

Comparing Sugar Content between Tea & Soda (Per 8 Ounces)

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I. Abstract

This study identified Teas as a possible healthier alternative to Sodas due to Teas' average lower sugar content in grams per 8 ounces. I hypothesized that on average Teas would contain fewer grams of sugar per 8 ounces than the average Soda contains in 8 ounces. The populations studied were 32 different brands and flavors of Teas and 32 different brands and flavors of Sodas by means of simple random sampling. The results revealed that on average, Teas contained 11.6g of sugar per 8 ounces and on average Sodas contained 26.6g of sugar per 8 ounces. The alternative hypothesis stating that $H_a = \mu_1 < \mu_2$; $\mu_1 = \text{Teas}$ $\mu_2 = \text{Sodas}$ was confirmed after performing a two-sample nonpooled t-Test, the null hypothesis was rejected.

II. Introduction

This study aims to compare the average sugar content levels between Teas and sodas in grams per 8 ounces. By doing so, I will identify the problem as to whether the average sugar content differs between these two beverages. Some people believe drinking tea is healthier than soda due to its lower sugar content. In fact, according to Harvard T.H. Chan: School of Public Health, cutting back on sugary drinks may help control your weight and lower your risk of developing type II Diabetes. I am interested to discover whether teas on average contain less sugar than sodas, which would indicate a healthier beverage option. Therefore, I hypothesize that on average, Teas contain less sugar in grams per 8 ounces than sodas do per 8 ounces.

III. Data Collection Methodology

Data collected for this study was gathered at random from my local King Soopers Market (8031 Wadsworth Blvd, Arvada, CO 80005) on December 12, 2017. I simply went to the beverage section of the store and proceeded to record brands, flavors, and sugar contents in grams per serving for 32 teas and 32 sodas as I saw them on the shelves. I first recorded sugar in grams per serving, number of servings per container and/or total ounces in container. Amongst all the teas and sodas, I had used for my data, I realized there were extreme variations in serving sizes and container sizes, and thus would not allow for an accurate comparison. Therefore, I converted all teas and sodas to grams per 8 ounces. For example: Tea 20g Per 16oz. $\rightarrow 16\text{oz.}/2=8\text{oz.}$ therefore, $20\text{g}/2=10\text{g}$ Per 8 ounces. This eliminated any unwanted variables, and left only one (type of beverage).

IV. Data Analysis

Summary statistics:

Column	Mean	Std. dev.	Min	Q1	Median	Q3	Max	Range
Tea's Grams of sugar Per 8 oz.	11.6	5.8	0	6	11.4	15.5	23.5	23.5
Soda's Grams of sugar Per 8 oz.	26.6	3.1	17.6	25.3	27.1	28.8	30.8	13.2

Frequency table results for Tea's Grams of sugar Per 8 oz.:

Count = 32

Tea's Grams of sugar Per 8 oz.	Relative Frequency
0	0.03125
5	0.09375
6	0.15625
7	0.03125
8.296	0.0625
10	0.03125
10.888	0.0625
11.429	0.125
13.333	0.03125
14	0.03125
15	0.09375
16	0.03125
17	0.03125
18.162	0.03125
19	0.0625
19.5	0.03125
22	0.03125
23.5	0.03125

Frequency table results for Soda's Grams of sugar Per 8 oz.:

Count = 32

Soda's Grams of sugar Per 8 oz.	Relative Frequency
17.6	0.03125
18.4	0.03125
23.333	0.0625
23.6	0.03125
24.8	0.03125
25.2	0.0625
25.333	0.03125
25.6	0.0625
26	0.125
26.667	0.03125
27.6	0.0625
28	0.125

Soda's Grams of sugar Per 8 oz.	Relative Frequency
28.4	0.03125
28.8	0.0625
29.2	0.0625
30	0.0625
30.4	0.03125
30.8	0.0625

Variable: Tea's Grams of sugar Per 8 oz.

Decimal point is 1 digit(s) to the right of the colon.

Leaf unit = 1

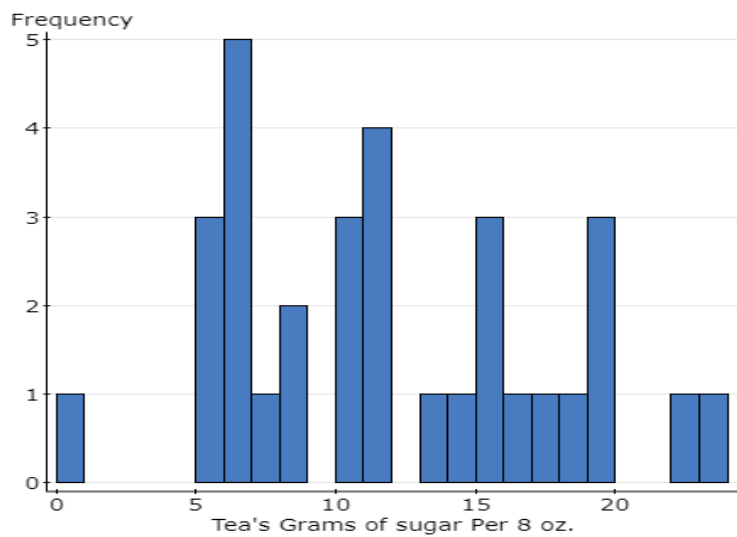
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1 : 011111134
1 : 55567899
2 : 024

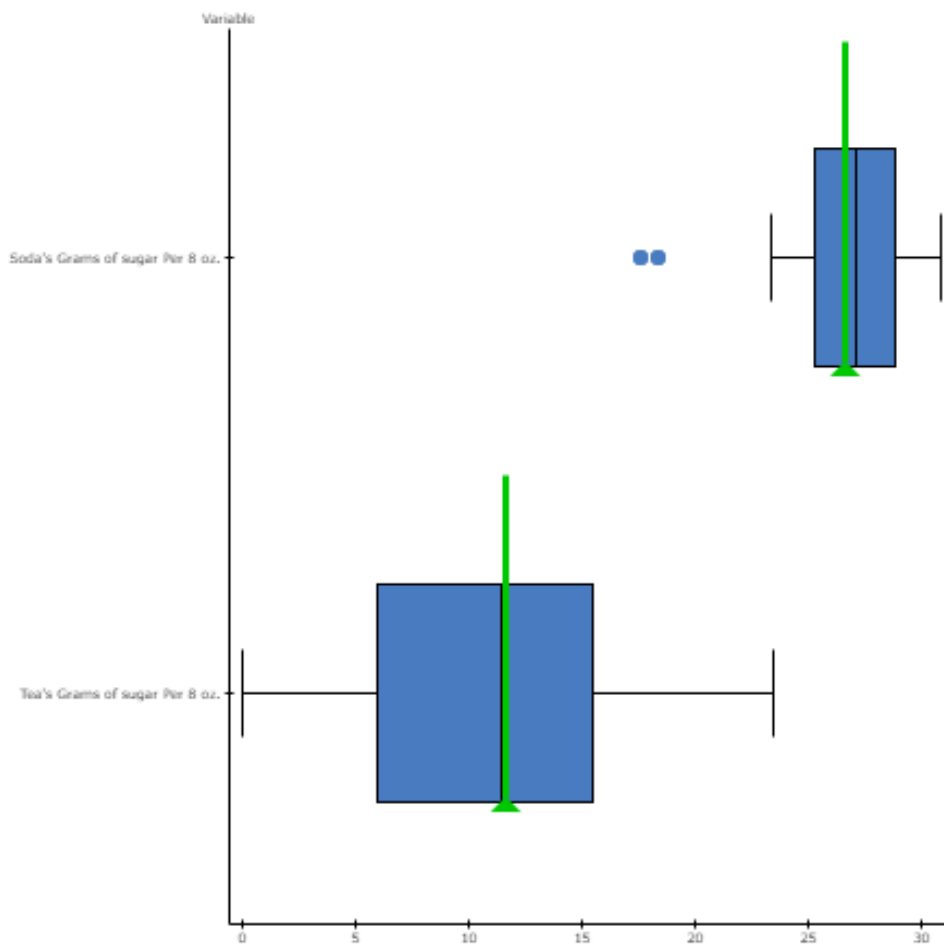
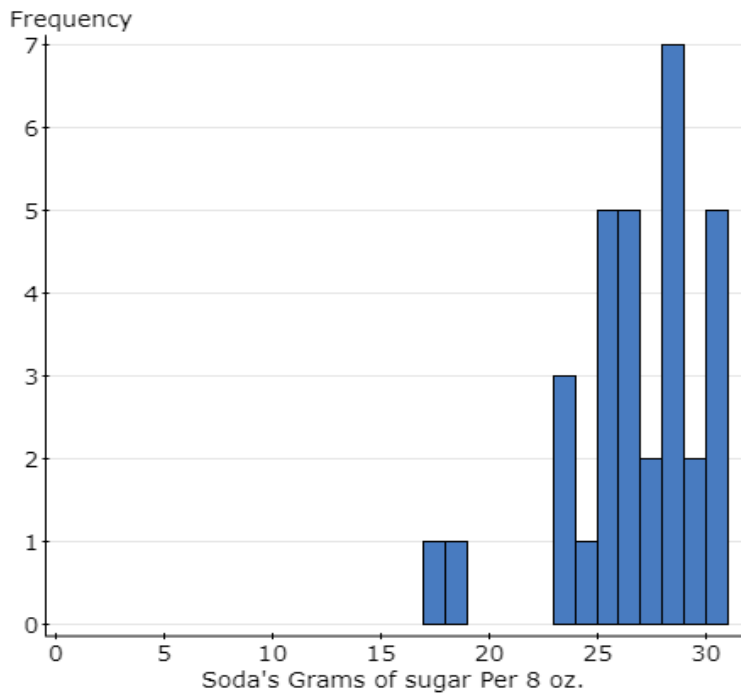
Variable: Soda's Grams of sugar Per 8 oz.

Decimal point is 1 digit(s) to the right of the colon.

Leaf unit = 1

1 : 88
2 : 334
2 : 5555666666788888889999
3 : 00011





d. Percentage of observations that fall within 1,2 and 3 standard deviations of the mean:

Tea- 1 Std. Dev. (5.8,17.4) → 25/32= 78.13% (Rounded)

2 Std. Dev. (0,23.2) → 31/32= 96.88%

3 Std. Dev. (-5.8, 29) → 32/32= 100.00%

Soda- 1 Std. Dev. (23.5,29.7) → 21/32= 65.63% (Rounded)

2 Std. Dev. (20.4,32.8) → 30/32= 93.75%

3 Std. Dev. (17.3,35.9) → 32/32= 100.00%

e. Conclusions drawn from Data Analysis

In the introduction, I hypothesized that on average Teas contained less sugar in grams per 8 ounces. Based on the above, the data appear to support my proposed hypothesis. With regards to n=32 different brands and flavors of Teas, mean (average) grams of sugar per 8oz = 11.6g, range =23.5g, min = 0g, Q1= 6g, Q2 = 11.4g, Q3 = 15.5g and max = 23.5g. With regards to n = 32 different brands and flavors of Sodas, mean = 26.6g, range = 13.2g, min = 17.6g, Q1 = 25.3g, Q2 = 27.1g, Q3 = 28.8g, and max = 30.8g. The summary statistics based on the randomly selected confirm that the average Tea (11.6g) contains less sugar than the average Soda (26.6g), even though Teas range (23.5g) and Std. deviation (5.8g) is larger than that of Sodas' range (13.2g) and Std. deviation (3.1g). In fact, 6 out of the 8 statistics for Teas are actually lower than Sodas (Mean, Std. dev., Min., Q1, Q2, Q3, and Max).

After examining the frequency histogram and boxplots for each sample population, I concluded that Teas data was unimodal and right-skewed/ slightly symmetrical (Mean 11.6g > Median 11.4g) and Sodas data was unimodal and left-skewed (Mean 26.6g < Median 27.1g). That is, both sample populations have a single data value that occurred with a high frequency, Teas 6g, and Sodas 28g.

V. Inferential Statistics

a. One sample Z confidence interval:

μ : Mean of variable

Standard deviation not specified.

95% confidence interval results:

Variable	n	Sample Mean	Std. Err.	L. Limit	U. Limit
Tea's Grams of sugar Per 8 oz.	32	11.643094	1.0166891	9.6504198	13.635768

We can be 95% confident that the mean sugar content in grams per 8 ounces in Teas is between 9.6504198 g and 13.635768 g. The mean of 11.6 g (rounded) is found between the lower limit and the upper limit. Conclusively, we can be 95% confident that the true population mean lies within the confidence interval of the sample mean.

One sample Z confidence interval:

μ : Mean of variable
Standard deviation not specified.

95% confidence interval results:

Variable	n	Sample Mean	Std. Err.	L. Limit	U. Limit
Soda's Grams of sugar Per 8 oz.	32	26.633312	0.54981746	25.55569	27.710935

We can be 95% confident that the mean sugar content in grams per 8 ounces in Sodas is between 25.55569 g and 27.710935 g. The mean of 26.6g is found between the lower limit and the upper limit. Conclusively, we can be 95% confident that the true population mean lies within the confidence interval of the sample mean.

b. Two-Sample Hypothesis Test:

My proposed hypothesis was that on average, Teas contain less sugar in grams per 8 ounces.

Null Hypothesis: Teas and Sodas have equal amounts of sugar in grams per 8 ounces.

$$H_0 = \mu_1 = \mu_2$$

Alternative Hypothesis: Teas on average, contain fewer grams of sugar per 8 ounces.

$$H_a = \mu_1 < \mu_2 \quad \mu_1 = \text{Teas} \quad \mu_2 = \text{Sodas} \quad \text{Left-tailed}$$

Nonpooled t-Test

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Two sample T hypothesis test:

μ_1 : Mean of Tea's Grams of sugar Per 8 oz.
 μ_2 : Mean of Soda's Grams of sugar Per 8 oz.
 $\mu_1 - \mu_2$: Difference between two means
 $H_0 : \mu_1 - \mu_2 = 0$
 $H_A : \mu_1 - \mu_2 < 0$
 (without pooled variances)

Hypothesis test results:

Difference	Sample Diff.	Std. Err.	DF	T-Stat	P-value
$\mu_1 - \mu_2$	-14.990219	1.1558356	47.703611	-12.969162	<0.0001

Based on a significance value of 5% ($\alpha = 0.05$) and a P-value of <0.0001, $P < \alpha$. I reject my null hypothesis of $H_0 = \mu_1 = \mu_2$. Therefore, $H_a = \mu_1 < \mu_2$. At a 5% significance level, the data do provide sufficient evidence that the mean sugar content in grams per 8 ounces was less for Teas than Sodas. The nonpooled t-Test supports the data analysis, in that the mean sugar content in grams per 8 ounces in Teas (11.6g) was less than the mean sugar content in grams per 8 ounces in Sodas (26.6g). At a 5 % significance level, I rejected the null hypothesis.

VI. Conclusions

This study that aimed to compare the average sugar contents per 8 ounces in Teas versus Sodas, revealed that Teas contained fewer grams of sugar in 8 ounces than did Sodas in the same amount. The average sugar content in Teas was 11.6g, whereas the average sugar content in Sodas was 26.6g, thus supporting the alternative hypothesis $H_a = \mu_1 < \mu_2$; After further statistical analysis such as performing a two-sample nonpooled t-Test, the null hypothesis was ultimately rejected. As mentioned earlier in this study, consuming high levels of sugar may lead to unstable weight patterns and increase a person's risk of developing type II Diabetes. Sodas and Teas are popular beverages in the United States, and by examining which beverage contains less sugar heightens consumer awareness and may further motivate them to be more health conscious.

References

“Healthy Drinks.” *The Nutrition Source*, Harvard T.H. Chan School of Public Health, 7 Oct. 2013, www.hsph.harvard.edu/nutritionsource/healthy-drinks/.

King Soopers
8031 Wadsworth Blvd, Arvada, CO 80005

TNN. “Food Fight: Which is More Unhealthy? | Health.” *IDiva.com*, IDiva, 8 June 2013, www.idiva.com/photogallery-health/food-fight-which-is-more-unhealthy/22713.

Data included on following page.

Tea	Tea's Grams of sugar Per 8 oz.	Soda	Soda's Grams of sugar Per 8 oz.
Inko's Organic White "Honey dew"		6 Reg. Pepsi	27.6
" "White Peach"		6 Reg. Dr. Pepper	25.6
" "Blueberry"		6 Reg. Coke	26
" "Apricot"		6 Mexican Pepsi	26
" "Original with Ginger"		6 Mexican Coke	26
Sweet Leaf "Mint & Honey"	15	Reg. Mtn. Dew	30.8
" "Half & Half"	22	Mexican Sprite	26.667
" "Peach"	19	Fanta "Orange"	29.2
" "The Original"	19	Reg. Sprite	25.6
ArgoTea "Mojitea"	8.296	Coke "Cherry"	28
" "Carolina Honey"	8.296	Pepsi "Cherry"	28
" "Hibiscus Tea Squeeze"	14	Pepsi "Salted Caramel"	17.6
Moonshine Sweet Tea "Mint & Honey"	15	Mtn. Dew "Throwback"	29.2
" "The Original"	15	" "Code Red"	30.8
Honest Tea "Pomegranite Blue Flavored Herbal Tea"	10.888	" "Pitch Black"	30
" "Half Tea & Half Lemonade"	10.888	" "Voltage"	30.4
Holy Kombucha "Hibicus Sangria"	7	" "Tropical Smash"	18.4
" "Prickly Pear"	5	Crush "Orange"	28.4
" "Green Apple Ginger"	5	Sunkist "Orange"	28.8
" "Blood Orange"	5	Seven Up "Chery"	24.8
PureLeaf "Valencia Orange Peel"	11.429	" "Regular"	25.2
" "Fuji Apple & Ginger"	11.429	Canada Dry "Ginger Ale"	23.6
" "Sicillian Lemon & Honey Suckle"	11.429	Squirt	25.2
" "Wild Blackberry & Sage"	11.429	A&W "Rootbeer"	30
" "Unsweetened Black Tea"	0	Dr. Pepper "Cherry"	27.6
" "Sweet Tea"	18.162	Jones "Berry Lemonade Soda"	25.333
Xing Tea "Green Tea & Ginseng & Honey"	16	" "Cream Soda"	23.333
Arizona "Green Tea With Ginseng & Honey"	17	" "Green Apple Soda"	26
Snapple "Peach Tea"	19.5	" "Orange Cream Soda"	23.333
" "Snapple Apple"	23.5	" "Grape Soda"	28
Brisk Iced Tea "Lemon"	13.333	Monster "Mutant Green Soda"	28
Steaz "Iced Green Tea"	10	" "Red Dawn"	28.8