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Characterization and Phytochemical Property of Okra Fruits

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Abstract*: The Okra crop is of significant nutritional value. It contains a high percentage of water, averaging 85%, total fat of 0.5%, protein content of 4% and 5.4% carbohydrate. The carbohydrate is present as cellulose, starch in small quantity and sugar. It also contains non-cellulose, non-starch, polysaccharides. Proteins play a particularly important role in human nutrition. Determination of okra for qualitative and quantitative phytochemicals properties and characterization of its mucilage were conducted using standard methods. The results of the characterization showed: Solubility (sparingly soluble in water and insoluble in acetone and ethanol), pH (6.9±0.22), viscosity (245.58±0.03) and swelling ratio (3.4±0.03). Phytochemical screening revealed the presence of Tannins, Steroids, Flavonoids, Saponins, Alkaloids, Anthraquinones, Phenol, Terpenoids, Cardiac Glycosides and Cardenoids. Quantitatively okra contained (%) Flavanoids (12.54), Saponins (18.33) and Alkaloids (10.53) while the estimated quantity of aqueous and ethanolic extracts are 17.43 and 14.65%. The presence of phytochemical in the okra suggests possible preventive and curative property of the lemon grass. Medically, the presence of these phytochemicals explains the use of the plant in ethno-medicine for the management of various ailments.*

Keywords: Okra, Characterisation, Phytochemicals; Qualitative and Quantitative

1.0 INTRODUCTION

Okra is an important vegetable crop in the tropical and subtropical regions of the world [1]. The crop is dicotyledonous, belonging to the order Malvales and the family Malvaceae [2] which consist of many important species including a number of other food, fibre, and medicinal crops such as okra, cotton, and kenaf [3]. The plant is robust, erect, and an annual herb, ranging between 1 to 2 m in height, with simple leaves, which are altenate and palmately veined. The flowers are regular and solitary, with superior ovaries and numerous stamens. The fruit is a pod, variable in colour when fresh.

It is one of the oldest cultivated crops and presently grown in many countries and is widely distributed in Asia, Africa, Southern Europe and America [4]. It is known to have originated in tropical Africa [5] and also in tropical Asia [6].The center of origin remains unclear, but centers of genetic diversity include West Africa, India and Southern Asia [7]. The crop is easy to cultivate and suited to regions with moderate rainfall. Okra is a warm season crop, requiring ample moisture for germination [8].

Okra has high nutritional, medicinal and industrial value [9] and high financial value [10]. The seeds are also a good source of vitamins, minerals and medically important compounds [11]. Mucilage occurs in most parts of the plant, and is associated with other substances such as tannins. It usually occurs in the roots, bark, and seeds, but is also found in the flowers, leaves and cell walls [11].The edible part of okra is the immature pod, which is harvested when tender. The leaves, buds and flowers are also edible.

Dried okra can also be stored and used later for soup or stew. In West Africa, okra is utilized mainly because of its high mucilage content which is used in the thickening of soup [2]. The name okra is of West African origin, but most often used in the United States and the Philippines. It is known in many English-speaking countries as lady's fingers, okra, or gumbo, quiabo in Portuguese, gumbo in French, bhinde or bhendi in India. In Ghana, it has different names depending on the region and dialect. For instance, it is called *nkruma* by the Akan speaking communities and *fetiri* by the Ewe [12]. In West and Central Africa (WCA), okra is called

Gombo (French), Miyan-gro (Hausa), La (Djerma), Layre (Fulani), Gan (Bambara), Kandia (Manding), and is among the most frequently and popularly consumed traditional vegetables.

Previous studies have shown that okra mucilage of *Abelmoschus esculentus* L. binds cholesterol and bile acid carrying toxins deposited into it by the liver. Moreover, is the vegetable of high value due to its high nutritional importance and contains a great proportion of fibres, which supports to stabilize blood sugar by improving the rate as a result of which sugar is absorbed from the intestinal tract. Despite aforementioned human benefit of Okra, there is little or no research on nutritional and phytochemical properties of Okra. The paucity of knowledge on nutritional and qualitative properties of okra mucilage extract has resulted in their neglect and under-utilization. It is envisaged that the result of this study will initiate the exploitation of their potentials.

This study will examine the nutritional and phytochemical properties of okra as part of measures to further appraise its role in health promotion and fight against diseases. The objective of this study includes, Characterization okra mucilage, Evaluation of the qualitative and quantitative properties of okra mucilage extracts.

2. MATERIALS AND METHODS

2.1 Sample collection

Okra (*Abelmoschus* esclentus) was purchased from Owode market in Ede North local Government Area, Osun state. The area was within the latitude and longitude of 7.7371° N, 4.4343° E respectively. The purchased okra sample was taken to Department Laboratory for analysis.

2.2 Isolation of okra mucilage

Organic solvent (acetone) was used for extraction of mucilage from fruits of Okra (*Abelmoschus* esclentus). This was carried out by slicing the fruits of Okra (*Abelmoschus esculentus*) was into small pieces and preceded by soaking in distilled water of 1000ml. The mixture was boiled in a water bath at 80^{o}C for an hour. It was then left for an hour to allow for the separation of the mucilage was from *Abelmoschus esculentus* fruits. Then, through addition of acetone, the Okra mucilage was precipitated from the filtrate. The mucilage was then dried at 45^{o}C in oven till it was completely dry. Mortar and pestle were used for milling of the mucilage. The dry powder of mucilage obtained was sieved through 80 meshes and later stored in desiccator for further evaluation.

2.3 Extraction procedure

2.3.1 Aqueous Extract

This was carried out through the use of pestle and mortar, dry powder of mucilage powder was homogenized at ratio of 1:8 w/v in sterile distilled water and filtered through muslin cloth. This was followed by strained of filtrate obtained through filter paper (Whattman No. 1). The extraction procedure was done at room temperature.

2.3.2 Ethanolic Extract

This was prepared by soaking 400g of the dry mucilage powdered of okra in 1000ml of ethanol for 48hrs at room temperature. Thereafter, extract was filtered through a Whatmann filter paper No. 42 (125mm) and subsequently through cotton wool. The extract was then concentrated using a rotary evaporator with the water bath set at 40◦C was used to concentrate extract to one-tenth its original volume and finally with a freeze drier. This was followed by storage of dried residue at 4ºC. The crude extract residue were then weighed and dissolved in distilled water for experimental analysis.

2.4 Characterization of okra mucilage

2.4.1 Solubility

This was done qualitatively by stirring 10mg of Okra mucilage powder in water of 10mL, with dispersion of acetone, chloroform, and ethanol (in 1%). Solubility was determined based on visual observation of solute.

2.4.2 pH Determination

This was determined by dispersion of dried okra mucilage in water at 1% W/V (okra mucilage: water). The mixture was then stirred consistently for 5 minutes, followed by pH determination using pH meter.

2.4.3 Viscosity study

This was performed using the Brookfield viscometer (Model DV-E, U.S.A) with helipad stand. Dry okra mucilage was mix with water at 1% W/V, and then the viscosity of the mucilage dispersion was studied at a rotational speed at 10 rpm using an S-64 spindle in triplicate.

2.4.4 Swelling ratio

This was achieved by addition of 1 g of dry okra mucilage into a 25ml glass Stoppard measuring cylinder containing 25 ml of water, then at intervals of every 10 min for 1 h the mixture was shook. The volume occupied by mucilage was measure after

allowing the sample to stand for 3 hours at room temperature. This was followed by estimation of mean value in relation to 1g of mucilage [13].

2.5 Qualitative Method of Analyses of Phytoconstituents

They were carried out using method described by Harborne [14] in order to established the producing extract and to identify numerous Phyto-constituents present in finely powdered of okra mucilage

2.5.1 Test for tannins

This was done by boiling 1g of each of the dried powdered samples (separately) in 40 ml of water in a test tube and then filtered. A brownish green or a blue-black coloration was observed after addition of a few drops of 0.1% ferric chloride.

2.5.2 Test for steroids

This was carried out by addition of 4 ml of acetic anhydride to 1 g of each of the crude extract (separately) with further addition of H_2S0_4(2ml). The presence of steroids was indicated by change of colour from violet to blue or green.

2.5.3 Test for flavonoids

This was determined through heating of 0.5g of the powdered okra mucilage extract sample (separately) with ethyl acetate (10 ml) over a steam water bath for 3 min. To 1 ml of dilute ammonia solution, 4ml of filtrate from the filtered mixture mixture was added and shook. Appearance of yellow coloration is an indication of presence of flavonoids.

2.5.4 Test for Saponin

To 10 ml of distilled water, 1 g of the powdered okra mucilage sample (separately) was added and boiled in a water bath. The mixture was then filtered and to resultant 5ml of filtrate, 2-3 ml of distilled water was added and shook vigorously for attainment of a stable persistent froth. Then, followed by mixture of frothing with 1-2 drops of olive oil and shook vigorously, then observed in the formation of emulsions.

2.5.5 Test for alkaloids

5 ml of the crude mucilage extracts were added to 8 ml of 1% HCl mixed, warmed and later filtered. Maeyer's and Dragendorff's reagents were added to the 2 ml of the filtrate, then alkaloids absence or presence were determined based on the turbidity or precipitate development [15].

2.5.6 Test for Anthraquinone

5 ml of each of the crude mucilage extracts (separately) was boiled with 10 ml of sulfuric acid (H_2SO_4) and was filtered while hot. The filtrate was shook with 5 ml of chloroform. The chloroform layer was pipette into another test tube and 1 ml of dilute ammonia was added. The resulting solution was observed for color changes [16].

2.5.7 Test for Phenols

To 2ml of various crude mucilage extracts of sample, 4ml of distilled water, followed by a few drops of 10% aqueous ferric chloride solution was added. Development of blue or green color indicated the presence of phenols (15).

2.5.8 Test for Resin

2 ml of crude mucilage extracts was added to a few drops of acetic anhydride solution, followed by addition of concentrated Sulphuric acid (2ml). Presence of resins was determined by change in colour from orange to yellow [15].

2.5.9 Test for Terpenoids

This was carried out by Salkowski's test described by Parekh and Chands (2008), To 4ml of chloroform, 10ml of the crude extract was added, followed by the careful further addition of 5ml concentrated (H_2SO_4). Formation of the reddish brown coloration at the interface is an indication of a positive result for the presence of terpenoids.

2.5.10 Test for Cardiac Glycosides

The Keller-Killani test method described by Parekh and Chands [15] was used for Cardiac Glycosides determination. To 2 ml of glacial acetic acid containing one drop of ferric chloride ($FeCl_3$) solution, 5 ml of the extract was added, this was followed by addition of 1 ml concentrated Sulfuric acid. Brown ring was formed at the interface which indicated the presence of deoxy sugar of cardenolides. A violet ring may appear below the brown ring, though in the acetic acid layer, a greenish ring may also form just progressively throughout the layer.

2.5.11 Test for Phlobatannins

An aqueous extract of the dry okra mucilage sample was boiled with 1% aqueous hydrochloric acid. Appearance of red precipitate indicates the presence of phlobatannins.

2.6 Quantitative Method of Analyses of Phytoconstituents

2.6.1 Flavonoids Determination

This was determined by method described by Osuntokun *et al*. [17]. 200 ml of 80% aqueous methanol was used for recurrent extraction of 20 g of the coarse powders of okra (*Abelmoschus esculentus*) at room temperature. Whatman filter paper No 42 was then used for filtration of the whole solution. The filtrate was then transferred into a crucible and evaporated to dryness over a water bath; the dry content was weighed to a constant weight.

2.6.2 Alkaloids Determination

To a 500 ml of beaker, 10 g of the coarse powders of okra and 400 ml of 10% acetic acid in ethanol were added; the beaker was then covered and allowed to stand for 4 hours. This was then filtered, extracted and concentrated on a water bath to one-quarter of the original volume. This was preceded by dropwise addition of concentrated ammonium hydroxide to the extract until the precipitation is completed. The whole solution was allowed to settle and the precipitate was collected, washed with dilute ammonium hydroxide and then filtered; the residue is the alkaloid, which was dried and weighed to a constant mass [18].

2.6.3 Saponins Determination

50ml of 20 % aqueous ethanol was added to 10 g of the coarse powders of okra in a conical flask. At about 55^{o}C, for 4 hours with continuous stirring, the mixture was heated using a hot water bath after which the mixture was filtered and the residue re-extracted with a further 100 ml of 20% ethanol. The combined extracts were reduced to 20 ml over a water bath at about 90°C. The concentrate was transferred into a 100 ml separatory funnel and 10 ml of diethyl ether was also be added and then shaken vigorously. The aqueous layer was recovered while the ether layer was then discarded. The purification process was repeated three times. 30 ml of n-butanol was added. The combined n-butanol extracts were washed twice with 5 m1 of 5% aqueous sodium chloride. The remaining solution was heated in a water bath. After evaporation, the samples were dried in the oven to a constant weight; the Saponin content was calculated as the percentage of the starting material [19].

2.7 Statistical Analysis

The data were taken in triplicate and mean values and standard deviation of the mean were determine

3. RESULTS AND DISCUSSION

3.1 Characterization of Okra Mucilage

3.1.1 Solubility study

The result showed that Okra powder appeared to be sparingly soluble in water whereas insoluble in acetone and ethanol (Table 1). When dispersed in water, Okra powder was swelled and formed viscous dispersion. The slightly solubility pattern of Okra gum is essential in this formulation because the swellable and viscous dispersion is an indication of a strong matrix polymeric system that is able to control the release of Lamivudine.

3.1.2 pH determination

The pH recorded in this study for Okra gum is 6.9±0.22 (Table 1). Okra plays vital roles in the retarding effect for the development of sustained release tablet because okra gum is known to have maximum viscosity at a neutral pH range. Neutral pH is suitable for uncoated tablets and causes minimum irritation to the gastrointestinal tract [20]. Moreover, the pH of Okra tablet that is formulated with Lamivudine will not be altering by the neutral pH of the okra gum.

3.1.3 Viscosity study

The value obtained for the viscosity of Okra mucilage is 245.58±0.05 cp (Table 1). More sticky mass produces by okra mucilage was due to more viscous properties and it provides better tensile strength and helps to slowdown the drug release from tablets. Okra mucilage produced here will be able to hold the ingredients in a tablet more efficiently and produce tablets with better retarding effects, this will be due to the fact that the mucilage with a higher degree of stickiness creates a more dense material with heavier cross linkage of molecules.

3.1.4 Swelling ratio

Swelling ratio of mucilage determined in this study is 3.4 ± 0.03 (Table 1). A significant change in swelling by the end of this work is an indication that the mucilage had exceptional swelling properties

3.2 Quantitative Phytochemical analysis of Okra

Therapeutic activity and functionality of plants species are based on its quantitative phytochemical constituents. The quantitative analysis of fruits extracts of *Abelmoschus esculentus* revealed the percentage yield of the chemical constituents of 17.43 and

14.65% for fruits aqueous and ethanolic crude extracts respectively, while the 12.54, 18.33 and 10.53% each were recorded for the flavonoids, saponin and alkaloids (Table 2).

3.3 Qualitative phytochemical analysis of aqueous and ethanolic of Okra fruits

The results of the qualitative phytochemical analysis of aqueous and ethanolic crude extracts of Okra fruits showed the presence of various secondary metabolites like tannins, steroid, flavonoids, Saponin, alkaloids, anthraquinones, phenol, terpenoids and cardiac glycosides, and absent of resin in aqueous and ethanolic extracts of fruits (Table 3). For instance, the main objective of diabetes regulatory is to maintain blood glucose level to prevent diabetes induced complications, and traditionally, it was used as an alternative cure for diabetes [21] and when taken regularly as a part of diet has shown a protective effect against Diabetes [22]. Also, the *Abelmoschus esculentus* may be considered by means of medicinal plant used as a nutritional for enhancement in dipping the blood glucose level in hyperglycemia induced by diabetes and as an important component of preventive therapy in the management of diabetes and its related complications. Moreover, the fruit mucilage is used to indulgence diarrhoea in acute inflammation, intestines and dysentery and kidneys catarrhal infections, ardour urine, dysuria irritation of the stomach and gonorrhea (21].

Table 1: Characterization of Okra mucilage

Parameters	**Characterization**
Solubility	Sparingly soluble in water and insoluble in acetone and ethanol
pH	6.9±0.22
Viscosity	245.58±0.05
Swelling ratio	3.4±0.03

Table 2: Quantitative analysis of crude extracts of *Abelmoschus esculentus* L fruits (Okra)

Chemical components	Percentage Yield (%)
Aqueous Extract	17.43
Ethanolic Extract	14.65
Flavonoids	12.54
Saponins	18.33
Alkaloids	10.53

Table 3: Qualitative phytochemicals analysis of the fruits aqueous and crude extracts of *Abelmoschus esculentus* (Okra)

Chemical components	**Aqueous extract**	**Crude extract**
Tannin	++	+++
Steroids	++	++
Flavonoids	+++	+++
Saponnins	++	+
Alkaloids	+++	+++
Anthraquinons	+	+
Phenols	++	+
Resin	-	-
Terpenoids	++	++
Cardiac Glycosides	+++	+++
Phylobatannis	--	- -

Key:
+++ = Highly present, ++ = Moderate or averagely present, + = good/slightly present, - = Absent

4 Conclusions

The report from the current study showed the presence of tannins, steroids, flavonoid, saponins, alkaloids, anthraquinones, phenol, terpenoids, and cardiac glycosides during phytochemical screening of aqueous and ethanol extract of *Abelmoschus esculentus* L leaves. This indicates that *Abelmoschus esculentus* L leaf extract is rich in the chemical composition exhibiting highest activities. The result available in this work shows the potential nutritional importance of okra as well as its role in health and nutrition improvement.

The study revealed that the okra is simple and an affordable source of Carbohydrate, vitamins, proteins, minerals, proteins, dietary fibre and essential fatty acids. As a result of complex in the nature of disease etiology and different factors links to their

occurrence, its pertinent that researchers continues unravel the mechanism and principle involved in disease control and braced up on how bioactive from plants and foods (Okra) can influence human health.

The phytochemical compounds found in the present study are another breakthrough and revelation on medicinal attributes of okra and pointer to pharmacological applications of okra in treating human diseases and several ailments. Apart from the above highlighted nutritional , medical and industrial characteristics of Okra, the phytochemical compound detected in this work is another scientific point towards its earlier used in many herbal formulations for the cure of various ailments, in particular the regulation of blood pressure, fat, diabetes, chronic dysentery genito-urinary disorders, simple goiter and ulcer.

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