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Unfermented and Fermented Soy-Carrot Beverages Sweetened With Dates and Honey: Physiochemical and Sensory Properties

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Abstract- Unfermented and fermented soy-carrot beverages sweetened with date, and honey were evaluated for their physiochemical, proximate, and sensory properties. The phytochemical content of soymilk, carrot juice, and their combination was also investigated. By homogenising soy milk and carrot juice in a 2:1 ratio and sweetening to 12 percent Brix, three sets of soy-carrot beverages were created. Date and honey were used to sweeten each set. A fourth set was left unsweetened as a control. After pasteurisation, one part was fermented for 24 hours at 42°C with a pure culture of Lactobacillus acidophilus. Fermentation decreased the pH (5.40–3.90), titratable acidity (0.55–0.90 percent lactic acid), and viscosity (0.65–0.87 Pa.S) of the soy-carrot beverages significantly (p0.05). Unfermented beverages had moisture, protein, fat, ash, carbohydrate, and energy content of 82.85–94.95 percent, 2.14–2.88 percent, 0.42–1.21 percent, 0.10–0.20 percent, 3.21–12.55 percent, and 26.46–74.53 Kcal/g, respectively, while fermented beverages had 90.00–92.00 percent, 2.06–2.20 percent, 0.87–1.08 percent, 0.11–10.20 percent, 4.86–8 and 36.77–53.20 Kcal/g, respectively. Total carotenoid, phenol, and DPPH radical scavenging activity ranged from 2.40–7.90 mg tannic acid/ml, 14.81–26.59 mg tannic acid/ml, and 4.02–27.83 percent, respectively, and were significantly (p0.05) higher in a soy-carrot blend with carrot as the major contributor. The degree of similarity of the sensory attributes for sweetened and unfermented beverages was significantly (p0.05) higher than for fermented beverages. Dates and honey (12 percent Brix) can be used as sucrose substitutes in the preparation of a nutritious beverage from soymilk and carrot juice.

Keywords- Unfermented soy-carrot beverages, fermentation, soy milk, carrot juice.

INTRODUCTION

Because of their sweet taste and flavour, beverages, particularly carbonated and sugar sweetened beverages, are widely consumed. Soft drinks with high sugar and acidity, on the other hand, contribute to poor oral health and other general health problems, such as fatty liver [1,2]. Health concerns have led to the popularity of natural drinks as alternatives to carbonated and sweetened beverages all over the world. Fruit drinks and juices are nutritious, delicious, and have numerous health benefits [3]. During the dry season, non-alcoholic beverages are served as after-meal drinks or refreshing drinks in rural and urban areas [4]. Because of their high protein content and low cost, soybean products are important in household nutrition programmes [5]. Soymilk is not technically milk because it lacks lactose, but rather an aqueous extract of soybean (Glycine max) that resembles milk after soybeans are soaked, finely ground, and strained [6,7]. Good quality soymilk has the same nutritional composition, appearance, and flavour as cow milk. Soymilk and cow's milk have nearly identical amounts of protein and water, but soymilk has some advantages: it does not contain lactose, which is beneficial to lactose intolerant people, it contains fiber, and it contains less fat, which is beneficial to health [7].

Carrot (Daucus carota) is a root crop grown for its flesh roots, which are consumed by humans and animals. It contains ascorbic acid, tocopherol carbohydrates, calcium, phosphorus, iron, potassium, magnesium, copper, manganese, sulphur, and phenolic compounds, but is low in protein and fat [8,9]. Carrots contain -carotene, which is a precursor to Vitamin A and promotes eye health.

Other carrot components have antioxidant and anticancer properties, leading to an increase in its consumption [10]. Carrots can be processed into a wide range of products (carrot juice, dehydrated carrot juice, beverages, candy, and preserves), the most popular of which is carrot juice [10,11].

Honey is a natural sweet, viscous substance produced by honeybees (Apis mellifera) from nectar of blossoms or secretions of living parts of plants or excretions of plant sucking insects on living parts of plants, which honeybees collect, transform, and combine with specific substances of their own, store, and leave in the honey comb to ripen and mature [13].

Honey has been used as a food, a sweetener for foods, and a therapeutic agent since ancient times. It is high in micro- and macronutrients and high in sugar, primarily fructose and glucose, making it an excellent source of energy and contributing to its physical properties such as hygroscopicity, granulation, and viscosity [14]. Date (Phoenix dactylifera) is a tasty fruit with a sweet taste and a fleshy mouth feel. Date flesh is low in fat and protein while being high in sugars, primarily fructose and glucose [15].

Date sugars are easily digested and metabolized, releasing energy for a variety of cell activities. Dates are also high in fibre and contain a variety of vitamins and minerals, including high levels of calcium, iron, fluorine, and selenium [16,17]. Dates have been shown to have antioxidant and antimutagenic properties, as well as some health benefits [18]. Fermentation is a traditional method of processing soybeans. It is a desirable biochemical modification of the primary food matrix caused by microorganisms and their enzymes [19]. Fermentation of soy beverages aids in the reduction of beany flavour as well as the associated problems of flatulence and indigestion.

Fermentation of soy beverages reduces beany flavour and the problem of flatulence and indigestion associated with the presence of raffinose and stachyose, in addition to improving protein digestion and increasing isoflavone bioavailability [20]. The fermentation of vegetable juices, as well as the low pH of the fermented juice, improves the stability of bioactive compounds such as Vitamin C [21]. Soymilk is high in protein, which carrots are low in. Soymilk can be fortified with carrot juice, which contains beta-carotene, and sweeteners can be added to increase the sweetness and acceptability of the beverages.As a result, the goal of this research is to assess the physiochemical and sensory properties of unfermented and fermented soy-carrot beverages sweetened with honey and dates.

METHOD

Sample

Soybean (Glycine max), carrot (D. carota), honey, date fruit (P. dactylifera), and table sugar (sucrose) samples were taken.

Soy milk preparation

After sorting to remove foreign matter, 500 g of the soybean was soaked overnight in distilled water at room temperature and then dehulled. The dehulled soybean was blended for 5 minutes with water (1:5) in a Philips HR2000 blender, and the milk was extracted by sieving the paste through a muslin cloth. The milk was heated at 95°C for 20 minutes with constant stirring, cooled, and refrigerated until needed.

Carrot drink preparation

The Banigo et al. [22] method was used. After sorting, scraping, and washing, about 200 g of carrot was sliced and extracted with a juice extractor. The pulp was sieved with muslin cloth to extract even more juice.

Unfermented and fermented soy-carrot beverages sweetened with date and honey are produced.

Three different types of soy-carrot beverages were created by blending and homogenizing soy milk and carrot juice in a 2:1 ratio with a blender. The beverages were sweetened to a Brix level of 11.5 percent. The first set of beverages was sweetened with dates, and the second set with honey.

The physicochemical (pH, titratable acidity [TTA], viscosity) analysis of unfermented and fermented soy-carrot beverages sweetened with date and honey was performed using the AOAC method [23]. To determine pH, sweetening, and viscosity, a pH meter , a viscometer, and a handheld portable sugar refractometer were used. TTA was titrated with 0.1 N NaOH and phenolphthalein solution as an indicator.

A mixture of unfermented and fermented soy-carrot beverages sweetened with date and honey.

The samples were subjected to proximate analysis using standard AOAC [23] methods. Moisture content was calculated after drying to constant weight at 105°C in an air oven (Thermo Scientific). The protein was determined using the Kjeldahl method. To calculate the protein value, the nitrogen efficiency was corrected with acetanilide values and multiplied by a factor of 6.25. Extensive extraction of known weight samples with petroleum ether using a rapid Soxhlet extraction apparatus was used to estimate fat (Gerhardt Soxtherm). After incineration in a muffle furnace (Carbolite) for 2 hours at 550°C, ash was determined gravimetrically. The difference between 100 percent and (percent MC + percent Ash + percent Crude protein + percent Fat + percent Crude fibre) determined the carbohydrate content. The total solid was calculated by deducting the moisture content from 100. The Atwater factor of 4.0 Kcal/g for protein and carbohydrate and 9 Kcal/g for fat was used to calculate energy (Kcal/g).

Sensory evaluation of fermented and unfermented soy-carrot beverages sweetened with date and honey.

A 15 member panellist comprised of staff and students from the Department of Food Science and Technology, Rivers State University, Port Harcourt, Rivers State, Nigeria, assessed the degree of similarity of the soy-carrot beverages. Color, flavour, mouth feel, odour, tartness, taste, and overall acceptability were the sensory qualities evaluated. The rating was based on a 9-point hedonic scale, with the degree of dislike expressed as follows: 1 – disliked extremely, 2 – dislike very much, 3 – disliked moderately, 4 – dislike slightly, 5 – neither like nor dislike, 6 – like slightly, 7 – like moderately, 8 – like very much, and 9 – like extremely [24].

Phytochemical analysis of unfermented and fermented soy-carrot beverage sweetened with date, and honey

Determination of total carotenoid content

The solvent extraction and spectrophotometric method described by Biswas and Chatli [25] were modified. In a centrifuge tube, 10 ml of 80 percent acetone was added to 0.5 ml of the soy-carrot sample, properly mixed, and centrifuged at 4000 rpm for 10 minutes. Using 80 percent ethanol, a supernatant of 15 mL was created. The absorbance was measured with a UV–visible spectrophotometer at 480 nm. Total carotenoid content (mg/kg) was calculated by dividing (4 OD Total volume of sample 100) by sample volume[1].

Antioxidant properties (1,1-diphenyl-1picryl-hydrazyl [DPPH] radical scavenging activities)

The effect of soy-carrot extract on DPPH was determined using a modified Liyana-Pathiranan and Shahidi [26] method. After vigorous shaking and standing for 2 hours, 25 ml of soy-carrot sample in 25 ml of ethanol was centrifuged at 2500 rpm for 17 minutes. To obtain the soy-carrot extract, the supernatant was concentrated by evaporating it in an 80°C water bath, and concentrations of 0.02, 0.04, 0.06, 0.08, and 0.10 mg/ml of the extract were prepared in ethanol. In ethanol, a 0.135 mM DPPH solution was prepared. 1.5 mL of the prepared extract was mixed with 1.5 mL of the DPPH solution. 1.5 ml of the prepared extract was mixed with 1.5 ml of the DPPH solution. At 517 nm, the absorbance was measured using ethanol as a blank and DPPH solution as a control. Ascorbic acid was used as a control. Antioxidant capacity was calculated as DPPH radical scavenging activity (percent) as (Abs of controlAbs of test sample100)/Abs of control.

Statistical analysis

Minitab, Statistical Software (Minitab Ltd.,) programme was used for data analysis. At a 95% confidence level, statistical differences were obtained using analysis of variance under the general linear model and Fisher pairwise comparison[1].

RESULT AND DISCUSSION

Figure 1 depicts the pH and TTA of the soy-carrot beverages. The pH of the unfermented and fermented beverages ranged between 5.40 and 5.55 and 3.75 and 3.90, respectively. TTA ranged from 0.25 to 0.55 percent lactic acid in unfermented beverages and from 0.90 to 1.31 percent lactic acid in fermented beverages. The pH of the unfermented beverages is comparable to that reported by Banigo et al. [22] for soy-carrot-beetroot drink but lower than that reported by Nwoke et al.

[28] for soymilk (6.12–6.28) from different varieties of soybean and 6.22 for untreated carrot juice [11]. In addition to the sweeteners, the treatment given to the soy-carrot beverage may have reduced the pH. Addition of sugar led to significant ($p \leq 0.05$) increase in the initial pH, while the other sweeteners did not differ from the control

Sharma et al. [11] reported a decrease in pH of treated carrot juices, and sweeteners like honey have a pH range of 3.21–3.50 [29]. Fermentation caused a significant (p0.05) drop in pH and an increase in TTA. This was expected due to the acid produced by the fermenting microorganism's activity. Such reduction in pH will discourage the growth of spoilage bacteria [1].

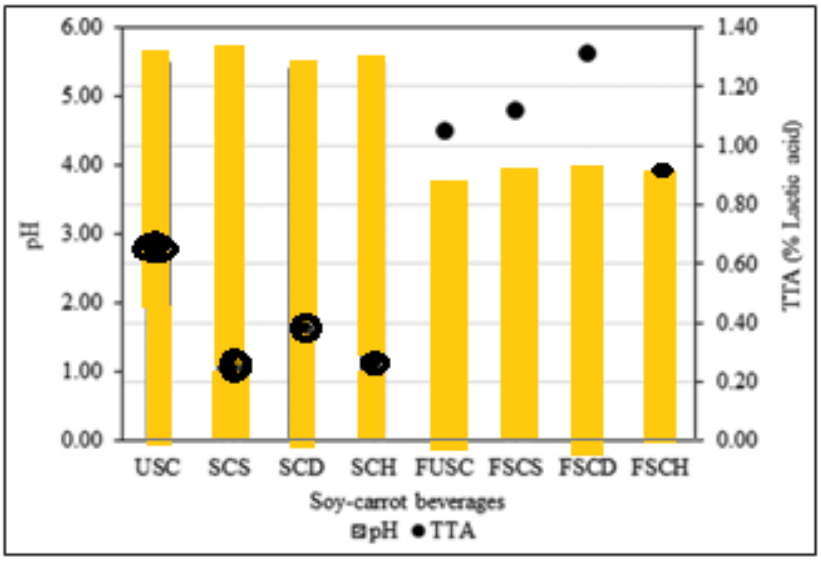

Fig.1 Unfermented and fermented soy-carrot beverages sweetened with date and honey were tested for pH and titratable acidity (TTA) (percent lactic acid). USC: Unsweetened soy-carrot beverage, FUSC: Fermented unsweetened soy-carrot beverage, SCS: Soy-carrot beverage with sugar, SCS: Soy-carrot beverage with sugar, SCS: Soy-carrot beverage with sugar, SCS: Soy-carrot beverage with sugar, SCS: Soy-carrot beverage with sugar, Fermented soy-carrot beverage with sugar, abbreviated as FSCS. SCD: Date-infused soy-carrot beverage Fermented soy-carrot beverage with date, FSCD SCH: Soy-carrot-honey beverage, FSCH: Fermented soy-carrot-honey beverage[1].

Table 1: Viscosity and sugar levels of unfermented and fermented soy-carrot beverages sweetened with date, and honey

Samples	Viscosity (Pa.S)	Sugar level (Brix)
USC	0.51 ± 0.01^{d}	5
SCS	0.64 ± 0.01^{c}	9
SCD	0.65 ± 0.00^{c}	9
SCH	0.57 ± 0.03^{d}	9
FUSC	0.66 ± 0.02^{bc}	5
FSCS	0.87 ± 0.01^{a}	9
FSCD	0.71 ± 0.00^{b}	9
FSCH	0.64 ± 0.00^{c}	9

Means with the same superscript in the same column do not differ significantly ($p \leq 0.05$) N=3 ± SD.
USC: Unsweetened soy-carrot beverage, FUSC:
Fermented unsweetened soy-carrot beverage, SCS: Soy-carrot beverage with sugar, FSCS: Fermented soy-carrot beverage with sugar, SCD: Soy-carrot beverage with date, FSCD: Fermented soy-carrot beverage with date, SCH: Soy-carrot
beverage with honey, FSCH: Fermented soy-carrot beverage with honey[1].

Sensory evaluation

Sweeteners improved the likeness of the sensory attributes of the unfermented beverages significantly (p0.05). The assessors' preference for sugary beverages was significantly (p0.05) higher: Between slight to moderate likeness, the control was significantly (p0.05) the least, and between dislike moderately to neither like nor dislike. Fermentation resulted in a significant (p0.05) decrease in the degree of likeness of the assessor. Except for yoghurts, most beverages are not consumed as fermented products, which could explain the decrease in assessors' likings of the fermented soy-carrot beverage, despite Kiros' recommendation that fermentation with fortified fruits be used[22].

Table 2: Phytochemical composition of plain unfermented soy, carrot, and soy-carrot beverages

Samples	Total carotenoid	Total phenol (mg tannic acid/ml)	DPPH radical scavenging activity (%)
Carrot juice	7.91 ± 0.10^{a}	20.22 ± 0.36^{b}	9.16 ± 0.30^{b}
Soymilk	ND	14.81 ± 0.02^{c}	4.02 ± 0.31^{c}
Soy-carrot beverage	2.40 ± 0.10^{b}	26.59 ± 0.70^{a}	27.84 ± 1.00^{a}

Means with the same superscript in the same column do not differ significantly ($p\leq0.05$) n=3 ± SD. ND: Not detected

CONCLUSION

Soymilk and carrot were combined to create an acceptable nutritious beverage with 12% Brix of date and honey. The addition of sweeteners improved the beverages' physicochemical, proximate, and sensory properties. Date and honey beverages were comparable to sugar beverages. Despite the fact that fermentation causes significant (p0.05) decreases, the decrease in pH and increase in acidity can provide storage stability. The beverage can also be fermented to create a unique refreshing drink. It was also discovered that the soy-carrot beverage contained antioxidants, with carrot juice playing a significant role. As a result, date and honey (12 percent Brix) can be used in place of sugar to make an acceptable nutritious antioxidant-rich beverage from soymilk and carrot blend. More research is needed to determine the storage stability of this beverage under various storage conditions.

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