Pharmaceutical formulation research and development pdf

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Drug Formulation Sources Chemical Exchange Methods The development of a new process of gentle drying, micronization and formulation of a viscous open biopoymer Reibe, Christian 2011-01-01 Biopolymers are characterized by their biodegradable behaviour in certain environments. In particular, the development of natural biopolymers from renewable resources is attracting increasing interest in the scientific and industrial sectors. Since biopolymers can be adapted to specific requirements, encapsulation of pharmaceutical compounds or flavours in biopolymers would open up great avenues for the production of controlled release systems. The most common mechanical spray... Additive manufacturing dropwise of pharmaceuticals for cast iron-based dosing forms. Science.gov (United States) Içten, Elçin; Giridhar, Arun; Taylor, Lynne S; Nagy, Zoltan K; Reklaitis, Gintaras V 2015-05-01 The U.S. Food and Drug Administration has introduced the quality approach by design and analytical technology process advice to encourage innovation and efficiency in pharmaceutical development, manufacturing and quality assurance. As part of this renewed focus on improving manufacturing, the pharmaceutical industry has begun to develop more efficient production processes with more intensive use of online measurement and detection, real-time quality control, and process control tools. Here we present additive manufacturing dropwise pharmaceuticals (DAMPP) as an alternative to conventional pharmaceutical manufacturing methods. This mini-manufacturing process for pharmaceutical production uses on-demand printing technology for the automated and controlled filing of cast iron formulations on edible substrates. The benefits of on-demand drop technology, including reproducible production of small droplets, adjustable droplet sizing, high placement accuracy and flexible use of different formulations, allow individualized dosing production, even for low-dose, high-potency drugs. In this work, DAMPP is used to produce solid oral dosing forms from hot casts of an active pharmaceutical ingredient and polymer. The dosage forms are analyzed to show the reproducibility of the dosage and the dissolving behavior of different formulations. © 2015 Wiley Periodicals, Inc. and the American Pharmacists Association. The policy of health sector reform in developing countries: three cases of pharmaceutical policy. (United States) Reich, M R 1995-01-01 This paper examines the political dynamics of health sector reform in poor countries, through a comparative study of pharmaceutical policy reform in Sri Lanka, Bangladesh and the Philippines. The paper first examines five reasons why policy reform is political. It then presents three political economic models of the policy reform process: political, political, and models of political survival. Next, the document describes the three cases of reform of national pharmaceutical policy and identifies the common conditions that have made these reforms politically feasible. The paper's analysis suggests that health sector reform is achievable at certain definable, and perhaps predictable, political times, especially in the early stages of new regimes. The most important and manipulative political factors are: the political calendar, which offers political entrepreneurs the opportunity to introduce their ideas into public debate, and the political management of group competition, which allows leaders to control the political effects of the consequences of distribution and protect the stability of the regime. A strong and narrow political coalition improves the ability of political leaders to withstand the pressures of concentrated economic costs (both within and outside national borders). The paper argues that for reform to succeed, policy makers need effective methods to analyze relevant policy conditions and shape key policy factors for policy reform. The political mapping method is briefly introduced as a technique that can help policy makers analyze and manage the political dimensions of policy reform and improve the political feasibility of reform. Development and validation of spectrophotometric methods for the determination of rasagiline in pharmaceutical preparations Directory of open access newspapers (Sweden) Serife Evrim Kepekci Tekkeli 2013-01-01 Full text Available This study presents three simple, fast and accurate spectrophotometric methods for determining Rasagiline (RSG in pharmaceutical preparations). Determination procedures depend on the RSG reaction with chloranilic acid for method A, tetrachloro-1.4-benzoquinone for method B, and 7.7,8.8-tetracyanoquinodimethana for method C. The colored products were spectrophotometrically quantities at 524, 535 and 843 nm for methods A, B and C, respectively. Different variables affecting the reaction have been optimized. Linearity ranges of methods with good correlation coefficients (0.9988-0.9996 were observed as 25 to 300 mL-1, 25-350 mL-1 and 50-500 mL-1 for methods A, B and C, respectively. Product formation is done through different mechanisms. The interaction sites were confirmed by elementary analysis using IR spectroscopy and 1H-RMN. The validation of the methods was carried out in terms of specificity, linearity, precision, precision, robustness, detection limit and quantitation. No interference was observed from the concomitant usually present in the dosage forms. The methods have been successfully applied to the determination of RSG in pharmaceutical preparations. Physicians' Perceptions of National and Multinational Pharmaceuticals: An Ongoing Investigation Directory of Open Access Newspapers (Sweden) Jashim Uddin Ahmed 2013-12-01 Full Text Available This exploratory study focuses on physicians' perceptions of national and multinational pharmaceuticals. Physicians can strongly influence drug purchasing decisions by playing the role of users (sometimes influencer, custodians and decision makers, while patients play the role of buyers and

users. The difference in perception was measured in terms of products, branding and price. The data were collected from a sample of 15 physicians (n-15 using a questionnaire comprising 12 questions measured in Likert scales. The study reveals that branding is the most influential factor in drug pricing and branding is strongly linked to the quality and level of promotion for the underlying product. In addition, physicians perceive multinational products as different and better than domestic products because of their stronger brand image. This study points out that physicians' preferences are not completely impartial and may be influenced by pharmaceutical companies. Due to its exploratory nature, the results may need to be validated in a more in-depth study with a larger sample. What do pharmaceutical industry professionals in Europe believe about patient and public involvement in drug research and development? A qualitative interview study. Science.gov (USA) Parsons, Suzanne; Starling, Bella; Mullan-Jensen, Christine; Tham, Su-Gwan; Warner, Kay; Wever, Kim 2016-01-07 Exploring the beliefs of European-based pharmaceutical professionals on patient and public participation (PPI) in drug research and development .D. pharmaceutical companies in the UK, Poland and Spain. 21 pharmaceutical industry professionals, four based in the UK, five with pan-European roles, four based in Spain and eight based in Poland. Qualitative interview study (telephone and in-person interviews, semi-structured). All interviews were audio-recorded, translated (if applicable) and transcribed for analysis using the framework approach. 21 pharmaceutical professionals participated. The key themes were: beliefs about (1) whether patients and the public should be involved in drug research and development; (2) the barriers and facilitators of PPI in research and development drugs and (3) how the current relationships between the pharmaceutical industry, patient organizations and patients influence PPI in research and development in Medicines. Although respondents appeared positive about PPI, many were uncertain as to when, how and what patients to involve. Patients and the lack of public knowledge and interest in drug research and development, as well as the pharmaceutical industry's lack of knowledge, interest and responsiveness to PPI were seen as key challenges in increasing PPI. Interviewees also felt that the relationship between the pharmaceutical industry, patient organizations, patients and the public PPI in drug research and development. Existing codes of practice in the pharmaceutical industry and negative reporting on the pharmaceutical industry were also considered negative influences on these relationships. Published by BMJ Publishing Group Limited. To obtain authorisation for use (where they are not already granted under a licence), please see EU OpenAIRE Urbinati, Duccio pharmaceutical expenditure forecasts; Remuzat, Cecile; Kornfeld, Sa; Vataire, Anne-Lise; Cetinsoy, Laurent; Aballéa, Samuel; Mzoughi, Olfa; Toumi, Mondher 2014-01-01 Background and Objectives: With constant incentives for health care payers to contain their pharmaceutical budgets, forecasts have become critically important. Some countries, for example, have developed pharmaceutical horizon scanning units. The objective of this project was to build a model to assess the net effect of the entry of new patented drugs compared to non-patented drugs, with a defined forecast horizon, on the ph... Development of a nanoparticle formulation of diminazene to treat African trypanosomiasie Energy Technology Data Exchange (ETDEWEB) Kroubi, Maya; Betbeder, Didier [EA 4483, IFR 114 IMPRT, Faculty of Medicine, Pole Research, Department of Physiology, 1 Place de Verdun, 59045 Lille Cedex (France); Daulouede, Sylvie; Mossalayi, Djavad; Vincendeau, Philippe [Laboratory of Parasitology, Universite Victor Segalen Bordeaux 2, 146 rue Leo Saignat, 33076 Bordeaux Cedex (France); Karembe, Hamadi [CEVA Animal Health, ZI la Ballastiere, BP 126, 33501 Libourne (France); Jallouli, Youssef [Faculty of Pharmacy, University of Lille 2, 3 rue du Professor Laguesse, 59006 Lille (France); Howsam, Mike, E-mail: dbetbeder@aol.com [University Center for Measurement and Analysis, Faculty of Pharmacy, University of Lille 2, 3 rue du Professor Laguesse, 59006 Lille (France) 2010-12-17 There is a real need to develop new therapeutic strategies for African trypanosomiasis infections. In our study, we developed a new system for administering diminazene drugs (DMZ), a trypanocidal drug registered for veterinary use. This drug candidate has limited efficacy, low affinity for brain tissue and instability. The development of colloidal formulations based on a porous cationic nanoparticle with an oily nucleus (sub 70-DGNP-sup), has potentially two advantages: the stabilization of the drug and the potential targeting of the parasite. We analyzed two drug loading processes: ongoing (DMZ was added during the preparation of 80 deg. C) and after (DMZ has been mixed with a 'sub 70' solution at room temperature). Poor stability of the drug was observed using the current technique. When using the post-loading technique more than 80% of the drug trapping efficiency was obtained at a DMZ:phospholipides (wt:wt) -lt; 5%. In addition, the DMZ loaded in 'sub 70'DGNP-sup' was found to be protected from oxidation and was stable for at least six months at 4 deg. C. Finally, in vitro tests on T.b. brucei have shown increased efficacy of DMZ charged in 'sub 70's DGNP.sup. A cross-sectional study of pharmacists' availability and knowledge of nano-pharmaceutical drugs in Palestinian hospitals. Science.gov (USA) Assali, Mohyeddin; Shakaa, Ali; Abu Hejleh, Sabaa; Abu Omar, Reham; Karajeh, Nareman; Ajory, Nawal; Zyoud, Saed; Sweileh, Waleed 2018-04-05 Nanomedicine is the medical application of nanomaterials that can have an infinite size with a range of less than 100 nm. This science has provided solutions to many of the current limitations in the diagnosis and treatment of diseases. As a result, the pharmacist's knowledge and awareness of nano-pharmaceutical drugs will increase their availability on the market and improve the patient's compliance with his or her drug therapy. The purpose of this study was to determine the availability of nano-pharmaceutical drugs in Palestinian hospitals and to assess the extent of pharmacists' knowledge about them. A cross-sectional study design questionnaire was used to determine the availability of nano-pharmaceutical drugs based on ministry of health data in Palestinian hospitals (government, private and non-governmental organizations). In addition, the knowledge of these nano-pharmaceutical drugs from pharmacists working in Palestinian hospitals was assessed on the basis of a questionnaire developed from the literature of pharmaceutical formulations and nano-formulations. The variables were analysed using the Statistical Package for Social Sciences (SPSS 22). Fifty-six pharmacists from 27 West Bank hospitals responded to the survey. Results on the availability of nano-pharmaceutical drugs indicate only eight available in hospitals with frequencies ranging from 0 to 39.3%. In addition, the pharmacist's knowledge of pharmaceutical formulations was better than in nano-formulations. The availability of nano-pharmaceutical drugs in Palestinian hospitals was not sufficient due to the absence of various nano-pharmaceutical drugs. Pharmacists' knowledge of nanopharmaceutical drugs should be improved by offering nanomedicine courses during undergraduate pharmacy programs. UV-spectrophotometric methods validated for the determination of Gemifloxacin Mesylate in the dosing forms of pharmaceutical tablets Directory of open access newspapers (Sweden) Rote Ambadas 2010-01-01 Full text Available Two simple, economical and accurate UV spectrophotometric methods have been developed for the determination of gemifloxacin mesylat in the formulation of pharmaceutical tablets. The first UV spectrophotometric method depends on the measurement of absorption at wavelength 263.8 nm. In the second curved zone The wavelength range for detection was selected from 268.5 to 258.5 nm. The beer law was respected in the order of 2 to 12 -ggmL-1 for both methods. The proposed methods have been statistically validated and successfully applied to the determination of gemifloxacin mesylate in pharmaceutical formulation. Development and validation of a new LC non-derivatization method for determining amikacin in pharmaceuticals from evaporative light scattering detection. Science.gov (USA) Galanakis, Evagelia G; Megoulas, Nikolaos C; Solich, Petr; Koupparis, Michael A 2006-03-18 A new method for direct determination of the antibiotic amikacin aminoglycoside and its precursor component kanamycin has been developed and validated, based on the inverted phase LC with evaporation light scattering detector (ELSD). The response of ELSD to amikacin was strengthened by: a) the use of acidic reagents of ions of increased molecular mass, b) increased volatility in the moving phases and c) decreased peak width and asymmetry (obtained by controlling the fluidity of the moving phase and/or the ratio of organic solvent to water). Using a Thermo Hypersil BetaBasic C(18) column, the optimized mobile phase selected was selected optimized nonafluoropentonoic acid (60:40, v/v), containing 3.0 mll(-1) nonafluoropenentanic acid (18.2 mM) (isocratic election with 1.0 mlmin (-1)). The experimental parameters of the ELSD were: nitrogen pressure 3.5 bar, evaporation temperature of 50 degrees C, and gain 11. Amikacin was elected at 8.6 min and kanamycin at 10.4 min with a resolution of 1.5. Logarithmic calibration curves were obtained from 7 to 77 microgml(-1) (r-0.9995) for amikacin and 8 to 105 microgml (-1) (r-0.998) for kanamycin, loD equal to 2.2 and 2.5 microgml(-1), respectively. In pharmaceutical raw materials amikacin sulphate, the simultaneous determination of sulphate (t(R)-2.3 min, LOD-1.8 microgml(-1), range 5-40 microgml(-1), %R.S.D.-1.1, r-0.9997), kanamycin and amikacin was feasible. There was no significant difference between the results of the developed LC-ELSD method and those of the reference methods, while the average recovery of kanamycin from peak samples (0.5%, w/w) was 97.3% (%R.S.D., developed method was applied for the determination of amikacin in pharmaceutical formulations (injection solutions) without any matrix interference (recovery from peak samples ranged from 95.6 to 103.8%). Radiopharmaceuticals using radioactive compounds in pharmacy and international medicine Nuclear Information (ISIS) Theobald, A. 1989-01-01 This review of the latest techniques and developments indicates the importance of radiopharmaceutical techniques in the development of pharmaceutical compounds. It presents practical demonstrations, offers practical exercises, as well as the underlying theoretical considerations: it will complement existing (mainly American) texts in this area, since most of the companies have a keen interest in the field and most pharmaceutical courses understand the subject at the diploma level. The authors focus on pharmaceutical applications throughout. They review the targeted aspects, including cell and protein labelling: and discuss radiotracers in dosing form testing and formulation studies. Safety and legislation are taken into account, with examinations of handling techniques, radiation monitoring, radiochromatography and the use of computer techniques. The final part of the work focuses on standards for radiopharmaceuticals, infertility and pyrogen testing, as well as radiochromatographic and electrophoric methods and their importance for quality control. (author) Stabilized polymer seals for the development of IT-147, a D Drug-Loaded smoothilone formulation directory from Open Access Newspapers (Sweden) Adam Carie 2016-01-01 Full Text Available Epothilones have demonstrated promising potential for oncology applications, but suffer from a narrow therapeutic window. Epothilone D stabilizes the microtubules leading to apoptosis, is active against multidristing cells, and is effective in animal tumor models despite the lack of stability in rodent plasma. Clinical development was terminated in Phase II due to dose limiting toxicities near the effective dose. Taken together, this made the ephothilone D attractive for encapsulation in a stabilized polymer crumb for better safety and efficiency. We designed a library of triblock copolymers to develop IT-147, a lead formulation of ephothilone D that extends plasma circulation for accumulation in the tumor environment, and potentially decrease systemic exposure to reduce dose limiting toxicities. The drug loading efficiency for IT-147 exceeds 90%, is 75 nm in diameter, and demonstrates pH-dependent release of epothilone D without chemical conjugation or enzymatic activation. The administration of IT-147 to 20 mg/kg increases the exposure of epithhilone D to the plasma compartment more than 6 times compared to the free drug. At the same dose, 20 mg/kg of IT-147 ephothilone D is considered the observed adverse reaction level (NOAEL, but is the maximum tolerated dose for the free drug. Therefore, IT-147 is positioned to be a safer and more efficient way to provide epothilone D. Development and validation of Ketorolac Tromethamine in eye drip formulation by RP-HPLC open access log directory method (Sweden) G. Sunil 2017-02-01 Full text Available One simple, accurate and accurate was developed and validated for the analysis of Ketorolac Tromethamine in eye drip formulation. An isocratic analysis of HPLC was performed on the Kromosil C18 column (150 cm × 4.6 mm × 5 m. The compound was separated with the methanol and ammonium dehydrogen phosphate buffer mixture in the ratio of 55:45 V/V, pH 3.0 was adjusted with o-phosphoric acid as a 1.5 mL min-1 flow moving phase. Uv Uv was performed at 314 nm using photo diode array detection. The retention time turned out to be 6.01 min. System adequacy parameters such as the theoretical number of plates, residue and the percentage of RSD between six standard injections were within the limit. The method has been validated in accordance with the ICH guidelines. The calibrations were linear over the concentration range of 50 to 150 mL-1, as indicated by the correlation coefficient (r of 0.999. The robustness of the method was assessed by deliberately modifying the chromatographic conditions. The method developed may be applicable to routine quantitative analysis. Multifaceted role of clay minerals in OpenAIRE Khurana, Inderpreet Singh pharmaceuticals; Kaur, Satvinder; Kaur, Harpreet; Khurana, Rajneet Kaur 2015-01-01 The desirable physical and physiochemical properties of clay minerals have led them to play an important role in pharmaceutical formulations. Clay minerals such as kaolin, smectite and palygorskite-sepiolite are among the most valuable and valuable industrial minerals in the world. The elementary characteristics of clay minerals that led them to be used in pharmaceutical formulations are a high specific area, sorption ability, favorable rheological properties, chemical inertia, swell... Development and validation of a liquid chromatography method for the simultaneous determination of eight water-soluble vitamins in multivitamin formulations and human urine. Science.gov (USA) Patil, Suyog S; Srivastava, Ashwini K 2013-01-01 A simple, accurate and fast method of RPLC was developed without incorporation of any ion pair reagent for simultaneous determination of vitamin C (C) and seven B-complex vitamins, viz, thiamine chloride (B1), pyridoxine hydrochloride (B6), nicotinamide (B3), cyanocobalamine (B12), folic acid, riboflavin (B2), and 4-aminobenzoic acid (Bx). Separations were achieved within 12.0 min to 30 degrees C by gradient ellion on a C18 RP column using a moving phase consisting of a 15 mM ammonium buffer mixture for the former and 0.1% pH 4.0-adjusted triethylamine with formic acid and acetonitrole. Simultaneous UV detection was carried out at 275 and 360 nm. The method has been validated for system adequacy, LOD, LOQ, linearity, accuracy, accuracy, specificity and robustness, in accordance with the guidelines of the International Conference on Harmonization. The method developed has been successfully implemented for the determination of the aforementioned vitamins in pharmaceutical formulations containing a vitamin in their combinations of multivitamins, and in human urine samples. The calibration curves for all analytes showed good linearity, with correlation coefficients greater than 0.9998. Accuracy, intraday repeatability (n-6) and interday repeatability (n-7) were satisfactory. The development of a self-sufficient self-sustaining pharmaceutical industry Spain: between need, utopia and fracoistic propaganda Open access newspaper directory (Sweden) Rael Rodroguez Nozal 2017-06-01 Full text Available The history of the Spanish pharmaceutical industry is conditioned by its ascription to a Mediterranean model, with a low economic impact and a strong presence of artisanal and professional elements. The organic and fermentative raw materials industry only emerged from the Franco dictatorship. During the autarchy period, an interest in stimulating the sector seems to have arisen: first, by continuing the long-term investment in natural products industries to obtain active medical ingredients, thus preventing their importation; second, long-term, by establishing an integrated organic chemistry industry to obtain drugs from coal; and finally, by promoting the development of an industry for the synthesis of penicillin. However, a number of factors have hindered the development of the chemical and pharmaceutical industry, including the inherent limitations of autarchic policies, the excessive number of laboratories and products marketed, the lack of small capitalization and research programs of these companies, and the insufficient technical and scientific capacity required for these activities. Formulation of an aloe-based product according to traditional Iranian medicine and development of its method of analysis. Science.gov (USA) Moein, Elham; Hajimehdipoor, Homa; Toliyat, Tayebeh; Choopani, Rasool; Hamzeloo-Moghadam, Maryam 2017-08-29 Currently, people are more interested in traditional medicine. Traditional formulations should be converted into modern drug delivery systems to be more acceptable to patients. In this study, a Ayarij-e-Faiqra (AF) poly-physiotherapy based on traditional Iranian medicine (ITM) was formulated and its quality control parameters were developed. The main ingredients of AF, including the barks of Cinnamomum zeylanicum Blume and Cinnamomum cassia J. Presl, the rhizomes of Nardostachys jatamansi DC., the fruits of Piper cubeba L.f., the flowers of Rosa damascena Herrm., the gum resin oleo de Pistacia terethbinus L. dried juices were powdered and used for the preparation of seven tablets of the herbal mixture. The flowability of the different powders formulated was examined and the best formulations were selected (F6-F7). The tablets were prepared from the formulations selected in relation to the physical characteristics and finally, F7 was selected and coated. The physicochemical traits of the basic and coated AF tablets were determined and the HPLC method for quantitation of as a tablet marker was selected and verified based on selectivity, linearity, accuracy, recovery, LOD and LOQ. The results showed that the basic and coated af tablets were consistent with usp requirements for herbal medicines. They they acceptable appearance, disintegration time, friability, hardness, dissolution behaviour, weight variation and consistency of content. The amount of aloin in the tablets was found 123.1 mg/tab. The HPLC method for determining aloin in AF tablets has been verified based on selectivity, linearity (5-500 g/ml, r 2:0.9999), accuracy (RSD: 1.62 per cent), recovery (108.0 per cent), LOD and LOQ (0.0053 and 0.0161 g/ml). The formulated tablets could be a good substitute for powder and AF capsules in ITM clinics with a feasible and accurate method for its quality control. Ayarij-e-Faiqra formulation. Development of a highly biocompatible anti-tb drug nanodedition formulation based on para-aminosaliclic acid —Zinc hydroxide nanocomposites Science.gov (United States) Arulselvan, Palanisamy; El Zowalaty, Mohamed Ezzat; Fakurazi, Sharida; Webster, Thomas J.; Geilich, Benjamin; Hussein, Mohd Zobir 2014-01-01 Tuberculosis is a deadly epidemic, difficult to control, killing thousands of people every year. We developed a nanodiverse formulation based on para-aminosaliclic acid (PAS) and hydroxide in zinc layers using zinc nitrate salt as a precursor. The formulation developed has a four times higher efficacy of PAS against mycobacterium tuberculosis with a minimal inhibitory concentration (MIC) found at 1.40 g/mL compared to the free drug NOT with a MIC of 5.0 mg/mL. The newly developed formulation has also been found active against gram-positive bacteria, gram-negative bacteria, and Candida albicans. The formulation was also found to be biocompatible with normal human lung cells MRC-5 and mouse fibroblastic cells-3T3. The IN vitro release of PAS of the formulation was found to be supported in a saline phosphate buffer solution (PBS) simulated by the human body at pH values of 7.4 and 4.8. More importantly, the nanocomposite prepared with zinc nitrate salt was efficient and free of toxic zinc oxide contamination and had a higher biocompatibility than that prepared with a precursor of zinc oxide. In summary, these promising in vitro results are very encouraging for further study of para-aminosaliclic acid and zinc hydroxide nanocomposites in vivo and possibly preclinical studies. PMID:25050392 Industry view on the use of quality control, biorevant and dissolution tests clinically relevant to the development, registration and marketing of pharmaceuticals. Science.gov (USA) Grady, Haiyan; Brother, David; Webster K; Mao, Yun; Lin, Yiqing; Flanagan, Talia; Mann, James; Blanchard, Andy; Cohen, Michael J; Lin, Judy; Kesisoglou, Filippos; Hermans, Andre; Abend, Andreas; Zhang, Limin; Curran, David 2018-01-01 This article intends to summarize the current views of the Task Force on the Dissolution of the IQ Consortium, which includes various industry companies, on the roles of dissolution testing throughout development, registration, marketing, and beyond. Over the past 3 decades, dissolution testing has gone from a routine and simple test as a component of final product release to a complete set of tools that the developer can deploy at various stages of the product lifecycle. Definitions of commonly used dissolution approaches, how they relate to each other and how they can be applied in the development of modern drugs, and life cycle management is described in this article. Specifically, this article discusses the purpose, benefits and limitations of quality control, biorevant and clinically relevant dissolving methods. Copyright © 2018 American Pharmacists Association®. Posted by Elsevier Inc. All rights reserved. Reserved.

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