# Proceeding

## International Conference

# Food for a Quality Life

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# FOOD FOR A QUALITY LIFE

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# CONTENTS

# Wheat Flour, Pumpkin Flour and Purple Sweet Potato Flour Formulation on the Muffin as an Altenative Source of Vitamin A

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## ABSTRACT

The high import wheat flour due to the increasing use of wheat flour as raw material in bakery products widely. Bakery product developments by using local carbohydrate sources are necessary to support the diversification program. One of them was developed muffin using pumpkin flour and purple sweet potato flour for substitution of wheat flour. The objectives of this research was to determine the effect of varied formulations of wheat flour, pumpkin flour, and purple sweet potato flour (100:0:0; 80:10:10; 70:15:15; 60:20:20; and 50:25:25) in muffin quality and to find the vitamin A content of the best formulation. The design of the experiment was a randomized complete design 1 (one) factor with 5 (five) levels and 3 (three) replications. Data analyzed using Analysis of Variant (ANOVA) and Duncan test (DMRT). The quality of muffin conducted from physical, chemical and sensory quality, vitamin A content only for the best formulation of muffin. The result showed that varied formulations of wheat flour, pumpkin flour, and purple sweet potato flour effects to hardness, puffing ratio, water value, color, taste, texture and rank test score of muffin. The best muffin was produced from a formulation of 60:20:20 wheat flour, pumpkin flour, and purp le sweet potato flour with 0.84 rank test score. The best muffin has 580.50 IU of Vitamin A. One serving muffin dish can be sufficient for 73.29% rate RDA of vitamin A.

***Keywords:*** *formulation, muffin, potato flour, pumpkin flour, purple sweet, wheat flour*

## INTRODUCTION

The high imports of wheat in Indonesia caused by the use of wheat flour increased, especially in bakery and noodle products. Wheat flour consumption in Indonesia is high an average of 3.5 million ton per year (Ambarsari *et al*., 2009). One of bakery product made from wheat and fairly popular at society is a muffin (Purnomo *et al*., 2012). Muffins have small cup-shaped quick bread that is, generally dominated by sweetness and serving at

hot temperature. Wheat flour normally used for muffin is moderate to weak flour with 9.5 to 11% protein content. It has potential to make muffin using flour whith weak protein content. This open the possibility to produce muffin from local carbohydrate sources flours such as pumkin and purple sweet potato which are lacking in gluten. In China, sweet potato roots and its products have been widely used in bakery food, starch noodle, snack foods, confectionery products, starch syrup production, alcohol production and the brewing industries (Chen *et al.*, 2003), whereas in Indonesia usually it are used for household consumption either in boiled, fried or roasted form due to low level of processing and industrial utilization.

Consequently, diversification by using wheat flour substitute pumpkin flour and sweet potato flour in muffin. Pumkin has a high content Pro vitamin A is 767 ww/dw. Pumpkin also contains vitamin C, fiber and carbohydrates high enough (Gardjiti, 2005). Purple sweet potato contains vitamin (A, B, C and E), minerals (calcium, potassium, magnesium, copper and zing), dietary fiber (7.96%) and carbohydrate instead of fiber, anthocyanin. Purple sweet potato has been reported to have anti hyper glycemic activity (Suda *et al.*, 2013). Pumpkin and purple sweet potato is local resources that can grow well in tropical climate of Indonesia that has a high level of productivity. Total production of pumpkin in Indonesia in 2010 was 369.846 tons and purple sweet potato 2.594.081 tons (Statistics Indonesia of Republic Indonesia, 2013). Thus, diversification program through the utilization of local resources is expected to fulfill the people independence on wheat flour in bakery products and increase food security in Indonesia. Vitamin A is a fat-soluble vitamin that was first discovered. Vitamin A is essential for the maintenance of health and survival. The vitamin A function was eye health, cell differentiation, immune function, growth and development, reproduction, prevention of cancer and heart disease (Almatsier, 2010). The importance of vitamin A for life, then the product development with high vitamin A necessary to fulfill the needs of vitamin A. The objectives of this research to determine the effect varied formulations of wheat flour, pumpkin flour, and purple sweet potato flour (100:0:0; 80:10:10; 70:15:15; 60:20:20; and 50:25:25) against muffin quality and to find the vitamin A content of the best formulation.

## MATERIALS AND METHODS

The materials used in this research were wheat flour, pumpkin flour, purple sweet potato flour, refined sugar, margarine, baking powder, egg, salt and vanilla. The chemist materials used in this research were standard for vitamin A palmitate, n-pentana and 2-propanol.

In the fist stages of research conducted to find formulation of wheat flour, pumpkin flour and purple sweet potato in muffin panelist preferred. On the other hand, to determine the basic formula used in based on the muffin recipe that is commonly used in the community. The result of the basic formulation wheat flour, pumpkin flour and purple sweet potato is the amount of flour mixture pumpkin flour and purple sweet potato flour to 50% of the total flour (Table 1). Other materials are refined sugar, margarine, baking powder, egg, salt and vanilla. Muffin formulation (100% flour basic) was presented at Table 2.

**Table 1.** Basic formulation of flour for muffins

| Formulation | Wheat flour (%) | Pumpkin flour (%) | Purple sweet potato flour (%) |
|---|---|---|---|
| A1 | 100 | 0 | 0 |
| A2 | 80 | 10 | 10 |
| A3 | 70 | 15 | 15 |
| A4 | 60 | 20 | 20 |
| A5 | 50 | 25 | 25 |

**Table 2.** Muffin formulation (100% flour basic)

| Material | (g) |
|---|---|
| Flour * | 100 |
| Refined sugar | 47 |
| Margarine | 62 |
| Baking powder | 1.6 |
| Egg | 150 |
| Salt | 0.8 |
| Vanilla | 1.6 |

*Appropiate to Table 1

**Hardness Test (Texture Analyzer TA-XT2i)**

Texture of muffin was measured using texture analyzer TA-XT2i. Appliance is turned on and the sample is stored in a container that has been provided. This section will be under pressure will go into the existing amplifiers and output in the form of chart recorder. Hardness is expressed as kg force of the highest peak on the curve began to increase when expressed as zero.

**Puffing Ratio Test (Christianty, 2007)**

Puffing ratio procedure of muffin is determined by using a stick with a thrust measured at the center of the dough of muffin. It is measured before and after baking of muffin.

$$\% \text{ puffing ratio} = \frac{B-A}{A} \times 100\%$$

Description:
A = high dough muffin before baking
B = high dough muffin after baking

**Water Content Analysis**

Water value analysis of muffin is using oven evaporation method (AOAC, 2006).

**Sensory Analysis**

The sensory analysis of muffin was conducted to determine the hedonic quality on color, taste, aroma, texture and the preference level of muffin in rangk test (Adawiyah and Wasyima, 2009). Muffin samples were presented in coded cups and evaluated by 25 semi skilled panelists. The panelist was asked to score the liking degrees (five scales) of muffin.

**Determination of Vitamin A Standard (British Farmacope, 2009)**

Activity of vitamin A standard set accordingly Britist Farmacope (2009), that is by carefully weighing standard amount of vitamin A palmitate, deluted with n-pentane and delute with 2-propanol until the concentration is 10–15 IU/mL. Absorbance measurement performed using spectrophotometer at maximum wavelength (326 nm). The activity of vitamin A in units of standard International Units (IU) per grams was calculated with formula :

$$\text{Vitamin A Activity} = \frac{A326 \times V \times 1900}{100 \times m}$$

Description :
$A_{326}$ = absorbance at a wavelength 326 nm
V = total dilution to obtain the levels of 10-15 IU/mL
1900 = factor to absorbance into becoming specific retinol ester IU per gram
m = the weight of the test substance (grams)

### Experimental Design

The design of the experiment was a randomized complete design 1 (one) factor with 5 (five) levels and 3 (three) replications. Mean data of all parameters analyzed by using Analysis of Variant (ANOVA). When significant differences were found, the means were tested by Duncan Multiple Range Test (DMRT). The experimental design was presented at Figure 1.

| | Treatment (A) | | | | |
|---|---|---|---|---|---|
| Replications | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ |
| 1 | $A_1$1 | $A_2$1 | $A_3$1 | $A_4$1 | $A_5$1 |
| 2 | $A_1$2 | $A_2$2 | $A_3$2 | $A_4$2 | $A_5$2 |
| 3 | $A_1$3 | $A_2$3 | $A_3$3 | $A_4$3 | $A_5$3 |

Description :
$A_1$ = Wheat flour : pumpkin flour : purple sweet potato flour = 100:0:0
$A_2$ = Wheat flour : pumpkin flour : purple sweet potato flour = 80:10:10
$A_3$ = Wheat flour : pumpkin flour : purple sweet potato flour = 70:15:15
$A_4$ = Wheat flour : pumpkin flour : purple sweet potato flour = 60:20:20
$A_5$ = Wheat flour : pumpkin flour : purple sweet potato flour = 50:25:25

**Figure 1.** Experimental DesignA

### Muffin Process

Muffin process consists of several stages: preparation, mixing I, mixing II, panning and baking. Preparation stage is done by weighing all materials to be used (Table 2). In the mixing I stage is done by mixing and blending all the ingredients except the flour, baking powder, and vanilla at high speed. Mixing II done by mixing and blending wheat flour, pumpkin flour, and purple sweet potato flour (100:0:0; 80:10:10; 70:15:15; 60:20:20; and 50:25:25) with a size of 80 mesh, baking powder, and vanilla to douh at moderate speed. After the dough form, it can pan and bake at 180°C for 20 minutes.

## RESULTS AND DISCUSSION

The general result at statistic analysis shows that varied formulations of wheat flour, pumpkin flour, and purple sweet potato flour effects to hardness, puffing ratio, water value, color, taste, texture and rank test score of muffin. Hardness (gforce), puffing ratio, and water value of muffin with

varied formulations of wheat flour, pumpkin flour, and purple sweet potato flour was presented at Table 3.

**Hardness**

Table 3 shows that varied formulations of wheat flour, pumpkin flour and purple sweet potato flour effects against muffin hardness level (**Significance < α = 0.01). Duncan test (Table 3) on the hardness of pumpkin flour and purple sweet potato substituted muffin indicates that the highest score of substitution for muffin hardness was 50:25:25 with 129 gforce.

The higher concentration of pumpkin flour and purple sweet potato flour in muffin formulation makes the higher the muffin hardness. This is probably due to the higher concentration of pumpkin flour and purple sweet potato flour causes the low gluten content of the muffin that causes an increase in the level of hardness.

**Table 3.** Hardness (gforce), puffing ratio and water value of muffin with varied formulations of wheat flour, pumpkin flour, and purple sweet potato flour

| Wheat Flour : Pumpkins Flour : Purple Sweet Potato Flour | Hardness (gforce) | Puffing Ratio (%) | Water Value (%) |
|---|---|---|---|
| A1 = 100:0:0 | 105.33±0.58a | 6.47±0.58a | 9.52±0.16a |
| A2 = 80:10:10 | 112.33±1.00b | 5.80±0.10b | 9.58±0.11a |
| A3 = 70:15:15 | 117.00±0.58c | 5.06±0.15c | 13.50±0.17b |
| A4 = 60:20:20 | 121.33±0.58d | 4.40±0.10d | 14.97±0.06c |
| A5 = 50:25:25 | 129.00±0.00e | 3.30±0.16e | 15.90±0.00d |

Different levels between letters showed highly significant effect between treatment α = 0.01. (**Significance < α = 0.01)

**Puffing Ratio**

Table 3 shows that varied formulations of wheat flour, pumpkin flour and purple sweet potato effects against muffin puffing ratio (**Significance < α = 0.01). Duncan test (Table 3) on the puffing ratio of pumpkin flour and purple sweet potato substituted muffin indicates that the highest score of substitution for muffin puffing ratio was 100:0:0 with 129 gforce.

The higher concentration of wheat flour in muffin formulation makes the higher the puffing ratio. This is probably due to the higher concentration of wheat flour causes the high gluten content of the muffin that causes an increase in the level of puffing ratio. Resource of gluten was protein, wheat

flour which used has 9.5 – 11% protein. Besides that, starch of wheat flour is high too with 77.3% carbohydrate (Azizah, 2009).

Solubilization and activation of carbon dioxide release agent developer that works to increase the volume of muffins. Starch gelatinization and protein coagulation generate permanent cell structure and development of crusts. Caramelization of sugars and the maillard browning of proteins and reducing sugar causes browning the skin layer. Gluten is elastic and allows the development of a muffin batter when added material developers. Pumpkin flour quality is determined by its constituent components that determine the functional properties of dough and flour products are produced as well as suspension in water. Protein pumpkin flour contains gluten protein types are quite high at 5.04 % (Widowati *et al.*, 2001) so as to form a three-dimensional network of cohesive and elastic. This trait will serve the development of the volume of bread and other food products that require the volume development. Pumpkin flour has a good quality because it has good gelatinization properties, so it will be able to form a batter with the consistency, elasticity, viscosity and good elasticity, so that the resulting bread will be good quality as well. Carbohydrates pumpkin flour is also quite high at 77.65 % (Widowati *et al.*, 2001). Carbohydrate is a very important role in the manufacture of starch dough. It will be attached to the starch granule proteins during dough formation. Stickiness between starch granules and protein structure will lead to continuity of dough (Hendrasty, 2003). The enzyme contained in the flour pumpkin is amylase, protease, lipase and oxidase. The enzyme amylase will hydrolyze starch into maltose and dextrin, while the protease enzyme that plays a role in protein breakdown will affect the elasticity of gluten (Sufi, 1999). Although, content of protein, starch and enzyme of wheat flour higher and more effect than the use of other flour on the puffing ratio of muffin.

**Water Content**

Table 3 shows that varied formulations of wheat flour, pumpkin flour and purple sweet potato effects against muffin water value (**Significance < $\alpha$ = 0.01). Duncan test (Table 4) on the water value of pumpkin flour and purple sweet potato substituted muffin indicates that the highest point of substitution for muffin water value was 50:25:25 with score 15.9%.

The higher concentration of pumpkin flour and purple sweet potato flour in muffin formulation makes the higher muffin water value. This is probably due to the higher fiber of pumpkin flour and purple sweet potato can bind water better than the fiber at wheat flour. Besides that, pumpkin flour contained pectin that is able to bind water better than the starch at wheat flour. Although, it has been made into flour, pectin of pumpkin is no

damage, even still able to bind water to the well. In addition, the fiber contained in the pumpkin can also bind water supposedly better than the starch contained in wheat flour. Increased water value in the muffin was also influenced by the high fiber content of the purple sweet potato that is equal to 7.96% dd (Widowati 2007). Purple sweet potato is one of food which has high fiber content. Food as a source of fiber if it is content at least 3% dietary fiber (Foschia *et al.*, 2013). So, fiber has the ability to absorb water, thereby increasing the water content in food products. Besides, water absorption index of purple sweet potato is 2.32% g/g (Julianti and Ridwansyah, 2008).

**Table 4.** Sensory responses of muffin with varied formulations of wheat flour, pumpkin flour, and purple sweet potato flour

| Wheat Flour: Pumpkins Flour : Purple Sweet Potato Flour | Hedonic Score | | | | Rangk Test Score |
|---|---|---|---|---|---|
| | Color | Aroma | Taste | Texture | |
| A1 = 100:0:0 | 2.9±0.2a | 3.4±0,2 | 3.0±0.1d | 3.0±0.3a | -0,99±0.02a |
| A2 = 80:10:10 | 3.1±0.1ab | 3.8±0.2 | 3.3±0.2cd | 3.2±0.2ab | -0,65±0.02b |
| A3 = 70:15:15 | 3.2±0.1b | 3.8±0.3 | 3.7±0.3bc | 3.5±0.2b | 0,03±0.05c |
| A4 = 60:20:20 | 4.0±0.1c | 4.1±0.3 | 4.0±0.3ab | 4.1±0.1c | 0,84±0.01d |
| A5 = 50:25:25 | 4.3±0.2d | 4.2±0.1 | 4.3±0.2a | 4.2±0.1c | 0,76±0.02d |

Discription :

a. Different levels between letters showed highly significant effect between treatment $\alpha = 0.01$ (**Significance < $\alpha = 0.01$); b. Color : (5) dark brown; (4) brown; (3) yellow brown; (2) dark yellow; (1) yellow; c. Aroma: (5) highly smell of bread; (4) smell of bread; (3) rather smell of bread; (2) not the smell of bread; (1) highly not the smell of bread; d. Taste: (5) highly sweet; (4) sweet, (3) rather sweet; (2) not sweet, (1) highly not sweet; e. Texture: (5) highly soft; (4) soft; (3) rather soft; (2) not soft; (1) highly not soft; f. Rank 1 = the most preferred product; 5 = most product are not preferred

**Sensory Responses**

Ovel all hedonic quality responses on the muffin is effected by formulation of wheat flour, pumpkin flour, and purple sweet potato flour, they are on color, taste and tekstur of muffin. On the other hand rangk test shows that one formulation has the highest score at rank test. Sensory responses on the muffin produced from varied formulations of wheat flour, pumpkin flour and the purple sweet potato flour is presented in Table 4.

**Color**

Table 4 shows that varied formulations of wheat flour, pumpkin flour and purple sweet potato effects against color of muffin (**Significance < α = 0.01). Duncan test (Table 4) on the panelis responses of pumpkin flour and purple sweet potato substituted muffin indicates that the highest point of substitution for muffin color was 50:25:25 with score 4.7 (brown).

Increased concentration of pumpkin flour and purple sweet potato flour in muffin formulation tends to resulted in dark brown color muffin. This is probably due to color muffin affected by raw material and process. In the baking process changes the development of the combustion gases in the dough due to ongoing, development happens at the beginning of the baking cycle that slowly solidified crust of bread expands light brown. The higher the concentration of flour pumpkin and purple sweet potato flour, produced more dark muffin due to maillard reactions and caramelization of sugar reducing existing on purple sweet potato flour and pumpkin flour. Maillard reaction is the reaction between reducing sugars group with a primary amine group, and produce brown color (Winarno, 1992; and Purlis and Salvadori, 2009). Result from this research about muffin color the same with Purnomo *et al.* (2012), it was increased in dark brown color muffin with an increase the number of sweet potato flour. High sugar content in sweet potato four also cause the dark of color muffin.

**Aroma**

Table 4 shows that varied formulations of wheat flour, pumpkin flour and purple sweet potato no effects against aroma of muffin (**Significance > α = 0.05). Although the higher concentration of pumpkin flour and purple sweet potato flour in muffin formulation tends to highly strong muffin aroma.

**Taste**

Table 4 shows that varied formulations of wheat flour, pumpkin flour and purple sweet potato effects against taste of muffin (**Significance < α = 0.01). Duncan test (Table 4) on the panelis responses of pumpkin flour and purple sweet potato substituted muffin indicates that the highest score of substitution for muffin taste was 60:20:20 and 50:25:25 with 4.3 and 4.0 (sweet). The sweet of the muffins are affected by the raw materials used. The raw materials used in the manufacture is a pumpkin flour and purple sweet potato flour which both have a fairly high sugar content. Therefore, the sugar content is high pumpkins, when the temperature used in the drying process is too high, the resulting flour will gather and smelling

caramel (Hendrasty, 2003). Chemical properties of purple sweet potato flour most prominent is the low starch sugar high followed by reduction. In the process of gelatinization of starch hydrolysis event has occurred, so that the starch decreased and turned into a reducing sugar. So increasing the concentration of flour pumpkin and purple sweet potato, then produced the muffins will be even sweeter.

**Texture**

Table 4 shows that varied formulations of wheat flour, pumpkin flour and purple sweet potato effects against texture of muffin (**Significance < α = 0.01). Duncan test (Table 4) on the panelis responses of pumpkin flour and purple sweet potato substituted muffin indicates that the highest score of substitution for muffin texture was 60:20:20 and 50:25:25 with 4.1 and 4.2 (soft).

Hedonic quality results muffin texture is consistenth with the results of an assessment of the texture based on physical test. The highest concentration of flour pumpkin and purple sweet potato flour in muffins makes muffins will be harder so in the sensory response it will be soft muffin. This is probably due to the lower gluten content on a muffin that causes an increase in the level of harder. The level of harder can be determined from the raw material and the baking process. Solubilization and activation of developers releasing carbon dioxide agent that works to increase the volume of muffins. Gelatinization of starch and protein coagulation produces permanent cell structure and development of crumb. Sugar caramelization and maillard browning of proteins is reducing sugars causes browning of the skin layer. Reduced water activity facilitated maillard browning as well as hardening of the skin layer. Selection of the oven, baking pan and baking temperature affects the final product (Purnomo *et al.*, 2012). Gluten is elastic and allows the development of muffin batter when added material developers. Pumpkin flour quality is determined by its constituent components that determine the functional properties of dough and flour products produced and suspension in water. Protein pumpkin flour contains gluten protein types are sufficiently high so as to form a three-dimensional network cohesive and elastic. These properties will work on the development of the volume of bread and other food products that require the development of volume. Wheat flour pumpkin has good quality because it has good gelatinization properties, so it will be able to form dough with the consistency, elasticity, viscosity and good elasticity, so the bread produced will be of good quality as well. Carbohydrates pumpkin flour is also quite high. Carbohydrates are very instrumental in making starch dough. It ill be attached to the starch granule proteins during the formation of the dough.

Adhesion between starch granules and protein will cause structural continuity dough (Hendrasty, 2003). The enzymes contained in pumpkin flour are amylase, protease, lipase and oxidase. Amylase enzyme will hydrolyze starch into maltose and dextrin, while the protease enzyme that plays a role in protein breakdown will affect the elasticity of gluten (Sufi, 1999).

**Rank Test**

Table 4 shows that varied formulations of wheat flour, pumpkin flour and purple sweet potato effects agains muffin rank test score (**Significance < α = 0.01). Duncan test (Table 4) on the panelis responses of pumpkin flour and purple sweet potato substituted muffin indicates that the highest score of substitution for muffin rank test was 60:20:20 with 0.84 (rank 1). Muffin with the higher rank test score (0.84) is the best muffin with wheat flour, pumpkin flour and purple sweet potato 60:20:20. The characteristic of the best muffin is hardness of 121.33 gforce, 4.40% puffing ratio, 14.97% water value, brown color (4.0), smell soft bread (4,1), sweet taste (4.0) and soft texture (4.1).

**Vitamin A**

The best muffin is muffin with wheat flour, pumpkin flour and purple sweet potato 60:20:20. It contains vitamin A of 580.50 IU/100 grams. Thus eating a muffin dish can be sufficient for 1451.25 IU or 73.29 % rate Recommended Dietary Allowances (RDA) of vitamin A.

## CONCLUSION

Varied formulations of wheat flour, pumpkin flour and purple sweet potato effects against hardness, puffing ration, water value, color, taste, texture and score of rank test of muffin (**Significance < α = 0.01). Muffin with wheat flour, pumpkin flour and purple sweet potato 60:20:20 contains vitamin A of 580.50 IU/100 g (73.29 % rate RDA of vitamin A).

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