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Formulation and evaluation of sustained release tablets of propranolol hydrochloride

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Abstract---The main objective of sustained release drug delivery system is to provide a steady state blood plasma level concentration which is non-toxic and therapeutically active for a longer period of time. Owing its increased patient compliance and prolonged release of action in delivering drugs several benefits can be contemplated in delivering of sustained release dosage form^[1]. Among various route of drug delivery Sustained release drug delivery is most widely preferred as it's less frequency of dosing and controls the release of drugs. Natural polymers are biodegradable and nontoxic in nature with reduced side effects. It is also eco-friendly and safe to be administered as compared to synthetic polymers. The current work was based on preparation of sustained release tablets of Propranolol Hydrochloride using natural polymers like Gum Acacia, Hibiscus Rosasinesis and Microcrystalline cellulose. Presently much attention is being paid for formulation of sustained release tablets that contains matrix system. Direct compression method was used for formulation of sustained release tablets of Propranolol Hydrochloride. The prepared tablets were evaluated for different pre-formulation studies and *in vitro* dissolution studies were performed using USP-III dissolution apparatus. Dissolution studies of different formulations were evaluated for 24 hours at 37°C. The prepared formulations having various concentrations of polymers were evaluated for different physicochemical characteristics and results of the *in vitro* dissolution study proved that F9 shown better drug release. Therefore, the study revealed that F9 may be a good choice in development of sustained release tablets of Propranolol Hydrochloride using natural polymers.

Keywords---Sustained release, *in vitro*, Propranolol Hydrochloride, F9, Natural Polymers.

Introduction

With many drugs, the basic goal of therapy is to achieve a steady-state blood or tissue level that is therapeutically effective and nontoxic for an extended period of time [1]. The design of proper dosage regimens is an important element in accomplishing this goal. In the recent past the controlled release concept and technology have received increasing attention face of growing awareness to toxicity and ineffectiveness of drug when administered or applied by conventional methods [2]. Thus, drugs administered in the form of tablets, capsules, injectable and ointments etc., usually produce wide ranging fluctuation in drug concentration in the blood stream and tissues with consequent undesirable toxicity and poor efficiency [3,4]. This factor as well as factor such as repetitive dosing and unpredictable absorption led to the concept of controlled drug delivery system or therapeutic system. A dosage form that release one or more drug continuously in a predetermined pattern for a fixed period of time, either systemically or to a specified target organ, is a controlled drug delivery system. The advent of drug delivery system brings rate-controlled delivery with fewer side effects, increased efficacy and constant delivery [5]. The primary objective of controlled drug delivery is to ensure safety of drugs as well as patient compliance. Controlled release drug administration means not only prolonged duration of drug delivery, as in sustained release and prolonged released, but also implies predictability and reproducibility of drug release kinetics [6]. Description such as retard, slow, gradual, controlled, continuous, sustained, programmed, fractionated, deferred and pulsatile release dosage forms and other similar definitions should be redefined as one of the following definitions. Prolonged release dosage forms that there may not be control of release rate, but prolongs therapeutic blood or tissue level of the drug for an extended period of time [7].

Controlled release dosage forms can provide some control, whether this is of a temporal or spatial nature or both of drug release in the body or in other words, the dosage form is successful at maintaining constant drug levels in the target tissue or cell. Delayed or repeated release dosage forms that release the dose or a part of the dose at a time different from that immediately following administration. The potential benefits that a sustained release system may bring to us can be appreciated by a consideration of prolonged and efficient delivery of

therapeutically effective dosages, patient compliance and localization of the therapy [8].

The bioavailability of drug molecules of drug molecule to the ailing tissue cells is governed by a sequence of pharmacokinetics process-release'-absorption, distribution, metabolism and elimination in some cases. These processes result in the inefficient bioavailability of drug to the target tissue cells [9]. The bioavailability to a target tissue can be maximized and the adverse side effect in non -target tissue can be minimized by applying the principle of sustained release system [10].

A well-designed sustained release system can reduce the frequency of drug dosing and also maintain concentration in blood circulation and target tissue cells. The pronounced fluctuation resulting from the conventional drug administration are likely to yield period of no therapeutic effect when the drug concentration falls below minimum effective dose level (med) and period of adverse reactions when the drug concentration exceeds the dose level. Drug concentration can be maintained within a narrow therapeutic range by use of sustained release system which will also minimize the incident and severity of adverse side effects [11]. The controlled or sustained release dosage forms are designed to complement the pharmaceutical activity of the medicament in order to achieve better and longer duration of action.

Advantages of sustained release formulations [12]

- Good patient compactibility
- Improved therapeutic activity
- Economically affordable
- Less dose variation
- Proper site of action

Disadvantages of sustained release formulations [13]

- Chance of over dosing
- Costlier
- Improper formulation may lead to excessive dosage or unreliable drug release
- Pharmacodynamics and pharmacokinetics factors Involved in Sustained release dosage form-
- Rate of absorption
- Distribution of drug
- Biological half-life
- Metabolism conversion of drug

Role of matrix system in sustained release formulations [7]

The tablet matrix is made by using both hydrophobic and hydrophilic polymers to sustain and increase the rate of drug release over a longer period of time. Now a day's much attention is being paid for formulation of sustained release tablets that contains matrix system.

Material and Methods

Natural polymers such as Hibiscus Rosasinesis leaves were collected, washed, dried at 37 °C for 24hr. Then it was crushed and soaked in warm demineralised (DM) water for 2-3hr and then left aside for 24 hr. Next day, the soaked leaves were stirred using overhead stirrer for 1-2 hr and it was heated up to 80-90 °C for 30-45 min while stirring for complete release of the water-soluble mucilage/polysaccharide in to the solvent. The mucilage was extracted by using a muslin cloth bag to remove the marc and acetone was added to the concentrated viscous solution with constant stirring. The precipitate formed was then separated by filtration and washed 2-3 times with acetone until obtain the paleyellow course powder, dried in an oven at 37 °C, collected, grounded, passed through sieve (# 40) and stored in desiccator. The dry powder was considered as water soluble polysaccharide for pharmaceutical use. which is used as release modifier. Gum Acacia and Micro Crystalline Cellulose were obtained from local market which is used as binder and diluent respectively. HPMC K100 M was used as stabilizing agent, CEMC was used as solubility enhancer, Aerosil was used as glidant and Titanium Di-oxide- Used as an Inactive agent. The tablets were prepared by direct compression by the mixture of drug and polymers. The weight of all tablets was kept constant i.e. 120 mg. A total of nine formulations were prepared and different preformulation studies and drug polymer interaction studies were conducted. The formulated tablets were subjected for studying *in-vitro* drug release by using USP-III dissolution apparatus for 24 hours at 37°C.

Table 1
Formulation Table

Ingredients (in mg)	F1	F2	F3	F4	F5	F6	F7	F8	F9
Propranolol Hydrochloride	80	120	120	120	120	120	120	120	120
Hibiscus Rosasinesis	40	50	60						
Gum Acacia				40	50	60			
MCC							40	50	60
HPMC K100M	10	10	10	10	10	10	10	10	10
CEMC	5	5	5	5	5	5	5	5	5
Titanium Dioxide	2	2	2	2	2	2	2	2	2
Total	137	147	157	137	147	157	137	147	157

Results and Discussion

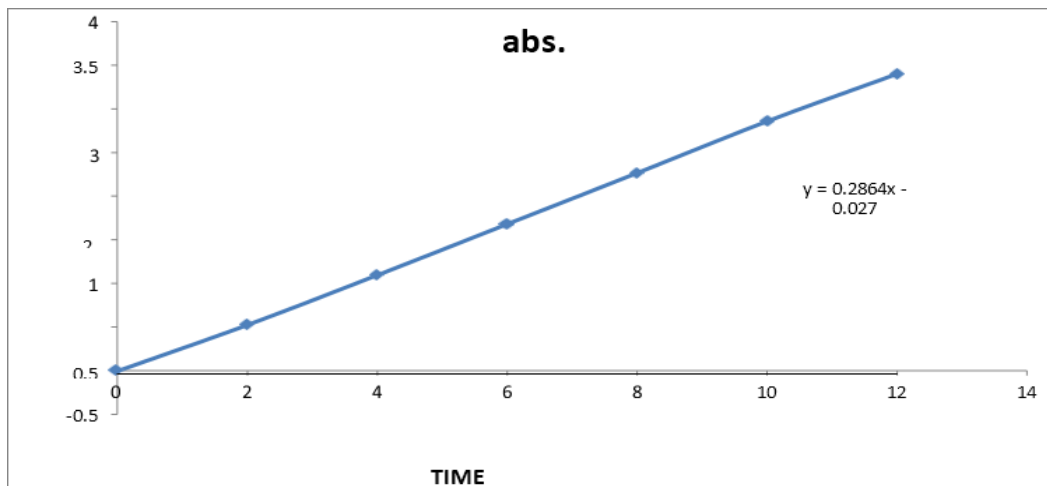


Figure 1- Calibration curve of propranolol hydrochloride using 0.1N HCL

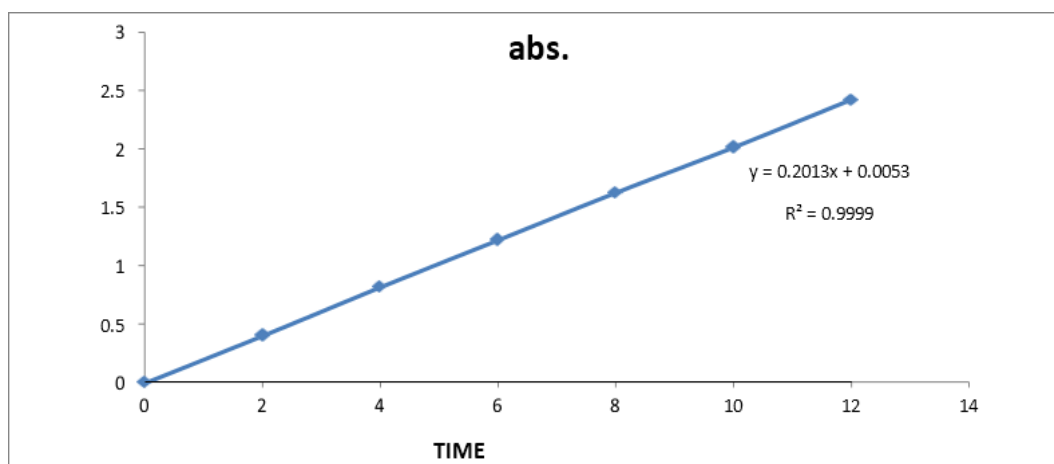


Figure 2. Calibration curve of propranolol hydrochloride using pH 6.

Table 2
Preformulation Study

Batch Code	Weight Variation (mg)	Friability (%)	Hardness (kg/cm ²)	Thickness (mm)
F1	400.74±2.27	0.67±0.03	5.1±0.56	3.58±0.17
F2	400.53±3.45	0.72±0.02	5.3±0.82	3.56±0.23
F3	400.45±2.40	0.64±0.01	5.2±0.73	3.58±0.32
F4	400.64±4.68	0.65±0.03	5.2±0.66	3.59±0.45
F5	400.84±1.23	0.73±0.04	5.5±0.65	3.48±0.55
F6	400.33±1.87	0.69±0.01	5.6±0.43	3.34±0.52

F7	400.15±2.05	0.57±0.05	5.5±0.18	3.53±0.86
F8	400.04±3.93	0.68±0.02	5.4±0.32	3.50±0.75
F9	400.24±4.87	0.56±0.05	5.3±0.43	3.51±0.72

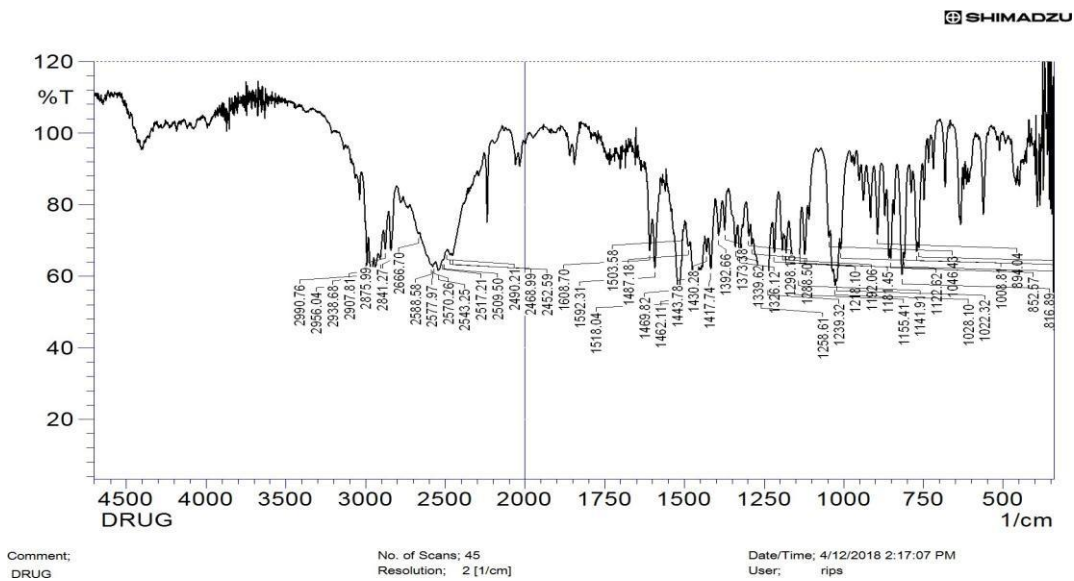


Figure 3. FTIR Spectra Of Pure Propranolol HCl

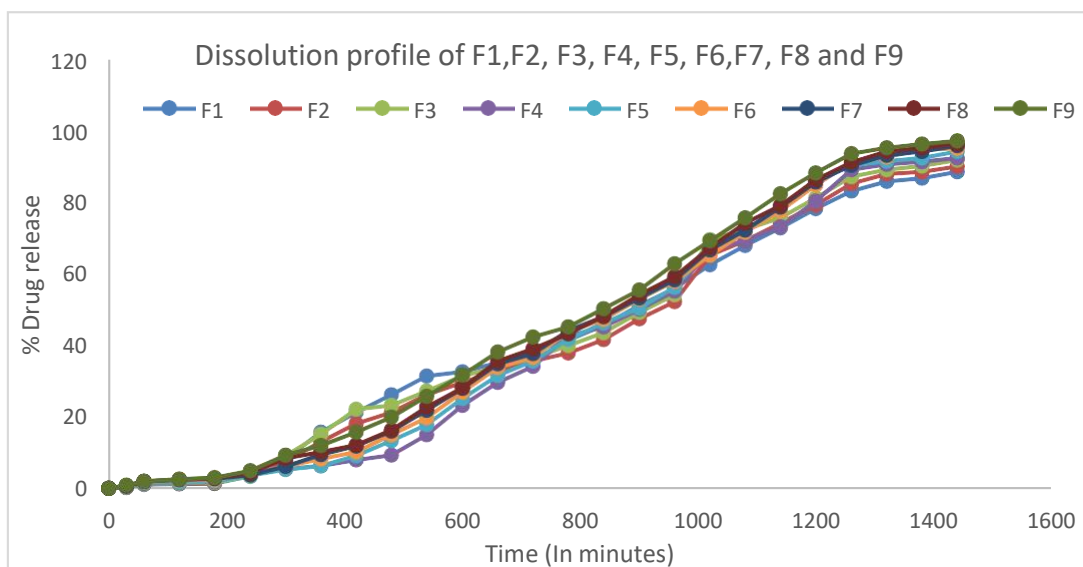


Figure 4. In-Vitro Dissolution Study

Table 3
Stability Data

Parameters	At initial day	After 1 month
Thickness (mm)	3.52±0.64	3.52±0.13
Hardness (kg/cm ²)	5.0±0.43	4.9±0.14
Weight variation (mg)	400.04±4.87	398±0.79
Drug content (%)	101.01±0.2	99.98±0.8

Conclusion

The formulations having various concentrations of polymers in combinations and alone were compressed by direct compression technique and were evaluated for different physicochemical characteristics, the results of the *in vitro* drug release profile shown that F9 having synthetic and semi-synthetic polymers in combination showed better drug release profile for a longer period of time i.e. 97.1% as compared to other formulations.

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Declarations:

Conflict of Interest- There is no conflicts of interest.

Ethical Approval- Nil.

Reference

1. Pradhan, R., Kim, Y. I., Chang, S. W., & Kim, J. O. (2014). Preparation and evaluation of once-daily sustained-release coated tablets of tolterodine-L-tartrate. *International Journal of Pharmaceutics*, 460(1-2), 205-211.
2. Fu, Q., Su, X., Hou, Y., Li, M., Li, J., Sun, J., & He, Z. (2016). Once-daily amoxicillin immediate-and extended-release bilayer tablets. *Powder Technology*, 301, 405-411.
3. Alkrad, J. A., Shmeis, R. A., Alshwabkeh, I., Abazid, H., & Mohammad, M. A. (2017). Investigation of the potential application of sodium bentonite as an excipient in formulation of sustained release tablets. *asian journal of pharmaceutical sciences*, 12(3), 259-265.
4. Dabbagh, M. A., Ford, J. L., Rubinstein, M. H., Hogan, J. E., & Rajabi-Siahboomi, A. R. (1999). Release of propranolol hydrochloride from matrix tablets containing sodium carboxymethylcellulose and hydroxypropylmethylcellulose. *Pharmaceutical development and technology*, 4(3), 313-324.
5. Lee, B. J., Ryu, S. G., & Cui, J. H. (1999). Formulation and release characteristics of hydroxypropyl methylcellulose matrix tablet containing melatonin. *Drug development and industrial pharmacy*, 25(4), 493-501.

6. Balan, G., Timmins, P., Greene, D. S., & Marathe, P. H. (2001). In vitro–in vivo correlation (IVIVC) models for metformin after administration of modified-release (MR) oral dosage forms to healthy human volunteers. *Journal of pharmaceutical sciences*, 90(8), 1176-1185.
7. Varia, U., Prajapati, B., & Katariya, H. (2018). Formulation and development of bosentan loaded once a daily tablet for pulmonary artery hypertension using lipid matrices by 3 (2) full factorial design. *International journal of pharmaceutical sciences and research*, 9(11), 4729-4740.
8. Hasan, A. A., Madkor, H., & Wageh, S. (2013). Formulation and evaluation of metformin hydrochloride-loaded niosomes as controlled release drug delivery system. *Drug delivery*, 20(3-4), 120-126.
9. Roy, H., Brahma, C. K., Nandi, S., & Parida, K. R. (2013). Formulation and design of sustained release matrix tablets of metformin hydrochloride: Influence of hypromellose and polyacrylate polymers. *International Journal of Applied and Basic Medical Research*, 3(1), 55.
10. Tahara, K., Yamamoto, K., & Nishihata, T. (1995). Overall mechanism behind matrix sustained release (SR) tablets prepared with hydroxypropyl methylcellulose 2910. *Journal of controlled release*, 35(1), 59-66.
11. Wadher, K. J., Kakde, R. B., & Umekar, M. J. (2011). Formulation of sustained release metformin hydrochloride matrix tablets: Influence of hydrophilic polymers on the release rate and in vitro evaluation. *International Journal of Research in Controlled Release*, 1(1), 9-16.
12. PATEL, M. R., PATEL, A. A., PRAJAPATI, L. M., & PATEL, N. M. (2012). Intra-gastric floating drug delivery system of metformin hydrochloride as sustained release component and glimepiride as immediate release component: formulation and evaluation.
13. Dsilva, L. C., Palmer, J. O. N. A. T. H. A. N., Sudershan, V. I. S. H. W. A. N. A. T. H., & GHORPADE, S. A. (2013). Effect of food on the absorption of metformin from sustained release metformin hydrochloride formulations in healthy Indian volunteers. *Asian J Pharm Clin Res*, 6, 95-9.