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CHEMICAL EVALUATION OF WINGED BEANS (*PSOPHOCARPUS TETRAGONOLOBUS*), PITANGA CHERRIES (*EUGENIA UNIFLORA*) AND ORCHID FRUIT (*ORCHID FRUIT MYRISTICA*)

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ABSTRACT

The proximate, mineral and sugar compositions of winged beans (*Psophocarpus tetragonolobus*), Pitanga Cherries (*Eugenia uniflora*) and Orchid Fruit (*Orchid fruit myristica*) and physico-chemical properties of their oils were determined using standard methods. All the samples were found to be rich in proteins (winged beans 33.83 %, pitanga cherries 14.71 % and orchid fruit 17.96 %). Each of the samples also had a considerably high amount of carbohydrate (22.30 %, 38.55% and 26.45 % in winged beans, pitanga cherries and orchid fruit, respectively). Orchid fruit had a significantly higher ($P < 0.05$) fat content of 34.36 % as compared to 17.51 % found in winged beans, and 15.62 % in pitanga cherries. Winged beans had the highest crude fiber (12.23 %) while orchid fruit had 6.03% and pitanga cherries had 9.77%. Winged bean and orchid fruit had similar ($P > 0.05$) water content, which is significantly different from pitanga cherries. Iron, cadmium, lead and manganese were absent in all the samples. Copper and calcium were absent in pitanga cherries. Pitanga cherries had the highest composition (g/100g) of sugar, winged beans ranked next, while orchid fruit had low sugar content. The peroxide values of the oil of the various samples ranged between 11.41 and 12.91 meq/kg, while the saponification values ranged between 182.58 and 191.05 mgKOH/g. The unsaponifiable matter was very low in pitanga cherries compared with winged beans and orchid fruit. The acid value ranged between 0.71 and 2.82 mg/KOH/g while iodine value ranged between 91.15 and 144.57. The refractive index ranged between 1.465 and 1.474 in all the samples. Based on the results of this study, winged beans could be useful in the formulation of infant formula, pitanga cherries in the production of fruit jam and as a flavour in food drinks, because of its sugar contents, while orchid fruit—which has very high oil content—could be used as a spice.

KEYWORDS: winged beans, pitanga cherries, orchid fruit

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EVALUATION CHIMIQUE DES HARICOTS AILÉS (*PSOPHOCARPUS TETRAGONOLOBUS*), DES CERISES PITANGA (*EUGENIA UNIFLORA*) ET DES FRUITS D'ORCHIDÉES (*ORCHID FRUIT MYRISTICA*)

RÉSUMÉ

Les constituants immédiats, en minéraux et en sucre, des haricots ailés (*Psophocarpus tetragonolobus*), des cerises *pitanga* (*Eugenia uniflora*) et des fruits d'orchidées (*Orchid fruit myristica*) et les propriétés physico-chimiques de leurs huiles ont été déterminés en utilisant des méthodes standards. Tous les échantillons se sont avérés riches en protéines (haricots ailés\ 33,83 %, cerises *pitanga* 14,71 % et les fruits d'orchidées 17,96 %). Chacun de ces échantillons avaient également une teneur très élevée en glucide (22,30 %, 38,55% et 26,45 % dans les haricots ailés, dans les cerises *pitanga* et dans les fruits d'orchidées respectivement). Les fruits d'orchidées avaient une teneur en graisse beaucoup plus élevée (P < 0,05) atteignant 34,36 % par rapport à 17,51 % trouvés dans les haricots ailés et 15,62 % dans les cerises *pitanga*. Les haricots ailés avaient le taux le plus élevé de cellulose brute (12,23 %) tandis que les fruits d'orchidées avaient 6,03% et les cerises *pitanga* avaient 9,77%. Les haricots ailés et les fruits d'orchidées avaient une teneur similaire en eau (P > 0.05), ce qui est très différent des cerises *pitanga*. Le fer, le cadmium, le plomb et le manganèse étaient absents dans tous les échantillons. Le cuivre et le calcium étaient absents dans les cerises *pitanga*. Les cerises *pitanga* avaient la composition la plus élevée (g/100g) de sucre, puis ont suivi les haricots ailés, tandis que les fruits d'orchidées avaient une faible teneur en sucre. Les valeurs péroxygénées de l'huile des différents échantillons variaient entre 11,41 et 12,91 meq/kg, tandis que les indices de saponification variaient entre 182,58 et 191,05 mgKOH/g. L'insaponifiable était d'un niveau très bas dans les cerises *pitanga* par rapport aux haricots ailés et aux fruits d'orchidées. L'indice d'acidité variait entre 0,71 et 2,82 mg/KOH/g tandis que l'indice d'iode variait entre 91,15 et 144,57. L'indice de réfraction variait entre 1,465 et 1,474 dans tous les échantillons. A partir des résultats de cette étude, les haricots ailés pourraient être utiles dans la formulation de la préparation pour nourrissons, les cerises *pitanga* dans la production de confitures de fruits et comme une flaveur dans les boissons alimentaires, à cause de leurs teneurs en sucre, tandis que les fruits d'orchidées—qui ont une teneur en huile très élevée — pourraient être utilisés comme des épices.

Mots-clés: haricots ailés, cerises ***pitanga***, fruit d'orchidée

INTRODUCTION

Winged beans is a tropical crop that is listed as one of the under—exploited legumes [10]. Winged beans have exceptionally high protein content and have been suggested as a potential food source for the tropics [4, 11]. It is unique among leguminous crops in that, several parts of the plant—leaves, pods, seeds and tubers—are edible and rich in protein [8].

Pitanga cherry is a shrub. It belongs to the family *Myrtaceae* and the order *Myrtales*. The *myrtle* family in this order has about 80 genera, which are widely distributed, within the tropics [19]. Eugenia is a large genus of shrubs with species in all kinds of vegetation. It has a solitary auxiliary four-part flower with a dense ring of white stamen around the edge of the receptacle. The plants are usually shrubs that grow as small trees. They have localized distribution along the coast. They are cultivated by planting the seeds from a matured fruit [19].

The orchid fruit (*Monodora myristica*) is readily distinguished by its heavy foliage and very conspicuous red and yellow flowers hanging from stalks. The leaves and fruits are much larger than the *Termifolia* species. The Nigerian species extends from Sierra Leone to Uganda, Kenya, Zaire and Angola [9].

In recent times, much attention has been drawn to the dependence of the world's population on very few species of crops for food. This has resulted in the overtasking of the available conventional protein and energy sources to the extent that their supplies have been disproportionately lower, relative to the demand of the population [6].

The essence of this work is to assess the nutritional potentials of some more minor food crops in the tropics such as winged beans (*Psophocarpus tetragonolobus*), pitanga cherries (*Eugenia uniflora*) and orchid fruit (*Orchid fruit myristica*) in order to provide useful information on the possible uses of these under exploited food items for human consumption, food industry and other technological uses.

The objectives of this study, therefore, are to determine the proximate, mineral and sugar composition of winged beans, pitanga cherries and orchid fruit, and the physico-chemical properties of their oils.

MATERIALS AND METHODS

Samples Collection

The samples were obtained from various sources. Pitanga cherries (*Eugenia uniflora*) seeds were harvested from the pitanga plant at Federal University of Technology, Akure, Nigeria. Orchid fruit and winged beans seeds were purchased from Akure main market, Akure, Nigeria.

Sample Preparation

Pitanga cherries (*Eugenia uniflora)* fruits of the flower were harvested with hands and the fleshy part was removed. The seeds were then sun dried. The dried seeds were blended and mixed thoroughly in a Kenwood food mixer. The powdered sample was then stored in an air-tight jar, labeled and kept in the refrigerator prior to the analysis. Seeds of the orchid fruitspice *(Mondora myristica*) were purchased dry. The dried seeds were shelled, blended and mixed thoroughly in a Kenwood food mixer. The powdered sample was then stored in an air-tight jar and kept in the refrigerator. The dry winged beans seed sample was also blended, mixed thoroughly in the Kenwood mixer and stored in an air-tight jar, labeled and kept in the refrigerator prior to the analysis.

Proximate analysis of the samples for crude fibre, moisture, fat and ash content were carried out in triplicate using the methods described by AOAC [5]. Nitrogen was estimated by the micro-kjeldahl method and the percentage nitrogen was converted to crude protein by multiplying with 6.25 as reported by Pearson [15]. The carbohydrate was calculated by the difference.

The physico-chemical properties i.e. refractive index, iodine value, acid value, peroxide value and unsaponifiable matter, were determined by the methods of AOAC [5]. The refractive index of the oil was measured on acetone-cleared surfaces of prisms through the telescope. Saponification value content of the oil was obtained by refluxing the alcoholic potassium hydroxide solution of the oil and then titrated with 0.5 M HCL using Phenolphthalein indicator as explained by Vogel [20]. The iodine value of the oil was determined by titrating the chloroform and potassium iodine solution of *Psophocarpus tetragonolobus, Eugenia uniflora* and *Orchid fruit myristica* oil with sodium thiosulphate solution using starch indicator. The peroxide value of *Psophocarpus tetragonolobus, Eugenia uniflora* and *Orchid fruit myristica* oil were obtained by dissolving the oil in a solvent mixture of acetic acid and carbon tetrachloride, warmed with potassium iodide, and then titrated with sodium thiosulphate solution using starch indicator. The unsaponifiable matter content of the oil was estimated by dissolving the oil in alcoholic potassium hydroxide and refluxed. The homogeneous soda was then extracted with diethyl ether, the extract was filtered then oven dried to a constant weight. The average and standard deviation were calculated.

The Lane and Eynon's method for reducing sugar was employed in determining the sugar composition of the samples [7]. Two grams of each of the sample were dry-ashed in a muffle furnace at 55 ^{0}C for about seven hours. The ash was dissolved in 10 % HCl acid in a conical flask. The solution was filtered into a 100ml standard flask and made up to the mark with distilled water. A blank sample was also run. The individual mineral element was estimated from the solution using the Atomic Absorption Spectrophotometer (AAS Model: PYE UNICAM SP9). The individual mineral element composition was calculated from the readings obtained for both the blank and the test solution.

Statistical Analysis

Data from the different chemical measurements of the three products were subjected to one-way ANOVA. Comparison of means was performed using Duncan multiple range test.

RESULTS

The proximate composition (%) of the samples is shown in Table 1. The mean crude protein content of winged bean was found to be significantly ($p < 0.05$) higher than the values obtained for pitanga cherries and orchid fruit. Orchid fruit was found to contain relatively high fat, which is significantly different ($p < 0.05$) to orchid fruit, the values obtained for winged bean and pitanga cherries. The crude fibre of winged bean was found to be significantly higher ($p < 0.05$) than the crude fibre for pitanga cherries and orchid fruit. Carbohydrate appears to be abundant in all the samples although significantly different with 22.3 %, 3855 % and 26.45 % for winged bean, pitanga cherries and orchid fruit, respectively. The ash contents were similar ($p < 0.05$) in all the samples. Apart from the ash content, all other components considered for proximate analysis were significantly different in all the three plants.

The mineral content is depicted in Table 2. Potassium was the most abundant mineral in all the samples. Magnesium ranked next to potassium in abundance in all the samples with 2238.18 mg/kg, 1246.41 mg/kg and 1962.45 mg/kg for winged bean, pitanga cherries and orchid fruit, respectively, while sodium ranked third. Lead and cadmium were not detected in all the samples. Apart from copper and calcium contents, all other minerals detected could be compared among the three foods.

Pitanga cherries had the highest composition (g/100g) of sugar with 7.88 g of hydrated maltose, 6.31 g of anhydrous lactose and 6.64 g of hydrated lactose as shown in Table 4. Winged beans ranked next, while orchid fruit had low sugar content (0.79 g of hydrated maltose, 0.66 g of anhydrous lactose and 0.69 g of hydrated lactose).

The physico-chemical property of the oil of the samples is presented in Table 3. The peroxide values of the oil of the various samples ranged between 11.41 and 12.91 meq/kg, while the saponification values ranged between 182.58 and 191.05 mgKOH/g. The unsaponifiable matter was very low in pitanga cherries (4.91 g/kg) compared with winged beans (16.36 g/kg) and orchid fruit (17.97 g/kg). The acid value ranged between 0.71 and 2.82 mg/KOH/g while iodine value ranged between 91.15 and 144.57. The refractive indices of the oils were similar in all the samples and ranged between 1.465 and 1.474.

DISCUSSION

The crude protein content of winged beans was higher than the values recorded for protein—rich foods, cowpea seeds (22.5 %), pigeon peas (22.4 %) and lima beans (23.3 %) [3]. It was, however, comparable with values obtained for soya beans (35 %) [2]. Orchid fruit, an oil seed, was found to contain a very high fat (34.53 %), which is significantly ($p < 0.05$) higher than the values obtained for winged bean (17.5 %) and pitanga cherry (15.62 %). The fat content of orchid fruit was within the range for oils seeds (25–50 %) and were comparable with the range given by (37–64.5 %) for nuts and oil seed. [1, 17]. The ash content was similar in all the samples. This could be an indication that there are large proportions of minerals in the samples and could also be largely attributed to their various planting locations. The crude fibre of winged beans was found to be slightly higher ($p < 0.05$) than the crude fibre for pitanga cherries and orchid fruit. Carbohydrate appears to be abundant in all the samples. The carbohydrate value obtained for winged bean was comparable with the values given by Sumati and Rajagopal for peas, jackfruit, yam, potatoes and mangoes. [17]. It was also observed that orchid fruit had very little sugar in spite of its high carbohydrate content. It follows, therefore, that orchid fruit contained other forms of carbohydrate in addition to sugar. (Carbohydrate includes starch, glycogen, cellulose plant gums and mucilage as well as sugar)[17].

Potassium was the most abundant mineral in all the samples. This is in agreement with the observation of Olaofe and Sanni, that potassium is the predominant mineral in Nigerian agricultural products [13]. The range in some grain products like soybean, cowpea, maize and sorghum is 644–4510 [12]. All the values obtained also fall within this range. Magnesium ranked next to Potassium—in abundance—in all the samples with 2238.18 mg/kg, 1246.41 mg/kg, and 1962.45 mg/kg for winged beans, pitanga cherries and orchid fruit, respectively, while sodium ranked third. Lead and cadmium were not detected in all the samples. Absences of lead and cadmium in all the samples enhance the edibility of these food materials as these elements are non-essential and toxic, even when present below 100 ppm [12].

The refractive indices of the oils were similar in all the samples. These values compare favourably with values reported by Ogungbenle for benniseed (R_f 1.4658) and cod-liver oil (R_f 1.479–1.485) [12]. However, they are found to be slightly lower than the value reported for linseed oil (R_f 1.480), and higher than those reported for palm oil R_f 1.450–1.452) [12]. The oils have low acid values (0.71, 2.7 and 2.82 mg KOH/g for winged bean, pitanga cherries and orchid fruit respectively). But, they are found to have high iodine and peroxide values. The iodine value of winged bean (144.57) is higher than that of soy bean 9132) reported by Ogungbenle [12]. The iodine values for pitanga cherries (91.15) and orchid fruit (106.30) are similar to the values reported for groundnut oil (102), and cottonseed oil (108) [12]. High peroxide and iodine values are an indication that the oil could be readily susceptible to rancidity. The saponification value obtained for winged bean (190.34) was comparable with values reported for soybean (190–194). The value for pitanga cherries (191.05) also falls within this range.

Nevertheless, the value obtained for orchid fruit (182.58) was found to be lower than most of the other fats reported by Ogungbenle - butter fat (220–241) coconut oil (200–250), cotton seed oil (190–200), soy bean oil (190–194), lard (193 – 200) and benniseed oil (203.40 $\pm$ 0.30) but higher than the value obtained for pearl millet (90 $\pm$ 0.2). These saponification values obtained for the samples are considerably high [12]. This is an indication that large quantities of alkali would be required to complete their saponification. It follows, therefore, that it would be economical to use them for soap making.

Hydrated maltose was found to be the most abundant sugar in all the samples. This is consistent with the observations of Ogungbenle with guinea and pearl millet [12.] The high sugar composition of pitanga cherries is consistent with its use in the fruit drinks production. Orchid fruit, an oil seed, has very high oil content (34.53 %). These oils are responsible for its characteristic aroma and for its use as a spice.

CONCLUSION

The absence of some toxic elements like lead and cadmium in all the samples is desirable for their edibility. Their high saponification values indicate that they can be used for industrial purposes. Winged beans, like soy bean, could be used in the formulation of infant food. Pitanga cherries which contain digestible sugars, could be employed in food manufacturing industries as sweetener, and in the manufacture of fruit jams and sweets, while orchid fruit could be used as a spice.

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Table 1. Proximate (%) of winged beans *(Psophocarpus tetragonolobus),* pitanga cherries (*Eugenia uniflora), and* orchid fruit (*Orchid fruit myristica)*

Parameter	Winged beans	Pitanga cherries	Orchid fruit
Moisture	9.22 ± 0.18^{a}	17.21 ± 0.57^{b}	9.44 ± 0.08^{a}
Total Ash	4.91 ± 0.01^{a}	4.94 ± 0.11^{a}	5.89 ± 0.09^{a}
Fat	17.51 ± 0.35^{a}	15.62 ± 0.45^{a}	34.53 ± 0.39^{b}
Crude fibre	12.23 ± 0.13^{c}	9.77 ± 0.57^{b}	6.03 ± 0.03^{a}
Crude protein	33.83 ± 0.61^{c}	14.71 ± 0.92^{a}	17.96 ± 0.69^{b}
Carbohydrate	22.30 ± 0.82^{a}	38.55 ± 0.89^{c}	26.45 ± 0.72^{b}

Means in the same row followed by the same superscripts are not significantly different at $P \geq 0.05$.

Table 2. Mineral composition (mg/kg) of winged beans *(Psophocarpus tetragonolobus),* pitanga cherries (*Eugenia uniflora), and* orchid fruit (*Orchid fruit myristica)*

Mineral	Winged beans	Pitanga cherries	Orchid fruit
Magnesium	2238.18 ± 0.04^{c}	1246.41 ± 0.64^{a}	1962.45 ± 0.70^{b}
Zinc	364.76 ± 0.64^{b}	273.34 ± 0.34^{a}	310.74 ± 0.44^{ab}
Copper	90.79 ± 0.72^{b}	ND	69.31 ± 0.70^{a}
Calcium	889.86 ± 0.63^{b}	ND	30.06 ± 0.70^{a}
Sodium	1972.34 ± 0.69^{b}	997.32 ± 0.23^{a}	922.54 ± 0.32^{a}
Potassium	4219.30 ± 0.81^{a}	4271.30 ± 0.80^{a}	4232.83 ± 0.56^{a}

ND = not detected
Means in the same row followed by the same superscripts are not significantly different at $P \geq 0.05$.

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Table 3. The physico-chemical properties of the oil of winged beans *(Psophocarpus tetragonolobus),* pitanga cherries (*Eugenia uniflora), and* orchid fruit (*Orchid fruit myristica)*

Component	Winged bean	Pitanga cherries	Orchid fruit
Peroxide value (meg/Kg)	11.41 ± 0.30[a]	12.91 ± 0.61[a]	11.90 ± 0.23[a]
Saponification value (mgKOH/g)	190.34 ± 0.33[a]	191.05 ± 0.55[a]	182.58 ± 0.41[a]
Unsaponification matter (g/Kg)	16.36 ± 0.64[b]	4.91 ± 0.61[a]	17.97 ± 0.04[b]
Acid value (mgKOH/g)	0.71 ± 0.01[a]	2.74 ± 0.53[b]	2.82 ± 0.04[b]
Iodine value	144.57 ± 0.53[c]	91.15 ± 0.33[b]	10.30 ± 0.05[a]
Refractive Index at 25 ^{o}C	1.47 ± 0.01[a]	1.47 ± 0.00[a]	1.47 ± 0.07[a]

Means in the same row followed by the same superscripts are not significantly different at P ≥ 0.05

Table 4. The sugar composition (g/100g) of winged beans *(Psophocarpus tetragonolobus),* pitanga cherries (*Eugenia uniflora), and* orchid fruit (*Orchid fruit myristica)*

Sugar type (g/100g)		Winged bean	Pitanga cherries	Orchid fruit
Invert sugar in the presence of % sucrose	Nil	2.57[b]	4.97[c]	0.53[a]
	1%	2.51[b]	4.90[c]	0.52[a]
	5%	2.36[b]	4.65[c]	0.48[a]
	10%	2.25[b]	4.50[c]	0.46[a]
	25%	2.07[b]	4.22[c]	0.42[a]
Dextrose		2.50[b]	4.83[c]	0.52[a]
Fructose		2.65[b]	5.13[c]	0.55[a]
Hydrated maltose		3.92[b]	7.88[c]	0.80[a]
Anhydrous lactose		3.19[b]	6.31[c]	0.66[a]
Hydrated lactose		3.36[b]	6.64[c]	0.69[a]

Means in the same row followed by the same superscripts are not significantly different at P ≥ 0.05.

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