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The effect of adding dragon fruit peel (*Hylocereus polyrhizus*) and red ginger extract on characteristics of jelly candy from aloe vera

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KEYWORDS

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Carrageenan
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Jelly candy

ABSTRACT

This research aimed to determine the effect of adding dragon fruit peel and red ginger extract on the characteristics of jelly candy made from Aloe vera. The study used a randomized block design (RBD) with two factors: the ratio of Aloe vera and dragon fruit peel (100:0, 90:10, 80:20, and 70:30) and red ginger extract (0%, 5%, and10 %). The parameters analyzed were moisture content, ash content, color value (ºHue), reducing sugar content, pH, crude fiber, anthocyanin value, antioxidant IC_{50}, total phenol, as well as the hedonic values of color, aroma, taste, texture, and general acceptance. The results showed that the ratio of Aloe vera and dragon fruit peel significantly affected the ash content, color value (ºHue), reducing sugar content, crude fiber, anthocyanin value, antioxidant IC_{50}, total phenol, hedonic of color, and general acceptance. The red ginger extracts significantly affected ash content, color value (ºHue), reducing sugar content, antioxidant IC_{50}, total phenol, hedonic aroma, and taste. The interaction between the two factors significantly affected the color value (ºHue) and total phenol. The formulation with a ratio of aloe vera:dragon fruit peel (70:30) and 10% red ginger extract yielded the best jelly candy.

Introduction

Aloe vera is a medicinal plant with thick leaf tissue that thrives in tropical and semi-tropical climates and dry areas. It is easy to cultivate as an agricultural and medicinal plant. Aloe vera is commonly used to nourish hair, soothe wounds, and maintain skin health. Aloe vera contains flavonoids that function as natural antioxidants (Boudreau and Beland, 2006), as well as vitamins (i.e., as vitamin A, B_1, B_2, and B_6), essential amino acids, and fiber (Sahu et al., 2013) which promote healthy functioning of the large intestine. When the aloe vera leaves are cut or peeled, they release a yellow and slimy liquid. The slimy liquid contains aloin, which imparts an unpleasant odor. Aloin can be hydrolyzed more than 50% by blanching at 70ºC to eliminate its component's unpleasant odor and bitter taste (Sadiq et al., 2022).

Jelly candy is a processed food product with a soft texture and distinctive sweet taste, appealing to people of all ages, from children to adults. Jelly candy is typically made of water, sugar, and gelling agents (i.e., carrageenan, pectin, or gelatin). Another essential ingredient for making jelly candy is sugar, which acts as gelling agent and a sweetener. Jelly candy made from aloe vera is transparent and has no distinctive taste. Previous research was conducted with the addition of food colorant to give the desired color for the aloe vera and jelly seaweed candy. It is considered that products without the addition of food dyes will produce unattractive jelly candy (Fitrina et al., 2014). Therefore, the addition of food dyes to aloe vera jelly candy will enhance its visual appeal to consumers.

Natural dyes contain beneficial compounds that are healthier compared to artificial dyes. Therefore, natural dyes are preferred over artificial ones as coloring and flavoring agents due to the latter's potential unfavorable side effects, such as allergies, insomnia, asthma, and hives. Dragon fruit peel can be used to make jelly candy because it has anthocyanin that produces dyes (Handayani et al., 2012). Natural dyes derived from sources such as dragon fruit peel, usually discarded as waste, offer several health benefits because of their many beneficial components. The dragon fruit peel contains higher anthocyanins than the pulp itself,

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with a high antioxidant activity of 83.48% (Nurliyana et al., 2010), protein, fat, and fibre content that are good for health (Jiang et al., 2021). Dragon fruit peel contains anthocyanin and betacyanin compounds. The anthocyanin and betacyanin compounds contribute to red, while beta-xanthin collates with the yellow-orange color (Sari et al., 2018).

Aside from being a traditional medicine, ginger has now been developed into instant drink products, snacks, herbal drinks, candies, and ginger syrup. The wide variety of ginger products helps increase its value. Using ginger in processed products aims to explore its potential beyond traditional applications. Jelly candy can be made using different fruit juices and flavors to enhance its taste and appeal. Red ginger, in particular, contains components that form a distinctive taste and aroma. Ginger is generally used to treat sore throats, relieve indigestion, and alleviate nausea. Essential oils, oleoresin, and gingerol are antioxidants, antibacterial agents, and anti-inflammatory compounds (Yang and Rahmawati, 2022). The essential oils, namely zingiberene and zingiberol compounds in red ginger, are aroma-forming agents, while the oleoresins, namely gingerols and shogaols, provide a combination of spicy and bitter flavors (Yang and Rahmawati, 2022). Red ginger contains the highest amount of essential oil and oleoresin compared to other types of ginger (Novianti et al., 2022). The essential oil content in red ginger is between 2.58-3.90% (Kurniasari et al., 2013).

The ratio of aloe vera, dragon fruit peel, and ginger extract can enhance the sensory value of jelly candy made from a medicinal plant while improving its nutritional content and contributing to food diversification by increasing consumer options. This study aimed to explore the use of aloe vera gel in functional food products, the utilization of dragon fruit peel as a natural dye for jelly candy, and the enhancement of jelly candy's flavor using red ginger extract, thereby examining the physico-chemical characteristics of Aloe vera jelly candy.

Research and methods

Materials

Fresh aloe vera was harvested from Sekip Street (Medan), fresh red dragon fruit purchased from Bunga Raya Street (Medan), and fresh red ginger was purchased from Tavip Binjai Market. Carrageenan powder was purchased from the online store Mitra Jaya Chemical. Other additional ingredients, such sugar, *Rose Brand* High Fructose Syrup (HFS), and citric acid were purchased from a cake shop in Medan City.

Preparation of aloe vera, dragon fruit peels, and red ginger extract

The procedure that used in this research was modified within some experiments to get the finest extracts. The aloe vera leaves were peeled, and the gel was extracted and washed thoroughly until clean. The aloe vera gel was then blanched by placing it in boiling water for 5 minutes and left to cool. Then, the gel was blended until smooth, followed by filtration to collect the aloe vera extract (Fitrina et al., 2014).

The dragon fruit was peeled to separate the peel from the flesh. The peel was then washed and cut into smaller sizes for easier juicing and blending with water at a ratio of 1:3 w/v. The blend was filtered using a clean cloth to obtain the dragon fruit peel extract (Sulistianingsih et al., 2017).

Good-quality red ginger was selected and washed with water to remove dirt and soil. The clean ginger was peeled and cut into smaller sizes to ease the grinding and blending process with water at a ratio of 1:1 w/v. The mixture was then filtered using a clean cloth to obtain the red ginger extract (Bactiar et al., 2017).

Experimental set up

This study used a randomized block design (RBD) with two factors. The first factor was the ratio of aloe vera:dragon fruit peel extract (i.e., 100:0, 90:10, 80:20, and 70:30 v/v). The second factor was the percentage of red ginger extract (i.e., 0%, 5%, and 10% v/v). Then, 30% sucrose, 5% fructose syrup (HFS), and 6% carrageenan were added to the mixture. The mixture was heated until thickened while stirring to reduce clumping at a boiling temperature of 90-100°C for 5 minutes. Then, the mixture was cooled by turning off the heat, and 0.2% citric acid was added. Next, the mixture was poured into a mold (with a size of 10.5x7.5x5 cm) and left at room temperature for 1 hour until it hardened. Finally, the jelly candy was cut into smaller sizer (2x1cm) and dried at 55°C for 90 minutes. The dried jelly candies were then packed in plastic packaging.

Parameters analysis

The parameters analyzed in this study were pH, crude fiber content, anthocyanin levels, and antioxidant activity. The analysis procedures were based on the standard measurements for aloe vera jelly candy, including moisture content (AOAC, 2012), ash content, color (^{o}Hue) (Simanungkalit

and Simanjuntak, 2020; Jouybari and Farahnaky, 2011), reducing sugar (Meilianti, 2018), pH, crude fiber content, anthocyanins using the single pH method (Rosjadi, 2020), antioxidant activity by DPPH method, and total phenol using the Folin-Ciocalteu method (Saeed et al., 2012). Additionally, Hedonic evaluations of color, aroma, taste, texture, and general acceptance were conducted using a panel of 100 untrained panelists. The panelists, consisting of males and females aged between 17 and 45 years, rated the samples on a scale of 1 to 7, with 1 representing 'strongly dislike' and 7 representing 'strongly like' (Soekarto, 1985).

Data analysis

The data obtained is analyzed using ANOVA two way with significant difference 5% and 1%. If the results are significantly different, the mean values were compared using the Least Significant Range (LSR) test.

Results and Discussion

Chemical characteristics of raw materials

The pH value of aloe vera's extract was 4.49, while the crude fiber content was 0.77%. Aloe vera has a small amount of fiber. Aloe vera is a plant with slimy and transparent tissue; therefore, it primarily comprises water (99.07%) (Wariyah et al., 2022). The antioxidant activity (IC_{50}) in aloe vera extract was 89.11 µg/mL. Based on Molyneux classification (2004), aloe vera extract exhibited strong antioxidant activity.

The pH value of the dragon fruit peel extract was 4.77 and the crude fiber content was 25.62%. The dragon fruit contains fiber because of its pectin content, which accounts for 14.96% (Ismail et al., 2012). The anthocyanin in dragon fruit peel extract was 25.92 mg/L and the antioxidant activity (IC_{50}) was 76.36 µg/mL. Betacyanin and anthocyanin compounds in dragon fruit peel are classified as flavonoid compounds and possess antioxidant properties (Sari et al., 2018).

The pH value of red ginger extract was 6.33, while the crude fiber content was 2.4%. The red ginger extract contributed some crude fiber to the jelly candy product. The extract exhibited antioxidant activity with an (IC_{50}) value of 61.08 µg/mL. Oleoresin phenolic compounds serve as antioxidants. The components were saponins, shogaol, and gingerol (Srinivasan, 2017). The results of the raw materials characteristics are shown in Table 1, while the characteristics of jelly candy can be seen in Tables 2 and 3.

Table 1. Analysis of raw materials

Test Parameters	Aloe Vera Extract	Dragon fruit Peel Extract	Red Ginger Extract
pH	4.49^{b} ±0.03	4.77^{b} ±0.27	6.33^{a} ±0.09
Crude fiber content (%)	0.77^{b} ±0.03	25.62^{a} ±0.53	2.4^{b} ±0.16
Antioxidant IC_{50} (µg/ml)	89.11^{a} ±0.36	76.36^{b} ±0.56	61.08^{c} ±0.91
Anthocyanins	-	25.92 ±0.24	-

Note: ± indicates standard deviation from three measurement, values followed by different superscripts on the same row indicates significant difference (P>0.05)

Table 2. The characteristics of jelly candy with different ratio of aloe vera:dragon fruit peel extract

Testing Parameters	Aloe Vera: Dragon Fruit Peel (%)			
	100:0	90:10	80:20	70:30
Moisture content (%)	28.57 ±0.04	28.42 ±0.05	28.32 ±0.04	28.14 ±0.06
Ash content (%)	0.77^{dD} ±0.09	0.91^{cC} ±0.04	1.13^{bB} ±0.06	1.42^{aA} ±0.07
pH	4.31 ±0.09	4.34 ±0.08	4.41 ±0.04	4.53 ±0.06
Color (^{0}hue)	89.29^{aA} ±0.38	48.41^{bB} ±9.00	27.73^{cC} ±9.08	21.30^{dD} ±3.58
Reducing sugar (%)	19.78^{dD} ±0.84	21.85^{cC} ±0.70	23.58^{bB} ±0.36	25.20^{aA} ±0.26
Crude fiber content (%)	0.84^{dD} ±0.05	1.18^{cC} ±0.03	1.63^{bB} ±0.04	2.36^{aA} ±0.05
Anthocyanins (mg/L)	0.09^{cC} ±0.02	0.91^{bB} ±0.04	0.97^{aAB} ±0.02	1.02^{aA} ±0.07
Antioxidant IC_{50}(µg/mL)	110.11^{aA} ±4.37	104.49^{bB} ±4.37	98.89^{cC} ±4.55	95.24^{dD} ±4.98
Total phenol (µgGAE/g)	14.21^{dD} ±0.98	17.24^{cC} ±1.48	20.38^{bB} ±1.28	24.87^{aA} ±2.30
Hedonic of color	5.51^{dD} ±0.02	5.73^{cC} ±0.05	6.09^{bB} ±0.09	6.30^{aA} ±0.09
Hedonic of aroma	5.87 ±0.29	5.86 ±0.32	6.00 ±0.33	6.01 ±0.39
Hedonic of taste	5.91 ±0.22	5.93 ±0.27	6.00 ±0.22	6.09 ±0.23
Hedonic of texture	6.18 ±0.03	6.08 ±0.04	6.03 ±0.05	5.99 ±0.06
Hedonic of general acceptance	5.90^{cC} ±0.08	5.95^{cC} ±0.06	6.10^{bB} ±0.05	6.27^{aA} ±0.04

Note: ± indicates standard deviation from three measurement, values followed by different superscripts on the same row indicates significant difference at P>0.05 (lowercase letters) and highly significant differences at P<0.01 (capital letters).

Table 3. The characteristics of jelly candy with different percentage of red ginger extract

Testing Parameters	Red Ginger Extract (%)		
	0	5	10
Moisture content (%)	28.41 ±0.17	28.36 ±0.18	28.32 ±0.19
Ash content (%)	1.00^{cC} ±0.29	1.05^{bB} ±0.26	1.12^{aA} ±0.29
pH	4.33 ±0.11	4.41 ±0.10	4.46 ±0.08
Color (^{0}hue)	41.80^{cC} ±33.03	45.62^{bB} ±31.15	52.62^{aA} ±28.26
Reducing sugar (%)	22.12^{cB} ±2.45	22.56^{bB} ±2.55	23.14^{aA} ±1.99
Crude fiber content (%)	1.46 ±0.66	1.51 ±0.66	1.54 ±0.66
Anthocyanins (mg/L)	0.78 ±0.47	0.73 ±0.43	0.73 ±0.42
Antioxidant IC_{50}(µg/mL)	106.73^{aA} ±5.83	102.12^{bB} ±7.38	97.70^{cC} ±6.32
Total phenol (µgGAE/g)	17.64^{cC} ±4.21	19.34^{bB} ±4.17	20.55^{aA} ±5.31
Hedonic of color	5.97 ±0.39	5.90 ±0.35	5.85 ±0.32
Hedonic of aroma	5.57^{cB} ±0.06	6.03^{bA} ±0.09	6.22^{aA} ±0.10
Hedonic of taste	5.72^{bB} ±0.09	6.05^{aA} ±0.07	6.17^{aA} ±0.08
Hedonic of texture	6.11 ±0.07	6.07 ±0.08	6.03 ±0.10
Hedonic of general acceptance	6.00 ±0.19	6.06 ±0.17	6.11 ±0.16

Note: ± indicates standard deviation from three measurement, values followed by different superscripts on the same row indicates significant difference at P>0.05 (lowercase letters) and highly significant differences at P<0.01 (capital letters).

Ash content

The results of ANOVA showed no significant interaction between the ratio of aloe vera:dragon fruit peel extract and the percentage of red ginger extract on the ash content(P>0.05).

Based on the results, it can be concluded that the jelly candy's ash content increased with higher amounts of dragon fruit peel extract and red ginger extract. The dragon fruit peel extract added to jelly candy produced an ash content of 0.77-1.42%, and jelly candy with red ginger extract had an ash content of 1.00-1.12%. These variations may be influenced by the mineral content present in the different ingredients used (Marulitua, 2013). The aloe vera extract had an ash content of 0.22%, the dragon fruit peel had an ash content of 0.98%, and the red ginger had an ash content of 5.60% (David et al., 2018; Nurhayati et al., 2017).

Color (°Hue)

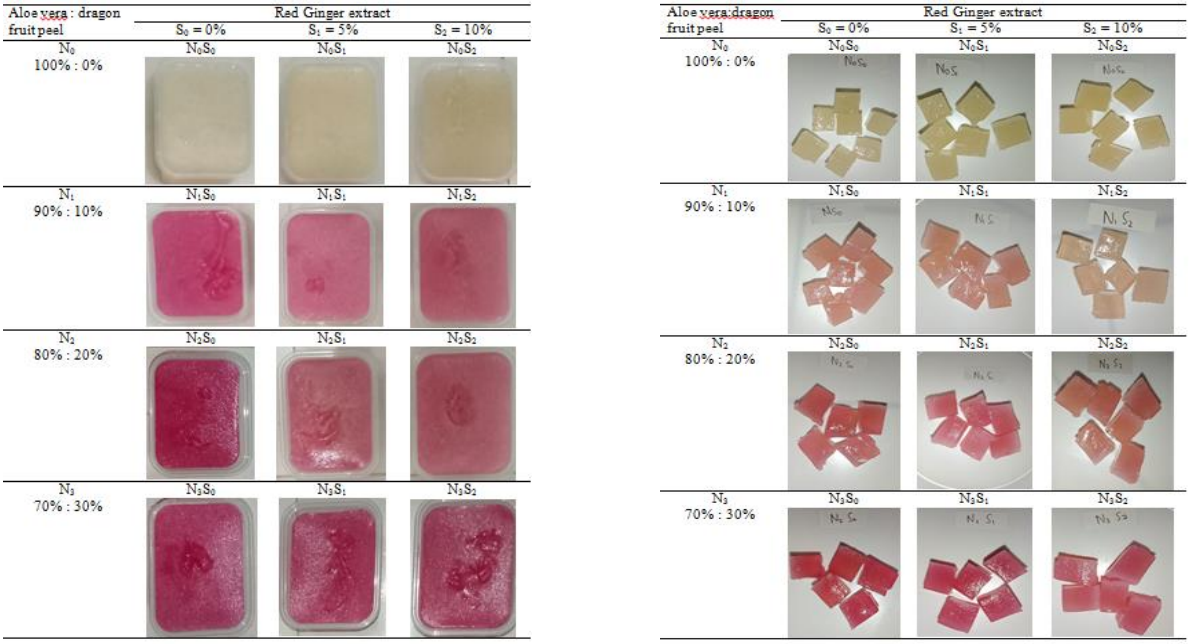
ANOVA test results showed that the two factors' interaction was significantly different on the color (P<0.01). The jelly candy with the addition of dragon fruit peel extract exhibited a color range of 89-21 °Hue (Table 2), indicating red color. On the other hand, the jelly candy without dragon fruit peel fell into the yellow-red category according to Hutching's classification (1999). The higher the amount of dragon fruit peel extract, the jelly candy's color took on a deeper shade of red. Compared to before drying, the jelly candy had a faint red and yellowish color (Figure 1). The red color of the jelly candy is attributed to the presence of anthocyanin and betacyanin pigments in the dragon fruit peel (Jiang et al., 2021).

Betacyanin is a type of betalain pigment that imparts a red to purple color, with compounds like bethanin, phyllocactin, and hylocerenin being the main betacyanin compounds in red dragon fruit (Khoo et al., 2017). Red ginger extract additions can reduce the red color index. This occurred because the oleoresin compound in red ginger is yellow-greyish (Novianti et al., 2022), thus increasing the product's brightness (*L) and the yellow color (*b) indication value. The more dragon fruit peel extract is added, the stronger the intensity of the red color in the jelly candy. This statement is in line with previous research, which reported that the percentage of betacyanin strongly influences the redness of the product (Patras et al., 2010). Additionally, the yellow color and brightness of the jelly candy increases with the addition of red ginger extract. The redness of the jelly candy ranged from 89-17º Hue (Table 3), indicating that the jelly candy fell within the red to yellow-red category.

Reducing sugar content

ANOVA test results indicated that the interaction between the two factors had no significant differences on the reducing sugar content (P>0.05).

These findings indicate that increasing the amounts of dragon fruit peel extract and red ginger extract in the treatment led to an increase in the reducing sugar content in the jelly candy. The reducing sugar content of the jelly candy with dragon fruit peel extract ranged from 19.78% to 25.20% (Table 2), and with red ginger extract ranged from 22.12% to 23.14% (Table 3). The increase in the reducing sugar content in the jelly candy with the addition of dragon fruit peel extract can be attributed to the high pectin content present in the peel, which was 14.96% (Ismail et al., 2012).



(a) (b)

Figure 1. The color of jelly candy before drying(a) and after drying (b)

The pectin in the dragon fruit peel is a polysaccharide compound. The jelly candy-making process used heat and acid, which can split polysaccharides into monosaccharides such as glucose and fructose, increasing the reducing sugar content through the Maillard reaction (Ngginak et al., 2020). Red ginger also contains a significant amount of starch. According to Ramadhan (2013), the red ginger extract contains 44.99% starch. The heating process during jelly candy production and the presence of acids (i.e., citric acid and organic acids) can hydrolyze the starch into simple sugars, increasing the reducing sugar content.

Crude fiber content

The ANOVA results indicated that the interaction between the ratio of aloe vera:dragon fruit peel extract and the percentage of red ginger extract did not significantly affect crude fiber content ($P>0.05$).

The findings confirmed that adding dragon fruit peel extract increased the crude fiber content of the jelly candy, giving values ranging from 0.84% to 2.36% (Table 2). The crude fiber of jelly candy increased with the addition of dragon fruit peel extract because it contains pectin, which was 14.96% (Ismail et al., 2012). As more dragon fruit peel extract is added, the pectin and crude fiber content in the jelly candy increases. The raw materials' crude fiber content may affect the jelly candy's content. Dragon fruit peel has a higher crude fiber content of 25.62% compared to aloe vera at 0.77%.

Anthocyanin

The ANOVA results showed that the interaction between the ratio of aloe vera:dragon fruit peel extract and the percentage of red ginger extract made a non-significant difference in anthocyanin ($P>0.05$).

Based on these results, it can be observed that the addition of dragon fruit peel extract increased the anthocyanin content in the jelly candy. The jelly candy with dragon fruit peel extract had anthocyanin levels ranging from 0.09 to 1.02 mg/L (Table 2). Dragon fruit peel contains anthocyanin and betacyanin compounds, contributing to its red pigmentation (Jiang et al., 2021). However, the anthocyanin content in the jelly candy decreased compared to the raw material of dragon fruit peel extract, which had an anthocyanin level of 25.92 mg/L. The decreased anthocyanin stability led to the diminishing of anthocyanin in jelly candy. The heating process and high temperature decrease the anthocyanin stability (Suryaningsih et al., 2020). Factors such as temperature, pH, light, oxygen, and storage duration can impact the stability of anthocyanins (Sipahli et al., 2017).

Antioxidant activity

The ANOVA results revealed that the interaction between the ratio of aloe vera:dragon fruit peel

extract and the percentage of red ginger extract did not make any significant difference in the antioxidant activity (P>0.05).

These results also indicate that increasing the amounts of dragon fruit peel extract and red ginger extract in the treatment led to higher antioxidant activity in the jelly candy. IC_{50} is the percentage value of the sample needed to counteract 50% of DPPH. Lower IC_{50} values indicate higher antioxidant activity (Pratiwi et al., 2019). The jelly candy with dragon fruit peel extract additions exhibited the highest antioxidant activity at 95.24 μg/mL, while adding red ginger extract resulted in the highest antioxidant activity with a 97.70 μg/mL value. Dragon fruit peel contains significant amounts of anthocyanin and betacyanin compounds, classified as flavonoid compounds responsible for color pigments and part of the polyphenols responsible for antioxidant properties (Suryaningsih et al., 2020). Red ginger, on the other hand, contains essential oils and oleoresins that contribute to its distinctive aroma and spicy taste, and these components also function as antioxidants. The oleoresin phenolic components in red ginger with antioxidant roles are saponins, shogaols, and gingerols (Srinivasan, 2017). According to Molyneux (2004), jelly candy can be classified as having a strong to moderate antioxidant activity.

Total phenol content

The ANOVA test results showed that the interaction between the two factors made a highly significant difference in the total phenol content (P<0.01).

Furthermore, it can be observed that increasing the concentration of dragon fruit peel extract and red ginger extract resulted in higher total phenol content. The jelly candy with dragon fruit peel extract additions exhibited total phenol levels ranging from 14.21 to 24.87 μgGAE/g (Table 2). In comparison, adding red ginger extract resulted in total phenol levels ranging from 17.64 to 20.55 μgGAE/g (Table 3). The amount of betacyanin in the material influences the antioxidant activity. The higher the betacyanin, the higher the antioxidant activity. The increase in total phenol content is in line with the increase in antioxidant activity of the jelly candy. Phenolic compounds in the jelly candy act as antioxidants by scavenging free radicals and stabilizing them, thus preventing free radical reactions. The increase in total phenol is also proportional to the increase in red ginger extract. Red ginger contains oleoresin, a phenolic compound inhibiting free radicals (Srinivasan, 2017).

The higher the percentage of dragon fruit peel extract, the greater the total phenol content of the jelly candy. This is attributed to betacyanin compounds in the dragon fruit peel. In this study, the phenol compounds, aloin, and tannins in the Aloe vera jelly candy were minimal due to the blanching process. Consequently, the increase in total phenolic content in the jelly candy was primarily derived from the betacyanins found in the dragon fruit peel. The main component responsible for the aroma and spicy taste of red ginger is the oleoresin compound, which is also classified as a phenolic compound (Srinivasan, 2017). These compounds increase the total phenol in jelly candy products.

Hedonic of color

The ANOVA results demonstrated that the interaction between the ratio of aloe vera-dragon fruit skin extract and the percentage of red ginger extract had no significant effect in the jelly candy's color (P>0.05).

The results also revealed that panelists preferred jelly candy with dragon fruit peel extract additions. Specifically, jelly candy with a 30% dragon fruit peel extract had the highest score of 6.30, indicating the "like" group. Consumers tend to be attracted to jelly candies with vibrant and bright colors. The increase in the color hedonic score was influenced by the color of the jelly candy, which intensifies as the percentage of dragon fruit peel extract increases. Aloe vera is colorless or transparent; hence, its addition did not affect the jelly candy's color. Instead, anthocyanins and betacyanins derived from the dragon fruit peel provide a red to purple color (Khoo et al., 2017).

Hedonic of aroma

The ANOVA test results indicated that the interaction between the ratio of aloe vera:dragon fruit skin extract and the percentage of red ginger extract had no significant difference in the jelly candy's aroma (P>0.05). The results revealed that panelists preferred jelly candy with red ginger extract additions. Jelly candy with a 10% red ginger extract received the highest score of 6.22, classified as the "liked" group. The addition of red ginger extract provides a distinctive ginger aroma to the jelly candy, attributed to the essential oil components such as zingiberene and zingiberol (Yang and Rahmawati, 2022).

Hedonic of taste

The ANOVA results showed that the interaction between the ratio of aloe vera:dragon fruit skin extract and the percentage of red ginger extract had a non-significant effect in the jelly candy's taste ($P>0.05$).

The results showed that the panelists favored the jelly candy with higher red ginger extract. Jelly candy with a 10% red ginger extract received the highest score of 6.17, indicating the "like" group. The increase in the hedonic taste score was influenced by the presence of the oleoresin component in red ginger, which contributes to the spicy taste. The main compounds in red ginger oleoresin are gingerols and shogaols (Yang and Rahmawati, 2022). Aloe vera and dragon fruit skin do not have a particularly distinctive taste, so the spicy taste and the red ginger flavor dominate the jelly candy taste.

Hedonic of general acceptance

The ANOVA test results showed that the interaction between the ratio of aloe vera:dragon fruit skin extract and the percentage of red ginger extract produced a non-significant difference in the general acceptance ($P>0.05$). The panelists's acceptance of jelly candy resulted in a score stating the "like" group with the highest score of 6.27. Products with bright colors tend to be favored by panelists, and the red and pink colors of the jelly candy, derived from the dragon fruit skin color pigment (Khoo et al., 2017) may have contributed to its appeal. The combination of sweet taste from the sugar, HFS, and the addition of red ginger, which provides a spicy taste and distinctive aroma (Srinivasan, 2017), likely attracted the panelists' taste preferences.

Conclusions

The interaction between a ratio of aloe vera:dragon fruit peel and the percentage of red ginger extract was shown to significantly effects the color value (^{o}Hue) and total phenol of the jelly candy. However, the interaction between these two factors made a non-significant difference in moisture content, pH, and hedonic texture. Further studies are required to investigate the impact of drying temperature and storage time on the quality of jelly candy. An in-depth evaluation of anthocyanin co-pigmentation to preserve anthocyanins and the color stability in jelly candy is essential.

Declarations

Conflict of interests The authors declare no competing interests.

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