Zobo (Roselle), a popular traditional Nigerian beverage, is known for its rich taste and potential health benefits. Recently, there has been growing interest in enhancing the nutritional value of Zobo through the addition of fruit juices. This research aimed to assess the anti-nutritional and nutritional composition of Zobo enriched with pineapple and orange juice. The results revealed that the incorporation of pineapple and orange juice significantly increased the moisture content as expected of a juice product. Crude fibre and carbohydrates were found to increase as pineapple and orange were added. All anti-nutrient contents were also found to be low in all samples. Notably, saponin concentrations in Zobo samples were found to be 5.70±0.02, 4.81±0.09, 4.09±0.03, 4.38±0.54. The presence of Saponin in food is known to kill protozoa and mollusks, and also act as antifungal and antiviral agents. Furthermore, indicates that the panelists accepted the four samples in all of the attributes except sample D. These findings support the potential of Zobo enriched with pineapple and orange juice as a functional beverage with enhanced nutritional qualities.

**Keywords:** Nutritional Qualities; Phytochemical Compositions; Pineapple; Orange; Zobo Drinks

### 1.0 INTRODUCTION

Zobo, a dark-red hibiscus-based beverage, is a popular traditional drink in Nigeria and other West African countries (Olawale-olakanle et al., 2023). It is traditionally prepared by steeping dried calyces of *Hibiscus sabdariffa* in water, often sweetened with sugar and spiced with ginger, cloves, or other flavorings (Akujobi et al., 2018). Natural flavorings such as orange, pineapple, and watermelon are sometimes added in addition to the other spices mentioned (Kehinde and Augustine, 2022). Zobo is well-known for its energizing flavor, vibrant color, and potential health benefits, which include antioxidant and anti-inflammatory properties. In light of these characteristics, it is suitable for the production of soft drinks (Salami and Afolayan, 2020).

As reported by (Salami and Afolayan, 2020), several studies have been carried out on the nutritional and medicinal functions of the Zobo drink. 100 g of calyces contained 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 vitamin A, and 14 mg vitamin C. Roselle calyces were also discovered to be high in vitamins (particularly vitamin C), carbohydrate, protein, antioxidants, and minerals (Etemadi Razlighi et al., 2023). In addition, the extracts of roselle have been reported to contain phytochemicals, vitamins, and several minerals (Keshinro et al., 2023). However, there has been a growing interest in fortifying Zobo with fruit juices to enhance its nutritional composition and potential health benefits (Idowu-Adebayo et al., 2021, Idowu-Adebayo et al., 2021). Pineapple (*Ananas comosus*) and orange (*Citrus sinensis*) juices are commonly consumed and rich in essential nutrients and bioactive compounds. Phytochemicals are bioactive compounds found in plants that have been associated with numerous health benefits. The incorporation of pineapple and orange juice into Zobo can significantly enhance its phytochemical composition. Pineapple is a rich source of bromelain, a proteolytic enzyme with anti-inflammatory properties, and vitamin C, a potent antioxidant (Nath et al., 2023). Similarly, Orange juice is abundant in flavonoids, particularly hesperidin, and naringenin, which exhibit antioxidant and anti-inflammatory activities. It also
contains vitamins, particularly vitamin C and vitamin A, as well as minerals like calcium, potassium, and magnesium. (Hosawi, 2023, Uthman and Garba, 2023). The addition of these fruit juices to Zobo may not only improve its nutritional value but also impart unique flavors and increase consumer acceptance.

Despite these obvious advantages of the Zobo drink, pineapple and orange juices, more research is needed to determine how the pineapple and orange juices affected the nutritional value of the mixed juice and to determine the concentration of anti-nutrients in the mixed juice.

2.0 MATERIALS AND METHODS
Dried Zobo leaves, ginger, cloves, pineapple and orange was purchased at Lapai Market Niger State, Nigeria. This was prepared and used for the analysis. Dirt and other foreign materials were removed by handpicking.

2.1 Preparation of Zobo drinks
Dry Zobo leaves, ginger and cloves were sorted. The ginger and cloves were grounded to powder using a blender. The pineapple fruit was thoroughly washed under running tap water and peeled with a stainless steel knife. To extract the juice, it was sliced into small chunks, blended, and sieved. The orange fruit was washed under running water and dried with a clean towel. A manual juice extractor was used for obtaining the juice.

The Zobo drink was made according to the method described by Akujobi et al. (2018), with minor modifications. In a pot, water and Zobo leaves were combined and boiled for 5 minutes. The ginger and cloves were heated in boiling water for 1 minute. After removing the pot from the heat, the Zobo drink was allowed to cool before filtering with a muslin cloth. The pure Zobo drink plus sugar stood for sample A, then 70% pure Zobo drink and 30% pineapple juice were added to the mixture for sample B, then 70% pure Zobo drink and 30% orange juices were added to the mixture for sample C, then 70% pure Zobo drink and 20% pineapple juice plus 10% orange juice were added to the mixture for sample D, and the product was packaged and labeled in a clear bottle for refrigeration.

2.2 Nutritional analysis: Proximate composition was determined using standard methods (Carbohydrate, Moisture and crude protein content, ash content, and crude fibre) (AOAC, 2000).

2.3 Determination of Anti-nutrients
The concentrations of saponin and alkaloid content were evaluated as described by (Harborne and Harborne, 1973). The method of (Ola and Oboh, 2000) was adopted for the determination of phytate. Oxalate was determined using the method adopted by Ahmad et al., (2022). For the determination of tannins, the method of Tiencheu et al., (2021) was employed.

2.4 Sensory evaluation
The sensory evaluation was carried out by a panel of 20 Food Science department students who are familiar with the sensory attributes of taste, aroma, consistency, and color. Their preference was rated on a hedonic scale of nine (9) points. Where 9 denotes extremely liked, 8 denotes liked very much, 7 denotes liked moderately, 6 denotes liked much, 5 denotes neither like nor dislike, 4 denotes dislike moderately, 3 denotes dislike much, 2 denotes disliked extremely. The samples were served in transparent disposable cups at the same time. Bottle water was provided for mouth rinsing between samples.

2.5 Statistical analysis
Using the statistical package for the social sciences (SPSS) version 21.0, the collected data were subjected to analyses of variance (ANOVA) and Duncan’s test to separate the means among the sample.

3.0 RESULT AND DISCUSSION
3.1 Nutritional analysis
The nutritional composition of the Zobo sweetened with Pineapple and Orange Juice is presented in Table 1. All samples exhibited a high moisture content as expected of a juice product. All moisture content result falls within the acceptable range for fruit juices (80-95 percent) as reported by Ahmed and Sohail, 2020, and Kolo et al., 2022). Crude fibre and carbohydrates were found to increase as pineapple and orange were added. This is similar to the result obtained by (Akujobi et al., 2018,
Omenna et al., 2023) where fruit portions were added to Zobo drinks. The fat content of all samples was found to be low. This makes the juice suitable for people seeking to lose weight or for people managing diseases linked to high dietary fat intake as reported by (Akujobi et al., 2018).

Table 1: Nutritional Analysis of Zobo Blend with Pineapple Juice and Orange Juice

<table>
<thead>
<tr>
<th>Samples (%)</th>
<th>Moisture</th>
<th>Ash</th>
<th>Fat</th>
<th>Protein</th>
<th>Crude fibre</th>
<th>Carbohydrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>92.52±0.04&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.81±0.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.40±0.08&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.04±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.08±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.04±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>B</td>
<td>97.05±0.01&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.84±0.02&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.40±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.39±0.01&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.14±0.01&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3.89±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>C</td>
<td>95.79±0.81&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.81±0.02&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.41±0.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.75±0.01&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.18±0.01&lt;sup&gt;d&lt;/sup&gt;</td>
<td>4.16±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>D</td>
<td>96.01±0.01&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.91±0.01&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.55±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.60±0.02&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.23±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.24±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Values are mean ± standard error of the mean. Values followed by different superscripts along the same column are significantly different at P < 0.05 DMRT

Keys
Sample A = Zobo 100% + pineapple juice 0% + orange juice 0%
Sample B = Zobo 70% + pineapple juice 30% + orange juice 0%
Sample C = Zobo 70% + pineapple juice 0% + orange juice 30%
Sample D = Zobo 70% + pineapple juice 20% + orange juice 10%

3.2 Anti-nutritional Analysis

Table 2. presents the anti-nutritional components of Zobo sweetened with Pineapple and Orange Juice. Tannins are known to interfere with the absorption and digestibility of iron and protein (Akujobi et al., 2018). Therefore the low content observed shows that Zobo sweetened with Pineapple and Orange Juice is safe for consumption. Alkaloid contents were also found to be low in all samples and in comparison with other authors, similar results were obtained in the Alkaloid content of Zobo drinks with the addition of various fruits. Alkaloid is reported to possess some medicinal and as well act as a stimulant when consumed (Kehinde and Augustine, 2022). In this study, saponin concentrations in Zobo samples were found to be 5.70±0.02·4.81±0.09·4.09±0.03·4.38±0.54. Presence of Saponins in food is known to kill protozoa and mollusks, and also act as antifungal and antiviral agents(Kehinde and Augustine, 2022). This could be the reason why Zobo drinks can last a few days at ambient temperature (Udensi et al., 2020). The concentration of phytate in all samples was low. This is in favor of consumers as phytate is known to negatively affect digestion, lowers mineral bioavailability and inhibit growth (Satheesh and Workneh Fanta, 2020).

Table 2: Anti-Nutritional Analysis of Zobo Blend with Pineapple Juice and Orange Juice

<table>
<thead>
<tr>
<th>Samples (%)</th>
<th>Tanin</th>
<th>Saponin</th>
<th>Phytate</th>
<th>Oxalate</th>
<th>Alkaloid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.40±0.02&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.70±0.02&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.86±0.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.36±0.04&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.42±0.01&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>B</td>
<td>0.80±0.12&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.81±0.09&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.84±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.29±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.39±0.01&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>C</td>
<td>0.33±0.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.09±0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.21±0.00&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.30±0.01&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.33±0.00&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>D</td>
<td>0.54±0.02&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.38±0.54&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.99±0.01&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.36±0.00&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.34±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

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Keys
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Sample C = Zobo 70% + pineapple juice 0% + orange juice 30%
Sample D = Zobo 70% + pineapple juice 20% + orange juice 10%
3.3 Sensory evaluation
Table 3. presents the values obtained from the sensory analysis on the analysis of blending Zobo with pineapple juice and orange juice. This result indicates that the four samples were accepted by the panelist in all the attributes tested except for sample D with a score of 5.63±0.04 in color. The score represents “neither like nor dislike” according to the hedonic scale. However, sample B which contained Zobo (70%), pineapple juice (30%) and orange juice (0%) was most preferred by the panelist as it had the highest score of 8.04±0.06.

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>AROMA</th>
<th>TASTE</th>
<th>COLOR</th>
<th>CONSISTENCY</th>
<th>OVERALL ACCEPTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>7.82±0.03</td>
<td>8.09±0.06</td>
<td>7.87±0.01</td>
<td>7.08±0.01</td>
<td>7.88±0.02</td>
</tr>
<tr>
<td>B</td>
<td>7.75±0.06</td>
<td>7.47±0.01</td>
<td>7.33±0.01</td>
<td>7.28±0.02</td>
<td>8.04±0.06</td>
</tr>
<tr>
<td>C</td>
<td>7.47±0.01</td>
<td>7.74±0.02</td>
<td>6.94±0.01</td>
<td>7.34±0.01</td>
<td>7.94±0.03</td>
</tr>
<tr>
<td>D</td>
<td>6.34±0.01</td>
<td>7.45±0.02</td>
<td>5.63±0.04</td>
<td>6.15±0.03</td>
<td>6.03±0.04</td>
</tr>
</tbody>
</table>

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Keys
Sample A= Zobo 100% + pineapple juice 0% + orange juice 0%
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Sample C= Zobo 70% + pineapple juice 0% + orange juice 30%
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4.0 CONCLUSION
The enrichment of Zobo with pineapple and orange juice presents an opportunity to enhance its nutritional value. The incorporation of these fruit juices exhibits a balanced nutritional profile, with notable amounts of moisture, dietary fiber, and carbohydrates. Consuming Zobo enriched with pineapple and orange juice can contribute to a diversified diet, providing essential nutrients and potential health benefits. Further studies are warranted to explore the bioavailability of the phytochemicals and the impact of enriched Zobo on human health. The development of functional beverages like enriched Zobo may offer an innovative approach to improving the nutritional status and overall well-being of individuals.

REFERENCES