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Assessment of Nutritional Composition of *Citrus Sinensis* (Sweet Orange) Seed in Madagali Admawa Nigeria

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Abstract

The Proximate, phytochemicals, elemental and anti-nutrients of *Citrus sinensis* seed collected from Madagali were investigated. The Proximate and phytochemicals were determined by standard methods. The anti-nutrient contents were determined using the high-performance liquid chromatography (HPLC), while the elemental composition by using the Atomic absorption spectrophotometer (AAS) and flam photometer. The result of the Phytochemical revealed that tannins (7.14 ± 0.02 mg / 100 g), alkaloids (11.0 ± 0.02 mg /100 g), flavonoids (9.21 ± 0.01 mg / 100 g), polyphenol (23.9 ± 0.03 mg / 100 g), terpenoids (1.05 ± 0.01 mg / 100 g), and steroids (0.65 ± 0.01 mg / 100 g) were present in the citrus sinensis seed. The elements present in the seed were Ca (132.53 ± 0.2 mg / 100 g), P (375.23 ± 0.2 mg / 100 g), Mg (85.63 ± 0.2 mg / 100 g), Zn (2.53± 0.1mg / 100 g), Na (51.43 ± 0.2 mg / 100 g) and Fe (12.46 ± 0.2 mg / 100 g).The proximate analysis result showed the values of Protein, Fat, Fibre, Ash, Moisture and Carbohydrate were 6.71 ± 0.2 %, 28.65 ± 0.1 %, 7.15 ± 0.1 %, 8.1± 0.01 %, 14.63 ± 0.2 % and 34.82 ± 0.03 respectively. The result showed that oxilate (3.15± 0.01 mg / 100 g), lectins (0.36 ± 0.02 mg /100 g), phytates (4.13± 0.01mg /100 g), saponins (5.76 ± 0.02 mg /100 g) and glycosides (6.24 ± 0.01 mg / 100 g) were present in the seed. The proximate composition and the minerals indicate that the *Citrus sinensis* seed could be an important nutrient to both human and livestock, the phytochemical is an indication of bioactive component, which is an effect source for drugs.

Key words: Phytochemical, Elemental Proximate, Anti Nutrient and *Citrus Sinensis*

Introduction

Plants are indispensable constituents of human diet supplying the body with mineral salts, vitamins and certain hormones precursors, in addition to protein and energy. Also plants serve as a source of medicinal product and shelter to man and his livestock. Medicinal plant is any plant in which one or more of its organ contain substances that can be used for the therapeutic purposes or which are precursors for the synthesis of useful drugs (Williams *et al*., 2020a)

The term phytochemical is often used to describe a diverse range of biologically active compounds found in plant. Phytochemicals provide plant with color, flavor and natural protection against pest (Xu, 2013). Phytochemicals are not essentially required for the sustenance of life but confer extra health benefit against pathogens (Methew *et al*., 2012). Phytochemical screening help us to see at a glance the various phytochemicals present in the plant material. This may give hint as to the possible range of bioactivity the plant product may possess. It also serve as a preliminary step in research protocol aimed at the isolation, purification and utilization of compounds inherent in the plant material for medical, pharmaceutical and agro industrial use. While anti-nutrient are considered to be problematic, some may provide health benefit the consumer should be aware of any possible effect whether beneficial or negative. Moreover, concentration dependent effect must be considered. Data may be manipulated in respect of health related advantages so that chronic diseases management becomes possible. Some anti-nutrients are valuable active ingredient in food and drinks. When used at low levels, phytic acid, lectins and phenolic compounds as well as enzyme inhibitors and saponins have been shown to reduce blood glucose and plasma cholesterol and triacylglycerol. Furthermore, saponins are reported to act effectively in maintaining liver function preventing osteoporosis as well as platelet agglutination. Another group of anti-nutrients like tannin were found to possess possible anti-viral, anti-bacterial and anti-parasitic effect. On the other hand, some compounds such as phytoestrogens and lignin's have been linked to induction of infertility in human. Therefore it is prudent to examine all aspect of food anti-nutrient and their potential health benefit (Williams *et al*., 2019).

Sweet orange (*citrus sinensis* L.) is the world's most commonly cultivated fruit tree. It belongs to the Rutaceae family which comprises mandarins, limes, lemons, grapefruits, sour and sweet oranges (Karoui and Marzouk, 2013). Citrus fruits are of immense economic value occupying the top position in fruits production. Orange trees are widely cultivated in tropical and subtropical climate for the sweet fruits which are peeled (to avoid the bitter rind) or cut and eaten directly or processed to extract orange juice (Pandharipande and Makode, 2009: Kamal *et al.*, 2011). The seeds are usually embedded at the center of the fruit (Liu *et al*., 2007).

The protection that orange fruit provides against diseases has been attributed to the various anti-oxidant phytonutrients contained in citrus species (Gottwald *et al*., 2007). Figuerola *et al*., (2005) reported that citrus fruits are rich in vitamin C or ascorbic acid and folic acid as well as a good source of fibre. Therefore the importance of sweet orange in nutrition and human health can hardly be overemphasized. Goudeau *et al*., (2007) noted that the regular intake of orange prevents frequent attack of common cool, influenza, bleeding as well as contribute to one's healthy living. In addition, orange juice compared with all the fruits juice is more suitable for all age groups and can be given to patients of all kinds of diseases. Apart from human consumption, other use of sweet orange includes the production of feed for livestock especially ruminant animals (Hegazy and Ibrahim 2012).

The orange oil is used to treat chronic bronchitis. Tea made from dried orange floor stimulates the nerve system. Orange peels traditionally used to treat sleeping problems. The phytochemicals limonene and flavonoids appear to have anti-carcinogenic properties. They can block the carcinogens by acting as blocking agents (Moreno *et al*., 2008). Leave decoction with salts is taken orally for digestive tract ailments, nerve disorder, fever, asthma, blood pressure, general fatigue and vomiting. Crushed leaves or fruit juice is robbed on the skin to relieve itching. Macerated roots, leaves or fruit mesoderm is taken orally for urethritis. Bark decoction is taken orally for liver ailment. In samoa, a leave infusion made from sweet orange is used against mouth sore in infants (Pillemon 1993).

Citrus sinensis L are used in many cultures for prevention and treatment of diseases. But the bases for their use for prevention and treatment of diseases in various part of the word have not been properly known. The orange fruit is of unique economic importance as all portions contain potential for diverse industrial usability. So far, researches into citrus waste have concentrated on the peels (flavedo) with little attention on the albedo and seed. Hence the aim of this paper is to investigate phytochemical, elemental proximate and anti-nutrients composition of *citrus sinensis* L seed locally grown in the study area.

Material and methods

Sample collection and identification

The matured ripped unaffected fruits of sweet orange (*citrus sinensis L*) were bought from the Madagali market, identified and authenticate by a botanist in the department of crop production Adamawa State University Mubi.

Sample preparation

.The fruits were cut opened and the seeds were removed, then washed with distilled water and dried at room temperature and pulverized in to powder.

Chemicals and reagents

All Chemicals and reagents used were of analytical grade

Preparation of extract

Twenty- five grams (25 g) of powdered seeds were extracted separately in a soxhlet apparatus and solvent were removed. The percentage yield was determined by following the method described by Harbone (1998) and Knapp (2000): The yield percentage = weight of extract recovered x 100 / weight of the dry powdered and the extract was used for the analysis of phytochemical, elemental, proximate and ani- nutrient composition.

Phytochemical analysis

The phytochemicals of the seed samples were estimated following the procedure adopted by Knapp, (2000) and Williams *et al*., (2020b).

Elemental Analysis

The mineral content of the samples were determined using the atomic absorption spectrophotometer and flame photometer following the procedure adopted by AOAC (2003)

Proximate analysis

The proximate composition (moisture, crude fibre, crude fat, ash content, protein and Carbohydrate) of powdered samples of citrus *sinensis* seeds were determined following the method described by AOAC (2005).

.**Anti-nutritional Content Analysis**

The anti-nutrient contents (oxalates, phytates, lectins, saponins and glycosides) were determined using the high-performance liquid chromatography (HPLC) following the procedures adopted by AOAC (2003).

Statistical Analysis

All determinations were replicated three times and results were reported in mean (±) standard deviation.

Results and Discussion

The result of the phytochemical analysis of *citrus sinensis* seeds were presented in Table 1. The result revealed that tannins (7.14 ± 0.02 mg / 100 g), alkaloids (11.0 ± 0.02 mg /100 g), flavonoids (9.21 ± 0.01 mg / 100 g), polyphenol (23.9 ± 0.03 mg / 100 g), terpenoids (1.05 ± 0.01 mg / 100 g), and steroids (0.65 ± 0.01 mg / 100 g) were present in the seeds.

Polyphenol has the highest value and steroids have the lowest value (Table1). The value of polyphenol recorded (23.9 ± 0.03 mg / 100 g) in this study was higher than the one reported (1.90 mg / 100 g) by Sharma *et al*. (2000). Polyphenol compounds are anti-microbial agents hence it is extensively used in disaffection and remain the standard with which other bactericides are compared (Guo 2001). The presence of these metabolites suggests that the citrus *sinensis* seeds could be a source of phytomedicines. For instance, the presence of flavonoids and alkaloids might be responsible for its use as anti-inflammatory, antimicrobial and antidiarrheal activity of *citrus sinensis seeds.* Alkaloids are known for decreasing blood pressure and balancing the nervous system in case of mental illness (Prashant *et al*., 2011). The presence of tannins could also show that it is an astringent, helps in wound healing and anti-parasitic. The presence of terpenes suggests its possible use as anti-tumor and anti-viral agent as some terpenes are known to be cytotoxic to tumor cells. Some of the eudesmane (sesquiterpenes) has been reported to exhibit antibacterial properties possess anti-malaria property; hence the seed may be a good source of anti-malaria (Tona *et al.,* 2001). However, long-term administration of citrus *sinensis* seeds to animals can be toxic (Górniak, 2015; Gotardo,2017; Panigrahi, 2018)

Citrus *sinensis* seeds containing polyphenols are believed to have antioxidant, anti-cancer, anti-inflammatory, anti-viral and anti-diarrheal this is the reason why citrus *sinensis seed* can be used as medicine (Sharma *et al*., 2000; Sadique *et al*., 1987). The results obtained in this study suggest that the identified phytochemical compounds may be the bioactive constituents responsible for the efficacy of the seeds. The presence of some of these compounds has been confirmed to have anti-microbial activity (Tona *et al.,* 2001). Hence it could be inferred that the extract from the seed can be a material for the industrial manufacture of drugs useful in the chemotherapy of some microbial infections (Samy and Ignacimuthu, 2000; Yadav, 2010).

Table 1 the result of the phytochemical analysis of citrus *sinensis* seed

Phytoconstituents	value (mg / 100g)
Tannins	7.14 ± 0.02
Alkaloids	11.0 ± 0.02
Flavonoids	9.21 ± 0.01
Polyphenols	23.9 ± 0.03
Terpenoids	1.05 ± 0.01
Steroids	0.65 ± 0.01

Table 2 contains the result of elemental analysis of *citrus sinensis* seeds. The elements present in the seeds were Ca (132.53 ± 0.2 mg / 100 g), P (375.23 ± 0.2 mg / 100 g), Mg (85.63 ± 0.2 mg / 100 g), Zn (2.53± 0.1mg / 100 g), Na (51.43 ± 0.2 mg / 100 g) and Fe (12.46 ± 0.2 mg / 100 g). The concentration of P was found to be the highest while that of Zn was the lowest. The concentration of phosphorus (P) was found to be 185.36± 0.010 mg/100g. Phosphorus plays a vital role in human body and is a key player for healthy cells, teeth and bones (Williams et al., 2020 b). It maintains blood sugar levels and normal heart contraction. It is also important for normal cell growth and repair, bone growth and kidney function. It plays an important role in maintaining the bodies' acid-alkaline balance (Williams et al., 2020b). Mg is an important mineral element in connection with a circulatory disease such as heart disease (Tona *et al.*, 2001). Mg is an active component of several enzyme systems in which thymile pyrophosphate is cofactor, oxidative phosphorylation is greatly reduced in the absence of magnesium. A common form of Mg deficiency in human includes depressed deep tendon reflexives and respiration. Sources include green vegetables and leaves (Afolayan *et al.*, 2009). Zn is involved in the normal function of the immune system. The *citrus sinensis* seeds have Zn content 2.53± 0.1 mg/100g comparable with the most value reported for plant seeds in literature (Samy and Ignacimuthu, 2000; Williams et al.,2019). Sodium deficiency causes low blood pressure of the body. Most natural food contains Na other sources of Na are table salt, salt added to prepare food. Sodium content of 51.43 ± 0.2 mg/100g was observed which suggest the possibility of incorporating it into the diet of the obese patient. Na concentration in the samples were higher compared to the one reported (0.015 ±0. 02 mg / 100 g) for cassia occidentalis seeds by Willian *et al*. (2019). Calcium is an important mineral required for bone formation and neurological function of the body. The Ca obtained in *citrus sinensis* seeds in this study was 132.53 ± 0.2 mg / 100 g which falls below the World health organization daily requirement and the one reported (241.260 ± 0.010 mg /100 g) for guava (psidiumguajava) by Williams et al. (2020b). World Health Organization recommendation for daily intake of 500 mg for adults and 400 mg for children (World health organization 2013).

Table 2 the result of elemental analysis of citrus *sinensis* seed

Minerals	concentration (mg / 100g)
Ca	132.53 ± 0.2
P	375.23 ± 0.2
Mg	85.63 ± 0.2
Zn	2.53± 0.1
Na	51.43 ± 0.2
Fe	12.46 ± 0.2

The result of the proximate analysis of *citrus sinensis* seeds were presented in Table 3. The result showed the values of Protein, Fat, Fibre, Ash, Moisture and Carbohydrate were 6.71 ± 0.2 %, 28.65 ± 0.1 %, 7.15 ± 0.1 %, 8.1± 0.01 %, 14.63 ± 0.2 % and 34.82 ± 0.03 respectively.

Carbohydrate content was the highest while protein content was the lowest. The value of carbohydrate recorded in this study was lower than the one reported (35.2 %) of similar shrub tree seeds by Sakata et *al*., (2003). The moisture value (Table3) found in this study was higher than those reported (8.30 ±0.03) for Guava seed powder by Uchoa,*et al*. (2014) and higher than those reported (2.00±0.02 %) for cassia occidentalis seed by Williams et al. (2019). The ash value found was 8.1 ±0.01 % which was lower than that of Williams *et al*. (2019) which was 8.220 ±0.002 but higher than the one reported (2.40 ± 0.10 %) by Matsuzhki *et al*. (2010) as well as that of Thomas *et al*. (2014), whose ash value was 3.12 ± 0.03 for the common guava and 3.05 ± 0.01 for the areca, a fruit of the same species.

The protein from *citrus sinensis* seeds has functional properties similar to those of other seeds which have been used as food ingredient and may be an alternative source of protein for future use in processed food. Comparing the result of the protein analysis, the protein content of the powder obtained from *citrus sinensis* seeds were lower than the one reported by Uchoa *et al*. (2014). Williams *et al*. (2019) and Thomas *et al*. (2014) reported that a food item can be considered a source of dietary fibre when it has 3 g/ 100 g in the finished product for solid food and 1.5 g / 100 ml for liquid; if it has twice as this amount, it can be considered as high fibre food. Nwinyi et al. (2008) obtained the value of 67.00 g /100 g for total dietary fibre for Guava seeds powder. The result presented (Table 3) suggests that new product based on fibres obtained from *citrus sinensis* seeds can be formulated to prevent diseases, especially those related to the gastrointestinal traced and the cardiovascular system *citrus sinensis* seeds are a better source of insoluble fibre than the fractions of the seeds and skin of the jabuticaba, a fruit belonging to the same family which has an insoluble fibre value of 26.93 and 26.43 g/ 100 g respectively (Farinazzi – Machado *et al*.,, 2012).

Table 3 the result of proximate analysis of citrus sinensis seed

Composition	Value (%)
Protein	6.71 ± 0.2
Fat	28.65 ± 0.1
Fibre	7.15 ± 0.2
Ash	8.01± 0.1
Moisture	14.63 ± 0.2
Carbohydrate	34.82 ± 0.2

The result of the anti-nutrient analysis of *citrus sinensis* seeds were shown in Table 4. The result revealed that oxilate (3.15± 0.01 mg / 100 g), lectins (0.36 ± 0.02 mg /100 g), phytates (4.13± 0.01mg /100 g), saponins (5.76 ± 0.02 mg /100 g) and glycosides (6.24 ± 0.01 mg / 100 g) were present in the seeds.

The presence of these secondary metabolites in plants produces some biological activity in man and animals and it is responsible for their uses as herbs in primary health care (Ramadass and Subramanian, 2018). These compounds also serve to protect the plant against infections by microorganisms, predations by insects and herbivores, while their odor and flavor are responsible for their pigments (Galeane1, et al., 2017).

. Oxalate can be complex with the most essential trace metal, therefore, making them unavailable enzymatic activities and other metabolic activities. Phytic acid has a complicated effect in the human system including indigestion of food and flatulence. These anti-nutritional factors can easily be reduced to the tolerable limit by proper simple technics such as soaking, cooking and frying (Williams *et al.*, 2019).

Table 4 the result of anti-nutrient analysis of *citrus sinensis* seed

Anti-nutient	concentration(mg /100/g)
Oxilate	3.15± 0.01
Lectins	0.36 ± 0.02
Phytates	4.13± 0.01
Saponins	5.76 ± 0.02
Glycosides	6.24 ± 0.01

Conclusion

The result of *citrus sinensis* seeds analysed in this study indicated that the seeds could be good sources of nutrient considering their proximate chemical composition. Phytochemicals inhibits the growth of microorganism suggesting the seed could be a source of raw materials in pharmaceutical industries for drugs production for the treatment of dysentery, diarrhea, typhoid, fever and hypertension. The result of the elemental analysis also showed appreciable amount of minerals in the seeds, indicates that the seeds could be a source of minerals in diet.

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