Antioxidant activity and Total Phenolic compounds of Fresh and Blanching Banana blossom (*Musa ABB CV. Kluai “Namwa”*) in Thailand

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Abstract. Fresh and blanching banana blossom were extracted by ethanol. Fresh banana florets crude extract had the highest antioxidant activity 42.74% and IC$_{50}$ were 1275.50µg/ml respectively. For blanching banana florets crude extract, The antioxidant activity and IC$_{50}$ value were 41.78 and 1306.67 µg/ml respectively. Antioxidant activity of fresh banana bract crude extract and blanching banana bract crude extract were only 28.43% and 13.33% respectively. Results also showed could not evaluation of IC$_{50}$ value for banana bract crude extract. However, Banana blossom able to antioxidant activity. Banana florets crude extract showed effective antioxidant activity more than banana bract crude extract (p<0.05). Blanching banana florets and fresh banana florets contained the highest total phenolic compounds were 1380.58 µg GAE/g and 1091.30 µg GAE/g respectively. While banana bract had low phenolic compounds. The food processing for consumption did not affected to total phenolic compounds. It was therefore suggested that banana florets have potential as good source of natural antioxidant.

Keywords : banana blossom, banana bract, banana florets, Antioxidant activity, Phenolic compounds, minimally processing

1. Introduction

Bananas are popular consumed fruits in the world because of its simple taste, high nutritional value and potential health benefits [1]. Cultivated Banana (*Musa ABB CV. Kluai “Namwa”*) is an important fruit crop of Thailand, Banana blossom (widely known as flower or heart) is byproducts of banana cultivation and it is known to have health beneficial effect [2]. In Thailand, Banana blossom is usually considered as vegetable, also has potential to be regarded as a functional food due to its high nutrient content (excellent source of fiber, good source of protein, vitamin A,C and E, minerals like phosphorus, potassium bleeding, facilitates lactation, helps in overcoming diabetes, helpful in weight loss and good for gastrointestinal health) [1]. Therefore, the ingredient of Thai food contained the banana blossom in recipe or vegetable side dishes for example, Pad Thai. The method of consumption, for example fresh eating or cooking has effect to natural antioxidant [3]. Minimally processed foods such as Fresh fruits and vegetables are recommended daily intake for the health benefits. The advantages of minimally food processing are easy and quick preparation of meals, maintain quality as fresh or close to the fresh prepared meals or products and maintain products’ nutritive values [4].
The objectives of the work were investigated the antioxidant activity and total phenolic compounds in the part of banana blossom (florets and bract) with the method of consumption or minimally food processing (fresh or blanching) by using DPPH assay analytical and Folin-Ciocalteu.

2. Materials and methods

2.1. Chemical and Reagents
All the chemicals and reagents used for experiment were of analytical grade.

2.2. Harvest of Banana blossoms and preparation
Banana blossoms were harvested in June 2017. The sample of blossom of Cultivated Bananas (*Musa ABB CV.Kluai “Namwa”*) were obtained from cultivated local farmland in Udon thani province. The outer part of banana blossoms were discarded (figure 1A). The banana blossoms were washed with water. The samples were divided into two parts. The first part was fresh sample (figure 1B) and second part was blanching in boiling water for 5 minutes (figure C), then florets and bract were separated. The fresh sample and blanching sample were ground by blender before experimentation.

![Figure 1. A: Banana blossom (*Musa ABB CV.Kluai “Namwa”*), B: Fresh banana bract and Florets, C: Blanching banana bract and Florets in boiling water for 5 minute.](image-url)
Extraction was carried out by using ethanol (95%). 5 g of each part of banana blossom; the fresh florets or blanching florets and the fresh bract or blanching were separately soaked in 100 ml of ethanol for 24 hours at room temperature to obtain successive extracts and filtered. The crude extracts obtained were evaluation of antioxidant activity and total phenolic compound.

2.3. Antioxidant Assays

The antioxidant activity of banana was evaluated using DPPH radical scavenging assay was assessed according to method described by Roobha et al. [5] and Mahmood et al. [6] with some modifications. Briefly, Prepared 0.1µg/L DPPH solution (DPPH 0.0039 g in 100 ml absolute ethanol). DPPH solution of 2 ml was added in each of test tubes containing the crude extracts sample of 2 ml. After mixing the solution was incubated for 30 minute in the dark. Then, the absorbance was taken at 517nm using a spectrophotometer (Cecil instrument, CE1011). Control contained ethanol instead of antioxidant solution and blank contained ethanol instead of DPPH solution. Ascorbic acid solution was used as positive control and establishing the standard calibration curve at concentration in range of 10 µg/ml – 30 µg/ml. Percent scavenging of the DPPH free radical was calculated using the following equation:

\[
\% \text{ Inhibition} = \left( \frac{A_C - A_S}{A_C} \right) \times 100
\]

Where, A_C = absorbance of control
A_S = absorbance of sample solution

Percent of inhibition (IC_{50}) were plotted against respective concentration used. Linear regression analysis was used to calculate IC_{50} values of the extracts.

2.4. Total phenolic compounds

Banana blossoms were harvested. The total phenolic compounds of the extracts were determined by the Folin-Ciocalteau colorimetric method according to method described by Arya and Sinija [7] and Mohamed et al. [8] with some modifications. 0.4ml of the extract solution was mixed with 10%v/v the Folin-Ciocalteau reagent (2ml) and 7.5% Na_2CO_3 (1.6ml). After 30 minute of incubation at room temperature, the absorbance were measured at 765 nm (spectrophotometer : Cecil instrument, CE1011). For each sample, three replicate assays were performed. Gallic acid was used for establishing the standard calibration curve and the total phenolic compounds was calculated as gallic acid equivalents (GAE) and expressed as µg GAE /g of extract.

2.5. Statistic analysis

Analysis of variance (ANOVA) was carried out on the 2^2 Factorial in CRD. The independent variables were the part of banana blossom (bract and florets) and method of minimally food processing (fresh and blanching). The significance of differences between means was compared by Duncan’s New Multiple Rang Test at p<0.05.

3. Result and discussion

3.1. Antioxidant Assays

Free radical scavenging is one of the know mechanism by which antioxidant inhibits lipid peroxidation. The DPPH radical scavenging activity has been widely used for screening antioxidants from fruit and vegetable juice or extract [5]. DPPH radical scavenging activities of fresh or blanching banana blossom were show in Table 1. The activity of DPPH radical depend on part of banana blossom and minimally food processing. The highest of inhibition of DPPH radical activity was observed that the fresh and blanching banana florets were 42.74% and 41.78% respectively. The results shown that the banana florets can effectively scavenge DPPH radicals (p<0.05). According to previous studies, China et al. [9] reported that the DPPH free radical scavenging activity of different
cultivars of banana flower (*Musa paradicicus* L.) extracts in India depend on the cultivars. In addition, % inhibition of the extracts were shown in range 10% to 65% similar to Divya *et al.* [10] who have found that the extract of banana flower (*Musa paradicicus* L.) exhibited radical scavenging activity of 80.07%. In the present study, the minimally food processing would have considered that had the effect of antioxidant properties of banana blossom. It was observed that DPPH free radical scavenging activities of the fresh or blanching were not significantly different for the banana florets extracts. Whereas the method of consumptions and % inhibition were different significant in the banana bract extracts. The results showed that % inhibition of blanching banana bract extract had decreased significantly when compared with fresh banana bract extract. A common perception is that thermally cooked foods have lower nutritional value of fresh food because of the loss of vitamin C and loss of particular physicochemical substance [3]. The previous studies have investigated the effect of various cooking processes on the level of antioxidant compound and antioxidant activities in fruits and vegetables. The results in this study were similar to *Hwang et al.* [3] who have found that boiling significantly reduced antioxidant activity in red pepper.

**Table 1.** Antioxidant assay in extract of fresh banana blossom and blanching blossom using DPPH assay

| Part of banana blossom | Minimally food processing | % Inhibition$^1$ |
|------------------------|--------------------------|-----------------|
| Florets extract        | Fresh                    | 42.74±9.44$^a$  |
|                        | Blanching                | 41.78±8.03$^b$  |
| Bract extract          | Fresh                    | 28.43±7.92$^a$  |
|                        | Blanching                | 13.33±8.17$^c$  |

$^1$ Values are expressed as the mean ± SD (N=3)

$^{a-c}$ Values followed by the different letter are statistically significant difference (P<0.05)

The activity of antioxidant in banana blossoms were shown in Table 2. *IC*$_{50}$ value of fresh florets extract was 1275.50 µg/ml demonstrated that fresh banana florets required low concentration of substance that the crude extract to inhibit a 50% DPPH color. While, the banana bract extract could not calculated as *IC*$_{50}$ value. This mean the fresh banana florets were stronger antioxidant activity than banana bract.

**Table 2.** Radical scavenging activity (*IC*$_{50}$) of fresh banana blossom and blanching blossom

| Part of banana blossom | Minimally food processing | Antioxidant activity (*IC*$_{50}$ value)$^1$ µg/ml |
|------------------------|--------------------------|-----------------------------------------------|
| Florets extract        | Fresh                    | 1275.50                                       |
|                        | Blanching                | 1306.67                                       |
| Bract extract          | Fresh                    | -                                             |
|                        | Blanching                | -                                             |

$^1$ *IC*$_{50}$ = The concentration of substrate that cause 50% loss of the DPPH color
The antioxidant activity of banana blossom usually study on banana bract but does not the information of antioxidants activity of banana florets include method of processing. The antioxidant activity of banana flower were reported by Mahmood et al. [6] were investigated IC_{50} of the ethanol extract of banana bract (Musa x Paradisiaca) compared with aqueous extract and Arya and Sinija [7] reported that high antioxidant activity (82%) was shown by ethanolic extract of banana blossom of two cultivars in India. The result of this study were in line with those of Sheng et al. [11], who have studied the antioxidant properties of banana flower of two cultivars (Musa spp. ‘Baxijiao’ and ‘Paradisiaca’) in China and expressed antioxidant properties in EC_{50}. It appeared that Baxijiao cultivar revealed better antioxidant properties by present much lower EC_{50} value. On the other hand, Bibechana and Varalakshmi [12] have been reported that banana (Musa paradisiaca) flower was rich in phytochemicals and had antioxidant properties with IC_{50} value of <10 µg/ml. The previous studies indicate that antioxidant properties of banana blossom depend on cultivars and region of grown. On the basis of the result obtained, banana blossom are found to be a potential source of natural antioxidant, especially fresh florets of banana.

The naturally plant compounds normally correlate to their physiological function as antioxidant. However, it is quite difficult to compare the DPPH scavenging capacity data between different laboratories due to a few reasons such as the reaction time, the concentration of DPPH used and the antioxidants in the assay mixture. The presence of phenolic compounds in the extract could be associated with the antioxidant properties of fresh and blanching banana blossom (Musa Abb CV.Kluai ‘Namwa’).

### 3.2. Total phenolic compounds

Phenolic compounds exhibit considerable free-radical scavenging activity, which is determined by their reactivity as hydrogen-or-electron–donating agent [8]. The total phenolic compounds of fresh and blanching banana blossom were shown in Table 3. Blanching banana florets and fresh banana florets contained the highest total phenolic compounds were 1380.58 µg GAE/g and 1091.30 µg GAE/g respectively. Although, total phenolic compounds present in both florets and bract but the concentration of compound were different. Moreover, the food processing for consumption did not affected to total phenolic compounds.

| Part of banana blossom | Minimally food processing | Total phenolic compounds (µg GAE/g)\(^1\) |
|------------------------|---------------------------|------------------------------------------|
| Florets extract        | Fresh                     | 1091.30± 156.98                         |
|                        | Blanching                 | 1380.58±175.61                          |
| Bract extract          | Fresh                     | 742.42±120.42                           |
|                        | Blanching                 | 741.18 ±95.58                           |

\(^1\) Values are expressed as the mean ± SD (N=3)

\(^2\) The main factor followed by the letter are statistically significant difference (P<0.05)

The main factors of this study were the part of banana blossom and the minimally food processing. Analysis of variance (ANOVA) was shown that no interaction between main factors. The minimally food processing including fresh and blanching did not impact on total phenolic compounds in banana blossom. On the other hand, total phenolic compounds depended on the part of banana blossom.
(P<0.05). The total phenolic compounds of banana blossom were shown in Table 4. The banana florets contained the highest total phenolic compounds was 1235.94 µg GAE/g while total phenolic compounds of banana bract was 741.79 µg GAE/g.

Table 4. Total phenolic compounds of part of banana blossom (main factors of experiment was significance)

| Part of banana blossom | Total phenolic compounds (µg GAE/g) |
|------------------------|-------------------------------------|
| Florets extract        | 1235.94± 217.48*                     |
| Bract extract          | 741.79± 97.34*                      |

1 Values are expressed as the mean ± SD (N=6)

* Values followed by the different letter are statistically significant difference (P<0.05)

The results of this study finding was in accordance with the previous findings obtained that phytochemicals contents in the banana blossom extract such as flavonoids and terpenoids observed only in the florets but not in the bract parts of the blossom [6]. Total phenolic compounds of the banana blossom were found to be within the part of blossom. In addition, pointed out that the cultivar and growing conditions effect of the variability in the phenolic compounds of banana blossom. According to Marikkar et al.[13] investigated the total phenolic content of banana flowers of six different Malaysian cultivars and found that the extracts of Malaysian banana flowers were potent sources of natural antioxidants.

4. Conclusion

This research work has investigated antioxidant activity and total phenolic compounds of banana blossom with considered the food processing for consumption. The analysis of banana blossom revealed their considerable antioxidant properties and it is well known that is a strong relationship between total phenolic compounds and antioxidant activity. From the results it can be concluded that cultivated banana (Musa ABB CV.Kluai "Namwa") has high amount of antioxidant activity and total phenolic compounds on its florets both of fresh or blanching. These findings confirmed that the banana blossom may have use in food ingredient, pharmaceutical or utilized for functional foods with potential health-benefit effects.

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