DOI: 10.21276/ijabpt.2016.7.4.7

INTERNATIONAL JOURNAL OF APPLIED BIOLOGY AND PHARMACEUTICAL TECHNOLOGY

www.ijabpt.com ISSN : 0976-4550

Volume-7, Issue-4, Oct-Dec-2016 CodenIJABFP-CAS-USA Copyrights@2016

Received: 19th June 2016 *Revised: 28th Aug 2016* *Accepted: 29th Aug 2016*

DOI: 10.21276/Ijabpt, http://dx.doi.org/10.21276/ijabpt *Research article*

FORMULATION AND *IN-VITRO* EVALUATION OF SUSTAINED RELEASE HERBAL MATRIX TABLET CONTAINING *OCIMUM SANCTUM* AND *GLYCYRRHIZA GLABRA* FOR THE TREATMENT OF COUGH

Sumit Summy*, Nisha Thakur, Niladry Sekhar Ghosh

School of Pharmaceutical Sciences, Bahra University, Shimla, India.

ABSTRACT: Coughing is the protective mechanism of the body. In the critical condition like cold it leads to form phlegm in the respiratory system. So, it needs to be cured as early as possible. Some pharmaceutical formulations used to treat coughing were syrups and solutions. These preparations had several disadvantages like bioavailability, dosing frequency and stability problems. To overcome these problems matrix tablet was developed. Matrix tablet consists of polymers which retards the release of the API and gave a prolonged action. Due to the controlled release of the drug, dosing frequency reduced thrice as compared to the liquid dosage forms like syrups. The API used in the formulation was herbal in nature so it had the advantage of having fewer side effects. Reduction in dosing frequency had also helped in increasing the patient compliance. The extracts were loaded in the formulation by mixing it with excipients like polymers, diluents, fillers, lubricants, etc. Direct compression technique was used to formulate the matrix tablets. Pre and post compressional parameters were determined with respect to the standards. The formulations passed all the physical and pharmaceutical parameters. The results of precompressional parameters were good to passable. The results of the post-compressional parameters were satisfactory. The *in-vitro* release of the formulation was from 18 to 20hrs. Dissolution profile of the drug showed zero order release.

Key words: Cough, Anti-tussive, matrix tablet, *Glycyrrhiza glabra*, *Ocimum sanctum*.

*Corresponding author: Sumit Summy, School of Pharmaceutical Sciences, Bahra University, Shimla, India
Mail ID : sumitsummy.summy7@gmail.com

INTRODUCTION

Oral route has been the most convenient and popular route of administration for the delivery of drugs. It provides ease of administration, patient compliance and greater flexibility in dosage form design. Sustained delivery of the drugs overcomes the demerits of conventional dosage forms such as short half life and chances of missing the dose (Raizada, et.al., 2015). Sustained release dosage forms have the advantage of achieving uniform drug plasma level and less side-effects (Maurya. A, et.at., 2014). Cough is the most common disorder that is faced by everyone. Cough is the natural protective mechanism of the body that removes foreign particles, toxins, secretions or mucous from the bronchi and bronchioles. Cough manifests in common cold, so it can lead to serious illness like asthma, pneumonia and tuberculosis. Therefore it needs to be cured as soon as possible (Rang, et.al., 2011, Jahan. Y, et.al., 2012, Lakshmi, et.al., 2011). *Glycyrrhiza glabra* Linn. is a commonly used herb since the period of Ayurveda. Common name is Liquorice and belongs to family Laguminosae (Lakshmi, et.al., 2011). The chief chemical constituent is Glycyrrhizic acid which is responsible for expectorant, tussive, immuno-modulatory and anti-inflammatory activity (Raizada, et.al., 2015). Glycyrrhizic acid acts at the cough centre in the CNS and suppress the response of cough centre. Therefore decreases mucosal secretion (Raju. S.K, et.al., 2014). *Ocimum sanctum* Linn (Labiatae) is commonly known as tulsi (Nadig. P.D, et.al., 2005). The chief chemical constituent of *Ocimum sanctum* is Eugenol (Kalra. M, el.al.,2011). Eugenol acts at the opoid and GABAergic receptors of CNS. Hence shows anti-tussive effects (Deore. S.L, et.al., 2014).

MATERIAL AND METHODS

Authentified extracts of *Ocimum sanctum* and *Glycyrrhiza glabra* were purchased from Sri Herbasia Biotech, Amritsar. HPMC K100 was purchased from Central Drug house (P) Ltd, New Delhi and carbopol from 940 from Qualikems fine Chemicals Pvt Ltd, New Delhi. Other chemicals like polyvinyl pyrrolidone K 30, Magnesium stearate, talc, lactose, were purchased from S.D. Chemicals Ltd. Mumbai.

Pre-compressional study

Determination of λmax. : Stock solution (1000µg/ml) of *Ocimum sanctum* and *Glycyrrhiza glabra* was prepared in 0.1NHCl. This solution was apparently diluted with same solvent to obtain concentration of 100µg/ml. The resultant solution was scanned in the range of 200-400 nm on double beam UV-spectrophotometer. The resultant was plotted on chart. (Krishnarajan. D, et. al., 2013)

Preparation of standard curves of *Ocimum sanctum* and *Glycyrrhiza glabra* in 0.1N HCl and 6.8 pH phosphate buffer:

In 0.1N HCl : Stock solution was prepared by dissolving 100.0 mg of drug (*Ocimum sanctum/ Glycyrrhiza glabra*) in 100.0 ml of 0.1 N HCl solutions, which was further diluted to give the solutions of concentration 10, 20,30, 40 and 50 µg/ml respectively. Absorbance of these solutions were measured on UV spectrophotometer (Systronic, India) at their respective wavelengths and plotted against the concentration to give the standard curve. (Krishnarajan. D, et. al., 2013)

In 6.8 pH phosphate buffer: Stock solution was prepared by dissolving 100.0 mg of drug (*Ocimum sanctum/ Glycyrrhiza glabra*) in 100.0 ml of 6.8 pH phosphate buffer solutions, which was further diluted to give the solutions of concentration 10, 20, 30, 40 and 50 µg/ml respectively. Absorbance of these solutions were measured on UV spectrophotometer (Systronic, India) at their respective wavelengths and plotted against the concentration to give the standard curve. (Krishnarajan. D, et. al., 2013)

Solubility studies: Traditional shake flask method was used to determine the solubility at given temperature and pH. According to the method, compound was added to the medium and was shaken for a specific period of time. (24hrs on rotary shaker at 200rpm) The solution was filtered using wattman filter paper. Filtered sample was analysed using double beam UV Spectrophotometer (Lakka. N. S, 2012).

Drug polymer compatibility studies: The drug and polymers were subjected to spectrophotometric studies using FTIR spectrophotometer. The samples were scanned in the range of 4000-400 cm^{-1} (Patidar D, et.al., 2011).

Preparation of controlled release matrix tablet of *O.sanctum* and *G.glabra*:

Various batches of controlled release matrix tablet of *Ocimum sanctum* and *Glycyrrhiza glabra* were prepared by direct compression technique with each batch containing 25 tablets with 400 mg of drug. All the ingredients were thoroughly mixed. Then the powder was passed through sieve mesh 20 to get uniform size of particles. Then it was lubricated by adding magnesium stearate and talc. The above powder was compressed with the help of tablet punching machine, by keeping average weight 990 mg. After compression the tablets were evaluated for weight variation, hardness, thickness, friability, dissolution, and assay test were determined. The composition of each formulation is given in following table (Krishnarajan. D, et. al., 2013).

Table 1: Development of different formulations containing varying proportions of polymers for controlled layer.

Formulation code	*G. glabra* extract (mg)	*O. sanctum* extract (mg)	HPMC (mg)	Carbopol (mg)	Poly vinyl pyrolidone (mg)	Magnesium stearate (mg)	Talc (mg)	Lactose (mg)
F1	200	200	90	210	10	20	30	230
F2	200	200	120	180	10	20	30	230
F3	200	200	150	150	10	20	30	230
F4	200	200	180	120	10	20	30	230
F5	200	200	210	90	10	20	30	230

Figure-1: Matrix tablet of *Ocimum sanctum* and *Glycyrrhiza glabra*

Pre compression parameters:

Angle of repose: Maximum angle between the horizontal plane and the surface of pile of the powder is known as angle of repose. 10g of the powder was weighed and allowed to flow freely through the funnel. The diameter and height of the formulated cone was measured using the scale. Angle of repose was calculated by using the formula:

$$\tan \theta = h/r$$

Where, h = height of the powder cone.

r = radius of the powder cone.

(Krishnarajan. D, et. al., 2013, Pawan. P, et.al., 2013, Patidar. P, et.al., 2011)

Range of pharmaceutical powders:

Less than 20 = excellent

20-30 = good

30-40 = passable

Above40 = very poor

Bulk density: A known quantity of powder was poured into the measuring cylinder. Powder was levelled without compacting and read the unsettled apparent volume, V_0, to the nearest graduated unit. Bulk density, in gm per ml was calculated by the formula,

$$\text{Bulk Density} = m / V_0,$$ (Krishnarajan. D, et. al., 2013)

Where m – weight of the powder,

V_0 - apparent volume

Tapped density = weight of the powder/tapped volume of the packing (Mahajan, et.al., 2011).

Compressibility index: The compressibility index of the granules was determined by Carr's compressibility index (Mahajan, et.al., 2011).

$$\text{Carr's index (\%)} = \frac{\text{Tapped Density} - \text{Bulk Density}}{\text{Tapped Density}} \times 100$$

Post compressional parameters:

General appearance: The general appearance of all tablets like colour and size is essential for patient compliance. Size and shape of formulated tablets were evaluated. The diameter and thickness of the tablets were measured using Vernier callipers (Kasahikar. V.S. et.al., 2011).

Weight Variation: The weight variation test was run by weighing 20 tablets individually and compared individual weight to average weight. The tablets meet the USP test, if no more than two tablets are outside the percentage limit and if no tablet differs by more than 2 times the percentage limit (Rathore. A.S. et.al., 2013).

Hardness test: Tablet require certain amount of resistance or hardness to withstand with the mechanical shocks. Hardness was measured using Monsanto harness tester. Unit of hardness is Kg/cm^2. 10 tablets were chosen randomly from each batch. Hardness of each tablet was noted. Average hardness was determined (Patidar. P, et.al., 2011, Rathore. A.S, et.al., 2013, Kushwaha. S.K, et.al., Deepu. S, et.al., 2014).

Friability: Friability test was performed using Roche friabilator. Ten tablets were weighed and placed in the friabilator, which was then operated for 25 revolutions per minute. After 100 revolutions the tablets was dusted and reweighed. The percentage friability was determined using the formula, (Kasahikar. V.S. et.al., 2011, Rathore. A.S, et.al., 2013, Deepu. S, et.al., 2014).

$$\text{Percentage friability} = \frac{\text{Initial weight - Final weight}}{\text{Initial weight}} \times 100$$

Drug content: Randomly 5 tablets were taken from each batch. Tablets were powdered separately. Powder equivalent to average weight of tablet each was poured into the 3 different volumetric flasks (100ml). Each volumetric flask was filled with phosphate buffer pH6.8. Powder was dissolved thoroughly in the phosphate buffer pH 6.8. Sufficient quantity of phosphate buffer pH 6.8 was added to make up the volume. Solution was kept for 1hr. Solution was filtered using wattman filter paper. Absorbance of the filtrate was measured at 280nm (*Ocimum sanctum*) and 282nm (*Glycyrrhiza glabra*) respectively using double beam U.V. Spectrophotometer (systronics, India) (Krishnarajan. D, et. al., 2013, Patidar. P, et.al., 2011, Mahajan, et.al., 2011).

Drug content was determined according to the following formula:

$$\text{Drug content} = \frac{\text{Actual drug content}}{\text{Theoretical drug content}} \text{X100}$$

Swelling index: Study is carried out to evaluate the extent of penetration of media into the tablet. Equilibrium weight gain method was used to determine the swelling index. One tablet from each formulation was randomly chosen. They were immersed in beaker containing media. Initially tablets were immersed in 0.1N HCl for 2hrs. Further it was transferred to the phosphate buffer pH 6.8. At regular intervals tablets were withdrawn, blotted with tissue paper and weighed. This process was repeated for upto 20 hrs (Patidar. P, et.al., 2011, Mahajan, et.al., 2011).

% weight gain was calculated using equation:

$$SI = \frac{W_t - W_0}{W_0} \text{ X } 100$$

Where: SI = Swelling Index

W_0 = weight of tablet at time zero

W_t = weight of tablet at time t

***In-vitro* Dissolution studies:** The *in-vitro* dissolution studies of formulated tablets of *Ocimum sanctum* and *Glycyrrhiza glabra* was performed using type 2 dissolution apparatus (Electrolabs) for 20hrs. 900ml of media was maintained at 37ºC ± 0.5ºC with stirring rate of 100 rpm. 3tablets from each formulation was tested individually in gastric fluid i.e. 0.1N HCl for first 2hrs and then in phosphate buffer pH 6.8 from 3 to 20hrs. 5ml of the sample was withdrawn at regular intervals for 20hrs. Withdrawn sample was replaced by equal volume of the same media. Withdrawn samples were analysed using double-beam UV- Visible spectrophotometer (Systronics) at determined wavelength of *Ocimum sanctum* (280nm) and *Glycyrrhiza glabra* (282nm). A plot of cumulative % drug release v/s time was plotted (Raizada, et.al., 2015, Pawan. P, et.al., 2013).

RESULT AND DISCUSSION

PREFORMULATION STUDIES:

Determination of λmax

λmax of *Ocimum sanctum* and *Glycyrrhiza glabra* was found to be 280nm and 282 nm respectively.

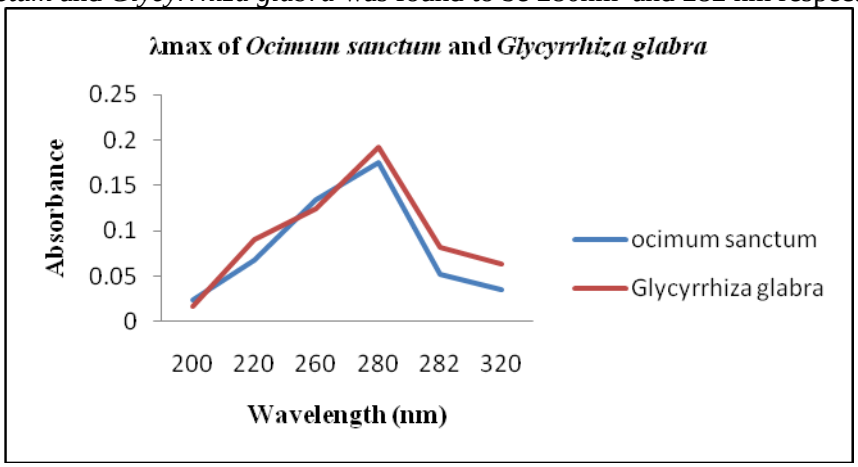

Figure-2: Maximum wavelength of *Ocimum sanctum* and *Glycyrrhiza glabra*

Preparation of calibration curves:

Calibration curve of *Ocimum sanctum* extract: Calibration of curve of *Ocimum sanctum* extract was prepared in 0.1N HCl and phosphate buffer pH 6.8 at λmax 280nm. Table no. 2 and 3 depicts the absorbance of *Ocimum sanctum* extract at different concentration range. The R^2 value obtained from equation depicts the linearity of curve as shown in figure 3 and 4.

Table No.2: Standard plot of *Ocimum sanctum* extract in 0.1 N HCl (pH 1.2)

Concentration (µg/ml)	Absorbance (nm)
10	0.046
20	0.073
30	0.12
40	0.177
50	0.199

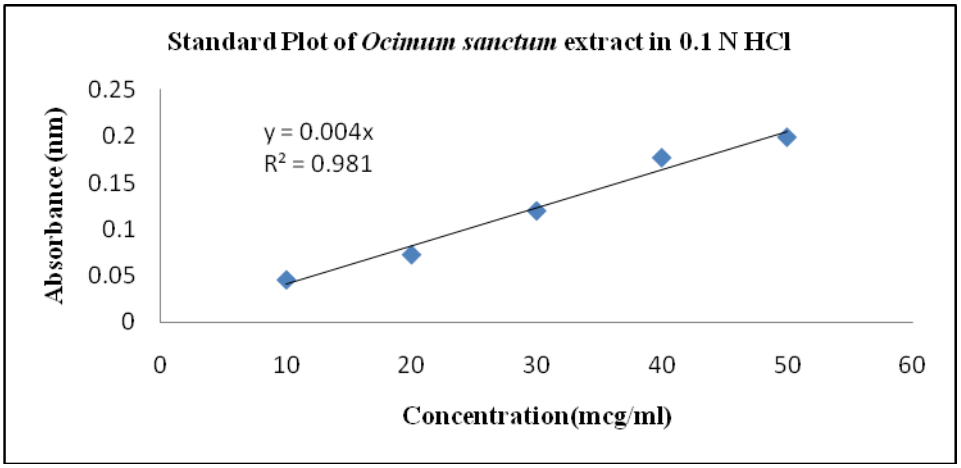

Figure-3: Standard plot of *Ocimum sanctum* extract in 0.1N HCl (pH 1.2).

Table No-3: Standard plot of *Ocimum sanctum* extract in phosphate buffer pH 6.8

Concentration (µg/ml)	Absorbance (nm)
10	0.08
20	0.181
30	0.273
40	0.358
50	0.43

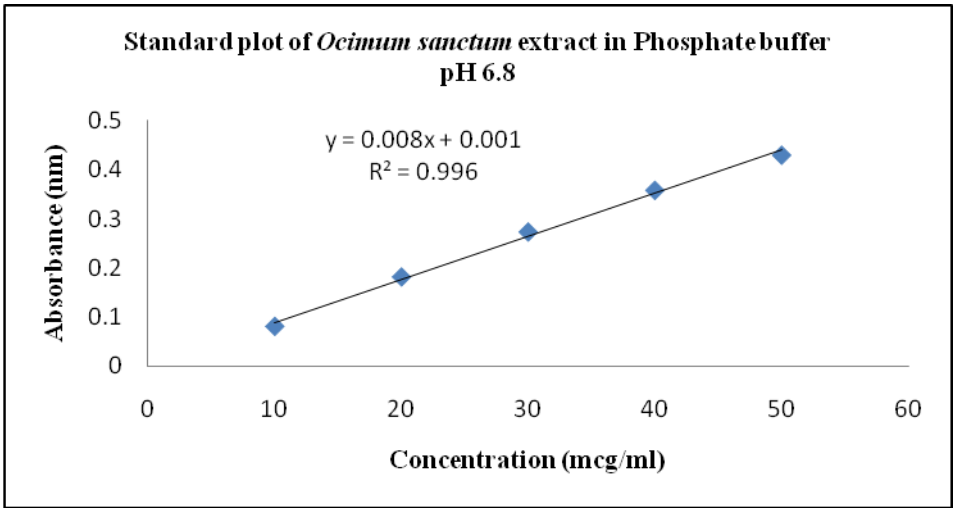

Figure-4: Standard plot of *Ocimum sanctum* extract in phosphate buffer pH 6.8

Calibration curve of *Glycyrrhiza glabra* extract: Calibration of curve of *Glycyrrhiza glabra* extract was prepared in 0.1N HCl and phosphate buffer pH 6.8 at λmax 282nm. Table no. 4 and 5 depicts the absorbance of *Glycyrrhiza glabra* extract at different concentration range. The R^2 value obtained from equation depicts the linearity of curve as shown in figure 5 and 6.

Table No-4: Standard plot of *Glycyrrhiza glabra* extract in 0.1 N HCl (pH 1.2)

Concentration (µg/ml)	Absorbance (nm)
10	0.142
20	0.176
30	0.259
40	0.32
50	0.38

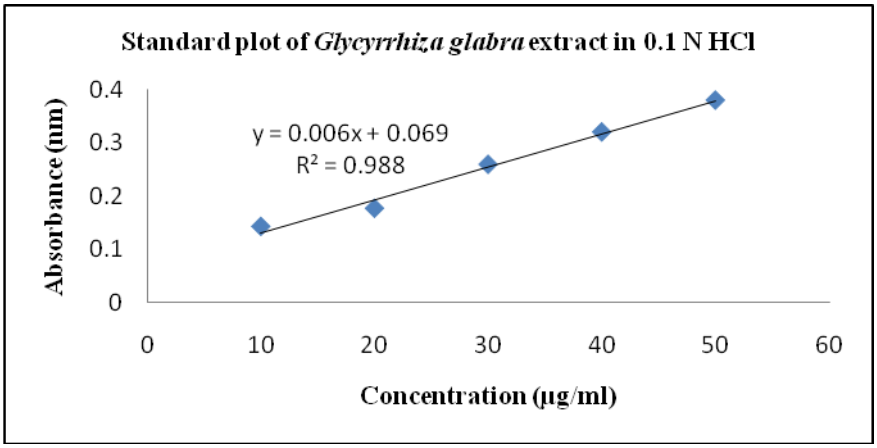

Figure-5: Standard plot of *Glycyrrhiza glabra* extract in 0.1N HCl (pH 1.2)

Table No-5: Standard plot of *Glycyrrhiza glabra* extract in phosphate buffer pH6.8

Concentration (µg/ml)	Absorbance (nm)
10	0.12
20	0.196
30	0.256
40	0.355
50	0.427

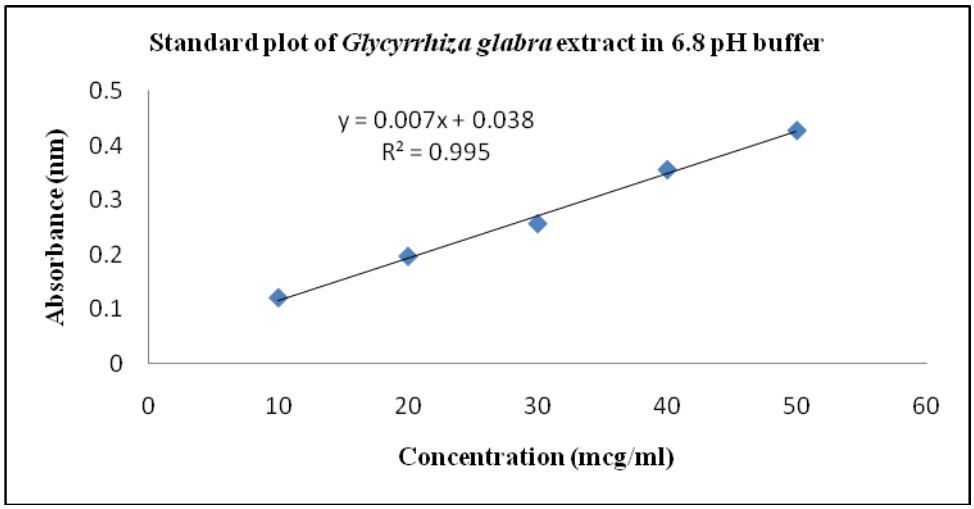

Figure-6: Standard plot of *Glycyrrhiza glabra* extract in phosphate buffer pH 6.8

Solubility studies:

Solubility of *O.sanctum*: Distilled water >Phosphate Buffer > 0.1N HCl > Methanol

Solubility of *G. glabra*: Distilled water >Phosphate Buffer > 0.1N HCl > Methanol

Thus, from above solubility studies it was found that *Ocimum sanctum* and *Glycyrrhiza glabra* found to be more soluble in distilled water.

Table No-6: Solubility of *Ocimum sanctum* and *Glycyrrhiza glabra* in different Solutions

Sr. No.	Solution	Solubility(µg/ml)	
		O.sanctum	***G. glabra***
1.	Distilled Water	375	480.86
2.	0.1N HCl	324.5	399.86
3.	Methanol	59.13	107.67
4.	Phosphate Buffer	373	408.86

Drug polymer compatibility studies: Drug-excipients compatibility studies were confirmed by carrying out FTIR studies. There was none of the extra peak found in the graph (Figure 7 and 8). Thus, FTIR studies showed that there was no drug-excipients interaction.

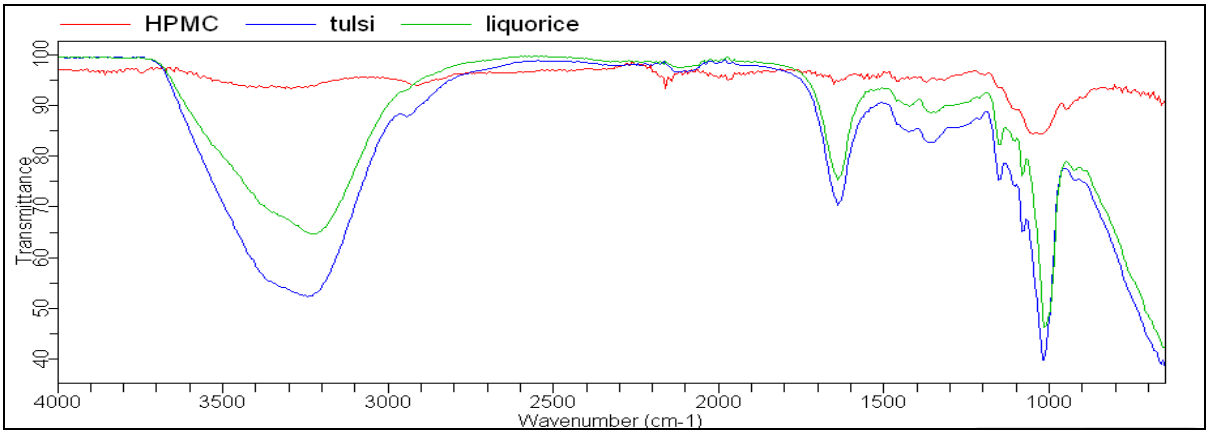

Figure-7: Drug-Polymer Interactions

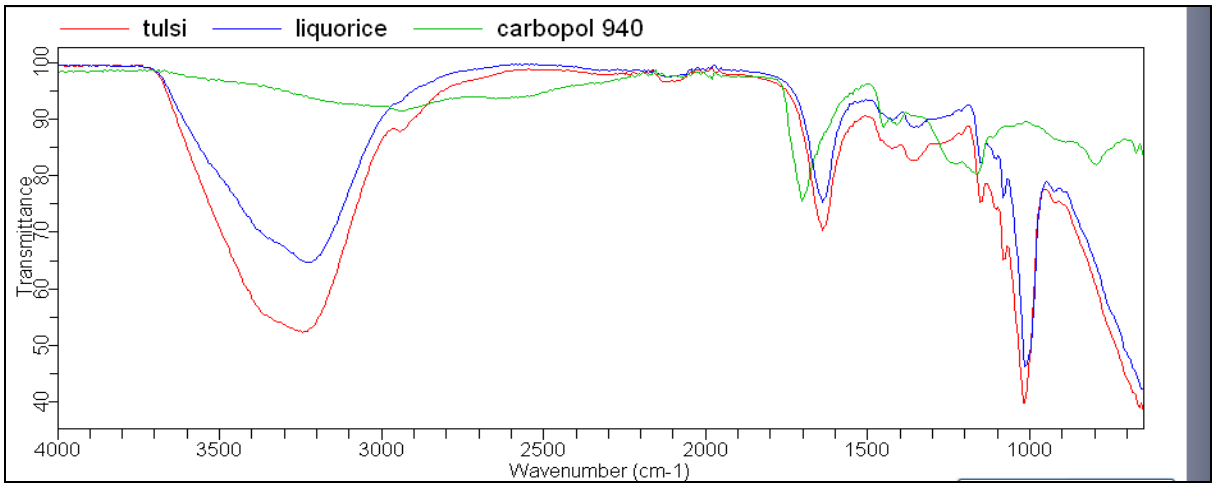

Figure-8: Drug-Polymer Interactions

Evaluation of pre compressional blend:

Angle of repose: Angle of repose was determined by fixed funnel method. Angle of repose was found to be in range of 24.34º - 29.24º for different powder blend batches, which indicates good powder flow. Results are shown in table no. 7.

Bulk and Tapped density: Pre-compressional blend was evaluated for bulk and tapped density by using tapped density apparatus. Bulk and tapped density was found to be 0.459 - 0.497 gm/ml and 0.621-0.684 gm/ml respectively. This shows good repacking ability of powder blend. Results are shown in table no. 7.

Carr's index and Hausner's ratio: Carr's index and hausner's ratio was calculated from bulk and tapped density. The carr's index of the ingredients was found to be in the range of 24.10- 29.01% and hausner's ratio in the range of 1.31- 1.38. These findings proves that the composition of ingredients for compression posses good compression property and good flow property. Results are shown in table no. 7.

Table No-7: Evaluation of physical properties of powder blend of all formulations

Formulations	Angle of repose (θ)	Bulk density (gm/ml)	Tapped density (gm/ml)	Carr's Index (%)	Hausner' Ratio
F1	29.24º±0.29	0.459±0.002	0.621±0.002	26.08±0.001	1.35±0.01
F2	24.34º±0.59	0.486±0.001	0.675±0.001	28.00±0.01	1.38±0.02
F3	26.56º±0.39	0.497±0.01	0.684±0.001	27.33±0.22	1.37±0.01
F4	27.52º±0.78	0.482±0.001	0.679±0.002	29.01±0.001	1.40±0.03
F5	28.92º±0.36	0.488±0.001	0.643±0.001	24.10±0.000	1.31±0.05

POST FORMULATION RESULTS

Evaluation of tablets: The formulated tablets were subjected to various evaluation tests like dimension, hardness, friability, weight variation and content uniformity as per standards. Dimensions for all tablets were found to be uniform indicating efficiency of the punching process.

Post compressional parameters of matrix tablet

The shape of the tablets of all formulations remained flat faced circular with no visible cracks. The thickness and diameter of tablets was measured by vernier calipers and was ranged between 8.20 to 8.40mm. The hardness of the tablets was measured by Monsanto hardness tester and was in between 14 to 14.30 kg/cm^2. The friability was measured by Friabilator and was found to be 0.321 to 0.618%, which is an indication of satisfactory mechanical resistance of the tablets. The drug content estimations showed values in the range of 91 to 95 % which reflects good uniformity in drug content among different formulations. All the tablets passed weight variation test as the % weight variation was within the Indian Pharmacopoeial limits of ±5% of the weight. All the formulations showed values within the prescribed limits for tests like hardness, friability and weight variation which indicate that the prepared tablets are of standard quality. Tablets composed of polymeric matrices build a gel layer around the tablet core when they come in contact with water. This gel layer governs the drug release. Kinetics of swelling is important because the gel barrier is formed with water penetration. The swelling index of matrix tablets of F1 to F5 is shown in table no 8. Tablets containing equal concentration of Carbopol 940 and HPMC showed constant increasing in swelling index up to 12 h. Tablet containing more concentration of carbopol resulted in a higher swelling index. The reason for this appeared to be its high viscosity and high water retention property. Initially tablet remained intact for 12 hr. With respect to time, swelling index of the tablet increased. Tablet was disintegrated within 20 hrs. (Results shown in Table no. 8)

Table No-8: Evaluation of Post compressional parameters of different formulations

Formulation	Hardness (kg/cm^2)	Thickness (mm)	Friability (%)	Avg. wt (mg)	Swelling index (%)	Drug content (%)
F1	14.10±0.50	8.35	0.464	1000	92.15	92
F2	14.20±0.50	8.30	0.536	980	97.36	93
F3	14±0.50	8.40	0.345	990	98.05	95
F4	14.30±0.20	8.20	0.618	1005	96.80	92
F5	14.10±0.50	8.35	0.321	1000	93.62	91

In-vitro Dissolution study:

Comparative study of different formulations (F2-F4) is shown in the plot. The *in-vitro* release of formulation F4 was found to be maximum.

Analysis of release mechanism:

The drug release data of tablets were fitted to models representing Higuchi's, zero order and Korsmeyer's equation kinetics to know the release mechanisms. The data were processed for regression analysis using MS EXCEL statistical function. The results are shown in Table and graphs in figure. The kinetic data showed that the release of drug followed diffusion controlled mechanism for the formulations. Diffusion is related to transport of drug from the dosage form into the *in vitro* fluid depending up on the concentration.

In order to understand the mechanism and kinetic of drug release, the drug release data of the *in vitro* dissolution study were analyzed with various kinetic model like zero order (fraction drug release *vs* time), Higuchi model (fraction drug release *vs* square root of time), and Peppas model equation. R^2 values were calculated for the linear curves obtained by regression analysis of the above plots. The regression value of zero order plot of formulation was found to be 0.9925 (*O.sanctum*) and 0.9833(*G.glabra*). Therefore the formulation showed Zero order release. Results are shown in table no. 9, 10 and figure 9 to 16.

Table No-9: %CDR of different formulations of matrix tablet

Time (min)	F1		F2		F3		F4		F5	
	O	G	O	G	O	G	O	G	O	G
15	7.88	7.82	6.12	8.96	5.64	8.32	8.37	8.91	7.95	7.85
30	11.65	12.86	8.16	15.87	7.13	11.75	10.55	18.86	12.31	11.28
60	18.86	23.54	11.12	24.27	9.01	15.35	12.03	25.61	17.54	15.54
120	25.35	26.42	13.42	30.9	12.21	16.58	15.52	29.45	22.64	18.06
180	28.89	32.93	17.47	34.47	15.60	18.05	18.28	34.21	26.71	24.28
240	33.94	35.28	22.64	37.32	19.4	22.66	23.57	38.43	30.16	27.46
300	35.51	39.05	26.58	40.75	22.34	28.05	27.94	42.65	36.83	30.05
360	38.97	42.87	28.25	43.35	25.27	31.33	31.43	44.37	40.52	34.91
420	42.64	45.09	33.75	47.58	29.44	35.89	35.67	47.2	44.86	39.22
480	46.06	48.57	36.43	50.05	32.14	39.28	40.62	52.73	49.57	42.87
540	50.11	51.76	40.17	52.66	35.36	43.06	46.23	56.27	52.41	46.54
600	54.71	53.54	44.36	55.05	38.12	47.03	52.38	62.30	55.62	50.39
660	57.53	55.03	49.16	58.33	41.23	54.84	58.42	64.23	57.84	57.67
720	60.29	58.76	52.33	60.89	46.59	57.26	64.89	67.34	60.76	60.43
780	63.65	60.25	55.58	62.03	50.26	64.83	68.72	70.37	63.81	63.76
840	67.54	62.57	57.29	64.83	55.78	69.68	73.12	74.09	65.03	67.58
900	69.07	65.42	62.38	70.83	60.45	73.55	76.38	78.49	69.61	70.73
960	70.44	67.09	71.86	76.67	66.12	77.67	80.61	82.36	71.84	73.24
1020	72.25	69.27	74.10	84.43	71.12	84.43	83.24	85.77	72.97	74.36
1080	73.65	71.05	82.46	87.44	82.19	87.76	85.39	89.31	75.08	76.87
1140	75.09	73.38	89.32	90.44	88.45	90.44	88.32	91.65	77.02	79.31
1200	77.21	75.54	92.45	92.77	90.23	93.75	91.50	94.77	80.34	82.92

O= *Ocimum sanctum*, G= *Glycyrrhiza glabra*

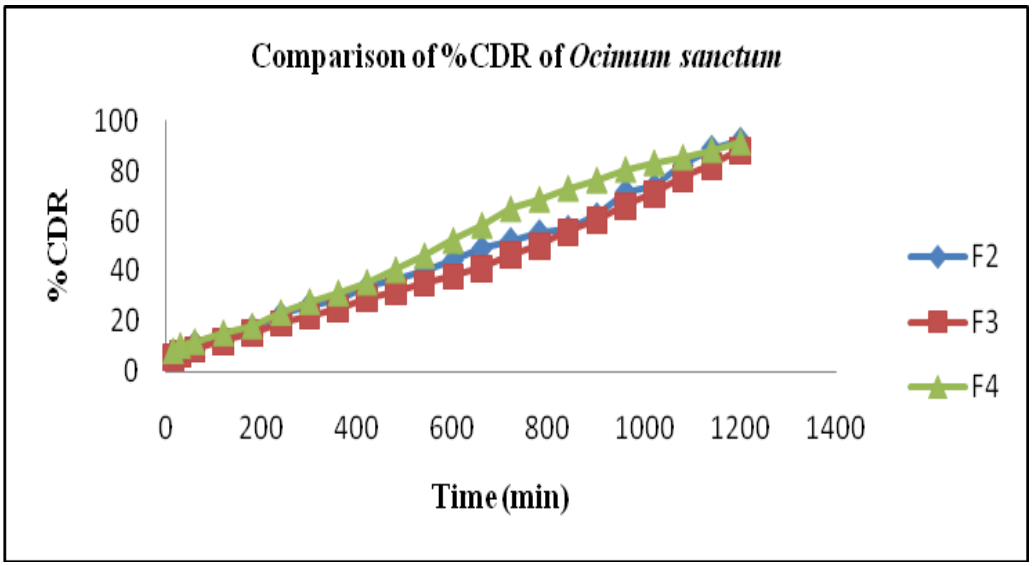

Figure-9: Comparison of %CDR of different formulations of *Ocimum sanctum*

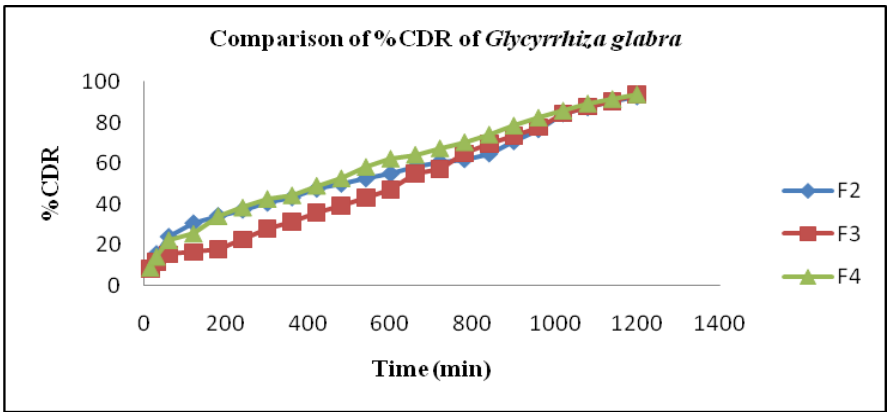

Figure-10: Comparison of %CDR of different formulations of *Glycyrrhiza glabra*

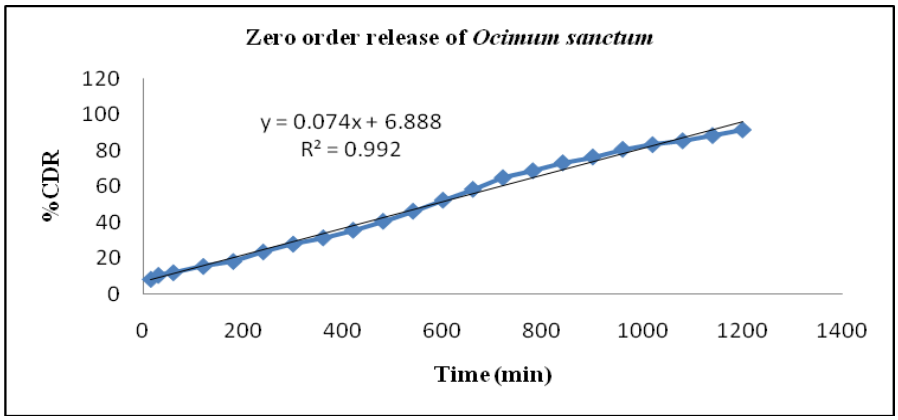

Figure-11: Zero order plot of *Ocimum sanctum* from formulation F4

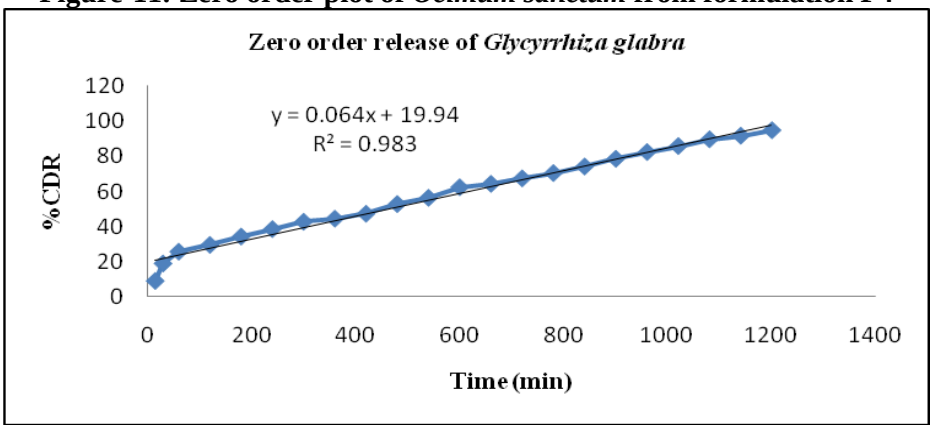

Figure-12: Zero order plot of *Glycyrrhiza glabra* from formulation F4.

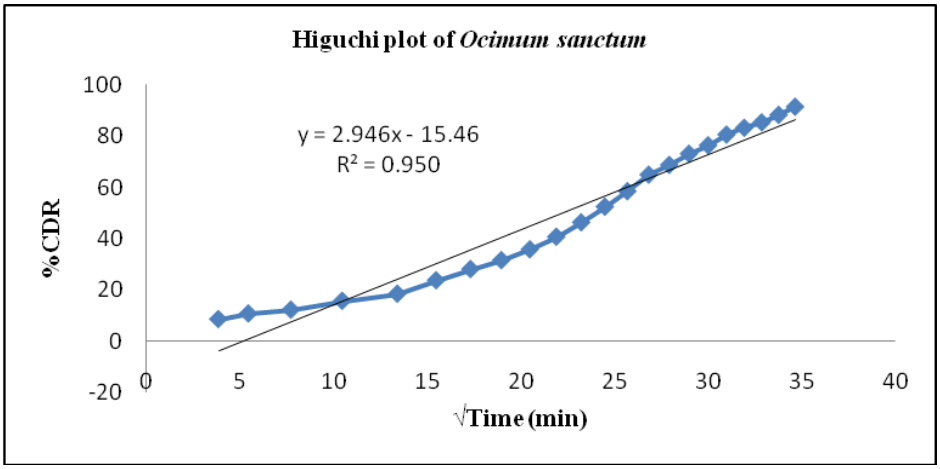

Figure-13: Higuchi plot of *Ocimum sanctum* from formulation F4.

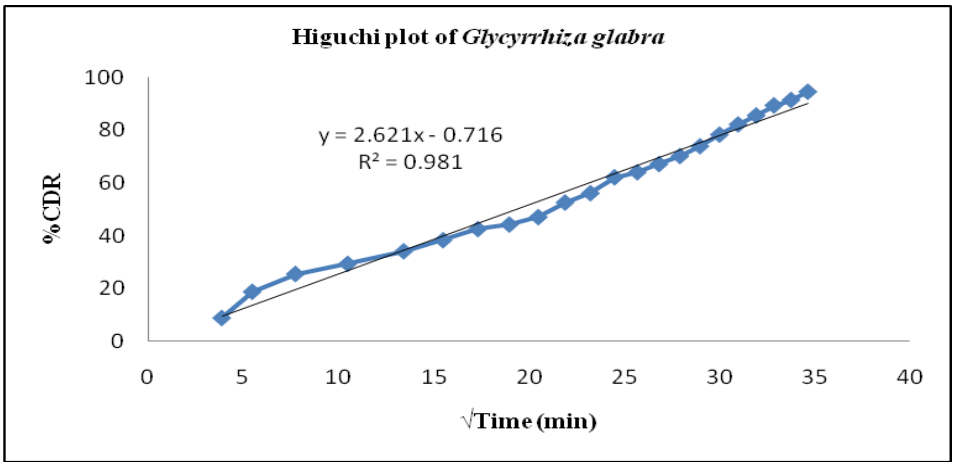

Figure-14: Higuchi plot of *Glycyrrhiza glabra* from formulation F4.

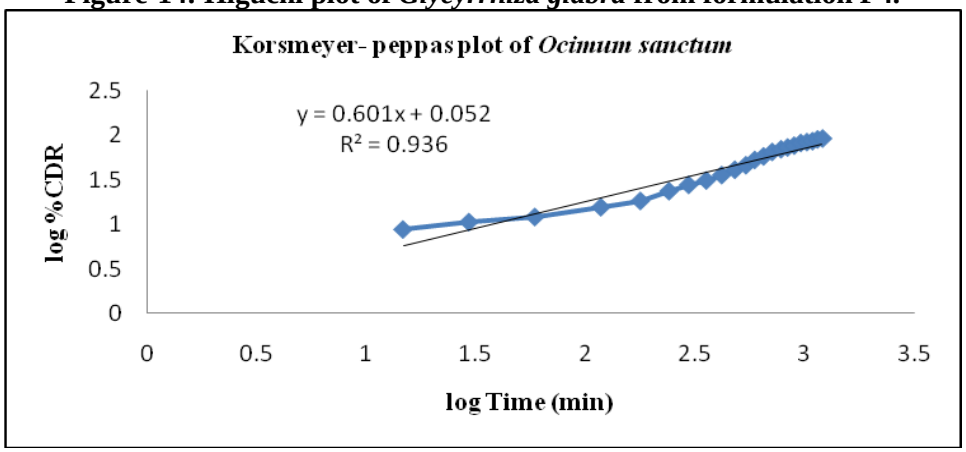

Figure-15: Korsmeyer- peppas plot of *Ocimum sanctum* from formulation F4

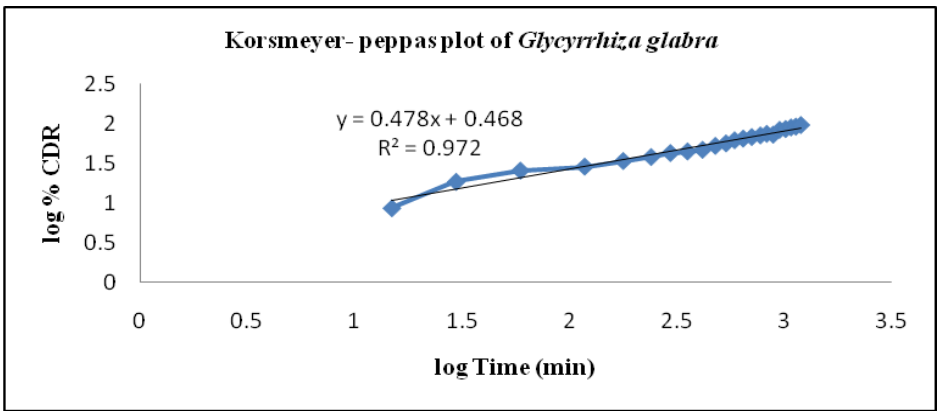

Figure-16: Korsmeyer- peppas plot of *Glycyrrhiza glabra* from formulation F4

Table-10: Results of model fitting of formulation F4

Model	Parameter	F4	
		O.sanctum	***G. glabra***
Zero order plot	Slope	0.0745	0.0649
	Intercept	6.8885	19.947
	R^2	0.9925	0.9833
Higuchi plot	Slope	2.9467	2.6218
	Intercept	15.469	0.7162
	R^2	0.9506	0.9811
Kosermeyer – peppas plot	Slope	0.6015	0.4788
	Intercept	0.0529	0.4685
	R^2	0.9361	0.9723

CONCLUSION

In the present study, controlled release matrix tablets of *Ocimum sanctum* and *Glycyrrhiza glabra* were formulated by Direct Compression technique. Sustained release matrix tablet was formulated with HPMC and Carbopol in order to sustain the drug release. The Pre-compressional parameters of matrix tablet i.e.; Angle of repose, Bulk density, Tapped density, Compressibility index, Hausner's ratio were studied and found to be in satisfactory limits indicating that the physical mixtures of the formulations were suitable to formulate the matrix tablets. Post-compressional parameters of matrix tablet i.e.; Weight variation, Hardness, Friability, Drug content, swelling index were evaluated and the results obtained were satisfactory. The *in-vitro* drug dissolution studies were carried out for the formulations at pH 0.1N HCL for 2hrs and in phosphate buffer for 20hrs. The formulation F4 comprising of HPMC and Carbopol sustained the drug release for a period of more than16 hrs. The formulation showed zero order drug release. Hence the above found formulations may be suitable for once a day administration.

ACKNOWLDGEMENT

I place my gratitude to our institution Bahra University, Shimla (H.P.). I thank my esteemed guide Mr. Niladry Shekhar Ghosh, (Head of the department) for his valuable guidance, keen interest, inspiration, unflinching encouragement and moral support throughout my dissertation work. I take this opportunity to express gratitude to all of the Department faculty members specially Miss Nisha Thakur for their help and support. Above all "Thank you" to the Almighty, who has given me this opportunity to extend my gratitude.

REFERENCES

Deepu.S, Molly. M and Shamna. M.S. (2014). Formulation and Evaluation of Swelling restricted Matrix Tablet containing Metformin Hcl, IOSR journal of Pharmacy: Vol. 4, 4, 43-52.

Deore S.L, Jaju P.S and Baviskar B.A. (2014). Simultaneous Estimation of Four Anti-tussive Components from Herbal Cough Syrup by HPTLC. International Scholarly Research Notice: 1-7.

Jahan. Y and Siddiqui. H.H. (2012). Study of Anti-tussive Potential of *Glycyrrhiza glabra* and *Adhatoda vasica* using a Cough Model Induced by Sulphur dioxide gas. International Journal of Pharmaceutical Sciences and Research: Vol. 3, 6.

Kalra Ma, Khatak.M[a] and Khatak S[b]. (2011). Cold and flu: Conventional vs Botanical & Nutritional Therapy. International Journal of Drug Development and Research: Vol. 3, 1, 314-327.

Kasahikar. V. S and Patkar. P. (2011). Formulation and Evaluation of Taste Masked Chewable Herbal Tablet for Cough Remedy. International Journal of Research in Ayurveda and Pharmacy: Vol. 2, 3, 830-833.

Krishnarajan. D, Reddy C.M, Kanikanti. S, Kumar N.S and Purushothaman.M. (2013). Formulation and Evaluation of Sustained Release Matrix Tablet of Levofloxacin using Natural Polymer. Pharmacophore: Vol.4, 5, 146-157.

Kushwaha. S. K and Kori M.L. (2014). Development and Evaluation of Polyherbal Tablet from some Hepatoprotective Herbs. Scholars Academic Journal of Pharmacy: Vol. 3, 3, 321-326.

Lakka. N. S and Goswami. N. (2012). Solubility and Dissolution Profile Studies of Gliclazide in Pharmaceutical Formulations by RP-HPLC. International research journal of pharmacy: Vol. 3, 6, 126-129.

Lakshmi. T and Geetha R.V. (2011). *Glycyrrhiza glabra* Linn Commonly Known as Liquorice: A Therapeutic Review. International Journal of Pharmacy and Pharmaceutical Sciences: Vol. 3, 4, 20-25.

Mahajan. P, Mahajan.S.C and Mishra.D.K. (2011). Valsartan Release from Sustained Release Matrix Tablet and effect of Cellulose Derivatives. International Journal of Pharmacy and Life Sciences: Vol. 2, 1, 521-530.

Maurya. A, Sharma P.K and Singh. J. (2014). Matrix tablet- Simplest Method of Sustaining Drug action. Journal of Drug Discovery and Therapeutics: Vol. 2, 18, 59-64.

Nadig. P.D and Laxmi. S. (2005). Study of Anti-tussive activity of *Ocimum sanctum* Linn. in Gunnia pigs. Indian Journal Physiol Pharmacol: Vol. 49, 2, 243-245.

Parihar. M, Chouhan. A, Harsoliya. M.S, Pathan. J.K, Banerjee. S, Khan.N and Patel V.M. (2011). A Review-Cough & Treatments. International Journals of Natural Products: Vol.1, 1, 9-18.

Patidar. D, Jain. A, Jatav. R.K and Sharma. H. (2011). Formulation and Evaluation of Pioglitazone Hydrochloride Matrix Tablet containing *Aloe barbadensis* Miller mucilage Natural Anti-diabetic agent. International Journal of Drug Discovery and Herbal Research: 2011, Vol. 1, 3, 157-163.

Pawan. P and Kumar. N. (2013). Formulation, Evaluation and Comparison of Sustained Release Matrix Tablet of Diclofenac Sodium using Natural Polymer, International Journal of Research in Pharmaceutical and Biomedical Sciences. Vol. 4, 1, 367-379.

Raizada. A, Baboota. S, Ali. J, Bhandari. A, Purhoit.V.K. and Chadha. H. (2015). Formulation and Evaluation of Sustained Release Matrix Tablet of Boswellia and liquorice. American journal of Pharmacy and Health Research: Vol. 3, 1, 175-186.

Raju. S.K. (2014). Analysis of Anti Cough Preparation Available in Indian Markets. IOSR-Journal of Dental and Medical Sciences: Vol. 13, 3, 16-18.

Rathore. A.S, Jat R.C, Sharma. N and Tiwari. R. (2013). An overview: Matrix tablet as Controlled Drug Delivery System. International Journal of Research and Development in Pharmacy and Life Sciences: Vol.2, 4, 482-492.

ISSN : 0976-4550

INTERNATIONAL JOURNAL OF APPLIED BIOLOGY AND PHARMACEUTICAL TECHNOLOGY

Email : ijabpt@gmail.com

Website: www.ijabpt.com