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Comparative Studies on the Phytochemical Composition of Unfermented and Fermented Unripe Musa Super Dwarf Cavendish Fruit Pulp

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Abstract
This study was carried out to compare the phytochemical compositions of unfermented and fermented unripe Musa Cavendish fruit pulp. The phytochemicals present include phenols, flavonoids, alkaloids, saponins, tannins and cyanogenic glycosides, with saponins having the highest concentration and tannins the lowest in the unfermented form. In the fermented form, flavonoids had the highest concentration and tannins the lowest. The concentrations of flavonoids and saponins increased upon fermentation, while the concentrations of phenols, alkaloids, tannins and cyanogenic glycosides were found to decrease. Fermentation of unripe Musa Cavendish increased its flavor there by making it palatable for consumption but decreased the concentrations of most the phyto-constituents, which could lead to a decrease in pharmacological properties of these phytochemicals. Fermentation also reduced toxicity which could have emanated from the cyanides in the fruit.
Keywords: Phytochemical; Musa Cavendish; Fermented; Unfermented; Fruit pulp.

1. Introduction
Phytochemicals are biologically active naturally occurring chemical compounds found in plants, which provide health benefits of humans as medicinal ingredients and nutrients. Phytochemicals accumulate in different plant parts such as fruit, stem, root, flower, leaf and seeds. They exhibit biological activities such as antioxidant, antimicrobial immune system stimulation, anticancer, modulation of detoxifying enzymes, decreased in platelet aggregation and modulation of hormone metabolism [1]. They also possess anti-inflammatory, anti-diabetic, anti-pyretic and analgesic properties. Fruits constitute an important part of balanced diet for humans and their consumption are known to promote good health, improve immune infections and also lower the risk of various chronic diseases such as heart diseases, stroke, cancer, gastrointestinal disorders and hypertension [2]. This is due to the presence of bioactive chemical compounds in them. One of such fruits is Musa Cavendish popularly known as banana. Musa Cavendish is a member of the Musaceae family. The genus Musa is the largest of the Musaceae and include both bananas and plantains. About 70 species and over 500 cultivars are known [3]. The various part of Musa Cavendish have been used traditionally to treat various diseases and infections. The flowers are used for ulcer, bronchitis, dysentery and diabetes. The unripe peels and leaves when ashed, are used for dysentery, diarrhea and ulcer. The plant sap is used for hysteria, fever, leprosy, epilepsy, hemorrhage, acute, dysentery and diarrhea while the root is given to relief digestive disorders [4]. Fruit is used for the treatment of anaemia, high blood pressure, depression and heartburn [4-6]. Cavendish fruit pulp is also used to treat burns and wounds, relief pain, constipation and arthritis. The phytochemical, proximate, vitamin and mineral elements composition of ripe species of Musa Cavendish have been reported [7-10]. There are also reports on the chemical compositions and pharmacological properties of the various parts of banana such as the peels and flowers [3, 11, 12]. The aim of the present study is to compare the phytochemical compositions of unfermented and fermented Musa Cavendish fruit pulp.

2. Materials and Methods
2.1. Sample Collection and Preparation
The unripe Musa Cavendish fruits were gotten from Umuezeagwu, Ibeku Umuahia Abia State Nigeria. The peels were removed using a knife. The fruits were cut into pieces, and oven-dried for 2 hours at 60^{o}C and then powdered using a blender. The powdered plant material was divided into two portions. The first portion was stored for phytochemical analysis while the second portion was fermented for 10 days before phytochemical analysis.

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2.2. Phytochemical Determination

Phenols were determined according to the method described by the Association of Official Analytical Chemists [13]. Alkaloids and saponins were determined by the method described by Harbone [14]. Tannins was determined as described by Kirk and Sawyer [15]. Flavonoids was determined according to the method established by Boham and Kocipal [16], while cyanogenic glycosides was determined according to the method described by Vetter [17].

2.3. Statistical Analysis

Data in Tables were mean ± standard deviation (SD) of triplicate determinations.

3. Results and Discussion

Table-1. Phytochemical composition of unfermented unripe Musa cavendish fruit pulp

Phytochemical	Concentration (%)
Phenols	0.57±0.02
Flavonoids	1.24±0.01
Alkaloids	2.15±0.10
Saponins	2.49±0.15
Tannins	0.03±0.01
Cyanogenic glycosides	0.43±0.01

Values are means ± SD of triplicate determinations

Table-2. Phytochemical composition of fermented unripe Musa cavendish fruit pulp

Phytochemical	Concentration (%)
Phenols	0.35±0.02
Flavonoids	3.12±0.08
Alkaloids	1.96±0.15
Saponins	2.69±0.17
Tannins	0.02±0.01
Cyanogenic glycosides	0.21±0.01

Values are means ±SD of triplicate determinations

The results of the phytochemical constituents of unfermented unripe Musa cavendish fruit pulp are shown in Table 1. Saponins had the highest concentration (2.49±0.15%), followed by alkaloids (2.15±0.10%), flavonoids (1.24±0.01%), phenols (0.57±0.02%), cyanogenic glycosides (0.43±0.01%) and lastly, tannins (0.03±0.01%). The results of the phytochemical consitutents of fermented unripe Musa cavendish fruit pulp are also shown in Table 2. From the results, flavonoids had the highest concentration (3.12±0.08%) followed by saponins (2.69±0.17%), alkaloids (1.96±0.15%), phenols (0.35±0.02%), cyanogenic glycosides (0.21±0.01%) and tannins (0.02±0.01%).

Saponins are known to possess pharmacological activities such as haemolytic, anthelminthic, antifungal, antiviral, antibacterial, antidiabetic and anti-hypercholesterolmia activities [18]. They also have beneficial effects in bone health, cancer and stimulation of the immune system. The fermented unripe Musa cavendish fruit had a higher concentration of saponin than the unfermented fruit. The highest content of saponin, on unfermented Musa cavendish could be attributed to the higher rapid inactivation of enzymes [19] while low level of tannins both in fermented and unfermented unripe Musa cavendish fruit pulp could be attributed to enzymatic degradation [20].

The flavonoid content of the fermented unripe Musa cavendish fruit was higher than the unfermented fruit (Table 1 and 2).

The increase in the flavonoid content could be due to the non-oxidation of the bioactive compounds [21] which would increase the flavor of the fermented fruit as well as antioxidant and anti-inflammatory properties. Flavonoids exhibit their antioxidant mechanism by free radical chain breaking, metal chelating and singlet oxygen quenching, while its anti-inflammatory activity is through the inhibition of arachidonic acid metabolism by blocking cyclooxygenase or lipoxygenase enzymes or both [22, 23]. Alkaloids are plant bases with hypotensive, anticonvulsant, antiprotozoal, anti-microbial and antimalarial activities [24]. They also exert neuroprotective effect against diseases such as dermentia, anxiety, memory impairment, depression, psychological disorders, Alzheimers and Parkiasons diseases[25, 26]. The alkaloid concentration of unripe Musa Cavendish decreased from (2.15±0.10%) to (1.96±0.15%) upon fermentation indicating a decrease in biological activity of alkaloids in the fermented fruit. The phenolic content of the unfermented and fermented unripe Musa Cavendish fruit were 0.57±0.02% and 0.35±0.02% respectively. Fermentation decreased the concentration of phenols. Phenolic compounds protect the body against diseases caused by free radicals through their antioxidant property.

The concentration of tannins were 0.03±0.01% and 0.02±0.01% for the unfermented and fermented fruit respectively. The amount of tannins in the unfermented fruit was higher than that present in the fermented fruit. The reduction in the amount of tannins would reduce their astringent property.

Cyanogenic glycosides release hydrogen cyanide when digested. This may result in cyanide poisoning which is implicated in several chronic diseases [27].

The concentration of cyanogenic glycosides in unripe Musa Cavendish fruit decreased form 0.43±0.01% to 0.21±0.01%. Fermentation decreased the concentration of cyanogenic glycosides, thereby reducing toxicity that may

emanate from hydrogen cyanide, and thus make the fermented fruit more safe for consumption than the unfermented unripe fruit.

4. Conclusion

The investigation revealed that unripe Musa Cavendish fruit contains phytochemicals such as flavonoids, phenols, saponins, alkaloids, tannins and cyanogenic glycosides. The concentration of these phytochemicals were found to decrease when fermented except for flavonoids and saponins, whose concentrations increased upon fermentation. Decrease in concentration of these phytochemicals would result in decrease in their pharmacological activities. However, fermentation decreases the risk of chronic diseases which could emanate from cyanides.

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