Assessment of drying method and pretreatment size on characteristic of dried chilli powder

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Abstract. The aim of this assessment was to investigate the characteristic of dried chilli powder with different drying methods and pretreatment size before dried. Chilli was cutted half and sliced before dried using solar drying or gas oven and then grind dried red chilli in a blender to produce chilli powder. The pretreatments is to make drying time shorter therefore can get better colour and vitamin C. The characteristic parameters were moisture content, colour (L*, a*, b* values), ash and vitamin C content. The results showed that the colour and vitamin C of dried chilli powder using solar drying was higher than that using oven. In addition, the sensory evaluation of abon cabe using the best quality of dried chilli mixture with fried shallots, fried garlic powder, andaliman powder, roasted teri and terasi were observed.

1. Introduction
North Sumatra Province is one of the provinces in Indonesia which produce of vegetable commodities such as red chilli. Red Chilli is widely consumed by the public and the price is often changed due to market’s demand. In 2017, The production of red chilli in North Sumatra was about 159,131 tons, and the largest production of this commodity was in Karo and Simalungun districts were about 50,724 and 36,430 tons, respectively. The production of these two districts were 54.76% of total production from North Sumatra Province [1].

Red chilli is a commodity that is easily damaged due to its high water content. This reason resulted local farmers not intended to storing their chilli crops for longer time. The process of drying agricultural products is an alternative to preserving to extend its shelf life. Most agricultural products do the drying process as an effort to extend the final quality of the product [2].

There are two alternative ways for drying red chilli by natural and artificial methods. The method of natural drying by utilizing sunlight while the artificial method is drying by providing artificial heat or flowing hot air into the material to be dried [3]. The drying process use high heat to evaporate the water contained in the material, but the use of high temperatures can cause changes in colour, aroma and vitamin content [4]. Solar energy taken by solar collector in day time can convert into energy that can be used for drying process [5]. Recently some drying process of agricultural products such as cocoa beans and coffee beans using solar dryer have reported in literature [6,7].
In this study the effects of different pretreatments size of red chilli before dried using solar drying or gas oven on the characteristics of dried chili powder were investigated.

2. Method

2.1. Preparation and processing of dried red chilli
The red chilli is a local red chilli North Sumatra taken directly from farmers in the Karo Regency area. The red chilli was first sorted by the best-looking chilli without damaged, it washed and then dispose the chilli’s stem. For the experimental treatments, the red chilli was cutted half or sliced about ±2 cm length, spread on the stainless-steel trays and dried using solar dryer or using gas oven at 60-65 ºC. Experiment using solar dryer was started at 09:00 am until 05:30 pm. Drying time ended if the dried chili texture was easily broken by hand. The size of dried chilli was reduced using a blender to produce chilli powder.

![Solar dryer](image)

**Figure 1.** Solar dryer

The solar dryer used in this research was designed as shown in Figure 1. The specification are given in Table 1.

| Parameter             | Specifications                  |
|-----------------------|---------------------------------|
| Drying Box size       | 50 cm x 50 cm x 70 cm           |
| Collector size        | 200 cm x 50 cm x 10 cm          |
| Collector material component | Tin-rockwool-styrofoam-wood |
| Slope angle           | 60º                             |
2.2. Chemical analysis
The proximate analysis was done by determine the vitamin C, moisture and ash content. The AOAC method [8] for determining the moisture content, ash content in a muffle furnace [9], vitamin C content determined by spectrophotometer and colour value by using Chromameter CR 400 that L* indicates for lightness, a* for the red or green coordinate and b* for the yellow or blue coordinates.

2.3. Making abon cabe for sensory evaluation
After the best quality of dried chilli powder was chosen, then consumer sensory quality was carried out with processed product, namely abon cabe. Three types of Abon Cabe was made by this following the producers: the mixture A of 8 grams of fried shallots and 1 gram of fried garlic flour was stirred with different additional ingredients (2 grams of dried andaliman powder with 18 grams of roasted dried shrimp (ACD) or with 18 grams of roasted teri (ACT) or with 18 grams of terasi (ACTE)) until blended, set aside. The mixture B of 8 grams of sugar was stirred in a pan (without using heat) with 3 grams of salt and 50 grams of the best quality of dried chilli until blended, then add 10 grams of cooking oil, stir again until completely mixed. Turn on the heat with low condition and stirred the mixture, immediately turn off the heat if a fragrant aroma arises. The mixture A was added into mixture B and stirred until blended.

The materials ingredients such as terasi was bought on a local market, the fried shallot and fried garlic flour was made by fried thin slices of shallot or garlic using cooking oil and grinding in a blender, the andaliman powder was made by dried andaliman using gas oven and grind dried andaliman in a blender, the roasted dried shrimp and roasted teri was made by fried dried shrimp or dried teri in a frying pan without using any oil until it’s crispy.

Abon cabe was ready to be tested for sensory evaluation carried out by 15 volunteered trained panellists who are familiar with dried chilli the ages between 20 to 40 years old. The scores were noted over a five-point hedonic scale: (5) like very much, (4) like, (3) normal, (2) dislike, (1) dislike very much.

2.4. Statistical analysis
All the obtained data were analysed statistically using a Completely Randomized Design with 2 treatment factors drying methods (use of solar dryer and oven) and pretreatments before drying process (whole chilli, cutted half and sliced) with 3 (three) replications, the significant difference identified using analysis of variance ANOVA with 5% Duncan’s Multiple Range Test using the statistical software SPSS.

3. Results and discussions

3.1. Effect of drying on proximate analysis and colour values
The results of effect of drying methods on Vitamin C content is shown in Table 2. Highest vitamin C content of dried red chilli using solar dryer were 24.04 and 24.07 mg/100g in cutted half and sliced treatment.

It was found that the effect of the drying methods were significantly affected the value of vitamin C content. This was due to a heat and mass transfer phenomenon which involves the migration of water from the interior of the red chilli to be dried on to the surface for its evaporation. Low operating temperature using a solar dryer compared with using gas oven with higher temperature can preserve the most nutrients [10]. Besides of temperature and drying time, pretreatment with cutted half condition of red chilli cause more loss in Vitamin C.

Table 2 showed, moisture content of CHS and SS were 9.35% and 9.45%, respectively. These moisture contents higher than CHO and SO but still in the standard quality of dried chilli, below 11% according to Indonesian National Standard, SNI 01-3389-1994 [11]. Moisture content has important impact to physic quality of dried chilli because when moisture content was higher than 11% can make mould grow easily [12]. Pretreatment of slicing or cutting red chilli before dried will expand the
surface of the material and its broad surface can provide more mass transfer of moisture from the surface to the surrounding air and the drying time became shorter than whole chilli.

Table 2. Vitamin C, moisture and ash content of dried chilli powder

| Sample  | Vitamin C (mg/100g) | Moisture Content (%) | Ash (g/100g) | Drying Time (h) |
|---------|----------------------|----------------------|--------------|-----------------|
| Fresh Chilli | 84.09 ± 1.06 d | 76.53 ± 0.48 c | 1.39 ± 0.10 a | - |
| WS | 23.83 ± 0.29 c | 9.38 ± 0.18 b | 4.59 ± 0.21 bc | 30 |
| CHS | 24.04 ± 0.13 e | 9.35 ± 0.15 b | 5.58 ± 0.24 d | 28 |
| SS | 24.07 ± 0.07 e | 9.45 ± 0.18 b | 4.47 ± 0.25 b | 28 |
| WO | 13.58 ± 0.32 ab | 6.89 ± 0.59 a | 4.59 ± 0.16 bc | 16 |
| CHO | 12.61 ± 0.57 a | 6.59 ± 0.33 a | 4.72 ± 0.18 bc | 10 |
| SO | 13.75 ± 0.53 b | 6.82 ± 0.49 a | 4.93 ± 0.14 c | 10 |

Means (± SD) values with different superscript in a column are significantly different (p<0.05). WS: Whole chilli solar; WO: Whole Chilli Oven; CHS: cutted half solar; SS: sliced solar; CHO: cutted half oven; SO: sliced oven.

The effect of drying methods on the colour value is shown in Table 3. It shown that the L* values of all dried chilli ranged from 22.91 to 28.61. The a* values ranged from 4.12 to 19.82 and the b* values ranged from 0.70 to 7.58. The lightness values of dried chilli using solar drying (CHS and SS) higher than using gas oven method (CHO and SO). The effect of drying on the colour of dried chilli has also been used to predict the destruction of pigments Carotenoid (yellow, orange and red) [13]. The values of a* decreased at different method of pretreatments. The value results of a* and b* showed that drying using gas oven is less red and less yellow in colour than using solar dryer. On the L* plane between WS and WO, the measurement difference L*=+4.3 shows that the dried chilli WS is lighter than WO. Pretreatment cutted half also shows lighter than whole chilli and sliced chilli.

Table 3. The colour value (L*, a* and b*) of dried chilli powder compare to fresh chilli

| Sample  | L*       | a*       | b*       |
|---------|----------|----------|----------|
| WS      | 25.38 ± 1.60 bc | 17.53 ± 0.38 b | 7.49 ± 0.30 c |
| CHS     | 28.61 ± 1.31 de | 19.31 ± 0.39 c | 7.29 ± 0.46 c |
| SS      | 27.15 ± 0.90 cd | 19.82 ± 0.24 d | 7.58 ± 0.38 c |
| WO      | 21.08 ± 0.45 a | 4.68 ± 0.29 a | 0.70 ± 0.52 a |
| CHO     | 28.43 ± 2.31 cde | 4.51 ± 0.47 a | 1.41 ± 0.34 b |
| SO      | 22.91 ± 2.96 ab | 4.12 ± 1.10 a | 1.53 ± 0.11 b |
| Fresh Chilli | 31.06 ± 0.37 e | 29.15 ± 0.04 e | 8.38 ± 0.07 d |

Means (± SD) values with different superscript in a column are significantly different (p<0.05). WS: Whole chilli solar; WO: Whole Chilli Oven; CHS: cutted half solar; SS: sliced solar; CHO: cutted half oven; SO: sliced oven.

3.2. Consumer sensory evaluation of abon cabe using best dried chilli powder

Then CHS was chosen as the best dried chilli and proceed becomes abon cabe. From the results of consumer sensory evaluation showed that for texture no significant difference between the different abon cabe. However, significant differences were shown in colour, aroma, taste and overall acceptability between samples.
Table 4. Consumer sensory evaluation of abon cabe

| Sensory attribute | ACD       | ACT       | ACTE      |
|-------------------|-----------|-----------|-----------|
| Colour            | 2.5 ± 0.85 b | 3.9 ± 1.37 a | 2.5 ± 0.84 b |
| Aroma             | 2.7 ± 1.25 b | 3.7 ± 0.82 a | 3.1 ± 1.28 a |
| Texture           | 2.3 ± 0.82 a | 3.5 ± 0.84 a | 2.5 ± 0.97 b |
| Taste             | 2.6 ± 1.26 b | 3.9 ± 1.37 a | 2.5 ± 1.08 b |
| Overall acceptability | 3.5 ± 1.64 a | 4.0 ± 1.05 a | 2.8 ± 1.13 b |

ACD = abon cabe using dried shrimp; ACT = abon cabe using teri; ACTE = abon cabe using terasi. Means (± SD) values with same superscript in a row are not significantly different (p > 0.05)

4. Conclusions

The pretreatment of slicing or cutting red chilli before dried resulted dried chilli powder moisture content below 11%. The solar dryer was found can gave better colour values and higher vitamin C of dried chilli powder than that sample using gas oven. Consumer sensory evaluation of abon cabe using the best quality of dried chilli added with roasted teri showed the highest score for overall acceptability.

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