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Research

Acceptability of flavoured zobo drink (*Hibiscus sabdariffa)* among undergraduate students of the University of Ibadan, Oyo State, Nigeria

Oyewole M. Fauziyah[1]

[1] Department of Agricultural Extension and Rural Development, University of Ibadan, Nigeria

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Abstract

The study was carried out to determine the acceptability of flavoured zobo drink (hibiscus sabdariffa) among undergraduate students of the University of Ibadan, Oyo State, Nigeria. A multistage sampling procedure was used to select 162 respondents for the study and data collected through questionnaires were analysed using both descriptive and inferential statistics. The respondents had mean age of 24±4 years, 56.3% were female, 92.0% were single, 83.3% were Christians and 77.2 were Yorubas. Sensory evaluation of four different recipes for zobo drink was carried out. A significant but negative relationship existed (r=-0.191, p=0.019) between constraints faced by respondents in the consumption of zobo and the level of acceptability of zobo drink. Three of the four recipes for zobo drink had an acceptability rating of 8.7 (mean) out of 9 possible and the other (which had no added flavouring) was 4.0. Nutritionist and beverage manufacturers should educate consumers, particularly undergraduate students about these health benefits through informative labels and marketing campaigns.

INTRODUCTION

Poor dietary habits, increased consumption of sugar-sweetened beverages and effect of excess caloric intake are documented among adolescents and young adults (Oluwafolahan et al. 2022). Sugar-sweetened beverages such as soda, sports drinks and energy drinks are major contributor to excessive sugar consumption among university students, leading to various health problems (Akinbule et al. 2024). Despite the known health risks, many university students consume such beverages regularly as a way to cope with stress, stay awake during long study sessions, or as a habit. Zobo drink is a traditional Nigerian beverage made from dried hibiscus sabdariffa flowers and is a potential substitute for sugar-sweetened beverages due to its natural sweetness, low calorie content, and numerous potential health benefits.

Roselle is well-known for its nutritional and possible therapeutic benefits, as it contains a variety of medically essential substances known as phytochemicals. Many parts of the Roselle plant, including seeds, leaves, fruits, and roots, are utilized in cuisine and herbal medicine as a non-pharmacological therapeutic option. Roselle extracts are used to treat a wide range of medical problems, including heart disease, helminthic disease, and cancer. The plant is also an antioxidant and is used to treat obesity (Suprabha et al. 2023).

Roselle is annual or perennial herbs, semi-shrubs, and shrubs. They can grow up to 2.5 m in height. The stem is smooth or almost smooth, cylindrical, and red in colour. The leaves are up to 15 cm in size, arranged alternately, deeply lobed, with 3–5 or even seven parts. The leaf edge is toothed. The flowers are 8–12 cm wide and occur singly in the leaf axils or terminal. They are white, pale yellow, yellow, rose, or with a maroon eye. The calyx has five large sepals with a collar (epicalyx) of 8 to 12 thin, pointed bracts (or bracteoles) around the base. The calyx is 2 cm wide and about 6 cm long, and it becomes fleshy and red as the fruit matures. Maturing takes about six months. After this time, the capsule breaks and the seeds spill out. The seeds are kidney-shaped, light brown, and up to 5 mm long\. The flower calyces are usually red (rose), but there are also white and purple varieties (Jamrozik et al. 2022).

* Corresponding author: oyemojidola2@gmail.com

According to the Food and Agriculture Organization (FAO) of the United Nations, the world's largest producers of Roselle are China and Thailand. The FAO ranks Roselle from Sudan as of the best quality, but poor packaging and distribution inhibit fruits from this part of the world from gaining global popularity. China and Thailand are the largest producers and control much of the world supply.

The Roselle calyces are and other parts of the plant are rich in polyphenols (anthocyanins, flavonoids, phenolic acids, and tannins), polysaccharides, pectin, non-phenolic organic acids, and carotenoids. The calyces are rich in calcium, magnesium, iron, trace elements and vitamins (Jamrozik et al. 2022).

The most important organic acids in Roselle are hibiscus acid, hydroxycitric acid, malic acid, ascorbic acid, oxalic acid, succinic acid, tartaric acid, arachidic acid, and citric acid. The most important anthocyanins in roselle are delphinidin-3-sambubioside and cyanidin-3-sambubioside (Jamrozik et al. 2022).

Roselle is a multi-task crop, used in chocolates, juice, pudding, fermented drinks, beverages, jellies, wine, and cakes. All are prepared from outer leafy part which is known as calyx (Onyeukwu et al. 2023).

MEDICINAL AND NUTRITIONAL IMPORTANCE

Dried Roselle flowers are used to prepare herbal tea in Sudan known as "Karkade". Liquid extract gotten from the boiled Roselle flowers with some amount of butter and salt is prepared for malaria patients. Leaves and flowers of the *hibiscus sabdariffa* plant are useful and people drink the aqueous decoction which is used to treat with high blood pressure, high cholesterol level and fever. In some nations like Africa, India and Mexico, the mixture of calyces or leaves are utilized for its diuretic, febrifugal, declining the thickness of the blood and reduce choleretic problems. In North African countries, the calyx part of the plant is used to treat sore throats, genital troubles, and cough. The softened leaf pulp can be used on external wounds. When ingested, the *hisbiscus sabdariffa* also serves as a great source of fibre. India and Pakistan extract jute from this plant which is used in preparing linen, ropes, clothes, and netting. Roselle is also a source of oil used in the preparation of scrubs and soaps and for cosmetic purposes in Malaysia (Onyeukwu et al. 2023).

Hibiscus sabdariffa appears to possess an antibacterial property, which may be due to the polyphenolic nature of its flavonoids called gossypetin (Rassem et. al. 2024). Due to the anti-acetylcholinesterase quality in the extract of its calyx, it is sometimes thought to be useful in dementia.

Hibisccus sabdariffa leaves extract known as zobo drink in Nigeria serves as a cheaply utilized drink that substitutes soft drinks due to its nutritional values like reducing sugar, vitamin C and pectin content (Ado, 2022). Zobo drink is traditionally known for its potential health benefits; it is thought to haveantioxidant properties and the ability to regulate blood pressure (Otolowo et al. 2022; Victor-Aduloju et al. 2025).

The simplicity in the production, availability of raw materials in many rural communities as well as the new economic revamping policies of the government has resulted in increased consumption and merchandise of many traditional foods at cottage level in Nigeria, thereby making *hibiscus sabdariffa* (zobo) drink a potential ready local alternative to both alcoholic and non-alcoholic drinks (Oyewo et al. 2019).

Consumption of sugar sweetened beverages has been on the increase *among* children and adolescents and has been implicated (Oladoyinbo et al. 2022). The University of Ibadan undergraduate students have been observed to consume more ready-to-serve bottled drinks because of their tight schedules and not considering the nutritional content of the drink or the effect. It is against the backdrop that the study assessed the level of acceptability through the evaluation of sensory properties of the zobo drink among undergraduates Students of the University of Ibadan, Nigeria and specifically ascertain the respondent's consumption level of zobo drink in the study area and ascertain the respondent's acceptability of improved zobo drink in the study area.

METHODOLOGY

AREAS OF STUDY

The study area is the University of Ibadan, Nigeria, which has over 33,000 students. Presently, there are sixteen faculties in the University of Ibadan.

STUDY SAMPLE

The study's target population includes male and female undergraduate students in the University of Ibadan whether or not they consume zobo drinks. Undergraduate students selected for this study were from the agricultural extension department, which had 210 students; food science and technology which had 219 students, and sociology, which had 380 students. Probability proportionate to size sampling technique was used to select 20% of the students from agricultural extension (42), food science and technology (44) and sociology (76), a total sample size of 162.

METHOD OF DATA COLLECTION

Data for this cross-sectional study were obtained through sensory evaluation and a questionnaire that was tested using content and face validity. It was used to elicit information from respondents on the objectives and medicinal and nutritional benefits of zobo drink, and constraints faced by respondents in consuming it.

The sensory evaluation of the zobo samples was carried out by 30% or 48 of the students. The samples were served cold in opaque cups labelled with codes to assess the aroma, taste, consistency, and overall acceptability, considered by Maina (2018) to be the sensory quality factors that decide the acceptance of food by consumers.

The opaque cups were to conceal the identities of the samples, since the *hibiscus sabdariffa* drink has a reddish colour. Afterwards, the samples for colour assessment were served in transparent glasses. All the scores were based on a 9-point hedonic scale (9 = like extremely, 8 = like very much, 7 = like much greatly, 6 = like slightly, 5= neither like nor dislike, 4 = dislike slightly, 3 = dislike greatly, 2 = dislike very much, 1 = dislike extremely).

DATA ANALYSIS

Frequency distribution, percentages, and means were used as descriptive statistical tools in presenting data, while

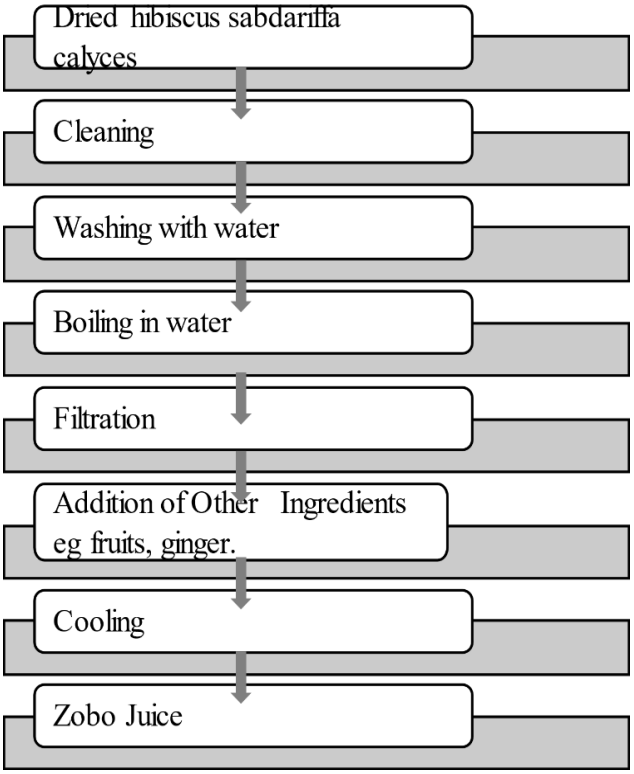
Pearson Product Moment Correlation was used as an inferential statistical tool in testing hypotheses.

PREPARATION AND METHODS

The *hibiscus sabdariffa* was sourced from the Bodija Market of Ibadan. Dry *hibiscus sabdariffa* leaf was purchased, cleaned and sorted. It was washed, boiled, and processed in the Department of Agricultural Extension and Rural Development Home Economics Laboratory. (See Figure 1.) The leaves were boiled with the following formulations:

hibiscus sabdariffa leaves + ginger + powdered mixed fruit flavour (HGP)
hibiscus sabdariffa leaves + pineapple + clove + dates (HPCD)
hibiscus sabdariffa leaves + pineapple + cinnamon + dates (HPCiD)
hibiscus sabdariffa leaves + pineapple + powdered mixed fruit flavour (HPP)
(Powdered Mixed fruit flavour is a ready-made artificial fruit flavour manufactured and packed in sachets by food companies.)

Figure 1. Flow chart for *hibiscus sabdariffa* (zobo) drink production



RESULTS AND DISCUSSION

Table 1 shows that the majority of the respondents were youths (mean age 24±4) and more were female than male students. The fact that most were Yoruba can be attributed to the fact that the study area is in the south-western part of the country where Yoruba are the major dwellers.

Consumption levels of *hibiscus sabdariffa* drink are shown in Table 2. HPP (*= zobo leaves + pineapple + powdered mixed fruit flavour.)* was the most popular, having the highest mean of 2.64. This was followed by HPCD (*HPCD= zobo leaves + pineapple +cloves + dates)* with mean of 2.38 and HGP (*zobo leaves + ginger+ powdered mixed fruit flavour*) (mean =2.37), while they least consumed HPCiD *(zobo leaves + pineapple + cinnamon+ dates* (mean =1.32). Akujobi et al. (2018) reported a higher level of student consumption of zobo drink than of other healthy drinks.

Table 1. Socio-economic characteristics of the respondents (N=162)

Variables	Frequency	Percentage
Age		
18-21	36	22.2
22-25	78	48.1
26-29	42	25.9
30 and above	6	3.7
Sex		
Male	71	43.8
Female	91	56.3
Religion		
Christianity	135	83.3
Islamic	26	16.0
Traditional	1	0.6
Ethnicity		
Yoruba	125	77.2
Igbo	25	15.4
Hausa	2	1.2
Others	10	6.2

ACCEPTABILITY OF FLAVOURED *HIBISCUS SABDARIFFA* (ZOBO) DRINK

The results of the acceptability to the respondent panel (N=48) are shown in Tables 3a-3d. The flavoured zobo drink HPCD had the highest rating (7.81). The majority of participants praised the drink within the "Like Very Much" to "Like Slightly" categories, with only a few articulating strong dislike for it.

Table 2. Consumption of *hibiscus sabdariffa* (zobo) drink (N=162)

Consumption	Seldom	Sometimes	Often	Almost always	Mean*
HGP	43 (26.5)	44 (27.2)	47 (29.0)	28 (17.3)	2.37
HPCD	28 (17.3)	46 (28.4)	48 (29.6)	40 (23.7)	2.38
HPCiD	126 (77.8)	25 (15.4)	6 (3.7)	5 (3.1)	1.32
HPP	30 (18.5)	39 (24.1)	51 (31.5)	42 (25.9)	2.64

**Calculated by assigning seldom=1, sometimes=2, often=3, and almost always=4. HGP= zobo leaves + ginger+ powdered mixed fruit flavour, HPCD= zobo leaves + pineapple +cloves + dates, HPCiD= zobo leaves + pineapple + cinnamon+ dates, HPP= zobo leaves + pineapple + powdered mixed fruit flavour.*

Table 3a. Respondents acceptability of improved *hibiscus sabdariffa* (zobo) drink (HPCD) (n= 48)

Rating Scale	Taste n (%)	Mouth feel n (%)	Appearance n (%)	Aroma n (%)	Overall Acceptability
Like Extremely	-	2 (4.2)	11 (22.9)	3 (6.3)	-
Like Very Much	15 (31.3)	5 (10.4)	24 (50.0)	7 (14.6)	10 (20.8)
Like Moderately	14 (29.2)	15 (31.3)	7 (14.6)	20 (41.7)	25 (52.1)
Like Slightly	14 (29.2)	16 (33.3)	5 (10.4)	8 (16.7)	9 (18.8)
Neither Like nor Dislike	3 (6.3)	8 (16.7)	1 (2.1)	3 (6.3)	1 (2.1)
Dislike Slightly	1 (2.1)	-	-	4 (8.3)	2 (4.2)
Dislike Moderately	-	-	-	3 (6.3)	1 (2.1)
Dislike Very Much	1 (2.1)	1 (2.1)	-	-	-
Dislike Extremely	-	-	-	-	-
Mean	6.73	6.27	7.81	6.48	6.77

Table 3b. Respondents acceptability of improved *hibiscus sabdariffa* (zobo) drink (HPP) (n=48)

Rating Scale	Taste n (%)	Mouth feel n (%)	Appearance n (%)	Aroma n (%)	Overall Acceptability n (%)
Like Extremely	7 (14.6)	7 (14.6)	9 (18.8)	6 (12.5)	7 (14.6)
Like Very Much	1 (2.1)	5 (10.4)	13 (27.1)	7 (14.6)	6 (12.5)
Like Moderately	16 (33.3)	10 (20.8)	12 (25.0)	9 (18.8)	17 (35.4)
Like Slightly	12 (25.0)	17 (34.5)	11 (22.9)	12 (25.0)	14 (29.2)
Neither Like or Dislike	11 (22.9)	4 (8.3)	-	5 (10.4)	4 (8.3)
Dislike Slightly	1 (2.1)	5 (10.4)	1 (2.1)	4 (8.3)	-
Dislike Moderately	-	-	2 (4.2)	2 (4.2)	-
Dislike Very Much	-	-	-	-	-
Dislike Extremely	-	-	-	3 (6.3)	-
Mean	6.54	6.56	7.19	6.15	6.96

Table 3c. Respondents acceptability of improved *hibiscus sabdariffa* (zobo) drink (HGP) (n=48)

Rating Scale	Taste n (%)	Mouth feel n (%)	Appearance n (%)	Aroma n (%)	Overall Acceptability n (%)
Like Extremely	1 (2.1)	4 (8.3)	6 (12.5)	8 (16.7)	2 (4.2)
Like Very Much	14 (29.2)	8 (16.7)	12 (25.0)	8 (16.7)	17 (35.4)
Like Moderately	10 (20.8)	8 (16.7)	11 (22.9)	13 (27.1)	12 (25.0)
Like Slightly	5 (10.4)	14 (29.2)	16 (33.3)	12 (25.0)	5 (10.4)
Neither Like or Dislike	4 (8.3)	3 (6.3)	3 (6.3)	6 (12.5)	7 (14.6)
Dislike Slightly	9 (18.8)	9 (18.8)	-	1 (2.1)	4 (8.3)
Dislike Moderately	2 (4.2)	2 (4.2)	-	-	1 (2.1)
Dislike Very Much	3 (6.3)	-	-	-	-
Dislike Extremely	-	-	-	-	-
Mean	6.02	6.19	7.04	6.94	6.71

Table 3d. Respondents acceptability of flavoured *hibiscus sabdariffa* (zobo) drink (HPCID) (n=48)

Rating Scale	Taste n (%)	Mouth feel n (%)	Appearance n (%)	Aroma n (%)	Overall Acceptability n (%)
Like Extremely	6 (12.5)	5 (10.4)	9 (18.8)	4 (8.3)	5 (10.4)
Like Very Much	4 (8.3)	7 (14.6)	2 (4.2)	6 (12.5)	4 (8.3)
Like Moderately	3 (6.3)	4 (8.3)	21 (43.8)	3 (6.3)	2 (4.2)
Like Slightly	7 (14.6)	5 (10.4)	8 (16.7)	5 (10.4)	9 (18.8)
Neither Like or Dislike	6 (12.5)	2 (4.2)	4 (8.3)	11 (22.9)	11 (22.9)
Dislike Slightly	5 (10.4)	14 (29.2)	3 (6.3)	4 (8.3)	5 (10.4)
Dislike Moderately	4 (8.3)	2 (4.2)	-	7 (14.6)	2 (4.2)
Dislike Very Much	12 (25.0)	8 (16.7)	-	4 (8.3)	6 (12.5)
Dislike Extremely	1 (2.1)	1 (2.1)	1 (2.1)	4 (8.3)	4 (8.3)
Mean	4.92	5.19	5.10	4.98	4.96

DIFFERENCES IN ACCEPTABILITY OF THE FOUR FLAVOURED ZOBO DRINKS

Table 4 shows the analysis of variance of the differences in the level of acceptability of the four recipes for improved zobo drink through the evaluation of its organoleptic properties. These differences align with Maina (2018) who opined that sensory quality attributes such as taste, appearance, and aroma are the factors that decide the acceptance of food by consumers.

TASTE

The superiority of the taste of HGP over HPC can be attributed to the addition of the artificial flavour in the powdered mix which is more potent, unlike HPC, which has a more subtle sweetness. Romagny et al. (2017) found that people tend to easily accept and consume most of the food that they previously did not prefer consuming mainly if these new foods are sweet.

Table 4. Test of difference (ANOVA) in the acceptability of *hibiscus sabdariffa* zobo drinks

Samples	Taste	Mouth feel	Appearance	Aroma	Overall acceptance
HPC	1.99±0.81	1.60±0.05	4.08±0.45	6.28±0.09	3.49±0.42
HPP	2.91±0.87	3.57±0.37	1.85±0.96	0.53±0.09	2.21±0.69
HGP	5.22±0.07	0.28±0.42	5.32±0.10	4.66±0.42	3.87±0.39
HPCiD	3.02±0.68	0.65±0.41	1.79±0.459	1.55±0.29	1.75±0.32
F-value	1.830	3.230	2.619	2.450	9.144
P-value	0.156	0.031	0.063	0.076	0.036

Key: *Each parameter was scored on a 9-point scale where 1 represents "dislike extremely" and 9 "like extremely."*
S=significant difference based on ANOVA test, NS= no significant difference. HPC= zobo leaves + pineapple + dates, HPP= zobo leaves + pineapple + powdered mixed fruit flavour, HGP= zobo leaves + ginger+ powdered mixed fruit flavour, HPCiD= zobo leaves + pineapple + cinnamon+ dates

MOUTH-FEEL

The two samples containing pineapple, HPP and HCC, had the best-rated mouth-feel. This aligns with the research of James et al. (2015) who concluded that there was high acceptability towards jam samples that had a higher proportion of pineapple.

APPEARANCE

HGP had the highest acceptability. This agrees with the research work of Opoku et al. (2023) who reported acceptability of a sample tea due to higher percentage of ginger.

AROMA

HPC is ranked the highest. Perhaps this is because dates have a pleasing aroma. However, HPCD also has dates, as well as cinnamon, which is usually considered to have a pleasing aroma. We do not know why it received such a lower score.

CONSTRAINTS FACED BY RESPONDENTS IN THE CONSUMPTION OF *Hibiscus sabdariffa* (ZOBO) DRINK

Table 5 indicates that constraints were faced by our respondents in the consumption of zobo drink. Perishability was the largest constraint, with a mean of 1.04. This corroborates reports of Oyewo et al. (2019) that poor storage facilities, hygienic safety and packaging were major constraints in the consumption of zobo drink.

Table 5. Constraints faced by respondents in the consumption of *hibiscus sabdariffa* (zobo) drink

Constraints	Not a constraint	Mild constraint	Severe constraint	Mean	Rank
Cost	116 (71.6)	38 (23.5)	8 (4.9)	0.33	6th
Taste	57 (35.2)	67 (41.4)	38 (23.5)	0.88	3rd
Packaging	51 (31.5)	71 (43.8)	40 (24.7)	0.93	2nd
Availability	63 (38.9)	78 (48.1)	21 (13.0)	0.74	4th
Perishability	51 (31.5)	52 (32.1)	59 (36.4)	1.04	1st
Aroma	71 (43.8)	68 (42.0)	23 (14.2)	0.70	5th

**The respondents' score on constraints in the consumption of hibiscus sabdariffa (zobo) drink were obtained by using a 3-point scale of ' Severe =2', 'Mild =1' and 'not a constraint =0'.*

CONCLUSION

The most accepted improved zobo drink by respondents was HPCD *= hibiscus sabdariffa* leaves + pineapple + cinnamon+ dates.

RECOMMENDATIONS

Creating awareness about the nutritional content of zobo may further enhance its acceptability among individuals. Beverage manufacturers should pay attention to packaging to make the product visually appealing and attractive to the target audience. Attractive labels, clear branding, and informative product information can contribute to enhancing the overall acceptability of zobo drink.

AUTHOR CONTRIBUTIONS

The sole author conceived and designed the analysis; collected the data; performed the analysis, Wrote and revised the paper.

CONFLICT OF INTEREST

The authors declare that they have no other potential conflicts of interest.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN SCIENTIFIC WRITING

Nothing to disclose.

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