Oral Biology
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Lecture - 06
Saliva - Composition and functions

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Welcome to today's session. Today's session is on topic Composition and functions of Saliva.

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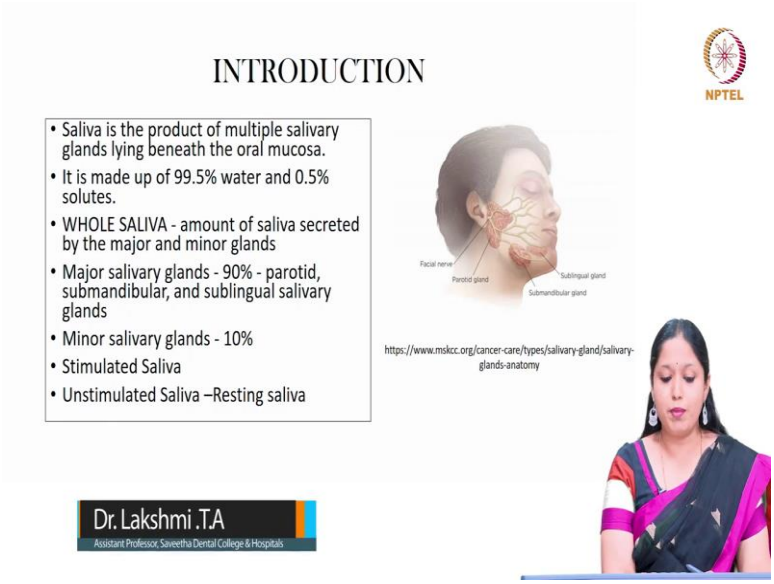

So, saliva is nothing, but a byproduct or a product of multiple salivary glands lying beneath the oral mucosa. Saliva is composed of 99.5 percentage of water and 0.5 percentage of solutes. There is something called as whole saliva; whole saliva means the amount of saliva which is secreted by both major salivary glands as well as the minor salivary glands.

So, the major salivary glands include parotid gland, submandibular gland and sublingual glands and all together these glands contribute about 90 percentage of total saliva. Minor salivary glands contribute about 10 percentage of the saliva. There is something called as stimulated saliva, which is nothing but saliva which is produced upon stimulation like chewing. Unstimulated saliva is also known as resting saliva.

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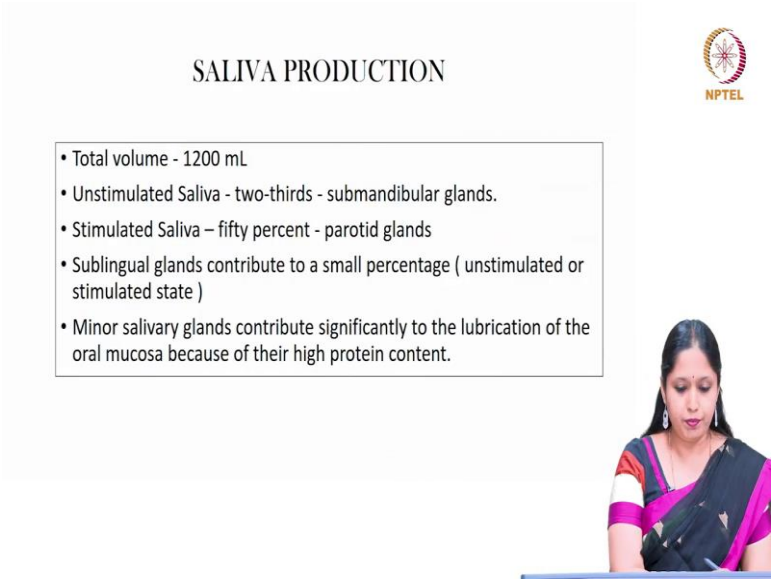

So, coming to saliva production, the total volume of saliva is supposed to be 1200 ml approximately. Two thirds of the unstimulated saliva is produced by submandibular glands; whereas fifty percentage of the stimulated saliva is produced by parotid glands.

Sublingual glands contribute to a small percentage for both stimulated as well as the unstimulated saliva. Minor salivary gland contributes significantly to the lubrication of the oral mucosa, this is because the salivary secretion has got high protein content.

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Now, coming to the salivary flow rate, whole unstimulated saliva flow rate is 0.3 to 0.4 ml per minute approximately. The rate decreases to 0.1 ml per minute during sleep time and it increases to 4 to 5 ml per minute during eating, chewing as well as other stimulating activities.

The saliva is always hypotonic to plasma, and salivary gland secretion is mainly controlled by the autonomic nervous system. So, parasympathetic stimulation will cause abundant quantities of watery saliva; whereas sympathetic stimulation causes more viscous saliva.

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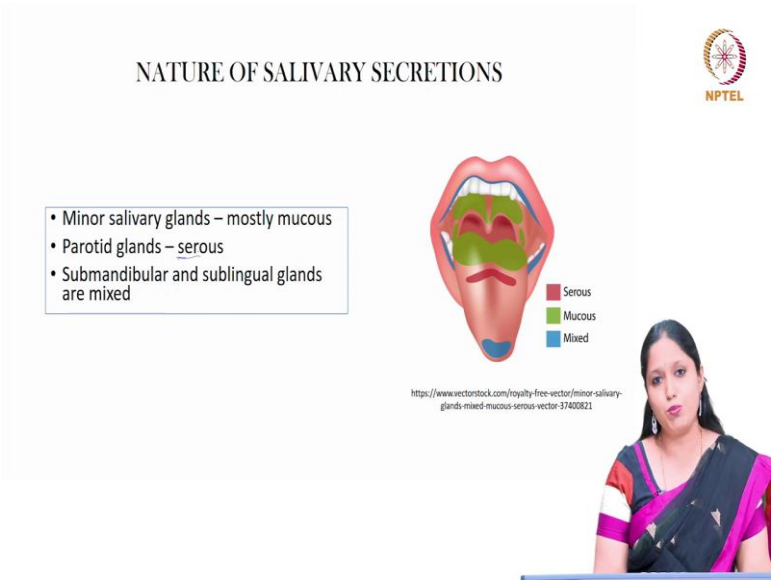

Coming to the nature of salivary secretion; salivary secretion will be either serous, mucous or mixed that is both serous as well as mucous. So, minor salivary gland mostly produces mucous type of saliva; whereas the parotid gland, always remember parotid gland produces serous type of saliva. So, submandibular and sublingual glands produce mixed type of saliva, that is both serous as well as mucous type of saliva.

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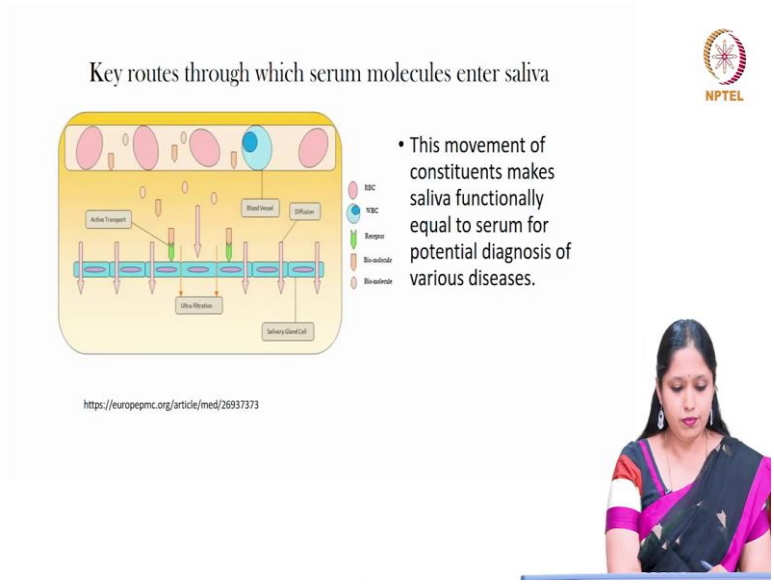

Coming to the key routes through which serum molecules can enter saliva. So, serum molecules enter the salivary gland cell either by means of active transport or by

ultrafiltration or by means of diffusion; they pass through the salivary gland cell and enters saliva. And these movement of constituents makes saliva functionally equal to serum for the potential diagnosis of various diseases.

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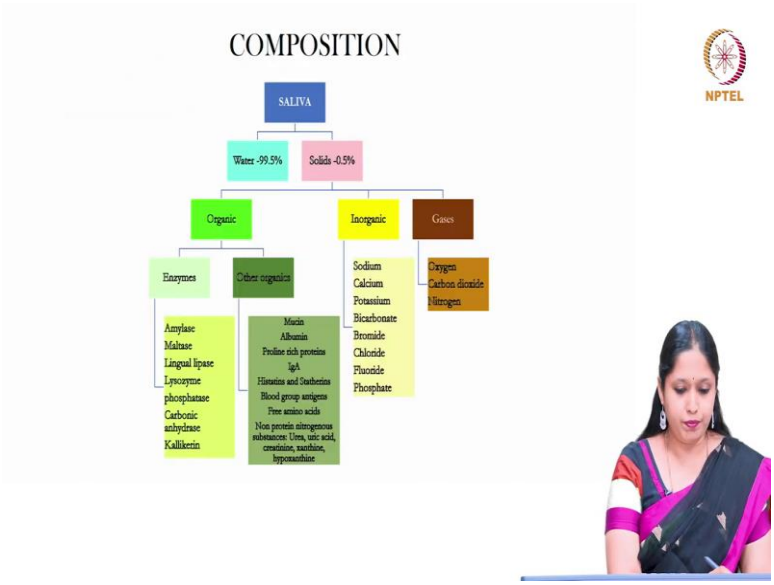

Now, coming to the composition of saliva; saliva is composed of 99.5 percentage of water and 0.5 percentage of solids. Under solids comes organic, inorganic and gases. Organic component is composed of enzymes and other organics; under enzymes comes salivary amylase, salivary lipase or lingual lipase, maltase, lysozyme, phosphatase, carbonic anhydrase, kallikrein.

Other organic components include mucin, albumin, proline rich proteins, immunoglobulin A, histatins, statherins, blood group antigens, free amino acids, non protein nitrogenous substances like urea, uric acid, creatinine, xanthine and hypoxanthine.

Under inorganic components comes the various ions like sodium, calcium, potassium, bicarbonate, bromide, chloride, fluoride as well as the phosphate. Under gases comes oxygen, carbon dioxide and nitrogen. So, these are all the composition of saliva.

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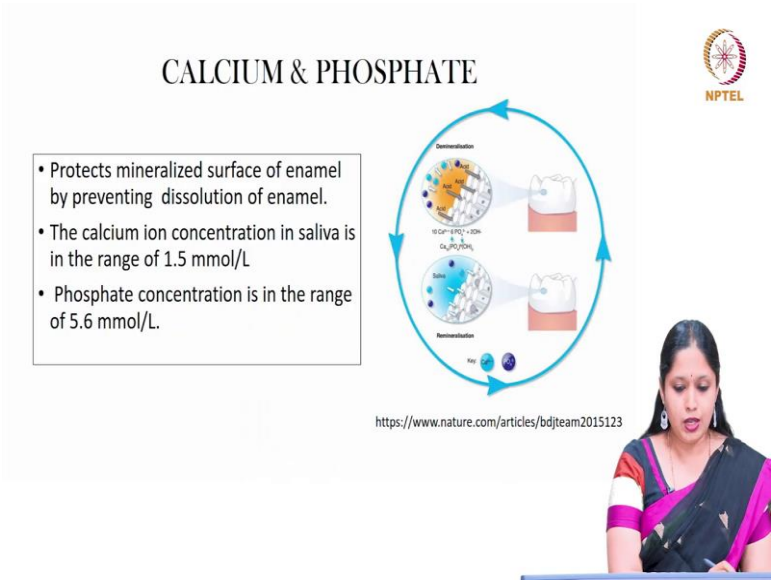

Now, let us see each inorganic component in detail, first is the calcium and phosphate. Calcium and phosphate protect the mineralized surface of enamel; it prevents dissolution of enamel. The calcium ion concentration in saliva is in the range of 1.5 millimoles per liter; whereas the phosphate concentration is in the range of 5.6 millimoles per liter.

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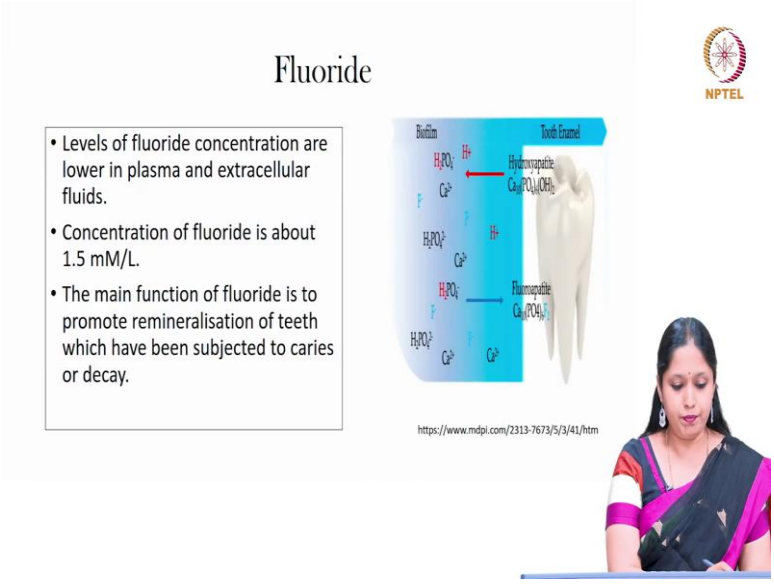

Coming to fluoride, so levels of fluoride concentration are lower in plasma and extracellular fluid; the concentration of fluoride in saliva is 1.5 millimoles per liter.

The main function of the fluoride is to promote remineralization of teeth, which have been subjected to caries or decay.

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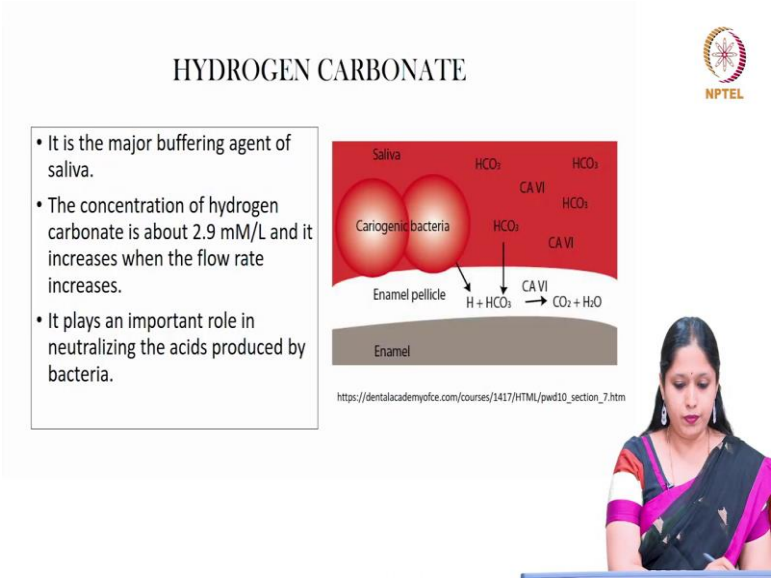

Next component is hydrogen carbonate or HCO3, it is a major buffering agent of saliva. The concentration of hydrogen carbonate is 2.9 millimoles per liter and it increases when the salivary flow rate increases. It plays a very important role in neutralizing the acids produced by bacteria, which causes dental caries or tooth decay.

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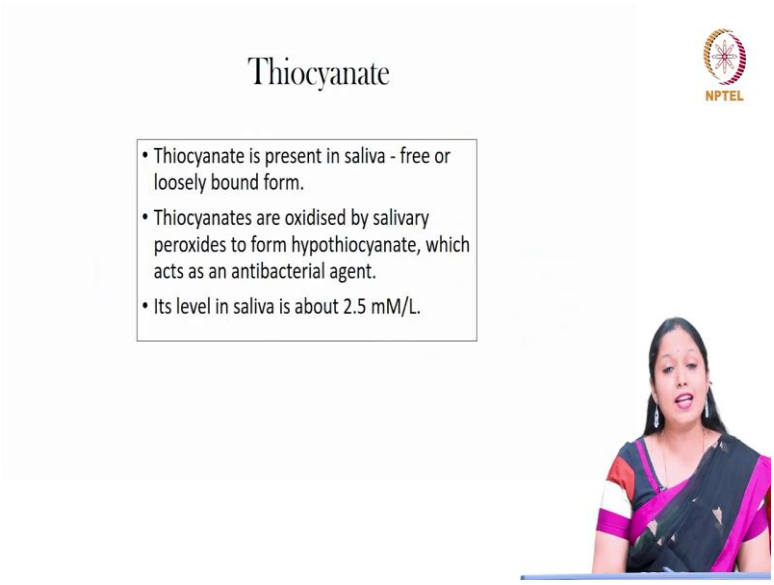

Next component is thiocyanate. So, thiocyanate is present in saliva either in the free form or in the loosely bound form. Thiocyanates are oxidized by salivary peroxides to form hypothiocyanate, which acts as an antibacterial agent. So, its level in saliva is 2.5 millimoles per liter.

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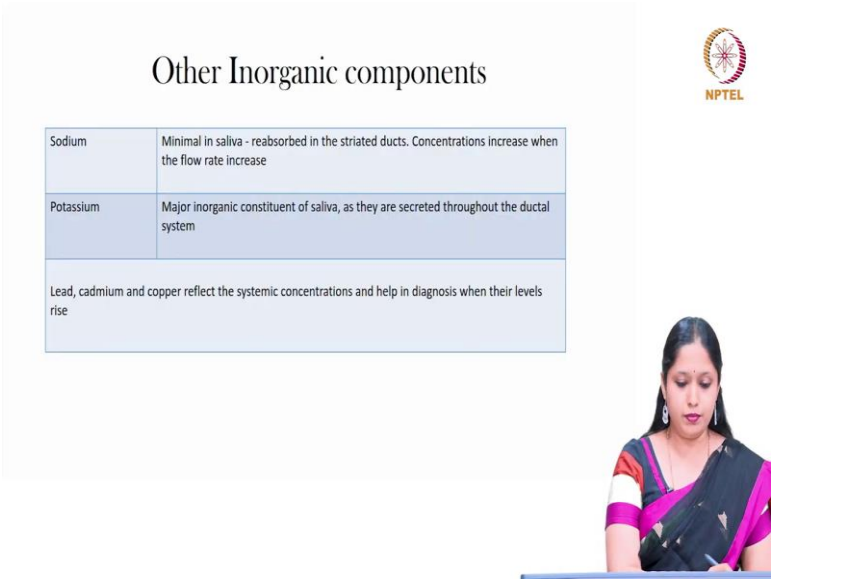

Now, coming to the other inorganic components, it includes sodium and potassium and other ions. Sodium is present in minimal amount in saliva and they are reabsorbed in the striated ducts. Concentrations increase when the salivary flow rate increases.

Potassium is a major inorganic constituent of saliva and as they are secreted throughout the ductal system. Various other ions like lead, cadmium as well as copper reflect the systemic concentrations and they help in diagnosing when their levels increase.

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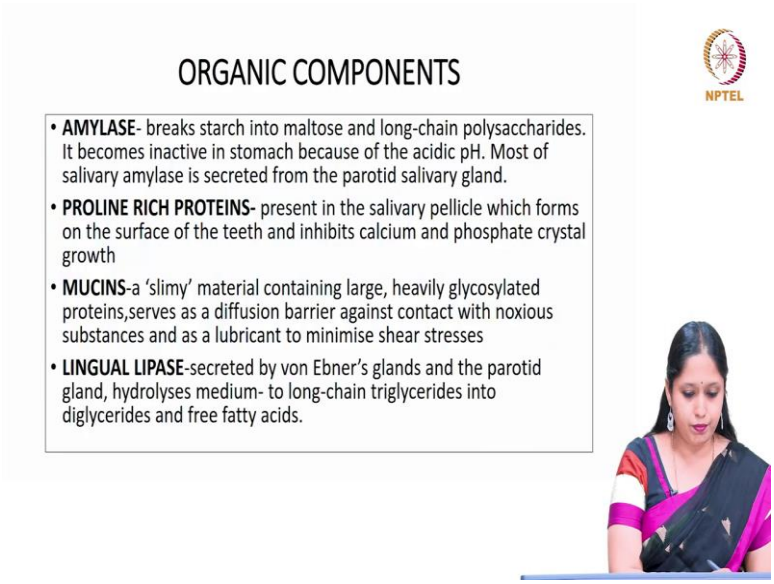

Now, we have discussed about the inorganic components and now we are going to discuss about the organic components. Organic components are the first one is amylase; amylase is an enzyme which is present in the saliva. Its main function is to break the starch, which is present in the food into maltose and long chain polysaccharides.

It becomes inactive in the stomach because of the acidic pH in the stomach. And most of the salivary amylase is secreted from the parotid salivary gland. Next component is proline rich proteins; proline rich proteins are present in the salivary pellicle which forms on the surface of the teeth and they inhibit calcium and phosphate crystal growth.

Another component is mucins; mucins are nothing but a slimy material which contain large, heavily glycosylated proteins and they serve as a diffusion barrier against contact with noxious substances and as a lubricant to minimize the shear stresses. Next component is lingual lipase, lingual lipase they are mainly produced by von Ebner's gland as well as parotid gland; they hydrolyses medium to long chain triglycerides into diglycerides as well as free fatty acids.

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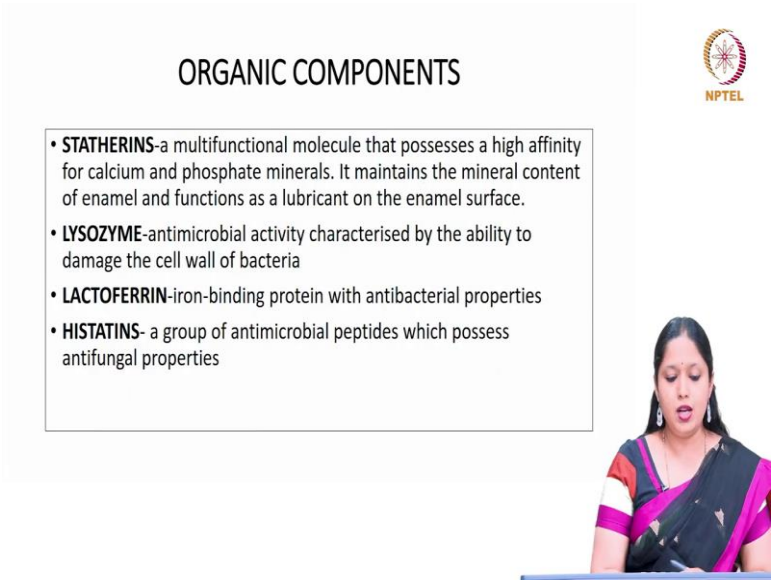

Statherins are nothing, but a multifunctional molecule that possesses a high affinity for calcium and phosphate minerals. It maintains the mineral content of enamel and functions as a lubricant on the enamel surface. The next components are lysozyme, lactoferrins and histatins, all these have antibacterial action.

So, lysozymes have an antimicrobial activity characterized by ability to damage the cell wall of bacteria. Next comes the lactoferrin, lactoferrin is an iron binding protein which has got antibacterial properties. Histatins are another group which has got a antimicrobial activity and apart from that, they also have an additional antifungal activity.

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Now, let us discuss about the functions of saliva. There are various functions of saliva which includes physico-mechanical flushing of the oral cavity, lubrication and permeability barrier, antimicrobial action, mineralization, taste, tissue repair, digestion and buffering action. Now, let us see each functions in detail.

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First is the physico mechanical flushing of the oral cavity; the watery nature of saliva helps in flushing action which also removes the, non adherent form of bacteria and food debris which are adhered to the tooth surface.

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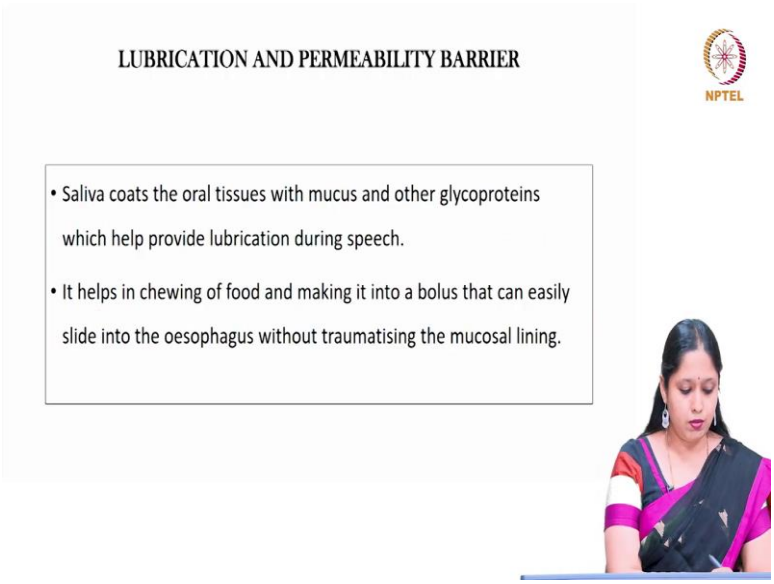

Next function is lubrication and permeability barrier. Saliva coats the oral tissues with mucus and other glycoproteins, which helps to provide lubrication during speech. It also helps in chewing of food and helps in making it into a bolus, so that it can easily slide down into the esophagus without traumatizing the mucosal lining.

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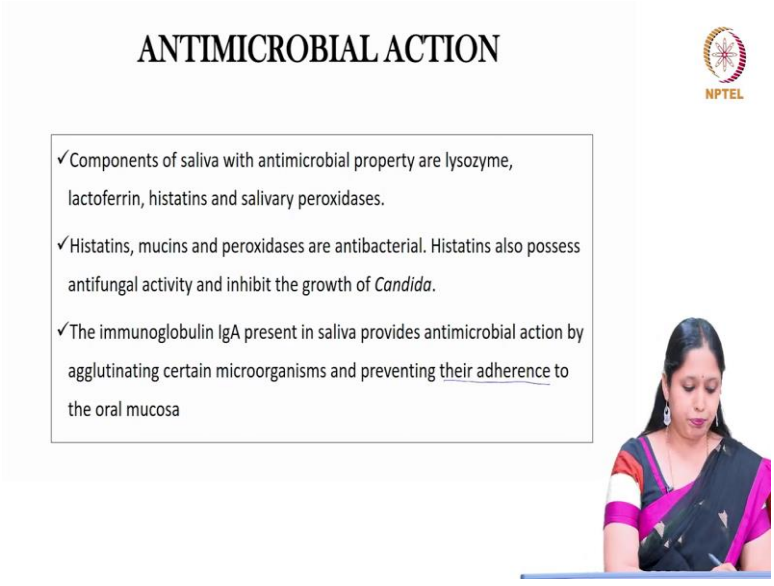

Another important function of saliva is antimicrobial action. Components of saliva with antimicrobial properties are lysozyme, lactoferrin, histatins and salivary peroxidases.

So, histatins, mucins and peroxidases are antibacterial and apart from that, histatin has got an additional anti fungal activity and they inhibit the growth of candida. The immunoglobulin which is present in saliva is IgA, it provides an antimicrobial action by agglutinating certain microorganisms and it also prevents their adherence to the oral mucosa.

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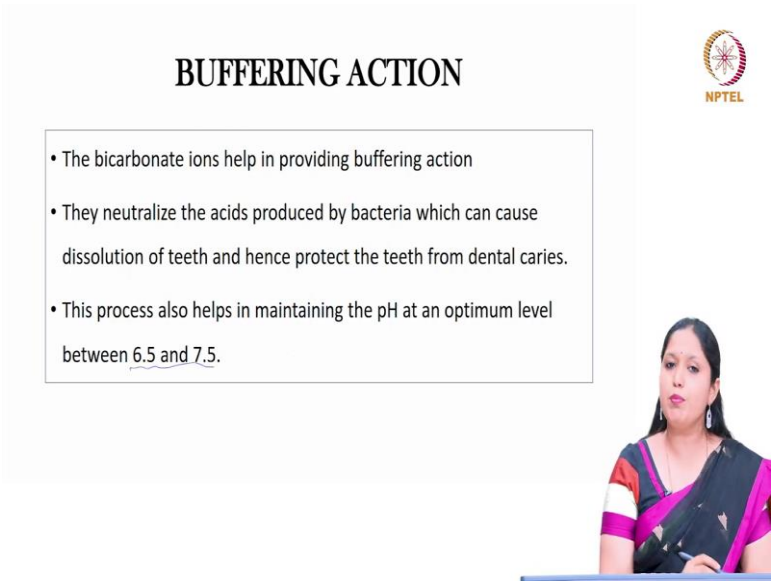

Next function is a buffering action, the bicarbonate ions, $HCO3^-$ ions present in the saliva helps in buffering action. They neutralize the acids produced by the cariogenic bacteria, which causes caries or damage to the teeth and hence protect the teeth from the dental caries. This process also helps in maintaining the pH of saliva at an optimum level between 6.5 and 7.5.

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Next thing is digestion. So, saliva contains various enzymes, digestive enzymes and they include amylase and lingual lipase. Amylase breaks down starch into maltose and long chain polysaccharides, and lingual lipase they hydrolyze medium and long chain fatty acids into diglycerides and free fatty acids.

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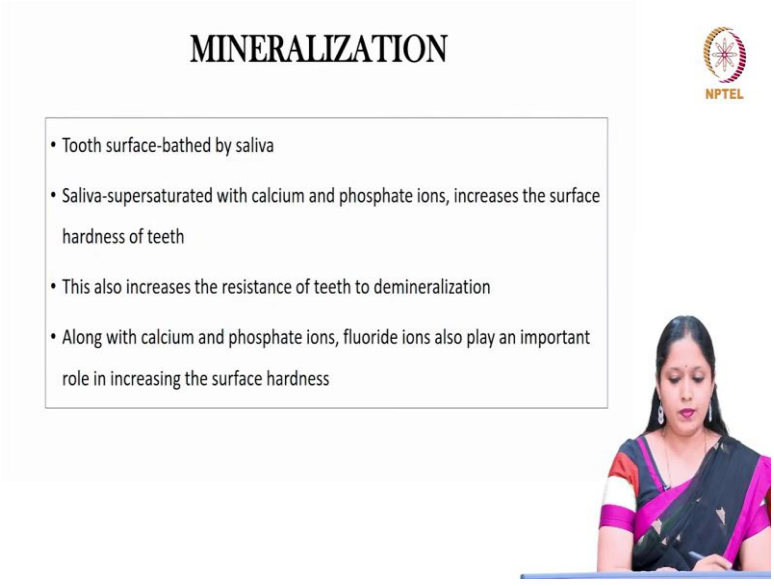

Next important function of saliva is the mineralization. So, tooth surface is always bathed by saliva. Saliva is supersaturated with calcium as well as phosphate ions and it increases the surface hardness of teeth; this also increases the resistance of teeth to

demineralization. Apart from calcium and phosphate ions, another ion which helps in this mineralization is fluoride; fluoride ions also play an important role in increasing the surface hardness.

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Next function of saliva is taste. Saliva plays an important role in perceiving the taste sensation; it helps in dissolving the food substances, so that they are easily perceived by the taste bud receptors. The decreased salivary secretion leads to decrease in taste sensation.

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Next function is tissue repair; tissue repair is mainly caused by means of epidermal growth factor as well as the vascular endothelial growth factor present in saliva.

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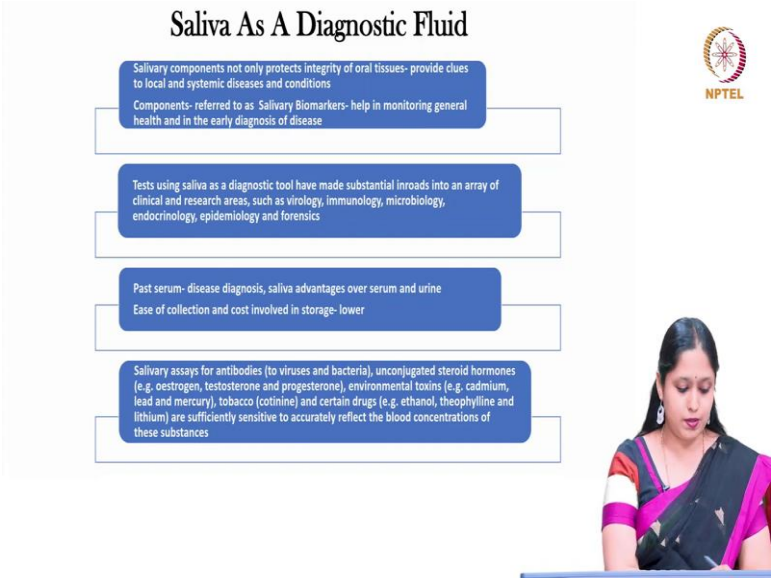

Now, we have discussed about the functions of saliva. Now, next is, why saliva is considered as a diagnostic tool. So, salivary components not only protect the integrity of the oral mucosa, but it also provides clues to the local and systemic conditions and diseases. These components are referred to as salivary biomarkers; they help in monitoring the general health as well as the early diagnosis of disease.

Tests using saliva as a diagnostic tool has made substantial inroads into an array of clinical and research areas, such as virology, immunology, microbiology, forensics, endocrinology as well as epidemiology. Past serum has been used for disease diagnosis, but nowadays saliva is used and saliva has got advantages over serum as well as urine; because of its ease of collection and cost involved is lower in case of saliva.

Salivary assays for antibodies to viruses and bacteria, unconjugated steroid hormones; like estrogen, testosterone and progesterone, environmental toxins like cadmium, lead and lithium and tobacco and certain drugs like ethanol, theophylline are sufficiently sensitive to accurately reflect the blood concentrations of these substances.

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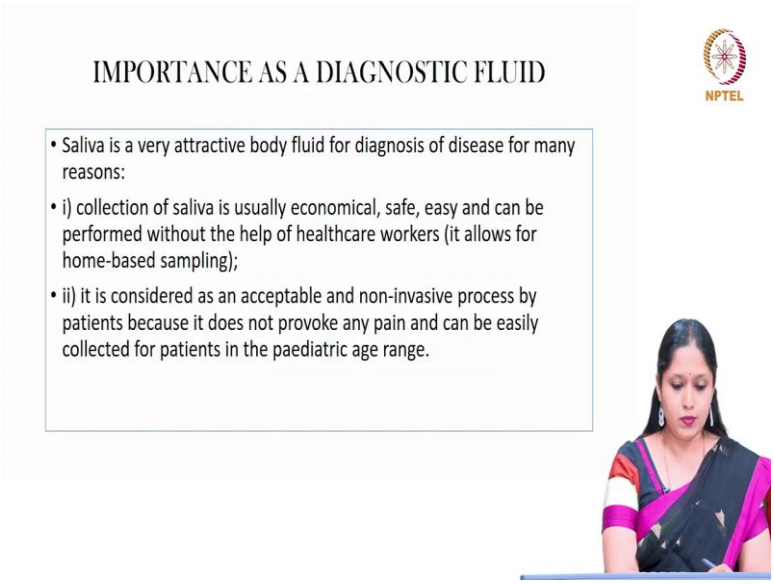

Importance as a diagnostic fluid. Why saliva is important diagnostic fluid? Because it is a very attractive body fluid for the diagnosis of disease for many reasons; because salivary collection is economical, easy, cost effective and safe and it can be performed without the help of health care workers and it also allows for home-based sampling. Moreover, it is considered as an acceptable and non-invasive process by patients; because it does not provoke pain and it can be collected for patients of the pediatric age group.

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Now, coming to clinical consideration, decreased salivary flow is known as xerostomia; it causes dry mouth. Various conditions contribute to decreased salivary flow, which includes medications, destruction of salivary gland tissue, radiation therapy and chemotherapy, because of carcinomas; autoimmune diseases, mainly Sjogren's disease.

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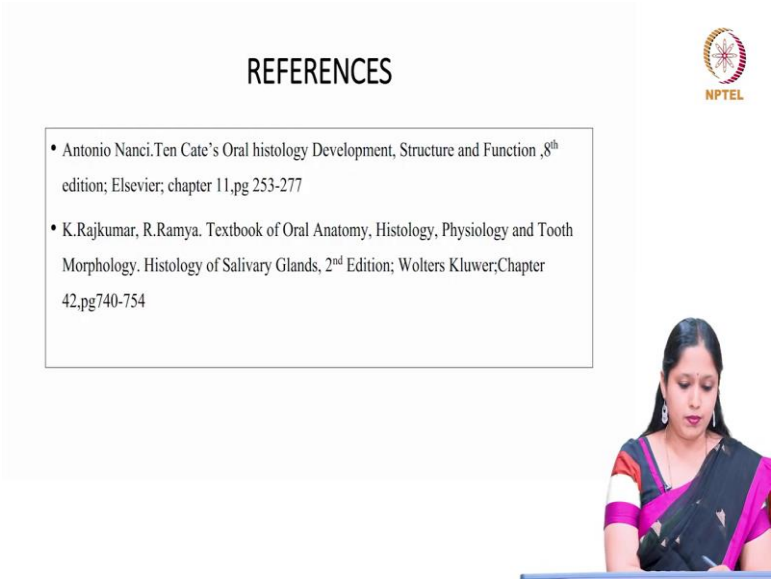

These are my references.

Thank you.