**Bubbleology Lab Report By Marcus Stevens and Jacob Warden September 8, 2015**

1. Introduction

In this experiment, dish soaps were tested on both their cleaning power and cost effectiveness, so a consumer can decide which soap to buy corresponding with their own needs. Four different soaps were tested during this experiment for their cleaning power, measured by the diameter of the bubble created by the dish soap. The cleaning power was tested by blowing a bubble on the table through a straw; the larger the bubble diameter the greater the cleaning power.

**The purpose:** The purpose behind this experiment is to find the most cost effective dish soap by utilizing a process through which the diameter of the bubbles of each dish soap are measured.

**The** **hypothesis:** When four soaps are tested for their cleaning power, the different brands of soap will have an insignificant impact/effect on the size of the bubble diameter.

1. Materials and Methods (Procedure)

**Materials:**

1. One 10ml pipet.
2. One 250ml beaker.
3. One graduated cylinder.
4. Four brands of dishwashing soap. Ajax, Dawn Pure, Ivory Ultra, and Gain Hawaiian Aloha.
5. One straw.
6. One measuring stick or ruler.
7. A flat surface to blow bubbles on.

**Procedure:**

1. 2ml of dish washing soap is measured using a pipet and is later transferred into a 250ml beaker by releasing the plunger button connected to the pipet.
2. Using a graduated cylinder, 100ml of tap water is measured and later poured into the same 250ml beaker that contains the 2ml of soap.
3. When both the 2ml of dish soap and the100ml of water are thoroughly mixed together in the 250ml beaker, 10ml of that solution is derived from the beaker by the pipet. The solution is then expressed from the pipet onto the table by pressing the plunger button, therefore the solution can be spread evenly throughout the surface of the table.
4. After spreading the solution on the table to make a consistent filmy area, dab a straw into the excess soap/water solution and touch the surface of the filmy solution on the table with the straw. When air is blown through the straw, a bubble will appear; note that the straw should be held at a 45 degree angle to get the best results.
5. When the bubble pops, measure the diameter of the bubble’s ring with a ruler in centimeters. If the ring is not a perfect circle, the diameter is measured multiple times (preferably 3) and averaged together.
6. Repeat this procedure at least 5 times for each of the 4 brands of soap and then average the data for each of the soap’s trials.
7. The data is recorded on an appropriate data table and graphed on two separate graphs. One is labeled Cost efficiency and the other graph is labeled Best Cleaner.
8. Results

**Graphs and Tables:**

**Data Table 2: Cost Efficiency**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Soap** | **Cost of Soap** | **ML’s per bottle of soap** | **Avg. Ring Diameter** | **Cost Efficiency** |
| Ajax | $1.87 | 828ml per bottle | 27.2cm | 12.04 cm/cent |
| Dawn Pure | $2.48 | 638ml per bottle | 19.7cm | 5.07 cm/cent |
| Ivory Ultra | $2.67 | 709ml per bottle | 28.2cm | 7.49 cm/cent |
| Gain Hawaiian Aloha | $1.97 | 709ml per bottle | 27.15cm | 9.77cm/cent |

**How** **to** **find** **Cost** **Efficiency**: 1 bottle of cleaner/bottle’s cost x ml’s/1bottle x ring diameter/ml’s used to create the bubble (10ml) = **Cost** **efficiency**

**Work to get the soaps’ Cost Efficiency:**

**Ajax:** 1 bottle/187 cents x 828ml/1bottle x 27.2cm/10ml = 22,521.6/1,870 = 12.04 cm/cent = **Cost Efficiency**

**Dawn Pure:** 1 bottle/248 cents x 638ml/1 bottle x 19.7cm/10ml = 12,568.6/2,480 = 5.07 cm/cent = **Cost Efficiency**

**Ivory Ultra:** 1 bottle/267 cents x 709ml/1 bottle x 28.2cm/10ml = 19,993.8/2,670 = 7.49 cm/cent = **Cost Efficiency**

**Gain Hawaiian Aloha:** 1 bottle/197 cents x 709ml/1 bottle x 27.15cm/10ml = 19,249.35/1,970 = 9.77 cm/cent = **Cost Efficiency**

**The ANOVA Calculations:**

To generate a proper analysis and deeper understanding of the null hypothesis, the ANOVA program was used. The program analyzes the data recorded to show the statistical probability on whether the null hypothesis is most likely true or false. The ANOVA program produces a P-value. The P-value is a measure of the strength of the evidence that goes against the null hypothesis. It also indicates whether there is enough evidence to express the hypothesis as either a true or false statement. The P-value will be .05 or above if there is a somewhat reasonable chance that the null hypothesis can be classified as correct. If the P-value is under .05, the null hypothesis is incorrect.

The data in this experiment was put through the ANOVA program to calculate the P-value. The program expressed the **P-value** as **0.001132**, **not** above **0.05**. This shows that the null hypothesis is extremely likely to be false in this experiment.

1. Conclusion

**Data evaluation:**

It was hypothesized that when four soaps are tested for their cleaning power, the different brands of soap will have an insignificant impact/effect on the size of the bubble diameter. This hypothesis, however, was debunked, as the data clearly shows. All four different brands of soap made four different averages in bubble diameter during this experiment. If the null hypothesis was true, this would not be the case and all bubble diameter averages would have been consistent throughout each brand of dish soap tested. If the averages are not convincing enough, then just analyze the ANOVA statistics. The ANOVA program provided a P-value of only 0.001132, which indicates that the probability of the null hypothesis being true is next to none.

The Cost Efficiency would have delegitimized the null hypothesis as well, but the four brands did not have the same quantity of soap in one container. That is why the cost efficiency could not have been used in this case to disapprove the hypothesis.

According to the data recorded, the best soap for its cleaning power ability was the Ivory Ultra with an average diameter of 28.2cm. The Ajax, however, had an exceptional cost efficiency of 12.04 cm/cent that is 2.27cm/cent above the closest competitor. The Ajax also came in second place with an average diameter of 27.2cm. This brand was also recorded as the cheapest dish soap to buy. The data recorded definitely sways in the favor of Ajax as the best overall soap in the categories tested during this experiment. This is most likely true in the case of cleaning power because of the types of ingredients Ajax is made with. The ingredients might have caused the water to have a higher surface tension, which will eventually result in a bubble becoming even larger than it was before the soap was applied.

With regard to the procedure and materials, there is not much to be changed besides a few minor things, such as the ml’s of soap per bottle. The brand’s containers should all hold a consistent amount of soap within them so that the cost efficiency can contribute to the analysis of the null hypothesis. Otherwise, this is considered as a limitation and it will not do its part in the experiment to its full potential.

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