Journal of CUDIMAC (J-CUDIMAC)
ISSN 0794-4764 (Print) ISSN 2651-6063 (Online)
Vol 6, No.1 2019

Science Process Skills Practised in Palm Wine Tapping

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Abstract

In this era of science and technology, there is need to uphold the practice of indigenous science. This facilitates discoveries and use of natural endowments in different cultural localities towards achieving sustainability in poverty eradication and crime reduction. This study investigated the science process skills practised in palm wine tapping of Raffia hookeria. Guided by two research questions, it was conducted in Orlu L.G.A. of Imo State using case study research design. A sample of 31 raffia palm wine tappers was drawn from a population of 336 active palm wine tappers in the area using purposive sampling and simple random sampling techniques. Data were collected using checklist whose reliability was 0.68 determined using K-R_{20} and analyzed using percentages. Findings revealed that raffia palm wine tappers practised science process skills of observing, communicating, measuring, classifying, manipulating, predicting and inferring; and exhibited more of basic process skills in science than integrated process skills. It is recommended among other things that effort should be made to train the raffia palm wine tappers in the acquisition of the integrated process skills in order to make palm wine tapping activity more scientific. Also, students' participation in palm wine tapping will encourage innovations that will boost palm wine production and makes it globally competitive.

Keywords: *Science Process Skills, Raffia Hookeria (Raffia Palm), Palm Wine*

Introduction

Palm wine as a natural sap, is a milky-white coloured liquid obtained from palm trees when they are tapped. Such palm trees are of different types. Among which are oil palm, raffia palm and date palm (Onuche, Shomkegh& Tee, 2012). It is also a beverage gotten from the fermentation of palm saps (Karamoko, Deni, Moroh, Bouatenin, & Dje, 2016). It is tapped in most West African countries and beyond. In the south-eastern part of Nigeria, it is among the significant traditional drinks enjoyed by people who know about the nutritional or food value of this wonderful gift of nature. When fresh, palm wine usually has refreshing taste. However, when fermented, its level of alcohol is increased. Palm wine is traditionally significant in Igbo land as it is used in libations, oath-takings and ceremonies such as marriage, burial and child-naming as well as other social gatherings. Palm wine as a nourishing beverage, has different local names in the south-eastern Nigeria among which are *mmanyangwọ* (wine from raffia palm) and *nkwụọcha.* In most communities in Orlu Local Government Area of Imo State, palm wine is largely produced from raffia palm (*Raffia hookeria*) and to an extent from oil palm (*Elaeisguineensis*).

Palm wine as a wonderful natural drink is of nutritional, medicinal and economic importance; to the extent that it is: used as beverage by breast-feeding mothers to induce lactation and a rich

source of vitamin A. It is helpful in curing nerve related ailments; and serves as a very profitable business that can earn somebody daily income (Nwachukwu, 2012). In addition, it contains sugar, yeast, vitamins C and B12 as well as alcohol level that varies as palm wine undergoes fermentation (Chandrasekhar, Sreevani, Seshapani, & Pramodhakumari, 2012). It can be used to demonstrate the process of fermentation in Biology and Chemistry laboratories when commercial yeasts are not readily within reach.

Palm wine Tapping

Raffia palms are tapped by specialists called palm wine tappers who bring to bear their expertise in improving the quality of palm wine. They use various non-toxic but medicinal leaves to increase palm wine's effectiveness. Quality of palm wine may also be dependent on whether the raffia palm being tapped is in a swamp and/or in the garden. Since an appreciable quantity of palm wine is obtained from the raffia palm in the area where this study was carried out, the scope of this study was limited to palm wine tapping from *Raffia hookeria*. *Raffia hookeria,* among the many species of raffia palm is botanically classified hereunder:

Kingdom Plantae
Division Tracheophyta/Angiospermatophyta
Class Monocotyledoneae
Order Arecales
Family Arecaceae
Genus *Raffia*
Species *hookeria*
Raffia hookeria (G. Mann & H. Wendl) Adapted from Aigbokhan (2014, p. 157)

Tapping of raffia palm requires a number of tools (Figures 2-12 of the Appendix). The tools and their basic functions include:

- Appropriate length of bamboo stem for climbing.
- Cutlass/machete for pruning few fronds and clearing the top of the raffia trunk.
- Tapping knife locally called "*Mmangwọ"* for drilling a pentagonal-shaped hole into the trunk.
- Plastic keg of 10-50 liters for collecting palm wine produced.
- Plastic funnel for pouring collected palm wine into another keg.
- "Filter" locally called "*nza"* used to filter the palm wine collected.
- Strong leaning rope (twine) to carry the weight of the tapper while on top of the raffia palm.
- Bamboo tube locally called "*ami"* to guide the sap (palm wine) into the plastic keg.
- Pulling-down rope (twine) for bringing down the collected palm wine.
- "Packs" which are mixture of special non-toxic leaves that boost the potency of the palm wine produced as well as supply the needed warmth crucial for large production. The leaves vary according to individual tapper.

- Small length of rod which is pierced above the (pentagonal-shaped) hole where the plastic keg is tied for support.
- Short, hard and thick wood for punching the tapping knife while tapping (optional)
- Strong cord for making a U-shaped support for the plastic keg.
- Jug for measuring the quantity of palm wine collected by the raffia palm tapper.
  (Oral interview of five raffia palm tappers in August, 2016)

Raffia palm tapping stances and the aforementioned tools are shown in the pictures (Figures 1-14of the Appendix). Tapping of raffia palm is procedural and involves a number of steps, which are shown in the flow chart below:

Discovered Ready-to-be tapped raffia palm

↓

Communicate the owner/getting approval
(When the raffia palm is not owned by the tapper)

↓

Assemble Basic Tapping Requirements/Tools

↓

Drill a (pentagonal-shaped) hole of at least 15cm from the top of the raffia trunk with width and depth and 12cm-14cm respectively
[The base of the (pentagonal-shaped) hole should be steeping for easy flow of palm wine]

↓

Place the bamboo tube at the drilled surface and guard securely. Fill the drilled surface with "packs", then, fix a plastic keg of between 10-50 litres below the bamboo tube and properly support with a U-fixed rope/cord

↓

Tapping twice daily
(Until the raffia palm ceases to produce good palm wine)

↓

Collection
(Collect the palm wine produced at least once a day depending on the quantity produced)

↓

Filtration
(Carefully filter the collected palm wine with net/"filter" to remove impurities such as crumbs from the drilled stem)

↓

Bottling/pouring the palm wine into various liters of plastic kegs for sale/consumption Adapted from (Chandrasekhar, Sreevani, Seshapani, & Pramodhakumari, 2012)

The procedural nature of palm wine tapping as illustrated above, appears to have some inherent science process skills which palm wine tappers put into practice in tapping raffia palm.

Science process skills are scientific means of identifying and solving problems in an environment. They are important tools used to produce as well as to solve problems (Aktamis & Ergin, 2008). In other words, science process skills are acquired and applied by scientists in carrying out their activities. Nwosu and Okeke (1995) in Nworgu (2009) defined science process skills as abilities, potentials as well as all the technical 'know how' which can be developed in an individual through experience and which can be employed in carrying out mental and physical operations in science. They in addition, are known as procedural skills, experimental as well as investigating science habits of mind or scientific inquiry abilities (Harlen, 1999in Zeidan & Jayosi, 2015). The American Association for the Advancement of Science (AAAS) classified the science process skills into two: basic process skills and integrated process skills (Ongowo & Indoshi, 2013). They grouped observing, communicating, measuring, classifying, predicting and inferring as basic process skills in science whereas the integrated process skills in science include: controlling variables, defining operationally, formulating hypotheses, experimenting, interpreting data and formulating models.

The American Association for the Advancement of Science (AAAS) (n.d.) tersely explained the imports of the above science process skills as follows: Observation involves the use of the sense organs to obtain information concerning a phenomenon, objects and characteristics. Measuring is comparing unknown quantity with what is known. It also means giving quantities to observations based on laid down rules. Classifying is putting things into groups based on their characteristics. Inferring is the interpretation given to observations. Communicating is the sending of information to others in spoken or written form. Manipulating is the ability to handle objects accurately and appropriately. Predicting is the formation of an idea that is not a guess about an expected result but stems from a belief of what will occur based on the present observation. Formulating models simply mean clarifying explanations and relationships by constructing mental, physical and/or verbal representation of concepts, objects or ideas. Interpreting data involves organizing and analyzing data for the purpose of making predictions, drawing inferences and/or formulating hypotheses. Defining operationally means creating a definition through the description of what is done and observed. Controlling variables has to do with the manipulation of one factor to examine the outcome of an event while keeping another factor constant. Experimenting means testing; by following laid down procedures in order to produce a verifiable result. Formulating hypothesis means making a guess about the expected result of an experiment. It is the opposite of predicting. These skills are used in solving problems while carrying scientific activities.

An investigative study was carried in 2015 on the relationship between the Palestinian secondary school students' knowledge level of science process skills and their attitudes toward science, and the effect of gender and residence of these students on their knowledge level of science process skills and on their attitudes toward science (Zeidan & Jayosi, 2015). The study employed questionnaire instrument containing 18-question science process skills test and a 25-item attitudes toward science. After data analyses, it was found out that the association between knowledge level of science process skills and attitudes toward science were significant with a correlation coefficient of 0.69. The significant relationship may be because students tend to exhibit scientific attitudes while

applying science process skills in carrying out scientific activities. In related development, Ongowo and Indoshi (2013) carried out a study on Science Process Skills in the Kenya Certificate of Secondary Education Biology Practical Examination for period of 10 years (2002-2012). Ex-post facto research design was adopted in the study. The content of Kenya Certificate of Secondary School Education Biology Practical questions (KCSE-BPQ) for the stated period were analyzed based on 12 categories of Science process skills and their descriptions. Data collected were analyzed using means. Results showed that the five most common science process skills identified out of the 12 examined in that were observation, communicating, inferring, experimenting and interpreting data. The results also revealed a high mean of basic process skills in science at 73.73% compared to the integrated process skills in science at 26.27%. The higher mean in basic process skill in science is an indication that much needs to be done in developing students' creative and problem-solving abilities by including more integrated process skills in science as they recommended. This study is expected to contribute to the aforesaid investigations though using palm wine tappers as respondents.

In addition, Onuche, Shomkegh and Tee (2012) conducted a study on "Palm wine Tapping Methods among Idoma and Tiv Ethnic Groups of Benue Sate, Nigeria: Implication on Conservation of Palm Trees (*Elaeisguineensis*)" using 150 respondents. Structural interview and field observation were used in data collection. The result identified three palm wine tapping methods namely inflorescent flower method, terminal budding method and felling of palm tree method. The inflorescent flower tapping method adopted by majority of tappers in the Idoma ethnic group was found to be more sustainable for palm wine tapping as it ensures survival of trees tapped, providing for the palm wine needs of today and future generations. Terminal budding method of palm wine tapping associated with Tiv ethnic group was destructive because only a fraction of one quarter palm trees survived after tapping. These authors though conducted a study on palm wine tapping; focused on palm trees tapping methods and not that of raffia palm. Also, they did not try to examine if there were science process skills the tappers exhibited in the course of tapping.

Theoretically, this study was guided by social learning theory proposed by Albert Bandura. Social learning theory is prominent in learning and development. Bandura (1977) in Cherry (2016) explained that:

> "Learning would be exceedingly laborious, not to mention hazardous, if people had to rely solely on the effects of their own actions to inform them what to do. Fortunately, most human behavior is learned observationally through modeling: from observing others one forms an idea of how new behaviors are performed, and on later occasions this coded information serves as a guide for action".

Social learning theory states that learning occurs through identification, imitation and modeling. This theory might be efficacious in teaching and acquisition of skills in science. In a social setting therefore, an individual continues to learn by imitating prominent figures in the society where he/she found himself/herself. Palm wine tapping as an occupation, involves several activities which may be procedural and might be learnt through observation and imitation; which social learning theory upholds. This study in effect, tends to support the tenets of social learning theory.

Statement of Problem

The need for the practice of indigenous science has evoked interesting discussions in recent times. Indigenous science is the science indigenous people developed without a recourse to western science in order to increase the awareness of native culture and identity as well as to help people of any locality solve problems that have social and cultural dimensions. One way of making science less alien is to bring it into our everyday life. In the south-eastern part of Nigeria, tapping of raffia palm is among the traditional significant occupations people engage in to earn a living. Tapping of raffia palm involves series of activities that are procedural and as such may have science process skills that are practiced; the knowledge of which students can key into, to aid them in understanding and using of the science process skills acquired from their study of Biology. The study seeks to answer the following questions: do palm wine tappers actually practicse science locally by applying the science process skills in their palm wine tapping? Is there percentage difference between the basic and integrated process skills in science practised by palm wine tappers in tapping raffia palm? The study therefore tried to investigate the science process skills practiced in the tapping of *Raffia hookeria* for wine.

Purpose of the Study

The general purpose of the study was to investigate the science process skills practiced in the tapping of *Raffia hookeria*. Specifically, the study sought to:

i. Identify the science process skills practised by palm wine tappers in tapping raffia palm.
ii. Find out the percentage difference between the basic and integrated process skills practised by palm wine tappers in tapping raffia palm.

Research Questions

The study was guided by the following research questions:

i. What are the science process skills practised by palm wine tappers in tapping raffia palm?
ii. What is the percentage difference between the basic and integrated process skills practised by palm wine tappers in tapping raffia palm?

Methods

The study adopted case study research design. This type of design provides thorough, in-depth, comprehensive and well-ordered information concerning the social unit in question (Nworgu, 2006). The design as further opined by Nworgu is time consuming and often demands the direct participation of the researcher in collecting certain critical information from the social unit.

Area of Study

The study was carried out in Orlu Local Government Area of Imo State. Orlu is a commercial city comprising more than thirty autonomous communities among which are Alaọma, Amaifeke, Amike, Eziachị, Ihiọma, Ihitte-owerre, Isiala, Isiọkwụ, Mgbee, Nnenatọ, Obibi-ochasị, Obor, Ofeahịa, Ogberuru, Okporo, Ọkwụabala, Orlu-Gedegwum, Owerre-Ebeiri, Owerre-Ụmụdioka, Ụmụdioka Ancient Kingdom, Ụmụdioka-ukwu, Ụmụezennachị, Ụmụna, Ụmụọwa,

ỤmụtanzeỤmụzike, and Ụzọubi. The people of Orlu are hospitable and accommodate strangers irrespective of ethnicity, language and religion. They have good cultural heritages such asoriri, new yam festival (iri ji), ọkọnkọ, oghu, ebuebu, mmanwụ, ekeleke and okorosha cultural dances. They take titles such as nze,ọzọ, ichie, chief, and eze/igwe (king). They engage in various occupations such as white-collar jobs, industrialist, trades, artisans, craft, palm wine tapping and farming. The choice of this area for the study is on the bases that there are many raffia palms within the communities and some indigenes chose palm wine tapping as their occupation. These were observed by the researcher during his three-year adjunct teaching in some public and private secondary schools in the area.

Population, Sample and Sampling Technique

The population of the study was all the 336 active raffia palm wine tappers in Orlu Local Government Area. Thirty-one (31) active raffia palm wine tappers were sampled using purposive sampling and simple random sampling techniques. The researcher first, wrote the names of the autonomous communities in Orlu L.G.A in different pieces of papers and purposively grouped them into two based on whether the said community has stream(s) or not. This is because raffia palms are dominant in communities with streams than those without stream. However, people in non-stream communities planted raffia palms in their gardens. Thereafter, the researcher folded the paper slips bearing the names of different communities properly and sorted them accordingly in two separate polythene bags tagged “stream” and “No stream”. The researcher tied the mouths of the polythene bags and shake vigorously. Then, the researcher randomly drew two autonomous communities from each bag by lucky dip with replacement. Thereafter, all the active raffia palm tappers from the four drawn autonomous communities were included in the study (12 from Mgbee, 7 from Nnenato and Isiokwu, and 12 from Owerre-Ebeiri); hence, the sample size of the study is 31 active raffia palm tappers.

Instrument for Data Collection

The data for the study were collected by observing the raffia palm tappers while they perform tapping activities. Checklist instrument was used to check the presence or otherwise of the science process skills each individual raffia palm tapper exhibited. The checklist on field observation of the science process skills practised by tappers of raffia palm (*Raffia hookeria*) was face validated by one expert in Science Education, one expert in Measurement and Evaluation, and three raffia palm wine tappers.

Reliability of Instrument

The checklist instrument was trial tested using ten raffia palm tappers from a different local government area who shared the same characteristics like cultural heritages. The data obtained after trial testing were used to compute reliability of the instrument. The reliability of the instrument was computed using Kuder-Richardson (KR_{20}) for dichotomously scored items and the reliability coefficient of 0.68 was obtained which according to Nworgu (2015) is high.

The researcher with the help of three research assistants trained by him observed each of the sampled 31 active raffia palm wine tappers for two months on different raffia palm wine tapping activities such as: pre-tapping stage (initial detection and clearing/preparation of ready-to-be tapped raffia palm), Tapping stage (actual tapping) and post-tapping (filtration and bottling stage); and tick as appropriate in the checklist, the science process skills practiced or otherwise. Thereafter, the ticked

checklists were analyzed using percentage.

Results

Research Question 1: What are the science process skills practised by palm wine tappers in tapping raffia palm?

Table 1: Science Process Skills Practised by Palm Wine Tappers in Tapping Raffia Palm

Science Process Skills	%Exhibited	%Not Exhibited
Observing	91.95	8.05
Communicating	95.70	4.30
Measuring	81.92	18.08
Classifying	90.30	9.70
Manipulating	93.09	6.91
Predicting	85.50	14.50
Inferring	93.50	6.50
Controlling Variable	32.26	67.74
Defining Operationally	29.00	71.00
Formulating Hypothesis	16.13	83.87
Experimenting	29.00	71.00
Interpreting Data	25.80	74.20
Formulating Models	22.80	77.40

Acceptable Percentage Skill = 50%, N = 31

The result of table 1 above shows that raffia palm wine tappers exhibited science process skills of observing, communicating, measuring, classifying, manipulating, predicting and inferring. This can be seen from their percentage skill exhibitions that are above the acceptable skill percentage of 50. However, their level of showing the acquisition of science process skills of controlling variables, defining operationally, formulating hypothesis, experimenting, interpreting data and formulating models is low. This is proved by their percentage skill exhibition that is below the acceptable skill percentage of 50.

Research Question 2: What is the percentage difference between the basic and integrated process skills practised by palm wine tappers in tapping raffia palm?

Table 2: Percentage Difference between the Basic and Integrated Process Skills Practised by Palm Wine Tappers in Tapping Raffia Palm

Category of Science Process Skill	Science Process Skills	%Exhibited	%Not Exhibited	Average %Exhibited	Average %Not Exhibited
Basic Skills	Observing	91.95	8.05		
	Communicating	95.70	4.30		
	Measuring	81.92	18.08		
	Classifying	90.30	9.70	90.28	9.72
	Manipulating	93.09	6.91		
	Predicting	85.50	14.50		

	Inferring	93.50	6.50		
Integrated Skills	Controlling Variable	32.26	67.74		
	Defining Operationally	29.00	71.00		
	Formulating Hypothesis	16.13	83.87	25.80	74.20
Experimenting	29.00		71.00		
Interpreting Data	25.80		74.20		
	Formulating Models	22.80	77.40		

Acceptable Average Percentage skill = 50%, N = 31

Table 2 shows that raffia palm wine tappers exhibited more of basic process skills in science than the integrated process skills in science. This is shown by the average percentage basic process skill in science exhibition of 90.28% that is greater than the acceptable average percentage skill of 50%. Conversely, the average percentage skill exhibition for the integrated process skills in science is 25.80% which is below the acceptable average percentage skill of 50%.

It can therefore be summarized from the above two tables that raffia palm wine tappers practised science locally in their tapping activity since they apply science process skills. Also, they possessed more of basic process skills in science than the integrated process skills in science.

Discussion

The results of the findings in tables 1 and 2revealed that raffia palm wine tappers practise science in their wine tapping activity since there were some process skills they exhibited as seen in the columns on percentage exhibited and average percentage exhibited. This showed that in raffia palm tapping activity, a number of science process skills are inherent. Among these skills is observing. Raffia palm wine tappers exhibited this skill in their ability to observe with their eyes the signs of maturity possessed by ready-to-be tapped raffia palm as well as noticed the signs when the raffia palm has stopped producing good palm wine. They exhibited communicating skill because they showed the ability to inform the owner of the raffia palm when the raffia palm is due to be tapped and when it has stopped producing good palm wine. There is also effective communication between the tappers and the consumers of palm wine. They showed possession of measuring skill. This is because they were able to mark-off few centimeters from the top of the raffia palm trunk before drilling the (pentagonal-shaped) hole. They also were able to tie the leaning rope to suit wine tappers' sizes. They were able to use suitable length of the bamboo stem for climbing the raffia palm. They wereable to measure the quantity of palm wine collected daily using gallons and jugs. In addition, they were able to measure the quantity of water to be added if the palm wine is needed to be in dilute form.

Tappers possessed the science process skill of classifying since they were able to distinguish spoilt raffia palms from those that were still good for tapping. Also, they could comfortably distinguish and group diluted palm wine and undiluted palm wine. They could as well group fresh and fermented palm wine. Raffia palm wine tappers exhibited manipulating skill. This is because

they were able to: use tapping knife and pruning machete specifically for their purposes in palm wine tapping activity; use tapping knife accurately and appropriately to drill a (pentagonal-shaped) hole into the trunk; place the bamboo tube appropriately for channeling the sap (palm wine) into the plastic keg; put 'packs' (leaves of non-toxic plants) above the bamboo tube to fill the drilled hole; fix plastic keg correctly below the bamboo tube, tap at least twice daily as well as rinse the plastic collecting keg with water and/or palm wine daily.

They showed predicting skill because they were able to say the likely period the raffia palm would be due for tapping having seen the signs of maturity and were also able to say the likely period the raffia palm being tapped would stop producing good tasty palm wine. In addition, the tappers proved proficiency in inferring skill as many of them were able to say with certainty that an identified raffia palm is ready to be tapped. The skill of controlling variables was not exhibited by most of the raffia palm wine tappers since many were not using variety of non-toxic leaves as 'packs' to increase the potency of the palm wine while keeping the known leaf of *Musa paradisiaca*constant. In other words, majority of them were using a specific non-toxic leaf.

A good number of the raffia palm wine tappers lacked the skill of defining operationally as they could not define how to use ruler to measure few centimeters from the top of the raffia trunk before drilling the (pentagonal-shaped) hole. They could only do such measurement adopting the conventional practice of using their tapping knives which in most cases yield an unexpected outcome. The skill of formulating hypotheses was not exhibited as very many of the raffia palm wine tappers could not guess the expected outcome at least three days after the drilling stage. The skill of experimenting was not also exhibited by majority of the tappers. This is because majority of the tappers observed could not test formulated hypothesis from observation. For instance, using local item and/or technique such as lump of wood charcoal, 'nche', fresh leaves of *Vernonia amygdalina* (Bitter leaf) as well as not keeping kegs of fresh palm wine on cemented/tiled floor and/or under the sun; to slightly delay fermentation process for few hours.

Furthermore, science process skill of interpreting data was not exhibited by many of the observed raffia palm wine tappers as they were not able to record or use tables, graphs or diagrams to illustrate the daily produce of the raffia palm tapped; and could not make valid conclusion about the raffia palm based on the illustrations or record of the proceed where it was kept. Finally, the skill of formulating models was not exhibited by many of the tappers because many of them lacked the ability to outline with accuracy, the procedural steps involved in tapping of *Raffia hookeria* (Raffia palm). Consequently, the tappers were more proficient in the use of basic process skills in science such as observing, communicating, measuring, classifying, manipulating, predicting and inferring than in the use of integrated process skills in science like controlling variables, defining operationally, formulating hypotheses, experimenting, interpreting data and formulating models. The above results were in line with the study conducted by Ongowo and Indoshi (2013) that there was a high mean of basic process skills in science compared to the integrated process skills in science. This could be because the basic process skills in science are not complex compared with the rigors of the integrated process skills in science.

Conclusion

Raffia palm tapping is an indigenous scientific activity that requires the acquisition and application of science process skills by raffia palm tappers. Raffia palm wine tappers exhibited

science process skills and were able to show more of basic science process skills such as observing, communicating, measuring, classifying, manipulating, predicting and inferring than the integrated skills.

Recommendations

Based on the findings and discussion of results, the following are recommended:

- Effort should be made to train the raffia palm wine tappers in the acquisition of the integrated process skills in science so that palm wine tapping activity could be more scientific.
- Raffia palm wine tappers need science process skills as it engenders in them scientific attitudes like patience, objectivity, honesty, clear mindedness, critical and analytic thinking in wine tapping activities.
- Students can key into raffia palm wine tapping in order to apply the science process skills acquired from their study of Biology.
- Students' participation in raffia palm wine tapping will encourage innovations and the application of modern technological equipment in palm wine tapping activity which shall help to boost the production and make it globally competitive.
- Students' involvement in raffia palm wine tapping activity will foster research breakthroughs using palm wine as well as working towards preserving this natural heritage.
- Raffia palm wine tapping activity should be embraced by the youths as it helps to reduce poverty and hunger which directly contributes towards achieving the sustainable development goals one and two of the United Nations.

Acknowledgements

The author humbly acknowledges the raffia palm wine tappers who made themselves available during the periods of this study and contributed immensely towards its successful completion. Worthy of mention are Mr. Edwin Ibenyenwa Okereke Okorie, Mr. Innocent Irobi Adimekwe and Mr. Fidelis Ezeala who not only face-validated the instrument but also were among the raffia palm wine tappers that participated in the study. The author sincerely appreciates the efforts and ingenuity of Late Mrs. Christiana U. Okereke, one of the trained research assistants in this study. May her soul rest in peace. Finally, the author immensely thanks Mr. Lazarus Chinasa Edwin for sponsoring the publication of this article.

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Appendix

Figure 1: Palm wine tapper (Edwin I. Okereke Okorie) arranging tapping tools

Figure 2: Bamboo stem

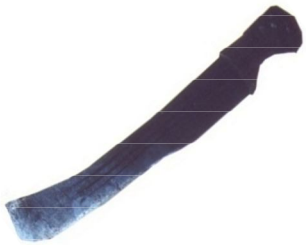

Figure 3: Cutlass/machete

Figure 4: Tapping knife locally called "Mmangwọ"

Figure 5: Plastic keg, Plastic funnel and "Filter"

Figure 6: Strong leaning rope (twine)

Figure 7: Bamboo tube

Figure 8: "Packs" e.g. dried leaves of *Musa paradisiaca L.*

Figure 9: Small length of rod

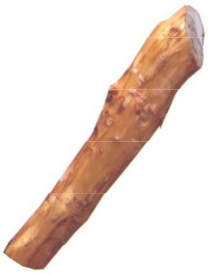

Figure 10: Short, hard and thick wood

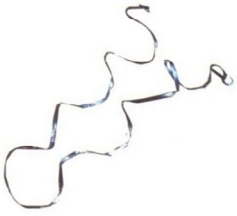

Figure 11: Strong Cord

Figure 12: Jug containing palm wine

Figure 13: Palm wine tapper (Edwin I. Okereke Okorie) in a tapping stance

Figure 14: Palm wine tapper bringing down collected palm wine