

# Effectiveness of tofu waste for decreasing chlorogenic acid of robusta coffee (coffee robusta Lindl.Ex De Will)

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**Abstract.** This study aimed to determine type and concentration of tofu waste which decreasing chlorogenic acid content of robusta green coffee effectively. Decaffeination of coffee could be done using protein-rich wastes, which could potentially act as an organic solvent containing protease. One of them known to be generated in large amount, but has not handled correctly is tofu waste. Generally, tofu wastes divided into two forms such as solid waste and liquid one. The expansion of tofu industry caused growing amount of produced waste. Method of this research consist of preparing coffee sample, preparing tofu waste and measurment of chlorogenic acid levels by spectrophotometry. The results showed that chlorogenic acid content decreased after immersion in the tofu waste. Tofu waste has a proteolytic activity originating from microorganisms in it producing protease. Immersion of robusta coffee beans in tofu waste could cause chlorogenic acid to transform into a compound having lower molecular weight making it easily get out of the coffee beans. As conclusion, robusta coffee beans immersed in liquid tofu waste in concentration of 90% could produce the most excellent quality in terms of chlorogenic acid content.

## 1. Introduction

Coffee is a class of phytochemical plants called plant phenols (Flavonoid polyphenolics). Plant phenols are derived chemical compounds of the plant and contains antioxidants ie cinnamic acid, benzoic acid, flavonoids, proanthocyanidins, stilbenes, coumarin, lignin and chlorogenic acid. Among the most common compounds in coffee are chlorogenate [1]. Chlorogenic acid is a secondary metabolite the largest in coffee beans, is an ester compound of trans-cinnamic acid and quinic acid. Chlorogenic acid and caffeine acid have antioxidant activity strong in vitro [2].

Chlorogenic acid is one type of polyphenolic compound including powerful antioxidants in coffee [3]. Chlorogenic acid naturally occurring in green beans coffee which binds to caffeine [4]. During the fermentation process there will be heat that can break the bond between caffeine and chlorogenic acid. Reduced chlorogenic acid levels an indication of the decline in the amount of caffeine in coffee beans [5]. It has been observed that in 200 mL arabica coffee contains chlorogenic acid of 70 - 200 mg, while robusta coffee contains 70-350 mg of chlorogenic acid [3]. The chlorogenic acid content in Robusta green bean is about 7 - 11% [6]. The consumption limit of chlorogenic acid in coffee is 2% [7]. Chlorogenic acid in coffee functions to form insulin so it can consumed by people with diabetes mellitus II [8]. Excess acid chlorogenate causes an increase in plasma concentrations of homocysteine trigger coronary heart disease [7].



Coffee bean decaffeination process in high solvent temperature causes easily detached chlorogenic acid [9]. Increasing temperature during the decaffeination process causing the bonds between the chlorogenic acid compounds to be so tenuous easily released then dissolved in the solvent [10]. It causes levels the chlorogenic acid in the coffee beans goes down in stages. Reduced acid levels chlorogenate in addition to an indication of decreased amounts of caffeine in the coffee beans, will also be influenced the taste of his coffee drink [5]. Acid compounds along with caffeine allegedly gives a bitter taste, and sepat on coffee [11].

Antioxidants act as inhibitors that work inhibit oxidation by reacting with reactive free radicals to form radicals non-reactive free is relatively stable [12]. Phenolic component plays a role as an antioxidant that serves to protect itself against stress oxidative and bacterial and fungal infections. One of the major phenolic components in in coffee is chlorogenic acid which is one of the main scavengers free radicals [13].

## 2. Material and method

### 2.1. Material

The material used is green bean robusta coffee from plantation coffee in Ambarawa Central Java, waste tofu from home industry tofu in Magelang Central Java, standard chlorogenic acid, Whatman No. 41, MgO, and aquades.

### 2.2. Method

*2.2.1. Coffee sample preparation.* The fruit of the coffee is taken from the robusta coffee plantation Ambarawa, Central Java. The fruit of coffee is taken by picking, its character is a ripe, red-colored coffee fruit of the same size and without physical disability. The pickled coffee fruit is then stored on low temperature 25°C. Furthermore, coffee fruit peeled, so get green bean coffee with horn skin.

*2.2.2. Sample waste tofu preparation.* Tofu waste obtained from home industry know in Magelang Java Central. Waste know that used in the form of liquid and solid. Range waste use cultivated before 12 hours because after 12 hours the tofu waste will smell bad. Solid waste and liquid know measured volume up to 100 mL which is then used for robusta coffee immersion.

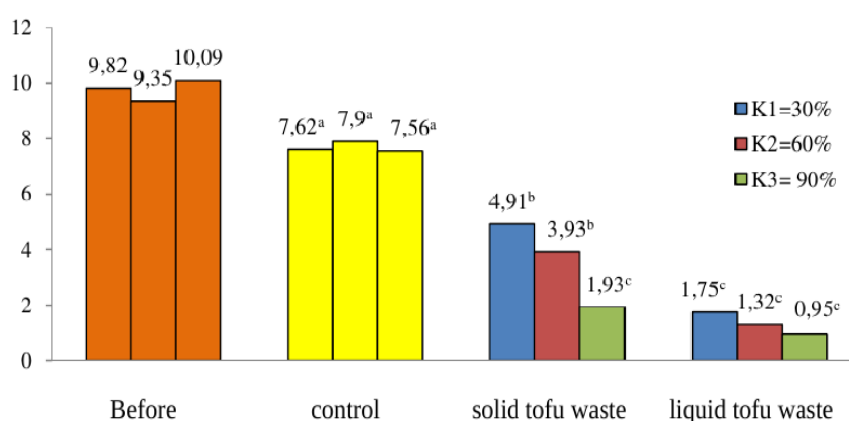
*2.2.3. Treatment.* Based on the results of pretermination obtained the optimal immersion time ie for 8 hours. Robusta coffee beans weighing 10 g that still has skin horn soaked in tofu waste with the type of waste in the form of solid waste tofu (L1) and tofu liquid waste (L2) with a waste concentration of 30%, 60 and 90% during the optimal immersion of 8 hours. Soaking robusta coffee beans in water is used as a control.

*2.2.4. Determination of chlorogenic acid content.* Determination of Chlorogenic Acid Content was using spectrophotometry method. The first step is the preparation of robusta coffee samples to be measured chlorogenic levels. Weighing 0.7 gram samples to be tested, then ground into powder. Added 5 grams of MgO powder, then put in centrifuge tube. Adding 25 mL of ether, shake up homogeneous. Samples were centrifuged 3000 rpm for 10 minutes, let separate. Then decant the clear parts and sediment, take the precipitate and let it until the solvent odor disappears, insert the sediment in Erlenmeyer 750 mL. Add aquades 400 mL and simmer for 15 minutes. After that allowed to cool the solution at room temperature and transferred into the flask 500 mL. The addition of aquades to tera marks. The next stage of filtrate as much as 10 ml is included in the flask 100 mL. The addition of aquades to tera marks. Absorbtion readings on wavelength 324 nm. Calculation of chlorogenic acid content with plot absorbance on standard curve equations. The standard curve-making stage begins with weighing 40 mg of chlorogenic acid, enter in the flask 500 mL. The addition of aquades until the last sign homogenized. Pipette each 5, 10, 15 and 20 mL aliquot, insert in a 100 ml measure flask, add

aquades to the tera mark. Reading absorbance of each solution at 324 nm wavelength. Calculation of levels chlorogenic acid with a standard curve equation.

### 3. Result and discussion

The difference in concentration of tofu waste affecting the decline of chlorogenic acid. Decaffeination process coffee beans which leads to high concentrations of solvent easy release of chlorogenic acid. Chlorogenic acid undergo hydrolysis into a compound with a lower molecular weight, followed by decomposition of chlorogenic acid into other organic compounds and have a nature easily dissolved in a solvent [14]. It was caused chlorogenic acid in coffee beans decreased gradually during decaffenation. It was similar patterns of decline that occurs with decreased caffeine content. Reduced contents of chlorogenic acid may be an indication of decreasing the amount of caffeine in coffee beans [15].



**Figure 1.** Chlorogenic acid level green bean coffee robusta after different types of treatment and concentration of tofu waste.

Figure 1 displayed results showing that chlorogenic acid of robusta coffee beans after soaking in water lower is lower than that in tofu waste. Chlorogenic acid content of robusta coffee prior to soaking was ranged 10.09% - 9.35%, while that content after soaking ranged from 7.9% - 0.95%. Chlorogenic acid content which meet limits consumption is 2% [16]. This means that robusta coffee beans producing chlorogenic acid within the limits of consumption resulted in this research was that treated in 90% solid tofu waste, 30% liquid tofu waste 30%, 60% liquid tofu waste, and 90% liquid tofu waste.

Chlorogenic acid compounds play a role in the formation of flavors bringing a sour taste on brewed coffee when consumed [15]. Excessive acid in coffee will interfere with the stomach of people consuming coffee, especially those who have condition of ulcer disease. The high risk comes from excess acid in coffee making coffee products could not be consumed by everyone actuating the emergence of treatments used to reduce the acidity in coffee.

Chlorogenic acid levels decreased after immersion in the tofu waste. Immersion of robusta coffee beans in tofu waste could cause chlorogenic acid to transform into a compound having lower molecular weight making it easily get out of the coffee beans. During the fermentation process, hydrolysis chlorogenic acid to caffeic acid will occur [16]. Tofu waste has a proteolytic activity come from microorganisms in it producing protease [17]. Protease acts as a catalyst that will speed up chemical reactions. This causes the bonds of chlorogenic acid previously bind with caffeine interrupted. Reduced levels of chlorogenic acid is an indication of decreasing the amount of caffeine in coffee beans [16].

The presence of water contained in the tofu waste making it easier for the hydrolysed chlorogenic acid to go out of the cell due to the stretch of bonds between the chlorogenic acid molecules so, so that they are easy to split into simpler compounds. Water molecules play very important role in decreasing

levels of chlorogenic acid in robusta coffee. It is known that liquid waste contains higher levels of water than solid tofu waste.

#### 4. Conclusion

As conclusion, robusta coffee beans immersed in liquid tofu waste in concentration of 90% could produce the most excellent quality in terms of chlorogenic acid content.

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