted from different parts of plants. Many plants possess different medicinal properties so they are being used in Ayurveda since ages. Extracts of plants can not only colour the textile substrate but also have potential to add additional property to it. *Terminalia Arjuna* generally called as Arjuna is one such tree which contains large amount of bio actives in its bark. Arjuna tree is found in Bangladesh, Uttar Pradesh, Madhya Pradesh, West Bengal and south and central India [2]. The silk moth which produces tassar silk is fed on leaves of Arjuna [3]. It has been reported by Dwivedi that the bark of Arjuna contains large amount of flavanoids and

tannins [4]. Chemical structures of important group present in Arjuna bark powder are shown in Fig. 1 and Fig. 2 [4].

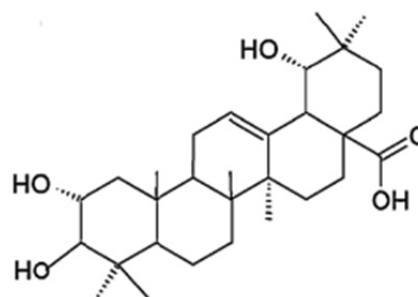


Fig. 1: Chemical structure of Arjunic Acid

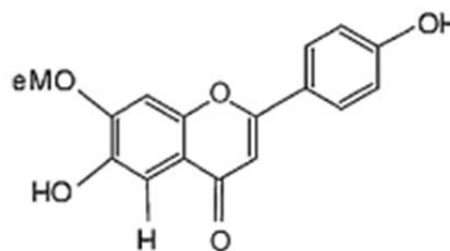


Fig. 2: Chemical Structure of Arjunolone

Powder of its bark has been used in traditional medicines [5]. It is reported that if the powder of Arjuna bark is applied topically it can treat ulcers and wounds [6]. Extract of colourant from its bark powder have potential to act as natural dye having medicinal properties for textile substrate.

So the present study is focused on the optimisation of conditions to extract colourant from bark of Arjuna tree.

## 2. EXPERIMENTAL

### 2.1. Materials

Arjuna bark was collected from local market and washed to remove if any dirt present on it. Dried bark was crushed and

grounded to make fine powder. This powder was used in the study for extraction of colour. All the chemicals used in the study were of LR grade.

## 2.2. Extraction of colour

Different experiments were performed to find out the optimised conditions for the extraction of colourant from Arjuna bark powder. The variables for the extraction are given in Table 1. To check the effect of MLR extraction was carried out at 80°C in water while effect of temperature was checked by carrying the extraction in water by taking the optimised MLR. The extraction at optimised MLR and Temperature was carried out to check the effect of solvent. Time 30min and pH 6 was kept fixed for all the extractions.

**Table 1: Variables for the extraction of colourant from Arjuna bark**

MLR	1:10, 1:20, <b>1:30</b> , 1:40
Temperature (°C)	40, 60, 80, <b>100</b>
Solvent	Ethanol, Methanol, <b>Water</b>

## 2.3. Colour measurement

Colour strength of the extracts obtained was measured on computer colour matching software according to the CIE system. Transmittance of light from the samples was measured by the instrument and converted into colour strength values.

## 2.4. Colour yield %

The colour yield % was calculated to check the effect of solvent on the extraction of colour. To calculate the colour yield % following formula was used:

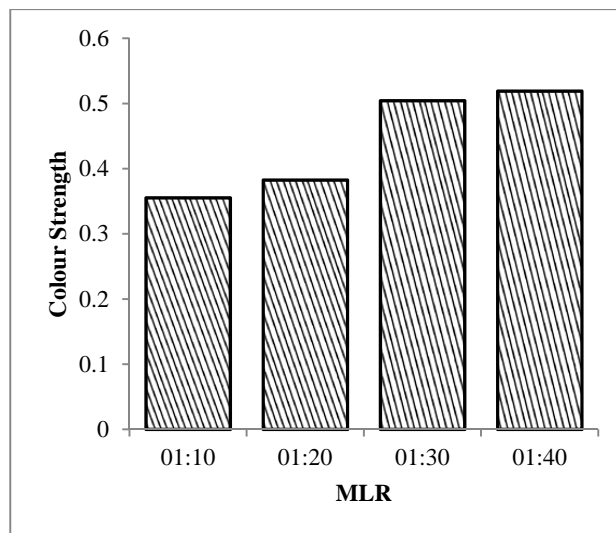
$$\text{Colour Yield \%} = \frac{\text{Dried weight of extract obtained}}{\text{Dried weight of powder taken for extraction}} \times 100$$

## 3. RESULTS AND DISCUSSION

Assessment of the obtained extracts was done to check the effect of different extraction conditions and to optimise those conditions. The findings of the study are discussed below.

### 3.1 Effect of MLR

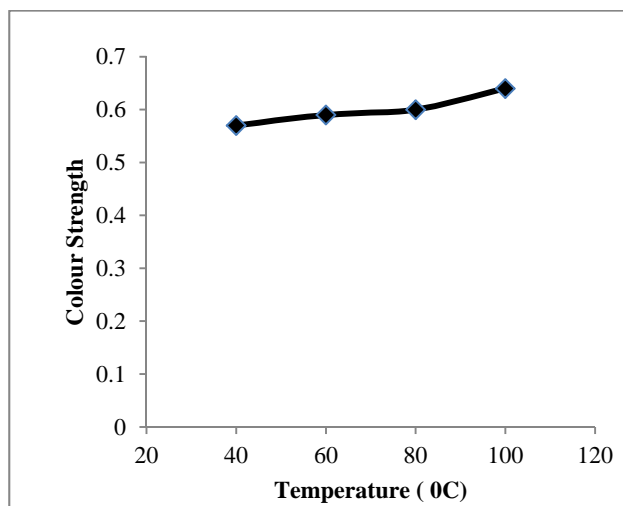
Effect of MLR on colour strength can be seen in Fig. 3. It is clear from the Fig. that with increase in material to liquor ratio the colour strength value increases. The increase in colour strength value from MLR 1:20 to 1:30 is more but after 1:30 the increase in colour strength with MLR is very less. Initially when the MLR is low due to less mobility of molecules less colour is coming out. After reaching 1:30 MLR almost all colour has come out and there is no further need to raise the MLR to 1:40.



**Fig. 3: Effect of MLR on extraction of colour**

### 3.2 Effect of extraction Temperature

Fig. 4 shows the effect of temperature on the extraction of colourant. We can see that with increase in temperature the colour strength of the extract kept on increasing. As we increase the temperature, more energy is provided which is responsible for the rupturing of cell walls causing the colour to come out in the solvent.



**Fig. 4: Effect of temperature on extraction of colour**

### 3.3 Effect of Solvent

Colour Yield % was calculated to check the effect of solvent on extraction. As it is clear from Fig. 5 that maximum yield was obtained when water was used as solvent followed by ethanol and methanol. It is reported by Saha et al that arjuna bark contains lot of phenolic groups [7]. Extraction of phenols is dependent upon the polarity of the solvent. Water being

most polar among the three taken solvents has shown maximum amount of colour yield %.

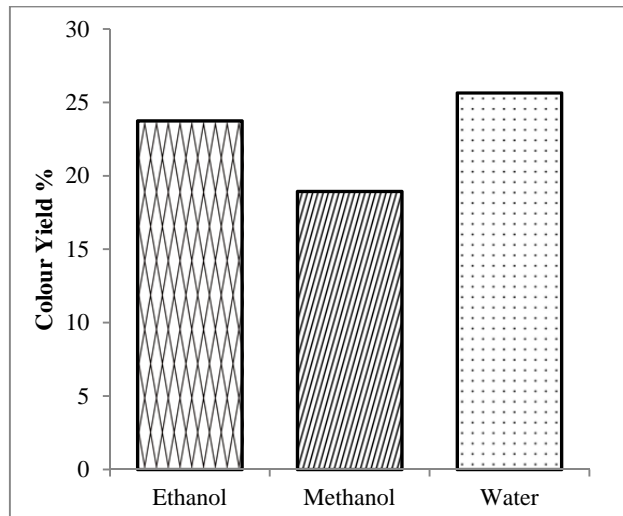


Fig. 5: Effect of solvent on colour yield %

#### 4. CONCLUSION

The results of the study affirm that extraction conditions play a vital role in the extraction of colour from Arjuna bark. Extraction variables have significant effect on the colour strength values of the extract so it becomes essential to optimise the extraction conditions. Optimum conditions for extraction were MLR 1:30, temperature 100°C and best solvent for extraction was water. Other variables like pH and time must also be optimised for the extraction conditions.

The obtained extract has potential to dye the textile substrate in reddish tone. It can be concluded that colour extracted from arjuna bark can act as natural dye for textiles.

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