

# Utilization of local food on the prevention of dental caries among the elementary school children in the fishing community



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**Abstract** The potential benefits of local food derived from rebon shrimp (*Acetes sp.*) as a preventive measure for dental caries are described in this study, which focused on Bagan Serdang village. Situated in the coastal area of Pantai Labu subdistrict, Deli Serdang Regency, this village relies mainly on fisheries for income resources, with rebon shrimp being one of the leading marine products. The high abundance of calcium in rebon shrimp is well-known, with 2,306 mg of shrimp paste equivalent to 16 times the calcium content of 100 g of dietary milk. This preliminary study aimed to investigate the potential of rebon shrimp as a preventive measure for dental caries in school children aged 8-12 years from public elementary school 106448 in Bagan Serdang village. The study utilized Cariogram software to assess caries risk factors, including caries experience, pH and saliva secretion, plaque index, diet contents and frequency, fluoride exposure program, and clinical judgment. Atomic Absorbed Spectrophotometer (AAS) method was used to measure salivary calcium ions. In addition, the calcium content in rebon shrimp was measured in the laboratory of the industrial research center in Medan. The concentration of salivary calcium ions was found to be very low, with a mean of  $0.75 \pm 0.32$  mmol/L. The Cariogram assessment revealed a high caries risk of 54.12% among elementary school children. The laboratory results showed that dried rebon shrimp had a calcium content of 1.50% (w/w), while fresh rebon shrimp had a calcium content of 1.54% (w/w). Given the high prevalence and caries risk profile of elementary school children in Bagan Serdang village, the study suggests that the low concentration of salivary calcium ions and the high availability of calcium-enriched rebon shrimp can be used as a preventive strategy against dental caries in this population.

**Keywords:** rebon shrimp, calcium, caries risk

## 1. Introduction

Dental and oral health is an integral part of general health. The high prevalence of dental and oral diseases that most of Indonesia's population suffers from is a matter of concern. According to the results of RISKESDAS (Basic Health Research in 2018), the proportion of people with dental and oral problems in North Sumatra was 54.6%, and only 6.7% received treatment from dental and medical personnel. People who experience tooth decay/cavities/sickness are 43.1%, and teeth lost due to extraction/deletion by themselves are 17.7% (Kemenkes 2018).

The influence of diet in the caries process is usually more local than systemic, especially regarding the frequency of food consumption. Every time a person consumes food and drinks that contain carbohydrates, some caries-causing bacteria in the oral cavity will start producing acid, resulting in demineralization that lasts for 20-30 minutes after eating. Between eating periods, saliva will neutralize acids and help the remineralization process. However, if carbonated foods and beverages are consumed too often, the tooth enamel will not have the opportunity to remineralize completely, resulting in caries (Rahayu 2013; Leal and Takeshita 2018; Almeida 2008).

In Indonesia, dental caries in children ranks first as the most common chronic disease experienced by school-age children. Unfortunately, most parents think dental caries in children is not a severe condition, so special treatment is unnecessary. At the same time, dental caries that are not handled properly can cause pain, tooth loss, and even death due to infection (Kemenkes 2018).

Generally, children who enter school age have a high caries risk because they have the behavior of consuming sweet snacks at school. All types of carbohydrate-based foods are one of the causes of caries. Therefore, the amount and frequency of a person consuming carbohydrates must be considered for dental and oral health and nutritional intake. Children's eating



habits at this time will shape their eating patterns in the future (Johansson et al 2010; Roma et al 2014; Retno and Murdijati 2014).

Calcium is the most abundant mineral in the body. About 99% of the total calcium in the body is found in hard tissues, especially in hydroxyapatite, and only a small part is found in extravascular fluid plasma (Bolland et al 2015). Calcium has function in preventing enamel demineralization by maintaining a neutral salivary pH, which ranges from 6.7 to 7.4 (Almeida 2008).

Bagan Serdang Village is one of the Deli Serdang, Pantai Labu sub-district villages. This is the location of *rebon* fish and shrimp production. The dried *rebon* shrimp is used to make shrimp paste and is one of the main livelihoods of the people in this village. *Rebon* shrimp is also a source of protein but not as familiar as beef, fish, or other chicken and shrimp. In everyday language, it is also known as the *kecepai* shrimp. A hundred grams of dried *rebon* contains 59.4g of protein.

In contrast to its high protein content, this type of shrimp has low-fat content, 3.6g of fat in 100g of dried *rebon*. The main advantage of dried *rebon* shrimp is that it contains 2,306 mg of calcium, equivalent to 16 times the calcium content of 100g of cow's milk. The phosphorus content of dry *rebon* is 625g, and iron is 21.4g, equivalent to 8 times the nutritional content of 100g beef. Their high nutritional content is because of one uniqueness: their flesh can be consumed whole with the skin, unlike other shrimp, in which people only consume the flesh without the skin (Sulistiyono et al 2017).

One of the efforts to prevent the occurrence of dental caries is to provide foods that are rich in calcium and phosphorus, favored by children, and easy to obtain. Foods that are expected to improve or overcome health problems can be fulfilled by eating functional foods. But keep in mind that health services, no matter how good, will not improve health if people are not empowered to behave in using them (Mansur 2020). The low public interest in consuming *rebon* shrimp has a high potential to prevent caries due to its high calcium content. The very high availability of *rebon* shrimp in this village is due to a lack of understanding of problems and the efforts that can be made to overcome these problems. Therefore, it is necessary to make efforts to empower the community so that they can understand and overcome the problem itself. The community here is an object and a subject in solving their problems, especially health problems. In other words, the community is empowered to overcome their health problems. Empowerment is one of the health promotion strategies launched by WHO in addition to advocacy and social support. Empowerment is also carried out so the community can sustainably overcome its health problems (Nurmala et al 2018; Bambang 2011).

One of the efforts to use *rebon* shrimp properly is to turn it into a portion of functional food. To overcome this caries disease, *rebon* prawns are processed into crackers/snacks so that children are interested. The form of crackers was chosen because when consumed in the mouth they can stimulate saliva by the process of mastication, so there is an exchange of calcium from the crackers to the oral cavity saliva.

This study aimed to describe the potential benefits of local food derived from *rebon* shrimp as a preventive measure for dental caries. Initial screening was carried out to determine the condition of the oral cavity of elementary school children and then to measure the nutritional content of local food ingredients, namely *rebon* shrimp, so that a solution could be found to overcome the problem of dental caries.

## 2. Materials and Methods

This research was a preliminary study with a sample from public elementary school 106448 students in Bagan Serdang village aged 8-12 years, totaling 85 people, which consisted of two stages. The first stage was to screen all elementary school students, including measuring the prevalence of dental caries, caries experience of deciduous and permanent teeth, assessing caries risk factors, and measuring salivary calcium ion concentration. The second stage was measuring the nutritional content of *rebon* shrimp.

The prevalence of dental caries was measured by directly examining the students' oral cavities. At the same time, the deft and DMFT indices were used to measure the caries experience of milk and permanent teeth. Caries risk factor measurement using Kariogram software by filling out and giving a score in the box available on eight parameters, namely caries experience measurement, pH and salivary secretion, dental plaque score, content and frequency of snacks consumed, fluoridation program ever obtained, and clinical assessment. Salivary calcium ion measurement using Atomic Absorption Spectrophotometry (AAS). Measurements of *rebon* shrimp calcium levels were carried out in the Medan Laboratory of Research and Industrial Standardization (Baristand) test laboratory.

## 3. Results

The number of elementary school students in Bagan Serdang village aged 8-12 years is 85 people, consisting of 8 years (7.1%), 9 years (35.3%), 10 years (31.8%), 11 years (20%), and 12 years (5.9%) (Table 1).

**Table 1** Characteristics of respondents of public elementary school 106448 Students.

Characteristics of Respondents	n	%
Age (years)		
8	6	7.1
9	30	35.3
10	27	31.8
11	17	20
12	5	5.9
Gender		
Females	49	57.6
Males	36	42.4

The prevalence of public elementary school 106448 students in Bagan Serdang village who experienced dental caries was 81.18% and caries-free 18.82% (Table 2).

**Table 2** Prevalence of dental caries in public elementary school 106448 Students.

Dental caries status	n	%
Caries	69	81.18
Caries-free	16	18.82
Total	85	100

The average dental caries experience in public elementary school 106448 students was  $3.02 \pm 2.79$ . The caries experience in deciduous dentition in female students was  $3.16 \pm 2.95$  higher than in male students, which is  $2.83 \pm 2.57$  (Table 3).

**Table 3** The caries experience in the deciduous dentition of public elementary school 106448.

Gender	n	Caries Experience in Deciduous Dentition							
		D		E		F		DEFT	
		$\bar{x}$	Sd	$\bar{x}$	Sd	$\bar{x}$	Sd	$\bar{x}$	Sd
Females	49	2.08	1.97	0.90	1.29	0.08	0.57	3.16	2.95
Males	36	2.19	2.30	0.64	1.05	0.00	0.00	2.83	2.57
Total	85	2.13	2.10	0.79	1.20	0.05	0.43	3.02	2.79

The average caries experience in permanent dentition was  $0.80 \pm 2.79$ . The caries experience in permanent dentition in female students was  $0.90 \pm 0.89$  higher than in male students, which is  $0.67 \pm 1.01$  (Table 4).

**Table 4** The caries experience in permanent dentition of public elementary school 106448.

Gender	n	Caries Experience in Permanent Dentition							
		D		M		F		DMFT	
		$\bar{x}$	Sd	$\bar{x}$	Sd	$\bar{x}$	Sd	$\bar{x}$	Sd
Females	49	0.88	0.97	0.02	0.14	0.00	0.00	0.90	0.89
Males	36	0.56	0.88	0.11	0.39	0.00	0.00	0.67	1.01
Total	85	0.74	0.94	0.06	0.28	0.00	0.00	0.80	0.96

The caries risk factors measured were the type of snack food, frequency of snacks, plaque index, fluoride use, salivary secretion, and saliva buffer. The percentage of snack food categories for elementary school students with the highest content of snacks (score 3), which contains a lot of sugar, such as sweet bread/cake, candy, chocolate, and chocolate ice cream, is 74.1% (Table 5).

**Table 5** Categories of snack food types of public elementary school 106448.

Skor	Snack Content	n	%
0	Low carbohydrates	0	0
1	Medium carbohydrates	6	7.1
2	High carbohydrates	16	18.8
3	Very high carbohydrates	63	74.1
Total		85	100

The frequency of snacking percentage of public elementary school 106448 students is in a low category (score 1), which is 4-5 times a day at 68.2% (Table 6).



**Table 6** Frequency of snacking of public elementary school 106448 students.

Score	Frequency of snacking	n	%
0	Very low: ≤ 3 times	2	2.4
1	Low: 4-5 times	58	68.2
2	High: 6-7 times	25	29.4
3	Very high: > 7 times	0	0
Total		85	100

The highest percentage of public elementary school 106448 students' plaque index was in the poor category (score 3), with a plaque index of 1.1-2.0, as much as 50.6% (Table 7).

**Table 7** Plaque index of public elementary school 106448 students.

Score	Plaque Index	n	%
0	Excellent, PI = <0,4	4	4.7
1	Good, PI =0,4-1,0	29	34.1
2	Fair, PI = 1,1-2,0	43	50.6
3	Poor, PI = >2,0	9	10.6
Total		85	100

The highest percentage of fluoride programs in public elementary school 106448 students, is using fluoride toothpaste (score 2) at 63.5% (Table 8).

**Table 8** The use of fluoride in public elementary school 106448 students.

Score	Flouride Program	n	%
0	Use fluoride toothpaste regularly and mouth rinse with a fluoride solution	0	0
1	Rarely use fluoride toothpaste and rarely do mouth rinse with a fluoride solution	0	0
2	Use only fluoride toothpaste	54	63.5
3	Never use fluoride toothpaste, and never do mouth rinse with a fluoride solution	31	36.5
Total		85	100

The percentage of salivary secretion of public elementary school 106448 students is included in the low category (score 2), namely 0.5-0.9 ml/, which is 96.5% (Table 9).

**Table 9** Salivary secretion of public elementary school 106448.

Skor	Salivary secretion	n	%
0	Normal, >1.1 ml/min	0	0
1	Moderate, 0.9 – 1.1 ml/min	2	2.4
2	Low, 0.5 – 0.9 ml/min	82	96.5
3	Very low, <0.5 ml/min	1	1.2
Total		85	100

The highest percentage of the salivary buffering capacity of public elementary school 106448 students is in the low category with pH 6-9 (score 1), 98.8% (Table 10).

**Table 10** The salivary buffering capacity of public elementary school 106448 students.

Score	Salivary buffering capacity	n	%
0	Normal pH ≥ 6.0	1	1.2
1	Low pH = 4.5-5.5	84	98.8
2	Very low pH < 4.0	0	0
Total		85	100

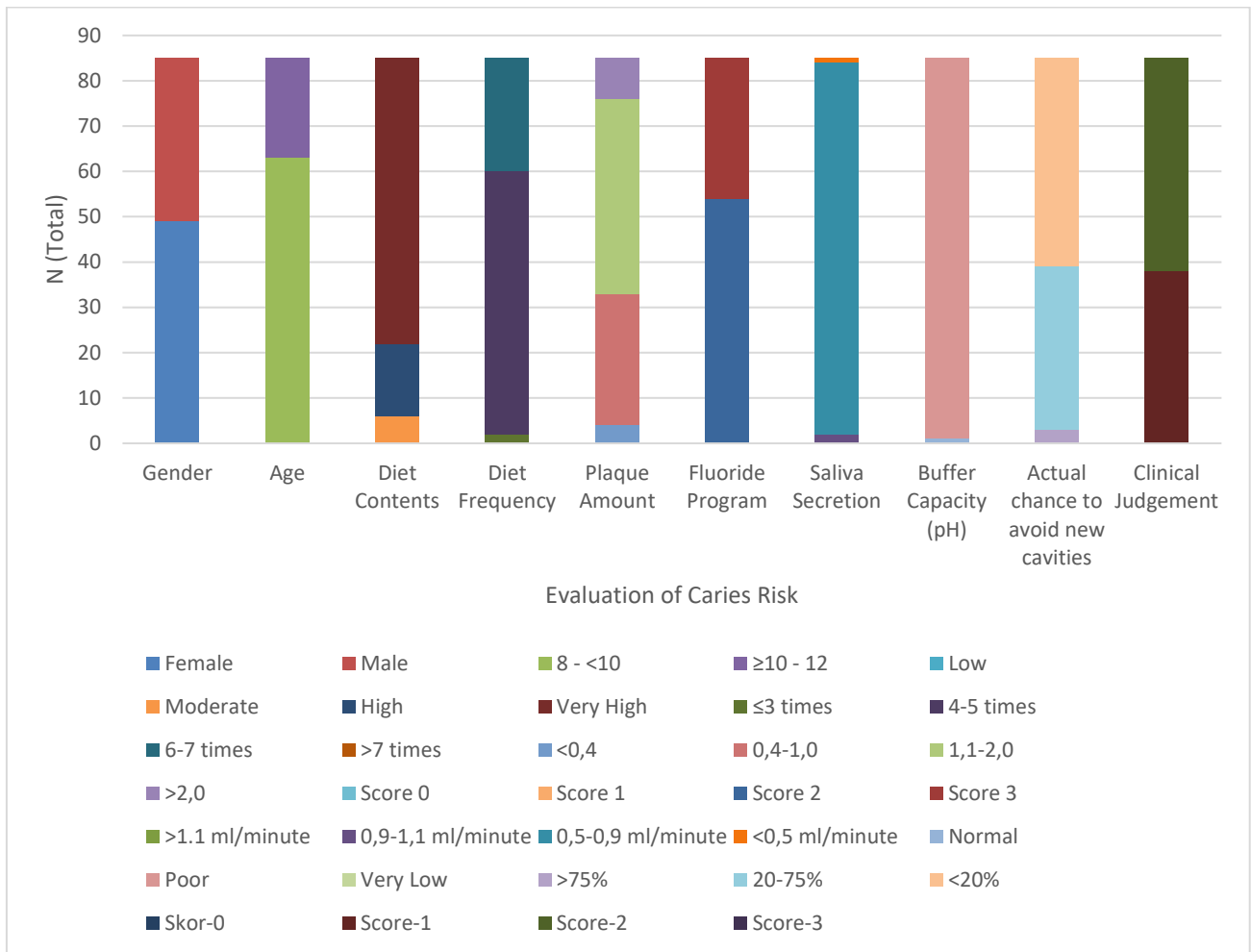
From the eight parameters above, it was found that the results of measuring caries risk factors using the Kariogram software for Bagan Serdang elementary school students were included in the category of high caries risk factors (54.1%). This means that the probability of caries occurring in the future is high. For this reason, it is necessary to consider steps to prevent dental caries in this village's elementary school students through local foods that are high in calcium (Table 11).

**Table 11** Results of caries risk assessment using kariogram software.

Risk Level of Caries	n	%
Low risk >75%	3	3.5
Moderate risk 20-75%	36	42.4
High risk <20%	46	54.1
Total	85	100

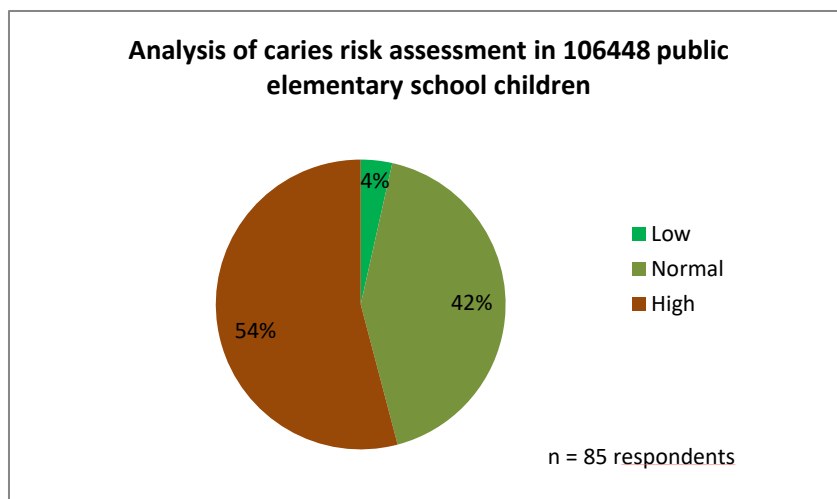


The bar chart of the evaluation of caries risk factors from eight parameters Kariogram shows the parameters of content and frequency of snacks, plaque scores, fluoride intake, salivary secretions, and buffers, as well as the clinical assessment of the examiner (Figure 1).



**Figure 1** Bar chart of caries risk assessment results using Kariogram.

The diagram of the results of the caries risk analysis using the Kariogram shows the dark green sector, which is 54%, meaning that the possibility of caries occurring in the future for these elementary school students has high caries risk (Figure 2).



**Figure 2** Caries risk assessment diagram for elementary school students 106448.

The average salivary calcium ion concentration in Bagan Serdang public elementary school students is very low, namely,  $0.75 \pm 0.32$  mmol/l, where the normal value of calcium ion concentration in saliva is 1.35-2.5 mmol/L (Table 12).

**Table 12** Salivary calcium concentration of public elementary school 106448 students.

	n	Mean salivary calcium
Public elementary school 106448	85	$0.75 \pm 0.32$ mmol/L

Based on the category of calcium ion concentration in saliva, most were in a low category (82.35%), followed by the normal category (17.65%), and none of the students were included in the high category (Table 13).

**Table 13** Category of salivary calcium in the concentration of public elementary school 106448.

Category of calcium ions	n	%
Low (<1mmol/L)	72	82.35
Normal (1-2 mmol/L)	13	17.65
High (>2 mmol/L)	0	0

Samples of fresh and dried rebon shrimp were taken from Bagan Serdang Village to analyze nutritional content, especially calcium. The calcium content in rebon shrimp taken directly from the beach in Bagan Serdang Village, Pantai Labu is 1.54% (w/w) for fresh rebon shrimp, or in 100 grams of fresh rebon shrimp it contains 154 mg of calcium. In contrast, the calcium content in dried rebon shrimp contains 154 mg of calcium taken directly from the beach in Bagan Serdang Village, Labu Beach is 1.50% (w/w) or in 100 grams of dried rebon shrimp it contains 150 mg of calcium.

**Table 14** Nutrient content in fresh rebon shrimp and dried rebon shrimp.

Parameter	Unit	Results of Dried Rebon Shrimp	Results of Fresh Rebon Shrimp
Protein	%(w/w)	18.1	11.7
Calcium	%(w/w)	1.50	1.54
Carbohydrate	%(w/w)	1.28	1.50
<b>Metal contaminants</b>			
Lead (Pb)	mg/kg	<0.003	<0.003
Iron (Fe)	mg/kg	34.6	35.7
Phosphor	mg/kg	53.3	1431.5
Total fat	%(w/w)	0.63	0.40

#### 4. Discussion

In this preliminary study, an analysis of the situation of dental and oral health problems was carried out on elementary school students in Bagan Serdang. The number of children suffering from dental caries is very high at 80.18%, much higher than the prevalence in North Sumatra, only 19.4%, and in Deli Serdang district, 42.1%. This is due to the mother's lack of knowledge about children's oral and dental health, where during the initial interview, it was found that mothers never supervise their children brushing their teeth at home. The children never received any education about dental and oral health at school. From the results of this study, it can also be seen that the consumption of children's snacks containing sugar, such as sweet bread/cake, candy, chocolate, and chocolate ice cream, is 74.1%, with a frequency of 4-5 times a day.

Dietary patterns include diet frequency, amount of carbohydrates, eating habits, types of carbohydrates, breastfeeding, formula milk or mixed milk, eating sweets, eating time, and soft-drink drinking habits. The influence of diet in the occurrence of the caries process is in terms of the frequency of consuming food. Consuming and drinking carbohydrates too often would cause tooth enamel will not have the opportunity to remineralize completely. Infants or children who are still fed breast milk, formula milk, or a mixture of the two until the age of 13 months tend to have a risk of caries, especially if they have dietary habits associated with cariogenic foods (Edelstein et al 2009; Anil and Anand 2017).

There are various forms of cariogenic food, namely liquid and solid forms. Cariogenic foods contain fermented carbohydrates, causing a decrease in plaque pH to 5.5 or less and stimulating the caries process (Kidd and Fejerskov 2016). Solid cariogenic food forms such as biscuits and candy are easier to stick to the teeth, while liquid cariogenic food forms such as ice cream and syrup are not easily attached to the tooth surface, making them easier to clean (Ramayanti and Purnakarya 2013). This can be seen from the number of cavities measured by the caries experience of both deciduous and permanent dentition. The average caries experience of deciduous dentition in elementary school students was  $3.02 \pm 2.79$ , while the average caries experience of permanent dentition was  $0.80 \pm 2.79$ .

To see the probability of caries in the future, the researchers measured caries risk factors using Kariogram software. These results were obtained by measuring the eight parameters used in the Kariogram. It was found that the probability of caries occurring in the future is very high, which is 54.1%.

In addition, the researchers also found a very low concentration of calcium ions in the saliva of elementary school students. This shows that students rarely eat snacks that contain lots of minerals, especially calcium. Snacks containing lots of sugar will cause a low saliva pH, making dental caries or cavities easy (Neel et al 2016). The pH of saliva influences the mineralization of tooth enamel. The low salivary pH will cause hydrogen ions to increase so that it can damage the hydroxyapatite bonds on the teeth and will dissolve the enamel crystals. This partial or complete loss of enamel minerals is called demineralization. When demineralization occurs, microporosity is formed on the tooth enamel surface. Severe demineralization will cause the formation of white spots that can lead to dental caries. If demineralization occurs continuously for a long time and is stimulated by bacteria, caries will occur (Widyaningtyas et al 2014).

Methods to reduce demineralization factors are changing diet or eating patterns, improving oral hygiene and health, and giving chemical action. Methods to increase the protective factor of the teeth are by increasing the flow, quantity, and quality of saliva, applying chemicals such as fluoride to the tooth surface, applying remineralizing agents, and using pit and fissure sealants. One of the diets to reduce demineralization factors is foods that contain lots of calcium (Heymann and Swift 2006).

Remineralization of tooth enamel occurs when the local acidic pH due to the metabolism of plaque bacteria rises again. Saliva contains high concentrations of calcium and phosphate ions, which serve as raw materials for remineralization (Heymann and Swift 2006) (Featherstone 2009). The acid produced by plaque bacteria is neutralized by saliva so that the pH increases and minerals can return, and remineralization occurs. Remineralization occurs only due to the permeability of the enamel to fluoride, calcium, and phosphate obtained from saliva and other sources (Garg 2011). In foods or snacks that contain lots of minerals, especially calcium, there will be an exchange of calcium ions from the food to the saliva so that the pH of the saliva will increase and can prevent demineralization, which can cause cavities (Rahayu 2013).

The results of measuring the nutritional content of fresh and dried rebon shrimp obtained from the beach in Bagan Serdang village showed the high nutritional content of rebon shrimp, especially phosphorus, protein, and calcium. 100 grams of fresh rebon shrimp contains 154 mg of calcium, and 150 mg of calcium in dried rebon shrimp. We can use the high calcium content in this rebon shrimp to prevent cavities by processing it into one of the functional food children like, namely crackers. The form of crackers was chosen because when consumed, the chewing process occurred, which stimulated the exchange of calcium ions from the crackers to the saliva so that it could increase the concentration of calcium ions in saliva, increase salivary pH, and prevent demineralization.

The livelihoods of residents of Bagan Serdang Village are mostly fishermen (83.86%), so the community belongs to a low socio-economic group. The main catch of fishermen in this village is rebon shrimp which is rich in nutrients, especially calcium (BPS Kabupaten Deli Serdang 2021). Utilizing local food ingredients in the form of rebon shrimp which are processed into crackers, has the potential for employment and additional income for the community and prevents dental caries by consuming these high-calcium crackers.

## 5. Conclusions

Due to the high susceptibility of caries risk among primary school children and low calcium concentration in saliva thus, the high availability of calcium-enriched shrimp paste can be used as a strategy to prevent dental caries among the school children from Bagan Serdang village.

## Ethical considerations

This research has passed ethical clearance with reference number 041/KEPK/UNPRI/III/2022 from the Ethic Committee of Universitas Prima Indonesia, Medan, Indonesia.

## Conflict of Interest

The authors declare that they have no conflict of interest.

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