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STUDY OF PHYSICO CHEMICAL AND PERCENTAGE PURITY OF COMMONLY USED FOOD GRADE DYES

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ABSTRACT

Food dyes are commonly used colouring substance. These synthetic food dyes are analyzed through various physico chemical techniques to obtain their percentage purity. Impurities mainly are of organic in nature and effects the health adversely specially when the food product are exposed to strong light & temperature present study showed discrepancy in the total dye content .

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INTRODUCTION

Dyes are coloured organic compounds, which have the property of imparting their coloured to other material such as textile fibers, plastic etc. The requirement from a substance to act as a dye is that, it must have a suitable colour and is capable of being "Fixed" to the surface to be dyed. Also, the colour of the dyed material should not be affected on prolonged exposure to light, water and soap, ie. the dye must have fastness properties. It is to be noted that all coloured compound are not dyes. A dye can generally be described as a coloured substance that has an affinity to the substrate to which it is being applied. The dye is usually used as an aqueous solution and may require a mordant to improve the fastness of the dye on the fibre. (In contrast, a pigment generally *has no affinity for the substrate, and is insoluble*) food colour includes synthetic food colour and natural food colour. Synthetic Food Colour is in more use than the Natural Colour, because of availability of wide hue range and competitive prices. Extensively used in food industry, these colours make the food items more delightful.

MATERIAL & METHOD

Food dye samples were collected from local market and the standard dyes namely sunset yellow (E110), Tartrazine (E102), Carmoisine (E122) and Brilliant blue FCF (E133) were obtained from FDA, Bhopal (M.P). Standard food dyes and samples were analyzed by various physico-chemical techniques. The solubility's in cold and for hot water were checked by reported method and use of reflux condenser was done for hot water solubility. Loss on drying was checked using a hot air oven where the standard and sample were heated at 135˚C for 3 hours Rf were recorded using 1% NH_3 solution as solvent pH was recorded by using universal indicator and colour change gave the value of pH as reported in Table 1. λ max calculation were done by dissolving dye in 0.1 N HCl and for standard viz. sunset yellow filter no.2 carmoisine filter number. 5, tatrazine filter number.2, and brilliant Blue filter no.7 were used and λ max are reported in table 1 their optical density values were also a recorded the procedure was repeated for samples as well as standards. Conductivity of dyes both standards and samples were studied by dissolving them in 0.1 HCl and calibrating the instrument by use of 0.1 N KCl solution. While analyzing the sample chemically, they were tested for presence of nitro group, for which Mulliken's test was performed and for presence of amino group and for Pb as impurity routine test were conducted. Total dye content was calculated gravimetrically for which samples were dissolved in 0.1 N NaOH boiled and dilute HCl were added and precipitate was weighed to obtain percentage of pure dye. The data was compared to those of standards as reported by Bureau of Indian Standards (BIS). The results were reported in the table 1 & 2.

Table 1 Showing Comparative study of physical properties of food dyes with their standard

Sample No.	Samples	Mol.wt	LOD	OD	p.H	Cold water solubility	Hot water solubility	Conductivity(ms)	Absorbance (nm.)	Rf. value
*	Std.Sunset yellow	452.37	13.00		>7	**100%**	**100%**		**480/1.829**	0.78
A1	ssy+ tartrazine	986.74	8.6	0.11	5.00	74.7	78.00	0.056	1.811	0.59
A2	ssy+ tartrazine	986.74	8.00	0.07	5.5	76.00	88.00	0.053		0.52
A3	ssy + tartrazine	986.74	8.00	0.08	5.5	77.00	78.5	0.168		0.52
B1	ssy + carmosine	954.81	9.00	0.08	5.00	73.2	76.5	0.8		0.61

B2	ssy +carmosine	954.81	10.5	0.07	6.00	75.6	78.00	0.58		0.61
*	**Std. Tartrazine**	**534.37**	**13.00**		**>7**	**100%**	**100%**		**426/1.802**	1
C1	tartrazine	534.37	5.1	0.07	6.00	72.6	73.00	0.09	1.802	0.35
C2	Tartrazine	534.37	7.00	0.04	5.5	76.6	79.00	0.045		0.65
C3	Tartrazine	534.37	7.5	0.06	5.00	71.5	73.2	0.096		0.62
C4	Tartrazine	534.37	8.00	0.06	5.5	73.00	76.5	0.108		0.75
C5	Tartrazine	534.37	6.5	0.05	5.00	70.00	77.00	0.104		0.72
*	**Std. carmoisine**	**502.44**	**13.00**		**>7**	**100%**	**100%**		**515/1.659**	0.61
D	Carmo. + indigo carmine	968.8	7.00	0.08	6.00	72.6	74.00	0.026	1.657	0.69
E	Carmo. + tart.+B.B.	1829.63	6.00	0.06	4.5	68.00	72.5	0.096		0.72
F1	Carmo.+ ssy	954.81	5.6	0.07	5.5	74.8	77.00	0.076		0.68
F2	Carmo.+ ssy	954.81	7.5	0.05	6.0	72.5	73.5	0.089		0.79
G	Carmoisine	502.44	5.5	0.07	5.5	73.00	75.5	0.135		0.72
*	**Std.brilant blue**	**792.82**	**13.00**		**>7**	**100%**	**100%**		**629/1.353**	0.65
H1	BB+ tartazine	1327.19	8.00	0.03	6.00	72.5	76.00	0.032	0.865	0.60
H2	BB+ tartazine	1327.9	7.5	0.04	5.5	76.5	80.5	0.012		0.60
H3	BB+ tartazine	1327.9	7.5	0.05	5.5	73.5	76.00	0.029		0.59
H4	BB+ tartazine	1327.9	8.00	0.08	5.5	75.5	77.4	0.078		0.61
I	BB+ tartazine+ carmo.	1829.63	7.00	0.07	6.5	72.00	76.5	0.067		0.60

Table2 Comparative study of chemical properties of food dyes with their standard

SampleNo.	Sample	Azo group test	Total dye content	Mullikan test (NO2)	Amine test	Lead test
*	Sunset yellow(Std.)	+	87%	Absent	Absent	Absent
A1	Ssy+Tartrazine	+	12%	-	-	-
A2	Ssy+Tartrazine	+	12%	-	-	-
A3	Ssy+Tartrazine	+	13%	-	-	-
B1	ssy+carmosine	+	12%	-	-	-
B2	ssy+carmosine	-	9%	-	-	-
*	Tartrazine(Std.)	+	87%	-	-	-
C1	Tartrazine	+	12%	-	-	-
C2	Tartrazine	+	12%	-	-	-
C3	Tartrazine	+	12.60%	-	-	-
C4	Tartrazine	+	12%	-	-	-
C5	Tartrazine	+	10%	-	-	-
*	Carmoisine(Std.)	+	87%	-	-	-
D	Carmo.+Indigo carmine	-	12%	-	-	-
E	Carmo.Tart.+Bb	+	11%	-	-	-
F1	Carmo.+SSY	+	12%	-	-	-
F2	Carmo.+SSY	+	8%	-	-	-
G	Carmoisine	+	10%	-	-	-
*	Brilliantblue(Std.)	NA	87%	-	-	-
H1	Bb+Tartrazine	+	10%	-	-	-
H2	Bb+Tartrazine	+	11%	-	-	-
H3	Bb+Tartrazine	+	12%	-	-	-
H4	Bb+Tartrazine	+	12%	-	-	-
I	Bb+Tat.+Carmo.	+	12%		-	-

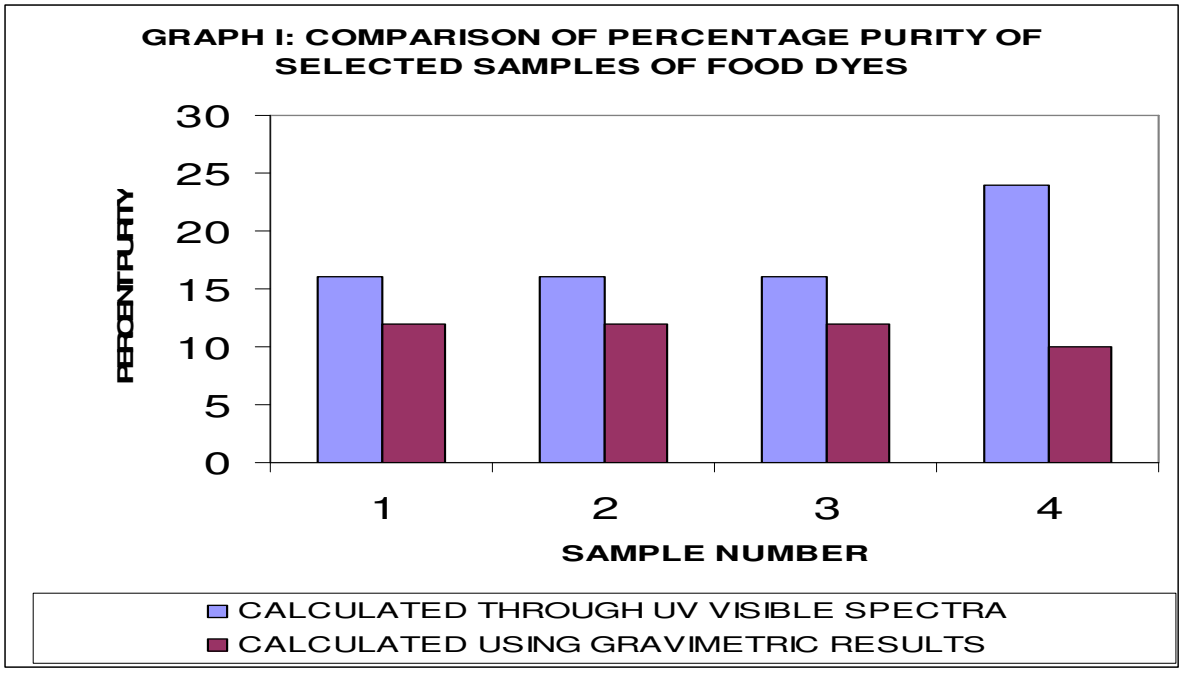
RESULT AND DISCUSSION:-

The various Physico-chemical analytical tests conducted on samples and their standards were used to analyze percent purity of dyes as impure dye may effects the health adversely. Total dye contents of samples were also calculated using gravimetric method and values obtain showed remarkable difference between reported dye content of samples.

Table 3 Comparative chart of gravimetric analysis and UV-Visible spectroscopy

Sample No.	Sample	Dye Content Reported	Dye Content Calculated By Gravimetric Method	Dye Content Calculated By UV Visible Spectroscopy
*	Std.Sunset yellow	87%	-	-
A1	Ssy+Tartrazine	<15%	12%	16%

*	Tartrazine(std.)	87%	-	-
C1	Tartrazine	<15%	12%	16%
*	Carmoisine(Std.)	87%	-	-
D	Carmo.+Indigo carmine	<15%	12%	16%
*	Brilliant blue(Std.)	87%	-	-
H1	Bb+Tartrazine	<15%	10%	24%



Further the data was used to analysis percentage of purity of selected samples by comparison of UV Visible spectra of standards and selected samples 1 is A_1, 2 is C_1 ,3 is D_1 and 4 is H_1.

Brilliant blue standards FCF in UV Spectra usually showed absorbance within 400-700 nm and shows characteristic peak at 629.6 nm with maximum absorbance for 1.353 which drop down to 0.865 in the sample. Suggesting that constitution of standards and samples are not same and also suggesting that organic impurity does not increase the conjugated system.

Tartrazine shows peak absorbance of 426 nm. The standard and samples selected both showed the UV visible spectra suggesting practically no impurity are present in selected samples. Where as in sunset yellow the maximum absorbance corresponding to wavelength 480.4 nm in standards exhibit maximum absorbance 1.829 drop down to 1.811 suggesting the standard and sample differ in the constitution which is also supported by gravimetric result.

In carmoisine practically lesser impurities are found as standard and sample UV spectra are practically matched. No significant changes in the peak were noticed in commercial sample suggesting lesser or no impurities present. The percentage of purity present in selection of food dyes in these dyes are toxic them self. And when organic impurities are present in then they

may further increase the toxicities of the synthetic food dyes.

The samples collected showed discrepancy in total dye content as reported in them and calculated in lab .Various Physico-chemical tests conducted on samples shows nature of impurities of organic nature .Comparison of data of percent of purity as obtain by gravimetric 09-12% and UV-visible spectra 16-24%. The organic impurities further increase the toxic effects of synthetic food dyes.

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