



SPHEROIDAL ORAL DRUG ABSORPTION SYSTEM(SODAS)

B.Venkata Phani Deepthi

Department of Pharmaceutics, Hindu College of Pharmacy, Amaravathi road, Guntur, Andhra Pradesh, India.

**For correspondence: E-mail : deepthibaddula@yahoo.co.in*

Abstract: Multiparticulate drug delivery systems are especially useful for controlled or delayed release oral formulations to obtain different release patterns. Consequently, multiparticulate drug delivery systems provide tremendous opportunities for designing new controlled and delayed release oral formulations. Recently pulsatile delivery and multiparticulate dosage forms are gaining much favor over single-unit dosage forms in pharmaceutical applications. Recently pharmaceutical companies developed various technologies that fulfill unmet medical needs in the treatment of various diseases include Accu-Break™ Technology, CODAS™ Technology, Geoclock®, Geomatrix™ Technology, IPDAS® Technology, PRODAS® Technology, PULSYS™ Technology, OSDrC® Technology, Versetrol™ Technology, and Magnetic Nanocomposite hydrogel etc. Current review discusses about the spheroidal oral drug absorption system SODAS® technology, a proprietary technology which is used for many applications.

Keywords: spheroidal oral drug absorption system, sodas, multi particulate, extended release etc.

INTRODUCTION

Multi-particulate drug delivery systems are mainly oral dosage forms consisting of thousands of small discrete units, each exhibiting some desired characteristics and the dosage of the drug substances is divided into small subunits usually consisting of thousands of spherical particles with diameter of 0.05-2.00mm. These subunits are filled into a sachet and encapsulated or compressed into a tablet in order to deliver a particular drug. Among the long-acting stimulant delivery systems are osmotically controlled-release oral delivery system (OROS), diffucaps, spheroidal oral drug absorption system (SODAS), MPH transdermal system (MTS) [1]. Spheroidal oral drug absorption system (SODAS) is a multiparticulate technology is also termed as biphasic release bead technology [2] enables the production of dosage forms including immediate release of drug followed by sustained release and the fast onset of action is maintained for 24 hours and in the opposite case the drug release is delayed for a number of hours. In case of pulsatile release the once daily dosage

form releases the drug in discrete doses throughout the day [1,3,4]. A beaded capsule preparation contains small, visually identical white beads within an opaque capsule. A proportion of the beads is uncoated for bolus effect. The remainder consist of a drug core coated with rate controlling polymers [5] that releases 50% of the medication initially and 50% is released 4 hours later [2] and is used to produce the extended-release component of the product. The extended-release beads are prepared by coating of a drug/excipient layer on to sugar/starch spheres, followed by copolymer coating of an ammonio-methacrylate [6]. The controlled release beads producing SODAS® technology is characterised by its inherent flexibility which enables the production of customised dosage forms that respond directly to individual drug candidate needs [4]. The products utilising SODAS® technology are approved and marketed throughout Europe, Japan and the U.S [3]. The drug release is found to be independent of food and pH [5]. Fig.1: shows the pictorial representation of

élan drug technologies- sodas technology [7]



Fig.1: The pictorial representation of élan drug technologies- sodas technology [7]

BENEFITS OFFERED BY THE SODAS[®] TECHNOLOGY INCLUDE

- Targeted release of the drug is possible to specific areas within the gastrointestinal tract
- Controlled absorption with resultant reduction in peak to trough ratios is possible.
- It is suitable for use with one or more active drug candidate.
- Combination dosage forms can be produced.
- Once or twice daily dose resembling multiple daily dose profiles
- Absorption is independent of the feeding state
- Sprinkle dosing” is achieved by administrating the capsule contents with soft food [3]

SODAS[®] TECHNOLOGY

Preparation Technique

Elan’s family of oral controlled-release technologies (Spheroidal Oral Drug Absorption System, SODAS [8]) is a multiparticulate system for controlling the release of drugs taken orally[9].

- By using drug and excipients uniform spherical beads of 1-2 mm in diameter were produced. The physicochemical properties and the composition of the polymer membrane will be different for each individual SODAS[®] formulation.

- Coating of the beads with product specific controlled release polymers (water soluble and insoluble, pH dependent/independent). By varying the nature and combination of polymers within a semi-permeable membrane enables varying degrees of release profile
- A number of different populations of beads with varying degrees of controlled release were mixed to get a SODAS[®] system for highly flexible and predictable for oral delivery.
- The beads were encapsulated into a hard gelatin capsule[3,4,9]. It contains half the dose as immediate release beads for bolus effect and half as enteric-coated, delayed release beads for sustained action.

The capsule may be swallowed as a whole capsule or may be administered by sprinkling the capsule contents on a small amount of applesauce or in food with a similar consistency (but not in a liquid). The capsules should not be crushed, chewed or divided [10]. The figure-2 shows the example of capsule containing verelan (verapamil)

THE DRUG RELEASE FROM SODAS TECHNOLOGY IS 2 TYPES

• Sustained Release

The sustained release of drug was maintained over 24 hours. Elan Drug Technologies’ controlled release morphine product, Morphelan[®] /Avinza[®]

• Pulsatile Release

The pulsatile release profile resembles the administration of the drug at discrete intervals throughout the day, without inconvenience to the patient because of a cumbersome dosage regime[3].

PRODUCTS MARKETED USING THE SODAS[®] TECHNOLOGY

The U.S regulatory authority approved once daily oral dosage forms are Avinza[®] once daily morphine product, Ritalin[®] LA methylphenidate with a bi-modal release profile, Focalin[®] XR dexmethylphenidate

hydrochloride also with a bimodal release profile and Luvox[®] CR fluvoxamine maleate extended release capsule. A number of other compounds are still under development [3,4,9].

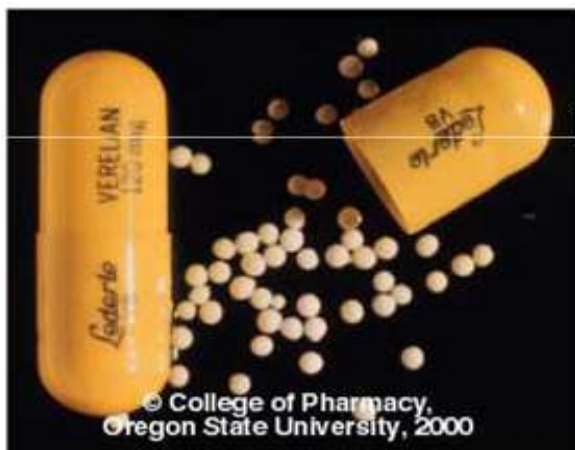


Fig.2: Verelan marketed capsules

APPLICATIONS OF SODAS

- Opioid Analgesics in Primary Care uses a spheroidal oral drug absorption system technology to maintain plasma morphine concentrations throughout the 24-hour dosing interval [11].

Eg; Avinza ,oral morphine formulation contains morphine sulfate^[12] in both immediate and extended-release beads that are 1-2 mm in diameter. It contains immediate-release component achieves plateau morphine concentrations within 30 minutes while the extended-release component maintains these plasma concentrations throughout the 24 hour dosing interval, which is longer than most other oral modified-release opioid products [6].

- Focalin XR[9] Dexmethylphenidate extended release utilizes spheroidal oral drug absorption system technology achieves a 50% immediate medication delivery and 50% delayed release approximately 4 h after ingestion. It is the best medicine for attention deficit hyper active disorder(ADHD) treatment because of its duration of effect, favorable tolerability and flexibility in dosing [13].
- Ritalin LA[®] (methylphenidate hydrochloride(MPH) extended-release capsules) which is a central nervous

system stimulant biphasic release bead technology uses the proprietary SODAS[®] (Spheroidal Oral Drug Absorption System) technology. Each bead-filled Ritalin LA (methylphenidate hydrochloride extended-release capsules)[9] capsule contains 50-50 proportions of immediate and delayed release i.e half the dose as immediate-release(IR) beads and half as enteric-coated, delayed-release beads, thus providing an immediate release of methylphenidate and a second delayed release of methylphenidate[2,14,15,16,17, 18].The studies revealed that switching from MPH-IR to MPH-SODAS did not affect stabilization of ADHD symptoms in the majority of patients. Ritalin LA,Focalin XR used to treat attention deficit hyper active disorder can be formulated as once daily pulsed profiles is useful for children during school hours[20,7].

- Luvox CR, Zanaflex Capsules [9] extended-release fluvoxamine for social anxiety disorder uses a spheroidal oral drug absorption system that limits peak to- trough variance for 24 hours [21].
- Verelan[®] SR (verapamil) [5], a calcium channel blocker is used in the treatment of mild-to-moderate hypertension was originally administered three times daily . It was developed as a once daily formulation using SODAS[®] technology[3,22] and it was effective throughout the 24-hour period after once-daily dosing[23].
- Spheroidal oral drug absorption system technology is used in the treatment of Attention-Deficit Hyperactivity Disorder (ADHD) where in the beads that are released immediately and others that are released slowly [24]
- Hydrocodone in combination with acetaminophen is one of the most widely prescribed opioids is a novel, oral, controlled-release formulation utilizes spheroidal oral drug absorption system (SODAS)[25] which enhances the release

profile of hydrocodone to provide constant 12-hour pain relief [26].

- Cardizem SR (a twice daily formulation of diltiazem) has a short half life and was administered three or four times daily, so by using this SODAS® technology once and twice daily dosage forms Cardizem CD (once daily

formulation of diltiazem) [9] were developed for the treatment of hypertension [3].

- Propranolol HCL (Innopran XL) produced by GlaxoSmithKline utilizes microencapsulation (beads)(Sodas) spheroidal oral drug absorption system for hypertension[27].

REFERENCES

1. Dey N.S., Majumdar S. and Rao M.E.B. Multiparticulate Drug Delivery Systems for Controlled Release; Tropical Journal of Pharmaceutical Research, 2008;7(3),1067-75.
2. Cindy Ellis; Psychopharmacology for Childhood Behavioral and Developmental Disorders; (<http://www.answers4families.org/system/files/8-psychopharmacology.pdf>) on December 6,2006.
3. SODAS® Multiparticulate Delivery System; © 2010, Elan Drug Technologies, Monksland, Athlone, Co. Wick, Ireland (http://www.elandrugtechnologies.com/oral_controlled_release/sodas)
4. Prajapati B.G. & Solanki H. Recent techniques for oral time controlled pulsatile technology. The internet journal of third world medicine, 2009; 8(1).
5. Celene M. Amabile Bill, Bowman J. Oral modified-release opioid products for chronic pain management: oral modified release opioid products; The Annals of Pharmacotherapy. 2006;40(7):1327-35.
6. Gurbinder Singh Rekhi; oral drug delivery and advanced excipients (advances in solid dose oral drug delivery); (http://www.ondrugdelivery.com/publications/Oral%202010/Oral_Drug_Delivery_2010_ONdrugDelivery.pdf)
7. Nicholas Basta Drug-Delivery Technologies for Controlled Release Score With Manufacturers; Packaging/Drug Delivery; 2010-04-30 (<http://www.pharmaceuticalcommerce.com/frontEnd/main.php?idSeccion=1472>)
8. APV focus group drug delivery; (http://www.apv-mainz.de/uploads/media/APV-DD-Newsletter_2011-02_final-release.pdf) ; International association for pharmaceutical technology, News letter 2011;2:1-15.
9. A Venter; The medical management of attention-deficit/hyperactivity disorder: spoilt for choice?; S Afr Psychiatry Rev 2006;9:143-151
10. Raymond Sinatra; Opioid analgesics in primary care: challenges and new advances in the management of noncancer pain. J. Am. Board. Fam. Med. 2006;19:165-77
11. Aragon C.L., Read M.R., Gaynor J.S., Barnhart M.D., Wilson D., Papich M.G. Pharmacokinetics of an immediate and extended release oral morphine formulation utilizing the spheroidal oral drug absorption system in dogs; J Vet Pharmacol Ther. , 2009; 32(2):129-36.
12. McGough J.J., Pataki C.S., Suddath R.; Dexmethylphenidate extended-release capsules for attention deficit hyperactivity disorder; Expert Rev Neurother, 2005; 5(4): 437-41.
13. Ritalin L.A. Drug Description; (http://www.rxlist.com/ritalin_la-drug.htm); retrieved on July 29, 2011
14. Tobias Banaschewski, David Coghill, Paramala Santosh, Alessandro Zuddas, Philip Asherson, Jan Buitelaar, Marina Danckaerts, Manfred Doepfner, Stephen V. Faraone, Aribert Rothenberger, Joseph Sergeant Hans-Christoph Steinhausen, Edmund, J.S. Sonuga-Barke, Eric Taylor; Long-acting medications for the hyperkinetic disorders; Eur. Child Adolesc. Psychiatry, 2006; xx(x):1-20.

15. Scharman, Elizabeth J., Erdman, Andrew R., Cough, Daniel, J., Olson, Kent R., Woolf, Alan D., Caravati, E. Martin, Chyka, Peter A., Booze, Lisa L., Manoguerra, Anthony S., Nelson, Lewis S., Christianson, Gwenn and Troutman, William G. Methylphenidate poisoning: An evidence-based consensus guideline for out-of-hospital management. *Clinical Toxicology* 2007 45;-2
16. Stimulants and related agents; Iowa medicare p & t committee therapeutic class review 2008;1-17.
17. Lisa A. Edwards A comparison of the newer treatment options for ADHD; *Formulary* 2003;38:38-52
18. Maia C.R., Matte B.C., Ludwig H.T., Rohde L.A. Switching from methylphenidate immediate release to MPH-SODAS in attention-deficit/hyperactivity disorder. *Eur. Child Adolesc. Psychiatry*. 2008 ;17(3):133-42.
19. Declan Quinn, Twyla Bode, Joseph L. Reiz, Graeme A. E. Donnelly, Andrew C. Darke Single-dose pharmacokinetics of multilayer-release methylphenidate and immediate-release methylphenidate in children with attention-deficit/hyperactivity disorder. *J. Clin. Pharmacol.* 2007;47(6):760-6.
20. John M. Kuzma, M.D. and Donald W. Black, MD; Extended-release fluvoxamine for social anxiety disorder and OCD. *Current Psychiatry* 2008 ;7(7):54-66.
21. Michael Prisant L. Novel drug-delivery systems for hypertension. *The American J. Medicine* 1992; 93(2); S45-S55.
22. Carr A.A., Bottini P.B., Prisant L.M., Fisher L.D., Devane J.G., O'Brien D.E., Rhoades R.B. Once-daily verapamil in the treatment of mild-to-moderate hypertension: a double-blind placebo-controlled dose-ranging study. *J. Clinical Pharmacology* 1991;31(2):144-50.
23. Kytja K.S., Voeller, M.D. Attention-deficit hyperactivity disorder (ADHD); *J. Child Neurol.* 2004; 19 (10): 798-814.
24. Michele B. Kaufman Drug updates information on new approvals and medication safety. *The Rheumatologist*, May 2010 .
25. Roger Hawley; Delivering innovative health care solutions; Zogenix, Inc.; page no 1-160. (<http://www.amstock.com/proxyservices/Files/AR40052.pdf>)
26. Raymond Sinatra Opioid analgesics in primary care: challenges and new advances in the management of noncancer pain. *J. Am. Board Fam. Med.* 2006;19:165-77
27. Jayanthi B., Manna P.K, Madhusudhan S., Mohanta G.P. and Manavalan R. Per oral extended release products -An overview. *J. Applied Pharmaceutical Science* 2011;1(2):50-55.