Int. j. adv. multidisc. res. stud. 2022; 2(4):293-296

Received: 25-05-2022
Accepted: 05-07-2022

International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

The Effect of Different Plant Parts and Solvent Extraction on Chemical Content and Quercetin Levels of Ketapang (*Terminalia cattapa* L.)

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Abstract
Ketapang has flavonoid content that is quercetin. The appropriate solvent can attract the active compound of quercetin on ketapang. The selection of solvents adjusts different levels of polarity with the aim of obtaining the best solvent. Differences in plant parts can also affect the amount of quercetin levels. This study aims to determine the difference between plant parts and extraction solvents to the quercetin levels of ketapang plants. Simplisia fruit and leaves ketapang made by winding. Maceration is carried out on each fruit and leaves of ketapang using 3 different solvents namely n-hexane, ethyl acetate, and ethanol 90%. The viscous extract obtained was analyzed for yield value and the phytochemical screening test was do qualitatively. Quercetin level measured by UV-Vis Spectrophotometry at a maximum wavelength of 375.6 nm. The absorbance value obtained is entered into the standard quercetin curve equation with the equation y=0.0885x+0.0037. The results of the yield value of ketapang leaf and fruit extracts with each different type of solvent resulted in different yield values, as well as the results of phytochemical screening and percent quercetin levels obtained. Analysis of the results concluded that differences in solvents and plant parts affected the yield value, chemical content and percent content of quercetin in ketapang plants.

Keywords: *Terminalia cattapa* L., Yield Extract, Phytochemical, Quercetin

1. Introduction
Ketapang (*Terminalia catappa* L.) is a plant that thrives in the lowlands to highlands, coastal forests, swamp forests, and river flows [1]. Phytochemical tests established that all extracts contained alkaloids, flavonoids, saponins, phenols, and terpenoids [2]. Part of the plant is one of the factors that affect the extract results obtained. Different plant parts can affect the pharmacological activity of *Annona squasmosa* extract [3]. Other studies also mention that plant differences can affect the antioxidant activity of *Lantana camara* [4]. Different types of solvents used during extraction can provide different content of bioactive compounds [5, 6].

Quercetin (*3,3',4',5,7-pentahydroxy-2-phenylchromen-4-one*) is a class of flavonoid compounds from subclass flavonol. Quercetin is found in several plants, including onnion (*Allium cepa* L.), asparagus (*Asparagus officinalis* L.), red lettuce (*Lactuca sativa* L.), tamarind (*Tamarindus indica* L) and Ketapang (*Terminalia catappa*) [7, 8]. Quercetin levels can be determined by UV spectrophotometry at a wavelength of 361.8 nm [8].

This study aims to determine the effect of differences in plant parts and extraction solvents on the yield value, chemical content of quercetin content of the ketapang plant. The research function is to determine the effective solvent so that the level of quercetin produced can be maximized, besides that it can determine the difference in the levels of quercetin in the fruit and leaves of ketapang.

2. Materials and methods
Materials and tools
The materials used in this study were leaves and fruit of ketapang, ethanol 90%, n-hexane, ethyl acetate. Analysis quercetin was performed using UV-Vis Spectrophotometry (Genesys 10s).

Ketapang Extraction
One kg of ketapang fruit and leaves each cut into small pieces and then dried by aerating then blended to form a powder. The fruit and leaf powders were macerated using 3 solvents, namely n-hexane, ethyl acetate, and ethanol 90% for 3x24 hours. The filtrate obtained from each solvent then concentrated using the wind dry method. The obtained extracts were calculated and

analyzed for their yield values.

Qualitative phytochemical analysis
Phytochemical screening tests carried out included tests for alkaloids, flavonoids, saponins, terpenoids, and tannins.

a. Identification of alkaloids
Sample dissolved in a few drops of hydrochloric acid 5%, after mixing and filtering, two aliquots were taken. Drops of Wagner and Dragendorff reagents were added to each, if it contains alkaloid it will change to a red-brown precipitate (Wagner) or red–orange precipitate (Dragendorff) [9].

b. Identification of flavonoids
Sample was dripped with 3 drops of 10% NaOH solution, if it contains flavonoids, it will change color to red (orange red) [9, 10].

c. Identification of saponins
Sample was put into a test tube then added 10 mL of distilled water and then shaken for 30 seconds, observed the changes that occurred. If a solid foam is formed (not lost for 30 seconds), identification indicates the presence of saponins [11].

d. Terpenoid identification
Sample has been dissolved in 96% ethanol added with 3 drops of chloroform solution and 3 drops of anhydrous acetic acid. Furthermore, 3 drops of concentrated sulfuric acid are added through the tube wall, producing a red-purple color if it contains triterpenoids, if it contains sterols, it will produce a blue-green color [9].

e. Identification of tannins
Sample dissolve in ethanol then drops $FeCl_3$ 3% reagent. Formation of a blue or green color indicating a material containing a tannin component [9, 12].

Preparation of quercetin standard curve
The standard solution of quercetin whose absorbance will be measured was made in various concentrations, namely 0.5 ppm, 1 ppm, 2 ppm, 4 ppm, 6 ppm, 8 ppm, 10 ppm, and 12 ppm. Absorption measurements were carried out with a maximum wavelength of 375.5 nm.

Measurement of quercetin content in ketapang extract
Ketapang fruit and leaf extracts were weighed as much as 10 mg, each diluted with 1 ml of ethanol p.a. 100 l of the solution was taken and put into a 10 ml volumetric flask, then add ethanol p.a to the mark. The dilution of the solution was carried out to a concentration of 100 ppm. The sample solution that had been diluted to a concentration of 100 ppm was measured for absorbance using UV-Vis Spectrophotometry at maximum waves. Checking the sample solution was made in 3 replications [8].

3. Results and discussion
The yield of the extract produced in this study is a comparison between the weight of the extraction result and the weight of the raw materials used for the extraction process. The results of extract yields in Table 1 show that leaf extracts with ethanol 90% solvent obtained extract yield values compared to leaf extracts with n-hexane and ethyl acetate solvents. This indicates that differences in plant parts and types of solvents affect the yield value of the resulting extract.

Table 1: The results of the yield value of the leaf and fruit extract of Ketapang

Solvent	Extract Yield (%)	
	Leaf	Fruit
Ethanol 90%	5,20 ± 0,15*	4,02 ± 0,48*
Ethyl acetate	2,85 ± 0,11*	1,16 ± 0,02*
n-Hexane	2,25 ± 0,18*	0,71 ± 0,49*

*There are significant differences between solvent groups and plant parts

Based on the solvent used, it is known that the higher the polarity level of the solvent, the higher the yield of the extract obtained [12]. This study showed that from the three solvents, it was found that the type of solvent ethanol 90% in the leaves showed the highest yield which gave the greatest yield compared to the types of n-hexane and ethyl acetate solvents. This is because the ethanol solvent has a high polarity so that it can produce more yields than other solvents [13]. The factor that affects the extract yield value is the higher the amount of solvent used, the more optimal the release of the target compound into the solvent can be and the solvent saturation can also be avoided. However, after the amount of solvent is increased by a certain amount, the increase in yield is relatively small and tends to be constant.

Table 2: Phytochemical screening of ketapang leaves and fruits

Group of compounds	Leaf			Fruit		
	EtOH	EtAc	Hex	EtOH	EtAc	Hex
Alkaloids	+[a]	-	-	+[b]	-	-
Tannins	+	-	-	-	-	-
Saponins	-	-	-	-	-	+
Flavonoids	+	-	-	+	-	-
Terponoids	+	+	+	-	-	-

Notes: (+): positive; (-): negative; EtOH: Ethanol 90%; EtAc: Ethyl Acetate; Hex: n-Hexane
[a]positive on Wagner's test
[b]positive Dragendorff's test

The results of phytochemical screening in Table 2 are known to get different results for each extract. Different phytochemicals show their presence in different solvents. The results of phytochemical screening on leaf extracts showed the presence of alkaloids, tannins, flavonoids, and terpenoids in the ethanol extract, and terpenoids in the n-hexane and ethyl acetate extracts. The fruit extract showed positive results for alkaloids and flavonoids in the ethanol extract, saponins in the n-hexane extract, and no positive results in the ethyl acetate extract. This shows that the part of the plant affects the different chemical compounds contained in a plant.
The differences in the results of phytochemical screening can be influenced by environmental factors where they grow, which vary in influencing the growth of plants of the same type, including the chemical content of the compounds they produce, both in terms of quantity and in terms of composition [14]. The phytochemical content of secondary metabolites such as flavonoids from a plant will be different in each region because it is influenced by several environmental factors including light, temperature, pH and altitude where it grows which will affect the phytochemical content of a plant [5]. Ethanol as a solvent in the extraction of a plant can extract many secondary metabolites [13]. The

polarity of the solvent can affect the yield of the chemical compounds contained. A compound will dissolve well in solvents that have the same polarity. This shows that the compounds in the leaves and fruits of ketapang have a polarity close to ethanol 90%, because the yield of the compound is based on the similarity of polarity with the solvent.

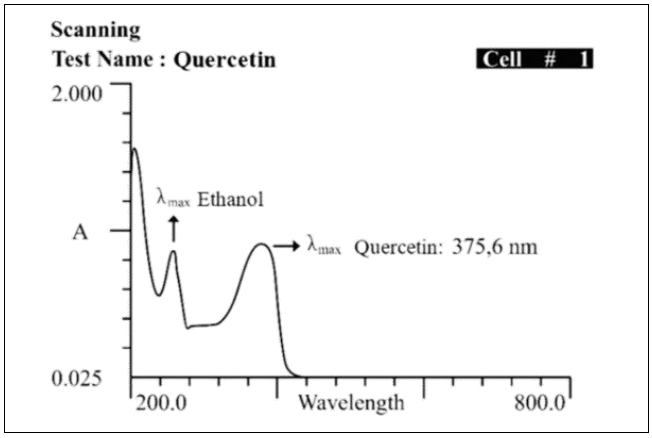
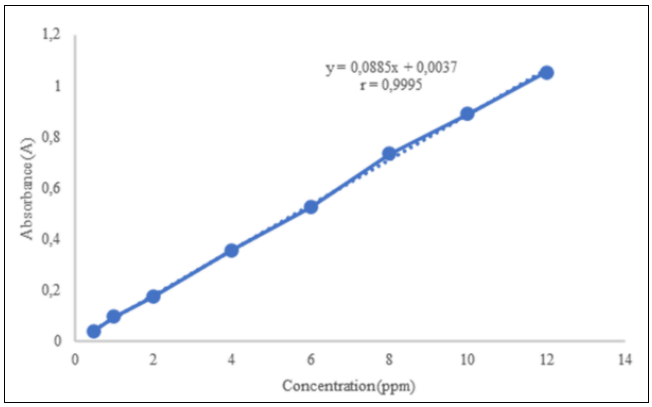


Fig 1: Quercetin Maximum Wavelength

The maximum wavelength of quercetin obtained was 375.6 nm (Fig. 1). In other research showed the results of the quercetin wavelength of 361.8 nm [8], while the other peaks show the wavelength of the ethanol solvent [15]. Ethanol has a wavelength of 210 nm [16] so that it can be seen that ethanol does not interfere with the absorbance of quercetin.



Fig, 2: Quercetin Standard Curve

The standard curve in Fig. 2 is made by measuring quercetin standards with concentrations of 0.5 ppm, 1 ppm, 2 ppm, 4 ppm, 6 ppm, 8 ppm, 10 ppm and 12 ppm. Determination of the absorbance of standard solutions by Lambert-Beer law, namely the higher the concentration, the higher the absorbance value because the absorbance will be directly proportional to the concentration of the substance contained in the sample [15].

Calculation of the standard curve using the form of a linear regression equation, namely y = bx + a, the results obtained are y = 0.0885x + 0.0037 with a value of r (correlation coefficient) of 0.9995. The value of r shows the linearity relationship between 2 variables. The value of r close to 1 indicates a linear calibration curve so that there is a relationship between the concentration of the quercetin solution and the absorption value [8]. The results of the measurement of quercetin levels in 10 mg extract using ethyl acetate solvent were greater than ethanol 90% and n-hexane solvents (Table 3).

Table 3: Quercetin content of ketapang fruit and leaf extract

Solvent	Quercetin Level (ppm)	
	Leaf	Fruit
Ethanol 90%	4,557 ± 0,141*	0,998 ± 0,060*
Ethyl acetate	6,528 ± 0,307*	1,732 ± 0,157*
n-Hexane	0,938 ± 0,102*	0,493 ± 0,058*

*There are significant differences between solvent groups and plant parts

Solubility of quercetin will be better in the ester and acid groups compared to alcohol groups such as ethanol, propanol and butanol [17]. This statement is in line with research showing that the concentration of quercetin content of ketapang fruit and leaves using ethyl acetate as solvent is higher than using ethanol 90% and n-hexane as solvent.

4. Conclusions

The results of the yield value of ketapang leaf and fruit extracts with each different type of solvent resulted in different yield values, as well as the results of phytochemical screening and percent quercetin levels obtained. Analysis of the results concluded that differences in solvents and plant parts affected the yield value, chemical content and percent content of quercetin in ketapang plants.

5. Acknowledgements

Thanks to the Ministry of Education and Culture-Research and Technology of the Republic of Indonesia for funding this research through a Research Grant for Beginner Lecturers in 2021.

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