Optimization of Ganyong Starch (*Canna edulis*) on Making of Dry and Instant Noodles

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Abstract. Ganyong (*Canna edulis*) noodle is one of the diversified products of composite starch-based carbohydrate from ganyong starch and wheat flour. This research aims to determine the effect proportion of wheat flour and ganyong starch to the organoleptic quality of: (1) dry and instant noodles; (2) dried and instant boiled noodles. The data of this experimental research was analysed by Friedman test. The results show that: (1) There was no effect of composite flour to the shape, flavour and colour of dry noodles and there was influence of the use of composite flour on dried instant noodles; (2) There was influence of the proportion of wheat and starch composite flour to form, and there was no effect on the elasticity, shape, colour, flavour, taste and likes of instant noodles in boiled form. This research supports government policy in order to accelerate diversification of food consumption based on local resources.

1. Introduction
Noodles are one type of food consumed as a staple food. This food is made from unleavened dough made from various types of components [1]. Based on the basic ingredients, various kinds of noodles are made from flour (wet, dry, instant noodles), rice flour (rice noodles), mung bean starch (*soun*) and a mixture of flour and rice flour (*shoimein*). The raw material for noodles is wheat imported from abroad. Various variations of processed flour products and changes in lifestyle cause an increase in wheat imports. Efforts to reduce wheat imports are replacing them with flour or local starch including Ganyong or Canna starch (*Canna edulis*).

Processing tubers Ganyong or Canna into prospective flour or starch in terms of functional properties and chemical composition [2]. Many studies have been carried out namely the use of canna flour and flour in the processing of noodles [3, 4] and the use of Ganyong or Canna starch for making rice noodles [5, 6]. In making noodles, the use of flour can be reduced by the presence of ganyong or Canna starch. Flour cannot be completely replaced by Ganyong or Canna starch, because the amylose content of Canna starch is relatively low. In accordance with the study Herawati et al., that noodles that use canna flour are 100% less preferred by panelists because of their stickiness and low noodle elasticity [7]. Aprianita et al. [8] stated that the amylose content of canna flour was 233.2%. Ideal starch as raw material for noodles is starch with high amylose content [9], so the use of flour is still needed in making noodles. The purpose of this study was to determine the effect of the proportion of Ganyong or Canna starch on organoleptic quality: (1) dry and instant noodles; (2) boiled noodles from dry and instant noodles.

2. Materials and Methods
The independent variable in this experimental study was the proportion of Ganyong or Canna starch and the dependent variable was the organoleptic properties of dried and instant Ganyong or Canna noodles.
2.1. Materials
The Ganyong or Canna starch material used in this study was produced by itself with the manufacturing procedure from the results of previous studies, namely by the method of destroying canna tubers in a shredded manner [10]. Other ingredients were flour. The tools used are noodle making machines, deep fryer and drying machines.

2.2. Process
The process of making noodles was done with several modifications, namely the proportion between wheat flour and Ganyong or Canna starch: 60:40; 50:50 and 40:60. Dry noodle making begins with the process of mixing the ingredients with the mixer to form granules. The mixture was ground to form a sheet with a thickness of 0.4 mm. Then cut with a flat shape. The dough is then printed in a circular shape weighing 30 grams. The noodle dough was placed on perforated aluminium molds and steamed for 10 minutes. Steamed noodles were then cooled with a blower at 50°C and dried by oven at a temperature of 50-60°C.

Making instant noodles begins with the process of mixing ingredients. The mixture was ground to form a sheet with a thickness of 0.4 mm. The noodle sheet was cut and then printed in a circular shape weighing 30 grams. The noodle dough is placed on perforated aluminium moulds and steamed for 10 minutes. Steamed noodles were then cooled with a blower at 50°C and dried by oven at a temperature of 50-60°C. The dried Ganyong or canna noodles were then fried with plenty of oil with the help of a deep fryer at a temperature of 160°C for 3 minutes. Instant Ganyong or Canna noodles were removed and drained.

2.3. Data Collection
Data collection techniques were carried out by observation through an organoleptic test conducted by 15 trained panelists. The parameters measured from dry and instant noodles in dry form were organoleptic quality in terms of: (a) form; (b) colour; (c) flavour. The parameters measured from dried and instant canna noodles in boiled form were organoleptic quality in terms of: (a) elasticity; (b) form; (c) colour; (d) flavour; (e) taste; and (f) preferences. Data were analysed with non-parametric statistics, namely the Friedman test with the help of the SPSS program. Data from Friedman's analysis of the quality of organoleptic dried and instant Ganyong or Canna noodles were then determined the best dry and instant noodle products.

3. Results and Discussions

3.1. Organelleptic assessment of dried and instant Ganyong or Canna noodles in dry form

3.1.1. Organoleptic assessment of dried noodles
Based on the results of the Friedman test, the proportion of flour and Ganyong or Canna starch used had no effect on the colour of canna noodles as indicated by the value of Xr2 (Chi-Square) = 5.692 smaller than the value of X 2 0.05 (2) = 5.99 with a probability of p = 0.058 greater from the real level of 0.05 (> 5%). Ganyong or Canna starch flour has a carbohydrate content of 84.34%. Of this amount, amylepectin was higher than the amylase which reaches 50-60% [11]. This amount causes the ability to absorb water lower, so that the viscosity becomes higher and the consistency of the resulting gel is harder and more sticky. The ability of starch in gel formation with stronger sticky properties will result in the form of noodles with denser and more elastic (elongated) tissue structures. Thus Ganyong or Canna starch flour can substitute flour because Ganyong or Canna starch with high amylepectin content also has the ability to gel more sticky and elastic in accordance with the properties of gluten protein and starch in flour.

The proportion of flour and Ganyong or Canna starch used did not affect the colour of canna noodles as indicated by the value of Xr2 (Chi-Square) = 0.400 smaller than the value of X 2 0.05 (2) = 5.99 with a probability of p = 0.819 greater than the real level 0.05 (> 5%). The colour of Ganyong or Canna noodles was influenced by the degree of white which showed the level of colour that was owned by the type of flour used. The degree of white was one element of the assessment of flour quality because
it will determine the power of appearance/attractiveness and the results of its processing. The assessment of the degree of white produced from the optimal extraction results of Ganyong or Canna tuber with 1% sodium bisulfite concentration was 72.1 [12]. This value was significantly different from the white degree value of wheat flour, which was 82.17 [11]. In this study the effect of composite flour does not give a different effect on the colour of noodles produced, because the noodles have undergone a drying process. In this process browning reaction occurs as a result of heating carbohydrates in flour, as a result does not give a different effect on the colour of the noodles produced.

The proportion of flour and Ganyong or Canna starch used had no effect on the aroma of canna noodles as indicated by the value of Xr2 (Chi-Square) = 1.652 smaller than the value of X 2 0.05 (2) = 5.99 with a probability of p = 0.438 greater than the real level 0.05 (> 5%). Fragrance in foodstuffs was formed by volatile compounds which were water insoluble, proteins and fats that evaporate when given a heating treatment. Fat causes oxidation which causes unpleasant formation and flavour. Likewise, high protein will cause unpleasant odors. The ingredients that trigger the smell will determine the quality rating of flour. Whereas good flour quality has a neutral flavour. The neutrality of the aroma of starch/flour was actually influenced by low levels of fat and protein [11]. Gayong starch type contains protein levels below 1%. It's just that it has the highest fat content compared to other types of flour and starch which reaches 6.43% [11]. This was the cause of the emergence of a relatively sharp distinctive flavour of Ganyong or Canna starch products in fresh condition. Thus this type of starch has a non-neutral flavour. This disadvantage makes it difficult for noodle products made from canna starch, because it changes the flavour of noodles produced.

3.1.2. Organoleptic assessment of instant Ganyong or Canna noodles
The proportion of flour and Ganyong or canna starch used to influence the form of dry instant cane noodles as indicated by the value of Xr2 (Chi-Square) = 7.600 greater than the value of X 2 0.05 (2) = 5.99 with a probability of p = 0.022 greater than the real level 0.05 (> 5%). There was an effect of flour proportion and canna starch on the form of noodles and the results of further tests indicate that composite flour has a different effect on the form of Ganyong or Canna noodles produced. The proportion of 60:40 Ganyong or Canna starch gives the same shape as the 50:50 Ganyong or Canna starch which showed from the shape of the dried instant Ganyong or Canna noodles. The two composite flour treatments provide different forms of noodles with the 40:60 Ganyong or Canna starch proportion, namely the shape of the strands was quite intact.

Wheat protein was elastic (creep) but hardens when heated, while starch with the ability to form a gel will also harden when heated in line with [13] that gluten in wheat can make the dough harder and not easily torn or broken due to its elastic nature, cohesive and strong. The nature of starch from Ganyong or Canna starch was somewhat different because it contains higher amylopectin, which was 50-60% of the amount of carbohydrates which reaches 84.34% [12]. This amount causes the ability to absorb water lower, so that the viscosity becomes higher and the consistency of the resulting gel was harder and more sticky. The ability of starch in gel formation with stronger sticky properties will result in the form of noodles with denser and more elastic (elongated) tissue structures. Thus the higher the proportion of Ganyong or Canna starch used will result in the form of noodles with a denser network structure.

The proportion of flour and Ganyong or Canna starch used had no effect on the colour of dry instant canna noodles as indicated by the value of Xr2 (Chi-Square) = 2.138 less than the value of X 2 0.05 (2) = 5.99 with a probability of p = 0.343 greater than the real level 0.05 (> 5%). Ganyong or Canna noodle colour influenced by the white degree which shows the level of colour that was owned by the type of flour used for the assessment of flour quality because it will determine the power of appearance/attractiveness and the processed product. The assessment of the white degree of Gayong or Canna starch produced from the optimal extraction results of canna tuber with 1% sodium bisulphite concentration was 72.1. This value was significantly different from the white degree value of wheat flour, which was 82.17 (BKP and FTP: 2002). In this study the proportion of composite flour had no effect on the colour of Ganyong or Canna noodles, because the noodles had undergone a drying process. Previous studies reported differences in the proportion of canna flour used to influence the colour of noodles, especially the brightness of noodles [14]. In this process browning reaction occurs as a result
of heating carbohydrates in flour, as a result does not give a different effect on the colour of the noodles produced.

The proportion of flour and Ganyong or Canna starch used had no effect on the flavour of Ganyong or Canna noodles as indicated by the value of Xr² (Chi-Square) = 2.138 less than the value of X ² 0.05 (2) = 5.99 with the probability of p = 0.343 greater than the real level 0.05 (> 5%). The flavour formed by volatile compounds, proteins and fats in food that evaporate when given a heating treatment. And the nature of the compound was insoluble in water. The presence of fat will cause oxidation which causes the formation of unpleasant taste and flavour. Similarly, the presence of high protein levels will cause unpleasant odors. In this study, the flavour of noodles caused by the main raw material, namely wheat flour and Ganyong or Canna starch. The smell of starch/flour with good quality was neutral. Thus the neutrality of the flavour of starch/flour was actually influenced by low levels of fat and protein [11]. Fat content of canna starch was higher than flour, which was 6%. This causes the emergence of a relatively sharp distinctive flavour of Ganyong or Canna starch products. In this study the proportion of flour and Ganyong or Canna starch had no effect on the flavour of noodles because the form of noodles was dry.

3.2. Organoleptic assessment of boiled noodles from dried and instant noodles.

3.2.1. Organoleptic assessment of boiled noodles from dried noodles

The proportion of flour and Ganyong or Canna starch used had no effect on the elasticity of boiled dried Ganyong or Canna noodles as indicated by the value of Xr² (Chi-Square) = 2.562 smaller than the value of X ² 0.05 (2) = 5.99 with a probability of p = 0.279 greater than the real level 0.05 (> 5%). The elasticity of Ganyong or Canna noodles formed by gluten protein and starch derived from Ganyong or Canna. Gluten protein has elastic properties that give the character of elasticity after boiling noodles. According to [13] which says that gluten in wheat can make the dough harder and not easily torn or broken because of its elastic, cohesive and strong nature. Wheat starch with its two constituent elements (amylose and amylopectin) was a gelling agent through a starch gelatinisation process that will form a sticky character. Even high levels of amylopectin from Ganyong or Canna starch were even more beneficial because the resulting gel was more sticky, so it can further strengthen the gel formed. With the reduction in the amount of gluten protein from flour, it can be replaced by Ganyong or Canna starch which actually has advantages in high amylopectin levels. The structural properties of elastic and cohesive amylopectin produce a more doughy mixture so that instant noodles were not easily broken [15].

The proportion of flour and Ganyong or Canna starch used to influence the form of boiled dried canna noodles as indicated by the value of Xr² (Chi-Square) = 9.742 greater than the value of X ² 0.05 (2) = 5.99 with a probability of p = 0.008 greater than the real level 0.05 (> 5%). The results of further tests showed that composite flour had a different effect on the form of boiled dried Ganyong or Canna noodles. The treatment of 60:40 Ganyong or Canna starch gave the same noodle shape as the treatment on 50:50 Ganyong or Canna flour starch which showed from the strands of boiled dried Ganyong or Canna noodles which had a fairly intact strand. The two composite flour treatments gave a different form of noodles to the 40:60 wheat flour-starch proportions, ie the shape of the blade was slightly destroyed.

The form of Ganyong or Canna noodles produced from the characteristics of wheat protein and starch contained in Ganyong or Canna starch. Wheat protein was elastic but hardens when heated, while starch with its ability to form a gel will also harden when heated. The nature of starch from Ganyong or Canna starch was somewhat different because it contains higher amylopectin, which was 50-60% of the amount of carbohydrates which reaches 84.34% [12]. This amount causes the ability to absorb water lower, so that the viscosity becomes higher and the consistency of the resulting gel is harder and more sticky. The ability of starch in gel formation with stronger sticky properties will result in the form of noodles denser and more elastic tissue structures.

The proportion of flour and Ganyong or Canna starch used had no effect on the colour of canna noodles as indicated by the value of Xr² (Chi-Square) = 1.050 smaller than the value of X ² 0.05 (2) = 5.99 with a probability of p = 0.592 greater than the real level 0.05 (> 5%). The colour of Ganyong or
Canna noodle influenced by the white degree which shows the level of colour that was owned by the type of flour used for the assessment of flour quality because it will determine the power of appearance/attractiveness and the processed product. The assessment of the white degree of Ganyong or Canna starch which is produced from the optimal extraction results of Ganyong or Canna tuber with 1% sodium bisulfite concentration was 72.1. This value was significantly different from the white degree value of wheat flour, which is 82.17 [11]. In this study, the proportion of composite flour had no effect on the colour of Ganyong or Canna noodles, because the noodles had undergone a drying process. In this process, browning occurs as a result of heating carbohydrates in flour, as a result it does not give a different effect on the colour of the noodles produced. This contradicts the results of previous studies which found the proportion of Ganyong or Canna starch used affected the colour of noodles [14].

The proportion of flour and Ganyong or canna starch used did not affect the flavour of Ganyong or canna noodles as indicated by the value of $Xr^2$ (Chi-Square) = 3.588 less than the value of $X^2$ 0.05 (2) = 5.99 with the probability $p = 0.166$ greater than the real level 0.05 (> 5%). The flavour formed by volatile compounds, proteins and fats in food that evaporate when given a heating treatment. And the nature of the compound was insoluble in water. The presence of fat will cause oxidation which causes the formation of unpleasant taste and flavour. Similarly, the presence of high protein levels will cause unpleasant odors. In this study, the flavour of noodles was formed by the main raw materials, namely wheat flour and Ganyong or Canna starch. One of the quality assessments on the type of starch and flour was from the flavour. This was because the fat content of canna flour was 0.59% (db). The low fat content in canna flour was related to the low fat content of Ganyong or Canna tuber. Protein content of Ganyong or Canna flour was 3.04% (db) [14]. The good flavour of starch/flour was neutral. The neutrality of the flavour of starch/flour was actually influenced by low levels of fat and protein [11]. Ganyor or Canna starch has a sharp distinctive flavour because of its high fat content compared to flour. In this study the proportion of composite flour had no effect on the flavour of Ganyong or Canna noodles which the form of the sample was boiled, because the nature of the compound evaporated during heating and was not water soluable.

The proportion of flour and Ganyong or Canna starch used had no effect on the taste of boiled dried canna noodles as indicated by the value of $Xr^2$ (Chi-Square) = 1.143 less than the value of $X^2$ 0.05 (2) = 5.99 with a probability $p = 0.565$ greater than the real level 0.05 (> 5%). According to Swinkels and Veendams [11], the presence of high levels of fat in starch has a less favorable effect such as causing oxidation of fat so that the taste of starch was unpleasant.

### 3.2.2. Organoleptic evaluation of boiled instant noodles

The proportion of flour and Ganyong or Canna starch used had no effect on the colour of canna noodles as indicated by the value of $Xr^2$ (Chi-Square) = 5.630 smaller than the value of $X^2$ 0.05 (2) = 5.99 with a probability $p = 0.060$ greater than the real level 0.05 (> 5%). The elasticity of Ganyong or Canna noodles was formed by gluten protein and starch derived from Ganyong or Canna starch. Gluten protein has elastic properties that give the character of elasticity after boiling noodles. Wheat starch with its two constituent elements (amylose and amylopectin) was a gelling agent through a starch gelatination process that will form a sticky character. Even high levels of amylopectin from Ganyong or Canna starch were even more beneficial because the resulting gel was more sticky. So that it can further strengthen the gel formed. With the reduction in the amount of gluten protein from flour, it can be replaced by Ganyong or Canna starch which actually has advantages in high amylopectin levels. With this basis, it can be ascertained that the results of the analysis on the proportion of composite flour did not affect the elasticity of boiled dried Ganyong or Canna noodles. In addition, depending on the time of rehydration. Rehydration time was the time needed for noodles to absorb water again so that the texture was hard and elastic as before drying. Optimal rehydration time was done by cooking the noodles in boiling water, and then calculating the time needed until the noodles were thoroughly cooked and ready to eat, but prevent them from being overcooked. Determination of optimal rehydration time was important to produce the desired noodle texture. If the noodles were too ripe, the noodles can become sticky and break easily. Conversely, if it was not ripe, the noodle center will still feel hard when chewed [14].

The proportion of flour and Ganyong or Canna starch used had no effect on the form of boiled instant canna noodles as indicated by the value of $Xr^2$ (Chi-Square) = 3,500 less than the value of $X^2$ 0.05 (2) = 5.99 with the probability $p = 0.166$ greater than the real level 0.05 (> 5%). The addition of dried canna noodles into the optimal flour composition produced from the optimal extraction results of Ganyong or Canna tuber with 1% sodium bisulfite concentration was 72.1. This value was significantly different from the white degree value of wheat flour, which is 82.17 [11]. In this study, the proportion of composite flour had no effect on the form of boiled dried Ganyong or Canna noodles, because the noodles had undergone a drying process. In this process, browning occurs as a result of heating carbohydrates in flour, as a result it does not give a different effect on the form of the noodles produced. This contradicts the results of previous studies which found the proportion of Ganyong or Canna starch used affected the form of noodles [14].
0.05 (2) = 5.99 with a probability of p = 0.174 greater than the real level 0.05 (> 5%). Ganyong or Canna starch flour has a carbohydrate content of 84.34% [12]. Of this amount, amylopectin was higher than the amyllose which reaches 50-60% [11]. This amount causes the ability to absorb water lower, so that the viscosity becomes higher and the consistency of the resulting gel was harder and more sticky. The ability of starch in gel formation with stronger sticky properties will result in the form of noodles with a denser network structure. On this basis, substitution of Ganyong or Canna starch on flour did not affect the form of Ganyong or Canna noodles, because Ganyong or Canna starch with high amylopectin content also has the ability to gel more sticky and plastic in accordance with the properties of gluten protein and starch in flour.

The proportion of flour and Ganyong or Canna starch used had no effect on the colour of Ganyong or Canna noodles as indicated by the value of Xr² (Chi-Square) = 2.385 smaller than the value of X 2 0.05 (2) = 5.99 with a probability of p = 0.304 greater than the real level 0.05 (> 5%). Canna noodle colour influenced by the white degree which shows the level of colour that was owned by the type of flour used for the assessment of flour quality because it will determine the power of appearance/attractiveness and the processed product. The assessment of the white degree of Ganyong or Canna starch produced from the optimal extraction results of Ganyong or Canna tuber with 1% sodium bisulfite concentration was 72.1. This value was significantly different from the white degree value of wheat flour, which is 82.17 [11]. In this study the proportion of composite flour had no effect on the colour of Ganyong or Canna noodles, because the noodles had undergone a drying process. In this process browning reaction occurs as a result of heating carbohydrates in flour, as a result does not give a different effect on the colour of the noodles.

The proportion of flour and Ganyong or Canna starch used had no effect on the flavour of boiled instant canna noodles as indicated by the value of Xr² (Chi-Square) = 2.229 smaller than the value of X 2 0.05 (2) = 5.99 with the probability of p = 0.328 greater than the real level 0.05 (> 5%). The flavour formed by volatile compounds, proteins and fats in food that evaporate when given a heating treatment. And the nature of the compound was insoluble in water. The presence of fat will cause oxidation which causes the formation of unpleasant taste and flavour. Similarly, the presence of high protein levels will cause unpleasant odors. In this study, the flavour of noodles was formed by the main raw materials, namely wheat flour and Ganyong or Canna starch. One of the quality assessments on the type of starch and flour was from the flavour. The good flavour of starch/flour was neutral. The neutrality of the flavour of starch/flour was actually influenced by low levels of fat and protein [11]. According to the results of the study, starch of gayong or Canna contains protein levels below 1%. However, the highest fat content compared to other types of starch, which reached 6.43% [11]. This was the cause of the emergence of a relatively sharp distinctive flavour of Ganyong or Canna starch products. Thus this type of starch has a non-neutral flavour. This deficiency makes constraints on noodle products made from Ganyong or Canna starch. In this study the proportion of composite flour had no effect on the flavour of Ganyong or Canna noodles, because the samples of Ganyong or Canna noodles in boiled form while the flavour properties of food will evaporate when heated and not water soluble, which actually reduces the flavour of Ganyong or Canna noodles.

The proportion of flour and Ganyong or Canna starch used had no effect on the taste of boiled instant canna noodles as indicated by the value of Xr² (Chi-Square) = 0.750 smaller than the value of X 2 0.05 (2) = 5.99 with a probability of p = 0.687 greater than the real level 0.05 (> 5%). According to Swinkels and Veendams [11], the presence of high levels of fat in starch has a less favorable effect such as resulting in fat oxidation so that changing the taste of starch becomes unpleasant. In this study the fat content found in Ganyong or Canna starch was the highest (6.43) compared to wheat flour, which was 1.07.

4. Conclusion
There was no effect of using wheat flour-starch proportions on the shape, flavour and colour of dried Ganyong or Canna noodles and there was an effect of wheat-starch flour on the form of dried instant Ganyong or Canna noodles, but not on the colour and flavour. There was an influence of wheat flour-Ganyong or Canna starch on the form, but it has no effect on the elasticity, colour, flavour of dried of
Ganyong or Canna noodles and no influence of wheat flour-Ganyong or Canna starch on elasticity, shape, colour, flavour, taste and preference of boiled Ganyong or Canna noodles instant.

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