

## Original Research Article

# Effects of Various Solvents on the Extraction of Bioactive Compounds and Antioxidant Activity from the Peels of Lotkon (*Baccaurea Motleyana Müll. Arg.*) and Longan (*Dimocarpus Longan Lour.*)

### ABSTRACT

The objectives of this study was to investigate how three types of solvent (ethanol, methanol, and acetone) affected the yield of total phenolic content (TPC), total flavonoids content (TFC) and DPPH radical scavenging activity of extracts from lotkon and longan peels. The results showed that the 50% methanol extracts for longan peel displayed the highest levels of TPC, TFC, and DPPH free radical scavenging activities. The TPC varied for lotkon and longan peels extracts from  $121.63 \pm 0.29^j$  to  $425.55 \pm 0.19^a$  mg GAE/100g dry weight; TFC from  $6.47 \pm 0.37^g$  to  $86.24 \pm 0.11^a$  mg QE/100g dry weight and DPPH radical scavenging activity from  $25.84 \pm 0.01^j$  % to  $60.01 \pm 0.02^a$  %. These findings showed that total phenolic compounds as well as antioxidant activity were significantly influenced by solvents with various levels of polarity. It was determined that the recovery of bioactive components and antioxidant activity of lotkon and longan peel extracts are significantly influenced by the extraction solvent and its subsequent concentrations. The findings of this study serve as a valuable guide for the food sector in determining the ideal conditions for extracting antioxidants and desirable phenolic compounds from lotkon and longan peels, as well as a solid foundation for more research in the future.

**Keywords:** antioxidant; extraction solvent; phenolic substances; lotkon and longan peels.

### 1. INTRODUCTION

Lotkon (*Baccaurea Motleyana Müll. Arg.*) is one of the most widely consumed fruits in Bangladesh and is a species of the Phyllanthaceae tribe. Lotkon is a significant evergreen, sluggish, dioecious fruit tree native to tropical and subtropical regions. Longan (*Dimocarpus Longan Lour.*), sometimes referred to as Kath Lichu regionally is a popular fruit that originates from China and Southeast Asia that is a subtropical evergreen tree from the Sapindaceae tribe. Due to the juicy and rich acidic flesh of longan, it is widely prized for its distinctive taste and flavor and is denoted as a snack eaten frequently [18]. According to S. Srumsiri and P. Silman [15], longan contains approximately 12.4-19.6% peel. While lotkon contains approximately 36.11% peel of the whole weight [12]. According to Rakariyatham et al. [13], the peels of longans were found to contain more than 50 phenolic chemicals. Phenolics, flavonoids, tannins, related hydrolysis products, and variations are among the various types of phenolic chemicals. As stated by Nurmayani et al. [14], the fruit and its peel both contain antioxidants and phenolics, two naturally occurring protectors, in addition to the lotkon's nutritional and dietary worth. The major bioactive compounds present in lotkon peel are polyphenols, flavonoids, and tannins [8].

These bio-wastes can be used to make these antioxidants for practical use because longan and lotkon peels are both abundant sources of bioactive substances, and phenolic compounds are well known for their health benefits related to antioxidant properties as well as their potential application in food processing industries as bio preservatives that enable

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Effect of different solvents and their purity on TPC, TFC and antioxidant activity of Lotkon ....and...

**Comment [e2]:** Results must be according to statistic analysis

**Comment [e3]:** Are Lotkon and Longan the same Family? Please mention.

Why preference of solvent is urgent?  
What do you expected with 3 different solvents with some different purity? Elaborate more, with some examples in other plant species

the production of food without synthetic chemicals for consumers [9]. Numerous investigations showed that the kind of solvent used has a significant impact on whether bioactive chemicals may be successfully extracted from plant material. Solvent diffuses into the solid plant material during extraction, solubilizing substances of a comparable polarity [11].

The polarity of the solvents was important to the extraction process, according to Alothman et al. [3] since it boosted the total solubility of antioxidant compounds. According to Muhamad et al. [10], the extraction parameters and solvent polarity had an impact on the antioxidant, total flavonoid, and total phenolic content yields from fruit extract. There is a lack of research comparing how various solvents affect the extraction and antioxidant activity of longan and lotkon peel extract.

This study aims to assess the effects of solvent type and polarity on the yields of total bioactive components and antioxidant activity in extracts of longan and lotkon peels.

**Comment [e4]:** Give some examples of this research in some plant species

**Comment [e5]:** Why so important? Give some examples in different species

**Comment [e6]:** No data presented, only flavonoid and phenol

## 2. MATERIAL AND METHODS

### 2.1 Chemical reagent

Aluminum chloride, sodium hydroxide, ethanol, acetone, Follin's reagent were bought from Merck (Darmstadt, Germany). All others chemicals and reagents used in the study were of analytical grade.

### 2.2 Sample preparation

From the Jashore area of Khulna, Bangladesh, fruit samples of the lotkon (*Baccaurea Motleyana Müll. Arg.*) and longan (*Dimocarpus Longan Lour.*) were collected. The fruits were picked out because of their similar sizes and appearances. The peels were hand detached after the fruits had been carefully cleansed with distilled water. They were dried in an oven (Hanyang Scientific Equipment Co. Ltd.) before being ground into powder in a lab mill (FW100, Taisite Instrument Co., Ltd, Tianjin, China). The supplies were stored in a desiccator at room temperature before to use.

**Comment [e7]:** This is unclear. What size? Ripe fruit?

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### 2.3 Extraction Procedures

With a small adjustment, extracts from samples of lotkon and longan fruits were made using the technique outlined by Addai et al. [1].

Using the maceration process, antioxidant and bioactive chemicals were extracted from fruit samples. For this procedure, 10 ml of solvent (1:10 w/v) was applied to universal bottles containing 1 gm of peel powder. Pure acetone, ethanol, and methanol are among the solvents, along with their corresponding aqueous solutions at 50% and 70% concentrations. After that, an ultra-turrax homogenizer was used to thoroughly blend the samples (peel powder with solvents) for 5 minutes. A tabletop centrifuge (DSC-200A-2, Digisystem Laboratory Instrument Inc., Taiwan) was used to centrifuge all of the extracted samples for 10 min at 3000 rpm. The supernatants were collected and stored at -20°C for further analysis.

### 2.4 Analysis

#### 2.4.1 Total Flavonoid Content (TFC)

Utilizing spectrophotometric analysis on aluminum chloride, the total amount of flavonoid was measured [5]. After being combined with 0.3 mL of 5% NaNO<sub>2</sub>, 1 mL of the sample was

diluted with 3.5 mL of demineralized water. 0.4 mL of  $\text{AlCl}_3$  (10% w/v) was added after 6 minutes. Following the addition of 2.1 mL of 1 M NaOH, 6 minutes later, 2.7 mL of demineralized water was added right away, bringing the total to 10 mL. After thorough mixing, the solution's absorbance was determined using a standardized ultraviolet-visible spectrophotometer at 510 nm. By comparing the result to the quercetin calibration curves, which were created under the same circumstances, the result was represented in mg quercetin equivalent/100g dried sample.

#### **2.4.2 Total Phenolic Content (TPC)**

The total phenolic content was calculated using a modified Folin-Ciocalteu method [19]. Briefly, 5 ml of Folin-Ciocalteu reagent (1:10 v/v in distilled water), 4 ml of Folin-Ciocalteu reagent, and 7.5% (w/v) sodium carbonate solution were mixed with 1 ml of each extract (1 g/ml). The mixture was vortexed for 15 seconds to enhance the color before being allowed to stand at 40°C for 30 minutes. In order to measure the absorbance at 765nm, a double beam UV-Vis spectrophotometer from Thermo Scientific was used (T60, UV-Vis Spectrophotometer, USA). In place of the sample, water was used to prepare the blank. A collection of gallic acid reference solutions was used to compare a blank too. A calibration curve using gallic acid was used to determine the result as mg GAE/100g dry sample.

#### **2.4.3 Antioxidant Activity**

The modified approach reported by [16] was used to measure the stable DPPH radical-scavenging activity. In order to conduct this test, 2 ml of extract solutions in a range of concentrations were added to 2 ml of 0.1 mM DPPH solutions. The mixture was then vigorously stirred for 15 seconds. The solutions were then allowed to stand for 30 minutes at room temperature in a dark environment in order for a reaction to happen. Utilizing a twin-beam Scientific UV-Vis Spectrophotometer at 517 nm (T60, UV-Vis Spectrophotometer, USA), absorbance was measured after 30 minutes against a blank. Equation (1) was used to direct the calculation,

$$\% \text{ DPPH free radical scavenging activity} = \frac{Ab(\text{blank}) - Ab(\text{sample})}{Ab(\text{blank})} \times 100 \dots\dots\dots(1)$$

#### **2.4 Statistical analysis**

Statistical Tool for Agricultural Research (STAR) software system was used to do an ANOVA on the triplicate data at a 5% level of significance.

### **3. RESULTS AND DISCUSSION**

#### **3.1 Total phenolic content (TPC) and Total flavonoid content (TFC)**

Natural phenolics' major health benefits are mostly brought about by their antioxidant activity [6]. Table 1 demonstrates the effect of various solvent concentrations on the TPC and TFC of extracts of lotkon and longan peels. The findings demonstrated that longan peel extract had significantly more total phenolic and flavonoid contents than lotkon peel extract ( $p < 0.05$ ). Fruit peel extracts from the lotkon and longan fruits increased in total phenolic and flavonoid components when the solvent's polarity was increased. When compared to the pure solvent, the solvent with a 50% concentration had the highest phenolic and flavonoid levels. Comparing the different solvent concentrations, 50% methanol generated the most phenolic ( $425.55 \pm 0.19^a$  mg GAE/100g dry weight) and flavonoid ( $86.24 \pm 0.11^a$  mg QE/100g dry weight) contents in longon peel extract. With 50% ethanol, longon peel extract had the second highest phenolic compound content ( $423.77 \pm 0.10^b$  mg GAE/gm dry weight) and flavonoid content ( $77.55 \pm 0.13^b$  mg QE/100g dry weight), and with 50% acetone, longan peel extract had the third highest phenolic compound content ( $422.17 \pm 0.05^c$  mg GAE/100g dry

**Comment [e10]:** Change the data presentation into bar charts

**Comment [e11]:** Discussion is poor.  
1. Make separately discussion into 3 parts, TPC, TFC and DPPH  
2. Always discuss according to statistic analysis  
3. Always compare between Lotkon and Longan  
4. Supports with many references of the similar works with same Genus and others

weight) and flavonoid content (76.40±0.22<sup>c</sup> mg QE/100g dry weight). The lowest amount of phenolics (121.63±0.29<sup>f</sup> mg GAE/100g dry weight) and flavonoids (6.47±0.37<sup>g</sup>mg QE/100g dry weight) were present in the lotkon peel aqueous extract.

In a study published in 2013, Addai et al. [1] found that pure solvent had a lower extraction efficiency than an aquas mix of solvent. Our findings concur with those of Ali et al. [2], who found that methanol was the most effective solvent for extracting bioactive components from ginger fruit. According to Turkmen et al. [16], solvents with various polarities considerably affected phenolic compounds and antioxidant activity. Muhamad et al. [10] found that *Averrhoabilimbi* had the maximum total phenolic and flavonoid levels at a solvent concentration of 50% methanol. Our results are in line with those of Addai et al. [1], who discovered that methanol was the most effective solvent for extracting phenolic and flavonoid components from papaya fruit.

Comment [e12]: Why?

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### 3.2 DPPH free radical scavenging activity

Table 1 demonstrates the impact of various solvent concentrations on the lotkon and longan peel extracts' ability to scavenge DPPH free radicals. The results showed that longan peel extract had considerably (p<0.05) higher scavenging activity than lotkon peel extract.

According to Table 1's findings, methanol offered the best extraction recovery whereas antioxidant activity was sensitive to extraction solvents. The DPPH values of the lotkon and longan peel extracts decrease as the organic solvent concentration rises until it reaches 100%. In both the peels of lotkon and longan fruits, 50% methanol proved to be the optimal solvent for producing extracts with high antioxidant activations. 50% methanol solvent extracts produced the highest DPPH values for longan (60.01±0.02<sup>a</sup>%) and lotkon (54.76±0.03<sup>a</sup>%). Water extracts produced the lowest DPPH values for longan (30.79±0.03<sup>b</sup>%) and lotkon (25.84±0.01<sup>b</sup>%). The DPPH value was influenced by the extracting solvents in the following order, from high to low: 50% methanol >50% ethanol >50% acetone.

Our results agree with those of Muhamad et al. [10] who discovered that extracting antioxidant activity from *Averrhoa bilimbi* fruit needed a solvent concentration of 50% methanol. It was shown that the solvent's chemical composition significantly affects the amount of chemicals recovered after extraction. Therefore, as it can increase the solubility of antioxidant chemicals, the polarity of solvents may have a secondary effect on the extraction procedure. [4]. The lowest levels of DPPH radical scavenging activity were seen in pure solvents, to Addai et al. [1] and Grant et al. [7]. According to Addai et al. [1], antioxidant activity results varied depending on the type of fruit, growth conditions, harvest maturity stage, storage settings, extraction time, and sample preparation method. It's likely that the use of various extraction techniques and solvents contributed to the uneven outcomes [17].

Comment [e15]: Why? Please elaborate more? Explain in detail. This something to do with different solvents and different purity.

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Comment [e20]: Needs a standard for DPPH analysis

Change into bar charts too

**Table 1. Effects of various solvent concentrations on antioxidant activity, total phenolic content (TPC), and total flavonoid content (TFC) extraction from longan and lotkon peels**

Solvents (%)	TPC (mg GAE/100gm dry weight)		TFC (mgQE/100gm dry weight)		DPPH%	
	Lotkon	Longan	Lotkon	Longan	Lotkon	Longan
<b>Ethanol</b>						
50%	262.50±0.11 <sup>b</sup>	423.77±0.10 <sup>b</sup>	14.48±0.40 <sup>b</sup>	77.55±0.13 <sup>b</sup>	51.98±0.02 <sup>b</sup>	57.19±0.02 <sup>b</sup>
70%	229.43±0.07 <sup>e</sup>	412.47±0.30 <sup>e</sup>	12.32±0.18 <sup>d</sup>	73.55±0.34 <sup>d</sup>	46.02±0.04 <sup>f</sup>	53.43±0.03 <sup>f</sup>
100%	168.44±0.11 <sup>i</sup>	352.27±0.18 <sup>i</sup>	10.30±0.31 <sup>e</sup>	51.57±0.25 <sup>i</sup>	44.73±0.06 <sup>g</sup>	50.77±0.04 <sup>g</sup>

Comment [e17]: Ethanol, acetone, methanol and water have different chemical structure, please discuss these differences in relation with TPC, TFC and DPPH.

Comment [e18]: Change into bar charts with standard error and notation of significance

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Acetone						
50%	257.84±0.07 <sup>c</sup>	422.17±0.05 <sup>c</sup>	13.66±0.04 <sup>c</sup>	76.40±0.22 <sup>c</sup>	49.77±0.03 <sup>c</sup>	53.23±0.02 <sup>c</sup>
70%	216.56±0.37 <sup>f</sup>	406.09±0.13 <sup>f</sup>	12.67±0.2 <sup>d</sup>	69.49±0.31 <sup>f</sup>	47.32±0.02 <sup>e</sup>	54.78±0.02 <sup>e</sup>
100%	180.61±0.16 <sup>h</sup>	359.32±0.23 <sup>h</sup>	10.51±0.07 <sup>e</sup>	53.38±0.28 <sup>h</sup>	44.77±0.04 <sup>h</sup>	41.75±0.02 <sup>f</sup>
Methanol						
50%	321.54±0.12 <sup>a</sup>	425.55±0.19 <sup>a</sup>	15.37±0.11 <sup>a</sup>	86.24±0.11 <sup>a</sup>	54.76±0.03 <sup>d</sup>	60.01±0.02 <sup>d</sup>
70%	255.74±0.36 <sup>d</sup>	421.45±0.17 <sup>d</sup>	13.45±0.27 <sup>c</sup>	71.31±0.18 <sup>e</sup>	49.38±0.03 <sup>d</sup>	55.72±0.02 <sup>c</sup>
100%	203.45±0.26 <sup>g</sup>	403.34±0.02 <sup>g</sup>	8.59±0.29 <sup>f</sup>	59.29±0.22 <sup>g</sup>	45.03±0.02 <sup>g</sup>	53.31±0.03 <sup>e</sup>
Water						
	121.63±0.29 <sup>j</sup>	343.39±0.22 <sup>j</sup>	6.47±0.37 <sup>g</sup>	48.24±0.09 <sup>j</sup>	25.84±0.01 <sup>i</sup>	30.79±0.03 <sup>i</sup>

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Note: The means that share the same letter do not differ substantially ( $p < 0.05$ ).

Mean ± S.E.M = Mean values ± Standard error of means of three experiments

#### 4. CONCLUSION

Our findings proved without a reasonable doubt that different solvent systems recovered phenolic contents and antioxidant activity that were distinctly different. Recovery of bioactive components and antioxidant activity was influenced by the characteristics of the longan and lotkon peels as well as the extracting solvent (DPPH). All of the available solvents were used to evaluate the extracts of longan and lotkon peels, and 50% methanol was shown to be the most effective at extracting bioactive compounds and antioxidant activity (DPPH).

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Comment [e23]: Is this your purpose? Please explain in discussion

Comment [e24]: No. Data is only for Flavonoid and Phenol

#### REFERENCES

Comment [e25]: Needs more related references

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