Comparison of Saponin Content on Three Species of Coffee Husk as Potential Feeding Originated From Southern Thailand and Jambi, Indonesia

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ABSTRACT
Coffee husk is one of solid coffee waste that contains the amount of phytochemical composition, including saponin. Saponin is a valuable compound for human and animal health. This research analysed and compared the saponin value of three species of coffee husk that originated from southern Thailand and Jambi, Indonesia. The analysis used the vanillin-sulphuric acid method with triplicate replication for each sample followed by DMRT ($P \leq 0.05$) for comparing treatments. The result showed that all coffee husk from southern Thailand and Jambi, Indonesia, consist of saponin value. The coffee husk species which contain the highest saponin value are Liberica from Thailand and Arabica from Indonesia. According to the composition, both species have the potential to develop as a health product for humans and animals.

Keywords: *Pericarp coffee, Phytochemical, Arabica, Robusta, Liberica.*

1. INTRODUCTION

Coffee is one of the important commodities in the world. Approximately 20 million coffee farmers around the world contribute to this sector [1]. Meanwhile, the coffee industry is not only producing a coffee product but also an amount of waste. A half of coffee processing will be the husk, pulp, mucilage of coffee that commonly did not utilize as a primary product. Coffee waste management still being a crucial problem in some countries as a coffee producer. Some of them just threw and did not recycle to be a new benefit product that will be an important issue for the environment. Additionally, around 15 million tons of coffee residual will be gained in the whole of the world every year [2].

Although, many references studies about the waste of coffee, which has a potential for some human life sectors. Some literature proved that coffee waste could be organic fertilizer and animal feed like rabbits, pigs, and fish [3]. Literature reported that coffee waste (pulp and husk) can replace the feeding for milking cows until 20% part and more than 15% of coffee waste can replace pig cereal in Brazil [4] because the pericarp of coffee produced a high phenolic content and glucose compared with coffee beans. It also has a similar value for tannin and polyphenol content with the coffee seed [5] [6].

Coffee husk is the dominant solid waste on coffee processing because the husk composed skin, pulp, parchment of coffee fruit after drying [7]. Additionally, husk consists of protein 7-8%, NDF 60%, and ADF 49% as good nutrition for animal feeding [1]. This part also conceived phytochemical compounds like tannin, flavonoid, saponin, and antioxidant activity. The husk of coffee also increases around 30 % of silage fermentation on silage, improving the protein content [4].

The general function of phytochemical in the animal has various benefits such as reducing methane, improving microbial activity, protein binding, controlling rumen disorders, and improving fiber digestion [8]. Saponin is one of the secondary metabolites that has supported the treatment of health ailments. Saponin has function as an anti-inflammatory, antimicrobial, and antivirus [9]. Earlier studies showed that saponin had variable effects on ruminal VFA concentration [10]. In the rumen, saponin may lead to selective defaunation from the rumen microbial ecosystem by a cell membrane cholesterol-saponin interaction that can indirectly increase growth, milk, and wool production [11]. Saponin can reduce methane and ammonia production in the rumen, enhancing growth and utilization of nutrition in animals [12].

The composition of the skin of coffee (pericarp) has various values on different coffee species. The local Africa species has a higher polyphenol than the skin of Arabica coffee [5]. The quality of coffee depends on many factors such as species, environment (soil, water, and weather condition), cultivation technique, and harvest method [13]. Bertrand *et al*. [14], the quality of Arabica coffee is influenced by the environment. The variety cultivated on mountain or highland areas with the average temperature gains high quality based on the acidity level and aroma.

Based on the above explanation, this research will compare various species of coffee husk that originated from Indonesia and Thailand. The purpose will expect the potential species on specific location based on saponin contain to develop the valuable product specifically for animal feeding.

2. MATERIALS AND METHODS

This experiment used three species of coffee husk, namely Arabica, Robusta, and Liberica, collected from southern Thailand (Songkhla and Trang provinces) and Jambi province, Indonesia, from October to December 2018. Condition of the places are Songkhla (latitude 7°00'17.3 N, longitude 100°30'15.1 E, and altitude 32 m above sea level), Trang (latitude: 7° 33′ 27″ N, longitude 99° 36′ 37″ E, and altitude 29 m above sea level), and Jambi Indonesia (latitude 01°81’92.5 longitude 101°25893 E and altitude 1449 m above sea level).

All of the coffee fruits were harvested at the ripe period (red skin). Separating the bean from the coffee fruit (coffee cherry) by modifying the wet method for coffee processing [15]. The coffee skin was dried in the heated oven at 60ºC for 72 hrs and followed by grinding process. Chemical for saponin analysis used escin (Sigma Alderich), vanillin (Sigma Alderich), and H_2SO_4 (Ajax Finechem, Australia), and distilled water.

The saponin analysis procedure was modified by Corciova and Ivanescu [16]. The dried coffee cherry was treated with 4% vanillin (mixed by ethanol 95%) and 72% H_2SO_4 and then soaked in the water bath at 60°C for 15 minutes. Continued by cooling processing on ice to room temperature for 5 minutes, the absorbance of the solution was analysed by spectrophotometry at 560 nm. The standards were prepared on a scale of 1 – 10 mg/L with the stock solution, which is aescin 0.03 g mixed with 50 ml distilled water. all of the samples were analysed in triplicate replication, and then these values were presented as average values along with their standard derivations. Data had been analysed with one-way analysis of variance, and P values ≤ 0.05 are regarded as significant and followed by DMRT ($P \leq 0.05$) for comparing among treatments.

3. RESULTS AND DISCUSSION

The weather condition of the three locations illustrates a bit difference among Jambi to Songkhla and Trang. Jambi has a lower total rainfall per year and temperature than other areas (Table 1). At the same time, the RH of the 3 locations is slightly similar, with the range from 78 to 80 percent. The rainfall on Jambi is appropriate to cultivate Arabica or Robusta coffee because the range rainfall for Arabica is 1100-2000 mm and 1200-2500 mm for Robusta [17]. On the other hand, based on the condition on Southern Thailand condition only suitable for Robusta coffee.

The source also informed about the temperature optimal that describes Arabica will grow well between 18 and 21ºC and from 22ºC to 26ºC for Robusta [17]. Based on Table 1, no area is proper for cultivating Arabica coffee according to the temperature, while the nearest temperature, still Jambi, will be the potential location for both species.

Table 1. The weather condition in the collecting location in 2018.

Location	Total rainfall per year (mm)	Average Temp per month (ºC)	Average RH per month (%)
Jambi, Indonesia	1806.70	22.91	80.75
Songkhla, Thailand	2096.30	27.14	78.56
Trang, Thailand	2315.00	27.60	80.83

Source : World weather online (Songkhla and Trang) [18] and BPS (Jambi) [19]

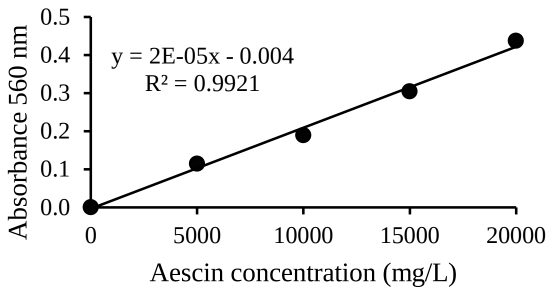

Figure 1. Standard curve for aescin using the modified vanillin sulphuric acid method on saponin analysis

Table 2. Saponin composition of three species of coffee husks originated from Indonesia and Thailand.

Species	Origin	Saponin content (g vanillin equivalent/100g DW)
C. arabica	Thailand	0.67±0.03[bc]
(Arabica)	Indonesia	0.74±0.09[c]
C. canephora	Thailand	0.61±0.15[b]
(Robusta)	Indonesia	0.50±0.02[a]
C. liberica	Thailand	0.77±0.09[c]
(Liberica)	Indonesia	0.59±0.06[ab]

Note: The averages of three samples being a value of each sample (mean ± SD), each analysis used triplicate (n = 1x3x3), Superscript letters (a-e) within the one column indicate significant (P≤0.05) differences of means within the sample of coffee husk.

Figure 1 informs the accuracy of the standard solvent used in this research. The absorbance and aescin concentration had a linear curve and had a high correlation value (R^2= 0.9921). This result shows that the solvent used on this treatment is feasible with the precise data and least error. The linear curve of aescin, also confirmed by Le *et al*. [20], informed that the aescin diluted by distilled water is substantially higher than another solvent.

The various species of coffee husk from different locations contain reveal the variation of saponin value. Table 2 reports Arabica coffee husk from Indonesia and Liberica coffee husk from Thailand have the highest saponin composition. In contrast, Robusta from Indonesia is the lowest saponin composition.

Coffea liberica is one of the local Africa coffee that contains a huge of phytochemicals. Liberica pericarp (skin of coffee fruit) has a higher total phenolic composition than Arabica [5]. Another research also showed that Liberica husk cultivated in Southern Thailand has many phytochemical contents such as tannin, flavonoid, and phenolic compound compared to Arabica and Robusta coffee husk collected from Thailand. Meanwhile, Arabica coffee from Indonesia is still a superior commodity with a lot of phytochemical composition (tannin, flavonoid, phenolic) and potential for antioxidant activity compared to the other coffee husk from Indonesia [21].

The utilization of coffee waste on animal feeding was already applied by Maxiselly [22] The Robusta coffee skin dried originated from Southern Thailand combined with concentrate for goat feeding and show the volatile fatty acid on goat metabolites increased significantly by adding 100 - 200g of Robusta coffee waste. In contrast, the cholesterol and methane decreased on the same treatment. Supported by Astuti *et al*. [23], reported saponin content can reduce the cholesterol in cattle.

According to the saponin composition and location condition, the interaction between species and environment will influence the phytochemical contents of coffee husk, including saponin value. Based on Lambot *et al*., the production of coffee fruit is highly affected by annual rainfall and temperature. Furthermore, the quality of Arabica coffee (volatile, acidity, taste, and aroma) is influenced by climate, namely altitude, and temperature [17]. Elias supports the nutrient composition pulp of coffee like glucose, fiber, protein, and fat affected by various factors such as species, environment, and agricultural practices.

AUTHORS' CONTRIBUTIONS

All authors in this manuscript provide valuable contributions.

YM: the principal investigator, analysis the data, drafting and developing the manuscript.

PA: research assistant (data collector) dan data analysis.

PC: Co-advisor, revising the initial manuscript and contributed to final editing manuscript.

RC: The main advisor, revising the initial manuscript and contributed to drafting and editing the final manuscript.

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