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Evaluation of Physical and Chemical Properties of White Sapote (*Casimiroa Edulis*) Fruits and Powder

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ABSTRACT

The objective of this study was to evaluate the physical and chemical properties of fresh and dried white sapote (*Casimiroa Edulis*) fruits. The physical properties, including weight, length, diameter, length/diameter ratio, volume, firmness and bulk density, were studied. Antioxidants, color, mineral contents and sensory evaluation of white sapote using different methods of drying have been studied. The physico-chemical properties results of white sapote fruits showed that the moisture, total soluble solid, total acidity, ash, crude fat, protein, crude fiber and total carbohydrates contents were 78.72, 19.33, 0.14, 1.11, 0.42, 1.39, 1.30, 17.06% and pH value 5.73, respectively. The contents of total sugar, reducing sugar and non reducing sugar were 13.63, 11.65 and 1.98%, respectively and the caloric value was 77.58 Kcal. On the other hand, mineral contents were recorded at 66.39, 3.35, 37.86 and 5.23mg/100 g for phosphorus, iron, calcium and zinc. Color (L*, a* and b*) values were 59.71, 6.33 and 16.29, respectively. Color measurements of all treatments showed that T6 had the highest value (12.87) for ΔE of color while T1 had the lowest value (5.72). Sensory evaluation data of powder quality during juice of T6, T5 and T3 had the highest overall palatability score compared with other treatments. Meanwhile, results were recorded for total phenolic (43.41mg/100g), total flavonoid (0.86mg/100g) and antioxidant activity (86.32%), respectively. It can be concluded that drying methods did not cause a substantial loss of nutrients, a low decrease in total phenolic compounds, an increase in total flavonoid compounds and antioxidant activity.

1. Introduction

White sapote (*Casimiroa edulis*) fruit is an economically and socially important crop. Hence, it is an important fruit for commercialization, income generation, import requests, and value-added products. On the other hand, the tree is cultivated in Egypt for its comestible fruits with nutritive and medicinal value. The white sapote is well acclimated to tropical and sub-tropical environments (Manjunatha, K.G. 2015, Raju et al., 2015, Deshmukh et al., 2015; and Satheesh 2015). It belongs to the family Rutaceae and is generally known as white sapote (English), zapote blanco (Spanish) and sapote blanc (French), also called ‘‘Mexican apple’’, ‘‘white sapote’’, ‘‘Casimiroa’’ and ‘‘Sapote blanc" by native people (Satheesh, 2015). White sapote fruit is native to the Mexican and Central American highlands (Satheesh, 2015; Crane and Balerdi, 2016).

It is commonly propagated by seed, but, vegetative methods are used as grafting in California and Florida in mid-summer and air layering in New Zealand (Ahlawat et al., 2016 and Abdalhady, 2017). In Egypt, the white sapote trees are deduced from the seed, resulting in great inheritable and fruiting variation amongst trees. The plant is known to be fluently managed and established with minimum agricultural practises and it is also known for its high biomass product

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(Arora 2014 and Article et al., 2020). The fruit is consumed encyclopedically as a medicine in numerous parts of the world. Also, the fruit is a climacteric fruit with a high respiration rate and has potential for commercialization due to its organoleptic quality (Van Leeuwen and Darriet, 2016). The white sapote fruits is an elliptical drupe with indigestible skin turning from green to yellow when ripe and a comestible pulp, which can be creamy-white in green skin varieties or blue-yellow in yellow skin varieties and has a smooth texture similar to ripe avocado (Workineh, et al*.,* 2021).

The fruit is a good source of different nutrients such as sugar, protein, bioactive composites (ascorbic acid, phenols, carotenoids, and polyunsaturated fatty acids), and minerals like sodium, potassium, magnesium, iron, calcium, phosphorus, copper, and zinc (Moo-Huchin et al., 2014). White sapote fruits are eatable and have nutritional value, which provides the minerals sodium, potassium, magnesium, iron, calcium, and phosphorous. The fruit is rich in vitamins A and C (180 and 800mg/kg, wet weight, respectively), and it possesses a high content of carbohydrates (160g/kg) (Satheesh, 2015). They provide fibres that prevent constipation. The higher carbohydrate content of white sapote than any other fruit suggests that they are a good ready-to-eat source of energy. The fruits are reported to have an energy level higher than apples, bananas, mangoes, and guavas, and a higher quantum of ash than apples (Abdalhady, 2017). The high ash content of the fruit indicates a good mineral source, which is veritably important for the metabolism. A calcium content of 9.9mg/100 g of white sapote was reported, which is higher than banana and apple and equal to mango. The phosphorous content of 20.4mg/100g was reported in casimiroa fruit, which is higher than apples, mangoes, and nearly all bananas. Iron content (0.33mg/100g) was also reported to be higher in casimiroa fruit than in apples, mangoes, bananas, and guavas. In terms of vitamins, thiamine content is lower in the casmiroa fruit than in apples, bananas, and mango (USDA, 2017). Riboflavin content of 0.043 mg/100g of Casimiroa fruit was reported. It is higher than the riboflavin content of apple, mango, and guava fruits, and the niacin content is higher than that of apples. In addition to its fresh consumption; it is known to retain medicinal properties. They are immune to numerous diseases and frequently used in different expressions of folk medicine (Abdalhady, 2017). White sapote fruits is an excellent source of different nutrients like carbohydrates, ascorbic acid, phenolic compounds, antioxidants activity, vitamins, and minerals (Osama et.al., 2022).

Sapote fruits has been reported to have the loftiest antioxidant activity among tropical fruits, substantially due to the presence of free radical scavenging compounds such as ascorbic acid, carotenoids, and polyphenolic compounds similar to D-quercitol, quercetin, myricitrin, gallic acid, apigenin, etc. The antioxidant potential of the comestible part of sapote fruits has been reported to be veritably high (404.75 µm Trolox equivalent/100g) (Moo-Huchin et al., 2014; Ribeiro da Silva et al*.,* 2014). The fruit has anti-mutagenic and anti-cancer properties and is constantly used in the different phrasings of folk medicine (Satheesh, 2015).

Dehydration is the process that involves the operation of heat to remove humidity from the fresh fruit and vegetable product (Sevik et al., 2019). Its primary purpose is to reduce microbial activity and deterioration and extend the shelf life of the product. The conversion of fresh fruits and vegetables into dried products has numerous advantages, including a substantial reduction in weight and volume and an implied decrease in transportation costs (Karam et al., 2016).

Among the numerous dried food products, food powders such as fruit drink powder, flour, spices, instant coffee, and powdered milk represent the largest fraction available in the food industry for different operations (Morioka et al., 2018). Powder quality depends substantially on the process applied and parameters chosen (Horszwald et al., 2013). Depending on the purpose and operation of the dried product, fruit and vegetables can be dried into different forms, such as whole, cut, sliced, flakes, or powder, using applicable drying technologies (Caparino, 2012).

During peak harvesting seasons, the loss is 30–50%, and, hence, the fruits are vended at low prices as a consequence of inadequate preservation methods (Getachew, 2018). Therefore, value-added processing is necessary to contribute towards the expansion of nutritional input and the request for white sapote fruit to be harvested during off-seasons (Zeru, 2018).

The aim of present study was directing to attention the importance of these fruits by identifying the physical and chemical properties of fresh white sapote (*Casimiroa Edulis*) fruits. And also, we used two dried methods for preserving fruit and its components which can be used powder in preparing natural and healthy juice.

2. Materials and Methods

Materials

White sapote fruits were obtained from a private farm in the village of Mit El-Ezz, Mit Ghamr Center, Dakahlia Governorate, Egypt. The plant identification was verified by the Horticultural Research Institute, Agriculture Research Center, Giza, Egypt. Tricalcium phosphate and sodium metabisulfite were obtained from El-Gomhorea Co. for chemical and medical supplies, Cairo. Diphenyl-2-picrylhydrazyl (DPPH), gallic acid, and quercetin were purchased from Sigma (St. Louis, MO, USA). Folin-circulate reagent was purchased from LOBA Chemie, India. All chemicals used were analytical reagent grade.

Methods

Technological methods

Part one: Control

White sapote fruits were washed thoroughly with tap water, peeled with a stainless-steel knife, and sliced into about 2-3mm thickness (Workineh, 2021), and then the slices of white sapote fruits before drying were divided into three parts: Part one: control

Part two: treated with 0.15% tricalcium phosphate, as a food grade anticaking agent to get a non sticky, free flowing powder (Jaya and Das, 2004).

Part three: treated by 0.15% tricalcium phosphate and 0.25% sodium metabisulfite, sulfuring has also been widely used in the fruit and vegetable industry to reduce darkening during drying and prevent quality loss during the process and storage of foods (Vega-Galvez et al., 2009 and Deng et al., 2019).

After treating, the slices of the three parts were divided into two equal parts: one was dried in an air-ventilated oven at 60ºC±5 and the other was dried under vacuum until it reached a constant weight. The white sapote dried slice was ground by a grinder and sieved to 350µm mesh, collected in polyethylene bags, and kept in a dry place at room temperature.

Table 1. Methods of pretreatments and drying of white sapote fruits

Treatment No.	Oven drying	Treatment No.	Vacuum drying
T1	Control	T4	Control
T2	Treated by 0.15%. tricalcium phosphate	T5	Treated by 0.15%. tricalcium phosphate
T3	Treated by 0.15%. tricalcium phosphate and 0.25% Sodium metabisulphite	T6	Treated by 0.15%. tricalcium phosphate and 0.25% Sodium metabisulphite

Analytical methods

Physical properties

Fruit weight (g), volume (cm^3), length (cm), diameter (cm), and fruit firmness were estimated by the Magness and Taylor pressure tester, which has a standard 5/16-inch plunger, and recorded as Ib/$inch^2$.

Bulk density

The bulk density of the white sapote powder samples was measured following the procedure described by (Barbosa-Canovas et al., 2005). Approximately 5 g were weighed at 1 mL, and the samples were repeatedly tapped manually by lifting and dropping the cylinder under its own weight at a vertical distance of 14±2 mm high until a negligible difference in volume between succeeding measurements was observed. Given the mass m and the apparent (tapped) volume of the powder, the powder bulk density was computed as m/v (kg/m^3). The measurements were carried out at room temperature in three replicates for all samples.

Chemical analysis

Fresh white sapote fruits and powder samples were determined for moisture, total soluble solids (TSS), pH value, total acidity, total sugar, reducing sugar, non reducing sugar, ash, crude fiber, crude fat, and crude protein. The methods were determined according to (AOAC, 2016). Total carbohydrates were calculated by difference. The caloric value was calculated according to the following equation:

$$\text{Caloric value} = 4\ (\text{protein\%} + \text{carbohydrates\%}) + 9\ (\text{fat\%}). \qquad (1)$$

Minerals (P, Fe, Ca and Zn) were measured using Perkin Elmer Atomic Absorption Spectrophotometer (Model 2380, Japan) as described with (AOAC, 2016). Total phenols were determined using the Folin -Ciocalteu method, according to (George et al., 2005). Total flavonoid was determined according to the method described by (Zhuang et al., 1992). The antioxidant activity of samples, an extract was studied through the evaluation of the free radical-scavenging effect on the 1, 1-diphenyl-2-picrylhydrazyl (DPPH) radical (Alothman, et al., 2009).

Color analysis

Color changes of white sapote powder were quantified in the L*, a*, and b* color spaces. The International Commission on Illumination (CIE) parameters L*, a*, and b* were measured with a Minolta CR 3600 (Minolta Camera, Co., Osaka, Japan). The calorimeter was calibrated with a standard white ceramic plate (L = 95.97, a = - 0.13, b = - 0.30) prior to reading. Corresponding L* value (lightness of color from zero (black) to 100 (white); a* value (degree of redness (0–60) or greenness (0 to -60); and b* values (yellowness (0–60) or blueness (0 to -60), according to (Farris and Piergiovanni, 2009). The total color difference (ΔE), which was used to describe the change in the sample's surface color, was calculated using the following equation (Carini et al., 2010).

$$\Delta E = \sqrt{(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2} \qquad (2)$$

Measurements were performed in 3 replications for each sample. Where ΔL*= L* sample - L* standard, Δ a*= a* sample - a* standard, Δb*= b* sample - b* standard.

Sensory evaluation of juice using white sapote powder

The white sapote powder was reconstituted by dissolving it in water. The reconstituted juice was prechilled in order to achieve a temperature of 15–18°C before serving to the panelists. All the reconstituted juice was organoleptically tested for its color, taste, odor, and overall palatability using a scale from 1 to 10, and the decisions were as follows: excellent (10); very good (8–9); palatable (6-7); and non-palatable (0 –5), according to (Larmond, 1970).

Statistical analysis

The results were analyzed by analysis of variance (ANOVA) using the procedure of the statistical analysis system (SAS) program, according to (Steel and Torrie, 1980). Significant differences were determined at the level of (P>0.05).

3. Results and Discussion

Physical properties of white sapote fruits

The physical properties of white sapote fruits are recorded in Table 2. It was shown that the average weight was 152.29 g, while the length, diameter, and length/diameter ratio were 5.33 mm, 6.73 and 0.79 cm, respectively. On the other hand, the data in Table (2) showed that the average of volume (140 cm^3) and firmness (1.35 Ib/$inch^2$), meanwhile, the bulk density was 0.44 g/cm, and it was also clear that white sapote fruit is a nearly large and round soft fruit.

Physico-chemical properties of white sapote fruits

The chemical properties of white sapote fruits were recorded in Table 3. The moisture, T.S.S., protein, fat, fiber, ash, carbohydrate, total sugar, reducing sugar, and non-reducing sugar contents were 78.72, 19.33, 1.39, 0.42, 1.30, 1.11, 17.06, 13.63, 11.65 and 1.98%, respectively. The results obtained were in agreement with (Zeru, 2018, Workineh, 2021 and Osama, 2022). The high amount of carbohydrate in white sapota fruit is a good indication that these are good sources of ready energy, caloric value content was (77.58) kcal. The pH value (5.73) of white sapota fruit contents and total acidity (0.14%) make it content was (77.58 kcal. The pH value (5.73) of white sapota fruit contents and total acidity (0.14%) make it very appropriate for food fortification, especially in foods with mild acidity. (Paiva et al., 1997) said that fruits with citric acid levels ranging from 0.08% to 1.95%, which can be classified as mild in favor, are well-accepted by consumers.

Table 2. Physical properties of white sapote fruits

Properties	Average
Weight (g)	152.29 ± 18.12
Length (mm)	5.33 ± 0.252
Diameter (cm)	6.73 ± 0.416
Length/Diameter ratio (cm)	0.79 ± 0.012
Volume (cm^3)	140 ± 20.00
Firmness ($Ib/inch^2$)	1.35 ± 0.346
Bulk density (g/cm)	0.44 ± 0.021

Results are mean of three determinations ± SD (standard deviation)

Minerals are expected to speed up metabolic processes and improve growth and development. The mineral contents of white sapote fruits were phosphorus (66.39mg/100g), iron (3.35mg/100g), calcium (37.86mg/100 g), and zinc (5.23mg/100g). The contents of minerals phosphorus, calcium, and zinc agreed with (Osama, 2022), but Iron was higher. Meanwhile, the color content of white sapote fruits was 59.71, 6.33, and 16.29 for L*, a*, and b*, respectively. (Moo-Huchin et al., 2014) found that the lightness (L) of white sapote was 67.53. The data indicate total phenolic compounds (43.41mg/100g), total flavonoid compounds (0.86mg/100g) and antioxidant activity (86.32%). The results obtained showed agreement in the contents of total phenolic compounds with (Osama, 2022). On the other hand, (Moo-Huchin et al., 2014), discovered that white sapote fruit edible parts contain (373.27mg of GAE/100g) total phenolic compounds, (341.88mg of quercetin/100g) total flavonoids, and (75.25 mg/100g) antioxidant activity.

Physico-chemical properties of white sapote powder

The chemical composition of white sapote powder is recorded in Table 4. Results indicate that there was a significant difference in moisture content due to the drying methods. It could be noticed that moisture content ranged between 7.52:7.85 for all treatments, and total soluble solids were 80.37 and 80.33% for T4 and T1, respectively, Other treatments showed a decrease, which may be related to pretreatments that cause soluble nutrients to lose their nutrient content. The PH value was ranged from 5.27: 5.87 for all treatments; there were very slight increments in total acidity between different treatments, which ranged from 0.13: 0.16 %. Meanwhile, the ash content of the treatments ranged from 2.73: 2.80%, and the crude fat, protein, crude fibre, and total carbohydrates contents results showed that there was no significant difference between treatments except for a very slight decrease observed in some treatments, which ranged from 1.10 to 1.12, 2.30 to 2.35, 3.55 to 3.37, and 82.43 to 82.71%, respectively.

Table 3. Physico-chemical properties, minerals, color and antioxidants contents of white sapote fruits.

Properties	Value
Physico-chemical properties	
Moisture (%)	78.72 ± 0.170
Total solids (TS) (%)	21.28 ± 0.260
Total soluble solid (T.S.S)	19.33 ± 0.153
pH value	5.73 ± 0.070
Total acidity (%)	0.14 ± 0.015
• Ash (%)	1.11 ± 0.085
• Crude fat (%)	0.42 ± 0.015
• Protein (%)	1.39 ± 0.165
• Crude fiber (%)	1.30 ± 0.015
• Total carbohydrates (%)	17.06 ± 0.068
• Total sugar (%)	13.63 ± 0.248
• Reducing sugar (%)	11.65 ± 0.236
• Non reducing sugar (%)	1.98 ± 0.483
Caloric value (Kcal)	77.58 ± 1.055
Minerals	
• Phosphorus (mg/100g)	66.39 ± 0.040
• Iron (mg/100g)	3.35 ± 0.015
• Calcium (mg/100g)	37.86 ± 0.114
• Zinc (mg/100g)	5.23 ± 0.021
Color	
L*	59.71 ± 0.480
a*	6.33 ± 0.730
b*	16.29 ± 1.310
Antioxidants	
Total phenolic compounds (as Gal lic acid) mg/100 g	43.41 ± 0.400
Total flavonoid compounds (as Quercetin) mg/100 g	0.86 ± 0.004
Antioxidant activity (%)	86.32 ± 1.152

- Dry weight basis. Results are mean of three determinations ± SD (standard deviation).

According to the findings, there was a substantial difference between the total sugar treatments, which varied from 48.04 to 54.53%; T6 had the highest concentration of reducing sugar (41.57%), while T1 had the lowest (40.32%). The highest value of non-reducing sugar was T1, followed by T4, which recorded 13.93 and 13.09%, while the other treatments had non-reducing sugar ranging from 7.49: 7.89%, respectively. The variation in sugar content between treatments may be related to the different methods of drying and pretreatments, which cause soluble nutrients to be lost (Deng et al., 2019). Results indicated that T1 and T4 had the same value of bulk density (0.93 g/cm3), but it ranged from 0.84: 0.87 g/cm^3 for different treatments. Concerning the caloric value contents, it showed that T2 had the highest caloric value (383.4 kcal) followed by T1 (334.2 kcal), while the value of other treatments ranged from 348.9 to 349.7 kcal. The difference in the energy content of the powders might be attributed to the differences in their crude protein, crude fat, and carbohydrate contents (Ho et al*.,* 2016).

Table 4. Physico-chemical properties of White Sapote powder

Properties	Oven drying			Under vacuum drying			L.S.D
	T1	T2	T3	T4	T5	T6	0.05
Moisture (%)	7.61^{ab}±0.305	7.55^{b}±0.100	7.85^{a}±0.123	7.60^{ab}±1.007	7.52^{b}±0.121	7.77^{ab}±0.116	0.281
Total soluble solid (T.S.S)	80.33^{a}±0.390	75.70^{b}±0.458	73.37^{b}±0.115	80.37^{a}±0.321	75.57^{b}±0.373	74.86^{b}±0.115	4.572
pH value	5.29^{c}±0.030	5.63^{b}±0.226	5.32^{c}±0.055	5.57^{a}±0.042	5.87^{a}±0.056	5.27^{a}±0.021	0.179
Total acidity (%)	0.13^{a}±0.015	0.14^{a}±0.015	0.14^{a}±0.021	0.15^{a}± 0.015	0.15^{a}±0.025	0.16^{a}±0.026	0.036
Ash (%)	2.80^{a}±0.012	2.76^{a}±0.036	2.73^{a}±0.066	2.79^{a}±0.135	2.78^{a}±0.070	2.75^{a}±0.070	0.159
Crude fat (%)	1.11^{a}±0.02	1.10^{a}±0.032	1.11^{a}±0.025	1.12^{a}±0.021	1.11^{a}±0.020	1.10^{a}±0.030	0.045
protein (%)	2.30^{a}±0.026	2.34^{a}±0.081	2.32^{a}±0.040	2.35^{a}±0.045	2.34^{a}±0.021	2.35^{a}±0.036	0.082
Crude fiber (%)	3.56^{a}±0.006	3.55^{a}±0.04	3.55^{a}±0.056	3.57^{a}±0.038	3.56^{a}±0.021	3.57^{a}±0.032	0.063
Total carbohydrates (%)	82.62^{a}±0.211	82.71^{a}±0.153	82.43^{a}±0.062	82.59^{a}±0.208	82.67^{a}±0.231	82.46^{a}±0.153	0.318
Total sugar (%)	54.24^{a}±0.065	48.42^{c}±0.466	48.04^{c}±0.136	54.53^{a}±0.073	49.09^{b}±0.185	49.06^{b}±0.238	0.422
Reducing sugar (%)	40.32^{b}±0.201	40.69^{b}±0.255	40.34^{b}±0.175	41.49^{a}±0.232	41.47^{a}±0.249	41.57^{a}±0.399	0.466
Non reducing sugar (%)	13.92^{a}±0.259	7.89^{c}±0.352	7.70^{c}±0.126	13.03^{b}±0.205	7.62^{c}±0.257	7.49^{c}±0.583	0.588
Bulk density (g/cm^3)	0.93^{a}±0.020	0.87^{b}±0.027	0.84^{b}±0.048	0.93^{a}±0.024	0.86^{b}±0.021	0.86^{b}±0.044	0.058
Caloric value (Kcal)	334.2^{b}±0.101	383.4^{a}±0.622	348.9^{ab}±0.116	349.7^{ab}±0.907	349.8^{ab}±0.611	349.1^{ab}±0.351	45.95

Results are mean of three determinations ± SD (standard deviation), Values in the same column with different letters are significantly different (P>0.05),1(control), 2(treated by 0.15%. tricalcium phosphate), 3(treated by 0.15%. tricalcium phosphate and 0.25% Sodium metabisulphite), 4(control), 5(treated by 0.15%. tricalcium phosphate), 6 (treated by 0.15%. tricalcium phosphate and 0.25% Sodium metabisulphite).

Antioxidants (total phenolic, total flavonoid compound content and Antioxidant activity) of white sapote powder

It is well known that plant flavonoids and phenolics in general are highly effective free radical scavengers and antioxidants. Polyphenols and flavonoids are used for the counteraction and fixation of different sicknesses that are basically connected with free radicals (Deepa et al., 2009). The content of total phenols, total flavonoids, and antioxidant activity in sapote powder is presented in Table 5., and the results recorded that there were significant differences between the values obtained for different treatments, which are related to the different drying methods. Data shows that T4, T5, and T6 had the highest content of total phenolic and total flavonoid compounds, which were 46.92, 46.91, and 46.51 and 3.87, 3.58, and 3.84 mg/100 g, respectively.

The lowest value of total phenolics is in T3 (39.99 mg/100 g), and T1 has the lowest value of total flavonoid compounds (3.51mg/100 g). On the other hand, regarding the antioxidant activity results, the highest antioxidant activity was recorded for T4 (97.89%), and for the other treatments, it ranged from 97.54: 97.87%. (Murakami et al., 2004 and Buchner et al., 2006) reported that different results in phenol content may be due to the degradation of phenolic compounds in products that may have antioxidant activity that is occasionally more advanced than the initial phenolic compounds. Meanwhile, (Capecka et al., 2005) explained that the total phenolic content obtained after the drying process may be higher or lower based on the type of phenolic compounds present and their location in the cell of the fruit.

Table 5. Antioxidants (total phenolic, total flavonoid compound content and Antioxidant activity) of white sapote powder

Properties	Oven drying			Under vacuum drying			L.S.D
	T1	T2	T3	T4	T5	T6	0.05
Total phenolic compounds (as Gallic acid)	$40.79^{b}\pm0.172$	$40.19^{bc}\pm0.349$	$39.99^{c}\pm0.289$	$46.92^{a}\pm0.534$	$46.91^{a}\pm0.227$	$46.51^{a}\pm0.336$	0.602
Total flavonoid compounds (as Quercetin) mg/100g	$3.51^{b}\pm0.208$	$3.71^{ab}\pm0.294$	$3.77^{ab}\pm0.190$	$3.87^{a}\pm0.091$	$3.85^{a}\pm0.097$	$3.84^{a}\pm0.133$	0.326
Antioxidant activity (%)	$97.81^{a}\pm0.589$	$97.62^{b}\pm0.266$	$97.54^{b}\pm0.120$	$97.89^{a}\pm0.245$	$97.87^{a}\pm0.309$	$97.84^{a}\pm0.307$	0.133

Results are the mean of three determinations ± SD (standard deviation), values in the same column with different letters are significantly different (P>0.05), 1 (control); 2 (treated by 0.15%). tricalcium phosphate), 3 (treated by 0.15%). tricalcium phosphate and 0.25% sodium metabisulfite), 4 (control), and 5 (treated by 0.15%). tricalcium phosphate), 6 (treated by 0.15%), tricalcium phosphate, and 0.25% sodium metabisulfite.

Color measurements of white sapote powder

The color is a critical factor influencing the quality of the products The color of white sapote powder was significantly different between the treatments, as shown in Table 6. The treatment T4 recorded the maximum lightness (L*) value (69.69), which was found to be non-significantly different from T6 (66.45), while a minimum value for L* (58.89) was recorded for T3. The dark color of dried sapote powder can be characterised by the Maillard reaction caused by the chemical reactions between sugars and proteins (Potter and Hotchkiss, 1995). Moreover, caramelization of sugars in sapote can occur due to high temperatures contributing to darkening during drying. There was a significantly higher maximum red (a*) color value of 1.75 over the rest of the treatments in T1. On the other hand, T5 and T6 recorded minimum values (0.32 and 0.38). The treatment T6 (22.17) appeared to have the maximum yellowness (b*), which may be related to treating with sodium metabisulfite; meanwhile, T1 showed the minimum value (18.59). Meanwhile, it appeared that T6 followed by T5 had the highest values of ΔE which were 12.87 and 10.51, respectively, but T1 had the lowest value of ΔE (5.72).

Mineral contents of white sapote powder

The findings in Table (7) demonstrated that the drying techniques and pretreatments of the white sapote fruit resulted in significant differences (P>0.05) in the composition of the elements phosphorus (P), iron (Fe), calcium (Ca), and zinc (Zn).

According to the data, P levels were highest in T4 (65.93mg/100g), followed by T1 (65.77mg/100g), and lowest in T3 (64.45mg/100g). Fe concentrations in T1 and T4 were high (3.28 and 3.29mg/100g), but 3.05 to 3.09 mg/100g was recorded in other treatments, indicating a modest reduction. The highest Ca level was found in T2, T3, T5, and T6, respectively, with 38.12, 38.07, 38.18, and 38.02mg/100g.

Meanwhile the treated products by tricalcium phosphate, showed a Ca decrease in T1 and T2

(37.24 and 37.33mg/100g). Also, Zn was ranged between 4.18:4.69mg/100g for different treatments. The results indicated that values content of calcium and iron were lowest than found by (Workineh, 2021) but the content of zinc was higher from data obtained.

Table 6. Color measurements of white sapote powder

Properties	Oven drying			Under vacuum drying			L.S.D 0.05
	T1	T2	T3	T4	T5	T6	
L*	61.32^{c}±0.239	60.08^{d}±0.167	58.89^{e}±0.327	69.69^{a}±0.387	65.89^{b}±0.476	66.45^{a}±0.185	0.564
a*	1.75^{a}±0.100	1.33^{b}±0.065	1.30^{b}±0.04	0.85^{c}±0.06	0.32^{d}±0.045	0.38^{d}±0.11	0.133
b*	18.59^{f}±0.324	19.07^{e}±0.242	19.85^{d}±0.629	20.11^{b}±0.596	20.96^{c}±0.682	22.17^{a}±0.625	0.450
ΔE	5.72^{c} ±0.338	5.88^{c}±0.070	6.14^{c} ±0.41	9.86^{b} ±0.416	10.51^{b} ±0.822	12.87^{a}±0.551	0.872

Results are mean of three determinations ± SD (standard deviation), values in the same column with different letters are significantly different (P>0.05), 1 (control), 2 (treated by 0.15%. tricalcium phosphate), 3(treated by 0.15%. tricalcium phosphate and 0.25% Sodium metabisulphite), 4(control), 5(treated by 0.15%. tricalcium phosphate), 6 (treated by 0.15%, tricalcium phosphate and 0.25% sodium metabisulphite).

Table 7. Mineral contents of white sapote powder

Minerals (mg/100g)	Oven drying			Under vacuum drying			L.S.D 0.05
	T1	T2	T3	T4	T5	T6	
Phosphorus (P)	65.77^{a}±0.281	64.71^{b}±0.383	64.45^{b}±0.458	65.93^{a}±0.124	64.73^{b}±0.378	64.83^{b}±0.163	0.484
Iron (Fe)	3.28^{a}±0.031	3.07^{b}±0.053	3.06^{b}±0.052	3.29^{a}±0.038	3.09^{b}±0.080	3.05^{b}±0.057	0.096
Calcium (Ca)	37.24^{b}±0.089	38.12^{a}±0.030	38.07^{a}±0.05	37.33^{b}±0.304	38.18^{a}±0.219	38.02^{a}±0.122	0.297
Zinc (Zn)	4.67^{ab}±0.396	4.29^{bc}±0.187	4.18^{c}±0.171	4.69^{a}±0.623	4.28^{bc}±0.418	4.18^{c}±0.249	0.392

Results are mean of three determinations ± SD (standard deviation), Values in the same column with different letters are significantly different (P>0.05), 1(control), 2(treated by 0.15%. tricalcium phosphate), 3(treated by 0.15%. tricalcium phosphate and 0.25% Sodium metabisulphite), 4(control), 5(treated by 0.15%. tricalcium phosphate), 6 (treated by 0.15%. tricalcium phosphate and 0.25% Sodium metabisulphite).

Sensory evaluation of white sapote juice

Sensory evaluation is one aspect of greatest importance since consumer acceptance usually encourages the marketing process of any new product, which is generally the final guide to quality from the consumer's point of view (Jimenez et al., 1989; Lawless and Heymann, 2010) show that the color and appearance of food products, especially fruits and vegetables, serve as the first impression and are typically the primary indicators of perceived quality. The scores for sensory evaluation in terms of color, taste, odor, and overall palatability were tested, and the results were statistically analysed and illustrated in Table 8. From the data, it could be noticed that there were significant differences between all the different sample juices, which may be due to different treatments and drying methods. The data showed that all the sapote juice using powder samples were accepted by the panelists, and the description of the overall palatability by the panelists ranged between very good and palatable for all sapote samples, it could be noticed that T6 had the highest score for overall palatability compared with the others, while T1 had the lowest score.

Table 8. Sensory evaluation of juice using powder of white sapote

Properties	Oven drying			Under vacuum drying			L.S.D
	T1	T2	T3	T4	T5	T6	0.05
Color (10)	$7.05^{e}\pm0.252$	$7.11^{e}\pm0.208$	$8.09^{b}\pm0.305$	$7.46^{d}\pm0.153$	$7.79^{c}\pm0.458$	$8.42^{a}\pm0.252$	0.284
Taste (10)	$6.79^{e}\pm0.153$	$7.41^{c}\pm0.231$	$7.13^{d}\pm0.153$	$8.41^{a}\pm0.115$	$7.94^{b}\pm0.252$	$7.68^{bc}\pm0.153$	0.261
Odor (10)	$7.27^{ab}\pm0.459$	$7.15^{bcd}\pm0.459$	$6.95^{d}\pm0.405$	$7.38^{a}\pm0.361$	$7.19^{abc}\pm0.723$	$6.99^{cd}\pm0.552$	0.224
Overall Palatability (10)	$8.13^{c}\pm0.353$	$8.20^{c}\pm0.635$	$8.51^{ab}\pm0.753$	$8.19^{c}\pm0.380$	$8.34^{bc}\pm0.573$	$8.77^{a}\pm0.458$	0.287

Results are the mean of three determinations ± SD (standard deviation), values in the same column with different letters are significantly different (P > 0.05); 1 (control); 2 (treated by 0.15%). tricalcium phosphate), 3 (treated by 0.15%). Tricalcium phosphate and 0.25% sodium metabisulfite), 4 (control), 5 (treated by 0.15%. tricalcium phosphate), and 6 (treated by 0.15% tricalcium phosphate and 0.25% sodium metabisulfite).

4.Conclusion

The present study was supporting the evaluation of physical and chemical properties of white sapote (*Casimiroa Edulis*) fruits and powder as good sources for natural compounds, minerals and bioactive components such as phenolic compounds, flavonoid compounds and antioxidant activity. The data obtained showed that the drying methods did not cause substantial loss of the nutrient. Therefore, drying white sapote fruits have a good nutritional value and dried sliced fruit, is largely needed to use the yield in future to avoid postharvest loss and make fruits year-round available.

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