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Research Article
Effect of Roasted Finger Millet Malt and Vegetable Juice on the Composition and Acceptability of Processed Malt Drink

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Abstract

Objective: The study was conducted to evaluate the effect of vegetable juice on the composition and organoleptic properties of the roasted finger millet malt drink. **Materials and Methods:** Finger millet was malted for 48 hrs, dried for 5 days and divided into two portions. A portion of the finger millet malt was roasted and combined with unroasted malt to prepare malt drinks. Extracted carrot and cucumber juice and finger millet malt drink were pasteurized, blended in different ratios and subjected to proximate composition, micronutrient, physicochemical properties and acceptability test. **Results:** The ash content of the malt drink varied from 0.3-0.9%. Juice without supplements had fat content of 0.60 and 0.30% for roasted and unroasted malt drinks, respectively which decreased with vegetable juice supplementation and the values ranged from 0.20-0.34 and 0.15-0.20% for supplemented roasted and unroasted sample, respectively. Malt drinks without supplements had carbohydrate contents ranging from 6.26 -8.05% which reduced to 4.51-7.46%. Total soluble solid contents of finger millet malt drink varied from 6.15 -19.05° Brix. The roasted finger millet malt drink had increased pro-vitamin A, vitamin E and pH contents when supplemented with juice from carrot, cucumber, or mixed juice. The incorporation of 25% cucumber juice and 25% carrot juice in the roasted or unroasted finger millet malt drinks had a marginal effect on the organoleptic properties of colour, appearance, flavour, taste and overall acceptability compared to malt drinks from 100% roasted and unroasted finger millet malt as rated by the panelists. Also, roasted finger millet malt drink was preferred in terms of colour and appearance while unroasted finger millet malt drink was preferred in terms of flavour, taste, after-taste and overall acceptability. **Conclusion:** Supplementation of roasted malt drinks with 25% cucumber and 25% carrot juice had no negative effect on the acceptability of products and was preferred in terms of their overall acceptability among supplemented samples.

Key words: Carrot juice, cucumber juice, non-alcoholic beverages, nutrient composition, roasted finger millet malt

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Development of novel products in the food and nutraceutical fields has recently attracted attention[1]. Due to strict regulations regarding drink drive, the market for non-alcoholic beverages has grown[2] and novel drinks from natural raw materials have raised awareness of the consumption of beverages. Malt drinks, like other beverages, are consumed for their thirst-quenching properties or stimulating effects. Originally, malt drinks were food for children and the sick but nowadays they are consumed by people of all ages. Due to increased awareness of health issues, malt-based drinks have established a reputation for their nutritional value over the centuries[3]. The drinks are common in many parts of the world and their consumption is increasing among African countries, particularly Nigeria. Malt is the major raw material used in preparing non-alcoholic malt drinks 'malta' around the world[4]. The malting process involves soaking, germinating and drying. The malting process changes grains into malt with high enzymes and vitamin contents. Malting of grains improves their organoleptic properties and decreases antinutrients (phytate, oxalate and tannin)[5]. Phenol and protein contents increase while the lipid component decreases in malted grains. The production of malted drinks in Nigeria depends mainly on imported raw materials, especially barley, therefore, the end product is expensiveness. Over-dependence on imported raw materials weakens a country's economic strength and impacts negatively on the brewing and allied industries.

Jones and Engleson[6] noted that utilization of cereal grains in food formulations is increasing worldwide due to their rich phytochemicals and dietary fibre which provide numerous health benefits. Millet grains, being underutilized in many developing countries have great potential to be processed into value-added foods and beverages. Also being gluten-free, millets can serve as food for celiac patients[7]. Finger millet (*Eleusine coracana*) is a cereal grain cultivated mainly in the semi-arid and subtropical regions of the world[8]. The plant yields satisfactorily on marginal lands and its tasty grain is remarkable for its long storage life. Finger millet is a staple food crop in drought-prone areas of the world and is considered an important component of food security[9], rich in methionine, an amino acid that is lacking in many of the diets consumed by millions of the world's poor. Phytochemicals such as phenolics, lignans, β-glucan, inulin, resistant starch, phytates and sterols are found in finger millet[10]. Tocopherol, dietary fibre and carotenoids are also present in finger millet. Millet foods contain polyphenols, among other phytochemicals that contribute to the antioxidant activity, this is an essential factor in health, aging and metabolic diseases[7]. Malted grains and natural plant juices are suitable for the production of functional beverages as they are generally considered healthy food ingredients.

Vegetables such as carrots and cucumbers have numerous health benefits due to their high content of vitamins and phytochemicals. It has been reported that cucumber reduces blood sugar levels[11] and carrot is rich in antioxidants and beta-carotene among others. This study evaluated the effect of vegetable juice incorporation on the composition and organoleptic properties of finger millet malt drink.

MATERIALS AND METHODS

Materials: Finger millet (*Eleusine coracana*) grain was purchased from Jos, Plateau state, Nigeria. Cucumber (*Cucumis sativus*) and carrot (*Daucus carota*) were purchased from Ogige market, Nsukka, Enugu state, Nigeria.

Processing of finger millet malt drinks: Finger millet grains were cleaned by winnowing and 400 g was weighed and steeped in water for 24 hrs at room temperature with a constant change of water at 6 hrs intervals. The excess water was drained off after 24 hrs and the steeped grain was then kept in a malting room and allowed to germinate for 48 hrs at an average temperature of 26±0.25°C. During germination, the grain was moistened by the sprinkling of water at 6 hrs intervals and mixed gently. The green malt was sun-dried at a temperature of 31±0.12°C for 5 days. After drying, the rootlets were removed manually by rubbing in-between palms and the malts were winnowed with a stainless steel tray. The dried malt was packed in airtight low-density polyethylene bags and kept inside a plastic container. Finger millet malt was roasted in a grain roaster with constant stirring at the temperature of 100°C for 20 min to obtain roasted finger millet malt.

Processed malt (roasted and unroasted) was ground in a hammer mill and sieved to obtain flour. Mashing was carried out in a stainless steel pot using flour to water ratio of 1:5 (w/v). For the protein rest period, the mash was held at 45°C for 45 min in a water bath while the mash temperature was increased from 45-60°C and held for 18 min for a sugar rest period. The mash temperature was then increased to 65°C and held for 30 min for dextrinizing rest period (saccharification rest) and further raised to 77°C and held for 8 min for the mashing off period. After mashing, the wort was separated from the spent grain using muslin cloth (2 folds) and then boiled for 10 min. The boiled wort was filtered

through a clean muslin cloth (4 folds) and left for 12 hrs to settle the suspended particles. Racking was done and the supernatant was boiled for 45 min.

Processing of cucumber and carrot juice: Mature fresh cucumber and carrot were sorted and washed thoroughly with clean water. Carrot fruits were scrapped and cut with a stainless steel knife and the juice was extracted using an electric blender (QASA, Model QBL-18L40). The extracted juice was filtered using a muslin cloth while cucumbers were peeled and cut into cubes with a stainless steel knife and the juice was extracted using an electric blender (QASA, Model QBL-18L40). The extracted juice was filtered using a muslin cloth (sieve size, 60 mm).

Production of enriched malt drink: Finger millet malt drinks (400 mL roasted and unroasted) were blended with cucumber juice, carrot juice, or their mixture at different proportion to generate 8 samples coded as:

R100 = Malt drink produced from roasted finger millet malt only
R50:25:25 = Malt drink containing 50% roasted finger millet malt, 25% cucumber juice and 25% carrot juice
R50:50:0 = Malt drink containing 50% roasted finger millet malt, 50% cucumber juice only
R50:0:50 = Malt drink containing 50% roasted finger millet malt, 50% carrot juice only
U100 = Malt drink produced from unroasted finger millet malt only
U50:25:25 = Malt drink containing 50% roasted finger millet malt, 25% cucumber juice and 25% carrot juice
U50:50:0 = Malt drink containing 50% unroasted finger millet malt, 50% cucumber juice only
U50:0:50 = Malt drink containing 50% unroasted finger millet malt, 50% carrot juice only

The formulated malt drinks were pasteurized at 80°C for 3 min, hot filled into clean sterilized bottles and corked. The bottles were allowed to cool to 25°C and stored at refrigerator (<10°C).

Analyses:

Proximate analysis of formulated enriched finger millet malt drink:

Moisture, ash and crude fibre contents of the processed malt drinks were determined as described by AOAC[12]. Crude fat was determined by the Soxhlet method. Protein content was determined by the micro Kjeldahl method as described by Ihekeronye and Ngoddy[13] and percentage of Protein was determined by percentage of Nitrogen 6.25. The carbohydrate content of the samples was determined by subtracting the sums of all other proximate parameters from 100 as described by AOAC[12]:

$$\text{Carbohydrate (\%)} = 100\text{-moisture (\%)+ash (\%)+protein (\%)+fibre (\%)+fat (\%)}$$

Physicochemical and micronutrient analyses of malt drink samples: Titratable acidity and pH (using a standard electrode pH meter) were determined by AOAC[12] methods. Total soluble solids were determined using a refractometric method at atmospheric temperature and expressed as percentage of sucrose by weight (°Brix). Beta-carotene, vitamin C and E contents of the sample were determined as described in AOAC[12]. All analyses were carried out in triplicates.

Sensory analysis: Sensory properties of the processed drinks were determined as described by Ihekoronye and Ngoddy[13]. Panelists (N = 20, age =16-55 years) were recruited based on the criteria that they were not allergic to any of the ingredients used in preparation of the malt drinks. The test was conducted in a sensory laboratory equipped with individual partitioned booths in the Department of Food Science and Technology, University of Nigeria, Nsukka. The panelists were provided with water to rinse their mouth before testing and between samples. Each panelist was presented with eight coded samples. The panelists received instruction on how to complete the questionnaire prior to the evaluation.

Experimental design and statistical analysis: Completely randomized design (CRD) was used in this study. All data were analyzed using one-way analysis of variance (ANOVA) according to Steel and Torrie[14]. Ducan's Multiple Range Test (DMRT) was used to separate the mean using SPSS (Statistical Package for the Social Sciences) version 20. Values of $p<0.05$ were considered statistically significant.

RESULTS AND DISCUSSION

The use of roasted finger malt in the preparation of malt drinks has no significant ($p<0.05$) effect on the moisture content of the drinks as evident in Table 1. The high moisture content of cucumber juice may have increased the moisture content observed in the malt drinks containing 50% cucumber juice (U50:50:0) because cucumbers contain 96% water[11]. High moisture content of the malt drink makes it a good source of hydration for the body as well as a thirst quencher. Generally, a low protein content (0.38-1.79%) was observed in the malt

Table 1: Proximate composition (%) of roasted finger millet malt drink supplemented with vegetable juice

Samples F:Cu:Ca	Moisture	Ash	Protein	Fat	Carbohydrate
R100	89.60±0.30^{a}	0.55±0.05^{a}	1.60±0.15^{a}	0.60±0.10^{b}	8.03±0.47^{e}
R50:25:25	89.80±0.20^{a}	0.35±0.50^{a}	1.70±0.20^{f}	0.25±0.15^{a}	7.46±0.20^{d}
R50:50:0	93.05±0.35^{c}	0.30±0.00^{a}	1.24±0.10^{d}	0.20±0.10^{a}	5.21±0.24^{bc}
R50:0:50	93.90±0.10^{d}	0.30±0.00^{a}	0.90±0.15^{b}	0.70±0.10^{b}	4.21±0.02^{a}
U100	91.20±0.10^{b}	1.05±0.15^{b}	1.34±0.10^{d}	0.25±0.50^{a}	6.26±0.21^{b}
U50:25:25	93.30±0.20^{c}	0.55±0.15^{a}	1.07±0.20^{c}	0.15±0.05^{a}	4.93±0.02^{ab}
U50:50:0	91.40±0.20^{b}	0.50±0.10^{a}	0.38±0.30^{a}	0.20±0.00^{a}	7.32±0.33^{d}
U50:0:50	91.15±0.35^{b}	0.55±0.15^{a}	1.25±0.20^{d}	0.40±0.10^{ab}	6.85±0.08^{a}

Values are mean of three replications±standard deviation. Values on the same column with different superscripts are significantly ($p<0.05$) different, R100: Malt drink produced from roasted finger millet malt only, R50:25:25: Malt drink containing 50% roasted finger millet malt, 25% cucumber juice and 25% carrot juice, R50:50:0: Malt drink containing 50% roasted finger millet malt, 50% cucumber juice only, R50:0:50: Malt drink containing 50% roasted finger millet malt, 50% carrot juice only, U100: Malt drink produced from unroasted finger millet malt only, U50:25:25: Malt drink containing 50% roasted finger millet malt, 25% cucumber juice and 25% carrot juice, U50:50:0: Malt drink containing 50% unroasted finger millet malt, 50% cucumber juice only and U50:0:50: Malt drink containing 50% unroasted finger millet malt, 50% carrot juice only drink

Table 2: Micronutrient contents of roasted finger millet malt drinks supplemented with vegetable juice

Samples F:Cu:Ca	Pro-vitamin A mg/100 mL	Vitamin C mg/100 mL	Vitamin E mg/100 mL
R100	0.22±0.05^{b}	2.50±0.17^{ab}	0.11±0.09^{a}
R50:25:25	0.63±0.04^{bc}	2.40±0.07^{ab}	0.33±0.02^{b}
R50:50:0	0.18±0.10^{ab}	2.33±0.14^{a}	0.06±0.04^{a}
R50:0:50	0.85±0.04^{c}	3.15±0.25^{d}	0.35±0.00^{b}
U100	0.07±0.02^{a}	2.80±0.05^{c}	0.07±0.02^{a}
U50:25:25	0.19±0.17^{ab}	2.69±0.02^{b}	0.09±0.02^{a}
U50:50:0	0.11±0.02^{a}	2.53±0.15^{ab}	0.06±0.00^{a}
U50:0:50	0.67±0.01^{bc}	3.20±0.07^{d}	0.33±0.03^{b}

Values are mean of three replications±standard deviation, Means on the same column with different superscripts are significantly ($p<0.05$) different, Key: R100: Malt drink produced from roasted finger millet malt only, R50:25:25: Malt drink containing 50% roasted finger millet malt, 25% cucumber juice and 25% carrot juice, R50:50:0: Malt drink containing 50% roasted finger millet malt, 50% cucumber juice only, R50:0:50: Malt drink containing 50% roasted finger millet malt, 50% carrot juice only, U100: Malt drink produced from unroasted finger millet malt only, U50:25:25: Malt drink containing 50% roasted finger millet malt, 25% cucumber juice and 25% carrot juice, U50:50:0: Malt drink containing 50% unroasted finger millet malt, 50% cucumber juice only and U50:0:50: Malt drink containing 50% unroasted finger millet malt, 50% carrot juice only

drinks. During the protein rest period, protein reduction is one of the steps involved in the processing of the malt drinks. Also, malt drinks are not consumed basically for their protein content but to provide satiety and refreshment. The level of ash in the malt drink indicated that it has higher mineral content as ash content is an indicator of the mineral content of products[15] suggesting that malt drinks may be a good source of minerals. Although ash content of the blends varies (0.30-0.90%), the differences were not statistically significant ($p>0.05$) among the blends except for malt drink produced from unroasted finger millet malt only. Malt drinks enriched with carrot juice or mixture had lower fat content than the control. The fat content of malt drinks with roasted finger millet malt was higher than their counterpart.

A reduction in fat content was observed in the finger millet malt supplemented with either cucumber juice or carrot juice or their mix. Cucumbers and carrot are vegetables, hence are not rich sources of fat[16,17]. The low-fat content of the malt may also be due to use of roasted finger millet malt. The fibre was undetected in the malt drinks. The absence of fibre in the processed drinks could be due to filtration which may have removed the fibrous materials. The highest carbohydrate content (8.03%) was observed in the sample containing 50% roasted finger millet and 50% cucumber (R50:50:0). The presence of carbohydrates in the drink indicates that the malt could serve as a source of energy.

Micronutrient contents of roasted and unroasted finger millet malt-cucumber-carrot drinks are presented in Table 2. A provitamin A content of the finger millet malt drinks measured as β- carotene varied from 0.11-0.85 mg/100 mL. A high value of β-carotene was observed in the blends containing carrot juice or cucumber-carrot juice compared to 100% roasted/unroasted finger millet malt drinks or formulation with cucumber juice while the use of roasted malt in formulation gave higher pro-vitamin A content compared to unroasted malt drink.

Increasing the quantity of cucumber in the blends reduced the β-carotene content while increasing carrot juice increased the β-carotene content. A high pro-vitamin A content observed in the blends containing carrot juice or a mixture of cucumber and carrot juice could be attributed to the high β-carotene content of carrot. The level of pro-vitamin A observed in the study suggests that consumption of the supplemented malt drinks may be good for the population that is vitamin A deficient as Beta-carotene is a vitamin A precursor.

Supplementation of roasted/unroasted malt drink with carrot juice increased the vitamin E and C contents which further increased when there was an increase in the quantity of carrot juice in the malt drinks compared to other blends. Vitamin C, a water-soluble antioxidant cannot be manufactured by the body but needs to be ingested from diets and as an antioxidant

Table 3: Physicochemical content of roasted finger millet malt drinks supplemented with vegetable juice

Samples F:Cu:Ca	pH	Titratable acidity (%)	TSS (°Brix)
R100	4.10±0.00^{a}	0.04±0.10^{a}	10.55±0.05^{d}
R50:25:25	4.35±0.05^{d}	0.04±0.01^{a}	10.30±0.10^{d}
R50:50:0	4.40±0.00^{de}	0.04±0.01^{a}	6.70±0.10^{bd}
R50:0:50	4.65±0.05^{f}	0.04±0.01^{a}	6.20±0.20^{a}
U100	4.15±0.05^{b}	0.05±0.10^{a}	9.05±0.15^{e}
U50:25:25	4.30±0.00^{cd}	0.04±0.01^{a}	6.15±0.15^{a}
U50:50:0	4.25±0.50^{c}	0.04±0.01^{a}	8.85±0.05^{c}
U50:0:50	4.50±0.05^{e}	0.07±0.0^{a}	6.70±0.20^{b}

Values are mean of three replications±standard deviation, Values on the same column with different superscripts are significantly ($p<0.05$) different, R100: Malt drink produced from roasted finger millet malt only, R50:25:25: Malt drink containing 50% roasted finger millet malt, 25% cucumber juice and 25% carrot juice, R50:50:0: Malt drink containing 50% roasted finger millet malt, 50% cucumber juice only, R50:0:50: Malt drink containing 50% roasted finger millet malt, 50% carrot juice only, U100: Malt drink produced from unroasted finger millet malt only, U50:25:25: Malt drink containing 50% roasted finger millet malt, 25% cucumber juice and 25% carrot juice, U50:50:0: Malt drink containing 50% unroasted finger millet malt, 50% cucumber juice only and U50:0:50: Malt drink containing 50% unroasted finger millet malt, 50% carrot juice

functions best when consumed together with bioflavonoids and other antioxidants as there is synergy between them. Vitamin C deficiency causes scurvy, 'pinpoint' hemorrhage under the skin and soft and spongy bleeding gum among others[3]. The vitamin E content of the formulated finger millet malt composite drinks ranged from 0.06-0.33 mg/100 mL. Values of vitamin E was higher in the sample made with roasted finger millet malt and carrot juice and the values were higher than those of samples made with unroasted finger millet malt. The highest quantity of carrot juice (R50:0:50) in the malt drink correlates with the highest vitamin E content suggesting that carrot juice contains more vitamin E than cucumber juice thus revealing carrot as rich sources of provitamin A and vitamin E[18]. Natural antioxidants especially vitamins C and E are found in abundance in fruits and vegetables[19]. The malt drink may release antioxidants into the body that protect healthy molecules from free radicals. As antioxidants offer electrons to free radicals and they prevent further damage to the body[19,20].

pH values of roasted /unroasted finger millet malt-cucumber-carrot juice drinks varied from 4.10-4.65 (Table 3). There were significant ($p<0.05$) differences in the pH values of the malt drink. Low pH value was observed in un-supplemented samples (controls). Supplementation of the malt drink with cucumber juice and/or carrot juice only increased the pH values of the malt drink and the increases were significant ($p<0.05$). However, the pH (4.10 -4.65) of the malt drink was comparable to the pH of Malta Guinness and Maltina (4.4) and Amstel, Hi-malt and Grand malt (4.6)[3]. The titratable acidity of the formulated malt drinks ranged from 0.04-0.07%. Only marginal differences in the titratable acidity of the malt drink were observed. The amount of acid obtain from titration with an alkali plays a vital role in the determination of different product flavours[21].

Although, titratable acidity values observed in this study varied, the variation effect was not evident in the pH values as titratable acidity is inversely related to pH. The low level of acidity observed indicates that the products were not fermented suggesting that malt drink supplemented with juice may provide a preservative effect on the product and may extend its shelf-life. The total soluble solid content of roasted and unroasted finger millet malt-cucumber-carrot drink varied from 6.20-10.55 °Brix and 6.15-19.05 °Brix, respectively. The incorporation of cucumber and/or carrot juice in the malt drinks decreased the total soluble solids. Unroasted finger millet malt drink (100%) had the highest total soluble solid (19.05 oBrix) which was significantly ($p<0.05$) higher than the values observed in other formulations. Decreased total soluble solids (TSS) in the malt drink may be due to an increase in moisture content caused by juice supplementation. It is also possible that carbohydrate reduction contributed to the decrease in TSS of the malt drink. Moisture content reduction generally increases the concentration of nutrients[22].

The sensory scores of finger millet malt drinks supplemented with cucumber and carrot juice revealed slight variation in the scores for most parameters (Table 4). Scores for colour, flavour and appearance varied significantly ($p<0.05$) among the blends. Roasted finger millet malt (R100) rated the highest in terms of colour (6.75), appearance (6.70) and flavour (6.70) revealing that the colour of the malt was much liked by the panelists.

In comparison with individual juice, malt drink supplemented with 25% cucumber juice and 25% carrot juice produced a hue that was much liked. The variations seen among the colours of different malt drinks could be due to masking of malt colour by cucumber juice or carrot juice. Visual observation showed that the juice from 100% cucumber was colourless, hence resulting in dilution of golden brown colour observed in the roasted millet malt (100%) drinks. The preference for sample R100 in terms of colour could be due to the use of roasted malt, which makes the colour of the sample similar to that of a commercial malt drink which the panelists were familiar with. Among the blends of the unroasted finger millet malt composite drink, sample U50:0:50

Table 4: Sensory scores of roasted finger millet malt drinks supplemented with vegetable juice

Samples F:Cu:Ca	Colour	Appearance	Flavour	Taste	After-taste	Overall acceptability
R100	6.75±0.2^{c}	6.70±0.27^{c}	6.70±0.29^{c}	6.50±0.32^{bc}	6.30±0.27^{bc}	6.80±0.40^{c}
R50:25:25	6.70±0.24^{c}	6.50±0.25^{bc}	6.55±0.37^{c}	6.40±0.28^{bc}	6.40±0.31^{bc}	6.70±0.32^{c}
R50:50:0	5.40±0.21^{a}	5.25±0.25^{a}	5.75±0.29^{a}	5.45±0.21^{a}	5.60±0.26^{a}	5.50±0.26^{a}
R50:0:50	6.15±0.32^{ab}	6.05±0.29^{abc}	6.10±0.31^{a}	5.65±0.33^{a}	5.65±0.21^{ab}	6.30±0.31^{abc}
U100	6.25±0.30^{ab}	6.45±0.28^{bc}	6.35±0.25^{b}	7.05±0.32^{c}	6.80±0.25^{c}	6.95±0.30^{c}
U50:25:25	6.10±0.28^{ab}	6.10±0.28^{ab}	6.15±0.31^{ab}	6.25±0.37^{ab}	6.10±0.35^{bc}	6.65±0.29^{c}
U50:50:0	5.90±0.30^{ab}	5.95±0.20^{abc}	5.90±0.26^{a}	5.65±0.29^{a}	5.50±0.26^{a}	6.20±0.19^{ab}
U50:0:50	6.40±0.29^{b}	5.65±0.27^{ab}	6.00±0.33^{a}	6.30±0.26^{b}	6.10±0.26^{abc}	6.35±0.28^{ab}

Values are mean scores of 20 panelists±standard deviation, Values on the same column with different superscripts are significantly ($p<0.05$) different, R100: Malt drink produced from roasted finger millet malt only, R50:25:25: Malt drink containing 50% roasted finger millet malt, 25% cucumber juice and 25% carrot juice, R50:50:0: Malt drink containing 50% roasted finger millet malt, 50% cucumber juice only, R50:0:50: Malt drink containing 50% roasted finger millet malt, 50% carrot juice only, U100: Malt drink produced from unroasted finger millet malt only, U50:25:25: Malt drink containing 50% roasted finger millet malt, 25% cucumber juice and 25% carrot juice; U50:50:0: Malt drink containing 50% unroasted finger millet malt, 50% cucumber juice only and U50:0:50: Malt drink containing 50% unroasted finger millet malt, 50% carrot juice only

(50% unroasted finger millet malt drink, 0% cucumber juice and 50% carrot juice) was preferred in terms of colour by the panelists with the score of 6.40 which was significantly ($p<0.05$) higher than the scores of other formulations.

The bright orange colour of the drink was due to the high quantity of carrot juice (50%). The flavour score (6.35) of 100% unroasted finger millet malt drink was significantly ($p<0.05$) higher than those of the other blends indicating that it was very much liked. The taste and aftertaste for unroasted finger millet malt drink scored high values (7.05, 6.80, respectively) though marginally different from malt drinks made from roasted malt and 25% substitution of carrot and cucumber juice. The preference for 100% unroasted finger millet malt in terms of taste may have decreased due to the bitter compounds in the malt. There were no significant ($p>0.05$) differences in the scores for overall acceptability among R100, U100, R50:25:25 and U50:25:25 of samples and values indicated that the products were very much liked by the panelists. This suggests that supplementation of roasted and unroasted malt drinks with 25% cucumber and 25% carrot juice had no effect on the overall acceptance of the product. Key attributes of malt drink for sensory evaluation are colour, appearance, flavour and taste. The mean scores for these attributes (5.25-5.95) in the drinks supplemented with 50% cucumber juice may be due to dilution since cucumber juice is colourless.

CONCLUSION

The study showed that nutritious malt drinks can be produced from finger millet malt, cucumber and carrot juice. Although, roasted finger millet malt drink was preferred in terms of colour and appearance, unroasted finger millet malt drink was preferred in terms of flavour, taste, after-taste and overall acceptability. The findings of the research revealed that formulated malt drinks were rich in pro-vitamin A, vitamin C and E that are potent antioxidants and may be consumed by people suffering from type-II diabetes. Supplementation of roasted malt drinks with 25% cucumber and 25% carrot juice had no negative effect on product's acceptance and was preferred in overall acceptability among supplemented samples.

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