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Nutritional Composition and Acceptability of Candy from Avocado Seed (*Persea americana*)

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***Abstract* – Avocado seed flour was prepared from ready to eat pear, the nutritional properties (proximate and mineral composition), phytochemical and antioxidant properties of seed flour were quantified. Proximate composition of the seed flour include moisture (8.6%), fat (14.1%), fibre (7.1%), ash (2.4%), protein (23.0%) and carbohydrate content (44.70%) while mineral content in mg/100g were magnesium (0.10), calcium (0.82), zinc (0.18), potassium (4.16), sodium (1.41) and phosphorus (0.09). Phytochemicals present in pear seed flour include flavonoid (0.11mg/g), tannin (1.41%), saponin (4.44%), total phenolics (0.53%) and antioxidant capacity using 2, 2-diphenyl-1-picrylhydrazyl (DPPH) was 44.65%. Avocado seed candy prepared with either 10% sugar or aspartame composed of varying proportions of 100% avocado seed flour, 95% avocado seed flour: 5% ginger, 90% avocado seed flour: 10%ginger and 85%avocado seed flour: 15%ginger. The quality of candy was assessed by determining moisture content which ranged from 77.3-92.5%, total sugar (0.10-0.66mg/100g), microbial count (1.5×10-6.20×10^3 cfu/g) and the sensory result revealed that for avocado candies were scored above average in taste, texture and flavor.**

***Keywords* – Avocado Seed Flour, Antioxidant, Candy, Mineral Analysis, Phytochemicals.**

I. INTRODUCTION

Avocado apple is a highly nutritious fruit rich in proteins, fats and oils and low in sugar. It is unusual among fruits for its high fat content (17-27%), of which 7-14% is linoleic acid, and also for the fact that it does not ripen until after it has been removed from the tree. Half an avocado (130 g) is a rich source of vitamin C and copper; a good source of vitamin B6; a source of protein and iron; contains 26 g of fat, of which 20% is saturated; provides 2.6 g of dietary fibre; supplies 265 kcal (1110 kJ). [(1)] From the perspective of the use of avocado seeds as sources of phytotherapeutic agents, they have traditionally been used to treat mycoses and parasitic infections. Furthermore, avocado seed preparations are known to have local anesthetic effects that decrease muscle pain. [(2)]

There is a global tendency towards industrial fruit processing and, following such processes byproducts are normally discarded. However, these byproducts can cause ecological problems such as increased numbers of insects and rodents. Thus, studies to investigate the benefits of these byproducts as sources of food supplements or medicinal products are needed.[(2)] The aim of this research therefore is to determine the proximate composition, mineral analysis, antioxidant and phytochemical properties of avocado seed. In addition, to prepare candy from avocado seed and assess the sensory evaluation of the candy.

II. MATERIALS AND METHOD

Materials- Ready to eat avocado fruit, ginger root and sweeteners (aspartame, sugar, glucose syrup) were bought from local market in Akure. All other materials used were of analytical grade and purchased from Pascal Scientific Laboratory, Akure, Nigeria.

Preparation of Avocado seed and ginger flour- Avocado fruits were sorted, washed and allowed to drain. Seeds were removed from the fruit manually and washed with distilled water, chopped to small pieces, dried in an oven at 45-50^{0}C, blended to powdered form and kept in an air-tight container for further analyses. Ginger roots were thoroughly washed, peeled, grated, dried in the oven at 40-45^{0}C blended into powdered form and stored in an air-tight container.

Determination of proximate composition of avocado seed- Chemical analysis of avocado seed flour was carried out using standard procedure of Association of Analytical Chemist. [(3)]

Determination of mineral content of avocado seed- The dry ashing technique was used for the determination of mineral composition. [(4)] The minerals analysed include Ca, Mg, K, Na, Zn, Fe, Mn and Cu.

Determination of free radical scavenging capacity of avocado seed (DPPH test)- The free radical scavenging activities of avocado seed flour solvent extract against 2, 2-Diphenyl-1-picrylhydrazyl radical was determined by UV spectrophotometer at 517nm. [(5)]

Phytochemical screening of avocado seed- The tests were carried out following modified method. [(6)] Bioactive compounds tested for include; total phenol, flavonoid, tannin and saponin.

Production of Avocado seed candy- Eight formulations of avocado seed flour with ginger (spice) candy were prepared in varying proportions using sugar and aspartame respectively (Table 1) following the modified method. [(7)]

Total sugar content of avocado candy- One gram of each sample of avocado seed candy was crushed, dispersed through shaking into 50ml distilled water and filtered through Whatman No. 42 filter paper of which 1ml of the filtrate was measured into separate tubes. Six milliliter of anthrone reagent was run into each of the tube under ice blocks. The tubes covered with aluminium foil to prevent evaporation were later allowed to boil for 10min. The absorbance of the solution was read at 620 nm against a reagent blank. The sugar content of the samples was determined by extrapolation using the standard curve obtained by standard glucose solution.

Table 1: Formulation of avocado candy with sugar or aspartame

Sample	Avocado seed flour (g)	Ginger (g)	Sugar/aspartame (g)	Glucose syrup (g)	Water (ml)
A	100	-	100	100	60
B	95	5	100	100	60
C	90	10	100	100	60
D	85	15	100	100	60

Microbiological analysis of avocado candy- Twenty-five grams of each candy was added to 225 ml of sterile 0.1% peptone water and serial dilutions were made. One milliliter of each appropriate dilution was pour plated using plate count agar (Merck) for total viable count, Sabouraud dextrose agar for fungi and MacConkey agar (total coliform) respectively. [8]

Sensory evaluation of avocado candy- The samples were coded and served to a twenty member panelists using multiple comparison test scales.

Statistical Analysis- All Analyses were carried out in triplicates. The results obtained were subjected to analysis of variance (ANOVA)

III. Result and Discussion

The proximate composition of avocado seed flour is presented in Table 2 with avocado seed flour having fat content 14.1%, fibre 7.1%, ash 2.4%, protein 23% and carbohydrate 44.7%. The protein content of avocado seed flour is high when compared with other crops such as tiger nut (7.15%-9.70%). [9]. Also, the fat content is relatively high when compared to pigeon pea flour (1.80%). [10] However, it was reported that avocado has 0% cholesterol level. [11]

Table 3 revealed the mineral content of the seed flour which ranged from 0.097mg/100g in phosphorus to 4.160mg/100g in potassium. Mineral contents of avocado seed flour were quite low when compared with African oil bean seed. [12]

Ability of avocado seed to scavenge DPPH radicals (44.65%) and phytochemicals present in the avocado seed flour are shown in Table 4. Radical scavenging activity of avocado candy was found to be higher than the values reported for 1% and 3% tomato fudge. [13] It was observed that phytochemical composition of avocado seed were found to be higher than the values reported in previous study. [14] The differences in the values of phytochemicals could be as a result of variety of avocado pear and the geographical location where fruits were sourced. Phytochemicals are natural occurring substance present in plant which helps to protect the body against diseases.

Table 5 showed that candy samples made with sugar had higher total sugar content when compared with those with aspartame as sweetener. The European Food Safety Authority (EFSA) concluded that aspartame and its breakdown products are safe for human consumption at current levels of exposure (40mg/kg of body weight per day). [15]

The result revealed that no coliform was detected, total viable bacteria count of candy ranged from nil to $6.2x10^2$cfu/g, yeast count (nil to $5.5x10^2$cfu/g) mold count from nil to $2.0x10^2$cfu/g (Table 6).

There was no significant difference between avocado candy made with sugar and aspartame (Table 7). Consumer acceptability of candy for various attributes include; taste (4.0-5.8), texture (5.0-6.9), colour (4.1-6.5), flavor (4.6-6.4) and size (3.6-6.2). It was observed that sample D, 85% avocado seed flour+15% ginger +sugar was most preferred by the panelist.

IV. Conclusion

The proximate, mineral, antioxidant and phytochemical properties of avocado seed showed that avocado seed flour possesses nutritional qualities that may be further investigated for application in food industry rather than constituting waste or nuisance to the environment.

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is working as a Food Microbiologist in the Department of Food Science and Technology, Federal University of Technology Akure, Nigeria. She obtained her PhD degree from Prince of Songkla University Thailand in 2009. Her research interest is in natural product development, functional foods and food microbiology. She has published 32 peer reviewed articles in journals of high impact factors and also co-authored two books. She has supervised several undergraduate students and five Masters' students.

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Table 2: Proximate composition of Avocado seed flour

Proximate composition	Avocado seed flour (%)
Moisture	8.6±0.14
Fat	14.1±0.18
Fibre	7.1±1.23
Ash	2.4±0.70
Protein	23.0±2.80
Carbohydrate	44.7±4.80

Values are average of three determinations

Table 3: Mineral content of Avocado seed flour

Element	(mg/100g)
Magnesium	0.100±0.01
Calcium	0.820±0.01
Zinc	0.177±0.02
Potassium	4.160±0.13
Sodium	1.410±0.11
Phosphorus	0.097±0.01

Values are average of three determinations

Table 4: Antioxidant and Phytochemical properties of Avocado seed flour

Parameters	Readings
DPPH %	44.65±0.23
Flavonoid(mg/g)	0.11±0.01
Tannin (%)	1.41±0.03
Saponin(%)	4.43±0.15
Total phenolic (%)	0.53±0.02

Values are average of three determinations

Table 5: Total sugar content of avocado candy

Avocado seed flour :	ginger:	sweetener	Total sugar in candy (mg/100g)
100	0	sugar	0.66
95	5	sugar	0.61
90	10	sugar	0.63
85	15	sugar	0.46
100	0	aspartame	0.16
95	5	aspartame	0.17
90	10	aspartame	0.10
85	15	aspartame	0.14

Table 6: Microbial status of avocado candy (cfu/g)

Avocado candy	Total viable count	Yeast count	Mold count
A	4.2×10^2	5.5×10^2	1.5×10^2
B	1.5×10^1	NG	1.0×10^2
C	1.5×10^2	NG	NG
D	3.3×10^2	4.0×10^2	1.0×10^2
E	6.2×10^2	2.7×10^2	2.0×10^2
F	3.5×10^2	NG	1.0×10^2
G	1.5×10^2	1.0×10^2	1.0×10^2
H	NG	NG	NG

NG= No growth

Values are average of three determinations

A =100% avocado seed flour +sugar, B = 95% avocado seed flour+5% ginger+sugar, C = 90% avocado seed flour+10% ginger+sugar, D = 85% avocado seed flour+15% ginger+sugar, E= 100% avocado seed flour+aspartame, F = 95% avocado seed flour+5%ginger+aspartame, G= 90% avocado seed flour+10%ginger +aspartame, H=85% avocado seed flour+15%ginger+aspartame.

Table 7: Sensory scores of avocado candy

Sample	Taste	Texture	Colour	Flavour	Size
A	5.3^{ab}±2.1	6.4^{ab}±2.0	5.0^{b}±2.2	5.9^{a}±1.8	4.5^{bcd}±2.0
B	4.0^{b}±1.8	6.1^{ab}±2.4	5.0^{b}±3.1	6.1^{a}±2.4	4.0^{cd}±2.3
C	5.0^{ab}±1.7	5.6^{ab}±1.7	4.7^{b}±2.9	4.3^{c}±1.3	3.6^{d}±1.5
D	5.8^{a}±2.3	6.5^{a}±2.2	5.5^{ab}±2.5	6.4^{a}±1.6	5.4^{ab}±2.1
E	5.6^{a}±2.1	5.6^{ab}±2.4	4.5^{b}±3.0	5.7^{ab}±1.9	4.4^{bcd}±2.5
F	5.8^{a}±2.5	5.0^{b}±2.3	4.1^{b}±1.8	4.6^{bc}±1.6	6.0^{a}±1.6
G	5.0^{ab}±2.1	6.8^{a}±1.5	6.5^{a}±1.7	5.2^{abc}±2.0	5.2^{abc}±1.8
H	5.1^{ab}±1.8	6.9^{a}±1.5	5.5^{ab}±1.2	5.2^{abc}±1.5	5.1^{abc}±2.0

Values are means ± SD from triplicate determinations, different superscripts inthe same columnare significantly different ($P < 0.05$).

A =100% avocado seed flour +sugar, B = 95% avocado seed flour+5% ginger+sugar, C = 90% avocado seed flour+10% ginger+sugar, D = 85% avocado seed flour+15% ginger+sugar, E= 100% avocado seed flour+aspartame, F = 95% avocado seed flour+5%ginger+aspartame, G= 90% avocado seed flour+10%ginger+aspartame, H=85% avocado seed flour+15%ginger+aspartame.