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Assessment of the nutritional constituents of Elaeis Guineensis Jacq exudates from different States of Nigeria

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ABSTRACT: The present work was set to examine the nutritional constituents of the three most popular brands of bottled exudates produced from three different states of Nigeria. Additionally, the work was set to highlight the health significances of the nutrients that were detected. The bottled exudates were purchased in the open market in Benin City on bi-weekly intervals. The parameters determined were P^H, taste, colour, relative density, alcohol, moisture, sucrose, proteins, acetic acid (acidity), thiamine, riboflavin, ascorbic acid and elemental constituents. The mean of the bi-weekly results are presented. The P^H values were between 6 and 7. The colour of the exudates was white. The moisture content of all the samples was not below 94%. While some of the exudates were sweet, some had sour taste. The relative density of all the samples was above 1. The entire samples had little quantity of acetic acid. The alcohol, vitamins and some elements detected were low in concentrations. The sucrose contents of most of the exudates were high, particularly for samples from Edo state. The concentration of potassium was high in all the samples irrespective of their sources. The exudates could be classified as a rich source of nutrients that are needed in man, as some of the nutrients act as sources of energy, body builders, components of body organs and tissues, coenzymes and play notable roles in biochemical functions and deficiency diseases. @JASEM

Key word: *Elaeis Guineensis Jacq*, Bottled exudates, Edo, Lagos, Enugu

The *Elaeis guineesis Jacq* is the common African oil palm. The palm is as old as creation. Every part of the palm is useful economically and for domestic purposes. *Elaeis guineesis Jacq* is cultivated in Nigeria in the heavy rain forest zones, characterized with a mean maximum temperature of 29-30^{0}C and a minimum temperature of 22-24^{0}C (Obahiagbon, 2012). The even distribution of rainfall throughout the year is considered adequate for the successful cultivation of the oil palm (Hartley, 1988; Ndon, 2006). In Nigeria, it is cultivated in the south east zone and in the Niger Delta areas.

The exudates in the fluid which flows from the palms when the inflorescence is tapped have social, economic and health significances. The exudates contain numerous phytonutrients which plays significant roles in human physiology and health (Tulley, 1964; Obahiagbon and Oviasogie, 2007). The medicinal roles of the exudates in the cure of malaria, measles, jaundice and the flow of breast in nursing mothers have been reported (Bassir, 1968). In Nigeria, the drinking of the oil palm exudates or palm wine, signals start and the end of all social activities particularly in the rural areas (Obahiagbon and Osagie, 2007). To maintain healthy living in humans both the micro and macro nutrients are needed. Sucrose is considered as a macronutrient in human nutrition that yields a quick source of energy.
Sucrose is main sugar produced in the exudates of the oil palm. Sucrose is a transportable and moblizable sugar that is stored in many plant cells as in the sugar beets and sugar cane (Obahiagbon and Osagie, 2007). Sucrose plays a central role in the carbohydrate metabolism of plants (Rees, 1980). The macro nutrients are required in amounts greater than 100 mg/d in human nutrition (Mayes, et al., 1993). On the other hand, the micronutrients are required in lower concentrations in human nutrition. For example, the elements and vitamins are part of the micronutrients required in minute quantities in human diet. The human system cannot synthesize the elements and vitamins and as a result they are normally acquired by ingestions (Ilori and Obahiagbon, 2011). The mineral elements function as structural components of body organs and tissues, constituents of body fluid and in tissues as electrolyte and as catalyst in enzymes and hormone system (Underwood, 1977). Additionally, the functional roles of the mineral elements in the human body are interrelated and balanced against each other and most often cannot be considered as single elements with independent and self sufficient roles in the organized bodily processes (McDowell, 1992).

Without water no living organism can survive (Ilori and Obahiagbon, 2011). Arising from the indiscriminate production of the oil palm exudates in bottles for consumption, this paper was aimed at examining the nutritional qualities of the three most popular brands from the heavy rain fall areas of

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Nigeria, and to highlight the significances of the detected nutrients in human health.

MATERIALS AND METHODS

The bottle palm wines used for these studies were purchased in the open market in Benin City, Nigeria. The purchase and choice of the products was based on the local demand for them. The products were purchased on biweekly intervals for three months. From the labels attached to the products care was taken to ensure that only those produced during the same periods were used for the assays. Additionally, the bottled wine used was tested for leakages and it was found that they were tightly corked and no leakages occurred even when they were turned upside down.

The reagents used for the analysis were of the Analar grade, supplied by Zayo Nig. Ltd. The following parameters were determined in all the samples:

pH: the method involving the use of an electronic pH meter was adopted as described by (Bates, 1973).

Taste: oral palatability test was conducted by three laboratory staff as described by (Otedoh, 1990).

Colour: sample was poured into a clean 100cm^3 beaker and observed visually.

Relative density: a clean relative density bottle was filled with distilled water to mark and weight was noted. Thereafter, the same bottle was filled with the product, weighed and the relative density was calculated.

Alcohol content: an alcohol meter was used to determine the concentration of alcohol in the products.

Moisture content: a moisture analyzer Model M-150, manufactured and supplied by Perkin Elmer was used to determine the moisture contents of the samples.

Sucrose determination: An Abbe hand refractometer was used in the determination of the sucrose content of the finished products (Obahiagbon and Osagie, 2007; Maley, 1968).

Acidity: the titrimetric method was adopted and acidity was calculated as % acetic acid (AOCS, 1965).

Protein: the micro kjedahl method was used in the determination of the total protein contents (Harris, 1970).

Thiamine, Riboflavin and Ascorbic acid: The fluoremetric method was used for the assay of thiamine and riboflavin (AOAC, 2002). The ascorbic acid was determined by the 2,6 dichlorophenolindophenol titrimetic method (Plummer, 1971).

Elemental determination: Atomic absorption spectrophotometer, Model 969, Unican series was used in the determination of sodium, potassium, magnesium, copper, zinc and manganese. Before use the instrument was adequately standardized and relevant filters associate with each of the elements were used (Perkin-Elmer Corp., 1968).

RESULTS AND DISCUSSION

To ensure accurate correlation of the data generated from these comparative studies, the following precautions were taken:

a. The exudates used were from the palm of *Elaeis guineensis Jacq only.*
b. The exudates were preserved by pasteurization.
c. The products used were produced during the same period, as indicated on the labels attached.
d. The location of the palms was in the same heavy rain fall area of Nigeria.

Eighteen parameters were determined in the samples as indicated in Tables 1, 2, and 3.

The colour of the exudates analyzed was white irrespective of their sources. The pH of the exudates from the three bottled brands was between 6 and 7. In other words, their pH was slightly acid. The moisture contents of the exudates from the three states were above 94%. The taste of the exudates from Edo state was sweet, while those from Lagos and Enugu states were both sweet and sour. The relative density for all the exudates from the three states was above 1. The acetic acid contents of the exudates were low in all the samples. The protein concentration in the exudates was generally low and within the same range. Sucrose concentration of 9.5% was detected in exudates from Edo state, while the exudates from Enugu and Lagos states were 8.0% and 7.5% respectively. The alcohol contents from the exudates were generally low. The concentrations detected in the exudates from Edo, Enugu and Lagos states were 0.09%, 1.50% and 2.01% respectively. Three water soluble vitamins were detected in all the exudates in very low concentrations. The three water soluble vitamins are thiamine, riboflavin and ascorbic acid. The ascorbic acid values were highest relative to its counterparts. The following elements, Na, K, Mg, Cu, Fe and Mn were detected in all the exudates from the three states. The concentration of K and Mg were relatively high in all the samples irrespective of their source. The concentration of Cu and Fe from Enugu

state were lowest relative to those detected in the exudates from Edo and Lagos states.

Table 1: Nutritional Constituents of Bottled Exudates From Lagos State (Mean)

s/n	*Month*	*April*	*May*	*June*	*July*	*August*	*Sept.*
1	Colour	Whitish	Whitish	Whitish	Whitish	Whitish	Whitish
2	pH	6.00±0.00	6.85±0.01	6.00±0.00	5.10±0.00	5.60±0.05	6.40±0.02
3	Moisture (%)	96.0±1.20	95.50±1.00	95.20±1.00	96.30±0.80	95.50±0.00	95.70±1.00
4	Taste	Sweet	Sweet	Sour	Sour	Sour	Sweet
5	Relative density	1.10±0.20	1.20±0.10	1.25±0.05	1.20±0.10	1.10±0.20	1.20±0.00
6	Acidity (%Acetic acid)	0.30±0.04	0.28±0.03	0.37±0.06	0.32±0.09	0.35±0.05	0.30±0.04
7	Protein (mg/100ml)	0.02±0.00	0.05±0.00	0.30±0.03	0.25±0.06	0.31±0.04	0.25±0.03
8	Sugar (% sucrose)	7.00±1.00	9.50±1.30	7.00±1.00	5.50±1.00	5.10±0.80	7.30±1.00
9	Alcohol (%)	0.07±0.00	0.05±0.00	2.00±0.04	1.50±0.02	1.70±0.20	0.08±0.01
10	Thiamine (mg/100ml)	0.01±0.00	0.45±0.04	0.20±0.06	0.15±0.02	0.25±0.04	0.18±0.04
11	Riboflavin (mg/100ml)	0.30±0.06	0.20±0.04	0.18±0.03	0.35±0.05	0.40±0.04	0.25±0.06
12	Ascorbic acid (mg/100ml)	0.09±0.03	1.99±0.90	1.20±0.40	0.95±0.20	0.70±0.10	1.00±0.20
13	Na (mg/100ml)	3.00±0.40	4.60±0.70	3.50±0.20	4.00±0.10	3.00±0.70	2.75±0.34
14	K (mg/100ml)	40.00±1.22	70.00±0.95	50.10±0.84	45.00±2.76	40.50±1.78	50.10±2.80
15	Mg (mg/100ml)	47.00±3.60	45.50±4.00	48.10±3.80	48.20±3.10	45.00±1.90	50.70±2.30
16	Cu (mg/100ml)	0.80±0.10	0.20±0.08	0.30±0.04	0.30±0.05	0.80±0.10	0.75±0.09
17	Fe (mg/100ml)	1.75±0.12	3.50±0.19	2.10±0.22	1.60±0.27	2.25±0.21	3.00±0.30
18	Mn (mg/100ml)	3.50±0.90	5.40±0.60	2.75±0.42	3.60±0.70	4.50±0.30	3.80±0.20

Table 2: Nutritional Constituents of Bottled Exudates From Edo State (Mean)

S/N	*Month*	*April*	*May*	*June*	*July*	*August*	**Sept.**
1	Colour	Whitish	Whitish	Whitish	Whitish	Whitish	Whitish
2	pH	6.80±0.01	6.75±0.00	6.85±0.00	6.80±0.03	6.85±0.01	6.70±0.01
3	Moisture (%)	96.0±1.10	95.40±1.00	95.50±1.20	94.50±1.00	95.20±0.90	94.80±0.60
4	Taste	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet
5	Relative density	1.20±0.32	1.15±0.18	1.20±0.34	1.15±0.12	1.25±0.08	1.10±0.10
6	Acidity (%Acetic acid)	0.25±0.04	0.30±0.08	0.28±0.07	0.30±0.10	0.24±0.00	0.26±0.08
7	Protein (mg/100ml)	0.05±0.00	0.04±0.01	0.05±0.00	0.06±0.00	0.05±0.01	0.05±0.00
8	Sugar (% sucrose)	9.00±1.10	8.50±1.00	9.50±1.10	8.30±0.90	8.50±1.60	8.00±1.30
9	Alcohol (%)	0.08±0.00	0.04±0.00	0.05±0.01	0.03±0.00	0.08±0.01	0.09±0.02
10	Thiamine (mg/100ml)	0.36±0.06	0.25±0.03	0.45±0.07	0.35±0.02	0.45±0.07	0.40±0.09
11	Riboflavin (mg/100ml)	0.35±0.07	0.25±0.09	0.20±0.00	0.30±0.00	0.25±0.07	0.35±0.12
12	Ascorbic acid (mg/100ml)	11.50±1.00	1.15±0.30	0.99± 0.14	0.90±0.26	1.10±0.30	0.95±0.14
13	Na (mg/100ml)	6.00±0.40	5.10±0.80	4.60±0.00	5.00±0.20	5.20±0.30	5.40±0.50
14	K (mg/100ml)	60.00±1.00	50.00±1.40	70.00±0.00	65.00±0.00	50.00±0.40	60.00±0.50
15	Mg (mg/100ml)	56.00±3.12	65.00±2.54	45.50±2.19	50.20±2.00	45.00±1.36	50.50±1.30
16	Cu (mg/100ml)	0.99±0.20	0.55±0.12	0.20±0.08	0.40±0.01	0.80±0.04	0.60±0.00
17	Fe (mg/100ml)	3.50±0.40	2.95±0.10	3.50±0.16	4.00±0.20	3.00±0.17	4.00±0.33
18	Mn (mg/100ml)	6.50±0.18	4.50±0.24	5.40±0.18	4.50±0.10	6.50±0.10	5.80±0.60

Earlier reports on the characteristic appearance of the exudates of *Elaeis guineensis Jacq* revealed that the colour is whitish and foamy (Eapen, 1982; Tulley, 1964). Our present investigations confirm these earlier observations. The characteristic whitish colour is impacted by the yeast, (saccharomyces cerevisiae), which ferment the exudates (Levi and Oruche, 1957).

The pH of the exudates from *Raphia* palm, a sister palm is also close to neutrality (pH 7) as already reported (Obahiagbon and Oviasogie, 2007). The pH concentrations in the exudates indicated a similar result for all the samples analyzed from Edo state while the results of the samples from Lagos and Enugu states had a lower pH. This could be attributed the level of action of the enzyme, sacharomyces cerevisae, which fermented the exudates before bottling. The resultant action of the enzyme is also implicated in the levels of acidity (acetic acid) and alcohol detected being by-products of the fermentation of sucrose. As a consequent, correlation was observed between the concentrations of sucrose, alcohol, acetic acid and pH. Higher sucrose level in all the samples correlated with higher pH and vice versa. Whereas, lower sucrose levels as observed in samples from Lagos and Enugu states correlated with higher alcohol/acid and low P^H levels. The pasteurization of the exudates was meant to arrest the activity of the fermenting enzyme, but if this is delayed before bottling a drop in sucrose level results and alcohol and acetic acid is formed (Fapurusi and Bassir, 1972; Obahiagbon and Oviasogie, 2007).

Sucrose is however considered as a macronutrient in human nutrition that yields a quick source of energy. Sucrose plays a central role in the carbohydrate metabolism of plants (Rees, 1980).

Table 3: Nutritional Constituents of Bottled Exudates from Enugu State (Mean)

S/n	*Month*	*April*	*May*	*June*	*July*	*August*	**Sept.**
1	Colour	Whitish	Whitish	Whitish	Whitish	Whitish	Whitish
2	Ph	6.30±0.00	5.15±0.01	6.70±0.03	6.55±0.03	5.60±0.02	6.50±0.01
3	Moisture (%)	94.60±1.60	95.00±1.14	96.00±1.28	95.00±1.20	94.20±1.10	95.10±1.18
4	Taste	Sweet	Sweet	Sweet	Sweet	Sour	Sweet
5	Relative density	1.10±0.20	1.21±0.27	1.23±0.09	1.20±0.13	1.10±0.15	1.15±0.37
6	Acidity (%Acetic acid)	0.30±0.11	0.55±0.15	0.25±0.11	0.31±0.08	0.45±0.10	0.30±0.06
7	Protein (mg/100ml)	0.04±0.01	0.03±0.01	0.02±0.00	0.03±0.00	0.04±0.01	0.03±0.00
8	Sugar (% sucrose)	7.50±1.20	5.60±1.00	8.00±1.90	7.00±1.00	6.00±0.00	7.20±1.13
9	Alcohol (%)	0.08±0.02	2.00±0.43	0.09±0.01	0.09±0.03	1.50±0.34	0.08±0.02
10	Thiamine (mg/100ml)	0.03±0.01	0.02±0.01	0.01±0.00	0.10±0.02	0.09±0.02	0.03±0.01
11	Riboflavin (mg/100ml)	0.40±0.12	0.25±0.10	0.10±0.03	0.25±0.03	0.30±0.02	0.25±0.00
12	Ascorbic acid (mg/100ml)	0.99±0.32	1.80±0.44	0.60±0.26	1.50±0.30	0.09±0.01	0.09±0.03
13	Na (mg/100ml)	2.50±0.67	1.20±0.34	3.00±0.40	2.50±0.44	1.55±0.38	2.00±0.42
14	K (mg/100ml)	52.00±1.66	59.00±1.60	48.00±1.38	55.00±2.00	67.00±2.10	69.00±1.58
15	Mg (mg/100ml)	50.00±1.20	49.00±0.80	42.00±1.20	50.00±1.60	63.00±2.30	67.00±1.00
16	Cu (mg/100ml)	0.60±0.23	0.45±0.14	0.39±0.27	0.25±0.09	0.35±0.08	0.40±0.10
17	Fe (mg/100ml)	0.99±0.19	0.98±0.27	1.10±0.00	1.25±0.27	1.00±0.22	1.10±0.08
18	Mn (mg/100ml)	2.50±0.60	3.50±0.00	2.60±0.000	2.10±0.40	2.00±0.20	1.50±0.28

The protein concentrations in all the exudates were generally low. This may be attributed to the low synthesis of protein by most palms (Obahiagbon and Oviasogie, 2007). However in human nutrition the importance of protein in a diet is correlated not only with the amount of the protein but also with the essential amino acids profile of the protein (Ukhun and Dibie, 1990). Research is underway to determine the amino acids profile of the exudates of Elaeis guineensis *Jacq*., to link it with the low values of proteins associated with the palm. The exudates from Edo state had highest values of proteins.

Three water soluble vitamins, thiamine, riboflavin and ascorbic acid were detected in all the exudates irrespective of their sources. The concentration of the ascorbic acid was highest in all the exudates though they were present in low quantities. The low quantities may be significant in human nutrition since vitamins are required in minute quantities for healthy living (Obahiagbon, et al., 2007). The low values of the vitamins in the samples could be attributed to their bioavailabilty, their need by the palms and other environmental factors (Mengel and Kirkby, 1979). The concentration of potassium was highest among the elements in the exudates. In plants, potassium is considered as the most important cation with regards to its content in plant tissues, physiological and biochemical function (Mengel and Kirkby, 1979). The high potassium contents of the exudates could be explained with the earlier observation by workers who concluded that he high rate of potassium uptake in plant nutrition is due to the fact that the element is a stronger competitor in the uptake relative to the other cation species (Grimme, et al., 1974). Additionally, they observe that the absorption rate of other cations is enhanced when the potassium uptake is low. Another worker observed that potassium is mobile in the plant and that it is taken up at higher rate, being one of its main features (Ansari and Bowling, 1972). Additionally, the above workers further observed that potassium uptake and retention in plants cells are also competitively affected by H^+, Ca^{2+}, mg^{2+} and N^+. The lower magnesium concentrations relative to the potassium concentrations in the exudates could be attributed to the antagonism of potassium against magnesium as reported (Grimme, et al., 1974). The above findings were further supported by the works of others (Legget and Gilbert, 1969). The low concentration of iron, zinc and copper in the exudates could be attributed to the fact that iron, zinc and copper are metabolically controlled (Moore, 1974; Ndon, 2006). Being micronutrients for plants nutrition, they are needed in small quantities (Mengel and Kirkby, 1979). Copper strongly inhibits the uptake of Zinc and vice versa (Bowen, 1969).

However, factors like low temperatures, alkaline earth metals like Mg^{2+} and Ca^{2+} and Cu^{2+} have been reported as capable of reducing the uptake of Zinc (Chaudhry and Lonerangan, 1972).

Conclusion: This research into the three most popular bottled exudates of *Elaeis guineensis Jacq.* produced in Lagos, Edo and Enugu states have revealed that they contain several health nutrients, like macronutrients (water, sugar and proteins), micronutrients (water soluble vitamins and minerals). The above nutrients existed in different

concentrations. The water content in the exudates is significant as humans cannot exist or survive without water. The proteins act as body builders while the sugars (sucrose) is one of the sources of energy utilization in man. The water soluble vitamins detected though required in small quantities play a number of roles in biochemical functions and deficiency disorders. In man, the mineral elements function as structural components of body organs and tissues, besides their roles in body fluids as electrolytes and they act as catalyst or coenzymes. The consumption of the exudates from *Elaeis guineesis Jacq.,* is therefore of immense health benefits to man if the nutrients are not destroyed by the delay in processing and during pasteurization.

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