Formulation and Characteristics of Dried Herbs for Herbal Tea Drink

Raden Cecep Erwan Andriansyah[1,*] Wawan Agustina[2] Devry Pramesti Putri[2]

Riyanti Ekafitri[2] Rima Kumalasari[2]

[1] *Research Center for Food Technology and Processing National Research and Innovation Agency*
[2] *Research Center for Appropriate Technlogy*
[*]*Corresponding author. Email: cecep.andriansyah01@gmail.com*

ABSTRACT

Spice plants are commonly used as dried herbs and served as liquid, steeped/powdered, boiled/chopped, and in the form of capsules/pills/tablets singly or in a mixture. Ginger, cinnamon, lemongrass, cloves, and rosella were formulated as dried powder for herbal tea drinks. This study aimed to determine the chemical characteristics and functional groups of dried herbs as herbal drink powder. This research was conducted experimentally using a single factor, completely randomized design. The responses observed were moisture content, ash content, total microbes, total mold/yeast, and IR spectra of dried herbs. The result shows that dried herbs formulas in this study contained different moisture, ash, total microbial, and mold/yeast content. The water content parameter of the dried herbs mix formula is 9,55-25,94%, ash content 4.51-6.8%, and total microbe <25-4.0 102 cfu/ml. Based on IR spectra, it can be seen that there are mixed component of powdered ginger, roselle, cinnamon, cloves, and lemongrass with different concentrations of ginger and roselle, which show as peak at wave numbers 763 cm^{-1}, 862 cm^{-1}, 1075 cm^{-1}, 1152 cm^{-1}, 1232 cm^{-1}, 1236 cm^{-1}, 1369 cm^{-1}, 1514 cm^{-1}, 2844 cm^{-1}, 2852 cm^{-1}, 3266 cm^{-1}

Keywords: *Formulation, Characteristics, Dried Herbs, Herbal Tea Drink.*

1. INTRODUCTION

Several plants have been used as raw materials for health products. Indonesian people usually consume rhizome-based traditional drinks such as ginger to increase stamina and endurance. Around 59.12% of the Indonesian population aged over 50 years has consumed herbal medicine, and 95.60% felt the benefits [1].

Spice plants such as ginger, cinnamon, lemongrass, and cloves are commonly used as herbal simplicia [2]. Rosella plants, especially flowers, contain chemical and active compounds that are good for health, such as phenols, alkaloids, tannins, flavonoids, saponins, organic acids, anthocyanins, and polysaccharides [3].

The active compounds in ginger are gingerol and zingerol [4]. The main volatile component in cinnamon is cinnamaldehyde (68.65-70%), which has the potential as an antioxidant and can scavenge free radicals [5]. Rosella contains anthocyanins delphinidin-3-xylosilglucoside and cyanidin-3-xylosyl-glucoside. The main component of clove-leaf oil is 80-90% eugenol as an antioxidant [6]. Lemongrass contains citronellal and geraniol which function as antioxidants [7].

Based on consumer preferences, herbal drinks are served in the form of liquid, steeped/powdered, boiled/chopped, and in the form of capsules/pills/tablets singly or in a mixture [1]. In this paper, we will study the formulation of dry herbal powders from ginger, cloves, lemongrass, cinnamon, rosella flowers and their mixtures. The purpose of this study was to determine the chemical characteristics of dried herbs powder formulas to be used as raw materials for herbal tea drinks.

2. METHODOLOGY

2.1. Time and Place

This research was carried out in May-December 2020 at the Process Laboratory and Quality Testing Research Center for Appropriate Tehnology, BRIN.

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2.2. Material and Tool

The research materials were: ginger (*Zingiber officinale*), cinnamon (*Cinnamomum verum*), lemongrass (*Cymbopogon citratus*), cloves (*Syzygium aromaticum*), roselle (*Hibiscus sabdariffa*), alufo-packaging, and box. The materials for analysis were: distilled water, acetate buffer, methanol, ethanol (Merck), DMSO (Merck), 2, 2- Diphenyl-1-picrylhydrazyl/DPPH (Sigma Aldrich D9132), and ascorbic acid. This research used analytical balance, cabinet dryer, grinder, sieve, and sealer. The equipment used for analysis was a spectrophotometer, FTIR, refractometer, pH meter, chromameter, and glassware.

2.3. Experiment Design and Data Analysis

This research was conducted experimentally using a single factor completely randomized design (dried herbs powder formula) with 8 levels; each treatment was repeated 3 times (Table 1). The responses observed were moisture content, ash content, total microbes, total mold/yeast, and IR- spectra of dried herbs powder. The data obtained were analyzed using Analysis of Variance (ANOVA) and Duncan's test ($P<0.05$). Data was displayed in the form of figures and tables. Small tables were placed within a column, and a bigger table was placed in a text frame spanning both columns. Use the Table facility available within the BPW. Each dilution was shaken at least 25 times. Then do the same for the 10-4, 10-5, etc. dilutions according to the sample conditions. Pipette 1 ml of each dilution of 10- 1, 10-2, and so on and put into sterile etri dishes. Do it in duplicate for each dilution. Add 12-15 ml of PCA (for total plate count analysis), and PDA (for molds and yeast analysis), which have been cooled to 45°C ±1°C, into each of the plates filled with the sample. So that the sample and PCA or PDA media are perfectly mixed, rotate the cup back and forth and left-to-right. For the total number of plates analyzed, the solidified agar and the plates were incubated upside down in an incubator for 24 hours ± 2 hours at 35°C and for 48 hours at room temperature for analysis of molds and yeasts.

Calculation:

$$N\left(\frac{colony}{gr}/[r1]\right) = \frac{(a \times 10^n) + (b \times 10^n)}{Z} \quad (1)$$

Note: Microbial count 25-250 colonies/g/ [r2]
a, b = Total microbial count in petri dish
n = Dilution
z = Total dilution dish

Table 1. Formulation of Dried Herbs Powder

Dried Herbs Powder	R1	R2	R3	R4	R5	R6	R7	R8
Ginger (%)	100		0	0	0	86	80	76
Roselle (%)	0	100	0	0	0	0	6	10
Cinnamon (%)	0	0	100	0	0	8	8	8
Clove (%)	0	0	0	100	0	2	2	2
Lemon grass (%)	0	0	0	0	100	4	4	4

2.4. Analysis Method

2.4.1. Total Plate Count and Mold-yeast Analysis (Indonesian National Standard 2897, 2008)

The Total Plate Count and Mold –Yeast analysis refers to Indonesian National Standard 2897:2008. Weight 10 g of sample aseptically and then put it in a sterile container. Add 90 ml of BPW solution then homogenize. This homogenate is a 10^{-1} dilution solution. Using a sterile pipette, take 1 ml of the above homogenate and put it in a tube containing 9 ml of BPW solution to obtain a dilution of 10^{-2}. Prepare the next dilution (10-3) by taking 1 ml of the sample from the 10-2 dilution into 9 ml of BPW solution.

2.4.2 Moisture Content Analysis Gravimetric Method (Indonesian National Standard 01-2891-1992)

The sample dish to be used is heated in an oven and then weighed to a constant weight (A). Weight the sample 1-2 grams into the dish (B). Then, preheat the dish containing the sample in an oven at 105°C for 3 hours. Cool in a desiccator for 10-15 minutes and it was weighed on analytical balance. Do the heating and weighing until a constant weight (C) is obtained. The moisture content of the sample can be calculated by the Equation (2).

$$Moisture\ content\ (\%) = \frac{(A+B)-C}{B}\ x\ 100 \quad (2)$$

2.4.3. Analysis of Ash Content Gravimetric Method (Indonesian National Standard 01-2891-1992)

The porcelain dish is heated in an oven and then weighed to a constant weight (W0). Weight the sample ± 2 grams into a porcelain dish (Ws). Then ignite over the flame of the burner. Put in the furnace for 3 hours at a temperature of 550ºC until complete ashing. Cool, then put in desiccator for 15 minutes. Weigh with an analytical balance (W1). The ash content of the sample can be calculated by the Equation (3).

$$Ash\ content\ (\%) = \frac{w1 - w0}{ws}\ x\ 100 \quad (3)$$

Description :
W_0 : weight of constant dish
W_s : initial sample weight
W_1 : final sample weight

2.4.4 IR Spectra - FTIR

FTIR Spectrometer ALPHA II (Bruker instrument, Billerica, MA-USA) was employed to assess the FTIR spectra of all samples. FTIR mesurment were perfomed in region 4000-650 cm-1 using ZnSe detector. Samples to be analyzed were placed on a diamond crystal sampling plate and clamped with a pointed tip. A background scan was obtained before every five sample scan with an empty sample plate. Reading was taken two times for each sample.

3. RESULT AND DISCUSSION

3.1. Dried Herbs Powder Quality Characteristics

Table 2. Quality characteristics of dried herbs powder

Formula	Moisture content (%)	Ash Content (%)	Total Microbes (cfu/ml)	Mold-yeast (cfu/ml)
R1	10,18±0,02^{bc}	5,2±0,4^{b}	1,6 x 10^{6a}	2 x 10^{6bc}
R2	11,7±0,22^{d}	6,61±0,15^{c}	< 25^{a}	< 25^{a}
R3	9,92±0,08^{ab}	4,51±0,53^{a}	4,0 x 10^{2a}	4,0 x 10^{2a}
R4	25,93±0,03^{e}	5,55±0,07^{b}	1,0 x 10^{2a}	3,0 x 10^{2a}
R5	9,55±0,02^{a}	6,8±0,03^{c}	1,0 x 10^{6a}	5,0 x 10^{5ab}
R6	10,24±0,13^{bc}	5,25±0,2^{b}	3,0 x 10^{6a}	3,0 x 10^{6c}
R7	10,62±0,5^{c}	5,58±0,15^{b}	8,0 x 10^{6a}	2,0 x 10^{6abc}
R8	10,58±0,09^{c}	5,44±0,13^{b}	3,0 x 10^{-6a}	2,0 x10^{6abc}

Note: numbers in different rows followed by the different lowercase letters were significantly different (Duncan P > 0.05).

3.2 Moisture content

The moisture content of a material indicates the moisture content of the weight of the material. Determining moisture content is significant because it determines the quality of dried herbs powder. High moisture content is a suitable medium for the growth of microorganisms which will reduce the quality of dried herbs powder because it destroys the compounds contained in it. The water content of dried ginger powder in this study was 10.18%. The moisture content of dried ginger powder was equivalent to the moisture content of ginger dried powder, which was 10.06-10.42% [8]. The moisture content of dried ginger powder in this study met the Indonesian National Standard No. 01-3933-1994 regarding the quality requirements of dry ginger (12%) [9]. The moisture content of rosella in this study was 11.7%, equivalent to the water content of rosella from drying in the sun, which was 11.30% [10]. Cloves powder had the highest moisture content compared to other dried herbs powder. Drying in the post-harvest process of cloves was carried out in stages, drying to reduce the moisture content to 22-25%, then processing with natural drying to reduce the moisture content to 12- 14%. The condition of the clove powder in this study had a moisture content of 25.93%, which indicated that the cloves needed to be dried again before being applied to the herbal tea drink formula. Lemongrass and cinnamon powder had lower moisture content than other dried herbal powders. Samples of mixed dried herbs powder formulas (R6, R7, and R8) had moisture content in the range of 10.24-10.62%.

The moisture content of the mixed dried herbs powder formula did not significantly differ from the

moisture content of the dried ginger powder; This caused the main component of mixed dried herbs powder to be ginger. The moisture content of all samples was higher than the herbal powder beverage mix of A. paniculate (2.12%) and lemon grass powder (7.01%) [11,12]. The higher moisture content of dried herbs in this study indicates that it is necessary to optimize the drying process to reduce the moisture content of the product.

3.3 Ash content

The analysis of ash content in foodstuffs aims to determine the mineral content and organic compounds of combustion residues contained in the tested material (dried herbs), determine whether or not a processing process was good, determine the type of material used, and as a parameter of the nutritional value of foodstuffs [13]. The greater ash content indicates the number of minerals in food products [14]. Ash content was divided into total ash content and acid insoluble ash content. The high ash content in food ingredients and products indicates a potential for high metal elements in the material or sample.

High acid insoluble ash content indicates the presence of sand or other impurities [15]. In this study, the total ash content was used to determine the quality characteristics of dried herbs powder. Based on the analysis results, it was known that the powder of the dried herb has an ash content in the range of 4.51% - 6.8%. The highest ash content was in dried lemongrass powder, 6.8%, while the lowest ash content was in dried cinnamon powder, 4.51%.

Dried ginger powder has an ash content of about 5.2%; This was under the quality requirements for the ash content of red ginger, which was 5.6% [16]. Samples of mixed dried herbs powder formulas (R6, R7, and R8) had ash content in the range of 5.25- 5.44%, which was not significantly different from the ash content of the dried ginger powder.; This was because ginger was the main ingredient used in mixing dried herbs powder formula. Based on this, it was known that the ash content of dried herbs powder in this study was higher than herbal powder mix beverage (0.09%) but lower than the ash content of lemongrass leaves powder tea (5.93-11.35%) [17,18].

3.4 Total Microbes

The results showed that the total microbes in various dried herbs powder formulations showed very high values (R1, R5, R6, R7, and R8), while the formulas R2, R3, and R4 showed relatively low (Table 2). In the mold/yeast analysis, the sample R2 (Rosella) showed that the final average of the mold/yeast number was < 25 cfu/mL, and R3 and R4 indicated the number of total microbes is below the required limit of 2 x104 cfu/. Therefore, samples of R2, R3, and R4 met the requirements for the number of total microbes and number of molds/yeasts is below the required limit. According to [17], one of the requirements of good traditional medicine is that it must be free from microbial contamination, namely the number of molds and yeasts. Molds and yeasts will breed if the place of growth is suitable for growth; besides that, certain molds produce toxic substances (toxins) such as Aspergillus flavus, which can produce aflatoxins.

Research by Faridah et al. [18] showed that the total microbe of instant bandrek products was 25x101 cfu/g, and the coliform was <3 MPN/mL. The growth of microorganisms in products made from ginger is not something to worry about because ginger has antimicrobial properties. Ginger extract has been used to extend the shelf life of mackerel [19], in instant ginger and candied ginger products [20], and ginger juice significantly reduces bacterial colonies on tuna [21]. Samples of herbal ingredients R1, R5, R6, R7, and R8 did not find the required limits for total plate count and mold/yeast numbers; this could be due to cross-contamination during the manufacturing process of raw materials and herbal tea products. Cross-contamination is the transfer of microorganisms to food through a medium. Cross contamination is defined as transferring microbial contamination from materials with high contaminants (raw materials, dirty equipment, environment, employees) to materials with low contaminants (heat-treated dishes).

3.5 Mold and yeast

The amount of mold and yeast in the source material has an impact on the final product Because of their capacity to create poisonous metabolites known as mycotoxins, they are extremely likely to be hazardous to human or animal health [22]. Table 2 shows that the total mold- yeast concentration of thedried herbs powder, namely R1, R2, R3, R4, and R5, which are sample codes for ginger, roselle, cinnamon, clove, and lemongrass powders, varies. The yeast and mold concentration (cfu/ml) from the lowest were rosella (R2, <25), clove (R4, 3.0 x 10^2), cinnamon (R3, 4.0 x 10^2), lemongrass (R5, 5.0 x 10^5), and ginger (R1, 2 x 10^6) powder varieties. The combined product, R6, R7, and R8, each have a total yeast mold of 3.0 x 10^6, 2.0 x 10^6, and 2.0 x 10^6, respectively. The inclusion of ginger powder as the major component in the mixture resulted in a high total yeast mold in the combined product. Contamination of raw materials with fungi (mold and yeast) can occur naturally, as well as contamination during harvest, handling, storage, manufacture, and distribution [23]. According to [24], fungus was found in 83.3% of the 48 herbal medications examined.

3.6 IR Spectra of Dried Herbs Powder

The Cinnamon powder IR spectra pattern shows a peak at wave number 994; 1152; 1075; 1232; 1266; 1369; 1424; 1454; 1518; 1633; 2848; 2921, and 3271 wave number of 1800-600 cm^{-1}. Peak at 2848-3271 cm^{-1} indicates the presence of C-H, N-H and O-H stretch. The IR spectra for clove powder showed many peaks at wave numbers 644-1689 and 2324-3432 cm^{-1}. According to [26], the peak at 3432 cm^{-1} in clove powder indicates the presence of an OH group, while at wave number 2929 cm^{-1} indicates a CH group, and at 1689 cm^{-1} (close to 1692 cm^{-1}) indicates the presence of a CO double bond, while the peak at 1454 (close to cm-1. Likewise, with the results of research by Li et al. [25] which states that most cinnamon finger print peaks are in the

1456 cm^{-1}) indicates a CC triple bond, and at a wave number of around 800 cm^{-1} indicates the presence of aromatic CC triple bonds. The IR spectra of lemongrass showed peaks at wave numbers 721, 986, 1028, 1160, 1241, 1373, 1454, 1633, 1731, 2848, 2916, and 3326 cm^{-1}. The results of this study are close to the spectra of lemongrass extracted with ethanol with IR spectra shown at wave numbers 881, 1048, 1275, 1383, 2929, 2974, and 3357 cm-1 [27].

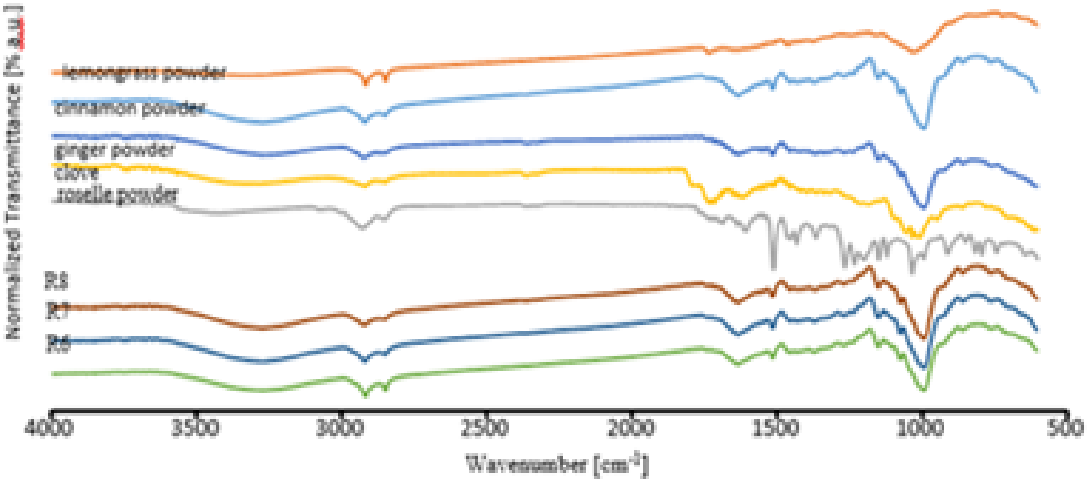

Figure 1 IR- Spectra of Dried Herbs

Herbal blend formula R6-R8 is a blended formula of At R6 powdered ginger, roselle, cinnamon, cloves, and lemongrass with different concentrations of ginger and roselle. Based on the IR peak spectrum, the peak at R6-R8 at wave numbers 763, 862, and 1075 cm^{-1} is close to the peak in the IR spectrum of ginger powder, indicating the presence of H, C-H, and C-O-C strains [27].

At R8, the IR peak was detected at a wave number of 1152 cm^{-1} indicating similarity to the peak in the component in cinnamon powder. At R6, the IR peak identified at wave number 1232 cm^{-1} shows the same peak as the peak in ginger powder and is close to the peak identified in ginger powder from previous studies [28], namely at 1244 cm^{-1}, which indicates the presence of a C-O-C strain bond. While at R7 and R8, the IR peak shifts at a wave number of 1236 cm^{-1}. At R7, the IR peak identified at 1369 cm^{-1} showed similarity to the peak in roselle powder, but this peak was not found in roselle powder research results by [29].

Similar to R8 with the highest roselle concentration, this IR peak was not observed. The peak at the wave number at 1514 cm^{-1} in samples R6 and R7 showed the same peak as the IR peak in clove powder. In sample R7, the IR peak at wave number 2844 cm^{-1} is close to the peak at wave number in citronella powder (2848 cm^{-1}). At R8, the IR peak identified at a wave number of 2852 cm^{-1} showed similarity to the IR peak in the roselle sample, indicating a symmetrical C–H vibration [29]. Samples R6-R8 have an IR peak at the same wave number as the peak in lemongrass powder, which is at 3266 cm^{-1}, which indicates the presence of H-OH stretching vibrations. Based on this IR spectrum, it can be seen that there are mixed components in samples R6-R8.

CONCLUSION

This study's dried herbs powder formulas contained different moisture, ash, total microbial, and mold/yeast content. The moisture content and total microbes parameter of the dried herbs powder formula. Based on IR spectra, it can be seen that there are mixed components in samples R6-R8 are the mixed formula of powdered ginger, roselle, cinnamon, cloves, and lemongrass with different concentrations of ginger and roselle identified at wave numbers 763 cm^{-1}, 862 cm^{-1}, 1075 cm^{-1}, 1152 cm^{-1}, 1232 cm^{-1}, 1236 cm^{-1}, 1369 cm^{-1}, 1514 cm^{-1}, 2844 cm^{-1}, 2852 cm^{-1}, 3266 cm^{-1}.

AUTHORS' CONTRIBUTIONS

Raden Cecep Erwan Ardiansyah: Investigation, Data Curation, Writing – review & editing; Wawan Agustina: Data Curation, Writing; Devry Pramesti Putri: Resources, Validation; Riyanti Ekafitri: Resources, Supervision, Methodology, Data Curation, Investigation; Rima Kumalasari: Data Curation, Funding acquisition, Writing – Original Draft

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