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EFFECT OF PROCESSING FACTORS ON THE QUALITY OF SILYMARIN MILK THISTLE TEA BAG

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Abstract

The Silymarin milk thistle tea bag is produced from four herbal plants in Phu Tho province, including Silybum marianum, Celastrus hindsii, Solanum procumbens, and Stevia ribaudiana. Tea products are used as a functional drink to prevent and treat liver diseases such as liver cirrhosis, non-alcoholic fatty liver, steatohepatitis, and alcoholic fatty liver diseases. The results indicated that suitable parameters for tea production technology include roasting material technology to yellow color, roasting temperature from 120°C - 150°C and roasting time 8 minutes per batch, grinding to powder size from 1.0 mm to 2.0 mm, and mixing ratio by weight (gram) between *S. marianum*, *C. hindsii*, *S. procumbens* powder was 3 : 5 : 2 with an addition of 5% S. ribaudiana. Sensory evaluation of the tea showed a desirable quality of the tea liquor, such as clear and medium brown color with a mildly sweet flavor and distinctive aroma.

Keywords: *Herbal tea, liver disease, mixing ratio, Milk thistle, powder size, silymarin.*

1. Introduction

Teabags have wide applications in the beverage industry, as they are convenient, easy to use, and dispose-off with a higher preference than loose tea, as they are easy to prepare and handle. The importance of teabags is the effortless blending of different herbal ingredients with various health benefits. Silymarin Milk Thistle tea bag is made from four herbs in Phu Tho province include Silybum marianum, Celastrus hindsii, Solanum procumbens, and Stevia ribaudiana. *S. marianum* is one of the valuable medicinal plants used to treat liver disorders such as hepatitis, cirrhosis, and gallbladder diseases [1, 2]. The main active compound of the plant seeds is silymarin, a mixture of three isomers silybin, silydianin, and silycristin. Silymarin is the most used herbal supplement in the United States for liver problems [2]. It acts as a hepatoprotective, anti-cancer, anti-inflammatory, immunomodulatory, neuroprotective, and lactogenic agent [3]. *C. hindsii* is a precious herbal plant in traditional medicine used in pharmaceutical technology to treat ulcers, inflammation, and tumors. It is widely distributed in some countries such as China, Vietnam, Myanmar, and Thailand [4]. The extract from *C. hindsii* leaf has potent cytotoxicity, antioxidant, anti-cancer activities [5, 6]. *S. procumbens* is a medicinal plant used

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to treat liver cirrhosis, teeth inflammation, rheumatism, pain in the tendons and bones, dry cough, whooping cough, allergies [7]. The glycoalkaloid in *S. procumbens* has hepatoprotective effects, inhibits cirrhosis development, and anti-inflammatory and antioxidant effects [8]. S. ribaudiana is an ancient perennial shrub of South America. The main active compound in S. ribaudiana is steviol glycosides that are low-calorie sweeteners, about 300 times sweeter than saccharose [9]. The extract from S. ribaudiana leaf has antimicrobial and antitumor [10], antioxidant, antimicrobial, and antifungal activities [9]. Currently, the health-protective food products are produced from *S. procumbens, C. hindsii*, and *S. marianum* (Milk thistle) is quite diverse such as Liver supplements *S. procumbens* - *C. hindsii* - Milk Thistle product that produced by Viet Nam Anh Quoc Truong Dai Hung.,JSC, Liver detoxification *S. procumbens* - *C. hindsii* - Silymarin product that produced PULIPHA Pharmaceutical Joint Stock Company, Milk Thistle Phytosome product with ingredients is Silymarin, *S. procumbens*, *C. hindsii* and other ingredients that produced Herbal Factors, American…These products are widely used in the physiotherapy of liver diseases, including acute and chronic viral hepatitis, toxin/drug-induced hepatitis, cirrhosis, and alcoholic liver diseases. To produce a drink that is healthy, convenient, and easy to use, we had researched the effect of processing factors on the quality of Silymarin Milk thistle teabag.

2. Methods

Materials: *S. marianum, S. procumbens, C. hindsii* and S. ribaudiana are cultivated in Phu Tho province. Parts used: dried trunk and leaves of *S. procumbens, C. hindsii* and S. ribaudiana; dried seeds of *S. marianum*. The materials were dried to 13% moisture content by cabinet dryer machine. The dried temperature was 55 oC - 60ºC. The filter paper used in the experiments is 125 mm paper, thickness: 0.074 mm, water absorption: 350 mm, ventilation: 150 cm3/cm2, curvature: 0.52 vertical direction, horizontal direction. 0.12, filtration rate 5%, quantitative 23 g/m2.

Equipments: YD-11 automatic quantitation teabag packing machine with packing speed 30-60 bag/Min, bag size 55-70 mm; Cabinet dryer machine with temperature range 30°C-100°C, 14 trays, total tray capacity 50 kg; Hammer crusher with small capacity 0.5-2 m3/h, Tea roasting machine with machinery capacity 2-10kg/batch. Determination of raw material moisture and tea moisture by Moisture Meter Handheld MS-G. Determining the size of powder by a screen sieve set include 0.1; 0.5; 1.0 and 2.0 mm of pore size.

Methods:

Effect of herbal powder size on the quality of teabag products

Dried herb materials were ground and sieved to classify powder with size (< 0.1 mm; 0.1-1.0 mm; 0.1-2.0 mm; 0.1-3.0 mm; 0.5-0.1 mm; 0.5-2.0 mm; 0.5-3.0 mm; 1.0-2.0 mm; 1.0-3.0 mm; 2.0-3.0 mm). Classified powder was mixed and packed to check quality of tea products. The percentage of gain, the shape of teabag, the sensory of tea and the score were recorded.

Effect of herbal powder mixing ratio by weight on the quality of teabag products

Herbal powder was mixed follow a ratio by weight (gram) between *S. marianum* : *C. hindsii*: *S. procumbens* were 1 : 8 : 1 (E_1); 1 : 7 : 2 (E_2); 1: 6 : 3 (E_3); 1 : 5 : 4 (E_4); 2 : 7 : 1 (E_5); 2 : 6 : 2 (E_6); 2 : 5 : 3 (E_7); 3 : 6 : 1 (E_8); 3 : 5 : 2 (E_9); 4 : 5 : 1 (E_{10}). The product after mixing was added with S. ribaudiana at a ratio 5%. Then powder mixture was packed and checked to select the best quality samples. The sensory of tea and the score were recorded.

Methods of evaluating the results

Sensory evaluation of tea in respect of color, flavor, taste and shape of teabag by TCVN 3218:2012 was conducted [11]. An evaluation was done using a 5.0-point hedonic scale, based on the assessment of 05 experts about the watercolor, aroma, taste and shape of the tea bag (Table 1). The classification of tea quality was based on the following ladder: the premium group obtained a score from 18.2 to 20 points; Good quality from 15.2 to 18.1; The average from 11.2 to 15.2, the bad from 7.2 to 11.1 and the nongroup ≤ 7.1. Calculate the average value to select the best formulation.

Table 1. Sensory evaluation of teabags

Score	Watercolor	Flavor	Taste	Shape of teabag
5.0	Medium brown	Herbal aroma	Mild sweet	Very beautiful
4.0	Light brown	More aroma	Bittersweet	Beautiful
3.0	Light brown	Mild aroma	Sweet	Normal
2.0	Yellow	No aroma	Harsh	Bad
1.0	Light yellow	Strange aroma	Bland	Be torn
0.0	Black or white	Horrible	Bitter	No shape

Determine food safety

Determine food safety of tea bag according to standard TCVN 7975:2008 - Herbal tea in bag [12] at Drug, Cosmetic and Food quality control center of Vinh Phuc province. The food safety criteria included Moisture content (%), Ash content (%), Acid-insoluble ash (%), Metal content (mg/kg): Arsenic, Cadmium, Lead, Mercury, Total Aerobic Bacteria (CFU/g), Total Yeast (CFU/g), Total Mold (CFU/g), Coliforms (CFU/g), Salmonella (CFU/25g), Total Aflatoxin (µg/kg), Pesticide residues (mg/kg).

Statistical analysis: Observed data were analyzed using Microsoft Excel and Irristart 5.0 software. Means and standard errors were applied to assess the experiment results using the ANOVA test at $P < 0.05$. Treatments were designed randomly with three replicates.

3. Results and discussion

The effect of herbal powder size on the quality of teabag products

The materials were roasted to yellow color, roasting temperature from 120°C-150°C and roasting time 8 minutes per batch based on Circular number 30/2017/TT-BYT dated 11 July, 2017 of the Ministry of Health - Instructions on processing methods of traditional medicines [13]. The effect of different material powder sizes varied significantly with the quality of tea products (Table 2). The highest score (17.9) with the best shape of teabag (Good-looking), and sensory evaluation of tea (clearwater, medium brown, mildly sweet, more aromatic) were observed at 1.0-2.0 mm powder size. Comparatively, a higher score (17.2) obtained at 0.5-2.0 mm powder size was followed by the beautiful shape of teabag, clear water, light brown color, sweet taste, and more aromatic. The comparison results among ground material sizes showed that the larger the size range gained the higher recovery efficiency. The highest percentage of recovery efficiency (77.8%) was obtained at 0.1-3.0 mm powder size, followed by 0.5-

3.0 mm powder size (76.7%), and the lowest (26.3%) was obtained when using less than 0.1 mm powder size. However, the material recovery efficiency is not the only indicator of tea quality. If the powder size is too small, there will be a large amount of tea dust stuck at the bag filter, resulting in cloudy water and a bitter taste. If the powder size is too large, there will be many tea particles that puncture the teabag. The present study's results showed that the most suitable powder size for producing teabags is from 1.0-2.0 mm as observed in other studies by Nguyen Thi My Trang et al (2015) [14], Vu Kim Dung et al (2019) [15].

Table 2. Analyzed properties for different herbs with material powder sizes

Powder size (mm)	Percentage of gain (%)	Shape of teabag	Sensory of tea	Score	Classify
< 0.1	26.3[a]	Be torn	Cloudy water, Light brown, Bittersweet, Mild aroma	12.3[a]	Average
0.1 - 1.0	47.8[c]	Bad	Cloudy water, Light brown, Sweet, Mild aroma	12.5[a]	Average
0.1 - 2.0	66.4[f]	Bad	Cloudy water, Light brown, Sweet, Mild aroma	12.8[ab]	Average
0.1 - 3.0	77.8[g]	Very bad	Cloudy water, Light brown, Sweet, Mild aroma	12.4[a]	Average
0.5 - 1.0	36.7[b]	Beautiful	Clearwater, Light brown, Sweet, More aroma	16.7[d]	Good
0.5 - 2.0	65.9[f]	Beautiful	Clearwater, Light brown, Sweet, More aroma	17.2[de]	Good
0.5 - 3.0	76.7[g]	Bad	Clearwater, Light brown, Sweet, More aroma	13.5[b]	Average
1.0 - 2.0	57.8[e]	Beautiful	Clearwater, Medium brown, Mild sweet, More aroma	17.9[e]	Good
1.0 - 3.0	65.3[f]	Bad	Clearwater, Medium brown, Mild sweet, More aroma	14.8[c]	Average
2.0 - 3.0	52.1d	Bad	Clearwater, Medium brown, Mild sweet, More aroma	15.0[c]	Average

Different letters (a, b, c, d) indicate significant differences in same colum (P ≤ 0.05).

Effect of herbal powder mixing ratio by weight on the quality of teabag products

The mixing ratio between ingredients is the most important factor determining the quality of tea bags. In the present study, ten different mixing experiments to evaluate the effect of herbal powder mixing ratio by weight on the quality of tea bag products (E_1, E_2, … E_{10}). The evaluation results are shown in Table 3. The results from table 3 showed that the highest score (18.0) was obtained from experiment E_9 with mixing ratio of ingredients: *S. marianum*: *C. hindsii*: *S. procumbens* were 3 : 5 : 2 and added 5% S. ribaudiana. The sensory of tea were clear water, medium brown, mild sweet, and more aroma. While the lowest score (13.6 and 13.8) was obtained to experiment E_1 and experiment E_2. The sensory of tea were cloudy water, high brown, bittersweet, mild aroma. The experiments E_4 and E_5 that score 14.3 and 15.1, respectively, were average

classified. The sensory evaluation showed clear tea liquor, medium brown, mildly sweet, mild aroma. The different experiments that had scored from 15.7 to 17.5 were classified as Good, characterized by clear water, medium or light brown, bittersweet or mildly sweet, mild or more aroma. The quality of teabag is depended on the ratio between the ingredients. When mixing high percentage *C. hindsii* and low percentage of *S. marianum* is, the tea liquor is featured by cloudy water, bittersweet taste. On the other hand, with a lower percentage *C. hindsii* and a higher percentage *S. marianum*, the tea liquor showed clear water, brownish with a mildly sweet taste, and more aromatic.

Table 3. Sensory evaluation of tea samples

Experiment	Mixing ratio of ingredients	Sensory of tea	Score	Classify
E1	1 : 8 : 1	Cloudy water, Light brown, Bittersweet, Mild aroma	13.6^{a}	Average
E2	1 : 7 : 2	Cloudy water, Light brown, Bittersweet, Mild aroma	13.8^{a}	Average
E3	1 : 6 : 3	Clearwater, Medium brown, Mild sweet, Mild aroma	14.3^{a}	Average
E4	1 : 5 : 4	Clearwater, Medium brown, Mild sweet, Mild aroma	15.1^{b}	Average
E5	2 : 7 : 1	Cloudy water, Light brown, Bittersweet, Mild aroma	15.7^{b}	Good
E6	2 : 6 : 2	Clearwater, Light brown, Mild sweet, More aroma	16.5^{c}	Good
E7	2 : 5 : 3	Clearwater, Medium brown, Mild sweet, More aroma	16.8^{cd}	Good
E8	3 : 6 : 1	Clearwater, Light brown, Mild sweet, More aroma	17.3^{de}	Good
E9	3 : 5 : 2	Clearwater, Medium brown, Mild sweet, More aroma	18.0^{e}	Good
E10	4 : 5 : 1	Clearwater, Medium brown, Mild sweet, Mild aroma	17.5^{e}	Good

Mixing ratio of ingredients: S. marianum : C. hindsii : S. procumbens and added 5% S. ribaudiana. Different letters (a, b, c, d, e) indicate significant differences in same colum ($P \leq 0.05$).

Determine food safety

The tea samples determined food safety to standard TCVN 7975:2008 - Herbal tea in bag [12] at Drug, Cosmetic and Food quality control center of Vinh Phuc province. The results from Table 4 showed that the Silymarin Milk Thistle tea bag was standard as required TCVN 7975:2008. The analytes include moisture content 5.2%, ash content (5.52%), acid-insoluble ash (0.19%), metal content (not detect), total aerobic bacteria (not detect), total yeast (not detect), total mold (not detect), coliforms (not detect), Salmonella (not detect), total aflatoxin (not detect) and pesticide residues (not detect).

Table 4. Results of analyte food safety

Analyte	Request TCVN 7975:2008	Results
Moisture content (%)	≤ 10	Standard (5,2%)
Ash content (%)	≤ 8	Standard (5,52%)
Acid-insoluble Ash (%)	≤ 1,0	Standard (0,19%)
Arsenic (mg/kg)	≤ 1,0	Not detect
Cadmium (mg/kg)	≤ 1,0	Not detect
Lead (mg/kg)	≤ 2,0	Not detect
Mercury (mg/kg)	≤ 0,05	Not detect
Total Aerobic Bacteria (CFU/g)	1×10^6	Not detect
Total Yeast (CFU/g)	1×10^4	Not detect
Total Mold (CFU/g)	1×10^4	Not detect
Coliforms (CFU/g)	1×10^3	Not detect
Salmonella (CFU/25g)	No	Not detect
Total Aflatoxin (µg/kg)	15	Not detect (LOD: 0,5µg/kg)
Chlorpynfos-methyl (mg/kg)	0.1	Not detect (LOD: 1µg/kg)
Cypermethrin (mg/kg)	20	Not detect (LOD: 10µg/kg)
Fenitrothion (mg/kg)	0.5	Not detect (LOD: 10µg/kg)
Flucythrinate (mg/kg)	20	Not detect (LOD: 10µg/kg)
Methidathion (mg/kg)	0.5	Not detect (LOD: 10µg/kg)
Permethrin (mg/kg)	20	Not detect (LOD: 10µg/kg)
Propargite (mg/kg)	5	Not detect (LOD: 10µg/kg)

4. Conclusions

The quality of Silymarin Milk Thistle teabag depended on the power size and the ratio between the ingredients. The highest quality of tea bag when the powder size was from 1.0 mm to 2.0 mm, and the mixing ratio by weight (gram) between *S. marianum*, *C. hindsii*, *S. procumbens* powder was 3 : 5 : 2 with an addition of 5% S. ribaudiana. The sensory of tea was clear water, medium brown color with a mildly sweet flavor and distinctive aroma.

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ẢNH HƯỞNG CỦA MỘT SỐ YẾU TỐ CÔNG NGHỆ ĐẾN CHẤT LƯỢNG TRÀ TÚI LỌC SILYMARIN MILK THISTLE

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Tóm tắt

Trà túi lọc Silymarin Milk Thistle là một sản phẩm được sản xuất từ 4 loại thảo dược Kế sữa (Silybum marianum), Xạ đen (Celastrus hindsii), Cà gai leo (Solanum procumbens), và Cỏ ngọt (Stevia ribaudiana). Sản phẩm trà túi lọc được sử dụng như một dạng nước uống thảo mộc để phòng và điều trị các bệnh về gan như sơ gan, gan nhiễm mỡ không do rượu, viêm gan và các bệnh gan nhiễm mỡ do rượu. Kết quả nghiên cứu cho thấy các yếu tố công nghệ phù hợp để sản xuất trà túi lọc gồm: nguyên liệu được sao vàng: nhiệt độ từ 120°C - 150°C, thời gian sao 8 phút/mẻ, kích thước bột phù hợp từ 1,0 đến 2,0 mm, tỷ lệ phối trộn giữa các nguyên liệu Kế sữa : Xạ đen : Cà gai leo là 3 : 5 : 2 (g) và bổ sung thêm 5% Cỏ ngọt. Đánh giá cảm quan trà cho thấy trà đạt tiêu chuẩn chất lượng nước trà trong, màu nâu, vị ngọt nhẹ và có mùi thơm đặc trưng của các nguyên liệu.

Từ khóa: *Bệnh về gan, kế sữa, kích thước bột, silymarin, trà thảo mộc túi lọc, tỷ lệ phối trộn.*