Determination of some nutritional value and organoleptic properties in fruity teas

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ABSTRACT

Fruity teas are popular due to variety in sensory properties as well as their nutritional and therapeutical characteristics. Recently, the worldwide researches related to fruity teas have been considerably developed. In this work, effects of fruit type (apple, quince and pear) and brewing time (10 or 20 min) on some nutritional properties (Mg, Fe and Ca contents, sugars and protein percent) as well as on the sensory attributes of final products were investigated. No chemical preservative, flavoring gents and colorants were added for preparation of the samples. At the end of 10 min brewing, the highest extraction rates of Mg and protein, Fe and sugars, and Ca were observed for pear, apple, and quince, respectively. At the end of 20 min brewing, the greatest extraction rates of Mg and protein, sugars, and Ca were related to the pear, apple, and quince, respectively. Increasing the time of brewing up to 10 min although did not noticeably affect the extraction rate of nutrients from dried fruits (especially for protein content), significantly influence the sensory characteristics (flavor and color) of final products; so that those prepared by 20 min brewing had higher acceptability. Among the fruity teas produced by 20 min brewing, apple had the best sensory acceptability from flavor and color points of view. After that, pear tea from taste and quince tea from color standpoints were realized as the best samples.

Keywords: Additive; Brewing; Fruity tea; Nutritional value.

INTRODUCTION

Fruits are important dietary components. They have beneficial effects such as anti-carcinogenic, anti-mutagenic, anti-viral and bacterial impacts due to their biological active substances with anti-oxidant and anti-bacterial properties [1-4]. It has also been proven that there is an inverse relation between consumption of fruits and their juice with cardio-vascular disease, arthritis and stroke [1]. Hot drinks such as tea and coffee are from the most common beverages consumed in all over the world (second grade after drinking water) [4-6]. Among hot drinks, teas of fruits and vegetables have relatively high acceptability due to their therapeutical properties and pleasant sensory attributes [4]. The US Department of Agriculture has set up a „Food-Guide Pyramid" as a guideline to the servings of the different food groups that should be consumed daily for a healthy, balanced diet. According to this pyramid, an adult should have 2 to 4 servings of fruits per day [5].

Fruity tea is popular because of variety in flavor as well as having therapeutical properties and they are highly being consumed in countries such as Portugal and European countries, especially Poland [4]. About 2.5 million tons of teas are produced in the world every year, but there is very little information on the production levels and sales of herbal and fruity teas. However, the wide

variety of fruity and herbal teas and large number of companies producing them, indicate an active and successful market [4]. It has been proven that bioactive compounds of these products are absorbed better than when its fruit is used, a value that has recently been under special attention in medical sciences [7]. Depending on the type of dried fruit used for production of this drink, fruity tea may contain useful minerals, C, A and D vitamins, flavonoids, sugars, different colorants (such as anthocyanin, lycopen and carotenoids) and proteins [8-10]. There are some studies on the health benefits of fruity teas indicating presence of significant amounts of different bioactive compounds. However, there are not enough publications about the minerals types and amounts in fruity teas [4]. Therefore, the aim of this study was to determine several important nutritionally valuable compounds as well as to evaluate the sensory characteristics in natural fruity teas of several types.

MATERIALS AND METHODS

Sample preparation

Dried powdered fruits (apple or quince or pear) were provided from Marham Khavar Company (Tehran, Iran). The original fruits were the product of „Damavand" area (Damavand, Iran) at the same conditions. Powdered fruits were brewed in boiling water for 10 min or 20 min. The trials were subjected to the chemical analysis before and after brewing process (in dried fruits and freshly made samples).

Chemical analysis

High Performance Liquid Chromatography (Varian Analytical Instruments, CA, USA) was used for measuring dried fruit sugar contents (sucrose, glucose and fructose) [11] and Kjeldal method (Kjeltec: Gerhardt, Germany) was used for determination of protein content [12]. Atomic Absorption Spectrometry (Spectrophotometer: Varian International, Sweden) was used for determination of minerals contents (Fe, Mg and Ca) [13]. For sensory evaluation, at the first stage, "paired comparison test" (which is known as "DUO test") was performed between the treatments with 10 or 20 min brewing time. Significant differences among treatments were determined using the table of DUO test significance [14]. The sensory parameters were flavor and color. The sensory panel group consisting of 7 men and 7 women were selected for sensory evaluation. The selected treatments in the first stage were compared using a Hedonic 5-point test (0= inconsumable, 1= unacceptable, 2= acceptable, 3= satisfactory, 4= highly satisfactory) [15].

Statistical analysis

Experiments were performed in triplicate and the ranked orders of means were determined in significance level of 0.05 ($p < 0.05$) using two-way ANOVA test from Minitab software (State College, PA, USA). The design was "completely randomized design".

RESULTS AND DISCUSSION

Nutrients in single consideration

Magnesium

Figure 1 indicates Mg extraction rate in different treatments with 10 and 20 min of brewing. Before extraction, the Mg content in pear was significantly higher than quince and then, than apple ($p<0.05$). After brewing for 10 and 20 min, this arrangement remained constant (pear>quince >apple). Therefore, before and after brewing, pear and its tea had the highest contents of Mg. The lowest Mg contents were related to apple and its tea. In quince, 90% of Mg content after 10 min and 99% after 20 min were extracted (Data not shown). Thus, the Mg extraction rate from 10 to 20 min of brewing was 9%. The extraction rates of Mg in apple after 10 and 20 min of brewing were 83 and 96%, respectively. Mg extraction from 10 to 20 minutes was 9%. For pear, these rates after 10 min, 10 to 20 min and after 20 min were 82, 5 and 87%, respectively. Comparing Mg extraction percentage in these three fruits reveals that the highest extraction rate after 10 min of brewing was for quince. After this period, the extraction of Mg content in apple and pear was equal ($p>0.05$). The highest extraction percent after 20 min brewing was related to quince (99%) and the lowest extraction rate was observed for pear (87%) (Data not shown).

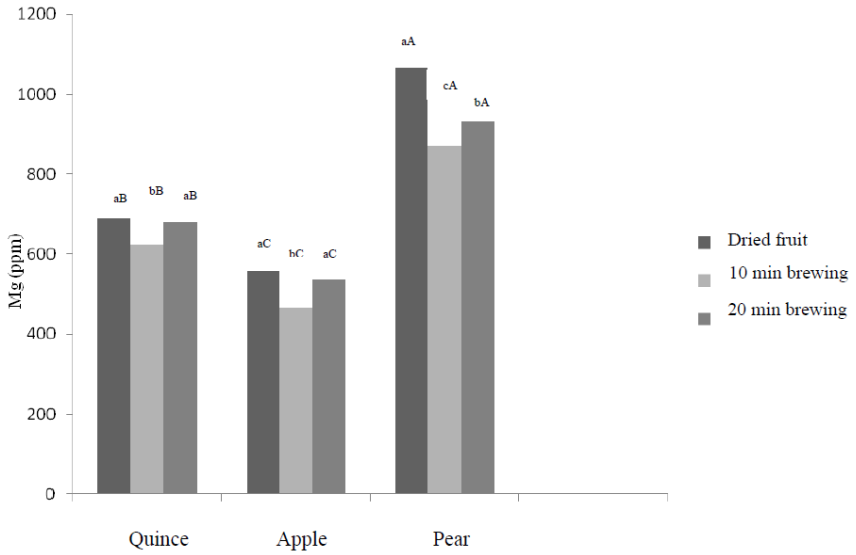

Figure 1- Combined effects of extraction time and type of fruit on Mg content (small and Capital English letters represent significant difference "p< 0.05" among the means between different times of brewing in a fruit, and a constant time of brewing in different fruits, respectively).

Iron

Figure 2 shows the extraction content of Fe after 10 and 20 min of brewing compared with Fe content before extraction in apple, quince and pear. Fe content before extraction in quince was significantly higher than apple and apple's Fe content was significantly higher than pear (quince>apple>pear). After 10 min brewing, Fe concentration in 3 fruits was not changed significantly. This property was also observed after 20 min of brewing. The extraction percentages in quince after 10 min, after 20 min and from 10 to 20 min of brewing were 22, 28 and 6%, respectively. The highest percent of extraction from 10 to 20 min was related to quince and after that, to the apple and pear. In general, pear showed the highest extraction rate after 20 min (87%) and the lowest percent was observed in quince (28%).

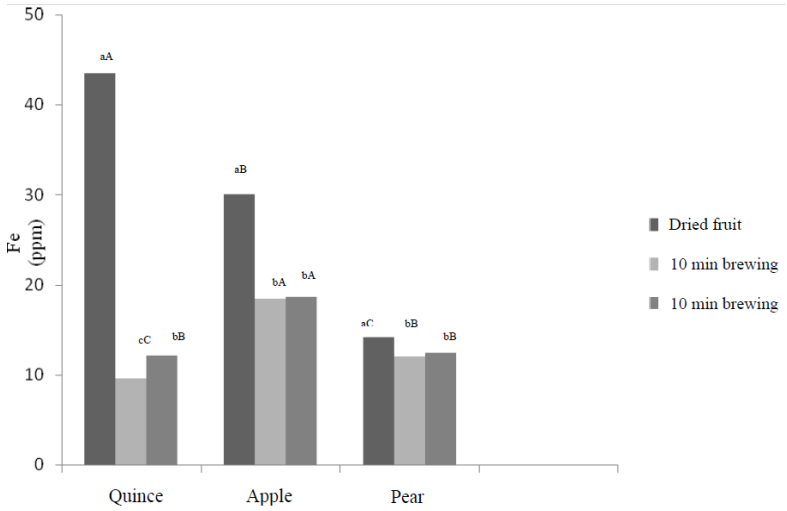

Figure 2- Combined effects of extraction time and type of fruit on Fe content (small and Capital English letters represent significant difference "p< 0.05" among the means between different times of brewing in a fruit, and a constant time of brewing in different fruits, respectively).

Calcium

Figure 3 indicates Ca content in apple, quince and pear after 10 and 20 min of brewing compared with its content before extraction. Before extraction, Ca content of quince was significantly higher than pear and pear's Ca content was significantly higher than apple. After brewing them for 10 min, mentioned order became inverse as follows: Quince>Apple>Pear. After 20 min of brewing, Ca content in quince was significantly higher than the two others; however, this content in apple and pear did not have significant difference. The Ca extraction rate in quince after 10 min, after 20 min and from 10 to 20 min of brewing were 61, 72 and 11%, respectively. These values for apple were 82, 97 and 15% and for pear were 69, 92 and 13% (Data not shown). Therefore, the highest extraction rate for Ca after 10 min brewing was related to pear and the lowest rate was observed for quince. In general, apple and then pear showed the highest percentage of extraction after 20 min of brewing and the lowest rate of the extraction in this period was related to quince.

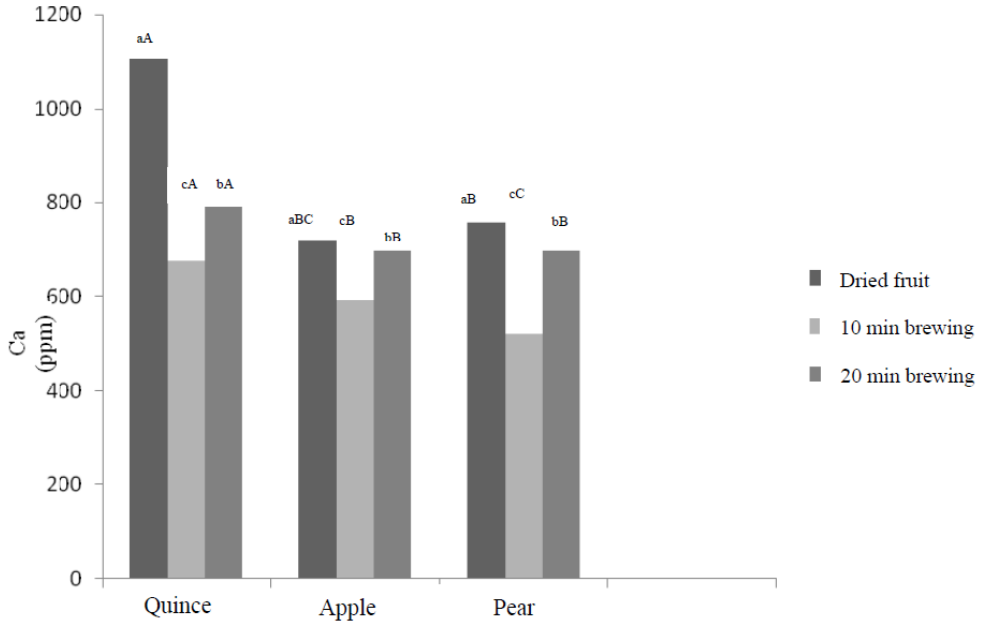

Figure 3- Combined effects of extraction time and fruit type on Ca content (small and Capital English letters represent significant difference "p< 0.05" among the means between different times of brewing in a fruit, and a constant time of brewing in different fruits, respectively).

Sugars

Figure 4 indicates sugars (sucrose, glucose and fructose) content in apple, quince and pear after 10 and 20 min of brewing compared with its initial content before extraction. Sugar concentration in apple was significantly higher than quince and pear. Mentioned proportion was also observed in treatments after 10 and 20 min of brewing. Extraction rate of sugars in quince after 10 min, from 10 to 20 min and after 20 min of brewing was 95, 4.1 and 99.9%, respectively (Data not shown). Thus, the highest percentage of extraction after 10 min of brewing was observed in quince and pear and then, in apple ($p<0.05$). From 10 to 20 min of brewing, quince had the lowest extraction rate. In general, after 20 min of brewing, quince and pear extraction rates were the highest, while apple was the lowest. It should be noted that extraction rate in quince after a 20 min brewing was about 100% (99.9%).

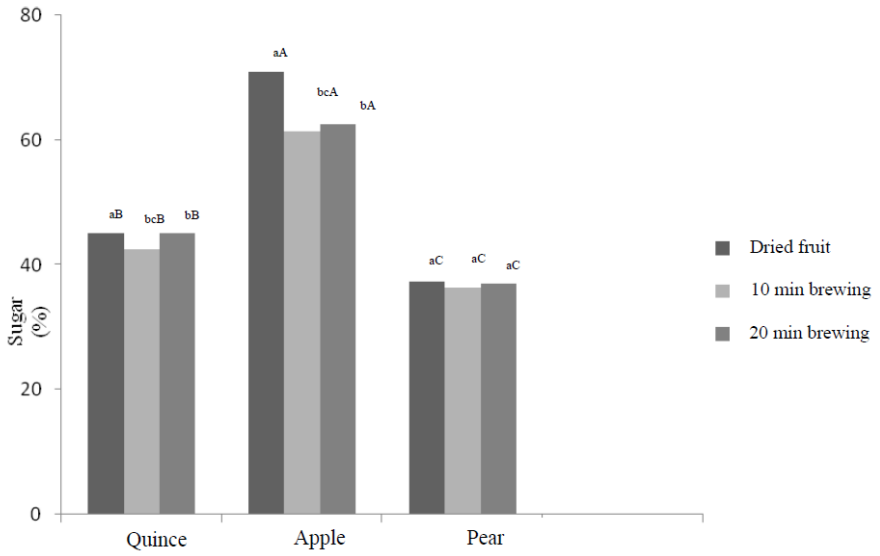

Figure 4- Combined effects of the extraction time and fruits type on sucrose concentration (small and Capital English letters represent significant difference "p< 0.05" among the means between different times of brewing in a fruit, and a constant time of brewing in different fruits, respectively).

Protein

Figure 5 implies protein content in apple, quince and pear after 10 and 20 min of brewing compared with its initial content before extraction. Before extraction and after 10 and 20 min of brewing, pear's protein content was significantly higher than the other two fruits. However, this value in apple and quince, both before and after the extraction (10 or 20 min after brewing) was not significantly different. The highest protein extraction in quince after 10 min, from 10 to 20 min and after 20 min of brewing was 1.3, 0.5 and 1.8%, respectively. The extraction rate in apple, after 10 min of brewing was 0.7% and this value did not change until 20 min after the extraction. The extraction rate from the highest to the lowest from 10 to 20 min after brewing was as follows: quince>pear>apple.

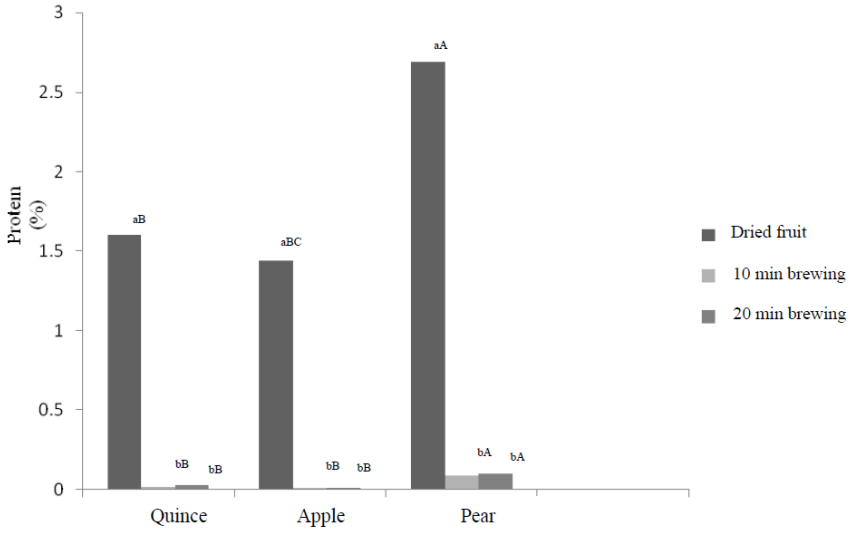

Figure 5- Combined effects of extraction time and fruits type on protein content (small and Capital English letters represent significant difference "p< 0.05" among the means between different times of brewing in a fruit, and a constant time of brewing in different fruits, respectively).

Nutrients in combined consideration

According to the results related to all nutrients, pear had the highest amounts of Mg and protein, quince the highest concentrations of Fe and Ca, and apple the highest amounts of sugars. In general, protein content (in dry basis) was low in all fruits and did not exceed 2.98% in pear. Dry basis percentage of sugars in all fruits was significant and reached 70.98% in pear. Fe content was not significant and its highest content was 43.5 ppm in quince. The amount of Ca and Mg were considerable in all three fruits, so that Ca content in quince was 1107 ppm and Mg content in pear was 1067 ppm. These values were consistent with data provided in basic sources [16].

In general, a 10 min-brewing process had significant effect on nutrients extraction. The highest extraction rate in treatments after 10 min was related to Mg and sugars, while Fe, Ca and specially protein were less extracted. After 10 min of brewing, the highest extraction of Mg and protein was observed in pear and apple showed the highest extraction of Fe and sugars. Ca was extracted more from quince than the other two fruits. This fact represented different matrix diffusion coefficients of different types of fruits. After 10 min of brewing, the lowest and the highest extraction rates, respectively were 82 and 90% for Fe, 22 and 85% for Ca, 61 and 82% for sugars and 0.7 and 3.6% for protein. Brewing of fruits from 10 to 20 min has far less or no effect on nutrient extraction compared to brewing them from 0 to 10 min in all fruits except quince. In quince, after brewing for 20 min, the extraction rate of Mg was increased from 90 (after 10 min) to 99% and Fe from 6 to 22%.

Sensory evaluation

Table 1 shows sensory evaluation for each fruit using DUO test after brewing for 10 or 20 min. It can be observed that in all three fruits, flavor and color indexes after 20 min of brewing compared to 10 min achieved significantly higher grade ($p<0.05$), indicated higher increase in pleasant flavor and color compounds. Color of fruity teas depends on extraction of natural pigments from dried fruits as well as producing brown pigments because of browning reactions such as caramelization and Maillard [17]. This clarifies why increasing of brewing time causes more acceptable color. Flavor in fruits is because of natural volatile compounds and other flavor compounds such as organic acids, sugars, phenolic compounds and reaction of these components with proteins and minerals. The latter complexes cause special flavors like astringent and bitter in fruity teas. In addition to mentioned compounds, browning products have important effect on flavor of teas [18]. Therefore, the longer fruits are taken to brew, the higher extraction of taste compounds as well as the higher production of new flavor compounds in the product.

According to the results of Hedonic 5-point test for pear, quince and apple, apple brewed for 20 min achieved the greatest sensory scores compared with other fruits from flavor (3.2; mean score) and color (3.4) standpoints. After that, pear in flavor (2.3) and quince in color (2.1) obtained the second scores.

Table 1. Paired comparison test among treatments with different brewing.

Treatments	Parameter	
	Flavour	Colour
Treatments with 10 or 20 min of brewing	10<20	10<20

***** The symbol ">" indicates significant priority ($p<0.05$)

CONCLUSION

Brewing the fruits for 20 min was optimum for reaching maximum reasonable extraction of nutrients as well as satisfactory sensory characteristics from both flavor and color points of view. It is recommended that the industrial techniques of brewing for production of fruity teas from different fruits of various types be investigated. Adequate sensory attributes should be under special attention; however, specific researches should also be performed on health-related aspects of such drinks.

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