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Original Article

EFFECT OF GARGLING GREEN COCONUT WATER (*COCOS NUCIFERA LINN VAR. VIRIDIS*) ON SALIVARY FLOW RATE IN 12-TO 13 Y OLDS CHILDREN IN MEDAN DELI SUB-DISTRICT

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ABSTRACT

Objective: This study aims to determine the effect of gargling green coconut water (*Cocos nucifera Linn Var. Viridis)* on salivary flow rate in children aged 12-to 13 y olds in Medan Deli Sub-district.

Methods: This study was conducted on 30 children with a high risk of caries aged 12-to 13 y olds. Saliva was collected before and after gargling using spitting method for 5 min.

Results: It was found that the average salivary flow rate before gargling green coconut water was 0.47±0.22 ml/min and after gargling was 0.65±0.12 ml/min. Paired T-test results showed a significant increase in salivary flow rate before and after gargling green coconut water (p = 0.008). Unpaired T-test results showed that there was no significant difference in the mean difference in salivary flow rate between children aged 12 y and 13 y after gargling green coconut water (p = 1.000). Unpaired T-test results showed no significant difference in the mean difference in salivary flow rate between boys and girls after gargling green coconut water (p = 0.486).

Conclusion: It was concluded that green coconut water can significantly increase salivary flow rate. Age and gender have no significant effect on salivary flow rate.

Keywords: Salivary flow rate, Green coconut water, Age, Gender

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INTRODUCTION

Saliva is a unique body fluid that constantly moistens the oral cavity, esophagus, and larynx [1]. Saliva is a clear mucinous-serous secretion and consists of 99.5% water and 0.5% organic and inorganic substances. Saliva is secreted by the major salivary glands and minor salivary glands. The salivary glands are under the control of the autonomic nerve stem and receive innervation from sympathetic and parasympathetic nerves [2, 3]. Saliva has a function as lubrication and moisturizer, helping taste perception, digestion, protection of the mucosa, protection of teeth, and protective functions as anti-viral, antifungal, and anti-bacterial [4-6].

Caries is a chronic and dynamic damage to hard dental tissues due to metabolic by-products or acidic material from the fermentation of carbohydrate foods by bacteria in the mouth and the process is a continuum resulting from the cycle of demineralization and remineralization [7-9]. Basic Health Research (Riskesdas) results in 2018 showed that 57.6% of Indonesia's population experienced dental and oral health problems with the largest proportion of dental problems being damaged/cavities/pain [10]. World Health Organization reports that 60-90% of children are affected by dental caries [11]. WHO sets the age of 12 y as the global monitoring age for caries because 79.97% of caries diseases strike at that age [12]. Children at this age also have a longer time to stay outdoors, which can increase the frequency of eating between main meals. This makes the group of children aged 12 y considered to have a high risk for caries [13].

Individuals who experience caries tend to experience a decrease in salivary flow rate [14]. Salivary flow rate is the amount of saliva produced by the salivary glands at one time [15]. It is the best clinical indicator of saliva's protective properties because salivary flow rate will affect other parameters. Salivary flow supports the clearance of bacterial substrates, protects the oral surface, and controls caries development. Reduced salivary flow can facilitate the accumulation and maturation of biofilms, resulting in acidification of oral environment and the development of acidogenic bacteria [16, 17]. The flow rate of saliva can be increased by providing stimuli in the form of mechanical stimuli or chemical stimuli. Mechanical stimuli can be in the form of gargling or masticatory activities, while chemical stimuli are in the form of tasting effects [18].

Green coconut (*Cocos nucifera Linn. Var Viridis)* is considered as an important crop and is widely planted globally, especially in Indonesia. Coconut water contains sugars, minerals, vitamins, amino acids, enzymes, volatile aromatic compounds, and other biochemical compounds [19]. One of the chemical compounds contained in green coconut water is tannins [20]. Tannins are a subclass of polyphenols that cause a bitter taste that stimulates salivary gland [21, 22].

This study aimed to determine the effect of gargling green coconut water (*Cocos nucifera Linn. Var Viridis)* on salivary flow rate in children aged 12-to 13 y olds.

MATERIALS AND METHODS

This study was adapted from a research design conducted by Andayani R, *et al.* [21]. The study was conducted with approval from the Health Research Ethics Committee of Universitas Sumatera Utara No.1262/KEPK/USU/2022. The study was conducted in January-February 2023 at the Al Jam'iyatul Washliyah Orphanage. The type of study carried out is experimental research with a pre-test and post-test control group design. Sampling was carried out by purposive sampling method with a total of 30 research subject. The inclusion criteria in this study were children aged 12-to 13 y olds who have a high DMF-T index and are willing to be the subject of research by submitting informed consent that has been approved by the person responsible/guardian. The exclusion criteria for this study were that children were using orthodontic devices or prostheses, children were taking drugs that affect salivary flow rate, they were suffering from diseases that affected salivary flow rate, and had allergies to green coconut water.

Research preparation

Researchers requested a letter of approval from the Al Jam'iyatul Washliyah Orphanage and a letter of approval from the Faculty of Dentistry, Universitas Sumatera Utara. The researcher provided an explanation and informed consent to the Al Jam'iyatul Washliyah Orphanage.

Selection of research subjects

Prospective subjects were asked to fill out questionnaires related to name, age, gender, history of drug consumption and others then continued with the DMF-T index examination. Subjects are selected according to the inclusion and exclusion criteria that have been determined by the researcher. Subjects who fit the research inclusion and exclusion criteria were collected to be divided into three gargling groups, namely the green coconut water gargling group (*Cocos nucifera Linn Var. Viridis*) as the experimental group, chlorhexidine 0.2% (Minosep, Minorock Mandiri) gargling group as the positive control group, and aquadest gargling group as the negative control group. Samples were selected using random sampling technique for each group.

Saliva retrieval procedure

Saliva collection before gargling and after gargling was carried out for three days for each gargling group. On the first day saliva was collected for green coconut water gargling group, on the second day saliva was collected for chlorhexidine gargling group, and on the third day saliva was collected for the aquadest gargling group. Preparation of gargling materials was carried out at 08.30 a. m. every day for three days for each gargling group. Saliva collection is carried out from 09.00-11.00 a. m.

Collecting saliva before gargling

Subjects were instructed not to brush their teeth, not to eat, and not to drink 1 h before saliva collection. Saliva collection before gargling was carried out by instructing the subjects not to speak, move their tongue, and swallow during saliva collection. The subjects were asked to sit with their backs straight, head slightly lowered, and left hand holding a measuring cup. The measuring cup used is the Saliva-Check Buffer (GC. Dental) salivary measuring cup. Saliva was collected with spitting method by instructing the subjects to let saliva collect at the floor of the mouth and then the subjects were asked to spit into a measuring cup every 60 sec for 5 min. The saliva collection time is calculated using a stopwatch. Researchers calculated the salivary flow rate before gargling by dividing the volume of saliva collected by the length of saliva collection, which was 5 min.

Preparation of gargling materials

The first day is carried out by the preparation of green coconut water (*Cocos nucifera Linn Var. Viridis*) gargling material by extracting coconut water from coconuts and then putting coconut water into a 600 ml drinking bottle. Green coconut water is measured as much as 15 ml with a measuring cup (Pyrex) and then put it in a container, tightly closed and labeled. The second day was carried out by the preparation of chlorhexidine 0.2%. Chlorhexidine was measured as 15 ml and then put in a container, tightly closed, and labeled. The third day is carried out by the preparation of aquadest gargling material. Aquadest are measured as 15 ml with a measuring cup and then put into a container, tightly closed, and labeled.

Collection of saliva after gargling

Subjects were asked to wait for 10 min before gargling procedures. The collection of saliva after gargling treatment is carried out by instructing the subject to gargle with the gargling material provided. The gargling procedure is carried out for 30 seconds. After gargling, saliva was collected and subjects were asked not to speak, move their tongue, and swallow. The subjects were asked to sit with their backs straight, head slightly lowered, and their left hand holding a measuring cup. Saliva was collected with spitting method by instructing the subjects to let saliva collect at the floor of the mouth; then the subjects were asked to spit into a measuring cup every 60 seconds for 5 min. Researchers calculated the salivary flow rate after gargling by dividing the volume of saliva collected by the length of saliva collection, which was 5 min.

Statistical analysis

The Statistical analysis was performed with SPSS devices. The data were analyzed with paired T-test to see changes in salivary flow rate before and after gargling green coconut water and unpaired T-test to determine the difference in average salivary flow rate before and after gargling green coconut water to the sex and age of children. The results of the study were stated with a value of $p<0.05$ to see the effect of gargling green coconut water on salivary flow rate in children aged 12-to 13 y olds in Medan Deli District.

RESULTS

The results of this study were obtained from 30 children aged 12 to 13 y olds. Research subjects are selected based on inclusion and exclusion criteria that have been set by researchers. The selected subjects were divided into three groups, namely the experimental group, the positive control group, and the negative control group.

Table 1 showed the distribution of study sample groups by sex and age. This study involved 15 children aged 12 y olds (50%) and 15 children aged 13 y olds (50%). The number of boys is 15 (50%) and the number of girls is 15 (50%).

Table 1: Distribution of study sample groups by sex and age

Characteristics	Green coconut water		Chlorhexidine		Aquadest		Total	
	n	%	n	%	n	%	n	%
Age (year-olds)								
12	5	16.67	5	16.67	5	16.67	15	50
13	5	16.67	5	16.67	5	16.67	15	50
Total	10	33.34	10	33.34	10	33.34	30	100
Gender								
Boys	5	16.67	5	16.67	5	16.67	15	50
Girls	5	16.67	5	16.67	5	16.67	15	50
Total	10	33.34	10	33.34	10	33.34	30	100

Table 2 showed changes in salivary flow rate of study subjects before and after treatment. The paired T-test results in the green coconut water gargle group showed that there was a significant increase in salivary flow rate before and after gargling (*p<0.05, **p = 0.008), paired T-test results in the chlorhexidine 0.2% gargle group showed *p<0.05, **p = 0.007 which means that there is a significant increase in salivary flow rate before treatment and after treatment, and paired T-test results in the aquadest gargle group showed *p<0.05, **p = 0.016 which means there is a significant increase in salivary flow rate before treatment and after treatment.

Table 2: Differences in the average increase in salivary flow rate before treatment and after treatment in the age group of green coconut water, chlorhexidine 0.2%, and aquadest

Gargling groups	n	Average of salivary flow rate, ($\bar{x}$±SD) (ml/min)		*p-value*
		Before	After	
Green Coconut Water	10	0.47±0.22	0.65±0.12	0.008*
Chlorhexidine 0.2%	10	0.46±0.13	0.83±0.21	0.007*
Aquadest	10	0.42±0.17	0.57±0.18	0.016*

*Paired T-test.

Table 3 showed the difference in the average salivary flow rate in terms of age in the gargling group of green coconut water, chlorhexidine 0.2%, and aquadest. The difference in the average salivary flow rate before gargling and after gargling in the green coconut water gargle group in children aged 12 y olds was 0.18±0.2 ml/min and in children aged 13 y olds was 0.18±0.15 ml/min. The unpaired T-test results of the difference in average salivary flow rate between children aged 12 y olds and 13 y olds resulted in *p<0.05, **p = 1.000 which means that there was an insignificant difference in salivary flow rate between 12 y olds and 13 y olds in the green coconut water gargling group.

Table 3: The difference in the average salivary flow rate in terms of age in the age group of green coconut water, chlorhexidine 0.2%, and aquadest

Gargling groups	Age (year-olds)	Difference in average of salivary flow rate (x̄±SD) (ml/min)	*p-value*
Green Coconut Water	12	0.18±0.2	1.000
	13	0.18±0.15	
Chlorhexidine 0.2%	12	0.34±0.19	0.644
	13	0.4±0.2	
Aquadest	12	0.2±0.12	0.195
	13	0.1±0.1	

Table 4 showed the difference in the average salivary flow rate in terms of sex in the gargle group of green coconut water, chlorhexidine 0.2%, and aquadest. The difference in the average salivary flow rate before gargling and after gargling in the green coconut water gargle group in boy was 0.22±0.23 ml/min and in girl was 0.14±0.09 ml/min. The unpaired T-test results of the difference in average salivary flow rate between boys and girls produced *p<0.05, **p = 0.486, which means that there was an insignificant difference from the salivary flow rate between boy and girl in the green coconut water gargling group.

Table 4: The difference in the average salivary flow rate in terms of sex in the age group of green coconut water, chlorhexidine 0.2%, and aquadest

Gargling groups	Gender	Difference in average of salivary flow rate (x̄±SD) (ml/min)	p-value
Green coconut water	Boy	0.22±0.23	0.486
	Girl	0.14±0.09	
Chlorhexidine 0.2%	Boy	0.28±0.23	0.139
	Girl	0.46±0.09	
Aquadest	Boy	0.16±0.11	0.806
	Girl	0.14±0.13	

DISCUSSION

This study was conducted to determine the effect of gargling green coconut water on salivary flow rate in children aged 12-to 13 y olds. This study involved 30 children with a high risk of caries.

This study showed that all three gargling ingredients significantly affected the increase in salivary flow rate. The results of Andayani, *et al.*'s research on the effect of gargling old coconut water on salivary flow rate found that there was a significant difference in salivary flow rate after gargling old coconut water with a value of p = 0.002 [22]. Literature study of Nurazizah, *et al.* also explained about the potential of young coconut water as a mouthwash to naturally increase the salivary flow rate [23]. The increase in salivary flow rate is caused by mechanical stimulation in the form of gargling activity and chemical stimuli originating from coconut water. Chewing or gargling can stimulate salivary secretion due to the manipulation of pressure receptors found in the mouth. Tannins in coconut water are a subclass of polyphenols that give it a bitter taste. Tannin compounds that come into contact with the taste bud on the tongue will form nerve impulses from the anterior 2/3 of the tongue. Nerve impulses formed will first be transmitted to the lingual nerve then through the tympanic cord to the facial nerve and finally to the solitary tract in the brain stem. Nerve impulses are then transmitted into the brain stem directly to the inferior and superior salivatory nuclei. This area will then transmit signals to the submandibular, sublingual, and parotid glands to secrete saliva. The process of nerve impulse formation by the taste bud and the transmission of nerve impulses to the salivary center will continue to occur as long as there is exposure to mechanical and chemical stimuli from gargling activity which will cause more salivary secretion. The tannin content in coconut water can stimulate the salivary glands so that there is an increase in salivary secretion. In addition, the high mineral content in coconut water is also thought to stimulate the salivary glands to increase the salivary flow rate [22-24]. Dinyanti, *et al.*'s study found a decrease in viscosity and an increase in salivary volume after gargling with mouthwash containing chlorhexidine in children aged 11-12 y. Chlorhexidine affects salivary viscosity and volume by stimulating a bitter taste on the tongue that stimulates the central nervous system so that the salivary flow rate increases [25]. Research conducted by Pratiwi, *et al.* found that there was an increase in salivary volume in the aquadest gargling group. The increase in salivary volume is caused by a mechanical stimulus in the form of gargling movements that result in muscle contractions that can stimulate the salivary glands to produce more saliva [26-28].

The study showed that age did not significantly affect the stimulated salivary flow rate. This study is in line with the results of research by Forcella L, *et al.* which found that there was no significant difference in the rate of unstimulated salivary flow in children aged 6-15 y (p = 0.27) [29]. The results of the study by Sanchez-Perez, *et al.* also explained that the unstimulated salivary flow rate and stimulated salivary flow rate in children aged 7-12 y were relatively stable after 6 y of follow-up. The average unstimulated salivary flow rate ranged from 0.41-0.46 ml/min at the time of initial observation and at the final observation did not show a significant difference (p = 0.445). The stimulated salivary flow rate also showed a stable pattern after follow-up (p<0.0001) [30]. Hypersalivation is the most common manifestation of tooth eruption. Increased salivary secretion occurs due to irritation of the gums. Children between the age range of 12-to 13 y olds do not have a significant difference in salivary flow rate because all of the child's permanent teeth had erupted except for the third molars [12, 31]. Insignificant differences in salivary flow rate in this age range are also associated with slow conversion of salivary gland parenchyma tissue into connective tissue and fat [29].

The results of the study also showed no significant difference in salivary flow rate in terms of gender. The results of research by Sanchez-Perez *et al.* explained that the unstimulated and stimulated salivary flow rate in boys and girls was relatively stable after 6 y of follow-up. There was no significant difference between the unstimulated salivary flow rate in boys and girls (p = 0.139) nor the stimulated saliva flow rate (p = 0.769) [30]. The results of the study of de Souza, *et al.* on salivary flow rate and protein in boys and girls

with autism spectrum disorders also stated that there was no significant difference in resting salivary flow rate between boys and girls (p = 0.1978), where the resting saliva flow rate in boys was 0.35 ml/min and in girls was 0.25 ml/min [32]. Women have less unstimulated salivary flow rate than men due to the smaller size of the female major salivary glands. Hormonal fluctuations in women were also associated with a lower salivary flow rate [32, 33], but the differences were not observed in this study.

CONCLUSION

From the results of the study, it could be concluded that gargling green coconut water could increase salivary flow rate. The study also found that age and gender did not affect salivary flow rate.

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AUTHORS CONTRIBUTIONS

Lasmawat Septania Silaban-Writing, original draft preparation, data design, and performed the experiments; Zulfi Amalia Bachtiar-Conception, writing, original draft preparation and revision of manuscript, data design and analysis, performed the experiments; Ami Angela Harahap-Supervision and visualization, revision of manuscript; Ika Devi Adiana-Supervision and visualization, revision of manuscript.

CONFLICT OF INTERESTS

The authors have no conflict of interest to declare

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