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Extract Optimisation for Natural Herb Kalanchoe-Pinnata

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Abstract—*Natural dyes obtained from leaves, plants and insects have been used for colouration since ancient times. Although, non availability of raw materials in bulk, poor fastness properties and shade limitations lead to invention of synthetic dyes. These dyes got popularity with huge market acceptance. But most of the synthetic dyes affects the human health at large extent being non bio-degradable and toxic. Therefore, sustainable herbal dyes again getting popularity due to their medicinal along with colouration properties. Kalanchoe-pinnata is a medicinal herb found in different parts of India and other tropical regions of world. Many researchers have reported its anti-oxidant and anti-microbial properties. But very less literature evidences are available for its colouration behaviour to textiles. Therefore there can be a vast research area in its application to textiles. In previous studies it was shown that different extraction conditions of pH and time of extraction affect a lot on dye yield % and anti-oxidant behaviour of extracts. Present study aims at extraction of Kalanchoe-pinnata in different solvent medias by varying other parameters of extraction. Further, medicinal properties and other characteristics were determined. The findings of the results show that temperature and MLR also affect dye yield % and anti-oxidant property of dye powder. Although, all extracts showed very good anti-oxidant property.*

Keywords*: Kalanchoe-pinnata, herbal, extraction, anti-oxidant.*

1. INTRODUCTION

Textiles have been the basic need of humans to protect, adorn and fulfilment of other comforts. The well known fact is that fulfilment of needs lead to desires and wants. Therefore, the concept of colouration came into existence. Dyeing is an ancient art of colour implantation to textiles since Bronze Age in written forms. Synthetic dyes even having brilliant fastness and shades causes generation of toxic effluents which are not easy to degrade. They are not only harmful to aquatic animals but also dangerous to humans and ecology. Therefore various countries of world have banned the use of certain carsogenic synthetic dyes [1]. Natural dyes being eco-friendly, bio-degradable, abundant and less costly are gaining popularity. New natural sources to be explored for fulfilling the demand of environment friendly dyeing and finishing of textiles [2]. Natural dyes have poor to moderate fastness properties and have been applied by different methods to textiles [3]. Although due to increased population less land is available for cultivation of natural dyes and only 1% of textiles are dyed with natural dyes annually. Different methods of extraction of natural dyes had been followed traditionally but standardisation is still under research [4, 5].

Dyeing and finishing are two different processes which are done separately. These processes need repeated wet treatments and drying of the substrates which results in a lot of energy consumption and a lot of water wastage. Therefore, simultaneous dyeing and finishing can be a healthier approach [6]. The natural products have been used as natural dyeing and finishing agents widely and also being clinically safer than synthetic agents [7]. Herbs like aloe vera, neem, tea tree oil, tulsi leaf and eucalyptus have a wide application area in textile finishing due to excellent anti-microbial and colouration behaviour. Apart from these various other functional properties like UV protection, anti-odour, anti-oxidant can also be applied using natural products. Anti-oxidants have a large potential in medicine, food and cosmetic industries [8]. But still very less study is documented on natural herbs and their application to textiles whereas they can be a better substitute to synthetics agents due to no adverse affects [9].

Kalanchoe-pinnata (Pattharchat) is also a medicinal herb belonging to Crassulaceae family. Kalanchoe-pinnata is a medicinal herb which is cultivated in different parts of India and world. This plant grows up to a height of 12-65 inches and has leaves with juicy material inside. It is known as a wonder plant due to its capacity of re-grow even after plucking off. It is known by different names in different languages and parts of India like Pathherchat, pathherkuchi, paranbeej etc. [10]. It's a folk medicine used in many parts of world. Juice of its leaves is used in curing of various ailments like jaundice, coughs, sores, wounds and cuts. This herb is also used as central nervous system depressant, anti-microbial and anti-oxidant agent. In composition this herb has alkaloids, triterpenes, glycosides, flavonoids, cardienolides, steroids, bufadienolides and lipids [11-12].

Functional properties of Kalanchoe-pinnata like anti-oxidant and anti-microbial have been studied for extractions in

different solvent medias since a decade in pharmaceutical industry. This herb has wide application area in cosmetic industry due to its anti-oxidant property [13]. Different extracts of Kalanchoe-pinnata in different solvents showed presence of alkaloids, tannins, amino acids and different fenolic groups [14]. It has been reported that extraction method and type of solvent taken for extraction affects obtained extracts, their yield and functional properties [15-16]. Hydro-alcoholic extracts of herb have good anti-oxidant capacity accessed by different methods of anti-oxidant testing [17]. Chloroform extracts possess brilliant medicinal properties like anti-cancer and anti-microbial. Ethanolic extraction of Kalanchoe-pinnata has very good anti-fungal and anti-bacterial property [18].

In present investigation Kalanchoe-pinnata has been extracted in various solvents and effect of extraction parameters on obtained extracts yield and functional behaviour has been studied. The reported chemical constituents of Kalanchoe-pinnata are shown in Fig. 1[19].

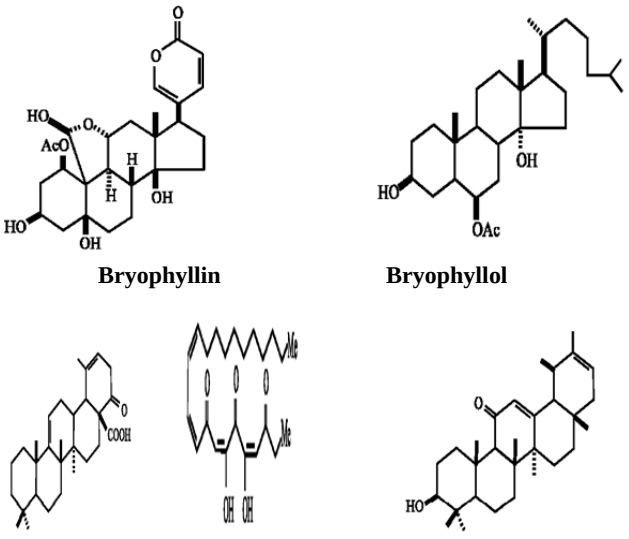

Fig. 1: Different chemical constituents available in leaves of Kalanchoe-pinnata

Kalanchoe-pinnata leave powder was extracted in different solvents by keeping time and pH of extraction as constant as reported earlier [20]. Extract yield % and anti-oxidant behaviour of obtained different extracts have been checked for optimising the extraction conditions.

2. EXPERIMENTAL

2.1. Materials

Kalanchoe-pinnata wet leaves were procured from locally available nurseries. De-ionized water, lab grade ethanol and Diphenyl-2-picryl-hydrazyl (DPPH) of sigma were used for extraction and anti-oxidant testing respectively.

2.2. Dye extraction

Soxhlet Apparatus was used for extraction of dye from Kalanchoe-pinnata in de-ionized water, absolute ethanol and water:ethanol in 50:50 proportions. The pH of solution was kept constant at 5.5 and time of extraction was taken as 90 minutes as reported earlier.

Extract Yield %

Extract yield % of extracts was calculated by following formula:

$$\% \text{ Yield} = \frac{\text{Amount of Kalanchoe-pinnata extract obtained}}{\text{Amount of Kalanchoe-pinnta leave powder taken initially for extraction}} \times 100$$

Anti-oxidant Property

Anti-oxidant property of all extracts was tested following the standard procedure [21]. DPPH was used for calculating the Free Radical Scavenging Activity (RSA) of Kalnchoe-pinnata extracts as capacity of scavenging the stable free radicals of DPPH is a measure of anti-oxidant behaviour. According to standard test conditions 0.20ml volumes of extracts were added to 3.8 ml of 0.1 mM DPPH solution in ethanol. Solutions were kept in dark for 30 minutes for completion of reaction at room temperature. Decolourisation occurs in solutions after reaction of extracts with DPPH solution and absorbance was measured on spectrophotometer at 517 nm wavelength. The percentage Radical Scavenging Activity was measured by following formula:

$$\text{RSA}(\%) = 1 - \frac{\text{Absorbance of sample}}{\text{Absorbance ofcontrol}} \times 100$$

Whereas: - Absorbance of sample refers to the absorbance of the solutions having Kalanchoe-pinnata leaves extracts and Absorbance of control refers to the absorbance of the solutions only having the solvents of extraction.

Flow chart of extraction process is as follows:

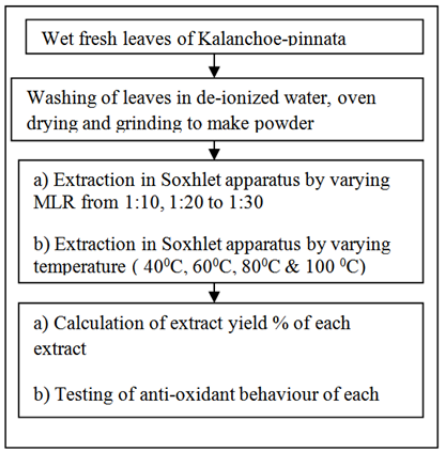

Fig. 2: Flow chart of dye extraction from Kalanchoe-pinnata leaves powder.

3. RESULTS AND DISCUSSION

Present study aims at optimisation of different solvent extractions of Kalanchoe-pinnata leaves powder. The assessment of extracted samples from Kalanchoe-pinnata was done and following are the findings of the study:

3.1. Effect of MLR on extracts

Dry leaves powder of Kalanchoe-pinnata was extracted in different three solvents i.e. water, ethanol and water+ ethanol in 50:50 proportions by keeping different material to liquor ratios (1:10, 1:20 and 1:30) keeping time of extraction 90 minutes and pH 5.5 as constant. The extract yield % obtained in different material to liquor ratios is shown in Fig. 3 whereas Radical Scavenging Activity (RSA) % of obtained extracts is shown in Fig. 4. It is clear from Fig. 3 that increase in MLR increases extract yield % as the MLR varies from 1:10 to 1:20 but afterwards it decreases. This may be due the reason that optimum MLR results in collision of extract molecules with each other therefore more extract yield % comes out but afterwards it decreases as MLR varies from 1:20 to 1:30. It may be due to decrease in collision of extract molecules as they become stable afterwards leading to lesser dye yield % [22].

It can be clearly observed from Fig. 4 that radical scavenging activity % of obtained extract increases when MLR ratio increases 1:10 to 1:20 but beyond 1:20 there is decrease in radical scavenging activity %. It can be also clearly observed that solvent of extraction also affect the extract yield % and Radical Scavenging Activity %. Water being the most polar among all have maximum yield and RSA % followed by water:ethanol and absolute ethanol.

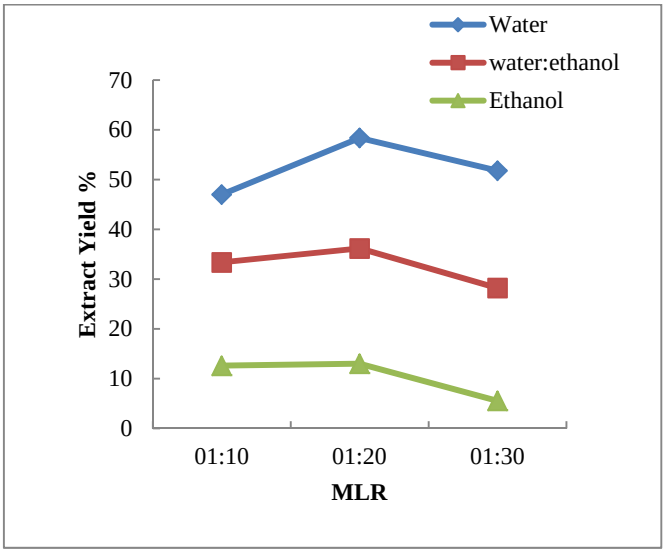

Fig. 3: Effect of MLR on obtained dye yield % from Klalnchoe-pinnata leaves in different solvents.

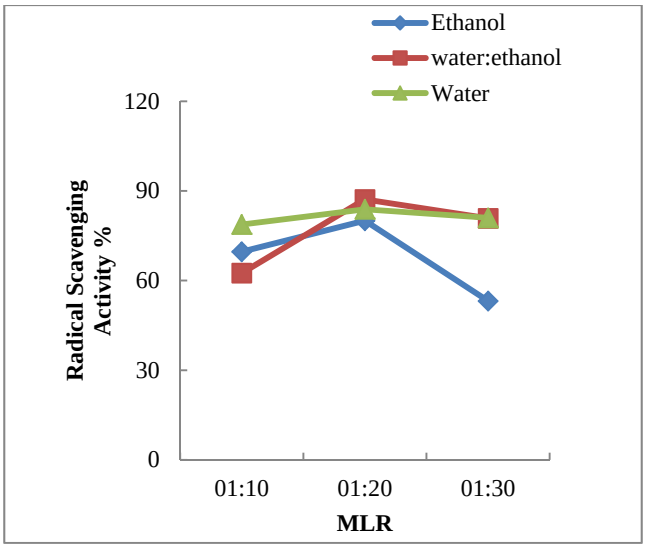

Fig. 4: Effect of MLR on obtained Radical Scavenging Activity % from Klalnchoe-pinnata leaves in different solvents.

3.2. Effect of Temperature on extracts

Dry leaves powder of Kalanchoe-pinnata was extracted in different solvents i.e. water, ethanol and water:ethanol in 50:50 proportions by varying temperature of extraction from 40 ^{0}C to 100 ^{0}C keeping time of extraction 90 minutes and 5.5 pH as constant. The extract yield % obtained in different temperature interval is shown in Fig. 5 whereas Radical Scavenging Activity (RSA) % of obtained extracts is shown in Fig. 6. It can be analysed from Fig. 5 that with increase in temperature increases extract yield % increases up to 80 ^{0}C. That may be due to increase in rapture of cell wall of leave powder resulting in more dye component leach out in the extraction solution and get dissolved. But the yield decreases after 80 ^{0}C that may be due to maximum dissolution achieved as Kalanchoe-pinnata has a lot of phenolic groups which are high energy species and result in decreased extract yield % [23, 24].

It can be clearly observed from Fig. 6 that with increase in temperature radical scavenging activity % decreases due to presence of high energy phenolic groups which becomes unstable as the temperature increases resulting decrease in anti-oxidant behaviour [25, 26]. Also it can be clearly observed that solvent of extraction also affect the extract yield % and Radical Scavenging Activity %. Water being the most polar among all have maximum yield and RSA % followed by water: ethanol and absolute ethanol.

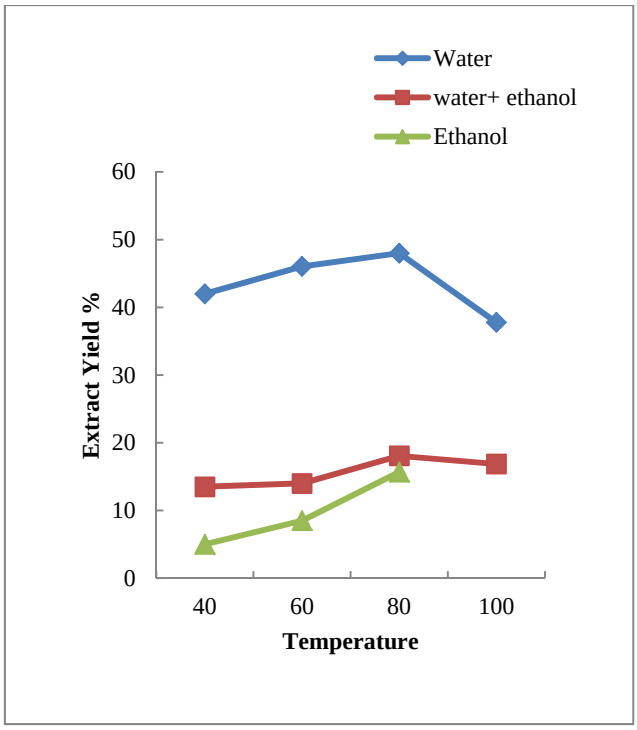

Fig. 5. Effect of temperature on obtained dye yield % from Klalnchoe-pinnata leaves in different solvents.

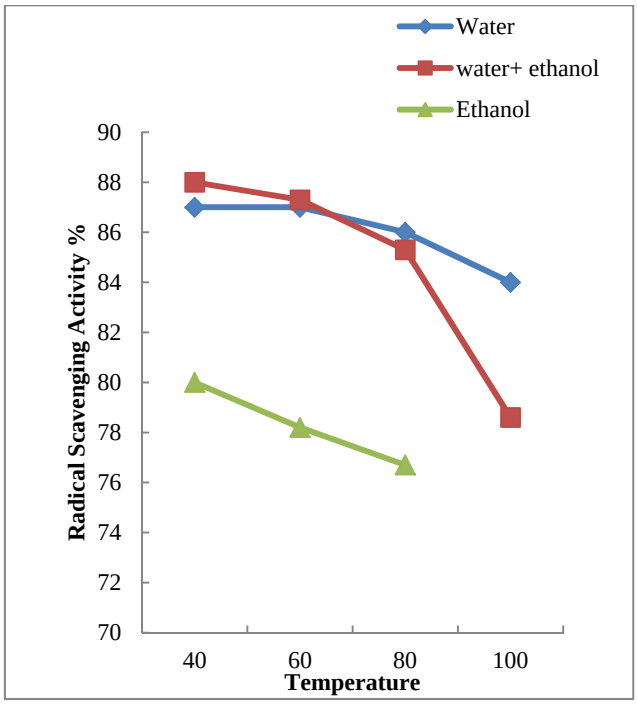

Fig. 6: Effect of temperature on obtained Radical Scavenging Activity % from Klalnchoe-pinnata leaves in different solvents.

4. CONCLUSION

The findings of the study show that extract of Kalanchoe-pinnata shows good anti-oxidant properties. Although all the extracts of Kalanchoe-pinnata in different solvents is affected by its extraction parameters but all obtained extracts show good anti-oxidant behaviour at 80 ^{0}C temperature and 1:20 MLR. Kalanchoe-pinnata extract has potential to substitute synthetic agents and can be used as herbal dyeing and finishing agent.

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