



## Kalimbahin: An Alternative Healthy and Safe Sports Drink

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### ABSTRACT

Kalimbahin Sports Drink is an alternative to create a healthy and natural sports drink for athletes and those who need rehydration. The study formulated a sports drink from locally grown vegetables and natural ingredients. The specific objectives are to analyze the safety of the prepared sports drinks based on the microbiological test and toxicity/heavy metal contamination and physicochemical properties based on pH and titratable acidity; to evaluate the nutritional value and composition of the formulated drinks through approximate nutrient calculator on total sugar, vitamins, and minerals. This research is an experimental type that was divided into two phases. The independent variables are the amount of sweet potato leaves and the source of sweet potato leaves, while the dependent variable is the nutrient contents. The controlled variables are the total amount of sugar, honey, fruit juice, and water. Phase I includes an initial analysis of the microbial load, heavy metal contamination, and physicochemical properties. Phase II involves the evaluation of the nutrient contents of the formulated Kalimbahin sports drink. Result showed that the components and composition of the beverage were well-formulated, which did not support the growth of any of the microorganisms that may affect the sensory properties of the freshly prepared sports drink, or compromise the health and safety of the consumers. Analysis of its components highlights the presence of the electrolytes : sodium and potassium, which are essential components for a sports drink. The study concluded that Kalimbahin contains significant amounts of nutrients classified as a sports drink.

### RESUMO

Kalimbahin Sports Drink é uma alternativa para criar uma bebida esportiva saudável e natural para atletas e aqueles que precisam de reidratação. O estudo formulou uma bebida esportiva a partir de vegetais cultivados localmente e ingredientes naturais. Os objetivos específicos são analisar a segurança das bebidas esportivas preparadas com base no teste microbiológico e de toxicidade/contaminação por metais pesados e as propriedades físico-químicas com base no pH e acidez titulável; Avaliar o valor nutricional e a composição das bebidas formuladas por meio da calculadora de nutrientes aproximados sobre o açúcar total, vitaminas e minerais. Esta pesquisa é do tipo experimental que foi dividida em duas fases. As variáveis independentes são a quantidade de folhas de batata-doce e a fonte de folhas de batata-doce, enquanto a variável dependente são os teores de nutrientes. As variáveis controladas são a quantidade total de açúcar, mel, suco de frutas e água. A Fase I inclui uma análise inicial da carga microbiana, contaminação por metais pesados e propriedades físico-químicas. A Fase II envolve a avaliação do teor de nutrientes da bebida esportiva Kalimbahin formulada. O resultado mostrou que os componentes e a composição da bebida foram bem formulados, o que não suportou o crescimento de nenhum dos microrganismos que podem afetar as propriedades sensoriais da bebida esportiva preparada na hora, ou comprometer a saúde e a segurança dos consumidores. A análise de seus componentes destaca a presença dos eletrólitos : sódio e potássio, que são componentes essenciais para uma bebida esportiva. O estudo concluiu que Kalimbahin contém quantidades significativas de nutrientes classificados como uma bebida esportiva.

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## **Introduction**

The Introduction must contextualize the proposal of the manuscript, justification and objectives. Sports drink is essential for athletes, for persons with active activity, and as well as a therapeutic drink for some health concerns. Sports drinks has the objective to replace lost electrolyte. It contains electrolyte (sodium, potassium and magnesium) while energy drink contains caffeine. Sports drinks are manufactured for the purpose of providing mental and physical stimulation for a short period of time. They are specially formulated for people who needs extra energy and are looking for a temporary mental and physical booster in order to get through day to day's activity. Commercialized sports drinks are very expensive and cannot afford by the common public. The proposal of having 'Kalimbahin Sports Drink' is an alternative to create healthy and natural sports drink for the athletes and rehydration drink for recuperating patients without added artificial flavors, chemicals and other additives. This will provide nutrients, vitamins, minerals and amino acids that are being useful especially for those people who are exposed to heavy work and thinking and need an extra energy to do so.

The study aims to develop a sports drink. The specific objectives were:

To analyze the safety of the formulated drinks based on the following: 1- microbiological tests: a. aerobic Plate Count; b. yeast and Mold Count; c total coliform count; 2. Toxicity/heavy metal contamination with: cadmium, lead; 3. To analyze the physico-chemical properties based on: ph; acidity; 3. To evaluate the nutritional value and composition of the formulated drink in terms of the following: total sugar, vitamins, minerals.

## **Materials and Methods**

### ***Sample Preparation***

The ingredients used in the product are the following : sweet potato leaves, water, citrus fruit, white sugar and honey. The researcher made used of the sample using white sugar for the initial analytical testing. The packaging for the product is 500 ml PET bottle as shown in figure 1. Figure 1 shows the five formulation of kalimbahin using different levels and types of sugar.

**Figure 1.**

Trial for sugar content



Table 1 shows the formulation of the product as for the first trial the independent variable was citrus fruit amount, and sweet potato leaves while the dependent variable is the amount of sugar and honey. White sugar and stevia were used in the trial. The amount and type of varies per sample trial.

**Table 1.**

*Sugar Formulation of Kalimbahin*

| Ingredients          | Sample XYZ | Sample YZX | Sample ZYX | Sample AXY | Sample YXA |
|----------------------|------------|------------|------------|------------|------------|
|                      | %          | %          | %          | %          | %          |
| Sweet potato leaves  | 30         | 30         | 30         | 30         | 30         |
| Water                | 30         | 30         | 30         | 30         | 30         |
| Stevia               | 20         | -          | -          | -          | 30         |
| Sugar                | -          | 15         | 20         | 30         | -          |
| Citrus fruit extract | 10         | 10         | 10         | 10         | 10         |
| Honey                | 10         | 15         | 10         | -          | -          |

Table 1 shows sample XYZ the composition of 30% sweet potato leaves, 30% water, 20% stevia,10% citrus fruit extract and 10% honey. Sample YZX is compose of 30% sweet potato leaves, 30% water, 15% sugar, 10% citrus fruit extract and 10% honey. Sample ZYX is compose of 30% sweet potato leaves, 30% water, 20% sugar, 10% citrus fruit extract and 10% honey. Sample AXY is compose of 30% sweet potato leaves, 30% water, 30% sugar, and 10% citrus fruit extract. Sample YXA is compose of 30% sweet potato leaves, 30% water, 30% stevia, and 10% citrus fruit extract.The researchers used the sample ZYX as the formula to be test.

Ingredients are washed properly. The ingredients are measured to take note of the formulation. The preparation of the samples follows the standard hazard analysis critical control point. Tools and equipment were washed, rinsed, sanitized and sterilized.

Figure 3 shows that the ingredients are measured and documented for formulation.

**Figure 3.**

*Measuring tools*



In figure 3 sweet potato is weigh using an electronic weighing scale.

To avoid contamination during transport of samples to the laboratory the was transported in a thermal bag on the way to the analytical laboratory to ensure safety as shown in Figure 4.

**Figure 4.**

*Samples in thermal bag*



Figure 4 shows that the samples are places in 250ml glass bottle and 250 ml PET bottles. This is the require preparation sample to be submitted to the laboratory. The analytical laboratories have standard submission of samples. DOST III Analytical laboratory requires an appointment and submission of samples at least 250ml .

This research was divided into two phases. Phase 1 the initial test was the microbiological test, heavy metal test and physico-chemical analysis. For phase 2 is the testing of the nutrient contents of Kalimbahin.

#### Phase I

The researchers submitted the samples into two laboratories the DOST and Lipa Quality Assurance in Bocaue branch. DOST III Analytical does not test for heavy metals therefore the sample was submitted at LQA.

#### Phase II

The researchers submitted the samples into Lipa Quality Assurance in Bocaue branch since most of the analytical test are being offer. The test are total sugar, potassium, calcium, sodium,

and vitamin C. Reformulation was done due to high iron content. The source of the sweet potato leaves were also considered. The researchers used two types: organic and inorganically grown as shown in Table 2.

**Table 2.**

*Reformulation of the Sports Drink*

| <b>Ingredients</b>                    | <b>Sample ABC<br/>%</b> | <b>Sample BCA<br/>%</b> | <b>Sample CBA<br/>%</b> |
|---------------------------------------|-------------------------|-------------------------|-------------------------|
| Non organically grown sweet potato    | 30                      | -                       | -                       |
| Organically grown Sweet potato leaves | -                       | 30                      | 15                      |
| Water                                 | 30                      | 30                      | 45                      |
| Sugar                                 | 15                      | 15                      | 15                      |
| Citrus fruit                          | 10                      | 10                      | 10                      |
| Honey                                 | 15                      | 15                      | 15                      |

The initial result for the mineral contents shows that the iron content is high. The researchers reformulate the Kalimbahin as shown in table 2. The independent variables are water, sugar, citrus fruit and honey while the dependent variable is the amount and source of sweet potato leaves.

## **Results and Discussions**

### ***Safety Analysis***

Microbiological analysis of the food and drinks is a part of the mandate of the Food and Drug Administration to ensure the safety of public consumers. Non-alcoholic beverages such as energy drinks may include processes that may prevent the growth and survival of microorganisms like bacteria, yeasts, and molds, but still not necessarily sterile. The chemical and nutritional components of these drinks are also suitable media for their organisms that can result in changes in the sensory properties, and worse, can put the consumers' health and safety at risk.

Presented in Table 4 is the summary of results obtained in all the microbiological tests performed from the initially formulated energy drink, where all tests gave the same result of <10 CFU/mL. Using the provided reference standard for each test in Table 4, it can be inferred that all results fall within the acceptable level following the set standards from the reference protocol recommended by the Food and Drug Administration (FDA) of the Philippines. This implies that the homemade processing and handling of the initially formulated energy drink complies with Good Manufacturing Practice. More so, the components and composition of the beverage were well formulated, which did not support growth of any of the microorganisms

that may affect the sensory properties of the freshly prepared energy drink, or compromise the health and safety of the consumers.

**Table 4.**

*Initial Microbiological Test Results of Kalimbahin Sports Drink*

| <b>Test Performed</b>         | <b>Reference Standard</b> | <b>Result</b>                | <b>Interpretation</b>   |
|-------------------------------|---------------------------|------------------------------|-------------------------|
| Aerobic Plate count           | 10 CFU/mL                 | <10 CFU/ mL<br>(approximate) | Within acceptable level |
| Total coliform count          | 1 CFU/mL                  | <10 CFU/ mL                  | Within acceptable level |
| <i>Escherichia coli</i> count | None available            | <10 CFU/ mL                  | Within acceptable level |
| Yeast and Molds count         | 1 CFU/mL                  | <10 CFU/ mL                  | Within acceptable level |

Note : <10CFU/mL=0 colony forming unit, based on the Aerobic plate count (dry rehydrate film methods) AOC International 20<sup>th</sup> edition,2016

The formulated energy drink was prepared from natural ingredients, grown locally within the province of Bulacan. Toxicity testing would then be necessary to determine if the source environment is contaminated for heavy metals such as lead (Pb), cadmium (Cd), chromium (Cr), iron (Fe), manganese (Mn), and nickel (Ni). Some heavy metals play a significant role in living organisms and are recommended in trace amounts. However, when the concentration exceeds the recommended level, they become toxic, especially to humans.

Table 5 shows the toxicity/heavy Metal Analysis of Kalimbahin Drink.

**Table 5.**

*Toxicity/Heavy Metal Analysis on Kalimbahin Sports Drink*

| <b>Heavy Metal</b> | <b>Detection Limit<br/>mg/kg</b> | <b>Result</b>        | <b>Interpretation</b>           |
|--------------------|----------------------------------|----------------------|---------------------------------|
| Cadmium (Cd)       | 0.02                             | None detected        | Absence of toxic element        |
| <b>Lead (Pb)</b>   | <b>0.06</b>                      | <b>None detected</b> | <b>Absence of toxic element</b> |

The results presented in Table 5 clearly show that neither cadmium (Cd) nor lead (Pb) was detected from the formulated drinks, indicating that it complies with the regulatory specifications. More importantly, the absence of these heavy metals in the sports energy drink further indicates that it's a safe energy drink. The plant-based major component of this product, including its natural ingredients, don't pose any possible risk or harm upon its consumption.

## Physico-chemical Analysis

Initial characterization of the physico-chemical properties of formulated Kalimbahin Sports Drink is presented in Table 5. Results showed a pH value of 2.81, suggesting that the formulated energy drink is moderately acidic. The pH in food and beverages is one of the significant factors being considered in preventing spoilage. Generally, the optimum pH for bacterial growth is near neutral, and in many cases, an acidic environment reduces the chance for microbial growth. The obtained pH value may support the initial microbiological result showing no significant microbial growth. It must be noted however, that there are few specific microorganisms that can tolerate low pH, and can therefore survive and proliferate.

The acidity of the energy drink was also measured in terms of titratable acidity, which gave a value of 4.32% (Table 6). The obtained result for titratable acidity (or total acidity), reflects the total acid content in the beverage. This value is considerably lower than the reported titratable acidity (11.78 %) of energy drinks (such as Red Bull), but almost comparable to the titratable acidity (3.58%) of some commercially available sports drink (Jain et al., 2012).

**Table 6.**  
*pH and Titratable Acidity of Kalimbahin Sports Drink*

| <b>Parameter</b> | <b>Results</b> |
|------------------|----------------|
| pH, %            | 2.81           |
| Total Acidity, % | 4.32%          |

Titratable acidity is often measured in food and beverages, because it provides information on the concentration of non-dissociated acids in foods or beverages. It then provides a more precise concentration of the total acids in foods or beverages. The titratable pH may also be good predictor of the impact of organic acids in food flavor since there are food properties that may be affected by partially ionized food acids, while some properties are affected by the total acid concentration (Tyl and Sadler, 2017). In addition, pH and titratable acidity have been reported to be responsible to erosive potential of beverages, including sports and energy drinks, which can lead to enamel dissolution (Jain et al., 2012).

The results show in Table 7 that Kalimbahin can be consider as a sports drink because of its composition. Sports drinks contains 6-8g.100ml of carbohydrate and electrolytes such as sodium, potassium , calcium, and magnesium. (Silva et.al.,2019) There are three types of sports drinks: isotonic, hypotonic and hypertonic drink. Isotonic sports drink contains same amount of carbohydrates and electrolytes compare with the human body. The total carbohydrates in an isotonic sports drink is 8%. The main objective of isotonic sports drinks is

to replace lost water, sugars, and salts during physical activities. Hypotonic sports drink contains less amount of carbohydrates and usually consumed by individuals/athletes who needs more fluid but lesser amount of carbohydrates. And hypertonic sports drink consist of highest amount of carbohydrates which further increase the osmolality of the drink. (Chatterjee et al., 2019).

**Table 7.**  
*Nutritional Value Evaluation*

| <b>Nutrient</b> | <b>Amount in Milligrams<br/>In 500 ml</b> | <b>Nutrient Daily Value<br/>Based in Phil.RENI<br/>Adult aged 19-29 years<br/>old</b> | <b>Nutrient Daily Value<br/>Adult aged 19-29 years<br/>old Per 250mg serving<br/>size %</b> |
|-----------------|---|---|---|
| Total Sugar     | 27.60                                     | 55-75   | 25  |
| Calcium         | 295.15                                    | 750   | 19.67   |
| Iron            | 47.75                                     | 45  | 53  |
| Potassium       | 112.71                                    | 2000  | 2.81  |
| Sodium          | 53.39                                     | 500   | 5.33  |
| Vitamin C       | 19.12                                     | 60  | 15.93   |

Table 7 shows the nutrient content of Kalimbahin in a 500 ml PET bottle. The serving size is 250 ml. The nutrient daily value of Kalimbahin in a 250ml serving size is 53% for iron, 25% for sugar, 19.67% for calcium, 15.93% Vitamin C, sodium is 5.33% and 2.81% for potassium.

### **Shelf Life Evaluation**

The shelf life of foods and beverages generally describes the length of time they can be stored without changes in the quality, taste and other properties. Thus, it is a property that can be associated with the safety of these products for human consumption. Although some may not immediately be too harmful for consumption after their shelf life, their properties deteriorate and the primary characteristics no longer conform the acceptable quality parameters (Young and O'Sullivan, 2011).

Microbiological stability of foods and beverages is a critical factor that is significantly relevant to the shelf life, that could also affect the physical and chemical stability (Kilcast and Subramaniam, 2011). Changes in these properties will definitely affect the taste, flavor and other qualities of foods and beverages, leading to product deterioration and spoilage.

Results on the microbiological analysis performed on the reformulated sports drink upon storage are presented in Table 8. Analysis on the commonly implicated microorganisms associated with non-alcoholic beverages such as energy drink showed no significant growth of microorganism within 3 days. Results show that in the three days storage at 5C the Kalimbahin Drink is still in the acceptable level. Further analysis is recommended due to time constraint and budget.



**Table 8.***Microbiological Test Results of Kalimbahin Sports Drink Upon Three Days Storage*

| <b>Test Performed</b>         | <b>Result</b>               | <b>Interpretation</b>   |
|-------------------------------|-----------------------------|-------------------------|
| Aerobic Plate count           | 10 CFU/ mL<br>(approximate) | Within acceptable level |
| Total coliform count          | <10 CFU/ mL                 | Within acceptable level |
| <i>Escherichia coli</i> count | <10 CFU/ mL                 | Within acceptable level |
| Yeast and Molds count         | <10 CFU/ mL                 | Within acceptable level |

Note :<10CFU/mL= No growth observed using 1:1- dilution

Reference/s:US Food & Drug Administration : January 2001 Bacteriological Analytical Manual Online  
3M Pertrilim E.Coli/Coliform Count Plate Interpretation Guide.

*Escherichia coli*, which also belongs to the family *Enterobacteriaceae*, can also be determined separately as a direct indicator of health risk. As member of enteric bacteria, *E. coli* is also widely distributed in the intestinal gut of humans and animals as non-pathogens. However, they can be opportunistic pathogens and cause infection in immunocompromised or vulnerable hosts. In addition, there are also pathogenic strains of this bacteria that can cause gastrointestinal infections even to healthy individuals (Feng et al., 2020).

Most common source of fungal contamination is soil (Tribst, 2009), such as species of *Rhizopus* and *Fusarium* that can grow at low oxygen concentration. These microbes can produce secondary metabolites called mycotoxins under stress conditions, which when ingested or inhaled can cause illness in humans and animals. Depending on the concentration, the toxic effects of mycotoxins may range from acute like to chronic immune suppression, and has the potential to lead to cancer of the liver and kidney damage (Boeira et al., 1999).

### **Conclusion**

Experimental results show the presence of the electrolytes sodium and potassium which are necessary for a sports drink. The drink also contains vitamin C and calcium as additional benefits. The drink contains enough amount sugar needed for the absorption of the electrolytes. Kalimbahin as an isotonic solution because it contains 27g carbohydrates for 500ml or 5.4g per 100ml. It is best use for short duration and high intensity exercise or activity or people suffering from severe dehydration.

The drink can also use for managing dengue fever and Covid 19 because patient is commonly suffering of dehydration. The symptoms of dengue include high fever, nausea, headache, and low blood platelet count. (Mayo Clinic,2020) There is no specific treatment for dengue fever exists. Drink plenty of fluids is the key to avoid dehydration. Fruit juice is a good source of electrolytes for the body. Some fruits are high in potassium, and some are high in

sodium. And many fruits contain lots of electrolytes, which are better to give to dengue sufferers than just plain water.

Speaking of 'Kalimbahin sports drink,' which is composed of natural ingredients such as fruits and vegetables, is a healthy and natural alternative rehydration drink not only for the athlete's but for the recuperating patients as well to experience drinking without added artificial flavor, chemicals, and other additives. Further, this will provide nutrients, vitamins, minerals, and amino acids. High body temperature is the way the immune system to have normal metabolism and also associated with dehydration and increased metabolism which can result to dehydration and increased nutritional needs.

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