The Effects of Drying Methods on Some Characteristic of West Sumatran Cocoa Beans Quality

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Abstract

Cocoa samples from hybrid *criollo* and *forastero* cocoa on Inang Sari Estate in West Sumatra was dried with three methods using sun dryer until the moisture content reach at 7%; mechanic (tunnel dryer), and the combination of both of sun dryer until the moisture content reach at 20% and tunnel dryer at 60℃ which was continuously treated for 18 hours. The observations have been carried out to evaluate the effect variations in pH, total amino acid, total reduction of sugar content and characteristic flavor of Indonesian cocoa beans treated in comparison with those of Ghanaian beans. The result showed that the cotyledon from treated beans has reached the highest level of pH, total amino acid content, total reduction of sugar content, flavor characteristics in the use of the combination with drying methods of sun dryer and tunnel dryer.

Keywords: Hybrid Criollo and forastero cocoa, cocoa drying methods, food.

Introduction

The color and flavor of cocoa have been associated with the Polyphenol contents of the beans. Polyphenol compounds are believed to be located in storage cells that contain no enzymes. Before change of any enzymatic can take place, these compounds must diffuse to the site of enzyme action. This can only occur after cell membranes lose to their semi permeability on the death of seed (Quesnel. 1965; Knapp, 1937; Roe lofsen, 1958; Brown, 1957; Mayuni, 2002). The early death of the seed is, therefore, crucial.

Roelofsen and Gies Berger (1947) reported that acetic acid is the primary cause of bean death while temperature and alcohol are contributory causes. The seed are fermented leading to many chemical changes in both the pulp surrounding to the seeds and within the seeds themselves. These changes will cause the developing of the chocolate flavor and the changing of seeds to its color (B. S. Mayuni, 2002).

The seeds were then dried and dispatched to processor as the raw material for the production of cocoa mass, cocoa powder and cocoa butter. The first stage of processing includes to the roasting of

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Table 1. The analysis of chemical composition of beans after fermentation and drying.

Composition	Nib % maximum	Shell % maximum
Water	3.2	6.6
Fat (coco butter, shell fat)	57	5.9
Ash	4.2	20.7
Total Nitrogen	2.5	3.2
Theo bromine	1.3	0.9
Caffeine	0.7	0.3
Starch	9	5.2
Crude fiber	3.2	19.2

Source: International cocoa organization, 1998.

beans to change the color and flavor as well as shell removal. After roasting, dishelming and alkalizing, process can take place to alter flavor (International cocoa organization, 1998; B. S. Mayuni, 2002).

After fermentation and drying, one analysis of chemical composition of beans can be seen in Table 1. The Table 1 gives us an indication of chemical composition of cocoa beans but it should not be forgotten that this will vary depending on the type of beans, the quality of the fermentation and drying, as well as the subsequent of processing the beans.

This paper illustrates the effects of methods for drying on the dried cocoa beans. The characteristics of flavor of West Sumatran cocoa beans treated with tunnel dryer were compared with those of Ghanaian beans. Drying process should cause a continuous chemical changes within the seeds (B. S. Mayuni, 2002; Sarmidi, 1997).

Materials and Methods

Ripe beans of hybrid criollo cocoa with porastero cocoa on Inang Sari Estate in West Sumatra were fermented in Sime Cadbury fermentation wooden box (1,5 m x 0,9 m x 0,42 m) with round holes 0,5 cm in diameter, 15 cm apart on all sides for aeration purposes instead of the traditional shallow fermentation box. Beans were left to be fermented for 6 days. The beans were dried by three drying methods: (1) sun drying method, (2) mechanic drying method (using tunnel dryer) and (3) combined drying method combining sun drying method until the moisture content tested at 20 % and mechanic drying method (using tunnel dryer) at 60℃ (for 35 hours) until moisture content reach at 7 % measured using Labinco moisture balance (Model 680, Breda the Netherlands).

Ten grams of each beans (in duplicates) was crushed mechanically using RX-100 National Blender (Matsushita Electric Industrial co. Ltd. Osaka, Japan) for 3 minutes in 100 ml distilled water. The crushed beans were filtered through muslin cloth and the pH measured using a pH meter (Hanna instrument, model H 18417, Limena, Italy). The suspension obtained from the crushed beans was centrifuged at 12,000 g for 30 min at 4℃ (Beckman centrifuge, Model JA-24, USA). The supernatant was collected for determination of pH, glucose and organic acid (Acetic-acid). Glucose was determined by

the total carbohydrate assays method (Dubions, Gilles, Hamilton, Rebers and Smith, 1956).

For determination of acetic acid, three microliters of samples was subjected to gas chromatography (GC) flitted with a flame ionization detector (Pye Unicame, 204 series chromatograph, U.S.A). The GC column (25 cm x 4.6 mm) used was Porapak Q (80–100 mesh); oven temperature was programmed isothermally at 220℃. The GC gas carrier nitrogen was maintained at a constant flow rate of 40 ml min^{-1}.

Non-volatile acids were determined by HPLC (Shimadzu LC-6 A, Chromatopac, Japan) flitted with a variable wave length UV detector and infector (column: Hibar RP-18, 25 cm x 4.6 mm; mobile phase; water + H_2SO_4: 0.008 N, pH 2.8; flow rate: 0.8 ml min^{-1}; programmed detector 230 nm, oven temperature 40℃, gas carrier: compressed air 0.5 lb sq in^{-1}). Volatile and non- volatile organic acids were determined from the peak areas by referring to a standard curve prepared with known amounts of pure acids of analytical reagent grade. All determinations for pH, glucose and organic acid were duplicated and results were estimated by averages.

Sensory evaluations were conducted in accordance with the procedures established by the MARDI cocoa and Coconut Research Division, (Said, Meyer and Biehl, 1988). Each of liquor was presented warm in sets of 3 samples per session, with 2 evaluations for each of liquor. They were evaluated against one another in a rotary fashion, using a Latinos Square Design for sample lay out. Ghanaian dry beans were used as the comparison.

Results and Discussion

1. pH changes

The pH profiles in the cotyledons using the techniques were similar. However, the pH of the treated beans was significantly higher than that of the control beans (sun dryer). The difference was more pronounced in cotyledon treated until moisture content at 7 % (with combination of dryers). The pH of mechanic treated cotyledon (tunnel dryer) was at 5.46, combination of dryers at 5.68 and sun dryer (control beans) at 5.18, respectively (Figure 1).

Figure 1 shows that pH increase from 5.18 to 5.68. The higher level of pH was found in beans dried using the combined of drying method compared to those of the use of tunnel dryer and sun dryer only. The level of beans' pH dried with sun dryer was the lowest because the alcohol oxidation was found more active at sun drying method rather than the other two methods. The drying process with higher temperature will delay the reaction of alcohol in forming the acetic acid, because of the increase of pH (up to 60℃). Other researcher had found that at the temperature of higher than 60℃, when the pH level was gone down (Siregar, 1998).

2. Total Amino Acid

Acetic acid production during microbial pulp fermentation was essential for the beans death (Roelofsen, 1958). Amino acid in combination of dryers gradually increased to 13.38, in the case of

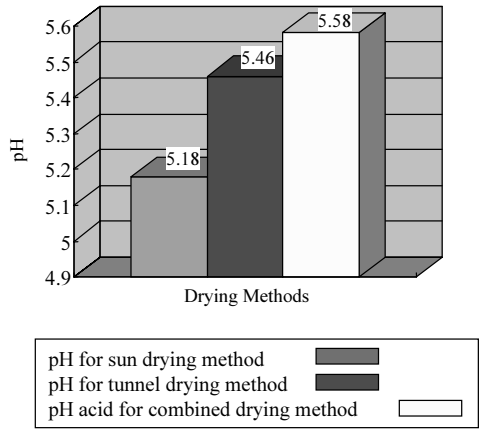

Fig. 1. The results of cocoa beans pH measurement on different drying methods.

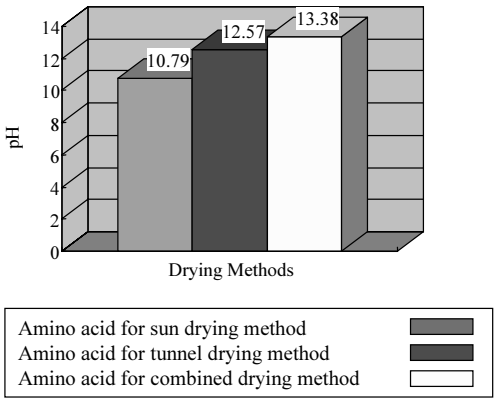

Fig. 2. Total of Amino Acid of cocoa beans using different drying methods.

tunnel dryer to 12.57 and for sun dryer (control beans) to 10.79 (see Figure 2), respectively.

Figure 2 revealed that the total amino acid of beans dried by using the combined drying methods were higher than that of the single method (tunnel and sun dryer). It is caused by the dissociation of protein to amino acid perfected by combination of sun dryer and tunnel dryer. Guritno and Harjosuwito presented that the increase of amino acid in the higher temperature is caused by the perfection of protein in cotyledon into amino acid.

3. Total Reduction of Sugar

Reduction of sugar was caused by the perfection of the sucrose to the glucose in cotyledon (Roclofsen, 1958). Total highest reduction of sugar was found in the combined drying method (Figure 3).

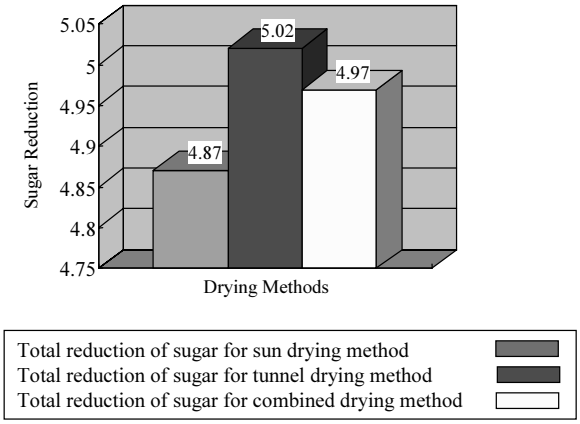

Fig. 3. Total reduction of sugar of cocoa beans in variation of drying methods.

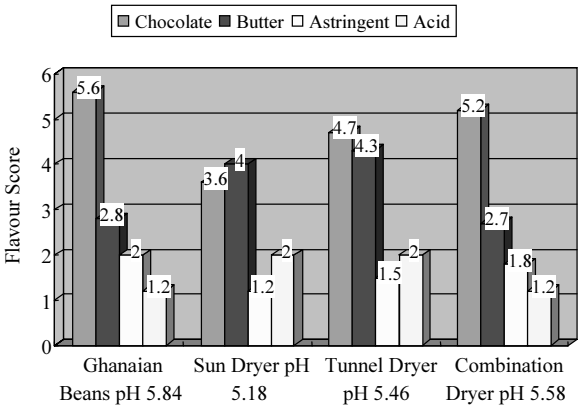

Fig. 4. The comparison of flavor score of chocolate, butter, astringent and acid content between Ghanaian Bean and beans resulted from three different drying methods.

4. Flavor and Aroma

According to Biehl et al. (1985), during the fermentation and drying processes, certain chemical compounds were formed. This chemical compounds will in its turn increase the characteristic of flavor and aroma of cocoa when the beans were roasted.

The result of sensory analysis is shown in Figure 4. The flavor assessment indicated that Ghanaian beans (pH 5.84) had a relatively higher chocolate flavor score compared to either sun dried beans (pH 5.18) or tunnel dried beans (pH 5.46), respectively. The chocolate's flavor production was the highest in combined drying method. Lopez and Quesnel (1973) stated that in low concentrations, acids might be regarded as contributing to normal chocolate flavor. However, higher concentrations will cause off-flavors. The data of acid productions in cocoa beans followed by the sensory evaluation

test showed that the combined drying method at 60℃ has reduced the aggravation of acidity levels within West Sumatran cocoa beans thus upgrading dried beans quality.

Conclusion

Characteristic of quality of cocoa beans was influenced by factors of fermentation and drying methods. The combined drying methods of sun dryer with moisture content up to 20 % and tunnel dryer at 60℃ (18 hours) has resulted the highest pH, total amino acid, total reduction sugar, flavor and aroma. The quality of West Sumatran cocoa beans processed well is nearly the same as Ghanaian beans in terms of quality as pH, total amino acid, total reduction of sugar and flavor and aroma.

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