Original Article

Effect of adding cinnamon and using spray drying method on antioxidant properties of instant green tea

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Abstract

Over the past few years, anti-cancer properties, pharmaceutical and specific health effects of instant green tea attracted consumers' attention. This paper seeks to assess the antioxidant properties of cinnamon instant green tea dried using the spray drying method. Firstly, we prepared a liquid extract (1:10) from green tea and then, the obtained extract was dried using a spray dryer apparatus to produce instant tea. In the next stage, three different percentages of dried cinnamon extract powder were added to the manufactured instant tea in separate containers. In continuous, sensory properties, acidity, pH, total polyphenols content and antioxidant activity of obtained cinnamon instant tea were evaluated. Eventually, the results exhibited that adding cinnamon to instant tea powder significantly increased the amount of polyphenolic compounds and antioxidant activity. Also, the acidity and pH of the tea extract and instant tea powder treatments had a significant difference, statistically ($p< 0.05$). However, the instant tea treatments containing 3 and 5% of cinnamon had no significant difference. Although when the cinnamon extract was added there was no significant difference, the sensory properties of flavored instant tea improved considerably.

Keywords: Instant tea; Cinnamon; Antioxidant activity; Spray dryer; Polyphenols

Introduction

During recent years, negative effects of free radicals on consumers' healthiness have become an important topic. The generation of these compounds can result in various human ailments including cancer, premature aging, reperfusion injury, and hepatic injury [1, 2]. Natural antioxidants can prevent oxidative damage caused by free radicals in human body. Thus, there is a growing attention to the investigations focusing on the natural antioxidants, since a lot of data indicated that synthetic antioxidants have adverse effects on consumers' body [3]. Different types of tea, especially green tea, contain large quantities of antioxidant compounds [4]. Therefore, tea is known as the healthiest drink in the world [5]. The green tea, which is a popular drink in Asian countries, is a non-fermented beverage and contains more polyphenols than other types of tea [6]. This beverage contains a huge amounts of alkaloids (e.g. caffeine) and polyphenols such as catechins [7, 8]. The catechins existing in the green tea are generally known as polyphenols [9]. Due to the biological properties of polyphenol compounds and beneficial effects of high antioxidant activity, they are both parameters of quality for tea [10]. As it can be perceived, the powder obtained from green tea contains all of its composition, such as polyphenols, amino acids, saccharides, and caffeine. Moreover, green tea powder has good solubility, dispersibility, and flowability and it can deliver more nutritional and functional components to consumers [11, 12]. Many researchers have reported that caffeine and catechins present in green tea cause potential antioxidant and cancer prevention activities [13, 14]. Also, several studies have proved that biological activities of polysaccharides existing in tea cause plenty of beneficial effects including antibacterial, antioxidant, anticancer, antiobesity and antiatherogenic effects [15-17].

Cinnamon (Cinnamomum zeylanicum L.) as a flavoring additive is widely used in foods. It can, also, be used as a

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remedy for the common cold, diabetes and as an antimicrobial and fungitoxic agent [18-20]. Cinnamon tea using prevention of lipid oxidation in human body can decrease oxidative stress, significantly [21]. Jayawardana et al., (2019) evaluated the antioxidant effect of green and black tea extracts in uncured pork sausages. They finally concluded that the total polyphenol content in the green tea extract (GTE) was significantly higher than the black tea extract (BTE) ($p < 0.05$). Anesini et al., (2008) conducted a research to investigate the total polyphenol content and antioxidant activity of Argentinian green and black teas. Eventually, they reported that green tea has a higher polyphenol content than black tea and the total polyphenol concentration in green tea was between 21 and 14.3 of gallic acid equivalents (GAE). In this study, we aimed to produce instant cinnamon green tea powder and evaluate its pH, acidity, antioxidant activity, total polyphenol content and sensory properties.

Material and Methodology:

Chemicals and samples

DPPH reagent was purchased from Sigma-Aldrich. Folin-Ciocalteu reagent and other chemicals were purchased from Merck. Deionized distilled water was used for all of the stages. Cinnamon sticks and dried green tea were bought from local markets in Lahijan, Iran.

Preparation of cinnamon green tea instant powder

Initially, a fluid extract was obtained from purchased green tea. For doing this, the tea sample, with a ratio of 1 to 6, was added to the deionized distilled water and the obtained mixture was placed in a shaking incubator at 80 °C. After 15min, the blend was filtered. The solid residue, with a ratio of 1 to 4, was blended with deionized distilled water and the mentioned stages were repeated. Next, the both obtained extracts were mixed and the final mixture was dried using a mini spray dryer equipment. In continuous, the purchased cinnamon sticks were ground to 0.5cm particles. Then, a required amount of it, with a ratio of 1 to 10, was added to the deionized distilled water and the mixture was placed in a bain marrie for 12h at 70 °C. Afterwards, the extract was filtered and the filtrate was dried using a mini spray dryer equipment. Eventually, 3, 5 and 7% of the prepared cinnamon powder were added to the instant green tea powder, and different treatments were created by adding these powders to tap water at 80 °C.

Determination of pH and acidity

In this stage, the pH meter device (JENWAY 4330) was calibrated, firstly and the pH value was recorded. In the sequence of pH measurements, the acidity analysis was carried out. For doing this, 0.01M NaOH solution was added to the cooled mixture of 250 mL boiled water and 20 g of green tea (25 mL of tea extract in a separate stage) in room temperature, until pH 7 was reached. The volume of 0.01M NaOH solution (in mL) used for achieving a neutral solution was recorded and finally, the amount of acidity was calculated. This procedure was conducted in triplicate for each sample [22].

Determination of total polyphenol content

The method provided by ISO (2005) was used to determine the total polyphenol content (TPC) using spectrophotometry device and gallic acid as the standard [23]. Briefly, we transferred 1.0 mL of the diluted sample extract in duplicate to separate tubes containing 5.0 mL of a 1/10 dilution of Folin-Ciocalteu's reagent in water. Then, we added 4.0 mL of a sodium carbonate solution (7.5% w/v). Next, the tubes were allowed to stand at room temperature for 60 min. Afterwards, the absorbance of samples was measured at 765 nm against water. The TPC was expressed as gallic acid equivalents (GAE) in g/100 g material. Eventually, a standard curve of gallic acid ranging from 10 to 50 µg/mL ($y = 0.1164x + 0.0078$, $R^2 = 0.999$) were used to calculate the concentration of polyphenols in samples.

Determination of DPPH radical scavenging activity (antioxidant activity)

The method offered by Yamaguchi et al., (1998) with some modifications, was utilized to evaluate the antioxidant activity [24]. First of all, we mixed 200 mL of sample with 0.1 M Tris-HCl buffer (pH 7.4, 800 µL). Then, we added the obtained mixture to 250µM of DDPH solution (1,1-diphenyl-2-picrylhydrazyl) prepared from 1000 µL of 0.5 M DPPH and ethanol. The blends were vibrated intensely and left to react in a dark place for 1/3 h at 18° C. Finally, using a spectrophotometer, the absorbance at 517nm was recorded. The BHA was used as positive control. Equation 1 was used for calculating the antioxidant activity of the samples:

Equation 1.
$$SA(\%)=\left(\frac{1-(A_{sample}-A_{blank})}{(A_{control}-A_{blank})}\right)\times 100$$

Where the SA is Scavenging activity, the A_{sample} is the absorbance of non-alcoholic beer + Tris-HCl buffer + dissolved DPPH in Ethanol, the $A_{control}$ is the absorbance of Tris-HCl buffer + dissolved DPPH in Ethanol and the A_{blank} is Ethanol (98%).

Sensory analysis

In order to carry out the sensory analysis, all of the prepared samples, using 5-point Hedonic Scale (1=very low, 2= low, 3=medium, 4=high, 5=very high), were evaluated by 20 trained assessors (10 females and 10 males). Evaluated Factors contained the degree of color, flavor desirability and overall acceptance [25].

Statistical analysis

The present study was carried out in the completely randomized design format with factorial arrangement in triplicate. The variance analysis was performed using SPSS software. Moreover, Duncan test was performed to obtain mean comparisons at 95% confidence coefficient. All of the charts were drawn using Excel software.

Results and Discussion:

Figure 1 and figure 2 illustrate the pH value and acidity, respectively. As can be seen from the charts, acidity and pH were inversely related, so that when the pH value was at the lowest level, the acidity was at the highest level. This fact has already been proved by Lunkes and Hashizume, (2014). According to data, adding cinnamon to instant tea decreased the acidity and conversely, increased the pH value in propotion to the A sample. Our result is consistent with the study conducted by Beta and Corke (2004) [26]. They proved that adding catechin (existing substance in cinnamon) can increase the pH value. Moreover, the highest and lowest pH for instant tea were 5.53 and 5.38, respectively. Furthermore, it can be concluded that the highest acidity was related to the tea extract (0.0462) and the lowest value was observed in the instant tea sample (0.01045). The differences between treatments in both acidity and pH values were significant ($P<0.05$). Baptista et al., (1998) reported that the concentration of catechins increased when temperature rose from 50° C and this quantity reached a maximum level at 70° C [27]. Thus, since the amount of catechins existing in green tea has a direct relationship with pH, the increase that was observed after drying process can be justified.

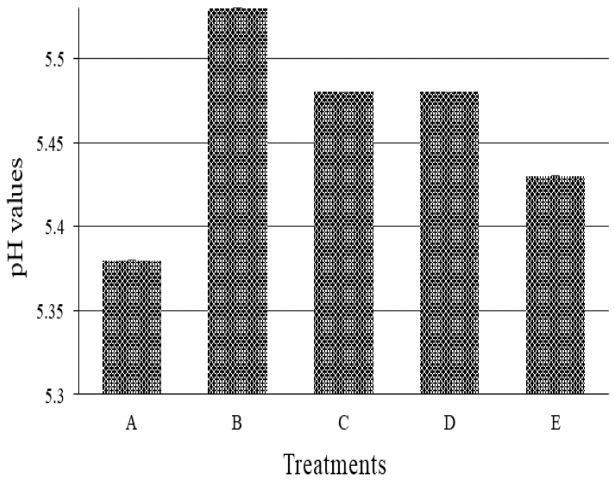

Figure 1 pH values in different treatments (A: tea extract, B: instant tea, C: instant tea with 3% cinnamon, D: instant tea with 5% cinnamon and E: instant tea with 7% cinnamon)

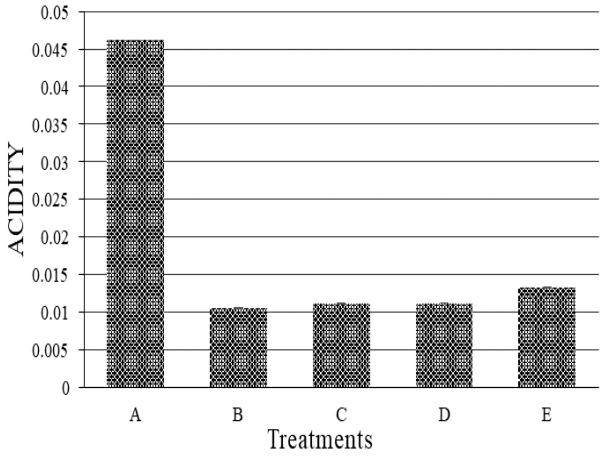

Figure 2 Acidity levels in different treatments (A: tea extract, B: instant tea, C: instant tea with 3% cinnamon, D: instant tea with 5% cinnamon and E: instant tea with 7% cinnamon)

Figure 3 indicates the total polyphenol content in different treatments. The total amount of polyphenols in tea extract was significantly higher than other treatments. In contrast, this parameter in the instant tea sample was considerably lower than other treatments ($p <0.05$). It can be immediately perceived from the chart that the polyphenol content after drying process had a considerable decrease which according to the conducted research, temperatures above 60 °C can cause a significant decrease in the levels of these compounds [28, 29]. However, Rajha et al., (2014) found a decrease in the phenolic content, even when the samples were dried at 45 °C [30]. Moreover, the amount of these compounds increased slightly after adding cinnamon. As it is proved, cinnamon contains high levels of phenolic substances [31-35]. Thus, the slight increase in the amount of polyphenolic compounds in our samples after adding cinnamon can be a result of its polyphenolic content.

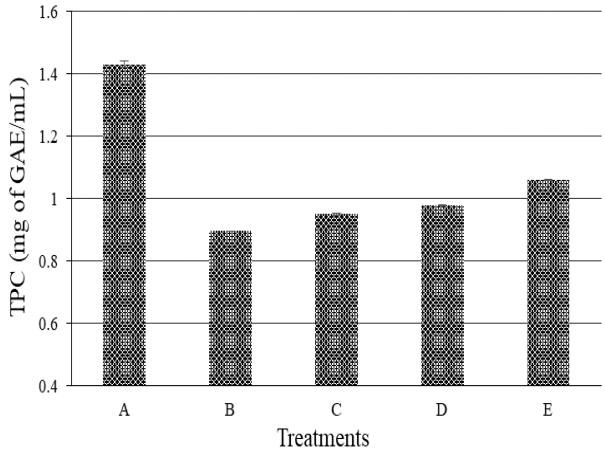

Figure 3 Total polyphenol content in different treatments (A: tea extract, B: instant tea, C: instant tea

with 3% cinnamon, D: instant tea with 5% cinnamon and E: instant tea with 7% cinnamon)

As shown in figure 4, in comparison to the BHA, the tea extract sample exhibited excellent antioxidant properties. The highest DPPH free radical scavenging rate was related to the tea extract, especially at the concentration of 400 ppm, which was even higher than the BHA treatments. On the other hand, tea extract with a concentration of 600 ppm owned the lowest percentage of DPPH free radical scavenging. Overall, the percentage of antioxidant activity fluctuated between different treatments. As it is regularly known, the measured value of the antioxidant capacity is strongly dependent on the polyphenolic content [36-41], but according to the conducted studies, since the antioxidant activity of phenolic acids and their derivatives, such as esters, depends on the number of hydroxy groups in the molecules, type and quality of phenolic compounds is more in charge of higher antioxidant activity than their quantity [42-44]. Therefore, the observed fluctuation in the percentage of this parameter can be described.

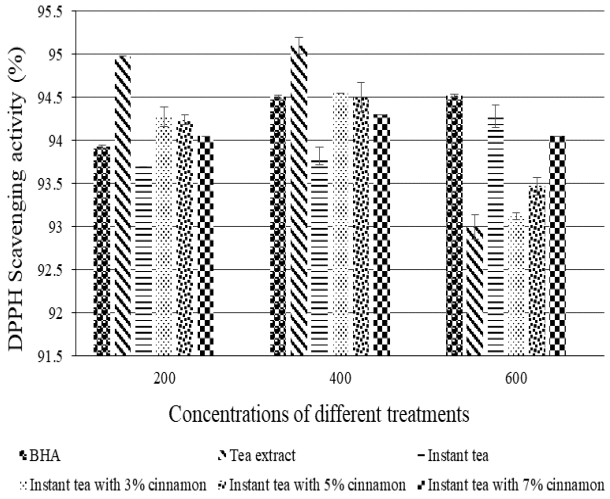

Figure 4. The percentages of DPPH Scavenging activity in different treatments

Currently, a lot of researches have been carried out on the sensory properties of different teas and they proved that there are a lot of factors influencing the sensory properties of this beverage such as water quality, the amount of catechins, storage period, heat processing, additives, etc [45-49]. The Means of overall acceptance scores of different treatments are shown in figure 5. As far as data gives us, the instant tea containing 5% cinnamon and the tea extract sample had the highest and lowest overall acceptance, respectively. As it can be seen, the sensory acceptability of tea samples increased when the tea extract was converted to instant tea and adding cinnamon gave rise to continuing of this increase because it can be a result of cinnamon's good flavor. Overall, the differences between the five treatments were not significant ($p < 0.05$).

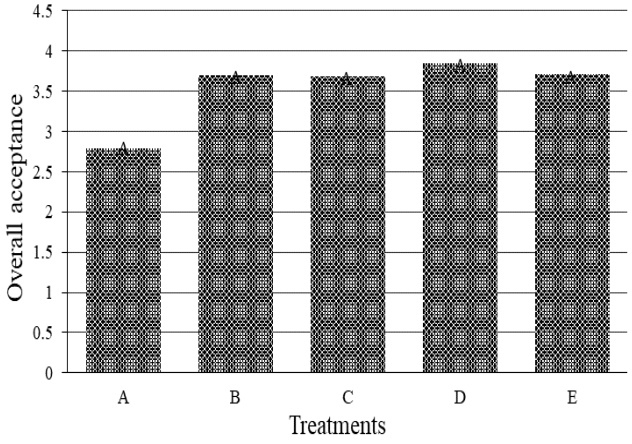

Figure 5. The mean of overall acceptance scores of different treatments (A: tea extract, B: instant tea, C: instant tea with 3% cinnamon, D: instant tea with 5% cinnamon and E: instant tea with 7% cinnamon)

Conclusion

Based on the results of this investigation, it can be stated that the production of instant tea from the tea extract, especially the extract made from low quality tea, can improve the sensory and even qualitative properties of green tea. Also, the addition of cinnamon can enhance effective antioxidant compounds in instant green tea and as a result, it can improve the beneficial and pharmaceutical properties of green tea. As a brief outcome of this work, it can be asserted that adding 5% cinnamon to instant green tea powder has best effect in sensory properties. Accordingly, because of better sensory properties and its reasonable antioxidant activity, it is the best concentration of cinnamon that can be added to this product. In conclusion, it can be said that the information obtained in this research gives interesting new insights for the marketing strategies of tea suppliers in Iran.

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Presentation at a meeting

None

Conflicting Interest

None

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