RESEARCH PAPER

Whole Fruit Versus Similar Packed Fruit Juices Consumption And Salivary Ph Levels Estimation

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ABSTRACT:
Introduction:
Dietary acids are recognized as one of the major etiological factors contributing to dental erosion by causing a temporary reduction in oral pH. Although fruits are an important part of a healthy diet, both natural fruit acids and commercially processed fruit juices can alter the salivary environment. Whole fruits stimulate salivary flow through mastication, enhancing the buffering capacity of saliva, whereas processed fruit juices often contain higher concentrations of acids and added ingredients that may prolong acidic conditions in the oral cavity. The present study aimed to evaluate and compare the changes in salivary pH following the consumption of whole fruits and their corresponding commercially packed fruit juices.
Materials and methods:
Baseline plaque and salivary pH were measured 60 volunteers, they divided into three groups each of 20. Study was performed for 2 days On day 1 they are provided with fresh fruits. On day 2 they are provided with similar packed juice. Samples are collected before and after consumption at 5,10,15 and 20 minutes time interval and measured using pH meter
Results:
All fruits and fruit juices caused a temporary decrease in salivary pH, orange juice showed maximum drop in pH followed by pineapple and apple juice. Packed juices resulted in lower pH and prolonged acidic pH than the whole fruits.
Conclusion:
People are unaware of the harmful effects of endogenous acids in the fruit juices and their effect on the teeth. Processed fruit juices show greater erosive potential on salivary pH due to higher acid content. Whole fruits should be preferred over processed fruit juice for better oral health.
Keywords: Salivary Ph , processed fruit juice , dental erosion , citric acid , oral health , pH meter.
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Introduction

Fruit juices have become an indispensable part of our day to day diet intake in various situation owing to easy availability, ready to use pack and convenience to use. Changing lifestyles, increased in health awareness, hygiene concerns, advanced modern retail, regular purchase, and introduction of new flavours are the reasons behind the growth of the packaged-juice industry. The role of diet in the etiology of dental erosion has received the most attention in recent years(1). Dietary acids are undoubtedly the principle causative factor for extrinsic tooth erosion. This study has been attempted to clarify the alteration of salivary pH levels between whole fruits and similar packed fruit juices, as many consumers mistakenly consider packaged juices to be a healthy substitute(2). Whole fruits provide fiber, which helps regulate blood sugar and promote satiety in contrast to package fruit juices(3). By examining these effects, the study will contribute valuable insights to public health

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recommendations and guide healthier dietary choices and promote natural fruits than packed juice. Several studies have raised concern about the increasing prevalence of dental erosion, which is associated with the marked increase in the consumption of acidic fruit juices, fruit drinks, and carbonated beverages(4).There have been several reports that have raised a concern about an increased prevalence of dental erosion, which is related to the marked increase in the consumption of acidic fruit juices, fruit drinks, and carbonated beverages(5).

Materials and methods

GROUP A	FRUIT	PACKAGED JUICE
20	APPLE	APPLE JUICE
GROUP B		
20	ORANGE	ORANGE JUICE
GROUP C		
20	PINEAPPLE	PINEAPPLE JUICE

The materials required for the study includes Ph meter, freshly cut fruits and similar packed processed fruit juice. The study was conducted for 2 days. On the day of sample collection volunteers were requested to have their food prior 2 hours to the procedure. Baseline sample was collected from all the participants and pH was measured using pH meter.

The study was conducted around 3 pm to 5pm on day 1 and 3pm to 5pm on day 2. Volunteers were divided into 3 groups of 20 subjects each, test fruits were given to the volunteers in premeasured cups. Salivary pH was measured at various intervals after exposing them to freshly cut fruits.

After consumption of different fruits (orange, apple and pineapple) for each volunteer salivary pH was measured at an interval of 5 ,10, 15, 30 minutes. Day 2 volunteers are provided with the commercially available processed packed similar fruit juices [orange, apple and pineapple] kept at room temperature After consumption of packaged juices, immediately salivary pH was measured at an interval of 5, 10, 15, and 30 minutes.

The obtained data were subjected to the statistical analysis. SPSS software was used to assess the pH level at different time intervals and expressed as mean ± SD. Changes in pH were assessed by Student's unpaired "t" test for the comparisons of interest.

Fig 1: Natural Fruit Apple, Orange, Pineapple

Fig 2: Similar Processed Fruit Juice

Fig 3: Natural Cut Fruits – Apple Orange & Pineapple

Fig 4: Processed Juice of Apple, Pineapple, Orange

Fig 5: Measuring Ph

Results

The table presents the intergroup comparison of different fruit types and their juice forms across various time intervals using the ANOVA test. At baseline (normal), all groups showed similar mean values, and the ANOVA test result ($p = 0.901$) indicated no statistically significant difference among them. This suggests that the groups were comparable at the start of the study.

At the 5-minute mark, a statistically significant difference was observed among the groups ($p = 0.000$), with the highest mean noted in the Apple Whole Fruit group (7.210 ± 0.4518) and the lowest in the orange juice group (5.345 ± 0.1669). A similar trend continued at 10 minutes, where the ANOVA test again showed a significant difference ($p = 0.000$). The Apple Whole Fruit group maintained the highest mean (7.695 ± 0.1959), while Orange Juice again had the lowest (6.315 ± 0.2907).

At 15 minutes, the intergroup variation remained significant ($p = 0.000$), with Apple Whole Fruit scoring the highest (8.040 ± 0.2703) and Orange Juice the lowest (6.890 ± 0.2100), although the gap between the groups began to narrow.

By 30 minutes, the differences between the groups were no longer statistically significant ($p = 0.594$), with all groups approaching similar mean values. This suggests that although initial differences in response were prominent, the effect tended to equalize over time across all fruit and juice forms.

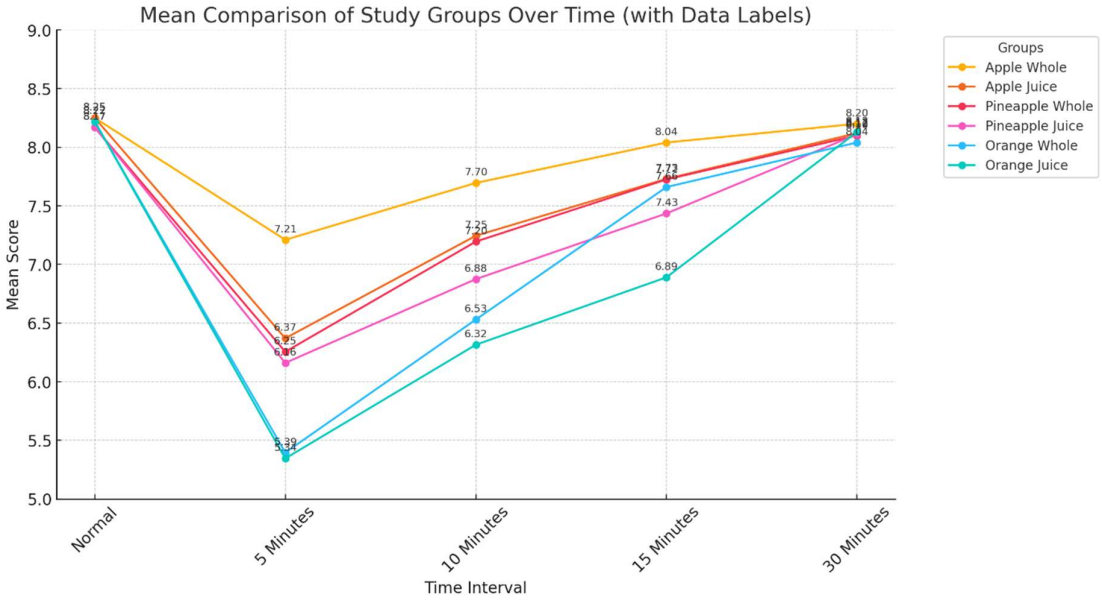
In summary, significant intergroup differences were evident at 5, 10, and 15 minutes, particularly favouring whole fruits over juices, especially apple, but these differences diminished by 30 minutes, indicating a possible recovery or stabilization effect.

TIME INTERVAL	GROUPS	MEAN	S.D	95% CONFIDENCE INTERVAL		ANOVA	SIG
				LOWER	UPPER		
NORMAL	APPLE WHOLE FRUIT	8.250	.3547	8.084	8.416	.026	.901
	APPLE JUICE	8.250	.3547	8.084	8.416		
	PINEAPPLE WHOLE FRUIT	8.170	.2736	8.042	8.298		
	PINEAPPLE JUICE	8.170	.2736	8.042	8.298		
	ORANGE WHOLE FRUIT	8.220	.2142	8.120	8.320		
	ORANGE JUICE	8.220	.2142	8.120	8.320		
5 MINUTES	APPLE WHOLE FRUIT	7.210	.4518	6.999	7.421	9.587	.000*
	APPLE JUICE	6.370	.1625	6.294	6.446		
	PINEAPPLE WHOLE FRUIT	6.255	.3720	6.081	6.429		
	PINEAPPLE JUICE	6.160	.3872	5.979	6.341		
	ORANGE WHOLE FRUIT	5.395	.2724	5.268	5.522		
	ORANGE JUICE	5.345	.1669	5.267	5.423		

10 MINUTES	**APPLE WHOLE FRUIT**	7.695	.1959	7.603	7.787	5.133	.000*
	APPLE JUICE	7.245	.2585	7.124	7.366		
	PINEAPPLE WHOLE FRUIT	7.195	.3818	7.016	7.374		
	PINEAPPLE JUICE	6.875	.3945	6.690	7.060		
	ORANGE WHOLE FRUIT	6.530	.2830	6.398	6.662		
	ORANGE JUICE	6.315	.2907	6.179	6.451		
15 MINUTES	**APPLE WHOLE FRUIT**	8.040	.2703	7.914	8.166	3.035	.000*
	APPLE JUICE	7.730	.2494	7.613	7.847		
	PINEAPPLE WHOLE FRUIT	7.725	.1943	7.634	7.816		
	PINEAPPLE JUICE	7.435	.1981	7.342	7.528		
	ORANGE WHOLE FRUIT	7.660	.1667	7.582	7.738		
	ORANGE JUICE	6.890	.2100	6.792	6.988		
30 MINUTES	**APPLE WHOLE FRUIT**	8.200	.3078	8.056	8.344	.053	.594
	APPLE JUICE	8.120	.3412	7.960	8.280		
	PINEAPPLE WHOLE FRUIT	8.100	.2575	7.979	8.221		
	PINEAPPLE JUICE	8.110	.2634	7.987	8.233		
	ORANGE WHOLE FRUIT	8.040	.2162	7.939	8.141		
	ORANGE JUICE	8.130	.1949	8.039	8.221		

**P value less than or equal to 0.05 is considered statistically significant difference*

Table 1: Intergroup comparison between the study groups by using an ANOVA test



Graph 2: This graph represents the mean comparison of study groups over time.

Discussion

The present study was undertaken to evaluate the changes in salivary pH following the consumption of whole fruits and their corresponding commercially packed fruit juices at different time intervals. Salivary pH is an important determinant of oral health, as a decrease below the critical level can predispose enamel to demineralization and dental erosion(6).

In the present study, no statistically significant difference was observed among the study groups at baseline ($p = 0.901$), indicating that all groups were comparable prior to intervention. This confirms homogeneity of the sample population and strengthens the reliability of subsequent comparisons.

At 5 minutes following consumption, a highly significant reduction in salivary pH was observed among the groups ($p < 0.001$). The lowest mean salivary pH was recorded in the Orange Juice group (5.345 ± 0.1669), whereas the highest mean was seen in the Apple Whole Fruit group (7.210 ± 0.4518). Similar statistically significant differences persisted at 10 minutes and 15 minutes, with whole fruits maintaining higher salivary pH values compared to their juice counterparts(7). These findings indicate that packed fruit juices exert a stronger acidogenic effect than whole fruits(8) . The greater reduction in salivary pH produced by commercially packed fruit juices may also be attributed to their higher content of free sugars and organic acids, which can prolong the acidic challenge within the oral environment(9)**.**

The marked fall in salivary pH observed in the Orange Juice group may be attributed to the presence of citric acid, which possesses high erosive potential and can chelate calcium from enamel surfaces(10). This finding is in accordance with **Jensdottir et al.**, who demonstrated the immediate erosive potential of orange juices and acidic beverages. Similarly, **Larsen and Nyvad** reported that the erosive effect of beverages depends not only on pH but also on buffering capacity and mineral content.-7

Whole fruit groups, particularly Apple Whole Fruit, consistently demonstrated higher salivary pH values throughout the early post-consumption period.This may be explained by the fibrous consistency of whole fruits, which necessitates mastication and thereby stimulates salivary flow(11). Mechanical mastication of whole fruits stimulates salivary gland activity, resulting in increased salivary flow and enhanced buffering capacity, which helps neutralize dietary acids more effectively(12).

In addition, the prolonged chewing time associated with whole fruits increases oral clearance and reduces the duration of acid contact with the enamel surface, thereby lowering the risk of dental erosion(13). Increased salivary secretion enhances bicarbonate buffering and accelerates clearance of acids from the oral cavity(14). Conversely, commercially packaged fruit juices require minimal mastication and are rapidly swallowed, resulting in comparatively lower salivary stimulation during consumption(15)**.** These observations are supported by **Humphrey and Williamson**, who emphasized the protective functions of saliva in maintaining oral equilibrium(16).

The present findings are also consistent with Jindal et al., who observed that commercially available fruit juices possess greater titratable acidity than fresh fruit preparations(17)**.** Likewise, Banan and Hegde reported significant alterations in salivary pH following beverage consumption, reinforcing the influence of dietary acids on oral pH dynamics(18)**.** Titratable acidity is considered a more reliable indicator of the erosive potential of a beverage than pH alone, as it reflects the amount of alkali required to neutralize the acid and therefore the duration of the acidic challenge within the oral cavity(19)**.**

Consequently, beverages with high titratable acidity may maintain a low oral pH for a longer period, thereby increasing the risk of enamel demineralization and dental erosion(20)**.** These findings further support the recommendation that whole fruits should be preferred over commercially packaged fruit juices as a healthier dietary alternative for maintaining oral health.

At 30 minutes, the intergroup differences were no longer statistically significant ($p = 0.594$), with all groups approaching similar values. The rapid recovery of salivary pH observed in the present study highlights the protective role of saliva in neutralizing dietary acids and maintaining oral homeostasis(21).

However, repeated exposure to acidic beverages at short intervals may overwhelm the buffering capacity of saliva, prolong the acidic challenge, and increase the susceptibility of enamel to erosion(22). Frequent and repeated consumption of acidic beverages may not allow adequate recovery time, thereby increasing the risk of cumulative enamel erosion(23). Within the limitations of the present study, it may be concluded that commercially packed fruit juices, especially orange juice, produce a greater immediate reduction in salivary pH compared to whole fruits. Whole fruits demonstrated a comparatively safer profile with faster stabilization of salivary pH. The presence of natural dietary fibre and the requirement for mastication may contribute to the favourable salivary response observed following whole fruit consumption(24)**.**

These findings support current dietary recommendations that encourage the consumption of whole fruits in preference to fruit juices as part of a healthy diet(25)**.** Therefore, preference for whole fruits over packaged juices may be beneficial in promoting oral health and minimizing erosive challenges.

Summary and Conclusion

The present study demonstrated that commercially packed fruit juices produced a greater immediate reduction in salivary pH than their corresponding whole fruits, with orange juice showing the maximum reduction. Although salivary pH gradually returned toward baseline within 30 minutes, repeated exposure to acidic packaged fruit juices may increase the risk of enamel demineralization and dental erosion.

Whole fruits exhibited a comparatively safer profile because of their lesser effect on salivary pH and their ability to stimulate salivary flow during mastication, thereby enhancing the natural buffering capacity of saliva. These findings highlight the importance of

considering not only the nutritional value but also the erosive potential of commonly consumed fruit beverages while making dietary choices.

Within the limitations of the present study, whole fruits may be considered a more favourable dietary choice than commercially packed fruit juices with respect to maintaining salivary pH and minimizing erosive challenges. The findings of this study may assist dental professionals in providing appropriate dietary counselling and educating patients about the potential oral health implications of frequent packaged fruit juice consumption.

Further studies with larger sample sizes, longer follow-up periods, and evaluation of additional salivary parameters and enamel changes are recommended to validate and expand upon the present findings.

Therefore, encouraging the consumption of whole fruits over commercially packed fruit juices may contribute to improved oral health and the prevention of dental erosion. Increased awareness among dental professionals, parents, educators, and the general public regarding the potential erosive effects of acidic packaged fruit juices may help promote healthier dietary habits and preserve long-term oral health.

References

1. Zero DT. Etiology of dental erosion--extrinsic factors. Eur J Oral Sci. 1996 Apr;104(2 (Pt 2)):162–77. doi:10.1111/j.1600-0722.1996.tb00065.x PubMed PMID: 8804884.
2. Moynihan PJ. Dietary advice in dental practice. Br Dent J. 2002 Nov 23;193(10):563–8. doi:10.1038/sj.bdj.4801628 PubMed PMID: 12481178.
3. Mavadiya HB, Roh D, Ly A, Lu Y. Whole Fruits Versus 100% Fruit Juice: Revisiting the Evidence and Its Implications for US Healthy Dietary Recommendations. Nutr Bull. 2025 Sep;50(3):411–20. doi:10.1111/nbu.70009 PubMed PMID: 40341750; PubMed Central PMCID: PMC12398644.
4. Tahmassebi JF, Duggal MS, Malik-Kotru G, Curzon MEJ. Soft drinks and dental health: a review of the current literature. J Dent. 2006 Jan;34(1):2–11. doi:10.1016/j.jdent.2004.11.006 PubMed PMID: 16157439.
5. Lussi A, Jaeggi T. Erosion--diagnosis and risk factors. Clin Oral Investig. 2008 Mar;12 Suppl 1(Suppl 1):S5-13. doi:10.1007/s00784-007-0179-z PubMed PMID: 18228059; PubMed Central PMCID: PMC2238777.
6. Humphrey SP, Williamson RT. A review of saliva: normal composition, flow, and function. J Prosthet Dent. 2001 Feb;85(2):162–9. doi:10.1067/mpr.2001.113778 PubMed PMID: 11208206.
7. Larsen MJ, Nyvad B. Enamel erosion by some soft drinks and orange juices relative to their pH, buffering effect and contents of calcium phosphate. Caries Res. 1999;33(1):81–7. doi:10.1159/000016499 PubMed PMID: 9831784.
8. Jensdottir T, Holbrook P, Nauntofte B, Buchwald C, Bardow A. Immediate erosive potential of cola drinks and orange juices. J Dent Res. 2006 Mar;85(3):226–30. doi:10.1177/154405910608500304 PubMed PMID: 16498068.
9. Saads Carvalho T, Lussi A. Chapter 9: Acidic Beverages and Foods Associated with Dental Erosion and Erosive Tooth Wear. Monogr Oral Sci. 2020;28:91–8. doi:10.1159/000455376 PubMed PMID: 31940633.
10. Shellis RP, Featherstone JDB, Lussi A. Understanding the chemistry of dental erosion. Monogr Oral Sci. 2014;25:163–79. doi:10.1159/000359943 PubMed PMID: 24993265.
11. Dodds MWJ, Johnson DA, Yeh CK. Health benefits of saliva: a review. J Dent. 2005 Mar;33(3):223–33. doi:10.1016/j.jdent.2004.10.009 PubMed PMID: 15725522.
12. Edgar WM. Saliva: its secretion, composition and functions. Br Dent J. 1992 Apr 25;172(8):305–12. doi:10.1038/sj.bdj.4807861 PubMed PMID: 1591115.
13. Hara AT, Zero DT. The potential of saliva in protecting against dental erosion. Monogr Oral Sci. 2014;25:197–205. doi:10.1159/000360372 PubMed PMID: 24993267.
14. Dawes C. Salivary flow patterns and the health of hard and soft oral tissues. J Am Dent Assoc. 2008 May;139 Suppl:18S-24S. doi:10.14219/jada.archive.2008.0351 PubMed PMID: 18460676.
15. Pedersen AM, Bardow A, Jensen SB, Nauntofte B. Saliva and gastrointestinal functions of taste, mastication, swallowing and digestion. Oral Dis. 2002 May;8(3):117–29. doi:10.1034/j.1601-0825.2002.02851.x PubMed PMID: 12108756.
16. Humphrey SP, Williamson RT. A review of saliva: normal composition, flow, and function. J Prosthet Dent. 2001 Feb;85(2):162–9. doi:10.1067/mpr.2001.113778 PubMed PMID: 11208206.
17. ResearchGate [Internet]. [cited 2026 Jul 8]. Evaluation of the (a) pH and (b) titratable acidity in juices of O.... Available from: https://www.researchgate.net/figure/Evaluation-of-the-a-pH-and-b-titratable-acidity-in-juices-of-O-ficus-indica-versus_fig2_366399381
18. Sánchez GA, Fernandez De Preliasco MV. Salivary pH changes during soft drinks consumption in children. Int J Paediatr Dent. 2003 Jul;13(4):251–7. doi:10.1046/j.1365-263x.2003.00469.x PubMed PMID: 12834385.
19. Lussi A, Carvalho TS. The future of fluorides and other protective agents in erosion prevention. Caries Res. 2015;49 Suppl 1:18–29. doi:10.1159/000380886 PubMed PMID: 25871415.
20. Barbour ME, Lussi A. Erosion in relation to nutrition and the environment. Monogr Oral Sci. 2014;25:143–54. doi:10.1159/000359941 PubMed PMID: 24993263.

21. Hara AT, Zero DT. The potential of saliva in protecting against dental erosion. Monogr Oral Sci. 2014;25:197–205. doi:10.1159/000360372 PubMed PMID: 24993267.
22. Ganss C, Lussi A. Diagnosis of erosive tooth wear. Monogr Oral Sci. 2014;25:22–31. doi:10.1159/000359935 PubMed PMID: 24993255.
23. Amaechi BT, Higham SM. Dental erosion: possible approaches to prevention and control. J Dent. 2005 Mar;33(3):243–52. doi:10.1016/j.jdent.2004.10.014 PubMed PMID: 15725524.
24. Edgar WM. Saliva: its secretion, composition and functions. Br Dent J. 1992 Apr 25;172(8):305–12. doi:10.1038/sj.bdj.4807861 PubMed PMID: 1591115.
25. Guideline: sugars intake for adults and children [Internet]. [cited 2026 Jul 8]. Available from: https://www.who.int/publications/i/item/9789241549028