



## Development Of Jelly Gum From Corn (*Zea mays L.*) And Tempeh (*Rhizopus sp.*) To Support Healthy Snacking In School-Aged Children

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### ABSTRACT

**Background:** Unhealthy snacking remains a major nutritional issue among school-aged children in Indonesia. The consumption of jelly gum available in the market today has the potential to pose nutritional risks due to their high sugar content. This research aims to develop a healthy snack formula in the form of jelly gum for school-aged children using corn (*Zea mays L.*) and tempeh (*Rhizopus sp.*).

**Research Methods:** This research is an experimental study carried out through several stages, namely idea development, product testing through standard recipes, production, proximate analysis, and product finalization.

**Research Result:** The results of the study indicate that corn and tempeh jelly gum is potential to be a healthier snack choice for school-aged children compared to similar products in the market with lower fat and sugar content per serving size.

**Conclusion:** Low-sugar jelly gum made from corn and tempeh is very suitable for school-aged children to prevent childhood obesity and diabetes.

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## 1. INTRODUCTION

Human resources are a key factor in assessing the success of a country's development, and their quality is greatly influenced by nutritional factors that comes from balanced diet. It is important to pay attention to the nutritional intake of school-aged children so they can nurture healthy balanced diet and become qualified human resources. School-aged children are those between the ages of 6 and 12. They fall into the middle childhood stage, which ranges from 5 to 10 years old. School-aged children are categorized as pre-adolescents, with girls ranging from 9 to 12 years old and boys ranging from 10 to 12 years old. During this period, children experience significant psychological and cognitive growth and development (Benner AD & Mistry RS, 2020). The role of parents and caregivers is crucial in selecting food for them. Proper nutritional intake is essential for children to grow and develop optimally. Snacking at school plays a significant role in children's daily eating patterns. Typically, these snacks are rich in carbohydrates and fats compared to other nutrients. High consumption of energy, fat, and salt, along with a lack of physical activity and a sedentary lifestyle, can lead to childhood obesity.

Eating habits are formed during school age, in addition to children's food preferences, which form the basis of their eating patterns and nutritional intake in the future (Ares G et al, 2024). These preferences are also influenced by idols or popular figures, peer eating habits, and living environment. Most children receive pocket money from their parents, giving them more opportunities to buy snacks. It is recommended that the daily consumption of sugar should not exceed 50 grams, salt should not exceed 5 grams, and fat should not exceed 67 grams (Ministry of Health, 2014). However, it is common to find snacks that may exceed these daily consumption limits. The excessive use of sugar, salt, and fat is done to attract buyers with more enjoyable tastes, such as bubble tea, cheese tea, and so on.

Excessive snacking without regard to timing can lead to childhood obesity. Besides obesity, excess sugar, salt, and fat in the body can cause various detrimental conditions, such as non-communicable diseases (NCDs). Children who consume excessive salt may experience weight gain and significantly increase the risk of high blood pressure. Children who consume 1,000 mg of salt per day have a 74% higher risk of high blood pressure if they are overweight or obese, while in children with normal weight, this risk only increases by 6%. This data comes from a study involving 6,200 children and adolescents aged 8-18 years. It is worth noting that high blood pressure at an early age can persist into adulthood and become a risk factor for heart disease. Therefore, parents are advised to pay more attention to their children's eating patterns to ensure they receive adequate and balanced nutrition (Buja A et al, 2021).

Based on issues related to high sugar consumption in children, children's habits of consuming indiscriminate snacks, and parents' lack of supervision of children outside the home, this research aimed to make low-sugar and low-fat snacks in the form of jelly gum using natural ingredients such as tempeh and corn to produce jelly gum with carbohydrates and protein contents that are safe for long-term consumption by children. Jelly gum with natural sweetness due to the addition of honey will be more easily accepted by children and safely consumed according to serving size recommendations and have been adjusted to processed food nutrition label references. If the habit of consuming unhealthy foods decreases and is replaced by consuming nutritious snacks, the risk of inadequate nutrition in children will also decrease, thus minimizing the risk of stunting and supporting the Indonesian government's SDGs program.

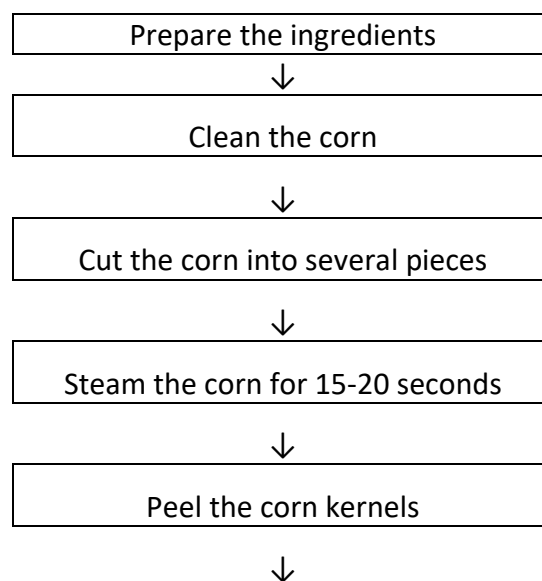
## 2. METHODS

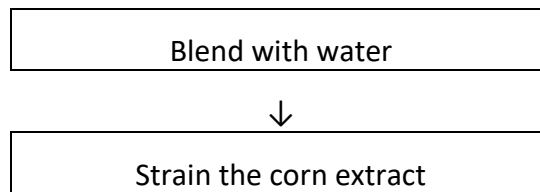
This research is an experimental study carried out through several stages, namely idea development, product testing through standard recipes, production, proximate analysis, and product finalization. The trial was conducted in the Culinary Laboratory and Food Processing Laboratory of the College of Vocational Studies of IPB University from January to February 2024. Proximate analysis was done in Integrated Laboratory Unit of IPB University. The ingredients needed for the production of jelly gum are in Table 1.

Tabel 1 Ingredients of jelly gum

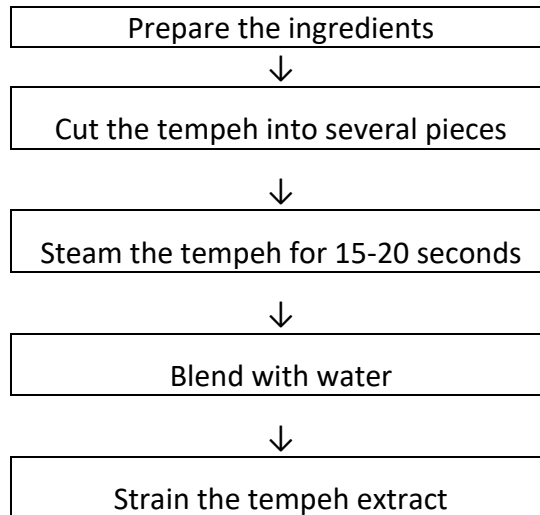
Ingredient	Weight (g)
Corn	200
Tempeh	200
Honey	120
Water	600
Agar-agar	54

The process of jelly gum production begins with preparing the equipment and ingredients. The ingredients used include sweet corn extract, tempeh extract, plain agar-agar, and honey. The equipment used during the production process include a stove, pot, bowl, strainer, cutting board, knife, blender, scale, mold, and dehydrator. The corn is cleaned, washed thoroughly, and cut into several pieces. The tempeh is cut into smaller pieces. Water is poured into a steamer and heated until boiling, indicated by the presence of steam. The cut corn and tempeh are placed into the steamer and steamed for 15-20 seconds. Once cooked, the tempeh and corn are removed and allowed to cool slightly. The corn kernels are then peeled and blended with 150 ml of water until smooth. The same treatment is applied to the tempeh. Afterwards, the blended corn and tempeh are strained. A pot with 300 ml of water is prepared, add 250 g of corn extract and 130 g of tempeh extract, then add 54 g of agar-agar powder into the pot, stir briefly, turn on the stove, and continue stirring until boiling. 120 g of honey is added and stir again. Prepared jelly mixture is poured into the mold, and wait until it cools evenly. Cut the jelly into cubes with a weight of 4 g/piece. The dehydrator is turned on to 40 degrees Celsius, neatly arranged the jelly to the dehydrator rack, and place it in the device for 18 hours. Figure 1-3 showed the production process of the jelly gum.

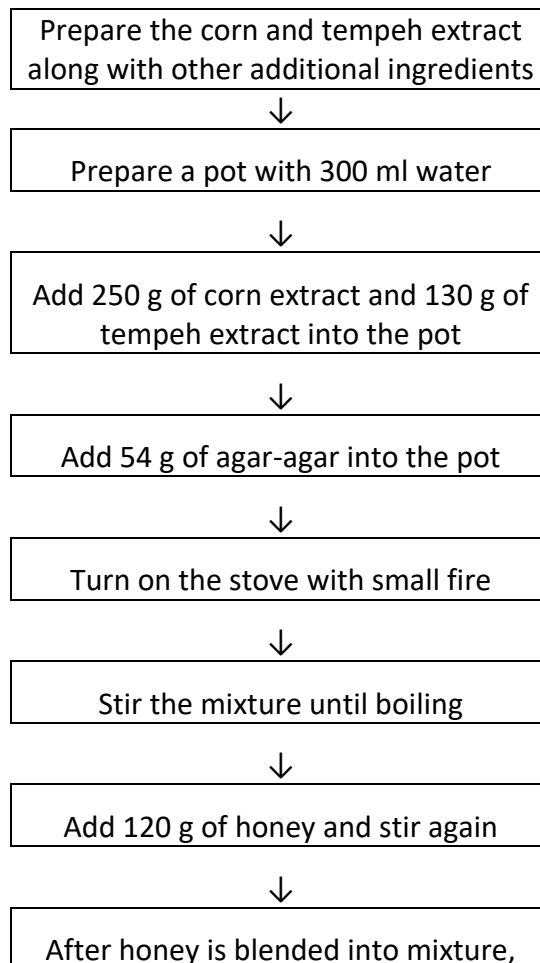


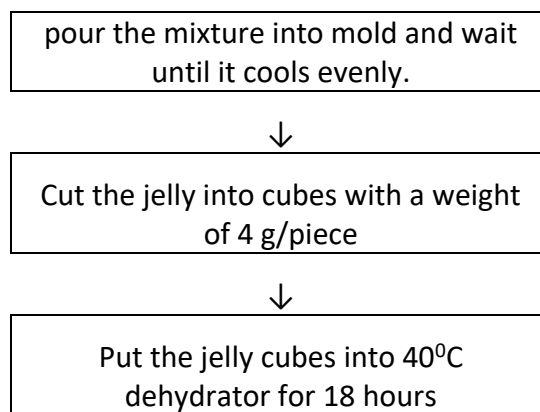


**Figure 1.** Corn extract production



**Figure 2.** Tempeh extract production





**Figure 3.** Jelly gum production

### 3. RESULTS AND DISCUSSION

School-aged children experience a 35% deficit in energy intake and a 20% deficit in protein intake from the recommended daily allowance (RDA). The lack of nutrient intake in elementary school children can lead to fatigue, decreased concentration, lack of comprehension, and difficulty in thinking effectively. Its long-term impacts can result in suboptimal growth and development, leading to a tendency towards short stature and an increased risk of stunting (Donkor WES et al, 2022). Additionally, 20% of children have a habit of eating less than three times a day. The lack of nutritional intake in children through staple foods, combined with the high level of children's consumption of unhealthy snacks containing high sugar, salt, and fats can cause serious health problems in children, including malnutrition and energy-protein deficiency, and childhood obesity.

Difficulty in controlling children's activities outside the home is one of the biggest challenges for parents with school-aged children. The need to increase the number of snacks with natural, nutritious ingredients that are safe for children's health is a solution in line with Sustainable Development Goal (SDGs) number two (Zero Hunger) and number three (Good Health and Well-Being). The creation of healthy and safe products for vulnerable populations such as school-aged children can improve the quality of life for Indonesian society. The nutrition content of corn and tempeh jelly gum per serving size are presented in Table 2.

Table 2. Nutrition content of corn and tempeh jelly gum and its contribution to RDA

Nutrient	Content per serving size (28 g)	Contribution to school-aged children (7-9 years) (%)
Energy (Cal)	57	3.5
Protein (g)	1.27	3.2
Fat (g)	0.003	0.001
Carbohydrate (g)	12.98	5.2

Notes: Based on the Regulation of Ministry of Health of Indonesia Number 28 Year 2019

Table 2 showed the nutrition content of corn and tempeh jelly gum per serving size (28 g). It showed that with the consumption one serving size of the jelly gum, it can fulfill 3.5% of energy, 3.2% of protein, and 5.2% of carbohydrate of school-aged children (7-9 years) recommended daily allowance. What is more important, the fat contents of the jelly gum are very low that it only contributes to 0.001% of RDA of fat in school-aged children. The comparison of corn and tempeh jelly gum to similar product in the market can be seen at Table 3.

Tabel 3 Comparison of corn and tempeh jelly gum to similar product in the market

Nutrient	Corn and tempeh jelly gum	Commercial jelly gum in the market
Calories (kcal)	57	101
Protein (g)	1.27	2.03
Fat (g)	0.003	1.88
Carbohydrate (g)	12.98	24.30
Total sugar (g)	7.53	20.25

In the table above, it can be concluded that jelly gum made from tempeh and sweet corn have a much lower sugar content compared to the sugar content in jelly gum in the market, at about 13 g. This indicates that jelly gum made with tempeh and sweet corn are safer for long-term consumption by children due to their lower sugar and fat content compared to commercial jelly gum. Sweet corn and tempeh jelly candies also contain sufficient carbohydrates and protein that can help meet the nutritional needs of school-aged children. By providing easy access to healthy snack products, it will create healthy snacking habits in children from a young age, thereby preventing malnutrition, stunting, obesity as well as reducing learning ability decline in children.

Malnutrition can arise if children's nutritional intake is inadequate or excessive from the time they are born until the age of 6 years. Parental monitoring will play a very important role in children's nutritional intake. Lack of parental control over children when children enter school age becomes a big challenge. Regulating children's patterns and behavior is quite difficult, therefore an environment is needed that can support children's growth. By having a variety of new healthy foods for children, both in terms of staple foods and children's snacks, can help creates healthy life habits for children.

#### 4. CONCLUSION

Low-sugar jelly gum made from corn and tempeh is very suitable for school-aged children to prevent childhood obesity and diabetes. The low sugar content of 7.53 grams helps reduce the risk of blood sugar and insulin spikes, which are major risk factors for diabetes. In addition, tempeh provides vegetable protein that supports children's growth and development. This jelly gum not only provides a healthier snack alternative compared to commercial jelly gum which is high in sugar, but also supports healthy eating patterns from an early age. Children who are accustomed to low-sugar foods are more likely to maintain healthy eating habits into adulthood, which is important for preventing obesity and various other chronic diseases, including diabetes. Apart from that, jelly gum made from corn and tempeh can be a means of educating children and parents about the importance of choosing nutritious snacks without sacrificing taste. By consuming these healthy jelly gum, children can learn to enjoy foods that are beneficial for their health in the long term.

#### 5. REFERENCES

- Benner AD, Mistry RS. Child development during the COVID-19 pandemic through a life course theory lens. *Child Dev Perspect.* 2020;14(4):236–43.
- Ares G, De Rosso S, Mueller C, Philippe K, Pickard A, Nicklaus S, et al. Development of food literacy in children and adolescents: Implications for the design of strategies to promote healthier and more sustainable diets. *Nutr Rev.* 2024;82(4):536–52.
- Kementerian Kesehatan RI. Peraturan Menteri Kesehatan Republik Indonesia Nomor 41 Tahun 2014 tentang Pedoman Gizi Seimbang. Indonesia; 2014.

Buja A, Grotto G, Montecchio L, De Battisti E, Sperotto M, Bertoncetto C, et al. Association between health literacy and dietary intake of sugar, fat and salt: A systematic review. *Public Health Nutr.* 2021;24(8):2085–97.

Donkor WES, Mbai J, Sesay F, Ali SI, Woodruff BA, Hussein SM, et al. Risk factors of stunting and wasting in Somali pre-school age children: results from the 2019 Somalia micronutrient survey. *BMC Public Health.* 2022;22(1):264.