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Phytochemical Screening and Proximate Analysis of Sweet Orange (Citrus Sinesis) Fruit Wastes

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ABSTRACT

Phytochemical and proximate composition of sweet orange (citrus sinesis) wastes parts were evaluated using standard analytical methods. The result of the study arising from ethanolic and aqueous crude extracts revealed the presence of some secondary metabolites which include alkanoids, flavonoids, steroids, phenols, saponins and carbohydrates (reducing sugars). This clearly shows that the supposedly wastes parts of the fruit has some preventive and curative property. The result also showed the percentage (%) moisture, ash, fiber, protein, fat and carbohydrate content of the peel (albedo)to be 2.20, 14.35, 26.50, 4.05, 10.00 and 42.90 respectively, while in the flavedo are 8.00, 11.85, 21.00, 0.91, 44.20 and 14.04(%) respectively. In the seeds, the result shows 6.20, 2.50, 5.50, 3.10, 54.20, and 28.50% moisture, ash, fiber, protein, fat and carbohydrates respectively. They posses various degree of disease preventive property and are valuable sources of raw materials for both traditional and orthodox medicine. These waste products when well harnessed can go a long way in enhancing the economy of a nation and avert environmental pollution and health epidemics.

Keywords : Phytochemicals, Flavonoids, Albedo, Metabolites

I. INTRODUCTION

Since ages, people have been exploring the nature particularly plants in search of new drugs and other useful purposes. The study of plants and its parts continued principally for the discovery of novel secondary metabolites (Dipali and Vilas, 2013). Around 80% of products are of plant origin and their sales exceeded US$65 billion in 2003.

Sweet orange (cirus sinesis) is the world most common cultivated fruit tree, belonging to the Rutaceae family which comprises mandarins limes, lemons, grape fruits, sour and sweet oranges (Karoui and Marzouk, 2013). Oranges were first cultivated in South East Asia, Northeastern India and Southern China and in the year 2500BC. In the first century AD, the Romans brought young sweet orange trees all the way from India to Rome. North Africa began growing oranges in the first century AD (Miami, 1987). Sweet orange seeds were brought by Christopher Columbus in 1493 across the Atlantic Ocean to Spain's Canary Island and to Haiti, where he planted orange orchards. By 1518 oranges were introduced to Panama and Mexico, and a little later, Brazil started growing orange trees. In America, the first orange tree was planted in Florida in 1513 by a Spanish explorer Juan Ponce de Leon. As at today, Brazil is regarded as the world's highest producer of sweet orange (Baghurst, 2003).

Citrus fruits are known to contain high amount of vitamin C and other bioactive compounds such as carotenoids and a wide range of phenolic compounds. Sweet oranges, apart from its sweet savoring taste and hunger savaging properties, industrial uses etc, has various and imperative health benefits to individual consumers. These include; anti-cancer, anti-microbial, anti-oxidant, anti-ulcer, anti-inflammatory, hypolipidemic and hepato protective properties. All these make it rich in phytochemical compositions. The consumption of citrus fruits is also believed to confer some protection against diseases such as cardiovascular disease and cancer (Baghurst, 2003; Guimaraes et al, 2010; Atolani et al, 2012).

This economically valued tree plant occupies the top most position in fruit production. It is widely cultivated in tropical and subtropical climates for the sweet fruit, which is peeled or cut and eaten whole, or processed to extract orange juice (Pandharipande and Makode, 2009; Kamal et al, 2011). Sweet orange oil is a by product of the juicy industry produced by pressing the peel. It is used as a flavoring of food and drink and for its fragrance in perfume and aromatherapy (Wilson, 2008).

The orange fruit is composed of an external layer (peel) formed by flavedo (epicarp or exocarp) and albedo (mesocarp), and an inner material called endocarp that contains vesicles with juice (Liv et al, 2007). The seeds are usually embedded at the center of the fruit, in direct contact with the juice sacs. Citrus trees are evergreen trees that produce fruits of different shapes and sizes (from long to oblong), which are full of fragrance, flavor and juice. It has a rough robust and bright colour from green to yellow skin or rind, known as epicarp (flavedo) and serves as a protective coat to the fruit. The internal part constitutes the pulp which is divided into separate segments or juice sacs (with or without seeds due to varieties) by a thick endocarp. This part is rich with soluble sugars, ascorbic acid, pectin, fibers, different organic acids and potassium salt that gives the fruit its characteristic citrine flavour (Okwi and Emenike, 2006). The peels obtained from citrus fruits constitute about 50 to 65% of the total weights of the fruits. When not processed further, these by products (albedo, flavedo and seeds) become very worrisome wastes capable of becoming very serious environmental pollutants (Mandalari et al, 2006; Hegazy and Ibrahim, 2012).

In Nigeria, citrus fruit wastes are mostly and carelessly discarded in the environment. This eventually leads to the release of odors, serving as fertile ground for insect proliferation and vector such as housefly which carries germs to our foods and infest them with diseases like cholera and generally constitute nuisance in the environment.

Phytochemical screening is very important in identifying new sources of therapeutically and industrially important compounds like alkanoids, flavonoids, phenolic compounds, saponins, steroids, tannins, terpenoids etc. (Akidele and Adeyemi, 2007). It is important to note that the knowledge of phytochemical constituents can help one speculate on the medicinal and other values/properties of a particular plant and its parts (Falodun and Nwozigo, 201). The present study aimed at finding the phytochemical constituents present in the ethanolic and aqueous extracts of sweet orange (citrus senesis).

II. METHODS AND MATERIAL

Plant materials

Fresh orange fruits were plucked from an orange tree in Hospital road, Orhuamudhu quarters in Ozoro town, Delta State, Nigerial during September 2016. The fruits were washed with distilled water and the outer peels were carefully removed with a sharp knife ensuring that the flavedo was not harvested alongside the albedo. The, albedo, flavedo and seeds were separated and shade dried at room temperature, pulverized and stored in an air tight bottle.

Extraction of plant materials

Extracts of albedo, flavedo and seeds were prepared using two different solvent systems—absolute ethanol, giving rise to ethanolic extract and distilled water to produce the aqueous extracts. 20g each of the pulverized citrus waste was soaked in 200ml of the solvents in an air tight container for 72hours with occasional stirring. The extracts were then filtered and concentrated by using a rotary evaporator at low pressure.

Proximate Composition

Freshly pulverized albedo, flavedo and seeds were used for the proximate analysis to determine the percentage moisture, crude fibre, crude protein, crude fat, ash content and carbohydrate using standard methods of analysis. The moisture and ash contents of the pulverized samples were determined by the gravimetric method of AOAC (1997) as described by Pearson (1976). The crude fibre contents were determined by the Weende method as described by Pearson (1976). The crude protein was determined by the Kjedahl method described by AOAC (1997). The protein was calculated using the general factor 6.25 (AOAC, 1997). The percentage crude fat content of the samples were determined by the continuous soxhlet lipid extraction method using soxhlet reflux apparatus as described by Horowitz (1984). The percentage carbohydrate contents were estimated as the difference between 100 and the sum total of the proximate composition of each sample.

Phytochemical Analysis

Phytochemical examinations were carried out for all the extracts as per the standard methods given by Harborne (1998), Sofowora (1993) and Trease and Evans (1996). A stock solution of the extracts with a concentration of 1mg/ml was prepared and subsequently used for the screening.

1. Determination of flavonoids:-

Extracts were treated with few drops of sodium hydroxide solution. An intense yellow colouration which becomes colourless on addition of dilute acid indicated the presence of flavonoids.

2. Determination of phenols:-

Extracts were treated with few drops of ferric chloride solution. The formation of bluish black colour indicates the presence of phenols.

3. Determination of alkanoids:-

Extracts were dissolved individually in dilute Hcl and filtered. The filtrates were treated with Wager's reagent (iodine in potassium iodide). The formation of reddish brown precipitate indicated the presence of alkanoids.

4. Determination of saponins:-

To 2ml of each extract was added 5ml of distilled water and the solution shaken vigorously for 5minutes. A stable and persistent frothing indicated the presence of saponins.

5. Determination of steroids:-

1mg of the extracts was dissolved in 0.5ml of acetic acid and 0.5ml of chloroform was added. The solution was pipette into a dry test tube and 1ml of concentrated sulphuric acid added at the bottom of the tube. A brown-red ring at the interface between the two liquids indicated the presence of steroids.

6. Determination of carbohydrates:-

1mg of the extracts dissolved in 2ml of distilled water and 1ml of Fehling's reagent which contained a mixture of Fehlings solution I and II was added and the mixture heated. A brick red precipitate indicated the presence of carbohydrates in the form of reducing sugars.

III. RESULTS AND DISCUSSION

The result (table 1) of the preliminary phytochemical screening of ethanolic and aqueous extracts of albedo, flavedo and seed of sweet orange (citrus sinesis) shows the presence of various phytochemicals. These include alkanoids, flavonoids, phenols, saponins, steroids and carbohydrates in the form of reducing sugars. With the exception of aqueous extracts of seed which shows the absence of phenol, ethanolic extract of seed shows the absence of alkanoids and steroids and ethanolic extract of flavedo indicate the absence of steroids. It is a known fact from this study that ethanol and aqueous sweet orange fruit parts (albedo, flavedo and seeds) extracts contained; alkanoids, flavonoids, phenols, saponins, steroids and carbohydrates (reducing sugars). These phytochemicals have been identified by other researchers in various plant parts (Josephine et al, 2010; Devbhuti et al, 2009; Hassan et al, 2007; Bennett et al, 2003; Tijjan et al, 2009).

This study reveals and established that like in previous studies not all phytochemicals are present in all plant parts and that those present differs based on the type of the extracting solvent applied (Josephine et al, 2010; Ayinde et al, 2007). El-Mahmood Muhammad Abubakar revealed the presence of alkanoids, phenols, tannins, saponins and cardiac.glucoes in methanolic stem bark extract (El-Mahmood, 2009), ethanolic flower extract of mangifera indica showed the presence of alkanoids, flavonoids, phenols and carbohydrates and absence of saponins (Parvathi et al, 2012).

Table 1: Phytochemical screening of albedo, flavedo and seed of sweet orange (citrus sinesis)

Solvent	Alkanoids	Flavonoids	Phenols	Saponins	Steroids	Carbohydrates
Albedo (Aq Extract)	+	+++	++	+	+	+
Flavedo (Aq Extract)	+	++	+	++ +	+	++
Seed (Aq Extract)	+	+	_	+ +	+	+
Albedo (Ethanolic Extract)	++	+	++	++	+	+
Flavedo (Ethanolic Extract)	+	+	+	++	_	++
Seed (Ethanolic Extract)	_	++	+	+	_	+

All tests were carried out in triplicates.
Key:- +(present), ++(moderately present), +++(highly present) –(not present)

Table 2: Proximate composition of albedo, flavedo and seed of sweet orange (citrus sinesis)

	Albedo	Flavedo	Seed
Moisture (%)	2.20	8.00	6.20
Ash (%)	14.35	11.85	2.50
Fiber (%)	26.50	21.00	5.50
Protein (%)	4.05	0.91	3.10
Fat (%)	10.00	44.20	54.20
Carbohydrate (%)	42.90	14.04	28.50

The presence of these notable phytochemicals in the supposedly wastes of sweet orange is an indication that they are highly of economic importance and posses capacity for nation building beyond the sweet juice in it. The peel (albedo), seed and flavedo have been shown (table 2) to contain certain amount of protein (4.05, 3.10 and 0.9%) respectively, and are rich in alkanoids, flavonoids and carbohydrates.

Flavonoids have been reported to have many useful properties inclucding anti-inflammatory, anti-oxidant, anti-microbial, anti-allergic, estrogenic, vascular and cytotoxic anti-tumour activities as well as anti-thrombotic vasoprotective (Harborne and Williams, 2000; Falodun and Nwozigo, 2010). Saponins are present in both ethanolic and aqueous extracts of all the parts of the sweet orange. Saponins have extensively been used as detergents, as pesticides and molluscides, in addition to their individual application as foaming and surface active agents as well as have beneficial health effects. The roles of alkanoids in anti-cancer and anti-viral activities have been well reported (Evans, 2000). Phytochemicals help plants defend against environmental challenges and also provide humans with protection against various diseases as well. Hence, it is not surprising while they are harvested for medicinal purposes (http://www.naturalnews.com/032463-phytochemicals health benefits. html#ixzz2mxSsMzAq). It is also documented that phytochemicals in plant-based foods can improve glucose metabolism as well as enhance the overall health of diabetic patients by improving lipid metabolism, anti-oxidant status, improving capillary function, and lowering blood pressure and cholesterol (Kelble ,2006; Broadhurst et al, 2000).

The availability of the various phytonutrients screened for is a strong indication that the wastes parts (albedo, flavedo and seed) of sweet orange (citrus sinesis) are rich sources of these secondary metabolites which may justifies its medicinal and physiological roles in human body (Safowora, 1993).

The result of the crude protein was highest in the albedo (4.05%), followed by seed (3.10%) and flavedo layer containing the least (0.90%) respectively. Proteins contributes to the structure and functions of the living cells as well as occur as independent unit combining with lipids, nucleic acids, carbohydrates and many other compounds (Dipali and Vilas, 2013; Sabnis and Daniel, 1990).

The albedo is found to contain significant amount of crude fiber (26.50%) when compared with the flavedo (21.00%) and the seed (5.50%) respectively. The fiber may be utilizable in food enrichment. This is especially so as fruit fiber is considered to be better quality than plant fiber. This is also due to higher total and soluble fiber content, water and oil holding capacity and colonic fermentability as well as lower phytic acid content and caloric value (Figuerola et al, 2005). The flavedo layer contains the highest amount of moisture content (8.00%) followed by seed and albedo (6.20 and 2.20%) respectively. High moisture content promotes susceptibility to microbial activity (Ponnusha et al, 2011). Ash contents of the albedo, flavedo and seed were (14.35, 11.85 and 2.50%) respectively. The result shows that the seeds, flavedo and albedo of sweet orange are rich in oil having values of (54.20, 44.20 and 10.00%) respectively. Orange oil is extensively utilized in aromatherapy as it helps soothe tensed muscles and aids as a mood lifter. It's commonly used as an added flavouring to beverages, sweet meats, chocolates, biscuits and confectionery and baked foods. Industrially, it is utilized as a concentrate for room freshners, deodorants, soaps, body lotions and cream (Akubugwo and Ugbogu, 2007)

IV. CONCLUSION

In this study, it has been revealed that the supposedly wastes parts of sweet orange contain phytochemicals such as alkanoids, flavonoids, steroids, phenols, saponins etc. which can be harnessed and put into use. They poseses various degree of disease preventive property, hence, are valuable source of raw materials for both traditional and orthodox medicine. These supposedly waste products of sweet orange when harness properly can go a long way in enhancing the economy of a nation and avert environmental pollution and health epidemics. There is the need therefore to carry out more pharmacological studies to support the use of sweet orange wastes parts as a medicinal plant.

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