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Original Article

PHARMACOGNOSTIC CHARACTERISTIC OF *KAEMPFERIA GALANGA* RHIZOME DRIED BY OVEN AND COMBINATION METHODS

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ABSTRACT

Objective: The research objective was to determine the effect of the drying process on the pharmacognostic characteristic of dried *Kampferia galanga* produced in the Post-Harvest Processing Center of Medicinal Plants facility.

Methods: The drying methods were oven-based drying in 80 °C temperature and a combination-based drying process, which included greenhouse drying for 6-8 h and transfered to 80 °C oven. The pharmacognostic characteristic of products were evaluated based on Indonesian Herbal Pharmacopeia standard, which included macroscopic and microscopic evaluation, thin-layer chromatography, water and ethanol soluble content, total ash and acid-insoluble ash content, volatile oil content, ethyl para-methoxycinnamate content, total plate count, and total yeast and mold count.

Results: The result showed *dried K. galanga* from both drying methods met the quality standard. Interestingly, the combination-based methods possed 6-7 h quicker in drying time compared to oven-based methods despite lower temperatures was used at the greenhouse.

Conclusion: It can be concluded that both methods could retain the quality of *K. galanga* rhizome.

Keywords: Combination drying, *Kampferia galanga*, Pharmacognostic characteristic, Oven dying

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INTRODUCTION

Medicinal plants are widely used as an herbal material for traditional medicine and herbal preparation. According to WHO, the production of herbal materials in post-harvesting process needs to follow the good practice of post-harvesting processing procedures, including sorting, washing, cleaning, primary cutting, and eventually drying [1]. The drying method used might considerably affect the pharmacognostic characteristic of the herbal material, thus the choice of suitable procedure is important and crucial as the main concern remains in using medicinal plants is wheter the quality of those raw material could be consistently assured. The majority of adverese events reported relation to the use of herbal products and herbal medicines are due to poor quality of the product, which can be determined by pharmacognostic evaluation [2].

In Indonesia, there are five major medicinal plants that used for traditional medicine which, one of them is Kencur (*Kaempferia galanga*), empirically used as medicine for cough, asthma, fever, stomach ulcers, and rheumatism [3]. Some studies also stated that *K. galanga* showed some activities as monoamine oxidase inhibition [4], larvicidal [5, 6], anticancer [7-9], antihypertensive [9], rheumatism, and antiiritation [10]. These suggests an important status of *K. galanga* as medicinal plant. Hence, production of dried *K. galanga* as raw herbal material in Indonesia needs to be developed according to the standad set [11]. This research aimed to determine the effect of drying process on the pharmacognostic characteristic of dried *K. galanga* produced by two different drying methods.

MATERIALS AND METHODS

Materials

Fresh *Kaempferia galanga* rhizome were obtained from Cidolog (Sukabumi Regency, West Java Province-Indonesia). The rhizome was harvested at least 8 mo after plantation. The plant was identified and determined in Herbarium Jatinangor. The rhizome was futher processed at the Post-Harvest Processing Center of Medicinal Plants, Soreang (Bandung Regency, West Java Province, Indonesia).

Preparation of fresh materials

A 25-30 kg Fresh rhizome of *K. galanga* were sorted by removing plant parts other than rhizome and other materials. Sorted rhizome were washed by soaking and hand-rubbed with tap water repeatedly until the soil were removed marked by clean rinse water. Washed rhizome was drained and chopped into smaller and thinner pieces.

Drying process

Oven based

The chopped rhizome was spread over the stainless-steel tray evenly to create one layer of samples. Oven temperature were set at 80 °C before the trays were inserted into the oven with alternating placement. This was carried out until the Loss on Drying (LoD) of the sample are below 10%.

Combination based

The chopped rhizome was spread over the stainless-steel mesh tray evenly to create one layer of samples. The samples were placed in a greenhouse dryer for approximately 6-8 hour and further, the samples were transferred to the oven after the temperature were set to 80 °C. The process continued to be carried out until the LoD of the sample are below 10%.

Pharmacognostic characteristic evaluation

Pharmacognostic characteristic evaluation was performed according to Indonesian Herbal Pharmacopeia [11], which were macroscopic and microscopic examination, thin layer chormatography fingerprint, water and ethanol soluble content, total and acid insoluble ash content, and determination of essential oil and ethyl *p*-methoxycinnamate (EPMC) content. Other evaluation parameters were performed according to Indonesian Pharmacopeia and National Agency of Drug and Food Control regulation [12, 13], which were total plate count (TPC), total yeast and mold count (TYMC), and heavy metals determination for Pb, Cd, As, and Hg.

RESULTS

The time of *K. galanga* drying process for oven-based (OB) and combination-based (CB) drying were 19.03±5.08 and 12.63±1.44 h,

respectively. The rendement of dried product for OB and CB drying were 22.36±4.30% and 24.91±1.14%. The results are shown in table 1.

Table 1: *K. galanga* drying methods comparison (n = 3)

Parameters	Oven	Combination
Average time (H)	19.03±5.08	12.63±1.44
Rendement (%)	22.36±4.30	24.91±1.14

n=3

Macroscopic evaluation showed that the dried product shape was irregular, averaging 4.5, 3.3, and 0.4 cm in length, width, and thickness. It had wavy and wrinkled edges and brown edges color with white middle parts as shown in fig. 1. The odor was a specific *K. galanga* aroma and the taste was spicy.

Microscopic evaluation showed that in both samples of *K. galanga* were found to contain fragments consisting of starch, parenchyma, periderm, spiral secondarily thickened vessel, parenchyma with secretion cells, and reticulate secondarily thickened vessel as shown in table 2.

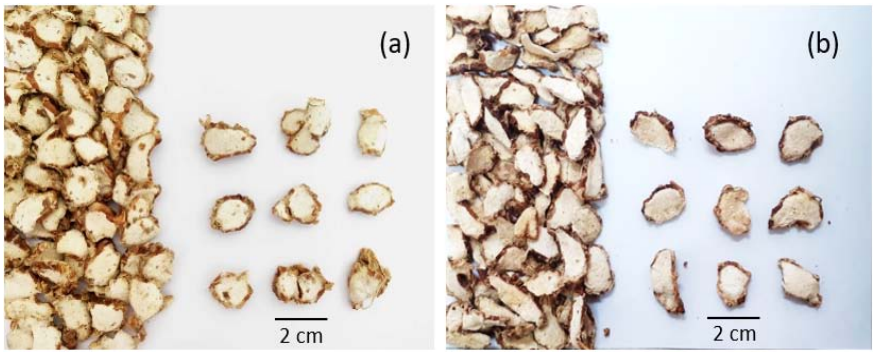
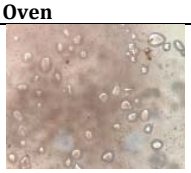
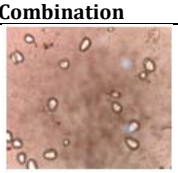
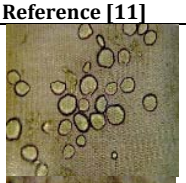
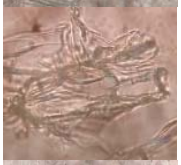
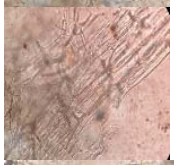


Fig. 1: Dried *K. galanga* product, (a) Oven-based drying, (b) Combination-based drying

Table 2: Microscopic fragment of dried *K. galanga*

Fragment	Oven	Combination	Reference [11]
Starch			
Parenchyma			
Periderm			
Spiral secondarily thickened vessel			
Parenchyma with secretion cells			
Reticulate secondarily thickened vessel			

The results TLC fingerprint showed that the spots detected by using UV 254 nm light contained two spots on each sample of OB and CB with Rf value of 5.8 and 6.6 for spot 1 and 2, respectively, while EPMC was spotted with Rf value of 5.8 as shown in fig. 2.

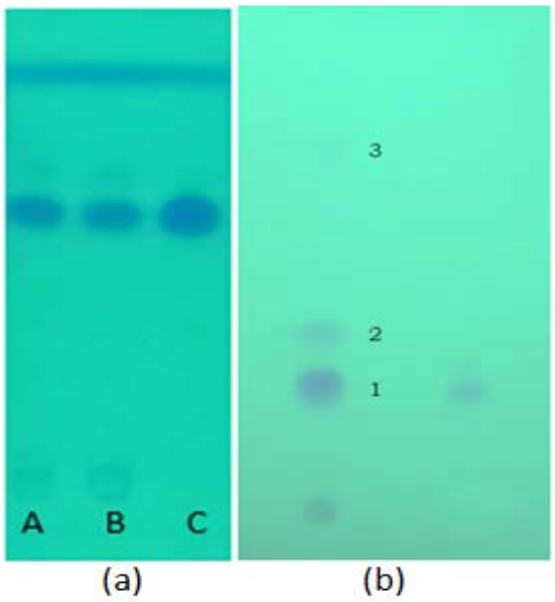


Fig. 2: TLC profile of dried *K. galanga* (a). TLC profile of dried samples, (b) Reference TLC profile [11]. A: Oven dried *K. galanga,* B: Combination dried *K. galanga,* C: EPMC standard

The result for OB and CB products in water-soluble content, ethanol soluble content, total ash content, acid-insoluble ash content, essential oil content, EPMC content, TPC, TYMC, and heavy metals determination are shown in table 3.

Table 3: Summary of dried *K. galanga* products quality comparison (n = 3)

Parameter	Oven	Combination	*P value*	Standard
Water Soluble Content (%)	12.28±0.33	17.11±1.13	0.002*	≥ 10.60 [11]
Ethanol Soluble Content (%)	5.90±0.58	5.02±0.38	0.094	≥ 4.60[11]
Total Ash (%)	3.50±0.43	5.46±0.30	0.002*	≤ 8.70 [11]
Acid Insoluble Ash (%)	0.95±0.34	1.50±0.19	0.072	≤ 2.50 [11]
Essential Oil Content (%)	2.40	2.80	-	≥ 2.40[11]
EPMC Content (%)	3.42±0.48	3.78±0.96	0.591	≥ 1,80 [11]
Total Plate Count (cfu/g)	3.35×10^2	0.95×10^1	-	$\leq 5 \times 10^7$[12,13]
Total Yeast and Mold Count (cfu/g)	0.37×10^1	0	-	$\leq 5 \times 10^5$[12,13]
Pb Content (ppm)	3.030	1.518	-	≤10 ppm [13]
Cd Content (ppm)	≤0.001	≤0.001	-	≤0.3 ppm [13]
As Content (ppm)	0.071	0.099	-	≤5 ppm [13]
Hg Content (ppm)	≤0.001	≤0.001	-	≤0.5 ppm [13]

*p value<0.05 significantly different with confidence internal (Cl) 95% of independent t-test

DISCUSSION

In this experiment, we used the oven-based method and combination-based method as these were two possible methods to be use in the facility to make a standardized pilot scale raw material for traditional medicine. The average weight of prepared fresh rhizome used for OB and CB were 25.67±7.74 kg and 21.81±1.89 kg, respectively. This difference was due to intial fresh material condition and preparation, as non-rhizome plant parts and the soil were removed during the sortation and washing process thus reduced the overall weight. This difference appeared to be non-significant by independent T-test analysis.

The temperature of the oven was set at 80 °C, while at the combination process, heat source at the greenhouse was only sunlight and further transferred to the oven, which was also set at 80 °C. The 8 h daylight average temperature at the greenhouse (9 am to 5 pm) at the top, middle, and lower rack were 42.7±1.6, 41.8±2.1, and 39.5±2.2 °C, respectively. This racks temperature difference was non-significant by one-way anova testing. Interestingly, the result of drying process showed that CB process gave a quicker drying time, averaging 6-7 h less compared to OB process despite the lower temperature. The moisture trapped in the oven might resulted in slower drying process compared to the combination process, which dried initially in greenhouse. The blower at the greenhouse could function along the drying process and played an important role as it reduced the moisture formed during the drying process. As the temperature started to drop at the dusk, the samples were transferred to the oven to continue the drying process until LoD 10% [11], was obtained. It was only needed further average 4-5 h drying process in oven.

Pharmacognostic characteristics were evaluated as government standard [11]. Macroscopic observation as shown in fig. 1, were in accordance with the reference description [11]. Microscopic testing was carried out to qualitatively determine the identifying fragment found in both dried products of *K. galanga*. The results showed that fragments were in accordance with reference as shown in fig. 2 [11].

The TLC fingerprint was also tested to ensure the identity of dried raw material as it is unique for each plant samples [2]. According to Indonesian Herbal Pharmacopeia, the marker compound of *K. galanga* rhizome is EPMC. There was a difference in retention factor (Rf) value compared to the reference, as shown in fig. 3, possibly due to a difference in chamber saturation time [2]. Aside from that, the samples showed to contain EPMC marked by identical Rf of first spot

with EPMC standard spot and the chromatogram profile also in accordance with the reference. Those were two key parameters to ensure that the identity of the sample was *K. galanga* rhizome and did not get contaminated.

The other parameters were water-soluble content, ethanol-soluble content, total ash, and acid insoluble ash. It was found from this study that all those parameter criteria were met by the product. The significant difference in total ash result could be due to washing process in preparation phase. It was critical to eliminate the soil from the rhizome as the presence of silicate in soil adhering to the plant surface, which is non-physiological ash, would increase the total ash and acid insoluble content [1, 14].

Essential oil content and EPMC content were the key parameter as these could directly affect the efficacy of *K. galanga* as traditional medicine. Two major components, namely EPMC and trans-ethyl cinnamate were found to be responsible constituents for most of *K. galanga* pharmacological activites [15-17]. Essential oils were obtained by the distillation method at temperatures less than 50 °C [18]. The determination of EPMC levels was carried out by TLC-Densitometry method that works by fluorescence or absorption [19]. The results showed that essential oil and EPMC content of *K. galanga* were met the requirement of Indonesian Herbal Pharmacopeia. The effect of high temperature used in drying process could be seen in essential oil content that was barely enough to meet the requirement. The EPMC content of CB products was higher although statistically, did not significantly different. CB dried product showed higher content for both, possibly due to shorter high-temperature exposure.

The result of TPC, TYMC, and heavy metal showed that both dried products were met the requirements from National Agency of Drug and Food Control to ensure the safety requirements of the sample as a raw material for traditional medicine [13]. The preparation and drying time of both processes were good and quick enough to prevent microbial growth, as prolonged drying render the medicinal plants vulnerable and exposed to microbial contaminants [20].

CONCLUSION

Based on the pharmacognostic characterization of dried *K. galanga* produced by oven-based and combination-based drying methods, it can be concluded that dried *K. galanga* products from both drying methods met the quality standard. Interestingly, the combination-based methods possed 6-7 h quicker in drying time compared to oven-based methods despite lower temperature was used at the greenhouse.

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AUTHORS CONTRIBUTIONS

All the authors have contributed equally.

CONFLICT OF INTERESTS

The authors declare no conflict of interest in preparing this research and article.

REFERENCES

1. World Health Organization, WHO expert committee on specifications for pharmaceutical preparations. 5th sec report of the WHO Expert Committee on Specifications for Pharmaceutical Preparations. Available from: https://apps.who.int/iris/handle/10665/272452.
2. World Health Organization. Quality control methods for herbal materials. Geneva, Switzerland: World Health Organization; 2011.
3. Silalahi M, Nisyawati, Walujo EB, Supriatna J, Mangunwardoyo W. The local knowledge of medicinal plants trader and diversity of medicinal plants in the Kabanjahe traditional market, North Sumatra, Indonesia. J Ethnopharmacol. 2015;175:432-43. doi: 10.1016/j.jep.2015.09.009. PMID 26435224.
4. Noro T, Miyase T, Kuroyanagi M, Ueno A, Fukushima S. Monoamine oxidase inhibitor from the rhizomes of Kaempferia galanga L. Chem Pharm Bull (Tokyo). 1983;31(8):2708-11. doi: 10.1248/cpb.31.2708, PMID 6652816.
5. Kiuchi F, Nakamura N, Tsuda Y, Kondo K, Yoshimura H. Studies on crude drugs effective on visceral larva migrans. II. Larvicidal principles in kaempferiae rhizoma. Chem Pharm Bull (Tokyo). 1988;36(1):412-5. doi: 10.1248/cpb.36.412. PMID 3378302.
6. Choochote W, Kanjanapothi D, Panthanga A, Taesotikul T, Jitpakdi A, Chaithong U. Larvicidal and repellent effects of Kaempferia galanga. South East Asian J Trap Med Public Health. 1999;30:470-6.
7. Kosuge T, Yokota M, Sugiyama K, Saito M, Iwata Y, Nakura M. Studies on anticancer principles in Chinese medicines. II. Cytotoxic principles in Biota orientalis (L.) Endl and Kaempferia galanga L. Chem Pharm Bull (Tokyo). 1985;33(12):5565-67. doi: 10.1248/cpb.33.5565, PMID 3833396.
8. Xue Y, Chen H. Study on the anticarcinogenic effect of three compounds of Kaempferia galanga L. Xei Shen Yan Jiu. 2002;31(4):247-48, 251.
9. Jagadish PC, Raghu CH, Vinod KS, Latha KP. Potent selective cytotoxic activity of Kaempferia galanga rhizome against cancer cell cultures. Int J Pharm Biol Sci. 2010;1:1-5.
10. Chithra M, Martin KP, Sunandakumari C, Madhusoodanan PV. Protocol for rapid propagation, and to overcome delayed rhizome formation in field established *in vitro* derived plantlets of Kaempferia galanga L. Scientia Horticulturae. 2005;104(1):113-20. doi: 10.1016/j.scienta.2004.08.014.
11. Indonesian Ministry of Health. Farmakope herbal Indonesia. 2nd ed. Jakarta, Indonesia: Indonesian Ministry of Health; 2017.
12. Indonesian Ministry of Health. Farmakope Indonesia. 5th ed. Jakarta, Indonesia: Indonesian Ministry of Health; 2014.
13. Badan Pengawas Obat dan Makanan. Peraturan BPOM Tahun 2019 tentang Persyaratan Mutu Obat Tradisional. Vol. 32. Jakarta, Indonesia: Badan Pengawas Obat dan Makanan; 2019.
14. Surekha D, Rajan VST, Kumar NA, Parameswari SA, Chetty CM. A review on role of quality control and quality assurance system in regulation of herbal drugs. Int J Res Phyochem Pharmacol. 2016;6(2):32-40.
15. Raina AP, Abraham Z. Chemical profiling of essential oil of Kaempferia galanga L. Germplasm from India. J Essent Oil Res. 2016;28(1):29-34. doi: 10.1080/10412905.2015.1077165.
16. Srivastava N, Ranjana, Singh S, Gupta AC, Shanker K, Bawankule DU. Aromatic ginger (Kaempferia galanga L.) extracts with ameliorative and protective potential as a functional food, beyond its flavor and nutritional benefits. Toxicol Rep. 2019;6:521-8. doi: 10.1016/j.toxrep.2019.05.014. PMID 31431884.
17. Ichwan SJA, Husin A, Suriyah WA, Lestari W, Omar MN, Kasmuri AR. Anti-neoplastic potential of ethyl-p-methoxycinnamate of Kaempferia galanga on oral cancer cell lines. Materials Today: Proceeding. 2019;16(4):2115-21. doi: 10.1016/j.matpr.2019.06.100.
18. Hudha MI, Daryono ED, Muyassaroh M. Minyak ken cur dari rimpang ken cur dengan variabel jumlah pelarut dan waktu maserasi. J Tekn Kimia. 2013;8(1):1-7.
19. Gandjar Rohman A. Analisis obat secara spektrofotometri dan kromatografi. Yogyakarta, Indonesia: Pustaka Pelajar; 2012.
20. Zamir R, Hosen A, Ullah MO, Nahar N. Microbial and heavy metal contaminant of antidiabetic herbal preparations formulated in Bangladesh. Evid Based Complement Alternat Med. 2015;2015:243593. doi: 10.1155/2015/243593, PMID 26587044.