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Chemical and antioxidant properties of snake tomato (*Trichosanthes cucumerina*) juice and Pineapple (*Ananas comosus*) juice blends and their changes during storage

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ABSTRACT

Juice blends made from the mixture of snake tomato (*Trichosanthes cucumerina*) and Pineapple (*Ananas comosus*) fruits were analyzed for pH, antioxidant properties, total titratable acidity, vitamin C, lycopene and total phenolic contents after different blend ratios were made. The addition of snake tomato juice increased the vitamin C, total carotene, lycopene and antioxidant properties of the juice blends. The radical scavenging properties of juice blends containing a higher ratio of snake tomato were higher and samples stored at room temperature (29 °C) showed an increase in antioxidant properties compared to samples stored at 4 °C. In conclusion, snake tomato juice up to 50% may be added to Pineapple juice to make a healthy juice blend.

1. Introduction

Snake tomato (*Trichosanthes cucumerina*) as it is commonly called or long tomato in some parts of Nigeria is consumed as a vegetable due to its good nutritional value (Sandhya, Vinod, Chandra, Aradhana, & Vamshi, 2010). The plant is a good source of bioactive compounds such as carotenoids, flavonoids, and phenolic acids and this makes it a suitable antioxidant source (Adebooye, 2008; Ojiako & Igwe, 2008). Bioactive compounds possess antioxidant properties which are known to neutralize free radical species (Skrovankova, Sumczynski, Mlcek, Jurikova, & Sochor, 2015).

Snake tomato has been found useful as a substitute for common tomato (*Lycopersicon esculentum*) (Adebooye, 2008; Ademosun, Oboh, Adewuni, Akinyemi, & Olasehinde, 2013) in some parts of the tropics when the common tomatoes are scarce or off-season. Onagoruwa (2002) reported that the snake tomato pulp is thicker, sweeter and less sour compared to the common tomato. Snake tomato juice and leaves are reported to be useful in treating liver disorders (Rahman, Anisuzzaman, Alam, Islam, & Zaman, 2006) and diabetes (Andrade-Cetto & Heinrich, 2005). Despite all the information on the usefulness of snake tomato, it still remains underutilized.

Mixed fruit juices are widely more popular than pure or concentrated juices and generally accepted due to their natural flavour, availability and health benefits (Oludemi & Akanbi, 2013). However, pure or concentrated juices are unacceptable to various consumers because of their astringent flavour and taste (Oludemi & Akanbi, 2013; Shaw, 1994). These limitations influenced the blending of snake tomato juice with another fruit such as pineapple which has a more appealing flavour and lower viscosity.

Pineapple (*Ananas comosus var Smooth cayennes*) is one of the common fruits in many tropical and subtropical countries. It is best consumed fresh or in form of a juice (Rattanathanalerk, Chiewchan, & Srichumpoung, 2006). Pineapple juice contributes to healthy living because it is a good source of vitamins, phenols, organic acids and carbohydrate (Zheng & Lu, 2011). Pineapple juice is popular amongst Nigerians and is fast becoming a fruit commodity of choice as it is on display in supermarkets, grocery stores, and fruit markets. It is usually sold whole, peeled or sliced and packaged inside low-density polyethylene bags. The presence of key phytochemicals such as lycopene in snake tomato informed the interest to evaluate its antioxidant properties in a blend with pineapple. The objective of this study was therefore aimed to determine the changes in chemical and antioxidant properties of snake tomato and pineapple juice blends during storage.

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2. Materials and methods

2.1. Materials

2.1.1. Juice preparation

Mature, fresh and ripe snake tomatoes (*Trichosanthes cucumerina*) were obtained from Obafemi Awolowo University teaching and research farm, Ile-Ife and fully mature fresh pineapple (*A. comosus var Cayennes*) were bought from the main market in Ile-Ife, Nigeria. The snake tomatoes were rinsed, sorted and seeds and skin removed. The fruit pulps were then blended using control blender Breville BBl605XL Hemisphere (Breville, China) and sieved through a muslin cloth to have relatively fine juice. Fresh, mature and ripe pineapple fruits were washed, peeled and cut into smaller bits after which they were blended and sieved to remove the pulp.

2.1.2. Blending and pasteurization of juice

Pineapple juice and snake tomato juice were mixed in a clean plastic bucket in three volumetric ratios 70:30, 50:50 and 40:60 and labeled sample C, D, and E, while 100% snake tomato juice was sample A and 100% pineapple juice was sample B. About 300 ppm potassium sorbate was added as preservative (Oludemi & Akanbi, 2013).

The juice blends were dispensed into sterile bottles previously washed and dried in the oven at 40 °C for 1 h. The fruit juice blends were pasteurized using hot water at 90 °C for 30 s and cooled under running water.

2.2. Methods

2.2.1. Determination of pH, total soluble solids (^{0}Brix), and total titratable acidity (TTA)

pH meter (Hanna Instrument, Poroa de Varzim, Portugal) previously calibrated with buffer solutions (4 and 7) was used to determine the pH of the samples. Total soluble solids were determined in $^{\circ}$Brix using a handheld refractometer previously adjusted to zero with distilled water (Hanna Instruments, Italy). The prism of the refractometer was cleaned with distilled water after each analysis. Titratable acidity of the samples was determined according to the method of AOAC (2005).

2.2.2. Ascorbic acid content (AA)

AOAC (2005) method was used in determining the ascorbic acid content. About 20 mL of fruit juice (100% juices and the juice blends) samples were made up to 50 mL with oxalic acid (0.1 M) (metal chelator) and filtered. The filtrate (5 ml) was dispensed into a beaker with a pipette and titrated with standardized 2,6-dichlorophenol indophenol dye. The coloured solution changed from orange to pink to mark the end point of the titration. The procedure was repeated three times. The titer values were converted to mg of AA/L of fruit juice samples.

2.2.3. Lycopene and total carotene determination

Lycopene and total carotene contents were measured using spectrophotometric (Hitachi, Model 100-20) method, modified by Goula and Adamopoulos (2005). The lycopene and total carotene were both extracted in a mixture of hexane–acetonitrile–ethanol [50:25:25 (v:v:v)]. About 1 ml of sample was extracted with 50 ml of the solvent mixture. The mixture was stirred (15 min) on a magnetic stirring plate in the dark to extract the carotenoids. Distilled water (3 ml) was added to the mixture and stirred further for 5 min after which it was allowed to settle for 5 min to have phase separation. The absorbance of the filtered hydrophobic phase was measured at 503 and 450 nm for lycopene and total carotenoids, respectively, using hexane as blank.

2.2.4. Total phenols (TPC) determination

Total phenolic contents were determined using Folin-Ciocalteu modified method of Tezcan, Gültekin-Özgüven, Diken, Özçelik, and Erim (2009). Diluted fruit juice samples 300 µl (1 ml of samples: 100 ml of water) with methanol: water (6:4) was mixed with 1.5 ml of 5-fold-diluted Folin–Ciocalteu reagent and 1.2 ml of 7.5% of sodium carbonate. The mixture was allowed to stand for 60 min at room temperature before the absorbance was measured (Hitachi, Model 100-20 spectrophotometer) at 760 nm. Total phenols were expressed as mg Catechin equivalents (mg CE/g) in dry weight basis.

2.2.5. $ABTS^{\cdot+}$ radical scavenging activity determination

The $ABTS^{\cdot+}$ radical scavenging activity of the blend fruit juice samples was measured using the procedure described by Awika, Rooney, Wu, Prior, and Cisneros-zevallos (2003). ABTS stock solution (2 ml of ABST stock solution (0.01 M) was added to 58 ml of phosphate buffer saline pH 6.9) was incubated for 12 h and the reaction mixture was incubated for 30 min. The absorbance was read at 734 nm. Trolox served as the standard and results were expressed as micromole Trolox equivalents per gram sample (µmol TE/g), dry weight basis.

2.2.6. DPPH radical scavenging activity determination

The DPPH radical scavenging activity of the blend fruit juice samples was determined using a modified method described by Apea-Bah, Minnaar, Bester, and Duodu (2014). A 0.609 mM DPPH stock solution was prepared in 80% (v/v) aqueous methanol from which 0.102 mM working solution was prepared. A 5× dilution of the fruit juice blend (10 µl) was reacted with 190 µl of DPPH working solution and incubated in the dark at a temperature (15 ± 2 °C) for 1 h in a 96-well plate. Absorbance was read at 570 nm using a microplate reader (Multiskan FC, Thermo Fisher Scientific, Shanghai, China). Trolox was used as standard and results expressed as millimole Trolox equivalent per gram sample (mmol TE/g) dry weight basis.

2.2.7. Juice blends storage study

The bottled fruit juice blends were immediately stored under two conditions: refrigerated (4 °C) and room temperature (29 °C). The juice blend samples were evaluated for antioxidant properties (using ABTS and DPPH radical scavenging) for a 30-day period at five days interval.

2.2.8. Sensory evaluation

A 15-member sensory panel randomly chosen among students based on consumption of various commercially sold juices. They were trained with different blank labeled juices with a mixture of various commercially sold juices to hedonically evaluate the sensory characteristics of the juices before introducing snake tomato-pineapple juice blends. All samples were randomly labeled alphabetically and the panelist evaluated each sample for taste, colour, aroma, and overall impression on a 9-point hedonic scale from one for dislike extremely to nine for like extremely. The sensory parameters were rated to the popular Five Alive Just Juice.

2.2.9. Statistical analysis

All analyses were performed in triplicates. Data were analyzed using IBM SPSS 20.0. ANOVA (One-way) was performed to determine significant differences between the means, and the means were separated using the least significant difference (LSD).