A Second Life for Unsold Tea
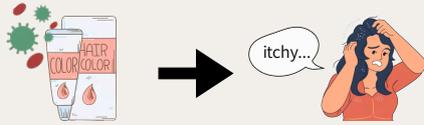## Image Analysis of the Relationship between Leaf Age and Hair Dyeing Efficiency

Miyazaki Prefectural Gokase Secondary School
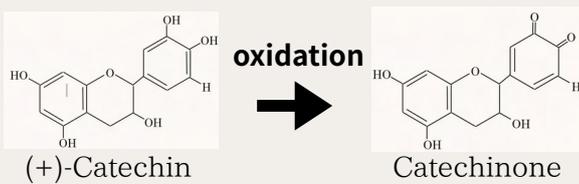
Background

① Some coloring agents contain allergens

itchy...

② Tea waste has increased & tea consumption has declined

③ Hair dyeing with catechins

oxidation

(+)-Catechin → Catechinone

Previous studies show that cathinone can function as a hair dye.

Objective

Clarifying the relationship between the age of the leaves and the degree of coloration using image analysis

Method (Tea leaves used：2023,2024,2025)

① After boiling water, add the tea leaves into it and stir it for 2 minutes.

② Leave it for 2 minutes. (To cool it down)

③ Strain the tea leaves and extract the liquid.

④ Boil the liquid to reduce by half.

⑤ 1：Add oxygen to the concentrated solution and leave for five days.

  2：Soak the hair, leave it for three days, then rinse it with water and soap.

  3：Take photos of the colored hair and analyze them using the app.

＜The experiment in progress＞

① ③ ④ ⑤1
⑤2 ⑤3 ⑤3

＜What is the app?＞
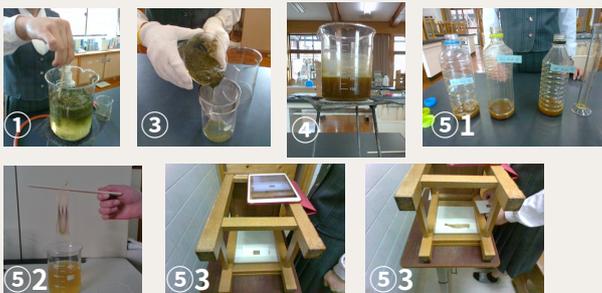
○This Python tool, supported by AI, analyzes an image to extract and visualize the main colors, including their percentage and RGB values.

○Colored samples were converted into black and white images (black for dark pixels, white for light pixels). We set a threshold to make the white area 80% of the total image, and then compared these thresholds to measure the difference in color intensity between the samples.

ex)The reference value when it reaches 80%

①threshold：178   ②threshold：75

The **lower** threshold, the **darker** color

Results

＜Photos of the colored hair＞

Blank   2023   2024   2025

＜Each threshold＞   (Blank＝Treated with pure water, substituting the dye)

Sample name	1	2	3	Average ①	Standard Diviation ②
Blank	181	187	181	183	3.5
2023	88	92	98	93	5
2024	100	93	104	99	5.6
2025	86	98	92	92	6

①— considerable difference between blank and the others.

②--- little difference in intensity across all age groups.

Conclusion

① Functions successfully as a setting agent
  → The potential of tea leaves as a **non-allergenic** coloring agent

② There is little difference in regardless of the age of the leaves.
  → New utility for **Aged Tea**

Future Outlook

① Older and Different Tea Varieties

② Comparison with Chemical Hair Dyes

③ Moving towards Practical Application

References

Matsubara, T. (2018). Synthesis and Functionality of Hair Dyes Chemically Modified from Natural Materials. Kakenhi (Grant-in-Aid for Scientific Research) Report