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Research Article

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Development and Production of Isotonic Sports Drink From Blends of Date Palm and Water Melon Fruits

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Abstract

Date palm and watermelon fruit with the addition of sucrose, glucose, sodium chloride, ascorbic acid, sodium metabisulphite and water were used in the production of isotonic sports drink and a commercial sports drink was used as the reference sample. The energy, carbohydrate, osmolality and pH of the drink were analyzed using standard methods.

A significant difference was observed in the energy, pH and osmolality content of the drinks but no significant difference was observed between the carbohydrate content of the drinks. The developed drink had carbohydrate content of 7.3%, energy of 30.1 Kcal, pH of 3.7 and osmolality of 323 mOsm/kg H_2O while the commercial sports drink had carbohydrate content of 6.7%, energy of 26.6 Kcal, pH of 3.1 and osmolality of 290 mOsm/kg H_2O. The developed drink compared favorably with the commercial sports drink and the correlation of the sensory parameters revealed that colour influenced the appearance of the drink.

Keywords: Date Palm Fruit, Watermelon Fruit, Sports Drink, Value Addition

Introduction

Date palm fruit (Phoenix dactylifera), is a sweet tasty fruit from the Family of Arecaceae. It contains fructose, glucose and sucrose [1]. It is a good source of magnesium, calcium, sodium, potassium, energy and it is an economic crop grown in the Northern part of Nigeria with an annual production of 22, 400MT [2]. Watermelon (Citrullus lanatus) is a vine-like flowering plant from the Cucurbitaceae family. It contains a high level of L-citrulline which is beneficial for athletic performance [3]. In Nigeria, it has been reported that post-harvest losses of fruits is about 15% this loss could be reduced by increasing the utilization of the fruits in the production of isotonic Sports drink [4].

Sports drink is a drink formulated to help athletes rehydrate, as well as replenish lost electrolytes and sugars. Sports performance can be hindered by various factors but the two main factors that cause premature fatigue are; depletion of the body's carbohydrate stores and dehydration due to loss of water and electrolytes through sweating [5,6]. There are three types of sports drink; the hypotonic, isotonic and hypertonic sports drink. The hypotonic drink has lower osmotic pressure as the body fluid, hypertonic drink has higher osmotic pressure than the body fluid while isotonic drink has the same osmotic pressure as the body fluid and for endurance performance, isotonic sports drink has been reported to be the ideal drink [4].

Date palm and watermelon fruits are abundant in Nigeria with no industrial utilization and there is currently no information on value addition of date palm and watermelon fruits in the production of isotonic sports drinks hence the basis for this study in adding value to the utilization of these fruits.

Materials and Methods

Materials

Date palm fruit, Watermelon fruit, sucrose, glucose, sodium chloride, ascorbic acid and sodium metabisulphite (food grades) were obtained from a local market in Mushin, Lagos. Lucozade sports drink was the commercial sports drink used as the reference sample and it was obtained from Shop rite in Lagos.

Methods

Date Powder Production

Date palm fruit was sorted, slightly washed to remove adhering impurities, dried in a drier (Cole Medical England, 04110JI) to about 10% moisture content at 65°C, it was de-seeded, milled and sieved using 250µm mesh size to obtain a fine powder.

Watermelon Juice Production

The fruit was washed, sliced, de-seeded and the flesh was separated from the rind. The Watermelon juice was extracted using a juice extractor and the juice was used for the production of the isotonic sports drink.

Date Powder and Watermelon Juice

The Date powder (10g) and Watermelon juice (90ml) were mixed and allowed to settle to obtain a clear mixture; it was decanted and filtered using a muslin cloth to remove any impurity in the mixture. Thereafter 5.29% date-watermelon juice was mixed with 0.52% sodium chloride, 52.14% glucose powder, 0.08% sodium metabisulphite, 2.87% ascorbic acid and 39.10% sucrose and further mixed with 92 ml water. The developed isotonic drink was filled into previously sterilized container and the drink was pasteurized at 80°C for two minutes.

Carbohydrate content

The protein, fat, ash, moisture and crude fibre contents of the drink were determined using the Association of Official Analytical Chemists' method and the carbohydrate content was determined by difference [7]. Carbohydrate = 100 - (% moisture + % ash + % protein + % lipids + % fiber).

Osmolality

The method described by Advanced Instruments Inc., was used for Osmolality determination using Osmometer (Micro-Digital Osmometer, Loser) and the standard solution used for calibration before analysis had the following parameters: -0.56°C and 300 mOsm [8].

The osmolality was estimated by measuring the freezing point depression of the drink. About 50µl sample was pipetted into the plastic tube and the sample was inserted into the osmometer. It was super-cooled below its freezing point in an insulated freezing bath and then mechanical agitation caused crystallization to occur. As crystallization occurred, heat of fusion was increased which caused the sample temperature to rise to liquid/solid equilibrium which is slightly below the freezing point of the sample. The equilibrium attained was the freezing point of the sample and the change in temperature was measured by a thermistor and the value was displayed on the screen as mOsm/kg.

pH

The pH content was determined with a pH meter (pH 2700 Series 68X544001, OAKTON, 2010). The pH meter was calibrated with buffer 4 and buffer 7 before determining the pH content. After calibration, the probe was rinsed in distilled water and cleaned. Then, the probe was inserted into the solution and the reading was recorded.

Energy

The Energy content was determined using ballistic bomb calorimeter (Manufacturer: Cal 2k-Eco, TUV Rheinland Quality Services (Pty) Ltd., South Africa 2010).

Sensory Evaluation

The developed sports drinks and commercial sports drink were served to 20 untrained panelists (both male and female) comprising of staff and industrial training students from the Federal Institute of Industrial Research, Oshodi, Nigeria who were willing to participate in the sensory assessment. The drink samples were scored for its acceptability in terms of appearance, colour, aroma, taste and after-taste and overall acceptability. A 9-point hedonic scale (1 = dislike extremely, 9 = like extremely) was used by the panelists to score the samples. The sensory evaluation of the drinks was conducted under uniform fluorescent illumination in the cubicles of the sensory laboratory.

Statistical Analysis

The data obtained in duplicate were subjected to Analysis of variance (ANOVA) using SPSS version 20.0 [9].

Results and Discussion

Carbohydrate, energy, pH and osmolality values of the developed and commercial sports drinks are shown in Table 1. A significant difference ($p<0.05$) was observed in the energy, pH and osmolality content of the drinks while there was no significant difference ($p>0.05$) between the carbohydrate content of the drinks.

Carbohydrate content is the most important factor influencing the rate of gastric emptying of rehydration drinks [10]. The developed isotonic Sports drink had the highest carbohydrate value of 7.3% while the commercial drink had 6.7%. It was reported by previous authors that Sport drinks with carbohydrate content between 6-8% maximize gastric emptying, thereby enhancing fluid absorption from the intestine, as well as supplying energy to the working but sport drink with carbohydrate values higher than 8-10% inhibits gastric emptying thereby reducing fluid available for absorption [11-13]. This probably implies that the developed Sports drink will maximize gastric emptying thereby increasing fluid absorption from the intestine.

Table 1: Carbohydrate, energy, pH and osmolality content of developed and commercial sports drinks

Samples (100ml)	Carbohydrate (%)	Energy (Kcal)	pH	Osmolality (mOsm/kgH_2O)
Developed sport drink	7.3±0.3^a	30.1±1.1^b	3.7±0.1^b	323±0.1^b
Commercial sports drink	6.7±0.2^a	26.6±0.8^a	3.1±0.0^a	290±0.0^a

Mean ± standard deviation (n=2). Mean values having different superscript within the same column are significantly different ($p<0.05$)

For the adequate performance of athletes, there is a need to prevent fatigue by supplying adequate energy to the working muscles. It was reported by the Scientific Committee on Food (SCF) that energy content for sports drink should be within the range of 8-35Kcal/100ml [14]. Energy content of the developed drink was 30.1 Kcal while the commercial drink was 26.6 Kcal. This probably implies that the developed drink will supply adequate energy to the working muscles.

The pH value is a measure of the acidity or alkalinity nature of a sample. The pH of both developed and commercial drinks were 3.7 and 3.1 respectively and this shows that both drinks were acidic in nature.

Osmolality is defined as the number of particles per kilogram of solvent water and its unit is mOsmol/kg H_2O. As reported by the Scientific Committee on Food (SCF) of the European Commission, osmolality is an important factor that influences the rate of gastric

emptying of drinks [14]. Drinks termed isotonic sports drink that is intended to supply energy efficiently and maintain or restore hydration especially for the sportsmen should have osmolality within the range of 270-330 mOsmol/kg [14]. The developed drink and the commercial drink are within this range and this implies that the developed drink produced from the date and watermelon fruits will supply energy and it will rehydrate the athletes.

Sensory evaluation of the developed Sports drink in comparison with the commercial Sports drink is presented in Table 2. There was a significant difference in the sensory attributes of developed and commercial Sports drink ($p< 0.05$), except taste and after taste.

Table 2: Sensory Evaluation of Sports Drinks

Sample	Appearance	Colour	Aroma	Taste	Aftertaste	Overall acceptability
AKM	5.7±1.8[a]	5.6±1.9 [a]	5.8±1.1 [a]	6.4±1.3 [a]	6.4±1.5 [a]	6.5±1.3 [a]
TCP	6.1±1.8 [a]	5.8±1.7 [a]	5.9±1.2 [a]	6.3±1.6 [a]	6.6±1.4 [a]	6.5±1.1 [a]
XUY	8.0±0.7 [b]	7.9±0.9 [b]	7.6±0.8 [b]	6.9±0.9 [a]	6.7±1.2 [a]	7.3±1.1 [b]

Mean ± standard deviation (n=20). Mean values having different superscript within the same column are significantly different ($p<0.05$) AKM denote developed sports drink, TCP denote developed sports drink (replicate of AKM), XUY denote commercial sports drink

Sensory evaluation is a means of finding out human reactions to foods and materials by measuring, analyzing and interpreting results obtained perceived by the senses of sight, smell, taste, touch, and hearing [15].

Appearance is a major attribute in the sensory evaluation because of its influence in products acceptability. The sensory scores were rated between 8.0 and 5.7 for commercial and developed drinks respectively. The developed Sports drink had the least acceptability in terms of appearance could be due to the plain colour of the drink which was very close to being a colorless product. The high correlation between the color attribute and appearance revealed that color had a significant effect on the appearance of the drink. This suggests that colorant could be added to the developed drink to enhance its appearance.

The sensory scores for color of the developed Sports drink ranged between 7.9 and 5.6 for commercial and developed drinks respectively. The high colour attributed to the commercial sports drink could be due to the added colouring agent which enhanced the acceptability of the drink.

Taste is another parameter used to determine the acceptability of a food product. There was no significant difference in the taste and after taste perception of the sports drink. The mean score for the taste ranged between 6.9 and 6.4, commercial sports drink had the highest mean score, while the developed drink had the least mean score. Due to the fact that no significant difference was observed in the taste perception, this probably implies that both samples had almost the same taste perception by the panelists.

The mean score for the after taste ranged between 6.7 and 6.4 for commercial and developed sports drink respectively.

The overall acceptability of a product is the aggregate preference of the product as perceived by sensory panelists. The mean values ranged between 7.3 and 6.5, the commercial drink was more rated than the developed drink. This implies that the commercial drink was more accepted than the developed drink.

Correlation of the sensory attributes as shown in Table 3 showed that the colour highly correlated with the appearance of the drink and this could be inferred that the appearance of a food product is influenced by its colour.

Conclusion

The Isotonic Sports drink developed from the Date powder and Watermelon juice was slightly accepted by the panelists used in this study but there could be improvement in the formulation by adding food grade colorant and flavors to enhance the acceptability of the developed product. The developed Sports drink showed that it possesses adequate energy and the osmolality of the drink is within range for isotonic Sports drink. This therefore shows that an appropriate combination of adequately processed Date palm and Watermelon fruits could be used in industrial production of isotonic Sports drink production especially in countries where both raw materials are widely grown and available in abundance.

This product is a suitable alternative for most of the commercially available isotonic sport drinks especially those consumed by Athletes in most developing countries of the world.

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