Determination of the physico-chemical properties and proximate composition of the pod samples of samanea saman.

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Abstract

The physico-chemical and proximate composition of *Samaea saman* pod samples were evaluated. The whole pods, pulp and seeds were analysed using standard procedures. The results of the physico-chemical analysis revealed that the pH of the whole pod, pulp and seed were 4.30, 4.35 and 3.98 respectively. Hence, indicating that he medium is acidic. There is no significant differences between the pH of the whole pod and pulp but differs significantly from the seed. The whole pod has a total titrable acidity (TTA) of 3.08 while the pulp has 2.84 and the seed has a TTA of 3.52. The total soluble solids (TSS) for the pod, pulp and seed were 7.52° Brix, 9.99°Brix and 2.0° Brix respectively. The results of the TTA and TSS indicated that there were significant differences among the samples. The samples have relative densities of 3.62, 3.61 and 3.64 respectively. The acid ratio was found to be 1.41 for the whole pod, 3.52 for the pulp and 0.57 for the seed. The acid ratio of *Samanea saman* pulp is significantly different from that of the whole pod and seed. The percentage moisture content of the whole pod, pulp and seed were 15.50, 19.30 and 9.20 respectively. The ash contents were 4.70, 2.90, and 2.60 respectively while the crude protein was 13.21, 10.98 and 21.55 respectively. The percentage crude fibre for the samples was 15.95, 6.77 and 8.47 respectively whereas the percentage carbohydrate content was recorded as 47.33, 57.53 and 55.52% respectively. The results of the proximate composition however indicated that all the samples were significantly different ($p<0.05$). The study indicated that the *Samanea saman* pod samples have low pH (acidic), low brix level and titrable acidity. Hence, *Samanea saman* pod samples were found to have high protein and carbohydrate content.

Keywords: *Samanea saman* pod sample, Pulp, Physico-chemical properties, Proximate composition, Titrable acidity.

Introduction

The rain tree (*Samanea saman merr*) belongs to the family of *leguminosae* (pulse family). It is commonly called "Saman", "Rain tree", "monkey pod" and "Cow tarmarind" in English, while it is called "Acacia preta" and "Cenizaro" in Spain. The French call it "abre de Pluie" and the Philipines call it "Mimosa". The name "Rain tree" was believed to have originated from the leaflets which are light-sensitive and close together on cloudy days or nights, allowing rain to fall through the leaves to the ground below [1]. It is native to Northern South America and has naturalized throughout the tropics. The plant is easily recognized by its characteristic umbrella-shaped canopy giving it a domed shape [2] reported the nutritional composition of *Samanea saman* pods and seeds as having crude protein values of 16.6% and 31.6%, crude fibre values of 12.0% and 14.0%, ether extract values of 1.4% and 4.3%, ash values of 3.5% and 4.3%, carbohydrate values of 18.5% and 20.3% respectively. Similarly, Duke (1983) reported that the whole pods and seeds of *Samanea saman* contained 15.3% and 16.1% moisture, 12.7% and 10.6% protein, 2.1% and 1.3% fat, 2.4% and 4.3% ash, 11.4 and 10.8% crude fibre and 55.3% and 42.0% carbohydrate respectively.

The ripe fallen pod is commonly eaten by children and animals while the sweet, sticky pulp is used in the production of fruit drink similar to tamarindo in Latin America [2]. The whole pods are used as feed and nutrient supplements for mammals such as Squirrels, cows, cattle and goats [3]. Reported that its seed has been used in the production of a local condiment called Anyu, [4], suggested that the high sugar content of rain tree pods and its aroma can be explored in alcohol production by fermentation. Though grape wine is perhaps the most common fruit alcoholic beverage, available literature shows that acceptable fruit wines have been produced from some tropical non-grape fruits such as pineapple, banana, paw-paw, apples and pears [5] in combination with edible herbs and flowers by yeast fermentation [2]. Thus there is research gap in this area of study.

However, [4] suggested the exploration of *Samanea saman* pods for alcohol production because of its high sugar content. However, the few works done on this pod were directed

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towards determining their anti-microbial and phytochemical potentials, and the use of their seeds in the production of "Anyu" a local condiment [4,6,7]. Available literature shows there is little or no research work on these pods in the areas of physico-chemical properties and proximate composition in other to acertain their utilization in other commercial food products such as wines, bread, etc., yet these pods are wasting in the gardens and road-sides where the trees are planted for ornamental purposes. Even in the campus of Federal University of Technology, Owerri (FUTO), the trees fruit heavily and animals (cows or others) at their will pick up the heavily littering pods within the fruiting season. Objective of the study is to analyze the physico-chemical and proximate composition of *Samanea saman* whole pods, seeds and pulp. The study is aimed at carrying out a research on *Samanea saman* with the hope of acquiring information on the seeds, pods and pulps, and consequently its potential uses. Hence, in justifying this research work, it is envisaged that a good nutrient-balance, in the pods, pulp or seed flour with regards to protein, lipids, crude fibre, ash, etc; will reveal their potentials for inclusion in human and animal diet.

Material and Methods

Collection of materials

Some ripe, fallen wholesome rain tree (*Samanea saman*) pods were picked from the tree sites around the School of Agriculture and Agricultural Technology (SAAT) of the Federal University of Technology, Owerri (FUTO).Some of the chemicals used for the analyses were obtained from the Department of Food Science and Technology laboratory, and School of Agriculture and Agricultural Technology laboratory in FUTO. Others were purchased from the Finlab Store Owerri. Some of the analyses were conducted in the laboratories of the Department of Food Science and Technology and School of Agriculture and Agricultural Technology, FUTO, while others were carried out in the Department of Zoology laboratory of University of Jos and International Institute for Tropical Agriculture (IITA), Ibadan.

Preparation of samples for chemical analysis

The pods were picked at various times from the tree site, sorted, washed and sun dried for about five days. Six hundred grams (600g) of wholesome, cleaned and dried pods were divided into two portions; one portion was ground as whole pod meal (sample 1), while the other portion was deseeded and ground as seedless meal (sample 2). Then the removed seeds were collected and ground separately as a sample (Sample 3) to obtain three samples for the desired raw material analyses, namely whole pod, pulp and seed samples.

Determination of the physico-chemical properties of the pod samples of samanea saman

Measurement of pH: The method of [8] was used. A 10% (w/v) suspension of the ground pod samples was prepared in distilled water and was mixed thoroughly in a warring blender and the pH was measured by inserting the electrodes into the suspension. The result was read from a digital display using GLP pH meter (Hanna model H1 98140).

Total treatable acidity: The method described by [9] was used. Twenty-five milliliters of each sample extract was introduced into a conical flask. Three drops of phenolphthalein indicator were added into each flask and the contents titrated with standardized 0.01N Sodiumhyroxide to a definite pink colour. The titratable acidity was calculated as percentage of the major organic acid (Tartaric acid) in the sample.

Determination of total soluble solids: The total soluble solids of the samples were determined with the aid of the hand refractometer. One drop of each sample extract was made on the screen of the refractometer prism and the readings were taken.

Determination of relative density/ Specify gravity: This was obtained by dividing the weights of same volume of sample and water.

Determination of Brix / Acid ratio: The Brix / Acid ratio was obtained by dividing the total soluble solids (Brix) value by the total titratable acid (Acid) value.

Proximate composition of the samples

Determination of moisture content: The [3] method was used for this determination. Two gramme portions of each of the freshly ground samples (1, 2 and 3) were weighed into previously weighed dry crucibles. The crucibles with samples were dried in an oven at 105^{O}C, cooled in desiccators for ten minutes, reweighed and returned into the oven until a constant weight was attained.

The moisture content was calculated with the following formula:

$$\% \text{ Moisture Content} = (W_1 - W_2)/W_1 \times 100/1$$

Where:

W_1 = the weight of sample before drying

W_2 = the weight of sample after drying

Sample 1= Whole pod

2= pod without seed (pulp)

3= seed

Determination of ash content: The Ash content was determined following the [4] method. Two grammes of the samples were weighed in triplicate into previously weighed silica crucibles. The samples inside the crucibles were charred on a heater inside a fume cupboard to drive off most of the smoke. The crucibles with the contents were transferred into a muffle furnace and heated for about four hours at 550^{O}C. They were cooled in a desiccator and weighed. The heating was repeated until the samples turned greyish white and attained constant weight. The ash content was then calculated as follows:

$$\% \text{ Ash} = (\text{weight of ash})/(\text{weight of sample taken}) \times 100/1$$

Determination of crude lipid (Ether - extract): The total lipid content of the samples was determined using the [3] Soxhlet fat extraction method. Five grammes (5 g) of the sample were weighed into a pre-weighed fat free extraction

thimble which was plugged tightly with cotton wool. The thimble was placed in the soxhlet extractor fitted up with reflux condenser, all connected to a boiling flask containing 200 ml of petroleum ether (Bp 60^{o}C) on a heating mantle. As the flask and petroleum ether were heated, the solvent evaporated and condensed into the thimble extracting oil from the sample and refluxed into the boiling flask with the extracted oil. This was done for four hours. At the end of extraction, the solvent (petroleum ether) was evaporated by heating at 70^{o}C on a hot plate leaving the lipid extract in the flask. The flask with its contents were placed in an oven and dried at 110^{o}C for one hour, cooled in a desiccator and re-weighed.

The percentage lipid was calculated as follows:

% Ether extract= (Weight of oil)/(Weight of sample)×100/1

Determination of crude protein: The crude protein contents of the samples were determined using the micro-Kjeldahl apparatus as described by [10]. Two grammes of each of the samples was placed in a Kjeldahl flask and 30 ml concentrated sulphuric acid (H_2S0_4) added followed by the addition of 10g potassium sulphate and 1g copper sulphate. The mixture was gently heated for few minutes until frothing ceased; the heat was increased and the sample allowed digesting for three hours. The digest was allowed to cool, diluted with distilled water (washing the digestion flask) up to 100 ml. Ten milliliters(10 ml) of the dilute digest was pipetted into a distillation flask and 10 ml of 40% (w/v) sodium hydroxide added. The mixture was distilled and the liberated ammonia collected in 10 ml of 2% boric acid containing indicator. This was titrated with 0.01N hydrochloric acid to grey colored end point. A blank was also prepared without a sample and treated as above. The amount of crude protein was then calculated by multiplying percentage nitrogen in the digest by the conversion factor (6.25).

%N= ((a-b)×0.01×14×v)/(W×C)×100/1

Where: a = the titre value of the digested sample

b = titre value of the blank sample

V = volume after dilution

W = weight of dried sample (mg)

C = Aliquot of sample used

14 = Atomic weight of Nitrogen

Crude protein = 6.25 × %N

Determination of crude fibre: The [4] method was used. Two grams of the ground samples were weighed in duplicate into a 600 ml, long pyrex beaker and 200 ml of 1.25% H_2SO_4 solution was added. The beaker was covered with a watch glass and the content gently boiled on a hot plate for 30 minutes. The acid was removed by filtering through a muslin cloth over a Buckner funnel and the sample washed three times with 50ml of boiling water to free it of acid, before putting it back to the beaker. Then, 200 ml of 1.25% NaOH solution was added to the residue in the beaker, which was covered with a watch glass and gently boiled on a hot plate for 30 minutes and then filtered. The residue was washed into a weighed No. 2 sintered glass crucible with 50 ml of boiling water and later washed twice with 30ml portions of petroleum spirit. The crucible was dried in the oven at 80°C to a constant weight and then ignited in a muffle furnace at 600°C until a light gray coloured ash was obtained. The crucible and content were cooled to ambient temperature in a desiccator and then weighed.

The crude fibre content was calculated as:

% Crude Fibre = (Loss in weight on ignition)/(Weight of sample)×100/1

Determination of carbohydrate content: The carbohydrate content was obtained by difference.

%Carbohydrate = (100% - %Moisture, %Crude protein - %Fat-%Ash-%Crude fibre).

Results

Table 1 means with different superscripts on the same row are significantly ($p< 0.05$) different.

All the samples were significantly ($p<0.05$) different from each other.

Table 2 shows the range of values for physico - chemical properties of the pod samples. Their values are as followed: pH (3.98 -4.35), Total titratable acidity (2.84%-3.58%), Total soluble solids (2.0^{o}Brix-9.99^{o}Brix).

Discussion

The physico-chemical properties of samanea saman pod samples

The whole pod meal of *Samanea saman* had a pH of 4.30 as compared to pH values of 4.35 for the pulp and 3.98 for the seed meal (Table 2). The pH values tended towards acidity levels and this could be responsible for the astringent taste of the pulp when eaten, an observation also reported by [1]. The titratable acidity (TA) values (as %tartaric acid) were 3.08% for whole pod meal, 2.84% for the pulp and 3.52% for the seed meal. These values indicated the total acid values which contributed to the sugar/acid balance, a factor in the flavor of the specific sample.

The pulp had a total soluble solids value of 9.99^{o}Brix as compared to values of 4.35^{o} Brix for the whole pod meal and 2.0^{o} Brix for the seed meal. Understandably, the pulp which is sweet to taste should have higher soluble sugar than either the whole pod meal which contained the pod hull or the seed which was more acidic (pH 3.98 as compared to 4.35 of pulp or TA 3.52 as compared to 2.84 of the pulp). The Brix/Acid ratio values of 1.4 (whole pod meal), 3.5 (pulp) and 0.57 (seed meal) are ratios of the soluble solids to the titratable acidities and therefore the reflections of the sugar- acid balance of the samples which indicate the relative sweetness of the samples. The three samples had a normal range of relative densities (3.60-3.63 g/ml). This observation suggested that the honey nature of the pulp made up the expected greater mass of the seed and this was in line with a suggestion made by [11] when *Hura crepitan* seeds were studied.

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Table 1. *Mean values of the proximate composition of rain tree (Samanea Saman) pod samples.*

	SAMPLES			
Proximate composition (%)	**Whole pod**	**Pulp**	**Seed**	**LSD**
Moisture	15.50±0.01^{b}	19.30±0.01^{a}	9.20±0.1^{c}	0.02
Ash	4.70±0.01^{a}	2.90±0.01^{b}	2.6±0.01^{c}	0.02
Ether Extract	3.31±0.01^{a}	2.52±0.01^{c}	2.66±0.01^{b}	0.02
Crude Protein	13.21±0.01^{b}	10.98±0.01^{c}	21.55±0.01^{a}	0.02
Crude Fibre	15.95±0.01^{a}	6.77±0.11^{c}	8.47±0.01^{b}	0.13
Carbohydrate	47.33±0.01^{c}	57.53±0.01^{a}	55.52±0.01^{b}	0.02

Table 2. *Mean values of the physico-chemical properties of Samanea Saman pod samples.*

	SAMPLES			
Physicochemical properties	**Whole pod**	**Pulp**	**Seed**	**LSD**
pH	4.30^{a}	4.35^{a}	3.98^{b}	0.4
Titratable Acidity (%)	3.08^{b}	2.84^{c}	3.52^{a}	0.02
Total Soluble Solids (°Brix)	7.52^{b}	9.99^{a}	2.0^{c}	0.12
Relative Density	3.62^{b}	3.61^{b}	3.64^{a}	0.02
Brix/Acid Ratio	1.41^{b}	3.52^{a}	0.57^{b}	1.03

*Means with different superscripts on the same row are significantly ($p< 0.05$) different.

Proximate composition of rain tree (samanea saman) pod samples

The fresh mature and ripe (brown) rain tree whole pod had a moisture content of 15.50% and understandably its pulp and seed had moisture contents of 19.30% and 9.20% respectively (Table 1). The values were significantly ($p\leq0.05$) different from each other. Moisture contents of 16.9% and 13.50% for *Samanea* whole pod and *Samanea* seed respectively were reported by the [1], while [12] obtained moisture contents of 15.3% and 16.1% for *Samanea* whole pod and *Samanea* seed respectively. [13] Found that *Samanea saman* husks, whole pods and seeds had moisture contents of 4.11%, 58.42% and 6.19%respectively. The slight variation in moisture content could be attributed to the drying conditions which the samples were subjected to before the analysis. Factors such as environmental conditions could also affect the moisture content of food materials [14].

However, [15] showed that the *Samanea saman* pod had a moisture content of 15.18%.The moisture content of 15.50% for the whole pod obtained in this study is in line with the values 15.30% and 15.80% reported by [7] and [5] The moisture content of foods determines the water activity which influences the rates of chemical, microbial and enzymatic reactions in foods. By lowering the water activity through drying, microbial deterioration of foods can be delayed, reduced or eliminated. The whole pod had higher ash content (4.70%) than the pulp (2.90%) or the seed (2.60%), indicating that it has a higher concentration of minerals than pulp and seed. This is in line with [8] who reported ash contents of 4.16% and 2.10% for *Samanea saman* whole pod and seed respectively. Thus, [5] reported a relatively higher ash content of 5.12% for *Samanea saman*whole pod, while on the contrary; [7] reported ash contents of 2.4% and 4.3% for *Samanea saman* whole pod and seed respectively while [1] obtained ash contents of 3.5% and 4.3% for the whole pod and seed respectively.

Though, there were slight variations in the ash contents of the samples, the values fall within a close range of 2.4% to 5.12%. Ash in food constitutes the residue remaining after all the moisture has been removed as well as the organic materials burnt away by igniting at temperature of about 500^{o}C. Thus, ash content represents the total mineral content in foods. The lipid content (ether extract) results in Table 2 shows that *Samanea saman* pod had the highest lipid content(3.31%) among the samples with *Samanea saman* seed having 2.66% and the *Samanea saman* pulp having the lowest lipid content (2.52%).The lipid content of all the [7] for whole pod (2.1%) and seed (1.3%) were lower than those obtained in this study but conversely, [1] obtained a lower lipid content of 1.4% for the *Samanea* whole pod and higher lipid content of 4.3% for the seed. Similarly, [8] reported a lower lipid value of 0.82% for the whole pod and 1.20% lipid content for the seed. The variations observed in the lipid contents could be as a result of agronomical factors and analytical techniques. With ether extract (fat) values of the samples ranging from 2.52% (in pulp) to 3.31% (in whole pod), certainly the pod is not a good oil source, thus its seed cannot be classified as an oil seed.

Among the three samples of *Samanea saman* pod studied, the seed had the highest protein value (21.55%). The whole pod had protein value of 13.21% while its pulp had a value of 10.98%. The differences between these values were significant ($p<0.05$). The protein value of 13.21% obtained in this study for the whole pod fell within the range of 10-18% reported by [1,6,7]. Reported a whole pod protein value of 28.48% and that was the highest value observed in accessible literature for the pod. There was no specific report on the pulp with regards to proximate composition, but reports on the protein content of seed had values ranging from 22-31.60% [1,6-8].

Notwithstanding the variations observed in the various reports, *Samanea saman* pods and seeds exhibited high protein content which could be explored in animal feed as nutrient source to improve animal diet and possibly for humans. The *Samanea saman* whole pod had a mean crude fibre content of 15.95% as compared to values of 8.47% and 6.77% for the seed and pulp respectively. The crude fibre content of the three samples were significantly ($p<0.05$) different. The crude fibre value of

15.95% obtained in this study for the whole pod is comparably higher than the values of 12.0% and 11.4% reported by [1] and [7] respectively, but certainly much lower than a value of 33.4% reported [8] and [12] for the same material. Also, a crude fibre value of 8.47% seed obtained in this study is comparably lower than the values; 14.0%, 10.8% and 16.15% reported by [1,7,8] respectively for the same material. Though agronomical factors may have contributed to the variations in the results obtained, different analytical conditions may have also led to the variation. Crude fibres play important roles in digestion processes and the lowering of gastric cholesterol [16].

From the proximate composition result in Table 1, among the three samples analyzed, *Samanea saman* pulp had the highest carbohydrate content (57.53%) as compared to the seed with a value of 55.52% and the whole pod with the least carbohydrate content of 47.33%. There were significant ($p<0.05$) differences among the carbohydrate contents of the three samples. Since the carbohydrate content was obtained by difference, the lower carbohydrate content observed in the whole pod could be a reflection of the higher crude fibre content of the whole pod which was much higher than that of the *Samanea saman* pulp and seed.

The result obtained in this research showed some similarities with those previously reported by other researchers, where the seed had higher carbohydrate than the pod, for instance, [1] reported lower carbohydrate values of 18.5% for the whole pod and 20.3% for the *Samanea saman* seed. [17] Also reported lower carbohydrate values of 26.73% and 34.89% for the *Samanea* pod and seed, respectively.

The relatively high carbohydrate content obtained in this research suggests that the various parts of *Samanea saman* pods could serve as energy source when included in animal feed.

Conclusion and Recommendation

The relative high protein (10.98% to 21.55%) and carbohydrate (47.33% to 57.53%) contents of the Rain tree (*Samanea saman*) pod samples suggest that they can be used as nutrient supplement in animal feeds and the seeds can be utilized as a rich protein meal in human diets. The rich nutrient potential of the rain tree pod should be also be utilized in the animal feed production. The study has also showed that the rain tree seeds, pods and pulp has relative low pH values (tending towards acidity), low brix levels and titrable acidity.

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