

Optimization Processing Parameters for *Curcuma xanthorriza* Oleoresin Yield and its Antioxidant Activity

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Abstract: Processing is a critical aspect of herbal based products, and processing method is known to affect the content, activity and bioavailability of bioactive compounds. Extraction of oleoresin from *Curcuma xanthorriza* is effected by several processing parameters. Appropriate solvent selection such as polar solvent result in better extraction yield while lower polarity solvent end up with extracts having higher concentration of active compounds. In this study, different processing parameters were carried out including blanching treatment (boiled, steamed) at range of time (24 hours, 48 hours and 72 hours), solvent of extraction (methanol, ethanol and acetone). The curcuminoid content and antioxidant activity were determined in *Curcuma xanthorriza* oleoresin. The result obtained was proved that ethanol was the most effective solvent. Blanching treatment affects the yield of oleoresin and promotes the release of curcuminoids content.

Keywords: *Curcuma xanthorriza*, optimisation, blanching, solvent, antioxidant activity.

1. INTRODUCTION

The emergence of functional food, dietary supplements which have medicinal benefits has become important for public health [1]. Herbs have been used throughout human history as source of food, medicines, beauty enhancer, and fragrances. Phytochemicals have evolved from herbalism and commonly used to define the biologically active molecules in plants however, vitamins or nutrients is not included.

Recently, there has been a considerable interest in finding natural antioxidants from plant materials to replace synthetic antioxidant in food products [2-6]. Temulawak or *Curcuma xanthorriza* is a curcuma genus belongs to the great Zingiberacea family used medicinally in Southeast Asia and also in any tropical regions. Most of the antioxidant compounds in a typical diet are derived from plant sources and belong to the various classes of compounds with a wide variety of physical and chemical properties. *C. xanthorriza* contains antioxidant properties of curcuminoids which is present in its oleoresin cells. The curcuminoids account for the yellow pigmentation in *C. xanthorriza* rhizome.

It is believed that biologically active phytochemicals and synergistic dynamics of all available chemical entities reported to have therapeutic effects to a plant or plant product [7-10]. Curcuminoids in *C. xanthorriza* consists of curcumin, 62% and desmethoxycurcumin

38%. As a results, *C. xanthorriza* exhibit strong yellow pigment colour than turmeric.

However, curcuminoids are found to exhibit antioxidant, anti-inflammatory, and anti-mutagenic properties and protects body from mutagens such as smoke and other pollutants [11]. These compositions make *C. xanthorriza* beneficial for health [12]. Other chemical composition in temulawak includes volatile oil, xanthorrhizol, camphor, cinnamaldehyde, and starch [13]

Traditionally, *C. xanthorriza* rhizome has been used for medical purposes for hundreds of year by simple preparation. The *C. xanthorriza* rhizome was boiling in oil; some people dried the leaf or dried the rhizome to treat inflammation [14]. However, this conventional processing technique may degrade the compositional content and leading to affect the quality of phytochemical as functional food materials. Curcumin is poorly bioavailable and are facilitated *via* secondary metabolites [15]. Because of curcuminoids is known for its antioxidant properties therefore, to retain the antioxidant activity is vital. For wider industrial application, the need to retain the maximum antioxidants in processed food or plant extracts is crucial mainly for food and pharmaceutical industries. The objective of this paper is to study the effect of blanching and solvent extraction on the yield of *C. xanthorriza* oleoresin and its antioxidant activity. Thus, the understanding of the effects is useful in designing a better processing technology to retain antioxidants in *C. xanthorriza* oleoresin as antioxidant source other than for its conventional use for colour, flavour and aroma.

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2. MATERIALS AND METHODS

2.1. Raw Material

Fresh dried *Curcuma xanthorriza* rhizome was procured from Pagoh, Johor State, Malaysia. The first batch (5.0 kg) of temulawak rhizomes was procured for the preliminary phase experiments. All the chemicals and standard were purchased from Sigma Aldrich (USA) and of analytical grade.

2.2. Extraction of Curcuma Xanthorriza

Extraction of oleoresin was carried out by infusion method either with ethanol, acetone or methanol for 24 hours 48 hours and 72 hours. Pre-treatment was carried out prior extraction includes boiled for 1 hour or steamed for 15 mins, untreated (control). The oleoresin extracts were filtered and the solvents were removed, respectively. Each sample was then kept in an amber bottle at room temperature (25 °C ± 2) for subsequent experiment.

2.3. Yield of Oleoresin

Yield of oleoresin was determined based on the initial mass of raw material

2.4. Quantitative Analysis of Curcuminoids

Curcumin content was determined by modified method [16] using spectrophotometer (Genesys10UV, Spectrosonic Unicam), with glass cuvettes (Sterna, Essex, UK) at 425nm of wavelength. The determination of curcuminoids content was carried out using Thin Layer Chromatography (TLC) and qualitatively using dual UV detector wavelength 254/365 nm (Cole Parmer 9818 Series, Illinois).

The amount of curcumin [15] was calculated using Equation 1.0.

$$\text{Amount of curcumin (g)} = \frac{A \times y \times F}{1\text{cm}} \times 100$$

where,

A = Absorbance
y = Amount of sample
F = Correlation factor

$$\frac{A}{1\text{cm}} \times 100 \text{ Curcumin} = 1607 \text{ (2)}$$

2.5. Antioxidant Activity

A modified of the DPPH method [17] was used for the determination of antioxidant activity. A 1.5 ml of DPPH solution (300 µm in 95 % ethanol) was added to

0.75 ml oleoresin. After that, the mixture was shaken vigorously and left in the dark at room temperature for 20 minutes. 5 ml BHT was used as a standard. Finally, the absorbance at 517 nm was read from the spectrophotometer (Genesys10UV, Spectrosonic Unicam). The percentage (%) radical scavenging activity was calculated as below.

Radical Scavenging activity (%) =

$$\frac{\text{Absorbance of control} - \text{Absorbance } t=20 \text{ min}}{\text{Absorbance of control}} \times 100$$

3. RESULTS AND DISCUSSION

3.1. Effect of Pre- Treatment

The results shows that the amount of *C. xanthorriza* oleoresin obtained from the experiment vary according to the type of solvent use and extraction time. Figure 1 shows the comparative on the value of *C. xanthorriza* oleoresin obtained with different types of solvent use (acetone, ethanol and methanol) and at different duration of extraction process (24, 48 and 72 hr), respectively. Based on the results, steamed samples exhibit higher yield of oleoresin which approximately 20.8%. However, boiling sample resulted a lower yield of oleoresin (15.8%) than untreated samples which was 16.6% yield of oleoresin. Hence, steamed blanching treatment enhances the to extraction of oleoresin. The highest yield of oleoresin was obtained at 24 hours of steamed blanching treatment. Steaming causes the break up the oleoresin cells in cell matrix and facilitates the rapid release of oleoresin containing curcuminoids. Therefore, more oleoresin was released into the surrounding area. The results indicate that blanching treatment was pronounced to increase the oleoresin containing curcuminoids. Despite increased the oleoresin; blanching treatment also potentially increased the superficial area available for mass transfer leading to increase the yield.

3.2. Effect of Solvent on Extraction Yield

Many factors contribute to the efficacy of the solvent extraction, such as the type of solvent, the pH, the temperature, the number of steps, the liquid-to-solid ratio, and the particle size and shape of the plant matrix [18]. From the results in Figure 2 methanol give the highest yield followed by acetone and ethanol. The overall yield results indicate that methanol was more effective in extracting oleoresin from *C. xanthorriza* compared to acetone and ethanol. The maximum yield of oleoresin obtained was 41.8% (w/w). The result

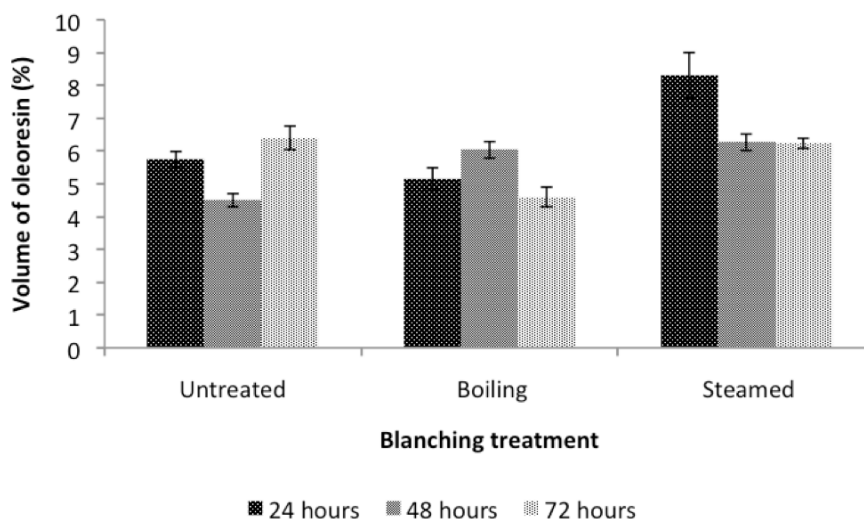


Figure 1: Yield of oleoresin (%) using type of time and blanching treatments at different time.

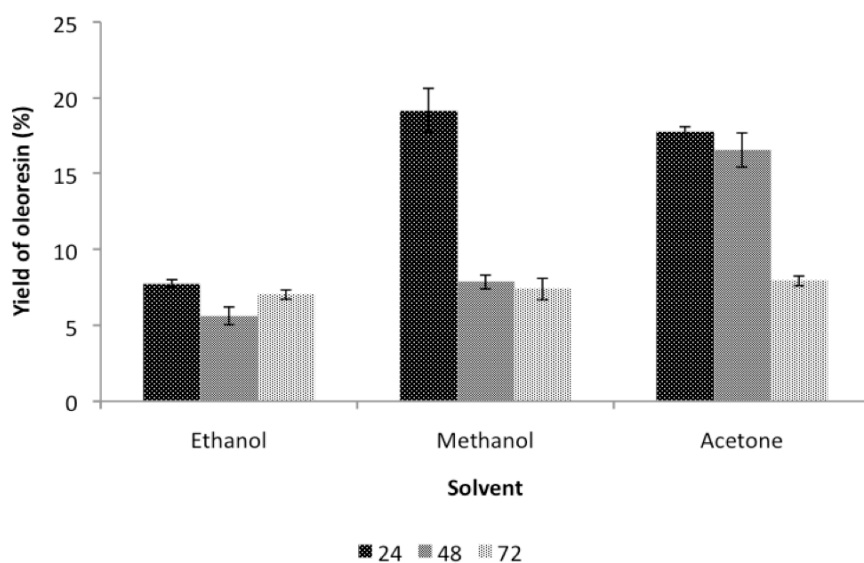


Figure 2: Yield of oleoresin using different solvent at different extraction time.

indicates that the suitable time for the extraction process is at 24 and 48 hours and under these conditions the value of oleoresin obtained was higher. Therefore, this suggests that there would be two different appropriate strategies of extraction. One is for extracting optimum antioxidant properties from the whole oleoresin and the other is for the optimum yield of oleoresin itself without consideration of antioxidant properties.

Addition of water to ethanol improved extraction rate [19] however, high water content may increase concomitant extraction of other compounds [20]. This suggesting that only different amount of antioxidant activity was obtained but not different compounds were recovered.

A chromatographic method for qualitative analysis was carried out in this work. Methanol gives higher R_f values which is 0.7653 at 24 hours of extraction time, 0.6837 for ethanol at 48 hours and acetone 0.5155 for 24 hours. These results suggested that the blanching treatments studied did not qualitatively affect the presence of curcuminoids in the processed *C. xanthorrhiza* oleoresin. Therefore, blanching treatment preserve the antioxidant property.

3.3. Curcuminoid Content in *C. xanthorrhiza* Oleoresin

For quantitative analysis of curcumin content in *C. xanthorrhiza* oleoresin, the value was determined as % of curcumin content based on the standard curcumin calibration curve [21]. Curcuminoids are contained in

Table 1: Curcuminoid Content in *C. xanthorrhiza* Oleoresin by Spectrophotometer Method

Type of solvent	Extraction time	Curcuminoid content (%)
Acetone	24	0.054 ± 0.003
	48	0.052 ± 0.001
	72	0.036 ± 0.002
Ethanol	24	0.034 ± 0.002
	48	0.069 ± 0.005
	72	0.100 ± 0.003
Methanol	24	0.012 ± 0.001
	48	0.011 ± 0.002
	72	0.008 ± 0.002

the oleoresin cells [22]. The curcumin content in *C. xanthorrhiza* oleoresin by spectrophotometer method [21, 22] is display in Table 1. Based on results, the minimum curcumin content (0.007 %) was extracted with methanol at 72 hours of extraction time. Extraction using ethanol as a solvent gives maximum curcumin content (0.01 %) at 72 hours of extraction time. The extraction using ethanol results in maximum curcumin content which is 0.20 % while extract curcumin with methanol results in minimum curcumin content (0.003 %).

3.4. Antioxidant Activity of Curcuminoids

The antioxidants play an important role in protection against disorder cause by oxidant damage [23]. In this study, curcumin is the active compound that contributes to the antioxidant activity [24]. Higher DPPH radical scavenging value, which indicates higher

antioxidant activity, was found for ethanol (18.31 %) and acetone (38.75 %) extracts. These values also are higher than the antioxidant activity for butyl hydroxyl toluene (BHT). Acetone extract shows the strongest DPPH radical scavenging activity at 16.28 %. This proves that solvents with a polarity between acetone and ethanol are good in extracting curcumin content in *C. xanthorrhiza* extract. Curcumin is responsible for the antioxidant activity of *C. xanthorrhiza* extract. Further work need to be done for the up-scaling the extraction to obtain the curcuminoid content [25].

CONCLUSION

Based on the results obtained, retention of antioxidants during processing can be achieved best using fresh materials with ethanol as solvent for extraction. Blanching treatments increase the yield of oleoresin but decreases the antioxidant activity. The

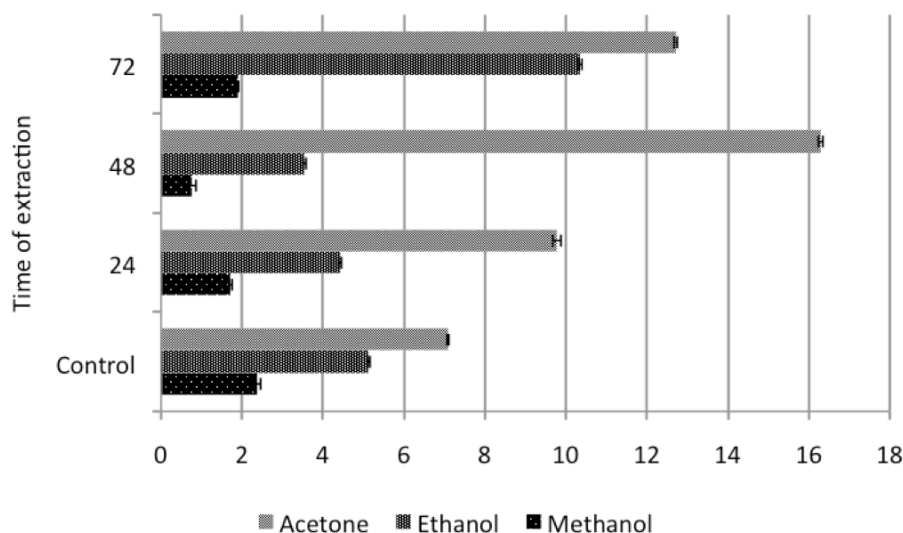


Figure 3: The comparison of antioxidant activity of *C. xanthorrhiza* oleoresin indicated by DPPH radical scavenging activity measured in inhibition percentage (IP) compared to synthetic antioxidants (BHT).

results suggest that fresh material is preferred over blanched samples due to its convenience to use and a higher content of bioactive compounds as well as a higher antioxidant activity. This property can be highlighted as an additional advantage taking into account that ethanol unlike acetone or methanol is generally considered GRAS (Generally Recognized as Safe).

It is important to determine the effect of processing on bioactive compounds so that processing time and temperature can be optimized to keep functionality of the active compounds. Since longer extraction time would also result in higher yield and curcumin content, the most appropriate processing parameters for retention of antioxidant activity should be determined.

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