The Production and Characterization of Kaempferia Galanga L. –Based Herb Powder: Blanching and Drying Procedure Influence on Proximate, Metal, and Microbial Contamination

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***Abstract*—This research was conducted to obtain the procedure for the production of herb powder based on Indonesian local Kaempferia galanga commodities which have proximate as well as metals and microbes contamination level that meet the requirements in the Indonesian National Standard (SNI) 01-3709-1995. Blanching and drying procedures are two things optimized in the production process of Kaempferia galanga powder in this study. The results show that the blanching procedure at a temperature of 80 °C has induced an increase in water content even though it is still below the SNI threshold. However, the application of drying procedures accompanied by increasingly intensive raw material reversal treatment has compensated for the increase in water content. Along with these conditions, there has been a decrease in ash as well as acid insoluble ash content of the resulting Kaempferia galanga herb products. This condition was strengthened by the results of the metal and microbes contamination levels analysis which showed a significant decrease, especially in the levels of copper metal contamination (25%), total plate number (9.56%) and aflatoxin (66.67%) of the Kaempferia galanga herbs powder products are produced by involving blanching stages accompanied by 2 times/hour reversal treatment.**

Keywords—herbs, kaempferia galanga, powder

I. INTRODUCTION

Herb drinks are not only healthy but also to support the people. The turnover of herbal medicine business in this country in 2013 reached Rp. 13 trillion / year. This is triggered by phenomena in the community who increasingly like treatment or prevention of health problems by using natural ingredients, including by consuming various types of herbal heritage which have been used for decades. More than 1,150 herbal medicine industries are spread in Indonesia, where 100 companies are classified as large industries, and the rest, 1,100 herbal medicine industries in Indonesia are home industries[1].

Nowadays the lifestyle grows back to nature, making herbal products, including herbs and herbal medicines, is hunted down by the public. Basic Health Research survey data in 2007 shows the magnitude of the potential for herbal medicine. There is 60 percent of Indonesian people have consumed herbal medicine with 90 percent have ever felt the efficacy of herbal medicine[2]. This potential is increasingly supported by the enormous potential of biodiversity, which is owned by Indonesia. From 40,000 species of plants that grow in the world, there are 30,000 types of plants grow well in Indonesia. As an agricultural country, besides being known for the product obtained from the forest, Indonesia is also known as a country producing herbs. There are 30,000 types of plants in Indonesia, 7,000 types of them include medicinal plants, 1,000 types of plants that produce toxins, and 50 types of aromatic plants. However, this potential has not been optimally developed in quantity. According to the research, of a large number of medicinal plants in Indonesia, only 15% were cultivated, while the remaining 85% was obtained by taking it directly from the forest [4].

Besides the quantity development has not been optimal, post-harvest diversification and standardization of quality have not been carried out optimally. This is evident from the facts which show that even though Indonesia has natural resources, agricultural products are found and abundant, but it turns out that Indonesia is also not free from imports. Ironically, Indonesia actually imports herb plant from the countries that previously also imported fresh herb plants from Indonesia, such as Singapore, Malaysia, and Japan. Herb plants imported by Indonesia is not a fresh product but in the form of raw materials for various products[1].

During this time, Indonesian people generally recognize the potential of medicinal plants cultivated as herbs, by selling in fresh condition. Even though the selling value of fresh herb products is very low. Even if herbs is processed into simplicia first, the price can go up 100% or twice that of the original [4]. The simplicia product is a sliced and dried processed product of herbs. Simplicia products must be produced according to certain standards in order to have high economic value when sold on the market, especially at export levels to foreign countries [5]. This standardization includes cleanliness, water content and oil content of dried simplicia according to SNI 01-3393-1994. Dry simplicia turned out to be improved again by processing it into simplicia powder. Economic value increase reaches 900% [4]. This is proof that with proper processing, the economic value of medicinal plants can increase. Not only that, processing of herbs commodities into various processed products is also very useful in maintaining the quality of herbs products during shipping, especially for export [6].

Kaempferia L. (Kaempferia galangal L.) is one type of important medicinal material that belongs to the Zingiberaceae family. This material is also known as *kacholam, kapur-kachri, aromatic ginger, sugandhavacha, Chandramulika or sidhul* [7]. Kaempferia L. is distributed in Asia and Africa with tropical climate with a total of 70 species worldwide and 4 species reported from the Indian Peninsula. In traditional medicine, Kaempferia L. rhizome is believed to have stimulant, expectorant, diuretic and carminative activity. This rhizome is also known to facilitate digestion and cure skin diseases, coughs, fever, epilepsy, lymph disorders, asthma and rheumatism [7] - [8]. Kaempferia L. rhizome contains alkaloids, starches, gums, fat compounds with fragrant essential oils. Raw rhizomes, dry drugs and essential oils are increasingly becoming industrial, commercial and medicinal, but not fully exploited [7], [10].

Herbal powder is one of the most economical choices for Kaempferia L.. To get high quality Kaempferia L. powder, it is important to strictly control a number of factors, including raw material quality, post-harvest handling procedures and processing techniques [11]. Especially for post-harvest handling, attention is focused on the stages of raw material sorting, washing, drying [12] - [15], product sorting, packaging, labeling and storage, both when it will be sold fresh or after further processing. However, in so far as there is not much research knowledge reported on the standardization of post-harvest Kaempferia L. production, especially in powder form, which can meet the standards of herbal products set by Materia Med Indonesia [15].

II. Materials and method

A. Materials

The main material used in the study was Kaempferia L. rhizome. There is no specific specification of the Kaempferia L. material used. Standardization of post-harvest handling procedures for Kaempferia L. commodities is based on the procedures previously reported [11].

B. Method

The procedure for making Kaempferia L. powder is done by covering the stages of washing, slicing, blanching and drying of the raw material specifically. In accordance with the results of previous studies, to obtain high-quality simplicia products, the raw material of Kaempferia L. was washed for 1 minute and then dried in open air for 12 hours to facilitate slicing (0.30 cm) which was continued at the next process stage. After slicing, raw material is blended to obtain herbal products with minimum mineral content, metal contaminants and microbes. The blanching procedure was carried out by soaking the Kaempferia L. slices in 90 ° C temperature for 6 minutes and in water with room temperature for 10 minutes. The procedure for making Kaempferia L. herbal powder is continued with drying. However, it is not the same as the previous drying procedure that relies on sunlight, at this stage drying is done using a controlled oven at a temperature of 80 ° C to obtain drying products with a water content below 16%. To avoid the occurrence of face hardening during drying, the Kaempferia L. slices are reversed every 30 and 60 minutes. As a comparison, Kaempferia L. powder is produced without reversal treatment during drying and without blanching procedures. The drying procedure is stopped immediately after the constant mass of the slice. To get Kaempferia L. powder products, dried Kaempferia L. slices were destroyed using a blend machine.

C. Analysis

To evaluate the quality of Kaempferia L. powder products, an analysis was carried out which included proximate analysis (water content, ash, acid insoluble ash), metal contaminant content (lead (Pb), copper (Cu) and arsenic (As)) and microbial contaminants (Plate Figures Total (ALT), E. Coli, and mold). Analysis of acid, ash and acid insoluble ash was carried out using gravimetric method, heavy metal content analysis was carried out using Atomic Absorption Spectrophotometry (AAS) method, while microbial contaminant analysis was carried out by referring to pharmacope IV (1995).

III. Results

Kaempferia L. (Kaempferia galanga L.) is one of five types of plants developed as native medicinal plants in Indonesia. Kaempferia L. rhizome contains essential oils, curcuminoids, minerals, ash, crude fiber and starch in 10% water content of dry matter. As with other herbs materials, essential oils are compounds that give rise to the distinctive smell of Kaempferia L. material, while curcuminoids are responsible for bringing out the distinctive flavor of Kaempferia L.. In Figure 1 and Figure 2, each Kaempferia L. powder product is produced with and without blanching and specific reversal quantity during drying.

Fig 1. Kaempferia L. instant powder products produced by blanching : (a) without reversal; (b) reversal in 60 minutes; (c) revesal in 30 minutes.

Fig 2. Kaempferia L. instant powder products produced without blanching : (a) without reversal; (b) reversal in 60 minutes; (c) revesal in 30 minutes.

The results of the quality of the instant Kaempferia L. powder product, as shown in table 1, shows the relatively small solubility level of volatile oil compounds and curcuminoids in 90 ºC temperature water medium used in the blanching process. This causes no significant changes in the organoleptic properties of the smell and taste of the Kaempferia L. material. Similarly, the increase in the quantity of reversal of Kaempferia L. material carried out during the drying process does not appear to cause significant changes in both organoleptic properties of instant Kaempferia L. powder products.

However, this is not the case with acid, ash and ash content that is insoluble in acid, blanching treatment using a temperature medium of 90ºC for 6 minutes, followed by reconditioning of the Kaempferia L. material to room temperature, which is carried out through the process of soaking the Kaempferia L. material in water at a temperature space, has provided a greater opportunity for the entry of water into the raw material of Kaempferia L. raw material, causing the need for a longer drying time and higher water content in instant Kaempferia L. powder products compared to instant Kaempferia L. powder products that do not receive blanch treatment. Meanwhile, an increase in the quantity of reversal of Kaempferia L. material during the drying process has led to the detection of significant differences in the water content of the instant Kaempferia L. powder product with a higher reversal quantity compared to the instant Kaempferia L. powder product produced with a lower reversal quantity.

Variations in the blanching method and treatment during drying do not only affect the water content of instant Kaempferia L. powder products, but also affect the ash content of instant Kaempferia L. powder products. Application of blanching treatment using 90 ºC temperature water medium has increased the solubility potential of several types of minerals from the raw material of Kaempferia L.. Solubility of several types of minerals will cause the creation of instant Kaempferia L. powder products with a lower total ash content. However, this is not the case with acid-insoluble ash content, its low solubility in acid which tends to be polar shows the low polarity level of the mineral concerned. This causes low solubility in the water.

Beside the blanching method, an increase in the reversal quantity of the Kaempferia L. material during the drying process also affects the water content, ash and acid insoluble ash from instant Kaempferia L. powder products. The increasing quantity of reversal of Kaempferia L. material during the drying process has optimized the process of evaporation of water from the raw material of Kaempferia L. raw material and led to the creation of instant Kaempferia L. powder products with lower water content. Lower water content will have a direct impact on the long shelf life of the food product concerned. In line with this, the increasing quantity of reversal of Kaempferia L. material during the drying process has also optimized the evaporation of several low boiling point minerals, such as organic salts, from the Kaempferia L. material. Thus, instant Kaempferia L. powder produced will have lower ash content. The complete data on the quality of instant Kaempferia L. powder produced with variations in blanching method and treatment during drying are shown in Table 1 and Table 2.

TABLE 1. QUALITY OF INSTANT KAEMPFERIA L. POWDER PRODUCTS WITHOUT BLANCHING

No	Quality Parameters	Instant Powder Products		
		Without Blanching		
		Without reversal	Reversal in 60 min	Reversal in 30 min
1.	Smell	Normal	Normal	Normal
2.	Flavour	Normal	Normal	Normal
3.	Water content (%)	10,00	5,00	5,00
4.	Ash content (%)	10,00	4,71	3,22
5.	Acid insoluble ash (%)	5,60	1,22	0,42

TABLE 2. QUALITY OF INSTANT KAEMPFERIA L. POWDER PRODUCTS

No	Quality Parameters	Instant Powder Products		
		Blanching		
		Without reversal	Reversal in 60 min	Reversal in 30 min
1.	Smell	Normal	Normal	Normal
2.	Flavour	Normal	Normal	Normal
3.	Water content (%)	10,00	10,00	5,00
4.	Ash content (%)	4,02	3,84	2,04
5.	Acid insoluble ash (%)	3,55	0,98	0,18

After obtaining standardized Kaempferia L. powder production procedures, at the next stage analysis of contamination of Kaempferia L. powder with the best qualification was carried out. Tests of contamination, both biological and chemical, carried out including analysis of levels of metal contamination include: (1) lead (Pb) (mg / Kg); (2) copper (Cu) (mg / Kg); (3) arsenic (As) (mg / Kg); and microbial contamination which includes: (1) total plate number (colony / g); (2) e.coli; (apna / g); and (3) mold (colony / g). Full details about the type of test and the standard threshold of each contaminant are shown in table 2. The existence of lead, copper, and arsenic metals in food products with levels that exceed the threshold can endanger human health. Lead metal (Pb) is a very popular metal and is widely known by ordinary people. This is due to the large number of Pb used in the non-food industry and causes the most poisoning in living things. Pb is soft metal and is blackish brown in color, and is easily purified from mining. Metal Pb can enter the body through breathing, food and drinks. Metal Pb is not needed by humans, so if the food is contaminated by the metal, the body will release it partially. The rest will accumulate in certain body parts such as kidneys, liver, nails, fat tissue, and hair.

Unlike metals Hg, Pb, and Cd, copper metal (Cu) is an essential microelement for all plants and animals, including humans. Cu metal is needed by various enzyme systems in the human body. Therefore, Cu must always be in food. What needs to be considered is to keep Cu levels in the body from being deficient and not excessive. The need for Cu in the body per day is 0.05 mg / kg body weight. At this level Cu accumulation does not occur in the normal human body. However, greater consumption of Cu can cause acute symptoms.

Most of the arsenic in nature is a form of basic compounds in the form of inorganic substances. Inorganic arsenic can be water-soluble or gaseous and exposed to humans. According to the National Institute for Occupational Safety and Health (1975), inorganic arsenic is responsible for a variety of chronic health disorders, especially cancer. Arsenic can also damage the kidneys and is very strong poison.

Not only metal contamination, microbial contamination in food products can also pose a fatal risk to human health. Therefore, in this study the analysis of contamination of Kaempferia L. powder products is not only focused on metal contamination, but also microbes. Total plate count (ALT) is a quantitative method used to determine the number of microbes present in a sample. ALT test is a method to calculate the number of mesophyll aerobic bacteria contamination found in the sample by pour plate method on solid media and incubated for 24-48 hours at a temperature of 35-45 ºC with the position reversed. Specific temperature of 35-45ºC was chosen because at this temperature mesophilic aerobic bacteria can grow well. The methods used include pouring, dropping and spreading. The principle of this analysis is the growth of mesophyll aerobic bacterial colonies after the samples are inoculated on the agar plate media by pouring and incubated at the appropriate temperature. ALT that exceeds the limit can be dangerous especially for nursing mothers and their babies. These bacteria can produce toxins that cause various diseases including diarrhea, vomiting, fever and infection. Specific to powdered spice products, as required by SNI 01-3709-1995, the maximum allowable value of ALT is 106 colonies / g.

E. coli is a type of bacteria that is classified as coliform and lives normally in human and animal feces. Therefore, this bacteria is also called fecal coliform. Specific for powdered spice products, as required by SNI 01-3709-1995, the maximum quantity of E. coli allowed is 103 apna / g. The quantity of E. coli in herbal powder products that exceeds the predetermined threshold can cause food poisoning and serious infections. E. coli O157: H7 can produce toxins that can damage the walls of the small intestine and cause stomach cramps, diarrhea mixed with blood, and vomiting.

In addition to the total plates count and E. coli, the level of mold contamination in herbs instant powder products is also important to study. Fungi are members of the fungus regnum which usually grows on the surface of food that has been stale or not treated for too long. Its presence is too large in food products, especially in this case is an herbal powder product, can cause food poisoning. Specifically, as required by SNI 01-3709-1995, the maximum quantity of mold permitted on powdered spices is 104 colonies / g.

At this stage of the research, analysis of contamination is not only carried out on Kaempferia L. powder products, but also on the Kaempferia L. material used as raw material in the manufacture of Kaempferia L. powder products. The purpose of this procedure is to find out the source of contamination in the Kaempferia L. powder products. Metal and microbial contamination can occur from the beginning in the raw material that is not lost even though it has gone through a series of production processes in the manufacture of Kaempferia L. powder products or derived from materials, equipment and production processes of Kaempferia L. powder. Table 3 and table 4 shows the results of the analysis of metal contamination and microbes in the raw material of Kaempferia L.. Meanwhile, in table 5 and table 6 it appears the results of the analysis of metal contamination and microbes in the Kaempferia L. powder product with the best qualifications.

TABLE 3. RESULT OF ANALYSIS OF METAL CONTAMINATION IN RAW MATERIAL FOR KAEMPFERIA L.

No.	Herbs Type	Metal Contamination		
		Lead	Copper	Arsenic
1	Kaempferia L	0	0,08	0

TABLE 4. RESULT OF ANALYSIS OF MICROBIAL CONTAMINATION IN RAW MATERIAL FOR KAEMPFERIA L.

No.	Herbs Type	Microbial Contamination		
		ALT	E.Coli	Mold
1	Kaempferia L	1,78 x 10^3	< 10	< 10

TABLE 5. RESULT OF ANALYSIS OF METAL CONTAMINATION IN KAEMPFERIA L. POWDER PRODUCT

No.	Herbs Type	Metal Contamination		
		Lead	Copper	Arsenic
1	Kaempferia L	1,78 x 10^3	< 10	< 10

TABLE 6. RESULT OF ANALYSIS OF MICROBIAL CONTAMINATION IN KAEMPFERIA L. POWDER PRODUCT

No.	Herbs Type	Microbial Contamination		
		ALT	E.Coli	Mold
1	Kaempferia L	1,78 x 10^3	< 10	< 10

The results of the analysis of the levels of metal contaminants of Kaempferia L. raw materials and Kaempferia L. powder products in Table 2 and Table 3 show a decreasing pattern of copper metal content which is predicted to occur due to the success of deep blanching procedures to induce the solubility of Cu metal from the raw material of Kaempferia L. so as to produce a lower metal content in the resulting Kaempferia L. powder product. Kaempferia L. powder products contain copper contaminants that are 33.33% lower than those of Kaempferia L.. In line with these conditions, although it does not appear to be significant, the results of the analysis of microbial contaminants from raw materials for Kaempferia L. and Kaempferia L. powder products. Especially for the results of the analysis of the levels of microbial contaminants, the reduction in E. Coli levels is predicted not only due to the effectiveness of the blanching procedure but also the reversal treatment during the drying process which inhibits the growth of E. Coli. Blanching procedures and reversal treatment for Kaempferia L. raw material during the drying process have reduced E. Coli levels by 10.56%.

IV. CONCLUSION

Based on the results of data analysis can be concluded that the production process of Kaempferia L. powder with washing procedure for 1 minute, drying with sunlight for 12 hours, slicing with a thickness of 0.30 cm, blanching at 90 °C for 6 minutes, drying using an oven with a temperature of 80°C which is accompanied by a reversal of raw material material per 30 minutes has produced Kaempferia L. powder products with the best qualifications, in accordance with the requirements in SNI 01-3709-1995. The best qualified Kaempferia L. powder product does not contain lead and arsenic contaminants, but still contains copper contaminants with a content of 0.06 mg / Kg. While the results of the analysis of microbial contamination showed that the best-qualified Kaempferia L. powder product had an ALT level of 1.61x10^3 cology / g; E. Coli <10 apna / g and mold <10 colonies / g.

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REFERENCES

[1] Wiyanto, G., Ma'ruf, A., Savitri, E. Panen Rupiah dari Ladang Jahe. Jakarta : Bhafana Publishing, 2014.

[2] Hambali, E., Fatmawati, Permanik, R. Membuat Aneka Bumbu Instan Kering. Jakarta : Penebar Swadaya, 2008.

[3] Setyawan, Budi. Peluang Usaha Budidaya Jahe. Pustaka Baru Press, Yogyakarta, 2015.

[4] Pribadi, E.R. Usaha Tani dan Pemasaran Jahe. Balai Penelitian Tanaman Obat dan Aromatik, Bogor, 2013.

[5] H. Setyaningrum, D., C. Saparinto. Jahe. Jakarta : Penebar Swadaya, 2013.

[6] Prasetyo, S., Sinta, A. Proceeding Seminar Rekayasa Kimia dan Proses. Jurusan Teknik Kimia Fakultas Teknik Universitas Diponegoro, Semarang, 2010.

[7] Raina, A.P., Abraham, Z., Sivaraj, N." Diversity Anslysis of Kaempferia Galanga L. Germplasm From South India Usig DIVA-GIS Approach". Industrial Crops and Products, 2015, 69 : 433-439

[8] Sivarajan, V.V., Balachandran, I. Ayurvedic Drugs and their Plant Sources. New Delhi : Oxford and IBH Publishing Co. Pvt. Ltd, 1994.

[9] Kirtikar, K.R., Basu, B.D."Indian Medicinal Plants vol IV. Bishen Singh and Mahendra Pal Singh (2nd Ed)". Allahabad : Lalit Mohan Publication, 1975.

[10] Ved, D.K., Goraya, G.S. Demand and Supply of Medicinal Plants in India. India : NMPB, New Delhi and FRLHT, 2007.

[11] Kusumawati, N., Anggarani, M.A., Rusijono, Setiarso, P., Muslim, S."Product Standarization of Ginger (Zingiber officinale Rosc.) and Red Ginger (Zingiber officinate var. Rubrum) Simplicia through Washing Time, Slice Thickness and Raw Materials Drying Process Optimization". International Journal on Advanced Science Engineering and Information Technology, 2017, **7(1)** : 15-21.

[12] Sari, K.I.P., Periadnadi, Nasir, N. "Antimicrobial Test of Fresh Ginger Extract (Zingiberaceae) on Staphylococcus aureus, Escherichia coli and Candida allbicans Uji Antimikroba (Ekstrak Segar Jahe-Jahean (Zingiberaceae) terhadap Staphylococcus aureus, Escherichia coli and Candida allbicans)". J. Bio. UA, 2013, **2(1)** : 20-24.

[13] Denyer, C.V. Jackson, P. Loakes, D.M., Ellis, M.R., Yound, D.A.B. 1994."Isolation of Antirhinoviral Sesquiterpeenes fro Ginger (Zingiber officinale)". J Nat Products. **57** : 658-662.

[14] Nwinuka, N., Ibeh, G., Ekeke, G. 2005."Proximate Composition and Levels of Some Toxicants In Four Commonly Consumed Spices". J. Appl. Sci. Environ. Mgt. **9** : 150-155.

[15] Kusumaningati, R.W. Analisa Kandungan Fenol Total Jahe (Zingiber officinale Rosc.) secara in Vitro. Medical Doctor thesis. Jakarta : Universitas Indonesia, 2009.