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Analysis of the Nutritional Value of Hibiscus Flower Leaves Mucilage

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ABSTRACT

The study was aimed at determining the suitability of the mucilages obtained from hibiscus flower leaves for food preparation by comparing its characteristics with those of okra fruit. Leaves of hibiscus flower and okra fruit were each subjected to pre-treatment operations (washing, slicing and grinding) prior to mucilage extraction for high purity mucilage and then macerated (soaked in cold water) and thereafter subjected to solvent extraction using ethanol. The mucilages obtained were subjected to physicochemical characterization and Fourier transform infrared (FTIR) spectrometry to establish characteristics and the bonds present respectively. The FTIR results showed presence of carbohydrate, proteins, oil and water for both samples. The chemical screening of the mucilages tested positive for triterpenoid/steroids, carbohydrates and cardenolide (edible nutrients) and negative for tannins and cyanogenic glycosides (poisonous/non-edible substances). The mucilages showed similar trends in all their characteristics, indicating that hibiscus flower (leaf) is suitable for consumption by human and animals.

1. INTRODUCTION

The adverse effect of food crisis resulting from war (communal clashes), free animal grazing, oil exploration induced deforestation, flood as well as fear of animal protein has led to the search for alternative sources of food for healthy living and also to complement the available food sources in Nigeria. The leaves of hibiscus flower (same family with okra) are consumed in parts of Nigeria, hence the need for a study to determine the suitability of the mucilage obtained from the leaves in food preparation (Singh et al., 2017).

Hibiscus flower is a member of the Malvaceae family and is also known as the shoe-flower plant. It is a vegetable crop grown for its immature pods that can be consumed as a fried or boiled vegetable or may be added to salads, soups and stews (Kashif et al., 2008). The plant is available in India in large quantities and the leaves contain mucilage (Anjaria et al., 2002). Mucilage is soluble but an undigested complex of the sugars arabinose and xylose found in some seeds and seaweeds and is used as thickening and stabilizing

agents in food processing by virtue of their water holding and viscous properties (Kassakul et al., 2014). The leaves of this plant was observed to be consumed by some of the indigene of Rivers State hence, the need to determine the suitability of the mucilages obtained from the plant's leaves for food preparation by comparing its characteristics with those of okra fruit, a well-known and edible vegetable belonging to same family with the plant. The aim of this study was to authenticate the nutritious values of hibiscus flower leaves as claimed by those who employed them for soup preparation. Studies had really not been focused on the suitability of hibiscus flower leaves as edible plant but this study was to juxtapose its edible characteristics with okra and therefore recommend for possible human consumption.

2. MATERIALS AND METHODS

2.1. Materials

Variety of fresh immature fruits of okra noted for its slimness were selected and purchased from Choba market in Port Harcourt, Rivers State, Nigeria while fresh Hibiscus leaves were collected from its plants within Choba community in Port Harcourt. The materials for the study include amber bottle, g-clamps, muslin cloth, weighing balance, beakers, knife, Whatman filter paper, and alkaline picurate paper. Others include water bath, desiccator, flasks (round bottom and Erlenmeyer flask), burette, pipette, digital pH meter and FTIR spectrometer. The reagents include ethanol, hydrochloric acid, Mayer's reagent, Drangendorff's reagent, Hager's reagent, sulphuric acid, sodium hydroxide, aluminum chloride, ferric chloride, benzene, ammonia solution, acetic anhydride, and olive oil.

2.2. Experimental Methods

2.2.1. Extraction of mucilage

Okra fruits with weight, 500 g were cleaned, washed, sliced and crushed. The seeds contain no mucilage and were isolated prior to extraction. The ground okra was homogenized with 10 times of its weight with water and it was heated in a water bath (at 45 ^{o}C) for 20 minutes to inactivate enzymes (Deveswaran et al., 2010). The hot solution was then filtered through a muslin cloth and the filtrate was centrifuged at 4000 rpm for 15 mins. The resulting clear, greenish jelly-like solution was mixed with 250 ml of ethanol to precipitate the mucilage. The cream- colored mucilage obtained was air dried, powdered and sieved through sieve No.60 and stored in a desiccator. Fresh hibiscus flower leaves with weight 500 g were washed with water to remove dirt, debris and then dried in an oven at 70 ^{o}C for 24 hours. The leaves were crushed and soaked in water for 5-6 hours, boiled using water bath at constant temperature of 45 ^{o}C for 30 mins and then removed and allowed for 1 hour for complete release of the mucilage into the water (Jani and Shah, 2008). The mucilage was extracted using a multi-layer muslin cloth bag to remove the raffinate from the solution. Thereafter, 250 ml of ethanol was added to the filtrate to precipitate the mucilage. The greenish colored mucilage was separated, dried in an oven at 40 ^{o}C, collected, ground, and passed through a No 80 sieve. This product was weighed using weighing balance, recorded as yield and the then stored in a desiccator. The percentage yield was estimated using Equation 1.

$$\%Yield = \frac{weight\ of\ \ muscilage\ obtained}{weight\ of\ \ sample\ used} \times 100 \quad (1)$$

2.2.2. Characterization of mucilage

The isolated mucilages (okra and Hibiscus leaves) were tested for physical properties such as appearance, odor, solubility in water (hot and cold), pH, yield and percent weight loss on drying. The appearance and odor of both mucilage samples were observed after its isolation. For solubility, the mucilages were both

soaked in cold and hot (at 100 ^{o}C) water and their reactions were noted. The pH of both mucilage samples was measured using a digital pH meter by dispersing individual mucilage in 25 ml of distilled water.

Five grams (5 g) each of the samples' powder were weighed and placed in a clean ceramic dish. The dishes containing the mucilages were placed in an electric oven operating at steady temperature of 105 ^{o}C for one hour. The mucilages were re-weighed and the % weight loss on drying was calculated using Equation 2.

$$\% \text{ WLOD} = \frac{\text{initial weight} - \text{final weight}}{\text{initial weight}} \times 100 \quad (2)$$

Where WLOD is weight loss on drying

Preliminary tests were performed on both samples to confirm the presence of mucilage. The chemical test conducted include test for alkaloids, flavonoids, tannins, anthraquinone and triterpenoid. Others included fixed oils, carbohydrates and cardenolide. Also, cyanogenic glycosides and saponins were tested for. These were performed using standard procedures:

Test for Alkaloid was carried out according to the methods reported by Harborne (1973), Jean, (1999) and Evans, (2002) while those for flavonoids, tannins and anthraquinone were according to Jean (1999), Evans (2002) and Evans (2002) respectively. Also, the test methods for triterpenoid/steroid, fixed oil and cardenolide were carried out according to the methods reported Sofowora (1993), Vinod (2002) and Evans (2002) respectively. Test for cyanogenic glycoside was in line with the report of Trease and Evans (1983). That for saponins was carried out according to the methods reported Harborne (1975) and Harborne (1973) while test for carbohydrate (Molisch test and Fehlings' test) were done in accordance with the report of Deogade et al. (2012) and Chandraskekar and Rao, (2013) respectively. FTIR spectrums of dried mucilages were recorded on samples in potassium bromide disks using FTIR spectrophotometer sample (mucilage). The scanning range was 400 to 4000 cm^{-1} (wavelength).

3. RESULTS AND DISCUSSION

Table 1 shows the physical characterization of the mucilages. The extracted mucilages from the hibiscus leaves were greenish in color while those of okra mucilage were creamy. However, both mucilages had pleasant/characteristics odor and were completely soluble in hot water and swells in cold water. The percentage yield of the dried mucilages obtained for hibiscus flower leaves and okra were 0.69% and 0.92% respectively. The percent weight loss on drying for hibiscus leave mucilage and okra mucilage were 8.8% and 17% with pH values of 7.01 and 7.09 respectively. Table 2 showed the chemical characteristics of the mucilage samples. The results of the various tests were positive for triterpenoid/steroids, carbohydrates and cardenolide and negative for alkaloids, flavonoids, tannins, anthraquinone, fixed oils, cyanogenic glycosides and saponins indicating the edible nature of the okra and hibiscus flower leave mucilage. The absence of flavonoids, fixed oils and saponins in the mucilages result as an inability to absorb the solvent (i.e. ethanol) that was used for the extraction (Hindustan et al., 2011).

Table 1: Physical characteristics of isolated mucilages

Characteristics	Observation	
	Okra mucilage	Hibiscus leave mucilage
Appearance	Cream powder	Green powder
Odor	Pleasant/characteristic	Pleasant/characteristic
Solubility	Completely soluble in hot water but swells in cold water	Completely soluble in hot water but Swells in cold water
Percent yield (%)	0.92	0.69
pH	7.09	7.01
Percent weight loss on drying (%)	17	8.8

Table 2: Chemical characteristic of the various mucilages

S/N	Constituents	Okra mucilage	Hibiscus mucilage	*Abelmoschus esculentus* (Nair et al., 2012)
1	Alkaloids	[-]	[-]	[-]
		[-]	[-]	[-]
		[-]	[-]	[-]
2	Flavonoids	[-]	[-]	
		[-]	[-]	
3	Tannins	[-]	[-]	[-]
		[-]	[-]	
4	Anthraquinone (Bontrager's)	[-]	[-]	
		[-]	[-]	
5	Triterpenoid/steroids	[+]	[-]	[+]
		[+]	[+]	[+]
6	Fixed oils	[-]	[-]	
7	Carbohydrates	[+]	[+]	[+]
		[+]	[+]	[+]
8	Cardenolide	[+]	[+]	
9	Cyanogenic glycosides	[-]	[-]	
10	Saponins	[-]	[-]	
		[-]	[-]	

[-] means absent [+] means present

Figures 1 and 2 show the FTIR spectra of the okra and hibiscus mucilage respectively. The presence of uronic acid was confirmed by the results obtained by FTIR (stretching > C=O, carboxylic acid group: -COOH) which establish the presence of two functional groups present in the structure (Hindustan et al., 2011).

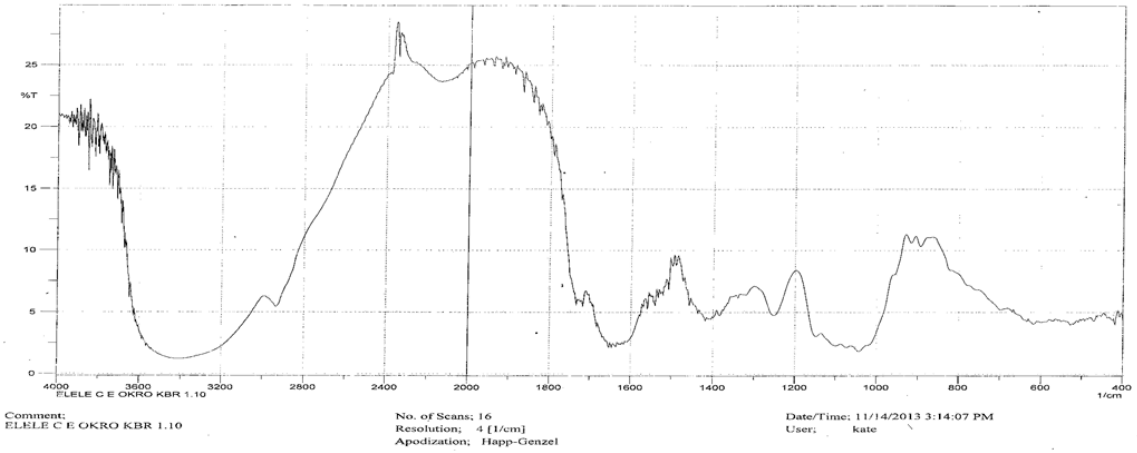

Figure 1: FTIR spectra for chemical bond identification in Okra mucilage

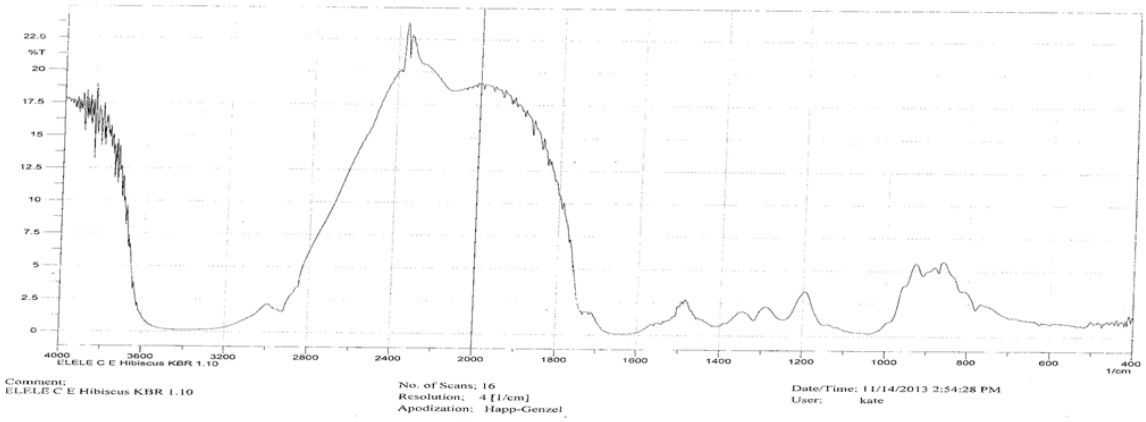

Figure 2: FTIR spectra for chemical bond identification in Hibiscus leaf mucilage

The wide peak in the 970-990 cm^{-1} range is characteristic of –OH groups for both mucilage samples. The results from nutritional analyses support this because of the –OH signals of moisture (water), oil and carbohydrate (glycerides). The carbohydrate peaks of mucilage of hibiscus flower leave were similar to okra mucilage because they have similar monosaccharide composition (Nair and Fahsa, 2012). There is characteristic of N-H stretching signals which also agree with nutritional analyses that indicate the presence of protein. The presence of carbohydrate, proteins, oil and water as revealed by FTIR suggest the edible nature of mucilage from hibiscus flower leaf (Hindustan et al., 2011).

Table 3: FTIR spectral data of Okra and Hibiscus flower mucilages

Absorption peak value (Exp. result)	Absorption (standard) range (Rajani et al., 2008; Hindustan et al., 2011; Ani et al., 2012)	Specific type of bond (Rajani et al., 2008; Hindustan et al., 2011; Ani et al., 2012)
2900	2400-3200	N-H bond (proteins)
2830	2923-2800	-C-H bond (carboxyl group)
2120	2140-1990	C-N bond
1650	1615-1700	C=C, C=N & N-H (amide group)
1650	1560-1680	N-H (primary amine)
1230	1220-1260	C-O (ethers, aromatic)
1020	≈1020	C-O (alcohols, secondary)
970	970-990	OH bond (vinyl, mono substituted alkenes)
840	800-860	CH bond (aromatic, para-di substituted benzene)
976.5	970-990	O-H bond (vinyl, mono substituted alkenes)

4. CONCLUSION

The results indicated that hibiscus flower (leaf) showed similar trends in all their characteristics to those of okra fruit. The chemical screening of the mucilages tested positive for triterpenoid/steroids, carbohydrates and cardenolide (edible nutrients) and negative for tannins and cyanogenic glycosides (poisonous/non edible substances). This was also confirmed by the FTIR spectrometric analysis results. It confirmed the presence of carbohydrate, proteins, oil and water (food). Therefore, hibiscus flower leaves are edible to both human and animals.

5. CONFLICT OF INTEREST

There is no conflict of interest associated with this work.

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