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Efficacy of some variables of extraction to the total phenolic and flavonoid content in young mango (*Mangifera indica* L.) leaf

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Abstract

Extract from mango (*Mangifera indica* L.) leaves has different antioxidant, anti-inflammatory and immunomodulatory properties. Tea prepared from *M. indica* leaves has a great potential as sources of mangiferin. Our research investigated the effectiveness of ethanol concentration, extraction duration and temperature to the total phenolic content (TPC) and total flavonoid content (TFC) in young mango leaves. Our results showed that all extractions had significant effect on the total phenolic content (TPC) and total flavonoid content (TFC) in this valuable herbal source. The optimal parameters were noticed at 60% ethanol for 75 min at 55°C to get the highest TPC and TFC. This finding gave a basic foundation for further experiments in production of instant soluble forms originated from this therapeutic leaf.

1. Introduction

Mango tree (*Mangifera indica* L.) has been popularly cultivated in Vietnam. The leaves are simple alternately arranged, 15-45 cm in length. The phytochemical contents and medicinal values of mango (*M. indica*) leaves contained bioactive compounds comprising mangiferin, coumarin, sesquiterpenoids, triterpenoids, alkaloids, flavonoids, saponins, tannins and phenols (Nunez-Selles, 2005; Donatus Eber Okwu and Vitus Ezenagu, 2008; Dhuha Alshammaa, 2016; GM Masud Parvez *et al.*, 2016; Olasehinde *et al.*, 2018). They were useful in vitiated conditions of cough, hiccup, hyperdipsia, burning sensation, hemorrhages, haemoptysis, haemorrhoids, wounds, ulcers, diarrhoea, dysentery, pharyngopathy, scorpion sting and stomachopathy (Adesegun and Coker, 2001; Pintu and Arna Pal, 2014). The aqueous young leaves extract of *M. indica* could be utilized in the management of gastro-intestinal disorders and its effect could be potentiating as required (Pintu and Arna Pal, 2014). Natalia Medina Ramirez *et al.* (2016) evaluated the chemical composition of teas prepared from *M. indica* leaves, their potential use as a source of mangiferin and their total phenolic compounds. Young leaves of mango (*M. indica*) could be dried into herbal tea for aqueous extraction (Nguyen Phuoc Minh *et al.*, 2018). With the purpose of utilization of phytochemical constituents

extracted from the young mango leaves, our present study focused on some major technical parameters influencing to the stability of antioxidant components during solvent extraction.

2. Materials and Methods

2.1 Material

Young mango leaves were collected from gardens in Tien Giang province, Vietnam. After collecting, they must be conveyed to laboratory for experiments. They were washed under tap water to remove foreign matters and dripped excess water before extraction. Chemical substances such as Folin-Ciocalteu reagent, sodium carbonate anhydrous, gallic acid, sodium nitrite, aluminium chloride, catechin were all supplied from Rainbow Trading Co. Ltd., Vietnam. UV-spectrophotometer was used for measurement.

2.2 Researching procedure

Young mango leaves were extracted by Soxhlet extractor with different ethanol concentrations (50, 55, 60, 65, 70%) at different extraction time (30, 45, 60, 75, 90, 105 min) and different extraction temperature (40, 45, 50, 55, 60, 65°C). The control sample was based on distilled water. The best ethanol concentration, extraction duration, extraction temperature were defined *via* TPC and TFC values.

2.3 Chemical analysis

Total phenolic content (TPC, mg GAE/100 g) was determined by the method of Li *et al.* (2008). Total flavonoid content (TFC, mg CE/100 g) as determined by application of a method described by Ozsoy *et al.* (2008).

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2.4 Statistical analysis

The experiments were run in triplicate with three different lots of samples. Statistical analysis was performed by the Statgraphics Centurion XVI.

3. Results

3.1 Effect of ethanol concentration to the stability of antioxidant components extracted from young mango leaves

Ethanol was safer, less toxic and more efficient as compared to other organic solvents. The highest significant total phenolic content (TPC, mg GAE/100 g) and total flavonoid content (TFC, mg CE/100 g) were noticed at 60% ethanol, while control treatments showed the lowest TPC and TFC (Table 1).

Table 1: Effect of ethanol concentration (%) to TPC (mg GAE/100 g) and TFC (mg CE/100 g) extracted from young mango leaves

Parameter	Ethanol concentration (%)					
	Control	50	55	60	65	70
TPC (mg GAE/100g)	14.29 ± 0.01 ^d	19.94 ± 0.03 ^c	22.34 ± 0.02 ^{bc}	27.48 ± 0.00 ^a	26.03 ± 0.02 ^{ab}	25.26 ± 0.03 ^b
TFC (mg CE/100g)	3.37 ± 0.02 ^d	7.42 ± 0.00 ^c	8.95 ± 0.01 ^{bc}	10.47 ± 0.03 ^a	9.89 ± 0.03 ^{ab}	9.16 ± 0.02 ^b

Note: The values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant ($\alpha = 5\%$).

Table 2: Effect of extraction duration (min) to TPC (mg GAE/100 g) and TFC (mg CE/100 g) extracted from young mango leaves

Parameter	Extraction duration (minutes)					
	30	45	60	75	90	105
TPC (mg GAE/100g)	27.48 ± 0.00 ^d	29.54 ± 0.03 ^{cd}	31.63 ± 0.02 ^c	34.57 ± 0.01 ^a	33.84 ± 0.03 ^{ab}	33.07 ± 0.01 ^b
TFC (mg CE/100g)	10.47 ± 0.03 ^d	11.04 ± 0.01 ^c	11.87 ± 0.00 ^{bc}	12.89 ± 0.02 ^a	12.74 ± 0.00 ^{ab}	12.31 ± 0.02 ^b

Note: The values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant ($\alpha = 5\%$).

Table 3: Effect of extraction temperature (°C) to TPC (mg GAE/100 g) and TFC (mg CE/100 g) extracted from young mango leaves

Parameters	Extraction temperature (°C)					
	40	45	50	55	60	65
TPC (mg GAE/100g)	34.57 ± 0.01 ^d	36.27 ± 0.03 ^{cd}	37.85 ± 0.01 ^b	39.71 ± 0.02 ^a	37.14 ± 0.03 ^{bc}	36.85 ± 0.00 ^c
TFC (mg CE/100g)	12.89 ± 0.02 ^c	13.28 ± 0.00 ^{bc}	13.87 ± 0.01 ^{ab}	14.27 ± 0.00 ^a	13.65 ± 0.02 ^{ab}	13.47 ± 0.03 ^b

Note: The values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant ($\alpha = 5\%$).

4. Discussion

The phenolic stability from *M. indica* was investigated by various ethanol concentration (0-100%, v/v). The optimal conditions for phenolic recovery were noticed at 40% ethanol (Chew *et al.*, 2011). It is obviously demonstrated that the binary-solvent was more effective than the single-solvent in the phenolic extraction (Chirinos *et al.*, 2007; Silva *et al.*, 2007; Spigno *et al.*, 2007; Wang *et al.*, 2008). In another research, the maximum concentration of phenolic compounds was achieved from *M. indica* at optimal extraction time 60 min (Chew *et al.*, 2011). The extended extraction duration would cause an exposure of abundant oxygen and, thus accelerate more chances for oxidation of phenolic constituents (Nacz and Shahidi, 2004; Chirinos *et al.*, 2007) as well as the possibility of destruction by endogenous enzymes (Kuljarachanan *et al.*, 2009). In another research, heat was found to enhance the recovery of phenolic compounds from *C. asiatica* at the optimal temperature 65°C (Chew

3.2 Effect of extraction duration to the stability of antioxidant components extracted from young mango leaves

Extraction duration is very important in decision of energy consumption and cost of the extraction assay.

The highest significant total phenolic content (TPC, mg GAE/100 g) and total flavonoid content (TFC, mg CE/100 g) were noticed at 75 min, while treatments with 30 min showed the lowest significant TPC and TFC (Table 2).

3.3 Effect of extraction temperature to the stability of antioxidant components extracted from young mango leaves

The highest significant total phenolic content (TPC, mg GAE/100 g) and total flavonoid content (TFC, mg CE/100 g) were noticed at 55°C, while treatments at 40°C showed the lowest significant TPC and TFC (Table 3).

et al., 2011). Accelerated thermal treatment could improve the phenolic extraction by speeding up both diffusion coefficient and solubility of phenolic compounds in extraction solvent (Al-Farsi and Lee, 2008; Lim and Murtijaya, 2007; Silva *et al.*, 2007). Thermal treatment was able to break down cellular components and release the bounded phenolics (Wang *et al.*, 2008). However, harsh temperature likely decomposed the phenolics (Chan *et al.*, 2009; Liyana-Pathirana and Shahidi, 2005).

5. Conclusion

Young mango leaves had various biological effects as an antioxidant and anti-inflammatory agent. It is interesting to investigate some major factors possibly affecting to the total phenolic and flavonoid content during solvent extraction. Our results revealed that ethanol concentration, extraction duration and temperature had significant influence to the total phenolic and flavonoid retention of the antioxidant stability.

Conflict of interest

The author declared that there is no conflicts of interest in the course of conducting the research. The author has final decision regarding the manuscript and decision to submit the findings for publication.

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