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THE EFFECT OF THE COMBINATION OF KEPOK BANANA HEART AND DRAGON FRUIT SKIN ON THE CHEMICAL AND SENSORY PROPERTIES OF HIGH-FIBER ANALOG DENGENG

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Abstract

Food diversification based on local ingredients is needed to produce alternative food products that are high in nutritional value and environmentally friendly. Analog jerky is a plant-based processed product that resembles beef jerky and has the potential to be a high-fiber ready-to-eat food. This study aims to analyze the effect of the proportion of kepok banana blossom (*Musa paradisiaca*) and red dragon fruit peel (*Hylocereus polyrhizus*) on the chemical and organoleptic properties of analog jerky and determine the best proportion. The study was conducted experimentally in a laboratory using a one-factor Completely Randomized Design (CRD) with four treatments, namely the ratio of banana blossom to dragon fruit peel P1 (90%:10%), P2 (70%:30%), P3 (60%:40%), and P4 (50%:50), each with three replications. The parameters analyzed included water content, protein, and crude fiber, the data obtained were analyzed using Analysis of Variance (ANSIRA) and continued with the Least Significant Difference (LSD) test if there was a significant difference. Organoleptic tests were conducted using the hedonic method for color, aroma, and taste, using Kruskal–Wallis non-parametric analysis . The results showed that variations in the proportion of kepok banana blossom and dragon fruit peel significantly affected the water content and protein of analog jerky. Treatment P4 produced the highest protein and crude fiber content, while organoleptic tests showed significant differences in color attributes, but not in aroma, taste, and texture. Overall, treatment P4 was the best formulation because it increased nutritional value without reducing the level of sensory acceptance.

Keywords : analog jerky, kepok banana heart, dragon fruit skin, chemical properties, organoleptic

INTRODUCTION

Developments in food and nutrition science are driving the diversification of food products based on local, fiber-rich ingredients as a healthy and environmentally friendly food alternative. One emerging innovation is analog jerky, a plant-based product that resembles beef jerky in shape, texture, aroma, taste, and color, but is made from non-meat ingredients. Analog jerky is a *meat analogue* that can be a high-protein, ready-to-eat food alternative, especially for vegetarians and the general public seeking a product high in fiber, low in saturated fat, and nutritionally balanced (Eveline, 2020). The use of plant-based ingredients in analog jerky can increase fiber content and reduce fat content. Kepok banana blossom (*Musa paradisiaca*) is an abundant by-product in Indonesia and contains high levels of dietary fiber, vegetable protein, and bioactive compounds such as tannins and flavonoids that are beneficial for health (Novitasari *et al* ., 2013). Its fibrous texture, similar to meat, makes it a potential main ingredient in analog jerky. Meanwhile, red dragon fruit peel (*Hylocereus polyrhizus*), which weighs up to 30–35% of the fruit's weight, is an agricultural waste rich in dietary fiber, betacyanin pigments as antioxidants, and has the potential to be used as a natural dye in food products. The use of dragon fruit peel not only increases the functional value of the product but also supports agricultural product processing and reduces agricultural waste (Nourah, 2016). Previous research has demonstrated the success of using plant-based ingredients in analog jerky. Falesta et al. (2024) used date palm pulp with soybean pulp to increase the protein, fiber, and sensory quality of the product. Sidup (2022) studied analog jerky with the addition of black soybean tempeh flour and obtained a product high in protein and fiber. Nuraeni (2024) developed katuk leaf jerky with the addition of soybean flour and wheat flour, which resulted in good chemical and organoleptic characteristics.

The aim of this study was to determine the effect of the proportion of kepok banana heart and dragon fruit peel on the chemical and organoleptic properties of analog jerky, and to determine the best proportion of the two ingredients.

LITERATURE REVIEW

Kepok Banana Heart (*Musa paradisiaca*)

Bananas are a widely consumed fruit due to their ease of peeling and versatility in processing. The banana blossom is the flower that forms during flowering and produces banana bunches. This banana has a reddish-brown-purple outer layer and a creamy white interior, with a clear liquid that fades when exposed to air (Novitasari et al., 2013). Kepok banana blossoms are rich in dietary fiber, vitamins A, C, and E, flavonoids, and phenolic compounds that act as antioxidants. These compounds help prevent diabetes, stroke, and coronary heart disease, as well as boost the immune system (Rukmana, 2001; Fingolo et al., 2012; Sheng et al., 2011; West Java Provincial Forestry Service, 2014). Although the taste is less desirable, proper processing can increase their economic value, for example, by making them into shredded meat, beef jerky, or meatballs (Kusumaningtyas et al., 2010; Novitasari et al., 2013).

Red Dragon Fruit Skin (*Hylocereus polyrhizus*)

Red dragon fruit peel, which makes up 30–35% of the total fruit, is generally underutilized, despite its high polyphenol and antioxidant content, including flavonoids, phenols, and betacyanins. This phytochemical content makes dragon fruit peel a good source of antioxidants and has the potential to be used in functional food products (Nourah, 2016).

Analog Jerky

Analog jerky is a dried meat substitute product made from plant-based ingredients that resembles real jerky physically and organoleptically, but its nutritional value can be adjusted, for example, lower in fat and cholesterol (Mulia, 2017; Eveline, 2020). This product can be an alternative source of protein for the community, including vegetarians. Falesta et al. (2024) reported that the best analog jerky treatment was the DK2 treatment (100 grams of pulp). Dates plus 10 grams of soybean dregs powder with the highest yield value of 5.67.

Supporting Ingredients for Analog Dendeng

Several important supporting ingredients in making analog jerky include soy sauce, black pepper, coriander, cumin, ngohiong (*five-spice powder*), powdered sugar, salt, sago flour, and honey. These ingredients enhance the product's flavor, aroma, texture, nutritional value, and shelf life. Some ingredients also have additional functions, such as the antimicrobial effects of cumin and the antioxidant properties of ngohiong (Cahyadi, 2017; Al Fady, 2015; Ariyanto & Dwi Kartika, 2022; Sepriyani et al., 2022).

RESEARCH METHODS

This research was conducted at the Food Processing Laboratory of the Faculty of Food Technology and Fisheries Dr. Soetomo Surabaya in October–December 2025. The main ingredients used were kepok banana blossom (*Musa paradisiaca*) and red dragon fruit peel (*Hylocereus polyrhizus*), while supporting ingredients such as salt, pepper, coriander, cumin, ngohiong, soy sauce, refined sugar, honey, and sago flour were obtained from Soponyono Market, Surabaya. The research method applied was a quantitative experimental laboratory to determine the effect of the proportion of banana blossom and dragon fruit peel on the chemical and organoleptic properties of analog jerky (Syafrida, 2022). The experimental design used a one-factor Completely Randomized Design (CRD) with four treatment levels, namely P1 (90%:10%), P2 (70%:30%), P3 (60%:40%), and P4 (50%:50%), each with three replications (Hasdar et al., 2021).

The process for making analog jerky includes washing, peeling, boiling, mashing, and filtering the banana blossoms, as well as cleaning and mashing the dragon fruit skin. All ingredients are weighed according to the recipe and mixed with the spices until homogeneous. Then, they are pressed onto a baking sheet lined with parchment paper and baked at 170°C for 35 minutes, with a honey brushing between the 10th and 20th minutes. The product is then cooled to room temperature and cut to size. The variables observed included water content, protein, crude fiber, and organoleptic properties including color, aroma, taste, and texture, tested on 30 respondents using a preference scale of 1–5 (Mehran, 2015). Quantitative data analysis was carried out using Analysis of Variance (ANSIRA) using SPSS version 24, with advanced tests of BNT, BNJ, or Duncan according to the

Coefficient of Variance (Paiman, 2015), while organoleptic data were analyzed hedonically and tested with Kruskal-Wallis to determine significant differences between treatments (Ayustaningwarno, 2014).

RESULTS AND DISCUSSION

1. Chemical Test

Water Content Test

Table 1 presents the results of the water content test of analog jerky made from kepok banana blossom (*Musa paradisiaca*) and dragon fruit peel (*Hylocereus polyrhizus*). The experimental design used was a Completely Randomized Design (CRD) with one factor, namely the ratio of kepok banana blossom and dragon fruit peel, which consisted of four treatment levels, namely P1 (90 %: 10%) , P2 (70%: 30%) , P3 (60%: 40%) , and P4 (50%: 50%) . The difference in the proportion of ingredients in each treatment shows the variation in the water content produced in analog jerky.

Table 1. Average water content results of analog jerky

Treatment	Mean ± SD
P1	15,610 ± 0,428[a]
P2	16.703 ± 0.150[b]
P3	17.607 ± 0.561[b]
P4	22.093 ± 0.367[c]

The results of the analysis of variance in Table 3 show a significance value (< 0.05), which indicates that the difference in the proportion of kepok banana blossom and dragon fruit peel has a significant effect on the water content of analog jerky . Based on the treatment tendency, increasing the proportion of kepok banana blossom tends to decrease the water content , while increasing the proportion of dragon fruit peel tends to increase the water content of the product . The test results show that the lowest water content is found in treatment P1 , which is 15.610% , while the highest water content is obtained in treatment P4 at 22.093% . Treatments P2 and P3 have water content of 16.703% and 17.607% respectively and are not significantly different , which indicates that increasing the proportion of dragon fruit peel from 30% to 40% has not had a significant effect on the water content of analog jerky.

The low water content in P1 is thought to be due to the dominance of kepok banana blossoms , which have a lower water-binding capacity, making water evaporate more easily during processing. Conversely, the high water content in P4 is related to the high proportion of dragon fruit peel, which is rich in hydrophilic fiber , which increases water-binding capacity. This finding is in line with Winarno (2008) and Putri et al. (2019) who reported that increasing fibrous materials, especially those containing pectin and cellulose, can increase the water content of analog jerky products. The water content of the resulting analog jerky ranges from 15.61 % to 22.09% , and does not meet the requirements of SNI 2908:2013 concerning beef jerky, which stipulates a maximum water content of 12% .

Protein Content

Table 2 presents the results of the protein content test of analog jerky made from kepok banana blossom (*Musa paradisiaca*) and dragon fruit peel (*Hylocereus polyrhizus*). The experimental design used was a Completely Randomized Design (CRD) with one factor, namely the ratio of kepok banana blossom and dragon fruit peel, which consisted of four treatment levels, namely P1 (90 %: 10%) , P2 (70%: 30%) , P3 (60%: 40%) , and P4 (50%: 50%) . The difference in the proportion of ingredients in each treatment shows the variation in the protein content produced in analog jerky.

Table 2. Average results of analog jerky protein content

Treatment	Mean ± SD
P1	6.270 ± 0.221[a]
P2	7,040 ± 0,262[b]
P3	7.843 ± 0.165[c]
P4	9.007 ± 0.081[d]

The results of the analysis of variance showed a significant value (< 0.05), which indicated that the difference in the proportion of kepok banana blossom and dragon fruit peel had a significant effect on the protein content of analog jerky . All treatments showed significant differences, as indicated by different letter notations in each treatment. Based on the treatment trend, increasing the proportion of dragon fruit peel in the formulation tended to increase the protein content of analog jerky , while the higher proportion of kepok banana blossom resulted in lower protein content. The test results showed that the lowest protein content was found in treatment P1 at 6.270% , while the highest protein content was obtained in treatment P4 at 9.007% .

The low protein content in P1 is thought to be related to the dominance of kepok banana blossoms, which have a relatively low protein content . Conversely, the increase in protein content in P2 to P4 is influenced by the increasing proportion of dragon fruit peel , which contributes to the total protein content of the product. These results are in line with research by Sari et al. (2018) and Pratama et al. (2021) who reported that the addition of certain plant-based ingredients to analog jerky formulations can significantly increase the protein content of the product, depending on the type and proportion of ingredients used. Based on quality standards, the protein content of the resulting analog jerky ranges from 6.27 % to 9.01% . This value is still lower than the provisions of SNI 2908:2013 concerning beef jerky , which requires a minimum protein content of around 18% . Therefore, enrichment of protein sources or modification of the formulation is needed to increase the protein content of analog jerky products to approach the established quality standards.

Crude Fiber Test

Table 3 presents the results of the crude fiber content test of analog jerky made from kepok banana blossom (*Musa paradisiaca*) and dragon fruit peel (*Hylocereus polyrhizus*). The experimental design used was a Completely Randomized Design (CRD) with one factor, namely the ratio of kepok banana blossom and dragon fruit peel, which consisted of four treatment levels, namely P1 (90 %: 10%) , P2 (70%: 30%) , P3 (60%: 40%) , and P4 (50%: 50%) . The difference in the proportion of ingredients in each treatment shows the variation in the crude fiber content produced in analog jerky.

Table 3. Average crude fiber results of analog jerky

Treatment	Mean ± SD
P1	2.837 ± 0.075^{a}
P2	4.020 ± 0.076^{b}
P3	4.503 ± 0.343^{b}
P4	5.370 ± 0.305^{c}

The results of the analysis of variance showed a significance value (< 0.05), which indicated that the difference in the proportion of kepok banana blossom and dragon fruit peel had a significant effect on the crude fiber content of analog jerky . Based on the treatment trend, increasing the proportion of dragon fruit peel tended to increase the crude fiber content , while increasing the proportion of kepok banana blossom resulted in a lower crude fiber content.

The test results showed that the lowest crude fiber content was found in treatment P1 at 2.837% , while the highest crude fiber content was obtained in treatment P4 at 5.370% . Treatments P2 and P3 each had crude fiber content of 4.020% and 4.503% and were not significantly different , indicating that increasing the proportion of dragon fruit peel from 30% to 40% had not had a significant effect on the crude fiber content of analog jerky.

The high crude fiber content in the P4 treatment is related to the increased proportion of dragon fruit peel, which is rich in dietary fiber , especially insoluble fiber. This finding is consistent with research by Putri et al. (2019) and Sari et al. (2020) , which reported that the use of high-fiber plant-based ingredients in analog jerky products can significantly increase fiber content. Increasing the crude fiber content in analog jerky has positive implications for the nutritional value and functional potential of the food , as fiber plays a role in improving digestive health and potentially reducing the risk of degenerative diseases.

2. Organoleptic Test

Table 4 presents the results of organoleptic tests of analog jerky made from banana blossom (*Musa Paradisiaca*) and dragon fruit skin (*Hylocereus Polyrhizus L.).* with each different treatment having an influence on the level of preference for analog jerky .

Flavor

Table 4. Average results of the hedonic test (taste)

Treatment	Mean ± SD	Category
P1	3.067 ± 0.719[a]	Neutral
P2	3,100 ± 0,764[a]	Neutral
P3	3.045 ± 0.704[a]	Neutral
P4	3.255 ± 0.671[a]	Neutral

The results of the hedonic test on the taste attributes of analog jerky showed that the difference in the proportion of kepok banana blossom and dragon fruit peel did not have a significant effect on the panelists' level of preference . The results of the Kruskal–Wallis test showed a significance value (> 0.05) , which indicated that there was no significant difference between treatments. All treatments were in the neutral category . The average value of panelists' preference for taste ranged from 3.045 to 3.255 . The highest value was found in treatment P4 (50 %: 50%) with an average of 3.255 , while the lowest value was found in treatment P3 (60%: 40%) at 3.045 . However, the difference in values between treatments was relatively small, so it did not show a significant difference in preference levels between the treatments. These results are in line with research by Putri et al. (2019) and Utami and Handayani (2020) who reported that variations in the proportion of plant-based ingredients in analog jerky products do not always significantly affect the level of taste preference, especially if the spice formulation and processing used are relatively uniform. This indicates that the taste of analog jerky is more influenced by the spice composition and processing techniques than differences in the proportion of the main ingredients , so that changes in the ratio of kepok banana blossom and dragon fruit peel within the treatment range have not had a significant effect on taste acceptance by panelists.

Color

Table 5. Average results of the hedonic test (color)

Treatment	Mean ± SD	Category
P1	3.156 ± 0.720[a]	Neutral
P2	3.589 ± 0.629[b]	Like
P3	3.378 ± 0.806[a]	Like
P4	3,600 ± 0,796[b]	Like

Based on the results of the hedonic test on color attributes (Table 5), there was a significant difference between treatments ($p < 0.05$) . Treatments P2 (70 %: 30%) and P4 (50%: 50%) showed the highest average color values, respectively 3.589 and 3.600 , and were in the same group (notation [b]). Both treatments were significantly different compared to P1 (90 %: 10%) which had the lowest average value of 3.156 and was in a different group (notation [a]). Treatment P3 (60 % : 40%) had a mean value of 3.378 and was in the same group as P1 (notation [a]), so it was not significantly different from P1. However, P3 also did not show a significant difference with P2 and P4, which indicated that this treatment was in a transitional condition between the low and high color groups. In general, a significant increase in the level of color preference was only seen in treatments P2 and P4 compared to P1.

These results align with research by Sari et al. (2021) , which reported that variations in the composition of raw materials in analog meat products significantly affected the final color due to differences in natural pigment content and the intensity of the browning reaction during the heating process. Similar findings were also reported by Lestari and Putra (2022) , who stated that color was the sensory parameter most responsive to formulation changes compared to aroma and texture. Furthermore, Rahman et al. (2023) explained that increasing the proportion of certain plant materials can enhance color intensity through the contribution of phenolic compounds and the Maillard reaction, resulting in significant color differences between treatments. Thus, the significant color difference in treatments P2 and P4 indicates that the composition of kepok banana heart and dragon fruit peel plays an important role in determining the visual acceptance of analog jerky , making color one of the most sensitive sensory attributes to treatment variations.

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Aroma

Table 6. Average results of the hedonic test (aroma)

Treatment	Mean ± SD	Category
P1	3.067 ± 0.474[a]	Neutral
P2	3,090 ± 0,619[a]	Neutral
P3	3.166 ± 0.654[a]	Neutral
P4	3.156 ± 0.585[a]	Neutral

Based on the results of the hedonic test on the aroma attribute (Table 6), the results of the statistical analysis showed no significant difference between treatments ($p > 0.05$) , which is indicated by the similarity of the letter notation ([a]) in all treatments. This indicates that variations in the proportion of kepok banana blossom and dragon fruit peel do not have a significant effect on the level of preference for the aroma of analog jerky. Judging from the tendency of the influence of the proportion of ingredients, an increase or decrease in the proportion of Kepok banana blossom does not show a consistent pattern of change in aroma . The average aroma value is in the range of 3.067–3.166 and all fall into the neutral category . The highest value was found in treatment P3 at 3.166 , while the lowest value was found in treatment P1 at 3.067 , but the difference was relatively small and not statistically significant.

The insignificant difference in aroma between treatments is likely due to the aroma characteristics being more influenced by the use of spices and the heating process than by differences in the proportions of the main ingredients . This finding aligns with Waluyo et al. (2021) , who stated that aroma attributes in processed food products tend to be less sensitive to formulation changes if the ingredients do not have a dominant, distinctive aroma. Rasid et al. (2024) also reported that substituting plant-based ingredients in processed meat products does not always result in significant aroma differences, as the volatile compounds that form the aroma are mostly derived from spices and reactions during processing. In relation to SNI 2908:2013 on beef jerky , although the standard does not specify quantitative aroma criteria, the results of the hedonic test show that the aroma of analog beef jerky in all treatments is in the acceptable category for the panelists. This indicates that the analog jerky formulation made from kepok banana blossom and dragon fruit peel meets the aspect of aroma acceptance as an alternative vegetable-based jerky product.

Texture

Table 7. Average results of the hedonic test (texture)

Treatment	Mean ± SD	Category
P1	2.899 ± 0.764[a]	Neutral
P2	2.933 ± 0.860[a]	Neutral
P3	3.099 ± 0.885[a]	Neutral
P4	3.078 ± 0.912[a]	Neutral

The results of the analysis of variance in the hedonic test of texture attributes showed that there was no significant difference between treatments ($p > 0.05$) , which was indicated by the similarity of letter notation in all treatments (Table 7). This indicates that the difference in the proportion of kepok banana blossom and dragon fruit peel in the analog jerky formulation did not have a significant effect on the panelists' level of preference for texture . Based on the tendency of the influence of the proportion of ingredients, it can be seen that increasing the proportion of dragon fruit skin is not followed by a consistent increase or decrease in texture value , and vice versa when increasing the proportion of kepok banana heart. This indicates that the variation in the composition of the ingredients within the treatment range used is not strong enough to influence the sensory characteristics of the product texture. Descriptively, the lowest average texture value was found in treatment P1 (2.899) with the highest proportion of kepok banana heart, while the highest average value was found in treatment P3 (3.099). However, the differences in these values were relatively small and not statistically significant, so all treatments remained in the neutral category. The insignificant differences in texture between treatments are thought to be due to similarities in processing and product matrix structure , such as grinding, mixing, molding, and heating methods, which more dominantly influence texture than variations in raw materials . This finding aligns with research by Sari and Nugroho (2021) which stated that the texture of analog jerky is more influenced by processing techniques

and binders than by differences in the proportions of the main ingredients. Utami et al. (2022) also reported that as long as the product's tissue structure remains homogeneous, panelists tend not to be able to differentiate texture significantly. Additionally, Rahman et al. (2023) found that variations in plant ingredients within a certain range did not always result in sensorially detectable differences in texture. In relation to quality standards, although SNI 2908:2013 on beef jerky does not specify quantitative texture parameters , the results of the hedonic test show that the texture of analog jerky in all treatments is in the neutral category and is acceptable to the panelists. This indicates that from the texture aspect, the resulting analog jerky still meets the sensory acceptance criteria as a processed food product.

CONCLUSION

Based on the research results, it can be concluded that:

Based on the research objectives that have been set, the following conclusions can be drawn:

1. Determination of the effect of ingredient proportions on the chemical and organoleptic properties of analog jerky
   Variations in the proportion of kepok banana blossom and dragon fruit peel significantly affected the chemical properties of analog jerky , namely water content, protein content, and crude fiber content ($p < 0.05$) . Increasing the proportion of dragon fruit peel tended to increase the water, protein, and crude fiber content , while increasing the proportion of kepok banana blossom showed the opposite tendency. In organoleptic properties , differences in ingredient proportions did not significantly affect the attributes of taste, aroma, and texture ($p > 0.05$) , but significantly affected the color of analog jerky ($p < 0.05$), where treatment with a higher proportion of dragon fruit peel resulted in a better level of color preference.
2. Determination of the best proportion of kepok banana blossom and dragon fruit peel
   Based on the combination of chemical and organoleptic test results, treatment P4 (50% kepok banana blossom : 50% dragon fruit peel) can be recommended as the best proportion, because it produces the highest protein and crude fiber content and a better level of color preference, with taste, aroma, and texture that are still acceptable to panelists. However, the water and protein content of the resulting analog jerky still do not fully meet the requirements of SNI 2908:2013 concerning beef jerky , so further formulation development is needed, especially to reduce the water content and increase the protein content so that the product quality is more optimal.

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