Functional characteristics of starch from red ginger, elephant ginger, emprit ginger and curcuma

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Abstract. The purpose of this study was to compare the functional characteristics of ginger starch which consisted of three varieties, namely red ginger, elephant ginger, emprit ginger and curcuma starch. The analysis was performed using a factorial randomized block design. The results showed that each type of starch had different functional characteristics. Based on the research results, it was found that curcuma starch had the highest water absorption capacity, swelling power and solubility values.

1. Introduction
Ginger and curcuma are spices that are in the same family, namely Zingiberaceae and are widely available in Indonesia. Ginger and curcuma contain bioactive compounds such as oleoresin, essential oils and other compounds. Ginger and curcuma have many benefits, apart from being used as a spice in the kitchen, also be used for medicine, cosmetics, and also for health. Therefore, ginger and curcuma are included in the category of biopharmaceutical [1,2].

In Indonesia, there are three varieties of ginger, namely red ginger, elephant ginger, and emprit ginger [3]. Red ginger (Zingiber officinale var. Rubrum) has a small rhizome size but has a very spicy taste due to its highest oleoresin content. The sharp aroma is due to its essential oil content which is also higher by 2.58% - 2.72% [4]. Red ginger rhizome is commonly used as a medicinal ingredient [5]. Elephant ginger (Zingiber officinale var. Roscoe) has less fibre, less spicy taste and less tangy aroma. Elephant ginger has an essential oil content of about 0.18% - 1.66% [6]. Elephant ginger is usually used as a spice in cooking and drinks. Emprit ginger (Zingiber officinale var. Rubrum) has a sharp aroma, and spicy taste even though the rhizome size is small. Emprit ginger rhizome also contains 3-5% oleoresin and 1-3% essential oil [7].

Utilization of ginger and curcuma is still relatively small, generally these two rhizomes are only used as a spice in the kitchen and raw materials for medicinal herbs. Therefore, it is necessary to diversify the use of ginger and curcuma. One of the diversifications of ginger and curcuma that can be done is processing it into starch. This study aims to determine the functional characteristics of starch from red ginger, elephant ginger, emprit ginger, and curcuma tuber.
2. Materials and methods

2.1 Materials

The materials used for this research were emprit ginger, elephant ginger, red ginger, and curcuma with a harvest age of 10 months which were obtained from Sipintuangin Village, Dolok Pardamean District, Simalungun Regency.

2.2 Research methods

The preparation of ginger starch and curcuma starch followed the previous research by Melluri and Sailaja, 2018 [8] with modification. In previous studies, Na-metabisulphite was used as starch soaking water, but in this study it was not. Making starch was done by cleaning the rhizomes of ginger and curcuma using a soft brush and then washing them, clean and draining. Each treatment was weighed as much as 10 kg and then mashed using a grated machine. Water in a ratio of 2:1 was added to the resulting chopped or slurry, then stirred squeezed using a filter cloth. After that squeezed 2 times with a water with ratio of 2:1. Then the juice was deposited for 12 hours. After that, it was separated between the juice and the starch that formed. The resulting starch was washed again with water and then deposited.

Figure 1. Starch manufacturing flow chart.

- Rhizome
- Cleaned the rhizome then washed
- Smoothed the rhizome
- Add water to each of the ginger pulp (2:1)
- Squeeze each pulp so that the pulp and water are separated
- Re-squeeze the dregs with the addition of the same amount of water
- The squeezed water was deposited for 12 hours
- Wasted the water
- Starch was dried by oven at 50°C for 7 hours
- Starch crushed and sieved with a 100 mesh sieve

Analysis of functional properties:
- Water absorption capacity
- Swelling power
- Solubility

Rhizome:
J1=Red Ginger
J2=Elephant Ginger
J3=Emprit Ginger
J4=Curcuma
again for 12 hours. After being separated the sediment, was then oven dried at 50°C for 7 hours until the starch was dry. After drying, the starch was mashed and sieved using a 100 mesh sieve and the starch was stored in polyethylene packaging. The flow chart can be seen in Figure 1.

2.3 Analysis of data
This research used a non-factorial randomized block design. Each treatment was carried out with 4 replications so that the total sample were 16 samples. The parameters tested in this study were water absorption capacity, swelling power, and solubility.

2.3.1 Water absorption capacity. The method of Sathe and Salunke [9] was used to study the water absorption capacity of ginger and curcuma starch.

2.3.2 Swelling power and Solubility. The method of Afolayan et al. [10] was used to study the swelling power and solubility of ginger and curcuma starch.

3. Results and discussion

3.1 Water absorption capacity
Figure 2 shows that curcuma starch has the highest water absorption capacity compared to other ginger starches, about 2.80 g/g. While the starch with the lowest water absorption capacity was red ginger starch at 2.11 g/g. The difference in water absorption capacity in each material is related to the composition and structure of the starch granules. Each material has varying water absorption due to the different proportions of the crystalline and amorphous regions of starch [10]. Amylose has a straight chain making the crystalline region more compact so that it was more difficult for water to penetrate while the amorphous region is less compact and easier to penetrate by water. So that if starch contain higher amylopectin, the water absorption capacity was also higher [11].

Note : J1 (Red Ginger), J2 (Elephant Ginger), J3 (Emprit Ginger), J4 (Curcuma)

![Water absorption capacity of starch from red ginger, elephant ginger, emprit ginger, and curcuma tuber.](image)

3.2 Swelling power
Figure 3 shows that curcuma starch has the highest swelling power among other starches, which was 10.53 g/g, while the smallest swelling power value was in red ginger starch of 9.09 g/g. Swelling power shows the ability of starch to swell or expand in water. The difference of swelling power depended on the structure and composition of the granule constituent [12]. Starch granule which contains high amylopectin content caused more water to be absorbed so that the swelling value was higher. Swelling
power is also related to water absorption, where the greater the water absorption, the swelling power will increase [13].

![Swelling power of starch from red ginger, elephant ginger, emprit ginger, and curcuma tuber.](image)

Note: J₁ (Red Ginger), J₂ (Elephant Ginger), J₃ (Emprit Ginger), J₄ (Curcuma)

**Figure 3.** Swelling power of starch from red ginger, elephant ginger, emprit ginger, and curcuma tuber.

3.3 Solubility

The solubility or solubility index is an indicator of the amount of amylose that comes out of the starch granule when heated. Figure 4 shows that curcuma starch had the highest solubility value compared to ginger starch at 2.15%. While the starch with the lowest solubility was red ginger starch at 1.02%. The solubility value was due to the amount of amylose content in starch. The higher the amylose content in the material, the higher the solubility because more amylose would dissolve in the water [14].

![Solubility of starch from red ginger, elephant ginger, emprit ginger, and curcuma tuber.](image)

Note: J₁ (Red Ginger), J₂ (Elephant Ginger), J₃ (Emprit Ginger), J₄ (Curcuma)

**Figure 4.** Solubility of starch from red ginger, elephant ginger, emprit ginger, and curcuma tuber.

4. Conclusions

Based on the results of the functional characteristics from starch of red ginger, elephant ginger, emprit ginger, and curcuma tuber, it was concluded that curcuma starch had the highest water absorption capacity, swelling power and solubility values compared to the other ginger starches.
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