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Full Length Research Paper

Production and stabilization of coconut-carrot drink using gum Arabic as stabilizer

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Beverages are consumed primarily for their thirst quenching and stimulating effects. Currently there is a growing awareness of the need to take beverages with high nutritional and health benefits. The aim of this research therefore is to produce a stable nutritious drink from coconut and carrot. Coconut (250 g) and carrot (250 g) were blended, the juice was extracted using different amounts of water (500, 600, 700, 800 and 900 ml) at 50°C. The drink sample produced with 700ml of water was found most acceptable by the consumer panel. The sample was therefore selected for subsequent analysis and drink stabilization with different levels of gum arabic (0, 1, 2, 3, 4 and 5%). The sample produced with4% gum arabic was significantly ($p<0.05$) more stable than the others with only 0.1% level of separation after 72 h. The vitamin C and β-carotene contents were 1164 mg/100g and 29 mg/100g respectively. These results suggest that gum arabiccan serve as a good stabilizer for the coconut:carrot drink.

Keywords: Coconut, Carrot, gum Arabic, nutritious drink, stability.

INTRODUCTION

Beverages are foods consumed in the liquid state, primarily for their thirst quenching and stimulating properties. Among the beverages available to consumers, there is an increasing attraction towards fruits and vegetable juices and drinks that provide additional nutrients (Chukwumalume and Nnaji, 2011). This is because, fruits and vegetables are naturally good sources of vitamin C, folate, potassium and β-carotene while others are fortified with important nutrients like calcium and vitamin D.

Carrot contains per 100g edible portion, 23 kcal, 1% protein, 0.2% fat, 5.4% carbohydrate, 90% water, 1200mgβ-carotene, 0.06mgthiamine, 0.05mgriboflavin, Nicotinic acid 0.6 mg and vitamin C66mg, sodium 95 mg, calcium 48 mg, magnesium 12mg, iron 0.6mg, Zinc 0.4mg (Baardseth 1979). Coconut meat on the other hand, contains per 100 g, 354 kcal, carbohydrates 24.23%, sugar 6.23%, dietary fibre 9%, protein 3.33%, water 47%, thiamine 0.66 mg, riboflavin 0.02 mg, niacin 0.54mg, pantothenic acid 1.014mg, vitamin B6 0.05 mg, Vitamin C. 3.3 mg, calcium 14 mg, iron 2.43 mg, magnesium 32 mg, potassium 356 mg, Zinc 1.1 mg (USDA, 2009).

Extracts obtained from carrots and coconuts though high in nutrients are highly unstable. They tend to separate into an upper (oil phase) and a lower (water) phase. An emulsifier/stabilizer can be added to the extract in order to produce a stable product.

Emulsifiers in foods reduce the surface tension at the oil/water interfaces, interact with the starch and protein as well as modifies the crystallization of fat and oil (Kamel, 1991). Examples include gum Arabic, xanthan gum, carrageenan etc. A stabilizer maintains the stability of the emulsion over a long period of time. (Dickson and Stainsby, 1988). However, the choice of the process and the emulsifier/stabilizer affects the stability of the emulsion as well as the sensory quality of

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the product (Kamel, 1991). Gum Arabic can function as an emulsifier, thickening agent as well as a stabilizer (Rinsky and Rinsky, 2009). Gum Arabic is a complex mixture of three molecular mass fractions classified as arabinogalactan, an arabinogalactan protein complex and a glycoprotein (Osman et al., 1993). These complex carbohydrates are able to stabilize oil in water emulsions and even form concentrated solutions of low viscosity (Islam *et al,* 1997). It does not have an upper limit as a food additive. By FDA standards, it is generally regarded as safe (GRAS) because it is natural, biodegradable and non-toxic to human. It is an import ingredient in soft drinks, candies, cake decorations etc (Vives et al., 2001).

In Nigeria, carrots and coconuts are generally eaten raw during certain seasons of the year when they are available in abundance. A lot of wastage is experienced during this season, due to lack of preservation/ processing methods for them. Currently, there are no commercial products made from them.

The objectives of this work therefore are:

1. To determine the coconut/carrot: water ratio suitable for an acceptable drink;
2. To produce a stable coconut/carrot drink;
3. To determine the effect of different levels of gum arabic on the stability of the drink.

It is expected that the results obtained from this work will be relevant for industrial production of coconut-carrot drink. This will help in reducing postharvest losses experienced by farmers and boost revenue for them. Proper utilization of these food crops will provide employment as well as providing a variety in the range of available nutritious drinks.

The scope of this work includes the determination of appropriate extraction procedures, the nutritional quality and the stability of the drink.

MATERIALS AND METHODS

Drink preparation

Mature, healthy carrots and coconuts were obtained from the market. The carrots were scrubbed, thoroughly with a brush and washed and drained, while the coconuts were shelled and the meat extracted. 250 g of the carrot and coconut respectively were weighed out and crushed in an electric blender. Different quantities of warm water (50%) were used to extract the juice (500, 600, 700, 800 and 900 ml). The slurry was sieved using a hand strainer and subsequently filtered with a cheese cloth.

The filtrate obtained was subjected to sensory evaluation using a 20-man panel. The colour, aroma, taste, mouthfeel and overall acceptance were tested on a 9point hedonic scale, to determine the most acceptable sample.

Chemical analysis

The most acceptable sample which is the sample produced using 700 ml of water was subjected to proximate analysis (AOAC, 1990). The vitamin C and β-carotene contents were determined using the methods described by AOAC (1990).

Drink stabilization

Gum Arabic was added at different levels (0, 1, 2, 3, 4 and 5%) to the drink samples. The drinks were pasteurized at 80^{0}C for 2minutes and hot filled into sterile bottles, corked, cooled and labelled. The filled bottles were graduated in millimetres (using a ruler and an indelible marker) and kept undisturbed on a cool dry shelf. The height of the drink in the bottles were read and recorded. Subsequently the height of the upper (separated oil) layer was read and recorded after 24, 48 and 72 h of storage.

The percentage phase separation was determined by the calculation:

$$\frac{\text{height of upper layer}}{\text{Height of the drink.}} \times 100$$

RESULTS AND DISCUSSION

The results (Table 1) of the sensory evaluation reveal that there was no significant differences is the taste of the juice extracts with values ranging from 6.4 to 6.9. The mean values for colour, aroma, mouth feel and overall acceptability were significantly higher for the samples, extracted with 500, 600 and 700 ml of water than those extracted with 800 and 900 ml.The samples extracted with 800 and 900 ml were very dilute and least accepted by the consumer panel.

The mean value for overall acceptability was highest (7.35) for the sample extracted with 700 ml of water. As a result the sample extracted with 700 ml water was chosen for the subsequent analysis.

The proximate composition of the drink sample (Table 2) revealed a moisture content of 90.9%, protein 0.59%, fat 3.01%, ash 0.25%, dietary fibre 0.03%, carbohydrate 5.21%. The high fat content suggests that the extract may likely separate if not well stabilized. This has been reported by previous researchers as a problem associated with production of most high nutrient vegetable milk extracts (Pirie, 1975).

The vitamin C and β-carotene contents were 1164 mg/100g and 29 mg/100g. β-carotene is a precursor of vitamin A in the human body. These values obtained implies that 100g of the fresh drink sample will provide more than the recommended daily allowance for these vitamins (Onyeka 2013). This is very important since most consumers are becoming more conscious of the nutritional benefits of the foods and drinks they consume.

Table 1. Mean sensory scores for coconut carrot juice extract.

Vol. of water used (ml)	Colour	Aroma	Taste	Mouthfeel	Overall acceptance
500	$7.25^{b}\pm1.33$	$6.0^{b}\pm1.80$	$6.9^{a}\pm1.55$	$7.25^{a}\pm1.25$	$7.0^{a}\pm1.65$
600	$7.85^{a}\pm1.03$	$6.9^{a}\pm1.48$	$6.65^{a}\pm1.7$	$6.8^{a}\pm1.60$	$7.05^{a}\pm1.43$
700	$6.95^{c}\pm1.43$	$7.15^{a}\pm1.18$	$6.5^{a}\pm0.82$	$6.85^{a}\pm1.26$	$7.35^{a}\pm1.18$
800	$6.4^{d}\pm1.64$	$6.1^{b}\pm1.25$	$6.4^{a}\pm1.57$	$5.65^{c}\pm1.92$	$5.57^{c}\pm1.51$
900	5.2e±2.17	$6.3^{b}\pm1.62$	$6.5^{a}\pm1.96$	$6.6^{b}\pm2.17$	$6.4^{b}\pm1.90$

Mean value on the same column with subscript are not significantly different (p>0.05).

Table 2. Chemical composition of the most accepted coconut carrot juice extract.

Component	Quantity
Protein	0.59%
Fat	3.01%
Ash	0.25%
Moisture	90.9%
Crude fiber	0.03%
Carbohydrate	5.21%
Vitamin C	1164 mg/100 g
B carotene	29 mg/100 g

Table 3. Mean values for percentage phase separation of drink produced with different levels of gum Arabic.

% Gum Arabic	24 h storage (% phase separation)	48 h storage (% phase separation)	72 h storage (% phase separation)
0	49_{a}	50_{a}	50.9_{a}
1	0.17_{b}	0.30_{c}	0.35_{b}
2	0.18_{b}	0.30_{c}	0.30_{c}
3	0.18_{b}	0.30_{c}	0.30_{c}
4	0.10_{c}	0.09_{d}	0.10_{d}
5	0.12_{c}	0.12_{d}	0.20_{e}

Mean value on the same column with same superscript are not significantly different (p>0.05).

The results of the stability test are shown on Table 3. The control sample (without a gum arabic stabilizer) had the highest level of phase separation (49–50.9%) and was significantly different (P<0.05) from the other samples throughout the period of the study. The samples stabilized with 1, 2 and 3% gum arabic had values of 0.17 to 0.18% separation after standing for 24hrs and were significantly different (P < 0.05) from the 4 and 5% gum arabic samples which gave 0.1% and 0.12% respectively. However, after 72hrs, there was a slight increase in the value for the 1%, 2% and 3% gum arabic samples which gave 0.35, 0.30 and 0.30% separation, respectively while the 4% and 5% samples still remained at only 0.1and 0.2% separation, respectively.

This suggests that 4% gum arabic can serve as a good stabilizer for the coconut:carrot drink. Gum Arabic has been used as emulsifier and stabilizer for products like soft drinks, hard gum candies etc (Vives et al., 2001, Rinsky and Rinsky, 2009). In a previous research by Randall et al. (1988), it was discovered that the high molecular mass protein-rich fraction of the gum Arabic is predominantly adsorbed at the oil in water interface. This is responsible for the emulsifying ability.

Conclusion

The results obtained show that an acceptable, nutritious drink can be obtained from coconut and carrot using the appropriate ratio of 250 g coconut and 250 g carrot with700ml of water. The stability of such a drink was well improved by the addition of 4% gum Arabic. This ensures that the drink will not separate in the glass when it is served.

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