

Analysis of Halitosis Increase due to Food Properties

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Abstract

Objectives: This study aims to investigate the halitosis increase after solid and liquid food intake, and to determine the type of food that aggravates halitosis. **Methods/Statistical Analysis:** A total of 60 healthy women filled out the survey questionnaire. Their normal halitosis levels and the levels after food intake were also measured using a Bad Breath (B/B) checker, and these were then compared. **Findings:** The survey revealed that the food that was expected to most likely increase halitosis was coffee mix (75%). On the other hand, the intraoral gas (OG) measurement using a B/B checker revealed that the food that increased halitosis the most after intake was cola, followed by coffee mix, orange juice, candy, chocolate bar, and gum, in that order. The study results showed that the halitosis increased the most after cola intake, and that liquid foods caused more halitosis than solid foods. **Improvements/Applications:** The study results showed that liquid foods caused more severe halitosis than solid foods. Therefore, it is recommended that solid foods be preferred to liquid foods to reduce halitosis.

Keywords: Bad breath (B/B) checker, Comparison, Halitosis, Liquid, Solid

1. Introduction

Halitosis refers to a foul odor produced in the mouth that is released when exhaling, which repels other people. People who have halitosis are worried about repelling other people, and may thus develop mental stress on account of this. Therefore, it should be considered a social problem and not a simple individual problem. Halitosis has emerged not only as an indicator of a person's oral and systemic health but also as an important factor affecting a person's social life¹. Halitosis occurs in more than 50% of adults, and is a very frequently experienced problem in the morning².

The major causative agents of halitosis include hydrogen sulfide (H_2S), methyl mercaptan (CH_3SH), and dimethyl sulfide ($(CH_3)_2S$), which have Volatile Sulphur Compound (VSC) as a major component. Additionally, various components, such as ammonia and alcohol, are known to be mixed with it in a complex manner³.

Volatile sulfur compounds account for 90% of the volatile materials that cause halitosis⁴, but there are various other factors that may bring about halitosis, including the saliva secretion rate, fasting, right after waking up, menstruation, drinking, smoking and drug taking, an individual's health state, and oral factors^{5,6}. Temporary halitosis can develop due to smoking or the intake of garlic, spicy foods, or alcohol⁷. Various other foods, however, also increase halitosis within the mouth, including onion, green onion, gum, candy, chocolate bar, cola, coffee mix, and juice.

There are various methods of examining halitosis. In one method, an examiner directly smells the subject's exhaled breath to determine the presence of halitosis and the halitosis level, and in another method, the concentration of each ingredient of the exhaled breath is measured using a halitosis test device. The first method has low accuracy because different results may be obtained depending on the examiner⁸.

The halitosis test devices include the oral chroma

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and the Bad Breath (B/B) checker. The oral chroma is a halitosis measurement device that measures the concentrations of three-element gases by dividing VSC, a major component of halitosis gas, into H_2S , CH_3SH , and $(CH_3)_2S$. The B/B checker, on the other hand, indicates the measurement result of VSC in exhaled gas and intraoral gas. In the B/B checker, OG is a measure of intraoral gas, and EG is a measure of exhaled gas. The B/B checker also measures the concentrations of 15 kinds of gases that exist within the mouth, including H_2S and CH_3SH , which are VSC, ethane, etc⁹.

Most people consume certain types of food to reduce their halitosis when they were not able to brush their teeth, but there are many foods that increase halitosis rather than reduce it. To correct this misconception, the change in the halitosis level after food intake was investigated in this study, targeting the foods, both solid and liquid, that increase halitosis among the foods that people eat frequently. A B/B checker was used to measure the change in the halitosis level.

The purpose of this study, therefore, was to determine the types of food that aggravate halitosis. The specific objectives of the study were 1. To determine the degree to which the different foods that people consume increase halitosis; 2. To find out how halitosis increases depending on the property of the food; and 3. To identify the foods that increase halitosis the most.

2. Materials and Methods

Sixty women agreed to participate in this study that sought to compare the solid and liquid foods that aggravate halitosis. The subjects filled out the 10-item survey questionnaire and then recorded their halitosis values before and after food intake using a B/B checker (mBA-21).

2.1 Survey

To identify the degrees of oral knowledge and oral management of the study subjects, a survey was conducted.

2.2 Classification of Experimental Group

The subjects in the experimental group were given the following foods that can aggravate halitosis: Solid A (Gum with added synthetic flavoring substances, excluding xylitol), solid B (Chocolate bar), solid C (Candy), liquid D

(Coffee mix), liquid E (Orange juice), and liquid F (Cola). The halitosis levels before and after the subjects' intake of these foods was measured.

2.3 Halitosis Test using a B/B Checker

The halitosis level was measured using a BB Checker[®] (mBA-21, Plustech, South Korea) 3 minutes after each subject's intake of food. Below is the read reference for the B/B checker (Table 1).

Table 1. B/B checker values

Quality	Classify	Halitosis degree
Numerical value	0-50BBV	Normal
	50-70BBV	Slight
	70-90BBV	Strong
	90-100BBV	Very strong (needing treatment)

2.3.1 Measurement of Intraoral Gas (OG)

The subjects were instructed to wait for 180 seconds after pressing the OG button, and to refrain from speaking. When only 5 seconds were left, each subject was guided or given assistance in putting a mouthpiece (paper tube) about 4-5 cm inside his/her mouth. The subjects were then instructed to exhale through their mouth while biting the mouthpiece for 15 seconds, and to inhale through their nose. After the measurement, the value indicated in the display screen was recorded¹⁰.

2.3.2 Measurement of Exhaled Gas (EG)

The subjects were instructed to wait for 30 seconds after pressing the EG button, and to refrain from speaking. When only 5 seconds were left, each subject was guided or given assistance in putting a mouthpiece (paper tube) about 4-5 cm inside his/her mouth. The subjects were then instructed to exhale through their mouth while biting the mouthpiece for 15 seconds, and to inhale through their nose. After the measurement, the value indicated in the display screen was recorded¹⁰.

3. Results and Discussion

Halitosis is a foul odor produced in the mouth or nasal cavity, upper airway, or upper digestive organ that may repel other people. It has emerged as an important factor affecting the quality of life and relationships of many people in the modern society¹¹. In the U.S., it is reported

that 50-65 % of the entire population have been distressed about or have suffered from halitosis at one time or another in their lives¹². Severe halitosis may harm the people one comes in contact with frequently, including his/her family, spouse, and friends, not to mention the person himself or herself who is suffering from the said condition. When people with halitosis talk or mingle with their friends, their halitosis may bother them and may repel those they are talking with. As such, halitosis is an important problem in the modern society.

To date, most studies have investigated certain food ingredients that may develop halitosis, but there have been insufficient studies comparing the degrees of increase of halitosis depending on the properties of foods. Therefore, this study was conducted to identify the property that causes or aggravates halitosis among liquid and solid foods. In this study, to procure basic data for the formulation of a halitosis removal plan, halitosis measurement was conducted, along with a survey.

3.1 General Characteristics of the Study Subjects

With regard to age, as shown in Table 2, 33 (55.0%) of the 60 study subjects were 22-24 years old, representing the largest age group. In other words, there were more people in their early 20s who participated in the study than people of other ages.

Table 2. Frequency and percentage of the subjects' ages

Quality	Classify	Frequency (%)
Age	19-21	22(36.7)
	22-24	33(55)
	25-26	4(6.7)
	Over 30	1(1.7)
Total		60(100)

The correlation analysis results on the self-halitosis level are presented in Table 3. For correlation analysis, only the coefficients in one side of the diagonal line are required to be checked¹³. The correlation coefficient between the halitosis level and the discomfort level was .482, showing a positive (+) correlation. This means that the severer the halitosis level was, the greater the subject's discomfort. This type of halitosis is called "pseudo-halitosis," a condition where a person thinks he/she has halitosis but there is no objective symptom of such and no halitosis is perceived by others¹⁴.

Table 3. Correlation coefficients of the degree of self-halitosis and discomfort index of the study subjects

Correlation coefficient		Degree of halitosis	Discomfort index
Degree of halitosis	Pearson correlation	1	.482**
Discomfort index	Pearson correlation	.482**	1

**The correlation is significant at the 0.05 level (two-tailed).

As presented in Table 4, the food that was most perceived by the subjects as most likely to increase halitosis was coffee mix, which accounted for the largest proportion of responses to the said questionnaire item (75%).

Table 4. Frequencies of survey responses citing certain foods as the most likely to increase halitosis

Quality	Classify	Frequency (%)
Food increasing halitosis	Gum	2(3.3)
	Chocolate bar	4(5.7)
	Orange juice	7(11.7)
	Coffee mix	45(75)
	Cola	2(3.3)
Total		60(100)

3.2 Development of Halitosis Depending on the Properties of Solid and Liquid Foods

3.2.1 Changes based on Solid Food Intake

Before and after candy intake, the subjects' intraoral gas was measured. Table 5 shows the average OG and EG values. After candy intake, the OG increased by 11.1, and the EG by 10.8.

Table 5. Average OG and EG values before and after candy intake

Candy intake		OG	EG
Before	Mean±SD	25.4±5.71	18.8±4.69
After	Mean±SD	36.5±9.23	29.6±6.47

Before and after chocolate bar intake, the subjects' intraoral gas was measured. Table 6 shows the average OG and EG values. After chocolate bar intake, the OG increased by 5.9, and the EG decreased by 3.4.

Table 6. Average OG and EG values before and after chocolate bar intake

Chocolate bar intake		OG	EG
Before	Mean±SD	23.6±8.63	27.1±9.48
After	Mean±SD	29.5±9.99	23.7±8.45

Before and after gum intake, the subjects' intraoral gas was measured. Table 7 shows the average OG and EG values. After gum intake, the OG increased by 5.8, and the EG by 3.0.

Table 7. Average OG and EG values before and after gum intake

Gum intake		OG	EG
Before	Mean±SD	32.2±11.51	32.9±10.86
After	Mean±SD	38±10.16	35.9±9.69

3.2.2 Changes based on Liquid Food Intake

Before and after orange juice intake, the subjects' intraoral gas was measured. Table 8 shows the average OG and EG values. After orange juice intake, the OG increased by 12.7, and the EG by 10.2.

Table 8. Average OG and EG values before and after orange juice intake

Orange juice intake		OG	EG
Before	Mean±SD	18.3±7.55	17.5±6.68
After	Mean±SD	31±8.06	27.7±7.55

Before and after cola intake, the subjects' intraoral gas was measured. Table 9 shows the average OG and EG values. After cola intake, the OG increased by 19.4, and the EG by 16.1.

Table 9. Average OG and EG values before and after cola intake

Cola intake		OG	EG
Before	Mean±SD	16.1±6.54	18.2±7.67
After	Mean±SD	35.5±8.27	34.3±10.03

Before and after instant coffee intake, the subjects' intraoral gas was measured. Table 10 shows the average OG and EG values. After instant coffee intake, the OG increased by 16.5, and the EG by 6.1.

Table 10. Average OG and EG values before and after instant coffee intake

Instant coffee intake		OG	EG
Before	Mean±SD	32.9±5.49	38.3±8.56
After	Mean±SD	49.4±7.90	44.4±7.72

The intraoral gas measurement results showed that the liquid food that caused the largest change in the halitosis level was cola, and among the solid foods, it was candy. Moreover, soft drinks, which people usually drink after food intake to remove halitosis, were confirmed to have increased halitosis.

Of all the factors that increase halitosis, the amount of saliva, the salivary viscosity, the saliva pH, and the amount and activity of the microorganisms in the mouth are reported to have relatively greater impacts on the development of halitosis¹⁵. In a study on the association between the saliva secretion rate and halitosis development, Lear reported that when the saliva secretion rate was too small, the density of microorganisms in the saliva increased, and as the frequency of swallowing decreased along with the reduction of saliva secretion, the contact time between the microorganisms and the compounds containing sulfur increased, and consequently, the halitosis increased¹⁶.

The results of the comparison of solid and liquid foods in this study are as follows. Among the solid foods that were given to the study subjects, candy caused the most halitosis (OG: 11.1; EG: 10.8), followed by chocolate bar (OG: 5.8; EG: 3) and gum (OG: 5.9; EG: -3.4). Among the liquid foods, cola caused the most halitosis (OG: 12.7; EG: 10.2), followed by instant coffee (OG: 19.4; EG: 16.1) and orange juice (OG: 16.5; EG: 6.1). These study results show that liquid foods cause halitosis more than solids foods do, perhaps because when solid food is swallowed, it stimulates the salivary glands, and as such, the halitosis ingredients are swallowed together with the food particles. This supports the theoretical basis of the general halitosis control method: That halitosis can be efficiently reduced by increasing the saliva secretion rate.

In addition, according to a study, as the activity of the acid-producing bacteria in the mouth (a major oral factor affecting the halitosis ingredients) is associated with the development of dental caries and is greatly involved in acid production, it causes halitosis by causing a drop in the pH¹⁷. Moreover, if the amount of bacteria in the saliva is large, the saliva composition may change due to the decomposition products of bacteria, and consequently, the viscosity may increase, which will lower the pH and may cause halitosis. The results of another previous study support this study's result that among solid foods, candy increases halitosis the most¹⁸.

To prevent the development of halitosis depending on the properties of foods, it is important to teach patients to

maintain proper oral hygiene by helping them recognize the fact that many of the foods that people often eat to reduce halitosis after a meal in fact actually increase halitosis. Moreover, proper health education programs for reducing halitosis must be developed.

4. Conclusion

Below are the study outcomes that were obtained from the analysis of the study results. In this study, the total intraoral gas before and after food intake was measured using a B/B checker to determine which between liquid and solid foods cause halitosis the most, and the foods' ingredients were analyzed. The results of this study will be used as basic data for preparing an efficient halitosis removal plan.

- The survey results showed that the food that was perceived by the study subjects to most likely increase halitosis was coffee mix (75%).
- The experiment results showed that the food that increased halitosis the most was cola, increasing the OG by 19.4 and the EG by 16.1.
- Among the solid foods, the food that produced the largest changes in the halitosis values was candy, increasing the OG by 11.1 and the EG by 10.8.
- The comparison of the halitosis levels before and after the intake of all the liquid and solid foods in this study showed that halitosis increased by 40 after the intake of the solid foods, and by 81 after the intake of the liquid foods.
- Therefore, it was concluded that liquid foods increase halitosis more than solid foods do.
- In conclusion, as liquid foods increase halitosis more than solid foods do, it is recommended that solid foods be preferred to liquid foods to reduce halitosis.

5. References

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