Functional characteristics and added value siger rice based on cassava as a local food source

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Abstract. The purpose of the study was to analyze functional characteristics (crude fiber content, dietary fiber content, starch content, and antioxidant content) and the added value produced by cassava in different siger rice. The study consisted of collecting non-fermented and fermented siger rice (MOCAF) from several districts in Lampung. The analysis of functional characteristics variants of siger rice, and calculating the added value of cassava into various variants of siger rice. The results showed that siger rice can be used as a functional food product because it has a high content of crude fiber, dietary fiber, starch content, and antioxidant activity. The functional characteristics can anticipate unhealthy eating patterns, as well as to help avoid over nutrition and degenerative diseases. Siger rice processing to business actors is a capital-intensive business due to the distribution of labor benefits that are smaller than the profits of siger rice business operators.

1. Introduction
Cassava is a strategic commodity as a source of income for farmers who play a role in improving the welfare of farmers. Cassava is not only used as food, but also used as local food consumption, industrial raw materials, and animal feed. Cassava has a significant role in meeting food needs as well as overcoming economic inequality and industrial development. In food-insecure conditions, cassava is a reliable food buffer which is used as a food source [1].

Siger rice is a staple food product made from cassava which for some people in Lampung Province is made an alternative as a staple food substitute for rice [2]. Previous research by [3] states that relatively brighter colors and better taste called siger rice or instant tiwul modification or analog rice. Analog rice is a modification tiwul which in its processing uses the extrusion method [4].

One of the advantages of modified tiwul products as a staple food as a substitute for rice is that it has characteristics as a functional food, especially for consumers who carry out diabetic and cholesterol diets [5]. Thus the potential of the siger rice market as a source of functional food is very much needed for consumers who are on diabetes and cholesterol diet. [6] the research that functional properties can be used to promote rice analog or rice siger.

In accordance with consumer demands, there are several choices of siger rice variants derived from processed non-fermented and fermented cassava. Siger rice from fermented cassava is a technological
development that has been carried out by research [7] in the form of a mocaf. Fermented cassava is expected to increase the nutritional value of flour produced and improve the expected taste and quality [8].

The prospect of siger rice is actually promising because it is rich in dietary fiber that can be beneficial for reducing cholesterol, preventing obesity or for diabetics who need to consume low-calorie carbohydrates [4]. The process of processing cassava into siger rice is important so that the commodity of cassava has a high value, increasing the added value and storability of the product. The aims of the research are to analyze functional characteristics (crude fiber content, dietary fiber content, starch content, and antioxidant activity) and the added value produced by cassava in different siger rice as a functional food source.

2. Material and Method

2.1 Material

The main ingredients of the study are siger rice from processed non-fermented and fermented cassava (MOCAF) original, and siger mocaf rice with the addition of red dragon fruit peel coloring, and chemicals for the analysis of the functional characteristics of siger rice. The tools used in this study are autoclave and tools for analyzing the characteristics of siger rice mocaf and siger rice.

Table 1. The calculate of the added value of tiwul mocaf in one production process

| I. Output, Input, and price | Value | Calculate |
|-----------------------------|-------|-----------|
| 1. Output (kg)              | 1     |           |
| 2. Input (kg)               | 2     |           |
| 3. Labor (HOK)              | 3     |           |
| 4. Conversion Factor        | 4     | = ½      |
| 5. Labor coefficient (Hok/kg)| 5  | = 3/2    |
| 6. output Price             | 6     |           |
| 7. Labor Wages ( IDR/Hok)   | 7     |           |

II. Revenue and Profit

8. Raw material prices ( IDR/Kg)  8
9. Other input contributions ( IDR/Kg)  9
10. Output Value ( IDR)  10 =4x6
11. a. Value added ( IDR/Kg) 11a =10-9-8
    b. Value added ratio (%) 11b = (11a/10)x100%
12. a. Labor income ( Rp/Kg) 12a =5x7
    b. Share of labor (%) 12b = (12a/11a)x100%
13. a. Profit ( Rp/Kg) 13a =11a-12a
    b. Profit rate (%) 13b = (13a/11a)x100%

III. Reply to the Factor Production Service Owner

14. Marjin ( Rp/Kg) 14 =10-8
    a. Labor income 14a =12a/14)x100%
    b. Other input contributions 14b = (9/14)x100%
    c. Businessman profit 14c = (13a/14)x100%

Note: the Siger rice agro-industry provides value-added will be positive (> 0) and negative (<0)

2.2 Research methods

Research Stages The study consisted of several stages, (1) the stage of collecting not fermented and fermented siger rice (MOCAF) from several districts in Lampung, (2) the stage of testing the functional compounds content of various variants of siger rice, and (3) calculating the added value of
cassava into various variants of siger rice. The data obtained were analyzed descriptively by comparing chemical tests with non-fermented and fermented siger rice (MOCAF).

Collection of Non-Fermented and Fermented Siger Rice. Non-fermented siger rice is derived from processed KWT from Kotabumi, Tulang Bawang, and South Lampung. Whereas the fermented siger rice comes from the processed business unit of Maju Bersama in the East Lampung Regency.

Testing the functional content of various variants of siger rice. Functional compound content testing is carried out in the form of crude fiber testing, acid-base hydrolysis methods, dietary fiber enzymatic testing methods, starch content of the luff schoorl method [9], Antioxidant activity was determined by the DPPH free radical method [10], and value-added analysis [11] (Table 1).

3. Result and Discussion

3.1 Functional Characteristics of Siger Rice

The test results in table 2, show that the original Togasari siger rice has higher crude fiber content (3.33%) compared to other siger rice. However, this crude fiber is lower than that produced by research [5] where white siger rice has different crude fiber content. This is related to the different stages of the manufacturing process between white siger rice (oyek method) and yellow siger rice and black siger rice (tiwul method). The original siger togasari rice is the original tiwul whose processing is the same as black siger rice (tiwul method), where there is no treatment of the size reduction and pressing steps after the soaking process on cassava.

Table 2. Characteristics of siger rice from cassava processing and mocaf flour

| No | Siger Rice (SR) type  | Crude Fibre (%) | Dietary Fiber (%) | Starch Levels (%) | Antioxidant (%) |
|----|----------------------|-----------------|-------------------|------------------|----------------|
| 1  | SR Mocaf Original    | 2.132           | 8.774             | 67,535           | 0              |
| 2  | SR Mocaf Dragon Fruit peel | 2.040       | 4.934             | 68,331           | 8,200          |
| 3  | SR RTB (Kota Bumi)   | 2.244           | 9.081             | 76,063           | 0              |
| 4  | SR Togasari red      | 2.906           | 9.723             | 72,734           | 3,400          |
| 5  | SR Togasari Original | 3.333           | 10,2970           | 72,211           | 0              |

The crude fiber contained in siger rice is in accordance with the requirements of crude fiber content in SNI that is 2%, while crude fiber siger rice made from mocaf flour ranges from 2.04 to 2.13%. [12] stated that the levels of mocaf flour fiber from the starter implementation ranged from 1.31 - 3.06%. The difference in fiber content is thought to be related to the mocaf flour sifting process because the crude fiber is a part that cannot be hydrolyzed by acids or bases.

Siger rice togasari original has a higher dietary fiber content than other siger rice. This is thought to be a contribution from resistant starch. Resistant starch is a much as starch resulting from the degradation of starch which cannot be absorbed by the human small intestine and grouped in food fiber [13].

The high content of crude fiber and dietary fiber shows that various variant siger rice has characteristics as a functional food. Food with high fiber content can be used as a functional food to reduce blood cholesterol levels. Fiber is recommended for consumption in order to anticipate unhealthy eating patterns, and help avoid over nutrition and the accompanying degenerative diseases. Dietary fiber is by far the most widely used component in functional food [14].

Siger rice starch levels from cassava raw materials are higher than siger rice from mocaf flour raw materials. This is in accordance with [15] research that there was a decrease in starch content in the treatment using modified starch (mocaf) in making analog rice. The role of lactic acid bacteria (BAL) which utilizes starch components as nutrients for growth and the breakdown of starch by microorganism activity into simple sugars [16].
Siger mocaf rice with the addition of dragon fruit peel extract produced antioxidant levels of 8.2% while the antioxidant levels of Togasari Tulang Bawang Barat Bawang were 3.4%. Togasari siger rice is produced from cassava tuber processing with the addition of dragon fruit extract, while East Lampung siger mocaf rice is processed from mocaf flour processing with dragon fruit peel extract. This shows that in the dragon fruit peel there have activity antioxidants. The research by [17] the ethanol extract of super red dragon fruit peel had strong antioxidant activity and [18] antioxidant levels resulting from frozen yogurt processing of dragon red fruit peel 12.25%. Antioxidants are parameters that show the percentage of the ability of food in inhibiting free radicals [19].

3.2 Value Added Siger Rice

Based on the calculation procedure of the Hayami value-added method, a conversion value of 0.23 was obtained in processing cassava into siger rice (SBS), 0.33 in processing cassava into mocaf flour (SM), 0.91 in processing mocaf flour into siger rice (TMBS), and 0.94 in the processing of mocaf flour into siger rice with red dragon fruit skin coloring (TMBSP). The conversion value means that every one kilogram of cassava processed in each siger rice processing produces siger rice from 0.23 to 0.94 kilograms, while in [20] research is SS agroindustry produces siger rice by 0.35 kilograms. The use of raw materials and different processing processes affect the conversion value obtained by siger rice. Analysis of the added value of siger rice from different raw materials treated, namely non-fermented cassava and fermented cassava (mocaf) table 3.

Table 3. Calculation of Value Added of Siger Rice from Cassava and Siger Rice from Mocaf Flour

| I. Output, Input dan Harga          | SBS | SM | TMBS | TMBSP |
|------------------------------------|-----|----|------|-------|
| 1. Output (kg)                     | 23  | 33 | 30   | 31    |
| 2. Input (kg)                      | 100 | 100| 33   | 33    |
| 3. Labor (HOK)                     | 2   | 2  | 0.25 | 0.25  |
| 4. Conversion Factor (Hok/kg)      | 0.23| 0.33|0.91 | 0.94  |
| 5. Labor coefficient (Hok/kg)      | 0.02| 0.02|0.01 | 0.01  |
| 6. output Price                    | 13,000| 8,000|15,000|17,000 |
| 7. Labor Wages (IDR/Hok)           | 50,000| 50,000|50,000|50,000 |

II. Revenue and Profit

| 14. Margin (Rp/Kg)                  | 1,990| 1,640| 5,636| 7,969 |
|-------------------------------------|------|------|------|-------|
| a. Labor income                     | 50,25| 60,98| 6,72 | 4,75  |
| b. Other input contributions        | 10,05| 20,30| 3,55 | 8,16  |
| c. Businessman profit               | 39,70| 18,72| 89,73| 87,09 |

Note Cassava to siger rice (SBS); Cassava to mocaf (SM), Mocaf flour to siger rice (TMBS), Mocaf flour to color siger rice (TMBSP).
In processing cassava into siger rice the labor needed to process one kilogram of cassava is 0.02 HOK while processing mocaf flour into siger rice the labor needed to process one kilogram of mocaf flour is 0.01 HOK. The labor coefficient of processing cassava into siger rice is greater because the processing of mocaf flour into siger rice chooses shorter processing stages.

Processing cassava into siger rice adds an added value of Rp1,790/kg of raw material or 1.79 times the price of raw material while processing cassava into a mocaf gives an added value of Rp1,307/kg of raw material or 1.31 times the price of raw material. While processing mocaf flour into siger rice gives the added value of Rp5,436/kg of raw materials or 0.68 times the price of raw materials and processing of mocaf flour into siger rice with natural dyes from red dragon fruit peels amounting to Rp7,319/kg of raw materials or 0.91 times the price of raw materials. Increasing the added value of processing mocaf flour into siger rice is greater than processing from cassava into siger rice. This is because the selling price of siger rice from mocaf flour is higher than that of siger rice from cassava.

Produced added value and the siger rice agroindustry revenue was able to provide the added value of Rp3,065.38/kg [20]. The added value is greater when compared to the added value generated from cassava processing but the added value generated from processing mocaf flour into siger rice is greater than that given by SS siger rice agroindustry. The addition of red dragon fruit peel as an additional material to produce a more attractive color given to siger rice mocaf flour gives greater added value (Rp.7.319/ kg). [21] The added value of frozen yogurt Red dragon fruit peel is Rp.85,800/kg. The amount of added value generated due to the red dragon fruit peel is an untapped waste. Siger flour mocaf rice with a combination of natural dyes of red dragon fruit peel is a potential for healthy functional products, especially for diabetics and people who are on a diet program.

The biggest profit margin was obtained from processing siger rice from mocaf flour raw materials with the addition of dyes from red dragon fruit peels amounting to Rp 7,969 / kg of raw materials, and the smallest profit margins on the processing of mocaf flour from cassava raw materials amounted to Rp1,640/kg of raw materials. Profit margins are distributed for agro-industry benefits, labor benefits, and other input contributions. The distribution of labor benefits that are smaller than the profit of processing cassava into siger rice shows that the mocaf flour processing business into siger rice is a capital-intensive business.

4. Conclusion
The results showed that siger rice can be used as a functional food product because it has a high content of crude fiber (3.33%), dietary fiber (10.29%), starch content (67.54%), and antioxidant activity (8.20%). Processing cassava into siger rice can provide the added value of Rp1,307 / kg of raw materials - Rp1,790 / kg of raw materials smaller than siger rice processed from mocaf flour of Rp 5,436 / kg of raw materials - Rp7,319 / kg of raw materials. Siger rice processing to business actors is a capital-intensive business due to the distribution of labor benefits that are smaller than the profits of siger rice business operators.

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