International Journal of Engineering Research
Volume No.5, Issue No.2, pp : 98- 101

ISSN:2319-6890)(online),2347-5013(print)
1 Feb. 2016

The Effect of Ginger Species and Concentration of Sodium Metabisulfite ($Na_2S_2O_5$) on the Physical and Chemical Quality of Ginger Powder (*Zingiber officenale*)

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Abstract: ***Indonesia society has generally known and used ginger (Zingiber officenale) in daily life for various purposes, such as a mixture of food ingredients, beverages, cosmetics, perfumes and others. The objective of this research is to determine the effect of ginger species and concentration of sodium metabisulfite ($Na_2S_2O_5$) on the physical and chemical quality of ginger powder (yield, moisture content, rehydration properties, colour space (L, a*, b*), sulfite residues and total phenolic content). The best treatment is obtained from big white ginger with sodium metabisulfite concentration 3000 ppm with value for each parameter is: yield 23.22 %; moisture content 0.08 %; rehydration properties 750.00 %; lightness (L) 64.66; redness (a*) 20.43; yellowness (b*) 30.66; sulfite residues 112.31 ppm and total phenolic content 464 ppm.***

Keywords: ginger species, sodium metabisulfite, ginger powder, physical and chemical quality

I. Introduction

Ginger (*Zingiber officenale*) is a perennial rhizomatous herb of the family Zingiberaceae which has a spicy taste. Purseglove (1972); Kress (1990); and de Padua *et al*. (1999) reported that the Zingiberaceaeconsist of approximately 47 genera and 1400 species, they are found in all tropical regions and mostly concentrated in Southeast Asia. Ginger rhizome produced from underground stem of the plant (Purseglove, 1981).

In Indonesia, ginger has generally known and used in daily life for various purposes, such as a mixture of food ingredients, beverages, and others. Based on phenotyphic characters, ginger is divided into three types of ginger in Indonesia, i.e. *Z. Officinale* var. *officinale* (big white ginger or giant ginger, known as *jahe badak* or *jahe gajah*), *Z. officinale* var. *amarum* (small white ginger, know as *jahe emprit*), and *Z. officinale* var. *rubrum* (small red ginger, known as *jahe merah* or *jahe berem*) (Ochse, 1931; Burkill, 1935; Heyne, 1950).

Rostiana *et al* (1990) reported that the big white ginger has big rhizome size, less pungent and less fibrous, it is used only for food and beverage purpose. Small white ginger has smaller rhizome size, fibrous and pungent, while small red ginger has small rhizome size with red skin color, more pungent and more fibrous, and has darker green leaves compared with two others. Small white ginger and red ginger are generally used for medicinal purposes and cooking spices. Ginger requires warm, humid climate, and hilly region for better growth. Ginger has the aroma that it is pleasant and spicy. Its penetrating flavor makes ginger indispensable in the manufacture of a number of food products like ginger bread, curry powders, table sauces, in pickling and the manufacture of certain soft drinks like ginger cocktail, carbonated drinks, etc. Ginger is also used for the manufacture of ginger oil, oleoresin, essences, tinctures, etc (Pruthi, 2006). Setyawan (2002) reported that the essential oil content of the big white ginger is the lowest compared with the other varieties.

Fresh ginger rhizome is perishable after harvested, so that it is quite common to find dried sliced ginger rhizome or in its powdered form. The major components in the original aroma of fresh ginger, gerental (24.20%) and zingerone (14.20%) will be decreased during processing Indian fresh ginger (Menon *et al.*, 2007). The effect of drying ginger rhizome on its (6)-gingerol content decreases when the drying time increased (Puengphian and Sirichote, 2007). Barley and Jacobs (2000) reported that the drying process also decreased the amount of the gingerol content of fresh ginger, but it increased terpene hydrocarbon content and conversion of some monoterpene alcohols to their correponding acetates. Ginger components and the antioxidant activity of powdered form are stable after heat treatment at 120º C (Vankar *et al*., 2006). The addition of sodium metabisulfite ($Na_2S_2O_5$) in drying process of organic materials, sulfite will be oxidized to sulfate, thereby reducing the oxidation process in the other compound (Susanto and Saneto, 1994).

Considering the above facts the present investigation, the objective of this research is to determine the effect of ginger species and concentration of sodium metabisulfite ($Na_2S_2O_5$) on the physical and chemical quality of ginger powder (yield, moisture content, rehydration properties, colour space (L, a*, b*), sulfite residues and total phenolic content).

II. Materials and Methods

The 3 species of fresh gingers (big white ginger, small white ginger, and small red ginger) were collected from the local market in Malang, East Java, Indonesia. The gingers were washed with clean water to remove dirt and other field-damaged portion. The clean and fresh gingers were sliced up to 2 mm to 3 mm with knife. The slices were

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soaked in sodium metabisulfite solution with concentration of 0 ppm, 1500 ppm, and 3000 ppm for 20 minutes. The slices were dried in cabinet drying at 60 °C for 19 hrs up to moisture content 8-13%.

After cooling at room temperature, the dried ginger slices were grounded into powder in a blender separately. Then the ginger powder were sifted using 60 mesh sifter. The ginger powder were analyzed for their yield (Rangana, 1987), moisture content (Sudarmadji, 1997), rehydration properties (Beuchat, 1977), sulfite residues (AOAC, 1970), total phenolic content (Tang *et al.*, 2002), and colour space (L, a*, b*) where L*, a* and b* represent lightness, redness and yellowness, respectively (Yuwono and Susanto, 1998).

The experiment was designed as a factorial (3x3) in completely randomized block design. All data were analyzed by using repeated measurement of the Analysis of Variance (ANOVA) procedure. Means were separated by Duncan's New Multiple Range Tests (DMRT). The best treatment was selected by Multiple Attribute Method.

III. Results and discussion

Figure 1 shows the relationship between concentration of sodium metabisulfite and yield (%) of ginger powder. The yield of ginger powder is not affected by different concentrations of sodium metabisulfite ($p<0.05$), but it is affected by the 3 species of fresh gingers (big white ginger, small white ginger, and small red ginger) ($p>0.05$). The results showed that the addition of concentration of sodium metabisulfite of 3000 ppm for big white ginger, small white ginger, and small red ginger preserved yield of ginger powder of 23.22 %, 19.89 % and 17. 93 %, respectively.

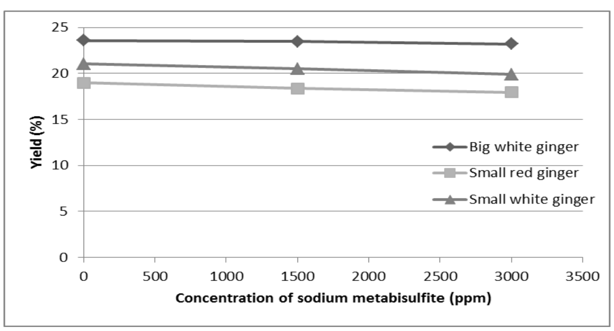

Figure 1. Yield of ginger powder

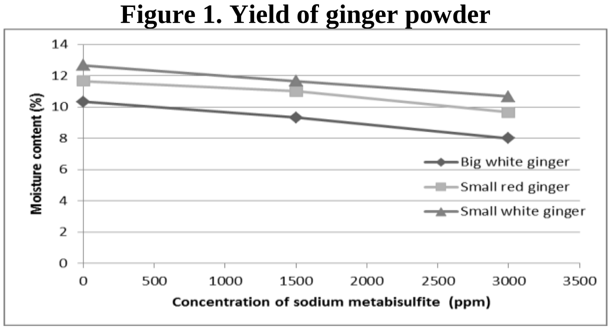

Figure 2. Moisture content of ginger powder

The relationship between concentration of sodium metabisulfite and moisture content (%) of ginger powder is showed in Figure 2. The moisture content of ginger powder is not affected by different concentrations of sodium metabisulfite ($p<0.05$), but it is affected by the 3 species of fresh gingers (big white ginger, small white ginger, and small red ginger) ($p>0.05$).

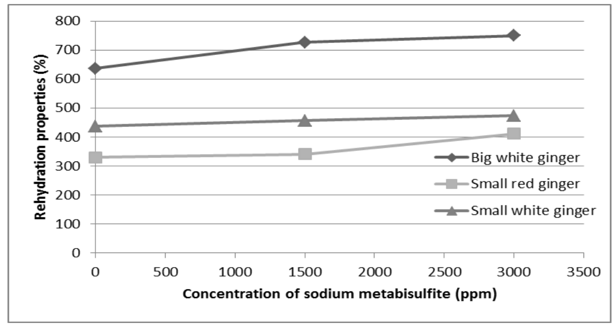

Figure 3. Rehydration propeties of ginger powder

Rehydration properties increased by increasing concentration of sodium metabisulfite up to 750.00%, 411.67%, and 473.33% for big white ginger, small white ginger, and small red ginger, respectively (Figure 3). The rehydration properties of ginger powder is not affected by different concentrations of sodium metabisulfite ($p<0.05$).

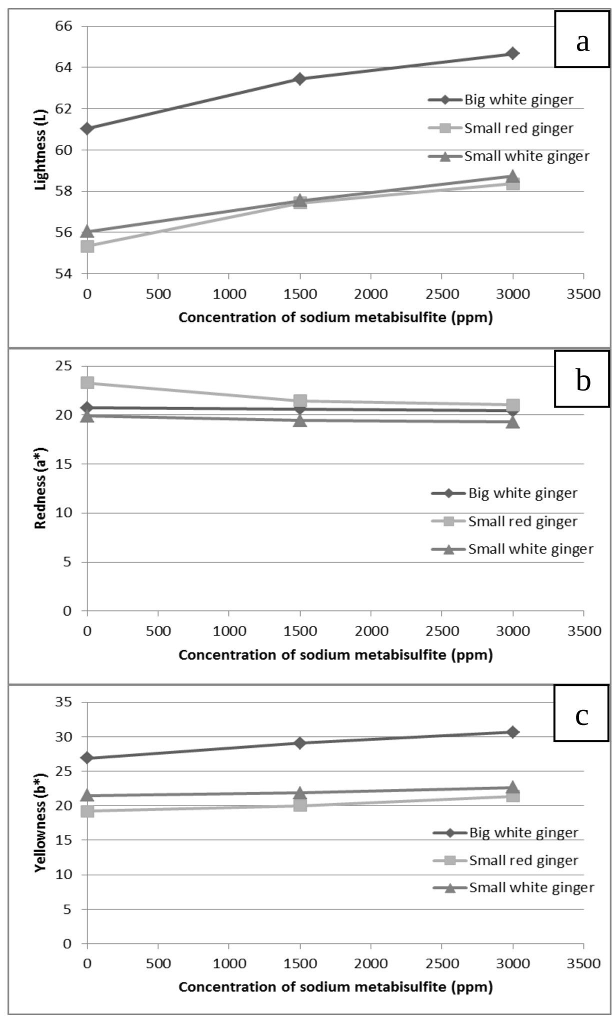

Figure 4. Colour space of ginger powder: (a) lightness; (b) redness; and (c) yellowness

ISSN:2319-6890)(online),2347-5013(print)
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The relationship between concentration of sodium metabisulfite and colour space (L, a*, b*) of ginger powder is showed in Figure 4. Colour space was represented by L, a* and b* where L values range from black (0) to white (100). As concentration of sodium metabisulfite was increased, the L value and yellowness of ginger powder also increased, but the redness of ginger powder decreased (Figure 4). The colour of dried product is affected by higher drying air temperature due to a non-enzymatic browning reaction (Phoungchandang, 2008). Sodium metabisulfite was able to increase lightness of the ginger powder products. The best colour value of ginger powder was found at big white ginger and 3000 ppm of sodium metabisulfite concentration.

Figure 5 shows the relationship between concentration of sodium metabisulfite and sulfite residues (ppm) of ginger powder. Sulfite residues increased by increasing concentration of sodium metabisulfite up to 112.31 ppm, 96.04 ppm, and 94.79 ppm for big white ginger, small white ginger, and small red ginger, respectively. This is probably due to size of gingers rhizome. Big white ginger has bigger rhizome size than small white ginger and small red ginger (Rostiana *et al.*, 1990).

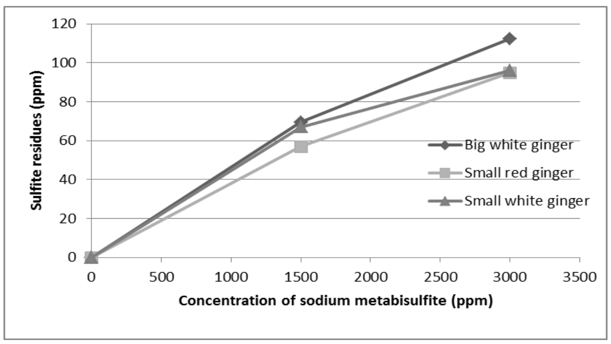

Figure 5. Sulfite residues of ginger powder

Total phenolic content increased by increasing concentration of sodium metabisulfite (Figure 6). SO_2 will denature the protein in the enzyme phenolase. Disulfide (S-S) bonds in protein enzymes will be reduced by SO_2. The reduction of disulfide bonds affects the enzyme that it is not active anymore (Susanto and Saneto, 1994).

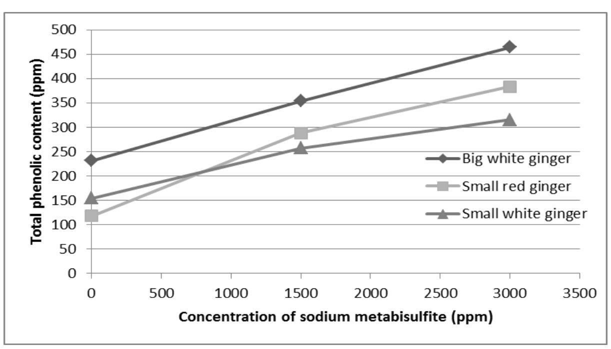

Figure 6. Total phenolic content of ginger powder

The best treatment was selected by Multiple Attribute Method (Zeleny, 1982) which was covered by the physical and chemical parameters. The best parameter is the treatment with minimum density distance values in L1 and L2, but maximum density distance values in L∞ (Table 1).

Tabel 1. Selection of the best treatment

Ginger species	Sodium metabisulfite (ppm)	(L1)	(L2)	(L∞)
Big white ginger	0	0,27	0,0023	0,125
	1500	0,20	0,0011	0,125
	3000	**0,14***	**0,0003***	**0,125***
Small red ginger	0	0,42	0,0051	0,125
	1500	0,37	0,0044	0,125
	3000	0,31	0,0032	0,125
Small white ginger	0	0,39	0,0048	0,125
	1500	0,35	0,0041	0,125
	3000	0,32	0,0033	0,125

*best treatment

The best treatment is obtained from big white ginger with sodium metabisulfite concentration 3000 ppm with value for each parameter is: yield 23.22 %; moisture content 0.08 %; rehydration properties 750.00 %; lightness (L) 64.66; redness (a*) 20.43; yellowness (b*) 30.66; sulfite residues 112.31 ppm and total phenolic content 464.00 ppm.

IV. Conclusion

The research concluded that physical and chemical qualities of ginger powder could be affectd by ginger species and concentration of sodium metabisulfite ($Na_2S_2O_5$). The physical and chemical qualities from ginger species were significantly different compared to the yield, moisture content, rehydration properties, colour space (L, a*, b*), sulfite residues and total phenolic content. The concentrations of sodium metabisulfite ($Na_2S_2O_5$) were significantly different compared to colour space (L), sulfite residues and total phenolic content. There was no interaction between ginger species and concentration of sodium metabisulfite ($Na_2S_2O_5$) of ginger powder for all analysis.

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