Making artificial rice from sorghum flour, corn flour and cassava starch by using mini extruder

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Abstract. The research was did to introduce how to making artificial rice from composite flour (Sorghum bocolor L. Moench, Zea mays, and Manihot esculenta) by using mini extruder. The research was conducted using a non-factorial randomized block design using two steps of processes. The first step is making composite flour based on sorghum flour (with two types of pre-treatment such as hulled sorghum seeds and germinated sorghum seeds), corn flour and cassava starch. Hulled sorghum flour was processed such as being sorted, hulled, cleaned, dried, milled, and sieved. Germinated sorghum flour was made by steps such as being cleaned, sorted, soaked for 72 hours in room temperature, germinated for 36 hours on damp gunny, washed, dried, milled, and sieved. The second step is making artificial rice by using mini extruder. The artificial rice with the hulled sorghum flour has darker colour than the germinated sorghum flour and both of those treatments has the heterogen shapes and was not similar to rice in shape. The artificial rice with germinated sorghum seemed to be more appealing than the artificial rice with hulled sorghum. Mini extruder still need to be improved so that it could give the better results in making artificial rice.

1. Introduction
Rice is the main resources to fulfil carbohydrate necessary in Indonesia. Indonesian usually consume rice from rice plants. Almost all Indonesian consume rice as the staple food. The high number of rice consumption along with the increase of population in Indonesia may rise problem in the process to fulfil Indonesia rice demands [1]. Central Statistic Agency (BPS) of Indonesia reported that Indonesia imports 2.2 million tons rice in 2018, in which the import was only 305.75 thousand tons in 2017 [2]. This tendency was not good for Indonesia, because importing rice could give the bad impact to the nation which might lead to the decrease in Indonesian income. In addition, routine rice consuming could create the mindset that rice is the only staple food that could give the benefit or energy to do activities in daily life. In the future, Indonesian people might have other problems which force the nation to choose an alternative main food. In contrast, Archipelagic Indonesia have various varieties of food resources which contain nutrition as like as rice plant, even more than that such as corn, cassava, sorghum, and other foods [3]. From the reasons above, the government established the rules about food diversification to find an alternative main food to fulfil the necessary of society.

Sorghum is grown in Indonesia and has good resistance in dry lands. Sorghum contains almost the same nutrition as corn and more nutrition than rice plant [4]. Sorghum contain about 73% of carbohydrates, 3.5% of fats, 10% of proteins, and kind of minerals. Based on that, sorghum is highly potential to be one of Indonesian main food besides rice. On the other hand, sorghum contains
antinutrition component tannin, that could give bad effect to our digestive if it is consumed in excess. Tannin could decrease human digestibility by forming a complex bond with the protein. Furthermore, high number of tannin could make the dark colour and the bitter taste [5]. Hulling process is one of the way that could decrease the number of tannin of sorghum. Hulling process is done by using a machine that would scrape off the seeds skin and testa’s layer of sorghum [6]. Another way to decrease the number of sorghum tannin by doing the germination process, with two steps: soaking and germinating. Soaking decrease the number of tannin because tannin is soluble in water, and germinating causes hydrolysis and enzymes activation which change the molecule structures of tannin [7].

Artificial rice could be one of alternative to change the eating habit of Indonesian society. Artificial rice is the “rice” that are made by flour from food ingredients (except rice plant and wheat) [8]. In this research sorghum, corn, and cassava were used as the ingredients in making the artificial rice. Artificial rice could be made by using two types of methods, such as granulation [9] and extrusion [10]. The most popular method in making artificial rice is extrusion, so that in this research hot extrusion by using mini extruder was applied. Mini extruder is the self-making machine with temperature control from 0-320 °C which could produce flour product (in this case artificial rice) into many shapes. The research was aimed to introduce how to make artificial rice from composite flour (Sorghum bicolor L. Moench, Zea mays, and Manihot esculenta) by using mini extruder.

2. Materials and methods
The raw material for the artificial rice was sorghum flour with the hulling process, sorghum flour with the germination process, corn flour, cassava starch and glucose monostearat (GMS).

2.1 Research methods

![Diagram of making artificial rice]

Figure 1. Scheme of making artificial rice
There are two steps in making artificial rice. The first step is making composite flour and the second step is making the artificial rice. Composite flour was made by two treatments, one of them was composite flour consisted of hulled sorghum flour, corn flour, and cassava starch and the other one was composite flour made up of germinated sorghum flour, corn flour, and cassava starch. Hulled sorghum flour was processed following steps such as being sorted, hulled, cleaned, dried, milled, and sieved [11]. Germinated sorghum flour was made by steps such as being cleaned, sorted, soaked for 72 hours in room temperature, germinated for 36 hours on damp gunny, washed, dried, milled, and sieved [12]. Corn flour was processed following steps, being sorted, cleaned, loosen beans, dried, milled, and sieved [13]. Cassava starch was made by steps, being sorted, cleaned, cutted and rasped, added water in cassava pulp (2:1), extracted, sifted, sedimentated, decanted by water, dried, milled, and sieved [14]. Then, there were two types of treatments, the first was composite flour consisted of hulled sorghum flour, corn flour, and cassava starch and the second was composite flour made up of germinated sorghum flour, corn flour, and cassava starch were added by 2% GMS in making artificial rice by using mini extruder. The process of making artificial rice will showed in the scheme in Figure 1.

3. Results

Figure 2 shows the mini extruder that was made by Chemistry Department’s student of University of Sumatera Utara. The machine used the heat as the energy to make the dough stick together. The first thing to do is insert the plug into socket then set the temperature (80 °C). This machine is used manually, the dough was poured from the topside, then the rotator was cranked clockwise manually.

![Rice mould](image1)

![Zoom in mini extruder](image2)

![Zoom out mini extruder](image3)

Figure 2. Rice mould (A); zoom in mini extruder (B) and zoom out mini extruder (C)

This research was undertaken to make artificial rice from two different pre-treatments of sorghum which were sorghum flour with hulling process and sorghum flour with germination process. Figure 3 shows that the artificial rice who made by hulled sorghum (A) has darker colour compared to the artificial rice who made by germinated sorghum (B) because of the tannin in sorghum itself. Hulling process could decrease the number of tannin not as much as germination process [15]. The colour of the artificial rice who made by germinated sorghum (B) was brighter than artificial rice with hulled sorghum (A) because germination process was decreasing more tannin compared to hulling process. The germination process was done by two steps: soaked and the germinated. The soaking process made the tannin to be soluble in water. In addition, the germination process will decrease more tannin because the hydrolysis and enzymes activation can change the molecule structures of tannin [16]. In general, the resulted product was not homogen and was not similar to rice in shape. The shape difference might have been caused by the operation of the machine which was still operated manually in which the power, pressure and speed were depended solely on operator.
Figure 3. Artificial rice with hulled sorghum (A) and germinated sorghum (B)

The artificial rice with germinated sorghum seemed to be more appealing and looking better because the colour of this product was brighter than the artificial rice with hulled sorghum.

4. Conclusions
It was evident that the production of artificial rice based on composite flour (sorghum flour, corn flour, and cassava starch) by using mini extruder gave the results which the artificial rice with the sorghum made by germination process has brighter colour than the sorghum from hulling process because of the germination process can decrease more tannin than hulling process. Because of the energy to operate mini extruder was manual or using human energy, so that the power/pressure and speed were depended on the human itself so that hulling and germination process created the heterogen shapes and was not similar to rice in shape. It would be better if the mini extruder is modified by adding automatic button or equipment to operate it (not manual/using human energy) so the ingredients will get the same treatment and give the same results in shape.

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