Which flower extract will have the highest rate of electrolysis?

<u>Science Fair Project Report</u>

Level : *Middle Level*

Category : Physical Science

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(Creating the community of Excellence)

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ABSTRACT

The nature had given us so many flowers on our earth. People are using flowers for various purposes. Electrolysis is a commonly used process that separates bonded compounds by breaking the substances into ions. This process is often used in the chemical industry, as well as in other applications such as mining and manufacturing. I want to investigate, "Which flower extract will have the highest rate of electrolysis?" For my investigation, I selected ROSE, MARIKKOLUNDU, WHITE SEVANHI AND YELLOW SEVANTI flower extracts.

These flowers extracts act as the electrolyte. I used iron and zinc nail electrodes separately to pass the electricity to the extracts. I passed constant current to all the flowers extracts through the iron and zinc electrodes for 3 hours. After that I measured the mass of cathode and anode and then I subtracted their final mass with their initial mass and then I divided that mass with the time taken for the electrolysis process to calculate the rate of electrolysis in each of the flowers extracts.

Through my investigation I found Marikolunthu *(Artemisia pallens-Davanam) has the highest rate of electrolysis among the flower extracts I had taken.*




INTRODUCTION

The electrolysis process is a chemical reaction that takes place in an electrolyte solution when electricity is passed through it. Solutions that contain the capability of conducting electricity are called electrolytes. Because the electrical current is transported by the ions in solution, the conductivity increases as the concentration of ions increases or decreases when the ionic concentration decreases.

The electrolyte solution contains both positive and negative ions. The positive ions are called anions while the negative ions are known as cations. Both the anions and cations will move freely inside the electrolyte solution.

Conductors, called electrodes, are connected to the battery terminals and immersed in the electrolyte solution for the electrolysis process to take place. The cathode is the electrode that is connected to the negative terminal of the battery. The anode is the electrode connected to the positive terminal of the battery.

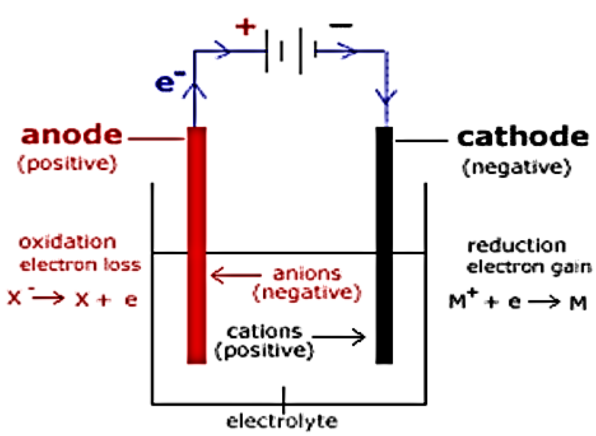
When the terminals of the battery are connected to the electrodes and immersed in the electrolyte, anions will move towards the anode while cations will move towards the cathode.

When the ions reach the surface of the electrodes, the following reactions may happen:

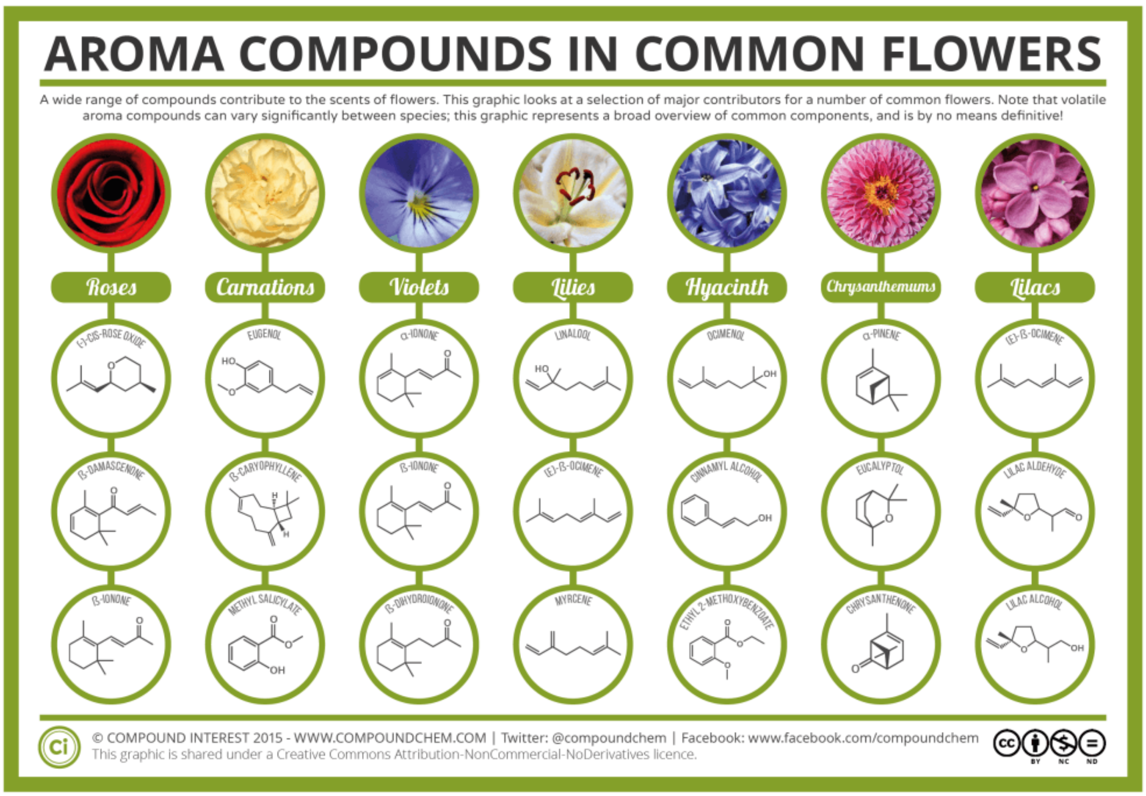
a. Deposits may form on the electrode surfaces.

b. Gases may be released from the electrodes.

c. The deposits and gases formed may subsequently be dissolved in the electrolyte.



Flowers are the most beautiful creation of the nature which also helps to make atmosphere more pure and toxin free. Flowers are the beneficial food for many types of birds, insects, and animals even some flower also work as medicines in some cases. Flowers give off a complex mix of volatile organic chemicals, and whilst not all of these will contribute to the aroma, a significant number will impact it to varying degrees. Whilst we can't point to single compounds as being the cause of flowers' scents, we can identify those that have a major impact on the aroma that our noses detect; in many cases, there will be molecules that make a large contribution.



<u>Electrical Conductivity:</u>

Conductivity is linked directly to the total dissolved solids (T.D.S.). High quality deionized water has a conductivity of about 5.5 μS/m at 25 °C, typical drinking water in the range of 5–50 mS/m, while sea water about 5 S/m[2] (or 50,000 μS/cm) (i.e., sea water's conductivity is one million times higher than that of deionized water:). (Micro-simens). An electrical conductivity meter (EC meter) measures the electrical conductivity in a solution. It is commonly used in hydroponics, aquaculture and freshwater systems to monitor the amount of nutrients, salts or impurities in the water.

STATEMENT OF THE PROBLEM

Electrolysis is a method for separating compounds such as NaCl. It uses electricity to separate these compounds. As an electrical current is applied to the two electrodes in the solution, the substances begin to ionize, or break apart, into separate ions. Positively charged ions (such as Na+) will be attracted to the cathode, which is the negative electrode. Those ions are called cations. Negatively charged ions (such as Cl-) will be attracted to the anode, which is the positive electrode. Those ions are called anions.

I want to investigate, "Is electrolysis using flower extracts and if yes, which flower extract will have the highest rate of electrolysis?"

HYPOTHESIS

*Yellow **Chrysanthemum Indicum** flower extract has the highest rate of electrolysis.*

DESIGN OF STUDY

Methods of Research:

INDEPENDENT VARIABLE:

- Types of Flower extract [Rose, Marikolunthu *(Artemisia pallens-Davanam)*, White Sevanthi, Yellow Sevanthi (*Chrysanthemum indicum*)]

DEPENDENT VARIALBE:

- Rate of Electrolysis

CONTROLLED VARIABLES:

- Time (seconds)
- Voltage (volt)
- Quantity of flower extracts
- Electrodes (Nature and Distance between the electrodes)

Materials:

- 8 transparent cups
- Alligator clips
- Connecting wires
- 8 Iron and 8 Zinc nails of equal dimension
- Battery Eliminator
- Electrical Conductivity meter (EC meter)
- Distilled water
- 500 g of Rose, Marikolunthu *(Artemisia pallens-Davanam)*, White Sevanthi, Yellow Sevanthi (*Chrysanthemum indicum*) flower petals
- Water
- Mixer
- Filter
- Plastic cups
- 8 square pieces of thermocols
- Digital weight balance
- Clock

Procedure

1. Grind 500 g of different flower petals separately by adding 500ml of water and filter the extract.
2. Measure and record the mass of iron and zinc nails separately using a digital weight balance.
3. Label the transparent cups as Rose, Marikolunthu *(Artemisia pallens-Davanam)*, White Sevanthi, Yellow Sevanthi (*Chrysanthemum indicum*).
4. Pour equal amount of flower extract in all the respective cups.
5. Take 8 iron nails and make 4 pair of iron electrodes using four square pieces of thermocol. (Make sure the distance between the two iron nails (Electrodes) should be same in all the thermocol pieces and remains in the same distance throughout the experiment).
6. Place the thermocol piece over the transparent flower extract cup such that the iron nails is hanging inside the flower extract.
7. Connect the positive terminal of the battery eliminator to one of iron nails (Anode) and the negative terminal of the battery eliminator to the second iron nails (Cathode) in each thermocol pieces using wires.
8. Set the battery voltage as 6 V and switch on the battery eliminator. Electrolysis starts to happen.
9. Leave the electrolysis bath for 3 hours to see the better results. After 3 hours switch of the battery eliminator.
10. Repeat the steps 3-9 for Zinc electrode.
11. Now slowly take the anode and cathode from every flower extract bath and measure the final mass of the anode and cathode for all the flower extracts and record.
12. Calculate the rate of electrolysis for each flower extracts for both iron and zinc electrodes.
13. **Formula to calculate the Rate of Electrolysis**

    Rate of Electrolysis=Change in Mass of Electrodes/Time

    Change in Mass of Electrodes = [Change in Mass of Cathode] + [Change in Mass of Anode]) / 2
14. Make a graph of the results with flower extract on the x-axis and rate of electrolysis on the y-axis.

COLLECTION OF DATA

PHOTOGRAPHS

<u>Qualitative Data:</u>

Table 1: Electrical Conductivity of the flower extracts (EC meter reading)

S. No	***Flower extract***	***Conductivity (Micro Simens-*** µS)	***Temperature (°C)***
1	Rose	2636	29.9
2	Marikolunthu	7870	30.3
3	White Sevanthi	4626	30.3
4	Yellow Sevanthi	4114	29.9

Table 2A: Electrolysis using Iron Electrode

Initial Mass of Iron: 8.89 g

Time: 3 Hrs=3x60x60=10,800 s

S. No	***Flower extract***	***Initial mass of Cathode (g)***	***Final mass of Cathode (g)***	***Change in Mass of Cathode (g)***	***Initial mass of Anode (g)***	***Final mass of Anode (g)***	***Change in Mass of Anode (g)***	***Change in mass of Electrodes (g)***	***Rate of electrolysis (g/s)***
1	Rose	8.89	8.99	0.1	8.89	8.72	0.17	***0.135***	***0.000025***
2	Marikolunthu	8.89	9.00	0.11	8.89	8.17	0.72	***0.415***	***0.000038***
3	White Sevanthi	8.89	8.99	0.1	8.89	8.17	0.72	***0.41***	***0.000037***
4	Yellow Sevanthi	8.89	8.89	0	8.89	8.25	0.64	***0.32***	***0.000029***

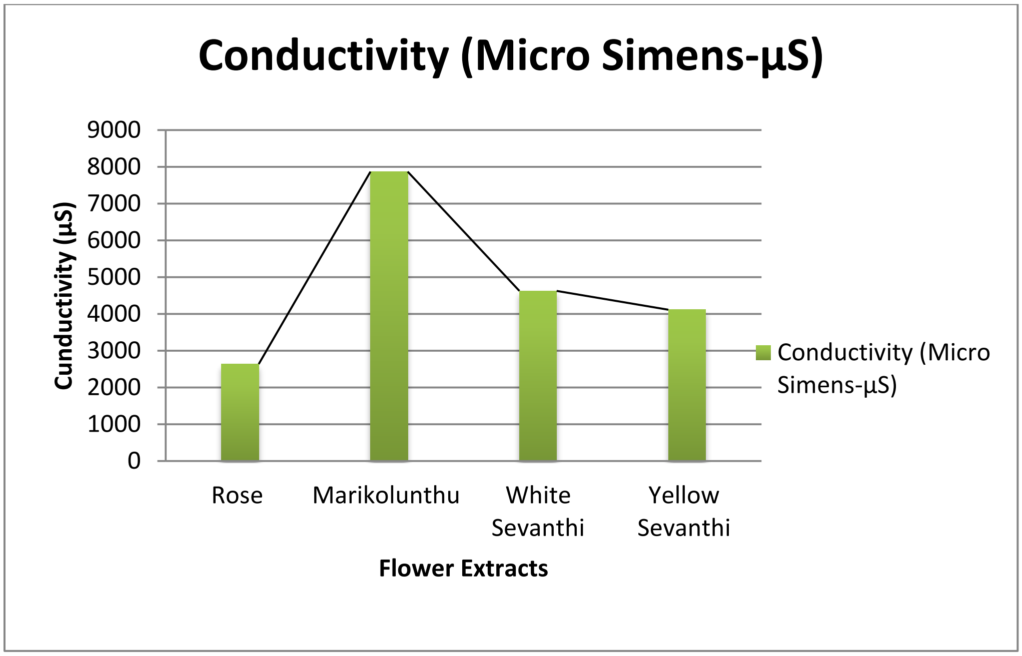
Table 2B: Electrolysis using Zinc Electrode

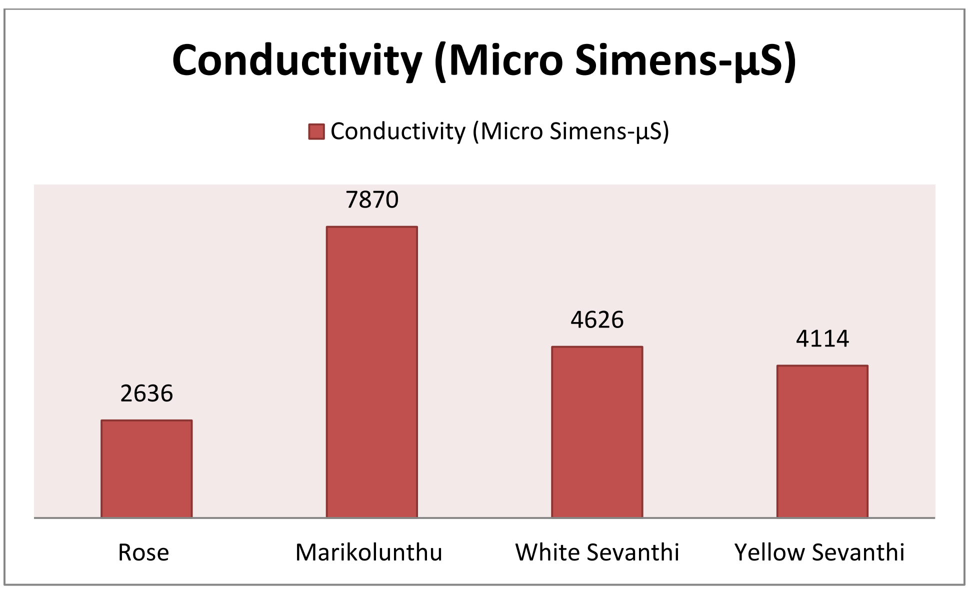
Initial Mass of Zinc: 13.02 g ***Time***: 3 Hrs=3x60x60=10,800 s

S. No	***Flower extract***	***Initial mass of Cathode (g)***	***Final mass of Cathode (g)***	***Change in Mass of Cathode (g)***	***Initial mass of Anode (g)***	***Final mass of Anode (g)***	***Change in Mass of Anode (g)***	***Change in mass of Electrodes (g)***	***Rate of electrolysis (g/s)***
1	Rose	13.02	13.23	0.21	13.02	12.99	0.03	***0.12***	***0.000011***
2	Marikolunthu	13.02	13.33	0.31	13.02	12.51	0.51	***0.41***	***0.000038***
3	White Sevanthi	13.02	13.19	0.17	13.02	12.80	0.22	***0.195***	***0.000018***
4	Yellow Sevanthi	13.02	13.20	0.18	13.02	12.86	0.16	***0.17***	***0.000016***

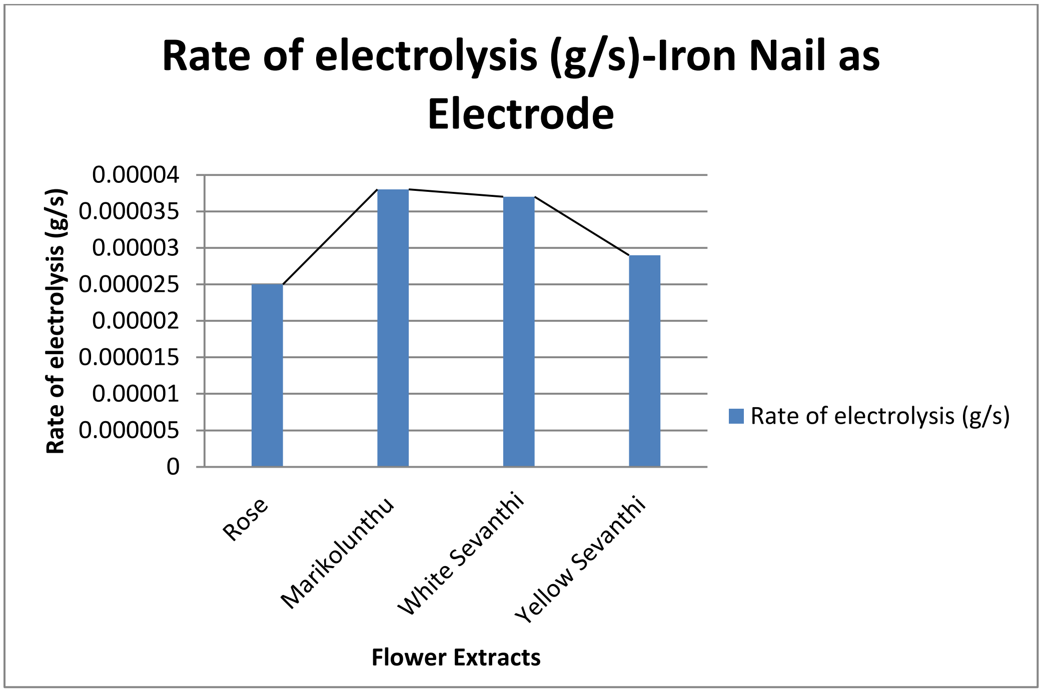
GRAPHICAL REPRESENTATION

a. Table 1:

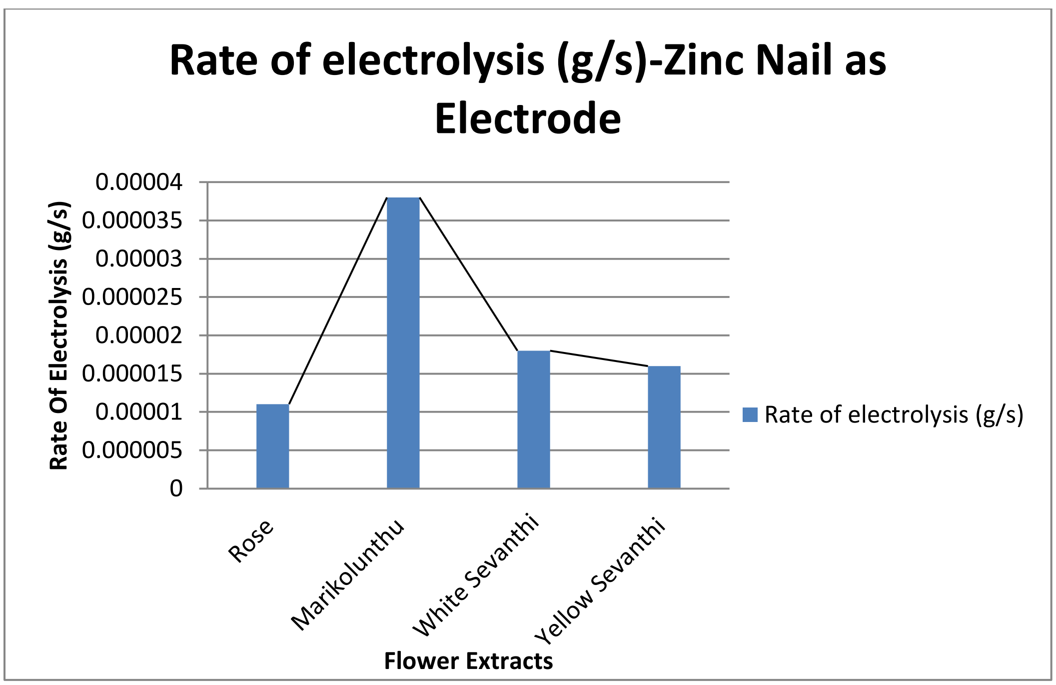




b. Table 2A:



c. Table 2B:



RESULT AND DISCUSSION

- While doing the experiment, the whole area smells good due to the fragrance of the flowers.
- After few minutes of electrolysis, there appeared some changes (bubbles stared to appear) on the top surface of the flower extract.
- Two different electrodes (Iron and Zinc) are used. After electrolysis process gets over, the cathode and anode of both the iron and zinc nails showed good colour difference.
- The cathode and anode of Marikolunthu *(Artemisia pallens-Davanam)* extract showed beautiful colour difference (Yellow deposits was observed) both in iron and zinc nails.
- After calculating the change in the mass of the electrodes of all the flower extracts separately and applying that in the formula, it was found that the rate of electrolysis happened in the order of ;
  - Marikolunthu *(Artemisia pallens-Davanam)*
  - White ***Chrysanthemum indicum***
  - Yellow ***Chrysanthemum indicum***
  - Rose
- The same order was observed in the case of both electrodes.
- The Electricity conductivity meter also shows the same order for conductivity.

CONCLUSION

- My hypothesis, "Yellow ***Chrysanthemum indicum*** flower extract has the highest rate of electrolysis." has not proved.
- Marikolunthu *(Artemisia pallens-Davanam)* extract has the highest rate of electrolysis.

APPLICATION

- Electrolysis is used in the mining industry to split reactive metals from their ores after they are taken from the ground. It is also used to plate (cover) things with metal because it costs less than using, for example, 100% pure solid gold to make jewellery.
- Many beauty shops use electrolysis or electrology to remove hair. This is done by "electrocuting" the hair so it splits along its root.
- Electrolysis makes the anions (negative ions) go to the anode (positive electrode) and the cations (positive ions) go to the cathode (negative electrode). So, for example, oxygen would go to the anode and iron would go to the cathode.
- Chemical Constituents of flowers:
    - ***Rose:*** The flower contains volatile oil, the volatile oil composed of linalool, linalyl formate, β-citronellol, citronellyl formate, citronellyl acetate, geraniOl, geranyl formate, geranyl acetate, phenylethanol, nerol, 3-methyl-1-butanol, transβ-ocimene, pentadecane, 2-tridecanone, 1-pentanol, 1-hexanol, -hexenol, hexyl acetat, 3-hexenyl acetate, benzyl alcohol, eugenol, methyl eugenol, etc.
    - ***Marokolunthu (Artemisia pallens-Davanam)*** Dried davana plant used as aromatic bouquet. Davanone, davan ether, davana furan and linalool are the major constituents of davana oil. Methyl cinnamate, ethyl cinnamate, bicyclogermacrene, 2-hydroxyisodavanone, farnesol, geranyl acetate, sesquiterpene lactones, and germacranolides are also found. The amount of davanone and linalool decreased while those of (Z)− and (E)−methyl cinnamate, (E)−ethyl cinnamate, bicyclogermacrene, davana ether, 2-hydroxyisodavanone, and farnesol increased from flower heads emergence stage to the initiation of seed set stage. Five compounds, (Z)− and (E)−methyl cinnamates, (Z)− and (E)−ethyl cinnamates, and geranyl acetate, were identified for the first time in davana oil.
    - ***Sevanthi (Chrysanthemum indicum):*** acacetin (1), tricin (2), 2',4'-dihydroxychalcone(3), 5-hydroxy-4',7-dimethoxyflavon(4),7hydroxyflavonone (5), isorhamnetin (6),5,6,7-trihydroxy- 3',4', 5'-trimethoxyflanon (7), quercetin (8) , (3 beta, 5 alpha, 6 beta, 7 beta, 14 beta)-eudesmen-3,5,6,11-tetrol (9), syringaresinol (10), liriodendrin (11), and genkwanin (12).

FUTURE ENHANCEMENT

From this research I found electrolysis happens in flower extract. I want to continue my experiment to check whether the flavour pigments or colouring pigments can be extracted from the flower under low cost and high efficiency and can be used for natural flavouring and colouring in soaps, scents, disinfectants, floor cleaners, etc.

ACKNOWLEDGEMENT

I am over helmed in all humbleness and gratefulness to acknowledge my depth to all those who have helped me to put these ideas, well above the level of simplicity and into something concrete.

First I want to thank almighty Allah for the successful completion of this entire project.

I would like to express my special thanks of gratitude to my guide as well as our Principal, Mrs.R.Sameem M.Sc., B.Ed., P.G.D.C.A., who helped me a lot in gathering different information, collecting data and guiding me from time to time in making this project, despite of her busy schedules.

I extend my thanks to our Correspondent sir, Mr. Sathakkathullah M.Tech who gave me the golden opportunity to do this wonderful project which also helped me in doing a lot of Research and I came to know about so many new things.

A special thanks to my Science Coordinator, Mrs. Taj Nisha M.Sc, B.Ed.,B. A., and Science teacher Ms. A. Anis Parveen B.Sc., B.Ed., who supported me.

Any attempt at any level can't be satisfactorily completed without the support and guidance of my parents and friends.

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