

Comparative Study of Powdered Ginger Drink Processed by Different Method: Traditional and using Evaporation Machine

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Abstract. Ginger drink is one of the traditional beverage that became one of the products of interest by consumers in Indonesia. This drink is believed to have excellent properties for the health of the body. In this study, we have compared the moisture content, ash content, metal content and the identified compound of product which processed with traditional technique and using an evaporator machine. The results show that both of products fulfilled some parameters of the Indonesian National Standard for the traditional powdered drink. GC-MS analysis data showed the identified compound of both product. The major of hydrocarbon groups that influenced the flavor such as zingiberene, camphene, beta-phelladrine, beta-sesqupelladrine, curcumene, and beta-bisabolene were found higher in ginger drink powder treated with a machine than those processed traditionally.

1. Introduction

Ginger (*Zingiber officinale*) is a member of the Zingiberaceae family of plants. The plant is native to Asia but now cultivated in the West Indies, Africa, India, and other tropical regions [1]. This rhizome has become popular spice and used widely in Indonesian cuisine as well as in other countries. Traditionally, it also used as a carminative and stimulant, to increase appetite, treat the digestive tract disorder such as nausea and vomit, to treat common cold, cough, FDVdiarrhea, malaria, fever, and arthritis [2]. Another study also described the benefits of ginger on the treatment of catarrh, rheumatism, nervous diseases, gingivitis, toothache, asthma, stroke, constipation and diabetes [3]. Some scientific research has proven that it has some pharmacological activity such as antiemetic, antidiabetic, antioxidant, antinausea, antihistaminic activity on duodenum immunomodulator, antimicrobial in vitro antihelminth, antifungal and anticancer [4].

Some literature has reported the major compound that obtained from ginger rhizomes such as 4-hydroxy-3-methoxyphenyl moieties, gingerols, acetyl gingerol derivatives mono- and diacetylgingerdiol derivatives, shogaols, paradols, dihydroparadol, zingerones, 1-dehydrogingerdione, diarylheptanoide and metal ether derivatives [1-5]. Among these compounds, 6-gingerol was found to possess anti-oxidative activity through the inhibition of phospholipid peroxidation [5].

In Indonesia, ginger can be processed into various ready to consume products such as essential oil, ginger powder, ginger syrup, ginger sweet, ginger candy and ginger crystal [6]. The supporting trend of ginger demand is the current shift in lifestyle in which more people are opting to get jamu, or



traditional or herbal medicine, to keep them healthy or to remedy some illnesses despite the major development in the chemical based pharmaceuticals industry. Nowadays, people can obtain jamu in powder form. They can deserve their own beverage more practice. With a sweet instant powder, the quality of the product can be maintained, not easily contaminated, not easily infected with the disease, and the product without preservatives [7].

According to Phoungchandang et al. [8], one of the important keys to making beverages in the form of powder is the evaporation process. Evaporation is an operating unit used to remove some of the water contained in liquid food by boiling. Evaporation aims to increase the solids and still in the form of puree. In another case, Menon et al. [9] had studied the effect of heat processing on the flavor compounds of fresh Indian ginger (*Zingiber officinale* Roscoe). They reported that gerental (24.2%) and zingerone (14.2%) were decreased during the thermal processing. Purnomo et al. [10] and Okyne et al. [11] also reported a significant active compound decomposition during thermal processing of ginger.

Almost all of ginger drink small industry in Indonesia still used the traditional technique to produced the ginger drink powder. They used traditional stove and pan, boil the ginger solution with the high temperature, and stirred manually until the powder obtained. In this study, we have been comparing the quality of ginger drink product that produced with traditional technique and using evaporation machine. Some parameter such as moisture content, heavy metal content and compound content was analyzed.

2. Materials and Methods

2.1. Materials

The fresh samples of ginger rhizome of 9-month-old, sugar, and spice such as cinnamon (*Cinnamomum zaylanicum*), cardamom (*Amomum compactum*), and cloves (*Syzygium aromaticum*) were obtained from Beringharjo Market, Yogyakarta Province, Indonesia.

2.2. Methods

Ginger drink production :

Traditional process: 2.5 kg of ginger rhizomes are washed, ground with a machine and extracted with water. A total of 10 kg of refined sugar put into the pan, added 1 Liter of water, stirred on the stove until all the sugar melted, added ginger extract and spice solution, stirred continuously until it became powder.

With evaporation machine: 2.5 kg of ginger rhizomes are washed, grounded and extracted with water. The machine has operated by heating the oil in the bath vessel for preparing the temperature conditions on the evaporative tube. After a heat transfer process, the temperature at the evaporative tube monitored reaches 100 °C, 10 kg of refined sugar introduced until completely melted, then the ginger extract and spice solution added. The evaporation process begins, followed by a continuous stirring process at a temperature of 100 °C which is the boiling point of water solvent. At that stage the temperature inside the vessel is kept constant by the Thermo control, the flame of the stove can be reduced and enlarged automatically to maintain the desired temperature. The inside material stirred continuously until granules are formed and become dry.

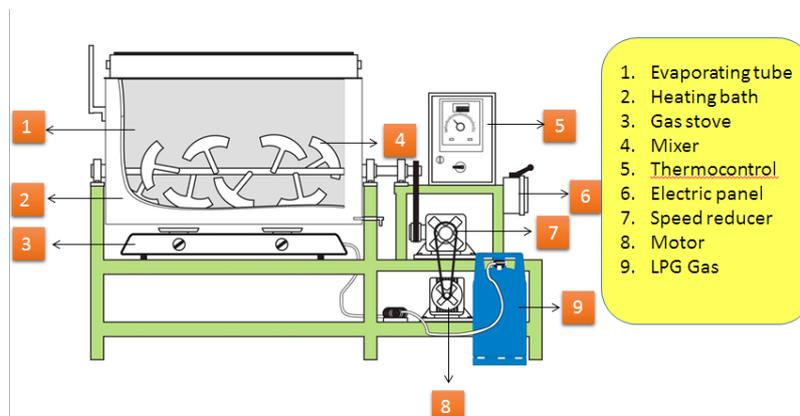


Figure 1. Scheme of evaporation machine

Sample Analysis:

Moisture content :

The moisture content of ginger powder samples was determined gravimetrically by drying the samples at 105 °C for 24 h. The moisture content was calculated as the percentage of water removed from the initial mass sample.

Ash content :

The ash content of samples was determined gravimetrically by heating the samples at 550 °C for 5 hours. The ash content was calculated as the percentage of inorganic residue remaining after the calcination process from the initial mass sample.

Chemical element content :

Chemical element content of ginger powder samples was analyzed using Atomic Absorption Spectrometer (AAS) Perkin Elmer 5100PC for Cd(326.1 nm), Pb(283.3 nm), Cu(324.8 nm), Sn (284.0 nm) and Zn(213.9 nm).

GC-MS Analysis :

The ginger powder extracted with petroleum ether, then the filtrate was analyzed with Shimadzu GCMS-QP2010 S with the following condition: column used was Rti-5MS, 30 m length, and the inner diameter of 0.25 mm and the initial column temperature was 280 °C (5 °C/minute), while the injector temperature was 300 °C, the flow rate was 40 mL/minute.

3. Results and Discussion

The instant ginger powder produced with two different techniques did not visually differ significantly. The results of the water content analysis, as well as the metal content of the products, are presented in Table 1. The moisture content for the manually processed samples has a moisture content of 0.39%, while the sample processed using a machine has a moisture content of 0.27%. It is lower than the moisture content of ginger powder produced by Phoungcangdang [8] which ranged from 1-1.25%. Both of water content values have qualified the SNI criteria for traditional powder drink (SNI 01-4320-1996). Based on the standards set by Indonesian National Standard (SNI 01-4320-1996), the value of water content for the traditional powdered drink is at a maximum of 3%. Low moisture content has a closely related to the quality and durability of these products. Ash content for both products did not differ significantly, 0.13% for traditional technique and 0.12% for the product

processed by a machine. Indonesian National Standard (SNI 01-4320-1996) requires that the maximum ash content for traditional powder drink is equal to 1.5%.

The metal content of the product is identified using Atomic Absorption Spectroscopy and presented in Table 1. Both products have similar profiles of cadmium (Cd), lead(Pb), copper(Co), and tin(Sn), while Zn metals found with levels of 3.65 mg/kg for products which traditional technique, and 2.90 mg/kg for machine-treated products. The maximum Zn content required by SNI is 50 mg/kg. Thus the content of metal Cd, Pb, Cu, Zn and Sn already qualified the SNI for traditional powder drink.

Table 1. Analysis results of ginger drink powder produced by different technique

| | Manual | Machine |
|------------------|------------|------------|
| Moisture content | 0.39% | 0.27% |
| Ash content | 0.13% | 0.12% |
| Cadmium (Cd) | undetected | undetected |
| Lead (Pb) | undetected | undetected |
| Copper (Cu) | undetected | undetected |
| Zinc (Zn) | 3.65 mg/kg | 2.90 mg/kg |
| Tin (Sn) | undetected | undetected |

Limit of detection : Cd=0.01 ppm; Pb= 0.01 ppm; Pb= 0.01 ppm; Sn= 0.25 ppm

Identification compound of both products appeared in Table 2. The major compound identified in the ginger drink with the traditional technique were alpha-pinene (11.02%), zingiberene (10.82%), decanoic acid ethyl ester (9.69%), hexadecane (7.31%) and citral (5%). Other compounds detected in low quantities such as beta-bisabolene (2.29%), beta-sesqupelladrine (2.26%) and beta-pelladrine (2.06%). Different results showed by beverage powder manufactured by machine. The major detected compounds were zingiberene (17.46%), citral (17.05%), camphene (6.93%), curcumene (6.18%), beta-sesqupelladrine (5.88%), 1,8- Cineole (5.61%), and Borneol (4.3%).

Based on these data, it showed that different processing techniques would cause the different content of the products. The content of alpha pinene, camphene, beta-phellandrene and curcumene have influenced the flavor of ginger [10]. The taste of ginger is primarily affected by monoterpenes (Camphene, limonene, myrcene, beta-phellandren, alpha-pinene, borneol, 1,8-cineol, citronellol, geranial, geraniol, geranyl acetate, linalool, neral and others) [3]. Some of these compounds could arise from dehydration of oxygenated compounds [10]. In both samples, these compounds were detected, so it can be seen that the ginger flavor that appears on the ginger drink is a representation of the content of the compounds.

The [6]- gingerol compounds did not find in the GC-MS data; it is possible that these compounds suffered damage due to heating treatment during the process of making ginger powder. The molecular structure of gingerol consisted of hydroxyl keto functional group which was thermally labile [12]. Therefore, in a ginger-based drink, it was found that the content [6]-gingerol 35-80 times lower when compared in fresh ginger [13].

The major of hydrocarbon groups that influenced the flavor such as zingiberene, alpha-pinene, camphene, beta-phelladrine, beta-sesqupelladrine, curcumene and beta-bisabolene had been compared (Figure 2). It showed that the amount of these compound in the ginger drink produced by machine was higher than those produced by a traditional method, except alpha-pinene. It may be due to a closed heating system, heating at a relatively lower temperature and a relatively faster processing so that the compound content still maintained. However, sensory evaluation should be done to obtain a complete data on the flavor of the ginger drinks.

Table 2. Identified compounds of ginger drink powder extract produced by traditional technique and by evaporation machine.

| Peak | Traditional | | | | Machine | | | |
|------|----------------------------------|------------------------------------------------|----------------------|------------|-----------------------|------------------------------------------------|----------------------|------------|
| | Compounds | Molecule structure | Retention time (min) | Amount (%) | Compounds | Molecule structure | Retention time (min) | Amount (%) |
| 1 | Alpha-Pinene | C ₁₀ H ₁₆ | 13.517 | 11.02 | Alpha-pinene | C ₁₀ H ₁₆ | 13.586 | 7.45 |
| 2 | 1-Decene | C ₁₀ H ₂₀ | 15.057 | 1.98 | Camphene | C ₁₀ H ₁₆ | 14.325 | 6.93 |
| 3 | Beta-myrcene | C ₁₀ H ₁₆ | 15.205 | 1.31 | Beta-myrcene | C ₁₀ H ₁₆ | 15.402 | 1.27 |
| 4 | Methyl-heptenone | C ₈ H ₁₄ O | 16.252 | 1.25 | Methyl-heptenone | C ₈ H ₁₄ O | 16.457 | 1.01 |
| 5 | 1-Limonene | C ₁₀ H ₁₆ | 17.303 | 1.65 | 1-Limonene | C ₁₀ H ₁₆ | 17.015 | 1.2 |
| 6 | Beta-pheladrine | C ₁₀ H ₁₆ | 18.533 | 2.06 | Beta-pheladrine | C ₁₀ H ₁₆ | 17.270 | 1.98 |
| 7 | 1-Undecene | C ₁₁ H ₂₂ | 18.669 | 1.29 | 1,8-Cineole | C ₁₀ H ₁₈ O | 17.486 | 5.61 |
| 8 | Undecane | C ₁₁ H ₂₄ | 18.791 | 0.85 | Linalool | C ₁₀ H ₁₈ O | 20.294 | 1.96 |
| 9 | 1,8-Cineole | C ₁₀ H ₁₈ O | 19.485 | 0.84 | Phellandral | C ₁₀ H ₁₆ O | 20.917 | 0.46 |
| 10 | Linalool | C ₁₀ H ₁₈ O | 21.877 | 1.31 | Limonene oxide | C ₁₀ H ₁₆ O | 22.467 | 1.24 |
| 11 | Phellandral | C ₁₀ H ₁₆ O | 21.997 | 0.93 | Camphor | C ₁₀ H ₁₆ O | 22.850 | 1.24 |
| 12 | Citronelol | C ₁₀ H ₂₀ O | 22.631 | 0.69 | Limonene oxide | C ₁₀ H ₁₆ O | 23.040 | 0.52 |
| 13 | Citral | C ₁₀ H ₁₆ O | 22.767 | 2.85 | Terpineol | C ₁₀ H ₁₈ O | 23.217 | 0.4 |
| 14 | Citral | C ₁₀ H ₁₆ O | 24.652 | 2.15 | Borneol | C ₁₀ H ₁₈ O | 23.546 | 4.3 |
| 15 | Undecenoic acid | C ₁₁ H ₂₀ O ₂ | 25.044 | 0.93 | Alpha-terpineol | C ₁₀ H ₁₈ O | 23.867 | 1.21 |
| 16 | Ethyl octanoate | C ₁₀ H ₂₀ O ₂ | 25.146 | 1.00 | Citronelol | C ₁₀ H ₂₀ O | 24.762 | 1.35 |
| 17 | Nonanoic acid, ethyl ester | C ₁₁ H ₂₂ O ₂ | 25.880 | 2.92 | Citral | C ₁₀ H ₁₆ O | 25.745 | 7.52 |
| 18 | Tetradecane | C ₁₄ H ₃₀ | 26.040 | 0.44 | Citral | C ₁₀ H ₁₆ O | 26.630 | 9.53 |
| 19 | Methyldecanoate | C ₁₁ H ₂₂ O ₂ | 26.787 | 1.20 | Geranyl Acetate | C ₁₂ H ₂₀ O ₂ | 28.748 | 2.93 |
| 20 | Tetradecane | C ₁₄ H ₃₀ | 26.967 | 0.72 | Hexadecane | C ₁₆ H ₃₄ | 29.042 | 5.84 |
| 21 | 1-Pentadecene | C ₁₅ H ₃₀ | 28.037 | 1.63 | Heptadecane | C ₁₇ H ₃₆ | 29.251 | 2.89 |
| 22 | Geranyl Acetate | C ₁₂ H ₂₀ O ₂ | 28.124 | 1.44 | Curcumene | C ₁₅ H ₂₂ | 32.310 | 6.18 |
| 23 | Ethyl cis-4-decenoate | C ₁₂ H ₂₂ O ₂ | 28.502 | 0.61 | Zingiberene | C ₁₅ H ₂₄ | 32.543 | 17.46 |
| 24 | Decanoic acid, ethyl ester | C ₁₂ H ₂₄ O ₂ | 28.848 | 9.69 | Beta-bisabolene | C ₁₅ H ₂₄ | 33.033 | 3.64 |
| 25 | Allo-aromadendrene | C ₁₅ H ₂₄ | 30.674 | 1.22 | Beta-sesquepelladrine | C ₁₅ H ₂₄ | 34.039 | 5.88 |
| 26 | Hexadecane | C ₁₆ H ₃₄ | 31.397 | 7.31 | | | | |
| 27 | Heptadecane | C ₁₇ H ₃₆ | 32.284 | 2.39 | | | | |
| 28 | Curcumene | C ₁₅ H ₂₂ | 33.183 | 1.40 | | | | |
| 29 | Zingiberene | C ₁₅ H ₂₄ | 33.607 | 10.82 | | | | |
| 30 | Beta-bisabolene | C ₁₅ H ₂₄ | 35.568 | 2.29 | | | | |
| 31 | Beta-sesquepelladrine | C ₁₅ H ₂₄ | 36.807 | 2.26 | | | | |
| 32 | Hexadecane | C ₁₆ H ₃₄ | 41.252 | 2.24 | | | | |
| 33 | 3-Undecen-5-yne, (E)- | C ₁₁ H ₁₈ | 42.274 | 7.23 | | | | |
| 34 | Tetradecanoic acid, methyl ester | C ₁₅ H ₃₀ O ₂ | 45.444 | 6.79 | | | | |
| | Total Area | | | 94.71 | | | | 100 |

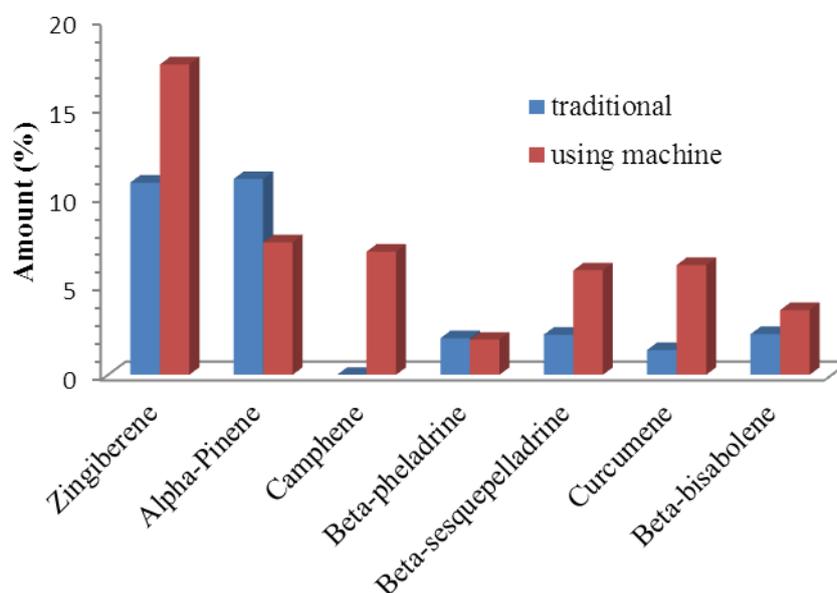


Figure 2. Comparison of hydrocarbon compounds contribute to the flavor of ginger in both product

4. Conclusion

Based on the study, the production of instant ginger beverages produced with two different processes fulfilled the criteria of traditional powder drink based on water content criteria, ash content and heavy metal content. The results of identification using GC-MS show the content of some typical compounds contained in ginger. However, some compounds detected in low amounts may be due to the stage processing that involving heating at high temperatures.

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