Optimizing the Drying Temperature of Temulawak Simplicia (Curcuma xanthorrhiza Roxb.) Based on Water and Ash Content and Functional Compound

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Abstract. This study has been conducted to produce the standardization of temulawak (Curcuma xanthorrhiza Roxb). Simplicias was one of the harvest-processed forms. The parameters were optimized based on water content and ash content and functional compound (essential oil, xantorizol, oleoresin, curcumin, and curcuminoid). To get temulawak simplicias product with high quality, it has been done the optimization on the stage of drying process. For the dried by the oven, it has been conducted optimization on the drying temperatures of 70 ºC, 80 ºC and 90 ºC. The analysis result shown that the active compound content in the simplicia product indicates that the product of temulawak simplicia with optimum quality has been obtained from the production process by oven drying method using temperature of 80 ºC. The temulawak simplicia product contains essential oils, xantorizol, oleoresin, curcumin, and curcuminoid, each by 1.48%, 67.32%, 1.21%, 92.42% and 1.25%. Meanwhile, the temulawak water content and ash content are 5% and 3.16% that achieve in standard applicable of simplicias product.

1. Introduction

Temulawak (Curcuma xanthorrhiza) is a native Indonesian plant and traditionally utilized for a range of illness including liver damage, hypertension, diabetes, and cancer. Most people use the rhizome of this plant as they believe it has medicinal effect. Curcumae xanthorrhizae rhizoma consists of the dried rhizome; Curcuma xanthorrhiza Roxb. (C. xanthorrhiza D. Dietrich). The synonyms of Curcuma xanthorrhiza is also known as Javanese Turmeric or Temulawak. The rhizomes of Curcuma xanthorrhiza Roxb contain volatile oil, saponin, flavonoid and tannin. Chemistry analysis showed that the main substances of Curcuma xanthorrhiza Roxb are starch (48.18-59.64%), fiber (2.58-4.83%), volatile oil such as, phelandren, camphor, tumerol, simeol, borneol, and xanthorrhizol (1.48-1.63%), and also curcuminoid, curcumin and desmetoxicurcumin (1.6-2.2%) (Afifah, 2005). The root contains two classes of characteristic constituents; curcuminoids (1-2%), a mixture of dicinnamoylmethane which derivatives like curcumin (diferuloylmethane), monodemethoxycurcumin (feruloylphydroxycinnamoylmethane) and bisdesmethoxycurcumin (bis-(p-hydroxycinnamoyl) methane) [1].

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and other phenolic and non-phenolic diarylheptanoids [2]. Volatile oil (3-12%), composed mainly of sesquiterpenes (e.g. β-curcumene, ar-curcumene), xantherizzol (44.5%) and a small amount of camphor (1.39%) [3].

The Material handling after harvesting time needs to be considered because it affects the quality of the processed product. The quality and safety of bio-farm product determines by the quality of raw material, post-harvest handling and processing techniques. The post-harvest handling techniques consist of the stages of sorting, washing, and drying [4], sorting/grading, packaging, labeling, and storage, either before it is sold in fresh form or after further processing. However until at a recent time there is no researcher who report in detail about the standard operating procedures (SOP) for the manufacture of processed products after harvesting.

Based on its usefulness, on this research, the content of the functional compound in temulawak include: (1) essential oils; (2) xantherizol; (3) oleoresin; (4) curcumin; (5) curcuminoid. The content of functional compound is influenced by the water content and the ash content. Functional compound, water content, and ash content become the nutritional content parameters of temulawak simplicia product.

2. Method
2.1 Material
The main material used in this research is temulawak (Curcuma xanthorrhiza Roxb). The optimization of post-harvest handling of temulawak was conducted using a number of apparatuses as in the previous publication [5]. It includes washer (homemade) used to optimize washing time with NESCO Lab MS-H280 Pro magnetic stirrer as a motor producing whirlpool was used in order to remove the contaminants, Bosch MUZ4DS3 slicer machine with slicing capacity of 60 g/min and the slicing thickness of 0.30 cm; J-LabTech LDO-030E (Daian Labtech Ltd. Co.) as well as the drying machine with a range temperature of 50 ºC – 250 ºC and a drying time up to 60 minutes, were used to optimize rhizome drying.

2.2 Manufacturing of temulawak simplicia
Post-harvest handling of temulawak rhizome is done through three main stages covering washing, slicing, and drying. To obtain optimum rhizomes quality, it has been done the drying process by oven. Specifically, the temperature used was 70 ºC, 80 ºC and 90 ºC. In addition, during the drying process, it was not involved the reversing, and drying process was stopped as soon as constant mass was obtained.

2.3 Water content and ash content testing of temulawak simplicia product
The testing procedure performed used the gravimetric method.

2.4 Functional compound testing of temulawak simplicia product
The testing procedure of functional compound content of temulawak simplicias products includes essential oil content using Stahl distillation methods. The testing procedure of curcuminoids, curcumin was performed using Agilent 1290 Infinity Liquid Chromatography (LC) and STM Columns. While for oleoresin and xantherizol, an analysis was performed using Pharmaspec UV-1700 UV Visible Spectrophotometer.

3. Result and Discussions
Data in Table 1 shows the Quality Requirements of temulawak Simplicia [6]. Based on data in Table 2, it is known that the drying process by using oven with temperature 80 ºC has produced temulawak simplicia with water content and ash content respectively 5% and 3.16% which was obtained from drying for 1,600 minutes.
Table 1. Quality Standard of Temulawak Simplicia Issued by Materia Med Indonesia

| No | Criterion             | Units | Requirements |
|----|-----------------------|-------|--------------|
| 1  | Appearance            |       |              |
| 1.1| Odor                  | -     | Normal       |
| 1.2| Taste                 | -     | Normal       |
| 2  | Water                 | % (b/b)| Max. 12.0    |
| 3  | Ash                   | % (b/b)| Max. 7.0     |
| 5  | Metal contamination   |       |              |
| 5.1| Lead (Pb)             | mg/kg | Max. 10.0    |
| 5.2| Copper (Cu)           | mg/kg | Max. 30.0    |
| 6  | Arsenic contamination | mg/kg | Max. 0.1     |
| 7  | Microbe contamination |       |              |
| 7.1| The total of plate account | colony/g | Max. 10^6   |
| 7.2| E. coli               | apna/g| Max. 10^3    |
| 7.3| Mold                  | colony/g| Max. 10^4   |
| 8  | Aflatoxin             | mg/kg | Max. 20.0    |

Table 2. Quality of temulawak simplicia from the drying process by oven for 1,600 minutes

| No. | Parameter of quality | Drying Temperature |
|-----|----------------------|--------------------|
|     |                      | 70 °C   | 80 °C   | 90 °C   |
| 1   | Aroma                | Normal  | Normal  | Normal  |
| 2   | Taste                | Normal  | Normal  | Normal  |
| 3   | Water content (%)    | 10      | 5       | 5       |
| 4   | Ash content (%)      | 6.02    | 3.16    | 3.16    |

The data has been shown that the simplicia product of this experiment has the normal aroma and taste (organoleptic testing). It can be inferred that the product has been accordance with the quality standard of temulawak simplicia. The Table 2 has been shown that the lowest water content of temulawak simplicia can be obtained when it is dried at a temperature of 80 °C. From this temperature, the water content and the ash content are categorized as lower level. It can be inferred that the product has been accordance with the quality standard of temulawak simplicia that the maximal level of water content is 12.0 % and the maximal level of ash content is 7.0 %, while the water content of this experiment is 5.0 % and the ash content of this experiment is 3.16 %.

Microbial growth in foodstuffs is closely related to the amount of water available. The amount of water in materials for microbial growth is known as water activity (aw / activity). Total microbial inhibition will occur in the food which stays less than 0.6. The water content which is contained in a food product will affect the appearance, taste, and age. The water content presented in a food product will affect the appearance and the taste of the product. According to [7] the water content in the material also determines the acceptance, freshness and durability of the material. Ash content is a parameter of product purity that is influenced by mineral elements in the foodstuff [7]. Ash content illustrates the amount of un-burnt minerals to substances that can evaporate.

On the previous data, it has been shown that the lowest water content and ash content can be obtained when it is dried at a temperature of 80 °C. Water is a major component in foods that affect appearance, texture, aroma, and taste of its ingredients. The water content in food ingredients also determines the acceptability of a food ingredient. The sensitivity of a commodity against water losses due to evaporation depends on the deficit at atmospheric pressure in the vicinity and the surface layer of the commodity. Organoleptic test is an important parameter to measure the level of consumer
acceptance and its preference to the product. Organoleptic assessments are made in this hedonic test which includes color, aroma, taste, texture and general acceptance of the product.

Drying is the oldest preservation technique of agricultural products and it is essential process used all over the world for the preservation of farm product. It helps in reducing the water contains of the produced simplicia to a level below deterioration. It does not occur for a definite duration [4]. Lower water content will have a direct impact on the easily covered by mold and bacteria. It also eliminates the activity of enzymes that can decipher the active compound content. Further, it facilitates further processing, so it can be more compact, durable and easily stored [5].

Drying will never replace canning and freezing because the method does a good job of retaining the taste, appearance, and nutritive value of fresh food, but drying is an excellent way to eat delicious food. One of the biggest advantages of dried foods is that much less storage space than canned or frozen foods.

However, to obtain optimum drying temperatures in the production process of temulawak simplicia, at this stage it was also conducted an analysis of active compounds content in simplicia products which was dried using an oven temperature 70 °C; 80 °C; and 90 °C. Based on data from the product which is shown in the Table 9, it can be seen that there is the highest content of essential oil, oleoresin, xantorizol, curcuminoid and curcumin, which were obtained on the drying temperature at 80 °C.

| No. | Drying Temperature (°C) | Essential Oil (%) | Oleoresin (%) | Xantorizol (%) | Curcuminoid (%) | Curcumin (%) |
|-----|-------------------------|-------------------|--------------|---------------|----------------|-------------|
| 1   | Raw material            | 1.89              | 1.23         | 68.67         | 1.28           | 94.37       |
| 2   | 70 °C                   | 1.50              | 1.21         | 67.40         | 1.25           | 92.57       |
| 3   | 80 °C                   | 1.48              | 1.21         | 67.32         | 1.25           | 92.42       |
| 4   | 90 °C                   | 1.29              | 1.00         | 60.05         | 1.00           | 87.98       |

Based on data from the active compound content of temulawak simplicia products which is shown in Table 3, it is concluded: (1) increasing the drying temperature from 70 °C to 80 °C did not cause a significant decrease in the active compound content of temulawak simplicia; (2) increasing the drying temperature from 80 °C to 90 °C caused a significant decrease in the active compound content of temulawak simplicia. Drying temperature at 80 °C claimed as the best temperature to dry temulawak to produce temulawak simplicia, with the lowest water content and ash content. Moreover, it contains an active compound with the highest content (percentage). Thereby, it can be said that the temulawak material has higher stability of increased drying temperature.

Furthermore, in order to obtain the manufacturer procedure of temulawak simplicia quality, an analysis had been performed using a standard which was established by Materia Med Indonesia (Table 2) [5]. Based on optimization result of temulawak simplicia production with optimum quality, the temperature of drying at 80 °C, contains 1.48% essential oil; 1.21% oleoresin; 67.32% xantorizol; 1.25% curcuminoid; and 92.42% curcumin.
Figure 1. Curcuminoid structure of temulawak

Curcuminoid is a fraction that responds to the yellow color of temulawak rhizome. Curcuminoids are insoluble in water but dissolve in acetone, alcohol, acetic acid, and alkali hydroxide. In addition, curcuminoid has a distinctive aroma and is non-toxic manner [1-2]. This curcuminoid fraction is stable against a high temperature but it is unstable of light. Because of this nature, when curcumin is exposed to light, there will be such degradation or decomposition of the structure of cyclization of curcumin [8]. Curcuminoids and components that make up volatile oils such as xanthorrhizol are phenolic compounds that are antioxidants [1-2]. The main functions of antioxidants are used as an effort to minimize the oxidation process of fat and oil. It minimizes the occurrence of food damage, extends the life of the food industry, increases the stability of fats contained in foods and prevents the loss of the sensory and nutritional quality [6]. Natural antioxidants can protect the human body against damage caused by reactive oxygen species. It also able to inhibit the occurrence of degenerative diseases and is able to inhibit lipid peroxidation in food. Natural antioxidants generally have a hydroxy group in their molecular structure.

4. Conclusion

The result showed that the drying temperature affects the water content, the ash content, and the active compound of temulawak simplicia products. Drying temperature at 80 ºC is claimed as the best temperature to dry temulawak to produce temulawak simplicia, with the lowest water content and ash content, and contain an active compound with the highest percentage. The water content of temulawak simplicia at optimal temperature of drying is 5%, and ash content of temulawak simplicia at optimal temperature of drying is 3.16%. Based on the optimization result of temulawak simplicia production with the optimum quality at 80 ºC, it is resulted that the product contains 1.48% essential oil; 1.21% oleoresin; 67.32% xantarizol; 1.25% curcuminoid; and 92.42% curcumin.

5. References

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