

Effectiveness of Rebon Shrimp in Preventing Dental Caries among Elementary School Children in Bagan Serdang Village

Gema Nazri Yanti^{1*}, Ida Yustina¹, Ameta Primasari², R. Kintoko Rochadi¹

1.Public Health Department, Faculty of Public Health, Universitas Sumatera Utara, Medan, Indonesia.

2.Dentistry Faculty, Universitas Sumatera Utara, Medan, Indonesia.

Abstract

The aim of this study was to evaluate the effectiveness of rebon shrimp crackers to increase salivary calcium ion among elementary school children. This study was quasi-experimental, with pre and post test control group design. At first, rebon shrimp were processed into functional food that is rebon shrimp crackers which were favoured by children. Nutry Survey software was used to measurement the nutritional content of rebon shrimp crackers. Based on the sample size calculation for the hypothesis test, it was obtained a minimum sample size of 60 samples, in which 30 samples were included in the intervention group who were given rebon shrimp crackers for 30 days, while 30 samples were included in the control group and were not given crackers. Saliva sampling was carried out using the unstimulated method, and the measurement of the salivary calcium ion concentration before and after the intervention using the Atomic Absorption Spectrophotometer (AAS) at USU Integrated Research Laboratory, Medan. The concentration of salivary calcium ions before and after given the intervention measured using paired t-test and to analyze the difference in the concentration of salivary calcium ions between the two groups using unpaired t-test. There was a significant difference in the concentration of salivary calcium ions between the group given rebon shrimp crackers and the group that was not given rebon shrimp crackers ($p=0.047$).

There was a significant increase in the concentration of salivary calcium ions also in the group given rebon shrimp crackers before and after trial ($p=0.0001$), but there was no increase in the significant in the group that was not given crackers before and after it ($p=0.156$). it was concluded that rebon shrimp crackers are effective in increasing the concentration of calcium ions in saliva so that it can be used as a strategy to prevent dental caries.

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Introduction

Bagan Serdang Village is one of the villages producing fish and rebon shrimp. Fresh rebon shrimp are usually directly processed into dried rebon shrimp. The livelihoods in Bagan Serdang Village are various, with the highest percentage being fishermen with 395 people (83.86%) and some of them having home industries, namely shrimp processing. The location of Bagan Serdang Village which is located in a coastal area and the large number of

people who work as fishermen lead dry rebon shrimp one of the superior products of Bagan Serdang Village.¹

Rebon shrimp are source of protein, but are not as well known as beef, fish, or other chicken and shrimp. In everyday language, the rebon shrimp is better known as the kecepe shrimp. One hundred grams of dried rebon contains 59.4 grams of protein. Not in line with the high protein content, this shrimp has low fat, which is 3.6 grams of fat per 100 grams of dry rebon. The specialty of this type of shrimp is found in the content of calcium, phosphorus and iron. Another advantage of dried rebon shrimp is that it contains 2,306 mg of calcium or 16 times the calcium of 100 grams of cow's milk. The content of phosphorus in dry rebon is 625 grams and iron is 21.4 grams, or equal to 8 times the nutrition of 100 grams of beef. Dried rebon shrimp contains

*Corresponding author:

Gema Nazri Yanti
Public Health Department, Faculty of Public Health,
Universitas Sumatera Utara, Medan, Indonesia
E-mail: my.paper.usu@gmail.com

299 kcal of energy, 59.4 grams of protein, 3.6 grams of fat, 3.2 grams of carbohydrates, 2,306 mg of calcium, 265 mg of phosphorus, 21.4 mg of iron, 0.06 mg of vitamin B1, and 21.6 grams water, while the fresh rebon shrimp contains 81 kcal of energy, 16.2 grams of protein, 1.2 grams of fat, 0.7 grams of carbohydrates, 757 mg of calcium, 292 mg of phosphorus, 2.2 mg of iron, 60 vitamin A. mg, vitamin B1 0.04 mg, and water 79 grams.²

Calcium has various functions in the body both systemically and locally, including the formation of bones and teeth, regulating biological reactions, helping muscle contractions, and regulating blood clotting. In the bones, calcium has two functions, namely as part of the bone structure and as calcium reserve of the body.^{3,4}

In particular, calcium also has a role in the stage of growth and development of teeth. Tooth growth and development are divided into three stages, i.e. growth, calcification, and eruption. Calcium plays a role in the calcification stage, which is the hardening of the matrix by the deposition of calcium salts.^{5,6}

Calcium in the saliva is an important electrolyte in saliva. The normal concentration of calcium is 1.35-2.5 mmol/L with the highest concentration from the submandibular gland 3.7 mmol/L.⁷ Salivary composition is influenced by salivary flow. Calcium has a role in preventing enamel demineralization by maintaining a neutral pH of saliva around 6.7 - 7.4.⁸ The initial stage of dental caries is characterized by demineralization (the release of minerals from the teeth) with clinical signs in the form of white spots on the teeth. Dental caries can only occur when the demineralization stage is greater than the remineralization stage.^{9,10}

During the initial interview, it was found that the community in Bagan Serdang Village did not consume rebon shrimp and it was directly processed into dried rebon shrimp (kecepe), which is one of the superior products of Bagan Serdang Village. The results of a preliminary study conducted on elementary school students between the ages 8 to 11 years in Bagan Serdang Village showed that the calcium ion content in saliva was 0.75 ± 0.32 mmol/L which the results of this study included in the very low category.

Efforts that can be carried out for the prevention of dental caries is to provide foods

which is rich in calcium and phosphorus, favoured by children, and easy to obtain. Sources of calcium in food can be obtained from milk, vegetables, shrimp and fish. One of the efforts so that rebon shrimp can be utilized properly is to turn it into a functional food. To overcome this dental caries, rebon shrimp is processed into rebon shrimp crackers so that children are interested.

The form of crackers was chosen because when consumed in the mouth it can stimulate saliva by the mastication process so that there is an exchange of calcium from the crackers to the saliva of the oral cavity. In addition, making it in the form of crackers can open up business opportunities for local community to sell rebon shrimp crackers. The easy and practical process of making crackers is the reason the research was chosen in the form of crackers.

Materials and methods

This study was quasi-experimental, with pre and post test control group design. At first, rebon shrimp were processed into functional food that is rebon shrimp crackers which were favoured by children. Nutry Survey software was used to measurement the nutritional content of rebon shrimp crackers. One pack of rebon shrimp crackers is 35-40 grams, which in each gram contains 6.32 mg of calcium.

The population was all students of public elementary school 106448 as many as 231 people. Based on the sample size calculation for the hypothesis test, it was obtained a minimum sample size of 60 samples, in which 30 samples were included in the intervention group who were given each day one pack for 30 days during school breaks and supervised by teachers, while 30 samples were included in the control group and were not given crackers. The sampling uses purposive sampling method, with inclusion criteria, such as between the ages 8 to 12 years, *decay* <5 teeth, got parental consent and was willing to be examined, while the exclusion criteria are uncooperative student.

Primary data collection by direct collection of saliva of elementary school children before and after the intervention was given to measure the salivary calcium ion concentration. Saliva sampling was carried out using the unstimulated method, and the measurement of the salivary calcium ion concentration before and after the

intervention using the Atomic Absorption Spectrophotometer (AAS) at USU Integrated Research Laboratory, Medan.

Normality test was carried out using Kolmogorov Smirnov and the results showed normal distributed data ($p > 0.05$). Then the mean concentration of salivary calcium ions before and after given the intervention measured using paired t-test and to analyze the difference in the mean concentration of salivary calcium ions between the two groups using unpaired t-test. This research has passed ethical clearance with reference number 041/KEPK/UNPRI/III/2022 from Ethic Committee of Universitas Prima Indonesia, Medan, Indonesia.

Results

From the results of nutritional analysis using Nutry Survey software, it was found that in 500 grams of fresh rebon shrimp there were 3.785 mg of calcium so that one gram of fresh rebon shrimp contained 7.57 mg of calcium. Then in one batter of rebon shrimp crackers (700 grams of dried crackers) found a result of 4.421.65 mg of calcium so that one gram of rebon shrimp crackers contained 6.32 mg of calcium (Table 1).

Food Name	Ingredient	Weight (g)	Nutrients						Iron (mg)
			Energy (kcal)	Protein (g)	Fat (g)	Carbohydrate (g)	Calcium substances (mg)	Phosphorus (mg)	
Rebon Shrimp	Rebon Shrimp	500	405	81	6	3.5	3785	1460	11
Crackers	Tapioca Flour	750	2722.5	8.25	3.75	661.5	630	937.5	7.5
	Garlic	15	16.8	0.675	0.03	3.465	6.3	20.1	0.15
	Sugar	7	27.58	0	0	6.58	0.35	0.07	0.007
	Palm Oil	150	1326	0	150	0	0	0	0
Total			4497.88	89.925	159.78	675.045	4421.65	2417.67	18.657

Table 1. Nutritional Analysis of Rebon Shrimp Crackers (700 gr).

Characteristics of Respondents	n	%
Age (years)		
8	11	18.3
9	14	23.2
10	6	10.0
11	23	38.3
12	6	10.0
Gender		
Females	22	36.7
Males	38	63.3

Table 2. Characteristics of Respondents of Public Elementary School 106448 Students.

The characteristics of respondents showed more male students (63.3%) than female

students (36.7%). Students age 11-year-old were the most numerous (38.3%) compared to ages 8, 9, 10 and 12 (Table 2).

There was no significant difference in salivary calcium ion concentrations between the intervention group who consumed the crackers and the group who was not given crackers before trial ($p = 0.989$) (Table 3).

Group	n	Mean Calcium Ion Concentration (mg /L)	Statistical Test Results
Consumed the crackers	30	0.22 ± 0.03	p=0.989
Not given the crackers	30	0.22 ± 0.04	

Table 3. Mean Concentration of Saliva Calcium Ions Before Trial.

There was a significant difference in the concentration of salivary calcium ions in the intervention group who consumed the crackers with the group not given the crackers after trial ($p = 0.047$) (Table 4).

Group	n	Mean Calcium Ion Concentration (mg /L)	Statistical Test Results
Consumed the crackers	30	0.27 ± 0.04	p=0.047
Not given the crackers	30	0.24 ± 0.07	

Table 4. Mean Concentration of Saliva Calcium Ions After Trial.

There was a significant increase in the concentration of salivary calcium ions before and after trial ($p = 0.0001$), while in the group that was not given trial there was no significant increase ($p = 0.156$) (Table 5).

Group	n	Mean Calcium Ion Concentration (mg/L)		Mean Difference (mg/L)	Statistical Test Results
		Before	After		
Consumed the crackers	30	0.22 ± 0.03	0.27 ± 0.04	0.05	p=0.0001
Not given the crackers	30	0.22 ± 0.04	0.24 ± 0.07	0.02	

Table 4. Mean Concentration of Saliva Calcium Ions Before and After Trial.

Discussion

The results of the initial concentration of calcium ions measuring in saliva before given intervention was seen that there was no significant difference in salivary calcium ion concentration between the intervention group which rebon shrimp crackers are given and the group which rebon shrimp crackers are not given. This shows that before the initial trial, the condition of the student's oral cavity was almost the same because at the time of selection of the respondents, the inclusion criteria were made,

namely students who had less than five dental caries, both for the intervention group and the control group. Then a test was carried out after students consumed crackers compared to those who did not consume crackers. There was a significant difference in the concentration of salivary calcium ions between the group given rebon shrimp crackers and the group that was not given rebon shrimp crackers. There was a significant increase in the concentration of salivary calcium ions also in the group given rebon shrimp crackers before and after trial, but there was no increase in the significant in the group that was not given crackers before and after it. This means that rebon shrimp crackers are effective in increasing the concentration of salivary calcium ions. It is hoped that this rebon shrimp cracker can be an alternative to prevent dental caries that is cheap, easy to get, and has high nutritional value so that it can be used by the people of Bagan Serdang Village.

The results of this study are almost the same as the results of previous studies, where researcher conducted a study on the effectiveness of chewing cheddar cheese on increasing the concentration of salivary calcium ions. Cheddar cheese is famous for its very high content of calcium substances and is already a daily staple food in European and American countries. Cheese is one of the dairy products rich in minerals, vitamins, phosphorus, calcium and protein substances. Cheddar cheese can reduce the risk of dental caries because calcium ions in cheese can protect teeth from acid by increasing the pH of saliva. The results of this study showed a significant increase in the concentration of calcium ions in saliva before and after chewing cheddar cheese and there was no significant increase in the control group.¹¹

In addition, researchers also obtained very low concentrations of salivary calcium ions of the elementary school children. This shows that students rarely consume snack foods that contain a lot of minerals, especially calcium. Snacks that contain a lot of sugar will cause low pH of saliva so it is easy for dental caries or cavities to occur. The mineralization of tooth enamel is affected by the salivary pH. Low salivary pH will cause the hydrogen ion to increase so that it can damage the hydroxyapatite bond in the tooth and will dissolve the enamel crystals. The loss of part or all of the enamel minerals is called demineralization.

When demineralization occurs, microporosity will form on the surface of the tooth enamel. Severe demineralization will cause white *spots* to form and can result in dental caries. If demineralization occurs continuously for a long time and is stimulated by bacteria, then dental caries will occur.^{12,13}

Methods to reduce demineralization factors are by changing diet, improving hygiene and oral health, and giving chemical action. Methods to increase the protective factor of the teeth are by increasing the flow, quantity and quality of saliva, chemical applications such as *fluoride* on the tooth surface, application of remineralizing agents, and the use of *pit and fissure sealant*. One of the diets to reduce the demineralization factor is a food that contains a lot of calcium substances.^{9,14}

Remineralization of tooth enamel occurs when the local acidic pH due to the metabolism of plaque bacteria rises again. Saliva contains a high concentration of calcium and phosphate ions that serve as raw materials for the remineralization process. The acid produced by plaque bacteria is neutralized by saliva, so that the pH increases and the mineral can return and remineralization occurs. Remineralization only occurs due to the permeability of enamel in fluoride, calcium substances, and phosphates obtained from saliva and other sources.¹⁵ In foods or snacks that contain a lot of minerals, especially calcium, there will be an exchange of calcium ions from food to saliva so that the pH of saliva will increase and can prevent the occurrence of demineralization which can cause cavities easily.¹⁶

When the pH is high enough (>5.5) and calcium and phosphate ions are present, the process of demineralization into dental caries can be reversed by remineralization of the damaged tooth enamel structure. If remineralization occurs before cavitation of the tooth surface it may show evidence of dental caries with the appearance of discoloration. If remineralization occurs after cavitation, the rest of the affected surface becomes harder and often becomes dark brown or black color. These surfaces can be called arrested caries and are more resistant to future cariogenic.¹⁶

The measurement results show the high nutritional content of rebon shrimp from Bagan Serdang Village, especially phosphorus, protein and calcium. In 100 grams of fresh rebon shrimp

contains 154 mg of calcium substance and 150 mg of calcium substance in dried rebon shrimp. The high content of calcium in rebon shrimp can be used as a way to prevent cavities by processing them into a functional food that are favoured by children, namely crackers. The shape of the cracker was chosen because when consumed there is a chewing process that stimulates the exchange of calcium ions from the cracker to saliva so that it can increase the concentration of calcium ions in saliva, increase the pH of saliva and prevent demineralization.

Functional food is food that has three functions, namely primary function, meaning that the food can meet nutritional needs (carbohydrates, proteins, fats, vitamins and minerals), secondary function, meaning that the taste can be accepted by consumers, and tertiary function, this means that the food has a function to maintain health, reduce the occurrence of a disease and maintain the body.¹⁷

The definition of functional food according to the National Agency of Drug and Food Control (BPOM) is food that naturally or has gone through a process, contains one or more compounds that based on scientific studies are considered to have certain physiological functions that are beneficial to health. Although it contains compounds that are beneficial to health, functional foods are not in the form of capsules, tablets, or powders derived from natural compounds. Functional foods are distinguished from dietary supplements and drugs by their appearance and effect on health. If the drug's function against disease is curative, then functional food is only to help prevent a disease.¹⁷

In addition to rebon shrimp, there are also many local foodstuffs that have been used to prevent dental caries. Research by Marlindayanti in 2018 in Palembang on the effect of consuming purple sweet potato biscuits on saliva pH in an effort to prevent dental caries concluded that purple yam biscuits have advantages in slowing down the demineralization process after consumption and accelerating the remineralization process. Purple sweet potatoes have a high content of calcium, vitamins A, C, B1, B2, and minerals, namely iron, phosphorus, and sodium. From the results of the study, it is known that the average amount of saliva pH after consumption of purple sweet potato biscuits is 8.58 and the average pH of saliva after

consumption of wheat biscuits is 6.45. The normal pH return time of saliva after consuming purple sweet potato biscuits is 30 minutes (average saliva pH 7.39), and after consuming wheat biscuits is 40 minutes (average saliva pH 7.18).¹⁸

Another research by Darwati and Anggraeni is the use of local foodstuffs in the form of guava (*Psidium guajava*) as a source of fluoride to prevent dental caries in children. Fluoride elements take part in the process of demineralization and remineralization because fluoride can slow down the rate of demineralization and increase mineral intake. With fluoride intake, enamel that has a hydroxyapatite structure ($\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$) turns into fluoroapatite ($\text{Ca}_{10}(\text{PO}_4)_6\text{F}_2$) which is not easily soluble against acids.¹⁹

Research by Deviyanti in 2019 in South Jakarta on the non-cariogenic potential of *Stevia rebaudiana Bertoni* leaf extract as a natural sweetener to replace sugar with glycoside diterpene content which plays a role in sweetness 250-400 times sweeter than sucrose, is an alternative source of traditional sugar (sucrose). Studies have proven that *Stevia rebaudiana Bertoni* leaf extract has a non-cariogenic potential because it can not be fermented into acid by cariogenic bacteria in dental biofilms, able to improve biofilm pH, salivary pH and salivary buffer capacity in patients with high dental caries and reduce cariogenic bacteria in biofilm and saliva. *Stevia rebaudiana Bertoni* has also been scientifically proven save and effectively protects against dental caries because it causes lower enamel demineralization than sucrose.²⁰

The country of Indonesia has a variety of commodities that can be used as a source of food. Ideally, the Indonesian people can consume various types of food ingredients and need to make good use of these local foodstuffs. Lack of knowledge about the use of existing local foodstuffs is a problem that must be overcome. One way to overcome this is to optimize the use of existing local foodstuffs, to produce more varied and quality food products. Optimizing local foodstuffs is not only the task of researchers or food observers, but local communities are also expected to contribute.

Conclusions

From the results of the research above, it was concluded that rebon shrimp crackers are effective in increasing the concentration of salivary calcium ions so that it can be used as a strategy to prevent dental caries.

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Declaration of Interest

The authors report no conflict of interest.

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