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Red Ginger Gummy Candy as a Stunting Prevention Strategy in Children Under Five

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ABSTRACT

Introduction: Stunting is a major public health problem that affects the growth and development of children under five. Functional foods in child-friendly forms may provide an alternative nutritional approach to support linear growth and stunting prevention.
Objective: This study aimed to evaluate the potential of red ginger extract gummy candy as a functional food to support linear growth and stunting prevention among children under five.
Method: This quasi-experimental study used intervention and control groups. Children in the intervention group received red ginger extract gummy candy, while those in the control group received a placebo for one month. Changes in height and weight were assessed before and after the intervention.
Result: The Shapiro–Wilk test showed that the anthropometric data were not normally distributed ($p<0.05$). In the intervention group, height increased significantly after the intervention ($p=0.005$), whereas the change in body weight was not statistically significant ($p=0.161$). In the control group, neither body weight ($p=0.138$) nor height ($p=0.059$) showed statistically significant changes. However, the Mann–Whitney U test showed no statistically significant difference between the intervention and control groups in changes in body weight ($p=0.970$) or height ($p=0.701$)..
Conslusion: Red ginger gummy candy was associated with a significant increase in height within the intervention group, but the change was not significantly different from the control group. Further studies with larger samples and longer interventions are needed to determine its potential in supporting linear growth.

Keywords: Gummy Candy, Red Ginger, Stunting, Child Growth

Introduction

Globally in 2016, there were around 22.9% or 154.8 million children who experienced stunting. Stunting is a growth and development disorder experienced by children due to malnutrition, recurrent infections, and inadequate psychosocial stimulation. Children are declared stunted if their height according to their age is more than two standard deviations below the median Child Growth Standard. Stunting in children can occur in the first 1000 days after conception and is related to many factors, including socioeconomic status factors, dietary intake, nutritional status, infectious diseases, micronutrient deficiencies, and due to poor environmental factors (WHO, 2018).

Stunting is still a severe health problem. Stunting can have long-term impacts on children's health and development, including reduced cognitive ability, decreased productivity in adulthood, and increased risk of chronic diseases (WHO, 2021).

Efforts to overcome stunting have been carried out in various ways, including food fortification programs and nutritional supplements. However, the main challenge that is still faced is the low acceptance rate of children to conventional nutritional supplements. Therefore, innovation in the form of functional food products that are preferred by children is very important to increase compliance with the consumption of nutritional supplements (Kemenkes RI, 2019).

One of the natural ingredients that has long been used in traditional medicine is red ginger. Red ginger is a plant that contains several phytochemical compounds, such as gingerol, shogaol, zingeron, and essential oils. In addition, ginger also contains vitamins and minerals such as vitamin C, vitamin K, calcium, and magnesium. Ginger also contains fiber which is beneficial for maintaining the health of blood vessels and the digestive system. Ginger has various health benefits, including its ability as an anti-inflammatory and antioxidant, and can boost the body's immune system. Ginger is also considered a safe herbal remedy with few and no significant side effects (Beal et al., 2018; Keino et al., 2014; Mashhadi et al., 2013; Ratri et al., 2022).

Red ginger has long been known to have bioactive content that has the potential to increase appetite, improve the digestive system, and increase the absorption of nutrients in the body. The gingerol and shogaol content in red ginger also has anti-inflammatory effects that can support gastrointestinal health and improve nutrient metabolism efficiency (Ariyanti et al., 2023; Nurhayu et al., 2021; Rofia Nurfadillah et al., 2023; Zoidis et al., 2014).

Based on the results of the study, it is stated that regular administration of red ginger extract can increase the linear growth of children under five and can reduce the occurrence of stunting (Rahayu S, 2020). In addition, red ginger can increase food intake and nutritional status in children under five, with the use of about 0.5 grams to 1.2 grams per day (Sudarsono, 2018).

Jelly candy better known as Gummy Candy, is a candy made from water or fruit juice and gelling ingredients, which has a clear, transparent appearance and has a texture with a certain chewiness. This Gummy Candy is one of the processed candies that has the advantages of sweetness, practicality, ease of use, and ease of serve and is very liked by children so it can increase children's compliance to take medication (Agustin et al., 2019; Rashati et al., 2021).

The results of the hedonic test or preference test for Gummy Candy red ginger extract show that red ginger gummy candy has a very large potential to be accepted by children under five years old. Overall, babies under the age of five love red ginger gummy candy and are willing to consume it (Heryani et al., 2024).

Previous research by Heryani et al. (2024) demonstrated that red ginger extract gummy candy had good acceptability among children under five based on a hedonic test, indicating its potential as a child-friendly functional food. However, the previous study focused only on product acceptability and did not evaluate its effectiveness in supporting children's growth or nutritional status. Therefore, evidence regarding the efficacy of red ginger gummy candy as an alternative to conventional nutritional supplementation remains limited.

The novelty of this study lies in the development of red ginger extract in the form of gummy candy as a child-friendly functional food and the evaluation of its efficacy as a follow-up to the previous hedonic study. Unlike conventional nutritional supplements, which may have limited acceptance among children, this formulation combines the potential nutritional and bioactive benefits of red ginger with an appealing, practical, and easy-to-consume dosage form. This study therefore evaluates whether regular consumption of red ginger gummy candy can support linear growth and contribute to stunting prevention among children under five.

Objective

This study aims to evaluate the potential of red ginger extract gummy candy as an effort to prevent stunting in children under five years old.

Method

Design and setting

This research method is quasi-experimental, with cases and controls. The research was conducted at the Cempaka Posyandu, Main Village, Cijeungjing District, Ciamis Regency. The first stage of this research process is the manufacture of gummy candy preparations. The way to make gummy candy is to mix mannitol and corn syrup until homogeneous, then heat it in aquadest at a temperature of 80^0C and stir well, then add corn oil when hot. Then dissolve the gum arabic in 10 ml of aquadest at a temperature of 50^0C-60^0C. Next, mix the gelatin solution into the gum Arabic solution, stirring evenly. Put the gelatin and gum solution into the base at 70^0C temperature. Add sucrose, lactose, and essence to the mixture while stirring until homogeneous. The result of gummy candy is dark brown, with a heart shape, with an average weight of 125 mg. Gummy Candy is flavored with ginger and fruits, sweet with a hint of ginger, and soft and chewy.

Population and sampling

The population in this study is children under five years old. The total population in this study is 50 people. The sample was selected using a purposive sampling technique based on predetermined inclusion criteria, namely children aged 3–5 years whose weight-for-age status was below or approaching the yellow line on the Kartu Menuju Sehat (KMS), or children whose body weight had not increased compared with the previous weighing measurement. Twenty children meeting the inclusion criteria were selected as study participants. These participants were randomly assigned to either a case group or a control group, each comprising 10 children.

This study has a few limitations. First, it was conducted in only one research location, so the findings might not be generalizable to other populations and places. Second, the sample

size is limited, mainly because the number of children who met the inclusion criteria at the research site was very small.

Before the intervention, Weight measurements were carried out using calibrated scales, and Height measurements were carried out using a height-measuring device. The case group was given red ginger extract gummy candy with a dose twice a day, namely morning and night, and the control group was given a placebo with the same dose, namely morning and night. The intervention was given for 1 month.

Instrument and measurement

Data were collected using a structured observation sheet to record participants' characteristics and anthropometric measurements before and after the intervention. The observation sheet documented body weight and height measurements for children aged 3–5 years in both the intervention and control groups. Body weight was measured in kilograms (kg) using a calibrated weighing scale, while height was measured in centimeters (cm) using a height-measuring device.

Anthropometric measurements were performed using the same procedures and instruments at baseline and after one month of intervention to ensure measurement consistency. Body weight was measured using a calibrated digital weighing scale with a precision of 0.1 kg, while body height was measured using a stadiometer with a precision of 0.1 cm. The observation sheet was completed by the researcher during each measurement session. The recorded data were subsequently used to evaluate changes in body weight and height between the red ginger gummy candy intervention group and the control group.

Data collection and analysis

Data were collected from children aged 3–5 years who met the study criteria and were randomly selected from the target population. Participants were divided into an intervention group and a control group, with 10 children in each group. Baseline measurements of body weight and height were performed before the intervention. The intervention group received red ginger extract gummy candy twice daily, in the morning and evening, while the control group received a placebo at the same frequency. The intervention was administered for one month, after which body weight and height were measured again using the same measurement procedures.

Data were analyzed to compare changes in body weight and height between the intervention and control groups. The normality of the data was assessed using the Shapiro–Wilk test. The results indicated that the data were not normally distributed ($p < 0.05$). Therefore, a non-parametric test was used for further analysis. The Wilcoxon test is used to find out if there is a significant change between the pre-test and post-test in the same group. The Mann–Whitney U test was performed to compare changes in body weight and height before and after the intervention between the intervention and control groups. Statistical significance was determined at a significance level of $\alpha = 0.05$ with a 95% confidence interval. A p-value < 0.05 was considered statistically significant.

Result

Overall, the administration of red ginger extract gummy candy has an increase in weight and height. The following are the results of the average weight gain and height in the case group and the control group.

Table 1. Result of The Shapiro-Wilk Normality Test

Group	Variable	W	p-value	Conclusion
Case	Weight	0.695	0.001	Not normal
Case	Height	0.841	0.046	Not normal
Control	Weight	0.769	0.006	Not normal
Control	Height	0.808	0.018	Not normal

Table 2. Anthropometric Change Before and After Intervention in The Case and Control Groups.

Variable	Pre Median Cases (IQR)	Post Median Cases (IQR)	p*	Pre Median Control (IQR)	Post Median Control (IQR)	p*	p⁺
Weight (Kg)	12.30 (10,90-13.72)	12.40 (11,10-13,70)	0.161	12.85 (11,48-13,15)	12.95 (11.80-13.45)	0.138	0.970
Height (CM)	91.30 (86.32-92.52)	91.75 (81	0.005	90,60 (85,95-94,20)	91,00 (86,60-94,75)	0.059	0.701

p*= wilcoxon signed-rank test; p⁺= mann-Whitney U Test

In the case group, the median body weight increased from 12.30 kg (IQR 10.90–13.72) at pre-test to 12.40 kg (IQR 11.10–13.70) at post-test; however, this change was not statistically significant (Wilcoxon Signed-Rank Test, p = 0.161). In contrast, the median height increased from 91.30 cm (IQR 86.32–92.52) to 91.75 cm after the intervention, showing a statistically significant change (p = 0.005). In the control group, the median body weight increased from 12.85 kg to 12.95 kg, but the change was not statistically significant (p = 0.138). Similarly, median height increased from 90.60 cm to 91.00 cm, but the difference was not statistically significant (p = 0.059). Comparison between the case and control groups using the Mann–Whitney U test showed no statistically significant differences in body weight (p = 0.970) or height (p = 0.701).

Discussion

Based on the results presented in Table 2, body weight increased slightly in both groups during the one-month intervention. In the intervention group, the median body weight increased from 12.30 kg to 12.40 kg, while in the control group it increased from 12.85 kg to 12.95 kg. However, the Wilcoxon Signed-Rank test showed that these changes were not statistically significant in either the intervention group (p=0.161) or the control group (p=0.138). Furthermore, the Mann–Whitney U test showed no significant difference in body weight changes between the intervention and control groups (p=0.970). These findings

indicate that the administration of red ginger extract gummy candy for one month was not associated with a statistically significant improvement in body weight compared with the control group.

This is most likely due to the relatively short duration of the intervention. The process of gaining weight takes longer than increasing height, as it involves an increase in overall body mass that relies on energy intake and metabolic balance (Jensen et al., 2018). In addition, body weight in children is influenced by multiple factors, including dietary intake, total energy and protein intake, illness, physical activity, and baseline nutritional status. Therefore, the one-month intervention period may not have been sufficient to demonstrate a measurable difference in body weight between the two groups.

In contrast, the median height in the intervention group increased from 91.30 cm to 91.75 cm, representing an increase of approximately 0.45 cm, and the Wilcoxon Signed-Rank test demonstrated a statistically significant within-group change ($p=0.005$). In the control group, median height increased from 90.60 cm to 91.00 cm, but the change was not statistically significant ($p=0.059$).

The observed increase in height in the intervention group may be related to the biological properties of red ginger. Ginger contains bioactive compounds, particularly gingerols and shogaols, which have been reported to possess antioxidant and anti-inflammatory activities. These properties may contribute to maintaining gastrointestinal function and overall physiological health.

Mao et al. (2019) reported that ginger contains various bioactive compounds with antioxidant, anti-inflammatory, and other biological activities that may support gastrointestinal health and nutrient utilization. These properties provide a scientific basis for developing ginger-based complementary foods for children, as they may support nutritional health and linear growth as part of a broader, multifactorial approach to stunting prevention.

The ginger plant is one that can be consumed and has health benefits, one of which is made into an immune booster. The body's immune system is important to improve body health so that it can prevent stunting. Red ginger has various active compounds such as gingerol, shogaol, paradol, and zingerone which have antioxidant effects, one of which is phenol compounds that have the potential to prevent hemolysis and inhibit the oxidation reaction of free radicals in the body, anti-inflammatory and good digestion. So that this can help in increasing the absorption of nutrients, which has an impact on children's growth (Mao et al., 2019) (Rofia Nurfadillah & Hutuba, 2023) (Indiarto et al., 2021) (Intan Fadila et al., 2024).

The increase in height in this study is likely due to the increased efficiency of micronutrient absorption after consuming red ginger gummy candy. Giving red ginger to children with indigestion has been shown to increase the absorption of iron and zinc, which are micronutrients that are very important for children's growth. Iron plays a role in the production of hemoglobin, while zinc plays a role in the process of cell division and growth. Ginger is known to increase the activity of several digestive enzymes such as amylase and protease, which can help in the digestion process and better absorption of nutrients (Ishfaq et al., 2022).

Ginger has also been investigated in relation to gastrointestinal function. (Zhang et al., 2022), in a review of red ginger (Zingiber officinale var. rubrum), described various traditional and pharmacological uses of red ginger, including its potential effects on digestive disorders and inflammation. Similarly, (Nikkhah Bodagh et al., 2019) reported that ginger may influence

gastrointestinal motility and digestive function. Improved digestive function could theoretically support nutrient utilization.

Some research results also support the benefits of ginger can improve children's nutritional status and growth. With good nutritional status and child growth, it will be an effort to prevent stunting. The antioxidant activity and metabolic enzyme inhibitors in red ginger can potentially improve metabolic health. So that red ginger can provide significant health benefits, which can improve nutritional status which is very relevant for stunting prevention. (Rampengan et al., 2024) (Avnalurini Shariffa et al., 2017).

The results of this study showed that the administration of red ginger gummy candy did not have a statistically significant effect on weight or height gain among toddlers at risk of stunting. However, the case group showed a greater increase in height compared with the control group, suggesting a potential trend that may warrant further investigation. Red ginger contains bioactive compounds, including gingerol and shogaol, which have been reported to possess antioxidant and anti-inflammatory properties and may support gastrointestinal function. These biological properties provide a plausible basis for considering red ginger as a complementary food ingredient in nutritional interventions. However, the present findings do not establish that red ginger gummy candy directly improves nutrient absorption, linear growth, or prevents stunting. Therefore, red ginger gummy candy may be considered as a potential complementary food, but its effectiveness in supporting child growth requires further investigation using a larger sample size, longer intervention period, and more controlled study design.

The potential role of red ginger in supporting gastrointestinal function may provide a possible explanation for the greater increase in height observed in the case group, although this mechanism was not directly assessed in the present study. Red ginger has been reported to have various biological and pharmacological activities and has traditionally been used to alleviate digestive complaints such as nausea and abdominal discomfort. Ginger has also been reported to influence gastrointestinal motility and gastric emptying, which may contribute to improved digestive function(Zhang et al., 2022)(Hardi et al., 2024). From a nutritional perspective, adequate gastrointestinal function is important for the digestion and utilization of nutrients required for child growth. Therefore, the use of red ginger as a complementary food ingredient may have a plausible nutritional rationale.

Nevertheless, the potential nutritional benefits of red ginger gummy candy should be considered alongside the safety of its sweetener content. The World Health Organization recommends limiting free sugar intake to less than 10% of total energy intake in children, with further reduction to below 5% providing additional health benefits, particularly in reducing dental caries (WHO, 2019) . Excessive consumption of added sugars in children has also been associated with adverse oral and metabolic health outcomes, emphasizing the importance of controlling the amount and frequency of sugar consumption (Muth et al., 2019).

In the present study, red ginger gummy candy was administered in a predetermined amount and for a limited period, allowing sweetener exposure to be controlled. Therefore, when appropriately formulated and consumed according to the recommended portion and frequency, the product may be used as a complementary food while considering the child's total daily sugar intake. However, dental health, total sugar intake, and metabolic parameters were not assessed in this study; therefore, its long-term safety cannot be established. Further studies with larger samples and longer follow-up are needed to evaluate its safety and nutritional effects in young children.

However, the study also had some limitations, such as a relatively short duration of the intervention and a limited number of samples. Further studies with longer intervention periods as well as wider populations are needed to confirm the long-term benefits of red ginger gummy consumption in stunting prevention.

Conclusion

The administration of red ginger extract gummy candy was associated with a significant increase in height within the intervention group after one month (p=0.005), while the change in body weight was not statistically significant (p=0.161). However, the comparison between the intervention and control groups showed no statistically significant difference in changes in height (p=0.701) or body weight (p=0.970). Therefore, although red ginger gummy candy may have potential as a child-friendly complementary food to support linear growth, this study does not provide sufficient evidence to conclude that it is more effective than the placebo in supporting growth or preventing stunting. Further research involving larger samples, longer intervention periods, and control of potential confounding factors such as dietary intake, infection, nutritional status, and adherence to the intervention is needed to determine its effectiveness.

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Author Contribution

Heni Heryani, as the firs and corresponding author, was responsible for developing the research concept and preparing the initial manuscript. She coordinated the writing process, integrated the contributions of all authors, and conducted substantial revisions to the manuscript.

Davit Nugraha contributed to drafting and reviewing the sections related to the development and formulation of red ginger gummy candy, as well as providing critical input to improve the scientific content of the manuscript.

Anna Yusuf contributed to writing and reviewing the pharmaceutical aspects of the study, particularly those concerning the preparation and characteristics of the red ginger gummy candy.

Siti Rahmah Kurnia Ramdan contributed to the preparation and revision of the manuscript, particularly in presenting the research methods and findings in accordance with the study procedures.

Lusi Lestari contributed to the interpretation and presentation of the research results, literature review, citation management, and critical review of the manuscript.

All authors contributed to the review and refinement of the manuscript and approved the final version for publication.

Conflict of Interest

This research has no conflict of interest. The entire research process is carried out independently without any pressure from any party. Ethics toward research are upheld throughout the research process. With this statement, the researchers hope that the research results can be trusted and used as a valid reference for the development of health science and practice related to ethnomedicine and reproductive health.

Ethical Clearance

This research has received ethical approval from the Health Research Ethics Commission of the STIKes Muhammadiyah Ciamis, number 056/KEPK-STIKESMUCIS/X/2024.

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