# EFFECT OF AMYLOSE CONTENT AND HEATING TEMPERATURE ON CHARACTERISTICS OF FRESH RICE FLOUR-BASED SPRING ROLL WRAPPERS

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# EFFECT OF AMYLOSE CONTENT AND HEATING TEMPERATURE ON CHARACTERISTICS OF FRESH RICE FLOUR-BASED SPRING ROLL WRAPPERS

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## ABSTRACT

The effects of amylose content and heating temperature on characteristics of fresh rice flour-based spring roll wrappers were investigated by using added free amylose of cassava to rice flour. The used rice flour in this research was from variety Mentik ( an Indonesian local rice variety ). Amylose content of blended rice flour ranged from 25% up to 40%. The fresh rice flour-based spring roll wrappers were made without frying oil on Teflon frying pan at 72°C and 82°C during 4 minutes. After heating, the product was tempered for 30 minutes at 25°C. The product was evaluated for rice starch granules size, moisture content, water activity and elongation at break. Each experiment was conducted by three replications. All of the data were analyzed by analysis of variance (α 5%). Duncan multiple range test (α 5%) was used to determine the significant difference among the treatments. The result showed that free amylose adding to rice flour blend homogenized the swelling of rice starch granules. The increasing of amylose content more than 34% increased water activity. The amylose content from 31 % up to 40% increased the moisture content. Increasing amylose content decreased elongation at break. Calculated amylose content in the range of 25% to 31% at 72 ° C for 4 minutes produced products with relatively high elongation at break of 14.45% -16.84%. Heating temperature at 82 ° C for 4 minutes produced lower elongation at break characteristics which ranged between 10, 16% to 12.02%.

**Keywords:** amylose content, heating temperature, fresh spring roll, rice flour, characteristics.

## INTRODUCTION

Characteristics of fresh rice flour-based spring roll wrapper are affected by several factors, such as natural properties of rice, heating temperature and duration of heating. Gertz (2000) in Jack (2006) described the changes during heating, it is involved mass transfer, heat transfer, removal of heat, internal cooking and several physicochemical reactions. The rate of evaporation and water migration within the product will determine the final characteristics of the food product. If the rate of evaporation and water migration were not optimal, the gummy texture will be produced. There are some parts that bind more hydration water, so that the impression is not mature (under-cooked). Evaporation of water in the layers of material (subsurface water) will also cause heat loss from the surface toward the center of the material. Lanner *et al*. (2001) stated that the heating temperature must be regulated in order to optimize the evolution of water vapor from the constant rate period of moisture loss during heating or frying. Certain degree of gelatinization should be reached in order to get sufficient tensile strength and to prevent cracking due to uneven distribution of water (Wanous, 2004).

Low heating temperature resulted insufficient gelatinization process. The gummy texture due to excessive hydration during inefficient heating process (Lanner et al., 2001). Mechanical properties of formed gel are strongly influenced by time and temperature in addition to tempering conditions. It was also affected by protein and polysaccharide content, pH and the addition of salt (Nunes *et al*., 2003). Heating temperature has a role in the decomposition of the biopolymer structure into smaller parts which results in increased molecular interactions. Heating temperature is an important factor in the formation of a stable film, in related to the implementation of thermal gelation, denaturation, and precipitation (Li, *et al*., 2005). Heating temperature has to provide enough energy to denature various proteins of rice varieties, at 73.3 ° C for albumin and 82.2 ° C for glutelin, whereas the temperature is required for protein-starch interaction of rice around 80.5 ° C ( Ju *et al*., 2001). Egg white albumin began to coagulate at 62 ° C and becomes very solid at temperatures higher than 70 ° C (Endre and Monegle, 1987 in Mukprasirt *et al*., 2000). Increasing heating temperature 70°C to 80°C induced protein denaturation that produce an increase in the number and localization of a stronger bond between the chains of the protein. It will decreased ability of detention stretches that can be observed with elongation decreasing of edible films made from green bean protein (Bourtoom, 2008). Thus the heating temperature will determine the characteristics of food product, which is included spring roll wrapper.Too long heating will result in fracture of the matrix due to shrinkage as

a result of evaporation of water and damage the binding material ability of starch (Anderson and Hodson, 2006). Proper heating temperature will produce a cohesive mass that can be caused by an increasing amount of amylose in a continuous phase of the system and the occurrence of strong interactions between starch granules and the continuous matrix system (Rodriguez-Sandoval *et al.*, 2008). Thus, the temperature and duration of heating determine the characteristics of the product.

Starches with higher amylose content will form stronger gel and will be more difficult to damage. Increasing of amylose content will inhibit the swelling of the granules thus maintained the integrity of the swollen starch granules. The purpose of this study is to investigate the influence of amylose content and heating temperature on the characteristics of fresh rice flour-based spring roll wrappers.

## MATERIALS AND METHOD

### Materials

Mentik rice from Candi, Nglames, Madiun, obtained from the UD. Eka Jaya rice mill at Surabaya. Rice flour obtained by grinding the rice in dry process (without soaking) and be sifted by a 80 mesh sieve size. Amylose extraction from tapioca used modified method of Takeda et al. (1986) and Patindol et al. (2003). Leghorn chicken eggs obtained from a local shop in Surabaya.

### Methods

The research design was factorial experiment with randomized completely block design. Various factors is the amylose content consists of six levels: 25%; 28%; 31%; 34% ; 37% and 40% (w / w); while heating temperature on 72°C and 82 °C. The observed dependent variables are starch granule size, $a_w$, moisture content and elongation at break. The data were processed by analysis of variance, the difference of among treatments were tested by Duncan Multiple Range Test with $\alpha = 5\%$. Starch granules size was measured by using Olympus DP 20 Digital Camera Microscope. Water activity was measured with a Rotronic hygrometer AW1 Hygro Palm at 85% RH + / - 1% at temperature of 25 ° C + /-2 ° C. Moisture content was measured by gravimetric method (AOAC, 2000). Elongation at break was measured by Shimadzu Autograph. The batter has been mixed to be homogeneous by placing the mixture on a Labinco magnetic stirrer hot plate model L-81with speed of 100 rpm for 2 minutes, then placed on a Teflon material frying pan (diameter 10 cm). Heating was held for 4 minutes. The formulation are listed in Table 1.

Table 1. Formula of Fresh Rice flour-based Spring Roll Wrapper

| Ingredients (g) | Amylose Content (%) | | | | | |
|---|---|---|---|---|---|---|
| | 25 | 28 | 31 | 34 | 37 | 40 |
| Rice Flour | 3.00 | 2.85 | 2.70 | 2.55 | 2.40 | 225 |
| Crude amylose of 85% purity* | 0.00 | 0.15 | 0.30 | 0.45 | 0.60 | 075 |
| White Egg | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 |
| Water | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 |
| Tapioca | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Total (g) | 13.00 | 13.00 | 13.00 | 13.00 | 13.00 | 13.00 |

## RESULTS AND DISCUSSION

### Rice Starch granules size

Data in Table 2. showed a significant difference in the effects of amylose content and there was interaction between two factors to the size of rice starch granules.

Table 2. Rice Starch Granule Size of Fresh Rice Flour-based Spring Roll Wrappers on Different Levels of Amylose and Heating Temperature

| Heating Temperature (° C) | Rice Starch Granule Size (µm2)* Amylose Content (%) 25 | 28 | 31 | 34 | 37 | 40 |
|---|---|---|---|---|---|---|
| 72 | 1673.14 **h** | 1531.39 **f** | 1476.12 **d** | 1408.92 **c** | 1323.34**b** | 1271.57 **a** |
| 82 | 1700.85 **i** | 1609.67 **g** | 1506.48 **e** | 1484.40 **de** | 1415.69 **c** | 1344.85 **b** |

*Values in same column with different letter are significantly different based on DMRT test with α =5%

Starch granules size decreased significantly with increasing amylose content on both heating temperatures. This is caused by increasing levels of amylose starch, the more hydrophilic side of the dough system, resulting in competition between the granules in water absorption and produced restriction of swelling. Swelling restrictions would affect the cohesiveness and elongation (Shih, 1996). It also affected distance between the granules with one another, so at the optimal distance will result cohesive and flexible product with sufficient high elongation characteristics. The data also showed an increase in the size of rice starch granules in the respective levels of amylose starch at 82°C compared to products of heating temperature at 72 ° C. Increased temperature lead to breaking of some bonds between and intra molecular which makes the structure of starch granules are more open and to facilitate the entry of water in the structure of starch granules (Hongsprabhas, 2007).

**Water activity ($a_w$)**

Table 3 showed a trend of increasing in $a_w$ as increased levels of amylose. This phenomena could be influenced by amylose alignment molecules which produced free water.

Table 3. $A_w$ of Fresh Rice Flour-based Spring Roll Wrappers on Different Levels of Amylose and Heating Temperature

| Heating Temperature (° C) | Amylose Content (%)* 25 | 28 | 31 | 34 | 37 | 40 |
|---|---|---|---|---|---|---|
| 72 | 0.509 **a** | 0.512 **ab** | 0.514 **b** | 0.521 **c** | 0.527 **c** | 0.535 **d** |
| 82 | 0.653 **h** | 0.659 **i** | 0.665 **j** | 0.609 **g** | 0.603 **f** | 0.598 **e** |

*Values with different letter are significantly different based on DMRT test with α =5%

This phenomenon is supported by the strong correlation between size of rice starch granules and $A_w$ with a coefficient of determination (R2) of 0.92 (Y = 7506.6 X -11688.05) as shown on Fig. 1.

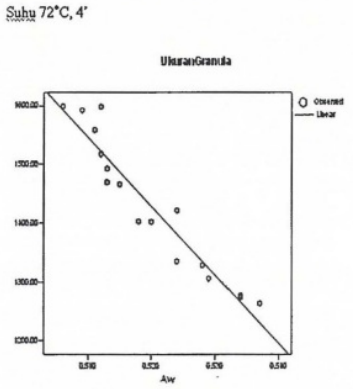


Figure.1 Regression Curve between Starch Granule Size and $A_w$ on 72 ° C Heating **Moisture Content**

The average moisture content showed a trend of increasing water content as increasing levels of amylose.

Table 4. Water Content of Fresh Rice Flour-based Spring Roll Wrappers on Different Levels of Amylose Content

| Amylose content (%) | Water content (%)* |
|---|---|
| 25 % | 34.76 **a** |
| 28 % | 36.49 **ab** |
| 31 % | 38.15 **bc** |
| 34 % | 38.85 **bc** |
| 37 % | 40.35 **c** |
| 40 % | 40.74 **c** |

*Values with different letter are significantly different based on DMRT test with α =5%

This phenomenon is caused by the amount of water trapped in the gel system will increase along with greater levels of amylose in the material system. The data in Table 5 showed an average decline in water levels with an increase in heating temperature from 72 ° C to 82 ° C. This is due to the increase in heating temperature means an increase in the rate of evaporation of free water that produce lower water content.

Table 5. Water Content of Fresh Rice Flour-based Spring Roll Wrappers on Different Heating Temperature

| Heating Temperature (° C) | Water content (%)* |
|---|---|
| 72 | 39.67 **b** |
| 82 | 36.74 **a** |

*Values with different letter are significantly different based on DMRT test with α =5%

**Elongation**

An increasing of amylose content decreased elongation due to longer distance of molecular components as the consequence of more amount of water trapped in gel system (Table 6). The increasing levels of amylose starch provided the more hydrophilic side of the dough system. In this condition,water acted as a plasticizer materials (Chang et al., 2006).

Table 6. Elongation at Break of of Fresh Rice Flour-based Spring Roll Wrappers on Different Levels of Amylose Content and Heating Temperature

| Heating Temperature | Amylose Content (%)* | | | | | |
|---|---|---|---|---|---|---|
| (° C) | 25 | 28 | 31 | 34 | 37 | 40 |
| 72 | 16.84**f** | 14.62 **e** | 14.45**e** | 13.68**d** | 11.85 **c** | 10.02**a** |
| 82 | 12.02**c** | 11.83**c** | 11.11**b** | 10.97**b** | 10.85**b** | 10.16**a** |

*Values with different letter are significantly different based on DMRT test with α =5%

## CONCLUSION

Based on the study of all the response of depended variables, it can be concluded that the treatment of amylose content of rice flour and heating temperature influenced the characteristics of fresh rice flour-based spring roll wrappers. Amylose content in the range of 25% to 40% tend to increase the moisture content of product. Heating temperature at 72°C for 4 minutes with 34% of calculated amylose content

produced best characteristics of fresh rice-based spring rolls wrappers, based on elongation. Heating temperature at 82°C for 4 minutes decreased elongation significantly compared with product at 72°C for 4 minutes. Higher heating temperature could strengthen the chemical bonds among the polymers and affected elongation of product.

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