WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
Coden USA: WJPRAP Impact Factor 8.63
Volume 15, Issue 6, 869-908. Research Article ISSN 2277–7105

SILDENAFIL-EXCIPIENT COMPATIBILITY STUDIES FOR PHARMACEUTICAL SUSPENSIONS ADVANCED DRUG DELIVERY SYSTEMS DEVELOPMENT

Abdalwali Ahmed Saif[1], Jalal H. Abdullah[2], Mahmoud Mahyoob Alburyhi[1,3]*, Maged Alwan Noman[1,4] and Sami Ahmed Saeed[5]

[1]Professor Dr. of Pharmaceutics and Industrial Pharmacy, Department of Pharmaceutics and Industrial Pharmacy, Faculty of Pharmacy, Sana'a University, Sana'a, Yemen.
[2]Professor Dr. of Medicinal Chemistry and Drug Design, Department of Medicinal Chemistry, Faculty of Pharmacy, Sana'a University, Sana'a, Yemen.
[3]Head of Department of Pharmacy, Faculty of Medical and Health Sciences, AlJeel AlJadeed University, Yemen.
[4]Professor Dr. Pharmacy Department, Faculty of Medical Sciences, Al-Yemenia University, Sana'a, Yemen.
[5]Assistant Professor of Pharmaceutics and Industrial Pharmacy, Sana'a, Yemen.

Article Received on 15 Feb. 2026,
Article Revised on 05 March 2026,
Article Published on 16 March 2026,

https://doi.org/10.5281/zenodo.19045675

***Corresponding Author**
Prof. Dr. Mahmoud Mahyoob Alburyhi
Professor Dr. of Pharmaceutics and Industrial Pharmacy, Department of Pharmaceutics and Industrial Pharmacy, Faculty of Pharmacy, Sana'a University, Sana'a, Yemen.

How to cite this Article: Abdalwali Ahmed Saif[1], Jalal H. Abdullah[2], Mahmoud Mahyoob Alburyhi[1,3]*, Maged Alwan Noman[1,4] and Sami Ahmed Saeed[5]. (2026). Sildenafil-Excipient Compatibility Studies For Pharmaceutical Suspensions Advanced Drug Delivery Systems Development. World Journal of Pharmaceutical Research, 15(6), 869–908.

ABSTRACT

The main objective of the present study was to the preformulation studies were performed to know the physico-chemical and mechanical properties of Sildenafil for formulation development of pharmaceutical suspensions ADDS. The drug-excipient compatibility studies were conducted to characterize the drug Sildenafil present in pharmaceutical suspensions ADDS. The safety, efficacy, quality and stability of a formulation are major concepts of any API development process. In API development process, a detailed characterization of the API and other formulation components is usually carried out during the preformulation stage. Preformulation, formulation and evaluation of Sildenafil to avoid problems associated with conventional delivery system such as limited permeation, low dissolution and bioavailability and also to improve bioavailability and pharmaceutical suspensions ADDS for manage pulmonary arterial hypertension in pediatric patients. In the present study that the compatibility

was assessed by, FTIR spectroscopy, and melting point apparatus, preformulation parameters. Results showed that physical mixtures of Sildenafil and various excipients as xanthan gum, HPMC, CMC, citric acid, sodium benzoate, aspartame, sucralose, and sucrose were evaluated for preformulation studies parameters. It was concluded that the drug Sildenafil was found to be compatible with various excipients which were selected for the formulation development of the Sildenafil pharmaceutical suspensions ADDS for manage pulmonary arterial hypertension in pediatric patients. Formulation scientist from his experience and knowledge have to significantly in the preformulation study stage and is an important factor in the ADDS (Advanced Drug Delivery Systems) product development process.

KEYWORDS: Sildenafil Citrate, Management of Pulmonary Arterial Hypertension, Pharmaceutical Suspensions ADDS, Compatibility, Excipients, Development, Preformulation, Advanced Drug Delivery Systems.

INTRODUCTION

Background[1-18]

Sildenafil Citrate and Management of Pulmonary Arterial Hypertension (PAH) in Pediatric Patients

Sildenafil citrate (SLC), a Phosphodiesterase type 5 inhibitor (PDE 5), is used in the management of pulmonary arterial hypertension (WHO) in both adults and children. It is available as tablets of 20mg, 25 mg, 50 mg and 100 mg strengths as well as an intravenous solution and oral suspension, in the United States. Its mode of action is stimulation of pulmonary vasodilation through raising the levels of intracellular cyclic guanosine monophosphate (cGMP). The safety and efficacy of Sildenafil citrate for management of pediatric pulmonary arterial hypertension has been demonstrated, and the United States Food and Drugs Administration (FDA) recommends its use given continued routine monitoring.

Sildenafil citrate is useful in management of persistent pulmonary hypertension of the newborn (PPHN), although use in children under one year of age is off-label. The dosing recommendation for SLC in management of acute pulmonary hypertension in children below 1 year is a starting dose of 0.25-0.5 mg/kg per oral every 4 to 8 hours, and 2.5mg three times a day for those aged above 1 year, with a body weight below 20 kg. Due to lack of a dose-specific formulation, current practice in resource limited settings involves splitting the adult tablets and extemporaneous preparations of liquid dosage forms.

Splitting tablets is based on the assumption that the active pharmaceutical ingredient (API) is uniformly distributed throughout the product, which is often not the case. Tablets are often difficult to cut and divide appropriately. Their palatability is also reduced due to rough edges revealing the active drug's taste. There is need therefore for a dosage form that provides accurate dosage, to enhance efficacy and safety, one that is easy to produce and dispense, with minimal manipulation to reduce the risk of errors. liquid dosage form is highly convenient dosage form that takes into consideration swallowing difficulties especially among pediatrics, geriatrics, patients suffering from difficulties in swallowing, and repeated episodes of vomiting.

Sildenafil citrate has been demonstrated to be effective when administered orally in the management of pulmonary arterial hypertension (PAH) in adults and children. It is particularly useful for the management of persistent pulmonary hypertension of the newborn (PPHN) although use in children under the age of 1 year is off-label. There however lacks a suitable dosage form for children locally, with current practice involving splitting adult tablets into multiple pieces to achieve doses fit for children, and the tedious preparation of liquid formulations extemporaneously. Tablet Splitting is usually difficult and wasteful with the inherent risk of errors. There is need for a suitable and convenient pediatric dosage form. A 2.5 mg SLC dry suspension will be dose specific and highly convenient for children.

Research Paths[19-53]

Scientific research that is organized in the form of Research Paths is characterized by the fact that, it is the most effective in achieving an idea, innovation, and development. It is linking the inductive plan, steps, goals, research methods, results, conclusion, materials, and equipment required to achievement scientific research. Research Paths are distinguishing that by build on each other and link the common relationship between them.

Pharmaceutical Research Paths

Pharmaceutical research is characterized by having both a natural source and synthetic source for primary active raw materials and excipients, each source is mainly prepared to the effectiveness and safety of the drug.

The Pharmaceutical Research Paths include: Pharmacognosy deals with natural sources of drug, Pharmaceutical Chemistry specializes in synthetic sources of drug, Pharmaceutics specializes in designing of pharmaceutical dosage forms and drug delivery systems from

natural and synthetic sources of active pharmaceutical ingredients and excipients that help in developing dosage forms and drug delivery systems.

The Pharmaceutical Research Paths link steps are manufacturing and development of drug according to the standard parameters evaluation such as physiochemical properties, preformulation, formulation, evaluation, drug stability, Pharmaceutical analysis, pre-clinical, post-clinical stages, pre-marketing, post-marketing, Pharmacovigilance, Pharmacoeconomics, Pharmacy Management, Pharmacology, Toxicology, Therapeutics, Pharmaceutical Care, Health Care, Advanced Industrial Pharmacy, Biopharmaceutics and Pharmacokinetics, Advanced Clinical Pharmacokinetics, Pharmaceuticals Cosmetics, Pharmaceutical Biotechnology, Drug Design, Pharmacy Law and Ethics, Pharmacogenomics, Good Manufacturing Practice, and Good Pharmacy Practice etc.

All of these Pharmaceutical Research Paths are interconnected, and whenever the link between them is made in a scientific relationship and the goal of pharmaceutical care is achieved gradually according to plan of a scientific pharmaceutical research path.

Pharmaceutical Research Paths are the scientific methods through which the scientific relationship between the pharmaceutical team, research, supervisor or specialist researcher, the scientific research materials, equipment's, scientific institution, pharmaceutical companies, reference standards, and the goals of pharmaceutical research improve and development of community services of pharmaceutical care and health care.

Pharmaceutical Scientists are considering natural sources and medicinal herbs in the pharmaceutical industry an important part of drug development because natural sources of drugs have properties that are greater than industrial sources of drugs in NDDS. And the pharmaceutical industry strategies depend on the development of different pharmaceutical dosage forms and recent novel drug delivery systems. Using medicinal herbs and natural sources as important goals of drug development. It is part of the art of innovation in drug development with different of novel drug delivery systems and pharmaceutical care for patients and society, it's the basic of development of the new pharmaceutical industry by developing different novel drug delivery systems from different sources.

Preformulation Studies[54-130]

The safety, efficacy, quality and stability of a formulation are major concepts of any API

development process. In API development process, a detailed characterization of the API and other formulation components is usually carried out during the preformulation stage. Formulation scientist from his experience and knowledge have to significantly in the preformulation study stage and is an important factor in the ADDS (Advanced Drug Delivery Systems) product development process.

Preformulation Study Includes: Determination of physical chemical properties of API substance with the goal of developing a new drug which is safe stable and efficacious, each API, has intrinsic chemical and physical properties that were considered prior to the development of pharmaceutical formulation, the purpose of preformulation study is to generate useful information for the formulator in the development of stable and bioavailable dosage form, inappropriate preformulation study results in poor stability of active ingredients increase the overall cost of development and increased development time, preformulation studies help to fortify the pharmaceutical scientific foundation of the guidance, provide regulatory relief and conserve resources in the drug development and evaluation process, enhance public safety standards, improve product quality, promote the implementation of new technologies, aids policy development and regulatory decision making and after compiling all data it is transferred to the development pharmacist and for the day work on formulation of dosage form.

Preformulation Study Objectives: To establish the Physico-chemical parameters of a new API entity, determine its kinetics and stability, establish its compatibility with common excipients, it provides insights into how drug products should be processed and stored to ensure their quality, estimate problem may arise during formulation that is stability problem poor *in-vivo* dissolution, poor bioavailability, to interpret BCS classification of drugs and its significance and develop optimal drug delivery system.

Drug-Excipient Compatibility Study: The primary objective of this investigation was to identify a stable storage condition for API in solid state and identification of compatible excipients for its formulation. Incompatibilities are major concerns in formulation development. Selection of the proper excipient during preformulation studies is of prime importance.

Dosage Forms: DF contain API and pharmaceutical excipients, which are intended to generate an ideal formulation and manufacturability of pharmaceutical products, thereby

enabling a much safer and more effective administration. Pharmaceutical excipients are ideally inactive and have no impact on the stability or therapeutic effect of the active ingredient. On the other hand, there are studies that have presented that some pharmaceutical excipients are just allegedly described as inactive ingredient. Some pharmaceutical excipients have the capacity to affect API, efficacy by affecting its pharmacokinetics. Excipients can affect the physical and chemical form of pharmaceuticals by several factors such as hydrogen bond interaction, polymorphic conversion, and others. Accordingly, drug-excipient compatibility should be conducted so as to determine any drug-excipient interactions that may obstruct the stability, bioavailability, and manufacturability of pharmaceutical dosage forms.

Importance of Drug-Excipient Compatibility

Studies of active pharmaceutical ingredient (API)-excipient compatibility represent an important study in the preformulation stage of the development of new dosage forms, stability of the dosage form can be maximized, any physical or chemical interaction between API, and excipient can affect bioavailability and stability of drug, it helps to avoid the surprise problem, by performing drug excipient compatibility studies (DECS) we can know the possible reaction before formulating final dosage form, DECS data is essential for IND (investigational new drug) submission, and now, USFDA has made it compulsory to submit DECS data for any new coming formulation before its approval.

The potential physical and chemical interactions between an API, and the excipients can affect the chemical nature, the stability and bioavailability of the former and, consequently, its therapeutic efficacy and safety, solid dosage forms are generally less stable than their API components and despite the importance of API-excipient compatibility testing, there is no universally accepted protocol to assess such interactions.

Pharmaceutical Excipients: Excipients are additive substances used to improve the bulkiness, disintegration, dissolution rate, and bioavailability of a formulation etc. Different dosage forms like powders, granules, capsules, tablets, oral liquids, injectable products, implants, eye products, nasal products, inhalers, topical creams, ointments, gels, transdermal patches and suppositories etc, contains different types of excipients. To make it acceptable and compatible various pharmaceutical excipients are added in pharmaceutical dosage form for their direct therapeutic action, manufacturing process, to protect, support or enhance stability, for bioavailability or patient compliance. These must be physiologically and chemically

stable, must not have any incompatibility with the API, and must meet the standards of regulatory requirements.

Evaluation of Drug-Excipient Compatibility

The compatibility study of API and excipients is important to predict the stability of the API, in the final pharmaceutical product. It's the first time that API was compatible with excipients promoted physical and chemical compatibility studies was achieved by thermal and non-thermal methods. As a part of preformulation study, a compatibility study of API with the other excipients was carried out using physical blends in analytical techniques for the evaluation of drug-excipient interactions. The most commonly used pharmaceutical analytical techniques include, thermal techniques such as Differential Scanning Calorimetry (DSC), Thermogravimetric Analysis (TGA), Isothermal Microcalorimetry (IMC) and Hot stage microscopy (HSM) etc, and non-thermal techniques such as UV-Visible Spectrophotometric (UV), Infrared, Near-Infrared and Raman Spectroscopy (FT-IR), (NIR), Powder *X*-Ray Diffraction (PXRD), Solid-State Nuclear Magnetic Resonance Spectroscopy (ssNMR), Microscopic techniques: Scanning Electron Microscopy (SEM), Chromatographic techniques: Thin Layer Chromatography (TLC), and High-Performance Liquid Chromatography (HPLC) etc.

Preformulation Parameters: According to dosage form of API, mainly solid state, particle size, shape, pKa, pH determination, common ion effect, temperature, partition coefficient, solubility studies, dissolution rate, melting point, powder flow properties, crystallinity, polymorphism, hygroscopicity, stability study and drug-excipient compatibility etc. While other dosage forms according to important of preformulation parameters used in study before start in development of formulation.

Drug-excipient compatibility and formulation stability are not depended on API only but also its affected by excipient. Excipient play important role in dosage form but side by side it also increases compatibility problem so proper selection of excipient is very important in development of formulation. Incompatibility can be result mainly in any of following changes: Changes in organoleptic properties, changes in dissolution performance, decrease in potency, and increase in degradation rate etc.

Drug excipient physicochemical characterization is a systematic approach towards design of therapeutically active and stable dosage forms. The rapid advancements in novel drug

delivery systems development have led to an interest by formulation scientists in the role and functionality of the excipients.

In the present study, it was proposed to drug-excipient compatibility studies of Sildenafil, with commonly different excipients using for formulation development of pharmaceutical suspensions ADDS for manage pulmonary arterial hypertension in pediatric patients.

MATERIALS AND METHODS

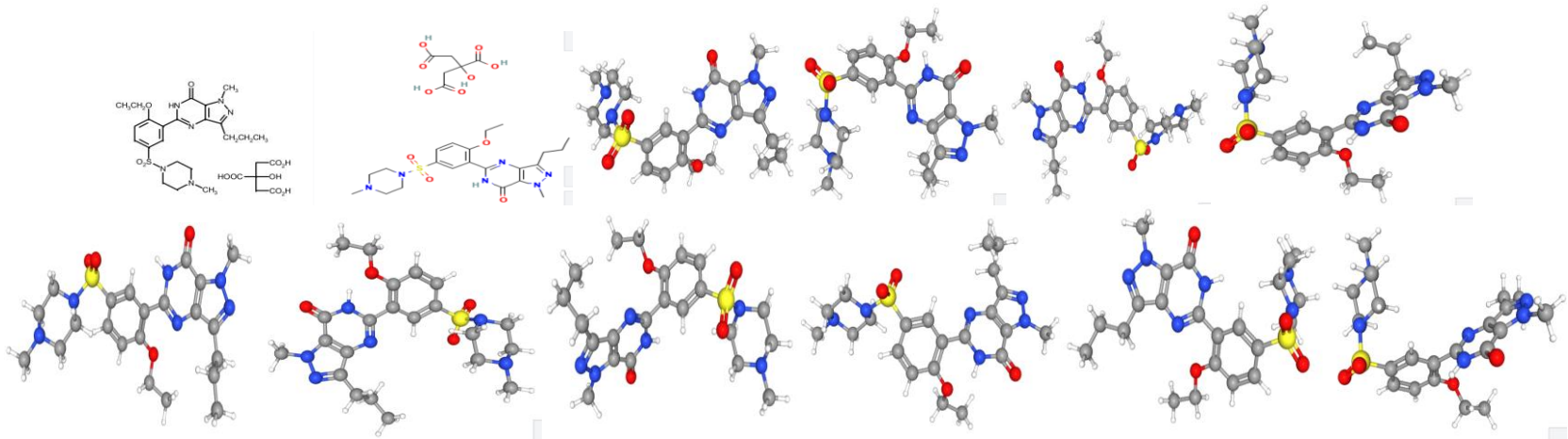
Sildenafil and all raw materials used in the preformulation and formulation including active pharmaceutical ingredients (APIs), excipients, and analytical reagents were obtained as a gift sample from (Modern Pharmaceutical Industry Company-Yemen) and (Shaphaco Pharmaceutical Industry Company-Yemen). As shown in Table 1.

Table 1: List of Materials Used.

No	Materials
1	Sildenafil Citrate
2	Xanthan Gum
3	HPMC
4	CMC
5	Citric Acid
6	Sodium Benzoate
7	Strawberry Flavor
8	Mentha Piperita
9	Aspartame
10	Sucralose
11	Sucrose
12	Distal Water
13	Ethanol
14	Methanol

Evaluation of Drug–Excipient Compatibility Studies Methods[110-196]

Table 2: Sildenafil Data.

Characterization of Sildenafil			
 **Sildenafil Structure and 3D Conformer**			
Chemical Structure	1-[[3-(6,7-dihydro-1-methyl-7-oxo-3-propyl-1H-pyrazolo[4,3-d] pyrimidin-5-yl)-4-ethoxyphenyl] sulfonyl]-4-methylpiperazine citrate.	**Appearance**	a white to off-white crystalline powder.
Chemical Formula	$C_{22}H_{30}N_6O_4S \cdot C_6H_8O_7$	**Solubility**	It is sparingly soluble in water and slightly soluble in ethanol. The solubility in water is approximately 3.5 mg/ml. The melting point of sildenafil citrate is approximately 191-195°C.
Molecular Weight	666.7 g·mol−1	**BCS**	Class-II Drug
Action and Use	Pulmonary arterial hypertension is the first broad group in the WHO classification of pulmonary hypertension. It is further		

<table>
<tr><td></td><td colspan="3">subdivided into primary, genetic, drug or toxin induced, persistent pulmonary hypertension of the newborn (PPHN), and PAH associated with other systemic diseases.
PAH causes vasomotor imbalance in the pulmonary vascular bed leading to constriction of the blood vessels with their consequent restructuring, inflammation and the ultimate luminal blockade that may cause thrombosis within the vessels. Subsequently, pulmonary arterial pressure increases due to the high vascular resistance. Consequently, right ventricular malfunctioning ensues leading to low cardiac output hence the progressive and debilitating symptoms of PAH.
Sildenafil decreases the pulmonary vasculature resistance by promoting pulmonary vasodilation.
Sildenafil citrate is a selective inhibitor of phosphodiesterase type 5 (PDE5), an enzyme responsible for the degradation of cyclic guanosine monophosphate (cGMP).
By inhibiting PDE5, sildenafil increases cGMP levels in the corpus cavernosum, leading to smooth muscle relaxation and increased blood flow, which facilitates erection in response to sexual stimulation.
Indications:
Pulmonary Arterial Hypertension (PAH): It is also approved for the treatment of PAH where it helps to relax pulmonary vascular smooth muscle and reduce pulmonary hypertension.
Adverse Effects:
Common side effects include headache, flushing, dyspepsia, nasal congestion, dizziness, and visual disturbances (such as changes in color vision or blurred vision). Rare but serious side effects include priapism (prolonged erection), sudden hearing loss, and cardiovascular events.
Contraindications:
Concomitant use with nitrates or nitric oxide donors due to the risk of severe hypotension.
Hypersensitivity to sildenafil or any component of the formulation.</td></tr>
<tr><td colspan="4">Pharmacokinetics of Sildenafil</td></tr>
<tr><td>Drug Absorption</td><td>Sildenafil is rapidly absorbed after oral administration, with peak plasma concentrations (Cmax) reached within30 t o 120 minutes) median 60 minutes) Food
especially high-fat meals, can delay absorption.</td><td>Drug Distribution</td><td>It is widely distributed in tissues, with a volume of distribution of approximately 105 liters. Sildenafil is about 96% protein-bound.</td></tr>
<tr><td>Drug Metabolism</td><td>Primarily metabolized in the liver by cytochrome P450 enzymes, mainly CYP3A4 (major route) and CYP2C9 (minor route). The major active metabolite, N-desmethyl sildenafil, has about 50% of the parent drug's potency.</td><td>Drug Excretion</td><td>Excreted mainly as metabolites in feces (approximately 80%) and urine</td></tr>
</table>

			(approximately 13%).
The Elimination Half-Life (T1/2)	The elimination half-life is about 4 hours	**Availability**	Tablets, Suspensions

Table 3: Pharmaceutical Excipients Data.

Nonproprietary Name	Synonyms	Functional Category	Incompatibilities
Hydroxypropyl Cellulose	Cellulose, 2-hydroxypropyl ether; 2-hydroxypropyl ether (lowsubstituted) cellulose; hyprolose, low-substituted; L-HPC; oxypropylated cellulose.	Tablet and capsule disintegrant; tablet binder	Alkaline substances may interact. If a tablet formulation contains such a material, the disintegration time may be extended after storage.
Xanthan Gum	Corn sugar gum; E415; Grindsted; Keldent; Keltrol; polysaccharide B-1459; Rhodicare S; Rhodigel; Vanzan NF; xanthani gummi; Xantural.	Gelling agent; stabilizing agent; suspending agent; sustained-release agent; viscosity-increasing agent.	Incompatible with cationic surfactants, polymers, and preservatives, often leading to precipitation, and at concentrations exceeding 15% w/v, anionic and amphoteric surfactants can also precipitate xanthan gum from solution. It is incompatible with oxidizing agents, some tablet film coatings, carboxymethylcellulose sodium, dried aluminum hydroxide gel, and certain active pharmaceutical ingredients.
Aspartame	3-Amino-N-(a carboxyphenethyl) succinamic acid N-methyl ester; 3-Amino-N- (a methoxycarbonylphenethyl) succinamic acid;	Sweetening agent. It enhances flavor systems and can be used to mask some unpleasant taste characteristics; the approximate sweetening power is 180–200 times that of sucrose.	Incompatible with dibasic calcium phosphate and also with the lubricant magnesium stearate. Reactions between aspartame and sugar alcohols.
Hypromellose	Benecel MHPC; E464; hydroxypropyl methylcellulose; HPMC; hypromellosum; Methocel;	Bioadhesive material; coating agent; controlled-release agent; dispersing agent; dissolution	Hypromellose is incompatible with some oxidizing agents. Since it is nonionic, hypromellose will not complex with

	methylcellulose propylene glycol ether; methyl hydroxypropylcellulose; Metolose; MHPC; Pharmacoat; Tylopur; Tylose MO.	enhancer; emulsifying agent; emulsion stabilizer; extended-release agent; film-forming agent; foaming agent; granulation aid; modified-release agent; mucoadhesive; release-modifying agent; solubilizing agent; stabilizing agent; suspending agent; sustained-release agent; tablet binder; thickening agent; viscosity-increasing agent.	metallic salts or ionic organics to form insoluble precipitates.
Citric Acid	Acidum citricum monohydricum; E330; 2-hydroxypropane-1,2,3- tricarboxylic acid monohydrate.	Acidifying agent; antioxidant; buffering agent; chelating agent; flavor enhancer; preservative.	Citric acid is incompatible with potassium tartrate, alkali and alkaline earth carbonates and bicarbonates, acetates, and sulfides. Incompatibilities also include oxidizing agents, bases, reducing agents, and nitrates. It is potentially explosive in combination with metal nitrates. On storage,
Sodium Benzoate	Benzoic acid sodium salt; benzoate of soda; E211; natrii benzoas; natrium benzoicum; sobenate; sodii benzoas; sodium benzoic acid.	Antimicrobial preservative; tablet and capsule lubricant.	Incompatible with quaternary compounds, gelatin, ferric salts, calcium salts, and salts of heavy metals, including silver, lead, and mercury. Preservative activity may be reduced by interactions with kaolin or nonionic surfactants.
Sucralose (SucraPlus)	plenda; sucralosa; sucralosum; SucraPlus; TGS; 10 ,40 ,60 -trichlorogalactosucrose; 4,10 ,60 -trichloro-4,10 ,60 -trideoxy-galacto-sucrose.	Sweetening agent.	---
Sucrose	Beet sugar; cane sugar; a-D-glucopyranosyl-b-D-fructofuranoside; refined sugar; saccharose; saccharum;	Confectionery base; coating agent; granulation aid; suspending agent; sweetening agent; tablet binder;	Powdered sucrose may be contaminated with traces of heavy metals, which can lead to incompatibility with active ingredients,

	sugar.	tablet and capsule diluent; tablet filler; therapeutic agent; viscosity-increasing agent.	e.g. ascorbic acid. Sucrose may also be contaminated with sulfite from the refining process. With high sulfite content, color changes can occur in sugar-coated tablets; for certain colors used in sugar coating the maximum limit for sulfite content, calculated as sulfur, is 1 ppm. In the presence of dilute or concentrated acids, sucrose is hydrolyzed or inverted to dextrose and fructose (invert sugar). Sucrose may attack aluminum closures.

According to Sildenafil and excipients data as shown in Tables 2 and 3, it was selected that the different excipients to preformulation study with Sildenafil in the present study, the equipments used as shown in Table 4.

Table 4: The Equipment's Used.

No	Equipment's
1	Fourier Transform Infrared Spectrophotometer
2	UV/VIS Spectrophotometer
3	Melting Point Tester
4	Viscometer
6	pH Meter
7	Electronic Balance

UV Scanning of Sildenafil in 0.1NHCl

The concentration of Sildenafil 10µg/ml solution was prepared in 0.1NHCl and was subjected to scanning under UV visible spectrophotometer, between the range 200-400nm. The λmax was found to be at 290nm.

Preparation of Standard Calibration Curve

An accurately weighed 100mg of Sildenafil was dissolved in 1000ml of 0.1NHCl to get a concentration of 0.1mg/ml. Aliquots of stock solution were pipetted out ranging from volume 25 ml, 50 ml, 100 ml, 150 ml, 200ml and 250 ml in a volumetric flask and the volume was adjusted with 0.1NHCl to produce concentration of 25, 50, 100, 150, 200, 250µg/ml respectively. Absorbance of the above solutions was measured at 290 nm by UV visible spectrophotometer against a blank of 0.1NHCl solution. The standard calibration curve was obtained by plotting absorbance verses concentration in µg/ml.

Preformulation Studies

Preformulation studies are initiated to define the physical and chemical properties of the agent. The key goals of preformulation studies are to ensure the delivery of drug product with acceptable stability, bioavailability, and manufacturability.

Melting Point Determination of Sildenafil

Melting Point: Melting point of the Sildenafil was determined by capillary method; one sided closed capillary filled with drug and put into the Melting Point Apparatus. Temperature was noted at which solid drug changed into liquid.

Drug-Excipient Compatibility Studies

A physical mixture including Sildenafil and excipient was created in a 1:1 ratio, and it was subjected to analytical techniques such as FTIR spectroscopy. FTIR, of both pure drug and physical mixes were obtained, and the spectra of the both drug and mixture of excipient with drug were compared to look for any incompatibilities.

FTIR Spectroscopy Study

FTIR study KBr-disc method was used to record the FTIR spectra and KBr pellets were made in 1:100 ratio of sample and KBr. FTIR spectra was recorded using FTIR spectrum in a range of 4000-400cm^{-1}. Different functional groups of test compound for distinctive vibrational frequencies are identified using FTIR spectroscopy. FTIR spectra were used for the investigation of interaction in the physical mixture of API and excipient through shifting of peaks to lower or higher wavenumbers and appearance or disappearance of characteristic peaks of functional groups for pure API in physical mixture. FTIR spectroscopic study was performed to check the compatibility between API, and different excipients in amount (5mg:5mg) as ratio (1:1) as shown in Table 5. The FTIR spectra of a API alone and API with excipients were obtained by KBr method and compared with the standard FTIR spectrum of the pure API. Infrared spectrophotometer is not only used for determining the compatibility of excipients with the APIs, but also for API identification.

Preparation of IR Samples

The sample was determined by the disc method. Triturate 5mg of the substance to be examined with 300-400 mg of finely powdered and dried potassium bromide R or potassium chloride R. Each excipient was mix with Sildenafil equally then of potassium bromide is added to the mixture. Carefully grind the mixture, spread it uniformly in a suitable die, and submit it to a pressure of about 800 MPa (8 t·cm^{-2}). Then the tablets were inserted to the device and the Infrared spectra was recorded at mild-infrared light in wavenumber range of 4000 cm^{-1} to 400 cm^{-1}. After that the spectra were compared with the reference.

Infrared Spectral Study of Samples in Room Condition

Compatibility studies were performed by preparing blend of different excipients with **Sildenafil** in room condition as shown in Table 5.

Table 5: Samples of Sildenafil Citrate and Different Excipients for Compatibility Studies.

No	Component(s)	Amount(5mg:5mg)
1	Sildenafil Citrate	1
2	Sildenafil Citrate and Xanthan Gum	(1:1)
3	Sildenafil Citrate and HPMC	(1:1)
4	Sildenafil Citrate and CMC	(1:1)
5	Sildenafil Citrate and Sodium Benzoate	(1:1)
6	Sildenafil Citrate and Citric Acid	(1:1)
7	Sildenafil Citrate and Sucralose	(1:1)
8	Sildenafil Citrate and Aspartame	(1:1)
9	Sildenafil Citrate and Sucrose	(1:1)
10	Sildenafil Citrate and Peppermint	(1:1)
11	Sildenafil Citrate and Strawberry	(1:1)

RESULTS AND DISCUSSION

Identification Test

There are many of identification tests used in Sildenafil identification. We used Melting point, IR spectrum and calibration curve.

Melting Point Determination of Sildenafil

Melting point of pure Sildenafil was determined by open capillary method. The capillary tube was closed at one end by fusion and was filled with Sildenafil by repeated tapings. The capillary tube was placed in a digital melting point apparatus. The instrument was set to automatically increase the temperature of the heating bath. The rise in temperature was viewed through screen. The temperature at which the drug started d melting was recorded. The melting point range of Sildenafil was identical to reference melting point stated in MP (191-195°C). The sample started to melt at 194°C, and turned into liquid at 195°C, indicating that the sample used is pure. That reading has stated in melting point tester. as shown in Table 6.

Table 6: Results of Melting Point of Sildenafil.

Test	Temp Rang Analyzed (Melting)	Results
Test I Sildenafil	(191-195°C)	195°C
Test II Sildenafil	(191-195°C)	195°C

Calibration Curve of Sildenafil

The maximum absorbance of Sildenafil in 0.1NHCl was determined by scanning the Sildenafil solution from 200-400 nm. The maximum absorbance was found at 290nm. as

shown in Table 7.

Table 7: Calibration Curve of Sildenafil in 0.1NHCl.

NO.	Concentration mg/ml	Absorbance
1	0.00	0.00
2	0.0025	0.0709
3	0.0050	0.1352
4	0.0100	0.2754
5	0.0150	0.4425
6	0.0200	0.5651
7	0.0250	0.7093

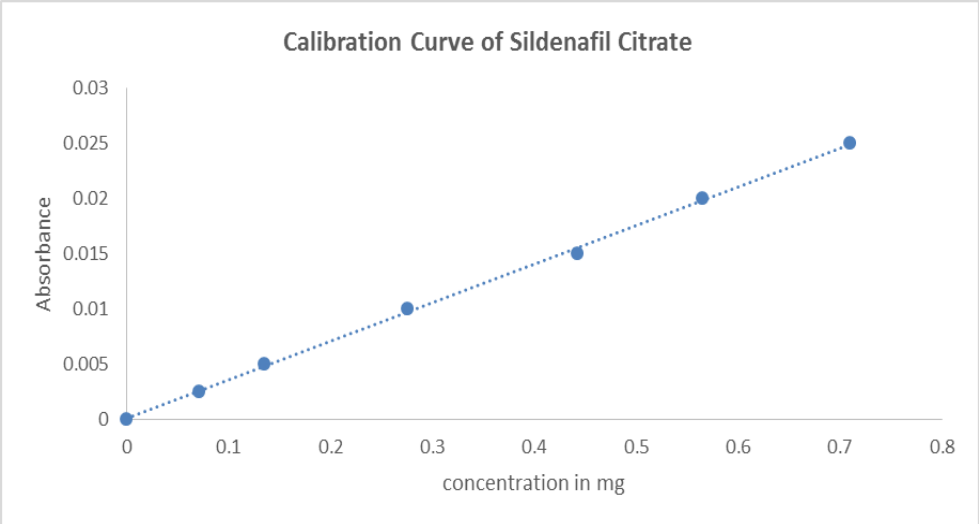


Fig. 1: Calibration Curve of Sildenafil in 0.1NHCl.

The calibration curve of Sildenafil was prepared in 0.1NHCl. The plot of different concentrations of Sildenafil versus absorbance was found linear at 290 nm in calibrations. The absorbance at different concentrations is shown in Table 7. The regression equation for Sildenafil was obtained by plotting absorbance (A) versus concentration of Sildenafil (C). The data of standard curve was linearly regressed. The linear regression equation was Y = 0.003380274 C - 0.0349. The regression coefficient (R^2 = 0.99985) was very much significant. The calibration curve was shown in Table 7 and Figure 1.

Characterization of Sildenafil by FTIR

FT-IR spectral studies indicated that the drug is compatible with all the excipients. The FT-IR spectrum of physical mixture showed all the characteristic peaks of **Sildenafil Citrate**, thus conforming that no interaction of drug occurred with the excipients as shown in Figures (2-13) and Table 8.

Table 8: Functional Group of Sildenafil Citrate According to Spectrum.

NO	Functional Goup	Frequency (cm^{-1})	Explanation
1	**Aromatic Ring (C=C)**	1450-1600.	Peaks appear due to the stretching vibrations of the aromatic ring (benzene ring) in the molecule.
2	**Ester Group (C=O and C-O)**	C=O: 1700-1750. C-O: 1100-1300.	The ester group in citric acid contributes to these peaks.
3	**Hydroxyl Group (O-H)**	3200-3600 (broad peak).	The hydroxyl group in citric acid contributes to a broad peak due to hydrogen bonding.
4	**Methyl piperazine Group (C-N and C-H)**	C-N:1200-1250. C-H:2850-3000.	The methyl piperazine group contributes to these peaks due to C-N and C-H stretching vibrations.
5	**Sulfonyl Group (S=O)**	1300-1350 (asymmetric) and 1150-1200 (symmetric).	The sulfonyl group in the sulfonamide moiety contributes to these peaks.
6	**Ether Group (C-O-C)**	1000-1100.	The ethoxy group (C-O-C) attached to the benzene ring contributes to this peak.
7	**Amide Group (N-H and C=O)**	N-H: 3300-3500. C=O:1650-1700.	The amide group in the sulfonamide moiety contributes to these peaks.

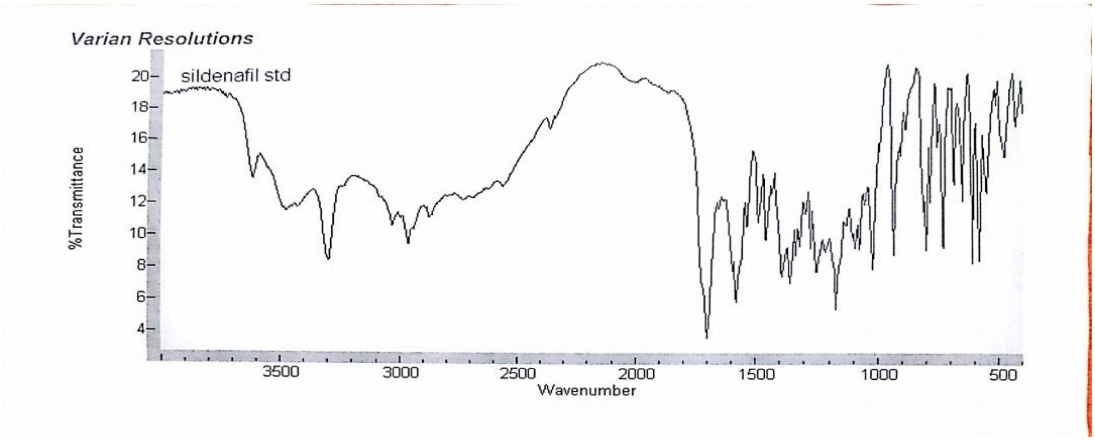


Fig. 2: FTIR Spectrum of Standard Sildenafil Citrate.

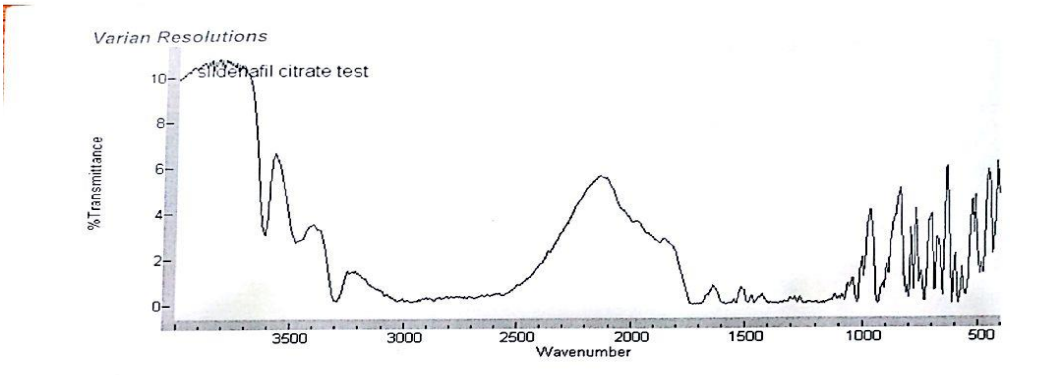


Fig. 3: FTIR Spectrum of Standard Sildenafil Citrate and Sildenafil Citrate.

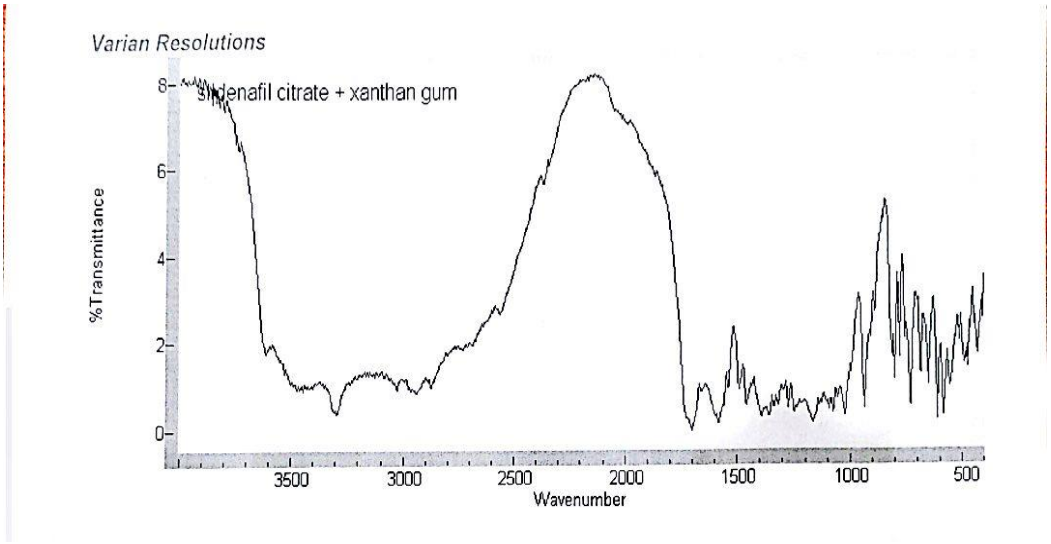


Fig. 4: FTIR Spectrum of Physical Mixture of Sildenafil Citrate and Xanthan Gum.

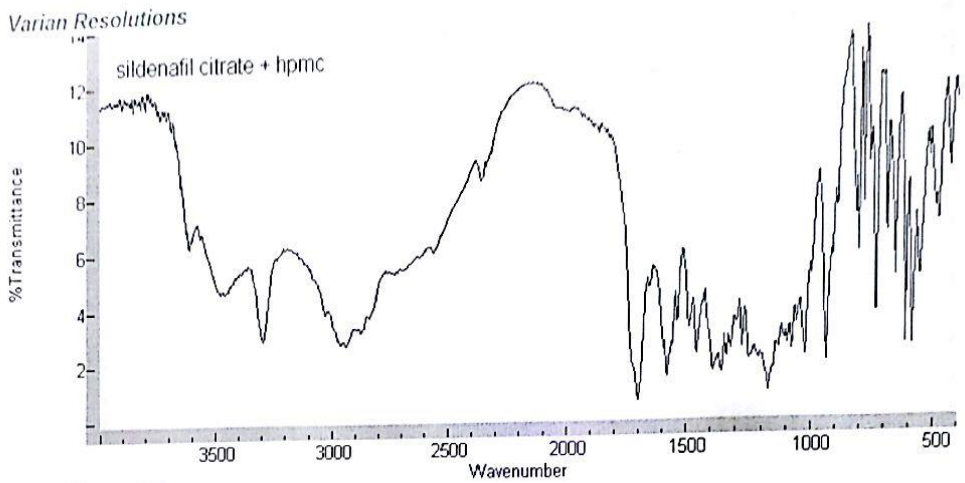
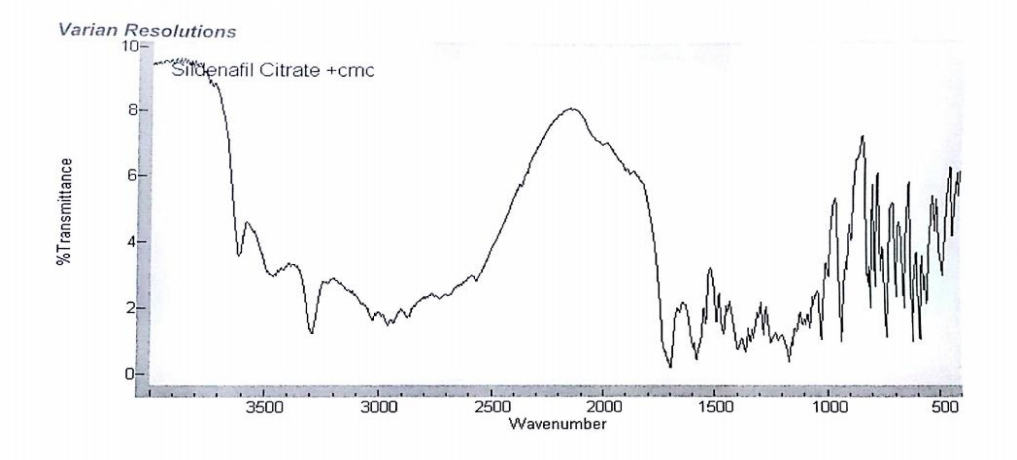


Fig. 5: FTIR Spectrum of Physical Mixture of Sildenafil Citrate and HPMC.



ig. 6: FTIR Spectrum of Physical Mixture of Sildenafil Citrate and CMC.

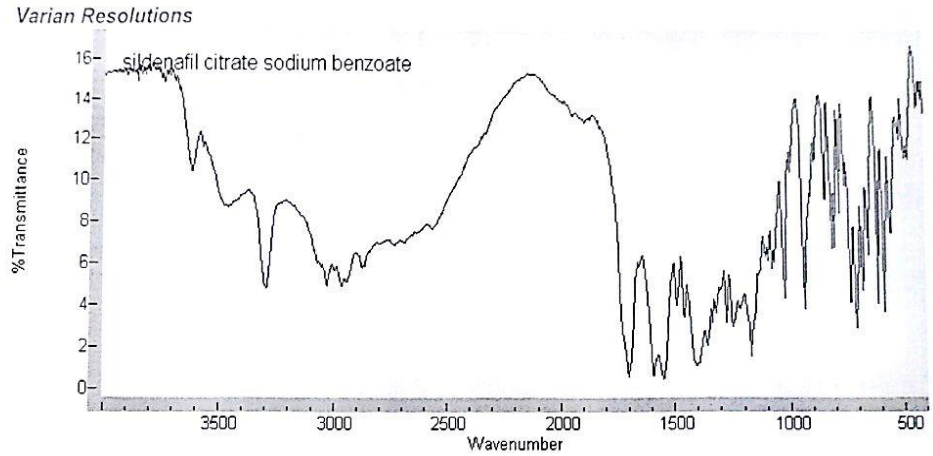


Fig. 7: FTIR Spectrum of Physical Mixture of Sildenafil Citrate and Sodium Benzoate.

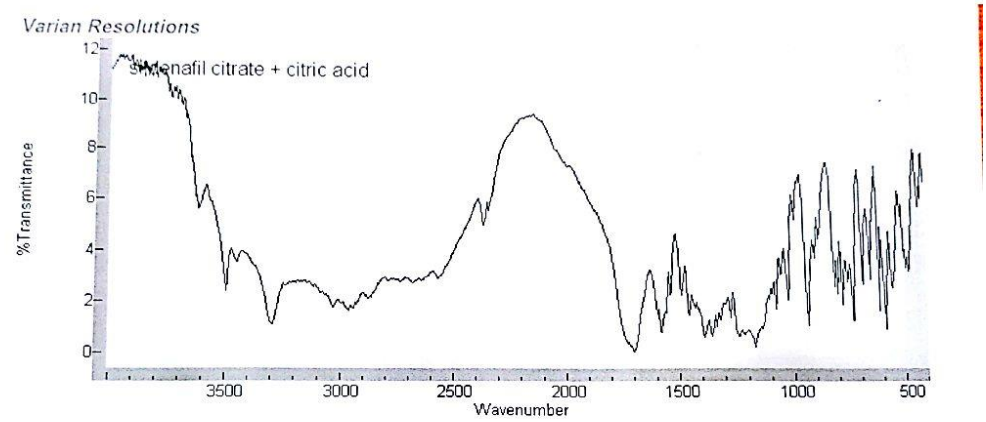


Fig. 8: FTIR Spectrum of Physical Mixture of Sildenafil Citrate and Citric Acid.

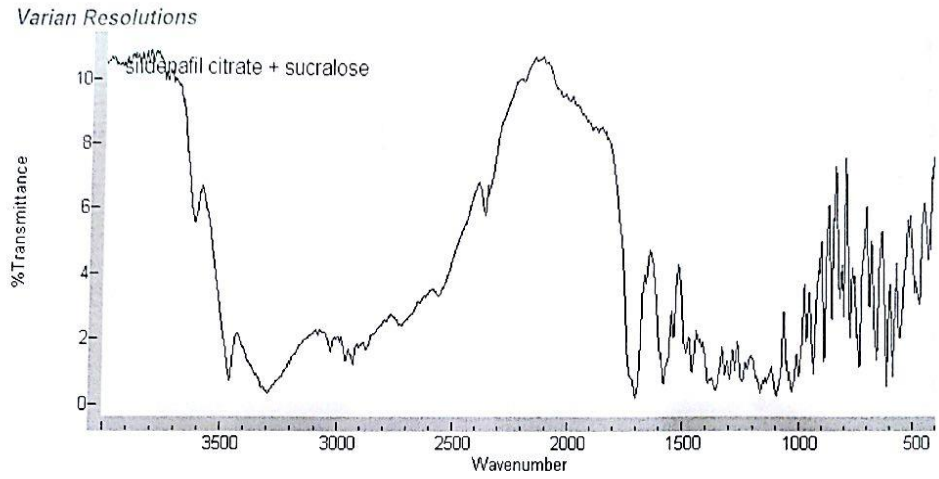


Fig. 9: FTIR Spectrum of Physical Mixture of Sildenafil Citrate and Sucralose.

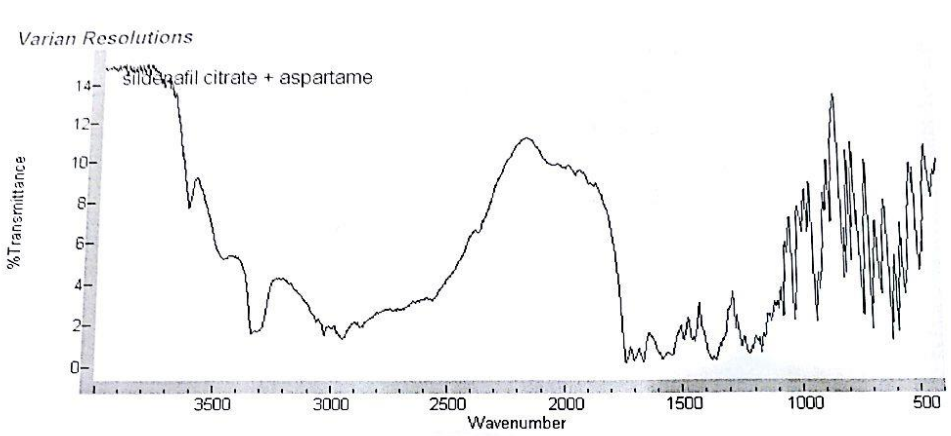


Fig. 10: FTIR Spectrum of Physical Mixture of Sildenafil Citrate and Aspartame.

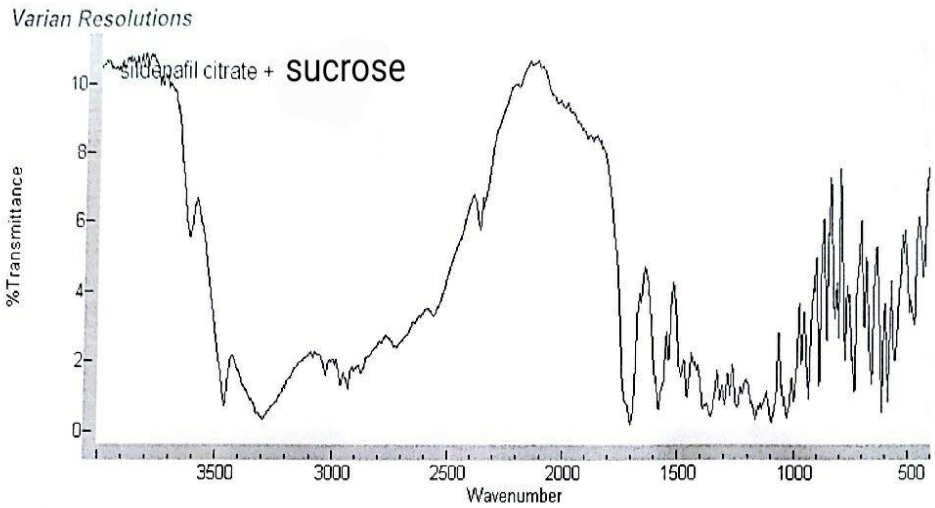


Fig. 11: FTIR Spectrum of Physical Mixture of Sildenafil Citrate and Sucrose.

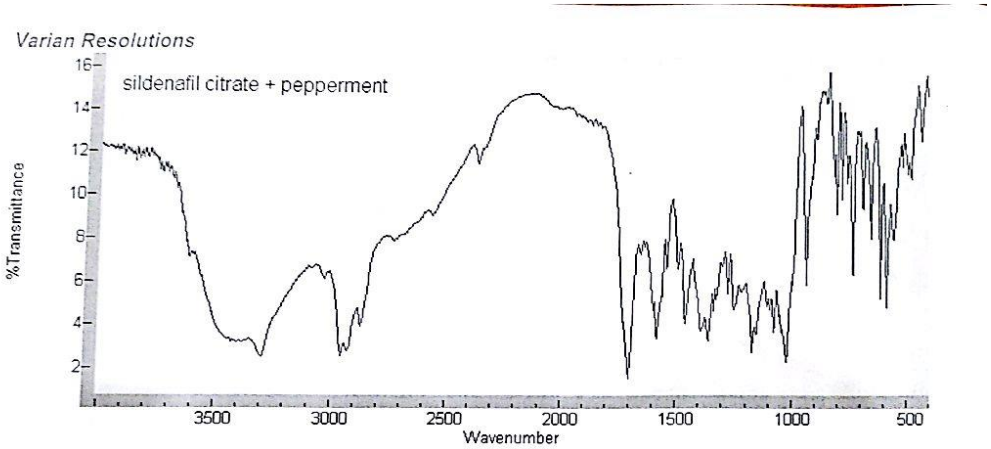


Fig. 12: FTIR Spectrum of Physical Mixture of Sildenafil Citrate and Peppermint.

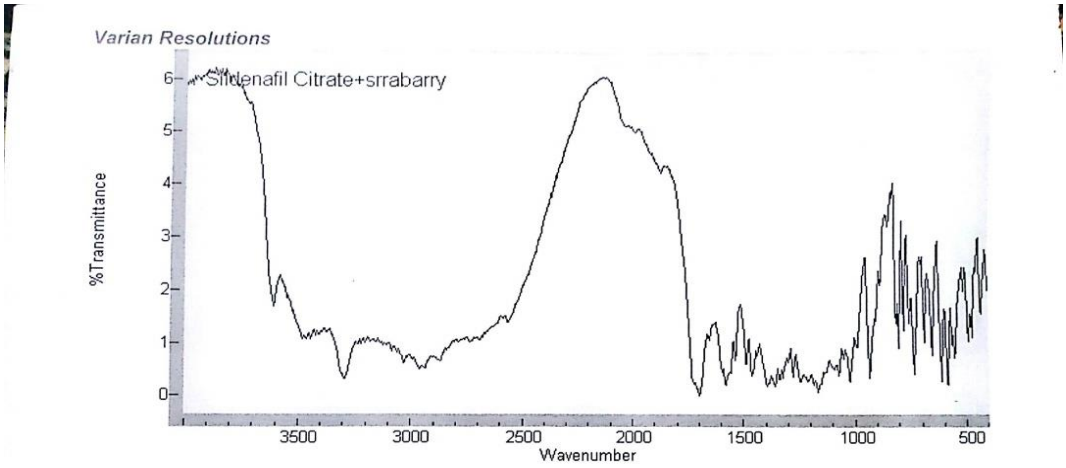


Fig. 13: FTIR Spectrum of Physical Mixture of Sildenafil Citrate and Strawberry.

CONCLUSION

The compatibility studies of physical mixtures of Sildenafil with different used excipients such as xanthan gum, HPMC, CMC, citric acid, sodium benzoate, aspartame, sucralose, and sucrose were investigated by FTIR it was detected that there was no variation or minor deviation in the characteristic peaks in FTIR spectroscopy. It was concluded that the drug Sildenafil was found to be compatible with various excipients which were selected for the formulation development of the Sildenafil pharmaceutical suspensions ADDS for manage pulmonary arterial hypertension in pediatric patients. Formulation scientist from his experience and knowledge have to significantly in the preformulation study stage and is an important factor in the ADDS (Advanced Drug Delivery Systems) product development process.

ACKNOWLEDGEMENT

The authors are thankful to Modern Pharmaceutical Industry Company -Yemen and Shaphaco Pharmaceutical Industry Company-Yemen for their support and facilities.

REFERENCES

1. https://www.thecardiologyadvisor.com/news/pediatric-pah-prognosis- predicted-by-who-functional-class-hospitalization/
2. Jooste N. Extemporaneous preparation in a resource limited setting: sildenafil citrate suspension. South Africa Pharmacy Journal., 2011; 78(8): 49–50.
3. Taneja R, Furin J, Maheshwari HK. Pediatric formulations of second-line antituberculosis medications: challenges and considerations. The International Journal of Tuberculosis and

Lung Disease., 2015; 19(12): 61–9.

4. Kundu S, Patil AV, Srinivasan G, Borkar N. Controlled Release Suspension: A Review. International Journal of Pharmaceutical Innovations., 2011; 2(4): 1-18.
5. Patel M, Patel KR, Patel MR, Patel NM. Formulation and Evaluation of Microemulsion Based Gel of Ketoconazole International Journal of Universal Pharmacy and Bio Sciences., 2014; 3(2): 93-111.
6. Singh VK, Mishra VK, Maurya JK. Formulation and evaluation of cephalexin monohydrate re-constitutional oral suspension with piperine and their antibacterial activity. World Journal of Pharmaceutical Research., 2014; 3(3): 821-831.
7. Kumar RS, Yagnesh TNS. Pharmaceutical Suspensions: Patient Compliance Oral Dosage Forms. World Journal of Pharmacy and Pharmaceutical Sciences., 2016; 1471-1537: (12).
8. Kumar KS, Bhowmik D, Srivastava S, Paswan S, Dutta AS. Diabetes Epidemic in India--A Comprehensive Review of Clinical Features, Management and Remedies. The Pharma Innovation., 2012; 1(2): 17-33.
9. M. Gabriëls, J. Plaizier-Vercammen, Experimental designed optimization and stability evaluation of dry suspensions with artemisinin derivatives for pediatric use, International J of Pharmaceutics., 2004; 283: 19–34.
10. Bardeskar C, Geeverghese R. Reconstitute Oral Suspensions (Dry Syrups): An Overview. World Journal of Pharmaceutical Research., 2014; 4(3): 462-484.
11. Damor SR, Jethara SI, Patel MS, Patel MR. A Review on Dual Release Oral Reconstitute Suspension. World Journal of Pharmaceutical Research, 2015; 4(3): 592-613.
12. Bhandare P, Yadav A. A Review on “Dry Syrups for Pediatrics”. Int J Curr Pharm Res., 2015; 9(1): 25-31.
13. Goldstein I, Lue TF, Padma-Nathan H, Rosen RC, Steers WD, Wicker PA. Oral sildenafil in the treatment of erectile dysfunction. New England Journal of Medicine., 1998; 338(20): 1397-1404.
14. Galiè N, Ghofrani HA, Torbicki A, Barst RJ, Rubin LJ, Badesch D, Simonneau G. Sildenafil citrate therapy for pulmonary arterial hypertension. New England Journal of Medicine., 2005; 353(20): 2148-2157.
15. Alok K Kulshreshtha, Onkar N Singh, G Michael Wall. Pharmaceutical Suspensions from Formulation Development to Manufacturing Pharmaceutical Press, 2010.
16. Dodgen A.L, Hill K.D. Safety and tolerability considerations in the use of sildenafil for children with pulmonary arterial hypertension. Drug Healthcare and Patient Safety, 2015; 17(12).

17. Pavane M, Shirsat M, Dhobale A, Joshi D, Dhembre G, Ingale P. Formulation, Development and Evaluation of Oral Reconstitute Dry Syrup. Indo American Journal of Pharmaceutical Sciences, 2018; 5(1): 483-491.
18. Sravani M. Formulation and Evaluation of Mouth Dissolving Tablets of Nebivolol HCl for Treatment of Hypertension. Int J Pharma Chem Res., 2017; 3: 200-212.
19. Raweh SM, Noman MA, Alburyhi MM, Saif AA. Formulation and Evaluation of Anti-acne Gel of Azadirachta Indica Extract Herbal Product. European Journal of Pharmaceutical and Medical Research, 2024; 11(2): 427-433.
20. Alburyhi MM, Saif AA, Noman MA. Compatibility Studies of Pyrimethamine with Pharmaceutical Excipients for the Development of Suppositories Novel Drug Delivery Systems. European Journal of Pharmaceutical and Medical Research., 2025; 12(9): 394-412.
21. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Capsicum Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Tonic and Natural Stimulant. European Journal of Pharmaceutical and Medical Research., 2025; 11(6): 323-337.
22. Alburyhi MM, Raweh SM, AlGhoury ABA, Alkhawlani MA, Noman MA, Saif AA. Recent Innovations of Novel Drug Delivery Systems for Formulation, Development and Evaluation of Grewia Tenax Extract Naturaceutical Ointment for Antimicrobial Activity. World Journal of Pharmaceutical and Medical Research., 2025; 11(7): 413-426.
23. Alburyhi MM, Raweh SM, Al-Ghorafi MA, Saif AA, Noman MA. Formulation and Evaluation of Argemone Ochroleuca Extract Cream Naturaceutical Delivery Systems as Antimicrobial and Wound Healing Activity. European Journal of Pharmaceutical and Medical Research., 2025; 12(7): 445-459.
24. Mohamed YAS, Alkhawlani MA, Wadi ZAS, Yahya TAA, Faisal A, Alburyhi MM. Modern Analytical Techniques for Authentication of Yemeni Ambergris. World Journal of Pharmacy and Pharmaceutical Sciences., 2025; 14(8): 686-697.
25. Alburyhi MM, Saif AA, Noman MA. Compatibility Studies of Sulfadoxine with Pharmaceutical Excipients for the Development of Suppositories Novel Drug Delivery Systems. World Journal of Pharmaceutical and Life Sciences., 2025; 11(9): 189-207.
26. Alburyhi MM, Mohamed YAS. Formulation, Development and Evaluation of Cosmeceutical Natural Pigmented Lipstick from Opuntia Dillenii Fruit Extract. European Journal of Biomedical Pharmaceutical and Medical Sciences., 2025; 12(9): 466-479.

27. Alburyhi MM, El-Shaibany A, Al-Wajih AM, Almlhani AN, Alqadhi AA. Innovative Approaches in Herbal Drug Delivery Systems Enhancing Efficacy and Reducing Side Effects. World Journal of Pharmacy and Pharmaceutical Sciences., 2025; 14(1): 919-929.
28. Alburyhi MM, El-Shaibany A, Al-Wajih AM, Alqadhi AA, Almlhani AN. Advancements in Nano- Formulation Systems for Enhancing the Delivery of Herbal Ingredients. European Journal of Pharmaceutical and Medical Research., 2025; 12(1): 212-231.
29. Alburyhi MM, Moharram BA. Formulation and Evaluation of Aloe Niebuhriana Extract as Naturaceutical Effervescent Granules Novel Drug Delivery Systems for Antidiabetic Activity. World Journal of Pharmaceutical Research., 2025; 14(18): 1147-1157.
30. Saif AA, Alburyhi MM, Noman MA, Almaktari AM. Formulation and Evaluation of Trimetazidine Hydrochloride and Clopidogrel Bisulphate Multi-unit Solid Dosage Forms. Journal of Chemical Pharm Research., 2014; 6(2): 421-426.
31. Othman AM, Alburyhi MM, Al-Hadad GH. Formulation and Stability Studies Evaluation of the Selected Captopril Mouth Dissolving Tablets MDTs. World Journal of Pharmaceutical and Medical Research., 2025; 11(11): 275-284.
32. Alburyhi MM, Moharram BA. Formulation and Evaluation of Jatropha Variegata Extract as Antibacterial Naturaceutical Cream Novel Drug Delivery Systems for Wound Healing Activity. World Journal of Pharmaceutical and Life Sciences., 2025; 11(10): 177-190.
33. Noman MA, Alburyhi MM, Saif AA. Formulation and Evaluation of Skin Whitening Naturaceutical Composition Gel as Advanced Drug Delivery Systems. World Journal of Pharmaceutical and Medical Research, 2025; 11(10): 400-414.
34. Al-Samawi HM, El-Shaibany A, Alburyhi MM. Review Article: The Therapeutic Potential of Micromeria Biflora: A Comprehensive Review. World Journal of Pharmaceutical Research., 2024; 13(6): 7-11.
35. Alburyhi MM, Moharram BA. Formulation and Evaluation of Aloe Inermis Extract for Wound Healing Activity as Antibacterial Cream Novel Drug Delivery Systems. European Journal of Pharmaceutical and Medical Research., 2025; 12(10): 297-308.
36. Al-Wajih AM, El-Shaibany A, Alburyhi MM, Abdelkhalek AS, Elaasser MM, Raslan AE. Comparative Study of Phytochemical Composition, Oral Toxicity, Antioxidant, and Anticancer Activities of Both *Aloe Vera* and *Aloe Vacillans* (Asphodelaceae Family) Flowers Extract: *In Vitro*, *In Vivo*, and in Silico Studies. Trends in Phytochemical Research., 2025; 9(1): 1-22.

37. Al-Samawi HM, El-Shaibany A, Alburyhi MM. Review Article: The Pharmacological Potential of The Genus Micromeria. World Journal of Pharmaceutical Research., 2024; 13(6): 1-6.
38. Mohamed YAS, Hamidaddin MA, Yahya TA, Alkhawlani MA, Alburyhi MM. Phytochemical and Physicochemical Analysis of Yemeni Kalanchoe Marmorata Baker. World Journal of Pharmacy and Pharmaceutical Sciences., 2025; 14(9): 1024-1033.
39. Al-Samawi HM, El-Shaibany A, Abdelkhalek AS, Alburyhi MM, Elaasser MM, Raslan AE. Metabolite Profiling and Toxicity, Antioxidant, and Antitumor Evaluation of Micromeria Biflora Aerial Parts Extract Combined with ADMET Prediction and Molecular Docking Analysis. Chemistry & Biodiversity., 2025; 0: e202403258: 1-19.
40. Noman MA, Alburyhi MM, Saif AA. Effect of Chewing Khat on Nutritional Status Among Female Students at Undergraduate Level in Sana'a, Yemen. World Journal of Pharmaceutical Research., 2023; 12(20): 75-88.
41. Al-Samawi HM, El-Shaibany A, Alburyhi MM. Review Article: Phytochemistry and Pharmacological Activities of Micromeria Species. World Journal of Pharmaceutical Research., 2024; 13(15): 1335-1347.
42. Al-Ghani AM, Alkhawlani MA, Alburyhi MM, Alwosabi A. Formulation and Evaluation of Yemeni Zizyphus Spina-Christi Leaves Extracts as Anti-Bacterial and Anti-Dandruff Serum. European Journal of Pharmaceutical and Medical Research., 2024; 11(10): 40-46.
43. Noman MA, Alburyhi MM, Saif AA. Knowledge, Attitude and Practice Regarding the Proper Use, Risks and Resistance of Antibiotics Among Undergraduate Level Medical and Health Sciences Students in Sana'a, Yemen. European Journal of Pharmaceutical and Medical Research., 2025; 12(12): 414-425.
44. Almamari A, Alburyhi MM, Alhag S. Species-Species Prevalence of Vaginal Candidiasis with Type 1 and Type 2 Diabetes Mellitus Among Women in Sana'a City. Journal of Chemical and Pharmaceutical Research., 2013; 5(8): 217-224.
45. El-Shaibany A, Alburyhi MM, Aoun MA, Ghallab HA. Pharmacological Evaluation of Marine Macroalgae from Yemeni Coastal Waters: Expanded Investigation into Their Antimicrobial and Antioxidant Activities. World Journal of Pharmaceutical Research., 2025; 14(13): 1763-1770.
46. Al-Ghani AM, Alkhawlani MA, Alburyhi MM. Formulation Evaluation of Effect of Yemeni Allium Sativum (Garlic) in Treatment of Oral Candidiasis. European Journal of Pharmaceutical and Medical Research., 2024; 11(8): 14-19.

47. Noman MA, Saif AA, Alburyhi MM. The Impact of Vitamin D Deficiency and Nutritional Habits on Height and Health Among Yemeni Adult Female Students in Sana'a, Yemen. World Journal of Pharmacy and Pharmaceutical Sciences., 2026; 15(3): 855-875.
48. Noman MA, Alburyhi MM, Saif AA, Yahya TAA. Formulation and Evaluation of Polyherbal Extract for Skin Hyperpigmentation as Gel Advanced Delivery Systems. World Journal of Pharmaceutical Research., 2024; 13(22): 1260-1280.
49. Saif AA, Noman MA, Alburyhi MM. Formulation and Evaluation of Salicylic Acid and Kojic Acid as Gel Novel Drug Delivery Systems for Treatment of Acne and Whitening Skin Effect. World Journal of Pharmaceutical and Medical Research., 2025; 11(9): 538-548.
50. Alburyhi MM, Noman MA, Saif AA, Alemad AF. Dispersible and Orodispersible Tablets Delivery Systems for Antibacterials Development. World Journal of Pharmaceutical Research., 2025; 14(1): 1229-1257.
51. Noman MA, Alburyhi MM, Saif AA. Knowledge and Perception about Pharmacovigilance Among 4Th and 5Th Levels Pharmacy Students in Some Public and Private Universities, Sana'a Yemen. World Journal of Pharmaceutical and Medical Research., 2023; 9(11): 14-19.
52. Al Ghoury AA, Al-Ghorafi MA, Alburyhi MM, Noman MA. Antimicrobial Susceptibility Patterns of Staphylococcus Aureus to Different Antimicrobial Agents Isolated as Clinical Samples at Certain General Hospitals in Sana'a City, Yemen. World Journal of Pharmaceutical Research., 2024; 13(16): 35-47.
53. Noman MA, Alburyhi MM, Saif AA, Yahya TAA. Assessment of Knowledge, Attitude, and Practice of Pharmacovigilance Among Pharmacists and Health care Professionals in Four Government Hospitals at Sana'a City, Yemen. European Journal of Biomedical and Pharmaceutical Sciences., 2025; 12(5): 250-267.
54. Sweetman SC. (Ed.). Martindale: The Complete Drug Reference (36th ed.). Pharmaceutical Press, 2009.
55. Brittain HG. (Ed.). Polymorphism in Pharmaceutical Solids (2nd ed.). CRC Press., 2007.
56. Paul J Sheskey, Walter G. Cook and Colin G. Cable. Handbook of Pharmaceutical Excipients Eighth edition. Pharmaceutical Press, 2017.
57. Gaurav K. Jain, Farhan J. Ahmad and Roop K. Khar. Theory and Practice of Physical Pharmacy. Pharmaceutical Press, 2012.
58. Gandhi L, Akhtar MS. Comparative Study on Effect of Natural and Synthetic

Superdisintegrants in the Formulation of Orodispersible Tablets. J Drug Deliv Ther., 2019; 9(2): 507-513.

59. Santosh Kumar R, Kumari A. Fast Dissolving Tablets: Waterless Patient Compliance Dosage Forms. J Drug Deliv Ther., 2019; 9(1): 303-317.
60. Raymond CR, Paul JS, Marian EQ. Handbook of Pharmaceutical Excipients, 6th Edition. Pharmaceutical Press and American Pharmacists Association., 2009; S48-S760.
61. Upadhyay P, et al. A Review on Formulation and Evaluation Approaches for Fast Release Tablet. Mathews J Pharma Sci., 2023; 7(1): 15.
62. Gupta DK, Maurya A, Varshney MM. Orodispersible Tablet: An Overview of Formulation and Technology. World J Pharm Pharm Sci., 2020; 9(2): 1408.
63. Jassem NA. Orodispersible Tablets: a Review on Recent Trends in Drug Delivery. IJDDT., 2022; 12: 433.
64. BNF. BMJ Group and Royal Pharmaceutical Society. September 2022-March, 2023; S140-S141.
65. Borse LB, Bendale AR, Borse SL, Naphade VD, Jadhav AG. Formulation and Evaluation of Mouth Dissolving Tablet Rivaroxaban and its Validation. Biosci Biotechnol Res Asia., 2022; 19(4): 943-954.
66. Matos APS, Costa JS, Boniatti J, Seiceira RC, Pitaluga Jr A, Oliveira DL, Visçosa AL, Holandino C. Compatibility Study Between Diazepam and Tablet Excipients. J Therm Anal Cal., 2017; 127: 1675-1682.
67. Veiga A, Oliveira PR, Bernardi LS, Mendes C, Silva MAS, Sangoi MS, Janissek PR, Murakami FS. Solid-State Compatibility Studies of A Drug Without Melting Point. J Therm Anal Cal., 2018; 131: 3201-3209.
68. Ding T, Chen L, Zhai LH, Fu Y, Wang-Sun B. Compatibility Study of Rivaroxaban and Its Pharmaceutical Excipients. J Therm Anal Cal., 2017; 130: 1569-1573.
69. Pires SA, Mussel WN, Yoshida MI. Solid-State Characterization and Pharmaceutical Compatibility between Citalopram and Excipients Using Thermal and Non-Thermal Techniques. J Therm Anal Cal., 2017; 127: 535- 542.
70. Canbay HS, Doğantürk M. Application of Differential Scanning Calorimetry and Fourier Transform Infrared Spectroscopy to The Study of Metoprolol-Excipient and Lisinopril-Excipient Compatibility. Eurasian., J Anal Chem., 2018; 13: 1-7.
71. Rosasco MA, Bonafede SL, Faudone SN, Segall AI. Compatibility Study Between Tobramycin and Pharmaceutical Excipients Using Differential Scanning Calorimetry, FT-IR, DRX and HPLC. J Therm Anal Cal., 2018; 134: 1929-1941.

72. Prasanna Kumar et al. An Overview on Preformulation Studies. Indo Am J Pharm Sci., 2015; 2(10).
73. Allen L, Ansel H. Pharmaceutical Dosage Forms and Drug Delivery Systems by Ansel (10th Edition). Lippincott Williams & Wilkins, Philadelphia., 2014.
74. Hrishav DP, Nath B. Formulation and Evaluation of Oral Fast Disintegrating Tablet of Ibuprofen Using Two Super Disintegrants. Int J Curr Pharm Res., 2017; 9: 92-5.
75. Da Silveiraa LM, Fiorota AB, Xaviera TP, et al. Drug-Excipient Compatibility Assessment of Solid Formulations Containing Meloxicam. Eur J Pharm Sci., 2018; 112: 146-151.
76. Mishra A, Sinha VR, Sharma S, et al. Molecular and Qualitative Characterization of Compatibility Between Valacyclovir Hydrochloride and Excipients as Raw Materials for Development of Solid Oral Dosage Formulation. Am J Biopharmacy Pharm Sci., 2023.
77. Krishna BJ, Satyanarayana J, Rao NR. Rivaroxaban: Compatibility with Pharmaceutical Excipients using DSC and FTIR Spectrophotometry. J Pharm Res Int., 2022; 43-50.
78. Jagtap S, Magdum C, Jadge D, Rajesh Jagtap R. Solubility Enhancement Technique: A Review Published by Journal of Pharmaceutical Sciences & Research., 2018; 10(9): 2205-2211.
79. Kumar PJ, Muzib YI, Misra G. Formulation and Evaluation of Pulsatile Drug Delivery of Lovastatin. Research Journal of Pharmacy and Technology., 2018; 11(7): 2797-2803.
80. Reddy NV, Kishore K, Kumar GV. Formulation and Evaluation of Enalapril Floating Pulsatile Tablets. EPRA International Journal of Research & Development (IJRD)., 2021; 6(11): 1-11.
81. Gupta MK, Saraf S. Formulation and Evaluation of Pulsatile Drug Delivery System of Ramipril for Controlling Morning Spate of BP. Journal of Pharmaceutical Research., 2018; 17(1): 2-12.
82. Shekhawat P, Pokharker V. Understanding Peroral Absorption: Regulatory Aspects and Contemporary Approaches to Tackling Solubility and Permeability Hurdles. Acta Pharma Sin B., 2017; 7: 260-280.
83. Chamarthi, RP, Kishore GV, Krishna Mohan. Structural Identification, and Estimation of Rosuvastatin Calcium Related Impurities in Rosuvastatin Calcium Tablet Dosage Form. Anal Chem Research., 2017; 12: 17-27.
84. Mishra B, Panigrahi D. Mouth Dissolving Tablets an Overview of Preparation Techniques, Evaluation and Patented Technologies', Indian Journal of Pharmaceutical Sciences., 2005.

85. Jin Y, Li Tong, Ping Ai, Miao Li, Xinpu Hou. Self-Assembled Drug Delivery Systems Properties and In Vitro –In Vivo Behavior of Acyclovir Self-Assembled Nanoparticles (san). Int J Pharm., 2006; 309(1–2): 199–207.
86. Goyal P, et al. Liposomal Drug Delivery Systems: Clinical Applications. Acta Pharm., 2005; 55: 1–25.
87. Sheetal B, Raval K, Sandip B. Formulation and Evaluation of Fast Dissolving Tablets of Amlodipine and Rosuvastatin. Int J Pharm Bio Sci., 2015; 2(1): 1-12.
88. Neelamma G, Chaitanya MV, Satyavathi B. Design and Evaluation of Solubility Enhancement of Poorly Soluble Drug Rosuvastatin Using Liquid Solid Compacts. Int J Pharmacol Res., 2015; 5(5): 231-8.
89. Ahai Luvai, Wycliffe Mbagaya, Alistair S. Hall, and Julian H. Barth., Rosuvastatin: A Review of the Pharmacology and Clinical Effectiveness in Cardiovascular Disease, Clin Med Insights Cardiol, 2012; 6: 17–33.
90. Venkatesh N, Spandana K, Samba Moorthy U, Suresh K. Formulation and Evaluation of Fast Dispersible Tablet of Rosuvastatin Using Cyclodextrin Complexation Method. Int J Med Pharm Res., 2014; 2: 785-93.
91. Tabbouche OS. Validation of a UV-Spectrophotometeric Method for the Assay Paracetamol in Solutions. Int J Pharm., 2013; 3(1): 24-7.
92. Biradar S S, Bhagavati S T, Kuppasad I J. Fast Dissolving Drug Delivery Systems: A Brief Overview. Int J Pharmacol., 2006; 4(2).
93. Bahlul Z Awen, Varun Dasari, Babu Rao Chandu, Mukkanti Khagga. New UV-Spectrophotometeric Method for the Estimation of Valganciclovir in Bulk and its Formulation. Int J Pharm Studies Res., 2011; 2(1): 1-4.
94. Maswadeh H, Abdulhalim A, Demetzos C. Improvement of Encapsulation Efficiency of Diclofenac Sodium into Uncoated and Chitosan-Coated Liposomes. Indian J Pharm Sci., 2004; 66: 607–612.
95. Kannan K, Karar PK, Manavalan R. Formulation and Evaluation of Sustained Release Microspheres of Diclofenac Sodium by Solvent Evaporation Technique. J Pharm Sci & Res., 2009; 1(1): 3639.
96. Lakshmana Prabu S, Shirwaikar AA, Shirwaikar A, Kumar A. Formulation and Evaluation of Sustained Release Microspheres of Rosin Containing Aceclofenac. Ars Pharm., 2009; 50(2): 51-62.

97. Kumar MU, Babu MK. Design and Evaluation of Fast Dissolving Tablets Containing Diclofenac Sodium Using Fenugreek Gum as a Natural Superdisintegrant. Asian Pacific Journal of Tropical Biomedicine., 2014; 4: S329-S334.
98. Naz A. Pharmacokinetics Study of Aceclofenac in Pakistani Population and Effects of Sucralfate Co Administration on Bioavailability of Aceclofenac. The Journal of Applied Research., 2011; 11(1): 55-63.
99. Seyda A. A Non-Steroidal Anti-Inflammatory Drug, Aceclofenac. FABAD Journal of Pharmaceutical Science., 2010; 35: 105-118.
100. Chandel N. Co-Crystalization of Aceclofenac and Paracetamol and Their Characterization. International Journal of Pharmacy & Life Science., 2011; 2(8): 1020- 1028.
101. Jayanthi B, Madhusudhan S. Preformulation Characterization, Designing and Formulation of Aceclofenac Loaded Microparticles. International Journal of Drug Development & Research., 2012; 4(3): 186-196.
102. Sharma S. Spectrophotometric Method Development for Estimation of Aceclofenac in Phosphate Buffer Dissolution Media. International Journal of Pharmaceutical Quality Assurance., 2010; 2(1): 5-8.
103. Bansal SY. Effect of Aceclofenac on Pharmacokinetic of Phenytoin. Pakistan Journal of Pharmaceutical Science., 2012; 25(2): 295-299.
104. Amit Modi, Abhishek Pandey, Vandana Singh, Bonde CG, Dheeraj Jain, Sandeep Shinde. Formulation and Evaluation of Fast Dissolving Tablets of Diclofenac Sodium Using Different Superdisintegrants by Direct Compression Method. International Journal of Pharmaceutical & Biological Archives, 2012.
105. Sona PS, Muthulingam C. Formulation and Evaluation of Taste Masked Orally Disintegrating Tablets of Diclofenac Sodium. International Journal of Pharm Tech Research., 2011.
106. Jagadeesh Induruand, Padmaja Bookya. Excipient Screening and Development of Formulation Design Space for Diclofenac Sodium Fast Dissolving Tablets. International Journal Pharmaceutical, Pharmaceutical sciences., 2011.
107. Prabhakar Shirse. Formulation and Evaluation of Bilayer Tablets of Diclofenac Sodium with Ranitidine HCL for Sustained and Immediate Release. J Appl Pharm Sci., 2012; 2: 136-4.
108. United States Pharmacopoeia. 30th edition NF 25, The Official Compendia of Standards., 2007.

109. Rajlakshmi G, Vamsi C, Balchandar R, Damodharan N. Formulation and Evaluation of Effervescent Tablets of Diclofenac Potassium. Int J Pharm Biomed Res., 2011; 2(4): 237-243.
110. https://pubchem.ncbi.nlm.nih.gov/compound/Slidenafil-Citrate
111. https://go.drugbank.com/drugs/DB00203
112. Bary AA, El-Gazayerly ON, Alburyhi MM. A Pharmaceutical Study on Lamotrigine. Ph.D. Thesis, Faculty of Pharmacy, Cairo University., 2009.
113. Alburyhi MM, Saif AA, Noman MA, Abudunia A, Yassin SH, Abdullah JH. Formulation, Development and Evaluation of Amoxicillin Fast Dissolving Tablets. World Journal of Pharmaceutical and Life Sciences., 2025; 11(7): 183-197.
114. Alburyhi MM, Salim YA, Saif AA, Noman MA. Furosemide-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. World Journal of Pharmaceutical Research., 2024; 13(22): 1178-1219.
115. Alburyhi MM, Saif AA, Noman MA. Lornoxicam-Excipient Compatibility Studies for Microsponge-Based Drug Delivery Systems Development. World Journal of Pharmaceutical and Medical Research., 2025; 11(4): 70-81.
116. Alburyhi MM, Noman MA, Saif AA. Formulation and Evaluation of Natural Herbal Anti-acne as Gel Delivery Systems. World Journal of Pharmaceutical Research., 2024; 13(21): 1447-1467.
117. Alburyhi MM, Yahya TAA, Saif AA, Noman MA. Formulation and Evaluation of Lornoxicam Microsponge-Based Gel as A Transdermal Drug Delivery Systems. World Journal of Pharmaceutical and Life Sciences, 2025; 11(5): 200-217.
118. Alburyhi MM, Hamidaddin MA, Noman MA, Saif AA. Recent Innovations of Novel Drug Delivery Systems for Formulation, Development and Evaluation of Metronidazole Medicated Chewing Gum Tablets. European Journal of Biomedical and Pharmaceutical Sciences, 2025; 12(6): 353-370.
119. Alburyhi MM, El-Shaibany A. Recent Innovations of Novel Drug Delivery Systems for Formulation, Development and Evaluation of Pandanus Odoratissimus Extract Capsules as Naturaceutical for Breast Cancer. World Journal of Pharmaceutical Research., 2024; 13(8): 1092-1112.
120. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Tribulus Terrestris Extract Capsules as Naturaceutical Novel Drug Delivery Systems for Kidney Stones. World Journal of Pharmacy and Pharmaceutical Sciences., 2024; 13(5): 1425-1443.

121. Alburyhi MM, Noman MA, Saif AA, Al-Ghorafi MA, Al Khawlani MA, Yahya TAA. Formulation and Evaluation of Anti-acne Spironolactone Emulgel Novel Trend in Topical Drug Delivery System. World Journal of Pharmaceutical Research., 2023; 12(22): 96-119.
122. Alburyhi MM, Noman MA, Saif AA, Salim YA, Hamidaddin MA, Yahya TA, Al-Ghorafi MA, Abdullah JH. Lisinopril-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. World Journal of Pharmaceutical Research., 2024; 13(16): 59-111.
123. Alburyhi MM, Saif AA, Noman MA, Saif RM. The Importance of Stability Testing in Pharmaceutical Development of Ceftriaxone Implant Biodegradable Tablets. Matrix Science Pharma (MSP), 2025; 9(2): 58-63.
124. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Aloe Vera Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Controlling Diabetes. World Journal of Pharmacy and Pharmaceutical Sciences., 2024; 13(4): 1408-1423.
125. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Curcuma Longa Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Cancer. European Journal of Biomedical and Pharmaceutical Sciences., 2024; 11(6): 37-43.
126. Alburyhi MM, Saif AA, Noman MA, Yassin SH. Compatibility Studies with Pharmaceutical Excipients of Simvastatin for the Development of Novel Drug Delivery Systems. World Journal of Pharmaceutical Research., 2024; 13(19): 1463-1512.
127. Hamidaddin MA, Alburyhi MM, Noman MA, Saif AA. Formulation and Evaluation of Rosuvastatin Fast Dissolving Tablets. World Journal of Pharmacy and Pharmaceutical Sciences., 2023; 12(9): 2293-2303.
128. Alburyhi MM, Hamidaddin MA, Noman MA, Saif AA, Yahya TA, Al-Ghorafi MA. Rivaroxaban-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. European Journal of Pharmaceutical and Medical Research., 2024; 11(9): 370-404.
129. Alburyhi MM, Noman MA, Saif AA, Hamidaddin MA, Yahya TA, Al-Ghorafi MA. Rosuvastatin Calcium-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. World Journal of Pharmaceutical Research., 2024; 13(13): 1549-1582.

130. Bary AA, El-Gazayerly ON, Alburyhi MM. Formulation of Immediate Release Lamotrigine Tablets and Bioequivalence Study. Journal of Chemical Pharm Research., 2013; 5(10): 266–271.
131. Alburyhi MM, Saif AA, Noman MA. Stability Study of Six Brands of Amoxicillin Trihydrate and Clavulanic Acid Oral Suspension Present in Yemen Markets. Journal of Chemical Pharm Research., 2013; 5(5): 293-296.
132. Alburyhi MM, El-Shaibany A. Formulation and Evaluation of Antitumor Activity of Artemisia Arborescence Extract Capsules as Dietary Supplement Herbal Product Against Breast Cancer. World Journal of Pharmaceutical Research., 2024; 13(3): 95-114.
133. Saif AA, Alburyhi MM, Noman MA, Yahya TA, Al-Ghorafi MA. Famotidine-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. World Journal of Pharmaceutical Research., 2024; 13(18): 1346-1408.
134. Alburyhi MM, El-Shaibany A. Recent Innovations of Novel Drug Delivery Systems for Formulation, Development and Evaluation of Aloe Rubroviolaceae Extract Capsules as Naturaceutical for Hepatoprotective. European Journal of Biomedical and Pharmaceutical Sciences., 2024; 11(4): 53-61.
135. Alburyhi MM, Saif AA, Noman MA, Yahya TA. Formulation, Development and Evaluation of Famotidine Orodispersible Tablets. European Journal of Pharmaceutical and Medical Research., 2023; 10(10): 56-62.
136. Al-Ghorafi MA, Alburyhi MM, Saif AA, Noman MA, Yahya TA. Drotaverine-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. World Journal of Pharmaceutical Research., 2024; 13(18): 1285-1340.
137. Alburyhi MM, Saif AA, Noman MA. Ticagrelor-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. World Journal of Pharmacy and Pharmaceutical Sciences., 2024; 13(10): 1081-1132.
138. Alburyhi MM, Noman MA, Saif AA, Al-Ghorafi MA, Yahya TA, Yassin SH, AlKhawlani MA. Diclofenac-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. World Journal of Pharmaceutical Research., 2024; 13(14): 1297-1333.
139. Noman MA, Alburyhi MM, Saif AA, Yahya TAA. Evaluation and Drug Stability Studies Some Atorvastatin Tablets Brands Available in Sana'a Market Yemen. World Journal of Pharmaceutical and Medical Research., 2024; 10(12): 231-236.

140. Alburyhi MM, Saif AA, Noman MA, Salim YA, Hamidaddin MA. Formulation and Evaluation of Lisinopril Orally Disintegrating Tablets. World Journal of Pharmacy and Pharmaceutical Sciences., 2023; 12(9): 357-369.
141. Alburyhi MM, Hamidaddin MA, Saif AA, Noman MA. Formulation and Evaluation of Rivaroxaban Orodispersible Tablets. World Journal of Pharmacy and Pharmaceutical Sciences., 2024; 13(2): 2066-2092.
142. Saif AA, Noman MA, Alburyhi MM, Yahya TAA. Evaluation and Drug Stability Studies Some Levocetirizine Tablets Brands Available in Sana'a Market Yemen. World Journal of Pharmaceutical Research., 2024; 13(24): 1009-1022.
143. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Aloe Vera Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Cancer. World Journal of Pharmaceutical Research., 2024; 13(8): 1052-1072.
144. Alburyhi MM, Saif AA, Noman MA, Saif RM. Recent Innovations of Delivery Systems for Antimicrobial Susceptibility Study of Ciprofloxacin Biodegradable Formulations for Post-Operative Infection Prophylaxis. European Journal of Pharmaceutical and Medical Research., 2023; 10(9): 32-36.
145. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Dictyota Dichotoma Extract Medicinal Seaweed Capsules Delivery System as an Advanced Phytotherapy Approach for Cancer. European Journal of Biomedical and Pharmaceutical Sciences., 2024; 11(4): 63-70.
146. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Celery Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Gout. World Journal of Pharmaceutical Research., 2024; 13(11): 2383-2404.
147. Othman AM, Alburyhi MM, Al-Hadad GH. Formulation and Evaluation of Captopril Mouth Dissolving Tablets. European Journal of Pharmaceutical and Medical Research, 2024; 11(1): 18-28.
148. Alburyhi MM, Saif AA, Noman MA. Formulation and Evaluation of Ticagrelor Orodispersible Tablets. World Journal of Pharmaceutical Research., 2024; 13(5): 26-55.
149. Alburyhi MM, Saif AA, Noman MA, Yahya TA, Al-Ghorafi MA. Formulation and Evaluation of Drotaverine Orally Disintegrating Tablets. World Journal of Pharmaceutical Research., 2023; 12(18): 66-79.
150. Al-Ghorafi MA, Alburyhi MM, Saif AA, Noman MA. Meloxicam-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. World Journal of Pharmaceutical and Medical Research., 2025; 11(1): 87-106.

151. Alburyhi MM, El-Shaibany A. Formulation and Evaluation of Effervescent Granules of Artemisia Arborescence Herbal Product for Foodborne Illness. World Journal of Pharmacy and Pharmaceutical Sciences., 2023; 12(12): 1429-1444.
152. Alburyhi MM, Saif AA, Saif RM. Preformulation Study of Ceftriaxone and Ciprofloxacin for Lipid Based Drug Delivery Systems. EJUA-BA, 2022; 3(4): 339-350.
153. Noman MA, Alburyhi MM, Alqubati MA. Preformulation and Characterization Studies of Clopidogrel Active Ingredient for Orodispersible Tablets Development. World Journal of Pharmacy and Pharmaceutical Sciences., 2024; 13(3): 996-1015.
154. Alburyhi MM, Noman MA, Alemad AF. Preformulation Studies of Cefixime for Dispersible Tablets Delivery System Development. World Journal of Pharmacy and Pharmaceutical Sciences., 2024; 13(12): 75-99.
155. Alburyhi MM, Noman MA, AA Saif. Formulation and Evaluation of Meloxicam Emulgel Delivery System for Topical Applications. World Journal of Pharmaceutical Research., 2025; 14(4): 1324-1337.
156. Bary AA, El-Gazayerly ON, Alburyhi MM. A Pharmaceutical Study on Methocarbamol. MSc Thesis, Faculty of Pharmacy, Cairo University., 2006.
157. Alburyhi MM, Saif AA, Noman MA, Saif RM. Recent Innovations of Delivery Systems for Antimicrobial Susceptibility Study of Ceftriaxone Biodegradable Formulations for Post-Operative Infection Prophylaxis. European Journal of Pharmaceutical and Medical Research., 2023; 10(8): 95-99.
158. Alburyhi MM, Saif AA, Noman MA. Domperidone-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. World Journal of Biomedical and Pharmaceutical Sciences., 2025; 12(3): 250-269.
159. Alburyhi MM, Saif AA, Noman MA. Spironolactone-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. World Journal of Pharmacy and Pharmaceutical Sciences., 2025; 14(3): 871-910.
160. Saif AA, Alburyhi MM, Noman MA. Ketoprofen-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. World Journal of Pharmacy and Pharmaceutical Sciences., 2025; 14(4): 92-123.
161. Alburyhi MM, Saif AA, Noman MA, Yassin SH. Formulation and Evaluation of Simvastatin Orodispersible Tablets. World Journal of Pharmaceutical Research., 2023; 12(16): 1033-1047.

162. Alburyhi MM, El-Shaibany A. Formulation and Evaluation of Anti-peptic Ulcer Capsules of Curcuma Longa Herbal Product. World Journal of Pharmaceutical Research., 2023; 12(22): 76-96.
163. Noman MA, Alburyhi MM, El-Shaibany A, Alwesabi NA. Preformulation and Characterization Studies of Pandanus Odoratissimus L Extract Active Ingredient in Treatment of Nocturnal Enuresis. World Journal of Pharmacy and Pharmaceutical Sciences., 2024; 13(2): 1603-1620.
164. Alburyhi MM, Saif AA, Noman MA, Al Ghoury AA. Formulation and Evaluation of Antimalarial Drugs Suppositories. World Journal of Pharmaceutical Research., 2023; 12(20): 89-108.
165. Alburyhi MM, Saif AA, Noman MA, Saeed SA, Al-Ghorafi MA. Formulation and Evaluation of Diclofenac Orodispersible Tablets. European Journal of Pharmaceutical and Medical Research., 2023; 10(9): 01-06.
166. Saif AA, Alburyhi MM, Noman MA. Formulation and Evaluation of Ketoprofen Fast Dissolving Tablets. International Journal of Sciences., 2018; 7(09): 27-39.
167. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Chamomile Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Gout. World Journal of Pharmaceutical and Life Sciences., 2025; 11(04): 215-228.
168. Alburyhi MM, Noman MA, Saif AA. Metronidazole-Excipient Compatibility Studies for Medicated Chewing Gum Delivery Systems Development. European Journal of Pharmaceutical and Medical Research., 2025; 12(4): 567-589.
169. Othman AM, Alburyhi MM, Al-Hadad GH. Captopril-Excipient Preformulation Studies for Mouth Dissolving Tablets Development. World Journal of Pharmaceutical Research, 2025; 14(10): 1398-1420.
170. Alburyhi MM, Saif AA, Noman MA, Al-Ghorafi MA. Comparative Study of Certain Commercially Available Brands of Paracetamol Tablets in Sana'a City, Yemen. European Journal of Pharmaceutical and Medical Research., 2018; 5(12): 36-42.
171. Alburyhi MM, Saif AA, Noman MA, Alkhawlani MA. Formulation and Evaluation of Bisoprolol Fast Dissolving Tablets. World Journal of Pharmaceutical Research., 2023; 12(16): 01-10.
172. Noman MA, Alburyhi MM, El-Shaibany A, Alwesabi NA. Formulation and Evaluation of Pandanus Odoratissimus L Extract for Treatment of Nocturnal Enuresis as Orodispersible Tablets Delivery System. World Journal of Pharmaceutical Research., 2024; 13(5): 56 -71.

173. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Tribulus Terrestris Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Controlling Diabetes. World Journal of Pharmaceutical Research., 2024; 13(7): 1264-1282.
174. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Pandanus Odoratissimus Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Hepatoprotective. European Journal of Pharmaceutical and Medical Research., 2024; 11(4): 06-13.
175. Saif AA, Alburyhi MM, Noman MA. Evaluation of Vitamin and Mineral Tablets and Capsules in Yemen Market. Journal of Chemical Pharma Research., 2013; 5(9): 15-26.
176. Alburyhi MM, Noman MA, Saif AA, Salim YA, Abdullah JH. Formulation and Evaluation of Domperidone Orodispersible Tablets. World Journal of Pharmacy and Pharmaceutical Sciences., 2024; 13(3): 49-68.
177. Alburyhi MM, Saif AA, Noman MA, Hamidaddin MA. Formulation and Evaluation of Clopidogrel Orodispersible Tablets. World Journal of Pharmaceutical Research., 2024; 13(6): 42-64.
178. Alburyhi MM, Saif AA, Noman MA, Al Khawlani MA. Bisoprolol-Excipient Compatibility Studies for Advanced Drug Delivery Systems Development. World Journal of Pharmaceutical and Medical Research., 2024; 10(10): 304-324.
179. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Plicosepalus Acacia Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Hepatoprotective. World Journal of Pharmaceutical Research., 2025; 14(8): 1309-1334.
180. Saif AA, Alburyhi MM, Noman MA, Abudunia A. Amoxicillin-Excipient Compatibility Studies for Advanced Drug delivery Systems Development. European Journal of Pharmaceutical and Medical Research., 2025; 12(6): 530-562.
181. Alburyhi MM, El-Shaibany A. Formulation and Evaluation of Oral Pharmaceutical Solution of Pandanus Odoratissimus L Extract Herbal Product in Treatment of Nocturnal Enuresis. World Journal of Pharmacy and Pharmaceutical Sciences., 2024; 13(1): 1840-1851.
182. Alburyhi MM, El-Shaibany A. Formulation and Evaluation of Antibacterial Orodispersible Tablets of Artemisia Arborescence Extract Herbal Product. European Journal of Pharmaceutical and Medical Research., 2024; 11(2): 409-417.

183. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Acalypha Fruticosa Extract Tablets Delivery System as an Advanced Phytotherapy Approach for Controlling Diabetes. World Journal of Pharmaceutical Research., 2024; 13(8): 1073-1091.
184. Alburyhi MM, Mohamed YAS, Saif AA, Noman MA, Abdullah JH, Yahya TAA. Recent Innovations of Novel Drug Delivery Systems for Formulation, Development and Evaluation of Amlodipine and Furosemide Orodispersible Tablets. World Journal of Pharmaceutical and Medical Research, 2025; 11(5): 358-378.
185. Alburyhi MM, Mohamed YAS, Saif AA, Noman MA. Compatibility Studies with Pharmaceutical Excipients of Amlodipine for the Development of Novel Delivery Systems. World Journal of Pharmacy and Pharmaceutical Sciences., 2024; 13(11): 95-136.
186. Alburyhi MM, Saif AA, Noman MA. Compatibility Studies with Pharmaceutical Excipients of Clopidogrel for the Development of Novel Delivery Systems. World Journal of Pharmaceutical Research., 2025; 14(06): 1448-1486.
187. Alburyhi MM, El-Shaibany A. Formulation, Development and Evaluation of Ginger Extract Capsules Delivery System as an Advanced Phytotherapy Approach for Controlling Diabetes. World Journal of Pharmaceutical and Medical Research., 2025; 11(6): 400-415.
188. Noman MA, Alburyhi MM, Yahya TAA, Saif AA. Evaluation and Drug Stability Studies of Different Brands of Clopidogrel Tablets Available in Sana'a City Market, Yemen. European Journal of Biomedical and Pharmaceutical Sciences, 2025; 12(7): 181-191.
189. Alburyhi MM, Saif AA, Noman MA, AlGhoury ABA. Compatibility Studies of Chloroquine Phosphate with Pharmaceutical Excipients for the Development of Suppositories Novel Drug Delivery Systems. World Journal of Pharmaceutical Research., 2025; 14(14): 1325-1360.
190. Bolhuis GK, Armstrong NA. Excipients for Direct Compaction - an Update. Pharma Dev and Tech., 2006; 11(1): 111-124.
191. Bravo SA, Lamas MC, Salomon CJ. Swellable Matrices for The Controlled-Release of Diclofenac Sodium: Formulation and In-Vitro Studies Pharm Dev and Tech., 2004; 9(1): 75-83.

192. Shivakumar H, Desai BG, Deshmukh G. Design and Optimization of Diclofenac Sodium Controlled Release Solid Dispersions by Response Surface Methodology. Ind J Pharma Sci., 2008; 70(1): 22-30.
193. Sankar S V, Chandrasekharan AK, Durga S, Prasanth KG, Nilani P. Formulation and Stability Evaluation of Diclofenac Sodium Ophthalmic Gels. Ind J Pharm Sci., 2005; 67(4): 473-476.
194. Swamy NGN, Mazhar P, Zaheer A. Formulation and Evaluation of Diclofenac Sodium Gels Using Sodium Carboxymethyl Hydroxypropyl Guar and Hydroxypropyl Methylcellulose. Indian J Pharm Educ Res., 2010; 44(4): 310-314.
195. Patil PB, Datir SK, Saudagar RB. Journal of Drug Delivery and Therapeutics., 2019; 9(3-S): 989-994.
196. Priya P, Munshi DS, Mohale R, Akkalwar AV Chandewar. Formulation and Evaluation of Diclofenac Gel.
197. Research J Pharm and Tech., 2011; 4(9): 1394-1399.