REVIEW OF RESEARCH
ISSN: 2249-894X
IMPACT FACTOR : 5.7631(UIF)
VOLUME - 11 | ISSUE - 4 | JANUARY - 2022

QUANTITATIVE ASSESSMENT OF PHOSPHORIC ACID IN VARIOUS SOFT DRINKS AVAILABLE IN INDIA

Anjali Sudhir Puranik
Sheth J.N. Paliwala Commerce College, Science and Arts College, Pali-Sudhagad.

ABSTRACT:

Two major categories of soft drinks include carbonated and non-carbonated which are commonly available in market. The carbonated soft drinks usually contain phosphoric acid whereas the non -carbonated soft drinks contain citric acid as a major component. In addition, some other constituents such as caffeine, colour, flavours cocoa like and preservatives are added to develop the taste and increase shelf life of the product. In the current study the phosphoric acid content in eight samples of common carbonated soft drinks is determined using pH-metre with combined glass electrode. The concentrations for Phosphoric acid in common samples of carbonated soft drinks found is range of 0.440±0.07 *to 1.839*±0.13 *g/L by pH metric method.*

KEYWORDS: *soft drinks, phosphoric acid.*

INTRODUCTION

A few main subcategories soft drinks viz bottled water, carbonated soft drinks, dilutable concentrates, (squashes, powders, cordials and syrups), fruit juices (100% fruit juice and nectars (25-99% juice content) and still drinks (including ready-to-drink (RTD) teas, sports drinks and other noncarbonated products (with less than 25% fruit juice) [1]. Troiano et al. [2] reported that 20 - 24% of energy intake came from beverages.

Carbonated Soft Drinks are beverages with added carbon dioxide that gives an effervescent taste to the beverages. Carbonated soft drinks are further divided into colas and non-colas, as well as diet and regular soft drinks. The cola-flavoured carbonated beverages usually contain added phosphoric acid to enhance the tartness [3]. A few lime - tasting carbonated drinks also contain phosphoric acid for the same purpose [1]. Acidity regulators are the food additives used to change or maintain the pH whereas acidulants are the acids added to confer sour flavours [3]. Phosphoric acid plays double role as acid regulator as well as acidulant in the soft drink it contains[4]. Acid like ascorbic acid is a Vitamin (Vitamin C) as well as an antioxidant. Malic acid, Fumaric acid and tartaric acid provide natural taste to the drink. Caffeic acid is another antioxidant used commonly [5]. Taylor [6] summarized that the components of soft drinks are as follows: water up to 98% v/v, carbon dioxide 0.30 - 60% m/v, acids 0.03 to 0.05% Sweetener (sugars 7-12 % m/v), colours (natural or synthetic) 0-70ppm.

Phosphoric acid has a drier, and sharper flavour than citric and tartaric acid in contrast with fruitiness of citric acid. Hence it is blended with non-fruit drinks. [5].

The phosphate content in cola type carbonated beverages could have reduced levels of the active form of Vitamin D and led to a decline in calcium absorption and to bone decalcification, increasing bone fracture risk higher calcium in urine detected after consumption of caffeinated cola beverages. It also found to result in obesity epidemic. [6] The solubility of dental tissues is affected by pH and titratable acidity and the soft drink. When oral pH drops below 5.5, enamel dissolution occurs [7] The acids that have erosive potential are mainly carbonic, phosphoric, maleic and citric acid. [8] [9] Thus consumption of carbonated soft drinks with high acid content whether regular or diet types are found to associate significantly with dental erosion.[10] Heller et al [11] revealed that cola consumption more than three times a week increased the risk of the erosion to three times as compared to non-cola drinks. A reduction in the erosive potential of soft drinks can be achieved by adjusting pH, acidity and addition of calcium.[12]. The most recent Dietary Reference Intakes (DRIs) for phosphorus in the United States were established by the Institute of Medicine in 1997. These include the estimated average requirement (EAR), and the recommended dietary allowance (RDA). In healthy adults, the phosphorus EAR is 580 mg/d and the RDA is 700 mg/d (1). However, the average phosphorus intake of U.S. adults over the age of 20 is 1399 mg/d which is approximately 2.5 times the EAR and twice the RDA. [2]. According to Mona S. Calvo et al. [13] phosphorus intake exceeding nutrient needs in healthy individuals disrupts phosphorus regulation and negatively affects bone accretion or loss. G Wyshak [14] obtained a data for youngsters show a strong association between cola beverage consumption and bone fractures in girls also no association between the non-cola drinks and bone fractures was found. In boys, only total caloric intake was associated with the risk of bone fractures; the association was inverse for cola drinks. M S Calvo[15] in another paper shows evidence that such high phosphorus intakes may impair synthesis of the active metabolite of vitamin D and disrupt calcium homeostasis particularly in older women. In one more paper, of M S Calvo[16] the correlation is given as phosphorous in excess could be linked to tissue damage by a variety of mechanisms involved in the endocrine regulation of extracellular phosphate, specifically the secretion and action of fibroblast growth factor and parathyroid hormone. Disordered regulation of these hormones by high dietary phosphorus may be key factors contributing to renal failure, CVD, and osteoporosis.

MATERIALS AND METHODS:

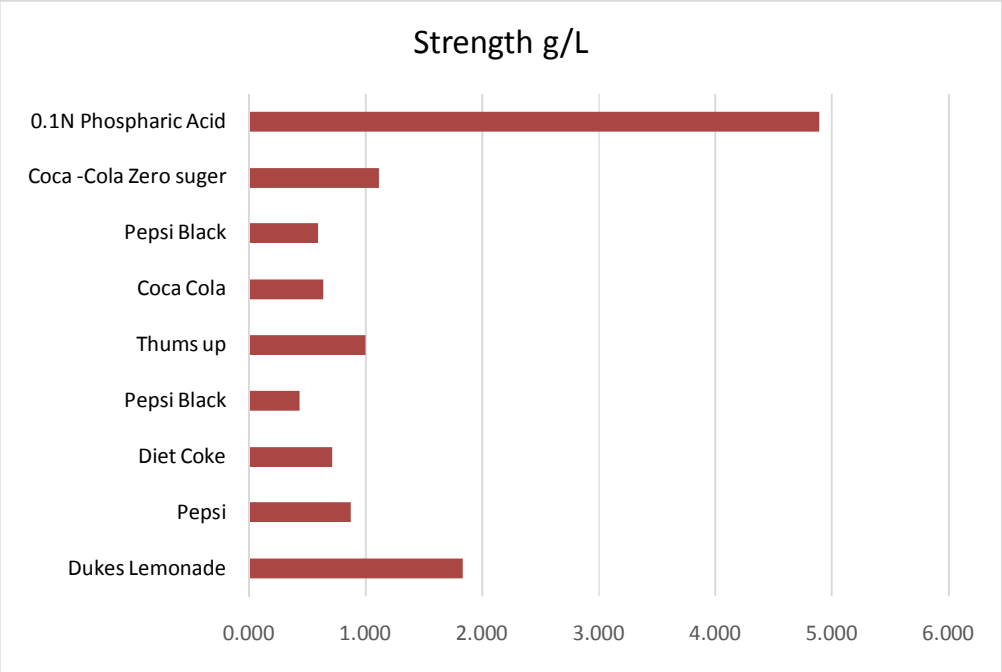
1. Various soft drinks bottles were purchased from market. To prepare the analysis sample, the bottled drink is poured in a 250 cm^3 borosil beaker and boiled for ten minutes to remove the dissolved carbon dioxide.
2. All the reagents used are of AR grade. Sodium Hydroxide solution is standardised using 0.1N K-H Phthalate solution. An aliquot of 25 cm^3 of sample is titrated with standard NaOH solution in both methods. Similarly, Standard determination is done for Phosphoric Acid (85.5%).
3. The pH-meter with combined glass electrode is standardised by using the buffer solutions of pH= 7, pH = 9.2 and pH = 4. The titration of samples and standards was continued till pH of the titter solution exceeds the value of 10 and remains constant for further additions of titrant.
4. Two types of graphs are plotted in instrumental method. pH Vs Volume of NaOH solution added and $\frac{\Delta pH}{\Delta V}$ with volume of NaOH solution added. The first derivative graph is used to determine the equivalence point whereas the titration curve confirm nature of acid in the soft drink.

RESULTS:

1. The estimation is done by instrumental method and comparison with standard
2. Pure Phosphoric acid shows two peaks in the first derivative curve corresponding to first two dissociations.
3. Since the other acidic ingredients are neutralised simultaneously, the end point corresponds to the total acid contents instead of specifically phosphoric acid.

4. The phosphoric acid content ranges from 0.440±0.07 to 1.839±0.13 g/L by pH metric method.

Sr. No.	Name of drink	Strength by pH metric in g/L
1	Dukes Lemonade	1.839
2	Pepsi	0.879
3	Diet Coke	0.720
4	Pepsi Black	0.440
5	Thumps up	0.999
6	Coca Cola	0.640
7	Pepsi Black	0.660
8	Coca Cola zero sugar	1.119
9	Pure Phosphoric acid	4.897



DISCUSSIONS:

For phosphoric acid, $pKa_1 = 2.15$, $pKa_2 = 7.2$, $pKa_3 = 12.35$.The third dissociation is less probable to take place. [17] The suitable indicator phenolphthalein shows colour change between pH range of 8.2 to 10. During titration with NaOH, this range corresponds to second dissociation. Hence the equivalent weight of phosphoric acid is considered as half of its molecular weight.

This estimation is more valuable since the acid regulators and acidulants are neither mentioned by their names nor their concentration is printed. A common science student would not know the acid content of the drink whereas one can read the composition of pharmaceutical. There is a numbering system used in Europe for all approved additives which is now adopted and extended internationally by Codex Alimentarius [18]. For example, Phosphoric acid as E330, Acetic acid as E 260 etc. In some countries other than Europe, the letter E is replaced by INS (International numbering system) or somewhere, E is dropped and simply number is used. The United States Food and Drug administration (FDA) lists these items as 'Generally Recognized As Safe' [19]

CONCLUSIONS:

Using instrumental method, the acid content estimated in ready to consume soft drink is between 0.440±0.07 to 1.839±0.13 g/L for phosphoric acid containing drinks it is. There is no upper limit for concentration of phosphoric acid in soft drinks in any guideline in any country. However, it shifts intake of phosphorous towards higher side than EAR which is 580 mg/day and the RDA is 700 mg/day as recommended by US and other countries. Since the daily food is sufficient to provide phosphorous and the cola drinks provide high concentration of easily soluble phosphate regular consumption of these drinks is proved harmful to health.

REFERENCES:

1. Roethenbaugh G (2005) Ingredients. In Chemistry and Technology of Soft Drinks and Fruit Juices. Ashurst PR (Eds.), Sheffield Academic Press, England, pp. 15-34.
2. Troiano RP, Briefel RR, Carroll MD, Bialostosky K (2000) Energy and fat intakes of children and adolescents in the United States: data from the National Health and Nutrition Examination Surveys. Am J Clin Nutr 72(5 Suppl): 1343S-1353S.
3. Abdeiazmi Sayed and Abdelazimf Abdellati: (2018): The Beverages: Agri Res &Tech: open AccesJ.2018; 14(5) 555933
4. National Soft Drink Association (2003) What's in Soft Drink.
5. Taylor RB (2005) Other beverage ingredients. In: Ashurst PR (Ed.), Chemistry and Technology of Soft Drinks and Fruit Juices. Sheffield Academic Press, England, pp. 90-128.
6. M Nassiruddin, M Mahmudul Hasan (2019): Quantitative Analysis of Juice, citric acid, vitamin -C content, sugar levels and sugar acid quantitative relation in some cultivated citrus fruits. ISSN: 2455-4898 Volume 4 Issue 2Page 38-41
7. Chowdhary et al (2018) Highly acidic pH values of carbonated sweet drinks, fruit juices, mineral waters, and unregulated fluoride levels in oral care products and drinks in India: a public health Concern) Perspect Public Health 2018.
8. Shenkin et al (2003) Soft drink consumption and caries risk in children and adolescents 51:30-6.
9. Gonzalez et al (2019) Relationship between erosive tooth wear and beverage consumption among a group of schooMexico city. Clin Oral Investing 23:715-23.
10. Al- Majed et al (2002) Risk factors for dental erosion in 5-6 years old and 12–14-year-old boys in Saudi Arebia. Community Dent oral Epidemiol 30:38-46, Pachori et al
11. Hellar et al (2001) Sugared soda consumption and dental caries in United states Journal of dental research 80(10): 1949-1953
12. (West NX et al(1999 Development and evaluation of low erosive blackcurrent drink 2. Comparision with a conventional blackcurrent drink and orange juice. J Dent: 341-344)
13. Mona S Calvo [1], Jaime Uribarri Public health impact of dietary phosphorus excess on bo ne and cardiovascular health in the general population (2013 Jul;98(1):6-15. doi: 10.3945/ ajcn. 112.053934. Epub 2013 May 29.
14. G Wyshak [1], R E Frisch Carbonated beverages, dietary calcium, the dietary calcium/phosphorus ratio, and bone fractures in girls and boys(1994 May)15(3): 210-5. doi: 10.1016/1054-139x(94)90506-1.
15. Mona S Calvo [1], Katherine L Tucker Is phosphorus intake that exceeds dietary requirements a risk factor in bone health? (2013) Oct) 1301:29-35, doi: 10.1111/nyas.12300.
16. M S Calvo [1], Y K Park Changing phosphorus content of the U.S. diet: potential for adverse effects on bone1996 Apr;126(4 Suppl):1168S-80S. doi: 10.1093/jn/126.suppl_4.1168S.
17. Open Library Press Books Appendix: Selected Acid Dissociation Constants at 25°C
18. CODEX ALIMENTARIUS COMMISSION PROCEDURAL MANUAL. Twenty-fifth edition Joint FAO/WHO Food Standards Programme (2018)
19. FDA (2019) Generally Recognized As Safe (GRAS)