Study of Making Gluten-Free Fettuccine from Taro Flour (*Colocasia esculenta* L. Schoot)

Sekti Rahardjo[1a], Aminudin[2], Saleha[1], Tatik Sriwulandari[1], Nisa Rahmaniyah Utami[1]

[1]Sekolah Tinggi Pariwisata Bogor: Jl. Curug Mekar No.17, RT 01 RW 04, Kecamatan Bogor Barat, Kota Bogor, Jawa Barat 16113.

[2]Sekolah Tinggi Ilmu Ekonomi Dewantara: Jl. Raya Pemda-BDB III Karadenan Cibinong, Kab. Bogor, Jawa Barat 16914

[a]Correspondence : Sekti Rahardjo, E-mail: sektirahardjo@gmail.com

ABSTRACT

We often encounter fettuccine pasta in cafes and restaurants, usually made from wheat flour as the main ingredient. Wheat flour is a food ingredient that contains gluten, which is a protein compound from cereals that cause allergies and irritate the small intestine and can also cause celiac (autoimmune) disease in certain people. Several studies have substituted wheat flour for making fettuccine with non-gluten taro flour. The formula obtained is still a mixture of taro flour and wheat flour. This research used 100% pure taro flour with additional ingredients of two types of egg yolk, namely chicken egg yolk and duck egg yolk. This research aimed to determine the organoleptic results of fettuccine from 100% taro flour based on the formulation using the type of egg yolk and boiling time. This study used a completely randomized trial (CRD) design with four treatments and two repetitions. The types of treatment in this study were the use of duck eggs with a boiling time of 35 seconds, the use of boiled duck eggs for 1 minute, the use of boiled chicken eggs for 35 seconds, and the use of boiled chicken eggs for 1 minute. The research results showed that fettuccine was successfully made using 100% taro flour without being mixed with wheat, using additional egg yolk as a binder. A perfect assessment was obtained from the expert panelists for the duck egg yolk formula boiling for 1 minute. The type of egg yolk and boiling time affect the sample in terms of taste, color, and texture, but not aroma.

Keywords: fettuccine, gluten free, pure taro flour, yolk, boiling time

INTRODUCTION

Along with the function of food becoming a lifestyle in the current era of globalization, the food industry is showing rapid development, as can be seen from the proliferation of businesses in the food sector such as restaurants, cafes and other eatery places. Indonesia Central Agency of Statistics (Statistics, 2018) states that in West Java Province alone there are around 6,849 new businesses related to food, consisting of restaurants, restaurants and cafes. This business provides various types of food from traditional to international, one of which is fettuccine pasta.

Fettuccine is a type of pasta that has a long, flat shape. This technique for making fettuccine is relatively easier than other forms of pasta because it can be made without using tools so that all catering services, both small and large scale, can make it. However, it turns out that not everyone can consume foods made from wheat flour because they contain gluten, which is a protein compound from cereals that causes allergies so that it cannot be digested by people with certain conditions, who are called gluten intolerant. According to Goi (2017), gluten intolerance causes changes in the small intestine resulting in impaired absorption of nutrients entering the body, causing various disturbances in the function of the human body. Gluten-related disorders are classified into three main groups according to their pathological mechanisms, namely celiac disease, dermatitis herpetiformis, and autoimmune gluten ataxia. It is estimated that in Indonesia 1 in 100 people suffer from celiac disease. In addition, around 34% of the population of children who have difficulty eating are sufferers of celiac disease.

Taro is a type of tuber that has the advantage of being easy to grow anywhere. The popular type of taro is *Colocasia esculenta L.* or Taro Bogor. Taro is a carbohydrate producer that has the potential to replace wheat flour because it has a high starch content, namely around 70-80% (Saputra et al., 2016). Taro flour is also a food ingredient that does not contain gluten. The results of Luckyanto's research (Luckyanto, 2017) were successful in making fettuccine from taro flour using three paste-making trials, namely 30%, 60% and 90% taro flour. Of the several treatments, the most preferred is a product with a taro flour percentage of 30%, followed by 60%, and finally 90%. Santoso (Santoso, 2021) conducted research with the results that the good quality of the pasta product was 25% taro flour because it got the best response and value from respondents. Based on exploration from research by Widiyawati & Komariah (Widiyawati & Komariah, 2020) to determine the right formula for making noodles, the best substitution for taro flour is 30%.

This research was carried out by making fettuccine using 100% pure taro flour. Because the non-gluten nature of taro flour causes the resulting paste to become brittle and break easily, egg yolk is added which functions as a dough emulsifier. Andrianto (Andrianto, 2013) stated that the use of eggs is widely known as an emulsifier, binder, and foaming agent, used to make mayonnaise, ice cream, noodles, bread, cakes, and so on. Eggs are a food ingredient that has functional properties, namely physicochemical properties beyond nutritional properties, which enable eggs to contribute desired characteristics to food. Egg yolks have a different function to egg whites, egg yolks contain a lot of fat so egg yolks function as a natural dough emulsifier, making the dough come together more quickly, thicken and bind. According to Suyanti (Suyanti, 2010), adding eggs to make noodles functions to provide protein to the noodles and creates a dough that is tougher so it doesn't break easily. The research results of Risti & Arintia (Risti & Rahayuni, 2013) show that increasing the number of eggs also affects the level of acceptability in terms of color and texture but does not affect the aroma and taste. Widyastuti et al. (Widyastuti et al., 2015) stated that the additional ingredient used to help

improve the texture of biscuits is egg yolk. The addition of egg yolk concentration showed an increase in water, fat and protein content.

This research aims to determine the organoleptic results of fettuccine made with 100% taro flour based on the formulation using types of egg yolk, namely chicken egg yolk and duck egg yolk, as well as the length of boiling time.

MATERIALS AND METHODS

Materials and Tools

The ingredients used in making gluten-free fettuccine pasta are taro flour, chicken or duck eggs, olive oil, and salt. While the tools used are rolling pin, pasta maker, plastic wrap, bowl, digital scale, scraper, stove, strainer/sieve, and thermometer.

Method

This research was conducted for 3 months. The product manufacturing process is carried out in the kitchen of the Royal Tulip Hotel Gunung Geulis Golf and Resort. In determining the formulation for making fettuccine, it refers to research (Luckyanto, 2017), but the research conducted has not found a 100% formulation of taro flour, but the highest is only 90%. Initially the researcher made a formulation using whole eggs in accordance with the previous research formulation, but after organoleptic evaluation of three panelists of experts at the Royal Tulip Hotel Gunung Geulis Golf and Resort and getting some input the researcher tried a formulation using only egg yolks, and the results were better after that the researcher conducted a comparison of the treatments in the egg ingredients, namely chicken eggs and duck eggs, in the end the researchers carried out four treatments namely from the cooking method, namely the boiling time was divided into two, 35 seconds and 1 minute. As for other treatments, namely in terms of materials. The researcher made a difference from the protein, namely using duck and chicken eggs so that the researcher had a total of four samples. After conducting several experiments, the researchers finally found a formulation that is considered the closest to the physiology of fettuccine pasta, which is as follows:

Table 1. Chicken Egg Gluten-Free Fettucine Formula

Name of Material	Number	Unit
Taro Flour	125	gram
Water	100	ml
Chicken Egg Yolk	1	pc
Olive oil	4	ml
Salt	4	gram

(Source: Personal Data, 2023)

Table 2. Duck Egg Gluten-Free Fettuccine Formula

Name of Material	Number	Unit
Taro Flour	125	gram
Water	100	ml
Duck Egg Yolk	1	pc
Olive oil	4	ml
Salt	4	gram

(Source: Personal Data, 2023)

Product Manufacturing Process

Mix all ingredients, knead until smooth using hands. Wrap and let stand for about 30 minutes. After that, roll the dough, do the lamination, flatten the dough and cut it using a pasta maker according to the fettuccine shape. Boil in boiling water at 90° Celsius plus a little salt and olive oil according to the treatment time. Fettuccine pasta is ready to be served.

There were four treatments in this study, namely boiling time and egg ingredients:

1. using duck egg yolk by boiling for 35 seconds (treatment F1/392)

2. use of duck egg yolk by boiling for 1 minute (treatment F2/375)

3. use of chicken egg yolk by boiling for 35 seconds (treatment F3/294)

4. use of chicken egg yolk by boiling for 1 minute (treatment F4/279)

According to Suyanti (2010), the addition of eggs to noodle making functions to provide protein to the noodles and creates a tougher dough so it doesn't break easily. The results of research by Risti & Arintia (2013) showed that increasing the number of eggs also affected the level of acceptance in terms of color and texture but did not affect aroma and taste. Widyastuti et al. (2015) stated that the additional material used to help improve the texture of biscuits was egg yolk. The addition of egg yolk concentration showed an increase in water, fat and protein content.

Sensory Testing Method

In this study, researchers used a preference test and a differentiator test. This test has four variables, namely Formula F1/392, Formula F2/375, Formula F3/294, and Formula F4/279 with each indicator being a sensory characteristic consisting of taste, aroma, color and texture.

Sensory Testing (Organoleptic Test)

This reasearch has four variables, Formula F1, Formula F2, Formula F3, and Formula F4 with each indicator in the form of sensory characteristics consisting of taste, aroma, color and texture. Sensory and discriminative tests are used on this research.

1. Organoleptic Test

Organoleptic test is an assessment carried out by sensing and is widely used to assess the quality of agricultural and food commodities. Organoleptic tests are widely used to assess quality in the food industry and other agricultural product industries. This assessment can provide very thorough assessment results. In assessing food ingredients, the characteristics that determine whether a product is accepted or not are its sensory properties. The senses used in assessing are the senses of sight, touch, smell and taste. Meanwhile, a questionnaire is a tool in the form of a list of questions that must be filled in by the person (respondent) who will be measured (Ningrum et al., 2017). Organoleptic assessment requires a panel, which is a tool consisting of people or groups of people who assess the nature or quality of objects. People who are members of a panel are called panelists. In this research, the author chose to use consumer panelists (people who have consumed fettuccine pasta), as well as expert panelists (Sous Chef Breakfast, Sous Chef Kitchen Banquet, and Sous Chef Fire Grill and Bar Resto).

To observe the results of the four treatments in the manufacture of non-gluten fettucine, sensory testing (Organoleptic Test) was then carried out. Observations in this test were in the form of taste, aroma, color, and texture.

• Preference Test (Hedonic Test)

Panelists were asked to express their responses regarding likes or dislikes.

Table 2. Operational variables for the preference test

Variable	Operational Definition	Measurement Scale
Color	Level of preference for product color	4=Very Like 3=Like 2=Dislike 1=Totally Dislike
Aroma	Level of preference for product aroma	4=Very Like 3=Like 2=Dislike 1=Totally Dislike
Texture	Level of preference for the texture of the product	4=Very Like 3=Like 2=Dislike 1=Totally Dislike
Taste	Level of preference for the taste of the product	4=Very Like 3=Like 2=Dislike 1=Totally Dislike

The scale model used in this research questionnaire is the Ordinal/Likert Scale model which will contain several questions to state the object under study. Rangkuti (2011) states that the Ordinal/Likert Scale is a psychometric scale commonly used in questionnaires, and is the most widely used scale in research in the form of surveys. Respondents will determine their level of agreement with a statement by selecting one of the available options.

2. Data Analysis

Data from the results of distributing questionnaires were analyzed using the Kolmogorov Smirnov test to determine whether the data was normally distributed or not. This research was experimental using a Randomized Block Design with four treatments and two repetitions.

Anova test

Anova is part of a statistical analysis method which is classified as comparative analysis of more than two averages. Anova is carried out to determine differences in more or 2 related sample groups. It can be said to be different from looking at decision making if sig < 0.05.

Duncan's test

Duncan's test performs multiple comparisons of the average score ranking for each population. In this test, the critical value is used as a comparison for each pair of average score rankings

Friedman test

The Friedman test is a non-parametric test as an alternative to repeated measures Anova or Anova with repeated measurements. This test is used when there are assumptions that are not met in Anova, for example the assumption of normality in the population. The Friedman test functions to see whether three or more treatments have different effects on

the same sample or subject. The effect of each treatment is said to be the same if the median value from one subject is the same as the median value from other subjects.

RESULTS AND DISCUSSION

Preference Test Results

Following are the results of the Preference Test (Hedonic Test) based on the assessment of 2 groups of panelists, namely 80 consumer panelists, and 3 expert panelists. The total is 83 panelists.

Table 3. Preference test on consumer panelists

Aspect	Treatment	Mean	Median	Modus
Taste	F1	3,28	3	3
	F2	3,28	3	3
	F3	3,18	3	3
	F4	3,20	3	3
Color	F1	3,06	3	3
	F2	2,99	3	3
	F3	3,05	3	3
	F4	3,04	3	3
Texture	F1	3,14	3	3
	F2	3,06	3	3
	F3	3,28	3	3
	F4	3,18	3	3
Aroma	F1	3,14	3	3
	F2	3,06	3	3
	F3	3,28	3	3
	F4	3,18	3	3

Table 3 shows the results of the consumer panelist preference test. The mean, median and mode values show that for the aspects of taste, color, texture and aroma, consumer panelists place themselves on the preference scale. The lowest average value appeared in the color aspect in treatment F2, formula uses duck yolk with a boiling time of 1 minute, with a value of 2.99 producing fettuccine that is dark yellow to light brown. However, the F2 formula on the other hand shows the highest average value in the taste aspect of 3.28, namely that fettuccine tends not to taste like taro. The highest average value was also shown in the taste aspect in treatment F1 (using duck yolk, boiling 35 seconds) which produced fettuccine without taro taste, as well as the texture aspect and aroma aspect in treatment F3 (using chicken yolk, boiling 35 seconds) which produces fettuccine with a chewy texture and no taro aroma.

Table 4. Preference test on expert panelists

Aspect	Treatment	Panelist 1	Panelist 2	Panelist 3	Mean
Taste	F1	3	3	3	3
	F2	3	3	4	3,33
	F3	3	3	3	3
	F4	3	3	4	3,33
Color	F1	3	4	4	3,67
	F2	3	4	4	3,67
	F3	3	3	3	3
	F4	3	3	3	3
Texture	F1	4	3	3	3,33
	F2	4	4	4	4
	F3	4	3	3	3,33
	F4	4	4	4	4
Aroma	F1	3	4	4	3,67
	F2	3	4	4	3,67
	F3	3	4	4	3,67
	F4	3	4	4	3,67

Table 4 shows the results of the preference test for expert panelists. For the taste aspect, the mean (average) value for all treatments shows a value scale of 3 and 3.33, meaning that the expert panelists liked the taste. For the color aspect, the average value of the data above shows a scale of 3 and 3.67. This shows that the expert panelists liked the colors produced by the F3 and F4 treatments, leading to a strong liking for F1 and F2. The texture aspect shows a perfect average value, namely a scale of 4, which means the expert panelists really like textures F2 and F4. In the aspect of the resulting aroma, it shows the same mean value, namely 3.67, which is close to the scale of really liking the aroma of all treatments in this study.

Fettuccine Taste

The results of Sandy's research (Sandy et al., 2022) showed the most accepted taste by respondents was pasta with the main ingredients being a mixture of 25% taro flour and 75% wheat flour. Many respondents said that the taste of 100% taro flour paste has a very distinctive taste, but it's not delicious to make food like pasta. Santoso also recommended carrying out other experiments by increasing the contribution of taro flour from 25% to 50%, or even 75% by changing the composition of other ingredients such as eggs or processing method.

This research succeeded in getting the right formula for making fettuccine pasta, even using 100% taro flour without mixing it with wheat, by adding egg yolk treatment and boiling time. All formulas are generally acceptable with no taro taste in response. The best taste based on consumer preference tests in this study was shown in fettuccine used duck egg yolk, with a boiling time of 35 seconds and 1 minute (Formula F1 and F2). These two formulas produce the same average value. Meanwhile, the expert panelists showed that their preference for taste was the formula used duck egg yolk with boiling for 1 minute (Formula F2) or using chicken egg yolk with boiling for 1 minute (Formula F4). Expert panelists provide higher scores than the average rating of consumer panelists. The differentiation test was carried out using the Friedman Test aimed to determine the effect of replacing materials on the given sensory aspects.

Table 5. Friedman test for the taste of taro fettuccine

N	80
Chi-Square	9,927
df	3
Asymp. Sig.	,019

Asymp. Sig. 0.019 = smaller than 0.05, meaning that there is a significant difference between each formula, so that there is a significant influence from the panelists on each treatment, the type of egg yolk and the length of boiling given on the difference in taste of fettuccine made from 100% taro flour.

Fettuccine Color

Sandy et al. (15) stated that the addition of taro paste had an influence on the panelists' preferences for the taste of wet noodles. Panelists preferred noodles with a colored appearance compared to colorless noodles.

This research resulted in the highest average color value among consumer panelists appearing in the treatment using duck egg yolk with boiling time of 35 seconds (Formula F1). The resulting color is light brown. The results of the preference test among expert panelists showed that the highest color value was in the formula with duck egg yolk with boiling time of 35 seconds and 1 minute (Formula F1 and F2), which was dark brown.

Table 6. Friedman test for the color of taro fettuccine

N	80
Chi-Square	10,533
df	3
Asymp. Sig.	,015

Asymp. Sig. 0.015 = smaller than 0.05, meaning there is a significant difference between each formula, so there is a significant influence from the panelists on each formulation given on the color difference of taro flour fettuccine.

Fettuccine Texture

Respondents in Santoso's (16) research stated that 100% taro flour paste had a texture that was too soft which resulted in it being brittle and easily crushed, not chewy, slimy. As a result, taro flour paste with a lower taro flour content of 25% is superior because it has the smoothest/spongiest texture, is not brittle, is not slimy, and almost matches the texture of the original pasta.

This research used 100% taro flour, and to improve the texture of the resulting pasta, egg yolk was added in combination with the boiling time. Consumer panelists gave the highest average score for the texture aspect to fettuccine made using chicken egg yolk with a boiling time of 35 seconds (Formula F3). The results were assessed as being at the chewy level. Meanwhile, the expert panelists gave perfect marks for making fettuccine with chicken egg yolk but by boiling for 1 minute (Formula F4). The expert panelists' perfect assessment was also seen in the treatment with duck egg yolk with a boiling time of 1 minute (Formula F2).

Table 7. Friedman test for the texture of taro fettuccine

N	80
Chi-Square	14,320
df	3
Asymp. Sig.	,003

Asymp. Sig. 0.003 = smaller than 0.05, meaning that there is a significant difference between each formula, so that there is a significant influence in each formulation given on the difference in texture of taro flour fettuccine.

Fettuccine Aroma

The fettuccine with the best aroma according to consumer panelists appeared in a formula treated with chicken egg yolk with a boiling time of 35 seconds (Formula F3). The aroma produced from this formula does not smell like taro. Meanwhile, the expert panelists gave the same score for all formulas, with a higher score than the consumer panelists, so it was close to the value of very no taro smell.

Table 8. Friedman test for the aroma of taro fettuccine

N	80
Chi-Square	7,197
df	3
Asymp. Sig.	,066

Asymp. Sig. 0.066 = greater than 0.05, meaning there is no significant difference between each formula, so there is no significant influence of each formulation given on the difference in aroma of taro flour fettuccine.

The following is a summary of the preferences of consumer panelists and expert panelists for all treatments.

Table 9. Consumer panelist preferences for taste, color, texture and aroma on four formulas for making gluten-free fettuccine from taro flour

	Taste	Color	Texture	Aroma
F1	✓	✓		
F2	✓			
F3			✓	✓
F4				

Table 10. Expert panelist preferences for taste, color, texture and aroma on four formulas for making gluten-free fettuccine from taro flour

	Taste	Color	Texture	Aroma
F1		✓		✓
F2	✓	✓	✓	✓
F3				✓
F4	✓		✓	✓

Based on the overall results of the Friedman Test, significant differences in each formula appear in the aspects of taste, color and texture. Meanwhile, in the aroma, there is no visible difference. The best formula was obtained in F2, formula using duck egg yolk with a boiling time of 1 minute. This formula shows result that the fettuccine doesn't taste of taro (scale 3 out of 4, which the panelists like it), is light brown in color, have a chewy texture, and do not smell like taro.

CONCLUSION

Based on the research results, fettucine pasta was successfully made using 100% taro flour as the main ingredient without being mixed with wheat flour, using additional egg yolk as a binder. All egg yolk formulations and boiling times can be used as the basis for making this gluten-free fettuccine pasta. A perfect assessment was obtained from the expert panelists for the duck yolk formula with boiling for 1 minute. The type of egg yolk and boiling time affect the sample in terms of taste, color, and texture, but not aroma.

BIBLIOGRAPHY

Andrianto, R. (2013). *Kandungan Albumin dan Organoleptik Telur Ayam Leghorn dan Kampung Setelah Penambahan Ekstrak Bawang Putih (Allium Sativum) dengan Konsentrasi Berbeda*. Universitas Muhammadiyah Surakarta.

Badan Pusat Statistik. (2018). Banyaknya RM Makan, Restauran dan Cafe Menurut Kabupaten/Kota 2017-2018. Diakses pada tanggal 02 April 2022.

https://jabar.bps.go.id/indicator/16/217/1/banyaknya-rm-makan-restauran-dan-cafe-menurut-kabupaten-kota.html.

Goi, M. (2017). *Penanganan Gizi pada Celiac Disease.* Journal Health and Nutritions. Vol. 3, 2.

Luckyanto. (2017). *Pembuatan Pasta Fettuccine Dengan Subtitusi Tepung Talas Sebagai Pengganti Tepung Terigu*. Sekolah Tinggi Pariwisata Trisakti.

Ningrum, L., Rosavira, T., & Pambudi, B. (2017). How the panelists votes chicken ballotine with analog chicken turkey and duck talita rosavira. *International Journal of Innovative Science and Research Technology*, *2*(4), 119–124. www.ijisrt.com

Rahardjo, S., Soeswoyo, D. M., Simanihuruk, M., & Kusumawardhani, Y. (2022). STUDY ON THE QUALITY OF FOOD AND BEVERAGE PRODUCTS IN SUKAJADI VILLAGE, BOGOR. Jurnal Cakrawala Ilmiah, 1(11), 3057-3068.Rangkuti, F. (2011). Riset Pemasaran. Jakarta: PT. Gramedia.

Rangkuti, F. (2011). *Penelitian pemasaran*. PT. Gramedia.

Risti, Y., & Rahayuni, A. (2013). Pengaruh Penambahan Telur Terhadap Kadar Protein, Serat, Tingkat Kekenyalan Dan Penerimaan Mie Basah Bebas Gluten Berbahan Baku Tepung Komposit. (Tepung Komposit : Tepung Mocaf, Tapioka Dan Maizena). *Journal of Nutrition College*, *2*(4), 696–703. https://doi.org/10.14710/jnc.v2i4.3833

Sandy, M., Rahayuni, T., Pangan, D. T., & Tanjungpura, U. (2022). *Study of The Characteristics of Taro Wet Noodles (Colocasia esculenta) with The Addition of Carrot*. *1*(1), 7–14.

Santoso, A. W. S. B. (2021). Trend Wisata Kuliner melalui Olahan Produk Pasta. *Media Wisata*, *17*(1). https://doi.org/10.36276/mws.v17i1.152

Saputra, F., Hartiati, A., Admadi, B. H., Jurusan Teknologi Industri Pertanian, M., Teknologi Pertanian, F., & Jurusan Teknologi Industri Pertanian, D. (2016). KARAKTERISTIK MUTU PATI UBI TALAS (Colocasia esculenta) PADA PERBANDINGAN AIR DENGAN HANCURAN UBI TALAS DANKONSENTRASI NATRIUM METABISULFIT. *Maret*, *4*(1), 62–71.

Statistics, C. B. o. (2018). *Number of Restaurants, Restaurants and Cafes by Regency*. https://jabar.bps.go.id/indicator/16/217/1/banyaknya-rm-makan-restauran-dan-cafe-menurut-kabupaten-kota.html

Suyanti. (2010). *Membuat Mie Sehat*. Penyebar Swadaya.

Widiyawati, E., & Komariah, K. (2020). Eksplorasi Formula dan Uji Kesukaan Mie Lidi Talas dengan Menggunakan Substitusi Tepung Talas. *Jurnal Aplikasi Teknologi Pangan*, *9*(2), 57–61. https://doi.org/10.17728/jatp.5762

Widyastuti, E., Claudia, R., Estiasih, T., & Ningtyas, D. W. (2015). Karakteristik biskuit berbasis tepung ubi jalar oranye (Ipomoea batatas L.), tepung jagung (Zea mays) fermentasi dan konsentrasi kuning telur. *Jurnal Teknologi Pertanian*, *16*(1), 9–20.