The use of Zalacca seeds and its potential analysis as functional beverage

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Abstract. Zalacca (Salacca edulis) consists of three main parts namely skin, flesh, and seeds. The most utilize part of zalacca is the meat, while skin and seeds were throwing away as waste. Currently, industries have started to process zalacca seeds into powder that can be brewed as substitute for coffee. However, there still lack scientific research has been done on active compounds of zalacca seeds. This study aimed to observe the active compound of zalacca seeds by observing its flavonoid level, caffeine level, consumer preference level (color, flavor, and taste), and business analysis turning zalacca seed into coffee. Result shows that zalacca seed has flavonoid level of 9.69% and caffeine content of 0.1009%. The formula of 90 : 10 of zalacca seeds and cinnamon powder, respectively, produces the most preferred zalacca seeds coffee compared to other formula. According to business analysis, the zalacca coffee has B/C ratio 2.19 per processing. Based on this study, the coffee made from zalacca seed could be used and claimed as functional beverage.

1. Introduction
Zalacca (Salacca edulis) are categorized as exotic native fruit from Indonesia. It possessed a unique shape spiked with chocolate blackish’s colored skin. Zalacca plants grow in high altitude areas about 700 meters above sea level. It is often found in Sleman and several regions in Central Java, such as Wonosobo, Magelang, and Banjarnegara.

Zalacca has three main parts namely skin, flesh, and seeds. This fruit can be processed into various products such as "dodol," candy, jam, chips, etc. Processing is one solution to reduce the post-harvest damage and give more added value for farmers' income. The processing of zalacca fruit will produce waste consisting of skin and seeds, which commonly thrown away. The percentage of the amount of zalacca fruit waste is quite large. It can reach 35-44% of the total weight of zalacca fruit, with a portion of 10-14% skin and 25-30% seeds of whole zalacca fruit [1]. Zalacca skin can be processed into fertilizer while the seeds can be transformed into a kind of beverages like coffee. This process has been performed in several areas in North Sumatra and Java.

The coffee made from zalacca seeds was claimed to have health benefits. However, there are lack of scientific study published, only as popular articles displaying some empirical experience of consumers [2]. The results of previous research Werdyani et al. [3] showed that the ethanol extract and fraction of “salak pondoh” fruit seeds contain phenols, flavonoids, and tannins. The highest antioxidant activity was found in 100% methanol treatment with an IC50 value of 110.16 µg / ml. The extraction methods are mostly carried out using water, ethanol, methanol, ether, ethyl acetate, and
butanol as solvents, with IC50 values from various fruit sources in Indonesia ranging from 0.01408 ppm to 660.08 ppm [4]. Antioxidant activity is caused by the presence of secondary metabolites such as flavonoids, phenolics, tannins, and anthocyanins. The higher antioxidant activity lead to higher activity toward off free radicals.

In food products, antioxidants used to prevent oxidation processes that can damage the product, such as rancidity, discoloration and change in flavor, and other physical damage. Some types of antioxidants are in the form of (a) nutrients, such as vitamins E and C, (b) non-nutrient, such as carotene pigments, lycopene, flavonoids, and chlorophyll, and (c) enzymes, such as glutathione peroxidase, coenzyme Q10 or ubiquinone. Antioxidants can be divided into three categories, namely (a) antioxidant preventive (enzyme super oxides mutase, catalase, and glutathione peroxidase), (b) primary antioxidants (vitamin A, phenolics, flavonoids, catechins, quercetin), and (c) antioxidants complementary (vitamin C, β-carotene, retinoids) [5]. The most useful function of antioxidants in inhibiting oxidation is to stop the chain reaction of free radicals. The use of these antioxidants in neutralizing systems can be in the form of enzymes or non-enzymatic. Some antioxidants in the form of enzymes are found to protect from free radicals, such as superoxide dismutases, catalases, and glutathione peroxidases. At the same time, the type of non-enzymatic antioxidants in the form of small molecules distributed widely in biological systems can fight free radicals. Besides contains active compounds that act as antioxidants, zalacca seeds also include several other nutrients, such as fat 0.48%, protein 4.22%, carbohydrate 38.9%, and water content 54.84% [6].

Coffee drink is one of a beverage that is much favored by the public. Coffee has a specific flavor and contains high caffeine compounds. High content of caffeine in coffee, is avoided by people who don't like it. For that, an analog of coffee drink (brewed) is made from seed plant. Zalacca seed, has potential to be converted into coffee drink to fill the demand.

Coffee made from zalacca seeds, is categorized as new beverage product. Therefore, it is necessary to add a specific flavor, such as with cinnamon and ginger, to improve the consumer preference. The benefits of cinnamon and ginger are not only as flavor enhancers but also have functional properties needed by human body. For that, this study was aimed to determine the potential of zalacca seeds as coffee drink as functional beverage, to know the level of consumer preference, and to analyse the added value of processing zalacca seeds into the coffee.

2. Materials and methods
This research was conducted in Sungai Langka Village, GedongTataan Subdistrict, Pesawaran Regency, from August to October 2018. The main ingredient used in this research was zalacca seeds. For the consumer preference level test, zalacca seeds coffee was made with three formulas, namely: 100% zalacca seeds (A), 90% zalacca seeds + 10% cinnamon powder (B), and 90% zalacca seeds + 10% ginger powder (C). Parameters observed were flavonoid levels, caffeine levels, consumer preference levels, and business analysis of making zalacca seeds coffee.

Analysis of flavonoid and caffeine levels was conducted in the Laboratory of the Bogor Postharvest Development Center. Analysis of the level of consumer preferences to color, flavor, and taste of zalacca seed coffee was conducted using the Hedonic scale test with a score of 1-5, as follows: 1 = dislike; 2 = like slightly; 3 = like; 4 = like very much; 5 = like extremely. Twenty-five respondents consisting of males and females with the age range of 34 - 60 years were used for the consumer preference analysis. Data obtained were statistically analyzed using Analysis of Variance (ANOVA). If there were differences in the mean values, the analysis was continued with Least Significant Difference (LSD) at the 5% level. Analysis of the business of making zalacca seeds coffee is done by calculating the price of inputs and outputs produced for a one-time process using 20 kg raw zalacca seeds. Flow chart of zalacca seed coffee showed at Figure 1.
3. Results and analysis

Zalacca coffee seed is a new product, and it is not widely known by the public; therefore, it is necessary to conduct laboratory analysis of the content of active compounds. Zalacca seed coffee has flavonoid content which beneficial to health. However, it also contains caffeine, so it is necessary to conduct laboratory analysis to determine the amount of that component in processed products. Analysis of the flavonoid and caffeine content of zalacca coffee is presented in Table 1.

Table 1. The flavonoids and caffeine content of zalacca seed coffee.

| Sample type            | Total flavonoid (%) | Caffeine (%) |
|------------------------|---------------------|--------------|
| Zalacca seeds coffee   | 9.69                | 0.1009       |

The results of the analysis in Table 1 show that the flavonoid content of zalacca seeds is 9.69%, while the caffeine level is 0.1009%. Flavonoid compounds are the largest group of phenolic compounds found in nature, present in all plant parts including leaves, roots, wood, bark, flowers, fruits, and seeds, as well as having a phenolic compound that has potent antioxidants [7].

According to earlier study [8], flavonoids are compounds that have biological activity as a diuretic. The mechanism of action of flavonoids as a diuretic is by inhibiting the reabsorption of Na+, K+, and Cl, resulting in an increase in the electrolyte in the tubules so that diuresis and urine volume increase [9]. This current study was in line with the study of [10], which showed that the flavonoid compounds produced by ethanol extract in zalacca seeds had a diuretic effect on white male Wistar rats (Rattus norvegicus). Diuresis causes a decrease in blood plasma volume, which will reduce the amount of blood pumped by each ventricle per minute (cardiac output) and ultimately lower blood pressure [11; 12]. Some practical experience from hypertension sufferers stated that they experienced a decrease in blood pressure after consuming zalacca seed coffee. It was suspected that a reduction in blood pressure was caused by diuresis due to the flavonoid content in zalacca coffee.
The study of Putri et al. [13] revealed that the phytochemical test of zalacca seed contains flavonoids, tannins, and alkaloids that act as antioxidants. These antioxidants will help better absorb vitamin C, prevent and treat allergies, viral infections, arthritis, and specific inflammation, by neutralizing the nature of free radical damage to prevent these diseases. Moreover, antioxidants can prevent early blood vessel damage if consumed regularly. They will capture free radicals, blood vessels to the heart so that the heart blood vessel damage does not occur [14].

As a psychoactive aphrodisiac and a mild diuretic [15]. A coffee drink made from real coffee seeds favored by people. However, its caffeine content is too high so that when consumed in excess can have an impact on health, such as insomnia and dangerous for people with high blood pressure. The caffeine content in some kinds of coffee as follows, mocca coffee was 0.82%; Java Robusta coffee 1.48%; Arabica coffee 1.16%; Liberica coffee 2.19%; and instant coffee 2.8 - 5.0% [16; 17]. Additionally, [18] found that the caffeine content in robusta coffee was 44,922 mg/kg (4.5%) while civet robusta coffee 47,599 mg/kg (4.6%).

Zalacca seed coffee is one solution for consumers because it has low caffeine content and will reduce the adverse effects of excessive caffeine consumption. Consumers can beverage zalacca seed coffee like ordinary coffee. The results in Table 1 showed that the caffeine content of zalacca seed coffee is 0.1009 %, which in accordance with previous study (0.2%) [19]. The current study's value was lower than the maximum limit of caffeine in coffee robusta [20], about SNI 01-3542-2004 in the amount of 0.9 to 2% w/w, then it is safe for health. Besides having a negative effect, caffeine has a positive impact on health if consumed in moderate amount. A low caffeine supply (250 mg) will cause a vasoconstrictive effect from blood vessels to reduce blood flow as much as 20-30% so that it can be used for migraine/headache therapy [21].

Zalacca seed coffee is a new type of beverage that has a distinctive taste, and some do not like it. Therefore, in this study, ginger powder and the cinnamon powder were added to the coffee to reduce the unique flavor and taste and to improve the usability of zalacca seed coffee. Three formula of zalacca seed coffee were tested to know the level of consumer preference. The results are presented in Table 2.

| Formula | Color | Flavor | Taste |
|---------|-------|--------|-------|
| 100% zalacca coffee seeds (A) | 3.31 a | 3.00 b | 2.77 b |
| 90% zalacca seed coffee + 10% cinnamon powder (B) | 3.23 a | 3.32 a | 3.23 a |
| 90% zalacca seed coffee + 10% ginger powder (C) | 2.69 b | 2.38 c | 2.77 b |

Note: values with the same letter in the same column are not significantly different with LSD at 5% level.

The analysis of the level of consumer preferences for three formulas of zalacca seed coffee (Table 2), showed that consumers most like formula B (the mixture of 90% zalacca seed and 10% cinnamon powder), compared to other formula. The ingredient used to strengthen the aroma and taste of coffee is cinnamon (*Cassia*). Cinnamon has potential health benefits because it has high antioxidant content. Moreover, it has a distinctive aroma and flavor so that it is good to be added to food or beverage to give a better flavor and preferable. According to Azima et al. [22], cinnamon powder contains many tannins, flavonoids, and others that are thought to act as antioxidants. While the previous results [23], showed that flavonoids act as antioxidant compounds that can reduce cholesterol in the blood by protecting 3 LDL (*low-density lipoprotein*) from the oxidation process to prevent atherosclerosis. The main component in the cinnamon's flavor is sinamaldehyde, an oxygenated hydrocarbon group that became the essential component in delivering taste and aroma [24]. Several studies show that added cinnamon has many benefits for health, so cinnamon is expected to improve the quality and flavor of the zalacca seeds coffee.

The economic analysis of the production of zalacca seeds coffee was conducted to determine the business opportunities, as shown in Table 3.
| No | Description               | Volume | Unit (Rp) | Total (Rp) |
|----|--------------------------|--------|-----------|------------|
| A  | Input                    |        |           |            |
|    | Zalacca seeds            | 20 kg  | 1,000     | 20,000     |
|    | Plastic wrap             | 280 pc | 300       | 84,000     |
|    | Fuel                     | 1 kg   | 7,000     | 7,000      |
|    | Total cost of input      |        |           | 111,000    |
| B  | Labor cost               |        |           |            |
|    | Cutting                  | 1.3 person per day | 50,000 | 65,000     |
|    | Drying                   | 1.5 person per day | 50,000 | 75,000     |
|    | Roasting                 | 0.5 person per day | 50,000 | 25,000     |
|    | Milling                  | 0.25 person per day | 50,000 | 12,500     |
|    | Sifting                  | 14 kg  | 5,000     | 70,000     |
|    | Packaging                | 0.5 person per day | 50,000 | 25,000     |
|    | Total cost of labor      |        |           | 272,500    |
| C  | Total cost (A + B)       |        |           | 383,500    |
| D  | Output                   |        |           |            |
|    | Zalacca seeds coffee     | 280 pc | 3,000     | 840,000    |
|    | = 14 kg (280 pc @ 50 g)  |        |           |            |
|    | B /C ratio               |        |           | 2.19       |

The economic analysis results of processing zalacca seed coffee for a 1-time process (Table 3) show that processing zalacca seeds into zalacca coffee as the functional beverage is quite profitable and has excellent chances and to develop on a scale larger business. From the calculation of business analysis, the B/C ratio was 2.19 per process. It means that each expenditure of Rp. 1 will get an income of Rp. 2.19. This result shows that zalacca seeds which have not been utilized by the community can be processed into economically valuable beverage products that contains good antioxidant. The study results of Fitrianingsih et al. [25], showed that the extract of zalacca seeds has antioxidant activity with IC50 values of 229.27±6.35 μg/mL. Besides, it has the potential to be marketed into beverage products that contain antioxidants and have economically valuable.

4. Conclusion
It was concluded that zalacca seed coffee has the potential to be used as a functional beverage. It has flavonoid levels of 9.69%. Consumers most preferred formula of zalacca seeds with the composition of 90% of zalacca seeds and 10% cinnamon powder (B) compared to other treatments. The business of making zalacca seeds coffee is quite profitable, with a B/C ratio for one process of 2.19.

Author contributions
RWA planned the experiments, RWA and RA data collection, analyzed the data, interpreted the results, and write up the manuscript and made up the illustrations.

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