

A Study of Caffeine Level Changes, Fat and Water in Arabica Coffee Due to the Attack of Coffee Borer Pests (*Hyphothenemus Hampei*)

Olyfia Rosalina¹, Muhammad Sayuthi², Rita Hayati²

¹Master Student at Agroecotechnology Department, Agriculture Faculty, Syiah Kuala University, Indonesia

²Agriculture Faculty, Syiah Kuala University, Indonesia

Abstract: Coffee borer beetles (*Hyphothenemus hampei*) generally bore the coffee fruit which its endosperm has already hardened, and then there is a disability at coffee bean causing a damage of chemical quality, while the flavor of coffee is influenced by combination of chemical compound components contained in the coffee bean. This study aims to see the changes in levels of caffeine, fat and water in coffee due to the attack of coffee borer beetle (*H. hampei*). The levels test of caffeine, fat and coffee water were carried out in the laboratory of Baristan Aceh and the farm laboratory of agriculture faculty of Syiah Kuala University. The results of the test show that *H. hampei* pests can cause the increase of caffeine level in the coffee beans up to 1.41%, decrease of fat level in the coffee beans up to 15, 81% and the increase of water level in the coffee bean up to 2.58%.

Keywords: caffeine level, fat level, water level, *Hyphothenemus Hampei*.

I. Introduction

Coffee is one of the leading commodities with high economic value in the world market, the demand keeps increasing from time to time because coffee has unique characteristics such as robusta coffee which has the advantage in terms of shape and arabica coffee is superior in terms of its distinctive taste (Yusianto, 2008). Rahardjo (2012) also explains that coffee is one of the plantation commodities that have high economic value among other plantation crops and play an important role as a source of foreign exchange which is also a source of income for one and more than a half million coffee farmers in Indonesia. In the seventeenth century the spread of coffee crops to Indonesia was brought by the Dutch aristocrats around 1646 who obtained Arabica beans from Arabia but this plant died from floods. In 1699 the new seeds were brought back which then developed around Jakarta and West Java and eventually spread to various parts of the Indonesian archipelago (Gandul, 2010).

In Indonesia, the best coffee producer is found in Aceh Province precisely in Gayo Highlands supported by geographical area which is suitable for coffee plantation. Currently the area of Arabica coffee in this region reaches more than 90,000 ha. Coffee cultivation is generally done by local farmers and is a source of their livelihood (Ramadhan, 2011). *H. hampei* insects come into the coffee fruit by making a hole in the tip of the fruit around the *discus*, causing fruits damaged and fall. The physical damage caused by PBKo pests also affects the taste of coffee. The defects of coffee beans such as holed coffee will cause flaws taste smoky, earthy, musty and chemical (Kirom, 2005). The purpose of this study is to determine the changes in caffeine, fat and water levels in arabica coffee due to the attack of coffee borer beetle (*Hyphothenemus Hampei*). The results obtained are important information for the coffee farmers and entrepreneurs.

II. Research Method

This research was carried out at Farming Laboratory of Agriculture Faculty of Syiah Kuala University and Baristan Aceh Laboratory. The material used in this research is Arabica coffee with two samples, namely the quality of coffee beans I (which is not defective due to *H. hampei* pest) quality II (defect caused *H. hampei* pest attack).

2.1 Caffeine Test

The equipment used: HPLC, analytical scales, agitator, paper filter cone Whatman no 1, water bath; vacuum filter (pore size: 0.45 µm, 13 mm diameter), membrane filter, 100 ml erlenmeyer glass, 100 ml cup glass, 500 ml measuring flask, 250 ml measuring flask, 100 ml measuring flask, 50 ml measuring flask, syringe with filter membrane (pore size: 0.4 µm, 13 mm diameter), reaction tube, 50 µl syringe.

The reactor: Pb acetate, PbO, Aquadest, aquadest filter, standard caffeine (brand), ethanol absolute, methanol (grade gradient for liquid chromatography).

- a. Preparation of aquadest filter: the aquadest filter uses a filter vacuum with filter membrane (pore size: 0.45 μm , 47 mm diameter)
 - b. Preparation of main liquor
 - Weigh carefully the caffeine standard of 0.125 g.
 - Dissolve with absolute ethanol: aquadest filter (1: 4) into a 250 ml measuring flask and put on the line.
 - c. Preparation of standard solution
 - the Pipette of each 2 ml, 5 ml, and 10 ml standard main solution into a 50 ml measuring flask.
 - Then add with aquadest filter until the line marks.
 - d. Preparation of Pb-acetate solution
 - Weigh 115 g of acetate and 60 g PbO.
 - Dissolve with aquadest in a 500 ml measuring flask until all PbO dissolves and creates a cloudy white solution.
 - Apply with aquadest until the line marks.
 - e. Preparation of test solution
 - Weigh + 1 g of coffee powder sample into a 100 ml erlenmeyer.
 - Dissolve with + 40 ml of aquadest, add 1 ml of acetate Pb.
 - Heat in a water bath at 100 ° C for 15 minutes, then cool at room temperature
 - Move into the 100 ml flask with a funnel and rinse the erlenmeyer with aquades at least 3 times, then apply it to the line mark, then filter with filter paper of Whatman No.1 into a 100ml cup glass.
 - 10ml pipette of filtrate into 50 ml measuring flask, add aquades until the line marks.
 - Then filter the filtrate using syringe with membrane filter (pore size: 0.45 μm , 13 mm diameter) into the test tube.
 - f. Preparation of mobile phase
 - Solvent used as mobile phase for checking caffeine content with HPLC tool is 70% aquadest filter and 30% methanol (gradient grade for liquid chromatography).
 - Solvent should be filtered first using a vacuum filter with membrane filter (pore size: 0.45 μm , 47 mm in diameter) before being used for inspection.
 - g. Procedure
- Both standard and test solutions of 10 μl were injected by 50 μl syringe to HPLC device, where the condition of HPLC tool at the time of analysis:
- | | |
|--------------|--|
| Column | : Hypersil ODS C 18.5 UM, 100 x 4.6mm |
| Mobile phase | : Aquadest filter; Methanol (70%: 30%) |
| Flow rate | : 0.75ml / min Temperature: 35 ° C |
| Detector | : VWD with UV 272 nm |

h. Result statement

The caffeine level of the sample was obtained from a comparison of standard chromatography with the sample chromatography obtained.

2.2 Fat Level Test

There are three ways to do this:

The first involves grinding up the food and mixing it with water. Pass the liquid part of the solution through filter paper, squeezing out any 'gunge' - thick bits of the suspension into the same test tube. You should now have a slightly opaque liquid mixture in your test tube. Because fat is less dense than water, if you leave this mixture it will separate out into a layer of fat and a layer of water. The second test is even easier. Rub the food sample on filter paper and then hold the filter paper up to the light. If the paper is translucent (slightly see-through) there was fat present in the food. Don't try this with watery foods - the water will make the paper translucent and you'll get a false positive. The third method involves adding ethanol to a very small amount of the test substance. Shake or crush the food to make it dissolve. Filter or dilute the food and ethanol mix so that you get a clear liquid (a solution of fat in ethanol). Add this to a test tube of water. A white (milk-like) emulsion indicates the presence of fats or oils.

2.3 Water Level Test

One of the factors that affect the drying process is the level water. Drying aims to reduce the water content of the ingredients inhibits the development of decay organisms. Water content of a material affect the amount of water vaporized and the length of the process drying (Taib et al., 1988). The water content of a material is the amount of water content of unity the weight of the material expressed in a wet base basis or in percent dry basis. Wet basin moisture content has theoretical maximum limit of 100%, while the base water content is dry more 100%. Moisture base water content (Mwb) is the ratio between weight water present in the material with the total weight of the material. The structure of materials in general can be based on moisture

content usually indicated in the percentage of water content of wet or base basis dry. Moisture base water content (Mwb) is widely used in the determination the market price while the dry base water content (Mdb) is used in the field technique (Brooker et al., 1974). The equation in the determination of moisture content

$$Mdb = \dots\dots\dots (1)$$

Description: Mdb = dry base water content (%)

Wt = total weight (gram)

Wd = solid weight (gram)

$$Mwb = \dots\dots\dots (2)$$

Description: Mwb = moist base moisture content (%)

Wt = total weight (gram)

Wd = solid weight (gram)

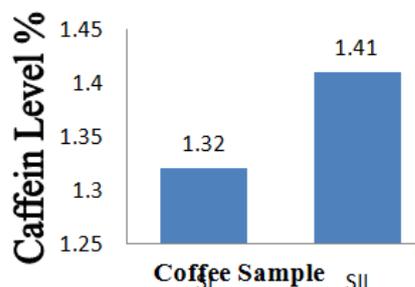
Determination method of water content can be done in two ways, namely direct methods and indirect methods. Direct methods apply oven method and distillation method. In the oven method, the material sample put into the oven to obtain a constant weight on the material. The determination of moisture content in oven method is based on the amount of water that is lost from the product. As for the method of distillation, water content is removed by heating the seeds into water and then determining the volume or the mass of water lost to the seed in a condensed or vapor with a reduction in sample weight (Brooker et al., 1974).

III. Results And Discussion

1. Caffeine Levels

One of the compounds contained in coffee is caffeine. Caffeine is one type of alkaloids that are mostly found in coffee beans (Aryanu, 2016). Caffeine content in coffee besides giving the negative impact on humans, it also provides a positive impact. The coffee is used as a lung capacity enhancer in patients asthmabronchial, Rahayu (2007). Coffeefag (2001), also describes that caffeine has a clinically beneficial pharmacological effect, such as stimulating central nervous system, smooth muscle relaxation, especially bronchial smooth muscle and heart muscle stimulation. The harmful thing is when the levels of caffeine in coffee are too high. The excessive (over dose) effects of caffeine can cause nervousness, anxiety, tremors, insomnia, hypertension, nausea and seizures (Pharmacology UI, 2002).Based on the percentage analysis of caffeine level in coffee beans, it showed that the attack of *H. hampei* pest can cause the increased levels of caffeine in coffee beans.The average percentage of caffeine level of coffee beans after tested can be seen in Figure 1.

Figure. 1 Level Percentage of Coffee Caffeine

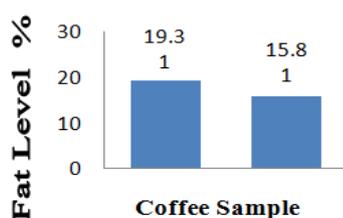


The figure above shows that, caffeine content of coffee beans attacked by *H. hampei*(S II) is higher than caffeine content of coffee beans that are not attacked by *H. hampei*(S I). The combination of chemical compounds contained in coffee beans greatly affect the taste of coffee while the *H. hampei*attack can cause defective coffee beans and also negatively affect the composition of chemical compounds contained in coffee beans, especially in caffeine and reducing sugar (Tobing Et al., 2006). *H. hampei* is one of the main causes of declining production and quality of coffee in Indonesia, even in all coffee-producing countries. The resulting damage to the fruit is the fruits become undeveloped, they turn reddish yellow and eventually fall resulting in a decrease in the number and quality of results (Hayata, 2016).

2. Fat Level

Based on the analysis of fat ;eve; percentage of coffee beans showed that the attack of *H. hampei*pest can cause decreased fat level in coffee beans.The average percentage of fat level of coffee beans after tested can be seen in figure 2.

Figure. 2 Level Percentage of Coffee Beans Fat



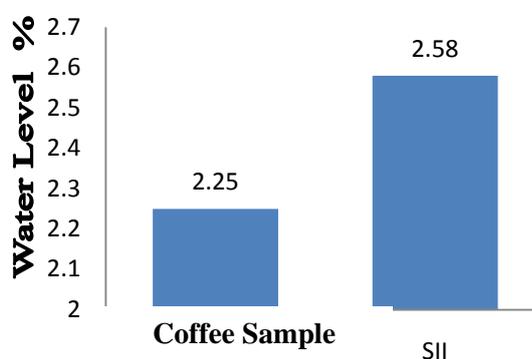
The figure above shows that the fat level of coffee beans attacked by *H.hampei* (S II) is lower than the fat content of coffee beans that are not attacked by *H. hampei* (S I). *H. hampei* gets into the coffee fruit by making a hole around the discus, which causes the young coffee fruits to fall and disability in the old coffee fruit this resulted in the quality of the resulting coffee (PPKKI, 2006). The losses caused by the attack of *H. hampei* become more significant because besides directly reduces the physical production, it also decreases the quality resulting in decreased price of coffee beans produced (Yahmadi, 2000).

3. Water Level

Based on the analysis of water level percentage of coffee beans, it showed that the attack of *H. hampei* pest can cause the increasing water level in coffee beans. The average percentage of water level of coffee beans after tested can be seen in Figure 3

Figure. 3

Water Level Percentage of Coffee Beans



The picture above shows that, the water level of coffee beans attacked by *H.hampei* (S II) is higher than the water content of coffee beans that are not attacked by *H.hampei* ((S I). The severe damage can occur when the coffee hardened, because in addition to drilling and eating coffee beans, this beetle also breeds in the seeds so that the beans are deformed and perforated so that the coffee produced is a low quality market coffee with the damage it can cause Reaching 30 - 80% of production (Juneanto, 2000).

IV. Conclusion

The test results obtained that the attack of *H. hampei* pest can cause the increased levels of caffeine in coffee beans, the decreased levels of fat in coffee beans and the increased water level in coffee beans.

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