

The pH of Beverages and Its Impact on Tooth Mineralization



INTRODUCTION

- Dental enamel is the hardest and most highly mineralized substance in the body.
- The enamel structure is a crystalline latticework composed of a myriad of minerals, predominantly hydroxyapatite.
- The inorganic structure of the tooth enamel surface are products of the active demineralization and remineralization process.
- Dental biofilm adjusts the tooth surface pH which affects the demineralization/remineralization process.
- Dietary ingestion of fermentable carbohydrates, especially sucrose, provides the substrate for the cariogenic microorganisms in the biofilm to form organic acids.¹
- When acids lower the pH of the dental biofilm, the demineralization process begins to break down tooth enamel.

DEMINERALIZATION & REMINERALIZATION

- Demineralization is the process of removing mineral ions from the hydroxyapatite crystals of tooth tissues and is one of the leading causes of dental erosion and carious lesions.
- Remineralization is the restoration of mineral ions to the hydroxyapatite crystals. Both processes occur on the tooth surface.²
- Demineralization of tooth tissues can be caused by a variety of intrinsic and extrinsic factors.
- Intrinsic factors are commonly due to diseases while extrinsic factors include diet and medications.²
- Extrinsic factors of particular interest include the various beverages that are available today and their impact on tooth mineralization.

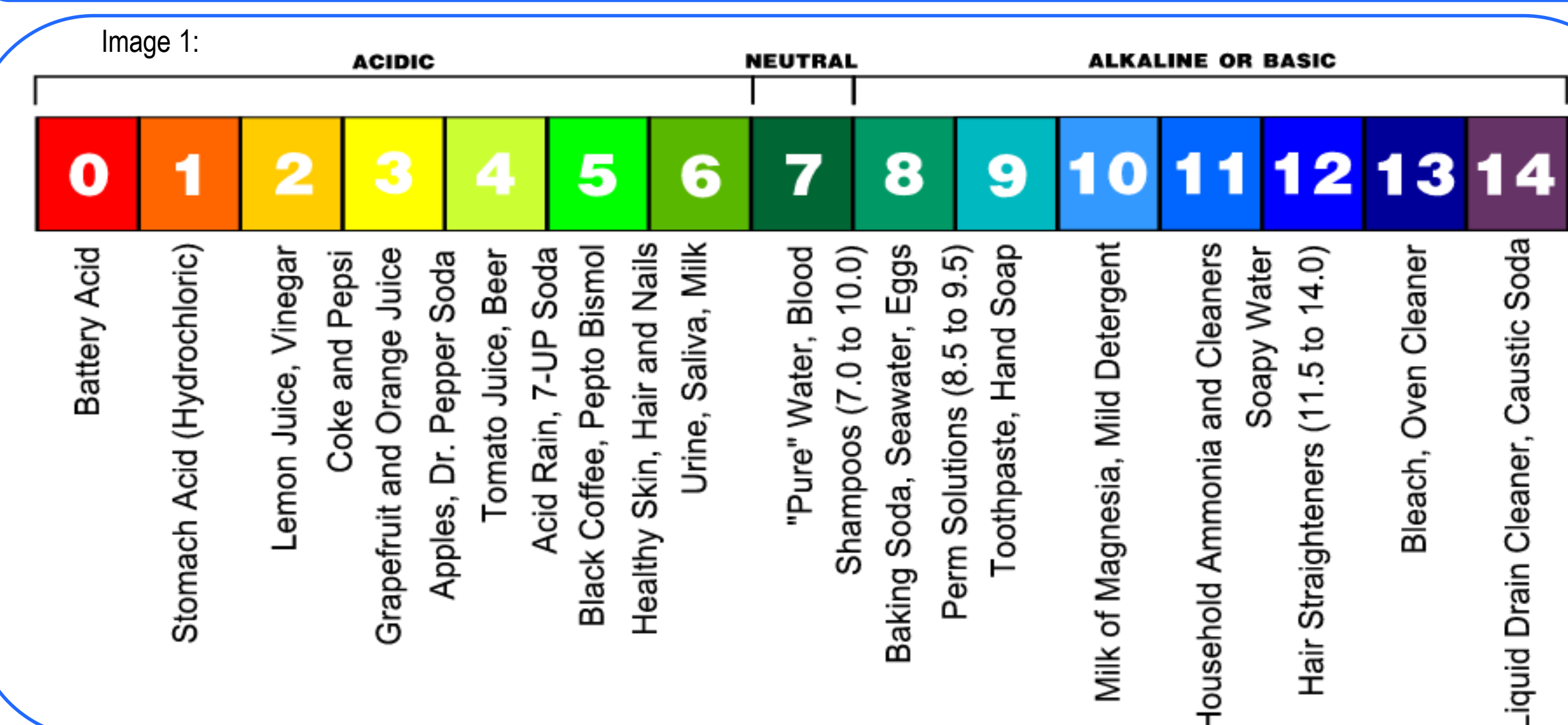
IMPORTANCE OF pH

- The pH scale ranges from 0 to 14 with 7 being neutral. The pH level of a liquid is the measurement of free flowing electrically charged particles in the substance indicating acidity (below 7) or alkalinity (above 7).³
- Subsequently, the impact of a beverage's pH has on the demineralization of teeth is an important factor to consider during each patient's assessment.
- As the pH in the oral cavity drops below 4.0, the tooth surface erodes.
- With each unit of decrease in pH, there is a ten-fold increase in enamel solubility resulting in a one-hundred-fold increase in enamel demineralization.
- The consumption of beverages with higher concentrations of available hydrogen ions (pH < 4.0) results in the immediate softening of the tooth surface causing the tooth to become susceptible to abrasion and attrition.⁴

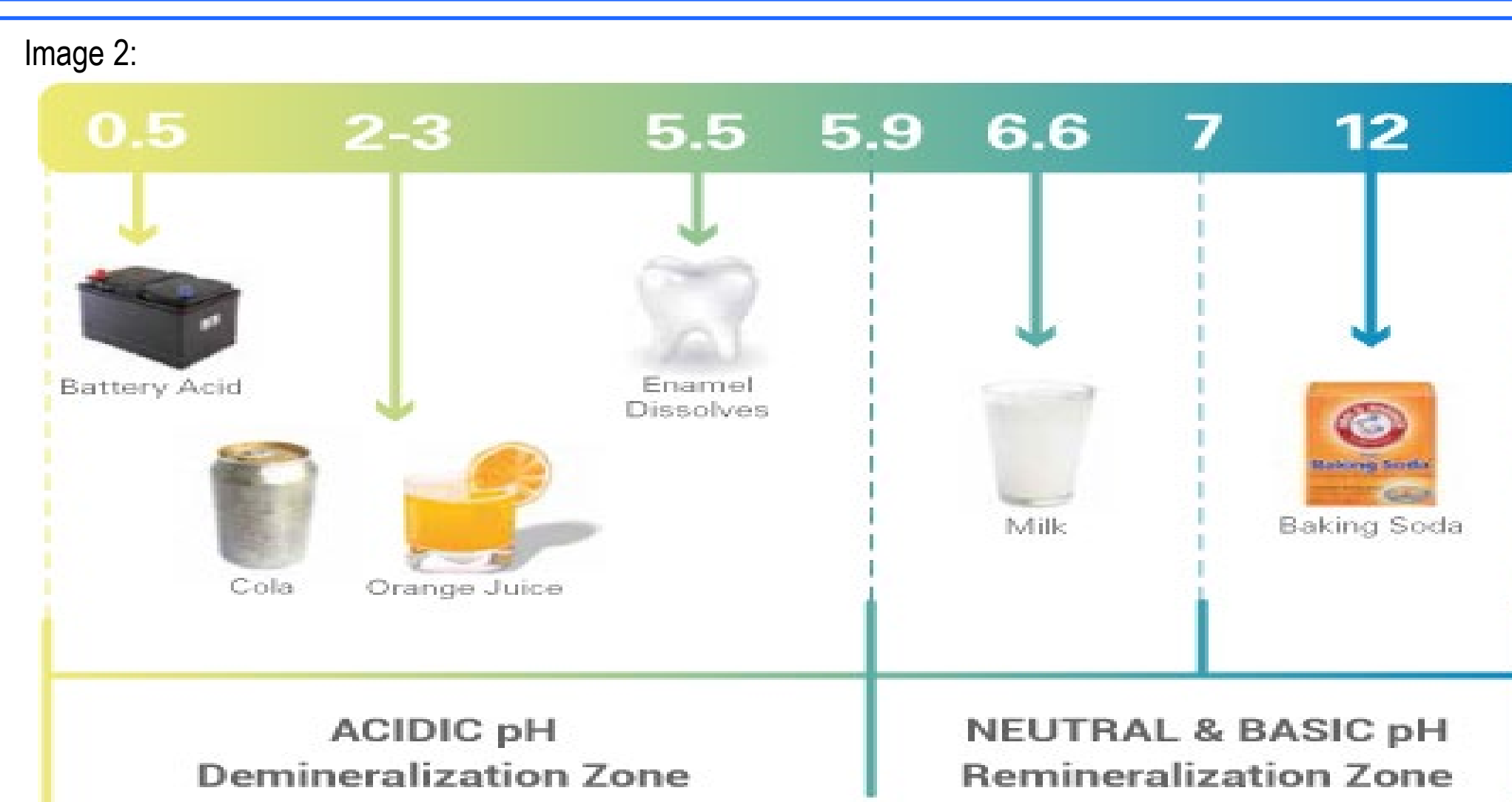
REMINERALIZATION AND FLUORIDE

- Remineralization is a natural repair mechanism used to restore minerals in ionic forms, to the hydroxyapatite crystal lattice of the tooth and occurs under near neutral physiological pH conditions whereby calcium and phosphate mineral ions are redeposited within the carious lesion from saliva.
- Consequently, it results in the formation of newer hydroxyapatite crystals, which are larger and more resistant to acid dissolution.
- Fluoride compounds have been widely used and are considered the standard therapy for tooth remineralization. It forms a fluorohydroxyapatite complex rendering it stronger and more resistant to decay than hydroxyapatite alone.
- Fluoride also works by acting as a catalyst in the remineralization of enamel with phosphate ions present in the saliva.²

THE pH LEVELS OF COMMON SUBSTANCES



DEMINERALIZATION & REMINERALIZATION ZONES



CPP - ACP

- A recent study found that remineralization of enamel was observed after immersion in beverages modified with casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) paste.
- CPP-ACP bound to the apatite crystal faces in the surface of enamel lesions and kept the diffusion pathways open to allow ions to penetrate more deeply and resulted in remineralization throughout the lesion rather than just in the surface layer.
- Clinically this could be of significance because the application of CPP-ACP paste may enhance the remineralization after an erosive challenge thus offering some protection for patients who are at risk for erosion.
- CPP-ACP paste may even be supplemented in certain beverages to further prevent against tooth erosion.⁵

PATIENT EDUCATION

- Eliminating extremely erosive drinks (pH < 3.0), minimizing erosive drinks (pH 3.0 – 3.99), and substituting drinks with a (pH ≥ 4.0) would be prudent advice for patients in the prevention of erosion.⁴ Studies have shown that carbonated drinks have lower pH than fruit juices.
- The buffering capacities are in the following order: fruit juices > fruit-based carbonated drinks > non-fruit-based carbonated drinks.⁶
- The pH of beverages should be incorporated in the successful development of preventive and remineralization treatment planning for patients with signs of clinical demineralization.
- Oral health care providers should recommend appropriate dietary suggestions when counseling patients regarding the damaging effects of acidic beverages.

CONCLUSION

- Due to their popularity, oral health care providers should discuss any consumption of acidic beverages during their comprehensive evaluation with each patient.
- This is especially true for children and adolescents with a vulnerable mixed dentition who may be unaware of the possible demineralization properties of sports and energy drinks.⁷
- The addition of fluoride mouth rinses into oral hygiene regimens will help to remineralize the susceptible areas in dental enamel. Using products containing calcium phosphate technologies may also support remineralization.
- Oral health care providers may suggest rinsing with water after consuming sports, energy or alcoholic drinks in order to neutralize the acidogenic properties of the beverage, thereby decreasing the likelihood of demineralization.⁷

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- Image 1 Courtesy of: <https://www.chegg.com/learn/biology/anatomy-physiology-in-biology/ph-designation-values-of-common-solution>
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