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EFFECT OF SOLAR TUNNEL DRYING AND CHEMICAL BLANCHING SOLUTIONS ON THE PHYSICOCHEMICAL QUALITY OF STEVIA (STEVIA REBAUDIANA) LEAVES AND ITS APPLICATION IN GREEN TEA – STEVIA DRINKTITLE

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ABSTRACT

Nowadays, consumers are very concerned about the health benefits of food products besides its taste and appearance. Tea is one of the most favorite drinks in the world, including in Indonesia. Normally, all people tend to add sugar in tea which certainly causes many negative health effects, such as obesity and diabetes. Of all the existing types of tea, green tea is the best kind of tea due its high antioxidant activity. Instead of sugar, Stevia rebaudiana has many benefits. The dried stevia leaf is 10-15 times sweeter than sucrose, does not produce calories, and etc. The purpose of the research is to optimize the drying process of stevia fresh leaves using Solar Tunnel Dryer, select the best chemical blanching solution and analyze the quality of stevia dried leaves and its acceptability in green tea - stevia infusion. Blanching process as a pre-treatment prior to the drying process turned out to have a significant effect. Sodium bicarbonate and calcium chloride were used as chemical blanching with three different concentrations: 0.1%, 0.5% and 1%. It was found out that calcium chloride 1% treatment as the best treatment hence it could preserve the quality of Stevia rebaudiana leaves in terms of its antioxidant activity, sweetness level as well as color. For sensory analysis, dried stevia leaves 0.4% added to the green tea was the most preferrable samples for the panelists. Although Stevia rebaudiana has some shortage in sensory, it still showed a great potential to replace sucrose in our daily life consumption.

Keywords:*Health Benefits, Green Tea, Stevia rebaudiana, Pre-treatment, Drying*

INTRODUCTION

Today, health is becoming a main concern for people around the world. There were a significant increasing number of people suffering from obesity and diabetes worldwide (WHO, 2012). *Stevia rebaudiana* is one natural plant-derived sweetener that can answer this problem. Steviol glycosides were extracted from *Stevia rebaudiana*leaves to act as natural sweetener. It has many benefits compared to sugar, which are 250 times sweeter than sucrose, contains zero calories, can decrease blood sugar, etc. The idea of this project is to combine green tea with dried stevia leaves in a tea bag product so that it makes consumers easier to serve

and also healthy to consume. Moreover, steviol glycosides is approved as GRAS or Generally Recognized as Safe with Codex Alimentarius number E-960 as food additive (EC, 2011).

MATERIALS AND METHODS

Materials

Fresh stevia leaves (CV Satu Kaya Communiti, Solo) and green tea commercial (Djenggot brand) as the main materials. For blanching process, Sodium bicarbonate and Calcium chloride with three different concentrations (0.1%, 0.5% and 1%) were used prior to the drying process in order to preserve the quality of stevia leaves. The drying process use Solar Tunnel Dryer. As for analysis, DPPH (2,2-Diphenyl-1-Picrylhydrazyl), phenol, methanol were used as solutions while spectrophotometer, chromameter and electronic scale were used as instruments. For serving, materials like tea bag, hot mineral water (80^0C), thermometer, glass, disposable cups, dropper, electronic scale were used to complement all the process.

Methods

Optimization Blanching process of Stevia Leaves

Calcium Chloride and Sodium Bicarbonate with three different concentrations: 0.1%, 0.5% and 1% were used for blanching at 98oC for 10 seconds. Then the leaves were dried until its moisture content <10%. The dried stevia leaves were analysed its moisture content, color, antioxidant activity, sweetness intensity and sensory analysis.

Sensory Analysis of Green Tea – Stevia Production

The dried leaves from the best treatments then reduced in size using food processor until become powder in size. For the dried stevia concentration, it was divided into three concentrations: 0.2%, 0.4% and 0.6%. For sucrose, the concentration was 6%, as the Indonesia National Standard, SNI 3143:2011 (Minuman Teh dalam Kemasan). In order to know the best composition of stevia leaves and the green tea, there were 4 treatments samples presented to the 9 trained panelists. Each of the treatments have been mixed with green tea commercial and dissolved in 250 ml mineral water 80^0C. The trained panelists were asked their hedonic ranking test about the overall liking preference and also rating intensity test of astringency, sweetness intensity, aroma and color from each sample in a 7 points line scale questionnaire which consisted of anchor points that have been discussed and approved before in the Focus Group Discussion.

RESULTS AND DISCUSSION

Moisture Content

The final moisture content produced was in the range of 4.16- 7.54%. This moisture contents have qualified the moisture content target which is 10% (Velic, 2 007). The temperature ranges from 55°C to 65°C with 55-77% Relative Humidity. Eac h samples showed the same trends which its moisture content were reduced every 10 minutes of analysis. Solar Tunnel Dryer is safe from exposure of the foodstuff to rain and dust, infestation by insects, attack by animals and also beneficial in terms of economical (Bolaji & Olalusi, 2008).

Color

In this research, it was foun d out that blanching process as a pre-treatment prior to the drying process had a great effect on changes of the color during the drying process. Calcium chloride treat ments were the better treatment as it can preserve the color quality of stevia leaves in terms of its lightness, a* and b*. Calcium blocks the amino group, whereby the latter is restrained from entering into the browning reaction. It is also capable of forming chelating compounds with organic substances having an alpha amino carboxylic acid structure (Davoodia et al., 2007). Post harvests dips in calcium chloride solutions are also combined with heat treatment to produce a great effect. Heat allows the formation of COO- groups from vegetables with which Ca2+ ions can form salt-bridge cross-links (Stanley e t al, 1995). This makes the cell wall less acc essible to the enzymes that cause softening.

Antioxidant Activity

Stevia leaves has high antioxidant activity (Singh et al., 2012). It was foun d that drying process decreased the stevia' s antioxidant activity. Control samples got the lowest antioxidant activity, while treat ment samples were found that it could preserve the antioxidant activity of the stevia leaves. The antioxidant activities were varying from 84% until 88% with Calcium Chloride 1% treatment got the highest antioxidant activity, which it is not significantly diff erent with the fresh samples. With all of this benefit of calcium, it can stabilize or strengthening the stevia leaf's cell walls hence it can preserve polyphenols contained in the stevia leaves.

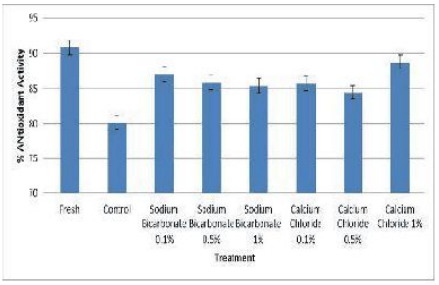

Figure 1. Antioxidant Activity o f Stevia Leaves on Each Treatments

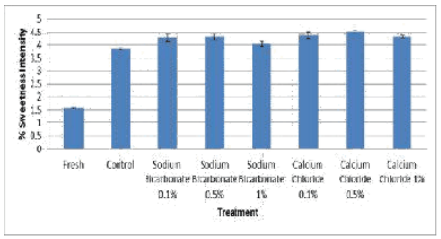

Figure 2. Sweetness Intensity of Stevia Leaves on Each Treatments

Sweetness Intensity

All the dried samples showed a greater level of sweetness intensity because the drying process will improve the to tal solids contained in the leaves hence the water was evaporated through the drying process. All the calcium chloride treatments showed a better sweetness intensity comparing to the sodium bicarbonate treatments. It showed that pH had an effect on the sweetness intensity of the stevia leaves. This results was agreed with Chang and Cook (1983) and the 63rd JECFA (Joint Expert Co mmittee for Food Additives) for the informa tion on the hydrolytic stability of steviol gl ycosides in foods. The committee received results of thermal and hydrolytic stability studies for the specified material at 100oC decomposition. The decompositio n was 4% at pH 6.0, but increased to about 16% at pH 8.0. Similar results were ob tained by Buckenhuskers and Omran (1997) who showed that stevia sweeteners in aqueous solutions are stable in acidic and neutral conditions but not in alkaline condition.

Sensory Analysis

It was found out that higher co ncentration of stevia would effected the sens ory intensity attributes which give a higher intensity of sensory. This trend is affecte d because of stevioside component, which is the major component from Stevia rebaudiana (Melis, 1992). These results agr eed with Arab et al. (2010) and Yoshikawa et al. (1979) who found that stevioside had slight bitterness, some astringency aftertaste. S oejarto et al. (1983) also reported that volatile aromatic or essential oils, tannins and flavonoids, contribute to the unpleasa nt flavours associated with Stevia. The re sults can be seen in Table 1 below.

Table 1. Results of Sensory Analysis

Treatments	Hedonic Ranking	Intensity Rating Test				
	Overall Liking	Sweetness	Color	Aroma	Bitter Aftertaste	Astringent Aftertaste
Sucrose 6%	2.56 ± 0.88^{bc}	3.22 ± 1.20^{ab}	1.33 ± 0.71^{a}	2.67 ± 1.00^{a}	2.56 ± 0.73^{a}	3.00 ± 1.32^{a}
Stevia 0.2%	1.67 ± 0.71^{ab}	2.67 ± 0.87^{a}	2.56 ± 0.88^{b}	3.11 ± 0.78^{a}	4.00 ± 1.00^{b}	4.00 ± 1.73^{ab}
Stevia 0.4%	3.56 ± 0.73^{c}	3.89 ± 0.93^{b}	4.00 ± 0.87^{c}	4.56 ± 1.33^{b}	4.56 ± 0.88^{b}	4.33 ± 1.32^{bc}
Stevia 0.6%	2.22 ± 1.30^{b}	5.22 ± 1.09^{c}	5.56 ± 0.88^{d}	5.22 ± 1.92^{b}	4.89 ± 1.83^{b}	5.44 ± 1.88^{c}

Notes:
All values are *estimate* ± *standard deviation*
Value with different superscript show significant differences with Friedman test and LSD test in the confidence level of $\alpha = 0.05$
This Sensory Analysis was done by 9 selected Trained Panelists

Figure 3. Main Sensory Analysis Set of Sample

CONCLUSIONS

- The drying process using Solar Tunnel Dryer was done in the temperature range of 55-65^{o}C with 55-77% relative humidity and achieve the target moisture content(<10%) in 120 minutes for the control sample and 140 minutes for all the treatment samples.

- Blanching process as pre-treatment prior to the drying process can preserve the benefits and quality from Stevia rebaudiana leaves.

- Calcium chloride treatment was found better to maintain stevia leaves quality in terms of its antioxidant activity, sweetness intensity andcolor, with calcium chloride 1% was the best chemical blanching solution.

- The increasing concentration level of calcium chloride produced a brighter color of stevia leaves, while the increasing concentration level of sodium bicarbonate resulted in a darker appearance of stevia leaves.

- The increasing concentration of dried stevia leaves added to green tea would give a higher intensity of sensory in terms of sweetness, color, aroma, bitter aftertaste and astringent

aftertaste, with calcium chloride 0.4% was the most preferable for the panelists.

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