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Extraction of natural dye and preparation of herbal gulal from beetroot (*Beta vulgaris*)

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Abstract
The present work was planned to extract more colouring component with keeping the environment friendly extraction procedure excluding the extensive application of organic solvents. There are three types of technique such as aqueous technique; acidic technique and alkaline technique have been used for extraction of natural dye from beetroot. After preparation of natural dye analyze the prepared dye. Now I have also prepared herbal gulal by using above beetroot extract with wheat and rice flour

Keywords: Natural dye, beetroot, herbal gulal, wheat flour, rice flour

1. Introduction
The is the taproot portion of the beet plant, usually known in North America as the beet, also table beet, garden beet, red beet, or golden beet. It is one of several of the cultivated varieties of *Beta Vulgaris* grown for their edible taproots and their leaves called beet greens. These varieties have been classified as B.
Vulgaris sub-species *Vulgaris Conditiva* group (Cultivar group). Beetroot is the taproot portion of the beet plant, usually known in North America as the beet, also table beet, garden beet, red beet, or golden beet. It is one of several of the cultivated varieties of *Beta Vulgaris* grown for their edible taproots and their leaves called beet greens. Beetroot contains macro components (energy, carbohydrate, fat, and protein), minerals (calcium, iron, and potassium), electrolytes, vitamins (vitamin A, C, E, and K), and phyto-nutrients. Kannanmarikani *et al*. [1] studied that according to dye yield and fastness properties the plant was chosen for fabric dyeing. We are chosen the plant *Lawsonia inermis* to color the fabrics in this work. Amlepatil *et al.* [2] studied that to extract natural color from various novel techniques of extraction especially ultrasonication and microwave assisted extraction techniques and their efficiency and suitability. Daberao *et al*. [3].
studied that there are huge numbers of process to do coloration. Natural and man-made colors are also used. The natural dyes are extracted and fabric dyeing is analyzed by applying dye on 100% pure cotton. Yeniocak *et al*. [4] developed an eco-friendly wood stained extracted from beetroot *(Beta vulgaris)* and determined the color stability of stain to UV light irradiation. Siva *et al.* [5] studied that in India, there are more than 450 plants that can yield dyes. S. Ali *et al.* [6] studied that the alkaline conditions for extraction of natural dye from Henna leaves were optimized and the resulting extract was used to further optimize its dyeing conditions on cotton by exhaust method. D. Jothi *et al.* [7] studied that marigold flowers, which are yellow to orange red in colour, are a rich source of lutein, a carotenoid pigment. Bhatnagar *et al.* [8] studied about festival called Holi and its hazardous ocular effects at tertiary care ophthalmic center in north India.
I have selected the work on the extraction of natural dye & preparation of herbal gulal from Beta Vulgaris because to till date this work has not been done by any researcher. Therefore, the purpose of this work is to use Beta Vulgaris extract as a cheap source of colour, herbal and no harmful for skin.

2. Materials and methods
All materials used in extraction of natural dye and preparation of herbal gulal from beetroot were purchased from the local market Mungeli.
The instruments used in extraction of natural dye and herbal gulal such as induction, weighing machine, steel container. We have analyzed of our extracted sample by using the UV/VIS digital spectrophotometer model 371, which is available in Engineering Chemistry Laboratory, BRSM CAET and RS, Mungeli.

Table 1 Materials used in extraction of natural dye and preparation of herbal gulal from beetroot.

Material used	Quantity	Cost (Rs.)
Beetroot (*Beta Vulgaris*)	7 kg	40 Rs. per kg
Distilled Water	7 litre	20 Rs. Per litre
Wheat Flour	100 gm	40 Rs. Per kg
Rice Flour	100 gm	45 Rs. Per kg

2.1 Different methods of extraction of natural dye

There are three types of techniques used for extraction of natural dye from beetroot:

2.1.1 Aqueous technique
2.1.2 Acidic technique
2.1.3 Alkaline technique

Table 2: Different type of solution, which are abbreviating as follows

Name of the samples	Symbolic Representation
Dye extracted by Distilled water	SN1
Dye extracted by Acidic solution	SN2
Dye extracted by 0.10 M NaOH Solution	SN3
Dye extracted by 0.20 M NaOH Solution	SN4
Dye extracted by 0.30 M NaOH Solution	SN5
Dye extracted by 0.40 M NaOH Solution	SN6

2.1.1 Aqueous technique

Firstly beetroot extract was prepared by boiling the beetroot pieces. We have to gather 1 kg of fresh beetroot, 1 ml of distilled water and rinse the beetroot thoroughly then peel it and cut it into small pieces then this beetroot soaked overnight. Now 1000 ml of distilled water is boiled with eetroot for 1 hour. After preparation it filters and collected in fresh beaker. After this, soak cotton and polyester cloths in the extraction. Then after 5 minutes, remove the cloths and dry it for 24 hours. These cloths are analyzed that the changes occurred in colour of fabric in 1 hour interval.

2.1.2 Acidic technique

Firstly beetroot extract was prepared by boiling the beetroot pieces with acid. We have to gather 1 kg of fresh beetroot, 1 ml of distilled water and 10 ml of concentrated HCl. Rinse the beetroot thoroughly then peel it and cut it into small pieces then this beetroot soaked overnight. Now 1000 ml of distilled water and 10 ml of HCl is boiled with beetroot for 1 hour. After preparation it filters and collected in fresh beaker. After this, soak cotton and polyester cloths in the extraction. Then after 5 minutes, remove the cloths and dry it for 24 hours. These cloths are analysed that the changes occurred in colour of fabric in 1 hour interval.

2.1.3. Alkaline technique

Firstly beetroot extract was prepared by boiling the beetroot pieces. We have to gather 1 kg of fresh beetroot, 1 ml of distilled water and rinse the beetroot thoroughly then peel it and cut it into small pieces then this beetroot soaked overnight. Now 1000 ml of distilled water and 4gm sodium hydroxide (NaOH) is boiled with beetroot for 1 hour. After preparation it filters and collected in fresh beaker. Now 8 g of NaOH flakes and 1000 ml of distilled water boil with 1kg of beetroot for 1 hour. After preparation it filters and collected in fresh beaker. Now 12.5 gm of NaOH flakes and 1000 ml of distilled water boiled with 1kg of beetroot for 1 hour. After preparation it filters and collected in fresh beaker. Now 16 g of NaOH flakes and 1000 ml of distilled water boil with 1kg of beetroot for 1 hour. After preparation it filters and collected in fresh beaker. After this, soak cotton and polyester cloths in the extraction. Then after 5 minutes, remove the cloths and dry it for 24 hours. These cloths are analysed that the changes occurred in colour of fabric in 1 hour interval.

2.2 Preparation of herbal gulal

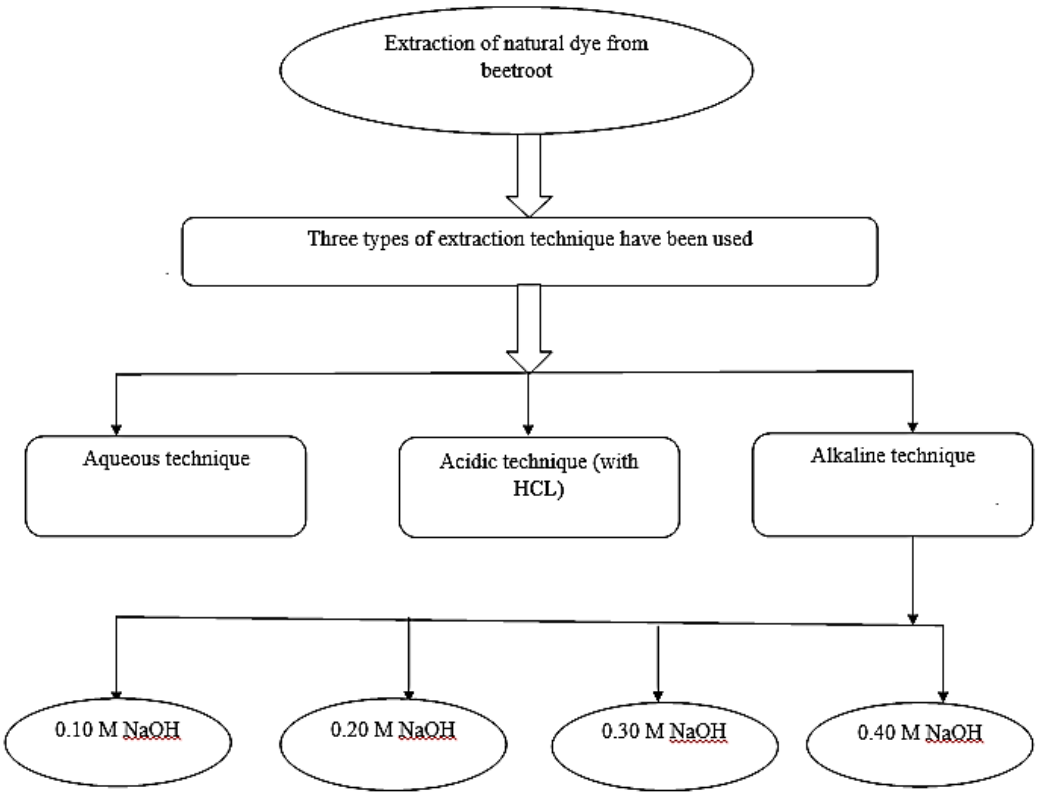
2.2.1 Preparation of herbal gulal by using wheat flour

Firstly beetroot extract was prepared by boiling the beetroot pieces. We have to gather 1 kg of fresh beetroot, 1 ml of distilled water and rinse the beetroot thoroughly then peel it and cut it into small pieces then this beetroot soaked overnight. Now 1000 ml of distilled water is boiled with beetroot for 1 hour. After preparation it filters and collected in fresh beaker. Then mix 50 g of wheat flour with 35 ml of pure beetroot extraction. Now divide the prepared dough into small pieces. Then dry it for 24 hours in sun. After drying grind it in a powder form. Finally we obtained herbal gulal by using wheat flour.

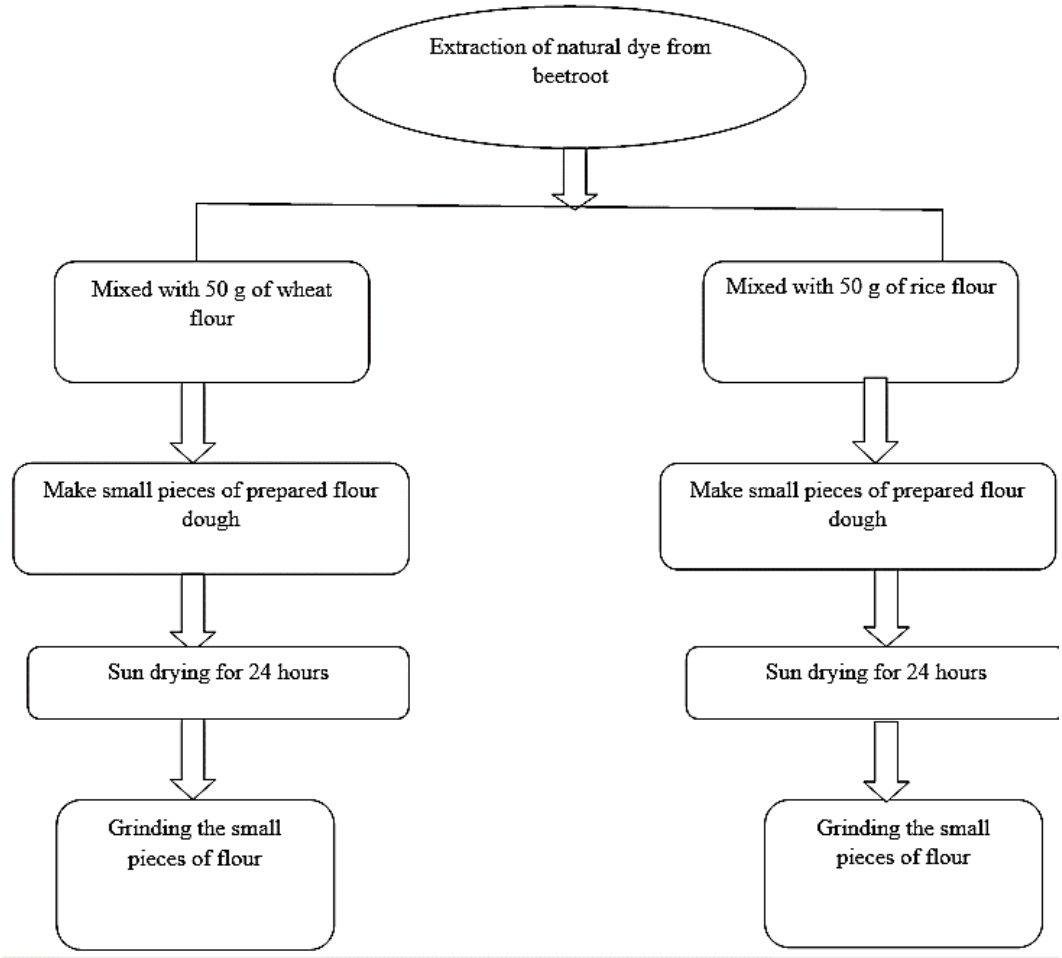
2.2.2 Preparation of herbal gulal by using rice flour

Firstly beetroot extract was prepared by boiling the beetroot pieces. We have to gather 1 kg of fresh beetroot, 1 ml of distilled water and rinse the beetroot thoroughly then peel it and cut it into small pieces then this beetroot soaked overnight. Now 1000 ml of distilled water is boiled with beetroot for 1 hour. After preparation it filters and collected in fresh beaker. Then mix 50 g of rice flour with 50 ml of pure beetroot extraction. Now divide the prepared dough into small pieces. Then dry it for 24 hours in sun. After drying grind it in a powder form. Finally we obtained herbal gulal by using rice flour.

2.3 Methodology: Flow chart of extraction of natural dye



2.4 Methodology: Flow chart of preparation of herbal gulal



3. Result and Discussion

3.1 Different sample prepared by beetroot extract

By using beetroot extract we have prepared total six numbers of samples. For extraction of the sample we have using three types of extraction technique such as aqueous technique, acidic technique and alkaline technique. In alkaline technique we have taken different concentration of NaOH such as 0.10M, 0.20M, 0.30M and 0.40M. All six types of extracted samples are denoted which showed in 3.1.

Table 3. Different type of sample prepared by using beetroot extract.

Name of the samples	Symbolic Representation of samples
Dye extracted by Distilled water	SN1
Dye extracted by Acidic solution	SN2
Dye extracted by 0.10 M NaOH Solution	SN3
Dye extracted by 0.20 M NaOH Solution	SN4
Dye extracted by 0.30 M NaOH Solution	SN5
Dye extracted by 0.40 M NaOH Solution	SN6

3.2 Analysis of prepared natural dyes

(i) Percentage of yield

Table 4: Percentage of yield of all the extracted natural dyes from beetroot.

S. No.	Name of Samples	Yield	% Yield
1	SN1	520	52%
2	SN2	500	50%
3	SN3	530	53%
4	SN4	510	51%
5	SN5	540	54%
6	SN6	535	53.5%

After extraction of natural dyes we have determined the percentage of yield of all the samples which shown in table 2 and Figure 1 & 2. We find that in case of natural dye extracted by distilled water we get 520 yield i.e. 52%, in case of natural dye extracted by acidic medium (i.e. SN2) we get 500 yield i.e. 50% and in case of natural dye extracted by alkaline medium in different concentration such as in case of 0.10M we get 530 yield i.e. 53%, in 0.20M we get 510 yield i.e. 51%, in 0.30M we get 540 yield i.e. 54% and in 0.40M we get 535 yield i.e. 53.5%. And we have observed that the maximum yield we achieved in case of 0.30M NaOH solution and it is 540 yields i.e. 54%. And the minimum yield we observed in case of acidic medium (i.e. SN2) is 500 yields i.e. 50%.

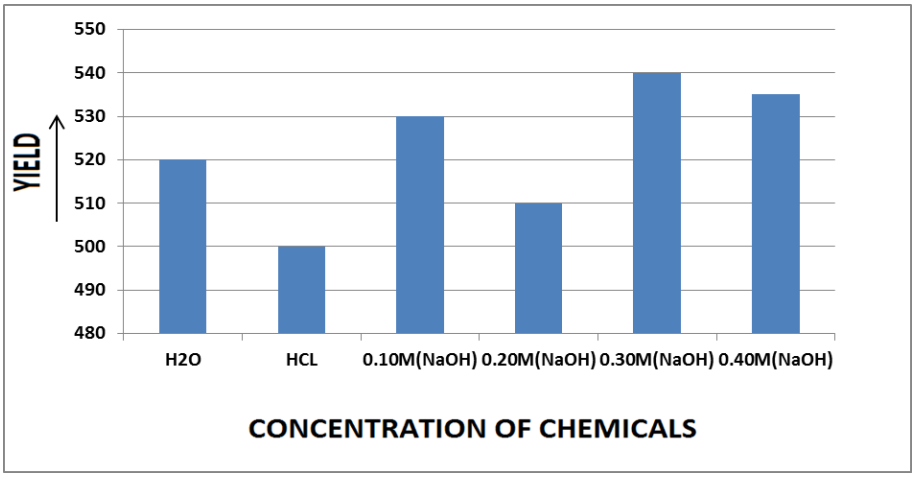


Fig 1: Shows that the graph between the types and concentration of reagent verses yield.

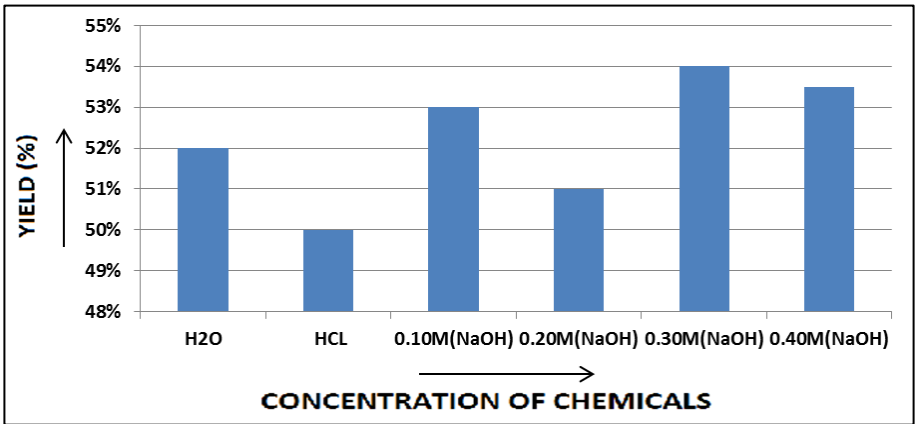


Fig 2: Shows that the graph between the types and concentration of reagent verses percentage of yields.

(ii) Study the Absorbance maxima

(a) Absorbance maxima of natural dye extracted by distilled water

The extracted natural dye has characterized by UV/VIS spectrophotometer. We checked wavelength (nm) and absorbance maxima of all prepared samples which shown in table 3 and Fig. 3. We find that in case of natural dye extracted by distilled water sample is 1.6 absorbance in 400 nm wavelength, 1.0 absorbance in 420 nm wavelength, 1.2 absorbance in 440 nm wavelength, 1.8 absorbance in 460 nm wavelength, 1.1 absorbance in 480 nm wavelength, 1.7 absorbance in 500 nm wavelength, 1.9 absorbance in 520 nm wavelength, 2.0 absorbance in 540 nm wavelength, 2.2 absorbance in 560 nm wavelength, 2.6 absorbance in 580 nm wavelength, 2.3 absorbance in 600 nm wavelength, 0.9 absorbance in 620 nm wavelength, 0.8 absorbance in 640 nm wavelength, 0.5 absorbance in 660 nm wavelength.

And we have observed that the maximum absorbance 2.6 in 580 nm wavelength and minimum absorbance 0.5 in 660 nm wavelength of natural dye extracted by distilled water sample.

Table 5: Absorbance maxima of natural dye extracted by distilled water.

S. No.	Wavelength (nm)	Absorbance
1	400	1.6
2	420	1.0
3	440	1.2
4	460	1.8
5	480	1.1
6	500	1.7
7	520	1.9
8	540	2.0
9	560	2.2
10	580	2.6
11	600	2.3
12	620	0.9
13	640	0.8
14	660	0.5

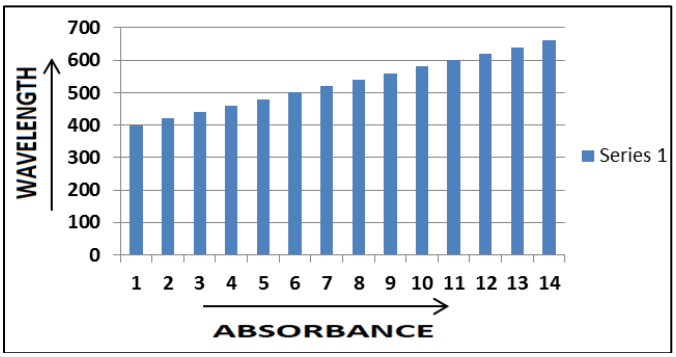


Fig 3: Shows the graph between wavelengths of distilled water sample verses absorbance.

(b) Absorbance maxima of natural dye extracted by Acid

We find that in case of natural dye extracted with acidic medium, we get 580 nm wavelength and 2.5 absorbance by using acidic solution (Hydrochloric acid) which shown in Table 4.

Table 6: Absorbance maxima of natural dye extracted by Acid.

S. No.	No. of sample (acid)	Wavelength (nm)	Absorbance
1	HCl	580	2.5

(c) Absorbance maxima of natural dye extracted by base

In case of 0.10M NaOH we get 580 nm wavelength and 2.59 absorbance, in 0.20M NaOH we get 580 nm wavelength and 2.65 absorbance, in 0.30M NaOH we get 580 nm wavelength and 2.8 absorbance, in 0.40M NaOH we get 580 nm wavelength and 2.7 absorbance which shows in Table 5 and Figure 4 & 5.And we have also observed that the maximum absorbance 2.8 in case of 0.30M NaOH solution and minimum absorbance 2.59 in case of 0.10M NaOH solution.

Table 7: Absorbance maxima of natural dye extracted by base

S. No.	Concentration of NaOH	Wavelength (nm)	Absorbance
1	0.10 M	580	2.59
2	0.20 M	580	2.65
3	0.30 M	580	2.8
4	0.40 M	580	2.7

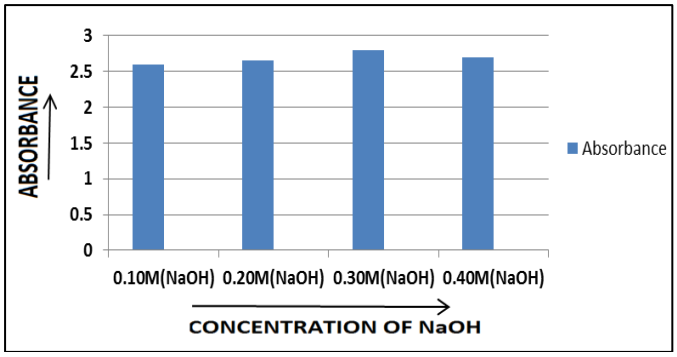


Fig 4: Shows the graph between absorbance verses different concentration of NaOH.

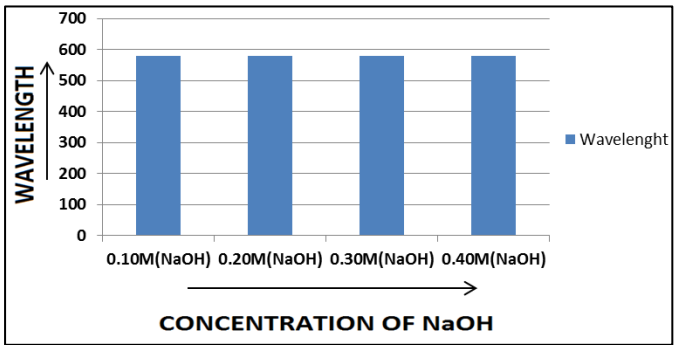


Fig 5: Shows the graph between wavelength verses different concentration of NaOH.

3.3 Preparation of herbal gulal

We have also prepared two types of gulal by using natural dye of beetroot extract.

3.3.1 Preparation of herbal gulal by using wheat flour and natural dye

We have prepared herbal gulal by mixing beetroot extract and wheat flour. This beetroot extract is prepared by using 1 kg of fresh beetroot with 1000 ml of distilled water.

We use 50 gm of wheat flour with 35ml of pure prepared beetroot extract. After sun drying and grinding the small pieces of mixture we obtain fine powdered form of gulal and we observed that the colour of the herbal gulal is brown colour which shown in Figure 6.

Fig 6: Photograph of herbal gulal made by natural dye added with wheat flour.

3.3.2 Preparation of herbal gulal by using rice flour and natural dye

We have also prepared herbal gulal by mixing beetroot extract and rice flour. This beetroot extract is prepared by 1 kg of fresh beetroot with 1000 ml of distilled water. We use 50 g of rice flour with 35ml of pure beetroot extraction. After sun drying and grinding the small pieces of mixture we obtain fine powdered form of gulal and we observed that the colour of the herbal gulal is pink colour as shown in Figure 7.

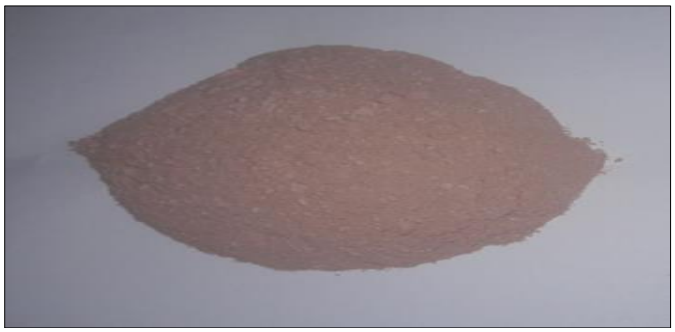


Fig 7: Photograph showing Herbal gulal made by natural dye added with rice flour

4. Conclusion

I have extracted natural dye from beetroot by using three techniques such as aqueous, alkaline and acidic techniques and conclude that In case of natural dye extracted by distilled water give 52% yield, by acidic medium 50% and alkaline medium in different concentration such as in case of 0.10M get 53%, in 0.20M 51%, in 0.30M, 54% and in 0.40M, 53.5% yield. We have also observed that the maximum yield in case of 0.30M NaOH solution is 54% and the minimum yield in case of acidic medium is only 50%. We also observed that the maximum absorbance 2.6 in 580 nm wavelength and minimum absorbance 0.5 in 660 nm wavelength of natural dye extracted by distilled. We find that the natural dye extracted with acidic medium, get 580 nm wavelengths with2.5 absorbance by using acidic solution. In case of 0.10M NaOH get 580 nm wavelength and 2.59 absorbance, in 0.20M NaOH 580 nm wavelength and 2.65 absorbance, in 0.30M NaOH 580 nm wavelength and 2.8 absorbance, in 0.40M NaOH observed 580 nm wavelengths with 2.7 absorbance. We have also observed that the maximum absorbance 2.8 in case of 0.30M NaOH solution and minimum absorbance 2.59 in case of 0.10M NaOH solution. I have also prepared herbal gulal by mixing beetroot extract and wheat and rice flour. We observed that with wheat flour get brown colour & with rice flour get pink colour.

The extraction of natural dye from the beetroot is completely eco friendly because they come from the natural sources and natural dyes are not harmful to the environment. This process is also green synthesis. Prepared natural dyes and herbal gulal are not harmful for skin and human health while other colour and gulal which is available in market are very dangerous for human health as well as the skin. The cost of the extracted natural dyes and prepared herbal gulal is very low and they can easily make.

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