

EXTENDED ABSTRACT

Effect of Fermentation on Antioxidant Contents, Antioxidant Activity, and Mineral Contents of *Cleome gynandra* Leaves

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SUMMARY

C. gynandra provides medicinal benefits due to nutritional properties. This study aimed to determine the effect of fermentation on antioxidant properties and mineral contents of *C. gynandra*. The findings showed that fresh *C. gynandra* had the highest total phenolic content (60.44±3.14 mg GAE/g extract), followed by commercial fermented (49.48±1.88 mg GAE/g) and self-fermented (7.89±0.83 mg GAE/g). Fresh *C. gynandra* also showed the highest scavenging activity (66.01±1.14%) compared to both fermented samples. The fresh sample had the highest minerals content except sodium. Fermentation might reduce the antioxidants and minerals in *C. gynandra*.

Keywords: Antioxidant, *Cleome gynandra*, Fermentation, Mineral contents, Nutritional value

INTRODUCTION

C. gynandra is used for culinary and treating diseases (1). Besides antioxidant properties, *C. gynandra* also has anti-inflammatory and anticancer (1) properties. Every part of *C. gynandra* has different nutritional and medicinal benefits. The leaves of *C. gynandra* are found to help improve eyesight and treat diseases such as scurvy and marasmus and are also reported to treat headaches, earache, and arthritis (2). Food preservation is vital in slowing down food spoilage, especially for fresh products. Fermentation is one of the common preservation methods such as fermented *C. gynandra* is mostly consumed as food products. Simple brining, which will cause lactic acid fermentation, is usually used to ferment vegetables. However, fermentation may reduce the nutritional value of the foods. Thus, it is imperative to determine the effect of fermentation on the nutritional values of *C. gynandra*.

MATERIALS AND METHODS

Samples were collected from Kuala Pilah, Malaysia. Collectively, three samples were produced, which are fresh, self-fermented (addition of brine solution with no added vinegar), and commercial fermented (addition of vinegar) samples. The preparation of fermented samples was based on Muhiyaldin et al. (3). Microwave assisted extraction was carried out for the extraction method. To determine antioxidant content, total phenolic content (TPC) used Folin-Ciocalteu assay and

total flavonoid content (TFC) used aluminium chloride colorimetric assay. Diphenylpicrylhydrazyl (DPPH) radical scavenging activity and β-carotene bleaching (BCB) assay were carried out for total antioxidant activity determination, and atomic absorption spectrophotometer was used for mineral content determination (4). All experiments were conducted in three independent repeats. One-way ANOVA followed by Tukey test was used for all experiments and all values with $p < 0.05$ were considered significant.

RESULTS AND DISCUSSION

As shown in Table I, TPC of the *C. gynandra* samples in descending order was fresh, followed by commercial fermented and fermented. Fresh *C. gynandra* leaves had the highest TFC, followed by commercial fermented and self-fermented leaves. The TPC and TFC were markedly reduced in both fermented samples compared to fresh samples. In comparison between both fermented samples, the commercial fermented had higher antioxidant contents compared to self-fermented sample. In addition, fresh *C. gynandra* also showed the highest scavenging activity compared to both fermented samples. The BCB also showed the same trend compared between fresh and fermented samples. The decrease in TPC and TFC after fermentation was due to an increase in anaerobic bacteria that need phenolic compounds as their nutrient source for their growth (3). The reduction of TFC was due to flavonoids diffusion into the solution. They were easily diffused as they were water-soluble.

The reduction of DPPH scavenging and BCB activities in fermented samples might be due to the decrease in phenolic compounds and flavonoids. It was found that when there was higher TPC or TFC, there would be a higher antioxidant activity (4).

As shown in Table II, fresh *C. gynandra* leaves had the highest content of minerals. In contrast, the sodium content of *C. gynandra* leaves had an inverse sequence, in which fermented leaves had the highest sodium content, followed by commercial fermented leaves and fresh leaves. During fermentation, minerals such as calcium and iron in the vegetables will migrate into the fermentation liquid, and the migration becomes stable

Table I: Antioxidant content and activity of fresh, self-fermented and commercial fermented *C. gynandra* leaves

Variables	Fresh	Self-Fermented	Commercial fermented
TPC (mg GAE/g extract)	60.44±3.14 ^{ac}	7.89±0.83 ^{ab}	49.48±1.88 ^{bc}
TFC (mg CE/g extract)	31.34±0.44 ^a	4.41±0.44 ^{ab}	28.26±2.35 ^b
DPPH assay (%)	66.01±1.14 ^{ac}	8.66±1.04 ^{ab}	44.82±0.29 ^{bc}
BCB assay (%)	47.73±2.50 ^{ac}	15.98±0.37 ^{ab}	42.70±2.19 ^{bc}

Value expressed in mean±standard deviation (concentration of the samples: 1,000µg/mL). Values with different letters in the same row are significant at p<0.05

Table II: Mineral content of fresh, self-fermented and commercial fermented *C. gynandra* leaves

Variables	Fresh	Self-Fermented	Commercial fermented
Calcium (Ca) (mg/100g DW)	1719.04±12.02 ^{ac}	318.19±34.58 ^{ab}	1076.54±77.78 ^{bc}
Iron (Fe) (mg/100g DW)	44.11±3.95 ^{ac}	19.62±1.73 ^a	28.45±0.78 ^c
Magnesium (Mg) (mg/100g DW)	563.04±2.55 ^{ac}	91.89±0.92 ^a	103.34±8.77 ^c
Potassium (K) (mg/100g DW)	3394.19±236.17 ^{ac}	350.24±6.58 ^a	492.69±9.33 ^c
Sodium (Na) (mg/100g DW)	122.33±10.96 ^{ac}	3737.68±8.49 ^{ab}	2083.68±50.91 ^{bc}

Value expressed in mean±standard deviation. Values with different letters in the same row are significant at p<0.05

when a balance is reached (5). During fermentation, minerals such as calcium and iron in the vegetables will migrate into the fermentation liquid, and the migration becomes stable when a balance is reached.

CONCLUSION

Antioxidant capacities and mineral contents were higher in fresh samples. Fermentation would reduce the antioxidant and minerals except for sodium. Therefore, it is recommended to consume fresh *C. gynandra* leaves, but if fermented is preferred, addition of vinegar and reduction of salt content might be considered.

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