THEME	Group No.	Members' Name
Improving the Oral Hygiene in Developing Countries by Using Oral Care with Less Water	4	Ito Kano, Iwasaki Fumika, Koba Haruka, Mizoguchi Karen

1. Introduction

The purpose of our research is to improve oral hygiene in developing countries by taking advantage of swallowable gum. Oral hygiene is involved in the health of our whole body. For example, periodontal sometimes cause pneumonia, osteoporosis, and diabetes. Furthermore, it is involved in low-weight delivery. Therefore, it is important to maintain good oral hygiene and practice oral care. However, it takes a lot of money to brush teeth, one of the most typical forms of oral care, so people in countries that have water problems cannot brush their teeth every day. They have big problems with periodontal and oral cancer in the area. They are essential problems that can lead to other health problems. It is especially important for developing countries because people in those countries cannot receive enough medical services. For these reasons, we want to improve oral hygiene in developing countries that have water problems. To solve these problems, it is will be most effective if we make a method of caring for oral hygiene with less water. According to Nishida Wataru(2018) and Azuma Miyuki(2014), saliva can compete against bad teeth. To secrete saliva, it is necessary to chew a lot, and gum is effective. (*1) Gum can also remove plaque which has a bad impact on teeth because of its elasticity and stickiness. Chewing gum doesn't need water. Hence, we decided to research gum and make swallowable gum in order to prevent the risks of accidental ingestion. We also want to spread the information about our gum to those countries.

2. Objective and Literature Review

(a)Objective

Our purpose is to improve oral hygiene in developing countries, so we set the question "can swallowable gum improve oral hygiene in developing countries?" In order to solve this question, we set the following research questions.

RQ1: Does making gum need less water than brushing teeth?

RQ2: Can the swallowable gum remove as much plaque as store-bought gum?

RQ3: Can the swallowable gum increase the amount of saliva to the ideal amount?

RQ4: What is a good ingredient for the gum to work better?

RQ5: How to spread the information of the gum to developing countries?

RQ1~RQ4 are the questions in order to make sure that swallowable gum can is truly an

oral care method that can maintain good oral hygiene.

(b)Literature Review

There were not any preceding studies linked directly to improving oral hygiene in developing countries with the use of gum. However, we could find the date in which it was suggested that gum is able to maintain oral hygiene and the importance of oral hygiene.

Shimazaki(2020) says that oral disease, especially periodontal diseases, link with total diseases in a variety of ways. The disease with the highest relevance is diabetes mellitus, while other total diseases linked with oral hygiene are heart diseases, chronic kidney diseases, respiratory disease, osteoporosis, articular rheumatism, malignant neoplasm, premature birth and low birth weight. (*2)

The function of saliva is necessary in order to improve oral hygiene. Nomura and Hoshi(2020) says, saliva contains lysozyme which controls the activity of bacteria, peroxidase and immunoglobulin, which have antibacterial properties. Also, calcium ion, phosphate ion, fluorine ion found in saliva, promote decalcified tooth substance to rebecome recalcified. (*3)

Thus, we thought that increasing the amount of saliva can lead to the improve oral hygiene. Masticating is important to increase the amount of saliva. According to Nishikawa and Yoshida(1995), it seems that masticating foods lead the activity of the chewing motor center increase, and the secretion of saliva is promoted.

With further investigation, we found masticating is effective in increasing the amount of saliva. Nakagawa(2005) shows “It seems that the process of secretion and swallowing of saliva is did in oral by chewing gum.”(*5)

We decided to target Pakistan. In Pakistan, waterworks are not good and there are some bacteria or virus, so drinking tap water is not good for their health. Not only tap water but mineral water also have some bacteria. These are the causes of diarrhea and hepatitis. In Pakistan, there are general hospitals which are public and private. Public hospitals have cheap treatments, but there are too many patients and they are not well equipped.

The official language of Pakistan is Urdu, but various ethnic groups live in Pakistan, so 72 different languages are spoken. However the official language is English.

There are some problems with the environment of the internet in Pakistan. The number of internet users was 35.1 million in 2017. It is 18% of the total population there. The number of active social media users was 31.0 million in 2017, and it is 16%of the population. A lot of people cannot easily
take advantage of the internet.

On the other hand, it ranks eighth in the world in wheat production. It is the second largest agricultural product exported by Pakistan. Also, the first place of it is rice, so it can be said that Pakistan is a major producer of cereals. Gum production needs wheat flour, so we

thought it would be a good choice for our research area.

3. Methods / Approach / Study

RQ1

We tried to make our own swallowable gum a total of three times in total.

[Ingredients] (about 15 grains) ・Bread flour 50g ・Water 20cc

[Process] 1, Mix bread flour and water

2, Let it rest in a plastic bag for an hour

3, Wash it until the water becomes transparent and the gluten has been removed

We measured the amount of water we used to make the gum. Also, during the second and third productions, we added salt to the ingredients in order to decrease the amount water used in the third step of the gum making process. Furthermore, in third step of the process, we researched what would happen to the gum if we didn't wash it.

RQ2

We used a plaque checker to examine the plaque removing power of chewing gum. The plaque checker is a colored liquid and we can easily check for plaque. If there is plaque on our teeth, the color of our teeth will change to red. We examined three types, chewing swallowable gum, chewing store-bought gum, and brushing. The examinees were 5 students in the second grade of Nagasaki Higashi High School.

1, After eating lunch, put the plaque checker in your mouth, and keep it in your mouth for 30 seconds before spitting it out.

2, Take a picture with a digital camera to see how many red teeth you have.

3, Examine each oral care (chew swallowable gum for 1 minute, chew store-bought gum for 1 minute, and brushing teeth)

4, Put plaque checker in your mouth again and keep it in your mouth for 30 seconds.

5, Repeat step 2

6, Check the amount of plaque before oral care and after oral care for each oral care method.

RQ3

We checked the amount of saliva while normal times and the amount of saliva after chewing the swallowable gum.

1, Spit saliva into the paper cup and weigh it

2, Chew the swallowable gum for 1 minute

3, Repeat step 1

In this experiment, we changed the amount of water when we made our gum and investigated whether it was related to the amount of saliva. The amount of water was changed 0L, 1L, 2L, and 3L. The examinees were 3 students in the second grade of

Nagasaki Higashi High School.

RQ5

We made a pamphlet which was mainly meant for Pakistan by using power point. The reason why it is for Pakistan is that the official Pakistani language is English, and that the literacy rate there is not low. The contents of the pamphlet are written below.

1, Title (the Introduction of the Swallowable Gum)

2, explanation of the swallowable gum

3, importance of oral care

4, how to make the swallowable gum

4. Results and Discussion

（a） Results

RQ1

In the first production of our gum, we made the gum in the order mentioned above. Consequently, 16L of water was needed in total. During the second and third productions in which salt was added to the ingredients, 2L of water was needed in each time. We omitted water in step 3 of the process and used water only for the ingredients (20cc). The finished product was easy to bite off, and it was difficult to continue chewing.

RQ2

The pictures of teeth taken in this experiment were shown below.

(Teeth on the left pictures are before the oral care, and teeth on the right pictures are after.)

[Brushing]

[Store-bought gum]


[Our swallowable gum]


RQ3

The results of this experiment are shown below.

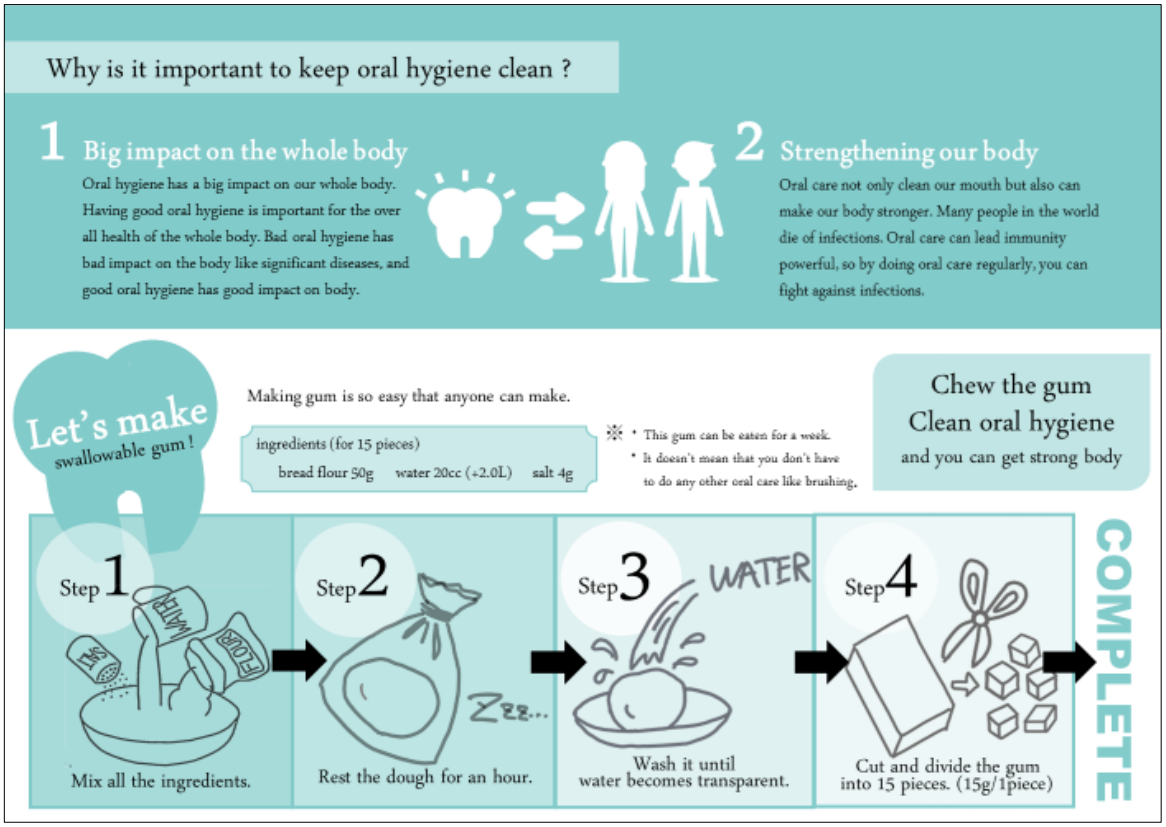
The amount of saliva （g）	Subject 1	Subject 2	Subject 3	Average
Normal	1	1	1	1
0L	1.5	6.5	1.5	3.16
0L (the gap from normal)	0.5	5.5	0.5	2.16
1L	4.0	3.5	2.5	3.33
1L (the gap from normal)	3.0	2.5	1.5	2.33
2L	3.0	2.5	2.5	2.66
2L (the gap from normal)	2.0	1.5	1.5	1.66
3L	3.5	2.5	2.0	2.66
3L (the gap from normal)	2.5	1.5	1.0	1.66

RQ5

The pamphlet we made is attached below. This is a three-fold pamphlet.

The first page, from right to left, shows the front cover, back cover, and wrap-around page, each with the title, the name of our school, and an introduction about the importance of oral care.

The second page is as follows. We wrote the importance of oral care in the upper part of the pamphlet and how to make the swallowable gum in the lower part.



(b) Discussion

RQ1

In the first production, 16L of water was used. This means that about 1L of water is needed to make one piece of the swallowable gum. But, in the second and third productions, 2L of water was needed. This means that about 0.13L of water is needed to make one piece of the gum. It seems that this change occurred by adding salt to the ingredients. Therefore, we can say that salt is good to make gum a more suitable oral care method for the areas which have water shortage. In addition, it is said that we use 6L of water when we brush our teeth once. Only 0.13L of water is needed to make one piece of the swallowable gum when we add salt to the ingredients, so making and chewing gum need less water than brushing teeth.

RQ2

From the pictures, brushing teeth removes almost all the plaque. Chewing store-bought gum removes some plaque. Chewing the swallowable gum removes plaque to some degree. When comparing the work of the swallowable gum with that of the store-bought gum, the amount of plaque that was removed by the swallowable gum seems to be more than what was removed by the store-bought gum. So, the swallowable gum can remove more plaque than the store-bought gum.

RQ3

From the table shown above, the swallowable gum can promote salivating and increase the amount of saliva. But the gum which 0L of water used in step 3 of the process tasted incredibly salty. In addition it didn't have enough elasticity, so it was difficult to keep chewing. Then the number of the times to chew was small. It seems that the amount of secreted saliva was large because of strong salty taste. The swallowable gum which the amount of saliva used to make the gum was 1L remained a little salty taste though the salty taste of it was not as strong as that of the gum that used 0L of water, and it was hard to keep the gum in our mouths. The swallowable gum using 2L of water had little salty taste and the amount of secreted saliva was large. The effectiveness of gum using 3L of water was the same as that of 2L. Thus, the swallowable gum can increase the amount of saliva, and it is desirable that we use 2L of water to make the swallowable gum.

RQ5

The pamphlet is made entirely by the members of this group. We haven't received any opinions and advice from others, so this pamphlet hasn't been completed. Therefore, we have not sent it to our target area of Pakistan. It is not clear whether this pamphlet is a effective way to spread the information of the gum or not.

However, in our opinion, with it written in English, this pamphlet can adapt to not only Pakistan but also countries whose official language is also English. If it is translated into various languages, it can be used around the world.

5. Conclusion

We recommend our swallowable gum for people in developing countries to improve their oral hygiene. It is made of flour and uses less water. This gum can remove plaque which is one of the causes of bad teeth, and it can also increase the amount of saliva which protects our teeth from bacteria. Therefore, our gum can work as an oral care tool. However, there are problems. One is that our subjects were too few. Another is that the result of RQ5 is subjective.

In addition, there is an unexamined research question. It is RQ4: what is a good material for the gum to work better? To solve RQ4, xylitol seems to be good, but we have not determined whether it is available for people in developing countries. As of now, we believe, tannin, which is in tea, coffee, and persimmon, is thought to have a good effect on the restraint of inflammation of periodontal tissue.

References

*1 Nishida Wataru（2018），“Tonyobyo ga iyanara ha wo migakinasai”(Brush your teeth if you hope not to become diabetes.), Togensha

Azuma Miyuki（2014），“Hamigaki Kakumei！～hamigaki yorimo taisetuna koto～”(Brushing Reform! ～What is more important than brushing～) , Bunkeido

*2 Shimazaki Yoshihiro（2020），“kouku no kenkou jotai to zennshinntekina kennkou jotai no kannren” (The connection between the oral hygiene and overall health） , Ministry of Health, Labour and

Welfare e-healthnet, https://www.e-healthnet.mhlw.go.jp/information/teeth/h-01-006.html

*3 Nomura Yoshiaki・Hoshi Keika（2020）, “ha to kuchi no kinou”(The function of teeth and mouths), Ministry of Health, Labour and Welfare e-healthnet, https://www.e-healthnet.mhlw.go.jp/information/teeth/h-01-006.html

*4 Nishikawa Yasuo・Yoshida Yoh（1995), “soshaku undou to daeki bunpitsu tono kanrensei ni tsuite”(About the connection between mastication and salivation), https://www.jstage.jst.go.jp/article/shikaigaku/58/2/58_KJ00003022781/_pdf/-char/ja

*5 Nakagawa Kimiko（2005), “gamu sohakuzi niokeru enka tyokuzen・tyokugo no koukuunai daekiryo ni tsuite”(About the amount of saliva in mouths before and after swallowing when chewing gum), https://www.jstage.jst.go.jp/article/jspd1963/43/2/43_185/_pdf/-char/ja