SASTA OLIPHANT SCIENCE AWARDS

SOUTH AUSTRALIAN SCIENCE TEACHERS ASSOCIATION

Highly Commended

Scientific Inquiry

Year 5-6

Shaya Ismail

Norwood Primary School

Sugars and Acids!
How healthy are our drinks?

Shaya Ismail

Year 6, Norwood Primary School

(Word count excluding headings, titles, figure captions, tables and references is 1012 words)

20th July 2021

Table of Contents

1. Introduction

Sugar is a rich source for energy. But high consumption of sugar can lead to several health problems such as weight gain, obesity, heart disease, tooth decay and diabetes [1]. Drinks (soft drinks, juice, milk flavoured drinks) have lots of sugar. Drinks with high acidity can also lead to bone loss and can be very bad for our teeth and body functions [2]. This scientific inquiry investigates the sugar content and acidity of commonly available drinks. The sugar content is measured and compared to the actual amount of sugar shown on the drink can/bottle. I have not seen any study conducted in Australia 1) investigating acidity of drinks and 2) comparing the measured sugar content to the amount given by the manufacturer. This scientific inquiry will also conduct another simple experiment to investigate the effect of sugary acidic drinks on our teeth.

2. Measuring Sugar Content and Acidity

2.1 Sugar content measurement

The sugar content was measured using a refractometer (Figure 1). A refractometer is a professional instrument used in food industry to measure sugar content in drinks and beverages. This instrument measures the sugar content using refraction of light on the test liquid [3]. The unit of sugar content measured by the refractometer is 'Brix Percentages'. One percent (1%) Brix is equal to 1 gram (g) of sugar in 100 milli-litres (ml) of liquid. For this scientific inquiry I am assuming 100 ml of test drink weighs 100g.

Figure 1: Refractometer

The sugar content is measured by putting a few drops of test liquid on the glass prism (tip) of the meter and then aiming the prism side to a light source. The sugar content is measured by looking on the eye piece and reading the Brix percentage. The Brix % is the number on the line where the blue (upper side) and the white (lower side) regions meet. For example, the reading in Figure 1 shows a Brix % of 48 (48g of sugar in 100ml of liquid). Before measuring the sugar content, the refractometer was calibrated using distilled water (Brix 0% - no sugar).

2.2 Measuring acidity

Acidity of the drinks was measured using a pH meter (shown in Figure 2).

Figure 2: pH Meter

pH is a measure of how much hydrogen ions are in a liquid [4]. The pH scale ranges from 0 (very acidic) to 14 (very alkaline / basic). A pH of 7 means that the liquid is neutral. Normal drinking water should have a pH value of around 7. The pH scale is shown in Figure 3 [4].

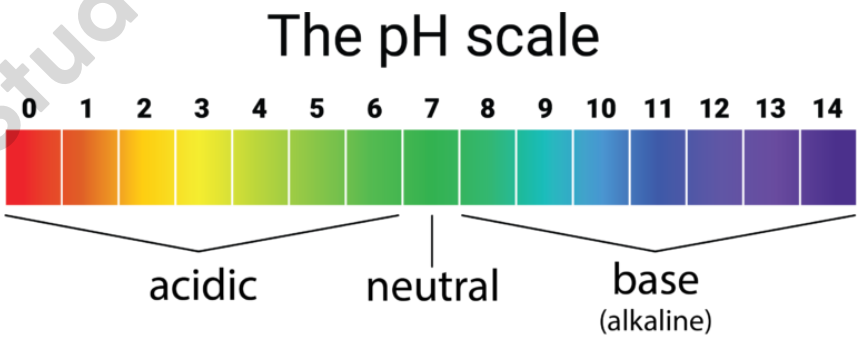


Figure 3: pH Scale [4]

The acidity was measured by dipping the meter (tip) in the liquid and recording the number displayed on the digital screen. The pH meter was tested for accuracy by comparing with distilled water (which has a pH of 6.0). The measured pH value using the distilled water was 6.2, which is very close to the value shown on the bottle. So I didn't do further calibration on the meter.

2.3 Safe levels of pH and sugar consumption

Safe pH level: According to the website [5] the pH of the human body is between 7.35 and 7.45. Even a small change in this pH range could cause serious health issues. Therefore the safe level for drinks is around 7 (neutral). The website [6] indicates the safe range for drinking water is between 6.5 to 8.5.

Safe sugar content: According to the website [7] the daily recommended sugar consumption limit for most women is 24g and for most men is 36g.

2.4 Selected drinks

The drinks and the meters used for the scientific inquiry are shown in Figure 4.

Figure 4: Drinks and meters

3. Results

The results from the measurements are shown below in Table 1.

	Drink	Sugar content on the manufacturer's label		Sugar content measured from Refractrometer	Measured pH level	% Amount the actual measured sugar content is above that reported by manufacturer
		Total (Per Serving) (in g)	Per 100ml (in g)	Per 100ml (in g)		
	Soft Drinks					
1	V Energy Drink	**26.4**	10.6	13	**3.35**	22.6
2	Coca Cola	**27.0**	10.6	11	**2.49**	3.8
3	Coca Cola No Sugar	0	0	0	**2.85**	0.0
4	Bundaberg Passionfruit Sparkling Drink	**43.2**	11.5	11	**3.07**	-4.3
5	Schwepppes Lemon & Lime	9.3	3.7	4	**2.95**	8.1
6	Sprite Natural Flavour	12.3	4.9	5	**3.28**	2.0
7	RedBull Energy Drink	**27.0**	11	11	**3.55**	0.0
	Juices					
8	Cocobella Coconut Drink	11.8	4.7	6	5.51	27.7
9	Daily Juice Co Orange Juice	**41.0**	8.2	10	**3.97**	22.0
10	Just Juice Orange Juice	16.6	8.3	11	**3.88**	32.5
11	Lipton Peach Ice Tea	21.0	4.2	11	**3.06**	**161.9**
12	Berri Apple Juice	25.3	10.1	13	**3.51**	28.7
13	Nudie Orange	15.0	7.5	11	3.84	46.7
	Milk Flavoured					
14	Oak Strawberry Milk Shake	19.2	7.7	19	6.70	**146.8**
15	Woolworths Chocolate Milk	14.5	5.8	14	6.70	**141.4**
16	Woolworths Banana Milk	18.0	7.2	14	6.69	**94.4**
17	Milo Can	16.6	6.9	17	6.78	**146.4**

Table 1: Measured sugar content and acidity

These results are shown graphically in Figure 5 and 6.

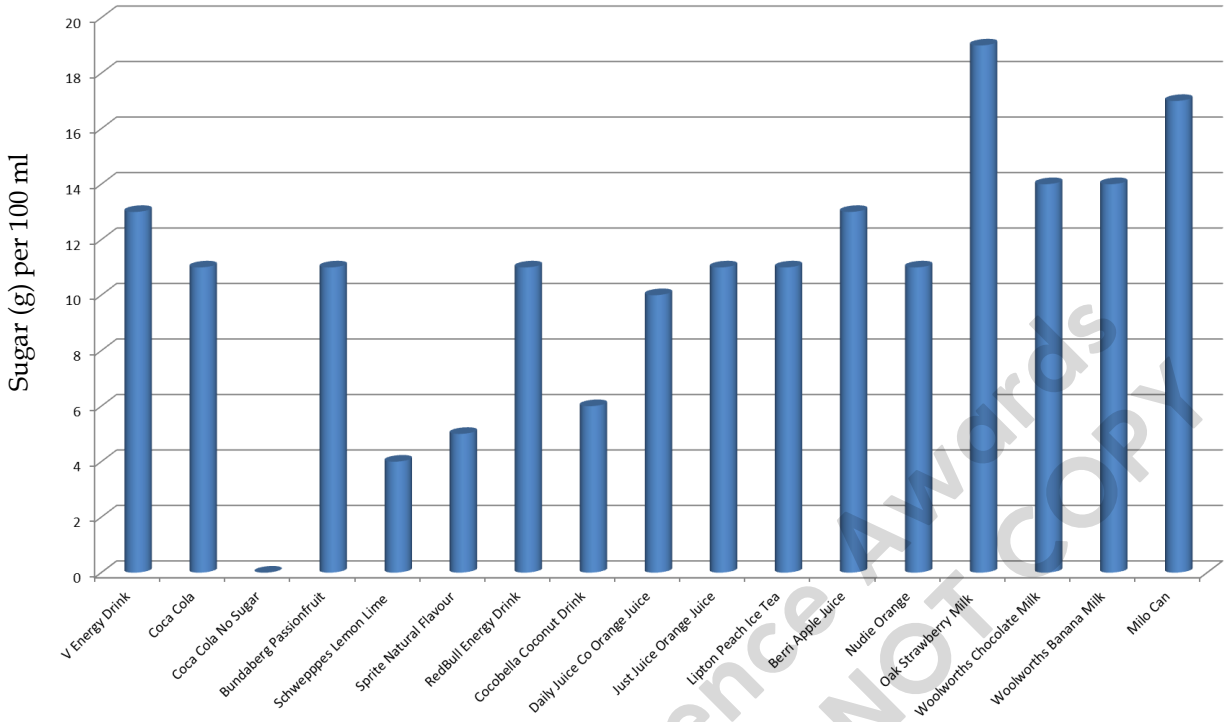


Figure 5: Measured sugar content (per 100 ml)

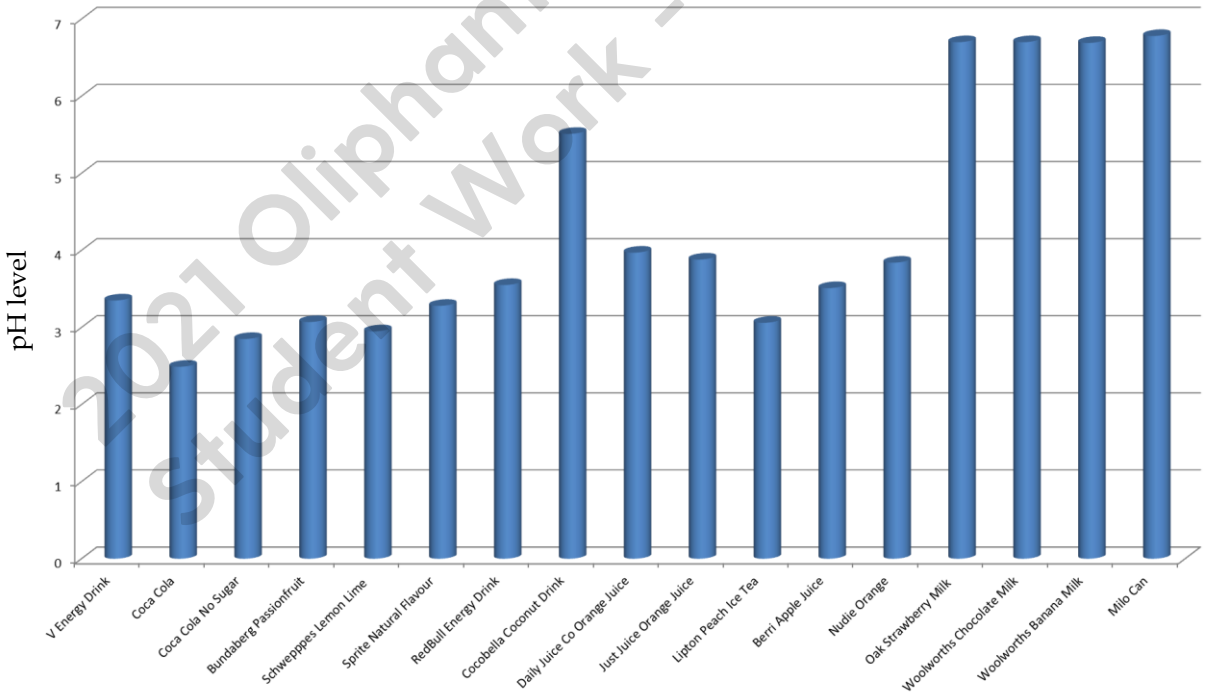


Figure 6: Measured pH levels

The average sugar content calculated for the three types of sugar drinks (soft drinks, juices and milk flavoured drinks) are shown in Table 2 and graphically in Figure 7.

Average sugar (g) per 100ml		
Soft drinks	Juices	Milk flavoured drinks
7.9	10.3	16.0

Table 2: Average measured sugar content

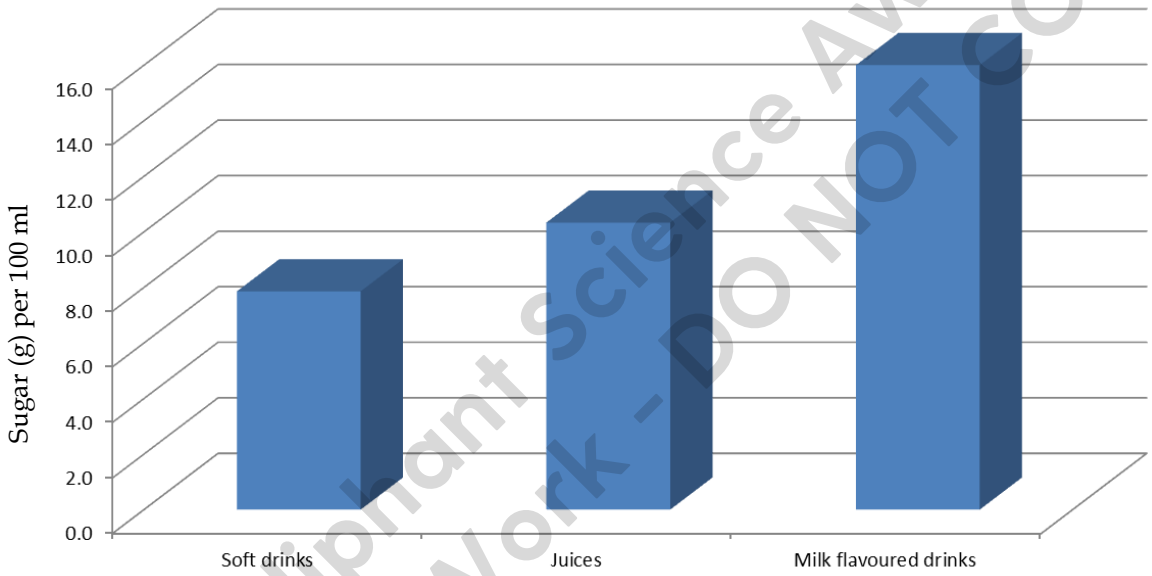


Figure 7: Average measured sugar content

The average pH level calculated for the three types of drinks (soft drinks, juices and milk flavoured drinks) are shown in Table 3 and Figure 8.

Average pH levels		
Soft drinks	Juices	Milk flavoured drinks
3.1	4.0	6.7

Table 3: Average measured pH levels

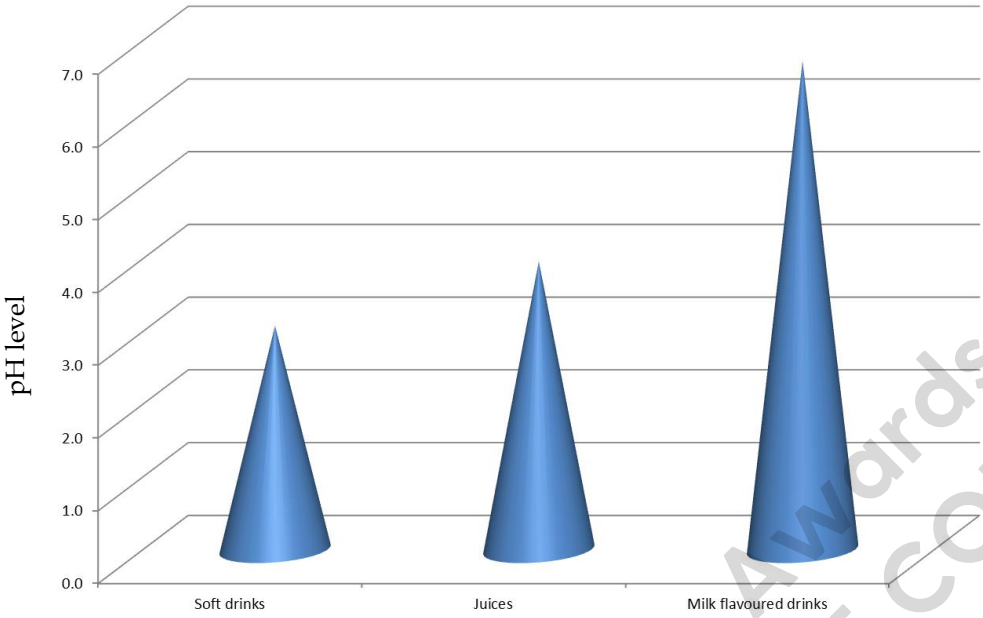


Figure 8: Average measured pH levels

4. The Egg Experiment

Eggshells and our teeth enamel have very similar chemical composition (calcium). A simple egg experiment was carried out to investigate the effects of sugary drinks on the teeth. For this experiment, two eggs with white shells were emptied by making a small hole. One eggshell was then put in a glass of Lemonade (sugary acidic drink) and other eggshell in drinking water (Figure 9).

Figure 9: Egg experiment

These were left for two weeks and the eggshells were inspected. The results are shown below in Figure 10.

Figure 10: Eggshells after 2 weeks

To see the strength of the eggshells the two eggshells were dropped (horizontally) onto our coffee table from a height of half a meter. The result is shown in Figure 11.

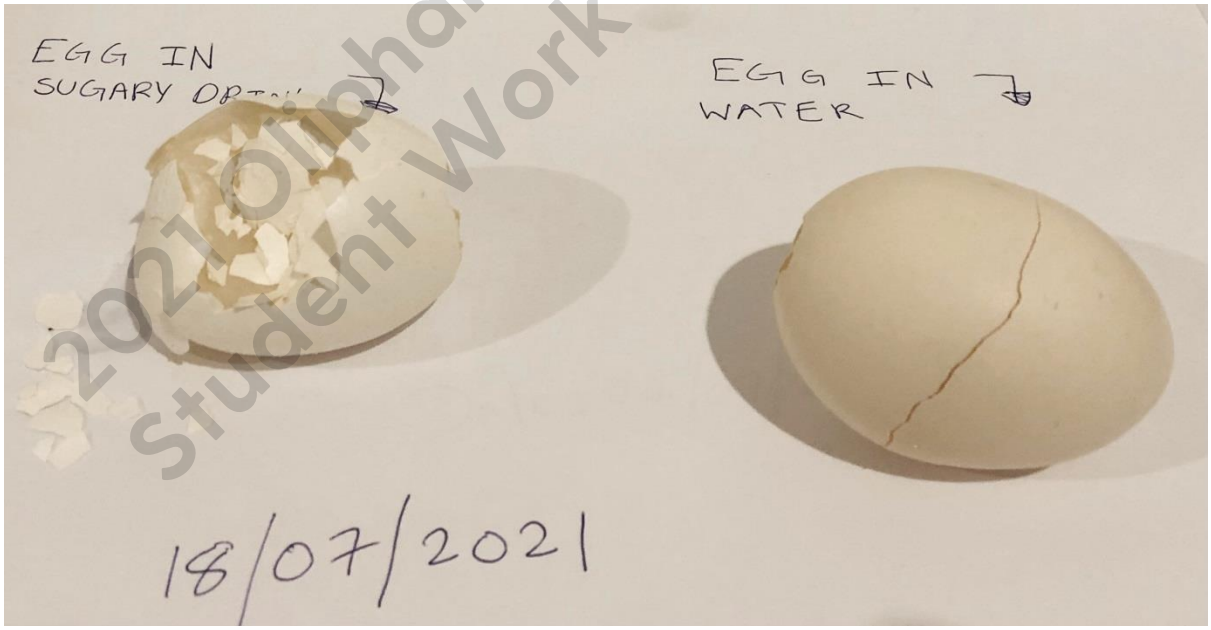


Figure 11: Condition of the eggshells after dropping

5. Discussions and Conclusions

This scientific inquiry investigated the sugar content and acidity of commonly available drinks. A simple experiment was also carried out to see the effects of sugary acidic drinks on our teeth. The main findings from this scientific inquiry are indicated below:

1. Most of the companies under reported the actual amount of sugar on the drink's label. For example, the sugar content (per 100ml) on the Lipton Peach Ice Tea label was 4.2g. The actual measured amount was 11g. The Oak Strawberry Milk Shake and Milo drink had twice more than the sugar amount reported on their labels (Table 1).

2. The milk flavoured drinks have the most sugar and the soft drinks have the least amount of sugar. Another shocking observation was that the juices had more sugar than the soft drinks. This may indicate that juices are less healthy than soft drinks. (Table 2 and Figure 7).

3. Many soft drinks and the Daily Juice Co Orange Juice had more sugar (in one serving) than the recommended daily sugar intake (for woman or man).

4. The results in Table 2 and Figure 8 show that the soft drinks and the juices were highly acidic while the milk flavoured drinks are within the safe pH level.

5. The egg experiment: After leaving the eggshells in sugary acidic drink and water for 2 weeks, the following observations were made:
    a. Egg in the sugary acidic drink: No colour change observed but the texture of the shell was very rough (see Figure 10).
    b. Egg in the water: No colour change observed and the texture was smooth as before (see Figure 10).
    c. When both eggshells were dropped, the one in the sugary acidic drink got cracked quite badly but only a small crack was seen on the egg in water (see Figure 11). This shows sugary acidic drinks can make our teeth weaker and brittle.

6. References

[1] Fact Sheet - What are the effects of consumption of high sugar drinks?, Australian Department of Health, Sept. 2014
https://www1.health.gov.au/internet/publications/publishing.nsf/Content/sugar-drinks-toc~sugar-drinks-3-fact-sheets~sugar-drinks-factsheet-3-2-effects-high-sugar-drinks

[2] Lindsay Boyers, What Are the Dangers of Acids in Carbonated Drinks?, Dec 2018
https://healthyeating.sfgate.com/dangers-acids-carbonated-drinks-12078.html

[3] What is a Brix Refractometer, and how do they work?, Oct. 2020
https://www.instrumentchoice.com.au/news/what-is-a-brix-refractometer-and-how-do-they-work

[4] Autumn Ryan, The pH Scale, Aseptic Health
https://asepticheath.com/education/what-does-it-mean-to-have-a-neutral-ph/

[5] Dr Surat P., pH in the human body
https://www.news-medical.net/health/pH-in-the-Human-Body.aspx

[6] Brian Oram, The pH of Water, Water Research Center
https://water-research.net/index.php/water-treatment/tools/the-ph-of-water

[7] The Nutrition Source, Added Sugar in the Diet, Harvard TH Chan
https://www.hsph.harvard.edu/nutritionsource/carbohydrates/added-sugar-in-the-diet/

7. Acknowledgments

I would like to thank my dad for purchasing the meters/drinks for this scientific inquiry and explaining to me how to write a good scientific report and how to put references in my report. I also would like to thank my mum and sister, Shanza for proof reading my report and suggesting improvements.

OSA RISK ASSESSMENT FORM

for all entries in (✓) ☐ Models & Inventions and ☑ Scientific Inquiry

This must be included with your report, log book or entry. One form per entry.

STUDENT(S) NAME: Shaya Ismail ID: _____

SCHOOL: Norwood Primary School

Activity: Give a brief outline of what you are planning to do.

I plan to measure and compare the sugar and pH levels in commonly available drinks and investigate the effects of these drinks on teeth.

Are there possible risks? Consider the following:

- Chemical risks: Are you using chemicals? If so, check with your teacher that any chemicals to be used are on the approved list for schools. Check the safety requirements for their use, such as eye protection and eyewash facilities, availability of running water, use of gloves, a well-ventilated area or fume cupboard.
- Thermal risks: Are you heating things? Could you be burnt?
- Biological risks: Are you working with micro-organisms such as mould and bacteria?
- Sharps risks: Are you cutting things, and is there a risk of injury from sharp objects?
- Electrical risks: Are you using mains (240 volt) electricity? How will you make sure that this is safe? Could you use a battery instead?
- Radiation risks: Does your entry use potentially harmful radiation such as UV or lasers?
- Other hazards.

Also, if you are using other people as subjects in an investigation you must get them to sign a note consenting to be part of your experiment.

Risks	How I will control/manage the risk
No risks	Sugar and pH levels will be measured using battery powered meters. Egg shells will be used to study the effects of the sugary drinks on teeth.

(Attach another sheet if needed.)

Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): Shaya Ismail

SIGNATURE(S): Shaya

☑ By ticking this box, I/we state that my/our project adheres to the listed criteria for this Category.

TEACHER'S NAME: _____

SIGNATURE: _____ DATE: _____

Scientific Inquiry: Sugars and Acids!
How healthy are our drinks?

My Log-Book

15/06/2021

(Shaya's)
LogBook

Date: / /
Page:

15/06/2021

Aim 1: Measure sugar content in drinks.

Aim 2: Measure acidity of the drinks

Aim 3: Do the egg experiment to find effect of sugary acidic drinks on our teeth

---

- Plan -

- Do research on internet (find good websites.).
- Find good drinks for the Inquiry from the Woolworths website and ask Dad to buy the drinks.
- Go on a hunt for eggs with white shells. (Woolworths and Coles DO NOT have these). ② ② - eggs

Date: . .
Page:

18/06/2021

Find the special instruments to measure the Sugar and Acidity of the drinks.

- A Refractometer can be used to measure sugar. (www.instrumentchoice.com.au/news/what-is-a-brix-refractometer-and-how-do-they-work)

⇓

Need to find more info on Refractometers. (Dad might know about Refractometers 😉?

A pH meter is used to measure ~~to~~ the acidity in drinks. (en.wikepidia.org/wiki/PH_meter)

FOUND A REFRACTOMETER FOR $25 ON EBAY
ALSO FOUND A PH METER FOR $0 ON EBAY.

⇓

TODO: Ask Dad or Mum to buy these 2 meters.

Date:
Page:

19/06/2021

Dad bought and ordered the 2 meters. [redacted] (!!)

Do research to find effects of sugar and acidic drinks on our health.

[redacted] RESEARCH LINKS [redacted]

Some of the good websites I found:

- What are the effects of consumption of high sugar drinks. Available in WWW.1.health.au
(Search on google finding this title to this link.)
[Do same for other websites] —— (1)

- What are the dangers of Acids in carbonated drinks
(healthyeating.sfgate.com) —— (2)

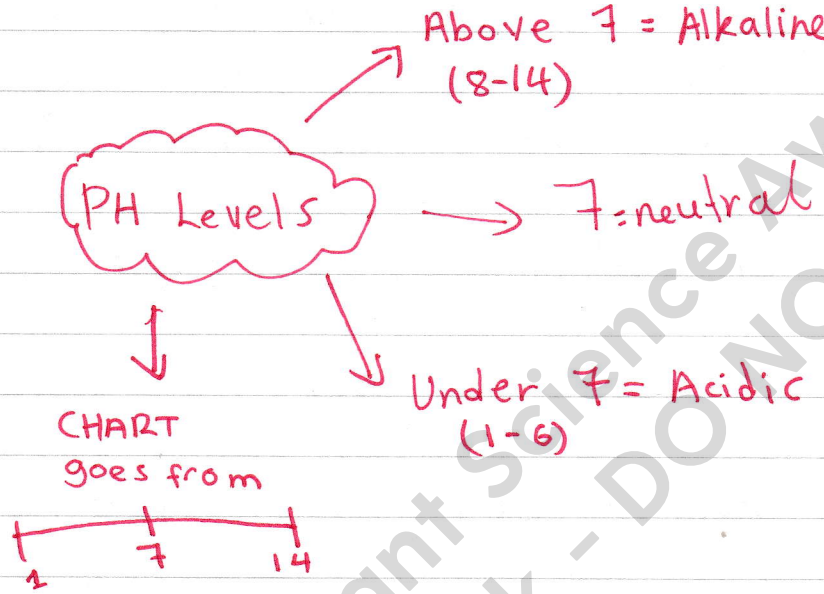
- PH in the human body by Dr Surat.P
(www.news-medical.net) —— (3)

- The Nutrition Source, Added Sugar in the Diet
(www.hsph.harvard.edu) HARVARD UNIVERSITY
—— (4)

- pH in Drinking Water
WHO.int (World health Organisation)
REMEMBER: TYPE THE TITLE OF THE WEBSITE TO FIND THE EXACT LINK. ∀?! —— (5)

22/06/2021

Important Information from Links.



SAFE PH LEVEL
6.5 - 8.5

SAFE SUGAR AMOUNT (PER DAY)

- 24g for MOST Women. [24g = 6 teaspoons]
- 36g for MOST men. [36g = 9 teaspoons]

Note: 4g = 1 teaspoon of sugar.

Date:
Page:

3/07/2021

Hunt for white eggshells

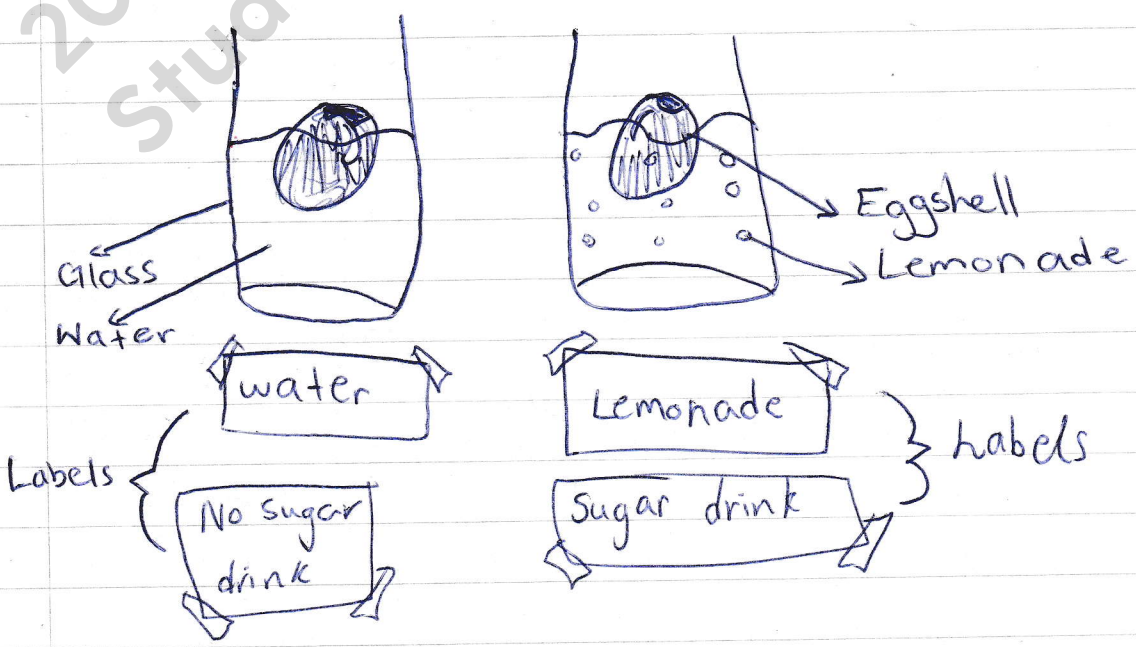
★ Could not find White eggs at the egg shop 😐.
- Is it Easter? [redacted]
★★ Went to Central Market. Hooray!! Found eggs at a stall called Happy little clucker, the manager let me pick out all the white chicken eggs into half a carton. They literally cut the carton in half! At least it was half the price too! Cut a hole on top of egg to let liquids go. Put to dry.

4/07/2021

The egg experiment

Today we did the egg experiment!

- Got Schweppes Lemonade
- Got normal water
- Filled two glasses with one of each liquid.
- Dunked empty eggshells into both glasses.



Date: . .
Page:

11/07/2021

We bought 17 different drinks

Sugar and acidity Test results

① V energy drink on label	Energy Per serving is 492kj	Sugars per serving 26.4g	Energy Per 100 ml 147kj	Sugar per V ml 100 10.6g	
V energy drink measured	PH is 3.35	Brix is 13			
② Cocobella coconut water on label	Energy Per serving is 238kj	Sugars Per Serving 11.8g	Energy Per 100 ml 95 kj	Sugar Per 100 ml 4.7g	
Cocobella coconut water measured	PH is 5.51	Brix is 6			
③ Coca cola on label	Energy per serving 450kj	Sugars Per serving 27g	Energy per 100ml 180kj	Sugar per 100ml 10.6g	
coca cola measured	PH is 2.49	Brix is 11			
④ Coca cola no sugar on label	Energy Per serving 3.5kj	Sugar Per serving 0g	Energy Per 100 ml 1.4kj	Sugar Per 100ml 0g	Coca cola no sugar measured
	PH is 2.85	Brix is 0			

Date:
Page:

11/07/21

5. Bundaberg Passionfruit Sparkling drink
on label

Energy per serving
~~135~~ kj

Sugar per Serving
~~43~~.2g

Energy per 100ml = 184kj

Sugar per 100ml
11.5g

5. Bundaberg Passionfruit sparkling drink
measured

PH is
3.07

Brix is
11

6. Schweppes Lemon and Lime with natural mineral water
~~on label~~

Energy per ~~100~~ serving
188kj

Sugar per serving
9.3g

Energy per 100ml
75kj

Sugar per 100ml

6. Schweppes
measured

PH is
2.95

Brix is
4

7 Sprite Natural flavour
on label

Energy Per serving

Sugar Per serving

Energy Per 100ml

Sugar per 100ml

Sprite Natural
measured

PH is
3.28

Brix is 5

8. Redbull Energy drink

Brix is
11

PH is
3.55

485 kj Energy Per Serving

Sugar Per Serving
27g

Energy Per 100ml
194kj

Sugar per 100ml
11g

Date:
Page:

11/07/21

	Name	Energy Per Serve	Sugar per serve	Energy per 100ml	Sugar per 100ml	Brix	pH
9.	Daily Juice Co OJ	835kj ~~383kj~~	41g	167kj	8.2g	10	3.97
10.	Lipton Peach Ice Tea	383kj ~~468kj~~	21g	77kj	4.2g	11	3.06
11.	Berri Apple Juice	468kj ~~334kj~~	3g	187kj	10.1g	13	3.51
12	Nudie OJ	~~787kj~~ 334kj	15g	167kj	7.5g	11	3.84
13.	Oak strawberry milk	~~584kj~~ 787kj	19.2g	315kj	7.7g	19	6.~~78~~
14.	choc milk	589kj ~~680~~	14.5g	235kj	5.8g	14	6.7
15	Banana milk	579kj	18g	231kj	7.2g	14	6.69
16.	Milo	680kj	16.6g	285kj	6.9g	17	6.78
17.	Just Juice	336kj	16.6g	168kj	8.3g	11	3.88

Date: . .
Page:

11/07/2021

- Discuss with dad the structure of report.

=STRUCTURE OF THE REPORT=

→ Introduction
→ Harmful effects of sugar and acids.
→ Safe levels of acids and sugar
→ Results
→ Analysis of results
→ Egg experiment
→ Discuss results
→ conclusions
→ Acknowledgments

Note:
Remember to use formal/ big words.

Start writing the report befor the egg experiment finishes.

DAD^HELP TIPS

Get help from Dad to plot bar charts from Excel.

Also ask him what ~~the~~ Document ~~Softw~~ uses for his scientific Articles.

Date: . .
Page:

12/07/21

- Some interesting results from the measurements.

1. Tons of companies under reported!! Lipton peach Label 4.2g, Real 11g!! Oak and Milo both had double the amount of sugar written on the label

2. The milk flavoured drinks have the most sugar and the soft drinks have the least amount of sugar.

3. The Juice had more sugar than the soft drinks!!

4. Many soft drinks and Daily Juice OJ had more sugar (in 1 serving) than the daily intake for both a woman and a man.

5. The results show that the soft drinks and juices ~~where~~ were highly acidic while the milk was inside the safe pH ~~for~~ level.

6. CONCLUSION:
SOME VERY SHOCKING RESULTS.

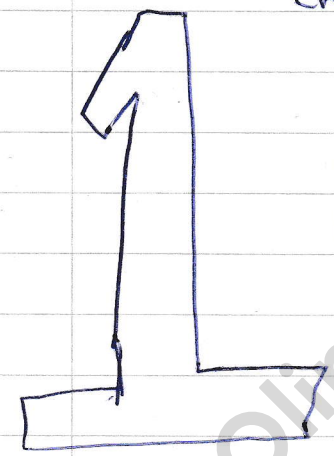
Date: . .
Page:

18/07/2021

Give the first draft to my family for some Family Feedback.

Egg Experiment final

* The egg in water had a slight ~~fault~~ colour change but was otherwise smooth.



* The egg in Lemonade had no colour change but was rough and delicate.

* When I dropped the eggshells ~~Lemonade~~

LEMONADE ONE: Big circular smash in the middle.

WATER ONE: 1 small crack in the middle.

CONCLUSION: EGG EXPERIMENT SUCCESSFUL!

NOTE: Write in report