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EFFECT OF STRAWBERRY POWDER SUBSTITUTION ON THE ORGANOLEPTIC OF INSTANT PUDDING

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ABSTRACT

Strawberries are a nutrient-dense fresh fruit, but their use is restricted and they are quickly damaged due to their high water content. Therefore, innovation in strawberry processing is required so that the range of strawberry-processed goods is wider and has a longer shelf life, such as instant pudding. This study examined the effects of substituting strawberry powder to produce instant pudding with the highest nutritional and organoleptic qualities. The experimental design of the study includes four treatments, F1 (2%), F2 (4%), F3 (6%), F4 (8%), and F0, each of which contains a different dose of strawberry powder (control). The research was conducted at the Saraswati Indo Genetech laboratory in Bogor and the culinary and dietetics laboratory at Binawan University. Using Microsoft Excel 2019 and SPSS, the normality test (Kolmogorov Smirnov) and the Kruskal-Wallis test were applied to the organoleptic test results data. The results of the Kruskal Wallis test indicated a significant effect; the Mann-Whitney test was then conducted. The results revealed that instant pudding significantly altered color, flavor, texture, and odor. The most popular product is the F4 formulation, which contains 8% strawberry powder. The instant pudding has a water content of 75,62%, an ash content of 0,72%, protein content of 2,84%, a fat content of 1,25%, and carbohydrate content of 19,56%, according to an approximate analysis. It was impossible to determine the vitamin C content of the instant pudding because it was not recognizable. The selected instant dessert contains 113 kcal per 113 g. It is necessary to do research on the shelf life of instant pudding products so the product's safety can be ensured.

Keywords: instant pudding, organoleptic, strawberry powder, vitamin C

INTRODUCTION

Strawberry leading prospective horticultural commodities because its production continues to increase (BPS, 2022). Currently, strawberries are grown in various highland areas in the distribution of the islands of Java, Bali, and Sumatra. The Central Statistics Agency (BPS) recorded the number of strawberries in 2019 reaching 7,501 tons and increasing by 10.17% in 2020 reaching 8,350 tons. This figure is in line with the increase in demand for strawberries by 5000 tons per year. Binawan Agro is an agrotourism that grows strawberries in the highlands of Cianjur, West Java. Yields Strawberries at Binawan Agro continue to increase but there is no development and processing of strawberries into a processed product that can be sold.

The strawberries that will be used are harvested from Binawan Agro which is planted in the highlands of Cianjur, West Java. Strawberry fruit is very familiar to the people of Indonesia, it's just that the distinctive taste, namely sweet, sour, and refreshing, is not liked by consumers, especially children. Currently, the most common uses of strawberries are juice, jam, powder, sweets, candies, and others.

In this study, we transformed strawberries into a powder and created an instant pudding. The purpose of this procedure was to create a strawberry processing variation. Children enjoy pudding because it has a chewy texture, easy to digest, and processed efficiently. The processing of pudding involves heating (70^0C) and cooling (Karo et al., 2021). Based Observations of commercial instant pudding goods containing less than 1% strawberry powder, together with other additives such as sugar, flavoring, and coloring. In one instance, researchers added strawberry powder to instant pudding to enhance its quality and value.

The benefits of strawberry powder include brightening teeth (Rahayu et al., 2021), improving skin texture (Kausar & Akhtar, 2017), and reducing oxidative stress and counteracting free radicals (Forbes-Hernandez et al., 2016).

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skin texture (Kausar & Akhtar, 2017), reducing oxidative stress, and fighting free radicals (Forbes-Hernandez et al., 2016). Strawberry powder contains vitamin C, which is beneficial to the body. However, vitamin C is not heat-resistant, so it must be processed at a relatively low temperature (60^{o}-80^{o}C) to maintain vitamin C's stability. Vitamin C content is diminished the longer it is exposed to high temperatures (Gong et al., 2018; Septyani, 2021). One of the operations requiring a relatively low temperature is the production of instant pudding.

Children enjoy pudding due to its chewy texture, digestibility, and convenient preparation. The pudding-making process involves heating and cooling. 500 ml of pudding requires 5 minutes at 70 °C and 30 minutes at 3-5 °C to cool down (Karo et al., 2021). Observations of commercial instant pudding products containing strawberry powder at a concentration of less than one percent, along with other ingredients including flavoring, sugar, and coloring. By substituting nutrient-dense fruit or leaves, pudding's nutritional value can be improved (Srimiati & Agestika, 2022). Therefore, in this study, researchers utilized strawberry powder to enhance the quality and value of instant pudding. This research has the advantage of finding a formula for instant strawberry pudding made with fresh strawberries.

Based on the above description, the researcher wishes to determine the effect of strawberry powder substitution on the organoleptic properties and nutritional value of instant pudding products. These products will be used as alternative snacks for toddlers with the potential to prevent COVID-19.

METHOD

This study used a simple Completely Randomized Design (CRD) with four treatments and one control to determine the highest quality strawberry powder substitute. This study was conducted from January to July of 2022. Instant pudding production and organoleptic evaluations were conducted In the Culinary and Dietetic Laboratory of Binawan University, Saraswati Indo Genetech (SIG) Laboratory, Bogor, Indonesia, vitamin C, and proximate level analysis. The research flow was presented on the Figure 1.

Food scales, a dry mixer, an 80-mesh sieve, a spoon, and a container are required to prepare instant pudding. For chemical analysis, pipettes, Erlenmeyer, and volumetric flasks are utilized, extruder with a single screw, oven, kiln, crucible, distillation apparatus, measuring flask, test tube, Erlenmeyer, spectrophotometer, dropper, vacuum pump, volumetric pipette, micro pipette, analytical balance.

The materials for the analysis of vitamin C levels using the HPLC method (AOAC, 1995) were 10% H_2SO_4, 1% starch, and I_2 solution.

The instant pudding ingredients are skim milk, strawberry powder, sugar flour, and agar-agar flour. The proses of strawberry powder production was presented on Figure 2, and the flow of instant pudding production is presented on Figure 3. This strawberry powder has antioxidant capacity 8,36 ppm but the vitamin C was not detected. An organoleptic test was conducted to analyze the hedonic characteristics and hedonic quality of processed instant pudding.

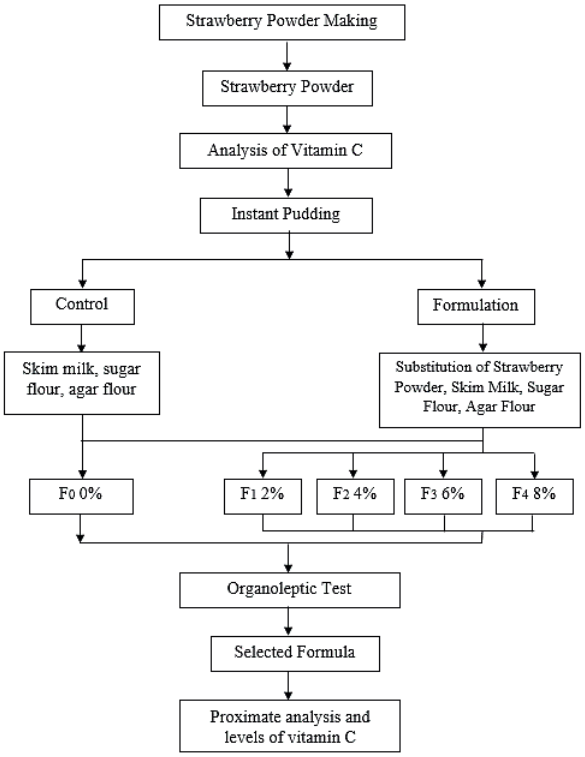

Figure 1. Research Flow

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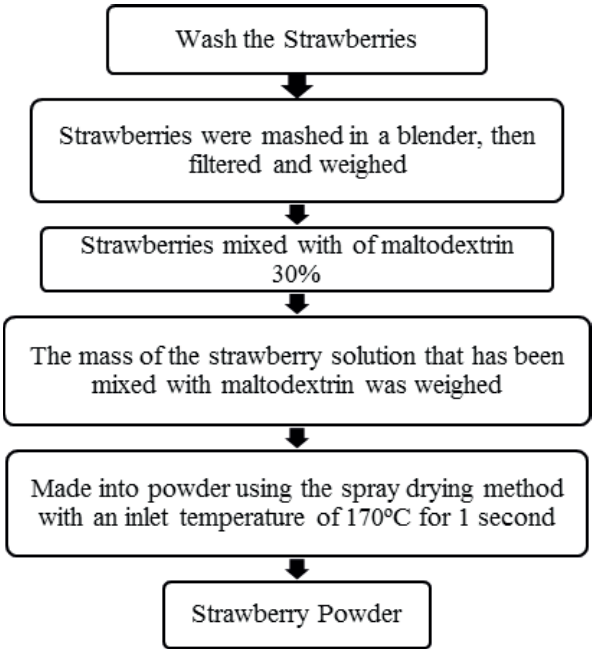

Figure 2. Making Strawberry Powder

The instant pudding formulation was determined by trial and error and the cost of strawberry powder.

Organoleptic data (hedonic and hedonic quality), proximate data (ash content (gravimetric method), moisture content (oven method), protein content (Kjeldahl method), fat content (Soxhlet method), carbohydrates (method: by difference), and vitamin C levels (HPLC method) were included in this study. Laboratory results yielded information on proximate and vitamin C concentrations. Organoleptic data were collected by administering an organoleptic test utilizing a questionnaire with a hedonic scale scoring method with a scale of 1 to 9. This study included 35 semi-trained panelists, namely sixth and eighth semester nutrition students at Binawan University who had taken Food Technology and Nutrition courses.

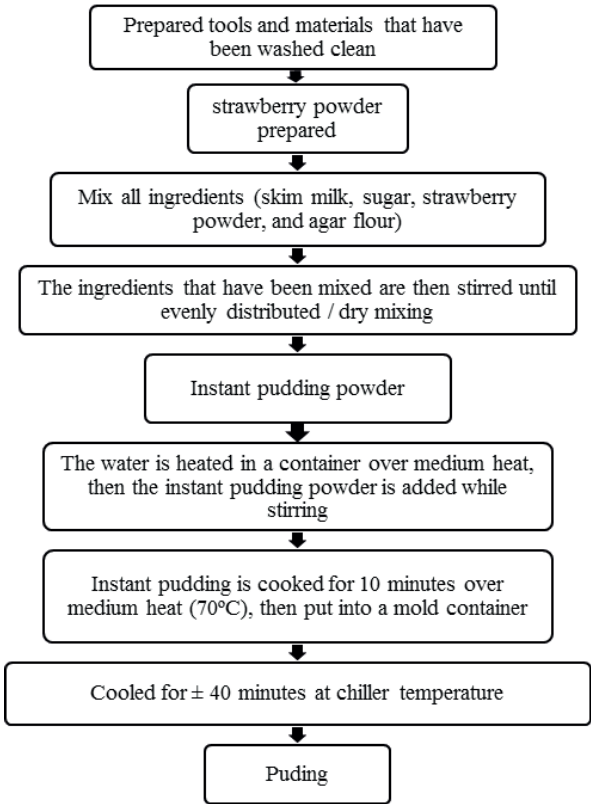

Figure 3. Instant Pudding Making Flow

In addition, the data were analyzed with the SPSS software for a Kolmogorov Smirnov normality test. The normality test demonstrated that the data were not normally distributed. In addition, it was statistically evaluated with the Kruskal-Wallis test. The Kruskal-Wallis test revealed a statistically significant treatment effect ($p<0.05$). Then, the data were further analyzed using the Mann Whitney test to determine if there were statistically significant differences between instant pudding formulations regarding color, flavor, aroma, and texture. KET-36/UN2.FI/ETIK/PPM.00.02/2022 was the approval number issued by the Health Research Ethics Commission of the University of Indonesia for this study.

Table 1. Instant Pudding Formulation

No	Ingredients (g)	Control (F0)	F1 (2%)	F2 (4%)	F3 (6%)	F4 (8%)
1	Sugar flour	50	49	48	47	46
2	Strawberry powder	0	1	2	3	4
3	Skim milk	50	50	50	50	50
4	Jelly powder	3	3	3	3	3
	Total	103	103	103	103	103

Source: Modification of Kristanti, 2020.

RESULTS AND DISCUSSIONS

A hedonic evaluation was conducted on pudding with strawberry powder substitution treatments F0 (0 percent), F1 (2 percent), F2 (4 percent), F3 (6 percent), and F4 (8 percent). Figure 1 illustrates the appearance of instant pudding.

The instant pudding hedonic test outcomes are shown in Table 2.

The formulation of instant pudding influences its color, aroma, flavor, and texture, as determined by hedonic testing. Moreover, the results of the Mann-Whitney test indicate that there were significant differences in instant pudding's color, aroma, flavor, and texture. Table 3 displays the results of the instant pudding quality test.

The instant pudding hedonic quality test revealed that the formulation affected color, aroma, flavor, and consistency. And according to the Mann-Whitney test, there are significant differences between instant pudding's color, aroma, flavor, and texture.

Figure 4. Visualization of Instant Pudding.

Table 2. The Hedonic Test Result

Formula	Attribute			
	Color	Aroma	Flavor	Texture
F0 (0%)	5,3 ± 1.398^{c}	4,55 ± 1.554^{a}	5,97 ± 1.515^{b}	5,45 ± 1.224^{b}
F1 (2%)	6,74 ± 1.688^{a}	5,23 ± 1.240^{b}	7,03 ± 1.498^{a}	6,58 ± 1.426^{a}
F2 (4%)	6,05 ± 1.736^{a}	5,03 ± 1.442^{ab}	6,87 ± 1.379^{a}	6,45 ± 1.465^{a}
F3 (6%)	6,16 ± 1.386^{b}	5,39 ± 1.462^{b}	6,71 ± 1.469^{a}	6,76 ± 1.532^{a}
F4 (8%)	6,82 ± 1.608^{a}	5,66 ± 1.146^{b}	7,74 ± 1.223^{c}	6,92 ± 1.363^{a}

Note: The attribute scale ranges from 1 (extremely dislike) to 9 (extremely dislike), with different letters in the same column indicating a statistically significant difference (Kruskal-Wallis, significant at p <0,05).

Table 3. The Result of Hedonic Quality Test

Formula	Attribute			
	Color	Aroma	Flavor	Texture
F0 (0%)	6,89 ± 1.247^{a}	4,45 ± 1.719^{a}	6,89 ± 0.924^{a}	6,79 ± 1.069 ^{ab}
F1 (2%)	6,47 ± 1.310^{a}	4,32 ± 1.579^{ab}	6,97 ± 0.854^{ab}	6,63 ± 1.051^{ab}
F2 (4%)	6,84 ± 1.053^{a}	4,43 ± 1.588^{ab}	6,95 ± 0.837^{a}	6,89 ± 0.953^{a}
F3 (6%)	6,92 ± 1.100^{ab}	4,47 ± 1.466^{b}	6,92 ± 0.712^{a}	6,74 ± 0.891^{a}
F4 (8%)	7,13 ± 0.741^{b}	4,66 ± 1.790^{c}	6,87 ± 0.704^{b}	6,84 ± 1.220^{a}

Note: Taste characteristics ranging from 1 = Extremely bitter to 9 = Extremely sweet; Aroma attribute scale of 1 = odorless to 9 = intense strawberry aroma; Attribute color scale ranging from 1 (dark red) to 9 (extremely pink) Texture attribute 1 = extremely hard to attribute 9 = extremely soft. Different letters in the same column display statistically significant differences (Kruskal Wallis, p0.05, significant).

Color

The Mann Whitney test for color attributes revealed that there was a significant difference in the pudding's color. The most preferred pudding color is F4, which is pink and has a rating of 6,82 (scale 1-9). The greater the concentration of strawberry powder added to the pudding, the more attractive the pink hue will make the pudding. Strawberry powder has a distinctive pink hue due to the anthocyanin content of strawberries. Anthocyanin is an antioxidant compound. In the production of strawberry powder, maltodextrin is added to the mixture of ingredients. Low reducing sugar in maltodextrin does not impart a dark hue when subjected to high temperatures during production (Agustina et al., 2019). As indicated by the findings of Arysanti et al. (2019), the greater the amount of fruit added to the pudding, the greater the color change and the greater the pudding's acceptance.

Aroma

According to the results of the Mann-Whitney test, there was a significant difference in the pudding's aroma. The highest average hedonic test for pudding aroma was 5,66 (ordinary/

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neutral), with an 8 percent strawberry powder (F4) concentration and a milky aroma. As a higher concentration of strawberry powder is added, and as the strawberry aroma from the powder becomes stronger, pudding's aroma is increasingly favored. The sour scent of strawberry powder results from the degradation of glucose in strawberries (Sumarlan et al., 2018).

Flavor

The results of the Mann-Whitney test revealed a statistically significant difference in instant pudding's flavor. F4, with a rating of 7,74 (like) and a slightly sweet flavor, was the pudding flavor that eight percent (8%) of respondents prefer the most (scale 6,87). Pudding is composed of ingredients that are readily available and well-known to the general public. In addition, pudding is one of the common snacks consumed by the general public and young children. Strawberry powder has a sour flavor similar to that of a strawberry, so the greater the concentration of strawberry powder added to pudding, the less sweet the flavor. Due to a deficiency of the enzyme amylase, which causes malabsorption and digestive disorders, an excessively sweet taste in food can cause nausea and diarrhea in children (Zahra, 2019). According to Wadhani et al(2020) .'s research, pudding products containing cauliflower and strawberries differ significantly.

Texture

Based on the results of the Mann-Whitney test, it was determined that the pudding's texture varied significantly. The highest average hedonic test for pudding texture was 6,92 (slightly like) at a concentration of eight percent 8% strawberry powder (F4) and had a texture that was slightly soft. In this study, sugar was replaced with strawberry powder mixed with maltodextrin as a binder. Maltodextrin has a high solubility level as well (Agustina et al., 2019). The greater the concentration of strawberry powder in the pudding, the more homogeneous the pudding and the smaller the granules caused by the sugar.

Selected Formula

In accordance with the results of the hedonic test for pudding, F4 (8 percent) has a higher average preference for taste (7.74 likes) than F1 (2 percent), F2 (4 percent), and F3 (3 percent) (6 percent). Figure 2 depicts the visual appearance of the selected pudding mix.

Figure 5. Visualization of Selected Formula

Table 4. The Result of Proxymate Analysis and Vitamin C

Nutrient composition	Unit	Amount
Ash content	%	0,7
Energy from fat	cal	11,2
Fat content	%	1,25
Water content	%	75,6
Total energy	cal	100,8
Carbohydrate	%	19,5
Protein	%	2,8
Vitamin C	mg	not detected

Proximate analysis and Vitamin C

The results of the approximate analysis and vitamin C are shown in Table 4.

Ash and Water Content

According to the results of the water content analysis (Table 4), the selected product contains 75,6% of water. During the heating process, the amount of water added affects the pudding's water content. According to Table 9, the analysis of the selected pudding formulation revealed that it contained 0,7% ash. In this instance, the ash content of the selected pudding satisfies SNI 2802:2015 requirements for pudding quality. According to China et al. (2019), the cooking process influences the high and low ash content of foods, and the ash content correlates with the mineral content of foods less minerals are present in foods with decreasing ash content.

Protein Content

According to the results of the protein content analysis (table 4) of the selected pudding product,

there were 2,8 grams of protein per 100 grams of pudding. The selected pudding contains less protein than the commercial product (Milna brand), which contains 1 g per serving (20 g) or 5 g per 100 g of commercial pudding. The main ingredient of the selected pudding product, which was only skim milk powder, contributed to its low protein content. Commercial pudding products contain vegetable creamer, full cream milk powder, and powdered buttermilk, resulting in a higher protein content than the selected pudding product.

Fat Content

The analysis of the pudding's fat content yielded a value of 1,25 grams per 100 grams of pudding. The selected pudding contains less fat than the commercial product (milna brand), which contains 2,5 g per serving (20 g) or 12,5 g per 100 g. This low fat content is influenced by the selected pudding raw material, which is skim milk, which is low-fat milk, resulting in a lower fat content in the selected pudding product.

Carbohydrate Content

The carbohydrate content of the selected pudding product was determined to be 19.5 g per 100 g pudding via analysis. The selected pudding product contains fewer carbohydrates than the commercial pudding product, which contains 15 g per serving (20 g) or 75 g per 100 g. The pudding's carbohydrate content is influenced by skim milk, the primary ingredient. Three types of milk are used as ingredients in commercial pudding. The strawberry powder also contributes to the pudding's carbohydrate content. The pudding's carbohydrate content contributes the most to the RDA.

Vitamin C Content

The amount of vitamin C in the selected pudding could not be determined because it was not detected. This is because vitamin C cannot be detected in strawberry powder. The loss of vitamin C content can be caused by high temperatures during the drying process (spray dryer). This is comparable to the findings of Sadowska, Widerski, and Hallmann (2020), who found that the vitamin C content of strawberry powder dried using spray drying is twice as low as that dried using freeze drying. Loss of vitamin C can also occur if the strawberry solution is too viscous and adheres to the spray drying apparatus, resulting in suboptimal drying.

Temperature, shelf life, and packaging are additional variables that can influence the loss of vitamin C content. Before the strawberries at Binawan Agro were processed into a solution and combined with maltodextrin, they were stored for three days in an unknown chiller and packaged in mica plastic weighing between 500 and 1,000 grams. Strawberries should be stored at 0°C for five to seven days. At room temperature (28-30°C), the shelf life is 2-4 days (Hutajulu, 2018). According to the findings of Hutajulu et al. (2018), packaging has a significant impact on biochemical changes, specifically respiration rate (CO_2 production) and vitamin C content. For optimum strawberry quality, it is suggested that 15 Styrofoam packaging containers per package be used. (Simatupang et al., 2021).

Seed variety is an additional factor that can affect vitamin C content. The strawberry plants at Binawan Agro are a mencir seed variety that combines the California and Festival varieties. The seeds should be planted in the lowlands, but Binawan Agro is located at an altitude of 900-1000 masl. Li et al. (2019) compared 7 varieties of strawberries based on their sensory quality and nutritional content; the results revealed that the Xiaobai strawberry variety cultivated in the highlands had the highest vitamin C content at 82,52 mg/100 g.

The spray dryer is the only drying method utilized in this study, thus it cannot be compared to the optimal drying method for the strawberry powder production process. The next study should be able to produce strawberry powder using the freeze-drying approach so that drying methods may be compared, particularly with regard to preserving the vitamin C content of strawberries.

CONCLUSION

Formula F4, which contains an 8 percent strawberry powder substitution, produces pudding with the best organoleptic qualities. However, the addition of strawberry powder was insufficient, as no vitamin C was detected in the pudding. In

order to obtain the benefits of vitamin C from strawberry instant pudding, additional research is required to increase the number of strawberry powder substitutes.

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