Lactobacillus

Lactobacilli are saprophytes in vegetable and animal material (e.g., milk).Some species are common animal and human commensals inhabiting the oral cavity and other parts of the body.
The taxonomy of Lactobacilli is complex. Two species of Lactobacilli, namely *Lactobacilli casei* and *L. rhamnosus*, are regularly isolated from the oral cavity.

The genus Lactobacillus (family Lactobacillaceae) consists of gram positive, microaerophilic to anaerobic, nonsporulating, and usually nonmotile rods with complex nutritional requirements. The Lactobacilli may be separated into groups on the basis of glucose fermentation: homofermentatives, which produce lactic acid predominantly, and heterofermentatives, which produce other aliphatic acids, as well as lactic acids (about 50% of the products), ethyl alcohol, and carbon dioxide .the homofermentatives do not grow at 15C°, whereas the heterofermentatives do. Among the homofermentative, species are *L. lactis*, *Lbulgaricus* , *L helveticus*, *Lplantarum*, *L acidophilus* and *L.casei*; among the heterofermentative species are L.fermentum, L. brevis, and L. buchneri.

The lactobacilli are referred to as aciduric, since they tolerate a level of acidity that usually kills other nonsporulating bacteria. They typically occur in fermenting dairy and plant products and as normal flora in the vagina, the alimentary tract, and the oral cavity of mammals and humans. Lactobacilli in the mouth usually found in saliva, plaque and on the teeth, tongue. Transmission routs unknown. For the isolation of lactobacilli, we need aciduric environment and complex nutritional requirement. The selective media for isolation of Lactobacilli are:

1- Tomato juice agar (pH=5) promotes the growth of lactobacilli while suppressing other r bacteria .identification by biochemical reactions.
2- Rogosa agar (pH=5.4)
3- MRS media(de-Man-Rogosa-Sharp media)

Oral ecology

Historically, lactobacilli were the first microorganisms implicated in the dental caries development. They appear during the first years of a child's life, and are present in high numbers in saliva, on the dorsum of the tongue, mucous membranes, the hard palate, in dental plaque and , in fewer numbers, on tooth surfaces. The presence of lactobacilli in the oral cavity depends on numerous factors such as the presence of ecological niches e.g. natural anfractuosities of

the teeth, partly erupted third molars or orthodontic devices. During the infant's passage through the birth canal, his oral cavity may become contaminated with *L. jensenii* and *L. acidaphilus*, but neither bacterium is able to establish itself. During the first 2 years of life, lactobacilli occur only transiently and in very low numbers. In adults, lactobacilli occur only rarely on the gingival mucosa and rarely in the sub-gingival microflora of normal gingival sulci , but found in root caries.

Study of the quantitative relationships among the various Lactobacillus species in some of the various niches of the oral cavity in older children and adults showed a slight predominance of heterofermentative Lactobacilli over homofermentative Lactobacilli in the saliva and on the tongue (51.5% to 48.5%) but a pronouncedly higher ratio of homofermentative in the dental plaque (80%-20%) and in carious dentin (65.7% to 34.3%) .in all four sites ,the predominant heterofermentative species was *L. fermentum* among the homofermentatives the most frequently found species was *L. salivarius* in the saliva and on the tongue, *L. acidophilus* in the plaque ,and *L. casei* in carious dentin. it is possible that these relationships will be influenced ,in part at any rate, by the bacteriocins that a number of Lactobacillus Species produce.

Saliva is a link between the different tissues and structures of the oral cavity. Its analysis reveals the oral microbiological characteristics. This principle is put into practice with the "caries detection". A correlation also exists between Lactobacillus rates in dental plaque and in saliva. If bacteria from the genus Lactobacillus represent 0.1% of the total salivary flora, a critical concentration of 10^5 CFU/ml of saliva is necessary for the detection of lactobacillus on the surface of enamel.

Other studies have shown a significative correlation between smoking habits and salivary rates of lactobacilli.

The first oral microorganisms to be cultivated were *Streptococcus mutans* and *Lactobacillus*. These organisms are amongst the family collectively designated as lactic acid bacteria. The group includes the mutans group streptococci, some other oral streptococci (although not all streptococci), and the genus *Leuconostoc.* Lactic acid bacteria characteristically ferment sugars through the glycolytic pathway to form pyruvate, which is then converted to lactate (lactic acid). The amounts of lactic acid produced by the individual bacteria depend upon the environmental conditions, e.g. pH, oxygen. They also depend upon the complement of enzymes present within the bacteria that produce alternative fermentation end products, like acetate (acetic acid), butyrate, propionate and ethanol. The genus *Lactobacillus* contains organisms that are highly acidogenic. This means that they produce large amounts of acid and, as a result, they are also aciduric (meaning able to survive, and sometimes grow, at very low pH). The lactic acid bacteria are characteristically associated

with the fermentation of milk, and the generation of fermented milk products, e.g. cheese, yogurt, etc. There is a theory, therefore, that these organisms evolved alongside the emergence of mammals.

Probiotics

Probiotic therapy provides a live microbial supplement that beneficially affects the host's healthy microbial balance. Probiotics have commonly been associated with food supplements, such as *Lactobacillus* and *Bifidobacterium* within yogurts. *Lactobacillus* species have also been shown to have some effect on preventing oral colonization by *S. mutans*. A novel approach to biological control of *S. mutans* has been to engineer a strain that lacks lactate dehydrogenase (does not produce lactic acid) and produces a potent bacteriocin that kills other *S. mutans*. In theory, introduction of this strain into the mouth, will destroy other *S. mutans* but reside harmlessly in plaque unable to produce lactic acid.

Some time Lactobacilli used as protective factor against overgrowth of pathogenic bacteria and some times used in the therapy of some infection like staphylococcal infection and oral ulcers because Lactobacilli produce special substances or bacteriocins (like antibiotics) lactobacillin, lactocidin, acidophillin or acidolin, these antibiotics inhibits the growth of different types of pathogenic bacteria like *proteus*, *salmonella*, *staph. aureus* .also ,acetic acid and lactic acid produced by Lactobacilli inhibit the growth of gram negative pathogenic bacteria.

The coactions of lactobacilli with *Candida albicans* have probably received more attention than those of any other pair of microorganisms commonly found in the mouth. As the isolation of lactobacilli in large numbers from saliva points to the presence of carious activity, they may be used as caries marker organisms; especially in epidemiological studies.

Symbiosis:

When Lactobacilli are grown in the presence of C. *albicuns*, there is an increased yield of acid. Since the same effect occurs with heat- killed Candida cells, the yeast probably provides some nutritional needs for the Lactobacilli. the heat and penicillin resistance of Lactobacilli are also increased when they are associated with C. albicans.

Lactobacilli are found in less quantity than *Streptococcus mutans*. Streptococcus mutans have a significant correlation with the initiation of dental caries because of their ability to produce acid and their powerful mechanisms for attachment (adherence) to the smooth surface of the tooth. Mutans streptococci play an important role in the attachment to the smooth surface of the tooth (enamel), so mutans strep. Correlate with the initiation of dental caries and because Lactobacilli no have mechanism for attachment, so they are responsible for progression of carious lesion. in other words the initial cause

(mutans strep) provide for Lactobacilli a suitable environment for establishment and growth (aciduric environment an d attachment site for multiplication of Lactobacilli),so Lactobacilli are responsible for the opening of cavity in the tooth.

Oral pathogenicity

Lactobacillus species have rarely been proved primary pathogens for humans, although it is recognized that they may participate in the development of dental caries.They are now considered secondary invaders rather than initiators of the caries process. Biofilm formation by the lactobacilli in mono-culture was poor. If little is known on their adhesive properties, the best known determinants of cariogenicity in lactobacilli are their capacity to produce acids and their ability to grow and survive in acidic environment.

Patients on a heavily immunosuppressive program, such as those with renal transplants, may develop lesions of the oral mucosa during episodes of acute rejection that clinically resemble candidiasis but yet are resistant to antifungal agent. These lesions consist of a white superficial plaque that is removable by scraping and leaves a bleeding mucosal surface. Cultivation of the plaque yields any of a number of oral bacteria, among which Lactobacilli have been found.

Review of the Caries Process

- Bacterially based
- Plaque ⇒bacterial film that produces acid as a byproduct of its metabolism
- Acid ⇒diffuses into the tooth ⇒dissolves the carbonated hydroxyapatite mineral

Two most important groups of bacteria that predominantly produce lactic acid:

- **mutans streptococci**
- **lactobacilli**
- **Associations between lactobacilli and caries**
- Elevation of fermentable carbohydrate in the diet ⇒ elevated lactobacilli counts
- Lowering ⇒ lactobacilli reduction.
- **Associations between lactobacilli and caries**
- Placement of dental appliances, such as orthodontic bands, on dentition sites changed the morphological conditions ⇒ enhanced

carbohydrate retention ⇒ more lactobacilli and other acid producing bacteria ⇒ more acidic plaque ⇒caries elevation

What specific ROLE does lactobacilli play in the caries process?

- Does NOT play a major part in initiation, but important in *progression*
- With established low pH ⇒ the number of lactobacilli increases and the number of *S. mutans* decreases
- Contribute to the demineralization of the teeth once lesions are established

WHY does lactobacilli only play a role in the progression and not the initiation of caries?

- Inability to initially adhere to tooth and form plaque….
  - Superficial carious lesions were formed in the absence of lactobacilli, but not in the absence of *S. mutans*
  - Dependence of lactobacilli on extracellular polysaccharide (EPS) produced by other oral organisms, mainly streptococci, for colonization
  - Lactobacilli cannot form plaque on the tooth on there own
  - Unlikely responsible for the initiation of caries *unless* other extracellular polysaccharide producing streptococci were already present in high numbers

Pathogenicity for various body sites

Anaerobic strains of Lactobacilli probably derived from the mouth have been isolated in cultures of acute and chronic bronchopulmonary infections, including pulmonary abscesses and *empyema. Lactobacilli have been cultured from the urine of patients with urinary tract symptoms, with the highest rates found in patients with diabetes mellitus. It has been suggested that increased tissue glucose may provide an ecologic basis for this association.

Lactobacilli have been implicated in some cases of sub acute bacterial endocarditis (SBE) ,including cases in which dental disease apparently was the source of the organisms. Lactobacillus SBE has developed following tooth extraction and dental scaling in persons with the teeth in poor condition. in the past Lactobacilli were commonly dismissed as being nonpathogenic when isolated in cultures of SBE ,but repeated isolation on subsequent cultivation would lead to a corrected diagnosis.

Beneficial Outcomes

- Used industrially for production of yogurt, cheese, sauerkraut, pickles, beer, wine, cider, chocolate, and other fermented foods.

- Maintenance of healthy intestinal and vaginal microflora by inhibiting the growth of some cariogenic bacteria.

- **Negative Outcomes**

Role of lactobacilli in the caries process…….

Therapy

It has been very difficult to find an effective antibiotic for clearing the blood of bacteria in Lactobacillus endocarditis. although some Lactobacilli with considerable resistance to penicillin have been isolated either in pure culture or in mixture with streptococci ,the isolates of SBE cultures are usually sensitive to a number of antibiotics, including penicillin ,lincomycin, chloramphenicol, and streptomycin .however, very high doses have been necessary for effective treatment.

References:-

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2-oral microbiology. 5th edition.