THE EFFECT OF INDIGENOUS FOODS ON THE P^H OF SALIVA OF CHILDREN WITH AND WITHOUT CARIES

BY

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INTRODUCTION

Dental caries is defined as a localised post eruptive pathological process of external origin, involving progressive demineralisation and subsequent softening and proteolysis of the hard tissue resulting in the form of a cavity. It begins on the external surface of the enamel in places where plaque consisting of micro-organisms, food debris, disquamated epithelial cells and salivary debris are retained (APHO, 1978).

An estimate shown by Anon, (1968) implies that 2000 million cavities need to be attended by dentists annually in India.

The progress of caries is more rapid in children than in adults. (Viswanath and Achar, 1970).

Dowden, (1975) found that the incidence of dental caries in the higher income groups at Coimbatore rural areas was 75% while in the poor income group there was no incidence of caries.

Mathur and Jain, (1976) have tried to analyse the various socio-cultural factors associated with dental caries among school girls (7 - 16 years) of Udaipur. They found that the dental caries prevalence in elite class was 16.3% and that the lower income class was 5.71%.

Some aetiological factors of dental caries are, nutrition habits, sugar consumption between meals, dietary carbohydrates, oral

hygiene, Fluoride prophylaxis, Microbiology-plaque-chlorhexidine cariogenic bacteria, and hereditary factors such as tooth composition morphology, physiology, saliva composition, rate of salivary flow and immunological defense (Lehmann, 1972).

Among dietary factors, consumption of carbohydrates was found to be the main cause of dental caries (Gafa, 1971).

During and for several years following world war II when sucrose containing products were rationed, a dramatic reduction in the incidence of dental caries occured (Toverud, 1942). In addition following the introduction of refined carbohydrates to the island of Tristan da Cunha, there was a large increase in the number of new carious lesions (Sognnaes, 1969).

Gustafsson et al. (1954) observed that subjects who consumed large amounts of carbohydrates, in the form of candy with meals developed substantially fewer lesions than those who consumed lesser amounts but who ingested it between meals. In a study carried out in Hopewood House, Australia, Harris, (1963) observed that those, who restricted their intake of carbohydrate had fewer lesions than those who restricted their intake of carbohydrate had fewer lesions than those who did not reduce their intake.

The P^H of the saliva is thought to have an important influence, in the growth and metabolism of the oral microbial flora. The P^H of freshly collected saliva has been found to vary between 5.7 and 7.0, with the mean near 6.7 which is satisfactory for the growth of a

wide variety of micro organisms. If the saliva become too alkaline, acidophilic organisms such as Lactobacilli and yeasts would be unable to grow if too acid, proteolytic bacteria such as Staphylococci and Streptococci could not maintain themselves (Miller, 1904)

The oral micro organisms produce enzymes, toxins and antigens of intra and extra cellular types (Lindahl et al., 1970).

Streptococcus Mitans, Strains of Lactobacilli and Actinomyces Viscosus

Streptococcus Mitans, Strains of Lactobacilli and Actinomyces viscosus are considered to be cariogenic to man and animals. The extent of these micro organisms in the oral cavity is somewhat proportional to the extent of carious lesions (Johnson, 1979).

Streptococcus Mitans

Streptococcus Mitans are known to have a high cariogenic activity (New Brun, 1976).

Sucrose was found to facilitate, the establishment of Streptococcus Mitans (Van Der Hoeven, 1974).

Carbohydrates produce a low P^H, which favours aciduric organism in the oral microflora, for example increase in Lacto Bacilli may indicate, a high carbohydrate intake which relates to a high caries incidence (Block and Krause, 1977).

Shovlin, (1972) noted a 95% correlation between Lactobacilli and dentinal lesion.

Lactobacillus has been reported, as the most frequent bacteria associated with carious lesions (Hamamura and Friedman, 1976).

Calcium, Strontium, Phosphorous and Molybdenum have been shown to be cariostatic elements (Navia, 1970).

Since the teeth consisted primarily of, Calcium and Phosphorous it is quite natural that over the last 40 years the dental scientists have investigated the effect of dietary phosphate supplements on dental caries and practically all of the animal feeding studies have shown that, there is a significant 20 to 80% caries reduction (Erickson, 1965).

Bunaff et al, (1962) reported that the injection of a recommended level of Fluorine, during calcification of teeth before eruption, increases resistance to dental caries.

Keeping in view of the available literature, the present study was designed with the following objectives.

Since the consumption of carbohydrates were found to be the main cause of dental caries, the effect of indigenous foods such as, carbohydrate rich snacks on the P^H of saliva of caries and normal

children was studied. Sucrose has been described as the arch criminal of dental caries therefore, the effect of mouth rinse with sucrose and gateaux on the P^H of saliva of caries and normal children was studied. Considering Lactobacillus as an index in the production of acidity to saliva, the Lactobacillus count was determined in the saliva of normal and caries children.

Since Streptococcus mutans were found to have cariogenicity, their count was determined in the saliva samples of normal and caries children.

The acidity produced by the micro organisms was determined in the saliva of normal and caries children using, Snyder's medium.

And the extent of caries was also studied, by the amounts of calcium in the saliva samples of normal and caries children.

REVIEW OF LITERATURE

The review of literature of "The effect of indigenous foods on the p^H of saliva of children with and without caries" can be discussed under the following heads

I. Epidemiology of dental caries.

II. The cariogenic food factors

a. The role of dietary carbohydrates
b. Sucrose, the arch criminal
c. Form and frequency of carbohydrates.
d. Trace elements
e. Vitamins and dental caries.

III. Role of Micro-organisms in dental caries.

IV. The anti cariogenic food factors

a. Fluorides and dental caries.
b. Phosphates and dental caries.
c. Fluorides and Phosphate combination, in dental caries.
d. Calcium and dental caries.
e. Proteins and fats in dental caries.
f. Vit. B_2 and dental caries.
g. Synthetic and unrefined carbohydrates in dental caries.

V. Saliva--(1) Composition (2) p^H (3) Flow rate

I. Epidemiology of Dental Caries

With modern civilization and industrialization, dental caries is assuming wider dimensions, so much so that it is a serious public health problem in most of the industrialised countries and the day is not far off, when in India too, where dental caries even now forms the bulk of dental diseases, it would be recognised as a public Health problem (Anon, 1966).

In some areas of the world such as, North and South America and Europe 96% of the population has experienced, dental decay during their life time. Data from a dental caries survey of groups of 20-24 years old civilians from different countries throughout the world show that the greater prevalence of dental caries is in America. In the United States dental caries prevalence can be considered as an endemic disease. Several independent dental caries surveys over a hundred years period have reportedly shown that natives of New England and North Western areas of the countries experience about twice as much dental caries as the natives of the south central states (Taylor and Dommonen, 1973). In other parts of the world such as India, Africa and Indochina, is still a relatively rare disease. Rao, (1961) reported the prevalence of dental caries in Vellore to be 21.1% Hari Rao et al. (1973) reported the prevalence of dental caries in school children of Delhi as 17.5%. While Singh, (1977) reported that dental caries was more prevalent, among girls

as compared to boys.

Mahler et al. (1970) studied the dentition pattern and prevalence of dental caries in Trivandrum and reported that dental caries occured in 49.1% of the children. The disorder was more common among non-vegetarians than in vegetarians and incidences increased with increase in family income. The incidence of enamel hypoplasia especially that of dental fluorides was low indicating that fluoride content of drinking water was not too high.

2. The Carbonaceous Food Factors

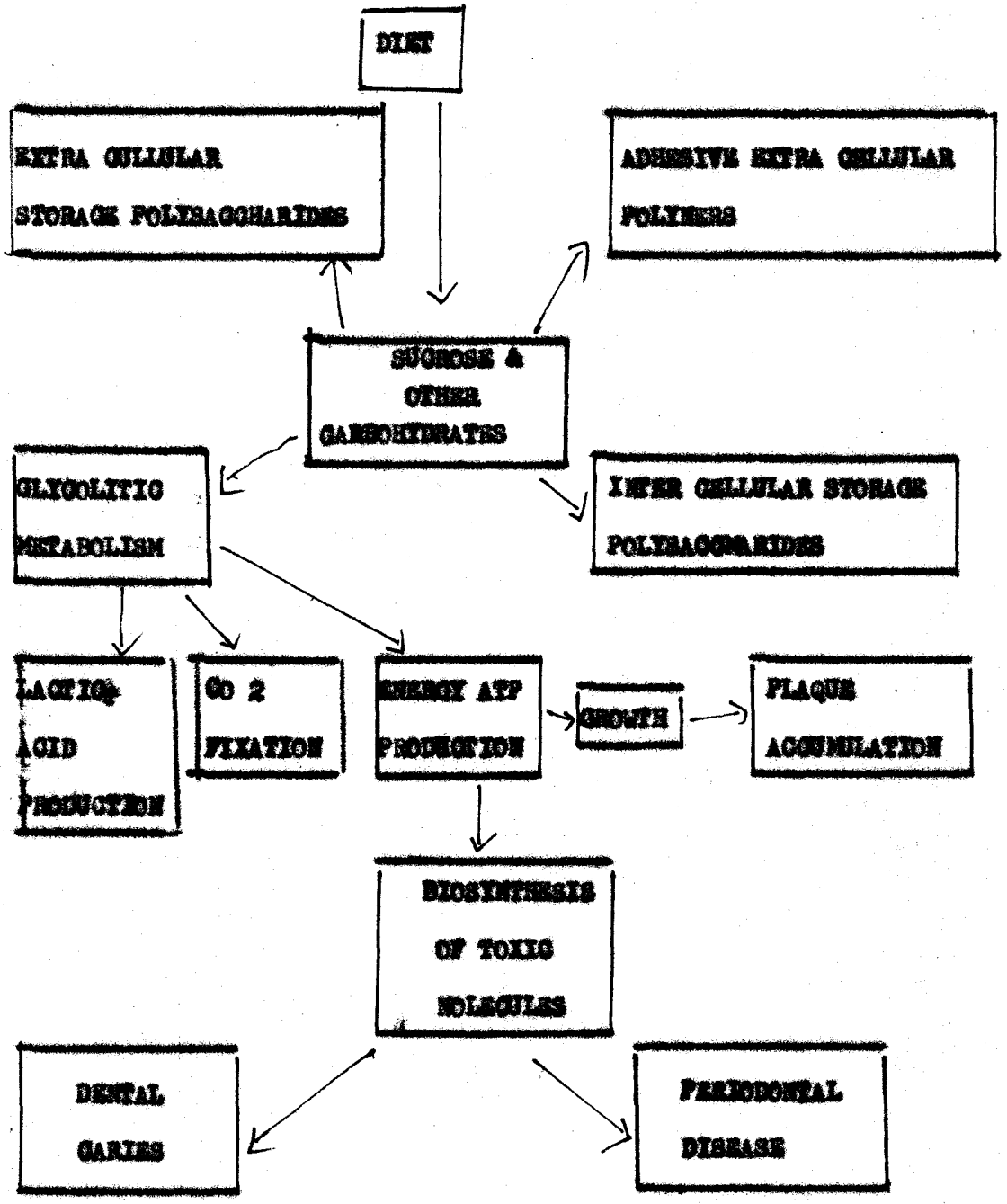
a. The role of dietary carbohydrates

There is substantial evidence from research with animals that carbohydrate in the diet is associated with the development of dental caries (Shaw, 1962).

Even in caries-susceptible rats when no carbohydrate was fed, freedom from caries was possible with its inclusion caries developed. The relative cariogenicity of different carbohydrates depends on frequency of intake, on their physical form-stickiness, retentive and cathair chemical type. Low molecular weight substances particularly sugars are, more dangerous because they can more readily diffuse into the plaque and the more rapidly metabolised by the bacteria (Johnson, 1979).

At least four aspects of dietary carbohydrate utilization by oral micro organisms collectively contribute to their disease potential through their role in the formation of dental plaque and through metabolic activity of various components of the plaque microflora, which yield a number of bacterial products that directly interact with oral hard and soft tissues or elicit an appropriate host response.

The four important areas of dietary carbohydrate metabolism are, their conversion to adhesive bacterial extra cellular polymers, bacterial extra cellular storage polysaccharides, bacterial intra cellular storage polysaccharides and their utilization as a fermentable energy (ATP) source by plaque micro organisms. All the dietary carbohydrates are readily utilized in this manner by a number of microbial components of dental plaque. The interrelationship of these four aspects of carbohydrate metabolism in plaque formation and oral disease is schematically represented in the figure (Brown, 1975).



CARBOHYDRATE METABOLISM IN PLAQUE FORMATION.

b. Sucrose the Arch Criminal:

Sucrose has been descended as the arch criminal of dental caries (New Brun, 1967). The first recorded suggestion that eating sweet foods might be a cause of dental decay was made by Aristotle, (384- 323 BC) 2000 years ago when he wondered, why soft and sweet figs damaged the teeth. In both, animal feeding experiments and human studies that dealt with comparing the relative cariogenicity of different carbohydrates, (Sucrose, Maltose, Lactose, Glucose, Fructose and starch) it was clearly shown that sucrose was, the most cariogenic and starch the least. Caries increased significantly when sucrose containing foods were made available, particularly in those who consumed sucrose between meals. Sucrose confined to meal times was far less dangerous, further more toffees which adhered to the teeth and maintained high sucrose levels in saliva for prolonged periods were far more damaging than those which were rapidly cleared from the mouth (Gustafsson et al, 1954). Gustafsson et al individuals suffering from hereditary fructose intolerance, provide another good example of the cariogenicity of sucrose and the relatively low cariogenicity of other carbohydrates. If children with inborn errors of metabolism all to survive, they must avoid foods containing Fructose and sucrose though they can safely and do consume milk sugar (Lactose) and starch. Such individuals have remarkably little-often zero caries (Hass and Graf, 1975). Roberts and Roberts,(1979) have reported that the children who were receiving sucrose based medicines,

had significantly more carious teeth and gingivitis. It is concluded that sucrose based medicines given continuously to children cause dental caries and gingivitis. Liquid medicines for children should be unsweetened or sweetened with non cariogenic substances.

c. Form and frequency of carbohydrates

The between meal eating of sweets, particularly the sticky or hard sucking types is an abnormally cariogenic food habit. In a study done in Vipeholm, with over 400 mental patients, it was shown that when a sugar with a strong tendency to be retained in the mouth was eaten between meals, anywhere from 8-24 hours dental caries increased, rapidly and extensively. If less retentive sugar in solution or even if more retentive sugar rich bread were eaten at meals the rise of increasing caries was least. The more important conclusion from this study was that between meal eating of sweets was more cariogenic than at meal eating even if they are retentive. Either the amount of sucrose or the form of sucrose if eaten at meals affected caries differently (Gustafsson et al. 1954).

In 1970, Mandel wrote that by using the Vipeholm studies as a base, apparent contradictions about the relationship between sugar and dental caries can be resolved. One of the main conclusions of the Vipeholm study was that the risk of sugar increasing caries was greatest if it is consumed in between the meals and in a form in which the tendency to be retained on the surfaces of the teeth is pronounced.

The consumption of carbohydrates, especially sticky candies and chocolates between meals and at bed time promotes dental caries (Arthur and Viswanathan, 1970).

Cohn and Neal, (1962) reported, a positive correlation between the prevalence of dental caries and the consumption of diets, in which there is considered to be an undesirable amount or type of food stuffs contained refined carbohydrates.

4. Trace elements and dental caries

The only other food chemical beside sucrose that has significant cariogenic activity is the trace element Selenium. The conclusion is based,on dental survey studies in the north western parts of United States where Selenium is relatively high in the foods which the natives eat. In animal studies, the incidence of caries increased, significantly when Selenium was given during the period of active tooth development and the increased caries was proportional to the amount of Selenium in the diet of animals. The incorporation of Selenium, during teeth formation,change the protein components of the enamel to make it more prone to caries attack (Nadjimuddin, 1952).

Curzon, (1970) reported that elements strongly associated with a high prevalence of caries were copper and to a less extent Aluminium, Sulfur, Titanium, Chromium, Nickel, Silver and Tin.

Lesse and Ludwig, (1970) have reviewed several clinical studies on the effects of various trace elements on Dental caries and they have concluded that B, Mo, Li and Vanadium can help caries incidence. On the other hand copper, Manganese, Selenium and Lead tend to increase caries.

e. Vitamins and Dental Caries

In general vitamins do not seem to play an important role, in caries control, in human beings although vitamin B_6 may be an exception.

Balogh, (1960) had found that Thiamine, and Riboflavin, suppressed the growth of oral microbes in saliva. Kinsely, (1960) had shown that microbial action in saliva produce some of the B-Vitamin such as Folic acid and Pantothenic acid and Pyridoxin. Cariogenic microbes need there vitamins for nourishment and reproduction Dreizen, (1958). A study showed that some of these microbial growth factors can permeate the tooth from within the surface Brown, (1962). Thus the cariogenic flora in dental lesions, may obtain its nutrients from fluids diffused within the tooth (Brown, 1962).

3. Role of Micro Organisms in Dental Caries

In 1903 Goadby concluded that 3 types of micro organisms functioned in dental caries. They are (1) acid producers (2) liquifiers or proteolysers and the (3) pigment producers.

The major micro organisms present in the plaque are:

1. Veillonella
2. Neisseri
3. Bacteriocema
4. Eubacterium
5. Bacteriolytieum
6. Actinomyces Viscosus Naeslundii
7. Actinomyces Israeli
8. Streptococci
9. Lacto bacilli

and 10. Bacteriods (Nelson and Southall, 1976).

Streptococcus mitans are known to have a high cariogenic activity in animals (New Brun and Crow, 1976).

A study by Svanson et al. (1973) utilized plaque samples taken from sound proximal surfaces of first molars, to show a correlation between streptococcus mitans and subsequent caries development.

A positive correlation was noted between streptococcus mitans and incipient smooth surface carious lesions. There is a strong involvement of streptococcus mitans in the initiation of the carious lesion (Handler and Johnson, 1974). Streptococcus mitans can colonize the tooth surface, both because of initial attachment and also by invading an existing microflora (Valkeng 1975).

The diet was also shown to influence the oral flora (Bibby, 1977).

The potent antidogmicity of Streptococcus mutans flora, both exogenous and endogenous carbohydrates, not only serves as the probable prime force in driving demineralization of the teeth but as an important modifier of the flora on the teeth surface (Tanner, 1973).

Lactobacilli and Dental Caries

Lactobacilli showed a relationship in all lesions of dental caries (Klock and Krasse, 1977).

There is a group relationship between the genus Lactobacillus and dental caries. (Snyder and Sims 1963).

A carious lesion developed as a result of acid attack on the enamel. Many organisms in dental plaque are capable of producing acid from carbohydrate. Among them Lactobacilli is the major one. (Sandham and Phillips, 1975).

4. The caries inhibitory food factors

The greatest advance in preventive dentistry was made when it was discovered that drinking naturally fluoridated water conferred a significant caries resistance upon the individuals (Dean, 1938).

In addition to Fluorides, Phosphate diet supplements seem to help in reducing caries development (Hisel, 1964). The phosphate moiety in phytate may be the reason for the claim that some unrefined carbohydrate foods may be less cariogenic than refined ones (Jenkins et al. 1959).

Ofcourse whenever total carbohydrate intake can be decreased by concomitant increase in protein and fat components of the diet, dental caries can be lessened. Finally, it is suggested by some preliminary evidence that vitamin B_6 supplements can change the oral flora to one with lessened cariogenic potential(Steven et al. 1958).

a. Fluorides and Dental caries

Originally Fluorides were found to be the cause of a congenital deformity of tooth enamel, mottled enamel. Fortunately it was soon noted that the same individuals whose teeth were mottled from fluoride seemed to have significant resistant to dental caries (Arnold, 1960).

Surveys done by Tank, (1964) showed that caries experience decreased., as fluoride concentration increased from 0.5-1.5 PPM compared with those whose water contains little or no fluoride. An important conclusion from these studies is that, the maximal benefits from water fluoridation are realized if fluorides are ingested during the period of tooth formation. Furthermore, there is persistent caries inhibitory effect throughout life if people continue to use water with optimum fluoride content (Tank, 1961). Vehicles for systemic

fluorides, other than water such as, table salt (Backrup, 1967) and milk (Bunoff, 1962) have been suggested. Each of these alterations has some drawbacks such as, difficult to control, more costly and less effective, but these measures are worth consideration when fluoridating the community water supplied is not feasible or possible.

b. Phosphates and Dental caries

Phosphates have been shown to inhibit acid demineralization of tooth surfaces invitro (Jenkins et al. 1959, and Manly et al 1963). Studies on the effect of dietary phosphate supplements on dental caries have shown that there is a significant 20-60 per cent caries reduction (Mixel, 1964) and Reisman 1965). The cariostatic effect of phosphates is generally regarded as being due to a protective action within the oral cavity (McClure, 1964).

The best phosphate compound appears to be a cyclical phosphate, Sodium Rat meta phosphate which exerts the maximal caries inhibiting effect. If it is fed during the newly eruptive period when the tooth is in its early maturation stage, (Navia, 1968) phytin among other phosphates included from brown flour and lost by processing was, cariostatic (Jenkin, 1959). Subsequently Phytin, Sodium and Calcium Phosphates and beta-Glycerol Phosphates were found to be caries inhibitors in rodents (McClure 1963).

There have been 9 different phosphate supplemented clinical dietary studies (Averill and Bibby, 1964). Seven of which reported

some caries inhibition and the remaining three reported no effect. The postulated mechanism of how phosphates reduce dental caries is a possible local ionic exchange of phosphate between the oral environment perhaps the plaque and the tooth surface.

Phosphate diet supplements seem to help in reducing caries development (Mizel and Harris, 1964).

c. Fluoride and Phosphate combination in Dental caries

An additive effect of phosphate and fluoride from a caries inhibitary stand point has been observed (Muhlemann 1961).

Fish protein concentration which is rich in natural fluorides, phosphates and protein has proved to be cariostatic when added to an otherwise cariogenic diet (Mizel and Harris, 1970).

This additive mechanism of action may be explained as follows. Fluoride through systemic and local action can build a strong caries resistant tooth whereas phosphates acting locally on the oral environment may satisfy the oral bacterial environment, (Mizel, 1973).

d. Other minerals and Dental caries

Harris, (1970) has suggested a tentative classification of mineral elements with respect to their ability to promote or reduce caries of cariogenicity and the elements that are believed to belong to each category. Caries promoting elements are, Se, Mg, Cadmium, Platinum, Lead and Silicon. Elements that are mildly cariostatic are

Mo, V, Sr, Cu, B, Li and Mn. Elements with doubtful effects on caries are Ba, Co, Mg, Sn, Zn, Br and I_2. Elements that are strongly cariostatic are Fluoride and Phosphorous.

Calcium and dental caries

When calcium, sucrose and phosphate was added at 5% level in flour syrup, honey, biscuits and canned fruits, it reduced the caries increment in 15 to 17 years children by 15 per cent (Harris, 1968).

Turbola, (1977) found out that there was an average rise in the concentrations of Calcium and Fluoride with increasing caries activity. In the material as a whole there was a negative and highly significant correlation between the secretion rate of saliva and the concentration of F_2 and Ca. The results suggest that the extra salivary F_2 and Ca is likely to be derived from the enamel.

e. Proteins and fats in Dental caries

A diet rich in protein and fat will below in CHO's and thus will be less cariogenic. Casein the phospho protein in milk when used as the source of protein in animal feeding experiments exerted a cariostatic anticaries effect (Himal, 1970).

In humans, it is postulated that high protein diet will increase the salivary urea level, which will neutralize the acids produced in the dental plaque and thus reduce caries development Dawes, 1970).

Fats are generally considered to have anti caries properties because of their ability to produce, a protective oily film, on the surface of teeth and not allow the ready penetration of acids into the enamel. When fats are mixed with carbohydrates in food preparations they tend to decrease the caries producing potential of carbohydrates. (Bowen, Stooky and Miller, 1970)

f. Vitamin B_6 and Dental caries

Pyridoxine supplements in the form of yeasty have been reported to have a caries - inhibitory effect in human dental caries. The mechanism for the action of this vitamin is thought to be its ability, to alter the oral flora, from a cariogenic type to a non-cariogenic type (Hillman and Shannon, 1968).

Monkeys with prolonged Vitamin B_6 deficiencies showed a high incidence of dental caries as well as other oral pathogenic symptoms (Bentjia, 1960).

Large doses of pyridoxine seemed to reduce dental caries in rats (Steinman et al. 1958).

g. Synthetic and unrefined carbohydrates in dental caries

Xylitol is a pentahydric sugar alcohol which occurs widely in many fruits. Various sugar studies (Schmidt and Mahlmann, 1975) have been conducted to find out the application of Xylitol as a

substitute to sugar and its prophylactic effect in the caries prevention. The results revealed enormous reduction of the caries rate in the Xylitol group.

Xylitol was found to have bacteriostatic effects in suspensions of isolated plaque (Mäkinen, 1972).

Studies showed that consumption of Xylitol is associated with increased levels of lactoperoxidase in saliva (Mäkinen and Kolling, 1972).

The branny particles of crude unrefined cereals do not adhere, to the teeth as much as refined flours and may remove plaque. (Hankuk, 1960).

In 1937, Osborn et al. found that sugar-cane juice, in contrast to refined flour and sugar, contained factors which reduced the solubility of enamel when incubated with saliva. Edgar and Jenkins, (1974) have shown that this apparent anomaly is due to the rapid degradation of the solubility reducing agents by bacteria in saliva.

Red Indians, African bushmen and Australian Aborigines had previously obtained the majority of their energy in fibre rich starch foods, when dental caries was rare among them. When Western foods such as sugar and white flour became available, they easily displaced traditional foods and consequently dental caries became common (Renge et al. 1971).

5. Role of saliva in Dental factors

Compositions

The saliva consists of 99.42 per cent water, 0.22 per cent of inorganic salts, 0.22% of organic contents and 0.14 per cent of enzymes. Calcium, Magnesium and Potassium are the cations of the salts and bicarbonates, Chlorides, Fluorides, Sulfate and Nitrates are the anions present. Trace amounts of glucose, Cholesterol, Mucin, Amino acids, Urea, Cellular elements are found to be present in the saliva. Various enzymes are found in saliva. Amylase and phosphatase are found to be the chief enzymes. Other enzymes of saliva which are present in trace amounts are Esterases Kinases B-glucuronidases, B-D- Galactosidases, Sulphotase, Hyaluronidase and lysozyme. Saliva also consists of trace amounts Ascorbic acid, B-Vitamin and E. Vitamin (Shannon, 1961).

Salivary P^H, in a random sample of 1990 Burmese children of 12 years old was from less than 5.5 to 8.0 and this study by Valentine et al, (1976) showed that, the lower the P^H, the greater the tendency to caries.

Increased salivation is conductive to decreased caries and increased flow may be beneficial in cariostatic effect(Mosel and Miller, 1974).

Saliva from caries resistant individuals have the higher buffering capacity than saliva from caries active one (Jenkins, 1969).

Caries is largely initiated or progressed, only when the p^H of saliva is decreased by bacterial acid production, during the approximately half to one hour, following the consumption of fermentable carbohydrates (Dawes, 1974).

Saliva provides protection against cariogenic challenge via four general mechanisms(1)

1. Bacterial Clearance
2. Direct anti bacterial activity
3. Buffering neutralising or modifying and production or acid transport in the plaque
4. Counter acting demineralization (or) encouraging remineralization through cations (Calcium and Magnesium) anions (Phophates and Fluorides) Fluoride) and other anti solubility factors, (Specific proteins) (Mandel 1974).

III. EXPERIMENTAL PROCEDURE

The present study was undertaken, to know the, "Effect of indigenous foods on the P^H of saliva of children, with and without dental caries". The experimental procedure pertaining to the study is as follows

A. 1. Grouping of target children
   2. Dental Assessment
   3. Collection of Saliva

B. Determination of the P^H of saliva.

C. Microbial Evaluation of saliva specimens

   1. Lactobacilli count/ml of saliva.
   2. Streptococcus mutans count/ml of saliva.
   3. Snyder's test for caries susceptibility

D. Analysis of the collected saliva specimens for calcium.

A. 1. Grouping of human children

A total of 150 children, both boys and girls in Coimbatore, between the age group of 5-15 years, participated in the study. Seventy five children among them were with caries and another seventy five children were without caries. Of these, fifty caries children between the age of 5-15 years, attended to ab out patient ward and dental department of Coimbatore Medical College Hospital. Hundred children, between the age of 5-15 years, (Twenty five caries children and seventy five normal children) were from Sri Avinashilingam High School and Elementary School.

2. Dental Assessment

Clinical examination of the teeth of the children were carried out, using a questionnaire as given in Appendix I. In which the dental assessment of the children were recorded, on the basis of their family income. The dental caries was classified as mild, severe and very severe depending on the nature and number of teeth affected. Since dietary factors play an important role in dental caries, diet survey of the children was conducted, to find out the frequency of the consumption of snacks, such as sweets, baked foods, beverages and sugar as side dish.

3. Collection of Saliva

The child was asked to chew on a piece of paraffin for five minutes. Then, 3.0 ml of the saliva was collected in a sterile

tube, plugged with cotton, and the specimen was subjected to bacteriological techniques (described below) as soon as it was collected.

b. Determination of the P^H of saliva

The children were given different indigenous snacks such as gooseberry, ice-cream, plantain, kozhukkattai, biscuit, vazhakki, bread and jam, tapioca, roasted bengal gram, murukku and groundnut each at a time. They were asked to eat them, by chewing. The P^H of the saliva was determined, five minutes after consumption. By this method the P^H lowering effect of different snacks, were determined.

The frequency of sugar intake was found to be a critical factor in caries initiation (Fosdick, 1977). Therefore, the effect of, the mouth rinse of, sugar solutions of, different concentrations were studied. Both, the caries and normal children were given a mouth rinse of sucrose, (some 10% and 20%) and glucose (some 20% and 30%). The P^H of saliva was determined at 5 minutes interval upto 30 minutes after the mouth rinse. The saliva P^H lowering effect of different concentrations of different sugars were determined by this.

c. Microbial Evaluation of Saliva Specimens

1. Considering the growth of oral Lactobacilli, as the index of caries activity, the Lactobacilli count/ml of saliva was

determined as in the procedure given in Appendix II.

2. Klock and Krasse, (1977) noted a positive correlation between, Streptococcus mutans and incipient smooth surface carious lesions. So Streptococcus mutans count of saliva was determined using blood agar medium as given in Appendix III.

3. Snyder's test for caries susceptibility

The saliva specimen was added to mixed snyder's medium, which contains, Bromocresol green as an indicator of acid production by the oral micro organism. The rate of acid production by oral Lactobacilli is an indicator of caries susceptibility. The Technique of this test is given in Appendix IV.

B. Analysis of the collected Saliva Specimens for Calcium

Depending upon the severity of carious lesions, the calcium level was increased in saliva (Bowden and Hilwood, 1979). Therefore, the calcium content of saliva was determined in normal as wells as in caries children. The Calcium content of saliva was determined using, Clark and Collip method (Gopalan, 1971). The procedure is given in AppendixV.

IV. RESULTS AND DISCUSSION

The results pertaining to the study of, "The effect of indigenous foods on the P^H of saliva of children, with and without caries", is discussed in this chapter as follows:

A. Survey of dental assessment of children, for the incidence of dental caries.

B. The P^H lowering effect of different indigenous snacks on the saliva of caries and caries free children.

C. The effect of mouth rinse of different concentrations, of Sucrose and Glucose on the P^H of saliva of caries and normal children.

D. Comparison of the growth rate of Lactobacilli in the saliva of caries and caries free children.

E. Comparison of the growth rate of Lactobacilli in the saliva of caries and caries free children, before and after the consumption of sweets and roasted bengal gram

F. Comparison of the acid production, in the saliva of normal and dental caries children, using Snyder's medium.

G. Comparison of the growth rate of Streptococcus mitans in the saliva of caries and normal children

H. Comparison of the Calcium content, in the saliva of caries and caries free children.

A. Survey of dental Assessment of children for the incidence of dental caries

The incidence of dental caries, the dietary habits and related factors were investigated, using a prescribed questionaire (Appendix I). The severity of caries and the surfaces involved were examined using, a mouth mirror and dental probe.

The investigation was carried out, on 105 children of 5-12 years age group. The socio economic status of the target group children, was studied in relation to the incidence of caries. The incidence of caries, belonging to different income levels is given in table, I.

TABLE I

INCIDENCE OF CARIES IN CHILDREN OF DIFFERENT INCOME GROUPS.

Sl.No.	Monthly income in Rupees	Total Number of children	Number of children with caries.	Caries incidence in per cent
1.	Below 100/-	15	4	26.6
2.	101-200/-	15	10	66.6
3.	201-400/-	15	12	80.0
4.	401-600/-	15	6	40.0
5.	601-800/-	15	10	66.6
6.	801-1000	15	8	53.3
7.	1000 and above	15	6	40.0
		105	56	53.333

The number of children, in each income group was the same (19). The incidence of caries, was found to be the lowest per cent (26.6%) in the very low income group (L Rs.100/-). The incidence of caries was comparitively lower, (40%) among groups '4' and '7'(The per cent incidence of caries was highest (84%) among group '3' whose income ranges from Rs.201-400. The incidence of caries was comparitively higher (66.6%) among groups '2' and '5'. This may be due to the frequent consumption of snacks.

Incidence of caries, as related to the consumption of sugar/ jaggary, as their side dish, shows that 71 per cent of children (75 out of 105) had the habit of consuming, sugar/jaggary as side dish. This sugar/Jaggary came essentiallyfrom beverages and side dish taken along with idlies and sweet snacks like Kesaribath. Out of this 75 children, the incidence of caries was found to be 56 per cent (42 had caries out of 75). These children were found to consume, 40-60 of sugar/Jaggary per day. Caries was not seen in those children whose intake of sugar/Jaggary was L 40g/day.

The intake of different snacks, by the target group children and the per cent incidence of caries, is given in table II.

TABLE II

Sl. No.	Monthly income in Rupees	Snacks consumption by number of children		Caries incidence with reference to frequency of consumption.	
		Often	Occasion	Often	Occasion
1.	Below 100/-	2	13	0	4
2.	101-200/-	9	6	7	3
3.	201-400/-	6	9	5	7
4.	401-600/-	8	7	5	1
5.	601-800/-	9	6	7	3
6.	801-1000/-	8	7	5	3
7.	1000/- and above	6	9	3	3
		48	57	32	24

Almost all the children were, found to consume snacks, in any form. Study of the frequency, of consumption of snacks, shows that out of 105 children, 48 consume snacks, 'often'. (The percentage of incidence of snack consumption is 47%). The incidence of caries, was studied with reference to the frequency of consumption of snacks. This, shows that 67% had caries in the group, 'often'. Whereas the

incidence of caries is 42 per cent in the group 'occasionally'. These results, indicate that the severity of caries is, directly related to the frequency of snack intake.

TABLE III.

SEVERITY OF CARIES, IN RELATION TO DIFFERENT TYPES OF TEETH AFFECTED.

Sl. No.	Types of teeth	Number of caries teeth		
		Mild	Severe	Very severe
1.	Molar	99	31	12
2.	Premolar	25	25	--
3.	Canine	3	--	--
4.	Incisors	4	--	--

Results indicate, that the most affected teeth are molars, followed by the premolars. The least affected teeth, are the canine. This may be due to the adherence of food residues, in the grooves of the molars and premolars, which favours the growth of cariogenic micro-organism.

Carious legion was seen on the occlusal surface, of the molar and premolar teeth to the maximum number (91). Carious legion was also seen, on the proximal surface, of the premolar and molar teeth to the minimum number (8).

B. EFFECT OF INDIGENOUS FOODS ON THE P^H OF SALIVA OF CHILDREN WITH AND WITHOUT CARIES.

TABLE IV.

P^H Lowering effect of different indigenous snacks, in caries free children, of age group 6-9 years, sample size-20

Sl. No.	Indigenous snack items	P^H Range of saliva			
		Non caries of children		Caries of children	
		Before consuming snacks	5 minutes after the consumption of snacks	Before consuming snacks	5 minutes after th e consumption of snacks.
1.	Plantain	6.5 ± 0.46	6.0 ± 0.54	6.3 ± 0.56	5.3 ± 0.31
2.	Gooseberry	7.2 ± 0.09	5.2 ± 0.65	7.1 ± 0.43	6.4 ± 0.14
3.	Ice-cream	7.0 ± 0.21	5.6 ± 0.33	6.9 ± 0.32	6.1 ± 0.16
4.	Kammarkattu	6.9 ± 0.49	5.4 ± 0.22	7.2 ± 0.53	6.0 ± 0.34
5.	Murukku	7.2 ± 0.24	6.9 ± 0.02	6.8 ± 0.41	6.4 ± 0.56
6.	Orange toffee	7.3 ± 0.32	5.9 ± 0.34	7.1 ± 0.51	6.0 ± 0.57
7.	Biscuit	7.5 ± 0.36	6.5 ± 0.17	7.0 ± 0.20	6.4 ± 0.24
8.	Bread & Jam	6.9 ± 0.91	5.6 ± 0.09	6.6 ± 0.63	6.3 ± 0.63
9.	Tapioca	6.8 ± 0.09	6.6 ± 0.65	6.9 ± 0.12	5.9 ± 0.71
10.	Roasted bengal gram	7.3 ± 0.34	7.4 ± 0.16	7.2 ± 0.19	7.1 ± 0.43
11.	Groundnut	6.0 ± 0.72	7.0 ± 0.24	6.4 ± 0.23	6.3 ± 0.92
12.	Varakki	6.9 ± 0.34	6.5 ± 0.53	5.9 ± 0.46	5.5 ± 0.27

TABLE V.

pH LOWERING EFFECT OF DIFFERENT INDIGENOUS SNACKS IN THE SALIVA OF CARIES AND CARIES FREE CHILDREN OF AGE GROUP 10-15 YEARS: SAMPLE SIZE-20.

Sl. No.	Indigenous snack items.	Range of Saliva pH			
		caries free children		Caries children	
		Before consuming snacks	5 minutes after the consump- of snacks	Before consuming snacks	5 minutes after the consumption of snacks.
1.	Plantain	6.5 ± 0.49	6.0 ± 0.15	5.9 ± 0.32	5.3 ± 0.54
2.	Gooseberry	7.2 ± 0.34	5.2 ± 0.20	7.1 ± 0.02	5.0 ± 0.30
3.	Ice-cream	7.0 ± 0.19	5.8 ± 0.82	7.02 ± 0.49	5.4 ± 0.68
4.	Mammarkattu	6.9 ± 0.41	5.4 ± 0.56	6.8 ± 0.32	5.3 ± 0.07
5.	Murukku	7.2 ± 0.09	6.9 ± 0.05	7.0 ± 0.61	6.0 ± 0.15
6.	Orange toffee	7.3 ± 0.24	5.9 ± 0.14	6.9 ± 0.21	5.4 ± 0.68
7.	Biscuit	7.5 ± 0.56	6.5 ± 0.29	6.8 ± 0.09	5.6 ± 0.61
8.	Bread and jam	6.9 ± 0.10	5.6 ± 0.74	6.3 ± 0.46	5.4 ± 0.29
9.	Tapioca	6.8 ± 0.08	6.6 ± 0.23	6.8 ± 0.37	5.37 ± 0.69
10.	Roasted bengal gram	7.3 ± 0.39	7.4 ± 0.01	7.0 ± 0.24	7.0 ± 0.08
11.	Ground nut	7.2 ± 0.08	7.0 ± 0.28	6.3 ± 0.17	6.1 ± 0.39
12.	Varakki	7.0 ± 0.46	6.5 ± 0.89	5.8 ± 0.09	5.3 ± 0.69

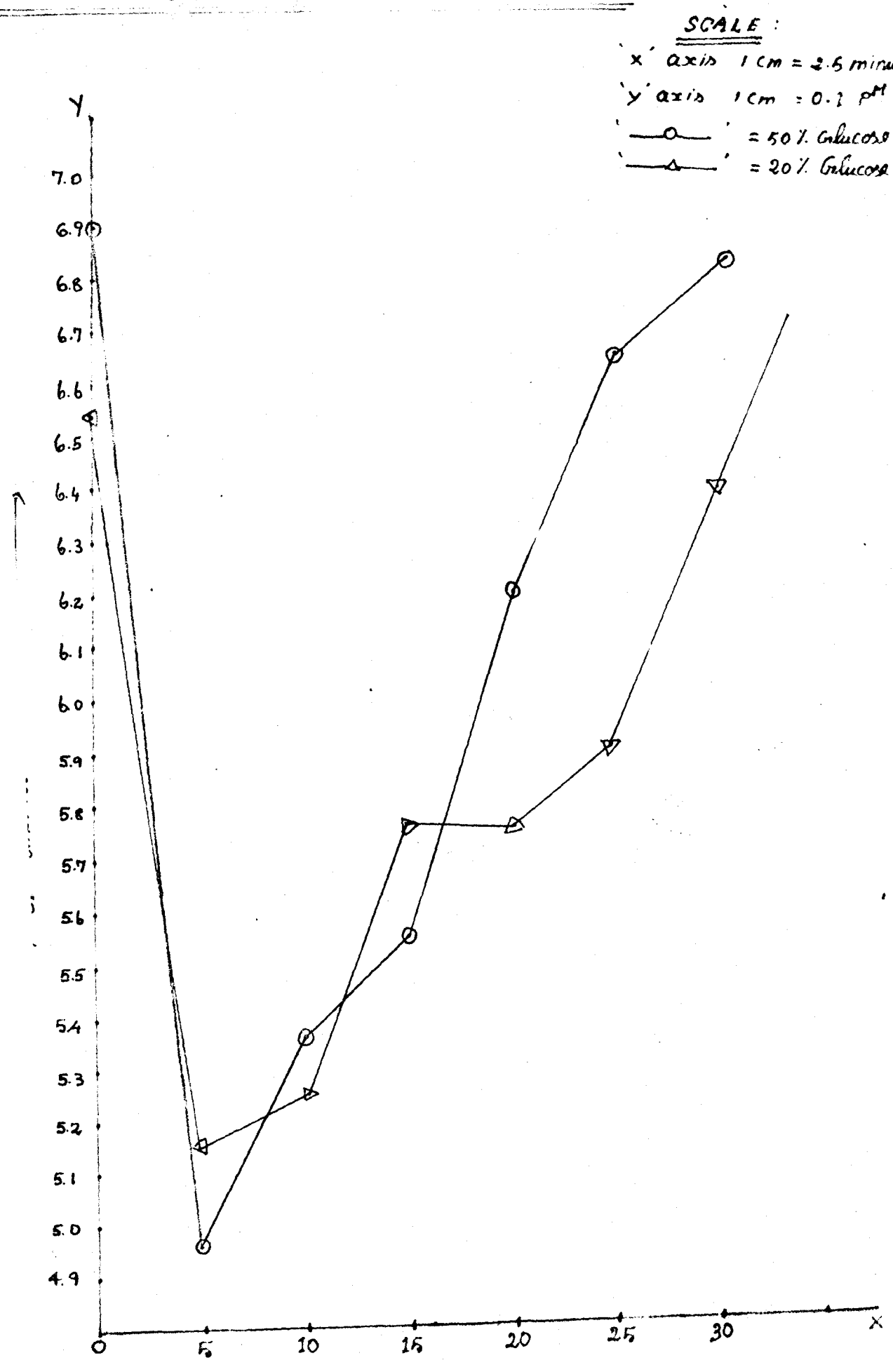
Table IV and V were found to be the indicators of P^H lowering effect of different snacks, in the saliva of caries and caries free children after 5 minutes of consumption. The maximum P^H lowering snacks are considered as cariogenic and the minimum P^H lowering snacks, are found to be cariostatic. The maximum P^H lowering snacks were, plantain, Gooseberry, Ice-cream, Kammarkattu and organge toffee. The moderate P^H lowering snacks were, murukku, bis mit, tapioca, bread and jam and vazhkki. The minimum P^H lowering snacks were, ground nut and roasted bengal gram.

Similar results were found out in the project, (1968) 'Incidence of dental caries in Coimbatore' by Devadas et al (un published), Frontal, (1969) experimented and similarly, with different sweets, cakes and biscuits and categorised them as sweets, cakes and biscuits of decreasing cariogenicity.

Among all the foods discussed here, roasted bengal gram and ground-nut, were found to be the most cariostatic, since they have the minimum P^H lowering effect.

It was also noted that the maximum P^H lowering effect upon the consumption of different snacks, was observed in dental caries children than in caries free children. This may be due to the higher amount of organic acids, produced in the saliva of caries children than in the case of caries free children after 5 minutes of the consumption of indigenous snacks.

GES IN THE SALIVARY P^H OF CARIES CHILDREN AFTER THE MOUTH-
NSE WITH 20% AND 50% GLUCOSE SOLUTION



C. The Effect of Mouthrinse of Different Concentrations of Sucrose and Glucose on the P^H of Saliva of caries and Normal children.

TABLE VI

CHANGES IN P^H AFTER THE MOUTHRINSE OF SUGAR SOLUTIONS OF DIFFERENT CONCENTRATIONS IN THE SALIVA OF CARIES AND NORMAL CHILDREN OF AGE GROUP 10-15 YEARS.

Sl.No.	Sugar	Conc. of sugar solution	P^H Range of saliva			
			Caries children		caries free children	
			Before mouth rinse	5 minutes after the mouth rinse	Before mouth rinse	5 minutes after the mouth rinse
1.	Glucose	50%	6.9 ± 0.36	4.9 ± 0.82	7.2 ± 0.15	6.0 ± 0.10
2.	Glucose	20%	6.63± 0.22	5.1 ± 0.39	6.7 ± 0.26	5.7 ± 0.32
3.	Sucrose	10%	6.4 ± 0.20	5.3 ± 0.24	6.6 ± 0.53	5.5 ± 0.4
4.	Sucrose	50%	7.0 ± 0.86	4.8 ± 0.32	7.1 ± 0.45	5.6 ± 0.62

CHANGES IN THE SALIVARY P^H OF CARIES FREE CHILDREN AFTER THE MOUTH RINSE WITH 20% AND 50% GLUCOSE SOLUTION

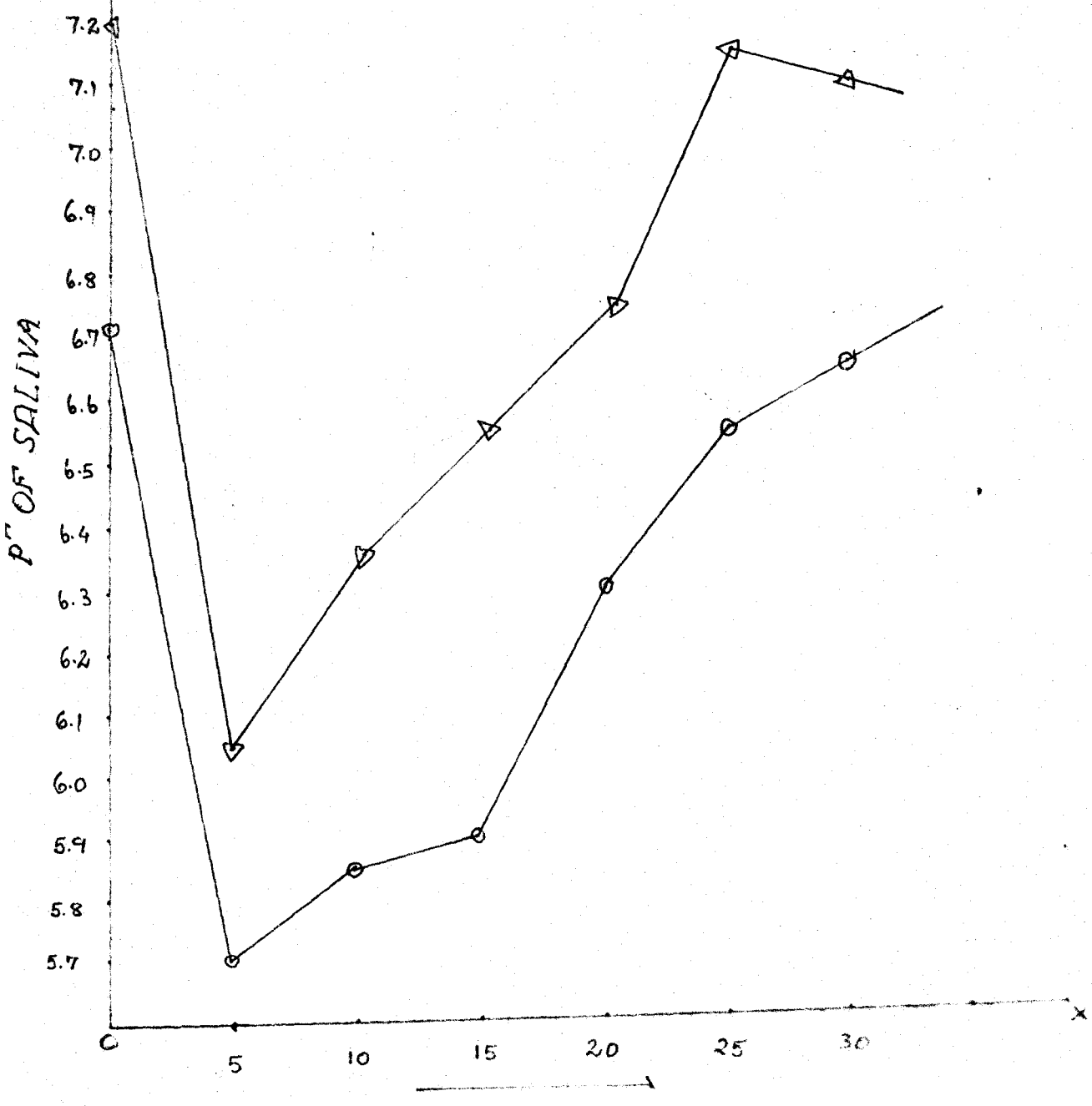
SCALE:

x - axis 1 cm = 2.5 minutes

y - axis 1 cm = 0.1 P^H

—△— = 50% Glucose

—○— = 20% Glucose



The P^H changes in the saliva of caries and caries free children of age group 10-15 years, 5 minutes after the mouth rinse, with sucrose (conc. 10% and 20%) and Glucose (conc. 20% and 30%) are presented in the Table VI.

The P^H lowering effect was more when the concentration of sugar solutions were increased and vice versa. These results are in accordance with the results obtainedby Frostell, (1971). Therefore, we may conclude, that the maximum P^H lowering effect, is proportional to the concentration of the sugar solution. Among Glucose and Sucrose, Sucrose was found to be more cariogenic, than Glucose, since it has the maximum P^H lowering effect than Glucose.

The salivary P^H lowering effect, after the mouth rinse, with the different concentrations of Glucose and Sucrose solutions, upto 30 minutes at 5 minutes interval was given in Appendix II.

D. Comparison of the growth rate of Lactobacilli in the Saliva of Caries and caries free children

TABLE VII.

COMPARISON OF THE GROWTH RATE OF MICRO ORGANISM (LACTOBACILLI) IN THE SALIVA OF CARIES AND NON-CARIES CHILDREN ALONG WITH THE pH OF SALIVA.

Sl. No.	Age in Years	pH of saliva in Caries free children	pH of saliva in Caries children	Lactobacillus count caries free children	Lactobacillus count caries children
1.	5	7.3	6.5	1.2×10^4/ml	3.46×10^5/ml
2.	6	6.9	6.8	8.2×10^4/ml	1.02×10^5/ ml
3.	7	7.0	6.7	6.8×10^4/ml	2.23×10^5/ml
4.	8	7.1	6.6	1.92×10^4/ml	2.62×10^5/ml
5.	9	6.6	6.7	1.57×10^5/ml	2.62×10^5/ml
6.	10	6.4	6.4	1.33×10^5/ml	5.42×10^5/ml
7.	11	7.1	6.5	4.32×10^4/ml	4.31×10^5/ ml
8.	12	7.2	6.3	3.6×10^4/ml	6.47×10^5/ml
9.	13	7.2	6.4	2.48×10^4/ml	4.95×10^5/ml
10.	14	7.1	6.7	2.7×10^4/ml	2.1×10^5/ml
11.	15	6.8	6.6	3.92×10^4/ml	1.6×10^5/ml

The growth rate of Lactobacilli in the saliva of caries and normal children was studied.

There was a significant difference between total Lactobacilli count in the saliva of caries and caries free children. It was also noted that the Lactobacilli count increased, when the P^H of the saliva was decreased and vice versa. From this it was concluded that the P^H of saliva and Lactobacilli count are interrelated. The P^H of saliva of caries children was found to be lower and the Lactobacilli count was found to be greater. In the case of caries free children, the P^H of saliva was found to be greater and the Lactobacilli count, was found to be lesser. In the same way, a positive correlation was noted, between Lactobacilli population with open carious lesion by Klock and Krasse, (1977)

E. Comparison of the growth rate of Lactobacilli in the saliva of, caries and caries free children, before and after the consumption of, sweets and Roasted bengalgram.

and F. Comparison of the acid production in the saliva of caries and normal children using snyder's medium.

TABLE VIII.

COMPARISON OF THE GROWTH RATE OF LACTOBACILLI, IN THE SALIVA OF CARIES CHILDREN BEFORE AND 5 MINUTES AFTER THE CONSUMPTION OF SWEETS.

Age in Years	pH of saliva			Total Lactobacilli count/ml of saliva			Snyder's medium		
	Before consuming sweets	After consuming sweets	't'	Before consuming sweets	After consuming sweets	't'	24 hrs.	48 hrs.	72 hrs.
5	6.5	5.5		3.46×10^5	3.65×10^5		+	+	+
6	6.8	6.0		1.2×10^5	1.41×10^5		+	+	+
7	6.7	5.8		2.23×10^5	2.54×10^5		+	+	+
8	6.6	5.9		2.62×10^5	2.8×10^5		+	+	+
9	6.7	6.0	1.606	2.2×10^5	2.02×10^5	1.4705	+	+	+
10	6.4	5.7		5.42×10^5	5.52×10^5		+	+	+
11	6.5	5.6		4.31×10^5	4.52×10^5		+	+	+
12	6.3	5.9		6.47×10^5	6.8×10^5		+	+	+
13	6.4	6.0		4.98×10^5	5.1×10^5		+	+	+
14	6.7	5.1		2.1×10^5	2.42×10^5		+	+	+
15	6.6	6.1		1.6×10^5	1.84×10^5		+	+	+

TABLE IX

COMPARISON OF THE GROWTH RATE OF LACTOBACILLI IN THE SALIVA OF CARIES FREE CHILDREN, BEFORE AND 5 MINUTES AFTER THE CONSUMPTION OF SWEETS.

Age in years	pH of saliva			Total lactobacilli count/ml of saliva			Snyder's medium		
	Before consuming sweets	After consuming sweets	't'	Before consuming sweets	After consuming sweets	't'	24 hrs.	48 hrs.	72 hrs.
5	7.3	6.4		12000	18000		--	--	+
6	6.9	6.5		82000	90200		--	+	+
7	7.0	6.3		68000	84000		--	+	+
8	7.1	5.9		19200	41000		--	+	+
9	6.6	5.8	1.3565	157000	174000	0.614	--	--	+
10	6.7	5.9		153000	167000		--	--	+
11	7.0	6.0		45200	62000		--	--	+
12	7.2	6.6		36000	54000		--	--	+
13	7.2	6.5		24500	34200		--	+	+
14	7.1	6.4		27000	41000		--	+	+
15	6.6	5.9		89200	109200		--	-	+

Table VIII and IX indicate the comparison of the growth rate of Lactobacilli, in the saliva of caries and caries free children before and after, the consumption of sweets. It was noted that the P^H value of the saliva was decreased, after the consumption of sweets and the Lactobacilli count was increased. The saliva P^H lowering effect and the increase in the Lactobacilli count, after the consumption of sweets was significant at 20% level. The P^H lowering effect, may be due to the large amount of organic acids, produced by the higher population of Lactobacilli in the saliva, using the carbohydrates present in the sweets as substrates.

The acidity produced by Lactobacilli was also found out by colour index method, using Snyder's medium. In 1953, Snyder, found out the acidity, produced by Lactobacilli through colour index method.

By comparing tables VIII and IX it was concluded that the increase in the Lactobacilli count after the consumption of sweets was found to be greater in the case of caries children than in the case of caries free children. In caries free children, the Lactobacilli count was lower and the acidity produced was also found to be lower. But in caries children, the Lactobacillus count was greater and the acidity, produced was also found to be greater. This inturn enhanced, the maximum lowering of P^H in caries children. Thus eating too many sweets like the one studied here, further damages the teeth in caries children and in normal children, incidence of caries occurs.

TABLE X

COMPARISON OF THE GROWTH RATE OF LACTOBACILLI IN THE SALIVA OF CARIES CHILDREN BEFORE AND 5 MINUTES AFTER THE CONSUMPTION OF ROASTED BENGAL GRAM:

Age in years	pH of saliva		Total Lactobacilli count/ml of saliva		Snyder's medium		
	Before consuming roasted bengal gram	After consuming roasted bengal gram	Before consuming roasted bengal gram	After consuming roasted bengal gram	24 hrs.	48 hrs.	72 hrs.
5	6.5	6.6	346000	354000	+	+	+
6	6.8	6.8	120000	120000	+	+	+
7	6.7	6.6	223000	220100	+	+	+
8	6.6	6.5	262200	260000	+	+	+
9	6.7	6.7	220000	224000	+	+	+
10	6.4	6.5	542000	540000	+	+	+
11	6.5	6.4	432000	432000	+	+	+
12	6.3	6.2	647000	646000	+	+	+
13	6.4	6.4	425000	429000	+	+	+
14	6.7	6.6	210000	209000	+	+	+
15	6.6	6.7	160000	158500	+	+	+

TABLE XI.

COMPARISON OF THE GROWTH RATE OF LACTOBACILLI IN THE SALIVA OF CARIES FREE CHILDREN BEFORE AND 3 MINUTES AFTER THE CONSUMPTION OF ROASTED BENGAL GRAM

Age in years	pH of saliva		Total Lactobacilli count/ml of saliva		Snyder's medium		
	Before consuming roasted bengal gram	After consuming roasted bengal gram	Before consuming roasted bengal gram	After consuming roasted bengal gram	24 hrs.	48 hrs.	72 hrs.
5	7.3	7.2	12000	12900	--	--	+
6	6.9	6.9	82000	82800	--	+	+
7	7.0	7.0	68000	68300	-	+	+
8	7.2	7.0	19200	18800	-	+	+
9	6.6	6.5	157000	161000	-	+	+
10	6.7	6.8	153000	152800	-	-	+
11	7.0	7.0	48200	48800	-	-	+
12	7.2	7.2	36000	34000	-	+	+
13	7.2	7.1	24500	24400	-	+	+
14	7.1	7.0	27000	28900	-	-	+
15	6.6	6.8	89200	89300	-	-	+

Table X and XI are specifically referred to indicate the growth rate of Lactobacilli in the saliva of caries and caries free children of age group 5-15 years, before and after, the consumption of roasted bengal gram. After the consumption of roasted bengal gram, the P^H of saliva was not decreased markedly. No significant change or increase in the Lactobacilli count was also noted.

This may be due to the alkalinity, produced by the metabolism of roasted bengal gram, in the saliva. Since Lactobacilling growth was found to be stimulated in the acid medium (Miller, 1924), the Lactobacilling growth was not found to be increased, after the consumption of roasted bengal gram.

Thus roasted bengal gram is considered as the most important cariostatic snack. It has an additional advantage of being low cost food.

By comparing Tables VIII and IX with X and XI the following conclusions may be established

1. The P^H of saliva, was decreased and the growth rate of Lactobacilli count, was increased after the consumption of sweets.
2. The P^H of saliva was not decreased to a significant level and the growth rate of Lactobacilli count, was also not increased to a greater extent after the consumption of roasted bengal gram.
3. Since the maximum P^H lowering effect was seen in the case of sweets, they may be considered more cariogenic, than roasted bengal gram.

6. COMPARISON OF THE GROWTH RATE OF STREPTOCOCCUS MUTANS IN THE SLIVA OF CARIES AND CARIES FREE CHILDREN.

TABLE XII.

Sl. No.	Age in years	Total Streptococcus mutan count/ml of saliva of normal children	Total streptococcus mutan count/ml of saliva of caries children	't'
1.	5	200	8600	
2.	6	300	9200	
3.	7	100	7300	
4.	8	100	9900	
5.	9	300	9400	
6.	10	400	7900	26.358
7.	11	700	8100	
8.	12	200	10100	
9.	13	100	8800	
10	14	600	9800	
11.	15	100	10200	

This picture reveals a comparisons of the growth rate of Streptococcus mutans in caries and caries free children.

THE GROWTH OF STREPTOCOCCUS MUTANS IN THE SALIVA OF A CARIES CHILD

It was concluded from the table that thegrowth rate of Streptococcus mutans were found to be greater in the saliva of caries children than in caries free children. The extent of Streptococcus mutans were, found to be proportional to the extent of carious lesions (Johnsen, 1979). Therefore, it may be assumed, that the Streptococcus mutans were, count is a parameter to indicate the extent of caries.

H. Comparison of Calcium Content, in the Saliva of Caries and Caries Free Children:

TABLE XIII.

AMOUNT OF CALCIUM PRESENT IN THE SALIVA OF CARIOUS CHILDREN OF AGEGROUP 5 to 10 YEARS.

Sl.No.	Extent of caries	No. of samples	Amount of calcium present in 100 ml of the saliva in mg.	't'
1.	Mild	20	7.35 ± 0.35	0.8375
2.	Moderate	19	8.083± 0.19	1.3385
3.	Severe	20	9.32 ± 0.18	3.0078
4.	Normal	18	6.68 ± 0.39	

Table XIII reveals the amount of Calcium present in the saliva of normal and caries children of age group 5-10 years.

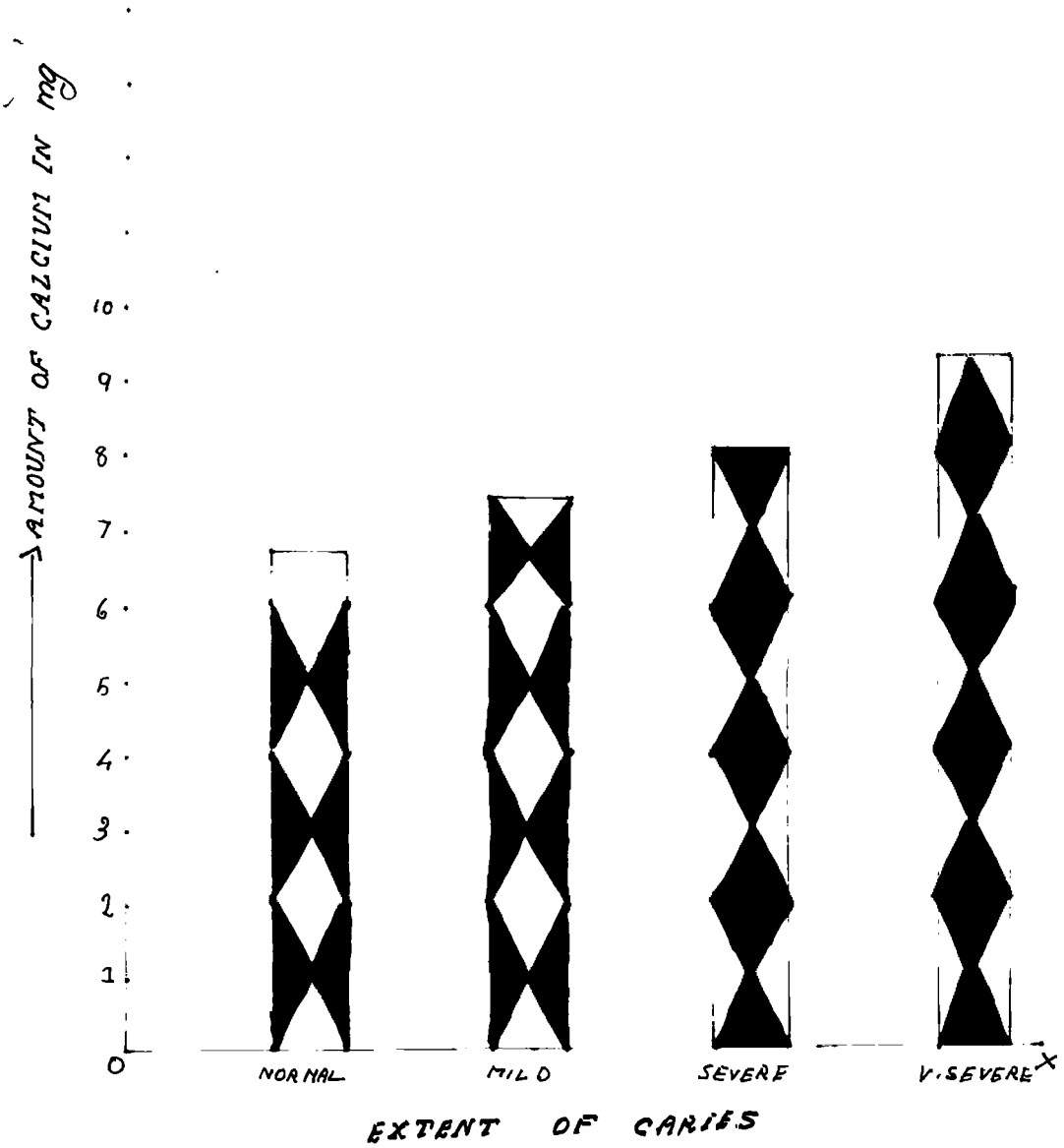
The amount of Calcium/100 ml of saliva was estimated in normal children and in mild, moderate and severe caries children of age group 5-10 years. From the results it was concluded, that the amount of Calcium/100 ml of saliva, was proportional to the extent of caries. The amount of Calcium/100 ml of saliva in normal children was found to be lower than that of the caries children.

The difference between the amount of Calcium, in 100 ml of saliva of caries and caries free children was found to be significant at 10% level. This maybe due to the demineralisation of the enamel of the teeth by the micro organisms in the oral cavity. Similar results were published in the Scandinavian journal of dental research by Tarkola, (1977).

AMOUNT OF CALCIUM PRESENT IN THE SALIVA OF CARIES - -
AND NORMAL CHILDREN OF AGE GROUP 5 - 10 YEARS.

SCALE :

y-axis 1cm = 1mg of Ca



V. SUMMARY AND CONCLUSION

The present investigation, "the effect of indigenous foods, on the P^H of saliva of caries and normal children" has the following objectives

1. Survey of dental assessment of children, for the incidence of dental caries.
2. Effect of indigenous foods on the P^H of saliva of caries and normal children.
3. Lactobacillus count, in normal and caries children
4. Lactobacillus count, in the saliva of caries and normal children before and after the consumption of:
   a. Sweets
   and b. roasted bengal gram.
5. Estimation of Streptococcus mitior population in the saliva of caries and normal children.
6. Determination of the Calcium content of the saliva of caries and caries free children

The incidence of dental caries among children of Coimbatore in relation to dietary habits, severity of caries and surface involved was studied in different income groups using a proforma. Among the 105, children examined the incidence of caries was found to be 53.33 per cent. The incidence of caries was highest in middle income group. The incidence of caries was directly related to the frequency

of snack intake. The most affected teeth were molars followed by premolars. This may be due to the adherence of food residues, in the grooves of the molars and premolars, which favours the growth of cariogenic micro-organism.

The lowering of P^H within 5 minutes after the consumption of indigenous snacks, was greater in caries children, than in the caries free children. The maximum P^H lowering effect, was due to sweets and the minimum P^H lowering effect was due to ground nuts and roasted bengal gram. This indicated that, the sweets are cariogenic and roasted bengal gram andground nuts are cariostatic.

Lactobacillus count w as higher in the saliva of caries children than in the saliva of caries - free children. The P^H of saliva of caries children, was found to be lower than that of the P^H of saliva of caries free children. Therefore, we may conclude, that the Lactobacilli count was found to be inversely proportional to the P^H of saliva. This may be due to the effect of higher amount of organic acid production, by the longer population of Lactobacilli in Saliva.

The P^H lowering effect was found to be higher, 5 minute, after the mouth rinse with 20% sucrose and Glucose solution than with 10% Sucrose and 20% Glucose solution. This revealed that, the P^H lowering effect increased with, the concentration of the sugar solution.

There was significant difference in the growth rate of Lactobacilli in the saliva of caries and non-caries children 5 minutes after the consumption of sweets. This proved that the sweets act as substrates, for the micro organism. However, the growth was found to be higher in the case of caries children than in normal children. This is due to the higher acidity, in the saliva of caries children, which favours the growth of Lactobacilli.

There was no significant increase in the Lactobacilli count 5 minutes after the consumption of roasted bengal gram, both in the saliva of caries and non-caries children. The P^H lowering effect was also found to be minimum. This leads to the conclusion that, the roasted bengal-gram is a cariostatic substance.

The Streptococcus mutans growth was also found to be higher in the case of caries children than in caries free children. Streptococcus mutans are the parameters to assess the extent of cariogenicity.

The calcium content of the saliva of normal children was found to be lower than that of the caries children. This may be due to the demineralisation of enamel by the oral microorganisms.

RECOMMENDATIONS

1. From this study the maximum P^H lowering effect was observed with sweets therefore, consumption of these snack items should be discouraged.

2. The roasted bengal gram and ground nuts have minimum or nil P^H lowering effect. Moreover, these snack items are easily available, economical and also they have high protein content. So, consumption of these snack items should be encouraged, to avoid the incidence of caries as well as protein caloric malnutrition.

Consumption of more indigenous snacks cause lower acidity in the saliva. The acidic medium, enhances the growth of micro-organisms which in turn will produce incidence of caries. So, it is recommended that the mouth rinse with water, immediately after the consumption of food is essential to prevent the occurrence of caries.

Based on the present study the following suggestion may be taken in the future investigation on dental caries and periodontal diseases.

1. Determination of the P^H lowering effect and Lactobacilli count, in adults.
2. Detailed study of the growth rate of Streptococcus mutans.
3. P^H lowering effect of some other indigenous foods such as raw coconut and raw carrot.

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APPENDICES

APPENDIX I

Proforma for the Social Survey of Children for the Institute of Social Service.

1. Name of the School :
2. Child's Name :
3. Standard and Section :
4. Sex :
   1. Male :
   2. Female :
5. Age :
6. Caste :
   1. F.C. 3. S.C.
   2. B.C. 4. S.T.
7. Religion :
   1. Hindu 3. Muslim
   2. Christian 4. Others
8. Name of the father :
9. Permanent address :
10. Total income per month :
    1. Rs.200 and below :
    2. Rs.201-400/- :
    3. Rs.401-600/- :
    4. Rs.601-800/- :
    5. Rs.801-1000/- :
    6. Rs.1001 and above :

11. Total consumption of sugar by the target child per day :

12. Total Consumption of Jaggery by the target child per day :

13. How many teaspoons of s ugar or Jaggery in milk/beverages per day :

14. Does the child eat sugar or Jaggery as dish for Idly, dosai etc., :

1. Yes :

2. No :

15. Is the child is vegetarian Non-vegetarian :

1. Veg etarian :

2. Non-vegetarian :

16. Sources of drinking water :

1. Sirucuni Water :

2. Well water :

17. Physical Nature of the dish :

1. Sticky :

2. Non-sticky :

3. Chewable :

4. Non-chewable :

5. Soluble :

6. Non-soluble :

18. Does the child eat any snacks and if so, list them :

a. :

b. :

c. :

d. :

19. Physical nature of the snacks :

1. Sticky :

2. Non-sticky :

3. Chewable :

4. Non-Chewable :

5. Soluble :

6. Non-soluble :

20. Frequency of Snacks :

1. Occasionally :

2. Often :

21. Does the child drink any beverages and if so list them :

a. :

b. :

c. :

d. :

22. Freque ncy of consuming Beverages :

1. Occasionally :

2. Often :

23. Oral Hygine Methods :

1. Finger :

2. Brush :

3. Twig :

24. Material used for cleaning the teeth :

1. Soft powder :

2. Coarse powder :

3. Herbal powder :

4. Tooth Paste :

25. P^H of saliva :

26. Does the child have any Mild Caries? Specify the region :

27. Does the child have any Severe caries? Specify the region. :

28. Does the child have very severe caries? Specify the regions :

29. SURFACE INVOLVED

Occlusal surface :

30. Lingual surface :

31. Buccal surface :

32. Proximal surface :

APPENDIX II

Identification and Determination of Lactobacilli Counts of Saliva using Selective Lactobacilli Medium.

Selective Lactobacilli medium

Rogosa, Mitchell and Sharpe's medium (1960).

Principle

Rogosa et al., Described an improved medium for Lactobacilli Counts. Owing to the action of a wetting agent (Tween 80), an acid p^H 5.4 and a special salt mixture, no other micro organism can grow in this medium except the Lactobacilli which are quite unaffected. The pour plate technique is used commonly with, 1.0 ml and 0.1 ml samples of a 1:100 dilution of saliva in physiological saline solution and the deep colonies of Lactobacilli can be easily counted in the almost transparent medium.

Ingredients

Peptone	: 10.0g
Meat Extract	: 10.0g
Yeast extract	: 5.0g
Glucose	: 20.0g
Tween 80	: 1.0 ml
Potassium Hydrogen phosphate	: 2.0g.

Tri Ammonium Citrate	: 2.0g
Manganese sulfate	50.0 mg
Sodium acetate	: 5.0g

Dissolved the ingredients in one litre of distilled water. Adjusted the P^H to 6.5 Distributed in 270.0 ml of fluid medium. Autoclaved at 15 lbs. for 15 minutes.

Inoculum:

0.1 ml and 1.0 ml of the 1/1000 serially diluted saliva was mixed with melted and cooled SL medium and poured into petridishes. Three plates were used for each dilution. The plates were observed after 3 days and the colonies were counted and the average was taken as the total count.

APPENDIX III

Identification and Determination of Streptococcus Mitans Count/ml of Saliva.

Aim

To determine the Streptococcus mitans count/ml of saliva using blood agar medium.

Reagents

Blood agar = Nutrient agar 90.0 ml. of sterile defibrinated blood.

Nutrient Agar

Peptone	: 10.0g
Meat extract	10.0g
Sodium chloride	: 5.0g
Water	: 1.0l

Adjusted the P^H to 7.6 Distributed in 200 ml amounts in flasks. Added 4.0g of agar into each flask. Autoclaved at 15 lbs for 15 minutes.

Sample media

Melted the nutrient agar and cooled the medium to 56^0 c. Added 20.0 ml of blood into 200 ml of the medium. Mixed it well

and poured into plates aseptic.

Technique

0.01 ml of saliva of dental caries and normal children were inoculated into the above medium. The Streptococcus mutans colonies were observed and identified after 24 hours and counted in an electronic counting chamber.

APPENDIX IV.

COLORIMETRIC TEST FOR CARIES ACTIVITY (SNYDER M.L. PORTER, AND G LANDON, 1962)

Principle

Simple colorimetric test, for the diagnosis of caries activity is based on the rate of acid production in a dextrose medium by oral acidogenic micro organisms, that will grow at a p^H from 4.7 to 5.0 (Principally Lactobacilli). The production of acid is detected by an indicator, bromocresol green, which changes from blue-green to green and then to yellow colour.

Snyder's medium Bromcrsl

Tryptophan ne	: 20.0g/litre
Dextrose	: 20.0g/litre
Sodium Chloride	: 5.0g/litre
Agar	: 20.0g/litre
Bromocresol green	:

To rehydrate this medium, suspended 65.0g in 100 ml distilled water. Heated to boiling, to dissolve the medium completely. Sterilized by autoclaving for 15 minutes at 15 pounds pressure at 121°C.

Technique

0.1 and 0.2 ml of the subject's saliva was mixed with (melted and cooled) Snyder's Agar. Incubated at 37°C. The colony changes were observed at 24, 48 and 72 hours incubation. (Incubated at 37°C.) The production of acid, is detected by an indicator, bromcresol green, which changes from blue green (p^H 4.7 to 5.0) to green (4.2 to 4.6) to yellow (p^H 4.0 or lower), yellow indicates a positive test. The final result is obtained within 72 hours.

APPENDIX V.

ESTIMATION OF CALCIUM IN THE SALIVA OF CARIES AND NORMAL CHILDREN (CLARK AND COLLIP METHOD)

Principle

Calcium from saliva is precipitated as calcium oxalate. The precipitate is dissolved in acid and the oxalate ions is determined, titrametically by titrating with potassium permanganate solution.

Reagents

1. Ammonium oxalate 4% solution
2. Ammonia 2% solution.
3. Potassium permanganate 0.01 N solution.
4. Approximately normal Sulphuric acid.

Procedure

To 2.0 ml of the saliva, added 2.0 ml of distilled water and 1.0 ml of 4% ammonium oxalate solution and adjusted the PH to 4.5 within Hydrochloric acid. Set it stand overnight at room temperature. Centrifuged and removed, the supernatent fluid, without disturbing the precipitate. Added 3.0 ml of 2% Ammonia down inside of the tube. Mixed the precipitate, centrifuged and poured off the supernatent. This is repeated until the supernatent gave no precipitate with calcium chloride solution. Added 2.0 ml of approximately normal Sulfuric acid, mixed and dissolved the precipitate

with the end. Warmed by placing in a beaker containing almost boiling water. Removed and titrated with 0.01. N Potassium permanganate keeping the mixture at 70°-75° C to a faint pink colour which persists for about a minute.

As a blank, titrated 2.0 ml of N/10 sulfuric acid to the same end point. The difference between the two titrations gives the volume of 0.01 N Potassium permanganate, required to titrate the calcium oxalate.

Calculations

1.0 ml of 0.01 N $KMnO_4$	'n' mg of calcium
Volume of 0.01 N $KMnO_4$ required by 2.0ml of saliva	'x' ml
Volume of 0.01 N $KMnO_4$ required by the blank	'y' ml
Volume of 0.01N $KMnO_4$ required by 2.0 ml of saliva	(x - y) ml
∴ Amount of Calcium present in 2.0ml of the saliva	(x-y) n mg
∴ Amount of calcium present in 100ml of the saliva	$\frac{(x-y) n \times 100}{2}$ mg

APPENDIX VI (A)

CHANGES IN P^H AFTER GIVING MOUTH RINSE OF SUGAR SOLUTIONS WITH DIFFERENT CONCENTRATIONS IN THE SALIVA OF CARIES CHILDREN.

Sl. No.	Age Group	Sugar solution	Concentration of the sugar solution	Time in minutes						
				0	5	10	15	20	25	30
1.	10-15	Glucose	50%	6.90	4.96	5.36	5.55	6.20	6.65	6.82
2.		Glucose	20%	6.53	5.15	5.26	5.76	5.75	5.90	6.19
3.	[illegible]	[illegible]	10%	6.40	5.35	5.54	5.60	5.85	6.06	6.30
4.		Sucrose	50%	7.00	4.80	5.20	5.65	6.32	6.60	6.90

APPENDIX VI (b)

CHANGES IN SALIVARY P^H AFTER GIVING MOUTH RINSE OF SUGAR SOLUTIONS WITH DIFFERENT CONCENTRATIONS OF CARIES FREE CHILDREN

Sl. No.	Age Group	Sugar solution	Concentration of the sugar solution	Time in minutes						
				0	5	10	15	20	25	30
1.	10-15	Glucose	20%	6.71	5.70	5.85	5.90	6.30	6.54	6.65
2.		Glucose	30%	7.20	6.05	6.35	6.88	6.80	7.15	7.10
3.	Boys	Glucose	40%	6.60	5.60	6.65	5.80	5.95	6.36	6.50
4.	[illegible]	Glucose	50%	7.15	5.66	6.30	6.40	6.65	6.86	6.90

APPENDIX VII

STATISTICAL ANALYSIS

In the present investigation, the mean value for the P^H and total Lactobacilli count in the saliva of caries and caries free children, before and after the consumption of sweets were calculated. The mean value of Streptococcus mitans count and Calcium content of saliva of caries and normal children were also calculated. The standard deviation was found out using the formula,

$$S = \sqrt{\frac{\Sigma x^2}{n}}$$

where, 'x' = mean - each item

'n' = Number of samples.

The test significance called the 't' - test to find out the significance in the variation between the total Lactobacilli count in the saliva of caries and normal children, before and after the consumption of sweets was studied. The test significance between the total Streptococcus count and the Calcium content in the saliva of caries and normal children was calculated.

The 't' value was calculated using the formula,

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1 n_1 \; S_2 n_2}{n_1 + n_2 - 2}}}$$

'x' = Mean

'S_1' = Standard deviation

'n' = Sample number