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# Production and Evaluation of Sport Drink from Coconut Juice and Watermelon Juice

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**Abstract**
In this experiment a sport drink was developed from coconut water and water melon juice. Six formulations were made designated SD1, SD2, SD3, SD4, SD5, and SD6 at the ratio of 100:0, 90:10, 80:20, 70:30, 60:40, 50:50 respectively and sensory evaluation carried out. Sample SD1 scored best for taste (1.58 ±0.50), SD2 was preferred for aroma (3.30±1.26), and sample SD6 had the highest for appearance and general acceptability. Four best formulations were taken from the sensory evaluation results, (SD1, SD2, SD5 and SD6) and subjected to various analyses including proximate composition, mineral, vitamin C, total sugars, total solids and microbial safety using standard methods. Results of the proximate analysis showed a decrease in moisture content (94.99±0.05 to 94.56±0.04) protein, (0.72±0.02 to 0.65.0.01), lipid(0.20+0.01 to 0.16±0.01) and increase in fibre content (1.2±0.02 to 1.24±0.02) ,ash (0.35±0.01 to 0.43±0.01), and carbohydrate (2.62±0.02 to 2.96±0.03). There was a gradual decrease in the mineral content; the highest being potassium (223.18±0.08 to 193.00±0.02). The vitamin C content and total sugars in the formulated sport drink increased from (119.70±0.02 to 449.07±0.04) and (3.82±0.03 to 6.89±0.04) respectively, while the total solids decreased from 9.85±0.03 to 8.92±0.02. From the result of this experiment, sample SD6 (50% each of coconut juice and watermelon juice) gave values as the most preferred formulation for a good sport drink.
**Keywords:** Coconut juice, watermelon juice, sensory evaluation, formulation, sport drink

## 1. Introduction

Nigeria is a country with abundance of coconut grown in the south and watermelon in the North with negligible diversification of both crops presently. Sport drinks are beverages designed for athletes or individuals needing replenishment of water as well as carbohydrates and electrolytes lost or utilized during prolonged rigorous physical activity, including activities performed in high temperature and humidity (Shirreffs *et al*., 2004). Although individual brands and products might vary, sports drinks typically contain nutrients such as water, electrolytes (primarily sodium and potassium) and carbohydrates (Snell *et al.,* 2010).

In competitive sports such as soccer, athletes are always striving to gain an advantage over their opponents. For ergogenic effects they turn to nutritional supplements such as sports drinks, which are legal, affordable, easily accessible and often contain mixtures of carbohydrates (CHO) and electrolytes (Thibault *et al.,* 2014;Hornsby,2011).

Since the beginning of sports drinks over forty years ago, its three main goals remain unchanged, that is to prevent dehydration, replace electrolytes lost in sweat, and to provide carbohydrate for use during exercise (Coombs and Hamilton, 2000; Murry, 1995).

Coconut plant has long been recognized as a valuable source of various commodities for human life (Campbell-Falck *et al,* 2000). The water contains a complex blend of vitamins, minerals, amino acids, carbohydrates, antioxidants, enzymes, health enhancing growth hormones and other important nutrients. Its electrolyte content is similar to human plasma, it has proven superior to commercial sports drinks unlike any other beverage, and it is completely compatible with the human body. It has about 15 times the amount of potassium as most sports and energy drinks. It is fat free and low in calories. Sodium, potassium, phosphorous, chloride and magnesium are the main minerals found in coconut water besides vitamin c and sugars. (Sulaxana *et al*., 2008; Reddy and Lakshmi, 2014).

Water melon is a native to tropical Africa and is a popular thirst – quencher fruit mainly available almost all year round (Quek *et al.,* 2007). It is rich in minerals, vitamins and viewed as a more nutritious alternative to having energy drinks or supplements prior to exercise (IITA, 2013; Anon, 2008). It serves as a good source of lycopene which act as anti-oxidant during normal metabolism and protect against cancer (Perkins & Collins, 2004; Sies & Stahl, 1998). Considering the usefulness of coconut water due to its electrolytes and carbohydrates content as well as that of water melon, developing a sport drink from a combination of both will save the hazard of synthetic sports drinks flooding the market. This is the thrust of this experiment. Fatigue caused by energy depletion and/or dehydration can be prevented by the ingestion of sport drinks whose main purposes are to prevent dehydration, supply energy and replace electrolyte (Maughan,, 1998). Today sports drinks are among the most researched food items and there is a consensus about the optimal composition of such drinks: sports drinks should contain water, carbohydrates and energy source; sodium for particular situations, and a defined osmolality (Coyle, 2004).

**2.1 Materials and Methods**

Coconuts were obtained from Ikot Ekpene while the watermelons were bought at Akpan –Andem market, Uyo both in Akwa Ibom State, Nigeria and conveyed to the Process Laboratory, Department of Food Science & Technology, University of Uyo, Uyo, Nigeria.

**2.1.1 Extraction of coconut water**

The coconuts were washed thoroughly with water to remove sand and dirt on them and thereafter washed with chlorine water to reduce microbes that might be on them. Coconut water was extracted by cracking the coconut shell and making a hole using a sterilized steel knife. The coconut water was then poured into clean containers.

**2.1.2 Extraction of watermelon juice**

The fruit was cut longitudinally using a sterile knife and edible portion was removed, cut into small pieces, transferred into a sterilized blender (Moulinex model) and blended until sufficient juice was produced. The entire slurry was transferred into a sterile muslin cloth to sieve off the particles. The clear liquid obtained was transferred into clean sterile air- tight bottles.

**2.1.3 Formulation of the sport drink**

The extracted coconut water and watermelon juices were blended into six different products with different concentrations as shown in Table 1.

**2.1.4 Proximate Analysis of formulated sport drink**

Moisture, crude protein, ash, fat and crude fibre were determined according to the method of AOAC (2005).

**2.1.5 Total Carbohydrate**

Total carbohydrate content of the samples were determined as total carbohydrate by difference, that is by subtracting the measured protein, fat, ash and moisture from 100 (Ihekoronye and Ngoddy, 1985).

**2.1.6 Determination of energy value of formulated drinks**

This was calculated using the method of AOAC (1999) as follows: (4 × fat) + (4× protein) + (4× carbohydrate) = (energy) calorie

1 calorie = 4. 182 KJ.

**2.1.7 Determination of Brix and pH**

Using a digital refractometer (Reichert #137531LO, Depew, NY), the formulated drinks were analyzed for soluble solids. Approximately 1ml of the formulated sport drink was placed on the lens of the refractometer analyzed at 25$^{o}$C. Results were reported at Brix Values. pH of the samples was measured using a VWR bench top meter (VWR Symphony SB70P, West Chester, PA).

The pH meter was calibrated with pH 4, 7 and 10 buffers prior to usage. The probe was placed in 10ml of watermelon juice and measured at 25$^{o}$C. Analysis was conducted in triplicate.

**2.1.8 Determination of Minerals in formulated sport drinks**

Mineral content of the formulated sport drinks was determined by atomic absorption spectrometry, flame photometry and spectrophotometry according to the methods of AOAC (2012).

Determination of sodium and potassium was by flame photometry. Iron, calcium, manganese and magnesium was by Atomic Absorption Spectrometry while phosphorus was determined by spectrophotmetry.

**2.1.9 Determination of Vitamin C in the formulated sport drinks**

Vitamin C was analyzed using the method of AOAC (2005).

**2.1.10 Determination of total Solids in the formulated sport drinks**

Total solid was determined using the method of AOAC (1999).

**2.1.11 Microbal Analysis**

Formulated sport drink was analyzed in triplicate for aerobic bacteria and coliforms using petrifilms (3 Company, St Paul, MN). Serial dilution bottles were filled with 99 ml of 1% peptone water and autoclaved at 121$^{o}$c for 45 minutes. One mililitre of watermelon juice was mixed thoroughly, added to the stock solution and then serially diluted. A 1ml aliquot of each dilution was plated on both aerobic and coliform petrifilms. The coliform and aerobic bacteria were incubated at 37$^{o}$C for 24hr and 48h respectively.

After incubation, the colonies were counted and reported as cfu/ml using the equation.

Cfu/ml = 1/ [no. of colonies × aliquot plated (1ml) × dilution factor]

Colonies of aerobic bacteria appeared red on petrifilms while that of coliforms also appeared red also but with gas formation.

**2.1.12 Sensory evaluation of formulated sport drink**

The samples prepared were assessed by a panel of 20 people. Flavor, aroma, mouth feel, after taste, color and overall acceptance were the major parameters evaluated. Evaluation was carried out using the acceptance of 1 as like extremely and 9 as dislike extremely (9 point hedonic scale). The results of overall evaluation were analyzed using one – way ANOVA ((Lawless and Heymann, 1998).

**3.1 Results and Discussion**

The mean percentage moisture content of the formulated drink is shown in Table 2. The moisture content SD1 was the highest which compared favorably with the result obtained by Santosa (1996). The moisture content in the formulated drink ranged from (94.56 – 94.99). Sample SD6 had the lowest moisture content. This could be due to the higher moisture content in coconut water than in water melon juice as reported by Ogunbanwo *et al*., (2013).Moisture content of the formulated sport drink decreased with decrease in coconut water. Sample SD1 and SD2 were significantly different but there was no significant difference in samples SD5 and SD6.

Protein is one of the determined parameters used to calculate the energy value of sports drinks. Result of the protein content is also shown in Table 2. There was no significant difference in the protein content of SD1 and SD2 as well as SD5 and SD6. However the trend showed a decrease in protein content of formulated drink with decreasing amount of coconut water.

The lipid content of the formulated sport drink is also shown in Table 2. Lipid in the sport drink must have come from the coconut water which contains some essential fatty acid required for normal functioning of the human body (Yong *et al*., 2009). The percentage lipid content of coconut water is higher than that of water melon juice which led to a decrease in the lipid content as coconut water decreased.

The percentage fibre content in the formulated drink (Table 2) showed that sample SD6 had the highest fibre content followed by sample SD2. Sample SD1 had the least fibre content. Fibre content in the formulated sport drink increased with increase in watermelon juice (Liu, 2004, Collins *et al.,* 2005).

The mean percentage ash content in the formulated sport drink is shown also in table 2. Samples SD1 and SD2 had the lowest ash content. This could be due to the high quantity of electrolyte in the samples. Mean percentage ash in the formulated drinks was significantly different $P > 0.05$. Ash content decreased with increase in coconut water. This could be due to the amount of coconut water in the formulated drink since coconut water contains high levels of electrolyte (USDA, 2009).

Result of the percentage carbohydrate in the formulated sport drink is also shown in Table 2. There was significant difference ($P > 0.05$) in all the samples. However carbohydrate content was highest in sample SD6 and lowest in SD1. Carbohydrate content increased with increase in the watermelon juice.

The result of the energy value is shown in Table 2. There was significant difference in the energy value of the formulated sport drink and could be due to the proportions of coconut water and watermelon juice in the various formulations.

The sugar level in the formulated sports drink increased with increasing amount of watermelon juice (Table 2) with the peak in sample SD6. This could be traceable to the fact that both coconut water and watermelon juice are good sources of sugar (Lapitan and Mabesa, 1983; Pue *et al*., 1992)

The pH of the sports drink is also shown in Table 2. The acidic range is likely to be from the coconut water in the drink. Coconut water is a low acid food (Reddy and Lakshmi, 2014).

The formulated sports drink contained high percentage of vitamin C. Highest was however recorded in SD6 since both coconut water and water melon juice are good sources of vitamin C (Chowdhury *et al.,* 2009; Kenje and Grum, 2003).

Table 3 shows the result of the mineral content of the formulated sport drink. From the result, potassium and sodium content were high in the drinks followed by calcium. However, the level of calcium was highest in SD1. Santaso *et a*l., (1996) reported high values of calcium from coconut water. This result agrees with that report. There was significant difference in the mineral content of the sport drink with decrease in decreasing level of coconut water in the formulated sport drink.

The result of the microbial analysis (Table 4) showed no growth of coliforms in all the samples except in SD2. This could be due to contamination (Sharma *et al*., 2005). Total Bacterial count showed colonies within safe limit. There was no fungal growth in all the samples. Generally, the presence of these microbes detected could be due to contamination during the handling and production processes which could be addressed by sterilization.

The result of the sensory evaluation is shown in Table 4. From the result, sample SD1 was the most preferred in terms of taste, followed by SD6. Samples SD5 and SD6 scored the highest in terms of the appearance. This could be due to the lycopene content in watermelon juice which impacted the color. Kalaivani (2015) reported that lycopene content determines the color in watermelon juice. However SD6 had the highest in terms of general acceptability. This could be attributed to the proportion of coconut water and watermelon juice in the formulated sports drink. There was no significant difference ($P > 0.05$) in aroma among the samples.

**4.1 Conclusion**

From the findings of this experiment, a sport drink could be produced from coconut water and watermelon juice at varying ratios. However, the most preferred in this result was the formulation at 50: 50 ratio each of coconut water and watermelon juice respectively. Its combination of the vitamin c content, percentage carbohydrate and energy for 100 ml would make it one of the safest sport drinks. With the availability of these raw materials in

Nigeria all year round, this product could be an economically viable venture. This will further maximize the utilization of these plants beyond their present status.

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**Table 1: Formulation of sport drinks from coconut water and watermelon juice**

| Coconut water composition (%) | Water melon composition (%) | Sample code |
|---|---|---|
| 100 | 0 | SD1 |
| 90 | 10 | SD2 |
| 80 | 20 | SD3 |
| 70 | 30 | SD4 |
| 60 | 40 | SD5 |
| 50 | 50 | SD6 |

**Table 2: Physico-chemical properties of the formulated drinks**

| Parameters | SD1 | SD2 | SD5 | SD6 |
|---|---|---|---|---|
| Moisture | $94.99\pm0.05^{a}$ | $94.84\pm0.04^{b}$ | $94.60\pm0.04^{c}$ | $94.56\pm0.04^{c}$ |
| Protein | $0.72\pm0.02^{a}$ | $0.70\pm0.02^{a}$ | $0.66\pm0.02^{b}$ | $0.65\pm0.01^{b}$ |
| Lipid | $0.20\pm0.01^{a}$ | $0.19\pm0.01^{a}$ | $0.16\pm0.00^{b}$ | $0.16\pm0.01^{b}$ |
| Fibre | $1.12\pm0.02^{c}$ | $1.18\pm0.03^{b}$ | $1.25\pm0.03^{a}$ | $1.24\pm0.02^{a}$ |
| Ash | $0.35\pm0.01^{c}$ | $0.40\pm0.01^{b}$ | $0.42\pm0.02^{ab}$ | $0.43\pm0.01^{a}$ |
| CHO | $2.62\pm0.02^{d}$ | $2.72\pm0.03^{c}$ | $2.91\pm0.02^{b}$ | $2.96\pm0.03^{a}$ |
| Energy | $15.24\pm0.04^{d}$ | $15.39\pm0.05^{c}$ | $15.72\pm0.02^{b}$ | $15.80\pm0.03^{a}$ |
| Total Sugars | $338.06\pm0.08^{d}$ | $390.24\pm0.05^{c}$ | $391.21\pm0.06^{b}$ | $397.50\pm0.11^{a}$ |
| pH | $5.22\pm0.02^{b}$ | $5.66\pm0.03^{a}$ | $5.07\pm0.04^{c}$ | $4.63\pm0.02^{d}$ |
| Total solids | $9.85\pm0.03^{a}$ | $9.67\pm0.04^{b}$ | $9.53\pm0.03^{c}$ | $8.92\pm0.02^{d}$ |
| Vit C | $119.70\pm0.02^{d}$ | $119.35\pm0.03^{c}$ | $261.89\pm0.03^{b}$ | $499.07\pm0.04^{a}$ |

Mean± SD of triplicate determination. Mean values with the same superscript in the same row had no significant difference ($p<0.05$).

Key: SD1 =100% coconut water; SD2 =90% coconut water and 10% watermelon juice; SD5 =60% coconut water and 40% watermelon juice; SD6 = 50% coconut water and 50%watermelon juice.

**Table 3: Mineral content of the formulated sport drinks**

| Parameters | SD1 | SD2 | SD5 | SD6 |
|---|---|---|---|---|
| Calcium | 26.37±0.06a | 24.85±0.02 | 21.48±0.02b | 19.89±0.03d |
| Magnesium | 29.56±0.04a | 27.31±0.03b | 23.48±0.02c | 21.49±0.02d |
| Potassium | 223.18±0.08a | 220.46±0.06b | 197.15±0.05c | 193.00±0.09d |
| Sodium | 101.56±0.10a | 98.48±0.07b | 96.02±0.05c | 94.28±0.04d |

Mean± SD of triplicate determination. Mean values with different superscript in the same row had a significant difference ($p<0.05$).

Key: SD1 =100% coconut water; SD2 =90% coconut water and 10% watermelon juice; SD5 =60% coconut water and 40% watermelon juice; SD6 = 50% coconut water and 50%watermelon juice.

**Table 4: Microbial Analysis of the formulated drinks**

| Sample | NA(TBC) | SDA(TFC) | MCA(TCC) | EMBA(T.E.coli) |
|---|---|---|---|---|
| SD1 | $17.00\times10^{-3}$ | Nill | Nill | $0.00\times10^{-3}$ |
| SD2 | $8.00\times10^{-3}$ | Nill | $2.00\times10^{-3}$ | $4.00\times10^{-3}$ |
| SD5 | $3.00\times^{-4}$ | Nill | Nill | $5.00\times^{-4}$ |
| SD6 | $9.00\times^{-4}$ | Nill | Nill | $4.00\times^{-4}$ |

KEY: NA= Nutrient Agar, TBC =Total Bacterial Count, SDA=Sabourad Dextrose Agar, TFC= Total Fungal Count, MCA= MacConkey Agar, TCC= tal Coliform Count, EMBA= Eosin Methylene Blue Agar; T.E.Coli= Total Escherichia coli Count.

**Table 5: Sensory Evaluation of the formulated drink**

| Samples | Taste | Aroma | Color | General Acceptance |
|---|---|---|---|---|
| SD1 | 1.58±0.50$^{a}$ | 3.30±1.45$^{a}$ | 3.40±2.30$^{bc}$ | 2.45±1.27$^{ab}$ |
| SD2 | 3.60±1.60$^{b}$ | 3.30±1.26$^{a}$ | 4.05±1.76$^{c}$ | 3.35±1.56$^{bc}$ |
| SD3 | 3.75±1.11$^{b}$ | 4.05±1.14$^{a}$ | 3.40±1.81b$^{c}$ | 3.70±1.26$^{c}$ |
| SD4 | 3.35±1.30$^{b}$ | 400±1.55$^{a}$ | 2.80±1.00$^{ab}$ | 3.65±1.46$^{c}$ |
| SD5 | 3.05±1.35a$^{b}$ | 4.15±1.56$^{a}$ | 2.25±1.06$^{a}$ | 3.10±1.20$^{abc}$ |
| SD6 | 4.02±1.18$^{c}$ | 3.35±1.72$^{a}$ | 2.25±101$^{a}$ | 2.35±1.38$^{a}$ |

Means±SD values within the same column with different superscript are significantly different ($p>0.05$)

Key: SD1 =100% coconut water; SD2 =90% coconut water and 10% watermelon juice; SD3 =80% coconut water and 20% watermelon juice; SD4 =70% coconut water and 30% watermelon juice; SD5 =60% coconut water and 40% watermelon juice; SD6 = 50% coconut water and 50%watermelon juice.