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RESEARCH ARTICLE

CHEMICAL COMPOSITION AND ORGANOLEPTIC EVALUATION OF FUNCTIONAL DRINK (ZOBO) SWEETENED WITH PINEAPPLE AND ORANGE JUICE

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ABSTRACT

This paper examined chemical and organoleptic assessment of functional Zobo drink. Traditionally, it is made by steeping dried *Hibiscus sabdariffa* calyces in water which has been flavored with spices. Orange and pineapple were added as sweetener. Four products were developed (Z= 100% zobo, Z= zobo with sugar, ZP=80% zobo with 20% pineapple, ZO = 80% zobo with 20% 0range, ZPO= 80% zobo with 15%pineapple and 5% orange). Chemical analysis and sensory evaluation were performed. After the data analysis, it was discovered that Zobo drink's moisture level varied between 86.58% and 93.62%. The moisture level of sample ZPO was higher than sample Z (control). With the exception of ZPO (1.82%±0.02), all the products had low ash contents, with sample Z (0.73%±0.02), ZP (0.79%±0.02), and ZO (0.74%±0.01). The fat content was 0.39%±0.01 for sample ZPO, 0.36%±0.01 ZO, 0.37%±0.01 ZP, and 0.38%±0.01 sample Z. Sample Z had the highest carbohydrate content (11.23%±0.05). The color of the zobo drink indicated that orange and pineapple could positively enhance the drink's color quality. The color quality of the pineapple/orange products were superior. Significant differences ($p>0.05$) did not exist among ZPO (4.80±0.45), ZP (4.80±0.45), and ZO (4.80±0.45). Sample Z color quality was the lowest (3.80±0.44). ZPO (4.60±0.89) had the best flavor, followed by ZP (4.40±0.54) and ZO (4.40±0.54). The calcium content varied between 162.01 to 178.26%. Sample Z had the highest calcium (178.26mg/L±0.01), followed by ZPO (164.02mg/L), ZO (162.41mg/l±0.01), and ZP (162mg/L±0.01). Sample ZO had the highest potassium content (534.02mg/L±0.02). The pH values varied between 3.14 to 3.51. All the products had extremely low pH readings, which indicated their shelf stability. Sample Z (3.42±0.02), ZP (3.51±0.02), ZO (3.41±0.02), and ZPO (3.50±0.02) are the products' pH values. The most accepted combination was 80% Zobo, 15% pineapple, and 5% orange juice because of its superior colour quality, nutritional value and longer shelf life.

KEYWORDS

Zobo, pineapple, flavor, juice, drink

1. INTRODUCTION

Nigeria and other West African nations have long enjoyed the traditional drink known as zobo, which is made from dark-red hibiscus (Olawale-Olakunle *et al.,* 2023). Dried *Hibiscus sabdariffa* calyces are traditionally steeped in sugar-sweetened water scented with cloves, ginger, or other spices (Akujobi, *et al.,* 2018). The other spices indicated are occasionally supplemented with natural flavorings like orange, pineapple, and watermelon (S. Kehinde and a. Augustine, 2022). In addition to its invigorating flavor and vivid color, zobo is well-known for its possible health advantages, which include anti-inflammatory and antioxidant qualities. It is appropriate for making soft drinks because of these qualities (Salami and Afolayan, 2020).

Hibiscus sabdariffa (Roselle), known as "Isapa" in Yoruba, is a significant vegetable that is rich in naturally occurring antioxidant and antiviral chemicals (Aworh, 2014). According to the study, *Hibiscus sabdariffa* is thought to have originated in East Africa and is a member of the super order Malvaceae (Ilondu and Iloh, 2007). Due to the high concentration of polyphenolic compounds and anthocyanins with significant health benefits, there is reliable evidence regarding the culinary and medicinal qualities of *Hibiscus sabdariffa* leaf and calyx extracts (Oboh *et al.,* 2011; Okeeke *et al.,* 2015; Adeoye *et al.,* 2019; Zhen *et al.,* 2016).

Many tribes around the world, like the Yoruba tribe in Nigeria, use the green leaf of the *H. sabdariffa* plant to make soup (Zhen *et al.,* 2016). However, the dried calyces of the red cultivars are mostly used to produce cool Zobo beverage or Soborodo, which came from the north but is now enjoyed by all Nigerian tribes (Adeooye *et al.,* 2019).

According to the study, a number of investigations into the nutritional and therapeutic properties of the Zobo beverage have been conducted. 84.5% water, 1.99 mg protein, 0.1 g fat, 12.3 g carbohydrate, 2.3 g fiber, 1.2 g ash, 1.72 mg calcium, 57 mg phosphorus, 2.9 mg iron, 300 g/ 100 g of calyces contained 14 mg of vitamin C and vitamin A (Salami and Afolayan, 2020). Additionally, it was shown that roselle calyces were rich in minerals such as vitamins, especially vitamin C, it is also rich in protein, carbohydrates, and antioxidants (Etemadi Razlighi *et al.,* 2023).

Furthermore, it has been discovered that roselle extracts include vitamins, minerals, and phytochemicals (Keshinro *et al.,* 2023). To improve Zobo's nutritional content and possible health advantages, researchers have shown concern in supplementing it with fruit juices (Idowu-Adebayo et al., 2021). Juices from oranges (*Citrus sinensis*) and pineapples (*Ananas comosus*) are frequently consumed and are high in vital nutrients and bioactive substances. Plants contain bioactive substances called phytochemicals, which have been linked to a host of health advantages.

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The phytochemical in Zobo could be considerably improved by adding pineapple and orange juice. Vitamin C, a strong antioxidant, and bromelain, are abundant in pineapple (Nath et al., 2023).

In addition, flavonoids are contained in orange juice which have anti-inflammatory and antioxidant properties, especially naringenin and hesperidin. Also, Vitamins C, A and some minerals (Ca, K, Mg) are included (Uthman and Garba, 2023; Hosawi and 2023). In order to increase Zobo's nutritional content and provide distinctive aromas and sweetness for maximum consumer appeal/acceptance, these fruit juices were incorporated.

2. Materials and Methods

2.1 Material source and Zobo drinks Preparation

At the Benin Market in Edo State, Nigeria, dried Zobo leaves were bought with ginger, cloves, alligator pepper, sugar, pineapple, and oranges. Dirt and other unnecessary items were picked out by hand. Cloves, ginger, and dried Zobo leaves were selected. The spices were ground into a powder in a blender. After washing the pineapple fruit under running water, a clean knife was used to peel it, chopped into pieces, blended, then sieved. The extraction of the juice was done using a juice extractor.

With a few minor adjustments, the Zobo beverage was produced in line with the technique outlined by (Akujobi, *et al.,* 2018). Water added to Zobo leaves and put in a kettle to boil for five minutes. For 5 minute, the cloves and ginger were cooked. The Zobo drink was cooled when the pot was taken off the stove and then filtered through a muslin cloth.

Pure Zobo drink plus sugar represented sample Z (control), ZP 80% pure Zobo and 20% pineapple juice, ZO 80% pure Zobo drink and 20% orange juice and ZPO 80% pure Zobo drink, 15% pineapple juice, and 5% orange juice. Proximate analysis: these were determined by using standard methods (AOAC, 2000).

2.2 Anti-nutrient Determination

The alkaloid content and saponin concentrations were assessed using the methodology outlined by (Harborne and Harborne, 1973). To calculate the phytate content, the procedure was used (Ola and Oboh, 2000). Using the methodology used, oxalate was measured by (Ahmad *et al.,* 2022). The method was used to determine the tannin content (Tiencheu *et al.,* 2021).

2.3 Mineral content determination

The approved method 925.10, which calls for the dry ashing operation, was used to identify the mineral elements (AOAC, 2003). A 5 ml sample was pre-ashed by evaporating it on a Bunsen flame in a thoroughly cleaned porcelain crucible. Sample was subsequently dried in a Muffle furnace at 550 degrees Celsius. The resulting grayish-white ash was dissolved in 5milliliters of HNO3/HCl (1:1) and heated on a hot plate until the solution's boiling point was reached, at which point brown odors vanished. 5milliliters distilled water added to the leftover material in each crucible, and the mixture heated to a colorless solution. After passing through a Whatman No. 42 filter paper, the mineral solution in the c rucible was poured into 100 ml volumetric flask, and the volume adjusted with distilled water. Using acetylene gas and a Perkin-Elmer Atomic Absorption Spectrophotometer (AAS) model-A Analyst 200, the elements Ca, Mg, Fe, and Zn were identified. The JANEWAY PF P7 was used for Flame Photometry evaluation to assess sodium (Na) and potassium (K).

2..4 Calculating the amount of vitamin C

The standard technique (967.21) was used to assess the sample's vitamin C content. 25 ml of the filtrate was pipette into a 100 ml titration vessel with 1 ml of starch solution (0.5 % w/v) added as indicator after 50 mililiters (50 ml) of each Zobo drink sample had been filtered into a sterile 100 ml volumetric flask (AOAC, 2003). A 100 ml graduated burette containing a 0.005M iodine solution used to titrate the sample. The first was a dark blue-black color caused by the creation of the starch-iodine combination was determined as titration's endpoint. Vitamin C in the sample was determined after the analysis was conducted three times.

2.5 Determination of pH

A pH meter (JANEWAY Instrument, Model 3510, UK) was used to measure the pH of each beverage. Before the pH meter's bulb end was dipped for measurement, fifty milliliters (50 ml) of each Zobo drink sample were thoroughly mixed for five minutes. Prior to being used to determine the sensitivity, the pH meter was calibrated with buffer solution at pH 7. With just minor adjustments to the equipment and sample size, the approach was implemented of (Osundahunsi, 2003).

2.6 Determination of titratable acidity (TTA)

Using phenolphthalein solution as an indicator, 10 ml of the sample was thoroughly mixed for 5 minutes before being titrated with 0.1N NaOH to measure the total titratable acidity (TTA) using the standard method (942.15). TTA was given as 1 ml 0.1N 0.009 g lactic acid, or % lactic acid (w/v) (AOAC, 2000).

2.7 Identification and quantitative analysis of tannins

Aqueous extract 0.5 g mixed with 10 milliliters (10ml) of bromine water. The presence of tannins was detected by the staining of the bromine water, which were then measured using the titrimetric method in accordance with the official methods 30.018; 30.019, which modified (Marin et al., 2009; Gul *et al.,* 2017; AOAC, 2003). The change was that since the Zobo drink samples were aqueous extracts of the components utilized, filtered with Whatman No. 1 filter paper.

$$\% \text{ Phytic acid} = \frac{(\text{Titre value} \times 0.0019 \times 100)}{2}$$

2.8 Determination of phytate

In order to determine the phytate content, the (Bello *et al.,* 2013) method was modified to require no further extraction. After diluting 50ml of sample with 100ml of distilled water, it was filtered into a 250ml beaker. After that, a standard iron (III) chloride solution containing 0.00195 g iron per milliliter was used to titrate 10ml of a 0.3% ammonium thiocyanate solution as an indicator. For five minutes, the terminus was seen to be yellow.

2.9 Sensory evaluation

20 panelists from Food Science Department, who are knowledgeable about taste, consistency, and color, participated in sensory evaluation. A hedonic scale of 5 points was used to rate their preference. Five means "extremely liked," four "moderately liked," three "slightly liked," two "neither liked nor disliked," and one "strongly disliked." The samples were served in clear disposable cups. There was bottle water available for mouthwash in between sampling.

2.10 Statistical Analysis

Using SPSS 20.0 Software Inc. USA, the data were analyzed for variance (ANOVA) and Duncan's multiple range test (DMRT) to separate means at $p<0.05$, significance level.

3. Results and Discussion

Table 1 displayed the nutritional composition of Zobo sweetened with pineapple/orange juice. The proximate composition of Zobo drink flavored with orange and pineapple juice varied significantly ($p<0.05$), according to analysis of variance. The Zobo drink's moisture content varied between 86.58% and 93.62%. The moisture level of zobo orange and pineapple juice was higher than that of 100% zobo without these flavors. When it came to moisture content, ZPO had the greatest (93.62%+0.02), followed by ZP (92.52%+0.02), ZO (90.13%+0.02), and Z (86.58%+0.02). As might be expected from a juice, all of the items showed a high moisture content. In addition, the moisture content obtained was within the 85 to 95 percent range that reported (Ahmed and Sohail, 2020; Kolo *et al.,* 2022). The findings demonstrated that the moisture content increased with increasing amount of orange and pineapple juice added. The moisture content found in this investigation was comparable to what reported (Akujobi, *et al.,* 2018). With the exception of ZPO (1.82%±0.02), all of the products had low ash contents. Z (0.73%+0.02), ZP (0.79%±0.02), and ZO (0.74%±0.01). The lipid content of the Zobo drink was significantly ($p<0.05$) reduced. ZPO, ZO, and ZP had fat contents of 0.39%+0.01, 0.36%+0.01, 0.37%+0.01, and 0.38%±0.01, respectively. Zobo's low fat content made it appropriate for those who want to reduce their body weight and for those who suffer from disorders linked to fat. It was found that adding orange and pineapple to the Zobo drink increased its protein content. Protein contents were 1.64%±0.01 for ZPO, 1.62%±0.01 ZO, 1.58%±0.01 ZP, and 1.02%±0.01 Z. Protein is essential for repairing damaged tissues. The beverage contained fiber, ZPO had the highest (0.33%±0.01). Fiber is essential to our diet because it helps with digestion and nutrition absorption. The percentage of carbohydrates ranged from 2.21 to 11.23%. Z had the highest carbohydrates (11.23%+0.05), and it differed considerably ($p<0.05$) from Zobo with pineapple/orange juice.

Table 1: Proximate composition of Zobo drink flavoured/sweetened with orange and pineapple juice

Proximate composition (%)						
Sample	**Moisture**	**Ash**	**Fat**	**Protein**	**Fibre**	**CHO**
Z	$86.58^{d}\pm0.02$	$0.73^{c}\pm0.02$	$0.38^{ab}\pm0.01$	$1.02^{d}\pm0.01$	$0.06^{d}\pm0.01$	$11.23^{a}\pm0.05$
ZP	$92.52^{b}\pm0.02$	$0.79^{b}\pm0.02$	$0.37^{bc}\pm0.01$	$1.58^{c}\pm0.01$	$0.13^{c}\pm0.01$	$4.61^{c}\pm0.05$
ZO	$90.13^{c}\pm0.02$	$0.74^{c}\pm0.01$	$0.36^{c}\pm0.01$	$1.62^{b}\pm0.01$	$0.19^{b}\pm0.01$	$6.96^{b}\pm0.04$
ZPO	$93.62^{a}\pm0.02$	$1.82^{a}\pm0.02$	$0.39^{a}\pm0.01$	$1.64^{a}\pm0.01$	$0.33^{a}\pm0.01$	$2.21^{d}\pm0.02$

Means with the same superscript down the colmn are not significantly different (p>0.05). ± Standard deviation. Z=100% Zobo, ZP=80%Zobo 20% pineapple and 0% orange juice, ZO=80% Zobo and 0% pineapple and 20% orange juice, ZPO 80% Zobo 15% pineapple and 5% orange juice.

Table 2 displayed the mineral composition of the Zobo beverage. The mineral composition showed substantial differences (p<0.05). The calcium content varied between 162.01 to 178.26%. Z has the highest calcium (178.26 mg/L±0.01), followed by ZPO (164.02mg/L±0.01), ZO (162.41 mg/l±0.01), and ZP (162mg/L±0.01). Calcium is a co-factor in the catalysis of certain enzymes and is required for growth and healthy bones and teeth (Achi *et al.,* 2017). ZP had the highest magnesium content (121.35mg/L±0.01). Magnesium keeps the heartbeat regular, promotes healthy immune system, helps maintain proper nerve and muscle function, and keeps bones strong (Witkowski *et al.,* 2011).

ZO had the greatest potassium content (534.02mg/L±0.02); Potassium helps keep bodily fluids balanced with sodium to avoid hypertension (Otolowo and Olapade, 2018). The highest concentrations of sodium (53.06mg/L±0.01), iron (4.72mg/L±0.01), and zinc (7.07mg/L±0.01) were identified in ZPO. Zinc is a mineral that is essential for the growth and operation of immune cells, (Achi et al., 2017). Products with pineapple or oranges showed higher levels of vitamin C in this study. ZPO had the highest (1.31 mg/100g±0.01). There was obvious similarity (p>0.05) in the vitamin C levels between ZP (1.24 mg/100g±0.01) and ZO (1.24 mg/100g±0.01). Vitamin C is essential for human health.

Strong antioxidants like vitamin C can boost the body's natural defenses against free radicals by strengthening the immune system and making it easier for the intestines to absorb iron from foodreported that vitamin C is abundant in Zobo, while reported ascorbic acid (vitamin C) in various *Hibiscus sabdariffa* types (Babalola *et al.,* 2001; Button, 2004; Kathleen, 2015). The iron content varied between 4.61 and 4.72 mg/L. Z had the highest iron levels (4.72 mg/L±0.01). Iron helps the immune system and is necessary for the production of hemoglobin and blood (Weiss, 2002).

Table 2: Mineral composition of Zobo drink flavoured/sweetened with pineapple and orange juice

Mineral composition (mg/L)							
Sample	**Calcium**	**Magnesium**	**Potassium**	**Sodium**	**Iron**	**Zinc**	**Vit. C(mg/100g)**
Z	$178.26^{a}\pm0.01$	$102.01^{d}\pm0.01$	$519.21^{d}\pm0.01$	$43.21^{d}\pm0.01$	$4.72^{a}\pm0.01$	$7.01^{c}\pm0.01$	$0.31^{c}\pm0.01$
ZP	$162.01^{d}\pm0.01$	$121.35^{a}\pm0.01$	$532.01^{c}\pm0.01$	$52.03^{b}\pm0.01$	$4.68^{b}\pm0.01$	$7.04^{b}\pm0.01$	$1.24^{b}\pm0.01$
ZO	$162.41^{c}\pm0.01$	$121.22^{b}\pm0.01$	$534.02^{a}\pm0.02$	$51.01^{c}\pm0.01$	$4.61^{d}\pm0.01$	$7.07^{a}\pm0.01$	$1.24^{b}\pm0.01$
ZPO	$164.02^{b}\pm0.01$	$120.24^{c}\pm0.01$	$533.61^{b}\pm0.01$	$53.06^{a}\pm0.01$	$4.67^{c}\pm0.01$	$7.04^{b}\pm0.01$	$1.31^{a}\pm0.01$

Means with the same superscript down the column are not significantly different (p>0.05). ± Standard deviation Z=100% Zobo, ZP=80%Zobo 20% pineapple and 0% orange juice, ZO=80% Zobo and 0% pineapple and 20% orange juice, 80% Zobo 15% pineapple and 5% orange juice.

Table 3 displays the anti-nutritional makeup of the Zobo drink that was flavored with pineapple or orange juice. The findings indicated that, in addition to the extremely low content of anti-nutrient, there were obvious variations (p<0.05) in Zobo drink flavorings made with pineapple or orange juice. Tanin levels in this study ranges from 0.31 to 0.71 mg/100g. ZP has the highest tannin (0.71 mg/100g±0.01), followed by ZPO (0.52 mg/100g±0.01), ZO (0.41mg/100g±0.01), and Z (0.31 mg/100g±0.01). According to Akujobi *et al*. (2018), tannins causes hindrance to the absorption and digestibility of iron and proteins. Thus, the minimal amount discovered suggests that Zobo flavored with orange and pineapple juice is safe to consume. The range of the saponin was 4.01 to 5.21 mg/100g. It has been demonstrated that foods with saponins have antiviral and antifungal qualities (S. Kehinde and I. Augustine, 2022). This may be the cause of Zobo beverages' several-day shelf life at room temperature (Udensi *et al.,* 2020). The range of phytotate was 0.71 to 1.18 mg/100g. All of the samples had low phytate concentrations. Phytate impair digestion, reduce mineral bioavailability, and impede growth, this is not advantageous for consumers (Satheesh and Workneh, 2020). The ranges for alkaloids and oxalate were 0.32 to 0.41 mg/100g and 0.24 to 0.32 mg/100g, respectively. When taken, alkaloids are said to have certain therapeutic properties and to stimulate the body (Kehinde and Augustine, 2022).

Table 3: Aniti –Nutrient of Zobo drink flavoured/sweetened with pineapple and orange juice

Anti-nutrient (mg/100g)					
Sample	**Tanin**	**Saponin**	**Phytate**	**Oxalate**	**Alkaloid**
Z	$0.31^{d}\pm0.01$	$5.21^{a}\pm0.01$	$0.74^{c}\pm0.01$	$0.31^{a}\pm0.01$	$0.41^{a}\pm0.01$
ZP	$0.71^{a}\pm0.01$	$4.58^{b}\pm0.01$	$0.71^{d}\pm0.01$	$0.24^{b}\pm0.01$	$0.35^{b}\pm0.01$
ZO	$0.41^{c}\pm0.01$	$4.01^{d}\pm0.01$	$1.18^{a}\pm0.01$	$0.31^{a}\pm0.01$	$0.32^{c}\pm0.01$
ZPO	$0.52^{b}\pm0.01$	$4.22^{c}\pm0.01$	$0.92^{b}\pm0.01$	$0.32^{a}\pm0.01$	$0.32^{c}\pm0.01$

Means with the same superscript down the column are not significantly different (p>0.05). ± Standard deviation Z=100% Zobo, ZP=80%Zobo 20% pineapple and 0% orange juice, ZO=80% Zobo and 0% pineapple and 20% orange juice, 80% Zobo 15% pineapple and 5% orange juice

Table 4: Sensory evaluation of Zobo drink flavoured/sweetened with pineapple and orange juice

Sensory attributes					
Sample	**Colour**	**Taste**	**Flavour**	**Consistency**	**Acceptance**
Z	$3.80^{b}\pm0.44$	$3.40^{b}\pm0.54$	$3.20^{b}\pm0.45$	$4.00^{b}\pm0.01$	$4.00^{b}\pm0.01$
ZP	$4.80^{a}\pm0.45$	$4.40^{a}\pm0.54$	$4.80^{a}\pm0.45$	$5.00^{a}\pm0.01$	$3.00^{c}\pm0.01$
ZO	$4.80^{a}\pm0.45$	$4.40^{a}\pm0.54$	$4.40^{a}\pm0.54$	$5.00^{a}\pm0.01$	$3.00^{c}\pm0.01$
ZPO	$4.80^{a}\pm0.45$	$4.60^{a}\pm0.89$	$4.80^{a}\pm0.44$	$4.60^{a}\pm0.89$	$4.80^{a}\pm0.44$

Means with the same superscript down the column are not significantly different (p>0.05). ± Standard deviation. Z=100% Zobo, ZP=80%Zobo 20% pineapple and 0% orange juice, ZO=80% Zobo and 0% pineapple and 20% orange juice, 80% Zobo 15% pineapple and 5% orange juice.

The sensory evaluation of the Zobo drink yielded significant results (p<0.05). The color of the zobo drink demonstrated that orange or pineapple could influence the drink's color quality. The colour quality of the pineapple/orange product was superior. There was obvious similarity among ZPO (4.80±0.45), ZP (4.80±0.45), and ZO (4.80±0.45) in colour. In Z, the color quality was the lowest (3.80±0.44). Additionally, the flavor of Zobo was enhanced by the addition of pineapple and orange. ZPO (4.60±0.89) had the best flavor, followed by ZP (4.40±0.54) and ZO (4.40±0.54), all of which did not differ substantially (p>0.05). Products with orange or pineapple had a better consistency and more flavor than those without. The consistency and flavor of products ZP, ZO, and ZPO did not differ significantly (p>0.05). Overall acceptance indicated that the pineapple and orange juice combination was the most accepted. The most accepted ZPO (4.80±0.44) was followed by Z (4.00±0.01), while ZO (3.00±0.01) and ZP (3.00±0.01) did not differ substantially (p>0.05). It was clear from the data that people really liked Zobo with pineapple/ orange juice.

The pH and titratable acidity (TTA) of zobo flavored with pineapple or orange juice differed considerably (p<0.05), as shown in Figure 2. The pH ranged from 3.14 - 3.51. All products had extremely low pH readings, which indicated their shelf stability. Z (3.42±0.02), ZP (3.51±0.02), ZO (3.41±0.02), and ZPO (3.50±0.02) are the products' pH values. It was shown that the TTA steadily drops as the pH rises. The TTA varied between 1.04 and 1.10. Z = 1.10±0.02, ZPO (1.08±0.02), ZO (1.04±0.02), and ZP (1.06±0.02) were found to have TTAs of 1.10±0.02.

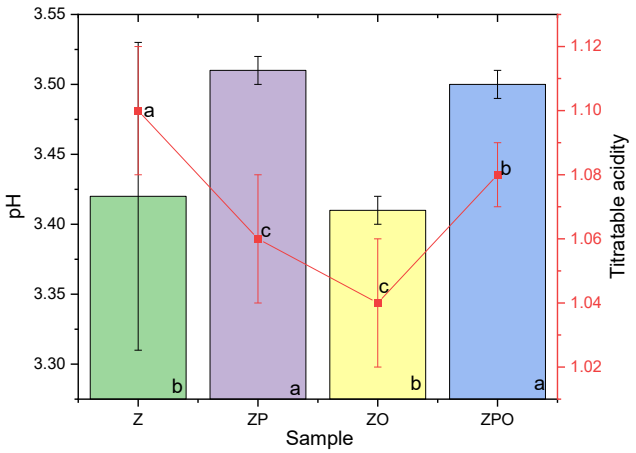

Figure 2: pH and Titratable acidity of Zobo drink

4. Conclusion

According to the research findings, Zobo beverages should be sweetened/flavored with pineapple and orange juices to improve their nutritional value and acceptability. The zobo drink had very low levels of anti-nutrients, and the pH was also very low, indicating that they were shelf stable. A varied diet that includes vital nutrients and possible health advantages could be achieved by consuming zobo enhanced with orange and pineapple juice.

Conflict of Interest

No conflict of interest reported by the authors.

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