Etiology of dental caries

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Dental caries (tooth decay) is a chronic disease, affecting a large number of populations. The carious process affects the mineralized tissues of the teeth, enamel, dentine and cementum, and caused by the action of microorganisms on fermentable carbohydrates in the diet.

The disease is often described to be progressive and if not treated may expand in size and progress to the pulp leading to pulp inflammation thus pain and discomfort, and the end result will be loss of vitality then loss of the tooth.

Dental caries is an infectious disease caused by acidogenic bacteria, may lead to dissolution of enamel and dentin, (coronal caries) and cementum and dentin (root caries).

Patients vary in their susceptibility to caries process and in managing dental caries. There is either a mild or a moderate challenge to caries attack, usually affecting deep pits and fissures and approximal surfaces.

Rampant caries on the other hand is a sudden rapid destruction of many teeth, affecting surfaces that considered relatively immune to caries attack. Other terms are also present as:
Nursing caries: Caused by prolonged breast or bottle feeding, especially during night.
Recurrent or secondary caries: Seen in the margins of an old restored area.
Arrested caries: Re mineralized carious lesion.

Dental caries is a multifactorial disease; it is the result of complex interaction between HOST, PLAQUE, DIET and TIME.

Host Factors:
This involves susceptible tooth and saliva, in addition to the subject him/her self.

Teeth vary in their susceptibility to dental caries from one surface to other and from one subject to other. There are several factors affecting tooth susceptibility as:

- **Morphology of teeth**: susceptible sites
  Sites on the tooth, which favour plaque retention and stagnation, are prone to decay.
  These are
  1. Enamel pits and fissures.
  2. Approximal enamel smooth surfaces.
  3. Cervical margin of teeth.
  4. Exposed root surfaces because of gingival recession.
  5. Deficient or over hang restoration (recurrent caries).
  6. Tooth surfaces adjacent to denture and bridges.

- **Positions of teeth**: posterior teeth are labial to be affected by caries compared to anterior.

- **Composition of teeth**, teeth composed of inorganic elements (96% in enamel, 70% in dentin), organic elements and water. Composition of teeth is effected by environmental factors (water, diet and nutrition).

Inorganic components: involve *major elements* as calcium, phosphate, hydroxyl group these are the constituents of hydroxy apatite crystals $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$.

The Ca/P ratio is 2.15. Any change in this ratio is an indication of presence of other types of crystals.

There are minor elements in teeth as Zinc, copper, magnesium, fluoride etc. These elements may incorporate the enamel crystal in substitutions with one if its major elements as for example substitution of Ca ions by Mg,

$$\text{Ca}_9\text{Mg} (\text{PO}_4)_6(\text{OH})_2$$

Or substitution of the OH by Fluoride ions $\text{Ca}_{10}(\text{PO}_4)_6\text{F}_2$. These minor or trace elements may also be adsorbed on the surface of the crystals.

This incorporation may take place either in the pre eruptive stage including all layers of enamel and dentin, or in the post eruptive stage involving the outer enamel surface only.

Some of these elements when incorporated may increase the resistance of teeth to dental caries as fluoride ions, tin ions, zinc, strontium, and molybdenum. While other elements, may increase the susceptibility to dental caries as magnesium. However, the role of other elements may not well understood as K, Mn, and Al.

**Saliva** affects caries etiology through the rate of secretion and composition. Saliva affects the integrity of teeth by the composition of (buffer system, calcium and phosphate). By the cleansing action of saliva (oral clearance), it can affect the number of oral micro organisms and food debris from the mouth. The oral immune system (specific and non specific) affect to a large degree the cariogenic bacteria.
**Subject:** The behavior, attitude and dental knowledge affect the caries etiology. These can influence the oral hygiene of the person as well as his dietary habits.

**Dental plaque:**
Plaque quantity and quality greatly influence caries etiology. Bacteria adhere to tooth surface and ferment carbohydrate causing release of acid thus demineralization of tooth surfaces. Cariogenic bacteria involve mutans streptococci, lactobacilli and others.

**Diet:**
Sweet consumption especially between meals may lead to continuous drop of pH and not allowing the enough time for the pH to return to normal, thus de mineralization of teeth.

![Oral cavity diagram](image)

**Development of dental caries:**
Theoretically when these all factors are present dental caries develop. Dental caries is an interaction between pH, mineral flux and solubility at tooth surface.

*Enamel Sieve Concept*
After sugar consumption there will be an increase in hydrogen ions in dental plaque causing an increase in pressure ingredients, this will lead to dissolution of hydroxyapatite crystals to their ionic components. These ions will diffuse toward dental plaque leaving behind micro spaces. By the increase of pH due to the action of buffer system and termination of carbohydrate a remineralization episode will be started, calcium, phosphorous ions and others will diffuse back to enamel from dental plaque. The precipitations of ions will be in form of a variety of complex salt crystals. In a succession of demineralization and remineralization cycle, if the sum of the demineralization is greater than the remineralization there will be a continuous loss of minerals thus porosity then cavitations ie dental caries.