October – December, 2023
Original Article
DOI: http://dx.doi.org/10.30867/action.v8i4.1182

AcTion: Aceh Nutrition Journal
Pages: 642 - 652
p-issn 2527-3310; e-issn 2548-5741

The content of proximate, beta carotene, and organoleptic pumpkin mooncake as a snack to improve the immune system in the elderly

Kandungan proksimat, beta karoten, dan organoleptik pumpkin mooncake sebagai snack peningkatan sistem imun pada lansia

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Article History:
Received: March 14, 2023; Revised: September 6, 2023; Accepted: October 6, 2023; Published: December 8, 2023.

Publisher:
Politeknik Kesehatan Aceh
Kementerian Kesehatan RI

Abstract

The elderly population continues to increase, so it is necessary to provide healthy foods that can boost their immune system, one of which is pumpkin. Pumpkin contains β-carotene, an antioxidant and anti-inflammatory to boost the immune system. This study aimed to develop pumpkin mooncakes for the elderly and analyze their proximate, beta-carotene, and organoleptic values. Research design uses the research and development (R&D) method with a 4D design, namely, defining, designing, developing, and disseminating. The study was conducted in Surakarta City in December 2021. Eighty older adults participated in the organoleptic test. Mooncake products were subjected to organoleptic examination and proximate analysis using the ANOVA test with a significance level of 95%. The results of the proximate analysis consisted of water content (38,91%), ash (0,74%), fat (5,80%), protein (2,20%), and carbohydrates (53,24%). The β-carotene content of the pumpkin mooncake increased by 28,42% compared to that of the reference product. The average liking was 4,69, and there was a difference in the level of panelists' liking for development and reference products (p= 0,020). In conclusion, pumpkin mooncake is a beneficial ingredient that supports the immune system. However, further research is needed to compare it with other healthy foods in the context of improving immunity in the elderly population.
Keywords: ßeta carotene, elderly, mooncake, pumpkin, proximate

Abstrak

Penduduk lanjut usia (lansia) terus mengalami jumlah peningkatannya, sehingga diperlukan penyediaan makanan sehat yang dapat meningkatkan sistem imun mereka, salah satunya yaitu berbahan labu kuning. Labu kuning mengandung β-karoten, berfungsi sebagai antioksidan dan antiinflamasi untuk meningkatkan sistem imun tubuh. Penelitian bertujuan untuk mengembangkan mooncake labu kuning bagi lansia dan menganalisis nilai proksimat, beta karoten, serta organoleptik. Desain penelitian menggunakan metode *Research & Development* (R&D) dengan desain 4D, yaitu *define, design, develop dan disseminate*. Telah dilakukan Kota Surakarta pada Desember 2021. Subjek uji organoleptik adalah lansia sebanyak 80 orang. Produk mooncake dilakukan pemeriksaan organoleptik dan analisis proksimat. Analisis statistik menggunakan uji ANOVA tingkat kemaknaan 95%. Hasil analisis proksimat terdiri dari kadar air (38,91%), abu (0,74%), lemak (5,80%), protein (2,20%) dan karbohidrat (53,24%). Kadar ß-karoten pada pumpkin mooncake menunjukkan peningkatan sebesar 28,42% dibandingkan dengan produk acuan. Rata-rata kesukaan yaitu 4,69 dan terdapat perbedaan tingkat kesukaan panelis terhadap produk pengembangan dan acuan (p= 0,020). Kesimpulan, mooncake labu menunjukkan kandungan yang menguntungkan yang dapat mendukung sistem imun. Namun, penelitian lebih lanjut diperlukan untuk membandingkannya dengan makanan sehat lainnya dalam konteks meningkatkan imunitas lansia.
Kata Kunci: ßeta karoten, labu kuning, lansia, mooncake, proksimat

Introduction

Globally, the population over 60 is increasing (Mahadevan et al., 2016). A new World Health Organization (WHO) report on the International Day of Older Persons predicted that the population over 60 will double by 2050 in low- and middle-income countries. Meanwhile, the elderly population aged 80 years and over in almost five decades has increased to 400 million (WHO, 2021).

The shift in a country's population distribution towards older age, known as the elderly population, began in rapidly developing countries (e.g., in Japan, 30% of the population is over 60). Aging is an inevitable process, usually measured by chronological age, and as a convention, a person aged 65 years or older is often referred to as elderly (Singh & Bajorek, 2014). However, the aging process is not uniform across populations owing to genetic, lifestyle, and overall health differences.

The increasing number of elderly people in Indonesia will increase the number of diseases caused by aging. The National Health Survey (*RISKESDAS*) data from 2018 showed that the most common diseases in the elderly include hypertension, diabetes mellitus, joint disease, mouth, vision, teeth, heart, and stroke (Kemenkes RI, 2018). Han & Yang (2020), with 199 elderly subjects, showed that dementia and Parkinson's disease were the most common diseases experienced by the elderly, followed by hypertension, musculoskeletal disease, diabetes, and stroke. Only 25,6% of the subjects had intact teeth, and 44,7% had difficulty chewing and swallowing.

According to Bajaj et al. (2021), the body's immune response decreases as age increases. Progressive biological changes in the immune system accompany natural aging, like every system in the body. Some of these factors lead to decreased function, as evidenced by the increased susceptibility to respiratory infections. In contrast, age-related immune-mediated inflammation and associated inflammatory diseases increase (Shaw et al., 2013; Fuentes et al., 2016; Fuentes et al., 2017). This leads to a gradual loss of physical and mental abilities and an increased risk of disease and death.

These findings indicate that the overall nutritional status of the elderly in long-term care facilities is less regular. According to Han & Yang (2020), vitamin D, calcium, vitamin C, riboflavin, and potassium intake are particularly deficient. Vitamin D intake was 5 g, and 86,4% of the elderly were below the estimated average requirement, whereas sodium intake was high. According to Aulia et al. (2020), malnutrition in the elderly is related to an imbalance in the development of foods that meet nutritional needs. In addition, to meet the nutritional needs of the elderly, the diet must pay attention to the physical condition of the elderly, such as tooth loss, weight loss, and decreased sensory functions.

Renzo et al. (2020) stated that balanced food consumption is critical for maintaining a healthy lifestyle. Carbohydrates are necessary for nutrition in the elderly because they provide the human body with the primary fuel source for body and brain functions. The role of nutrients, food, and diet is the subject of study to identify the best food intake recommendations to keep the elderly healthy and prosperous (Al Rahmad, 2021; Park et al., 2020). Therefore, efforts are being made to increase body power in the elderly by providing healthy snacks.

Healthy snacks are becoming popular owing to increasing awareness of the importance of food quality in maintaining good health. Healthy snacks can help fulfill energy needs before the main meal by providing extra energy for activities. Zizza et al. (2010) reported that healthy snacks contain vitamins, proteins, and β-carotene. Pumpkin is a global food and a good choice for developing diets for the elderly. Pumpkin is an essential vegetable owing to its nutritional value (Kwiri, 2014; Hussain et al., 2021; Hagos et al., 2022).

Pumpkin contains starch, protein, carotene, vitamin B, vitamin C, calcium, phosphorus, and other ingredients (Dali et al., 2017; Latif & Abdullah, 2020; Men et al., 2021). Sello & Mostafa (2017) found that pumpkin contains many pectins, mineral salts, carotene, vitamins, and other substances beneficial to human health. Pumpkin also has a high β-carotene content of 9-19,9 mg/100 g (Chimkerd & Winuprasith, 2018). Epidemiological evidence suggests that carotenoid-rich diets derived from pumpkin effectively enhance the immune response and reduce the risk of degenerative diseases, such as cancer, cardiovascular disease, atherosclerosis, cataracts, and age-related macular degeneration (Aversa et al., 2016).

In many countries, such as the United States, Mexico, India, China, and Brazil, pumpkin is traditionally used in medicine (Chinsembu 2019; Ulrich et al. 2022). Modern nutritional science and medicine have shown that pumpkins can effectively prevent hypertension, diabetes, liver disease, coronary heart disease, and hyperlipidemia and strengthen the human immune system (Banin et al., 2017; Banin et al., 2022). In pumpkins, polysaccharides, dietary fiber, pectin, and other substances have significant positive physiological effects on the human body (Liu et al., 2018).

The results of another study conducted by Chimkerd and Winuprasith (2018) showed that pumpkin snacks could be used as a product to help improve the nutritional status and quality of life of the elderly or people who have chewing problems. The research results above demonstrate the benefits of modifying raw materials or additional ingredients in making healthy elderly snacks. In this study, pumpkin flesh was used as the primary ingredient of pumpkin mooncake.

Mooncake is a traditional Chinese food of Han nationality with a specific shape according to the motif and size of the mold. Several studies have developed snacks made from pumpkin, including research by Igfar (2012), which has made biscuits with pumpkin flour that meet the biscuit quality standards (SNI 01-2973-1992). Research by Holinesti & Isnaini (2020) However, the development of traditional cakes, such as mooncakes from pumpkins in Indonesia, is still limited.

Mooncakes have a soft texture suitable for the physiological conditions of the elderly. Therefore, this research aims to develop a traditional cake product, a mooncake made from pumpkin, which can be used as a healthy snack to improve the immune system of the elderly.

Methods

The research method used is development research or Research & Development (R&D) with a 4D design in four stages: the define, design, development, and dissemination stages. The organoleptic test subjects were 80 elderly people in the Sukoharjo Vocational High School 3 environment and the Elderly *Posyandu* (Integrated Healthcare) in Sriwedari Village, Laweyan District, Surakarta City on 20-23 December 2021.

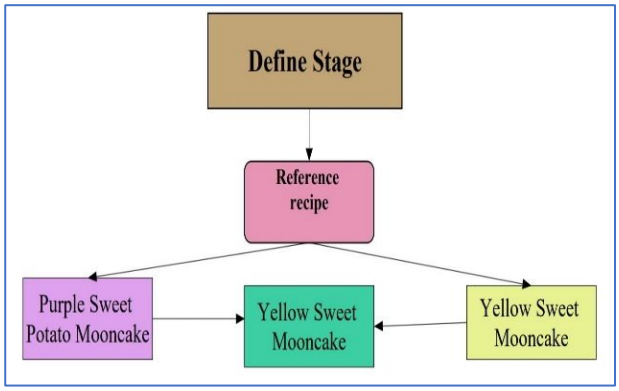


Figure 1. Define stage

The first stage of defining and determining the selected reference recipe consisted of reference recipe (1), purple sweet potato mooncake, reference recipe (2), pumpkin mooncake, and reference recipe (3), purple sweet potato mooncake, and reference recipes by examining several factors such as shape, color, aroma, taste, and texture in the mooncake making process.

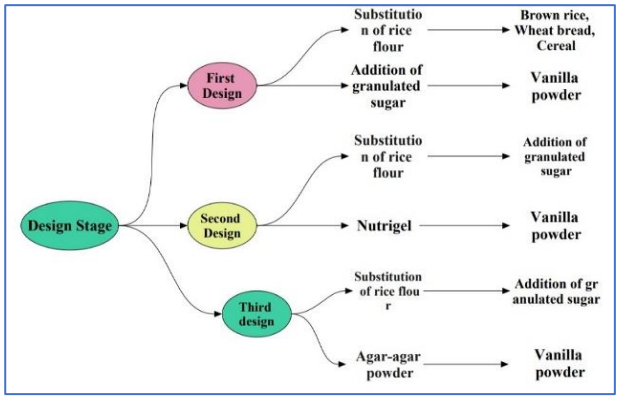


Figure 2. Design stage

We developed the product or selected reference recipe through three ingredient modifications in the second design stage. The first development involved the substitution of rice flour with sugar, steamed potatoes, and vanilla powder. The second development is substituting rice flour with sugar, nutrients, and vanilla powder. The third development involves the substitution of rice flour, sugar, agar powder, and vanilla.

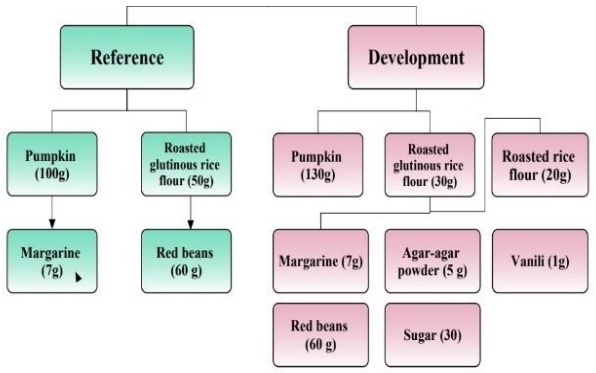
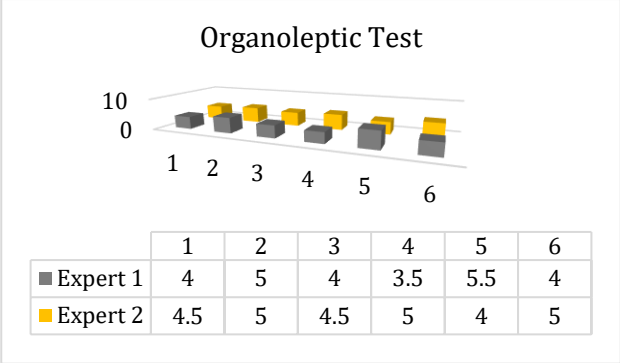


Figure 3. Develop stage

In the next stage, two expert lecturers validated the selected recipe from the design stage as validators and designed pumpkin mooncake packaging. The validation results were as follows:



	1	2	3	4	5	6
Expert 1	4	5	4	3.5	5.5	4
Expert 2	4.5	5	4.5	5	4	5

Figure 4. Expert validation result

The pumpkin used is flesh that is commonly consumed daily. Other supporting ingredients included agar powder, rice flour, sugar, vanilla, salt, margarine, and red beans. The research began by preparing pumpkin moon cake skin batter with agar-agar powder, rice flour, glutinous rice flour, sugar, margarine, vanilla, filling, molding, and steaming. The leading equipment used was a mooncake mold with a 10 cm diameter specification and a 32 cm steamer from Indonesia. The results are shown in Figure 5, respectively.

Figure 5. Pumpkin Mooncake

The last stage, disseminate, was to conduct content, proximate, and β-carotene tests at the chemistry laboratory of Sebelas Maret University. Product nutrition label information was determined based on the proximate analysis results, β-carotene, and featured nutrients. Proximate analysis is a method that determines macronutrient values in food samples. These values are generally expressed as nutritional facts that are usually indicated on the final food product label and determined during production.

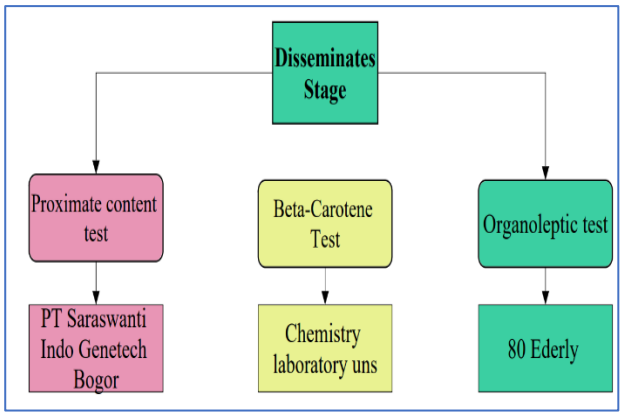


Figure 6. Disseminates stage

Furthermore, organoleptic tests were performed on the original mooncake, and the pumpkin mooncake was developed using 80 untrained panelists. It was then analyzed using the ANOVA test with a significance level of 95%, accompanied by customarily distributed and homogeneous data. The criteria for panelists were the elderly aged–45-59 years. The method used was a scoring form for each assessment with a 4-1 scale with each value of (4) really like, (3) like, (2) dislike, and (1) dislike.

This research obtained ethical approval from the Research Ethics Commission of Yogyakarta State University on 1 September 2021, with No.T/38.1/UN34.21/TU/2021.

Result and Discussion

Proximate

Proximate analysis is a method that determines macronutrient values in food samples. These values are generally expressed as nutritional facts that are usually indicated on the final food product label and determined during production. Proximate analysis was used to determine the categories of compounds,

including water, ash, protein, fat, and carbohydrates, contained in pumpkin mooncakes. The results of the proximate content analysis are shown in the table below.

Table 2. Proximate analysis of pumpkin mooncake

Nutrient content	content %		p-value
	Reference	Development	
Water (g)	47,26±0,148[a]	38,91±0,035[b]	0,010
Ash (g)	0,64±0,007[a]	0,74±0,007[a]	0,063
Fat (g)	5,80±0,028[b]	6,75±0,056[a]	0,013
Protein (g)	1,31±0,070[a]	2,20±0,063[b]	0,004
Carbohydrate (g)	43,14±0,127[a]	53,24±0,070[b]	0,009

Indicates a significant difference ($p < 0,05$) when using a paired t-test with different superscripts on the same row

Moisture content

Thermogravimetry was used to analyze the water content in this study. The water content of the pumpkin moon cake was 38,91%, whereas that of the original moon cake was 47,26%.

These results prove that the water content in the pumpkin moon cake developed was lower than that of the reference. According to Nilasari et al. (2017), cooking temperature influences the low water content. The higher the temperature and longer the cooking time, the lower the water content in the pumpkin. According to Mustofa and Wulandari (2020), excessive moisture in food can cause increased microbial growth, which not only spoils food but also shortens shelf life and causes changes in food composition (Gumolung, 2019).

Ash content

The main component of ash content is inorganic elements, the total amount of inorganic substances in food. Ash analysis of food ingredients aims to identify the mineral content of the tested ingredients. The ash content was analyzed using the drying method. The ash content of the moon cake development analysis was 0,4%, whereas that of the reference was 0,64%.

These results indicate that the ash content of the pumpkin moon cake development is higher than that of the reference moon cake. Subaktilah et al. (2021) state that the higher the pumpkin meat substitution, the higher the steamed brownish ash content. The increase in ash content and the amount of pumpkin meat occur because pumpkin is rich in minerals and vitamins.

Fat content

The fat content was determined using the Soxhlet method. The analysis results for the fat content of pumpkin moon cake development were 6,75% and 5,80%, respectively. These results indicate that the fat content in the developed moon cake was higher than in the reference moon cake. The high-fat content in the developed product was due to adding 7 g of margarine. Fats are a major source of energy for the human body. Ratnasari & Yunianta (2019) and Hastuti and Afifah (2019) supported this study's results that the fat content in biscuits tends to increase as the proportion of pumpkin flour increases with the addition of margarine.

Protein content

The results of the protein content analysis using the Kjedhal method on pumpkin mooncakes was 2,21%, while that of the original was 1,31%. This shows that the protein content of pumpkin moon cake development was higher than that of the reference. This increase is because additives increase protein levels during pumpkin moon cake processing. Chaumontet et al. (2019) stated that a sufficiently high protein intake is needed to maintain nitrogen balance and compensate for age-related lower energy intake.

Maintaining muscle mass in the elderly is one of the most important preventive health measures. The increase in protein in pumpkin mooncake was due to adding 30 g of pumpkin. The research results also support the finding by Hatta & Sandalayuk (2020) that protein in cookies significantly affects the addition of pumpkin meat. Thus, the higher the pumpkin addition, the higher the protein content of the cookies. The better the protein component following the roasting process, the better the flavor and aroma produced (Holinesti & Isnaini, 2020). Thus, the higher the protein content in food, the better the food quality for humans. The primary function of proteins in the body is to form new tissues and maintain existing ones (Gumolung, 2019).

Carbohydrate levels

Carbohydrates are essential nutrients for human health (Kole et al., 2020). Carbohydrates, proteins, and fats are the main types of macronutrients in the diet (nutrients needed daily in large quantities)—carbohydrate analysis using by difference. The carbohydrate content of the pumpkin mooncake was 53,24%, whereas that of the original mooncake was 43,14%.

This shows that the carbohydrate content of pumpkin moon cake development was higher than that of the reference. Adding pumpkin flesh and roasted rice flour to pumpkin mooncake in every aspect can increase the carbohydrate content of pumpkin mooncake. Based on the results of the ANOVA test (p= 0,000), it can be concluded that adding 30 g of pumpkin and 20 g of roasted rice significantly increased the carbohydrate content. According to Suryani et al. (2014), the increase in carbohydrates is influenced by adding pumpkins. According to PERSAGI (2009), pumpkin is a relatively high source of carbohydrates (10 grams per 100 grams).

ß-carotene

The β-carotene analysis in this study was performed using the Carr-Price method. Based on the laboratory test analysis at Sebelas Maret University, the β-carotene content of the pumpkin mooncake was 4523,09 ug/g while that of the reference product was 3522,47 ug/g.

This shows that the β-carotene content of the pumpkin mooncake was higher than that of the original mooncake. Carotenoids are antioxidants that boost immunity and reduce the incidence of cancer, chronic diseases, and embolic vascular diseases. Aversa et al. (2016) showed that a carotenoid-rich diet can improve the body's immune response and reduce the risk of various chronic diseases, including cardiovascular disease, atherosclerosis, and cancer. Haider et al. (2017) reported that β-carotene is converted into vitamin A after absorption by the human body, which can effectively protect visual function and prevent night blindness.

Organoleptic

Organoleptic refers to the aspects of food, water, or other substances that individuals experience through their senses. Sensory assessment is a method used to generate, measure, analyze, and interpret responses to products perceived by sight, smell, touch, taste, and hearing.

This sensory test determines the consumer acceptance of the developed product (Asyngari et al., 2017). The results of the organoleptic test are presented in the following table.

Table 3. Results of paired sample t-test analysis

Parameter	Reference Mean	Mean Development	p-value
Shape	3,96±0,404[a]	4,52±0,503[b]	0,000
Color	3,7±0,537[a]	3,8±0,403[b]	0,000
Aroma	3,64±0,484[a]	4,41±0,544[b]	0,000
Flavor	3,91±0,396[a]	4,69±0,466[b]	0,000
Texture	3,91±0,455[a]	4,55±0,501[b]	0,000
Overall	3,93±0,309[a]	4,69±0,466[b]	0,000

Indicates a significant difference (p < 0,05) when using a paired t-test with different superscripts on the same row

Shape

Shape is also a key component of sensory evaluation. The pumpkin mooncake has a more attractive body than the reference mooncake. The paired t-test results showed that the panelists preferred the developed mooncake to the reference, with an average value of 4,51>3,96 and a significance of 0,000<0,05. This is because mooncake development has a denser dough texture with the addition of glutinous rice flour, rice flour, and agar powder; thus, the printing process creates exciting shapes and motifs.

According to Radwitya et al. (2022), the role of glutinous rice flour and rice flour in pumpkin mooncake is as a structure and binder for other ingredients, namely glutinous rice flour and rice flour, when heated with a mixture of liquid ingredients. This is because rice flour and glutinous rice contain amylopectin, which makes pumpkin moon cake dough chewy and textured.

Color

Color is generally one of the determining factors in the choice of food. In making pumpkin

mooncake, as much as 30 g of pumpkin was added, resulting in a deeper color than the reference product. The paired sample t-test showed a significant difference (p<0,05) with an average value of 3,8>3,7. This shows that the developed pumpkin mooncake was more favorable than the reference mooncake (original).

The results of this study are supported by Holinesti & Isnaini (2020), that color can affect a person's attraction to the food they see. This follows his research finding that there is a significant effect on the quality of the yellow color of Serabi using pumpkin. Stated by Holinesti & Isnaini (2020) that the addition of suitable pumpkin flesh in food will tend to produce a deep and attractive color that tends to be liked by consumers. In addition, according to Hastuti & Afifah (2019), adding pumpkin flour to the product gives an additional yellow and slightly red color. This is due to the large amount of β-carotene present in the pumpkin. Carotenoids, belonging to the category of tetraterpenoids, provide natural color pigments in the form of yellow-orange-red (Mortensen, 2006).

Aroma

Aroma is one of the criteria that significantly influences consumers' food choices. Adding 1 g of vanilla to the pumpkin mooncake made the aroma more fragrant and delicious than the reference product. The results of the paired sample t-test (p <0,05) had an average value of 4,41.

The analysis results prove that the developed pumpkin moon cake is more favorable than the reference in terms of aroma. Spence (2015) mentioned that the aroma produced by food is a strong attraction that can stimulate a sense of smell. Hastuti & Afifah (2019) found that the aroma of food can be influenced by adding vanilla and pumpkin flesh, which affects the aroma changes in the product.

Flavor

The flavor is an essential factor in evaluating the results of adding ingredient formulations to foods produced by the tongue, measuring sweetness, sourness, saltiness, bitterness, or other combinations. It determines food liking Pekel et al. (2020).

In terms of flavor, pumpkin mooncake products are preferred over the reference. This is because, in the skin, there is the addition of sugar, agar-agar, vanilla, and the processing of red beans as a filling, resulting in a sweet and savory taste. Sugar is an essential organic compound used as a food source of calories (Radwitya et al., 2022). According to Holinesti & Isnaini (2020), the taste is formed from a combination of sugar and pumpkin flesh in making pumpkin mooncakes so that it tends to produce a sweet and savory taste. In addition, according to Tsatsaragkou et al. (2021), sugar can give a sweet flavor to cakes". The flavor of pumpkin pancakes is the sweetness caused by the use of granulated sugar during the processing of pumpkin pancakes.

Texture

Food texture is a collective term for sensory experiences derived from visual, audio, and tactile stimuli (Wadhani et al., 2021). The sensation of food texture is essential in influencing consumer preferences for a food product. Consumer attention and interest in food texture varies from one type of food to another (Megido et al., 2014). The analysis results in Table 3 show an average value of 4,55>3,91 or a significant difference (p= 0,000).

These results prove that panellists preferred pumpkin mooncake development results regarding texture. This is because pumpkin mooncake has a texture that suits the physiological needs of the elderly, namely, soft, soft, and not sour. According to Schmidt et al. (2021), food texture is essential for safe swallowing and reduces the risk of choking. Alternative textures are required to increase the attractiveness of food. The texture in this development resulted from the addition of glutinous rice flour and agar powder. This follows the results of the research by Firdaus et al. (2018) that glutinous rice flour gives thick properties to form texture. Glutinous rice flour substitution also significantly affects the chewiness, organoleptic taste, texture, and color of pumpkin mooncakes. In addition, according to Harismah et al. (2015), adding agar also helps soften the texture of food in pumpkin mooncakes.

Overall

Sensory testing of the overall parameters is a consumer's assessment of all indicators. This assessment was used to determine panelists'

acceptance of the overall product. The overall parameter evaluation showed that panellists preferred pumpkin moon cake development to the reference mean value of 4,69>3,93 (p= 0,000).

According to Sistanto et al. (2017), a comprehensive assessment of food is critical because consumer preferences for products are not influenced by only one factor. This is supported by Harjiyanti & Pramono (2013), who found that several factors, including color, taste, aroma, and texture, influence a person's food preference.

These results indicate that the pumpkin moon cake is more favorable than the original moon cake. The results of the above study prove that pumpkin mooncake can be used as an alternative healthy snack for the elderly because of its many vitamins. This conclusion is reinforced by many clinical studies that have confirmed that pumpkin has a positive effect on additional consumption in the elderly who have symptoms of degenerative diseases caused by age factors (Catanzaro et al., 2016; Musa et al., 2017).

However, although the findings are promising, certain limitations should be considered. The sample size may not wholly represent the entire elderly population, suggesting caution in generalized interpretations. Furthermore, individual responses to pumpkin mooncake consumption can differ based on variables such as health conditions and genetics, which this study may not have fully accounted for. There is also the potential influence of external factors that are not accounted for despite efforts to control as many variables as possible. Another aspect to consider is that while the study focused on the proximate and beta-carotene content, other nutritional elements in the mooncake could have influenced the results. Finally, the duration of this study may not encapsulate the long-term effects of pumpkin mooncake consumption on the immune system. These caveats notwithstanding, this research offers significant insights into the potential health benefits of pumpkin mooncakes for the elderly.

Conclusion

Pumpkin mooncake is considered to have a specific nutritional content with high proximate and β-carotene contents. Pumpkin intake in the form of snacks should continue to be developed because it reduces the risk of non-communicable diseases, such as diabetes, cancer, hypertension, hypercholesterolemia, arthritis, intestinal and cardiovascular diseases, atherosclerosis, cataracts, and macular degeneration due to aging.

In addition, pumpkin is rich in pectin, mineral salts, carotenoid compounds, and vitamin A. However, further investigations are needed to study the effects of processing conditions on the nutritional quality of the same or other plant species.

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