Original Article

A descriptive cross-sectional study on various uses and outcomes of *Garcinia kola* among people of Oshimili North in the Delta State of Nigeria

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Abstract

Background: A preliminary review of literature for this study shows that the use of *Garcinia kola* (bitter kola) as plant medicine is common among Africans but there are no scientific evidence to support its uses to prevent or treat common medical conditions. The main purpose of this study, therefore, is to examine the various uses and outcomes of *Garcinia kola* (*G. kola*) among people of Oshimili North in the Delta State of Nigeria. **Methodology:** This descriptive cross-sectional quantitative study was based on a structured questionnaire for adults aged 18 and above (n = 274) in Oshimili North local government area of Delta State of Nigeria. Likert scale data were coded as follows: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree. As Likert-type data are usually ordinal data, which make more sense when converted to interval data. The converted ordinal data were analyzed using SPSS computer software. Ethical requirement including the administration of information sheet, written informed consent, and the provision of confidentiality was ensured. **Results:** The analysis of results show that the benefits derived from ingesting bitter kola were rated high for cough, bacterial or viral infection and anticancer. The results also show that most of the respondents consider bitter kola having low benefits for relieving food poison, diarrhea or stomach upset. Chi-square results show no association between gender and perceived benefits of bitter kola for relieving these conditions. In addition, results show that females perceive benefits derive from ingesting bitter kola as low as an aphrodisiac whereas males consider it as average. Chi-square results show significant association between gender and perceived benefits of bitter kola as an aphrodisiac. **Conclusion:** The study found that *Garcinia kola* acts as anti-bacteria, anti-virus and provides protection against cancer. However, this study could not find any conclusive evidence to support the age long claim of bitter kola as treatment for food poison, diarrhea or stomach upset and aphrodisiac (libido).

Keywords: Antioxidant, bitter kola, flavonoid, health benefits, phytochemical, plant medicine

Introduction

The study was spurred on by the World Health Organization (WHO) Plant and Traditional Medicine Strategy for 2014–2023, which aims to harness the use of plant medicine to improve population health. The WHO data demonstrated that of 129 member countries, 80% recognized the use of plants' medicine. *Garcinia kola (G. kola)* is one of the medicinal plants, which has been used in African ethno medicine because of its purgative, antiparasitic, antimicrobial properties.[1] *Garcinia kola* is botanical name for bitter kola. It is flowering plant found in subtropical or tropical moist lowland forests of Nigeria, Senegal, Sierra Leone, Liberia, Ghana, Gabon, Ivory Coast, Democratic Republic of the Congo, Cameroon and Benin Republic [Figure 1]. The name bitter kola came from the bitter astringent and resinous taste, which is followed by a slight sweetness from chewing the kola. In Nigeria, *G. kola* is called aku-ilu, adu or ugolo in Igbo, orogbo in Yoruba, and namijingworo in Hausa. It is highly valued in Africa and used for hospitality during cultural and social ceremonies.[1]

The phytochemical property of *G. kola* has attracted the attention of many scientists. Phytochemicals are nonnutritive chemicals that plants produce to protect themselves from

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diseases.[2] Phytochemicals are known to possess antioxidants and antimicrobial properties that make them valuable to human. For example, a review of scientific literature found that antioxidant protects human cells against oxidative damage and reduces the risk of developing certain types of cancer.[3] *G. kola* protects against the oxidation of lipoprotein, through antioxidant and scavenging activities of flavonoid.[4] Some of the phytochemical compounds isolated from *G. kola* include oleoresin, tannin, saponins, alkaloids, cardiac glycoside, biflavonoids such as kolaflavonone and 2 hydroxyflavonoids. In addition, two new chromanols, i.e., garcioic and garcinal together with tocotrienol have been reportedly isolated from bitter kola.[5]

Garcinia kola is highly valued plant medicine and used widely in Africa for its medicinal properties,[1] but there is a disparity between highly prevalent use of the plant and solid evidence of it health benefits. Researchers were unable to find any previous research that has been carried out to explore this topic using quantitative research method. Thus, this study aims to examine the various uses of *G. kola* among people of Oshimili North in the Delta State of Nigeria. The objective is to determine the outcomes of *G. kola* uses as remedy for common health conditions such as cough and flu symptoms, food poisoning, bacteria, virus infections, cancer prevention and libido enhancement [Figure 1].

Methodology

A quantitative research method was chosen for this study because it is probably the most commonly used research method in quantifying or measuring health benefits. The quantitative research method was also selected for this study because the research question involves quantifying a population sample rather than the experiences of an individual. Quantitative research method has its origins in positivism, a world of objective reality that can be measured or quantified.[6] The method lends itself to be interpreted in a quantifiable way without allowing for manipulation of respondents' outcomes.[7]

The quantitative approach made it possible for this study to be reproducible and its findings generalizable to other communities ingesting bitter kola. Furthermore, these researchers have a positivist view, in that the finding of the study is identified by unbiased, impartial observers who look closely and carried out the study in a detached and unemotional way. Finally, using the quantitative research approach, these researchers were able to examine the relation between ingesting bitter kola and health benefits.

Sample selection

An initial study shows that most adults in Oshimili North local government of Delta State in Nigeria ingest bitter kola. As it was impossible to gather information from an estimated population of 80,000 people from the local government area, a sample of 300 adults was randomly selected.[8] A sample is a subsection of a population selected to participate in a research study.[9] A survey that is based on some form of random sampling technique will produce a sample, which is representative of the particular population under the study and will produce findings that may be generalized to the wider population.[10] Therefore, the use of random sampling technique in this study is intended to give every member in the population frame equal chance of being selected and thereby produce a sample that is representative.

The survey took place between the months of June 2015 and September 2015. Of the 300 questionnaires that were handed out, 210 were returned by the 1st week of September. Additional 60 questionnaires were returned by the last day of September after many follow-up prompts and reminders. Thus, a total of 270 questionnaires were returned.

Data collection

Quantitative researchers usually use methods of data collection, which is then transformed into numerical data to be statistically manipulated in order to answer the research question.[11] Quantitative data are often gathered through questionnaires that are carefully developed and structured to provide researcher with numerical data that can be explored statistically and yield a result that can be generalized to a larger population.[10] Data on the use of bitter kola were collected using a purpose-designed, cross-sectional anonymous questionnaire, administered on a single occasion. The data were collected using questionnaire consisting of 9 questions, which took approximately 20 min to complete.

Pilot study

The pilot study was conducted on 20 members of Isunambagu social club of Ibusa and Ibusa Development Union United Kingdom branch. The aim of the pilot study is in line with some scholars view that it is a mini version of the main study designed to help the researchers determine the feasibility of the study and reliability of the data collecting tool.[12] Thus, subsequent adjustments were made to the questionnaire based on the outcome of the pilot study.

Data analysis

To analyze the Likert scale data, these researchers "coded respondents" responses as follows: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree. As Likert-type data are usually ordinal data, it could only be said

Figure 1: Sample of Seeds of *Garcinia kola*

Table 1: Question: How do you rate the following statements in relation to your use of *Garcinia Kola?*

Statements	Analysis of responses							
	Gender	Frequency (%)				χ^2	df	*P*
		Disagree	Neutral	Agree	Total			
I use bitter kola for: Cough	Male	16 (14.41)	5 (4.50)	90 (81.08)	111 (100)	0.71	2	0.701
	Female	23 (18.40)	6 (4.80)	96 (76.80)	125 (100)			
	Total	39 (16.53)	11 (4.66)	186 (78.81)	236 (100)			
I use bitter kola for: Food poison, diarrhea or stomach upset	Male	13 (13.13)	8 (8.08)	78 (78.79)	99 (100)	1.96	2	0.375
	Female	27 (24.32)	2 (1.80)	82 (73.87)	111 (100)			
	Total	40 (19.05)	10 (4.76)	160 (76.19)	210 (100)			
I use bitter kola for: Flu, sneezing, catarrh and/or other cold symptoms	Male	24 (23.53)	8 (7.84)	70 (68.63)	102 (100)	0.62	2	0.733
	Female	28 (25.93)	11 (10.19)	69 (63.89)	108 (100)			
	Total	52 (24.76)	19 (9.05)	139 (66.19)	210 (100)			
I use bitter kola for: Bacterial infection	Male	31 (25.83)	18 (15.00)	71 (59.17)	120 (100)	2.33	2	0.312
	Female	31 (26.72)	10 (8.62)	75 (64.66)	116 (100)			
	Total	62 (26.27)	28 (11.86)	146 (61.86)	236 (100)			
I use bitter kola for: Anticancer	Male	22 (21.78)	7 (6.93)	72 (71.29)	101 (100)	1.41	2	0.494
	Female	18 (16.51)	11 (10.09)	80 (73.39)	109 (100)			
	Total	40 (19.05)	18 (8.57)	152 (72.38)	210 (100)			
I use bitter kola for: Aphrodisiac (libido)	Male	24 (26.97)	15 (16.85)	50 (56.18)	89 (100)	17.15	2	0.0002
	Female	36 (29.75)	48 (39.67)	37 (30.58)	121 (100)			
	Total	60 (28.57)	63 (30.00)	87 (41.43)	210 (100)			

Table 2: Question: How do you rate the benefits derives from ingesting *Garcinia Kola* in relation to the following statements

Statements	Analysis of responses							
	Gender	Frequency (%)				χ^2	df	*P*
		Low	Average	High	Total			
Cough	Male	23 (23.47)	10 (10.20)	65 (66.33)	98 (100)	0.3	2	0.861
	Female	27 (24.11)	9 (8.04)	76 (67.86)	112 (100)			
	Total	50 (23.81)	19 (9.05)	141 (67.14)	210 (100)			
Food poison, diarrhea or stomach upset	Male	57 (57.58)	18 (18.18)	24 (24.24)	99 (100)	2.47	2	0.291
	Female	67 (60.36)	12 (10.81)	32 (28.83)	111 (100)			
	Total	124 (59.05)	30 (14.29)	56 (26.67)	210 (100)			
Flu, sneezing, catarrh and/or other cold symptoms	Male	27 (26.73)	8 (7.92)	66 (65.35)	101 (100)	1.34	2	0.512
	Female	32 (29.36)	13 (11.93)	64 (58.72)	109 (100)			
	Total	59 (28.10)	21 (10.00)	130 (61.90)	210 (100)			
Bacterial or viral infections	Male	21 (18.42)	15 (13.16)	78 (68.42)	114 (100)	0.51	2	0.775
	Female	18 (18.18)	10 (10.10)	71 (71.72)	99 (100)			
	Total	39 (18.31)	25 (11.74)	149 (69.95)	213 (100)			
Anticancer	Male	23 (22.33)	9 (8.74)	71 (68.93)	103 (100)	0.24	2	0.887
	Female	21 (19.63)	10 (9.35)	76 (71.03)	107 (100)			
	Total	44 (20.95)	19 (9.05)	147 (70.00)	210 (100)			
Aphrodisiac (Libido)	Male	60 (48.00)	44 (35.20)	21 (16.80)	125 (100)	8.25	2	0.016
	Female	32 (37.65)	46 (54.12)	7 (8.24)	85 (100)			
	Total	92 (43.81)	90 (42.86)	28 (13.33)	210 (100)			

that one score is higher than another, not the distance between the points. In addition, ordinal data make more sense when converted to interval data using interval scale. The interval scale is a metric scale that allows equal distance between values to be measured. It is measured on a linear scale and can take on positive or negative values.[13] Thus, the interval scale used for this data analysis is designed to show how the respondents agree, neutral or disagree with statements in relation to their use of bitter kola on a five-point scale. For example, the Likert scale uses the response categories of strongly agree, agree, disagree, strongly disagree, neither agree nor disagree, combine agree and strongly agree responses into one category and the

disagree and strongly disagree into another. This gives us three categories of responses: agree, disagree and neutral.

The use of Likert scale in this study yielded ordinal data which were converted to interval data using interval scale.[14] Inferential statistics for ordinal data, on the other hand, uses nonparametric tests, such as Chi-square test, because parametric tests require internal data.[15] Thus, to display the distribution of respondents' responses (i.e., agree, neutral, and disagree), these researchers used percentages and a bar chart as illustrated in Tables 1 and 2. In addition to the use of percentages and bar charts to display measure of responses, Chi-square statistical test was used to show correlation between the data and the question. The aim of applying Chi-square statistical test is to indicate whether a statistically significant relationship exists within the data relationships.

The data analysis, therefore, involves descriptive analysis and testing for significance of associations, which were carried out within the collected data. These researchers have chosen descriptive statistics because it is an appropriate approach when large quantities of data have been collected.[16] The descriptive statistics made it possible for the data to be organized and presented using tables and graphs in line with quantitative research method. The analyzed data using descriptive statistics yielded results that can be generalized to a larger population.[16]

Results

A total of 300 questionnaires were handed out to respondents. Of these, 26 questionnaires were omitted from the data analysis, as they were missing responses amounting to 8.7% dropouts. Therefore, the final response rate was 274 which amounted to 91% response rate. The respondents were asked to a list of in relation to their use of *G. kola*. The statements and their responses are illustrated in Table 1 and 2. The analysis of data in Table 1, shows no significant association with gender for statements of using bitter kola for cough; food poison, diarrhea or stomach upset; flu, sneezing, catarrh and/or other cold symptoms; bacterial infection; and anticancer. The data also show that both males and females mostly agree to using bitter kola for cough; food poison, diarrhea or stomach upset; flu, sneezing, catarrh and/or other cold symptoms, bacterial infection and anticancer.

A significant association was seen for the statement of using *G. kola* as an aphrodisiac wherein 56.18% of the males agreed on this whereas 39.67% of females were mostly neutral on this.

The analysis of data in Table 2, shows ratings of all respondents for the health benefits derived from ingesting *Garcinia kola*. The benefits derive from ingesting bitter kola were rated high for cough. In other words, most of the respondents consider *Garcinia kola* as having high benefits for relieving cough. Chi-square test result shows no association between gender and perceived benefits of *Garcinia kola* for relieving cough. The respondents consider *Garcinia kola* having low benefits for relieving food poison, diarrhea or stomach upset regardless of gender. Chi-square results show no association between gender and perceived benefits of bitter kola for relieving food poison, diarrhea or stomach upset.

The data in appendix 2 also shows that most of the respondents consider bitter kola having higher benefits for relieving bacterial or viral infection regardless of gender. Chi-square results show no association between gender and perceived benefits of *Garcinia kola* for relieving bacterial or viral infection. The data analysis, in addition, shows that most of the respondents consider *Garcinia kola* as having high benefits as an anticancer. Chi-square results show no association between gender and perceived benefits of *Garcinia kola* for anticancer. Further analysis of the data shows that most females perceive bitter kola as low as an aphrodisiac whereas males consider it as average. Chi-square results show a significant association between gender and perceived benefits of *Garcinia kola* as an aphrodisiac.

Discussion

The results from this study provide scientific evidence that *Garcinia kola* has the capability of relieving cough symptoms and viral and bacterial infections. The finding is supported by one study, which demonstrated that both the seed and leaf of bitter kola have antibacterial activity on clinical isolates of *Escherichia coli* and *Salmonella typhi* including *Streptococcus pyogenes* and *Staphylococcus aureus*. The researchers used 10 g of the ground bitter kola's seeds and leaves in four sets; 90 ml of the extraction solvents was added to each set, which was tested on organism, rather human. Phytochemical screening of the extracts revealed the presence of some bioactive components such as alkaloids, saponins, tannins, anthraquinones and cardiac glycosides. The antibacterial activity of *G. kola* is attributed to these components of the seed and leaf extracts. The acclaimed antivirus and antibacterial activities of bitter kola demonstrated by this research data may be attributed to phytochemical property of *Garcinia kola*.[17]

The phytochemical property of *Garcinia kola* has attracted the attention of many scientists in recent times.[18] One study demonstrated that phytochemicals found in *Garcinia kola* possess antioxidants properties. Antioxidant protects human cells against oxidative damage and reduces the risk of developing certain types of cancer. It inhibits proliferation of cancer cells as well as alters cellular redox status. The study added that bitter kola protects against the oxidation of lipoprotein, through antioxidant and scavenging activities of flavonoid.[19] Another study showed that phytochemical from *Garcinia kola* could successfully treat the virus that causes Ebola hemorrhagic fever by halting multiplication of the virus in laboratory rats. If repeated in humans, this would give the body a chance to fight off the virus. (Dr. Maurice Iwu, who set up and heads the Bioresources Development and Conservation Programme, led the research team and announced the discovery at the 16th International Botanical Congress in St. Louis in the US.)[20]

One study found that the high-rated antivirus and bacterial activities of *Garcinia kola* might be attributed to its active compound known as dimeric flavonoid, which is one of the phytochemical compounds isolated from *Garcinia kola*.[21] Another study demonstrated that baicalin, a flavonoid isolated from *Scutellaria baicalensis* (*Lamiaceae*), inhibits HIV-1 infection and replication. Baicalein and other flavonoids such as robustaflavone and hinokiflavone have been shown to inhibit HIV-1 and reverse transcriptase.[22] Some scholars studied the dengue virus properties of four types of flavonoid – quercetin, hesperetin, naringin, and daidzein at different stages of dengue virus type 2 infection and replication cycle. They found that quercetin-type flavonoid should be most effective against DENV-2 in Vero cells.[23]

Table 2 shows that majority of the participants in this survey rated antivirus and antibacterial activities of *Garcinia kola* high. The table also shows that most of the respondents consider *Garcinia kola* having low benefits for relieving food poison, diarrhoea or stomach upset. The Chi-square test results show no association between gender and perceived benefits of the *Garcinia kola* for relieving food poison, diarrhea or stomach upset. This may be because the conditions are not only caused by bacteria and virus; there are also caused by certain parasites, such as giardia intestinal parasite that causes giardiasis.[24,25]

Some scholars argued that consumption of antioxidant-rich plants helps prevent cancer.[26] In other words, major public health benefits could be achieved by substantially increasing consumption of the antioxidant-rich foods.[27] This present study confirms the findings of the studies from the perspective of bitter kola having antioxidant properties. Antioxidants were alluded to earlier protect cellular components from oxidative damage, which is likely to decrease risk of mutations and carcinogenesis and also protect immune cells, allowing them to maintain immune surveillance and response.[26] The mechanisms for antioxidant action include suppression of reactive oxygen species (ROS) formation. ROS is chemically reactive molecules that contain oxygen and form as a natural byproduct of the normal metabolism of oxygen, which has important roles in cell signaling and homeostasis.

Some studies posited that antioxidant suppresses ROS formation either by inhibition of enzymes or by chelating trace elements involved in free radical generation.[28] Similarly, flavonoid, which is one of the phytochemical compounds isolated from bitter kola, inhibits the enzymes involved in ROS.[21] Flavonoids possess many biochemical properties, but the best-described property of almost every group of flavonoids is their capacity to act as antioxidants.[27]

The mechanisms by which flavonoids act to prevent cancer include downregulation of mutant protein, cell cycle arrest, tyrosine kinase inhibition, inhibition of heat shock proteins, estrogen receptor binding capacity, and inhibition of expression of Ras proteins. The mutations of proteins have been claimed to be among the most common genetic abnormalities in human cancers. Inhibition of expression of the p53 was found to result in the arrest of cancer cells in the G2-M phase of the cell cycle.[27] Flavonoids were also found to downregulate expression of mutant p53 protein to nearly undetectable levels in human breast cancer cells.[29] One study demonstrated that the induction of cancer cell apoptosis by flavonoids is associated with their ability to inhibit fatty acid synthase activity.[30]

Several animals' studies demonstrated that *Garcinia kola* has sexual invigoration properties.[31] For example, one study using 70% ethanolic extract of *Garcinia kola* seeds to treat male Wistar rats in a group of eight; two doses of the *G. kola* (200- and 400-mg/kg body weight) were used for the treatment group, while distilled water was administered to the control group. All the treatments were orally administered daily for 28 days. On day 28, mounting frequency (MF), intromission frequency (IF) and expulsion frequency (EF) were quantified during sexual behavior tests. The study found that the rats showed marked aphrodisiac activity with significantly increased sexual behavior parameters compared to controls.[32]

Contrary to the finding of the above study, this current study could not find clear evidence to support the age long acclaimed aphrodisiac potentials of *Garcinia kola.* However, another nonhuman study evaluated the effect of *G. kola* at the dosages of 25, 50 and 100 mg/kg body weight on sexual behavior of male rats. Male rats weighing 215.00 ± 18.58 g were randomized completely into four groups (A–D) of six animals each. Animals in Group A received, orally, 0.5 ml of distilled water only while those in Groups B, C and D received the same volume containing 25, 50 and 100 mg/kg body weight of the seed extract, respectively. MF, IF, frequency genital toilet and EF as well as latencies of mount (ML), intromission and ejaculation were evaluated following the pairing of male rats (1:1) with nonoestrous female rats. The parameters were monitored for the first (15–30 min), second (75–90 min) and third (180195) observatory periods. The levels of testosterone, luteinizing (LH) and follicle-stimulating hormones (FSH) were also determined. Phytochemical screening of the bitter kola extract revealed the presence of saponins (2.78%), cardiac glycosides (0.26%), cardenolides and dienolides (0.24%), flavonoids (1.28%), and steroids (1.14%). The 25 and 100 mg/kg body weight increased ($P < 0.05$) the MF whereas the ML was decreased by all the doses of the extract. MF and ML were not altered during the second observatory period whereas the 50-mg/kg body weight increased these parameters during the third observatory period. Other sexual behavior parameters as well as serum testosterone, FSH, and LH were not significantly altered throughout the observatory periods. The study found that *G. kola* did not have aphrodisiac or libido-enhancing potential, thereby supporting the finding of this current study.[31]

Thus, this study appears to be the first human study to scientifically establish the anti-bacterial, anti-virus and cancer prevention and question the age long acclaimed aphrodisiac (libido) potentials of the *Garcinia kola*.

Study limitations

This study may be limited by the sampling method used. Surveys are dependent on the chosen sampling frame and the representativeness of any survey is entirely dependent on the accuracy of the sample used. This study used random sampling technique, which was intended to give every member in the population frame equal chance of being selected and thereby produce a sample that is representative. Although random sampling is known to be unbiased approach to surveying, sample selection bias may occur. A representation of the full population is skewed when a sample set of the sampling frame is not inclusive enough.[10]

This study may also be limited by the Likert scale used for the data collection. Likert scale questions are limited from the perspective of being unidimensional. In other words, they only gave the respondents certain amount of choices, implying that the space between each possibility is equidistant, which is not always the case in real life. However, the benefits of Likert scale questions outweigh this main limitation. For example, Likert scale is a universal method of collecting data, mainly because it is easy to use by researchers and also easy to understand by respondents. The responses to the questions are easily quantifiable, and since it does not require the respondents to provide a simple and concrete yes or no answer, it does not force them to take a stand on a particular topic but allows them to respond in a degree of agreement.[33]

Finally, these limitations are in no way affect the value and contribution of this study to knowledge. For example, every effort was made to minimize any impact; these limitations might have on the outcome of this study. For example, to minimize sample selection bias, a broad-based sample was selected from the sample frame, and it was ensured that the adequate number of respondents from the sample was received. Much as it was easy to use Likert scale in the data collection, due diligence was employed when working with the quantitative data, such as tabulation of results, plotting of graphs, analysis of results, and drawing of conclusions from the responses. We were guided by Polit and Beck requirement that quantitative data must lend itself to be interpreted in a quantifiable way without allowing for manipulation of respondents' outcomes.[9]

Funding

There was no funding sought for this piece of research, as monetary value can create bias. To further minimize bias, maximum effort was deployed at the sample selection stage to achieve more interest than may be needed as large-scale dropout from the study could have had adverse effect on the study outcome.

Ethical considerations

Ethics is the aspect of moral philosophy, which helps professionals to consider what will be right (ethical) or what will be wrong (unethical) in their action and thus guide their decisions.[34] Some scholars in reference to research ethics stated that ethics is concerned with the degree to which research procedures adhere to professional, legal and social obligations to the study participants.[9] The responsibilities of academic researchers in terms of ethical values include principles of respect for respondent's autonomy, beneficence, non-maleficence and justice which are relevant to the conduct of any research.[35] Although no ethical approval was obtained for this study, these researchers were challenged by these ethical principles and in response consent form and information sheet was designed and handed out to respondents. The information sheet summarized the purpose and justification for the study. It states that participation is entirely voluntary and that data collected will be confidential and anonymous. It also states that by completing the consent form, the participant will be consenting to the study. By explaining these details and offering the opportunity to get in touch if they have any questions, we were able to ensure that participants have enough information to make an informed decision as to whether or not they want to participate in the study. We also ensured that the participant reads the information sheet and signed the consent form before completing the questionnaire. By offering a detailed information sheet and offering support where necessary, we were able to ensure that the participants were motivated rather than coerced.[36]

The participants' names were not used to protect anonymity; each questionnaire was provided with number that made participants identifiable only by the number. Much as physical harm was not an issue in this study, we were mindful of potential psychological consequences needing sensitivity. We, therefore, informed all participants that if they feel that some parts of the questionnaire are too much sensitive for them to respond; they should feel free to withdraw from the study or choose not to answer the questions. The participants were protected from potential adverse effect by ensuring that information that they provide to us was used only for the achievement of this study's goal. In addition, the participants in this study were already ingesting bitter kola as a habit without any known side effect. Thus, their participation in the study is not an unusual behavior and would have taken place anyway.

Conclusion

The finding of this study supports the age long claim of medicinal properties of flavonoids as antibacterial, anticancer, and antiviral agents. This study, also, becomes the first observational human study to question the age long acclaimed aphrodisiac (libido) property of bitter kola and discourages the continued claim or assumption of bitter kola as treatment for food poison, diarrhea or stomach upset.

Finally, the finding of this study is only a small contribution in an effort to address the lack of robust human research on potential health benefits of ingesting bitter kola. Thus, a much larger study is required to reinforce the finding of this study and establish the optimal dosage and bio efficacy of the bitter kola as plant medicine.

Disclaimer

The finding of this study is for educational purpose only and should not be construed as medical advice or prescription. Readers should consult their family doctor or any other qualified health-care professional on any matter relating to their health and well-being. In other words, these researchers and the publishers of the study are not responsible for any act of omission or commission arising from misuse of information contained in this publication.

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Conflicts of interest

There are no conflicts of interest.

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