Effects of Household vs Commercial Cleaning Agents on Stain Similarity % using ΔE

Research question and Variables

Question

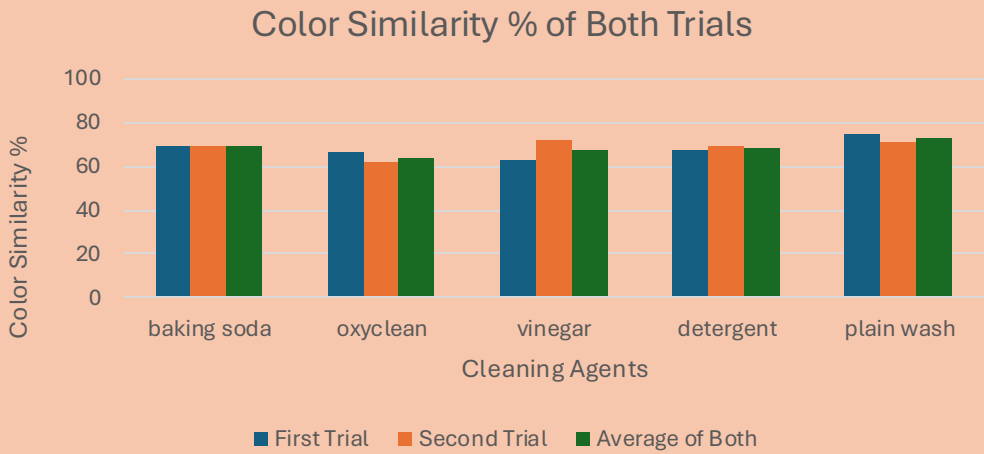
household vs commercial products in the removal percentage of a stain

Variable

Independent variable: Use of household vs commercial stain removal products

Dependent variable: The similarity percentage

Data Analysis and Results



Procedure

1. Staining agents were applied to cloth
2. The cloth was left to dry
3. Various cleaning methods were enacted
4. The cloth was left to dry
5. Data was collected from the images

Conclusion

Oxyclean was the best cleaning agent overall having an average color similarity of 64.05%. However, vinegar is a viable alternative with only a 3.39% difference between the two.

Stains

What are stains

- A dirty mark on something. (Cambridge Dictionary)
- Can result from household liquids, e.g., coffee

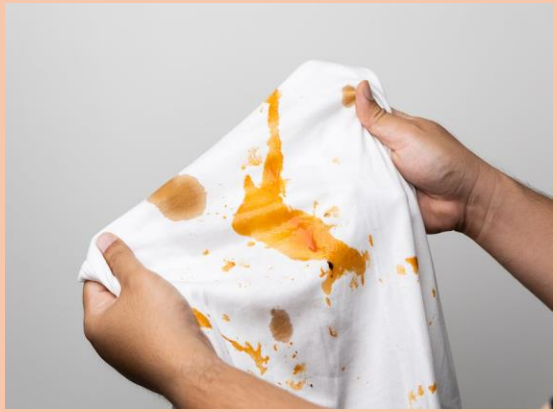


Photo Credit: Ingredientsmatter.com

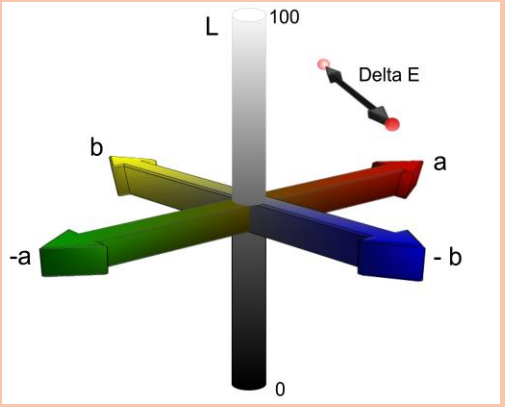
Why they are hated

- Ruins the aesthetic, financial, and reminiscent value of clothing
- Can leave odd smells with clothing
- Can change the texture of clothing

Delta E (ΔE)

What is ΔE?
(Viewsonic.com)

- Delta E is a standard measurement — created by the Commission Internationale de l'Eclairage (International Commission on Illumination) — that quantifies the difference between two colors that appear on a screen.



How is ΔE measured?
(Viewsonic.com)

- measured on a scale from 0 to 100, where 0 is less color difference, and 100 indicates complete distortion
  - <= 1.0: Not perceptible by the human eye
  - 1-2: Perceptible through close observation
  - 2-10: Perceptible at a glance
  - 11-49: Colors are more similar than the opposite
  - 100: Colors are exactly the opposite

Photo Credit: Justpaint.org

Research question, hypothesis, and variables

Research question

How does the use of household / D.I.Y. (Do It Yourself) items vs commercial stain removal products affect the removal percentage of the stain removed

Photo Credit: thespruce.com

Hypothesis

If measured using the ΔE formula, commercial products will have a lower color similarity % than D.I.Y stain removers.

Variables

- **Independent variable:** Use of household / D.I.Y. (Do It Yourself) stain removers vs commercial stain removal products
- **Dependent variable:** The similarity percentage of the stain.

Materials

1. Bacon grease
2. Ink
3. Coffee
4. Balsamic Vinegar
5. Food coloring
6. Baking soda
7. Detergent
8. White vinegar
9. Oxyclean
10. Water
11. 4x4 Inch Cloth
12. Metal sheet
13. Pipette
14. Airtight
15. Washing machine

Procedure

1. Cloths were lined up in 5x6 rows and columns then photographed

2. Various staining agents were applied to their respective rows

3. The cleaning agents and practices were applied to the first 5 columns of cloth, with the 6th as control

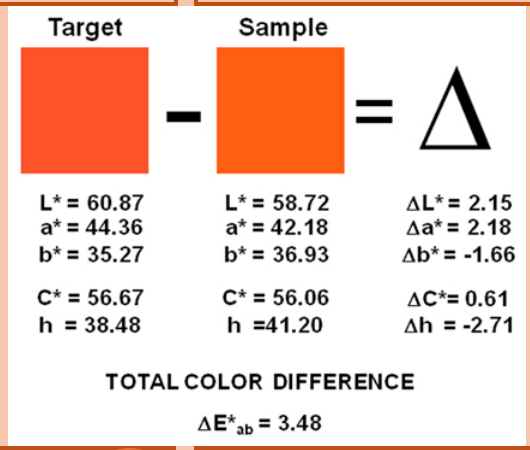


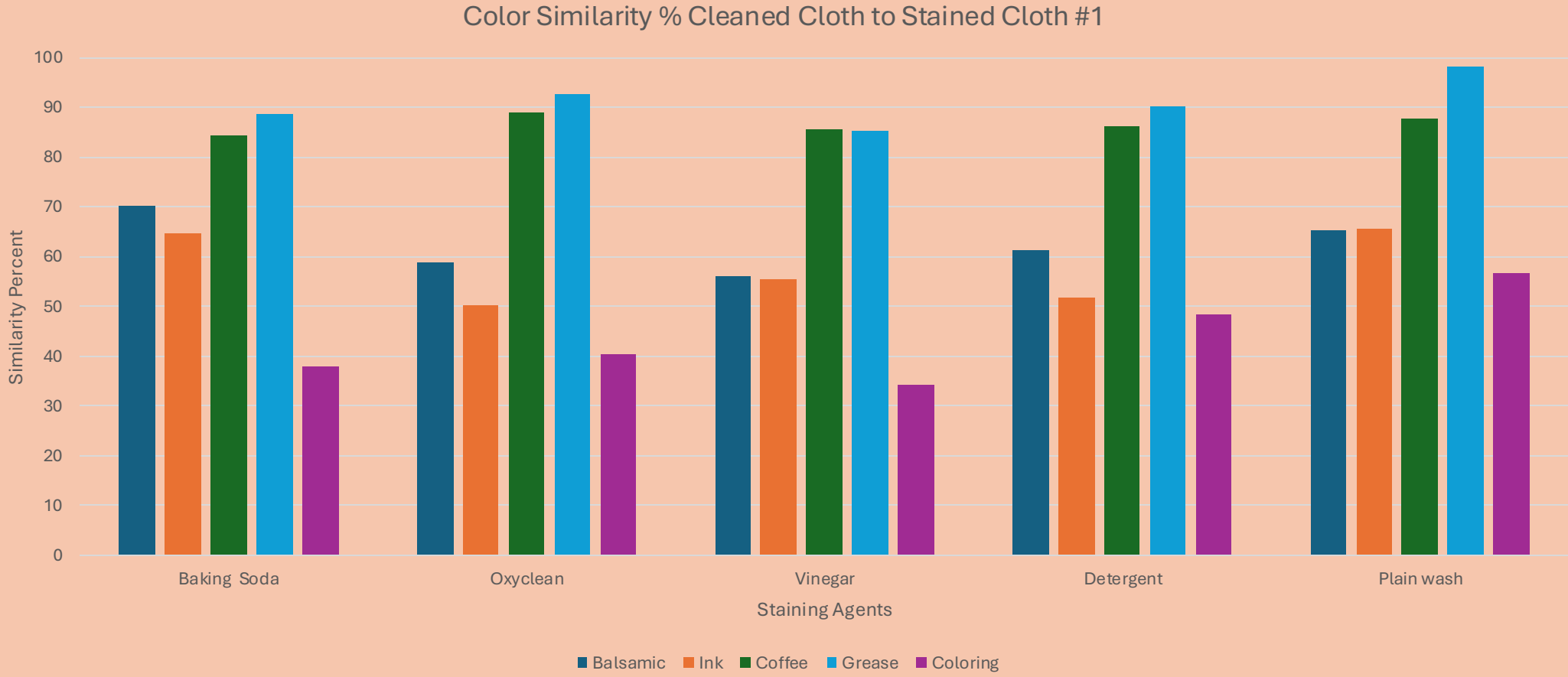
Photo credits: johnthemathguy.blogspot.com

7. Photos were taken of the post stain-removed cloth

8. The RGB values of the cloths were taken and compared to the control using the ΔE formula

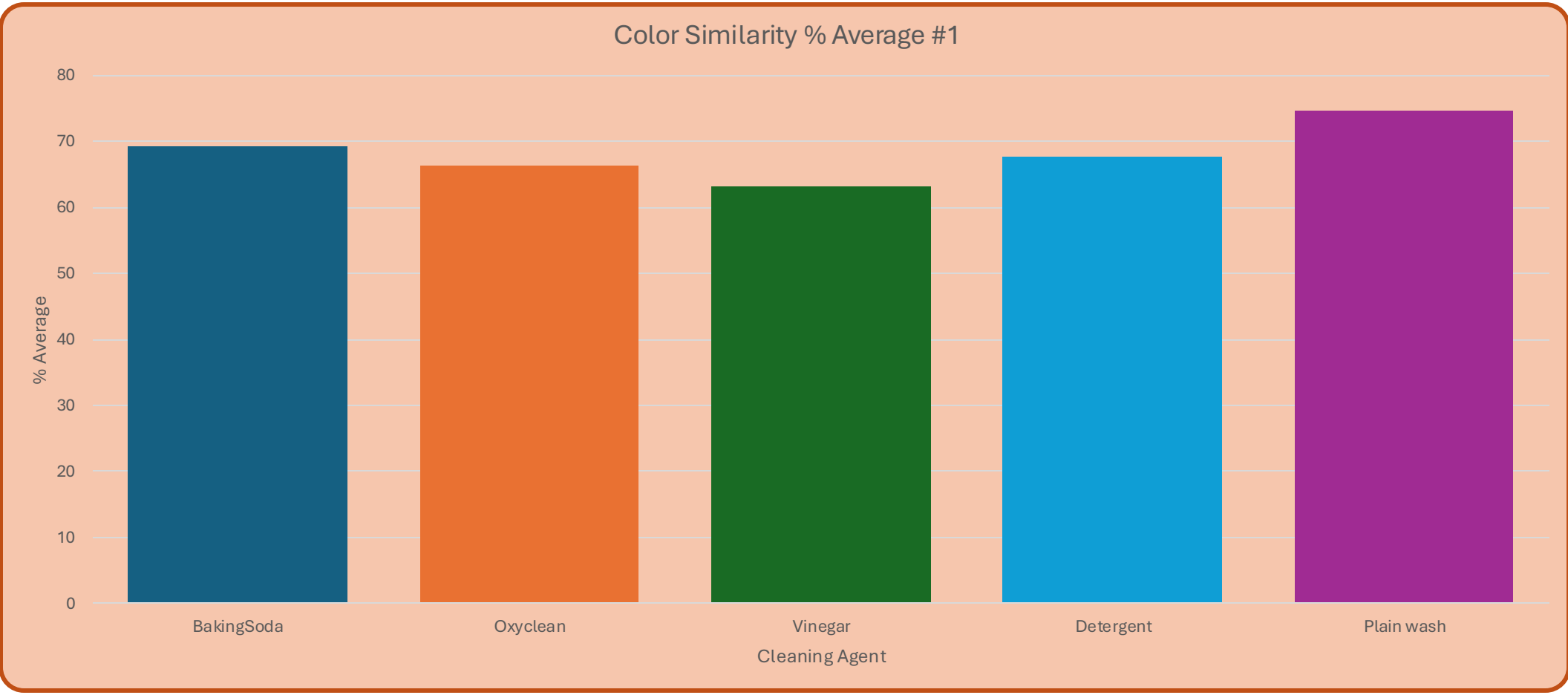
9. The data was then compiled into graphs on excel.

Color similarity % of Cleaned Cloth to Stained Cloth First Trial



The data shows the similarity percent (calculated using 100 - ΔE = %) of the cloth after its treatment, to the stained cloth before treatment of the first trial, ideally as low as can be. Baking soda scored a lower percentage in Coffee, which shows that it is better for removing that kind of stain.

Average of Color similarity % First Trial

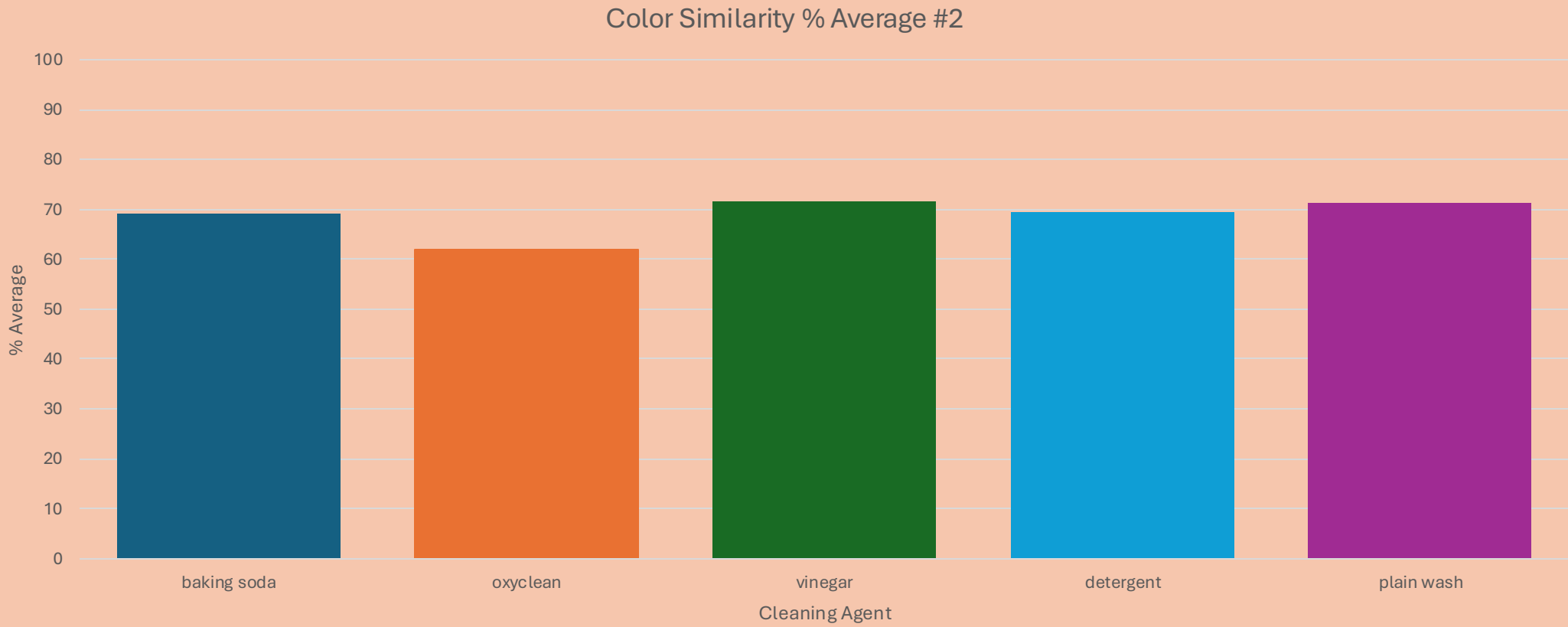


The data shows the averages of all the similarity percentages of the cleaning agents of the first trial. Vinegar scored the lowest with a noticeable gap, demonstrating that it is the most desirable stain removal method according to the results of the first trial.

Color similarity % of Cleaned Cloth to Stained Cloth Second Trial

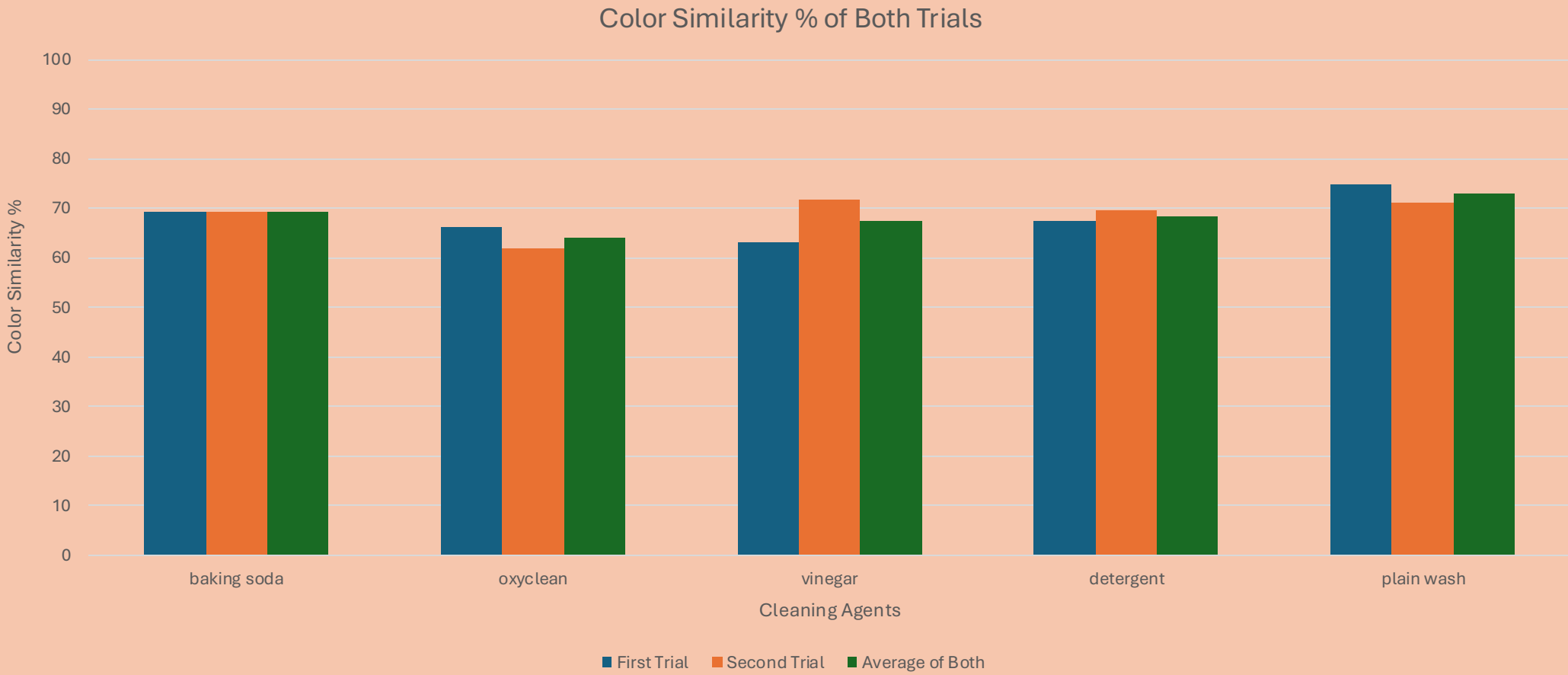
The data shows the similarity percent of the cloth after its treatment, to the stained cloth beforetreatment of the first trial. Vinegar scored lower than detergent in Coffee and Grease, reinforcing itas a cheaper at home alternative to detergent.

Averages of Color Similarity % Second Trial



The data shows the averages of all the similarity percentages of the cleaning agents of the second trial. Oxyclean had the lowest percentage of the others by far, scoring 1.4 (rounded) points lower than Vinegar in the last average, meaning it's better than Vinegar at removing stains.

Average of Two Trials



The data shows the averages of all the similarity percentages of the cleaning agents of both trials. The results show that Oxyclean is the best stain removing agent out of all tested, both trials averaging with Oxyclean at the lowest %. However, vinegar is a suitable D.I.Y alternative.

Conclusion

Claim

The experiment showed that Oxyclean was the best cleaning agent overall, however, vinegar is a viable alternative.

Evidence

Oxyclean had an average similarity in color of 64.05% for between both trials. Vinegar, when avergaing out the 2 trials, had a color similarity of 67.44%. Leaving a difference between the 2 of 3.39%.

Photo Credit: oxiclean.com

Reasoning

The data shows that the average % similarity was lowest for Oxyclean, though the difference of 3.39% with Vinegar barely qualifies for perceptible at a glance on the ΔE scale.

Errors Within the Experient

Possible Errors

- differences in time of day, folds in the cloth, as well as changes in the arrangement of illuminating objects within the room.
- Differences in product content, such as the ingredients in differing balsamic vinegar products.

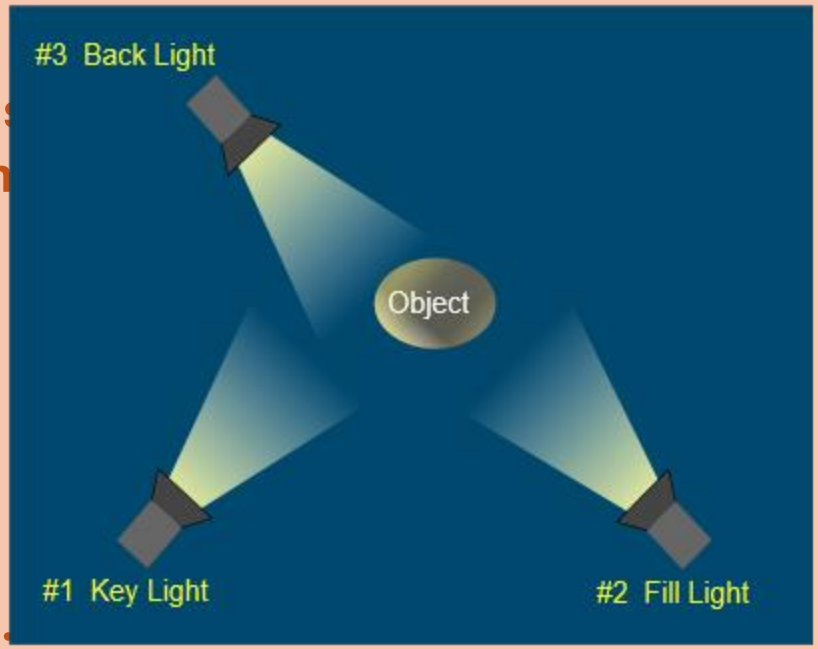


Photo Credit: en.wikipedia.org

Effect

- These errors could affect the accuracy of the data during the RGB color picking process and make one solution seem more effective than another.
- People could be misled into purchasing ineffective products or damaging clothing based on the data presented.

Next Steps with Stain Removing Products

Reasoning

- More experiments with vinegar, Oxyclean and detergent should be in order as they scored the lowest %.
- There must be a reason as to why vinegar scored so low in the first trial, but extremely high the second.

Future Tests

- Find ways to replicate the results of th first trial.
- Cleaning agents' effects on stain size.
- Cleaning agents' effects on structural integrity of fabric.

Uses

- By reducing the impact of stains on clothing, money can be saved from purchasing new clothing.
- Cleaner clothing on individuals can lead to a boost of confidence and charisma.

Photo Credit: dreamstime.com

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