

Oral Health Foundation | Fact sheets

Toothpaste



**Oral Health
Foundation**

Better oral health for all

Toothpaste

Strong, healthy teeth have a considerable role in determining facial appearance as well as playing an important part in the intake and digestion of our food. Neglect of teeth can result not just in an unattractive appearance but more seriously, can also lead to oral disease, bad breath and effects on general health.

Hence the cleaning and care of the teeth are not solely cosmetic practices, but are important aspects of body hygiene and health care. While the importance of dental care was already recognised by the Greeks and Romans, modern dentifrices are much more convenient to use and there is a growing interest in formulations incorporating ingredients that promote oral hygiene and help in reducing the incidence of disease.

Dentifrice is the general term for tooth cleaning preparations, which may be pastes, powders or liquids. The majority of modern dentifrices are pastes; hence we are more familiar with the specific term toothpaste than with the term dentifrice. Because toothpastes are the most important dentifrice formulation, the information that follows, while substantially relevant to all formulation types, places particular relevance on the paste products.

Properties

Certain properties of an ideal dentifrice will be common to all types and formulations (toothpastes, powders, liquids) whereas toothpastes that are intended for special purposes, e.g. anti-caries, will have additional properties. The most important features of an ideal dentifrice include:

Cleaning action: when used with a toothbrush the product should remove food debris, stains and plaque (the gelatinous coating which builds up on teeth).

Freshening action: the product should have a pleasant taste and leave the mouth feeling fresh and clean after use.

Convenience: the dentifrice should be inexpensive and easy to use, in terms of both formulation and packaging, encouraging regular use.

Safe in use: the formulation should be free from harmful effects, even if swallowed.

Stability: the product should be stable in use and during storage.

Conform to standards: the abrasive action of the dentifrice should conform to accepted standards e.g.; British Standards.

Ingredients

The formulation of a product is a skilled process involving an understanding of the structure and physiology of teeth and gums as well as requiring a thorough knowledge of available ingredients, their actions and interactions.

The main ingredients used in the formulation of dentifrices include:

General ingredients

Abrasives: dentifrices require some abrasive action in order to remove the surface coatings such as the pellicle (a layer mainly made of protein) and plaque (a mucous layer involved in the development of cavities). The abrasive action should not be so severe that the tooth surface is damaged. Commonly used abrasives include calcium carbonate, calcium phosphates, silica and alumina.

Surface-active agents: in order to achieve a good general cleaning effect a dentifrice needs to contain a detergent. Tasteless synthetic detergents, such as sodium lauryl sulphate, are now used to give the necessary foaming properties, replacing the soaps used in earlier formulations.

Humectants: these are used to prevent drying out of the dentifrice. Examples include glycerine, sorbitol, and propylene glycol.

Gelling and binding agents: gelling or binding agents, such as sodium carboxymethylcellulose and carrageenan, are needed to stabilise the high solids suspensions found in toothpastes.

Flavouring: the pleasant taste of dentifrice is very important in determining consumer acceptability of a product. Minty flavours are particularly common, and a sweetener, e.g.; saccharin is usually added.

Colouring and whitening materials: in order to make the appearance of the dentifrices more attractive colouring materials may be added.

Water: an important ingredient of toothpastes, the water-soluble ingredients are dissolved in it, the gelling agents swell in it, and the solids are dispersed in it to form the familiar paste.

Active ingredients for special claims

Anti-plaque ingredients

Dental plaque is a sticky mucous coating containing mainly bacteria, with saliva-derived proteins and bacterial polysaccharides, which form naturally on teeth. The plaque bacteria metabolise sugars to acids that can demineralise the tooth enamel and lead to the formation of cavities (caries). Decrease in plaque formation is normally achieved through the use of bacteriostats.

Any bacteriostats considered for use in dentifrices must be non-toxic and non-irritant, and should continue to act for some time after each use of the product. The bacteriostats must also be effective against the bacteria found in the

Active ingredients for special claims

Fluoride exchanges with the hydroxyl groups of hydroxyapatite, the main constituent of tooth enamel, to form

fluorapatite that is more resistant to attack by acids than the original hydroxyapatite. This is thought to be the mechanism by which fluoride reduces the incidence of caries. Incorporation of fluoride salts (e.g. sodium fluoride, sodium monofluorophosphate) in dentifrices may necessitate modifications to the formulation to ensure continuing stability.

Anti-tartar ingredients

Tartar, or calculus, is a mineralised deposit that forms on teeth and may increase the incidence of periodontal disease. Tartar is formed by the calcification of plaque. Pyrophosphates help to prevent tartar formation.

Sensitive teeth formulations

The causes of sensitivity in teeth are not fully understood, but appear to be connected with dentinal tubules, microscopic, liquid filled tubes in the dentine (the layer under the outer enamel layer of the tooth) which link with the tooth pulp. The enamel layer is not continued under the gum and as a natural part of ageing; gums recede slightly from the teeth, exposing the dentine.

One theory suggests that heat, cold and certain substances cause changes in the fluid in the tubules and these changes are transmitted to the nerve endings in the pulp, causing a sensation of pain. Agents that reduce sensitivity of teeth may act by blocking the tubules. Strontium salts and potassium nitrate are effective agents for reducing sensitivity.

Manufacture

The majority of modern dentifrices are paste formulations. A typical manufacturing process begins with dissolving most of the soluble components in the water, then adding the solids (abrasives) using high shear mixing to achieve a homogenous dispersion.

The gelling Agent is then added and swells, producing a uniform paste. Finally, the remaining ingredients, such as flavourings, are mixed into the product. The Procedure is carried out in vacuum vessels, so that the final product is air free. The toothpaste is now ready for filling into containers (usually tubes).

Further Reading

Harry's Cosmeticology, 7th Edition, edited by J.B. Wilkinson and R.J. Moore, and published 1982 by Longman Scientific and Technical.

Cosmetics Science and Technology, vol.1, 2nd Edition, edited by M.S. Balsam and E. Sagarin, published 1972 by Wiley-Interscience.

Cosmetic Science and Technology, Series vol.6. Oral Hygiene Products and Practice, by M. Pader, published 1988 by Marcel Dekker, Inc.

Need further advice?

The Dental Helpline is the Oral Health Foundation's own confidential advice service. Qualified dental professionals are available to answer your questions personally from 9am – 5pm, Monday to Friday.

The Oral Health Foundation is an independent, UK based charity dedicated to promoting the benefits of good oral health to the public throughout the world. The Oral Health Foundation promotes three key messages:

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- Brush your teeth last thing at night and at least one other time during the day, with a fluoride toothpaste.
- Cut down on how often you have sugary snacks and drinks.
- Visit your dentist regularly, as often as they recommend.

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