A study on processing bottled banana-flavored herb tea

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Nghiên cứu chế biến trà thảo mộc hương chuối đóng chai

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ABSTRACT

Herb tea is tending to be consumed widely and increasingly in the world. In Vietnam, banana is one of the most popular fruits, but their peels are often wasted which can be reproduced in food processing. The purpose of this study was to determine the combination of banana-flavored water mixed with other herb extraction to create a kind of herbal drink meeting demand's consumers. Therefore, banana peels were extracted directly in boiling water to create steam and condense water with a strong banana flavor. The optimal volume of banana-flavored water was 25 mL added into 100 mL herbal extract water. Among seven studied herbs, licorice with the number of 2 branches was accepted the most by panelists for herb tea's sweetness and valued 3.8 for the taste sensory score in the 5 -point Hedonic scale. In addition, saffron with 3 branches was the best coloring agent for bright yellowness, determined 4.2 for the color sensory score. On the other hand, jujube (1 gram) was the best appropriate herb for the best flavour, well mixed with other herbs to produce the best acceptance by major panelists (the total sensory score of 14.6). The final herb tea product made by the selective recepi is potential to supply for the market a new healthy herbal drink.

***Từ khóa**:*
Cam thảo, nhuỵ hoa nghệ tây, nước hương vị chuối, táo tàu, thang điểm đánh giá cảm quan Hedonic, trà thảo dược đóng chai.

TÓM TẮT

Trà thảo dược đang trở thành xu hướng được tiêu thụ rộng rãi trên thế giới. Ở Việt Nam, nguyên liệu chuối là một trong những loại trái cây được ưa chuộng nhưng vỏ chuối thường bị bỏ phí, chúng hoàn toàn có giá trị sử dụng có thể đưa vào sản xuất nước trà uống đóng chai nhằm mang đến một loại đồ uống có hương vị đặc trưng và hấp dẫn cho thị trường trong nước. Mục tiêu của nghiên cứu này là khảo sát nhằm tìm ra công thức kết hợp giữa nước hương chuối với các loại thảo dược khác để tạo ra một loại nước uống thảo dược đáp ứng được nhu cầu người tiêu dùng. Bởi vậy, nước hương chuối được tạo ra từ vỏ chuối bằng cách chưng cất trực tiếp trong nước để tạo ra nước ngưng tụ có hương vị đặc trưng của chuối, với thể tích đề xuất tối ưu là 25 ml thêm vào 100 ml nước chiết xuất thảo dược. Trong số bảy loại thảo mộc được lựa chọn nghiên cứu, cam thảo với số lượng lựa chọn là 2 nhánh đạt điểm đánh giá cảm quan về vị là 3,8 theo thang Hedonic đáp ứng thị hiếu. Ngoài ra, nhuỵ hoa nghệ tây với số lượng là 3 nhánh tạo màu vàng tươi sáng hấp dẫn cho loại trà thảo dược, đạt điểm cảm quan là 4,2 về màu sắc. Mặt khác, nguyên liệu táo tàu (khối lượng 1 gram) là loại thảo mộc thích hợp và hài hoà nhất trong số các loại thảo dược còn lại khi phối chế để tạo ra một loại nước uống đáp ứng tốt nhất với người tham gia đánh giá cảm quan (tổng điểm cảm quan đạt 14,6). Sản phẩm trà thảo mộc được sản xuất bởi công thức pha chế lựa chọn trong nghiên cứu này triển vọng cung cấp cho thị trường một loại nước uống thảo dược mới có lợi cho sức khỏe.

1. INTRODUCTION

Herbs have been used since ancient times for their medicinal properties, mostly concentrated into teas, drinks and tinctures. Recently, herbs have been realized their healthful value as a food ingredient. Herbs contain rich of vitamins and antioxidants content [1]. Their flavonoids which are compounds with mild anti-inflammatory properties, others are good for human's immune system and create antibiotics for the body. There are many outstanding health benefits such as preventing cancer, reducing the risk of diabetes and complications, preventing the risk of neurodegenerative diseases, increasing metabolism, reducing fat, protecting the liver, clear heat, detoxify, reducing fever, and reducing stress [2].

Nowadays, there are many choices of healthy drinking water products. There is an increasing trend of using herb teas to refresh, purify, detoxify for the body and replacing a portion of daily fresh drinking water. Tea has become the most widely consumed beverage in the world in which herb tea is increasing its demand by global consumers. Each herb can be used in different ways, individual [3] or combination [1, 4, 5]. When combining several herbs together, they can have outstanding and effective uses to keep healthy and prevent diseases. Nowadays, people tend to use natural products originated from precious herbs via foods and drinks. Herb teas are prepared from plants that follow a simple procedure. Plant materials are immersed into hot water (70 to 100 °C) for a few minutes (about 1 – 5 min). The medical plants can usually be contained in a bag or extracted into the water. Herb tea can be drunk hot, warm, cool or iced, packed in a bag or bottled as ready to drink as beverage [6]. In some cases, milk and/or a sweetener such as honey or sucrose may be added into the drinking water/tea [7].

At the present, drinking herb tea has become a smart choice for modern people. Consumers not only get refreshment but also benefits of nourishing the body, supporting the treatment and prevention of diseases with high mortality rates such as coronary artery disease, cancer, stroke, diabetes, atherosclerosis...[8, 9]

Some herbal ingredients and plant materials are studied in this research. Namely Licorice, its scientific names of *Scoparia dulcis* L., belongs to the Family of *Scrophulariaceae* [10]. Licorice is one of the oldest and most frequently used herbs in traditional Chinese medicine. In the literature, licorice contains more than 20 triterpenoids and 300 flavonoids, so it has strong anti-inflammatory and antibacterial properties. Besides, it was revealed about its antitumor, antiviral, immunoregulatory. This contributes to the recovery and protection of the nervous, alimentary, respiratory, endocrine, and cardiovascular systems [11].

Apple has been an ancient fruit cultivated in China more than 4000 years, mainly varieties traveled beyond Asia centuries ago and today planted spread in US, Africa, Western countries [12]. It has a common name as jujube, red date or Chinese date, and its scientific name of *Zizyphus jujuba* Mill [13]. It was in the literature reported to support cancer treatment, stabilize blood pressure, atherosclerosis, diabetes, Alzheimer's disease, obesity and prevent cardiovascular diseases [14].

Goji, goji berry, or wolfberry, its scientific name of *Fryctus lycii* is an exotic "berry-type" fruit of the plant *Lycium barbarum*. *F. lycii* is used for cooking in traditional Chinese home and in the Chinese Pharmacopeia as a remedy for diabetes to balance in the body for about two centuries. It has macronutrients, micronutrients, and several bioactive compounds (macronutrients: 46% carbohydrate, 13% protein, 1.5% fat, 16.5% dietary fiber; micronutrients: vitamins and minerals) [15]. Because of its high antioxidant, antiaging, anti-diabetic activities, its extract helps to lower blood sugar, protect liver and reduce obesity… [16].

Crocus sativus, commonly known as *saffron crocus* or *autumn crocus* belongs to the Family of *Iridaceae*. It was originated in Greece or Southwest Asia, which was first grown in Greece 3000 years ago, then introduced to other regions such as North Africa, North America and Oceania. Saffron is good for

digestive system, cardiovascular health, supporting cancer prevention, improving vision and beauty… [6].

Red rose belongs to the genus *Rosa*, family *Rosaceae*. Roses contain biosubstances in its essential oils, high content of vitamin C in hips and flowers, and other different phenolic and flavonoid constituents... [17].

Jasmine has a scientific name of *Jasminum sambac* (L.), a genus of shrubs and vines in the olive family *Oleaceae*. Jasmine flowers contain aromatic fats with a content of 0.08%, namely methyl anthranylic ester, indole, formic acetic-benzoic-linalyl ester, paraffin… The flowers of *Jasminum sambac* are used as flavor for tea leaves. In concern of pharmacological research, its flowers are used for treatment of diarrhoea, abdominal pain, conjuctivitis and dermatitis… [18].

Yellow chrysanthemum or *Chrysanthemum indicum* are grown widely in Hung Yen, Hai Duong, Bac Ninh, Hanoi and some other provinces in the North of Vietnam. *Chrysanthemum* plants contain Carotenoid (chrysanthemoxanthin) and essential oil. There have been many studies showing the active ingredient bisabolol in Chrysanthemum oil. It has anti-irritant, anti-inflammatory and anti-bacterial properties, thus it has been proven therapeutic effects of cough, stuffy nose reduction, detoxifies and respiratory system supports… [19].

Bananas (*Musa* spp.) belonging to the *Musaceae* family are considered fruits that provide as food for millions of people throughout the tropical and subtropical regions in the world. Currently, bananas are grown in 150 countries around the world with an area of over 4.84 million hectares, providing 97.5 million tons/year, accounting for approximately 44% of fresh fruit production and are the second most important fruit crop after Citrus group. This is one of the oldest and tastiest fruits used as a food supplement [20]. Bananas are commonly used as fruit and their peels after consumption are often thrown away or used as additional food for animals. However, banana peels can be reused in food processing for different types of useful products [21].

In this study, the banana peel was distilled directly in water to obtain banana-flavored water in a lab-scale. Besides, the other herbs mentioned above were to investigate the herbal extraction and mixed with the banana-flavored water to create an herb tea, partly replacing drinking water for people. This refreshing herb tea with a typical Vietnamese banana flavor is suitable for the tastes of major consumers.

2. RESEARCH METHODS

2.1. Materials

Bananas were collected and purchased from a household's garden in Soc Son, Hanoi, Vietnam. After taking the fruits, banana peels were reused to extract pure banana-flavored water in a 10 L distillation unit.

Some dried herbs selected to be extracted in boiling water include licorice, goji berries, jujubes, chrysanthemums, jasmine, roses, and saffron purchased at the Metro supermarket system in Hanoi, Vietnam.

2.2. Experiments

2.2.1. Procedure of general processing banana-flavored herb tea

The selected herbs are weighed (1 gram of each herb, except *saffron crocus* taking 3 branches) and added with 100 ml of clean boiled water to extract compounds dissolved in water. Next, banana peels obtained are cut into small pieces (1 cm). 1 kg of small sized banana peels are added into the 10 L stainless boiler and filled with 5 L of clean water to prepare for hydro-distillation. The distillation is kept about 3 hours at the medium heat mode to obtain the condensed water containing a small amount of banana essential oil. Therefore, the condensed water has a strong typical banana flavor. This step is to produce banana-flavored water for herb tea production. Then, the herbal extracts and banana-flavored water are mixed with appropriate ratios. After being processed, the complete herbal water will be bottled. Finally, the bottles are sterilized with boiling clean water for about 10 minutes. Store the product bottles at 4^{o}C temperature for long-term use and analysis (see Figure 1).

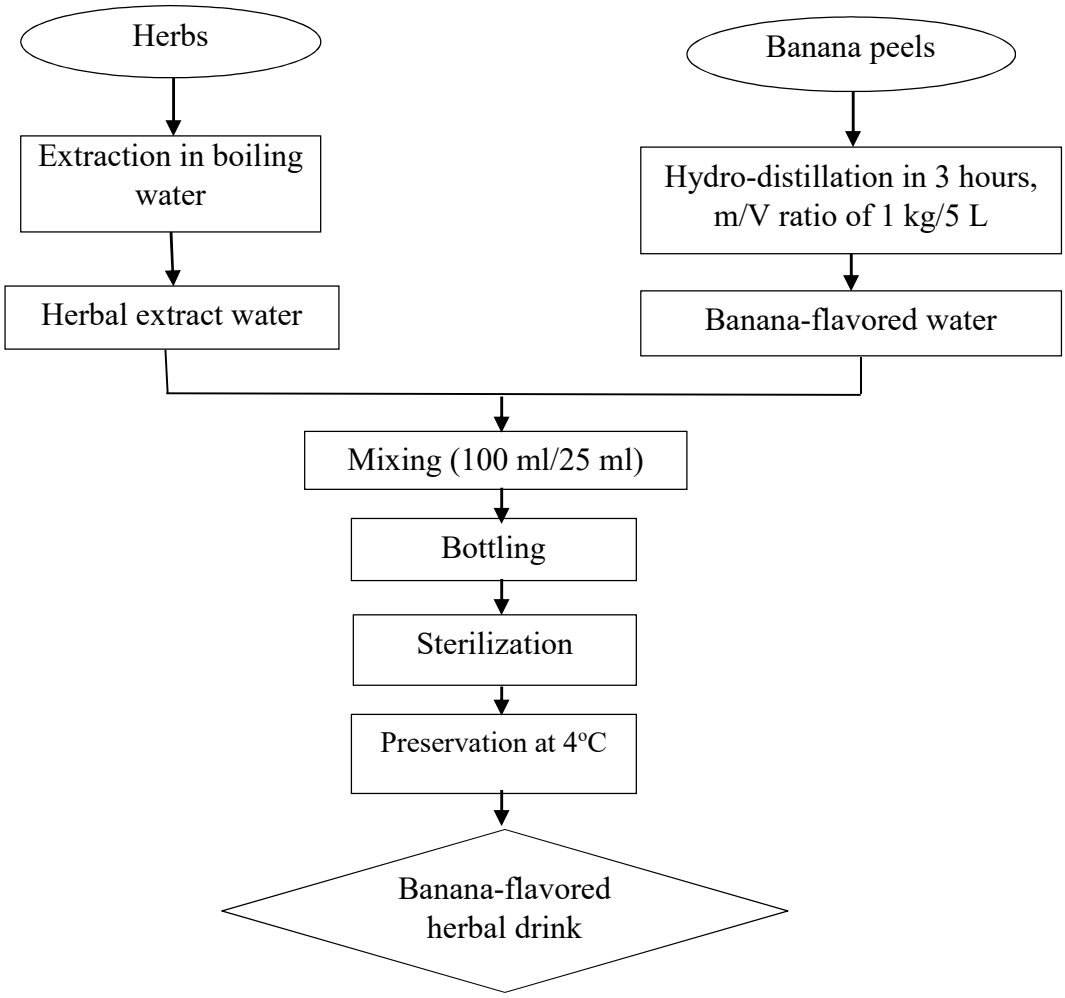

Figure 1. Procedure of general processing banana-flavored herb tea

2.2.2. Selection of herbal ingredients

Experiments were conducted with the selected herbs with a dried weight of 1 gram including licorice (Li), goji berries (Gj), jujube (Ju), and roses (Ro), dried jasmine (Ja), chrysanthemum (Ch) flowers, and 3 branches of saffron (Sa) were mixed with 100 ml of boiled water for 5 minutes. Then successively added about 25 ml of the banana-flavored water (Ba) to evaluate which herbal ingredients are the most suitable and highest score of sensory evaluation of taste, flavor, color, texture, and total according to Hedonic scale. As a result, the herb with the highest scores in each of flavor, taste, color, texture and total were chosen to be investigated in the next experiments.

2.2.3. Development of mixing recipe for banana-flavored herb tea

In succession, it was conducted 3 experiments to investigate the most preferable weight of the above selective herbs that achieved the highest score of taste, flavor, and color/texture. As a result, the optimal recipe of herb tea was proposed.

2.2.4. Analytical method of quality of banana-flavored herb tea

The quality of the banana-flavored herb tea was analyzed some typical physical, chemical and biological indexes by the following methods: Evaluation of sensory in a group of five trained panelists followed to the Hedonic method with a 5-point scale with 1 meaning 'dislike very much' and '5' meaning 'like very much' [22]; pH determined by Mettler Toledo pH meter - S220, China; Brix using Brix meter RHSN-10 ATC, Gamand-Index, China; Reducing

sugar content by Bertrand method using alkaline solution of tartarate complex with cupric ion [23]; Total aerobic microorganisms according to TCVN 5165:1990 [24]; Determination of vitamin C (reduced ascorbic acid) applied 2.6– Dichloroindophenol titrimetric method according to TCVN 5246-90 [25].

2.3. Data analysis

Experiments were carried out duplicate with five trained panelists (n=5) and the Hedonic scores were expressed as average. Data was expressed in radar-typed graphs using Microsoft Excel software 2016.

3. RESULTS AND DISCUSSION

3.1. Selection of herbal ingredients mixed with banana-flavored water

When combining the banana-flavored water and one kind of selective herbs, the results of Hedonic sensory scores are presented in Figure 2 and 3 to choose the herb having the highest score of taste, color, flavor, texture, and total.

In Figure 2, it was seen that the total sensory scores of the mixtures ranged from 8.8-14.6. The total sensory score ranked in order from low to high as follow: P5 < P6 < P2 < P4 < P7 < P3 < P1. The combination of jasmine, or chrysanthemum with banana-flavored water was not preferable by the major panelists, gaining the lowest total score of 8.8 and 10.8, respectively. In contrast, P1, P3 and P7 treatments mixed with licorice, jujube and saffron achieved the highest total scores as 14.6, 12.8, and 12.4, respectively. For a tea, the taste is the most important factor to make a good drink. In term of taste, licorice and/or jujube was the herb among the others bringing the best and second of sweetness and deliciousness. For flavor evaluation except jasmine and/or goji berry, the other five herbs made the drink good sensory-appealing flavor, and maintaining the typical banana flavor of the tea. In concern of color and/or texture, saffron was the best, and jujube and/or chrysanthemum was equally the second herb of the attractive appearance that the drink had bright, attractive yellow color. Therefore, in the next experiments licorice (Li) was chosen for the major sweetener, saffron (Sa) for the bright yellow coloring agent when mixing with the banana-flavored water (Ba). The other herbs including jujube (Ju), rose (Ro), and/or chrysanthemum (Ch) was in turn able to be added into the mixtures.

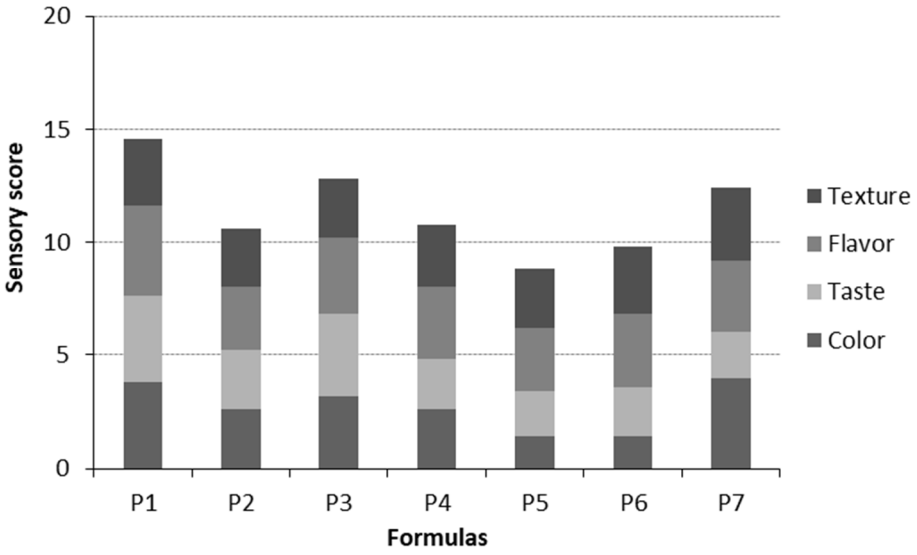

Figure 2. Panelist scores of acceptance test for herb selection

P1: Ba/Li, P2: Ba/Gj, P3: Ba/Ju, P4: Ba/Ro, P5: Ba/Ja, P6: Ba/Ch, P7: Ba/Sa (n=5)

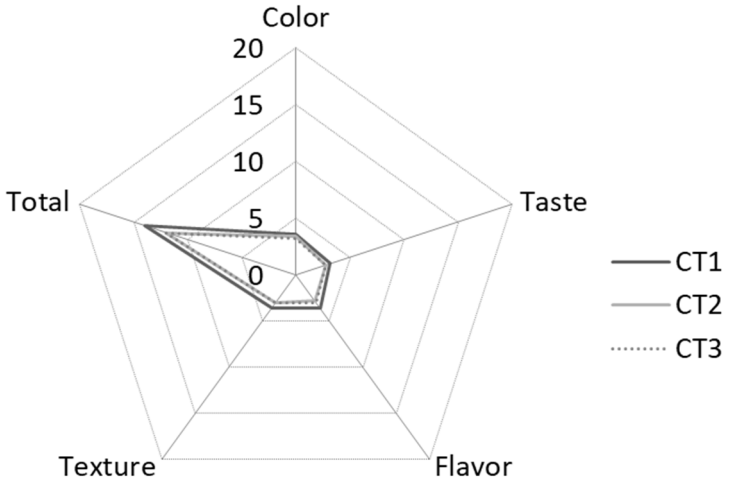

Figure 3. Panelist scores of acceptance test for mixtures of banana-flavored water (Ba) and other herbs
CT1: Ba/Li/Sa/Ju; CT2: Ba/Li/Sa/Ro; CT3: Ba/Li/Sa/Ch.

As shown in Figure 3, the total sensory scores of formulas CT1, CT2 and CT3 were 14.0, 12.0 and 12.0, respectively. The reason of the CT2 and CT3 formulas achieved the lowest total Hedonic score because rose and chrysanthemum had strong scent overwhelming the banana flavor of the drink that resulted in the significantly lower scores of taste and flavor indexes. Thus, the best formula of the herb tea found was CT1 (Ba/Li/Sa/Ju) including banana water mixed with the three herbs of licorice, saffron and jujube. This mixture was continued to study in the next experiments to find out the optimal recipe of the herb tea.

3.2. Development of recipe for mixing banana-flavored herb tea

Investigation of optimal taste

Licorice was the best herbal sweetener chosen to study and mixed with other two herbs and banana-flavor water. Its weight was used 1, 2, and 3 branches equivalent to formulas M1, M2 and M3. The result was presented in Figure 4.

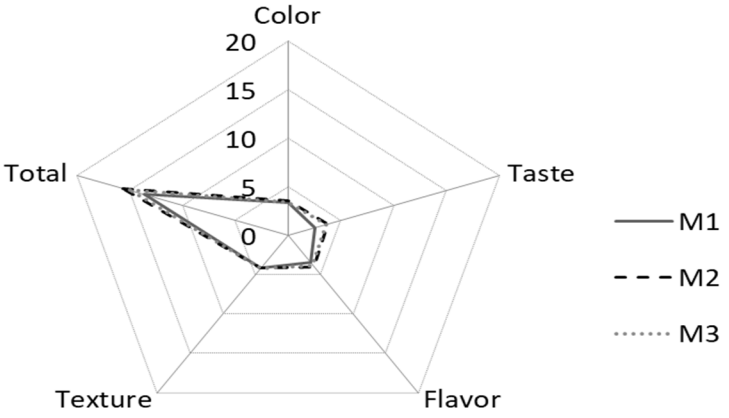

Figure 4. Panelist scores of acceptance test for taste
M1: Ba 25 ml/Li 1 branch/Sa 3 branches/Ju 1 g; M2: Ba 25 ml/Li 2 branches/Sa 3 branches/Ju 1 g; M3: Ba 25 ml/Li 3 branches/Sa 3 branches/Ju 1 g.

It was seen that when changing the amount of licorice, the herbal main sweetener, the taste and/or flavor of the drink was the most affected with its score ranging from 2.6-4.0. The highest was obtained for the licorice with two branches (M2) that led to the moderate sweetness. On the other hand, the color/texture score was almost the same among the three investigated formulas. Thus, the formula M2 with two branches of licorice was chosen to be optimal for the taste accepted by the major panelists.

Investigation of optimal flavor

In this experiment, the banana-flavored water volumes were changed as 20, 25 and 30 mL corresponding to three studied formulas of M1, M2 and M3, respectively. The result was presented in Figure 5.

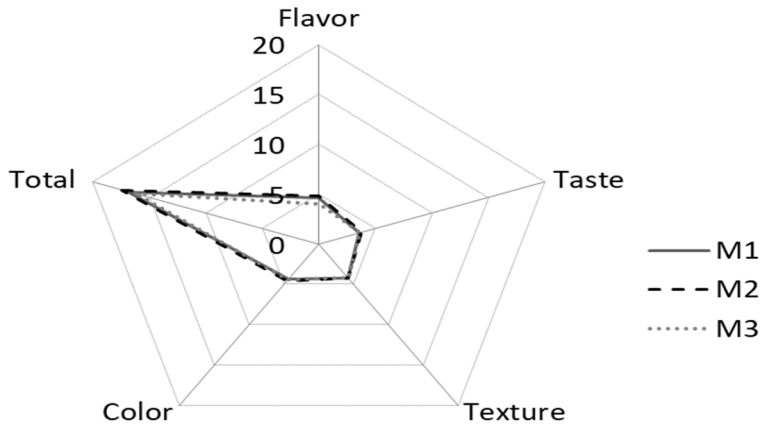

Figure 5. **Panelist scores of acceptance test for flavor**

M1: Ba 20 ml/Li 2 branches/Sa 3 branches/Ju 1 g; M2: Ba 25 ml/Li 2 branches/Sa 3 branches/Ju 1 g; M3: Ba 30 ml/Li 2 branches/Sa 3 branches/Ju 1 g.

In Figure 5, the highest flavor score was 4.8 reported for the M2 formula using 25 ml banana-flavored water. The other sensory indexes were similar, thus the total Hedonic score was the highest for M2. The proposed volume of banana-flavored water was 25 ml dissolved with 100 ml extracted herbal solution.

Investigation of optimal color

As presented above, saffron was the main coloring herb producing the attractive bright yellow for the drink. It was changed the number of its branches from 2, 3 and 4 as M1, M2 and M3 studied formulas, respectively.

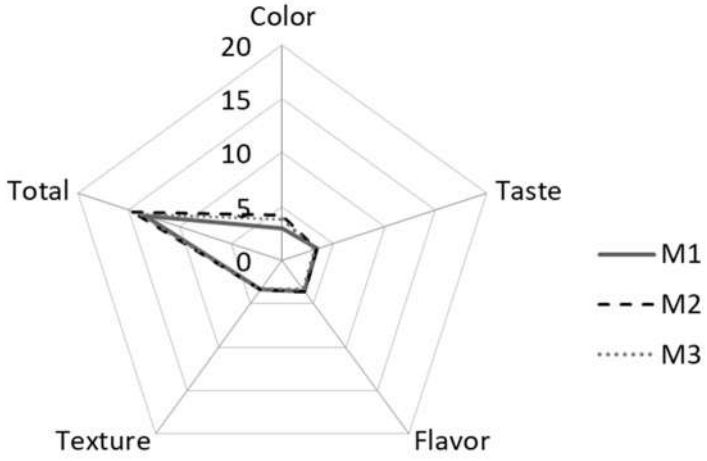

Figure 6. **Panelist scores of acceptance test for color**

M1: Ba 25 ml/Li 2 branches/Sa 2 branches/Ju 1 g; M2: Ba 25 ml/Li 2 branches/Sa 3 branches/Ju 1 g; M3: Ba 25 ml/Li 2 branches/Sa 4 branches/Ju 1 g.

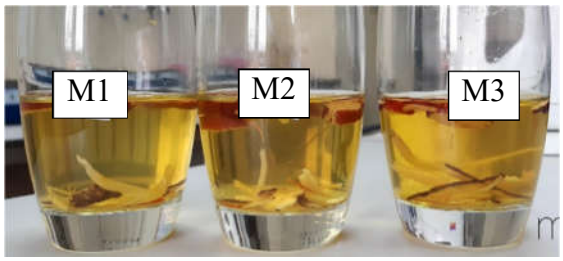

Figure 7. Samples of herb teas for acceptance test of color

It was shown in Figure 6 and 7 that the color score of M2 formula with three saffron branches resulted in the highest as 4.2. While the other taste, flavor or texture scores were similar among three formulas. As a result, the total score of M2 was 14.6 as the best flavor formula accepted by the major evaluators. Consequently, the recipe of the best banana-flavored herb tea was M2 or Ba 25 ml/Li 2 branches/Sa 3 branches/Ju 1 g.

3.3. Evaluation of quality of banana-flavored herb tea

Table 1. Analysis result of quality of herb tea

Parameter	Result	Requirement (QCVN 6-2: 2010/BYT [26])
pH	5.08	-
Brix	10 ^{o}Bx	-
Total sensory score	17.4	-
Texture	*4.2*	
Color	*4.2*	
Flavor	*4.8*	
Taste	*4.2*	
Reducing sugar	22.0%	-
Total aerobic microorganisms	40	Maximum 100 CFU/mL
Vitamin C	4.92 g/100 g	-

- : Not applied.

As presented in Table 1, it was reported that the complete herb tea had pH mildly acid of 5.08; Brix 10^{o}Bx; total sensory score of 17.4, reducing sugar content of 22%, small content of Vitamin C 4.92 mg/100 g and total aerobic microorganisms of 40 CFU/mL significantly smaller than the maximum acceptance level according to QCVN 6-2: 2010/BYT. Therefore, the bottled herb tea production with the selected recipe is safe and it is a potential and healthy beverage in the Vietnam market.

4. CONCLUSION

In this study, banana-flavored water was made from banana peels by hydro-distillation process. Among selective herbs, licorice with 2 branches showed the highest acceptance score by panelists for herb tea's sweetness (the taste score of 3.8). Saffron with 3 branches was chosen to be the best yellow coloring agent for the tea (the color score of 4.2). The optimal volume of banana-flavored water was 25 ml mixed with 100 ml extracted herbal water. In comparison with other studied herbs, jujube with the mass of 1 gram was the best suitable one well mixed with other ingredients to achieve the best total sensory score accepted by the major panelists (the total score of 14.6). The herb tea produced by the selective recipe is promising to provide a healthy herb tea in commerce.

Acknowledgments

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