Physical quality of chicken patties containing red beans
(*Vigna angularis*) with different filler levels of taro meal

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Abstract. This research aims to evaluate the use of different filler levels of taro meal on the physical quality of chicken patties containing red beans (*Vigna angularis*). Patties produced from chicken meat with the ratio of red bean flour and taro flour as filler substitution for tapioca flour are 15:0 (CP0), 15:3 (CP1), 10:0 (CP2), 10:3 (CP3), 5:0 (CP4), and 5:3 (CP5). The analysis showed a significant difference in the tenderness (P<0.01), the value of pH, cooking loss, and water holding capacity (P<0.05) of patties. The addition of taro flour can increase the tenderness value of chicken patties. Reducing the amount of red beans resulted in a decrease in the pH value of chicken patties, but the increase in the use of taro meal did not result in a difference in the pH value. The highest cooking loss was achieved with the use of 5% red beans without taro meal. The highest water holding capacity of patties produced was obtained with a ratio of red bean and taro meal of 5:3. The conclusion is that adding 10% red beans and 3% taro flour red beans increased the physical quality of chicken patties and can be accepted by consumers.

1. Introduction
Demand for fast food has increased in recent years due to lifestyle changes. Statistical data in 2018 shows that 35.61% of the community consumes fast food once a week [1]. The complexity of life develops and causes the community to need ready-to-eat food in processed products [2]. The ready-to-service meat products such as frankfurters, nuggets, and burgers are popular foods and in demand by consumers [3].

Chicken patty for burgers is popular meat processed fast food product in almost all countries due to practicality, and it is usually consumed as a snack or hunger delay food. However, the quality of the nutrition is questionable by health experts because it contains a high amount of animal fat, up to 30% [4]. Fat on meat products is an important source of energy and essential fatty acids, also containing fatsoluble vitamins [5]. Excessive fat consumption can lead to obesity, cardiovascular disease, and several types of cancer [6]. This encourages the development of healthy meat products that are the main target of the food industry for consumers.

Fat reduction in products can provide an unwanted effect, such as increased cooking shrinkage, deteriorating texture, and lower heating stability so that it is needed to minimize these changes [7]. One strategy that can be applied is the substitution of non-meat fat to achieve the desired texture.
characteristics and certain functional characteristics, including animal protein or vegetable, hydrocolloid, or food fiber [8]. There is the possibility of using vegetable fats that have a composition of unsaturated fatty acids better than animal fats.

Red beans are a good source of fat that can be used as a substitute for animal fat. Red beans contain 14.36% protein, 6.5% fat and 2.5% fiber [9]. A good product texture requires a source of carbohydrates to bind water and form gel [10], improve texture, reduce shrinkage due to cooking and increase product elasticity [11]. As a source of carbohydrates, especially starch, Taro flour contains 5.55% amylose levels and 74.45% amyllopectin levels [12]. Higher amyllopectin than amylose causes potato taste and texture into sticky and fluffy [13], and it can also maintain digestive health because it contains fiber. This current study aims to evaluate the physical and sensory characteristics of chicken patty products produced from the combination of fat sources and carbohydrates according to healthy food qualifications. This research is also important because chicken patties have certain formulations containing functional nutrients sourced from taro flour and red beans. Besides being bioactive for health, talas flour and red beans can also improve the quality of chicken patties. Therefore, it can be applied to replace beef patties for burgers with measurable quality, purchase value, and healthy and safe for consumers.

2. Materials and methods
Chicken patties were made from some ingredients with the proportion adjusted to research treatments (Table 1). Chicken patties were conducted according to modification as follows: firstly, chicken meat was minced into 5mm using a traditional grinder machine and stored in a refrigerator to maintain its temperature at 5°C [14]. Afterward, minced chicken meat was mixed well with other ingredients, including white egg of brown layer, red bean flour, tapioca, and seasoning. In the next step, the patty dough would be formed into a round shape with the weight of 80g, the diameter of 76 mm, and 17 mm in height. The chicken patties were then placed in plastic containers and stored in refrigeration to keep their temperature until testing.

| Ingredients          | C1   | C2   | C3   | C4   | C5   | C6   |
|----------------------|------|------|------|------|------|------|
| Minced chicken meat  | 66.0 | 66.0 | 71.0 | 71.0 | 76.0 | 76.0 |
| Red bean flour       | 15.0 | 15.0 | 10.0 | 10.0 | 5.0  | 5.0  |
| Tapioca flour        | 4.5  | 1.5  | 4.5  | 1.5  | 4.5  | 1.5  |
| Taro flour           | 0.0  | 3.0  | 0.0  | 3.0  | 0.0  | 3.0  |
| Iced water           | 3.0  | 3.0  | 3.0  | 3.0  | 3.0  | 3.0  |
| White egg            | 5.0  | 5.0  | 5.0  | 5.0  | 5.0  | 5.0  |
| Seasoning            | 4.5  | 4.5  | 4.5  | 4.5  | 4.5  | 4.5  |
| Salt                 | 1.4  | 1.4  | 1.4  | 1.4  | 1.4  | 1.4  |
| Stabilizer           | 0.3  | 0.3  | 0.3  | 0.3  | 0.3  | 0.3  |
| Sugar                | 0.3  | 0.3  | 0.3  | 0.3  | 0.3  | 0.3  |
| Total                | 100  | 100  | 100  | 100  | 100  | 100  |

The test of chicken patties consisted of pH, water-holding capacity, cooking loss, and tenderness. All samples were prepared according to the test. For pH measuring, as many as 10g of sample was ground well, and it then was poured and homogenized with 10 ml of distilled water in backer glass. The mixture was subsequently tested using a pH meter [15]. Next up, water-holding capacity was measured using modification [16], by pressing 0.3g of patty sample placed into between 2 glass plat using a load of 35kg for 5 minutes [17]. In the cooking loss testing, each 25g of samples was individually put into polyethylene plastic containers and tightly sealed [18]. The samples were then put into water bath at 88°C for 1 minute. After boiling, the samples were cooled using running water for 15 minutes, and they took off from the plastic containers and dried using clean tissue. Afterward, the samples were individually weighed and calculated using the formula:
Cooking loss = \frac{\text{weight before cooking} - \text{weight after cooking}}{\text{weight before cooking}} \times 100% \\

To measure the tenderness used penetrometer, 50g of patty sample was formed in square shape, and it was placed under the needle of penetrometer [19]. The needle was then stabbed into 3 different locations of the sample, and the tenderness value could be evaluated through the shifting scale on the tool.

All data were analyzed using analysis of variance (ANOVA), and if there was a significant difference of means, it would be continued using Duncan’s Test [20].

3. Results and discussion
The results of the physical quality of uncooked chicken patties are shown in Table 2.

The results of the analysis showed that there was a difference (p<0.01) in pH. The treatment of C5 and C6 resulted in different pH values compared to C1, 2, 3, 4. The results showed that the addition of 5% red beans, either without or with 3% taro flour caused a decrease in the pH of chicken patties. The results of this study are different from the previous study, in which the addition of black bean paste to the level of 10% in fresh chicken patties was not significantly different from the control [21]. These different results are possible due to differences in the type and form of the added base material. This study used red bean flour mixed into the main ingredient of chicken meat, while another study used black bean paste [21]. The addition of ingredients in food processing can affect the physicochemical and organoleptic quality [22], and one that can be affected is the pH value of the product. The decrease in the pH value is also possible due to the addition of meat and the reduction in red bean flour composition. Broiler chicken meat has a pH value in the range of 6.00-6.37 [23] so that an increase in the use of meat can result in a decrease in the pH of the patties.

| Physical Quality          | C1       | C2       | C3       | C4       | C5       | C6       |
|---------------------------|----------|----------|----------|----------|----------|----------|
| pH                        | 6.8±0.01b | 6.6±0.01b | 6.7±0.01b | 6.6±0.01b | 6.5±0.01a | 6.3±0.01a |
| Cooking loss (%)**        | 2.89±1.37a | 3.98±0.43b | 2.14±0.42a | 2.24±0.25b | 5.4±1.36c | 4.78±2.32b |
| Water holding capacity (%) | 32.45±4.91a | 34.5±2.06b | 38.8±3.84b | 36.1±3.89b | 41.8±1.75c | 42.8±3.81d |
| Tenderness (mm/minutes)   | 4.76+0.39b | 5.28±0.12a | 4.86+0.15b | 5.04+0.19a | 4.92+0.15b | 5.01+0.19a |

Information:
* P <0.05
** p <0.01
a,b,c,d Different superscript in the same line showed significantly different

C0 = comparison of meat, red beans, tapioca flour and taro flour = 62: 15: 5.5: 0
C2 = comparison of meat, red beans, tapioca flour and taro flour = 62: 15: 1.5: 3
C4 = comparison of meat, red beans, tapioca flour and taro flour = 67: 10: 4.5: 0
C6 = comparison of meat, red beans, tapioca flour and taro flour = 67: 10: 1.5: 3
C8 = comparison of meat, red beans, tapioca flour and taro flour = 72: 5: 4.5: 0
C10 = comparison of meat, red beans, tapioca flour and taro flour = 72: 5: 1.5: 3

The results showed that there was a significant difference in the value of cooking loss (CL) (P<0.01) between treatments C2, C5, and C6 against C1, C3, and C4. The addition of red beans at the lowest level of 5% had the highest cooking loss CL in patties. The cooking loss value is related to the amount of water bound in the meat [17]. Thus an increase in the CL value indicates the amount of liquid that comes out of the patties during cooking. The results of this study agreed with previous research [24], which found that decreasing the use of Moringa seed flour, which is a source of vegetable fat, can reduce the value of CL in beef burgers. Furthermore, it was also stated that the swelling of the fiber influenced the CL value during product cooking, so that fat and protein could be absorbed and form a matrix in the meat grinder. This is possible because the decrease in the red bean content can reduce the fat content, so the amount of fat bound in the fiber decreases and affects the CL value of the patties.

The results showed that there were differences (P<0.01) in the water holding capacity (WHC) patties produced from the treatment formulas C3, 5, and 6 to C1, 2, and 4. The WHC values at C3, 5, and 6
were higher than C1, 2, and 4. The value of WHC patties with the addition of taro flour increased and was better than tapioca flour. Several types of flour containing starch and amylopectin are used in meat products to form an emulsion gel as a liquid binding agent in the meat product [25]. Taro flour has a range of higher amylopectin and amylose content than tapioca flour [26], so the ability of taro flour to bind meat liquid is higher.

The tenderness of chicken patties showed a significant difference (P<0.05) between treatments. The value of tenderness of patties produced from formulas C2, 4, and 6 have a higher tenderness value than C1, 3, and 5. The addition of taro flour can increase the tenderness value of chicken patties. This showed that taro flour could cause chicken patties to have a lower level of hardness. The results of this study are different from the previous study, in which the addition of taro starch caused an increase in the hardness of chicken nuggets [27]. Furthermore, it was also stated that the increase in hardness was caused by the retrogradation of taro starch when the nugget dough was cooled where the amylose formed a rigid and hard character. In this study, the retrogradation of taro starch could be prevented by adding a source of vegetable fat as an emulsion-enhancing function that could weaken protein cross-links in meat. The addition of fat to pork patties can increase the value of tenderness, or patties become more tender by weakening protein cross-links [28]. The addition of taro flour can improve the level of tenderness in goat meatballs so that with the addition of taro flour goat meatballs are more tender [28]. A combination of ingredients for meat products will determine the quality of the product [29]. Therefore, the difference in the value of tenderness in this study was due to the different types of meat and red beans.

4. Conclusion

The addition of 10% red beans and 3% taro flour red beans increased the physical quality of chicken patties and can be accepted by consumers.

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