Utilization of Corn Flour (Zea mays L.) as Material Subtitution for Ice Cream Cone

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ABSTRACT

Flour needs that continue to increase will have an impact on increasing the need for flour in Indonesia. To reduce this increase, wheat flour substitution is needed. This study aims to determine the right amount of corn flour substitution for wheat flour which produces the best quality for physical properties (rendement, the thickness, the breakability, the endurance of cone to ice cream) and chemical properties (moisture content, protein content, reducing sugars) and knowing consumer acceptance of cone produced. The study was made using Factorial Randomized Block Design (FRBD) with two factors. The first factor is the proportion of corn flour and wheat flour has 5 levels (0%: 100%, 25%: 75%, 50%: 50%, 75%: 25%, 100%: 0%). The second factor is the roasting time with 3 levels (20 minutes, 25 minutes, 30 minutes). Parameters observed included water content, protein content, reducing sugar, rendement, the thickness, the breakability, the endurance of cone to ice cream and organoleptic properties such as color, aroma, texture, taste. Data obtained from physical and chemical tests were analyzed using variance (ANOVA). The results analysis of variance have significant differences so that the Smallest Significant Difference Test (LSD) is performed with a real level of 5%. Then the best selection was made from each treatment. The best selection results obtained in the treatment of 100% corn flour and 0% wheat flour with a time of 30 minutes has a moisture content of 3.52%, protein content 0,0007%, reducing sugar 0,0007%, yield 85,13%, thickness 2, 71 mm, fracture 0.26 N and cone resistance to ice cream 68 minutes 5 seconds.

Keywords: Cone, Consumer Acceptance, Corn Flour, Corn

ABSTRAK

Kebutuhan terigu yang terus meningkat akan berdampak pada peningkatan kebutuhan terigu di Indonesia. Untuk mengurangi peningkatan tersebut diperlukan bahan subtitusi terigu. Salah satu bahan yang dapat digunakan adalah jagung yang dapat diolah menjadi tepung jagung. Penelitian ini bertujuan untuk mengetahui jumlah subtitusi tepung jagung yang tepat terhadap tepung terigu yang menghasilkan kualitas terbaik terhadap sifat fisik (rendemen, ketebalan, daya patah, daya tahan cone) dan kimia (kadar air, kadar protein, gula reduksi) serta mengetahui penerimaan konsumen terhadap cone yang dihasilkan. Penelitian dirancang menggunakan metode Rancangan Acak Kelompok Faktorial dengan dua faktor. Faktor pertama adalah proporsi tepung jagung dan tepung terigu memiliki 5 taraf (0%:100%, 25%:75%, 50%:50%, 75%:25%, 100%:0%). Faktor kedua adalah waktu pemanggangan dengan 3 taraf (20 menit, 25

menit, 30 menit). Parameter yang diamati antara lain kadar air, kadar protein, gula reduksi, rendemen, ketebalan, daya patah, daya tahan cone, dan organoleptik seperti warna, aroma, tekstur, rasa. Data yang diperoleh dari uji fisik dan kimia dianalisis menggunakan sidik ragam (ANOVA). Hasil analilis ragam terdapat beda nyata maka dilakukan Uji Beda Nyata *Terkecil (BNT) dengan taraf nyata 5%. Kemudian dilakukan pemilihan terbaik dari masing-masing perlakuan. Hasil pemilihan terbaik diperoleh pada perlakuan tepung jagung 100% dan tepung terigu 0% dengan waktu 30 menit memiliki kadar air 3,52 %, kadar protein 0,0007%, gula reduksi 0,0007%, rendemen 85,13%, ketebalan 2,71 mm, daya patah 0,26 N dan daya tahan cone terhadap es krim 68 menit 5 detik.*

***Kata Kunci**: Cone, Penerimaan Konsumen, Tepung Jagung, Jagung*

INTRODUCTION

In Indonesia, the need for flour continues to increase. Flour demand in Indonesia in 2013 amounted to 4.84 tons and increased to 5.05 tons in 2014. If this increase continues, it will increase food growth (Aptindo, 2014). Wheat flour is used as raw material by the food industry in processing a food product. The volume of flour imports also increased by 4.8 million tons in 2010 and increased by 5.2 million tons in 2011 (Abidin et al, 2013). According to Welirang in Yulifianti et al (2012), wheat flour consumption reached 30% for dry noodles and wet noodles, 25% for instant noodles, 20% for bread and cakes, 15% for biscuits and snacks, 5% for fried foods, 5% for households. This causes an increase in wheat and wheat production which is proportional to people's consumption with population growth and income.

One alternative that can be used to minimize the use of flour is to utilize local food ingredients to substitute wheat flour, which is corn will be processed into corn flour. Corn flour is a semi-finished product from corn, which is obtained by grinding or flouring, then sifted (Ariyani and Asmawit, 2016). Based on research conducted by Suarni (2009), using corn flour to make pastries obtain the results of corn flour can substitute 50-80% wheat flour with increasing consumer acceptance levels. The resulting cake has a pretty good quality and appearance. Thus, corn flour is worthy of flour. As technology develops and uses local raw materials, corn can be used as an ingredient in ice cream.

Cone is a biscuit in the wafer classification. Wafers are snacks made from flour, sugar, margarine, air and yeast (yeast, soda, ammonium bicarbonate) (Aprilliana, 2010). Biscuit maturity is reduced by the temperature and baking time. The quality of biscuits is based on taste, aroma, color and crispness. Products received by consumers must have good quality. This can be seen from the product aspect (Suarti et al, 2015).

MATERIALS AND METHODS

Materials

The materials used in this study were corn varieties Bima 19 (Balitkabi), wheat flour (blue triangle), margarine, refined sugar, egg whites, salt and commercial cones.

Tools
The tools used to make corn flour are sold in a basin (platik), a grinding mill (disc mill FFC-15), an 80 mesh sieve (Akebonno). Equipment used to make ice cream basin cones (plastic), digital scales (Kitchen Scale HL-4350), mixers (Cosmos CM-1579), spoons, paper cup cones, paper cups, 0.88 mm pp plastics (Petromax), oven (Memmert UN 55 53L), sealer (Iron Wiratech FS 300), jar (star of the lion). Tool used to test thickness for calipers. To test the breaking power using a hardness tester (Lutron FR-5120)

Methods
This research was designed using a factorial randomized block design method with two factors. The first factor is the proportion of corn flour and flour having 5 levels (0%: 100%, 25%: 75%, 50%: 50%, 75%: 25%, 100%: 0%). The second factor is roasting time with 3 levels (20 minutes, 25 minutes, 30 minutes). Of the two factors obtained 15 combinations and repeated 2 times obtained 30 experimental units.

Research Implementation
The study was conducted with two glasses. The first stage is making corn flour and the second is making ice cream from corn flour.

Observation Parameters
Parameters collected in making ice cream cones include: water content (Kumalasari, 2012), protein content (Sudarmadji, 1984 in Ermaiza, 2009), reducing sugars (Sudarmadji, 1984 in Ermaiza, 2009), rendemen (Marwah, 2018), thickness (Istinganah et al, 2017), cone endurance (Aprilliana, 2010), and organoleptics such as color, aroma, texture, taste (Sari et al, 2014). The panelists used as a substitute for 30 semi-approved people.

Data analysis
Data obtained from physical and chemical tests are processed using analysis of variance (ANOVA). If there is a real difference done on the Least Significant Difference test (LSD) with a significance level of 5%. Then the best selection of each meeting is conducted.

RESULTS AND DISCUSSION

1. Results of Chemical Analysis of Ice Cream Cone

1.1 Water content

The average creamy water content in the proportion of flour and time of assessment was between 3.52% to 4.88%. The results of analysis of variance (ANOVA) showed the comparison of corn flour with flour did not give an effect on air content. Time also has no effect on cadra air, and neither does interaction between proportion and time have an effect on air content. The following is the average water content of ice cream cone containing flour and the time that can be seen in **Figure 1.**

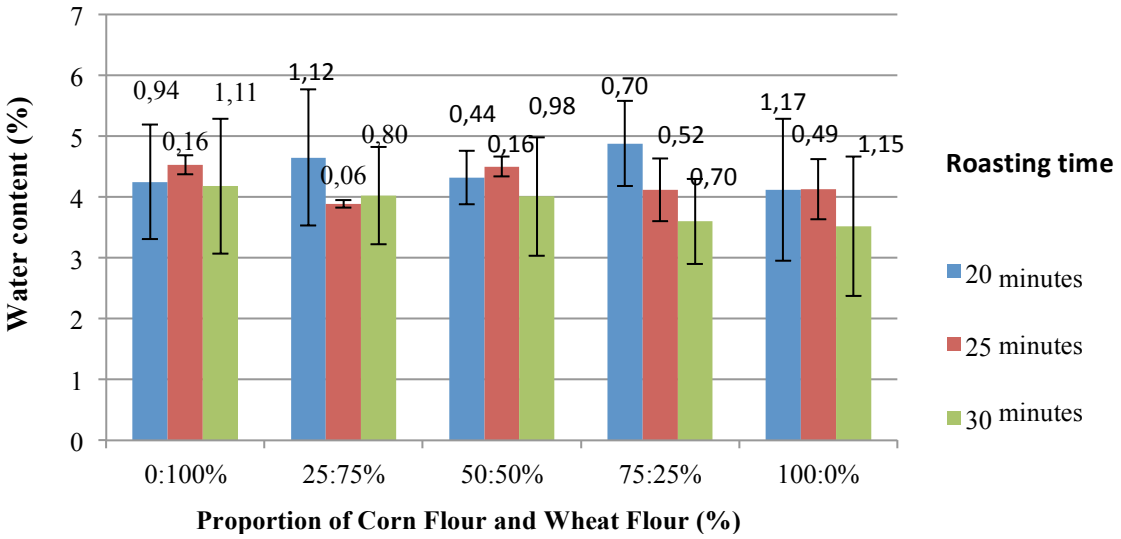

Figure 1. Average Water Content of Ice Cream Cone Treatment of Flour and Time Proportion

In **Figure 1,** the moisture content of ice cream cones from flour and time have fluctuating results. The lowest mean water content in the ice cream cone of 3.52% was produced when corn flour was 100%: wheat flour 0% within 30 minutes, while the highest water content (4.88%) was produced when corn flour was 75%: wheat flour 25% with a time of 20 minutes. High and low levels of water in the roasting process is not high which can be caused by evaporation of air and roasting time, causing a difference (fluctuation) of water content in the product produced. According to Murtiningsih et al (2013), during the roasting there was an air transfer from high to low pressure, but not all of the air released and evaporated produced a low amount of air contained in the biscuits. During the roasting process water will be converted into free water because microbial enzymes break down proteins, carbohydrates, salts and other organic compounds. In the process of drying the water content will decrease because it will evaporate.

2. Results of Physical Analysis of Ice Cream Cone

2.1 Rendemen

The average yield of flour ice cream cone and the distribution time between 82.92% to 87.82%. Results of analysis of variance (ANOVA) showed that the proportion of flour had a significant effect ($\alpha = 0.05$) on yield. But time does not provide a real change in yield. Interaction between does not provide real interaction with yield. Furthermore, to find out the difference between the tests conducted by the 5% Real Difference test. BNT results showing ice cream with various combinations of flour and baking time can be seen in **Table 1.**

Table 1. BNT Results of the Ice Cream Cone Yield

Proportion of Corn Flour and Wheat Flour (%)	Average	Notation
0 : 100	86,33	b
25 : 75	87,82	b
50 : 50	86,69	b
75 : 25	84,62	a
100 : 0	86,33	b

Note: the same notation shows no significant difference ρ = 0.05 (LSD = 2.51)

In **Table 1,** the evaluation of the duration of 75% cornmeal indicates that it has something to do with the provision of assistance. This is convincing in the notation of BNT results at the 95% confidence level (0.05). The highest composition in corn and wheat flour (25: 75%), and the lowest in corn and flour flour concentrations (75: 25%). This shows the more corn flour with a little extra flour used, the smaller the yield. In accordance with the opinion of Viani (2017), corn flour has higher amylose content than wheat flour. According to Aini et al, (2016), the amylose content of corn flour is 26.9% to 35.9%, flour is 25%. Amylose levels are high in a combination of air to the dough then released again during roasting so that it succeeds against low levels of air content. This is consistent with the opinion of Nurani and Yuwono (2014) which states the higher the amylose content in the material, the lower the air content in the material. Decreased water content causes a decrease in the yield value. According to Zhou and Hui (2014), the function of wheat flour containing gluten during the mixing of the dough is so that the ingredients which are concentrated, suspended by the gas during fermentation and roasting, are formed using a biscuit network.

2.2 Thickness

The average thickness of the flour ice cream cone and the comparison time between 2.51 mm to 3.24 mm. Results of analysis of variance (ANOVA) showed that the proportion of flour did not contribute significantly (α = 0.05) to thickness. Nevertheless, it gives real time for thickness. The interaction between does not make a noticeable difference in thickness. Furthermore, to find out the difference between the tests conducted by the 5% Real Difference test. BNT results of the thickness of the ice cream cone with various ratios of flour and roasting time can be seen in Table 2.

Table 2. Results of BNT Thickness of the Ice Cream Cone

Time (minutes)	Average	Notation
20	3,06	b
25	2,97	b
30	2,70	a

Note: different notations are significantly different ρ = 0.05 (LSD = 0.18)

In **Table 2** at 20 minutes to 30 minutes have a different notation. At the time of treatment 30 minutes. This was agreed on the BNT roasting test results at a 95% confidence level (0.05). The highest completion time is 20 minutes, then follow the 25 minutes treatment and 30 minutes treatment time with the lowest average. This shows the longer time is used, the higher or higher the product value. According to Pratama et al (2014) the length of roasting time depends on the cross-sectional area of a dried product. Size changes that occur with the roasting time involving the formulation of ingredients as well as the size of each arrangement. In this study different sizes are still arranged differently because they still use manual printing.

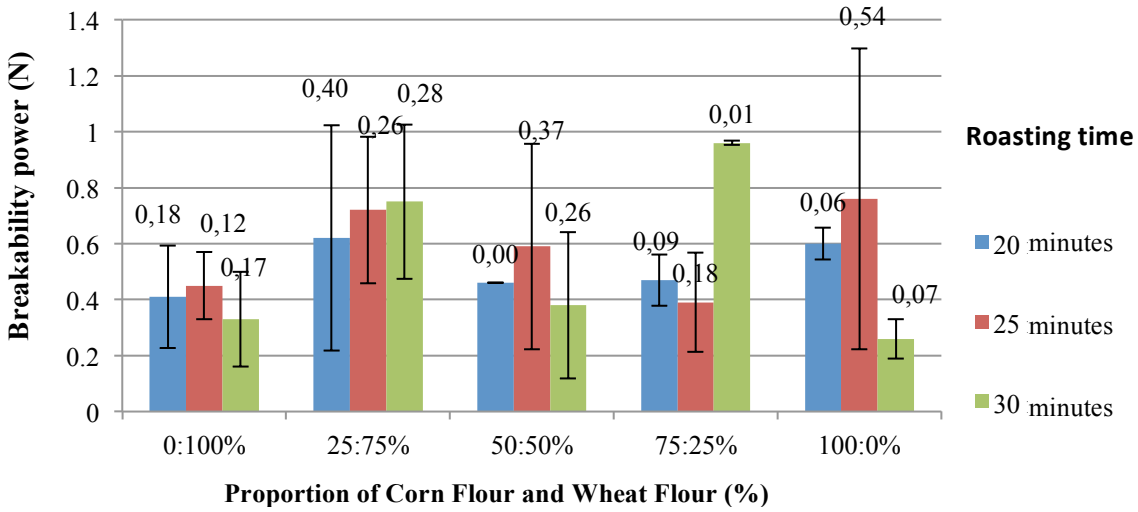

Figure 2. Average Breakability Power of Ice Cream Cones Treatment of Flour and Time Proportion

2.3 Breakability Power

The mean of ice cream cone damage in the proportion of flour and the comparison time between 0.26N to 0.96N. The results of analysis of variance (ANOVA) showed the comparison of corn flour with wheat flour did not give effect to the breaking strength. Time also has no effect on the power of breaking, and neither does the interaction between proportion and time have an effect on the power of breaking. The following is the average breakdown of ice cream cones that are broken down in flour and time can be seen in Figure 2.

In Figure 2 the lowest average destructive power of 0.26 N ice cream cone produced in 100% corn flour and 0% flour in 30 minutes, while the highest destructive power (0.96 N) is produced in 75% corn flour : 25% wheat flour in 30 minutes. In the histogram image, it can be seen that the effect of roasting proportion and time increases the fluctuating mean value. This can be caused by protein content in flour. Protein levels of corn flour and wheat flour are relatively low causing the dough to not be strong due to the small amount of gluten it contains. According to Viani (2017) biscuits with low protein flour will produce biscuits that have a fragile and crumbly texture because the dough contains a little gluten. According to Mahmudah (2013), the thickness of the biscuits also increases at the time of the biscuits, if the biscuits are getting thicker in size then the force to be able to break the biscuits is getting bigger. According to Azizah (2015), the force applied to break a biscuit shows the level of fragility of a product. If the force applied to improve the higher the product is more fragile.

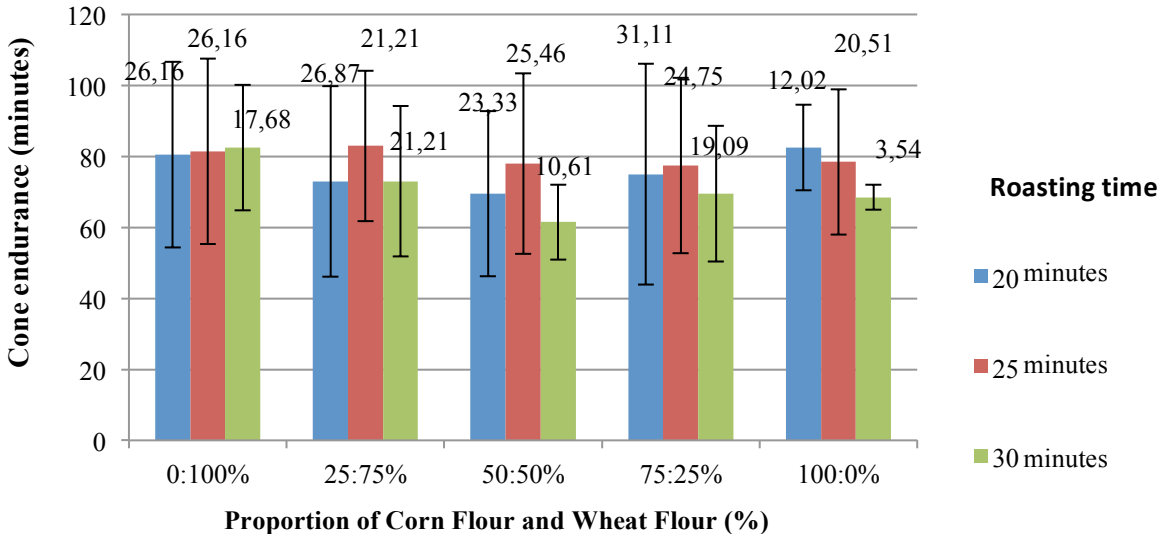

Figure 3. Average Durability of Ice Cream Cone Treatment of Flour and Time Proportion

2.4 Cone Endurance

The average endurance of ice cream cones on the proportion of flour and grading time ranged from 61.5 minutes to 83 minutes. The results of analysis of variance (ANOVA) showed that the comparison of corn flour with wheat flour did not influence the durability. Time also has no effect on endurance, and neither do interactions between (the proportion of flour and time) have an effect on endurance. The following is the average of ice cream cone contribution to flour contribution and time can be seen in **Figure 3.**

In **Figure 3** the lowest average durability of the 61.5 ice cream cone was produced in 50% corn flour: 50% wheat flour in 30 minutes, while the highest endurance (83) was produced in 25% corn flour: 75% wheat flour within 25 minutes. In the histogram image, it can be seen that the effect of roasting proportion and time increases the fluctuating mean value. This can be caused by the composition of the ingredients. According to Haryanti et al (2014), the more amylopectin content available in starch, the wider the amorphous area. Areas that consist of less dense areas, easily accessed. This amorphous part is easily absorbed by air.

3. Selection of the Best Treatment

The selection of ice cream cone treatments is done by the multiple attribute method (Zeleny, 2003). The variables used are the average value of air content, yield, thickness, breaking strength, and the resistance of the cone to ice cream. The best treatment obtained from the results of calculations L1, L2 and L∞ are small. The results obtained from the best results are 100% corn flour: 0% flour with a time of 30 minutes. has a moisture content of 3.52%, a protein content of 0,0007%, a reducing sugar of 0,0007%, a yield of 85.13%, a thickness of 2.71 mm, a

destructive power of 0.26 N and an endurance of ice cream 68 minutes 5 minutes.

4. Results of Organoleptic Analysis of Ice Cream Cones

After the best selection, organoleptic testing will be released which released the color, aroma, taste, and appearance. Organoleptic test uses a hedonic scale with 30 semi-compatible panels compared to commercial cones. Organoleptic data were analyzed using Friedman test. Back organoleptic results can be seen in Table 3.

Table 3. Average Results of Organoleptic Test of Corn Cones and Commercial Cones

Parameters	Corn Cone	Commercial Cone
Colour	2,93	3,87
Flavour	3,27	3,2
Taste	3,33	3
Texture	2,97	3,97

In Table 3 the organoleptic results for color show that the panelist corn cones did not like 2.93. While the commercial cone panelists preferences with an average of 3.87. This can change because the color produced by ice cream cones is more than commercial ice cream. The dark color produced by the corn cone can cause the temperature and the baking time of the dough to cause a maillard reaction. Maillard reaction is a browning reaction that occurs between protein and reducing sugars (Martunis, 2012).

In Table 3, the organoleptic results on aroma showed the panelists' favorite corn cones with an average of 3.27. In commercial cones panelists favor with an average of 3.2. This can cause the aroma of corn cone ice cream to be stronger with the distinctive aroma of corn from commercial cones that have less aroma. There are no additives in commercial cones that cause a distinctive aroma. According to Winarno (2004) in Anggraini (2015), the aroma produced from the roasting process, is produced by the results of the maillard reaction which produces sugar and free amino acids present in these foodstuffs, with the change causing an aroma.

In Table 3 the organoleptic results on taste for panelists' preferences for ordinary corn cones with an average of 3.33. In commercial cones panelists prefer an average of 3. This can cause corn ice cream cones to have a corn flavor, whereas commercial cones do not have flavor. This is in accordance with the opinion of Yudhistira (2016), corn flour which contains distinctive flavor produced becomes the dominant flavor of corn.

In Table 3, organoleptic results on texture showed that the panelist corn cones did not like an average of 2.97. While commercial cone panelists are ordinary with an average of 3.97. This can cause the corn flour used is still coarse because it still uses 80 mesh sieves, causing a cone texture. According to Rifai (2009), corn flour sieved using 80 mesh sieves can be used to make cones. But the results are not as smooth as using a 100 mesh sieve. If the mesh size used is higher, the flour flour will be smoother.

CONCLUSIONS

Based on the results of the analysis of the nature, chemistry, and organoleptics obtained from 100% 100% wheat flour and 0% wheat flour which can be tolerated for 68 minutes 5 seconds. It has a moisture content of 3.52%, a protein content of 0,0007%, a reducing sugar of 0,0007%, a yield of 85.13%, a thickness of 2.71 mm, a

fracture strength of 0.26 N. and an ordinary aroma, while the color and texture are not like it.

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