Snacking Habits and Level Acceptance of Freeze-Dried Probiotic Yogurt Snacks by Children

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ABSTRACT

Stunting in children is a significant problem worldwide, specifically in developing countries. One of the contributing factors to this condition is dysbiosis, characterized by an imbalance in gut microbiota and is commonly observed in affected patients. To reduce the prevalence of stunting, it is critical to provide products that are rich in protein, calcium, and probiotic. In this context, freeze-dried probiotic yogurt snacks can be used as an effective solution due to their high nutritional value, ability to preserve probiotic cell viability, and extended shelf life. Therefore, this study aims to determine snacking habits and level of acceptance of yogurt snacks among children through a sensory evaluation. The result showed that parents often considered taste, health benefits, and price when purchasing snacks. Meanwhile, children showed a high preference for freeze-dried probiotic yogurt snacks, particularly due to their appealing shape. Panelist parents also considered the products to be necessary, recommended, and an alternative to unhealthy snacks. Therefore, these products may be suitable for upper-middle-class consumers due to their higher prices and will require taste improvement to increase consumer acceptance among children.

Keywords: Consumer behavior; freeze-dried; probiotic; sensory evaluation; yogurt snacks

INTRODUCTION

In 2022, 148.1 million children under the age of five were affected by stunting across various countries in the world (WHO, 2023). Meanwhile, the prevalence in Indonesia remains relatively high at 21.6%, with projections showing a decline to 14% by 2024 (Rakornas, 2023). Several studies have shown that stunting is a condition where children's height is shorter compared to their age. This condition is caused by several factors, including low maternal education, premature birth, non-exclusive breastfeeding, low socio-economic conditions, and insufficient food supply in both quantity and quality (Beal et al., 2018). Low protein and calcium intake are frequently observed in affected children. This shows the need to ensure adequate consumption of these nutrients during the growth period because protein is essential for metabolic activities, and calcium promotes bone formation (Ismawati et al., 2020). In addition, stunted children often exhibit an imbalanced gut

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microbiota characterized by decreased Bacteroidetes phylum and increased Firmicutes phylum abundance compared to normal individuals. *Prevotella* 9, which positively correlates with body height, is also present at lower levels, while the pathogenicity-associated Enterobacteriaceae increases (Surono et al., 2021; Vonaesch et al., 2018). Consumption of probiotic has been reported to represent a potential remedy for stunting (McFarland, 2014; Velly et al., 2017).

One of probiotic products on the market is yogurt, which has several health advantages, including a lower risk of diabetes, heart disease, and osteoporosis. Yogurt's milk protein encourages the development of bone mass, the synthesis of insulin-like growth factor-1 (IGF-1), and lowers the risk of stunting. Moreover, the inherent probiotic improves digestion and enhances the immune system (Elena Hadjimbei et al., 2022; Givens, 2020). Yogurt has been reported to have a short shelf life and must be stored at low temperatures. Therefore, its production requires process innovation to reduce handling costs, such as drying. Given the sensitivity of probiotic to heat, lyophilization is the preferred alternative drying method to be considered. According to Tang et al. (2020), lyophilization of *Lactobacillus acidophilus* FTDC 3081 led to a 2.72 times higher cell viability compared to the spray drying method.

Freeze-dried probiotic yogurt snacks can be used as an alternative healthy food for children. Kulaitienė et al. (2021) reported that yogurt snacks or bites have a high calcium content of 198.78 mg/100 g. To support optimal bone growth, the calcium requirement according to Indonesia's RDA is 650 mg, while the contribution of snacks to daily intake is typically 20–30% (Khomsan et al., 2022). The products are manufactured in one bite-sized unit and possess a distinctive texture that melts in the mouth upon ingestion, rendering it an optimal choice due to its ease of consumption and safety profile. In addition, probiotic content contributes to the health of the digestive tract. This is evidenced by multiple studies conducted on malnourished children. Following the consumption of *Lactiplantibacillus plantarum* subsp. *plantarum* Dad-13, there was an increase in butyric acid-producing bacteria, a reduction in pathogenic bacteria, and a notable improvement in the z-scores for weight for age, height for age, and weight for height (Gunawan et al., 2021; Kamil et al., 2022). Several countries, including New Zealand, Switzerland, the United States, and Korea, have developed numerous freeze-dried yogurt products. However, these products are not yet widespread in Indonesia. A study by Kamil et al. (2021) showed that malnourished children exhibited a significantly higher consumption of snacks and sweet foods, with an average intake of 33.8 g/day compared to the control group. This led to a condition called dysbiosis, characterized by the presence of biomarkers in the form of abundant Proteobacteria and low levels of Bacteroidetes. Therefore, this study aims to evaluate the acceptability of freeze-dried probiotic yogurt snacks as a healthier snack alternative, especially among children.

METHODS

Freeze-Dried Probiotic Yogurt Snacks Sample Preparation

Freeze-dried probiotic yogurt snack products were produced through several stages. In the first step, yogurt was produced by combining pasteurized milk (90%) (PT Diamond Cold Storage, Bekasi, Indonesia), sugar (7,3%) (PT Sugar Group Companies, Lampung, Indonesia), skim milk powder (1,8%) (PT Mirota KSM, Sleman, Indonesia), and cassava starch (0,9%) (Tirta Kencana, Bogor, Indonesia). The second step, the mixture was pasteurized in a water bath (GFL 1003, Netherlands) at 80 °C for 30 minutes and then cooled to 30 °C. The third step, after combining the cultures of the fermentation process, *Lactiplantibacillus plantarum* subsp. *plantarum* Dad-13 and *Streptococcus thermophilus* Dad-11 (1:3) (Food and Nutrition Culture Collection (FNCC) Center for Food and Nutrition Studies, Universitas Gadjah Mada, Indonesia), the fermentation process was conducted for 24 hours in an incubator (Memmert IN55, Germany) at a temperature of 37 °C. The last step involved molding, 24 hours of storage in freezer (GEA AB-336R, Singapore) at -40 °C, and lyophilization using freeze dryer (Medlab Scientific LGJ-

Figure 1. Freeze-dried probiotic yogurt snacks product used in sensory evaluation

20F, China) at -70 °C for 30 hours. This product was made in a one-bite size of 1 cm x 1 cm with a thickness of 0.5 cm (Figure 1). During the sensory evaluation, this product was packaged in aluminum foil pouches filled with nitrogen gas, each pouch containing 10 pieces.

Calculation The Number of Panelist

The Raosoft website (http://www.raosoft.com/samplesize.html) was used with a population of 170,021 children and a 30% spare to determine the number of panelists as 100 children. In addition, the Special Region of Yogyakarta's 5 districts, namely Sleman, Bantul, Gunungkidul, Kulonprogo, and Yogyakarta all used the cluster sampling technique. All panelists had to adhere to the predetermined inclusion and exclusion requirements. Inclusion criteria were children aged 3 to 5 years residing in the Special Region of Yogyakarta, not having milk allergies, and being in healthy physical and mental conditions, with parental assistance. Exclusion criteria were limited to those with impaired sight, smell, or taste senses. To eliminate any bias, the age of panelists was determined based on the study of Jean-Xavier (2001) which reported that children aged 3 years and older were categorized in the early stages of reading and writing, where better decisions could be made, understanding simple scales, respond to questions, and express an idea about pictures. The children panelists who participated in this sensory test included 16% aged 3 years, 60% aged 4 years, and 24% aged 5 years. Moreover, in this study, 51% were male and 49% were female.

Sensory Evaluation and Market Surveys

The sensory testing method used a hedonic test to determine children' preferences for freeze-dried probiotic yogurt snacks. This study received protocol number KE/FK/0214/EC/2023, which was approved by the Medical and Health Research Ethics Committee (MHREC), Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada on February 9, 2023. The sensory test was conducted from May to June 2023. Children evaluated their preferences toward the product based on its shape, color, and taste using a picture scale, showing their level of likeliness. In addition, parents completed a market survey about their snacks purchasing habits, including frequency, the amount spent, and factors considered when selecting snacks for children. Parents were also allowed to take the test and rate overall metrics, including level of need, level of recommendation, and replacement level of substitution toward snacks of the children using the 5-point scale. The lowest score was represented by a scale of 1, and the highest score was represented by a scale of 5.

Statistics Analysis

The statistical analysis of the acquired data included descriptive analysis, which served to explain sample data by determining the mean (%) in Microsoft Excel 2019. In addition, correlation analysis was conducted on parental influence on consumer behavior using Kendall's Tau in IBM SPSS Statistics 22 software.

RESULT AND DISCUSSION

Parent's Behavior as Snacks Providers for Children

The children panelists in the sensory evaluation frequently consumed snacks, as seen in Table 1, showing the high frequency of parents purchasing snacks for their children more than once a week. Previous studies also confirmed that the consumption of snacks by children could provide up to 29% of their daily energy, 22.6% of their sodium, 27.6% of their saturated fat, 39.9% of their sugar, and 31.3% of their fiber needs. Snacking frequency and daily caloric intake were positively associated (Mireault et al., 2023; Xue et al., 2019). Numerous variables, including "benefits" and "wants", affected how frequently children snacks. Snacking satisfied the body's nutritional requirements and curbed hunger, hence providing the "benefits" component. However, gratifying an individual's "wants" factor resulted in a sense of fulfillment (Amalia et al., 2022).

Meanwhile, more than 60% of parents allocated Rp 50, 000 to Rp 150,000 every month for buying snacks. A correlation analysis showed no relation between high parental spending and a high frequency of snacks purchases. Therefore, it was possible that while the frequency of snacks purchases was high, the quantity could be low at a higher price point. Parents also considered several factors when deciding which snacks to buy. Similar tendencies were observed by Landwehr et al. (2023), such as health, price, and brand were analyzed. This was consistent with the statement by Maina (2018) that 3 factors influence consumer acceptance, namely (1) sensory characteristics such as appearance, aroma, taste, and texture; (2) consumer traits such as knowledge and perception of particular products; and (3) consumers' comfort in enjoying food. In this study, sensory characteristics and consumer preferences were the primary considerations for parents when purchasing snacks for children, specifically taste, health benefits, and price.

Table 1. Profile of parents' behavior in buying snacks for children (n = 100)

Parameters	Percentage (%)
*Frequency of snacks purchases**	
Less than once a month	2
Once a month	1
Several times a month	28
Once a week	2
More than once a week	67
*Snacks expenses**	
< Rp 50 thousand	14
Rp 50 thousand – Rp 100 thousand	36
Rp 100 thousand – Rp 150 thousand	26
Rp 150 thousand – Rp 200 thousand	13
> Rp 200 thousand	11
Consideration in choosing snacks	
Taste	38
Health benefits	27
Price	16
Availability	7
Appearance	6
Brand	5
Promotion	1

Note: The * shows there is no significant correlation between the two parameters with a significance level (p > 0,05) using Kendall's Tau

Level of Children' Preference for Freeze-Dried Probiotic Yogurt Snacks

According to the children hedonic test results showed in Figure 2, the product shape was the most favored preference with 83%. This was due to the product's unique shape in the form of animals such as rabbits, cows, koalas, and lions, which were considered to be more attractive to children. However, both children' preferences for both color and taste of products were only 66%.

The influence of taste had a strong correlation with level of consumer acceptance. This was also the reason why taste parameters were the main consideration for parents when buying snacks for their children. In general, children tended to have a higher acceptance of products with salty and sweet tastes compared to sour or bitter tastes (Romagny et al., 2017). Freeze-dried probiotic yogurt snacks had a sour taste as a result of yogurt fermentation process. Lactic acid bacteria, which were starter cultures, used lactose in milk as a carbon source (Chen et al., 2017; Weerathilake et al., 2014). However, the study by Karagiannaki et al. (2021) stated that taste preferences could be raised through exposure effects. Repeated exposure to once unfamiliar foods could enhance children's fondness and preferences.

Panelist Parents' Acceptance of Freeze-Dried Probiotic Yogurt Snacks

Parents' evaluation of the product was rated on a scale of 1 to 5. Scores of 4 and 5 showed a high level of necessity, recommendation, and snacks substitution with freeze-dried probiotic yogurt snacks. Figure 3 showed that around 62 parents thought the product was necessary, while 65 parents recommended the product. This high level of parental acceptance could be

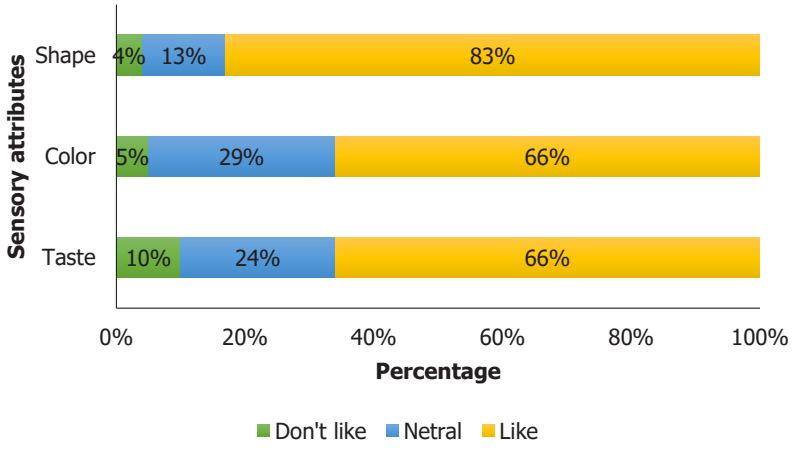

Figure 2. The children panelists' level of preference for freeze-dried probiotic yogurt snacks (n = 100)

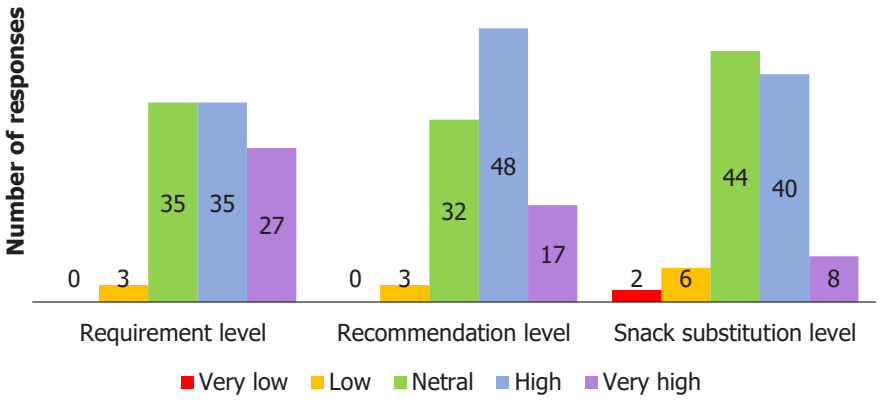

Figure 3. Panelist parents (n = 100) scored freeze-dried probiotic yogurt snacks based on requirement level, recommendation level, and snacks substitution level

attributed to the fact that freeze-dried probiotic yogurt snacks was an innovative product with an attractive shape, delicious taste, health benefits derived from the nutritional value of the product and probiotic it contained, as well as convenient packaging.

Only 48 parents rated the possibility of replacing typical snacks for children with freeze-dried probiotic yogurt snacks. This was because parents viewed the product as a complement to existing children snacks. In addition, parents showed that the product had some flaws, including its sour taste, lack of sweetness, unattractive color, and a high price for a small quantity. A drawback of freeze-drying process was its high cost. The equipment and maintenance necessary for preparing freeze-drying method required a sizable investment, resulting in the relatively expensive price of freeze-dried products compared to other drying methods (Hariyadi, 2013). Meanwhile, positioning this product for upper-middle class and highly educated consumers could be more effective, as these individuals were more likely to appreciate the product's functional personal health benefits. This was corroborated by a study from Darmon and Drewnowski (2015) that showed middle-class consumers selected health over price, leading to imposed greater dietary restrictions than their lower-class counterparts.

According to Figure 4, most parents (27.38%) were willing to substitute probiotic yogurt snacks with candy due to the product's visual and physical similarities to commercially available candies. However, the consumption of candy was associated with elevated

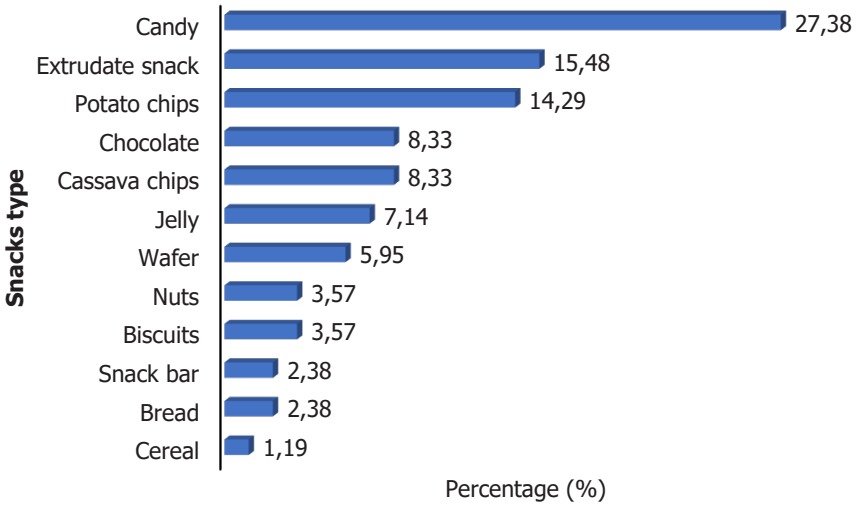

Figure 4. Snacks types were replaced by freeze-dried probiotic yogurt snacks based on the opinions of the panelist's parents who chose high value in Figure 3 (n = 48)

levels of sugar and calorie intake, which could increase the risk of adverse health outcomes, including obesity and a higher risk of cardiovascular illnesses (Duyff et al., 2015). More than 15.48% and 14.38% of parents wanted to substitute extruded snacks and potato chips, respectively (Fig. 4), which were considered unhealthy for children. The result was influenced by the higher usage of salt as their main ingredient for savory snacks, and people were unaware of the health risks of excessive sodium consumption (Zama et al., 2022). Original and flavored potato chips had a high sodium content, up to 400 to 760 mg/100g (Yaghi et al., 2021). Snacks with a high sugar and high-fat content, such as candies, chocolate bars, and potato chips, were perceived as unhealthy (Amalia et al., 2022).

CONCLUSION

In conclusion, children had the habit of snacking to meet their daily nutritional needs. While purchasing snacks for their children, parents must weigh several factors, including taste, health advantages, and pricing. Based on the result of the hedonic test, children preferred freeze-dried probiotic yogurt snacks for their shape, color, and taste. Panelist parents also found freeze-dried probiotic yogurt snacks were deemed useful, as well as a good alternative to unhealthy snacks like candy, extruded snacks, and potato chips. The product had multiple advantages, including appealing shape, delicious taste, nutritional value, probiotic content, and convenient packaging. However, it was not liked because of its relatively high price. When freeze-dried probiotic yogurt snacks were to be offered in the future, improvisation could be needed, particularly in the flavor department to enhance children' acceptance.

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CONFLICT OF INTEREST

The authors confirm that there is no conflict of interest disclosed in this study.

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