

Charcoal-containing dentifrices

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Key points

Describes how charcoal dentifrices have become fashionable oral hygiene products.

Suggests there is a paucity of scientific data on the efficacy of charcoal dentifrices.

Argues the claimed benefits of charcoal dentifrices are outweighed by the anticipated adverse effects.

Abstract

Charcoal toothpastes and powders are fashionable oral hygiene products, intended for toothbrushing, extrinsic stain removal and, it is claimed, 'tooth whitening'. The popularity of charcoal toothpastes is believed to be increasing in many countries across the world, including the UK, US, Japan, India, Thailand, Lithuania, Australia, Hong Kong, China, Korea and Switzerland, where charcoal-based toothpastes have been reported to be produced. It is understood that many patients ask members of their dental team for advice on the use and benefits of charcoal toothpastes and powders, and that such advice is often empirical. The purpose of this article is to provide an overview of the current knowledge and understanding of charcoal toothpastes and powders, including consideration of the strength of the evidence to support claims made by the manufacturers of these products.

Introduction

Charcoal dentifrices are increasingly fashionable oral hygiene products, intended for toothbrushing, extrinsic stain removal and 'tooth whitening'.¹ The popularity of charcoal toothpastes is believed to be increasing in many countries across the world. In the UK, charcoal toothpastes and powders may be purchased from major retailers including, but not limited to, Superdrug, Boots, Tesco and Sainsbury's (Table 1). Additionally, major manufacturers, including Colgate-Palmolive, are marketing charcoal dentifrices. With multiple celebrity endorsements and social media posts, it may be anticipated that the availability and popularity of charcoal toothpastes and powders will continue to increase.

Charcoal toothpastes have a wide price range, from as low as £1.50 (Arm & Hammer

Charcoal White Natural Toothpaste) to as much as £20.00 (Curaprox Black is White Charcoal Whitening Toothpaste).² Charcoal powders are dispensed in a pot, with directions for consumers to wet their toothbrush and dip it into the powder, possibly several times when brushing teeth. None of the products identified are specifically marketed for use by children; however, at least one product indicates suitability for adults and children of more than two years of age.

It is understood that many patients ask members of their dental team for advice on the use and benefits of charcoal toothpastes and powders, and that such advice is often empirical. The purpose of this article is to provide an overview of the current knowledge and understanding of charcoal toothpastes and powders, including consideration of the

strength of the evidence to support claims made by the manufacturers of these products.

Background

The first recorded use of charcoal for oral hygiene purposes dates to the time of ancient Greece.¹ As reported by Brooks *et al.*,¹ charcoal and charcoal-containing preparations have been used for cleaning teeth in many parts of the world. Powdered charcoal, soot and coal ash have been included among many different substances applied to teeth using fingers, chew sticks, cloths and, once introduced, toothbrushes. Preparations of charcoal for intraoral use have included various inorganic compounds, flavouring agents and botanicals,¹ to enhance the acceptability of the charcoal preparations and in the hope of helping to combat halitosis.

Table 1 The number of charcoal containing dentifrices and powders available at selected online stores

Store	Number of charcoal toothpastes/powders available
Superdrug	12
Boots	14
Tesco	3
Sainsbury's	2

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Historic interest in the use of charcoal-based preparations for intraoral use stemmed from the capacity of roughly ground charcoal to abrade away stains and deposits on teeth and absorb large quantities of noxious substances, including unpleasant exudates from diseased gums. The charcoal in charcoal toothpastes marketed today is typically a fine powder form of activated charcoal, which has been oxidised by controlled reheating or chemical means.³ The charcoal may be made from a range of carbon-rich materials, including nutshells, coconut husks, bamboo and peat, if not wood or coal. Fine powder charcoal is a very messy material, with variable abrasivity, depending on the source and methods used to prepare and mill the charcoal.

Literature review

The literature review by Brooks *et al.*,¹ published in 2017, which considered 118 articles and includes a database on 50 charcoal-based toothpastes, found ‘insufficient scientific evidence to substantiate the cosmetic, health benefits (antibacterial, antifungal, or antiviral; reduced caries; tooth whitening; oral detoxification), or safety claims of marketed charcoal-based dentifrices’. Brooks *et al.* concluded their article by urging dental practitioners to:

‘Educate their patients about the unproven claims of oral benefits and possible health risks associated with the use of charcoal dentifrices and the potential increased risk of developing dental caries with the use of these non-fluoridated or possibly charcoal-inactivated fluoride products.’¹

The ‘possible health risks’ associated with the use of charcoal-based toothpastes have been considered to be related to the possible inclusion of human carcinogenic polyaromatic hydrocarbons in charcoal and the use of bentonite clay in some charcoal-based dentifrices.¹ Bentonite clay belongs to a heterogeneous group of clays with various industrial applications and uses in skin care products, medications and toothpastes.⁴

Product information

The product information reviewed by Brooks *et al.*¹ indicated that only 8% of the dentifrices considered contained fluoride. More than 50% were claimed to have therapeutic benefits and 96% were claimed to have tooth whitening capabilities. Other claims



Fig. 1 The appearance of an example of a charcoal toothpaste (Black is White Curaprox)

included remineralisation, strengthening or fortification of the teeth (30%), low abrasivity (28%), capacity for detoxification (46%), antibacterial or antiseptic (44%) and antifungal (12%). Consumer-appealing terms, including eco-friendly, ecological, herbal, natural, organic, and pure, appeared in the product advertisements for 88% of the dentifrices, with 54% using at least two such terms. Only 10% included some form of dental professional endorsement. An example of charcoal toothpaste is illustrated in Figure 1.

Mode of action

Charcoal-based toothpastes work in a similar manner to regular toothpastes, with, it is assumed, the type of toothbrush used, the toothbrushing technique and time taken brushing being more important to the cleaning effect than the constituents and consistency of the toothpaste. That said, it is suggested in some of the product information supplied with charcoal-based toothpastes that activated charcoal binds to all tooth surface deposits. This binding, it is suggested, is possibly aided by bentonite clay in clay-containing formulations, ‘holding’ plaque, bacteria and stained material in the pores of the charcoal (and clay), which is then brushed away and supposedly leaves tooth surfaces free of any deposits.

As with many of the claims made for charcoal-based toothpastes and powders, there is a paucity of supporting scientific data. The worrying approach in the marketing of charcoal dentifrices, appears to be a strong emphasis on benefits which appeal to consumers, which have yet to be disproved. This ‘scientifically claimed until proved wrong’ approach is favoured over substantiated,

evidence-based promotion. Such a marketing approach is regrettably not unique to charcoal-based toothpastes and tooth powders; *caveat emptor*: let the buyer beware.⁵ The ethics of such an approach to the marketing of health-influencing products is at best questionable. False and deceptive messaging, together with the selective provision of information could be classed as misleading practice, contrary to consumers’ best interests and protection.

Given the high, absorptive capacity of activated charcoal, any fluoride and other active ions in charcoal-based toothpaste may not be available in use to affect enhanced cleaning or chemical changes to the tooth substrate.⁶ Activated charcoal’s absorptive capacity is such that it is used, among other purposes, to extract fluoride from drinking water in communities with a water supply which has excessively high fluoride content.^{6,7} As such, charcoal-based toothpastes, despite containing fluoride may have limited capacity to remineralise enamel, let alone increase its resistance to caries and tooth wear processes. Possibly more concerning is the potential for individuals changing from the use of a regular fluoride-containing toothpaste to the use of a charcoal toothpaste which contains no fluoride, thereby increasing their risk of caries.

In contrast to the conclusion drawn by Brooks *et al.*¹ that ‘controlled clinical trials and laboratory investigations of charcoal-based dentifrices (including products that also contain bentonite clay) are needed to determine product efficacy and safety’, it is suggested that the claims made by manufacturers of charcoal-based dentifrices should be limited to those which are supported by robust, high-quality, independent scientific evidence; thereby limiting the risk of misleading the public.



Fig. 2 This patient purchased a charcoal whitening toothpaste online in the hope of removing surface stains and whitening his teeth. Use of the paste resulted in the loss of the surface lustre of the enamel. The upper anterior central incisor teeth, which were the focus of the brushing with the whitening toothpaste, appear dull. Extrinsic staining remains on many teeth, notably the lower central incisors

That said, it is acknowledged that it would be an ideal world in which all advertising and marketing is evidence-based.

Abrasivity

The abrasive potential of charcoal-based dentifrices is considered to depend on the nature, method of preparation and particle size distribution of the charcoal included in the formulation. Certain forms of charcoal used in oral hygiene procedures have been found to have relatively high abrasivity (Fig. 2).⁸ The more abrasive the formulation, the more effective it will be at removing extrinsic stain and other tooth surface deposits; however, if abrasive, the use of the formulation may result in loss of tooth surface substance, in other words tooth wear. As with all forms of tooth wear, it may be associated with hypersensitivity, forms of which may prove difficult to resolve. While low abrasivity is included in the claims made for many charcoal-based dentifrices,¹ these claims have not, to date, been independently verified.

In considering abrasivity, it is to be remembered that users of charcoal-based dentifrices may have been persuaded to buy the product by claims of tooth whitening, as discussed later in this article, and in pursuing this goal may brush frequently and vigorously and for extended periods of time using the product. Such behaviour may be seen in individuals who believe that a charcoal-based dentifrice may offer them a low cost, 'quick-fix', tooth whitening option; if a little is good, more will achieve, if not exceed the desired goal quicker. As with any form of excessive toothbrushing, excessive brushing with a charcoal-based dentifrice may cause more harm than good, especially to tooth-coloured restorations with relatively low abrasion resistance.

Halitosis

Given the adsorption capabilities of activated charcoal, which make it an antidote to acute poisoning and drug overdose,⁹ it could be assumed that it would be good constituent of a dentifrice for adsorbing the substances responsible for halitosis. Brushing with a charcoal-based dentifrice may leave the mouth feeling fresh, but such mouth freshness, possibly tempered by an earthy aftertaste of charcoal, may be short-lived as charcoal does not counter the causes of halitosis.¹⁰ Furthermore, the absorptive nature of charcoal in the dentifrices may limit the effects of flavourings, essential oils and any other constituents included in the formulation to mask mouth odour, thus limiting the effects of the dentifrices on halitosis.

Periodontal considerations

The unsubstantiated claims that certain charcoal-based dentifrices, many of which are described as eco-friendly, ecological, herbal, natural, organic or pure, have antibacterial, antiseptic and/or antifungal qualities,¹ may lull consumers into thinking that the use of such dentifrices may be a sustainable way to prevent or possibly even treat periodontal disease, over and above whatever claims they are inclined to believe. Such persuasion of consumers, many of whom may have established oral and dental disease, is considered to be opportunistic 'marketing', with little regard to the consequences of the exploitation. One of the negative impacts of the use of charcoal-based dentifrices by patients with established periodontal disease may be the accumulation of charcoal particles deep in periodontal defects and pockets, causing grey/black discoloration of the periodontal tissues.

Whitening and bleaching

Brooks *et al.*¹ found that 96% of the charcoal dental products reviewed were promoted as having a 'whitening' effect. When evaluating any dental product advertised as having a 'whitening' effect, it is essential to have a clear understanding of the difference between 'whitening' and 'bleaching'.

Many over-the-counter (OTC) dental products are claimed to have 'whitening' properties. These products whiten teeth, to different extents, by the removal of surface (extrinsic) stains,⁸ which may reform relatively quickly in, for example, a smoker. Typically, these products do not change the intrinsic colour of the tooth,^{11,12} which is largely determined by the colour of the dentine. In contrast, tooth bleaching agents, best applied professionally change the intrinsic colour of the dentine and the enamel- in other words simultaneously whitening and bleaching.¹³ As such, bleaching products have a more profound and lasting effect on tooth colour and appearance than a whitening product. The common interchangeable use and misuse of the terms 'whitening' and 'bleaching' is therefore misleading and confusing to consumers and patients,¹³ with the marketing of some charcoal and other dentifrices being no exception.

Brooks *et al.*¹ found insufficient evidence to support the tooth whitening claims, let alone any associated bleaching effects of charcoal dentifrices. It was suggested, given the high absorbency of charcoal, that there would be insufficient availability of any free radical bleaching agent in a charcoal-based dentifrice capable of chemically reducing intrinsic staining present in enamel and dentine.

As noted earlier, charcoal dentifrices may be found to be most effective in terms of tooth colour maintenance when used to delay the recurrence of surface staining on intact teeth following professional cleaning. It seems that activated charcoal does not change the colour of the teeth other than by abrasive action similar to that of a 'smoker's toothpaste', and its use may pose some risk to the enamel and gingiva.¹⁴ Patients seeking to whiten their teeth by means of toothbrushing may be well advised to consider using one of the well-known brands of regular toothpaste formulated to have a whitening effect and to brush their teeth effectively, removing plaque and extrinsic staining, thus giving the teeth a whiter appearance.

Product use

Brushing with a charcoal toothpaste results in a dark grey slurry which may become a foamy grey lather with a greenish tinge (Fig. 3). The charcoal in the paste tends to adhere to deposits and stains on the teeth, accumulate in gingival cuffs and pockets, and discolour the brush (Fig. 4). Normal brushing time may be extended in attempts to remove charcoal-discoloured deposits and stains. When the paste is spat out, using a 'spit don't rinse' approach, it makes a mess of the basin. The tongue may also become blackened (Fig. 5) and this may require tongue brushing or scraping to remove. With repeated use of a charcoal-based toothpaste, the bristles of the toothbrush, especially if white, may acquire an unattractive grey colour, which resists rinsing under running water; one of the possible reasons for the marketing of black toothbrushes for use with charcoal-based toothpastes and powders. Accidental splashing or dribbling of charcoal toothpaste and charcoal-containing saliva on an item of clothing can be difficult to remove, without leaving a grey halo or stain. If transferred to a towel, charcoal toothpaste tends to leave grey-black smears in the towelling.

Also, particles of charcoal may build up in any marginal defects and deficiencies along the cavosurface margins of restorations, and in complex anatomic features such as deep fissures. Also, the charcoal may accumulate into surface defects in composite restorations. Charcoal staining of cavosurface margins and surface defects may compromise the aesthetic qualities of tooth-coloured restorations. If this occurs in the smile zone, dental attractiveness may be adversely affected, especially if the staining involves a number of adjacent restorations, such as a set of veneers or crowns with less than perfect supragingival margins.

The use of a charcoal-based tooth powders can be messier and more troublesome than the use of charcoal-based toothpastes, especially if some of the powder is accidentally spilt by, for example, inquisitive children.

Conclusions

Charcoal-based dentifrices, in the absence of supporting scientific evidence, may be considered to be a fashionable, marketing 'gimmick' based on folklore on the use of different forms of charcoal for oral and dental remedies, or present day uses of charcoal for medical purposes. Consumers are advised to check the ingredients in the charcoal

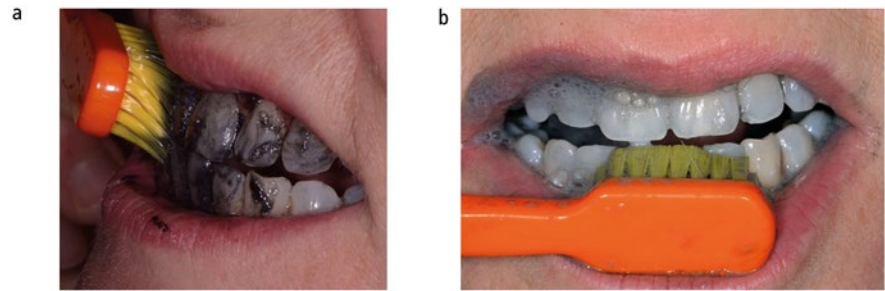


Fig. 3 Brushing with a charcoal toothpaste. As brushing progresses, the dark grey slurry of toothpaste: a) may become a foamy grey lather; b) may create a greenish tinge

toothpaste and there may be potential for increased abrasivity.¹⁵

If, however, the marketing of charcoal-based dentifrices has resulted in an increase in the number of people who brush their teeth at least once, if not twice a day, and have come to recognise the need for professional help to improve their oral health, then some good purpose may have been realised by this fashion. It is to be hoped, however, that those new to regular toothbrushing with a charcoal dentifrice will sooner or later come around to the routine use of a toothpaste with proven efficacy.

Practitioners and other members of the dental team questioned about fashionable charcoal-based dentifrices could usefully help divert interest in these media attention grabbing products towards the purchase and use of oral hygiene products known to help prevent oral and dental disease and thereby improve oral health.

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Fig. 4 Illustration of charcoal discolouring tooth deposits, accumulating in gingival cuffs and giving the toothbrush an unattractive grey appearance



Fig. 5 Blackening of the surface of the tongue following brushing with a charcoal toothpaste