

How to Optimize the Fusilli Carrot Pasta's Good Nutritional Condition?

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Abstract—Carrot's utilization as a processed product is still low to be used for any purpose. The purpose of this study is to optimize the carrot as a product and its nutrition. The organoleptic and chemical test had been done to measure the result of this study. The results showed that 1) the best fusilli color and texture quality in MOCAF (Modified Cassava Flour) was 30% and carrot purees was 30%, the best level in fragility MOCAF 45% and carrot purees was 40%, the best aroma quality in MOCAF was 45% and carrot purees was 30%: 2) Fusilli contain β -carotene 27,790 SI per 100 grams. This study indicates that carrot can be considered as potential alternative food.

Keywords—Carrot purees, Mocaf, Pasta, Fusilli

I. INTRODUCTION

Carrot (*Daucus carota L*) is a periodic or seasonal vegetable, comes from subtropical countries. This vegetable is a well grown in almost all of countries in the world that have relatively high production. Based on recent data, carrot productions in Indonesia are around 20 to 25 tons per hectare and it is ranked 16 [1] from 20 countries in the world after the top-ranked countries as carrot producers that are China, Uzbekistan, Russia, and the United States [2]. Nowadays, the utilization of carrot as a processed product is commonly less. It is evidenced that carrot is used only as an additional main course or a juice. Whereas, the carrot is a good raw material in the production of the processed products variety because it has many nutrition, especially β -carotene which is useful for human health [3]. Therefore, carrot's utilization as processed products with high nutritional component needs to be developed in such kind of pasta, specifically fusilli.

Carrot is classified as a seasonal vegetable for only once production. Carrot has a short life which ranged from 70-120 days depending on the varieties [4]. As a kind of popular vegetable, the people cultivated many varieties of carrot. Carrot can be differentiated from colour variation, such as white, orange, yellow, red and purple. In addition, it contains different combinations and quantities of macronutrient, fibres, vitamins, minerals and phytochemicals including carotenoids, phenolic acids, and anthocyanins [5]. Despite the fact that carrot has small usage of the processed product, it has a nutritional component which almost equal to the nutritional component of rice and wheat flour. Therefore, it has the potential to be used as processed food [6]. Nutritional

component in carrot per 100 grams of wet carrot is 9 grams carbohydrates, 5 grams sugar, 1.2 mg of vitamin B3, 0.1 mg of vitamin B6, 19 mg of vitamin B9, 3 g dietary fiber, 0.2 g fat, 7 mg of vitamin C, 3 mg calcium, 1 g protein, 835 mg of vitamin A. In addition, carrot also contains 0.66 mg Fe, 18 mg of mg, 82.85 mg of beta-carotene, 35 mg phosphorus, 0.04 mg of vitamin B1, 240 mg of potassium 0.05 mg vitamin B2 and 2.4 mg sodium [7]. Although carrot has a good nutritional component, it decays easily. Therefore, the innovation of carrot processing for processed food is necessary.

Pasta is an Italian food and one of the most popular foods, nutritious and multipurpose both from its nutrition and gastronomic [8, 9]. Food and Drug Administration (FDA) of United States and the World Health Organization (WHO) consider pasta as a good additional food and pasta are the first foods to be authorized by the FDA for fortification in its vitamins and iron [10]. Fortified pasta is highly acceptable for the component qualities. Pasta is able to use as a nutritional food for low-income countries or known as developing countries [11]. It becomes popular up to now because of its ease preparation, low cost, storage stability and nutritional qualities around the world [12]. The increasing nutritional qualities of pasta as a processed food and main course is necessary to be considered [13].

In particular, pasta is consumed in large quantities throughout the world for its nutritional importance, the contents of the complex carbohydrates, proteins, B-vitamins, and iron [14]. Pasta made from flour, egg, oil, water and salt and formed in various shapes. Some of the common pasta is spaghetti (round-rod), ribbon noodles (fettuccini, lasagna) and short-cut shape (macaroni and fusilli) [15].

Fusilli is a semi-processed food in the form of curly short pieces. Although pasta is traditionally produced using only durum wheat flour. It is possible to use the non-durum wheat flour and other ingredients to produce mixed pasta with a special label. It is also possible to add fibre into pasta that can increase the nutritional value to the consumer, compared with conventional pasta [16]. Variations other materials come from tubers, fruits or vegetables to develop a variety of processed food and to supplement the nutritional component can also encourage the low consumption. The addition of carrot purees to the fusilli in this study is expected to develop the quality of the ready-to-eat food. Fresh purees are used in this study can make the colour intensity and distribution of pigments are

better in the pasta dough thus it develops the quality of the pasta. This is the way to avoid drying of vegetable purees before it adds to the flour [17].

TABLE I. FUSILLI NUTRITIONAL CONTENT WITHOUT MODIFICATION

Analysis per 100 g	
Energy Value	1539/363 kJ / kcal
Fat	1.5 g
Saturate fat	0.3 g
Carbohydrates	78 g
Sugars	4.4 g
Fiber	2 g
Protein	8.3 g
Salt	0.28 g

Beside carrot purees as the additional ingredient, the basic ingredient that can also be added to fusilli is MOCAF. MOCAF is a product originally from cassava flour that uses the cell modification of cassava fermentation [18]. MOCAF has a potential to substitute wheat flour in pasta by utilizing the starch component in MOCAF flour, including the ratio of amylose and amylopectin fraction of the starch.

The substitution of carrot and MOCAF purees as fusilli pasta-forming materials is expected to develop the quality of ready-to-eat products that meet the best form, colour, texture and aroma criteria. The best criteria of carrot fusilli product are controlled by fusilli standard recipe.

TABLE II. FUSILLI STANDARD RECIPE [19]

Material	Amount
All-purpose flour	56.25 g
Salt	1 g
Whole egg	15 g

The procedures of fusilli preparation, at the first, mix all ingredients by hand and then mixed and flatten them until the mixtures are homogeneous. Third, divide the dough into three parts, then take the first part and flatten it using a pasta maker machine, fold, and flatten again, repeat it at least three times. Next, shape fusilli by using hand to the curly form and let them rest in 20 minutes before cooking or drying them for long storage; this may take up to 2 days. Dry using the oven with 65°C temperature for 2 hours to make it dry completely.

II. METHODS

A. Design, Places, Time

This research design was experimental studies with experimental design in a randomized design. The study was conducted from January to March 2017 in Surabaya. The laboratory used was Science Laboratory, Universitas Negeri Surabaya.

B. Materials and tools

The main ingredients in this study were carrot purees. Raw materials in fusilli were carrot, wheat flour, MOCAF flour, egg yolk and salt. In addition to the chemicals used for the analysis of the nutritional components consisted of distilled water, n-hexane, HCl, selenium-mix, concentrated H₂SO₄, HNO₃, NaOH, boric acid and the indicator consisted of methyl red and blue methyl. The material used for the analysis of physical properties was flour extracted. The tools that used were a steamer, blender, bowl, knife, cutting board, scale, pasta maker machine, and oven.

C. Stages of experiment

Carrot purees preparation. The preparation of carrot purees was done in the following steps: 1) purees carrot that has the best nutritional component was a puree made from carrot by cut-size, 2) it was steamed and then crushed with a blender then squeeze in fabric stuff. This method used steaming time for 20 minutes.

TABLE III. NUTRITIONAL COMPONENT OF CARROT PUREES

Nutrient levels Purees Carrot	
Sugar level	2.48%
Starch	7.03%
Beta carotene	87.32 mg / 100 g
fiber meal	2.41%

Carrot fusilli preparation, carrot fusilli preparation was done by testing the effect of concentration variation of MOCAF flour and carrot purees that equalled to carrot fusilli quality. The formula of fusilli in this study was based on the concentration differences between MOCAF flour and carrot purees with 4 degrees for the treatment, MOCAF was 30% and carrot purees was 30% (F1), MOCAF was 45% and carrot purees was 40% (F2). MOCAF was 30%, carrot purees were 40% (F3) and MOCAF 45%, and carrot purees was 30% (F4).

The procedures of carrot fusilli preparation, at the first, mixed all ingredients by hand and then mixed and flatten them until the mixtures were homogeneous. Third, divide the dough into three parts, then take the first part and flatten it using a pasta maker machine, fold, and flatten again, repeat it at least three times. Next, shaped fusilli by using hand to the curly form and dried them by using the oven with 75°C temperature for 3 hours. The main objective of the drying was to reduce the moisture components of the samples below 10%. Dried pasta must be stored in a dry place and tightly closed. The quality cooking the pasta remained constant during storage [20]. The samples were then subjected to various chemical and material analyses.

Organoleptic test, the organoleptic test indicated in four treatment F1, F2, F3 or F4. The differences in each formula are the level of MOCAF flour substituted with the formula of carrot fusilli. The tests were done in once repetition with 30 semi-trained panellists of culinary students and lecturers of Universitas Negeri Surabaya.

TABLE IV. THE CARROT FUSILLI FORMULA BASED ON THE CONCENTRATION OF MOCAF FLOUR AND CARROT PUREES

Material	Amount			
	F1	F2	F3	F4
All-purpose flour	56.25 g	56.25 g	56.25 g	56.25 g
mocaf flour	19.4 g	29.1 g	19.4 g	29.1 g
Salt	1 g	1 g	1 g	1 g
Egg yolk	7.5 g	7.5 g	7.5 g	7.5 g
Carrot purees	19.4 g	25.9 g	25.9 g	19.4 g
Total	103.55 g	110,05 g	110,05 g	103.55 g

III. RESULTS AND DISCUSSION

The addition or substitution of other food material will affect the quality of the product. In this study, fusilli colour is analyzed by material analysis for knowing the fondness level. The material analysis was made to verify the correctness of the standard colour selection and to determine homogenous varieties of the carrot [21]. MOCAF was 30% and 30% addition of carrot purees produced the best colour and texture. It is well known that MOCAF was one of the products of cassava flour *Manihod Esculenta Crantz*). It processed by using the principle of the cell-modified of cassava by fermentation. The fermentation process also occurs the subtraction component in brown and protein. The loss of the components caused the colour that contributed to a better product.

However, different results shown by the level of fragility and the aroma of pasta that was MOCAF in 45% and the addition of carrot purees in 40%, the level of fragility of the product was low. The dough materials influence the decay level. There was a positive correlation between the mixing time and hardness of boiled pasta and indicated that the hardness of boiled pasta dough was affected by the properties [22]. The more additions and substitution of materials, the more finished product is getting fail.



Fig. 1. Raw Carrot Fusilli

The use of a lower drying temperature than gelatinized temperature makes the noodle dough to be inelastic and the noodle has a coarse texture and easily broken [23]. The best method for carrot fusilli drying process is 75⁰C for 3 hours. The opposite research [24] used drying method by pressurized heating and microwave; pressurized heating for 50 minutes treatment and microwave treatment for more than 1 minute is confirmed that it is not good. In addition, 30 minutes is in under pressure of heating and microwave in 1 minute was selected.

While the best quality of the aroma results from the MOCAF 45% and 30% addition of carrot purees. Because

MOCAF is able to inhibit the growth of microbes that cause loss of aroma and flavour of cassava. In the use of cassava flour, unmodified change the characteristics of the flour produced in the form of the developing of viscosity, gelation capability, power rehydration, and ease dissolves. Microbes also produce organic acids; especially lactic acid will dissolve the material. When the material is processed it will be able to produce a distinctive smell that can cover up the original fragrance of cassava. MOCAF of 45% and 30% addition of carrot purees did not significantly affect the development level of texture quality and taste of the product. In line with that, the material analysis of spaghetti [25] that contained soy flour up to 35% indicated there was no significant difference in flavour and texture compared with control without soy, in general.

The addition of carrot purees in this study is 30% and 40% of the formulation. Therefore, it has a high score of the quality acceptance for its nutritional component and organoleptic quality. The opposite study shows that 10% of sweet potato flour formulation is recommended to take advantage of the health benefits of sweet potato flour without losing the quality acceptance of consumers [26]. The quality acceptance of carrot fusilli is measured by the organoleptic test.

Organoleptic test results carrot fusilli product showed in 20 percent, 62.5 percent, 12.5 percent and 5 percent of the panellists expressed fondness, like, just like, and dislikes on the colour of carrot fusilli products. Second, it showed in 5 percent, 27.5 percent, 60 percent and 7.5 percent of the panellists expressed fondness, like, just like, and dislikes on the aroma produced by the carrot fusilli products. Third, it showed in 5 percent, 35 percent, 47.5 percent and 12.5 percent of the panellists expressed fondness, like, just like and dislike the taste of carrot fusilli products. The last, respectively 12.5 percent, 42.5 percent, 42.5 percent and 2 percent.

TABLE V. NUTRIENT CONTENT OF CARROT FUSILLI

Analysis per 100 g	
Carbohydrate	28.46 g
Protein	11.32 g
Fat	27,81g
Water	27.64 g
Ash	2.06 g
Fiber	2,71g
Beta carotene	27,790 SI / 100 g

IV. CONCLUSIONS

The study result of carrot purees and MOCAF flour to the organoleptic material of carrot fusilli shows that the best fusilli colour and texture quality is in 30% of MOCAF and 30% of carrot purees addition. The best fragility level is in 45% of MOCAF and 40% of carrot purees addition. The best aroma quality is in 45% of MOCAF and 30% of carrot purees addition. Based on the nutritional level test, it is known that the best composition β-carotene contain carrot fusilli per 100 grams is 27,790 SI. This study indicates that carrot is classified as a potential alternative food.

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