Microwave Assisted Extraction of Polyphenols from Eclipta Prostrata

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Abstract- **Eclipta prostrata L. belonging to the family Asteracea is one of the oldest underutilized herbs used in traditional medicine. The plant is rich in bioactive components such as steroids, glucosides, tannins and saponins. It possesses antioxidant, antibacterial, antifungal and anti-inflammatory properties. The present work reveals the comparison of microwave assisted extraction with solvent extraction of polyphenols from Eclipta prostrata. Extraction of polyphenols was performed by varying the factors such as solvent concentration, extraction time and microwave power/temperature to analyze the effect of polyphenols. It is observed that the process parameters greatly influence the polyphenol content of the Eclipta prostrata extract. The yield of polyphenol was found higher in the microwave assisted extract than the macerated extract. This could be due to the rupture of cell wall at microwave power by the phenomenon of ionic conduction and dipolar rotation.**

Index Terms- Eclipta prostrata, Microwave assisted extraction, polyphenols, antioxidant property.

1. INTRODUCTION

Eclipta prostrata is an under-utilized plant, belonging to the family of Astraceae. The herb has been used in the various traditional treatments in India such as to avoid snake venom poisoning in Brazil (Melo et al. 1994), the leaves of this herb are used in the case of gastritis and respiratory disorders like cough and asthma (Kobori et al. 2004). In addition, the crude form of the herb is found to have anti-microbial, anti-bacterial (Karthikumar et al. 2007), anti-inflammatory, anti-fungal and anti-hepatotoxic properties (Wong et al. 1988). Recent reports showed that the triterpenoid saponins isolated from this plant has antimicrobial, immunosuppressant, anti-guardian and anti-venom potentials (Liu et al., 2000; Pithayanukul et al., 2004; Sawangjaroen et al., 2005; Zhang Guo, 2001; Zhao et al., 2001; Wiart et al., 2004). Phytochemically, E.prostrata is rich in wadeoloctone, eclalbasaponin, b- amyrin, stigmasterol and luteolin-7- glucoside (Asolkar et al.1992). Therefore the extraction of those components responsible for medicinal properties can be incorporated in food for wider applications.

Some of the novel extraction techniques are emerging in order to promote effective extraction process. Microwave-assisted extractions (MAE), supercritical fluid extraction (SFE), Ultrasound assisted extraction (UAE), accelerated solvent extraction (ASE), counter current extraction (CCE) and pressurized solvent extraction (PSE)) are carried out to recover valuable extracts. MAE is a potential and powerful alternative to conventional extraction techniques, for its moderate capital cost and its good performance under atmospheric conditions (Eskilsson & Björklund, 2000), shorter time, less solvent, higher extraction rate and better products with lower cost. MAE works on the principle of ionic conduction and dipolar rotation which increased the capillary-porous characteristics and the water absorption capacity of the plant material. These changes provide an opportunity for improving the extraction yield of target analytes from plant material (Kratchanova, Panchev, & Pavlova, 2004).

The present study investigates the extraction efficiency of polyphenols by MAE from Eclipta prostrata, to investigate the effect of various process parameters on the extraction of polyphenols from

Eclipta prostrata and to optimize the various process parameters for MAE.

2. MATERIALS AND METHODS

The methodology comprises of preparation of Eclipta prostrata for extraction, solvent extraction of polyphenols, microwave assisted extraction of polyphenols, and analysis of recovered components.

2.1 Raw materials and reagents

The leaves were identified as Eclipta prostrata from the botanical survey of India located in Tamilnadu Agricultural University, Coimbatore. Eclipta prostrata is obtained from local market near Erode, Tamilnadu, India (Fig. 2.1). Fresh samples were made free from foreign bodies and other dust. It was then washed in tap water and ground without the addition of water. All the chemicals used were of analytical grade.

Fig. 2.1 Identification of sample- Eclipta prostrata

2.2 Solvent extraction of polyphenols (Maceration)

Extraction of poylphenols was performed with the solvent extraction method by maceration (Arunachalam et al. 2009). The samples were taken and macerated with the help of mortar and pestle. A 500 ml glass beaker containing a mixture of macerated Eclipta prostrata sample with different amount of solvent concentration (60, 80, 100%) was placed in hot plate at various time (2, 3, 4min) and temperature (30, 45, 60^{0}C). After that, the mixture in the beaker was allowed to cool down to room temperature and filtered using filter paper. The filtered extract was taken for analysis.

2.3. Microwave assisted extraction of polyphenols

Extraction of poyphenols was performed according to the method described by Wang et al. (2007) with the help of microwave equipment working at frequency of 2450 MHz under different MAE condition. A 500 ml glass beaker containing a mixture of Eclipta prostrata sample with different amount of solvent (ethanol) concentration (60, 80, 100%) was placed in the middle of the microwave equipment and exposed to different microwave power (160, 240, 320W) and irradiation time (2,3,4min). At selected time, extraction process was carried out and after that, the mixture beaker was allowed to cool down to room temperature and filtered using filter paper. The filtered extract was taken for analysis.

2.4. Estimation of total phenolic content (TPC)

Folin-Ciocalteu method as described by Vatai et al. (2009) will be used to determine the TPC of the extracts. Briefly, 1 ml aliquots of dilute extracts (dilution with distilled water to adjust the absorbance within the calibration limits) will shake for 1 min with 1.5 ml of the Folin–Ciocalteu reagent and 10 ml of distilled water. After that, 6 ml of 10% (w/v) sodium carbonate will be added and the mixture will shake again for 1 min. Finally, the solution will be adjusted to 25 ml by adding distilled water. The absorbance will be measured at 760 nm on an Elico SL 244 spectrophotometer after incubation of 2 h. From the calibration curve of gallic acid, results will be calculated and expressed as gallic acid equivalents (mg GAE/g).

3. RESULTS AND DISCUSSION

All the process parameters are observed to influence the extraction yield individually and interactively. The yield was maximum at 320W, 4min and 80% ethanol concentration.

3.1. Effect of Microwave Power/Temperature on polyphenol content

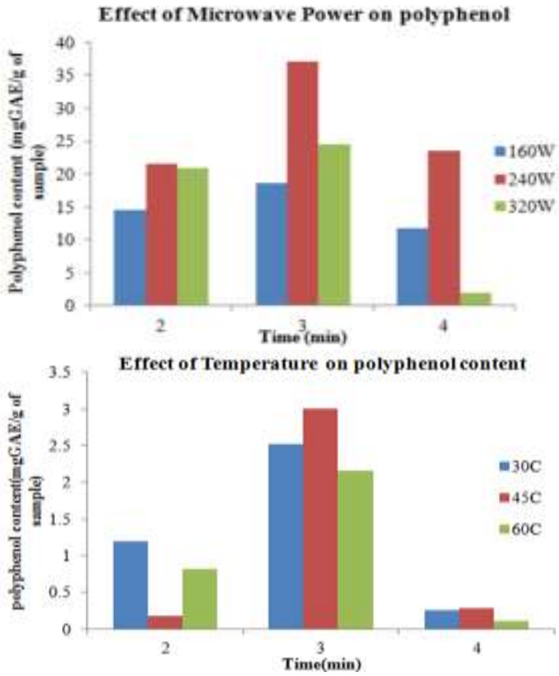
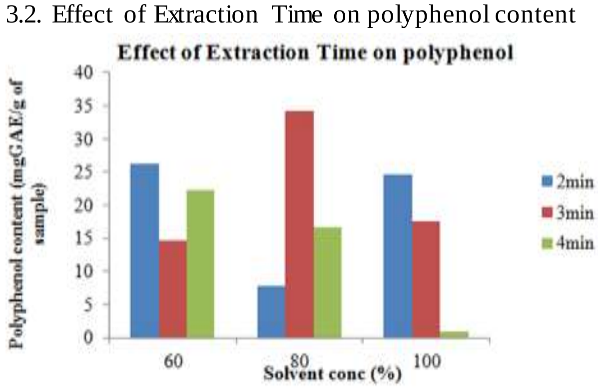


Fig. 3.1 Effect of Microwave Power/Temperature on polyphenol content by (a)MAE and (b)solvent extraction

The polyphenols increased by increasing microwave power which is related to the direct effects of microwave energy on the plant materials. Microwave open up the cell wall that will lead to increased interaction between extracting agent and source material in extraction process (Kratchanova et al., 2004). So that the yield was higher in MAE than the macerated sample (Fig. 3.1). More electromagnetic energy was transferred on biomolecules by ionic conduction and dipole rotations, which result in power dissipated inside the solvent till 320 and then it gradually reduced which might be due to degradation of polyphenols at higher temperature (Gfrerer & Lankmayr, 2005).

3.2. Effect of Extraction Time on polyphenol content



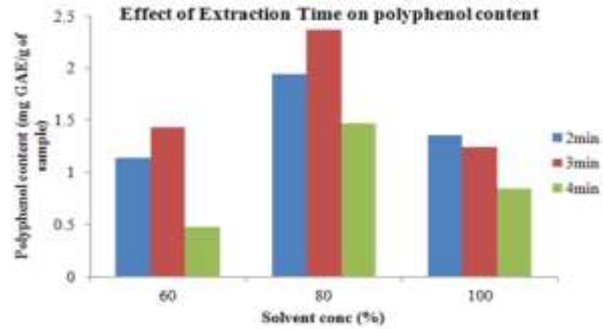


Fig. 3.2 Effect of Microwave Extraction time on polyphenol content by (a)MAE and (b)solvent extraction

Extraction time is one of the factors affecting the extraction yield. From the results, it is observed that, the polyphenol content increases with increase in extraction time and reached the maximum at 3min (Fig.3.2). This fact could be explained that, the absorption of microwave energy in the extraction system promoted by the thermal accumulation of the extraction solution leads to the dissolution of poylphenols into the solution until 3min. However, the excessive time exposure above 3min in the microwave field may cause the degradation of components (Zheng et al. 2011). So, the yield was decreased slowly beyond 3min. From the figure 3.2. it is observed that the yield was higher by MAE than the solvent extraction due to the above said facts.

3.3. Effect of Solvent concentration on polyphenol content

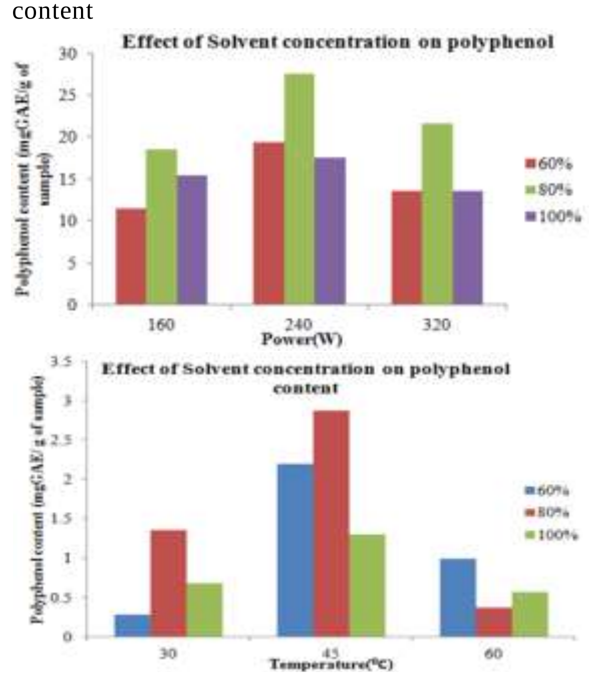


Fig. 3.3 Effect of Microwave Extraction time on polyphenol content by (a) MAE and (b)solvent extraction

Ethanol was used as a solvent and the concentration of 60,80,100% was taken for experimental analysis. 60% ethanol was carried out which showed the minimum yield, due to dissipation factor. And the polyphenol content increased till 80% due to the polarity of ethanol with high dielectric constant and high dissipation factor (Zheng et al. 2013) (Fig 3.3). At 100%, the ethanol was evaporated to the environment rapidly when exposed to microwave power, the extracted solution was less which therefore leads to less yield. From the result it was observed that the yield was higher by MAE than the solvent extraction due to the absorption of microwaves.

3.4. Optimization

Optimization is the condition of input variables to give maximum yield. Based on the experimentation results, the optimized conditions for maximum extraction yield of 37.2mgGAE/g of sample is 80% ethanol concentration and 240W power for 3min of extraction time with the condition of process parameters as within the levels and the response as maximum.

4. CONCLUSION

In this study, the effect of process variables such as microwave power, time and solvent concentration on the extraction of polyphenols from Eclipta prostrata was studied. The influence of microwave power, time and solvent concentration on the yield showed similar trend with an initial increase up to certain level and then decreased. To compare, MAE and solvent extraction (maceration) was carried out. It was found that the microwave assisted sample showed higher yield than the macerated sample. Polyphenol compounds recovered from Eclipta prostrata by MAE seem to be a promising material for food industries to enhance the functional properties of different food products. Future prospects can be studied by optimizing the solvent to feed ratio for efficient and higher yield.

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