

ADD HYGIENE TO YOUR SMILE.

**Sitaram Dixit,
Manager – Technical Services, Consumer Care Division,
BU Detergents & Cosmetics, Hindustan Ciba Geigy Limited.**

The World Oral care market is big business that comprises of toothpaste, mouth washes, toothbrushes, mouth fresheners, denture fixatives, plaque indicators, plaque removers, dental floss, toothpowder's and other related speciality products. In the overall personal product range of Toiletries and Cosmetics, oral care is a minuscule segment having an average share of say about 10%. Developed countries like Germany, UK, USA, etc., is well above average even outpacing inflation and some others much below.

The growth of Oral Hygiene products is largely due to changing consumer attitudes towards dental care and is directly related to the income and educational levels of the end user. The state of teeth, gums or the mouth as a whole plays a major role in the overall health of an individual and the realisation that tooth loss does not depend on age makes a person tend towards buying a premium priced product that offers therapeutic or value added benefits. Presently toothpaste represents the largest sector in the oral care market closely followed by mouthwashes and toothbrushes. In the Indian subcontinent, more so in rural toothpastes are also popular.

Dental creams for consumer acceptance should have various physical and chemical attributes. Toothpaste's should not be stringy, not show separation of solid and liquid phases and not have varying levels of viscosity on ageing. The dentifrice must be easy to dispense from a toothpaste tube and yet have excellent ribbon qualities without being runny in character. Toothpowder's should be free flowing with no lump formation and have a good feel. It should contain ingredients that greatly enhance the therapeutic and cosmetic benefits, and have an appealing taste for the consumer to continue buying the product. Dental creams and powders are complex mixtures of various ingredients, suitably optimised for maximum therapeutic benefits and consumer delight.

The major difference between toothpaste's and toothpowder is that the former is a semi solid paste or gel whereas toothpowder is a free flowing powder. Although many different types of toothpastes are available in the world market, majority of them is mixtures of Abrasives, humectants, surfactants, thickeners, binders, sweeteners, flavours, and speciality chemicals providing therapeutic benefits or actives. Essentially toothpowder's also contains similar ingredients but agents like thickeners, binders that maintain homogeneity and stability of toothpaste may not be necessary.

Some Basic Functional ingredients used in various toothpastes.

Abrasives	10 to 60%
Humectants	24 to 60%
Water	0.0 to 50%
Inorganic thickeners	0.2 to 12%
Organic Binders/ Gums, etc.	0.5 to 03%
Surfactants	0.5 to 03%
Buffer/ Salts, etc.	0.5 to 10%
Flavour/ Sweeteners	1.0 to 1.5%
Actives (Triclosan, Fluorides, etc.)	As recommended for a specific formulation and for specific claims.

The solid cleansing material of toothpaste that removes plaque, embedded food particles, removes stains from teeth are called as abrasives. Abrasive also functions as a polishing agent without adversely affecting tooth enamel or any exposed dentine. Oral cavity is an open system in the human body, and teeth readily acquire a layer of protein material, called as acquired pellicle. Continuous accumulation of pellicle leads to bacterial growth and plaque. Pellicle must be regularly brushed out with an effective toothpaste to prevent teeth from becoming discoloured or stained. Abrasiveness is usually expressed with Moh scale measuring hardness on a logarithmic scale of 0 to 10. Using the Moh scale, tooth enamel has a hardness of about 4 to 5, dentine of about 2 to 2.5, and the acquired pellicle about 1. A safe and suitable toothpaste abrasive considering the above should have an abrasive value in the range of 1 to 2 and the abrasiveness of a dental product be within reasonable limits to prevent any harm to the teeth. The other important factor to be considered in selecting an effective toothpaste abrasive is the particle size. A large sized particle will be ineffective in removing the adhering protein layer due to uneven distribution and will produce a gritty feeling when used. Therefore, it is preferable to have a particle size in the range of 2-15 μ for maximum efficiency. Likewise, a smooth and regular spherical shaped particle

will have little abrading property, whereas an irregularly shaped particle at the same time harmless to enamel and dentine may be more effective and acceptable for use in toothpaste.

Calcium Carbonate that is available in a variety of grades is an effective toothpaste abrasive. The alkaline nature of Calcium Carbonate helps in neutralising the acidity generated in the mouth after eating varieties of food stuff. Di calcium phosphate dihydrate is also widely used as an abrasive. It has a good colour and a nonobtrusive odour and taste. Aluminium trihydrate and silica are also used as toothpaste abrasives. The advantage of using silica in its pure form is its relative inertness and its compatibility with fluorides and many therapeutic materials. Silica is available in different grades and particle sizes. Popular among them includes silica Xerogels and precipitated silica. The refractive index of silica that is closer to the liquid phase of a toothpaste helps in formulating a clear and gel-type product. Silica types that are porous in nature are shear sensitive and create a self-adjusting particle size distribution in a toothpaste formulation.

Mildly alkaline abrasives such as baking soda, Sodium bicarbonate are also used successfully as a cleansing agent. Alkaline abrasives thus play a dual role in dental hygiene. Apart from mechanical removal of the unwanted pellicle it also neutralises the acidic metabolites present in the mouth cavity. Abrasives being a major component in toothpastes should have low levels of astringency to help formulating a consumer acceptable flavoured product.

Tooth decay and dental caries results from the continuous occurrence of plaque, a sticky film of bacteria that constantly forms on the mouth together with their decomposition products and food residues. Plaque adheres to teeth and the areas between them and if not removed calcifies to form a cement like substance called tartar. Tartar hardens staining teeth and makes them rough. It also provides a perfect place for bacteria to grow and proliferate. The bacteria present generate acidic metabolites lowering the mouth pH to 5.5, which causes an attack on the dental enamel. Such repeated attack breaks down the tooth enamel exposing the sensitive part of the tooth leading to rapid onset of dental caries. The formation of tartar also irritates the gums. Gums become red, swollen, or tender, and may bleed on brushing causing gingivitis to eventually culminate in periodontal diseases.

Oral diseases cause tooth loss and pain, bad odour cause embarrassment in social circle, loose teeth interfere with speech and in some cases spread infection to other areas of the mouth and body. Proper brushing helps prevent tartar formation only a professional dentist can remove build-up tartar by mechanical cleaning either to prevent or to delay the onset of periodontal disease. Dental treatments apart from being labour intensive are also relatively expensive and causing discomfort. To prevent plaque associated disease's plaque formed must be continuously removed. Unfortunately, simple brushing is only partially successful in this respect. The easier option to help remove plaque is to use toothpaste containing an effective antimicrobial ingredient.

For an antimicrobial to be considered effective in an oral formulation, the following attributes are necessary. a) It should have a broad spectrum activity, b) Good substantivity i.e. be retained on the surface of the teeth and other parts of the mouth cavity, c) It should have either no taste or acceptable taste, d) Have a very low toxicity and not disturb the oral microbial ecology, e) It should be stable, compatible with other ingredients used in a toothpaste, and easy to incorporate in a dentifrice. It is also very important that active ingredients must be properly blended in a formulation, so that their therapeutic activity is not lost.

Cationic ingredient like Chlorhexidine as its gluconate salt, because of its substantivity is effective, but its use is limited in a tooth paste formulation due to its incompatibility with many ingredients. It also has a tendency to cause discoloration of teeth and has a long lasting bitter taste. Cetyl pyridium chloride and plaque reducing enzymes like glucose oxidase and amyloglucoxidase have also been used as an active in a toothpaste. Cetyl pyridium chloride has relatively lower substantivity in the oral cavity and therefore frequent use is required to provide any useful activity.

Triclosan (2,4,4' trichloro-2 hydroxy diphenyl ether,®Irgacare MP) is a non-ionic antibacterial agent now being used by major toothpaste manufacturers, to effectively reduce gingivitis and other periodontal diseases. Triclosan is an effective antibacterial against both gram positive and gram negative organisms. Unlike other cationic agents, it does not induce staining of teeth. It is a very faintly aromatic, off-white powder, stable in normal storage conditions, easy to incorporate in a tooth paste formulation moreover does not impair taste sensation. Triclosan is stable to hydrolysis and prevents Sodium lauryl sulphate induced cytotoxicity to human cells. It also inhibits occurrence of inflammation of the mucous membrane in the mouth (mucositis) which

makes it a very suitable anti-microbial agent in a dentifrice. To claim benefits like, Prevents bleeding gums, gingivitis, plaque, etc. incorporation level of 0.2% to 0.3% (w/w) of Triclosan is necessary.

Fluorides are also used in dental creams to prevent caries. Stannous fluoride and sodium fluoride were widely used in toothpaste formulations; but nowadays Sodium monofluorophosphates is preferred. Stannous fluoride is said to stain teeth and sodium fluoride is reported to interfere with body enzymes. Sodium monofluorophosphates is popular because of its, relatively lower toxicity; superior stability and compatibility with calcium based abrasives without causing any adverse reactions. Currently the maximum level of fluorides permitted in a fluoride dentifrice is 1000 ppm. Toothpaste specially formulated for children contains much lower fluoride level.

Teeth become sensitive to temperature variations when the dentine and nerve on the dentine surface stand exposed and pain is experienced when eating an ice cream or drinking hot liquids. Relief may be obtained by use of certain ingredients in toothpaste specially formulated for such purpose. Formaldehyde, strontium chloride, strontium nitrate, potassium nitrate, etc. are used as therapeutic agents that are believed to block the dentinal tubes, connecting the pulp nerve endings. Dentifrice containing Vitamin A palmitate, Vitamin E acetate, Vitamin C, Vitamin B6 are also being developed in various research laboratories to combat various gum diseases to improve overall oral hygiene.

Besides water, toothpaste contains humectant to prevent the toothpaste from drying out and increase pleasant mouth feel. Glycerine, propylene glycol, sorbitol, etc. are frequently used as humectant. Usually a mixture of humectants is preferred to give superior function at optimum cost. Refined bentonites, silica, carbopols, sodium alginate, sodium carboxy methyl cellulose, natural gum, etc. are used as thickeners and binders to increase the viscosity of toothpaste's and to prevent the separation of liquid and solid phases. Binders provide body to the toothpaste. The final amount and combination to be used in a formulation depend on ingredient compatibility, cost limits, benefits desired, local customs and the market segment that has to be catered. In case organic thickeners are used, a suitable preservative such as sodium benzoate becomes necessary to prevent spoilage. Toothpastes may also contain titanium dioxide as an opacifier.

Sweetening agents like sodium saccharate or sodium cyclamate is used to mask the flat or bland slightly bitter taste of various toothpaste ingredients. Sodium Lauryl sulphate, sometimes in combination with sodium dodecyl benzene sulfonates, N-lauryl sarcosinate, sodium methyl cocoyl taurate, etc. are used as toothpaste surfactants. The primary function of a toothpaste surfactant is to impart a pleasant smooth feel during use. It also aids the wetting and cleaning action of toothpaste abrasives. Limited usage of surfactants in toothpaste prevents uncontrollable foam levels during usage. Complex blends of natural and synthetic compounds, to give a suitable flavour are also used to give fresh breath and pleasant taste. Oils of peppermint, spearmint, clove, cardamom, cinnamon & menthol is used to provide a cooling sensation in the mouth. Some times approved food colours are also used to make the product look bright and attractive.

Unlike olden days, modern dental creams have become far more complex mixtures providing important cosmetic and therapeutic benefits such as fluorides, Triclosan, plaque and tartar control agents, etc. All ingredients used require judicious selection in a formulation to make it compatible with one another, without creating adverse reactions. Much more important is the quality of the various ingredients used in the manufacture of dentifrice. Use of inferior quality ingredients does more harm than good. Toxic impurities like certain sultones, dioxins, furans, heavy metals that may be present in inferior quality materials could produce a plethora of responses in humans and their effects may include allergy, acne, carcinogenicity, reproductive and developmental effects, immunotoxicity, enzyme and hormonal disturbances, etc.

Good manufacturing practice is to be followed with utmost importance during manufacture of dentifrice to limit these impurities within acceptable limits. The water used for the manufacture of toothpaste should be of the highest quality, free from contamination. Toothpaste's made in unhygienic conditions can also harbor potentially harmful microorganisms and the microbial count in excess than the limit laid down by regulatory authorities. This is of paramount importance to the consumers because toothpaste is to be used for oral application and ingestion of microorganisms can prove to be sometimes fatal. Additionally toothpaste must taste wonderfully good, exhibit excellent physical properties and very economical to use forcing the consumer use the product repeatedly and to keep them smiling.