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The effects of various types of lozenges on halitosis: A crossover clinical trial

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SUMMARY

The aim of this crossover clinical trial was to assess the efficacy of three different types of lozenges on halitosis based on their composition and surface roughness. This crossover clinical trial comprised 35 healthy subjects who were tested after the induction of halitosis via the intake of chips and soft cheese. The breath was analyzed using the organoleptic and instrumental measurement techniques. The effects of three different types of lozenges were tested: apple-flavored (CA, control); apple-flavored with zinc (AZ, <0.2%); and apple-flavored with zinc and a rough surface (AZR, <0.2%). The instrumental and organoleptic measurements were repeated four times with a time interval of 120 s between measurements after the first measurement (baseline). Subsequently, the subjects were asked to describe their experience with the tested type of candy using a questionnaire. Statistically significant reductions in the grade of halitosis were observed after using the three different types of lozenges at the various time points compared to the baseline value ($p < 0.001$). Additionally, significant correlations were observed between the instrumental and organoleptic measurements for all the lozenges ($p < 0.001$). Neither AZ nor AZR showed a significant difference compared to CA with regard to the reduction of the instrumental readings. Furthermore, the subjective feeling of having a fresh breath was not related to the values obtained using the instrumental technique. These findings indicate that lozenges can significantly reduce artificially induced halitosis, regardless of the type used. Nonetheless, additional studies using a larger sample size are required to validate these findings.

Introduction

Halitosis is a widespread problem that is often repressed by society. A recent systematic review described, based on clinical observations, a prevalence of 31.8% among adolescents and adults worldwide (Silva et al. 2018). Other studies suggest that 20%–43% of the global population is temporarily affected by halitosis (Miyazaki et al. 1995; Loesche et al. 1996; Bornstein et al. 2009a, 2009b).

In most cases (85%–90%), halitosis originates from the oral cavity due to the bacterial metabolism of organic materials (Tonzetich 1977; Delanghe et al. 1997). A central role in this process is played by volatile sulfur compounds (VSC) that are formed by bacteria located on the biofilm on the surface of the tongue (Tonzetich & Richter 1964; Tonzetich 1977; Rosenberg & Mcculloch 1992; Filippi & Meyer 2004). In 40%–50% of the diagnosed cases, the tongue coating is the sole cause of halitosis (Delanghe et al. 1999; Quirynen et al. 2009; Seemann 2011).

Various techniques have been used to detect and measure the amount of halitosis. The instrumental technique is used to collect breath from the oral cavity using a disposable syringe and transfer it to the measuring chamber of a gas chromatograph or sulfide monitor (Filippi & Ortiz 2020). On the other hand, in the organoleptic method, breath odor is subjectively assessed from a defined distance (Rosenberg et al. 1991a; Rosenberg et al. 1991b; Greenman et al. 2004). The organoleptic method is considered the gold standard regardless of its subjective discrepancies (Brunner et al. 2010). The treatment of halitosis is primarily based on eliminating the cause. If the tongue coating is considered to be the cause of halitosis, mechanical cleaning of the tongue surface is indicated to reduce the biofilm (Delanghe et al. 1997, Quirynen et al. 2004; Seemann et al. 2014), which leads to a reduction in the concentration of VSC (Tonzetich & NG 1976; Miyazaki et al 1996).

The effects of different compositions of numerous chewing gums on halitosis, e. g. xylitol, maltose and zinc citrate, have been tested in the past (Muniz et al. 2017). The parameters of halitosis were reduced with chewing gums containing e. g. allyl isothiocyanate in combination with zinc lactate compared to placebo chewing gums (Muniz et al. 2017). One study compared five different types of lozenges (placebo, rough surface, rough surface with propolis, rough surface with zinc gluconate, and rough surface with propolis and zinc) and reported that those with zinc caused a reduction in halitosis (Barak & Katz 2012). Zinc ions have an inhibitory effect on halitosis by directly binding to gaseous hydrogen sulfide and suppressing the growth of VSC-producing bacteria (Suzuki et al. 2018). In addition, there are reports on the possible benefits of zinc-containing toothpastes (Navada et al. 2008) or mouth rinses (Young et al. 2003).

Tab. I The organoleptic scale according to Rosenberg et al. (1991a)

Number (value)	Description
1	No unpleasant odor
2	Slightly unpleasant odor
3	Moderately unpleasant odor
4	Strong unpleasant odor
5	Extremely foul smelling

The aim of this crossover clinical trial was to investigate the effects of different types of lozenges on halitosis; additionally, the beneficial effects of zinc and the surface roughness of the lozenge on halitosis were evaluated. The rough surface was intended to support mechanical cleaning of the tongue coating, analogous to the tongue brush. The null hypothesis was defined as no difference in halitosis improvement between the lozenges.

Materials and methods

This crossover clinical trial was conducted at the University Center for Dental Medicine in Basel (UZB) after it was reviewed and approved by the Ethics Committee of Northwestern and Central Switzerland (2021–00187). All investigation involving humans were conducted in accordance with the principles of the Declaration of Helsinki.

The minimum sample size was calculated to be 35 participants: Based on previous data, 35 participants are needed in order to detect a halitosis improvement of 100 ppb with power of 80% and a significance level of 5% as verified by a paired t test power calculation. Healthy subjects between 18 and 40 years of age who volunteered for the study were recruited, regardless of the presence of halitosis. Smokers, pregnant women, and those who presented with chronic diseases, regular use of medications (excl. contraceptives), and allergies or intolerances toward the ingredients of the products used were excluded from the study.

As part of the study preparation, the subjects were advised to refrain from consuming onions or garlic for two days prior to the examination day and from practicing oral hygiene and drinking coffee or eating for four hours prior to the examination. On the day of the examination, the subjects were not allowed to use cosmetic products and consume any type of candy or chewing gum. Furthermore, they were instructed to refrain from taking any antibiotics three weeks prior to the testing day.

Three different types of sugar-free hard lozenges specially manufactured by the company Ricola Group AG under conditions and practices required by the Good Manufacturing Practice and with the following compositions were tested: apple-flavored isomalt lozenge with a smooth surface (acidifier, <0.1%), which formed the control group (CA); apple-flavored isomalt lozenge with a smooth surface (acidulant, <0.1%; zinc, <0.2%; AZ group); and apple-flavored isomalt lozenge with a rough surface (zinc, <0.2%; acidifier, <0.1%; AZR group). The rough surface was created by pectin. Each subject was required to test all three lozenges in random order.

Procedure

First, the subjects were asked to eat 11 g of potato chips (Zweifel Chips® Provençale, Spreitenbach, Switzerland) within 2 min and three pieces of soft cheese 3–4 g (Cantadou mini® garlic and herbs, Bel SA, Suresnes, France) to be melted on the tongue within 3 min to induce halitosis. This was immediately followed by closing the mouth for 30 s, and the first measurements (instrumental and organoleptic) were obtained (baseline). After 2 min, the subjects were instructed to dissolve one of the three lozenges in the mouth for 70 s, and were given 20 s to prepare for the subsequent breath sample. They were asked to close their mouth for another 30 s before the second instrumental and organoleptic measurements. Both measurements were repeated four times with a time interval of 120 s each (270, 390, 510, and 630 s after the first baseline measurement). For hy-

Tab. II Comparisons between the instrumental measurements at the various time points and the baseline values for the different types of lozenges

CA	GMR or slope (for age)	Lower 95% CI	Upper 95% CI	p-value (Tukey)
After 270 s	0.37	0.32	0.41	<0.001
After 390 s	0.26	0.23	0.29	<0.001
After 510 s	0.23	0.21	0.26	<0.001
After 630 s	0.23	0.20	0.25	<0.001
Age	1.00	0.97	1.02	0.74
Sex (female vs. male)	1.17	0.92	1.48	0.19
AZ				
After 270 s	0.34	0.30	0.38	<0.001
After 390 s	0.23	0.21	0.26	<0.001
After 510 s	0.21	0.19	0.23	<0.001
After 630 s	0.20	0.18	0.22	<0.001
Age	0.99	0.97	1.02	0.43
Sex (female vs. male)	1.09	0.86	1.37	0.47
AZR				
After 270 s	0.31	0.28	0.35	<0.001
After 390 s	0.23	0.20	0.25	<0.001
After 510 s	0.21	0.20	0.24	<0.001
After 630 s	0.21	0.19	0.23	<0.001
Age	0.99	0.96	1.01	0.31
Sex (female vs. male)	0.99	0.78	1.26	0.93

CA: apple-flavored (control); AZ: apple-flavored with zinc; AZR: apple-flavored with zinc and a rough surface; GMR: geometric mean ratio; CI: confidence interval

gienic reasons, the lozenge was replaced with a new identical candy after each measurement.

After testing the lozenges, the subjects were required to complete a visual analog scale (VAS) questionnaire regarding the subjective sensation after having sucked on the lozenge. The following questions were asked:

1. Does the candy give a feeling of fresh breath?
2. Does the candy have a pleasant taste?
3. Does the candy have a rough surface?
4. Would you consume such a candy again?
5. Would you recommend this candy against bad breath?

The instrumental and organoleptic measurement techniques

The breath was collected by instructing the subjects to tightly enclose a plastic disposable syringe (Omnifix® Syringe, 10 ml, B. Braun, Sempach, Switzerland) with their mouth for 30 s and breathe exclusively through the nose. Subsequently, the syringe was drawn up by the subjects themselves. First the instrumental measurement was obtained with a sulfide monitor (HaliSens®, ScioDent, St. Sebastian, Germany), wherein 5 ml of the breath was injected into the monitor, and the displayed VSC readings were noted in parts per billion (ppb). For the organoleptic measurement, the remaining 5 ml were simultaneously used employing the so-called "negative pressure method" (Laleman et al. 2018). Owing to the current pandemic situation, a syringe filter (Millex-VV, PVDF, 33 mm with a pore size of 0.1 µm, Merck, Darmstadt, Germany) and a paper cup were used for each measurement to evaluate the quality of the breath (Filippi & Ortiz 2020). The examiner was required to leave the treatment room to smell the probe. Coffee beans were used to neutralize the sense of smell between measurements. The intensity of the oral odor was recorded using a point scale (Tab. I).

Statistical analysis

As verified by quantile comparison plots, the ppb values were analyzed on a logarithmic scale, which satisfies the conditions of an approximately Gaussian distribution of the residuals. Changes over time were evaluated using linear mixed-effects models, with the baseline value as reference. Possible significant interactions with sex or age were analyzed in advance. The p-values were calculated by applying Tukey's contrast to the mixed-effects models. Regression model estimates represented the geometric means with the corresponding 95% confidence

Tab. III Comparisons between the organoleptic measurements obtained at the various time points and the baseline values for the different types of lozenges

CA	Difference of means or slope (for age)	Lower 95% CI	Upper 95% CI	p-value (Tukey)
After 270 s	−2.00	−2.21	−1.79	<0.001
After 390 s	−2.87	−3.08	−2.66	<0.001
After 510 s	−3.23	−3.43	−3.02	<0.001
After 630 s	−3.41	−3.62	−3.200	<0.001
Age	0.02	−0.01	0.06	0.20
Sex (female vs. male)	0.24	−0.10	0.58	0.16
AZ				
After 270 s	−1.89	−2.12	−1.66	<0.001
After 390 s	−2.81	−3.04	−2.58	<0.001
After 510 s	−3.26	−3.49	−3.03	<0.001
After 630 s	−3.51	−3.74	−3.28	<0.001
Age	0.00	−0.03	0.04	0.96
Sex (female vs. male)	0.20	−0.12	0.52	0.20
AZR				
After 270 s	−1.99	−2.20	−1.79	<0.001
After 390 s	−2.99	−3.20	−2.79	<0.001
After 510 s	−3.40	−3.60	−3.20	<0.001
After 630 s	−3.60	−3.80	−3.40	<0.001
Age	0.00	−0.04	0.04	0.88
Sex (female vs. male)	0.23	−0.14	0.59	0.21

CA: apple-flavored (control); AZ: apple-flavored with zinc; AZR: apple-flavored with zinc and a rough surface; CI: confidence interval

intervals (CI) and p-values. The organoleptic scores were predicted analogously but on the original scale along with the differences in means.

Differences in ppb values from the baseline values were calculated and predicted on original scale using a linear mixed-effects model with a nested design (lozenges nested in time) to examine the effects at separate time points. Correlations between the instrumental and organoleptic scores were assessed using a mixed-effects model, which was run to predict the log-transformed instrumental scores, resulting in ratios per unit organoleptic scale score. Likewise, correlations between the instrumental values and the question on "fresh breath" were assessed using a mixed-effects model to predict differences in the instrumental values (baseline to 270 s), resulting in slope values related to the "fresh breath" scale values.

All regression models were adjusted for age and gender. A p-value of <0.05 was considered significant. Adjustment of significance level for multiple comparisons was not performed because of the descriptive nature of the study. All analyses were performed using the statistical program R, version 3.5.1 (R Core Team 2018).

Results

A total of 35 subjects (18 women and 17 men) aged 19–36 years ($\bar{x}$ = 28; standard deviation [SD] 4.6) were recruited. For the instrumental measurement, the median baseline values of the CA, AZ, and AZR were 1,155 (interquartile range [IQR] 826–1,182), 1,168 (IQR 960–1,298), and 1,160 (IQR 1,025–1,193) ppb, respectively. All three lozenges showed a statistically significant reduction in VSC values ($p < 0.001$) compared to the instrumental baseline values at each time point (270, 390, 510, and 630 s) (Tab. II). Neither age nor gender had a significant influence on the decrease in data. The VSC ppb values at the second measurement (after 270 s) were 2.7 times lower in CA, 3.0 times lower in AZ, and 3.2 times lower in AZR than those obtained during the first instrumental measurement. The VSC ppb values at the subsequent time points (390, 510, and 630 s) were reduced by up to a factor of 4.4 for CA, 5.1 for AZ, and 4.8 for AZR. Neither AZ nor AZR showed a significant difference compared to CA with regard to the reduction of the instrumental readings (data not shown).

In the organoleptic examination, all three lozenges demonstrated a statistically significant reduction ($p < 0.001$) compared

Tab. IV Correlations between the instrumental and organoleptic measurements

	GMR	Lower 95% CI	Upper 95% CI	p-value
CA	1.54	1.50	1.58	<0.001
AZ	1.57	1.53	1.61	<0.001
AZR	1.53	1.49	1.57	<0.001
Age	0.99	0.97	1.00	0.06
Sex (female vs. male)	1.00	0.87	1.14	0.96

CA: apple-flavored (control); AZ: apple-flavored with zinc; AZR: apple-flavored with zinc and a rough surface; GMR: geometric mean ratio; CI: confidence interval

Tab. V Evaluation of the responses to the VAS questionnaire

	CA	AZ	AZR	Total	p-value
Does the candy give a feeling of fresh breath?					Kruskal–Wallis test
Median (IQR)	6 (5.7)	6 (5, 7.3)	5 (4, 7)	6 (4.5, 7)	0.388
Mean (SD)	5.9 (1.9)	5.7 (2.2)	5.1 (2.5)	5.6 (2.2)	
Does the candy have a pleasant taste?					
Median (IQR)	8 (6, 8.8)	8 (7, 9)	8 (6.5, 9)	8 (7, 9)	0.825
Mean (SD)	7.5 (2.0)	7.8 (1.6)	7.5 (2.1)	7.6 (1.9)	
Does the candy have a rough surface?					
Median (IQR)	1 (0, 2)	1 (0, 2)	6 (3, 8)	2 (0, 4)	<0.001
Mean (SD)	1.4 (2.0)	1.3 (1.6)	5.4 (3.1)	2.7 (3.0)	
Would you consume such a candy again?					
Median (IQR)	7 (6, 8.8)	8 (5, 8.7)	6 (4, 8)	7 (5, 8)	0.121
Mean (SD)	6.8 (2.4)	6.9 (2.5)	5.8 (2.7)	6.5 (2.5)	
Would you recommend this candy against bad breath?					
Median (IQR)	6 (3.8, 7.3)	6 (3.3, 8)	6 (3.5, 7.5)	6 (3.5, 8)	0.72
Mean (SD)	5.6 (2.6)	5.6 (2.5)	5.2 (2.7)	5.5 (2.6)	

CA: apple-flavored (control); AZ: apple-flavored with zinc; AZR: apple-flavored with zinc and a rough surface; IQR: interquartile range; SD: standard deviation

to the baseline mean values (CA 4.8 ± 0.5; AZ 4.7 ± 0.6; AZR 4.8 ± 0.5) at each time point (Tab. III). During the second measurement (after 270 s), the organoleptic values were 2.0 units lower for CA, 1.9 units lower for AZ, and 2.0 units lower for AZR compared to the baseline organoleptic values. After repeating the measurements (390, 510, and 630 s), the following reductions in values were observed using the organoleptic measurement technique: 3.4 units in CA, 3.5 units in AZ, and 3.6 units in AZR. No significant differences were observed between CA and AZ or AZR.

A causative correlation was observed between the instrumental and organoleptic measurements ($p < 0.001$) (Tab. IV). Thus, the null hypothesis was rejected.

The responses to the VAS questionnaire at the end of the examination are shown in Table V. The mean values of the question "Does the candy give a feeling of fresh breath?" were 5.9 for CA, 5.7 for AZ, and 5.1 for AZR. Furthermore, the response to the question regarding whether one would recommend this lozenge to combat bad breath yielded a mean of 5.6 for CA, 5.6 for AZ, and 5.2 for AZR (Tab. V).

No significant correlations were observed between the VSC ppb values obtained using the instrumental technique and the response to the question "Does the candy give a feeling of fresh breath?" after 270 and 630 s (Tab. VI and VII, respectively). The greatest effect was observed in the measurements after 270 s.

Discussion

The subjects were enrolled in this crossover clinical trial regardless of whether they experienced halitosis. It was challenging to identify the subjects diagnosed with halitosis, owing to the design of the study; therefore, halitosis had to be artificially induced using chips and cheese. Nonetheless, this helped in creating a uniform baseline situation across the subjects. In one

Tab. VI Correlations between the instrumental measurements and the subjective perception of having a fresh breath after 270 s

	Slope or difference of means	Lower 95% CI	Upper 95% CI	p-value
CA	-1.04	-5.58	3.49	0.65
AZ	2.49	-1.42	6.40	0.21
AZR	-1.10	-4.83	2.63	0.56
Age	-2.39	-20.42	15.63	0.79
Sex (female vs. male)	-45.29	-208.29	117.72	0.58

CA: apple-flavored (control); AZ: apple-flavored with zinc; AZR: apple-flavored with zinc and a rough surface; CI: confidence interval

Tab. VII Correlations between the instrumental measurements and the subjective perception of having fresh breath after 630 s

	Slope or difference of means	lower 95% CI	upper 95% CI	p-value
CA	1.11	-3.30	5.52	0.62
AZ	2.00	-1.80	5.80	0.30
AZR	-0.63	-4.26	3.01	0.73
Age	6.20	-10.20	22.59	0.45
Sex (female vs. male)	-88.13	-236.48	60.22	0.24

CA: apple-flavored (control); AZ: apple-flavored with zinc; AZR: apple-flavored with zinc and a rough surface; CI: confidence interval

study, both onions and garlic were shown to cause halitosis (VSC 95–124 ppb) (Wyttenbach et al. 2018). However, egg white (VSC 82 ppb) would be more suitable for organoleptic measurement because onions and garlic can interfere with the examiner's sense of smell due to their inherent solid odor (Wyttenbach et al. 2018).

Studies indicate that organoleptic measurements are often not reproducible because they depend on subjective evaluations and other factors, such as the age of the examiner (Tonzetich 1977; Rosenberg et al. 1991a; Rosenberg et al. 1991b). Therefore, all investigations were performed by the same examiner in the present study. Organoleptic measurements are considered to be the gold standard when determining halitosis, and instrumental measurements should be considered as a complementary diagnostic tool (Brunner et al. 2010). Data in the literature for standard values vary in the range between VSC 70 to 110 ppb. A threshold value using the instrumental technique cannot be precisely determined because dimethyl sulfide or methyl mercaptan are integrated into the measurement to a lesser extent than hydrogen sulfide. The own sense of smell, however, perceives the individual components in different strengths (Seemann 2011). Therefore, no threshold ppb value was defined in the present study.

A correlation between the instrumental and organoleptic measurements was established in this study. Another study, which evaluated the efficacy of different measurement methods, reported that the values recorded using the instrumental technique correlated best with those obtained via organoleptic evaluations (Brunner et al. 2010). No correlations were observed between the responses to the VAS questionnaire and the instrumental measurements, which might be attributed to the apple flavor of the lozenge (instead of a mint flavor). The "lack of a refreshing effect" generally achieved with the mint flavor was mentioned a few times in the comments section of the questionnaire.

In most cases, treatment of halitosis encompasses the cleaning of the tongue, because most of the bacteria within the oral cavity are located on the tongue (Filippi 2011). However, it is not easy to implement this in everyday life. On-the-go aids such as chewing gum or lozenges offer a quick and easy solution. Therefore, a lozenge with a rough surface might aid in mechanically cleaning the tongue in combination with a chemical component, such as zinc. To the best of our knowledge, only one clinical study on lozenges containing zinc and a rough surface has been published (Barak & Katz 2012). The effects of five different lozenges, including one with 0.5% zinc gluconate and a rough surface, were evaluated in 15 subjects in this study. The intake of the lozenge with zinc gluconate resulted in significantly better ppb values than those observed in the control group. However, the results of the study by Barak and Katz could not be confirmed in the current study, possibly due to the lower concentration of zinc. In another study, zinc citrate was found to be significantly less effective than zinc gluconate (Rölla et al. 2002). Various studies have shown that the effect of zinc is dose-dependent and insufficient below 1% (Waler 1997a; Waler 1997b, Kleinberg & Kleinberg 2002). Nonetheless, a high zinc concentration was not used in the current study in order to make the lozenge more palatable for the subject. A comparison between lozenges AZR and CA showed a tendency to a statistical difference after the first measurement ($p = 0.067$), and an increase in zinc concentration could likely enhance this effect. Furthermore, a rough surface might have a mechanical impact on the cleansing of the tongue. However, this effect could not be demonstrated in the current study.

Statistically significant reductions in halitosis were observed with all three lozenges, including CA, in this study. This may be attributed to the time factor, the salivary stimulation provided by dissolving the lozenge in the mouth, and the small amount of malic acid (<1.0%) in the lozenges. The dissolving/chewing of acidic candy/food has been shown to further increase saliva production compared to non-acidic gum/food (Watanabe & Dawes 1988; Jensdottir et al. 2005).

In summary, the present crossover clinical trial showed that all lozenges with and without zinc significantly reduced the artificially induced halitosis, regardless of the surface texture of the lozenge.

The fact that neither zinc nor a rough surface had a significant effect on the results should be investigated further. To investigate this question in more detail, a study with unflavored lozenges would be interesting. Furthermore, a correlation between the instrumental and the organoleptic measurement was observed. However, further investigations using a higher number of participants and a control group without the intake of any type of lozenge and with a definitive diagnosis of halitosis due to tongue coating are required to confirm these findings.

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Résumé

Introduction

L'halitose est un problème très répandu qui, selon des études, touche environ 31,8% de la population adulte et adolescente dans le monde. La cavité buccale est le lieu d'apparition le plus fréquent de l'halitose (85–90% des cas). L'halitose est due à des bactéries qui métabolisent la matière organique. Les composés sulfurés volatils (VSC), formés entre autres par les bactéries du biofilm sur la langue, jouent un rôle central dans ce processus. Dans 40 à 50% des cas diagnostiqués, l'enduit lingual est la seule cause de la mauvaise haleine. L'objectif du présent travail était de tester l'efficacité de différents bonbons à sucer contre l'halitose. L'efficacité du zinc et/ou la rugosité de la surface des bonbons à sucer ont également été examinées.

Matériels et méthodes

Un essai clinique croisé randomisé a été réalisé au Centre universitaire de médecine dentaire de Bâle (UZB). 35 adultes volontaires en bonne santé âgés de 19 à 36 ans y ont participé. Les volontaires se sont vu administrer trois bonbons durs à l'isomalt différents, fabriqués par l'entreprise Ricola et aromatisés à la pomme. Pour créer une situation d'halitose, les volontaires ont consommé du fromage à pâte molle et des chips à l'ail. Ensuite, ils ont reçu les différents bonbons à sucer. Le premier bonbon été caractérisé par une surface lisse, contenant moins de 0,1% d'acidifiant (groupe témoin [CA]). Le deuxième contenait en plus <0,2% de zinc (AZ), le troisième avait une surface plus rugueuse (AZR). Tous les sujets devaient tester les trois bonbons à sucer dans un ordre arbitraire. Des mesures organoleptiques et instrumentales ont été effectuées après la consommation des aliments et après avoir sucé les bonbons.

Résultats

Lors de la mesure instrumentale, les trois bonbons à sucer ont présenté une réduction statistiquement significative des valeurs de CSV ($p < 0,001$) par rapport aux valeurs instrumentales de départ à chaque moment (270, 390, 510 et 630 s). Ni l'AZ ni l'AZR n'ont montré de différence significative par rapport à l'AC en ce qui concerne la réduction des valeurs de mesure instrumentales.

Lors de l'examen organoleptique, les trois bonbons à sucer ont présenté à chaque moment une réduction statistiquement significative ($p < 0,001$) par rapport aux valeurs moyennes initiales (CA, 4,8 ± 0,5 ; AZ, 4,7 ± 0,6 ; AZR, 4,8 ± 0,5). Aucune différence significative n'a été observée entre les trois groupes.

Les valeurs moyennes de la question « le bonbon donne-t-il une sensation d'haleine fraîche ? » étaient de 5,9 pour CA, 5,7 pour AZ et 5,1 pour AZR. De même, la réponse à la question de savoir si l'on recommanderait ces bonbons à sucer pour lutter contre la mauvaise haleine a donné une moyenne de 5,6 pour CA, 5,6 pour AZ et 5,2 pour AZR. Aucune différence significative n'a été observée entre les valeurs de VSC ppb déterminées de manière instrumentale et la réponse à la question « le bonbon à sucer donne-t-il une sensation d'haleine fraîche ? » après 270 et 630 secondes.

Discussion

Les résultats de l'étude ont montré que les trois bonbons à sucer entraînaient une réduction significative de l'halitose artificiellement induite, indépendamment de la nature de leur surface. En outre, une corrélation a été établie entre les mesures instrumentales et organoleptiques. Cependant, une autre étude avec plus de participants, un groupe de contrôle sans prise de bonbons à sucer et un diagnostic de l'halitose sur la base de l'enduit lingual seraient nécessaires pour confirmer les résultats de l'étude.

Zusammenfassung

Einleitung

Halitosis ist eine weitverbreitete Problematik, unter der einer neueren Studie zufolge weltweit etwa 31,8% der Jugendlichen und Erwachsenen leiden. Der häufigste Entstehungsort einer Halitosis ist die Mundhöhle mit etwa 85–90%. Halitosis entsteht durch Bakterien, die organisches Material verstoffwechseln. Eine zentrale Rolle hierbei spielen die flüchtigen Schwefelverbindungen (VSC), die u. a. durch die Bakterien des Biofilms auf der Zunge gebildet werden. In 40–50% der diagnostizierten Fälle ist der Zungenbelag die alleinige Ursache für den Mundgeruch. Das Ziel der vorliegenden Arbeit lag darin, die Wirksamkeit verschiedener Lutschbonbons gegen Halitosis zu prüfen. Dabei wurden zusätzlich die Wirksamkeit von Zink und/oder der Rauheit der Oberfläche der Lutschbonbons untersucht.

Material und Methode

Die klinische randomisierte Crossover-Studie wurde am Universitären Zentrum für Zahnmedizin Basel (UZB) durchgeführt. 35 freiwillige, gesunde Erwachsene zwischen 19 und 36 Jahren nahmen daran teil. Den Probanden wurden drei verschiedene, von der Firma Ricola hergestellte, harte Isomalt-Lutschbonbons mit Apfelgeschmack verabreicht. Um eine Halitosis zu erzeugen, konsumierten die Probanden Weichkäse und Chips mit Knoblauch. Danach bekamen sie

die verschiedenen Lutschbonbons. Das erste hatte eine glatte Oberfläche, enthielt <0,1% Säuerungsmittel und formte die Kontrollgruppe (CA). Das zweite enthielt zusätzlich <0,2% Zink (AZ), das dritte hatte zusätzlich eine raue Oberfläche (AZR). Alle Probanden mussten alle drei Lutschbonbons in willkürlicher Reihenfolge testen. Die Messungen nach dem Verzehr der Nahrungsmittel und nach dem Lutschen der Bonbons erfolgten sowohl organoleptisch wie auch instrumentell.

Resultate

Bei der instrumentellen Messung zeigten alle drei Lutschbonbons eine statistisch signifikante Reduktion der VSC-Werte ($p < 0{,}001$) im Vergleich zu den instrumentellen Ausgangswerten zu jedem Zeitpunkt (270, 390, 510 und 630 s). Weder bei AZ noch bei AZR zeigte sich ein signifikanter Unterschied zu CA in Bezug auf die Reduktion der instrumentellen Messwerte.

Bei der organoleptischen Untersuchung zeigten alle drei Lutschbonbons zu jedem Zeitpunkt eine statistisch signifikante Reduktion ($p < 0{,}001$) gegenüber den Ausgangsmittelwerten (CA 4,8 ± 0,5; AZ 4,7 ± 0,6; AZR 4,8 ± 0,5).

Es wurden keine signifikanten Unterschiede zwischen CA und AZ oder AZR festgestellt.

Die Mittelwerte der Frage «Verleiht das Bonbon ein Gefühl von frischem Atem?» lagen bei 5,9 für CA, 5,7 für AZ und 5,1 für AZR. Auch die Antwort auf die Frage, ob man diese Lutschbonbons zur Bekämpfung von Mundgeruch empfehlen würde, ergab einen Mittelwert von 5,6 für CA, 5,6 für AZ und 5,2 für AZR. Zwischen den instrumentell ermittelten VSC-ppb-Werten und der Beantwortung der Frage «Verleiht das Bonbon ein Gefühl von frischem Atem?» nach 270 und 630 s wurden keine signifikanten Korrelationen festgestellt.

Diskussion

Die Ergebnisse der Studie haben gezeigt, dass alle drei Lutschbonbons eine signifikante Reduktion der künstlich induzierten Halitosis herbeiführten, unabhängig von der Beschaffenheit ihrer Oberfläche. Ausserdem wurde eine Korrelation zwischen den instrumentellen und den organoleptischen Messungen festgestellt. Allerdings wäre eine weitere Studie mit mehr Teilnehmern und einer Kontrollgruppe ohne Einnahme von Lutschbonbons und mit einer definitiven Diagnose von Halitosis aufgrund von Zungenbelag nötig, um die Resultate der Studie zu bestätigen.

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