

Salivary pH before and after cranberry juice consumption

Dwiana Lisany Marunduri¹, Rosiliwati Wihardja¹, Winny Yohana^{1*}

¹Department of Oral Biology, Faculty of Dentistry Universitas Padjadjaran, Indonesia

ABSTRACT

Introduction: Cranberry (*Vaccinium macrocarpon*) is commonly consumed as a source of antioxidants. The cranberry juice has a sour and a little bit of bitter taste that can affect the salivary pH. The sour taste is a result of its high content of proanthocyanidin. Cranberry juice plays a role in maintaining oral and dental health. Cranberries' flavonol and proanthocyanidin content play a role in preventing dental caries by preventing the growth of *Streptococcus mutans*. This study was aimed to compare the salivary pH before and after cranberry juice consumption. **Methods:** This research was quasi-experimental. The research population was the students from the Faculty of Dentistry Universitas Padjadjaran, and the sampling method was purposive sampling. Thirty-five male and female students with no history of systemic disease and drug administration, no orthodontics appliance and denture, were involved in this experiment. Students with lesions on oral mucosa were also excluded from this study. The pH measurement was performed with a digital pH meter to record the salivary pH ratio before and after consumption of cranberry juice. Before salivary pH comparison analysis was performed, the normality test was conducted, then the analysis was continued using the paired t-test. Statistical analysis was determined at $\alpha=0.05$. **Results:** The average values of salivary pH ratio before and after consumption of cranberry juice were 6.714 and 7.246, respectively. The normality test showed that the p-value before and after consumption of cranberry juice were 0.143 and 0.285, respectively ($p\text{-value}>0.05$), which categorised in the normal distribution. The paired t-test statistical analysis showed the p-value of 0.001 ($p\text{-value}<0.05$), which considered as significant. This result indicated that there was a significant difference in the salivary pH before and after consumption of cranberry juice. **Conclusion:** The salivary pH is increasing after cranberry juice consumption.

Keywords: Cranberry, juice, salivary pH.

p-ISSN: 1979-0201; e-ISSN: 2549-6212; Available from: <http://jurnal.unpad.ac.id/pjd/article/view/16803>

DOI: [10.24198/pjd.vol32no3.16803](https://doi.org/10.24198/pjd.vol32no3.16803)

Submission: May 16, 2019; Accepted: Oct 14, 2020; Published online: Nov 30, 2020

INTRODUCTION

Fruits are one of the important foods in maintaining nutritional balance; because it contains carbohydrates, minerals and vitamins.¹

The benefits of each fruit are different due to their differing contents. An example of such fruit are the cranberries. In every 50 grams of cranberry fruit there are high amounts of the following micronutrients: vitamin C (11%), fiber

*Corresponding author: Winny Yohana, Department of Oral Biology, Faculty of Dentistry Universitas Padjadjaran, Indonesia. Jalan Sekeloa Selatan I, Bandung, Indonesia, 40132. Phone: +62811248932; e-mail: winnyspkga@yahoo.com

(9.2%), manganese (9%), vitamin K (3.1%), vitamin E (1%), and calories (1%). The cranberries' high content of phytonutrients, such as phenolic acid, proanthocyanidin, anthocyanin, flavonoid and triterpenoid are key to unlocking the fruit's full potentials. Proanthocyanidin may help in anticancer activity by inhibiting cancer cells. Anthocyanin inhibits oxidative processes associated with the prevention of cancer cell growth.² Cranberries can prevent recurrence of urinary tract infections especially in adult women. The incidence of bacteriuria may decrease in elderly patients by consuming cranberries.³

Cranberries also affect oral and dental health. The presence of flavonol and proanthocyanidin can inhibit the growth of *Streptococcus mutans*, thereby preventing caries forming.⁴ Caries is influenced by four factors: microorganism, teeth, substrate and time. These factors interact with each other. Food can be fermented by microorganisms to form acids that can decrease salivary pH within a certain time. It can cause caries.⁵ Caries can be prevented by saliva that acts as a cleanser. The faster the salivary secretion, the more thorough is the cleansing process. A higher salivary secretion will result in higher buffering capacity which will increase its ability to prevent the process of caries (defense mechanism).⁶

Cranberries contain ample amounts of proanthocyanidin that plays a role in producing the acidic taste, if we drink cranberries juice that binds to the saliva protein.⁷ Sour taste from cranberries juice will be received by the taste bud on the tongue. This will create the sensation of the taste and this will affect the salivary flow rate.

Factors that affect salivary pH are the circadian rhythm, dietary habits and salivary speed stimulation.⁸ Flavor is a major stimulant in the increase of salivary secretion, especially the taste of acid.^{9,10} Cranberry juice has a very low pH of about 2.5.^{11,12} Increased salivary secretion

leads to an increase in salivary pH.⁸ Due to its acidity, it will stimulate parasympathetic efferent neuron cells to activate salivation. This study was aimed to compare the salivary pH prior to and after cranberry juice consumption.

METHODS

The research population was students from the Faculty of Dentistry Universitas Padjadjaran, and the sampling method was purposive sampling, which obtained 35 students as sample. The inclusion criteria in this study were as follows: students of Faculty of Dentistry Universitas Padjadjaran batch 2010; agree to participate in the research; good oral hygiene; no smoking habits; no systemic disease; not using denture or orthodontic appliances; not currently taking antibiotics, analgesic, anti-depressant, diuretic, antihypersensitive and antihistamine. Exclusion criteria were subjects suffered from disease such as fever and diarrhoea. This study has been approved by the Ethical Committee of Universitas Padjadjaran, with the approval number of 222/UN6.C2.1.2/KEPK/PN/2014.

The material used was off the-shelf instant cranberry juice. At the beginning of the study, each student did a spitting method for collecting unstimulated saliva. The subjects were asked to sit still while letting their saliva accumulated under their tongue for one minute then they were directed to spit out the saliva to a measuring glass, and the procedure was repeated until 10 minutes. Their salivary pH levels were recorded using a pH meter. Afterwards, they were asked to ingest 100 mL of cranberry juice and leaving it still inside their mouths for 30 seconds before swallowed. After consumption of cranberry juice, the students were asked not to ingest any food or drinks for 5 minutes. At the end of the 10-minute period, the students had their salivary pH levels recorded again for the second measurement.

RESULTS

Table 1. The salivary pH before and after consumption of cranberry juice

Group	Mean	Minimum	Maximum
Before consumption	6.714	4.9	7.8
After consumption	7.246	5.7	8.0

Table 2. The results of normality test

Group	Normality test results	
	p-value distribution	
Before consumption	0.143	Normal
After consumption	0.285	Normal

The salivary pH results before and after drinking cranberry juice are presented in Table 1. Prior to the analysis of salivary pH differences, the data normality had to be assessed, and the result was that the data were normally distributed. Afterwards, the paired t-test was then conducted. The results of data normality test is presented in Table 2.

Table 3 Comparison of salivary pH before and after drinking cranberry juice

Group	Comparison test		P-value	Conclusion
	Mean	SD		
Before consumption	6.714	0.735	0.001	Significant
After consumption	7.246	0.549	0.001	

The above table is the result of the normality test of data by Kolmogorov Smirnov method, p-value seen in the group before and after drinking cranberry juice greater than 0.05 means that data in both groups are normally distributed, so the data analysis using paired t-test. The mean value of salivary pH before juice consumption (6.714) was less than that after juice consumption (7.246), with a p-value of 0.001 (p-value<0.05 considered significant). This means there is a significant difference before & after drinking cranberry juice.

DISCUSSION

The results showed that the lowest salivary pH before drinking cranberry juice was 4.9 while the highest salivary pH was 7.8. The lowest salivary pH after drinking cranberry juice is 5.7 while the highest salivary pH is 8.0. The mean salivary pH before consumption of cranberry juice was 6.414, while after consumption was 7.246. There was a statistically significant increase in the salivary pH due to cranberry juice consumption (p-value=0.001).

Flavonoid and proanthocyanidin comprised in cranberries function to slow down *Streptococcus mutans* growth rate.⁴ A research conducted by Weh et al.¹² suggested that flavonoid contained in cranberries are able to slow down the bacteria's

growth rate in approximately three hours. Meanwhile, another research by Koo et al.¹³ discovered that proanthocyanidin in cranberries slows down the bacteria's growth rate in four hours by the mechanism of decreasing *Streptococcus mutans* acidogenicity, hence causing an increase in the salivary pH. *Streptococcus mutans* is considered as a main aetiology of caries, by producing acid as one of its virulence. The acid produced can decrease the salivary pH in oral cavity. Flavonoid and proanthocyanidin contained in cranberries disrupt acid production by the bacteria, especially *Streptococcus mutans*.

One of the functions of the saliva is to prevent caries by maintaining the salivary pH.⁸ Salivary pH is affected by the circadian rhythm, diet patterns, and velocity of saliva secretion. Salivary pH increases with salivary velocity.^{8,9} Salivary secretions are influenced by various stimulants, food taste is the main stimulant of chemical stimulant. Flavor tasting is activated in the early stages of food entry.¹⁰ Some of the sensory receptors active at the time of entry of food are gustatory receptors, mechanoreceptor, nociceptor and olfactory receptor.

Taste stimulation can cause a gustatory-reflex secretion with sour being the most effective stimulus, followed by salty. Cranberry juice has a very acidic pH, which is 2.5.¹¹ Cranberries contain ample amounts of proanthocyanidin that plays a role in producing the acidic taste.⁷ Sour taste from cranberries juice will be received by the taste bud on the tongue. This will create the sensation of the taste and this will affect the salivary flow rate.

Increased velocity of salivary secretion may lead to increased bicarbonate concentration, thus increasing the buffering capacity of the saliva.^{8,13,14,15} Therefore, the sour taste possessed by cranberry juice can stimulate salivary secretions that lead to increased saliva production.

The cranberry juices also acts as antioxidants, with active proanthocyanidin (PAC) composition. Consumption of PAC will stimulate an increased in salivary secretions. Cranberries are known to contain anthocyanin, flavonol, and proanthocyanidin. Cranberries contain the best sources of flavonoids compared to other plants containing the substance.⁴

CONCLUSION

Cranberry juice consumption increases the salivary pH.

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