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A REVIEW ON TABLET MODIFIED DRUG DELIVERY AND COATING TECHNOLOGY

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Abstract:

The tablet is one of the most favorable and highly used solid dosage forms. The coating is defined as methods in which the desired dosage form may be a tablet or granule coated with an outer dry film to obtain particular objectives such as masking taste or protecting against environmental conditions. Among three types of tablet-coating processes (sugar coating, film coating, and press coating), film coating is the most generally used approach to solve various issues experience during manufacturing, storage, transport, and clinical use of drug products. The various tablet modified technologies are diffusion system, dissolution system, osmotic system, ion exchange resin, floating systems, bio-adhesive systems, matrix systems and stimuli inducing releasing. As tablet coating is a process driven by technology, it relies on advancements in coating techniques uses, equipment used for the coating process, examination of coated tablets, and coated material used. Polymers play a vital role in coating technology; sometimes, they are used for changing the delivery of dosage forms, taste masking, and film forming agent.

Keywords: *Tablets, Coatings, Modified drug delivery, Tablet evaluations.*

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INTRODUCTION:

Tablets are among the most appropriate and preferred oral dosage forms because of their many benefits, including ease of administration, greater patient compliance, and cost-effectiveness. Among the multiple steps in pharmaceutical formulating of tablets, coating is a critical process that is often used for functional and elegance reasons [1]. The aesthetic quality like texture, color, mouth feels, and taste masking is depending on coating methods [2]. These coating methods having certain restrictions or drawbacks to overcome these restrictions. Tablet is one of the best alternatives.

The tablet is one of the most favorable and highly used solid dosage forms. Tablets are the compressed dosage form that may or may not contains the active drugs. They differ in size, shape, and weight depending on the mode of administration and active ingredients used. Of all the dosage forms, approximately 70% - 75% of the medications were administered in tablets [3]. Tablets have some benefits over other dosage forms, such as precise dose, feasibility, and patient compliance, because they are produced on a large scale [4].

Coating:

The coating is defined as methods in which the desired dosage form may be a tablet or granule coated with an outer dry film to obtain particular objectives such as masking taste or protecting against environmental conditions. The coating material may be composed of coloring materials, gums, flavorants, waxes, resins, plasticizers, and a polyhydric alcohol. In the modern time, polysaccharides and polymers were principally used as coating materials along with other excipients like plasticizers and pigments. Many precautions must be considered during the coating process to make the coating durable and steady. According to the International Council for Harmonisation (ICH) guidelines, organic solvents are avoided in the formulation of pharmaceutical dosage forms due to their safety issues [5]. Tablets that are susceptible to degradation by moisture or oxidation must be coated by using the FC technique. This technique could increase its shelf life, mask its bitter taste, and make smoother covering safeguards, which makes swallowing easier. Chitosan and other muco-adhesive polymers were also used for coating tablets to adhere these tablets to mucous membranes and achieve sustained drug release in localized areas [6]. In recent periods, coating of the dosage form by using biopolymers has been extensively studied [7]. Active pharmaceutical ingredients (APIs), which are careful to light, can be secured by coating with opacifying agents. Similarly, enteric-coated tablets reach the intestine after an extended time and possibly help maintain the efficacy level of acid labile APIs [8].

Among three types of tablet-coating processes (sugar coating, film coating, and press coating), film coating is the most generally used approach to solve various issues experience during manufacturing, storage, transport, and clinical use of drug products [9]. For example, tablets containing active pharmaceutical ingredients (APIs) sensitive to light, oxidation, or moisture can be secured by film coating, leading to increased stability of drug products during manufacturing and storage. In addition, film coating can control the drug release patterns of tablets in terms of rate, site, and time [10,11,12].

Objectives of coating [13,14,15]

The objectives of tablet coating are as follows:

To mask the unpleasant odor, color or taste of the tablet and increase patient compliance.

To offer a physical and/or chemical safeguard to the drug and protect drug from external environment (particularly moisture, air, and light) in order to upgrade stability.

- To lengthen the shelf life of the drug.
- In improving product robustness.
- To delay loss of volatile ingredients.
- To increase ease of swallowing large dose forms.
- Increasing the mechanical p of the dosage form
- Masking batch differences in the appearance of raw materials.
- To include incompatible drugs together in a single dosage form
- Improving product appearance and help in identification by the manufacturer, the pharmacist and the patient (mostly colored).
- To modify and/or regulate the rate of drug release as in repeat-action, delayed release (enteric coated) and sustain-release formulations.

Masking batch differences in the appearan

Benefits of coating:

Coating gives stability to the tablets in handling and stops them from sticking together. The coating also better the mechanical strength of the dosage form, causes the dosage form smoother and more acceptable for swallowing purposes [16]. Pharmaceutical industries could print their symbols, marks, or abbreviations on the tablets and mask unpleasant color or odor of the tablets. The release of the active ingredient can even be regulates with the help of

coatings. Coated dosage forms could be site-specific. The coating stops acid-sensitive drugs from having a negative impact on the gastrointestinal tract (GIT). The drug release rate in the gastrointestinal tract could be regulated by controlling the dissolution rate of the tablet [17].

Types of coating:

The types of tablet coating used to go to increase specific functionality that ranges from hide bitter taste of the tablets, creating a smooth covering to promote easy swallowing, protect the pill from damage or external forces, create a branded pill for marketing motive as well as increase the shelf life of the tablets [18-22].

1. Sugar Coated Tablets

Have you ever administer on a tablet and had an eruption of bitter regret in your mouth? This type of covering offers a sweet coat mainly made from polysaccharides and sucrose to obscure the bitter taste of the tablet. The sugar coating also offers a sweet aroma mostly on foul smelling pills like fish supplements. The sugar syrup is coated on the tablet and water is left to vaporize from the syrup leaving a sugar coating. The coating results in a highly flavored and shiny tablet [18]. Sugar coating tablets is especially used for kids.

2. Film Coated Tablets

This is the most frequently used coating in the pharmaceutical industry today. The coating is used for elegance purposes and to improve the taste of the pill. Tablets especially those from herbal extracts are not graphic pleasing, therefore a coating is necessary for beautifying the tablet using dissimilar colors. In other cases, not all tablets need a coat, just a film to maintain its original color. Spraying is used to made an even film around a tablet [19,20]. This type of tablet is creates a stable and strong tablet, and tablet branding colors and identifiable coatings.

3. Gelatin Coated Tablets

Gelatin is a type of protein that is derived from limited hydrolysis of collagen. It is found from animal parts and contains amino acids that are the 'building blocks' of proteins. Gelatin is used to create the gel cap, a capsule-shaped tablet as the outer coat. Gelatin coated tablets are creates a rich protein-based coating [21].

4. Enteric Coated Tablets

This coating supply a stomach acid resistant coat for the tablets that have an ingredient that is sensitive to acid. If a tablet is to be absorbed in the small intestines, therefore there is need for the tablet to withstand stomach acid and reach the targeted area where it is absorbed slowly where there is no acidity.

This type of tablet should not be crushed or chewed to prevent the risk of damage due to a reaction with stomach acid [18,21]. This type of tablets is delivering the tablet to intestines without damaging effects to the drug or consumer.

5. Compression Coating Tablets

It involves compression of granular particles around assign tablet using special equipment through a dry process. It is less common than the rest and consists of the outer covering and an internal core. The delayed release of tablet especially those for intestines [22,23].

Equipment's used for tablet coating:

Equipment was normally used to coat the tablet outer layer with a thin film that acts as a coating material. The general motive of the film was to prevent the tablet from physical or chemical harm and mask the unpleasant odor, smell, and taste. The coating also shields the tablet from the harsh gastric environment and encourages sustained drug release. The coating also enhances the aspect of the tablet [24].

Equipment used for coating purposes was established on simple principles: the coating is applied on the tablets in a solution form while the rotator is moving vertically or horizontally. During rotation, a stream of hot air is also introduced, which promotes the evaporation of the solvent. Continued movement of the beds causes an even distribution of the coating material over the tablets and even drying [16].

Types of coating Equipment:

- Standard Coating Pan
- Perforated Coating Pan
- Fluidized Bed Coater / Air Suspension System

Standard Coating Pan:

Standard coating pan gadget comprises a round steel pan set up on a stand especially in angular position. The pan is 10-60 inches in diameter and is rotated by a horizontal axis by a motor. Hot air is sent to the pan and the surface of the tablet bed. And is exhausted through ducts position through the front of the pan. Coating solutions are transport to the drug by spraying or spraying the rotating tablet on the bed. By ladling or spraying the coating solution is applied to the tablet bed. Use of an atomizing system to spray the liquid coating material onto the tablets produces a faster more even dispensation of the solution or suspension. Spraying can significantly reduce the drying time between solution application in sugar-coating procedures and allows for continuous application of the solution in film coating [24,25].

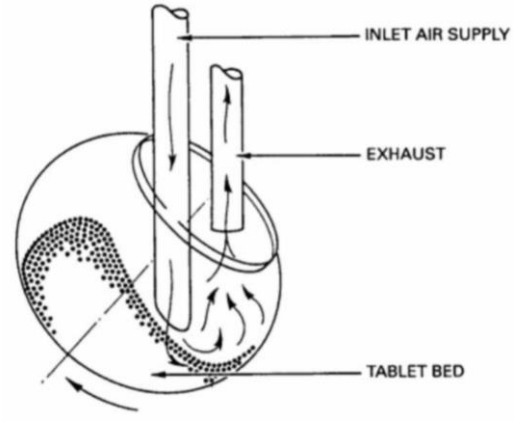

Figure 1: Standard coating pan

Perforated Coating system:
Perforated Coating system is used in two cases totally penetrate or partially perforated drum, which rotates in an enclosed housing on its horizontal axis. The drying of coating material by perforated coating system is better as compared to other conventional methods. This system makes a huge compensation in time [26].
Examples of perforated coating pans include:

1. Accela-cota & Hi-coater systems
2. Driacoater
3. Glatt coater

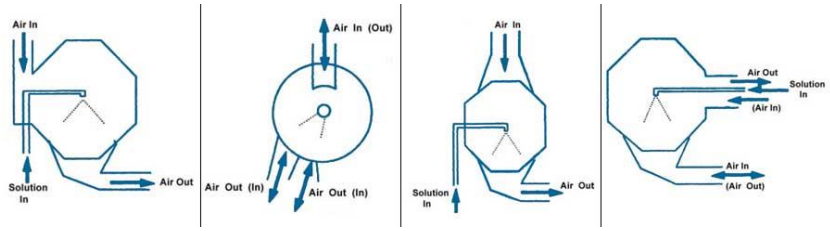

Figure 2: Perforated Coating system

Fluidized Bed Coater / Air Suspension System:
Fluidized Bed Coater is a highly methodical drying system. Fluidization of the tablet mass is attained in a columnar chamber by the upward flow of the drying air. The air flow is controlled to draw more air in the middle of the column, which causes the tablet to rise in the center. In some units a small column is used to control the motions of the tablet inside the main column. Coating solutions are applied constantly to the bottom of the chamber with a spray nozzle located above the chamber of the bed [25-27].

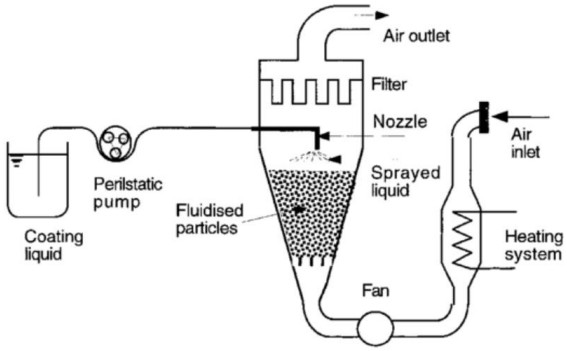

Figure 3: Fluidized Bed Coater or Granulator

Tablet Coating Evaluation:
Before a tablet is released out into the market it has to pass a some quality checks, which is compulsory. Evaluation of tablet includes the assessment of tablets chemical, physical, and biological properties. To studies them the following tests are formulated [28].

- Appearance,
- Size and Shape,
- Organoleptic properties,
- Uniformity of thickness,
- Hardness,
- Friability,
- Drug Content Uniformity,
- Weight Variation Test,
- Wetting time,
- Water Absorption Ratio,
- In vitro Dispersion Time,
- In vitro Disintegration Test,
- In vitro Dissolution Studies,
- Two set of apparatus.

Tablet Modified drug release technology:
There are many different methods used to obtain a sustained release.

Diffusion systems:
Diffusion systems' rate liberates is dependent on the rate at which the drug dissolves through a barrier which is usually a types of polymers. Diffusion systems can be broken into two subcategories, reservoir devices and matrix devices [29].

- Reservoir devices coat the drug with polymers and in order for the reservoir devices to have sustained-release results, the polymer must not dissolve and let the drug be released through diffusion [29]. The rate of reservoir devices can be changed by changing the polymer and is feasible be made to have zero-order release; however, drugs with higher molecular weight have difficulty diffusing through the membrane [30,31].
- Matrix devices forms a matrix (drug(s) mixed with a gelling agent)[9] where the drug is dissolved/dispersed [32]. The drug is usually distribute within a polymer and then released by go through diffusion. However, to make the drug SR in this device, the rate of dissolution of the drug within the matrix needs to be higher than the rate at which it is released. The matrix device cannot achieve a zero-order release but higher molecular weight molecules can be used [33]. The diffusion matrix device also tends to be easier to manufacture and protect from changing in the gastrointestinal tract, but factors such as food can affect the release rate [33].

Dissolution systems:
Dissolution systems must have the system dissolved steadily in order for the drug to have sustained release possessions which can be achieved by using suitable salts and/or derivatives as well as coating the drug with a dissolving material [29]. It is used for drug amalgams with high solubility in water [6]. When the drug is protecting with some slow dissolving coat, it will in the end release the drug. Instead of diffusion, the drug release depends on the solubility and thickness of the coating. Because of this mechanism, the dissolution will be the rate limiting factor for drug release. Dissolution systems can be broken down to subcategories called reservoir devices and matrix devices [32].
The waterproof device coats the drug with a suitable material which will dissolve slowly. It can also be used to administer beads as a group with varied thickness, making the drug release in multiple times creating a SR [29,32].

The matrix device has the drug in a matrix and the matrix is dissolved rather of a coating. It can come either as drug-impregnated spheres or drug-impregnated tablets [32].

Osmotic systems:
Osmotic controlled-release oral delivery systems (OROS) have the form of a rigid tablet with a semi-penetrable outer membrane and one or more small laser drilled holes in it. As the tablet passes through the body, water is absorbed through the semi-permeable membrane via osmosis, and the resulting osmotic pressure is used to push the active drug through the opening(s) in the tablet. OROS is a branded name owned by ALZA Corporation, which pioneered the use of osmotic pumps for oral drug delivery [33-35].

Osmotic release systems have a number of major advantages over other controlled-release mechanisms. They are significantly less pretentious by factors such as food intake, pH, GI motility, and differing intestinal environments. Using an osmotic pump to take drugs has additional intrinsic advantages regarding control over drug delivery rates. This allows for much more precise drug delivery over an extended period of time, which results in much more predictable pharmacokinetics. However, osmotic release systems are relatively complicated, somewhat difficult to manufacture, and may cause irritation or even blockage of the GI tract due to prolonged release of irritating drugs from the non-deformable tablet [33-38].

Ion-exchange resin:
In the ion-exchange method, the resins are cross-linked water-insoluble polymers that contain ionisable functional groups that form a repeating pattern of polymers, creating a polymer chain [29]. The drug is attached to the resin and is released when an appropriate interchanges of ions and ion exchange groups occur. The area and length of the drug release and number of cross-link polymers dictate the rate at which the drug is released, determining the SR effect [32].

1. **Floating systems:**

A floating system is a system where it floats on gastric fluids due to lower density. The density of the gastric fluids is about 1 g/mL; thus, the tablet administered must have a smaller density. The buoyancy will allow the system to float to the top of the stomach and release at a slower rate without worry of excreting it. This system requires that there are enough gastric fluids present as well as food [29]. Many types of forms of drugs use this method such as capsules, powders, and tablets [39].

2. **Bio-adhesive systems:**

Bio-adhesive systems generally are meant to stick to mucus and can be approving for mouth based interactions due to high mucus levels in the general area but not as simple for other areas. Magnetic materials can be added to the drug so another magnet can hold it from outside the body to assist in holding the system in place. However, there is low patient compliance with this system [29].

3. **Matrix systems:**

The matrix system is the combination of materials with the drug, which will cause the drug to slow down. However, this system has several subtypes: hydrophobic matrices, hydrophilic matrices, lipid matrices, mineral matrices, and biodegradable matrices [29].

4. **Stimuli inducing release:**

Examples of stimuli that may be used to bring about release include enzymes, pH, light, magnetic fields, ultrasonics, temperature, osmosis, cellular traction forces, and electronic control of MEMS and NEMS [40,41].

Spherical hydrogels, in micro-size with 3-dimensional cross-linked polymer, can be used as drug carrier to regulate the release of the drug. These hydrogels also known as microgels. They may possess a negative charge as example DC-beads. By ion-exchange mechanism, a large amount of oppositely charged amphiphilic drugs can be loaded inside these microgels. Then, the release of these drugs can be controlled by a specific triggering factor like pH, ionic strength or temperature [42].

CONCLUSION:

Coating the solid dosage form, such as tablets, is think about common, but it is a censorious process that supplies different features to tablets. It increases the value of solid dosage form, administered orally, and thus meets various clinical essential. As tablet coating is a process driven by technology, it relies on advancements in coating techniques uses, equipment used for the coating process, examination of coated tablets, and coated material used. Polymers play a vital role in coating technology; sometimes, they are used for changing the delivery of dosage forms, taste masking, and film forming agent. The biological properties exhibited for “jarillas” extracts would justify the use of extracts or bioactive compounds obtained from these species for the enlargements of phytomedicines and/or phytocosmetics and/or food products.

REFERENCES:

1. Mittal B. Pharmaceutical unit operations. In: Mittal B., editor. How to Develop Robust Solid Oral Dosage Forms from Conception to Post-approval. Academic Press; London, UK: 2017. pp. 69–95.
2. Pawar R, Jaimini M, Chauhan BS, Sharma SK (2014) Compression coated tablets as drug delivery system (tablet in tablet): a review. International Journal of Pharmaceutical Research and Development 6(1):21–33.
3. Saikh M.A.A. A technical note on granulation technology: A way to optimise granules. *Int. J. Pharm. Sci. Res.* 2013;4:55.
4. Silva J.P.S.e., Sousa S.C., Costa P., Cerdeira E., Amaral M.H., Lobo J.S., Gomes A.M., Pintado M.M., Rodrigues D., Rocha-Santos T., et al. Development of probiotic tablets using microparticles: Viability studies and stability studies. *AAPS Pharmscitech.* 2013;14:121–127.
5. Felton L.A., Porter S.C. An update on pharmaceutical film coating for drug delivery. *Expert Opin. Drug Deliv.* 2013;10:421–435.
6. Maheshwari R., Sharma P., Tekade M., Atneriya U., Dua K., Hansbro P.M., Tekade R.K. Microsponge embedded tablets for sustained delivery of nifedipine. *Pharm. Nanotechnol.* 2017;5:192–202.
7. Tekade R.K., Maheshwari R., Tekade M. *Biopolymer-Based Nanocomposites for Transdermal Drug Delivery*. *Biopolymer-Based Composites*. Elsevier; Amsterdam, The Netherlands: 2017. pp. 81–106.
8. Desai D.S., Li B.V. Coated Tablet Formulation and Method. EP1753406A1. *European Patent.* 2016 April 20;
9. Lee S.H., Bajracharya R., Min J.Y., Han J.-W., Park B.J., Han H.-K. Strategic approaches for colon targeted drug delivery: An overview of recent advancements. Pharmaceutics. 2020;12:68.
10. Yang S., Wang X., Jia J., Li P. Release property study on the novel divalproex sodium enteric-coated capsules. Saudi Pharm. J. 2016;24:245–249.
11. Mehta R.Y., Missaghi S., Tiwari S.B., Rajabi-Siahboomi A.R. Application of ethylcellulose coating to hydrophilic matrices: A strategy to modulate drug release profile and reduce drug release variability. AAPS PharmSciTech. 2014;15:1049–1059.
12. Jain S., Jain A., Jain A., Shrivastava S., Jain A.K. Development and evaluation of film coated aceclofenac and chlorzoxazone tablet with enhanced dissolution rate. J. Pharm. Investig. 2016;46:467–474.
13. Basu A, De A, Dey S. techniques of tablet coating: concepts and Advantages: a comprehensive review, Res Rev J Pharma Sci. 2013; 2(4):1-6.
14. Pawar AS, Bageshwar DV, et al. Advances in Pharmaceutical coating. Int J Vhem Tech res 2010;2(1):733-7.
15. Reddy BV, Navaneetha K, Reddy BR. Tablet Coating Industry point view- A Comprehensive Review . Int J Pharm Biol Sci. 2013;3(1):248-261.
16. Knop K., Kleinebudde P. PAT-tools for process control in pharmaceutical film coating applications. *Int. J. Pharm.* 2013;457:527–536.
17. Vilsinki BH. Pharmaceutical Coating and Its Different Approaches, a Review. Polymers (Basel). 2022 Aug; 14(16): 3318.
18. Grekov M., Kostyrko S. A multilayer film coating with slightly curved boundary. *Int. J. Eng. Sci.* 2015;89:61–74.
19. Han J.H. *Innovations in Food Packaging.* Pepsico Inc.; Plano, TX, USA: 2014. Edible Films and Coatings: A review; pp. 213–255.
20. Miller D.A., McGinity J.W. *Pharmaceutical Dosage Forms-Tablets.* CRC Press; Boca Raton, FL, USA: 2008. Aqueous Polymeric Film Coating; pp. 415–454.
21. Ahmed A.R., Mota J.P., Shahba A.A.-W., Irfan M. *Drug Delivery Aspects.* Elsevier; Amsterdam, The Netherlands: 2020. Aqueous Polymeric Coatings: New Opportunities in Drug Delivery Systems; pp. 33–56.
22. Grenier P., Taillemite J., Serreau S., Nhamias A. Pharmaceutical Composition Containing Coated, Floating Particles. US8927028B2. *US Patent.* 2015 January 6;
23. Maurya R., Sharma P.K., Malviya R. A review on controlled drug release formulation: Spansules. *Int. J. Pharm. Sci. Res.* 2014;5:78–81.
24. Hosseini A., Körber M., Bodmeier R. Direct compression of cushion-layered ethyl cellulose-coated extended release pellets into rapidly disintegrating tablets without changes in the release profile. Int. J. Pharm. 2013;457:503–509.
25. ND Kamble; PS Chaudhari; RJ Oswal; SS Kshirsagar; RV Antre. International Journal of Applied Biology and pharmaceutical Technology. 2011, 1(2), 214-218.
26. PS Avinash; BV Deepak; VK Vineeta; K Vilasrao. International Journal of Chem Tech Research. 2010, 2(1), 33-737.
27. L Lachman. The Theory and Practice of Industrial Pharmacy. 3rd(edn). Bombay (India): Varghese Publishing house; 1992, pp: 293-345, 346-373.

28. J. S. Swarbrick, Encyclopedia of Pharmaceutical Technology, Third dition 6 Volume Set, Taylor & Francis, 2006.
29. Lilesh Khalane, Atulal Kunte, and Arunadevi Blrajdar. Sustained Release Drug Delivery System: A Concise Review. Pharmatutor: pharmacy infopedia. 2016. Accessed: May 30, 2016.
30. Sampath Kumar, Debjit Bhowmik, Shweta Srivastava, Shravan Paswan, and A. Dutta. Sustained. Release Drug Delivery System Potential. The Pharma Innovation. 2012. Accessed: May 30, 2016.
31. Kapil Patil, Prashant Patil , Javesh Patil , and Sunil Pawar. A Basic Approach on Sustained Release Drug Delivery System. American Journal of PharmTech Research. 2011. Accessed: May 30, 2016.
32. Ratnaparkhi P. and Gupta P. Sustained Release Oral Drug Delivery System – An Overview. International Journal of Pharma Research & Review. 2013. Accessed: May 30, 2016.
33. Navin Dixit, Sheo Dutt Maurya, and Bhanu Sagar. Sustained Release Drug Delivery System. Indian Journal of Research in Pharmacy and Biotechnology. 2013. Accessed: May 30, 2016.
34. Perrie, Y., & Rades, T. Pharmaceutics: Drug delivery and targeting. London: Pharmaceutical Press. Accessed: May 30, 2016.
35. Tarun Parashar, Soniya, Vishal Singh, Gaurav Singh, Satyanand Tyagi, Chirag Patel, and Anil Gupta. International Journal of Research and Development in Pharmacy and Life Sciences. Novel Oral Sustained Release Technology: A Concise Review. 2013. Accessed: May 30, 2016.
36. Malaterre, V; Ogorka, J; Loggia, N; Gurny, R. "Oral osmotically driven systems: 30 years of development and clinical use". European Journal of Pharmaceutics and Biopharmaceutics. 2009;73 (3): 311–23.
37. Theeuwes, F; Yum, SI; Haak, R; Wong, P. "Systems for triggered, pulsed, and programmed drug delivery". Annals of the New York Academy of Sciences. 1991;618 (1): 428–40.
38. Conley, R; Gupta, SK; Sathyan, G. "Clinical spectrum of the osmotic-controlled release oral delivery system (OROS), an advanced oral delivery form". Current Medical Research and Opinion. 2006;22 (10): 1879–92.
39. Verma, RK; Mishra, B; Garg, S. "Osmotically controlled oral drug delivery". Drug Development and Industrial Pharmacy. 2000;26 (7): 695–708.
40. Bass, DM; Prevo, M; Waxman, DS. "Gastrointestinal safety of an extended-release, nondeformable, oral dosage form (OROS: a retrospective study". Drug Safety. 2002;25 (14): 1021–33.
41. Dusane Ratilal, Gaikwad D., Banker H., and Pawar P. A Review On: Sustained Release Technology. International Journal of Research in Ayurveda and Pharmacy. 2011. Accessed: May 30, 2016.
42. You JO, Almeda D, Ye GJ, Auguste DT. "Bioresponsive matrices in drug delivery". J Biol Eng.2010; 4: 15.
43. Pawar AS, Bageshwar D V, Khanvilkar V V, Kadam VJ. Advance
44. Basu A, De A, Dey S. Techniques of Tablet Coating : Concepts and
45. Basu A, De A, Dey S. Techniques of Tablet Coating : Conce