Comprehensive Review on Analytical Profile of Antidepressant Drug

Bhaskar Rajveer1, Ola Monika2, Patil Amod3, Chaudhari Kamlesh1, Ambatkar Ankita1, Mahajan Tejaswini1

1 Dept. of Quality Assurance, RCPIPER, Shirpur, INDIA, 425405
2 Dept. of Pharmaceutics, RCPIPER, Shirpur, INDIA, 425405
3 Dept. of Pharmaceutical Chemistry, RCPIPER, Shirpur, INDIA, 425405

ABSTRACT
Venlafaxine is an antidepressant belonging to a group of drugs called selective serotonin and norepinephrine reuptake inhibitors (SSNRIs). Venlafaxine affects chemicals in the brain that may be unbalanced in people with depression. It is used to treat major depressive disorder, anxiety and panic disorder. The present review assesses the various approaches for analysis of Venlafaxine in bulk drug as well as various formulations. A concise review represents the compilation and discussion of about more than 35 analytical methods which includes HPLC, HPTLC, UPLC, LC-MS and UV-Spectrophotometry methods implemented for investigation of Venlafaxine in biological matrices, bulk samples and in different dosage formulations. This detailed review will be of great help to the researcher who is working on Venlafaxine.

Keywords: Venlafaxine; Analytical Profile; HPLC; HPTLC; Bioanalytical; Stability indicating

Introduction
Depression is excessive general and disabling disease with important social and economic outcome, most of antidepressant agents are accessible in management of disorder; they are limitations of efficacy, because of toxic effects can be encountered. Most harmful effects found to risk for life threatening arrhythmias, particularly in patients with early survive cardiac disease or after overdose direction. Because depression and nervousness disorders are related with acute and prevalent psychosocial and occupational disfunction, significant reason of abnormality associated with chronic disease like, rheumatoid arthritis, hypertension and diabetes. [1]

It was referred to as a Serotonin nor-epinephrine dopamine reuptake inhibitor. Venlafaxine HCl was available in market name of Effexor tablets. [2]
Venlafaxine HCl side effects:

- Mood or behavior changes
- Anxiety
- Panic attacks
- Trouble sleeping
- Feel impulsive, irritable, agitated, aggressive, restless
- Nausea, vomiting, diarrhea
- Dry mouth
- Dizziness, headache, feeling nervous
- Fast heartbeats, vision changes
- Decreased sex drive, or difficulty having an organism.

Serious side effects:

- Attempting suicide
- Acting on dangerous impulses
- Thoughts about suicide or dying
- New or worsened depression
- New or worsened anxiety or panic attacks

Therapeutic uses of Venlafaxine HCl:

- Treatment of diabetic neuropathy
- Effectiveness of migraine prophylaxis
- Treatment of prostate cancer
- Action on both serotoninergic and adrenergic systems
- Reduce episodes of cataplexy
- Improve patient mood and energy level
- Help restore patient interest in daily living.

Analytical techniques used for determination of Venlafaxine HCl:

A. High-performance liquid chromatography (HPLC):

HPLC is a propelled fluid chromatography utilized in isolating the combine blend of particles experienced in substance and organic structure. In year 1980, HPLC technique originate for first time examine of mass medications materials (USP, 1980). The essential pieces of a HPLC are a solvent (A) Pump (B) Injector (C) Segment (D) Detector/Recorder. Each segments are associated in an arrangement to one another by steel tubing. The pump controls the progression of solvent through the system. Upon leaving the pump, solvent enters the injector, at that point goes through the section, lastly through the optical unit of a detector. The partition of a compound includes its physical cooperation with a stationary stage and a portable stage. In HPLC the stationary stage is incredibly little. A standard molecule size for column chromatography is 60 microns, while that for HPLC is ordinarily 5 microns, or the size of a spot of residue solvent course through such thick material requires a high weight, so in HPLC the stationary stage is stuffed in a hardened steel cylinder, and solvent is pumped through the framework under high weight, as much as a few thousand pounds for every square inch. This weight brings about a stream pace of a few ml's per minute. It broadly use detectors in HPLC is UV-detectors is equipped for inspect a few wavelengths is conceivable to applying the various wavelength in examining program. UV-detector surely all the UV-engage parts are identified.

The photodiode cluster (PDA) detector is likewise utilized in HPLC instrument. Most delicate detector among the LC detector is fluorescence detector. A photodiode cluster (PDA) is a lined exhibit of discrete photodiodes on a coordinated circuit (IC) chip for spectroscopy. It is put at the picture plane of a spectrometer to enable a scope of wavelengths to be detected simultaneously.
Table no.2: HPLC method for venlafaxine HCl:

| Sr. no. | Drug                          | Method             | Stationary phase          | Mobile phase                 | Detection                  | Linearity, LOD, LOQ (µg/mL) | Rt / Fr  |
|---------|-------------------------------|--------------------|---------------------------|------------------------------|----------------------------|-----------------------------|--------------------------|
| 1       | Venlafaxine HCl               | HPLC               | C18(150×4.6mm, 5µm) Coupled to Guard column C18 (30×4.6mm, 5µm) | Acetonitrile, Potassium phosphate buffer (pH6.5) (30:20v/v) | 228 nm UV-visible detection | Linearity: 1.05-10.5µg/mL LOD: -- LOQ: -- | Rt:15.2 min Fr: 1 mL/min |
| 2       | Venlafaxine HCl               | RP-HPLC            | ODS-C18 (50×4.6mm, 5µm) | Acetonitrile, Sodium acetate (65:35 v/v) | 225 nm                     | Linearity: 2.0-50.0µg/mL LOD: -- LOQ: -- | Rt:2.83 min Fr: 1 mL/min |
| 3       | Venlafaxine HCl               | HPLC               | ODS RP-C18 (4.6×150mm,5µm) | Acetonitrile, Water (70:30v/v) | 230nm                      | Linearity: 9 µg – 2 µg/mL LOD: 1.3µg/mL LOQ: 1.10 µg/mL | Rt: 4.8 min Fr: 1.5mL/min |
| 4       | Venlafaxine HCl               | RP-HPLC            | Microsorb MV 100 C18 (250×4.6mm,5µm) | Acetonitrile, 0.04 potassium dihydrogen phosphate, Methanol (45:25:30 v/v) | 224 nm                     | Linearity: 1.0-50 µg/mL LOD: 0.568µg/mL LOQ: 1.72 µg/mL | Rt: 3.43 min Fr: 1 mL/min |
| 5       | Venlafaxine HCl, Modafinil    | RP-HPLC            | C18 (4.6×250mm,5µm) | Ammonium acetate buffer (pH4.0), 10% Methanol in acetonitrile (60:40) | 225 nm                     | Linearity: 1.0-50 µg/mL LOD: -- LOQ: -- | Rt: Venlafaxine 4.4min Modafinil: 6.4 min Fr:1mL/min |
| 6       | Venlafaxine HCl               | HPLC-MS/MS         | Varomycin chiral column (250×4.6mm,5µm) | Methanol, Ammonium acetate (8:92 v/v) | 224 nm                     | Linearity: 0.28-423.0 µg/mL LOD:0.02 µg/mL LOQ:0.28 µg/mL | Rt: 6.72 min Fr: 1 mL/min |
| 7       | Esomeprazole, Venlafaxine HCl| HPLC               | C18 (150×4.6mm, 3.5µm) | A-Acetonitrile, buffer(25:75v/v) B-Acetonitrile, buffer(30:70v/v) | 230 nm                     | Linearity: 10.37-518.40µg/mL LOD:1.02µg/mL LOQ: 5.18 µg/mL Venlafaxine HCl LOD:1.02µg/mL LOQ: 5.09 µg/mL Fenofibrate LOD:1.05µg/mL LOQ:5.22 µg/mL | Esomeprazole Rt:3.25min Fr: 1.1mL/min Venlafaxine HQ Rt:4.7min Fr:1.1 mL/min Fenofibrate Rt:13.12min Fr: 1.1mL/min |
| 8       | Venlafaxine HCl, o-desmethyl venlafaxine | HPLC               | C18 (25×4.6mm) | Methanol, Acetonitrile (95:5v/v) and 40%Ammonium acetate | 235 nm                     | Venlafaxine HCl Linearity range: 1-20µg/mL LOD:0.2µg/mL LOQ:0.5 µg/mL 0-desmethyl Ven. HCl Linearity range: 1-25µg/mL LOD:0.3µg/mL LOQ:1.0µg/mL | Venlafaxine HCl Rt: 7.2 min Fr: 0.7mL/min O-desmethyl Ven. HCl Rt:4.9min Fr: 0.7 mL/min |
| 9       | Venlafaxine HCl               | RP-HPLC            | Kromasil KR100-5 C18(4.6×250mm, 5µm) | Diethylamine buffer, Methanol (90:10 v/v) | 225nm PDA detection        | Linearity: 0.5-5.0µg/mL LOD:0.095µg/mL LOQ: 0.29 µg/mL | Rt: 5 min Fr:1mL/min    |
| 10      | Venlafaxine HCl               | RP-HPLC            | C18socratic column(250×4.6mm, 5µm) | Acetonitrile, Water(50:50v/v) | 226 nm                     | Linearity: 1-5µg/mL LOD:0.0665µg/mL LOQ:0.199 µg/mL | Rt: 3.5 min Fr: 1.0mL/min |
B. UV-visible spectrophotometric method:

UV-visible spectroscopy is examining the wavelength of typical sample. The UV-visible spectra have expensive highlights are restricted use for test identification are helpful for quantitative estimations. Spectrophotometric method is most significant technique is recognize the substance element on premise of transmission or reflection properties of material as capacity of wavelength, adheres to the Beer-Lambert's law and synthetic compound which bear a chromophoric bunch for retention of light, it consume the less time when contrasted with other technique and gives incredible accuracy in practical.[15] The writing overview educate the UV techniques and RP-HPLC strategy are accounted for the assurance of venlafaxine HCl exclusively with different medications present examination includes improvement and approval of new UV-spectroscopy technique for assurance of venlafaxine HCl in unadulterated and its pharmaceutical plans suggest economical conditions. The investigative strategy was approved by ICH guidelines approval parameters.[16] Distilled water was researched to build up a reasonable UV-visible spectrophotometric technique for the investigation of Venlafaxine hydrochloride in details. For choice of media the criteria utilized were affectability of the technique, simplicity of test planning, dissolvability of the medication, and cost of solvents and appropriateness of strategy to different purposes.[17]

Table no.3: UV-Spectrometric Method for Venlafaxine HCl:

| Sr. No. | Drug       | Matrix                      | Method                                      | Solvent                         | Detection Linearity/LOD, LOQ | Ref. |
|---------|------------|-----------------------------|---------------------------------------------|---------------------------------|------------------------------|------|
| 1       | Venlafaxine HCl | Bulk and Formulation       | UV-visible spectrophotometric method (JascoV-630) | 0.1N NaOH                        | 223 nm Linearity: 5-25µg/mL R²:0.996 LOD:0.95µg/mL LOQ: 0.29µg/mL | 18   |
| 2       | Venlafaxine HCl | Bulk and Formulation       | Double beam perkin Elmer UV-visible spectrophotometer (Model Labda 25) | Water                           | 225 nm Linearity: 4-24µg/mL R²:0.9991 LOD:-- LOQ: -- | 17   |
| 3       | Venlafaxine HCl | API                         | ELICO SL-210 double beam UV-visible spectrophotometer | Water                           | 225 nm Linearity: 2-24µg/mL R²:0.999 LOD:0.955µg/mL LOQ:2.895µg/mL | 19   |
| 4       | Venlafaxine HCl | Bulk and Formulation       | UV-visible spectrophotometer model 117 with resolution of 0.1 nm Phosphate buffer (pH6.8) | Phosphate buffer (pH6.8)        | 222 nm Linearity: 2-26µg/mL R²:0.999 LOD:-- LOQ: -- | 20   |
| 5       | Venlafaxine HCl | Capsule dosage form        | UV 1601 series (Shimadzu), UV-visible double beam spectrophotometer | Water                           | 274 nm Linearity: 50-250µg/mL R²:0.9998 LOD:-- LOQ: -- | 21   |
| 6       | Venlafaxine HCl | Bulk and Tablet form       | Systronics UV-visible spectrophotometer Model-2203 | Water                           | 626 nm Linearity: 10-50µg/mL R²:0.9995 LOD:-- LOQ:-- | 22   |
| 7       | Venlafaxine HCl | Bulk and Formulation       | UV-spectrometry                             | Water                           | 225 nm Linearity: 50-160µg/mL R²:0.9995 LOD:0.29µg/mL LOQ:1.01µg/mL | 23   |

C. High performance thin layer chromatography (HPTLC):

Planar Chromatography instead of column chromatography (for example GC, HPLC) uses a level (planar) stationary stage for detachment. In Thin-Layer Chromatography (TLC) this stationary stage is support by magnifier sheets or a foil (plastic or aluminum). Again dissimilar to section partitions, of TLC plate comprises an open framework, which goes entire individual strides of TLC investigation in a disconnected mode. HPTLC is a most adaptable strategy and is known for consistency, immaculateness profile, measure and exactness and precision of results. It can deal with a few examples of even dissimilar nature and structure. Synthetic

**ISSN: 2250-1177**

CODEN (USA): JDDTAO
inspection is necessary section in enabling a research center to guarantee routine satisfying enforcement execution of scientific strategies. Arrangement and put resources into stages to a ultra-modern completely programmed HPTLC slope System with different identifiers. Perceivability of the example all through the chromatographic examination i.e., after example application and chromatograph advancement. The HPTLC framework (Camag, Muttenz, Switzerland) furnished with an example implement Linomat-V associated with a nitrogen chamber, twin trough plate advancement chamber (10×10cm), TLC Camag Scanner III and Wincats-4.02 pre-covered silica gel 60 F254 TLC aluminum plates. Most labs use TLC/HPTLC for investigation, test, or examination with comparable examples, screening of unclear examples or large number of samples. Quality control, logical R&D, process observing, and ecological labs discover TLC/HPTLC as a valuable instrument for standard investigation.

Table no.4: HPTLC Method for Venlafaxine HCl:

| Sr. no. | Drug and Matrix | Stationary phase | Mobile phase | Chamber saturation/ TLC plate development time | Detection | Linearity, LOD, LOQ (µg/mL) | Ref. |
|---------|-----------------|------------------|--------------|-----------------------------------------------|-----------|-----------------------------|------|
| 1       | Venlafaxine HCl (Bulk, Capsule formulation) | Precoated Silica gel 60 F254 (10×10cm, 0.2mm Thickness) TLC plate | Methanol, Ammonia (4.5:0.5 v/v) | CST: 25min PD: 20min Rf value: 0.65 | Densitometry scanning at 224nm | Linearity: 500-3000 µg/mL R²: 0.998 LOD: 7.7µg/mL LOQ: 23.3µg/mL | 25 |
| 2       | Venlafaxine HCl (API and pharmaceutical dosageform) | Precoated Silica gel 60 F254 on Aluminium sheets (10×10cm, 0.2mm Thickness) TLC plate | Toluene, Methanol (4:6 v/v) | CST: 25min PD: 20min Rf value: 0.47 | Densitometry scanning at 230nm | Linearity: 2-7µg/mL R²: 0.996 LOD: 0.17µg/mL LOQ: 0.53µg/mL | 27 |
| 3       | Venlafaxine HCl (Bulk, Tablets) | (10×20cm) Aluminium backed HPTLC plates coated with 0.2mm layer of Silica gel 60 F254 | Toluene, Methanol (7:3.5 v/v) | CST: 10min PD: 20min Rf value: 0.19 | Densitometry scanning at 228nm | Linearity: 400-2000µg/mL R²: 0.999 LOD: 97.12µg/mL LOQ: 294.30µg/mL | 28 |

D. Stability indicating method:
Singh and Bakshi discussed some conclusive points of developing SIM. Dolan suggests the comments on SIA. Smela discussed regulatory points about SIM is analytical method. SIM procedure is used to measure the diminution the quantity of API in drug substances prefer degradation studies. SIM may also check stability of drug matter and products changes in separate time intervals of study. These method accurately estimate the changes API concentrations in the absence of impurities, excipients and other degradation products.

Stress testing is done to demonstrate specificity of the created method to quantify the adjustments in grouping of substance when little data is accessible about prospective degradation product. The improvement of reasonable stability indicating method provides a background for preformulation thinks about, stability examine and improve the proper storage condition.

These ICH guidelines are relevant to forced degradation study:
- ICH Q1 A: Stability testing of new drug substance and products.
- ICH Q1 B: Photostability testing of new drug substance and products.
- ICH Q2 B: Validation of analytical procedure, methodology.

Solution state stability:
1. Acidic hydrolysis
2. Alkaline hydrolysis
3. Hydrolytic
4. Oxidative degradation
Solid state solubility:
1. Thermal degradation
2. Photolytic degradation

| No. | Method | Drug | R.T.&R.T of Degradation Product/Development Time/RF value of drug | Column/Stationary phase | Mobile Phase & Flow Rate, Chamber saturation time | Wavelength, Linearity, Coefficient correlation. | LOD & LOD (µg/mL) | Ref |
|-----|--------|------|---------------------------------------------------------------|--------------------------|--------------------------------------------------|-------------------------------------------------|------------------|-----|
| 1   | HPLC   | Venlafaxine HCl (Extended release) | Run time - 15min Retention time - 4.49min | (5µm, 250×4.6mm) Kromasil C18 column | Phosphate buffer (pH4.5), Methanol (40:60) Flow rate - 1mL/min | UV-detection 225 nm Linear range - 42-78µg/mL R²=0.9997 | LOD-0.075µg/mL LQO-0.15 µg/mL | 36  |
| 2   | HPLC   | Venlafaxine HCl (Sustained release tablet) | Run time- 10min Retention time - 7.6min | (5µm, 250×4.6mm) RP inertsil ODS-3V C18 column | Phosphate buffer, Acetonitrile (80:20) Flow rate - 0.8mL/min | UV-detection 225 nm Linear range - 0.1-5 µg/mL R²=0.9999 | LOD-0.26 µg/mL LQO-0.81µg/mL | 37  |
| 3   | LC     | O-Desmethylenalafaxine (API) | Run time- 14min Retention time - ___ | (3µm, 150×4.6mm) YMC-pack ODS-A column | A) Buffer, Acetonitrile (85:15 v/v) B) Water, Acetonitrile (20:80 v/v) Flow rate-1mL/min | 230 nm Linear range-20-160 µg/mL R²=0.9996 | LOD-0.04 µg/mL LQO-0.13 µg/mL | 38  |
| 4   | LC     | Venlafaxine HCl | Run time - 10min Retention time - 4.32min | (5µm, 4.6×250mm) Spherisorb C8 column | Acetonitrile, Sodium dihydrogen orthophosphate(pH6.8) (75:25) Flow rate – 1.5mL/min | 224 nm Linear range-1-10 µg/mL R²=0.9999 | LOD-0.15 µg/mL LQO-0.60µg/mL | 39  |
| 5   | LC     | Venlafaxine HCl (Extended release capsule) | Run time- 10min Retention time - 6.8min | (5µm, 250×4.6mm) Luna C18 column | Phosphoric acid, Acetonitrile, Methanol (62:30:8) Flow rate- 1mL/min | 226 nm FIDA detector Linear range- 10-70µg/mL R²=0.9999 | LOD-0.24 µg/mL LQO-0.80 µg/mL | 40  |
| 6   | HPTLC  | Venlafaxine HCl (Bulk & dosage form) | TLC Plate Development time - 20min RF value- 0.46±0.05 | (10×10cm, 2mm thickness) Aluminium plates precoated silica gel 60 F254 | Dichloromethane, Acetonitrile, N-Hexane, Triethylamine (0.5:0.5:4.0:7) Saturation time- 15min | Camag TLC scanner-3 225 nm Linear range-100-1000µg/mL R²=0.9918 | LOD-12.48µg/mL LQO-37.81µg/mL | 41  |
| 7   | HPTLC  | Venlafaxine HCl | TLC plate Development time- 25min RF value- 0.58±0.02 | (10×10cm, 2mm) HPTLC plate coated with 0.25mm layer of silica gel 60 F254 plates | Butanol, Acetic acid, Water (6:2:2) Saturation time- 20min | Reflectance scanning camag TLC scanner-3 225 nm Linear range-100-600µg/mL R²=0.9984 | LOD-39.23µg/mL LQO-130.89µg/mL | 42  |

**Table no.5: Stress Testing: (forced degradation):**

| Degradation factor | Condition |
|--------------------|-----------|
| Thermal            | ≥ 60°C    |
| Humidity           | ≥ 75% RH  |
| Acid               | 0.1N HCL  |
| Base               | 0.1N NaOH |
| Oxidative          | Oxygen gas, 3% H₂O₂ |
| Photolytic         | Metal halide, Hg, Xe lamp, UV-B fluorescent |

**Table no.6: Stability indicating method for venlafaxine HCl:**

| Sr. No. | Method   | Drug | R.T.&R.T of Degradation Product/Development Time/RF value of drug | Column/Stationary phase | Mobile Phase & Flow Rate, Chamber saturation time | Wavelength, Linearity, Coefficient correlation. | LOD & LOD (µg/mL) | Ref |
|---------|----------|------|-----------------------------------------------------------------|--------------------------|--------------------------------------------------|-------------------------------------------------|------------------|-----|

**E. Bio-analytical method:**

These bioanalytical validation technique established by Kames et al. in 1991 which was intentional to give direction to bioanalytical chemists. After one year, Shah et al. established these report the convention on Analytical technique validation of bioavailability, bioequivalence and pharmacokinetic studies organized in Washington in 1990. 

Bio-analytical method promotes the quantitative analytical technique appropriate biochemical approach. HPLC, RP-HPLC, HPLC-MS/ESI, UPLC-MS, UPLC-TMS, LC and GC combined with mass spectroscopic procedure, LC-MS, LC-
MS/MS. Bioanalysis is an innovative technique for improving the accuracy, precision, efficiency, sensitivity, specificity, assays, data handling, processes, analysis cost, data quality. [44]

Table no. 7: Bioanalytical method for venlafaxine HCl:

| Sr. No | Method      | Drug                          | Bio. Fluid       | Column                                      | Mobile Phase                          | Flow Rate & Retention Time | Detection/Detector | Linearity & LOD & LOQ | Re f. |
|-------|-------------|-------------------------------|------------------|---------------------------------------------|---------------------------------------|-----------------------------|-------------------|------------------------|-------|
| 1     | RP-HPLC     | Venlafaxine and O-desmethyl   | Human Plasma     | (4.6×150mm, 5µm) Spherisorb S5 C18 column  | Acetonitrile, Phosphate buffer (30:70 v/v) | Flow rate: 1.4mL/min; Retention time: 8min | UV-Detector and Datajet integrator at 229nm | Linearity: 0.2-0.5 µg/mL LOD: 200 µg/mL LOQ: 5.00 µg/mL | 45    |
| 2     | RP-HPLC     | Venlafaxine HCl               | Human Plasma     | (150×4.6mm, 5µm) Alltima C8 column         | 0.1% O-phosphoric acid, Methanol (50:50 v/v) | Flow rate: 0.7mL/min; Retention time: 7min | ---                | Linearity: 2-25 µg/mL LOD: 2.00 µg/mL LOQ: 5.00 µg/mL | 27    |
| 3     | HPLC-ESI/MS | Venlafaxine and O-desmethylvenlafaxine enantiomers | Human Plasma | (250×4.6mm, 5µm) Vancomycin chiral column | Ammonium acetate, Methanol (15.85v/v) | Flow rate: 1mL/min; VEN Retention time: 11.8 min; ODV Retention time: 11.2 min | Ionized in the positive electrospray ionization ion source of the mass spectrometry | Linearity: VEN: 5.0-400 µg/mL LOD1.0 µg/mL LOQ: 5.00 µg/mL ODV: 4.0-300 µg/mL LOD: 1.5 µg/mL LOQ: 4.3 µg/mL | 47    |
| 4     | HPLC-MS/ESI | Venlafaxine and its three metabolites | Human Plasma | (250×4.6mm, 5µm) Thermo BDS hypersil C18 column | Water, Acetonitrile (60:40 v/v) | Flow rate: 1mL/min; VEN Retention time: 4.43 min; ODV Retention time: 3.01 min; NDV Retention time: 3.95 min; DDV Retention time: 2.88 min | Ionized in electrospray ionization ion source of mass spectrometer detected in selected ion recording | VEN Linearity: 4.0-700 µg/mL LOD: 0.4 µg/mL LOQ: 3.5 µg/mL ODV Linearity: 2.0-900 µg/mL LOD: 0.2 µg/mL LOQ: 2.3 µg/mL NDV Linearity: 3.0-800 µg/mL LOD: 0.3 µg/mL LOQ: 2.7 µg/mL DDV Linearity: 2.0-700 µg/mL LOD: 0.2 µg/mL LOQ: 1.9 µg/mL | 48    |
| 5     | UPLC-TMS    | Venlafaxine and O-desmethylvenlafaxine | Human Plasma | (50×2.1mm, 1.7µm) Acquity UPLCBEH C18 column | Methanol, Ammonium acetate (85:15 v/v) | Flow rate: 0.3mL/min; Retention time: 3 min | Triple quadrupole tandem mass spectrometer (TMS) via electrospray ionization source (ESI) | Linearity: 0.200-200 µg/mL LOD: 0.10 µg/mL LOQ: 0.200 µg/mL | 49    |
Conclusion

The present review illustrates various analytical approaches exercised for the estimation of Venlafaxine. A numerous investigation had perform including, Bio-analytical, Stability indicating, HPLC, HPTLC, UV-Visible Spectroscopy, and LC-MS, etc. for estimation of Venlafaxine in bulk and in its combined pharmaceutical formulation and in plasma. Liquid chromatography with UV detection has been found to be most studied for estimation of ven, in bulk as well as pharmaceutical dosage forms, while hyphenated such as LC-MS methods are reported for determination of Venlafaxine and its metabolite in plasma and other biological fluids. Few chromatography approaches like HPTLC and UV Spectrophotometry methods are also used for assay of Venlafaxine.

References:

1. Khalifa M, Daleau P, Turgeon J. Mechanism of sodium channel block by venlafaxine in guinea pig ventricular myocytes. Journal of Pharmacology and Experimental Therapeutics. 1999 Oct 1;291(1):280-4.
2. Rao BK, Manjula KR, Babu KS, Rambabu C. Validation of stability indicating RP-HPLC method for the assay of venlafaxine in pharmaceutical dosage form. Pharm Lett. 2015;7:247-56.
3. Somasekar V, Gowrisankar D, Shivakumar HN. Development and validation of a rapid RP-HPLC method for the determination of venlafaxine hydrochloride in pharmaceutical dosage forms using experimental design. Journal of Chemistry. 2009;6(4):1091-102.
4. Nageswara Rao R, Narasa Raju A. Simultaneous separation and determination of process-related substances and degradation products of venlafaxine by reversed-phase HPLC. Journal of separation science. 2006 Dec;29(18):2733-44.
5. Siddiqui MR, Abidinza ZA, Rahman N. Analytical techniques in pharmaceutical analysis: A review. Arabian Journal of Chemistry. 2017 Feb;1;10(5):1-1.
6. Samanidou V, Nazyropoulou C, Kovatsi L. A simple HPLC method for the in vitro determination of venlafaxine enantiomers and application to a pharmacokinetic study in healthy Chinese volunteers. Biomedical Chromatography. 2020;11;43(5):1854-62.
7. Asafu-Adjaye EB, Faustino PJ, Tawakkul MA, Anderson LW, Lawrence XY, Kwon H, Volpe DA. Validation and application of a stability-indicating HPLC method for the in vitro determination of gastric and intestinal stability of venlafaxine. Journal of Pharmaceutical and biomedical analysis. 2007 Apr;44(5):1854-9.
8. Kiran BV, Rao BS, and Som Shankar Dubey. Validation of Venlafaxine in Pharmaceutical Dosage by Reverse Phase HPLC Method. Journal of Pharmacy Research. 2012;5(5):2683-7.
9. Peikova I, Ivanova P, and Yanita M. Development of HPLC method for determination of Venlafaxine during concomitant use of metoprolol. Pharmazie 60 (2013):12-16.
10. Younus M, Arif MF, Richards MP, Kumar B. Determination of venlafaxine and modafinil in individual tablet dosage forms using single RP-HPLC method. Tropical Journal of Pharmaceutical Research. 2013;12(2):239-45.
11. Liu W, Dai YC, Deng N, Liu XR, Luo Y. Development and validation of a HPLC-MS/MS method for the determination of venlafaxine enantiomers and application to a pharmacokinetic study in healthy Chinese volunteers. Biomedical Chromatography. 2011 Mar;25(3):412-6.
12. Kumar KS, Sammani PB. Development and Validation of a New HPLC Method for Simultaneous Determination of Esomeprazole, Venlafaxine HCl and Fenofibrate. Int. J. Chem. Tech. Res. 2014 Jan;6(1):838-44.

13. Nageswara Rao N, Narasa Raju A. Simultaneous separation and determination of process-related substances and degradation products of venlafaxine by reverse-phase HPLC. Journal of separation science. 2006 Dec;29(18):2733-44.

14. Panchal AS, Anusha RK, and Devadasu C. Development and validation of isocratic RP-HPLC method for determination of venlafaxine bulk and tablet dosage form.

15. Malik A, Firke SD, Patil RR, Shirkhedkar AA, Surana SJ. Determination of iron chelating agents by analytical methods: a review. Critical reviews in analytical chemistry. 2019 May;27:1-14.

16. Guideline, ICH Harmonised Tripartite. "Text on validation of analytical procedures." International Conference on Harmonization, Geneva. 1994.

17. Karani NA, Pingale P. Analytical method development & validation of venlafaxine hydrochloride in solid dosage forms using UV spectrophotometer. J Pharma Res. 2009;2:1246-9.

18. Pakhale BA, Shinkar DM, Saudagar RB. "Development and Validation of Spectrophotometric Method for Determination of Venlafaxine Hydrochloride." International journal of Pharma sciences and research. 2015 Jan;6(1).

19. Eswaranath MM, Anitha V, Babu PS. New simple UV spectrophotometric method for determination of venlafaxine hydrochloride in pure and pharmaceutical formulation. World journal of pharmacy and pharmaceutical sciences. 2017 May;6(7):1192-1300

20. Sowmya C, Reddy VP, Kumar MK, Raja MS. Development and validation of spectrophotometric method for the estimation of venlafaxine in bulk and formulations. International Journal of Chemical Sciences. 2011;9(1):5-28.

21. Rathore GS, Basnival PK, Suthar M, Gupta RN. Spectrophotometric estimation of Venlafaxine hydrochloride. Asian Journal of Chemistry. 2009 Sep 10;21(8):5908.

22. Raghubabu K, Swarup LS, Kalyanaramu B, Rao MN, Ramdas C. Simple and inexpensive methods development for determination of venlafaxine hydrochloride from its solid dosage forms by visible spectrophotometry. Journal of Chemistry. 2012 Apr 3;9(3):16-45.

23. Hosseini M. Application of UV-Spectrophotometry and HPLC for determination of Venlafaxine and its four related substances in pharmaceutical dosage forms. Turk J. Pharm. Sci. 2011 Jul 1;8(2):91-104.

24. Dave K, Desai S. Factorial design for development of a high-performance thin-layer chromatography method for thin-layer estimation of abacavir sulfamethazine hydrochloride, and dolasetro in sodium. JPC-Journal of Planar Chromatography-Modern TLC. 2018 Dec;31(6):489-95.

25. Redasani, VK, Patel PR, and Surana SJ. "Development and Validation of Venlafaxine Hydrochloride in Bulk and in Capsule Formulation by HPTLC." Journal Analytical and pharmaceutical research 4:2 (2017). 00103.

26. Jain A, Parashar AK, Nema RK, NarSinghani T. High Performance Thin Layer Chromatography (HPTLC): A Modern Analytical Tool for Chemical Analysis. Current Research in Pharmaceutical Sciences. 2014 Mar 8:14.

27. Phoujdar M, Maske S, and Keğin N. "Development and validation of HPTLC method for determination of venlafaxine HCl in API and pharmaceutical dosage form." World journal of pharmaceutical research. 2015 March 4(4):1590-1598

28. Shirvi V, Channasabavaro K, Kumar G, Mani T. HPTLC analysis of venlafaxine hydrochloride in the bulk drug and tablets. JPC-Journal of Planar Chromatography-Modern TLC. 2010 Oct 1;23(5):369-72.

29. Bakshi M, Singh S. Development of validated stability-indicating assay methods—critical review. Journal of pharmaceutical and biomedical analysis. 2002 Jun 15;28(6):1011-40.

30. Dolan JW. Stability-indicating assays. LC GC North America. 2002;20(4):346-9.

31. Smela JW. Regulatory considerations for stability indicating analytical methods in drug substance and drug product testing. Am. Pharm. Rev. 2005;8(3):51-4.

32. Blessey MR, Patel RD, Prajapati PN, Agrawal YK. Development of forced degradation and stability indicating studies of drugs—A review. Journal of pharmaceutical analysis. 2014 Jun;1(4):159-65.

33. Guideline IH. Stability testing of new drug substances and products. Q1A (R2), current step. 2003 Feb:4:1-24.

34. Guideline IH. Stability testing: photostability testing of new drug substances and products. Q1B, Current Step. 1996:4.

35. Guideline IH. Validation of analytical procedures: text and methodology Q2 (R1). International conference on harmonization, Geneva, Switzerland 2005 Nov 10 (Vol.11).

36. Kaur J, "Development and validation of stability indicating method for the quantitative determination of venlafaxine hydrochloride in extended release formulation using high performance liquid chromatography." Journal of Pharmacy and Bioalied Sciences 2.1 (2010):22

37. Srinivas CS, Devi RP, Gampa V. Stability indicating method of related impurities in venlafaxine hydrochloride sustained release tablets. Int J Adv Pharma Sci. 2010;1(2):177-83.

38. Rao KV, Reddy KP, Kumar VR. Stability indicating LC method for rapid determination of related substances of O-desmethyl venlafaxine in active pharmaceutical ingredients and pharmaceutical formulations. Journal of chromatographic science. 2014 Nov 1;52(10):1247-54.

39. Makhija SN, Vavia PR. Stability indicating LC method for the rapid determination of venlafaxine in pharmaceutical formulations. Journal of Pharmaceutical and biomedical analysis. 2002 Jun 15;28(6):1055-9.

40. Bernardi LS. "Development and validation of a stability-indicating method for the determination of venlafaxine in extended-release capsules and dissolution kinetic studies." Journal of chromatographic science 47.9 (2009): 770-776.

41. Dubey SK, Anand A, Saha RN. Stability indicating high performance thin layer chromatographic method for quantitation of venlafaxine in bulk and pharmaceutical dosage form. Drug Development and Therapeutics. 2015 Jan 1;6(1):33.

42. Ramesh B, Narayana P, Reddy A, Devi P. Stability-indicating HPTLC method for analysis of venlafaxine hydrochloride, and use of the method to study degradation kinetics. JPC-Journal of Planar Chromatography-Modern TLC. 2011 Apr 1;12(4):160-5.

43. Tiwari G, Tiwari R. Bioanalytical method validation: An updated review. Pharmaceutical methods. 2010 Oct 1;1(1):25-38.

44. Shah VP, Milka KK, Findlay JW, Hill HM, Hulse JD, McGilveray IJ, McKay G, Miller KJ, Patnaiq RN, Powell ML, Tonelli A. Bioanalytical method validation—a revisit with a decade of progress. Pharmaceutical research, 2000 Dec 1;17(12):1551-7.

45. Matoga M, Pehourcq F, Titter K, Dumora F, Jarry C. Rapid high-performance liquid chromatographic measurement of venlafaxine and O-desmethylvenlafaxine in human plasma: application to management of acute intoxications. Journal of Chromatography B: Biomedical Sciences and Applications. 2001 Sep 5;760(2):213-8.

46. Liu W, Wang F. Simultaneous stereoselective analysis of venlafaxine and O-desmethylvenlafaxine enantiomers in human plasma by HPLC-ESI/MS using a vancomycin chiral column. Journal of Chromatography B. 2007 May 1;850(1-2):183-9.

47. Liu W, Wang F. Simultaneous stereoselective analysis of venlafaxine and O-desmethylvenlafaxine enantiomers in human plasma by HPLC-ESI/MS using a vancomycin chiral column. Journal of Chromatography B. 2007 May 1;850(1-2):183-9.

48. Qin F, Li N, Qin T, Zhang Y, Li F. Simultaneous quantification of venlafaxine and O-desmethylvenlafaxine in human plasma by ultra performance liquid chromatography–tandem mass spectrometry and its application in a pharmacokinetic study. Journal of Chromatography B. 2010 Mar 1;878(7-8):689-94.

49. Shah GR, Thaker BT, Surati KR, Parabia MH. Simultaneous determination of venlafaxine and its main active metabolite O-desmethyl venlafaxine in rat plasma by LC-MS/MS. Analytical sciences. 2009 Oct 1;25(10):1207-10.

50. Dziurkowska E, Wesolowski M. Simultaneous quantification of venlafaxine and its main metabolite, O-desmethylvenlafaxine, in human saliva by HPLC. Journal of separation science. 2013 Jun;36(11):1726-33.