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The effect of green tea extract on the viability of *Lactobacillus casei* and the qualitative characteristics of a probiotic drink based on a mixture of celery, carrot and apple juice

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ABSTRACT

In this research, the effects of different concentrations of green tea extract (0, 1.5, and 2.5 percent) on Lactobacillus casei survival, antioxidant activity, and drinking sensation of probiotics based on a mixture of different concentrations of celery juice (10, 15, and 20 percent), apple juice (5, 7.5 and 10%) and carrot juice (5, 7.5 and 10%) were investigated. 10 treatments were investigated with three replications. The qualitative characteristics of the probiotic drink samples were investigated during the storage period (first, eleventh and twenty-first days). Based on the obtained results, increasing the percentage of green tea as well as the concentration of celery, carrot and apple juice decreased the pH and antioxidant activity (DPPH radical inhibition percentage), phenolic compounds, as well as increased the viability of Lactobacillus casei and organoleptic properties in the probiotic drink ($p<0.05$). On the other hand, the duration of storage decreased the pH and antioxidant properties ($p<0.05$). Also, the survival of Lactobacillus casei decreased during the storage period ($p<0.05$). The treatment had the highest amount of green tea (2.5%) and the highest concentration of celery juice (20%), carrot (10%) and apple (10%) and the highest sensory quality (taste, smell, texture, color, overall acceptance) and The population of probiotic bacteria in this treatment was more than 7 log cfu/g on the 21st day.

1- Introduction

Humans have tended to further use functional foods in recent years. In fact, functional food consumption is a promising strategy to prevent and/or eradicate diseases. To this aim, recent years have witnessed some efforts in this context. Among these activities, a major breakthrough is the production of fermented products by lactic-acid bacteria based on fruits and vegetables. These products are known as functional foods fortified with products such as probiotics, prebiotics, and synbiotics [1]. In addition to nutritional properties, functional and health-promoting foods possess health-promoting properties for consumers. Functional foods provide the body's primary needs, maintain consumers' health, and reduce the risk of developing various diseases [3].Probiotic foods comprise a considerable fraction of functional foods. The health-promoting effects of probiotic products depend on the probiotic bacteria population in foods and their viability in adverse gastrointestinal conditions, as well as parameters such as probiotic strains and the inoculation rate and ratio of probiotic bacteria population [4].

Fruits and vegetables have received considerable attention as they contain functional compounds. Celery is an important vegetable that contains oleoresin, various sugars (e.g., mannitol and inositol), amino acids (e.g., asparagine, tyrosine, and choline), and a glucoside, called apiin, with therapeutic effects.An essential oil, called apiol, renders celery a highly spicy taste. Celery leaves contain minerals, such as Ca, P, Fe, Na, and K, and vitamins A, C, and B. The aromatic substance of celery, called terpene, prevents calculus retention in the urinary tract and microbial contamination. During dehydration, special nutrients are released in the fiber of this plant that help defecation, hence celery juice is used as a natural laxative and anti-constipation [5].

Similarly, carrotsare of special importance among vegetables. It is rich in functional components, such as vitamins C, E, B, D, and K, and minerals (Ca, K, P, Na, and Fe). Carrots reportedly contain about 6-15 mg of carotenoids. Thus, increasing carrot consumption may lead to extensive vitamin A synthesis. Furthermore, carrot carotenoids and other antioxidants can play a critical role in reducing or ceasing oxidation processes and balancing free radical activity [6].

Among fruits, the apple is specifically important and contains water-soluble and insoluble nutritional fibers (including pectins), tannins, flavonoids, fruit acids, aromas, K, and vitamins A and C. In various apple types, fructose concentration is considerably higher than glucose, along withsorbitol. L-malic acid comprises 90% of apple organic acids and is the most abundant organic acid in this fruit, and the D-malic isomeric form is absent in apples.

By definition, juices are liquids extracted from unfermented fruits and include main processing procedures, such as pretreatment, extraction, and post-compaction treatments. Pretreatments mainly include sorting, cleaning, and inspection. Pretreatments with pectin-lysing enzymes are also necessary to help juice extraction insome fruits, such as strawberries and blueberries. Post-extraction operations include clarification, adjustment, and standardization of solid content, acidity, and sweetness, fortification with vitamins and antioxidants, pasteurization, and packaging. Juices are often converted to concentrates to reduce transportation costs and increase product stability [1].

Plant extract addition to drinks has been investigated in some studies. Dehghan et al. (2022) studied the effects of adding green tea extract (10%) on physicochemical, sensory, and microbial properties, as well as probiotic bacteria viability in a whey-based Piña coladacocktail. They reported that the physicochemical properties (e.g., pH), Brix degree, dry matter, and protein content of the drink were not significantly affected by adding green tea extract while the drink turbidity increased compared to the control sample (without green tea). Microbial contamination was not observed in the green tea-containing sample compared to the control. Moreover, *Bifidobacterium* viability decreased during 28-day refrigeration and passing through gastrointestinal conditions [7]. Rahaei et al. (2020) investigated the inclusion effects of smilax and green tea extracts on probiotic bacteria viability, antioxidant activity, and sensory properties of Kefir. Adding the plant extracts reduced pH while acidity and antioxidant activity increased in the samples ($p \leq 0.05$). In all samples, the population of these

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bacteria exceeded 10^8 CFU/ml by the end of the storage period [8].

The use of green tea extract in a mixture of celery, carrot, and apple juices has not so far been investigated in previous studies. Therefore, this study aimed to explore the effects of green tea extract concentrations on *Lactobacillus casei* viability and qualitative properties of a probiotic drink based on a mixture of celery, apple, and carrot juices.

2-Materials and Methods

Preparation of green tea aqueous extract

Green tea leaves were obtained from the Golestan factory, ground up to a mesh of 20, and sorted in terms of particle size. Next, powdered green tea samples were extracted with distilled hot water in an autoclave (80-105 °C) for 20 min. The samples were cooled and filtered at room temperature and then dried under vacuum at 40 °C [7].

Preparation of inoculum

L. casei was obtained from the bacteria and fungi collection of the Iranian Research Organization for Science and Technology. The number of inoculated bacteria was determined using the 0.5 McFarland standard, which was prepared by mixing 0.05 mL of 1.175% bariumchloride with 9.95 mL of 1% sulfuric acid. The resulting turbidity was almost equal to 1.5×10^8 CFU/ml bacterial cells. The optical density (OD) was measured through UV-V is spectrophotometry at a wavelength of 625 nm, with the OD range of 0.08-0.13 in this wavelength.

Preparation of fruit and vegetable juices

Celery, apples, and carrots were purchased from a local dealer, washed, peeled, and fragmented, followed by re-washing. Juices were then extracted using a juicer. The obtained mixture was filtrated with a 4-layer linen cloth to separate suspended solids. To inactivate enzymes and natural microbial flora, the juices were pasteurized mildly at 85 °C for 5 min. The samples were cooled to 37 °C to be prepared for *L. casei* inoculation.

Preparation ofa probiotic drink based on a mixture of celery, apple, and carrotjuices

The mixed concentrations of celery, apple, and carrot juices were used according to Table 1. Green tea was added at different concentrations (0, 1.5, and 2.5%), followed by inoculating 10^8 CFU/ml of *L. casei* population. Samples were then refrigerated at 4 °C. *L. casei* viability, antioxidant activity, and physicochemical/sensory properties of the samples were evaluated on days 1, 11, and 21.

Table 1. Treatments used in the research

Treatment	Green tea extract concentration (٪)	Carrot juice concentration (٪)	Apple juice concentration (٪)	Celery juice concentration (٪)	Juice and water concentrations (٪)	Bacterial concentration (CFU/ml)
Control	0	7.5	7.5	15	30	0
A_1B_1	0	5	5	10	20	10^8
A_2B_1	0	7.5	7.5	15	30	10^8
A_3B_1	0	10	10	20	40	10^8
A_1B_2	1.5	5	5	10	20	10^8
A_2B_2	1.5	7.5	7.5	15	30	10^8
A_3B_2	1.5	10	10	20	40	10^8

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A_1B_3	1.5	5	5	10	20	10^8
A_2B_3	2.5	7.5	7.5	15	30	10^8
A_3B_3	2.5	10	10	20	40	10^8

Physicochemical and sensory tests of the product

Measurement of pH

The pH of the drink was measured with a pH meter (C863, Consort, Denmark) at 20 °C.

Evaluation of antioxidant activity using the DPPH radical scavenging method

To this aim, 200 µl of each sample (10 mg/ml) was mixed with 1800 µl of a 0.002% DPPH solution in 99.5% ethanol. The reaction mixture was then kept at room temperature in the dark for 60 min. A reduction in the sample absorbance was measured at 517 nm. DPPH radical scavenging (%) was reported based on Equation 1 [10].

DPPHradical scavenging (%)= A0-A1/A0 × 100 (1)

where A0 and A1 are the absorbance of the control and the sample, respectively.

Sensory evaluation

This procedure was performed by 10 trained assessors who evaluated the features of taste, texture, color, odor, and overall acceptance by scoring from 1 (very good) to 5 (very bad) [9].

Probiotic bacteria viability (live cell count)

L. casei cells were counted with the pour plate method using the MRS-agar medium in anaerobic conditions (under ananaerobic jar) at 37 °C for 72 h [11].

Statistical analysis

This study was carried out with a completely randomized design of 10 treatments with three replications. The quantitative features of data were examined with the one-way analysis of variance (ANOVA). The means of data were compared using Duncan's test at a significance level of 0.05%. Data were statistically analyzed with SPSS version 22 software. Graphs were drawn using Excel software.

3-Results and Discussion

pH

As shown in Table 2, the pH and acidity levels of the probiotic drink samples based onthe mixedcelery, apple, and carrot juiceswere significantly affected by the treatments and storage time ($p \leq 0.05$). Significantly reduced pH and elevated acidity occurred in the probiotic drink samples with the rising concentrations of green tea and celery, apple, and carrot juices ($p \leq 0.05$). The lowest pH andhighest acidity values were recorded in T10 containing the utmost green tea level (2.5%) and the greatest concentrations of celery (20%), apple (10%), and carrot (10%) juices. The uppermost pH and lowermost acidity values were obtained in the control treatment. Storage time led to reduced pH and increased acidity in the probiotic drink samples.The reduced pH and increased acidity due to adding green tea extract probably result from the presence of acidic compounds (e.g., 2,3-dihydroxysuccinic acid, 2-bromotetradecanoic acid) and acidic polysaccharides (e.g., glucuronic acid and galacturonic acid) in this extract [12].

Table 2. The pH levels of probiotic drink samples containing different concentrations of celery, carrot, and apple juices

Treatment	Day 1	Day 11	Day 21
1	$5.28{\pm}0.1^{A,bc}$	$5.2{\pm}0.1^{B,a}$	$5.21{\pm}0.1^{C,a}$
2	$5.27{\pm}0.1^{A,cd}$	$5.15{\pm}0.1^{B,a}$	$4.99{\pm}0.1^{C,b}$
3	$5.25{\pm}0.1^{A,ef}$	$5.11{\pm}0.1^{B,c}$	$4.90{\pm}0.1^{C,d}$

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4	5.23±0.1^{A,g}	5.08±0.1^{B,d}	4.88±0.1^{C,e}
5	2.29±0.1^{A,b}	5.09±0.1^{B,e}	4.92±0.1^{C,c}
6	5.25±0.1^{A,ef}	5.04±0.1^{B,e}	4.84±0.1^{C,f}
7	5.24±0.1^{A,fg}	4.99±0.1^{B,f}	4.74±0.1^{C,h}
8	5.31±0.1^{A,a}	4.97±0.1^{B,g}	4.88±0.1^{C,e}
9	5.28±0.1^{A,bc}	4.88±0.1^{B,h}	4.76±0.1^{C,g}
10	5.26±0.1^{A,de}	4.75±0.1^{B,i}	4.67±0.1^{C,i}

*Dissimilar uppercase letters indicate significant differences between different days ($p < 0.05$).
*Dissimilar lowercase letters indicate significant differences between different treatments ($p<0.05$).

Acidity and pH values fall under major issues in producing probiotic products because pH reduction and acidity elevation during storage are associated with acid generation by bacteria, indicating probiotic bacterial growth. Juice sugar consumption by probiotic bacteria reduces pH and elevates acidity. A longer time after adding the bacteria decelerates pH reduction and acidity elevation because of reduced juice sugar. Shah et al. (2010) presented evidence of decreased pH from 3.8 to 3.3 in juices containing *Lactobacillus paracasei*, *L. rhamnosus*, and *L. lactis* [13], which corresponds to our results.

DPPH radical scavenging (%)

According to Table 3, DPPH radical scavenging (%) rose significantly in the probiotic drink samples ($p < 0.05$) after adding green tea and increasing concentrations of celery, apple, and carrotjuices. The highest DPPH radical scavenging (%) was observed in T10 containing the greatest green tea level (2.5%) and the utmost concentrations of celery (20%), apple (10%), and carrot (10%) juices. The control treatment contained the leastlevel of this parameter. Storage time reduced DPPH radical scavenging (%) in the probiotic drink samples.Free radicle scavenging is among the most well-known mechanisms through which antioxidant compounds can inhibit lipid oxidation. In this method, the results are expressed based on a percentage reduction in the absorbance level of extract-containing DPPH solutions compared to extract-free DPPH solutions [14].

A direct relationship was found between the phenolic compounds and the antioxidant activity of green tea extract in the drink.The antioxidant activity of green tea extract results from the presence of various phenolic compounds in these extracts. Green tea antioxidants possess various biological activities, such as preventing oxidative enzyme activity, scavenging reactive oxygen species (ROS), and chelating metals [14].Salem et al. (2014) reported a significant increase in the DPPH radical scavenging (%) of ice cream samples with increasing fed grape extract levels in the icecream formulation through increases in the contents of phenolic compounds and anthocyanins [15], which agrees with the present results. In line with the current research, Lim (2017) claimed that the scavenging level rose significantly with the increase of green tea extract levels in the yogurt formulation [16].

Table 3. DPPH radical inhibition percentages of probiotic drink samples containing different concentrations of celery, carrot, and apple juices

treatment	Day 1	Day 11	Day 21
1	15.934±0.596^{C,b}	29.216±1.907 ^{B,a}	62.388±6.787^{A,a}
2	22.834±0.389^{C,a}	24.951±0.929 ^{B,b}	33.032±2.806^{A,b}
3	15.926±.0.190^{c,b}	19.967±.0.892 ^{B,c}	27.338±0. 655^{A,c}
4	11.019±0.182^{C,c}	15.184±.0.895 ^{B,d}	20.169±0.713^{A,d}
5	4.058±0.12^{C,d}	4.524±.0.047 ^{B,e}	5.168±0.047^{A,e}
6	3.616±0.020^{C,de}	4.058±0.012^{B,ef}	4.277±0.016^{A,e}
7	3.360±0.001^{C,e}	3.665±0.010 ^{B,ef}	3.876±0.026^{A,e}

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8	2.272±0.062C,f	2.547±0.009B,f	2.719±0.006A,e
9	2.194±0.001C,f	2.414±0.013 B,f	2.523±0.006A,e
10	2.084±0.002C,f	2.275±0.004 B,f	2.375±0.035A,e

*Dissimilar uppercase letters indicate significant differences between different days ($p< 0.05$).
*Dissimilar lowercase letters indicate significant differences between different treatments ($p<0.05$).

***L. casei* count**

Based on Table 4, *L. casei* was redoubled significantly in the probiotic drink samples ($p < 0.05$) after adding green tea and increasing concentrations of celery, apple, and carrotjuices. The most abundant *L. casei* was counted in the treatment containing the utmost green tea level (2.5%) and the highest concentrations of celery (20%), apple (10%), and carrot (10%) juices. The treatment with the least concentrations of these components contained the least abundant *L. casei*. The number of this bacterial strain declined in the probiotic drink samples as a result of storage time.

In agreement with our results, Azarfam et al. (2021) reported that bacterial count in a drink was significantly affected by the concentrations of cherry, grape, and barberry juices, bacterial concentration, and storage time.The bacterial count in the drink decreased significantly ($p \leq 0.05$) with storage time increase from day 1 to week 4 of storage [17].

Table 4. *Lactobacillus casei* count (log CFU/g) of probiotic drink samples containing different concentrations of celery, carrot, and apple juices

Treatment	Day 1	Day 11	Day 21
1	3.724±A,g0.11	3.47±B,h0.021	3.370±0.039C,h
2	8.577±A,f0.065	8.242±B,g0.005	5.447 ±0.022C,g
3	8.630±A,ef0.004	8.320±B,f 0.003	5.914 ±0.008C,f
4	8.759±A,cd 0.016	8.386±B,e0.005	6.230±0.014C,e
5	8.653±A, e0.013	8.447±B,d0.001	6.378 ±0.006 C,d
6	8.707±A,d0.013	8.537±B,c0.045	6.648 ± 0.035C,c
7	8.799±A,bc0.019	8.638±B,b0.007	6.812 ±0.028C,b
8	8.712±A,d0.006	8.607±B,b0.023	6.693±0.017C,c
9	8.848±A,b0.022	8.730±B,a0.004	6.819 ±0.018C,b
10	8.916±A,a0.004	8.751±B,a0.038	7.107±0.009C,a

*Dissimilar uppercase letters indicate significant differences between different days ($p< 0.05$).
*Dissimilar lowercase letters indicate significant differences between different treatments ($p<0.05$).

Sensory evaluation

The results of sensory properties of the probiotic drink samples containing different concentrations of celery, carrot, and apple juices are presented in Tables 5-9.The sensory scores (flavor, odor, texture, color, and overall acceptance) increased significantly in the probiotic drink samples ($p < 0.05$) by adding green tea and increasing concentrations of celery, apple, and carrot juices. The sensory scores were uppermost in the treatment containing the greatest green tea level (2.5%) and the utmost concentrations of celery (20%), apple (10%), and carrot (10%) juices. The control treatment with the least concentrations of these juices received the lowest scores. The sensory scores (flavor, odor, texture, color, and overall acceptance) dropped in the probiotic drink samples because of storage time. Similar to our results, Azarfam et al. (2021) found that sensory evaluation scores decreased significantly with rising storage time, which was attributed to the presence of bacteria, metabolites, and organic acid production by bacteria [17].

Table 5. Taste scores of probiotic drink samples containing different concentrations of celery, carrot, and apple juices

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Treatment	Day 1	Day 11	Day 21
1	5±0 A, a	4±0 B, b	3±0C,c
2	5±0 A, a	5±1B,a	4±1 C,bc
3	5±0 A, a	5±1 B,a	5±1C,a
4	5±0 A, a	4±0 B, b	4±0 C,ab
5	5±0 A,a	5±1B,a	4±0 C,ab
6	5±0 A,a	5±1B,a	4±1C,bc
7	5±0 A,a	4±0 B, b	4±1C,bc
8	5±0 A,a	5±1B,a	5±1 C,a
9	4±0A, b	5±1 B,a	4±0C,ab
10	5±0A,a	5±1 B,a	5±1C,a

*Dissimilar uppercase letters indicate significant differences between different days ($p< 0.05$).
*Dissimilar lowercase letters indicate significant differences between different treatments ($p<0.05$).

Table 6. Odor scores of probiotic drink samples containing different concentrations of celery, carrot, and apple juices

Treatment	Day 1	Day 11	Day 21
1	4±0 A, b	3±0 B, b	3±1 B,c
2	5±0 A,a	4±0 B,ab	4±1 B,b
3	5±1 A,ab	5±1 B,ab	4±0B,ab
4	4±0 A,b	4±0 B,ab	4±0 B,ab
5	5±1 A,ab	4±0 B,ab	4±0 B,ab
6	5±0 A,a	4±0 B,ab	4±0 B,ab
7	4±0 A, b	4±0 B,ab	4±0 B,ab
8	4±0 A, b	4±0 B,ab	5±1B,a
9	5±1 A,ab	5±1 B,a	4±1 B,b
10	5±1 A,ab	5±1 B,a	4±0B,ab

*Dissimilar uppercase letters indicate significant differences between different days ($p< 0.05$).
*Dissimilar lowercase letters indicate significant differences between different treatments ($p< 0.05$).

Table 7. Texture scores of probiotic drink samples containing different concentrations of celery, carrot, and apple juices

Treatment	Day 1	Day 11	Day 21
1	4±0 A,ab	4±1 A,b	3±0B,b
2	4±0 A,ab	4±0 A,ab	4±0B,a
3	4±0 A,ab	5±1 A,a	4±0B,a

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4	5±1 A,a	5±1 A,a	4±0B,a
5	5±1 A,a	4±1 A,a	4±1 B,ab
6	4±0 A,ab	4±0 A,ab	4±0B,a
7	4±0 A,ab	4±0 A,ab	4±0B,a
8	4±0 A,ab	4±0 A,ab	4±1 B,ab
9	5±1 A,a	5±1 A,a	3±0B,b
10	4±0 A,ab	4±0 A,ab	4±0B,a

*Dissimilar uppercase letters indicate significant differences between different days ($p < 0.05$).
*Dissimilar lowercase letters indicate significant differences between different treatments ($p < 0.05$).

Table 8. Color scores of probiotic drink samples containing different concentrations of celery, carrot, and apple juices

Treatment	Day 1	Day 11	Day 21
1	4±0 A,ab	4±0 A,ab	4±1 B,ab
2	4±0 A,ab	4±0 A,ab	4±0B,a
3	4±0 A,ab	4±0 A,ab	4±1 B,ab
4	5±1 A,a	4±0 A,ab	4±0B,a
5	5±1 A,a	4±0 A,ab	4±0 B,ab
6	4±0 A,ab	4±0 A,ab	4±1 B,ab
7	4±0 A,ab	4±0 A,ab	4±1 B,ab
8	4±0 A,ab	4±0 A,ab	4±0B,a
9	5±0A,a	5±1 A,a	4±1B,ab
10	4±1A,ab	4±0 A,ab	4±0B,a

**Dissimilar uppercase letters indicate significant differences between different days ($p < 0.05$).
*Dissimilar lowercase letters indicate significant differences between different treatments ($p < 0.05$).

Table 9. Overall acceptance scores of probiotic drink samples containing different concentrations of celery, carrot, and apple juices

Treatment	Day 1	Day 11	Day 21
1	4±0 A,ab	4±1 A,b	3±0 B,b
2	4±0 A,ab	4±0 A,ab	4±0 B,a
3	4±0 A,ab	5±1 A,a	4±0 B,a
4	5±1 A,a	5±1 A,a	4±0 B,a
5	5±1 A,a	4±1 A,a	4±1B,ab
6	4±0 A,ab	4±0 A,ab	4±0 B,a

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7	4±0 A,ab	4±0 A,ab	4±0 B,a
8	4±0 A,ab	4±0 A,ab	4±1B,ab
9	5±1 A,a	5±1 A,a	3±0 B,b
10	4±0 A,ab	4±0 A,ab	4±0B,a

*Dissimilar uppercase letters indicate significant differences between different days ($p < 0.05$).
*Dissimilar lowercase letters indicate significant differences between different treatments ($p < 0.05$).

4-Conclusion

In this research, the effects of adding green tea extract concentrations (0, 1.5, and 2.5%) to a probiotic drink containing mixed concentrations of celery, apple, and carrot juices on *L. casei* viability, qualitative properties (pH, DPPH radical scavenging percentage, and phenolic compounds), and sensory properties were investigated inthe probiotic drinkon days 1, 11, and 21. The evaluation results of the probiotic drink properties indicated that increasing the green tea percentage and celery, carrot, and apple juice concentrations reduced the pH and antioxidant activity. This treatment increased the viability of *L. casei* and organoleptic properties in the probiotic drink. The pH and antioxidant properties, as well as the viability of *L. casei*, decreased by the storage duration. The scores of organoleptic properties were also reduced during thestorage.The treatment with the highest green tea level (2.5%), celery (20%), carrot (10%), and apple (10%) juices was selected as the best treatment, which presented the highest viability (7 log cfu/g) of probiotic bacteria.

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مقاله علمی_پژوهشی

اثر عصاره چای سبز بر زنده مانی *لاکتوباسیلوس کازئی* و ویژگی های کیفی نوشیدنی پروبیوتیک بر پایه مخلوط آب کرفس، هویج و سیب

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چکیده

در این تحقیق اثرغلظت های مختلف عصاره چای سبز (۰، ۱/۵ و ۲/۵ درصد)، بر زنده مانی *لاکتوباسیلوس کازئی*، فعالیت آنتی اکسیدانی، وحسی نوشیدنی پروبیوتیک بر پایه مخلوط غلظت های مختلف آب کرفس (۱۰، ۱۵ و ۲۰ درصد)، آب سیب (۵، ۷/۵ و ۱۰ درصد) و آب هویج (۵، ۷/۵ و ۱۰ درصد) بررسی شد. ۱۰ تیمار با سه تکرار مورد بررسی قرار گرفت. ویژگی های کیفی نمونه های نوشیدنی پروبیوتیک طی دوره نگهداری (روزهای اول، یازدهم و بیست و یکم) بررسی شد. بر اساس نتایج به دست آمده افزایش درصد چای سبز و همینطور غلظت آب کرفس، هویج و سیب باعث کاهش میزان pH و فعالیت آنتی اکسیدانی (درصد مهار رادیکال DPPH)، همچنین افزایش زنده مانی *لاکتوباسیلوس کازئی* و خواص ارگانولپتیکی در نوشیدنی پروبیوتیک شد(p<۰/۰۵). از طرفی مدت زمان نگهداری باعث کاهش میزانpH و خاصیت آنتی اکسیدانی شد(p<۰/۰۵). همچنین زنده مانی *لاکتوباسیلوس کازئی* طی مدت زمان نگهداری کاهش یافت(p<۰/۰۵). تیمارحاوی بیشترین میزان چای سبز(۲/۵٪) و بالاترین غلظت آب کرفس (۲۰٪) ، هویج (۱۰٪) و سیب (۱۰٪) بالاترین کیفیت حسی (مزه، بو، بافت، رنگ، پذیرش کلی) را داشت و جمعیت باکتری پروبیوتیک در این تیمار در روز بیست و یکم بیش از 7log cfu/g بود.