

Comparison of Fluoride Concentration of Various Citrus and Non Citrus Fruits Commonly Available In Patna, Bihar- In Vitro Study

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Abstract

Background: Fluoride is available from various sources, the total ingestion of fluoride by a person should be estimated taking into consideration the fluoride consumed from all the sources including fruits. There are very few epidemiological studies carried out associated with fluoride estimation in fruits samples and especially in the Indian scenario. So the aim of the present study is to estimation fluoride concentration of various citrus and non-citrus fruits commercially available and consumed by people in Patna, Bihar.

Materials & Method: Seventeen different types of fruits commercially available and consumed by people of Patna

were collected. Out of the 17 fruit samples 6 were citrus fruits and 11 were non-citrus fruits. The fluoride estimation of fruit samples was done at State Level Water Testing Laboratory, PHED, Government of Bihar, Chhajjubagh, Patna. Juices of all 17 fruit samples were prepared, from each sample 10 ml of juice was measured and fluoride testing of each sample was carried out by using Orion 4 star-ion electrode analyzer. The collected data was analyzed using the statistical software program SPSS, version 17.

Result: The fluoride concentration in citrus fruits ranged from 0.03 ppm to 0.08 ppm while in non-citrus fruits it ranged from 0.03 ppm to 0.19 ppm. No significant

difference was observed between the mean fluoride concentration of citrus and non-citrus fruits.

Conclusion: Both citrus and non-citrus fruits have fluorides. Guava was found to have the maximum amount of fluoride content (0.19 ppm) among both the citrus and non-citrus fruits.

Keywords: Citrus Fruits, Non-Citrus Fruits, Fluoride, Orion 4 Star-Ion Electrode Analyzer.

Introduction

Its generally said, Health is Wealth and as we all know that from the hair on our head to the bones that support us and the blood that runs through us, our body relies on different elements for optimal health whether be it general health or oral health.¹ One of that trace element is fluoride that remains a milestone in the prevention and control of dental caries.² A daily fluoride intake of 0.05 to 0.07 mg/kg body weight is considered optimal for greatest resistance to dental caries and freedom from mottled enamel.³ The fluoride in the concentration of 1ppm in the drinking water is considered optimal for the prevention of dental caries. Fluoride is available for human consumption from various sources like air, water, soil, tea, coffee, milk and milk products, agricultural products like fruit and vegetables. Fruits are the rich source of essential nutrients required by the body and nutrients are found in different amount in various fruits.⁴ Fruits can be classified under different headings such as citrus and non-citrus fruits, fibrous and non-fibrous, seeded and seedless fruits, tropical and subtropical fruits.⁵ Since fluoride is available from various sources, the total ingestion of fluoride by a person should be estimated taking into consideration the fluoride consumed from all sources including fruits. The fluoride content in fruit is also an important source of fluoride available through dietary intake; however in fresh fruits is not yet very clear. The fluoride content of citrus fruits varies from 0.07 ppm to 0.17 ppm and in non-citrus

fruits the fluoride content varies from 0.03 ppm to 0.84 ppm.⁴

There are very few epidemiological studies carried out associated with fluoride estimation in fruit samples and especially in the Indian scenario. Hence, this study has been conducted to estimate and compare the fluoride concentration of different commercially available citrus and non-citrus fruits in Patna. So the aim of the present study is to estimation fluoride concentration of various citrus and non-citrus fruits commercially available and consumed by people in Patna, Bihar.

Materials & Method

Collection of Fresh Fruit Samples: Seventeen different types of fruits commercially available and consumed by people of Patna were collected. Out of 17 fruit samples, 6 were citrus fruits and 11 were non-citrus fruit (250gm each).

The fruits included in the study were as follows:

| SL No. | CITRUS FRUIT |
|--------|--|
| 1. | Grapes (<i>Vitis vinifera</i>) |
| 2. | Pineapple (<i>Ananas comosus</i>) |
| 3. | Orange (<i>Citrus sinensis</i>) |
| 4. | Mausami (<i>Citrus aurantifolia</i>) |
| 5. | Tomato (<i>Solanumly copersicum</i>) |
| 6. | Lime(<i>Citrus australasica</i>) |

| SL No. | NON CITRUS FRUIT |
|--------|---|
| 1. | Watermelon (Citrullus lanatus) |
| 2. | Apple (Malus domestica) |
| 3. | Pomegranate (Punica Granaum/Punica malus) |
| 4. | Peanuts (Arachis hypogaea) |
| 5. | Coconut (Cocos nucifera) |
| 6. | Banana (Musa acuminata) |
| 7. | Papaya (Carica papaya) |
| 8. | Pears |
| 9. | Chikoo (Sapodilla / Manikara zapota) |
| 10. | Kiwi |
| 11. | Guava(Genus Psidium) |

Armamentarium used

| |
|--|
| Fruit samples(250 gm. each) |
| Deionised water standardised for its fluoride content(0 ppm) |
| Wooden Chopping board with chopper |
| Juicer |
| Juice sample (10 ml each) |
| Fluoride Ion electrode analyzer |
| Whatman filter paper no 41(Fast) |

Preparation of fruit juice: Fruit samples were first washed under running water and then rinsed with deionized water. Sample was taken into the juicer and 30ml deionized water was added. The juice was filtered using Whatman filter paper no 41 (fast) in a plastic beaker which was also rinsed with deionized water. Likewise, juices of all 17 fruit samples were prepared.

Laboratory analysis: The fluoride estimation of fruit sample was done at state level water testing laboratory, Government of Bihar.

Fluoride estimation: 10 ml of juice of each sample was measured in sterile plastic beakers using a plastic

measuring cylinder. The fluoride testing was carried out by using Fluoride ion electrode analyzer.

Ethical consideration: The proposed study was reviewed by the Ethical committee of Buddha Institute of Dental Sciences and Hospital, Patna and clearance was obtained.

Statistical analysis: The collected data was analyzed using the statistical software program SPSS, version 17. Independent t-test was used to compare the mean values of fluoride concentration of citrus & non-citrus values. A p value of ≤ 0.05 was considered as statistically significant.

Results

The present study was conducted to estimate fluoride concentration of various citrus and non-citrus fruits commonly available in Patna, Bihar. 17 different types of fruits commercially available in Patna were collected and grouped into 2 category.

- 1). Citrus group (6 fruits)
- 2). Non-citrus group (11 fruits)

Juices of all fruit samples were prepared and fluoride estimation was done by using fluoride ion electrode analyzer. The estimation fluoride data of fruits were obtained and tabulated, followed by subsequent statistical analysis. The results are presented here under the heading of various parameters considered for this study.

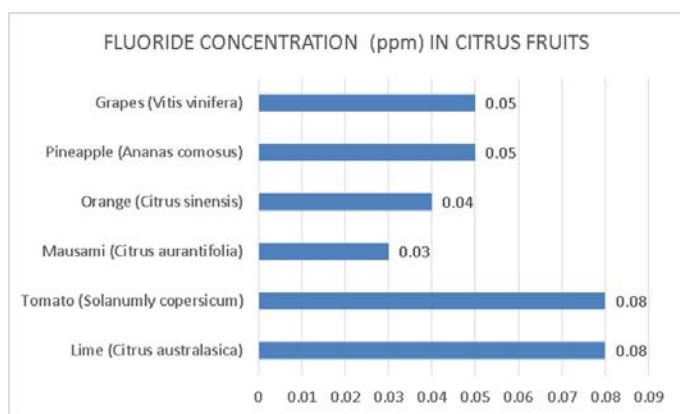
In the present study the maximum fluoride content was found in Guava (Genus Psidium)- 0.19 ppm followed by Pomegranate (Punica Granaum) and Papaya (Carica Papaya)- 0.09 ppm and minimum fluoride content was found to be in Mausami (Citrus aurantifolia) and Chikoo (Sapodilla)- 0.03 ppm.

The fluoride concentration in citrus fruits ranged from 0.03 ppm - 0.08 ppm. A least of 0.03 ppm was seen with Mausami (Citrus aurantifolia) and a maximum of 0.08 ppm was seen in Tomato (Solanum lycopersicum) and Lime (Citrus australasica). (Graph 1) While in non-citrus

fruits, the fluoride concentration ranged from 0.03 ppm - 0.19 ppm. A least of 0.03 ppm was seen with Chikoo (Sapodilla) and a maximum of 0.19 ppm was seen in Guava (Genus Psidium). (Graph 2)

The mean fluoride concentration in the citrus fruits was found to be 0.52 ± 0.02 ppm whereas in non-citrus fruits it was 0.81 ± 0.06 ppm. When this means values were compared for any statistically significance, it was found that there was no difference with p value 0.57. (Table 1)

Graph 1: Shows the concentration of fluoride (ppm) in Citrus Fruits



Graph 2: Shows the concentration of fluoride (ppm) in Non-Citrus Fruits

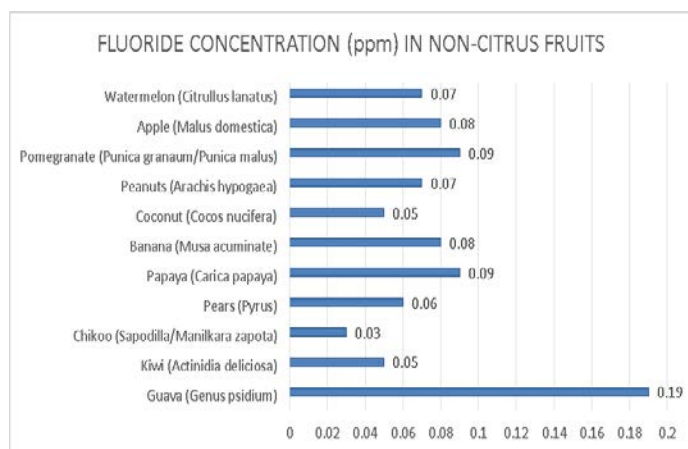


Table 1: Mean Fluoride Concentration of Citrus and Non-Citrus Fruits

| FRUITS | MEAN FLUORIDE CONCENTRATION (PPM) | P-VALUE |
|-------------------|-----------------------------------|-----------|
| Citrus (N=6) | 0.52 ± 0.02 | 0.57 (NS) |
| Non-Citrus (N=11) | 0.81 ± 0.06 | |

Discussion

According to Nizel the fluoride content in citrus fruits varies from 0.07 ppm to 0.17 ppm and in non-citrus fruits the fluoride content varies from 0.03ppm to 0.84 ppm.⁴ The range of fluoride concentration in drinks may vary as a result of factors such as geographical zone, temperature, altitude and origin of water supply.⁶

As per the data from the USDA Agricultural Research Service, the edible portion of apples contain 3.3mg of fluoride, bananas 2.2mg, water melon 1.5mg, grapes 1 mg, whereas pineapple and oranges contain 0 mg fluoride.⁷ Our findings were not consistent with these results (0.08 ppm in apples, 0.08ppm in banana, 0.07 ppm in watermelon, 0.05 ppm in grapes, 0.05 ppm in pineapple and 0.04ppm in orange).

This variation in the values can be attributed to the wider geographic area and different variety of each fruit.⁸ Also our findings are in accordance with the findings of Navin et al where fluoride concentration in apple was 0.08ppm, 0.10ppm in banana , 0.08ppm in watermelon , 0.05ppm in grapes , pineapple 0.06ppm and 0.04ppm in orange.⁹

In the present study the maximum fluoride content was found in Guava (0.19 ppm) and minimum fluoride content was found to be in Mausami and Chikoo (0.03 ppm). This finding is in accordance with the study done by Navin et

al where maximum fluoride content in guava was found to be 0.18ppm & minimum fluoride content was found to be in orange and Chikoo (0.04mm).⁹ The exact mechanism of how this fruits retains more fluoride is not clear with the existing literature available to us which indeed warrants further physiological investigation.

Our study show that the mean fluoride concentration in citrus fruit was found to be 0.52 ± 0.02 ppm whereas in non-citrus fruits it was found to be 0.81 ± 0.06 ppm which is in accordance with the study done by Navin et al where mean fluoride concentration in citrus fruit was found to be 0.56 ± 0.01 ppm whereas in non-citrus fruits it was found to be 0.84 ± 0.03 ppm.⁹

The fluoride concentrations of fruits in our study were found in accordance with the fluoride range of fruits reported by Zohouri and Rugg Gunn.¹⁰ The range of fluoride content for different fruits as per Zohouri and Rugg Gunn is 0.009-0.011 $\mu\text{g/g}$ for grapes and for water melon the values are 0.100-0.120 $\mu\text{g/g}$, oranges 0.013-0.054 $\mu\text{g/g}$, and for pomegranate it is 0.025-0.914 $\mu\text{g/g}$.¹⁰ and the value obtained in our study for grapes is 0.05 ppm, watermelon 0.07 ppm, orange 0.04 ppm and 0.09 ppm for pomegranate. (1ppm=1 $\mu\text{g/g}$)

The variation in fluoride content can be related to the use of various types of insecticides, Fluoride content of the soil where the fruits are growing or because of the fluoride concentration of the water given for irrigation or soil used for growing fruits. The difference can also be attributed to different climatic conditions.

Recommendations

Following recommendations are proposed:-

- 1). Intake of fluoride from various dietary sources must be considered.
- 2). Dentists prescribing fluoride supplement must enquire about the child's fluoride exposure from all important

sources like dentifrices, infant formula, beverages, fruits and vegetables etc.

- 3). Individuals with fluoride deficiency can be advised to consume more of fluoride rich fruits like guava as supplements.

Conclusion

It is evident from the present study that all fruits considered, have some concentration of fluoride in them. This can act as supplement for the individuals who have slight variation in intake of fluoride and ease in availability further augments its significance.

References

1. K. Park: In Chapter 2 "Concepts of Health and Diseases" Text Book of Preventive and Social Medicine; 25th Edition, Banarasidas Bhanot Publishers, India. 2019 Page no 14.
2. G. A. Scardina and P. Messina; Good Oral Health and Diet; Journal of Biomedicine and Biotechnology; Volume 2012.
3. Stannard JG, Shim YS, Kritsineli M, Labropoulou P, Tsamtouris A; Fluoride levels and fluoride contamination of fruit juices; J Clin Pediatr Dent. 1991; 16(1):38-40.
4. Nizel AE. Nutrition in Preventive Dentistry. 2nd ed. 1981. W.B. Saunders; Japan.
5. Feinberg. Fruits and Vegetable Processing; Agriculture and Consumer Protection; General Properties of Fruits and Vegetables, Chemical Composition and Nutritional Aspects; 1973.
6. Jimenez-Farfan MD, Hernandez-Guerrero JC, Loyola-Rodriguez JP, Ledesma-Montes C. Fluoride content in bottled waters, juices and carbonated soft drinks in Mexico City, Mexico. Int J Paediatr Dent. 2004 Jul; 14(4):260-6.
7. Fruits rich in Fluoride on Vegan Nutrients Project; The minerals view of Fruits rich in Fluoride.

8. McClure FJ. Fluorine in Foods: Public Health Reports. August 26, 1949; 64(34).
9. Navin Anand Ingle, Alankrita Chaudhary, Goutham B S, Navpreet Kaur, Rahul Gupta; Estimation of Fluoride Concentration Of Various Citrus And Non-Citrus Fruits Commonly Consumed And Commercially Available In Mathura city; JIAPHD,2013; 11(4):9-14.
10. Zohouri FV, Rugg-Gunn AJ. Fluoride concentration in foods from Iran. Int J Food Sci Nutr. 1999 Jul; 50(4):265-74.