Breath odour is the presence of odorous volatile organic compounds in the breath. It is a widespread problem, as it affects a high percentage of the adult population; 30% of the global population suffers from chronic oral malodour and 74% per cent consider it an issue. Breath odour has strong social implications for the sufferer and it significantly affects normal social interactions.

Breath odour can have physiological or pathological causes of intra-oral or extra-oral origin (Fig. 1). Physiological odour includes morning breath, which is transient and related to low saliva flow during the night. Other lifestyle factors can influence it too, such as smoking, as well as the consumption of alcohol or odorous foods and drinks (garlic, onion and cabbage, among others). These are fairly common and the adult population; they are non-odorous volatile organic compounds (VSCs) and VOCS, respectively) formed as a result of the degradation of amino acids, such as cysteine and methionine, proteins from numerous origins (diet, debris, cells) with their complex enzymatic machinery. Particularly the degradation of amino acids, such as cysteine and methionine, produces VSCs with a very high odour power.1 The bacterial density on the tongue surface has been related to the degree of breath odour.2–4 For example, individuals with noticeable breath odour (above 2.5 in the 5-point organoleptic scale) have more than 1 x 108 bacterial colony-forming units per cm² of the tongue, while individuals with lower organoleptic scores harbour lower bacterial numbers (approximately 1 x 107). Therefore, in order to reduce breath odour in patients, the tongue bacterial density must be reduced and kept at low levels.

**Treatment of oral malodour**

There are numerous over-the-counter products for oral malodour and these can be divided into chemical and mechanical treatments. Chemical treatments are mostly mouthrinses specifically developed for oral malodour, containing a combination of antimicrobials and metal ions. Commonly used antimicrobials are chlortetraxcline and cetylpyridinium chloride (CPC), which have a strong effect in killing bacteria. Metal ions, such as zinc, bind to sulphur compounds and form insoluble complexes (zinc sulphide) that are not volatile and are therefore non-odorous.5–10 Another category of mouthrinses for malodour contains chlorine dioxide, which neutralises the sulphur gases and oxidises VSC, while the chlorine anions act as an anti-bacterial compound.11–15

While mouthrinses have the potential to be very effective owing to their antibacterial and oral malodour-masking properties, they rarely provide a long-lasting result. They are effective for a few hours, but they have little effect on the tongue bacterial density.16,17 A possible cause of this limited effect on the tongue is that the active components of mouthrinses cannot reach the odour-producing bacteria. Biofilms that produce volatile gases are mostly located deep between the tongue papillae (Fig. 2c), where mixing and diffusion of active ingredients are difficult owing to the small papillary spaces, the viscosity of salivary molecules and the low permeability of biofilms. Guidelines for the treatment of oral malodour by dental professionals emphasise the need for tongue cleaning using scrapers or brushes.

Clinical studies have shown that the use of mechanical methods reduces the tongue coating.18–22 However, the effect on malodour is very short-lived,23 which is probably due to the reduction of the bacterial nutrients present in the tongue coating rather than the reduction of the bacterial density itself.24 The limited amount of bacterial removal from the tongue’s complex surface is due to the difficulty in reaching the biofilm between the tongue papillae. Moreover, as the tongue tissue is very flexible, the use of tongue scrapers could flatten the papillae, trapping the bacterial biofilm underneath and not removing it.

**Combined approach for all-day fresh breath**

The use of mouthrinses in combination with mechanical intervention could help the active ingredients penetrate deeper into the biofilm than when used alone, while simultaneously reducing the tongue coating and bacterial density. The combined approach of chemical and mechanical intervention could have a synergistic effect on oral malodour to deliver full-day
fresh breath, as has been shown in recent studies. In a recent clinical investigation, we showed that the combined use of a newly designed sonic tongue brush with an antimicrobial spray delivered a significantly superior reduction in breath odour than did the individual treatments.

Philips Oral Healthcare has recently developed and launched a new sonic powered tongue brush and antibacterial spray combination, Sonicare TongueCare+. The brush has been designed to penetrate between the tongue papillae and to provide thorough mechanical biofilm removal. Bristle dimensions and stiffness parameters were optimised based on analysis of the human tongue. The brush head consists of 240 flexible elastomer MicroBristles mounted on to a Sonicare power toothbrush handle, with 30,000 vibrations per minute to help break up any tongue coating and sweep away debris and bacteria (Fig. 3).

TongueCare+ brush is used in combination with the Breathix antimicrobial tongue spray (Philips), which contains antimicrobial agents, such as CPC and zinc. In the first proof of principle clinical investigation, it was shown that the organoleptic score and the tongue bacterial density can be significantly reduced with a single use of TongueCare+ alone or Breathix alone, supporting the idea that a combined approach is likely more effective. Moreover, TongueCare+ has been shown to significantly decrease the tongue bacterial density, which is kept low for at least 6 hours, indicating that the root cause of breath odour is addressed with this approach. This, in turn, provides a more effective and long-lasting treatment option for people suffering from breath odour.

**Possible oral health implications**

Overall, it is of key importance to integrate tongue cleaning into the oral hygiene routine in order to have fresh breath all day. Additionally, it has been suggested that the tongue can act as a reservoir of periodontal pathogens for the rest of the mouth, which could colonise other areas and have an impact on oral health in general. Moreover, several studies have shown that VSCs, such as hydrogen sulphide and methanethiol, are toxic to periodontal tissue even when present in very low concentrations, so it has been hypothesised that they can contribute to the progression of gingival diseases. Therefore, maintaining a good tongue cleaning routine could have far-reaching implications.

**Abbreviations**

- CPC: chlorhexidine
- VSC: volatile sulphur compounds
- H2S: hydrogen sulphide
- CH3SH: methanethiol

**TRENDS & APPLICATIONS**

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