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ORIGINAL ARTICLE

Production of Functional Beverage based on Carrot juice, Malt Extract and Ginger Extract

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ABSTRACT
Functional beverage due to their natural ingredients have beneficial effects on body. The purpose of this healthy drink is to improve consumer's health In this study. The functional beverage was produced based on carrot juice, malt extract and ginger extract with different proportions of carrot concentrate(12%,11%,10%,9%,8%,7%), malt extract (1/5%,2%,2/5%,3%,3/5%,4%), ginger extract (3%) and syrup (6%) for all treatments. Physiochemical tests such as total acidity, pH, brix, microbiological test and sensory evaluation tests were conducted in 30 days. Data analysis was conducted based on completely randomized design, means compared by Duncan test. The test contained six treatments and was repeated 3 times. Sensory evaluation tests were conducted in day by 9 specialized panel tester. The results showed that during the maintenance, brix, total acidity, had increased significantly($p<0.01$). Furthermore, pH had significantly decreased ($p<0.01$). The results showed that during 30 days no microbial growth was detected in either of treatments. Analysis showed that the F6 treatment, which contained 7% carrot concentrate, 4% malt extract, 3% ginger extract and 6% syrup, had the most total acceptance regarding sensory evaluation and was chosen as the best treatments.
***Keywords**: functional beverage, carrot juice, malt extract, ginger extract*

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INTRODUCTION

The use of herbal extracts and vegetable juices in the formulation of many different beverages are growing. Today, there are various extracts and vegetable juices for formulating functional drinks which their role are more crucial than a technical role. In fact, herbal drinks are among functional drinks [7]. Carrot is one of the most popular vegetables in the world. Carrot is native to Asia, Europe, North Africa and possibly the Mediterranean region [22]. China, Russia and the United States of America, are the three best growers of carrot in the world with China as the world's largest producer [5]. These countries can produce 50% of the carrots of the world. The carrot root shows a better color at 18 to 20 ° C. Shape and color of carrot root are affected by the moisture content of soil, however temperature has a greater effect on these factors of carrot root [17]. Carotenoid is the main pigment of carrot [23]. The most important carotenoid in carrot is β-carotene. Carrot is among diet ingredients containing high amounts of β-carotene [16]. Beta-carotene has a protective effect against some types of cancer and its lack in the diet may lead to heart disease and cataract [21]. Carrot juice can be fermented and become sour after 24 hours, so it can be replaced by carrot concentrate [6].

Barley is the fourth most important cereal after wheat, rice and maize which its cultivation dates back to about ten thousand years ago. The origin of barely is Zagros Mountains in the west of Iran, southern Anatolia and Palestine. Compared to wheat, nutritional value of barely is higher, however barley has more therapeutic properties than wheat. The crust and certain chemical compounds of barely cause favorable changes occur during the germination, so it has better features than other cereals in malt manufacturing process [12, 10]. Malt extract is mainly a concentrated barley malt syrup containing 70 to 80% sugar[12].

Malt extract has a density of about 1.39 and a desired malt flavor and a sweet taste. A group of enzymes in malt extract converts food starch into maltose and dextrin, which are easier to digest and absorb [2].
Ginger is grown in many countries with tropical and subtropical climates, especially China, India, Nigeria, Australia, Jamaica and Haiti [9]. Ginger is an aromatic plant. It is a perennial plant with a 2-4 long roots named underground roots or rhizomes [11]. The ginger rhizome is used as spice [20]. The ginger smell mainly depends on its volatile oils the amount of which varies from 1 to 3%. More than 50 components have been detected in ginger oil which are primarily "mono terpenoides" [8]. It is available in various forms such as powders, tinctures, fresh herbs, supplements, beverages (such as tea) [18].

MATERIALS AND METHODS

Sample preparation:

Carrot concentrate and malt extract were diluted in water, then sterilized ginger extract, sterilized syrup and carbon dioxide gas were added. The prepared samples were pasteurized at 72 ° C for 20 min and then stored at 4 ° C. The carrot concentrate and malt extract and syrup were prepared from Alifard (Sanich) Co. and Behnoosh Co. and Zamzam (West) factory, respectively.
Ginger extracting: first 200 grams of fresh ginger rhizome was mixed and the raw liquid was placed in a clean glass jar for 24 hours. The extract was filtered by using a sterile cotton cloth and exposed to air [15].
Beverage formulation: Carrot concentrate, malt extract, ginger extract, syrup and carbon dioxide gas were mixed with the ratios as shown by Table 1.

Table1. Treatments used in the study

Syrup	Ginger extract	Malt extract	Carrot concentrate	Treatment
6%	3%	1.5%	12%	**F_1**
6%	3%	2%	11%	**F_2**
6%	3%	2.5%	10%	**F_3**
6%	3%	3%	9%	**F_4**
6%	3%	3.5%	8%	**F_5**
6%	3%	4%	7%	**F_6**
6%	0%	0%	14%	**(Blank) C**

Samples characteristics determination

After preparing the treatments, the physicochemical, microbiological and sensory characteristics of them were compared and evaluated.

Physical tests

Water soluble solids (Brix) measurement of: it was done by a digital refractometer (ATAGo-, RX 7000 α, Japan) according to National Standard No. 2685 [2].
PH measurement: pH determination was performed by using a pH-meter model WTW according to the Iran National Standard No. 2685 [2].

Chemical tests

Titratable acidity measurement: the titratable acidity was determined by titration with 0.1 normal NaOH, according to National Standard No. 2685. Finally, it was reported in grams of citric acid per 100 g of sample [3].

Microbiological tests

Microbial cultivation: was carried out under sterile conditions after the departure of sample gas according to National Standard No.3414 as given by Table 2 [4].

Table2. Guide to microbiological juice tests

Incubation Time	Incubation Temperature	Individual agar / Method	Microbiological Test	
2 Day	37 ºC	Lactobacillus agar medium (MRS agar)/ Pour Plate	**Lactic acid Bacteria**	**1**
5 Day	30ºC	Orange-Serum Agar/ Pour Plate	**Acid duric microorganism**	**2**
5 Day	25ºC	Dichloran Rose-Bengal(DRB) / Pour Plate	**Yeast and Mould**	**3**

Sensory evaluation: the sensory evaluation of treatments was carried out by 9 food specialists [13]. To this end, the acceptance levels of sensory properties of beverages were evaluated by the consumers using

9-level method and a mean value was considered for each level which the level 9 and 1 were the highest and lowest level, respectively.
Statistical analysis: the experiment was performed in a completely randomized design with 6 treatments and a blank in 3 replications. The results were statistically analyzed by the software SPSS 20. Data analysis was conducted by ANOVA and Duncan's test.

RESULTS AND DISCUSSION

Measurement of water soluble solids: Figure 1 shows the changes of water soluble solids (Brix) over 30 days of storage. The results showed the significant effect of beverage formulation on the soluble solids (Brix) ($p< 0.01$). The Brix was fixed on the first day and then increased. Generally, the Brix increased in all the treatments during the 30 days of storage due to the increased content of carrot concentrate and the hydrolysis of carbohydrates. The results obtained were consistent with the findings of Saniah and Samsiah [19] who believed that the increase of Brix was due to the increased sugar concentration. Moreover, the increase was also due to the lack of glucose fermentation by microorganisms, confirming the findings of Hatami *et al* [14].

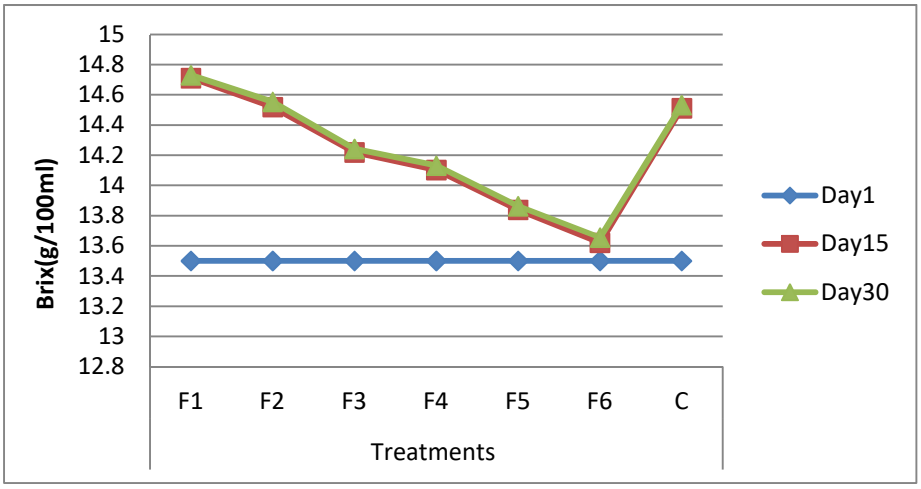

Figure1. Effect of 30 days storage on the Brix

PH: Figure 2 shows the pH changes during the 30 days of storage. The pH comparison of the control (C) with the samples containing different ratios of ginger extract, malt extract, carrot juice concentrate suggests that there are significant differences between them ($p<0.01$). Generally, the pH decreased within 30 days of storage at 4°C probably due to carbonating the samples. The research findings were consistent with the results obtained by Zhou *et al* [24] who mentioned that the conversion of carbon dioxide into carbonate and bicarbonate results in the pH decrease.

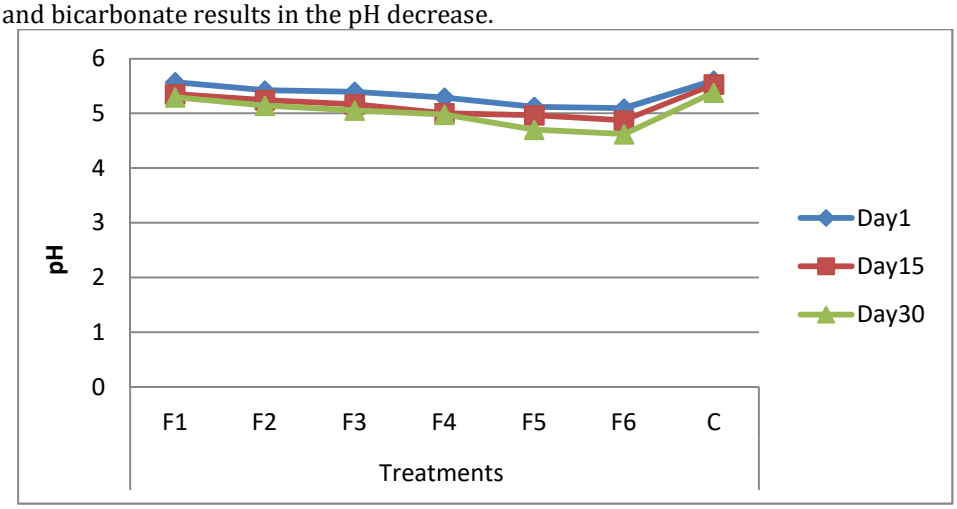

Figure 2. Effect of 30 days storage on the pH

Determination of titratable acidity: the trend of titratable acidity changes within 30 days was shown in Figure 3. The pH comparison of the control (C) with the samples containing different ratios of ginger

extract, malt extract, carrot concentrate shows the significant differences between the pH of control (C) and those of other treatments ($p<0.01$). The total acidity increased during the 30-day storage. By measuring the total acidity, acid content of food is determined. These acids are frequently organic acids. Organic acids are found naturally in foods or added to foods which affect the taste of food. These findings are in good agreement with Abdulkareem *et al* [1] findings, in which the acidity increased because of the acetic acid content of ginger.

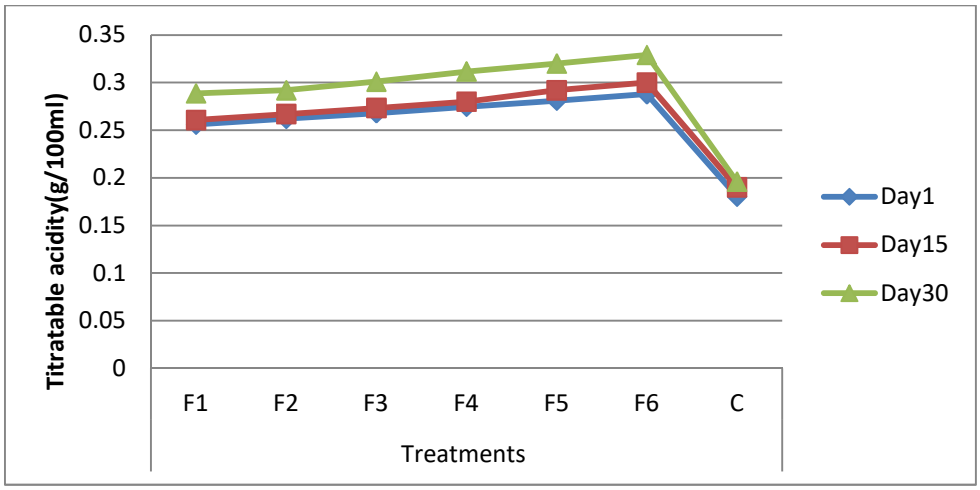

Figure 3. Effect of 30 days storage on the titratable acidity

Microbial changes: the microbial load of beverages in all the treatments were 0 CFU/ml and no growth was observed in terms of the three groups of microorganisms (acid resistant, lactic acid, molds and yeasts) during the 30-day storage at 4 ° C, due to the samples being pasteurized and carbonated. These findings are consistent with those of Hatami *et al* [14] in which no chemical changes and no microbial growth was observed due to pasteurizing the samples.

Sensory evaluation: Figure 4 shows the sensory evaluation of beverages. Among the seven samples containing different ratios of malt extract, ginger extract, carrot juice concentrate, the lowest score in terms of overall acceptance was related to the control (C). The treatment F6 with the formulation of 4% malt extract, 3% ginger extract, 7% carrot concentrate and 6% syrup obtained the highest score in the overall acceptance test and finally was chosen as the best treatment. Hatami *et al* [14] assessed the effect of carbonation and also the addition of orange juice on physical, chemical and biological properties of pasteurized carrot juice. The sample evaluation results indicated that the treatments containing co2 and 4% syrup achieved the highest score for sensory characteristics.

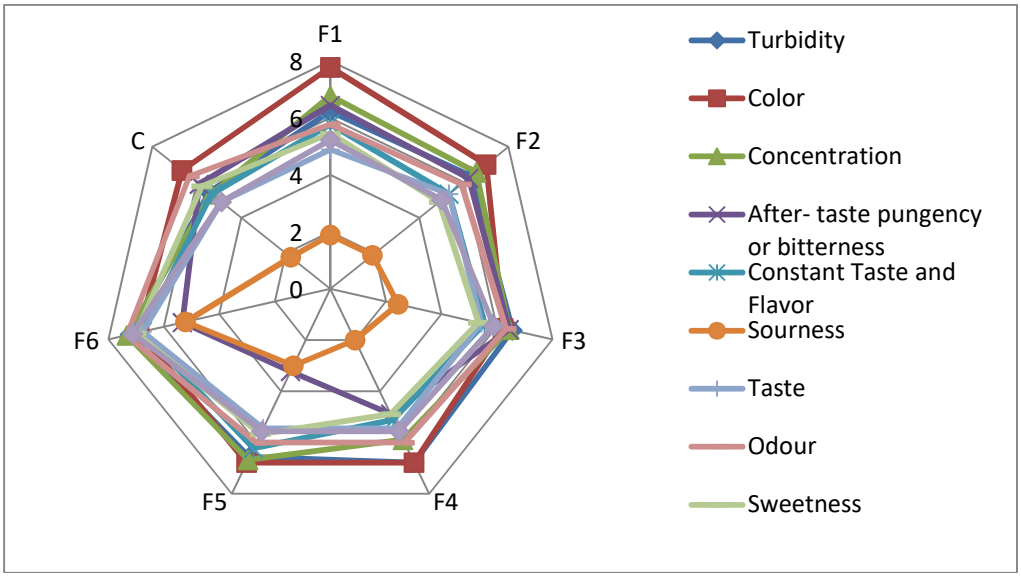

Figure 4. sensory evaluation of the Beverage

CONCLUSION

The results showed that the pH of all treatments dropped during the 30-day storage and so acidity increased significantly. In all the treatments, soluble solids (Brix) was fixed on the first day and gradually increased during the storage because of the total sugar concentration increase. In other words, by reducing carrot concentrate, the amount of water soluble solids was reduced, because of sugar content decrease of the beverage. Microbial analysis showed that the final product contained no harmful microorganism or byproduct. According to the results obtained, the treatment F6 containing 4% malt extract, 7% carrot concentrate, 3% ginger extract and 6% syrup showed the greatest influence on the sensory properties and was selected as the best treatment.

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