Processing mocaf into pie susu with the addition of super food 'spirulina'

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Abstract. The purpose of this study was to obtain pie susu mocaf-spirulina products with local fruit varieties (pineapple and Balinese grapes). Mocaf (modified cassava flour) has characteristics similar to low protein flour and gluten free. Spirulina is a type of blue-green algae that is considered a super food because of its nutritional properties that are very good for health. The research method includes 1) experimental trials of the formula for mocaf spirulina pie susu, in the variation of the addition of spirulina to the formulation of mocaf pie susu 2) conduct an Organoleptic Test, with an instrument using the Visual Analog Score (VAS) for the Hedonic test (preference) 3) Perform an Organoleptic Test, with an instrument using VAS for the Hedonic Quality test (quality). The results showed: 1) obtained a pastry formulation (skin) of mocaf pie susu with the addition of 2.5 gr of spirulina (0.5% of the weight of the ingredients) aimed mocaf pie susu formulation with the addition of 2.5gr spirulina to mocaf pie susu with pineapple and grape vla; 2) The level of preference for mocaf spirulina pie susu (pineapple vla and grape vla) is the color of the likes category, the texture of the likes, the aroma of the likes and the taste of the likes. 3) the quality level of mocaf spirulina pie susu (pineapple vla and grape vla) is greenish color, crunchy texture, pastry fragrant aroma and sweet taste.

1. Introduction
The island of Bali, with its natural beauty and traditions centered on Hinduism, is a major tourist destination in the world. According to data from the Bali Tourism Office, the number of foreign tourist visits to Bali during 2019, reached 6.3 million people. This figure is higher than in 2018. Meanwhile, according to the Central Statistics Agency (BPS), the number of domestic tourists to Bali has reached more than 10 million people. Tourist visits have an impact on the increasing need for souvenirs. Currently, the typical Balinese souvenir that is much sought after by tourists is "PIE SUSU". Pie susu is a sweet cookie of tart custard or pie susu, consisting of an outer cake base and egg custard filling or topping, then processed by oven. Although pie susu is available in various countries with different names, formulas and appearances, it is not a Balinese cake, even though it is currently a Balinese souvenir. Balinese souvenirs are supposed to be products made from local ingredients, but Balinese pie susu uses flour as the main ingredient which is imported food. This research is expected to obtain pie susu from modified cassava flour, meaning that it is based on local ingredient to support culinary tourism.
Efforts to utilize local food ingredients, such as cassava which is processed into MOCAF (Modified Cassava Flour) is an alternative to reduce dependence on wheat flour. Substitution means replacing entirely or a large part of imported food (wheat) with mocaf. Based on this definition, substitution is a way to replace product staples with other ingredients with products that match the quality criteria. Mocaf flour is processed through modified fermentation and has been recognized as a substitute for wheat. This process makes the quality of mocaf better, so that it can substitute 100%, even though consumers like the substitution of 60-80% mocaf flour in cookies (Ariani, 2019). The advantages of Mocaf Flour include: (a) Gluten free, so it is suitable for people with diabetes, autism and celiac disease. (b) Contains calcium, phosphorus, and fiber higher than wheat flour, and rich in vitamin C. (c) Contains phytoestrogens, a hormone that functions to prevent premature menopause that usually occurs in women (d) Whiter color, cassava aroma lost (no aroma of tape), and a smoother texture, (e) Increased elasticity, so that it expands more when used as raw material for making cake preparations, (f) Loss of bitter taste that sometimes appears in cassava. (g) Low sugar, safe for consumption by everyone.

In order to increase the nutritional value and selling value of mocaf pie susu, it is necessary to add super food ingredients. Spirulina is a super food because it is a food with a very high protein content and very good benefits for our bodies. The purpose of this study was to obtain the optimal mocaf-spirulina pie formula as a substitute for wheat flour in the manufacture of mocaf-spirulina pie susu, in order to obtain a high-quality product that the public likes.

### 2. Literature Review

#### 2.1 Pie Susu

Although pie susu is available in various countries with almost the same name, formula and appearance, and is not a traditional cake from Bali, it is currently a Balinese culinary icon. Of course, it is very important if the Balinese culinary icon is a product made from local ingredients. Balinese pie susu uses wheat flour as the main ingredient and which is imported food. This research is expected to obtain pie susu from mocaf flour (modified cassava flour) based on local food. Pie susu is a sweet cookie (short pastry dough) consists of two parts, as follows:

- a) The lower part of pie susu is made from flour, butter, egg white and salt, a short pastry dough using the main ingredient mocaf flour. This mocaf pie susu can substitute 100% low protein flour with mocaf flour, which is a local food ingredient. But it is preferred 60-80% substitution of Mocaf in the pie susu.

- b) The toppings used are milk vla from the local fruits (Balinese grape and pineapple).

Short pastry is a type of pastry that is widely preferred because of its sweet taste, attractive appearance, and high taste, this type of cake is the choice of dish, because of its delicious taste and soft texture, it can also be stored for a longer time. The success in making good pastry depends not only on the recipe, but also on understanding the function of each ingredient to avoid failure in the making. Pastry can be made in various variations both in terms of shape, content and presentation. The right formulation will produce a good pastry, this depends on the ingredients, the composition used in making it, how to beat it and how to cook it. The raw material used for making pastries is mocaf which substitutes wheat flour, shortening, eggs, sugar and salt.

Shortening as a source of fat in pie susu is useful for providing a delicious and tender / crunchy taste, improving quality, adding flavor, acting as an emulsifier and helping to bind products. Eggs function as a delicious and savory flavor enhancer, help bind the dough and add nutritional value. Egg white has a binding reaction so that when used in large quantities, the pastry texture is tougher and vice versa if uses more egg yolk. The use of these different types of sugar will affect the surface appearance of the pastry, because caramel gives a brownish color. Salt serves to add flavor, eliminates bland flavors and unpleasant tastes from other ingredients.
2.2 Local Fruits

Balinese grapes (Alphonse Lavalle) are blackish purple-colored grapes, so it is often called black grapes, which taste sweet and have a crunchy texture. This Balinese grape is widely grown in several districts in Buleleng Regency. Among them, the districts of Seririt, Banjar, and Gerokgak. According to the USDA National Nutrient Database, grapes are rich in thiamine, riboflavin, niacin folate, minerals, potassium, calcium, magnesium, phosphorus, and sodium. The benefits of grapes will increase the levels of nitric oxide in the blood to prevent blood clots and improve overall heart health. Grapes can prevent cancer, because they contain organic compounds, resveratrol in grapes will also work optimally for the prevention and treatment of cancer.

Pineapple is a fruit that has a sweet and slightly sour taste. This fruit is usually used as salad, and a mixture of dishes. The nutritional content that you can get from pineapple, among others, vitamin C, vitamin B6 and vitamin B1, and folate. In addition, pineapple is also rich in other antioxidants, including vitamin A, beta carotene, bromelain, and various flavonoid compounds. Pineapple can also prevent blood clots, because this fruit has a role in producing hemoglobin in the body. If the body is deficient in this substance, it can cause anemia, decreased levels of white blood cells, thyroid problems, and osteoporosis.

2.3 MOCAF (Modified Cassava Flour)

Modification of Mocaf is carried out through a fermentation process. It is important to increase the substitution of wheat flour with local commodities such as mocaf flour. Processing of semi-finished products is one way of preserving crops, especially for cassava with high moisture content. The differences in the nutritional composition of mocaf with wheat and cassava flour are as follows:

Table 1. Composition of various flour: mocaf, cassava flour and wheat flour.

| Component   | Mocaf (%) | *Cassava flour (%) | **Wheat flour (%) |
|-------------|-----------|--------------------|-------------------|
| Water content | 6.9       | 12                 | 12                |
| Protein levels | 1.2       | 1.2                | 8 - 13            |
| Ash content  | 0.4       | 0.4                | 1.3               |
| Starch content | 87.3      | 82                 | 60 - 68           |
| Fiber content | 3.4       | 3.34               | 2 - 2.5           |
| Fat level    | 0.4       | 0.32               | 1.5 - 2           |

* Suprapti 2006
** Depkes. 2005
Source: Lab. TP, UNUD. 2018

Figure 1. Mocaf and spirulina (powder & algae).
Flour technology is one of the recommended alternative processes for semi-finished products, because it is more resistant to the storage, easy to mix (made composites), enriched with nutrients (fortified), shaped, and faster to cook according to the demands of modern, practical life.

2.4 Spirulina

Is a type of blue-green algae that humans can consume as a dietary supplement. Spirulina is considered a super food because the nutritional content and benefits of spirulina is very good for health. Spirulina is high in protein and vitamins, which makes it an excellent dietary supplement for people on a vegetarian or vegan diet. Research shows that spirulina has antioxidant and inflammatory properties, as well as the ability to help regulate the immune system. The nutritional content of spirulina is very good, one tablespoon or 7 grams of dried spirulina contains: 20 calories, 4.02 gr protein, 1.67 gr carbohydrates, 0.54 gr fat, 8 mgr calcium, 2 mgr iron, 14 mgr magnesium, 8 mgr phosphorus, 95 mgr potassium, 73 mgr sodium, 0.7 mgr vitamin C. Consuming spirulina as part of a balanced diet can actually help a person to stay well nourished.

3. Method

Determination of product quality was based on a physical organoleptic approach, included taste, texture, color and aroma through the senses as food sensory ingredients. This research was an experimental study in order to obtain a formula for using mocaf flour with the addition of spirulina as a dietary supplement in making pie susu with a treatment designed by the researcher. This research was limited to the stages to obtain the right formulation and method to produce mocaf pie susu with the addition of spirulina, either the skin or the filling of Balinese grape and pineapple vla.

The results of previous research have produced mocaf (cassava flour) pie susu products, in terms of color, aroma, texture, and taste. The results of the targeted study were to obtain a variety of mocaf pie susu with the addition of spirulina to the filling of Balinese grapes and pineapple vla. The achievement of specific targets in this study was using the organoleptic method with instruments, the Visual Analog Score (VAS) for the Hedonic test as follows 1) The experiment of making mocaf pie susu with the addition of spirulina which matches the quality of mocaf pie susu with variations of Balinese grapes and pineapples so that it adds variation the taste of the resulting pie; 2) Obtaining an assessment of the mocaf spirulina pie product produced by the hedonic test (preference level); 3) Obtaining an assessment of the mocaf spirulina pie susu products produced through the hedonic quality test (quality level). The mocaf pie susu variation was developed with the use of Balinese grapes and pineapple, which were processed into vla. The criteria for good pastry according to Ariani (2019) have a description according to table 2, as follows:

**Table 2. Pastry Criteria.**

| NO. | PASTRY CRITERIA | DESCRIPTION |
|-----|-----------------|-------------|
| 1   | Fragility       | The level of crispness in pastry when eaten, but the shape of pastry remains intact / not destroyed |
| 2   | Aroma of Pastry | Fragrant pastry that can be felt by the senses of smell (nose) derived from ingredients of pastry, such as eggs, butter, vanilla etc. (other than mocaf flour) |
| 3   | Aroma of Cassava| Fragrant pastry that can be felt by the senses of smell (nose) are derived from mocaf flour. |
| 4   | Granules        | Level of subtley and flatness of pastry |
| 5   | Dry             | Dryness level of pastry, meaning pastry are not moist / sluggish. |
| 6   | Sweetness       | The level of sweetness of pastry obtained from the taste bud (tongue) comes from the sugar used. |
| NO. | PASTRY CRITERIA       | DESCRIPTION                                                                 |
|-----|-----------------------|-----------------------------------------------------------------------------|
| 7   | Taste of pastry       | The level of taste of pastry obtained from the taste bud (tongue) comes from a mixture of ingredients used. |
| 8   | Form                  | Pastry frame is clearly visible (in the form of a striped drop) and flatness or similarity in shape. |
| 9   | Color brightness      | Colors are not dull, but shiny / bright according to the type of pastry      |
| 10  | Cooking time          | The cooking time pastry gives the right color and taste (not bitter and burnt) |

To measure the level of preference for the panelists towards pie products, namely in the aspects of color, aroma, texture, and taste, this study used the Visual Analog Score (VAS) for the hedonic test and hedonic quality test. Data collection through the hedonic test were based on the like or taste of the panelists through the level of liking: very like (SS), like (S), quite like (CS), dislike (TS) and very dislike (STS) with the scale range used is 5 - 1. Collecting data through the hedonic test were based on preferences according to the quality or taste of the panelists through the level of favorite quality: bright green color, very crunchy texture, very fragrant pastry aroma and sweet taste with a maximum rating scale range of values 5. The number of panelists was limited to 10 people, type of mocaf pie susu with variations in the addition of spirulina to the pineapple and grape vla filling. Organoleptic assessments according to pastry criteria were obtained based on discussions from 3 researchers, then continued by panelist assessments consisting of 6 catering lecturers and 4 pastry entrepreneurs who were trained for the assessment of mocaf pie usu (pineapple and Balinese grape vla) with the addition of spirulina. Organoleptic test in this experimental research was carried out by using data collection techniques using assessment instruments with online links. Taste by filling out the instrument via the link: https://docs.google.com/forms/d/e/1FAIpQLSf3Vfb8G1c_Zei1Rs7QD42vPBMlozKlgK5DyaZ1TSN4OUsoIA/viewform?usp=sf_link. The data analysis technique in this research was quantitative descriptive analysis, where the data were presented and analyzed descriptively and quantitatively.

4. Result
Pie Susu is pastry dough with the lower part of the pie is a pastry dough with Balinese grape vla and pineapple vla filling which has a sweet taste and also a distinctive pastry aroma. The ingredients needed for mocaf pie susu can be seen in the Figure 2:

![Figure 2. Ingredients of Mocaf-Spirulina Pie Susu.](https://docs.google.com/forms/d/e/1FAIpQLSf3Vfb8G1c_Zei1Rs7QD42vPBMlozKlgK5DyaZ1TSN4OUsoIA/viewform?usp=sf_link)
The process of making pastry was divided into 3, namely the process of mixing, printing, and baking. One method of mixing was called the creaming method, namely shortening, sugar and salt were mixed and stirred evenly, added with eggs, then put the flour into the dough and stirred at a low rotation speed. In this process, liquid absorption occurred so that an even dough is produced, to produce a solid dough that can be processed into a quality final product.

The formation of a pie susu was handmade one by one, this process is called the molded technique. The dough was around 0.5 cm thick, then printed according to the mold, trimmed by hand and pricked by a fork, then filled with vla.

During roasting, the dough ripened, the sugar caramelized, protein coagulation, starch gelatinization and water evaporation occurred. Pastry roasting temperatures were average around 150-180 °C with duration of 45 minutes.

The experiments were carried out by using three repetition techniques in making pastry dough to obtain the best formula as an alternative to sampling techniques, then data analysis was carried out descriptively. After obtaining the basic formula of mocaf pie susu with the addition of spirulina, the hedonic test (preference) and hedonic quality test (quality) were continued. The mocaf pie susu formula that fitted the criteria was the basis for the mocaf pie susu formula with the addition of spirulina, with the following steps:

I. Experiment with mocaf-spirulina pie susu formula
   1. Trial I as a first step by substituting flour with a 2:1 ratio of mocaf and flour (Ekayani, 2016), hereinafter referred to as formula 1
   2. Trial II, was using formula 1, the addition of 1% (5 grams) of spirulina by weight of all ingredients was carried out by mixing in the flour first. The pastry products obtained are (a) good crispiness. (b) the distinctive aroma of pastry, and there is a sea aroma. (c) smells of mocaf. (d) Fine grains and evenly distributed crumbs (e) good dryness level (f) good sweetness level (g) pastry taste covered with slightly bitter spirulina taste. (h) clear pastry outline form (i) flatness of shape (j) dull dark green color, (k) brownish color of good maturity level. Pie susu does not meet the criteria. The results obtained are dark green skin color and the aroma of spirulina (sea) is very strong, so it is concluded that spirulina is reduced. This is formula 2
   3. Trial III, was using formula 1, the addition of spirulina by 0.5% (2.5 grams) of the weight of all ingredients by mixing in the flour first. The pastry products obtained are (a) good crispiness. (b) the distinctive aroma of pastry, and there is a sea aroma. (c) smells of mocaf. (d) Fine grains and evenly distributed crumbs (e) good dryness (f) good sweetness (g) dominant pastry taste. (h) clear pastry frame shape (i) flatness of shape (j) bright green color, (k) brownish color of good maturity level. This pie susu product meets the criteria (formula 3)
   4. Formula 3 was repeated two more times, obtaining the same results. This means that formula 3 of mocaf pie susu with the addition of 0.5% spirulina has met the pastry criteria.

II. Hedonic Test (preferred level)
   Furthermore, the hedonic test was carried out to measure the level of preference for mocaf pie susu with the addition of 0.5% spirulina using research instruments according to the criteria. The taste test was carried out at least on a limited number of trained panelists, from 6 lecturers in the culinary field and 4 culinary entrepreneurs in Singaraja City. Because the condition was still constrained by COVID-19 so there were no tourist in Singaraja.
   Based on the data tabulation of the hedonic test results, the average preference or taste of mocaf pie susu with the addition of 0.5% spirulina was obtained, as follows:
Figure 3. Hedonic test results or mocaf-spirulina pie susu pineapple vla and Balinese grapes vla.

The results were obtained for the preference level of mocaf pie susu with the addition of 0.5% spirulina are like the color, the texture, the aroma and the taste of the two pie susu with pineapple vla and Balinese grape vla. The panelists preferred the color of the pie susu with mocaf spiruline grape vla rather than the taste of the pie susu with the mocaf spiruline wine vla. As for the texture and aroma, the panelists preferred the pie susu with the mocaf spiruline pineapple vla.

Figure 4. Mocaf-spirulina 0.5% pie susu (2.5 grams).

2. Hedonic Quality Test (quality level)
Based on the data tabulation of the hedonic Quality Test results, the average quality of mocaf pie susu with the addition of 0.5% spirulina was obtained as follows:
The results obtained for the quality level of mocaf pie susu with the addition of 0.5% spirulina were bright green color, crunchy texture, distinctive pastry aroma and sweet pastry taste on both pie susu with pineapple vla and Bali grape vla. The assessment of the quality level was the same for color and taste, while the difference between texture and aroma was slightly different.

5. Conclusion

Research on mocaf pie susu with the addition of spirulina to the filling of Bali grape wine and pineapple vla produced several conclusions:

1. Obtained Mocaf Pie susu formula with the addition of 0.5% spirulina, which fulfilled the pastry criteria.
2. The favorite level of mocaf pie susu with the addition of 0.5% spirulina is like the color, the texture, the aroma and the taste of both the pie susu with pineapple vla and Bali grape vla.
3. The quality level of mocaf pie susu with the addition of 0.5% spirulina is bright green color, crunchy texture, distinctive pastry aroma and sweet pastry taste on both pie susus with pineapple vla and Bali grape vla.
4. Both types of mocaf pie susu with the addition of spirulina, the contents of pineapple vla and Bali grape vla received a preferred response and quality in accordance with pastry criteria. However, it is necessary to introduce the product more widely so that mocaf products such as pie susu become icons of Balinese society.

References

[1] Ariani R P dan Masdarini L 2019 Modified Cassava Flour Utilization As A Wheat Flour Substitution In Chochochip Cookies. Proceeding ICONHOMECS 406 234-239 ISBN 978-94-6252-910-6 https://doi.org/10.2991/assehr.k.200218.037 Advances in Social Science, Education and Humanities Research, Atlantis Press https://www.atlantispress.com/proceedings/iconhomecs-19/125934928

[2] Ariani R P 2016 Pemanfaatan Tepung Singkong Sebagai Substitusi Terigu untuk Variasi Cake Jurnal Ilmu Sosial dan Humaniora 5 ISSN: 2303-2898 DOI: 10.23887/jish-undikshav5i1.8283

[3] Badan Ketahanan Pangan 2018 Data Statistik Ketahanan Pangan Tahun 2017 Badan Ketahanan Pangan Kementan bkp.pertanian.go.id/tinymceuk/data_statistik_kp_2018
[4] IRSA (Indonesia Research and Strategic Analysis) 2016 Industri Tepung Terigu Nasional. Assosiasi Produsen Tepung Indonesia (APTINDO) website: http://aptindo.or.id/2016/10/26/industri-terigu-nasional/

[5] Puspita S and Dhyta 2019 Kurangi Impor Gandum melalui Ketahanan Pangan Berita Fajar https://fajar.co.id/2019/05/21/kurangi-impor-gandum-melalui-ketahanan-pangan/

[6] Putri N A, Herlina and Subagio A 2018 Karakteristik MOCAF Berdasarkan Metode Prnggilingan dan Lama Fermentasi Jurnal Agroteknologi 12

[7] Wulandari F K, Setiani B E and Susanti S 2016 Analisis Kandungan Gizi, Nilai Energi, dan Uji Organoleptik Cookies Tepung Beras dengan Substitusi Tepung Sukun Jurnal Aplikasi Teknologi Pangan 5 http://dx.doi.org/10.17728/jatp.183

[8] Saragih H 2016 Hari Pangan Sedunia 2016: Harga Pangan Melambung, Impor Pangan Meningkat dan Jumlah Petani Terus Menurun, Serikat Petani Indonesia website: http://www.spi.or.id/hari-pangan-sedunia-2016