Drinks that cause tooth decay health essay

Food & Diet

The content in the drinks that causes tooth decay is the acidic content in our food and beverages. In general, drinks with a pH below 5. 0 – 5. 7 have been known to trigger dental erosion. Previous scientific research findings have helped to warn consumers that the pH level in beverages could lead to tooth erosion, the breakdown of tooth structure caused by the acid and leads to tooth decay. The acidity level in popular beverages that we consume everyday contributes to the erosion of enamel. Dental erosion is the irreversible loss of a tooth due to chemical dissolution by acids not of bacterial origin. There is generally widespread ignorance of the damaging effects of acid erosion; this is particularly the case with erosion due to fruit juices, because they tend to be seen as healthy. Erosion is found initially in the enamel and if unchecked, may proceed to the underlying structure of a tooth. Numerous clinical and laboratory reports link erosion to excessive consumption of drinks, fruit juices such as orange juice (which contain citric acid) and carbonated drinks (citric and phosphoric acid). This essay examines scientific research of the issue to determine if, in fact, acidic drinks do cause tooth decay. As part of my research, I conducted my own experiment, using human teeth and different types of drinks. After considering the results I obtained, as well as other research, I conclude that acid contain in the drinks is the cause of tooth decay. The acid content will slowly dissolve the enamel of the teeth. It dissolves the calcium molecules from the teeth surface, thus the teeth will erode. This essay will examine the validity of acid content in the drinks as the real culprit to tooth decay, evaluate the extend of the damage and recommendations for proper tooth care.

Introduction

Tooth decay is the loss of enamel from the tooth surface. When sugary drinks are consumed by bacteria in the mouth, it turns the sugar into acids. These acids corrode the enamel of the teeth, which leads to cavities. Dental erosion is the irreversible loss of a tooth to chemical dissolution by acids not of bacteria origin. Tooth decay is the most common chronic disease for children aged 5 – 17 although it is only recently that it is recognized as a dental health problem. There is generally widespread ignorance of the damaging effects of acid erosion, this particularly due to fruit juices, because they are perceived to be healthy. Erosion is initially found in the enamel and if left unchecked, may proceed to the underlying structure of a tooth. Numerous clinical and laboratory reports linked erosion to excessive consumption of sweet drinks, carbonated drinks and fruit juices. Previous scientific research findings have help to warn consumers that the pH (potential of hydrogen) level below pH 5. 0 – 5. 7 may initiate dental erosion.

The consumption behaviour plays a major role in oral health. However, public awareness on dental erosion is not high. Sources of acids can be endogenous or exogenous, and erosive intensity is modified by quality and quantity of saliva. Acidic beverages are the most common extrinsic factors that cause dental erosion (tooth decay). Because of these identified factors, I am interested to do this research to clear my curiosity.

Basically this experiment is done to support my hypothesis. The experiment consists of gathering extracted human teeth of various shapes and sizes, disinfection and the submission in the selected beverages. Duration of 5

months is needed to complete the whole experiment. With the findings, I will be convinced and able to convince that acidic beverages cause tooth decay.

Review of Literature

Lemon Juice

The juice extracted from fresh lemon is used as refreshing beverage. People go for lemon juice because they are able to cool down our body temperature. This is why when people are sick, they are advised to drink more citric juices so that the body system can be cooled down and recover the patients. Besides that, lemon juice also has high content of Vitamin C which is essential to our body immune system.

2. 2 Coke

Coke is a very famous carbonated drink. Despite the fizzy feeling and sweet tasting of the drink, it is actually one of the main contributors to tooth decay. Coke is a very sweet beverage making it able to promote the growth of oral bacteria, which is known as Streptococcus mutan[1]as the sugar contained in coke can feed the bacteria. Coke contains phosphoric acid and has the ability to corrode the tooth enamel. Plus, coke can stain the teeth and forms caries on the surface of the teeth[2].

2. 3 Coffee

Coffee causes calcium loss in our bone mass, which leads to the excretion of calcium from our bones, doesn’t matter which part of our body it is. This causes the thinning of the teeth which in turn, causes the teeth to become

weak and is vulnerable to corrosion or break. Furthermore, coffee is also mostly acidic, which also causes tooth erosion, then leads to tooth decay[3].

2. 4 Energy Drink

Energy drinks can also cause tooth decay. The pH level of the drink can lead to tooth erosion and hypersensitivity. It causes the breakdown of the tooth structure. In energy drinks, it is not the acidity of the drink that cause tooth erosion, but it is the “ buffering capacity” of the drink that corrodes the tooth. “ Buffering capacity” is the ability to neutralize acid[4]. Energy drinks have high buffering capacity, making them to have the strongest potential to cause tooth erosion.

2. 5 Sugar Solution

Sugar is scientifically known as sucrose, a sweet tasting organic compound, derived from glucose and fructose. Streptococcus mutans which live in our oral cavity will react with the sugar and form lactic acid which will also causes tooth erosion. Sucrose will be converted into dextran which favors the bacteria to be attracted to the teeth. Dextran is the food for the oral bacteria and lactic acid is their waste product[5]. Therefore, those bacteria will just stick to the teeth. This will make it difficult to remove those bacteria[6].

2. 6 Tap Water

Tap water will not cause tooth decay as it does not have any effects on our teeth. Tap water is fluoride-enhanced, and it serves the purpose of making the teeth stronger and protects the teeth, making it an important teeth-

protecting agent. Therefore, tap water will not stand the possibility of causing tooth decay.

2. 7 Tooth Anatomy

As the function of the teeth is to bite and chew food, hence, they are the first step in the digestion of food. The long, sharp canine teeth tear up food. The wide, flat molars grind and mash up food. Teeth also help us say certain sounds. Human have two sets of teeth in their lives, the primary teeth (also called the baby, milk or deciduous teeth) and the permanent teeth. Children have 20 primary teeth; they are replaced by the permanent teeth by about age 13. Adult have 32 permanent teeth.

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Diagram of a tooth anatomy

3. 0 Hypothesis

Acid in drinks is the cause of tooth decay. Acidic drinks such as orange juice and lemon juice, the acid content will slowly dissolve the calcium in the teeth, corroding the enamel. The process starts from the surface of the teeth, towards the inner structure of the teeth.

Method Development & Planning

In order to carry out this research successfully, materials have been carefully chosen to give a more promising and accurate result. Materials were carefully studied through several researches and readings from various useful sources. For my research, I have studied and researched on drinks

such as lemon juice, coke, coffee, energy drink (100-Plus), sugar solution and tap water. The choice of tap water in my experiment is because of the neutral pH and fluoride enhancement. I have been studying about the compositions of the drinks and how they actually contributed to tooth decay.

This experiment was carried out in the Health Laboratory of a Government Health Clinic in Sibu. All the research work was done during each of my college holidays. I was fortunate because I was consented to use the apparatus like digital weighing scale, microscope and more. All the extracted human teeth were supplied by the dental clinic with consent granted by the dental officer. I was also being taught the proper way of disinfecting the teeth with a proper disinfectant by the health staff in the laboratory. The main reason I chose to do my experiment here is because of the proper equipment available. Besides, I can also handle the teeth in a correct way to prevent myself from the bacteria.

During the planning stage, I’ve done a thorough research in choosing the appropriate drinks to be tested in my experiment. I chose only those drinks is because they are some of the popular drinks and are consumed the most nowadays. Besides that, these drinks are easily available in the market, regardless whether it is in the urban or rural area. And since I am studying of the effects of these drinks on human, so children can be a good subject for me because these drinks are mostly consumed by children. These drinks are also very affordable, so there won’t be any financial problem in carrying out this experiment.

As for the teeth, various types of teeth were used in this experiment. However, no specific tooth is being used due to the unavailability. These teeth range from Incisors, Canine, premolar to molar. Tooth that is with minimal erosion noted is selected for this experiment as no perfect human tooth is being extracted and readily available for such an experiment. 30 human teeth are used in this experiment. Only 30 teeth are used because it is quite difficult to get human teeth as human teeth are really dirty and dentists usually dispose them off immediately due to hygienic reason. Besides that, as for the solutions, 200ml of each solution is used. The same amount of solutions are also used each and everytime when I change the solutions in each beaker, once a week.

This experiment takes approximately 5 months in order to obtain a more significant and accurate result. Initially the duration of the experiment was only 10 weeks as planned; however no significant change can be seen. Therefore, the duration of the experiment was extended to 5 months instead because the teeth required a longer period of time to witness a significant change in the structure of every tooth. The experiment was carried out at room temperature, which is approximately at. This is because oral bacteria can function well at such temperature, which may contribute to a more accurate result.

The experiment was done, with permission, for using the equipment at a Clinic laboratory of a Healthcare facility in Sibu. All the extracted teeth for this study were taken from the Dental Clinic of that facility with each tooth weighs between 0. 510 gram and 2. 280 gram depending on various types of teeth (molar, premolar, canine and incisor) extracted and the weight of these

extracted teeth. After being thoroughly washed and disinfected (to prevent any possible infections during the process of this experiment), specimens (extracted teeth) were alternately immersed, 5’s, in each different types of drinks place in a labelled beaker ranging from A to F as follows:

Beaker A – Lemon juice

Beaker B – Coke

Beaker C – Coffee

Beaker D – 100 Plus

Beaker E – Sugar Solution

Beaker F – Tap Water

This study was done for duration of 5 months. This is to enable me to note significant changes. This is necessary in order for me to chart and document accurately the gradually changes to these teeth. A shorter duration will not show any significant changes which could be documented. The first reading will only be done after 1 month post immersion in each of the marked beaker filled with the experimented drinks. These readings include the documentation of the colour, contour (mass) and the weight of each tooth after which at the end of my study I would be able to determine which of the 6 beakers show significant changes in the tooth mass. The inspection of each beaker will be done monthly for the next subsequent 5 months.

Beaker A (lemon juice) Beaker B (Coke) Beaker C (coffee)

Beaker D (100 Plus) Beaker E (sugar water) Beaker F (tap water)

In the meantime, a clean 200ml beaker was used to measure 200ml of lemon juice and the beaker is labelled accordingly. The pH of each drink is being measured to determine their acidity level. pH Chart from the journal of dental hygiene is being used as a guideline for my experiment. The diagram below show the various pH levels of frequently consumed foods and drinks below pH 5. 0 – 5. 7 which may initiate dental erosion. This step was repeated to measure out the same amount (200ml) of Coke, coffee, 100 Plus, sugar water and tap water. In the experiment, tap water acts as a control. After that, 30 teeth of almost the same size were cleaned and disinfected thoroughly with antiseptic disinfectant. The teeth must be clean and are without plague in order to detect new changes to the mass and contour of the teeth. Then, the teeth were dried with a hair dryer to ascertain that the teeth are totally dry and no residual water detected. This is done to make sure that the result will not be tempered. The initial mass of each tooth was also weighted and the measurements were recorded. After the measuring processes, each of the teeth was immersed into their respective beakers ranging from beaker A to beaker F, 5 teeth per solution per beaker due to the limited amount of human teeth available. Those teeth must be immersed completely in their respective solution. After that, those 6 beakers were left in the laboratory under standard room temperature and humidity.

After a month, every tooth in the 6 beakers was individually checked and the changes which had taken place on the surface of the teeth were observed and documented with each of the tooth mass measured. Then these teeth are re-immersed with fresh drinks (to ensure the potency of these drinks

does not decline) for the subsequent month documentation. This process will be carried out at a monthly interval with fresh solution to detect any changes occurring to the mass and contour of the teeth, be it acute or gradual. At the end of the experiment which lasted for 5 months, the teeth were removed from each of the solutions and they were cleaned. After cleaning process, the teeth were dried using a hair dryer until each of them was totally dry. The final mass of each tooth was weighted and all the measurements were recorded as shown in the table below. At last, the data collected, which is the final mass (quantitative data) and the observation on the teeth (qualitative data) were tabulated for analysis.

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Diagram of the pH level of frequently consumed food and

drinks below pH 5. 0-5. 7 may initiate dental erosion.

5. 0 Materials and Procedure

5. 1 Materials

Materials

Quantity

Extracted tooth

30

Lemon juice

200ml

Coke

200ml

Coffee

200ml

100 Plus

200ml

Sugar solution

200ml

Tap Water

200ml

5. 2 Apparatus

Apparatus

Quantity

200ml beaker

6

Forceps

1

Electronic balance

1

Magnifying glass

1

Hair dryer

1

Microscope

1

5. 3 Variables

Variables

Independent variable

Different types of drinks

(lemon juice, coke, coffee, 100 plus, sugar water, tap water)

Dependent variable

Condition of the teeth

Constant variable

Volume of drinks used

Type of teeth used

Temperature of the drinks

Duration of the experiment

Number of teeth used

5. 4 Methodology

Prepare 6 clean and empty beakers.

Label all the 6 beakers with alphabets, ranging from A to F.

Beaker A – Lemon juice

Beaker B – Coke

Beaker C – Coffee

Beaker D – 100 Plus

Beaker E – Sugar solution

Beaker F – Distilled water

In the mean time, use a clean 200ml beaker, measure 200ml of lemon juice.

Repeat step (3) with coke, coffee, 100 Plus, sugar water and distilled water.

The distilled water acts as the control experiment.

Then, clean 30 teeth of the same size thoroughly.

Make sure that there is no plaque on them.

Dry the teeth with a hair dryer.

Weight the initial mass of the teeth. Record the measurements.

Immerse the each of the teeth into respective beakers.

Label the teeth with numbers 1, 2, 3, 4 and 5 for easy recognition.

Make sure that the tooth is completely immersed in their respective solution.

Leave the 6 beakers in the laboratory with a standard surrounding temperature.

After 24 hours, check on the tooth in the 6 beakers and observe the changes which are taken place on the surface of the teeth.

Remove the teeth from the solutions and clean them.

Dry the teeth with a hair dryer and make sure that they are totally dry.

Weight the final mass of the teeth. Record the measurement.

Tabulate the data.

Data Collection

6. 1 Quantitative Data

Drinks

pH Value

Lemon Juice

2. 10

Coke

2. 30

Coffee

4. 95

100 Plus

3. 78

Sugar Solution

7. 00

Tap Water

7. 00

The table shows the pH level of each drink for this study.

Type of Drinks

pH Value

()

Month

Mass of Teeth/mg ()

Tooth 1

Tooth 2

Tooth 3

Tooth 4

Tooth 5

Lemon Juice

2. 10

1

2. 37

2. 68

1. 80

2. 22

1. 05

2

2. 37

2. 67

1. 79

2. 21

1. 04

3

2. 35

2. 65

1. 78

2. 20

1. 03

4

2. 33

2. 63

1. 75

2. 18

1. 01

5

2. 29

2. 60

1. 72

2. 14

0. 98

Coke

2. 30

1

1. 82

2. 33

2. 06

1. 80

2. 46

2

1. 81

2. 32

2. 06

1. 80

2. 44

3

1. 79

2. 30

2. 04

1. 78

2. 43

4

1. 75

2. 28

2. 01

1. 76

2. 41

5

1. 75

2. 26

1. 98

1. 74

2. 39

Coffee

4. 95

1

1. 55

1. 74

2. 34

2. 26

1. 37

2

1. 55

1. 73

2. 33

2. 26

1. 36

3

1. 54

1. 73

2. 32

2. 25

1. 36

4

1. 52

1. 71

2. 31

2. 25

1. 35

5

1. 50

1. 69

2. 29

2. 24

1. 33

100 Plus

3. 78

1

2. 67

2. 64

2. 75

1. 30

2. 14

2

2. 66

2. 63

2. 75

1. 30

2. 12

3

2. 64

2. 61

2. 73

1. 28

2. 10

4

2. 62

2. 60

2. 71

1. 25

2. 08

5

2. 60

2. 58

2. 69

1. 23

2. 06

Sugar Solution

7. 00

1

1. 37

1. 46

2. 06

1. 47

2. 33

2

1. 37

1. 45

2. 04

1. 46

2. 32

3

1. 35

1. 45

2. 03

1. 44

2. 30

4

1. 34

1. 44

2. 01

1. 43

2. 29

5

1. 33

1. 43

2. 00

1. 42

2. 28

Tap Water

7. 00

1

2. 65

2. 43

2. 86

1. 43

2. 63

2

2. 65

2. 43

2. 86

1. 43

2. 63

3

2. 65

2. 43

2. 86

1. 43

2. 62

4

2. 64

2. 43

2. 85

1. 43

2. 62

5

2. 63

2. 42

2. 84

1. 43

2. 61

The table shows the mass of the teeth throughout the experiment.

6. 2 Qualitative Data

Type of Drinks

Month

Colour

Contour

Mass

Lemon Juice

1

No change

No change

No change

2

No change

No change

Slight decrease

3

Yellowish

Microscopic flaking and softening of enamel

Slight decrease

4

Yellowish brown

Erosion noted

Significant decrease

5

Brown

Erosion noted

Consistent decrease

Coke

1

No change

No change

No change

2

No change

No change

Slight decrease

3

Yellowish

No change

Slight decrease

4

Yellowish brown

Erosion noted

Significant decrease

5

Brown

Erosion noted

Consistent decrease

Coffee

1

No change

No change

No change

2

Yellowish

No change

Slight decrease

3

Yellowish brown

Microscopic flaking and softening of enamel

Slight decrease

4

Brown

Erosion noted

Significant decrease

5

Brown

Erosion noted

Consistent decrease

100 Plus

1

No change

No change

No change

2

No change

No change

Slight decrease

3

Yellowish

Microscopic flaking and softening of enamel

Slight decrease

4

Yellowish

Erosion noted

Significant decrease

5

Yellowish brown

Erosion noted

Consistent decrease

Sugar Solution

1

No change

No change

No change

2

No change

No change

No change

3

Yellowish

No change

Slight decrease

4

Yellowish brown

Erosion noted

Significant decrease

5

Yellowish brown

Erosion noted

Consistent decrease

Tap Water

1

No change

No change

No change

2

No change

No change

No change

3

No change

No change

Slight decrease

4

No change

No change

Slight decrease

5

Yellowish

No change

Slight decrease

The table shows the observations obtained throughout the experiment.

7. 0 Data Processing & Analysis

7. 1 Data Processing

7. 1. 1 Calculation for the difference in mass of the teeth.

Formula:

Difference in mass = Mass in month 1- Mass in month 5

Example,

The 5th month (lemon juice), tooth 1:

Difference =

=

*Same calculation applied to others.

Type of Drinks

Difference in mass/mg ()

Tooth 1

Tooth 2

Tooth 3

Tooth 4

Tooth 5

Lemon Juice

0. 08

0. 08

0. 08

0. 08

0. 07

Coke

0. 07

0. 07

0. 08

0. 06

0. 07

Coffee

0. 05

0. 05

0. 05

0. 06

0. 04

100 Plus

0. 07

0. 06

0. 06

0. 07

0. 08

Sugar solution

0. 04

0. 03

0. 06

0. 05

0. 05

Tap water

0. 02

0. 01

0. 02

0. 00

0. 02

The table shows the difference in mass of each tooth throughout the 5 months for each drink.

7. 1. 2 Calculation for the uncertainties of difference in mass

Formula:

Uncertainty of the initial mass + uncertainty of the final mass

Example,

Therefore, difference in mass for tooth 1 in lemon juice:

Difference =

*Same calculation applied to others.

7. 1. 3 Calculation for the average difference.

Formula:

Example,

For lemon juice:

*Same calculation applied to others.

Type of Drinks

Average difference in mass/mg

Lemon juice

0. 08

Coke

0. 07

Coffee

0. 05

100 Plus

0. 07

Sugar solution

0. 05

Tap water

0. 01

The table shows the average difference in mass of the teeth in each drink.

7. 1. 4 Calculations for the Standard deviation of the average difference in mass.

Due to the complexity of the calculation, the standard deviation is calculated by using the Graphic Display Calculator (GDC).

Steps:

Press the STAT button.

Press the ENTER button.

List the data (the average difference in mass of the 5 teeth per solution) in one of the column.

Press the STAT button.

Press > button so that the CALC image on the screen is highlighted.

Press the ENTER button.

Beside the 1 – Var Stats words on the screen, type the 2ND button and the name of the column that contains the data (name of the column used in step 3).

Press the ENTER button.

The standard deviation is equal to.

The above steps are repeated to calculate the standard deviation for the teeth in the rest of the drinks.

Example,

For lemon juice,

Key in the difference in mass of the 5 teeth in the 1st column.

Based on the steps above, the GDC automatically calculated the standard deviation, which is,.

*Same calculation applied to others.

Type of Drinks

Average Difference in Mass/mgStandard Deviation

Lemon juice

0. 080. 004

Coke

0. 070. 007

Coffee

0. 050. 007

100 Plus

0. 070. 008

Sugar Solution

0. 050. 011

Tap water

0. 010. 009

The table shows the average difference in mass of the teeth with the standard deviation.

7. 1. 5 Calculation of the rate of reaction between the teeth and the drinks.

Formula:

Calculations:

Lemon Juice

Rate of Reaction =

=

Coke

Rate of Reaction =

=

Coffee

Rate of Reaction =

=

100 Plus

Rate of Reaction =

=

Sugar Solution

Rate of Reaction =

=

Tap Water

Rate of Reaction =

=

7. 1. 6 Calculation for the standard error of the rate of reaction.

Formula:

Where,

= uncertainty of the mass

= rate of reaction

Example:

Lemon juice

Coke

Coffee

100 Plus

Sugar Solution

Tap Water

Type of Drinks

pH Value

Duration of Experiment/ months

Average Difference in Mass/ mg

Rate of Reaction/ mg/day

Lemon juice

2. 10

5

0. 080. 004

Coke

2. 30

5

0. 070. 007

Coffee

4. 95

5

0. 050. 007

100 Plus

3. 78

5

0. 070. 008

Sugar solution

7. 00

5

0. 050. 011

Tap water

7. 00

5

0. 010. 009

The table shows the summary of the calculations in the experiment.

7. 2 Data Presentation

7. 3 Statistical Analysis

7. 3. 1 T-test lemon juice and sugar solution.

1st Month:

t-Test: Paired Two Sample for Means

Variable 1

Variable 2

Mean

2. 024

1. 738

Variance

0. 39683

0. 18467

Observations

5

5

Pearson Correlation

-0. 933627334

Hypothesized Mean Difference

0. 286

df

4

t Stat

2. 38114E-16

P(T <= t) one-tail

0. 5

t Critical one-tail

2. 131846786

P(T <= t) two-tail

1

t Critical two-tail

2. 776445105

To do a T-test, I came up with two hypotheses, which are as followed:

The difference between the average mass of the teeth in lemon juice and sugar solution for the 1st month is not significant.

The difference between the average mass of the teeth in lemon juice and sugar solution for the 1st month is significant.

From the result of T-test generated by Microsoft Excel 2010, the value of is and the value of is. Thus, . Therefore, is accepted and is rejected. This means that from the T-test, the difference between the average mass of the teeth in lemon juice and sugar solution for the 1st month is not significant. This is because all the teeth used in this experiment have an average mass initially.

7. 3. 2 T-test between lemon juice and sugar solution

2nd Month:

t-Test: Paired Two Sample for Means

Variable 1

Variable 2

Mean

2. 016

1. 728

Variance

0. 39858

0. 18127

Observations

5

5

Pearson Correlation

-0. 938299713

Hypothesized Mean Difference

0. 288

df

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