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REVIEW ON LIQUISOLID COMPACT TECHNIQUE

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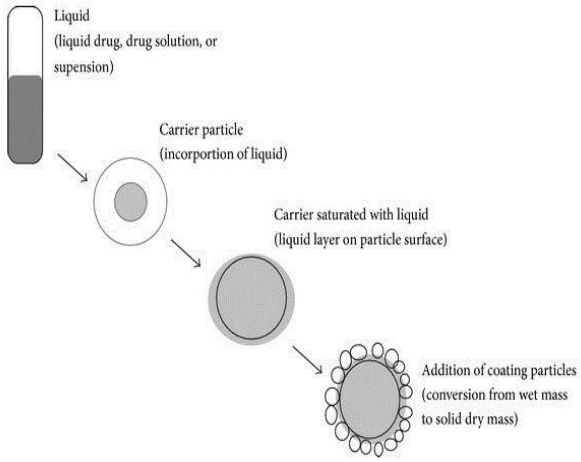
ABSTRACT

Dissolution of a drug and its release from the dosage form has basic impact on bioavailability. The active amount of the drug present at the target site depends upon solubility. The major challenge that the pharmaceutical industry is facing is the Solubility of the drug with the development of new pharmaceutical products.[1] There solubility can be enhanced by various approaches which includes micronization, Nanonisation, use of salt forms, use of surfactant, solid dispersion, and supercritical fluid recrystallization etc. Liquisolid technique is a latest and promising approach towards such novel drug delivery system, that the solubility of the insoluble drug moiety is enhanced by the using non-volatile solvents and hence improves the dissolution and bioavailability.[2] The experiment involves dissolving the insoluble drug into a non-volatile solvent and the mixture of a drug loaded solutions with appropriate carrier and coating materials are added to convert it into acceptably flowing and compressible powders.[3] The pharmaceutical medications such as solutions or suspensions which are water insoluble drugs in a suitable non-volatile liquid vehicles can be easily converted into powder form with acceptable flow properties and compression behaviour using suitable powder excipients.[4] The use of non-volatile solvent leads to improved wettability, improved solubility and ensures molecular dispersion of drug in the formulation. By using non-volatile solvents the release of the drugs can be modified by this technique, also solubility and dissolution rate can be improved, sustained drug delivery systems can be developed for the water soluble drugs.[5]

KEYWORDS: Dissolution of a drug and its release from the dosage form has basic impact on bioavailability.

INTRODUCTION

Currently, the pharmaceutical industries are facing several problems and challenges owing to global competition and increasing demand for better products. Mostly the oral route is the preferred route of drug administration, but the drug to be absorbed through the gastrointestinal tract (GIT) must be in solution form.[6] In case of drugs which are poorly soluble, dissolution is the rate limiting step in the absorption process. In general, drugs with low aqueous solubility (lower than 100 µg/ml) show dissolution-limited and incomplete absorption from the gastrointestinal tract of animals and humans.[7] The literature provides different techniques for the improvement of the dissolution of poorly soluble drugs. These mainly include solid dispersions, crystal engineering, ball milling, Complexation, self-emulsifying drug delivery systems and use of mesoporous silica carriers. Recently, liquisolid technique has shown promising approach for the enhancement of dissolution.[8] Liquisolid systems are explained as dry, non-adherent, free-flowing and compressible powder mixtures obtained by the conversion of liquid drugs, drug suspensions or drug solution into non-volatile solvents with chosen carriers and coating materials.[9] Since non-volatile solvents are used to prepare drug solution/suspension, the liquid is not evaporated and drug is carried with in liquid system and is dispersed throughout the final product. The liquisolid technique is a novel technique, where a liquid may be transformed into readily compressible, free flowing dry powder by a simple technique called as physical blending using suitable carrier and coating materials. Water insoluble drugs are usually dissolved in a suitable non-volatile solvent which then exists in solution or suspension form known as liquid medicament.[10] This liquisolid technique is applied to formulate liquid medications (i.e., solutions, suspensions, and emulsions of water-insoluble solid drugs taken in non-volatile solvent) into powders into powders which are suitable for tableting or encapsulation. Since the liquisolid tablets contain a solution of drug in a suitable solvent, the surface of drug for dissolution is increased to a very great extent. Due to increased surface area and wetting properties of drug available for dissolution, liquisolid compacts of water insoluble drugs are expected to show enhanced drug release characteristics and leads to improved oral bioavailability.[11]



Schematic Diagram of liquisolid system.

Advantages

- Biopharmaceutical class II drugs having high permeability, less solubility can be formulated into liquisolid systems.
- Improvement in the bioavailability of water insoluble drugs administered orally is obtained
- This principle leads the mechanism of drug delivery from liquisolid
- This principle involves the mechanism of drug delivery which mainly enhances and improves dissolution profile of liquisolid system of powder drug solution.[12]
- This technique is economical when compared to soft gelatin capsules
- The formulated drug from this technique is held in solubilized liquid state which improves wetting properties of the drug thereby leading to the enhancement of drug dissolution profiles.
- The larger surface area of drug is allowed to come in contact with dissolution medium specially for powdered liquid medications.
- This technique is capable for industrial production also.
- The bioavailability of drugs formulated by this technique is improved compared to conventional tablets.
- The dosage from obtained by this technique can be differentiated by addition of color into liquid vehicle.[13]

Limitations

- The high dose lipophilic drug formulation of liquisolid tablet is one of the limitations.
- Not applicable for high dose insoluble drug.
- Require Mathematical calculations
- Increased amount of coating materials and carrier materials are added in order to achieve the desired liquisolid systems.[14] This will lead to increased weight of tablets due to which tablets are difficult to swallow.

Historical Development

Historically, liquisolid compacts are offspring of powdered solutions.[15] It is a technique in which the solution of a drug is converted into a non-adherent powder by absorption of liquids onto silicas having large distinct surfaces. These preparations while being in powder dispersion form have been investigated for their dissolution form and not as compressed entities, because they couldn't be compressed into tablets.[16] Later studies showed that on powdered solutions compressibility was increased by adding the compression enhancers such as micro crystalline cellulose. In these studies the silica was used in large quantities and the compression and flow properties of these were never validated and were never standardized to industrial specifications and requirements. When such modified powdered solutions were compressed into tablets they showed a significant "liquid squeezing" out occurrence and produced soft tablets, due to which the industrial applications of such systems was retarded.[17]

On the other hand, the liquisolid compacts are compressible powders and acceptably flowing forms of liquid medications. These liquid medications are having industrial applications. The liquid medication implies to all the drug suspensions, emulsions, liquid oily drugs as well as powdered solutions.[18] In comparison with powdered, solutions these liquisolid compacts are of four types such as,

1:- Powdered drug solutions
2:- powdered drug suspensions
3:- powdered drug emulsions
4:- powdered liquid drugs

The powdered solutions term earlier seemed to be inadequate in elaborating the original system, because the drug remains in solution in the liquid vehicle was not proven. The latest liquisolid technique can be applied to formulate liquid medications like suspensions, emulsions of water insoluble solid drugs carried in nonvolatile liquid vehicles. The simple blending of such liquid medications with rest of excipients referred to be as carrier and material for coating.[19]

Concept of Liquisolid System

When the drug is dissolved in a liquid vehicle, it is consolidated into a carrier material having porous surface, both absorption and adsorption takes place. Once the system reaches to its saturation state, the absorption of the liquid occurs on both internal as well as external surfaces of porous carrier particles. The coating material having high absorptive properties and large surface area produces the liquisolid system with desired flow characteristics (Fahmy RH et al., 2008). The drug is already in solution form in liquisolid systems, also at the same time the drug is carried by the powder particles.[20] The liquisolid compacts of water insoluble substances can be achieved due to increased surface area and wetting property which leads to increased drug release and improved oral bioavailability. This occurs when the

drug is in solution form and hence dissolution of the drug is increased. Presence of non-volatile solvent in liquisolid system causes wetting of drug particles by reducing interfacial tension between tablet and dissolution medium.

Theory of Liquisolid Systems

For acceptable flow and compression properties the powder should retain only less amount of liquid. In order to calculate the required amounts of carrier and coating material, the formulation of liquisolid systems is expressed by mathematical approach which was developed by spireas. The introduced constants for powder liquid combinations are because of this approach which is based on flowable (Φ-value) and compressible (Ψ-number) liquid retention potential.[21]

The Φ-value of powder represents the max. Amount of a given non-volatile liquid which can be retained inside its bulk [w/w] while maintaining the acceptable flowability. The flowability can be determined from the flow of powder, by measuring the angle of repose or by measuring the angle of slide.[22]

Based on the excipient ratio (R) of the powder substrate, liquisolid system obtained can exhibit flowing and compressible properties, only when the maximum liquid loading material is not exceeded. This liquid/carrier ratio is called "liquid load factor Lf [w/w] and can be defined as the weight ratio of the liquid formulation (W) and the carrier material (Q) in the system:

$Lf = W / Q$ Eq. (1)

R represents ratio between the weights of the carrier (Q) and the coating (q) material present in the formulation:

$R = Q/q$ Eq. (2)

The liquid load factor which ensures acceptable flowability (Φ Lf) can be determined by:

$\Phi Lf = \Phi + \varphi \cdot (1/R)$ Eq. (3)

Here Φ and φ are the Φ-values for the carrier and coating material, respectively. Similarly, liquid load factor for the production of liquisolid systems with acceptable compatibility (ΨLf) may be determined by:

$\Psi Lf = \Psi + \psi \cdot (1/R)$ Eq. (4)

Where Ψ and ψ are Ψ-numbers for the coating material and carrier, respectively.

Hence, the optimum liquid load factor (Lo) that is required to obtain acceptably flowing and compressible liquisolid systems which is equal to either Φ Lf or Ψ Lf, whoever represents the lower value for the above.[23]

Once the optimum liquid load factor is determined, appropriate quantities of carrier (Qo) and coating (qo) material which is required to convert the given amount of liquid formulation (W) into the acceptably flowing and compressible liquisolid system can be calculated as follows:

$Qo = W / Lo$ Eq. (5)

And

$qo = Qo / R$ Eq. (6)

The applicability and validity for the above mentioned principles have been tested and verified for the production of liquisolid compacts which possesses acceptable flow and compaction properties.

Mechanisms of Enhanced Drug Release From Liquisolid Systems

The mechanisms which are introduced for the enhanced release of drug in literature for liquisolid systems are as follows

1:- Increased surface area of drug available for release.
2:- Increased aqueous solubility of the drug.
3:- Improved wettability of the drug particles.

a. Increased drug surface area

In a liquisolid system after dissolution of the drug in a liquid vehicle, the drug still remains in the solubilized and molecularly dispersed state. Hence, the surface area availability increases for the drug release when compared to drug particles when compared with directly compressed tablets. The release rate decreases when the drug content exceeds the solubility limit, which results in the increase of fraction of un-dissolved drug in the liquid vehicle. In some cases it is observed that the rate of release directly depends upon the fraction of drug which is molecularly dispersed in the liquid formulation. The rate of release increases linearly when FM increases. Moreover, this increase can be observed only above a certain FM limit.[24]

B. Increased aqueous solubility of the drug

With the enhancement of drug release by the first mechanism it is expected that the drug solubility might get enhanced as well by liquisolid systems.[25] The small amount of the liquid vehicle in a liquisolid compact is not sufficient to increase the overall solubility of the drug in aqueous dissolution medium whereas the solid/liquid interface between an individual liquisolid particle and the release medium, it may be possible that this microenvironment of liquid vehicle which diffuses out of a single liquisolid particle together with the drug molecules might be sufficient to increase the aqueous solubility of drug.

c. Improved wetting properties

The liquid vehicle can either act as a surface active agent or has a low surface tension in liquisolid system, wetting of the liquisolid primary particles gets improved, Which in turn results in the improved drug dissolution. Wettability can be demonstrated by measurement of contact angle.[26]

Components
The formulation components of liquisolid system are as follows:-

1:- Carrier material
Carrier materials are actually compression-enhancers, relatively large and preferably porous particles which possess a sufficient absorption contributing in liquid absorption and leads to increased solubility. E. g. Different grades of cellulose, lactose, sorbitol and starch, Eudragit RL and RS, Avicel PH 102.

2:- Coating material
Coating materials are flow-enhancers, very fine, highly adsorptive coating particles which participate in covering the wet carrier particles and it absorbs the excessive non-volatile solvent layer over the carrier particles and displays a dry-looking, non adherent, free flowing powder.[27] E.g. different grades of silica like aerosil-200, syloid-244FP, cab-O-silM5 etc.

3:- Non-volatile solvents
Non-volatile solvents used should be usually Inert, possess high boiling point, water-miscible and are not highly viscous organic solvent systems, should have the ability to solubilize the drug and also should act as binding agent are preferred as most suitable vehicles. E.g. propylene glycol, liquid polyethene glycols, glycerin, polysorbates, fixed oils, N, N-dimethylacetamide, PEG 200 and PEG 400 etc.

4:- Disintegrants
Disintegrants are used to increase the rate of drug release, its wettability and also increases the solubility of the drug. The most commonly used disintegrants are sodium starch glycolate, crosspovidone etc.

5:- Lubricant
The most commonly used lubricant is magnesium stearate or stearic acid.

Formulation of Liquisolid Compacts
Formulation of liquisolid compacts are mainly divided into two categories such as:
1:- Preformulation studies
2:- Formulation of liquisolid compacts.

1:- Preformulation Studies
a. Solubility of drug
Saturated solution is prepared to carry out the solubility of a drug in different solvents which is prepared by adding excess amount of the drug in a non-solvent. The solution obtained is then shaken with shaker for a specific period and then the solution is filtered. The solution is then analyzed under UV spectrophotometer.[28]

b. Determination of angle of slide
The flow properties of powders are measured by using angle of slide. Angle of slide is determined by weighing the specific amount of carrier material and it is then placed at one end of the metal plate having polished surface. The end of the metal plate raises gradually until the plate becomes angular to horizontal at which the powder gets slided easily. This is called as angle of slide. Angle of 33° is taken as optimum.

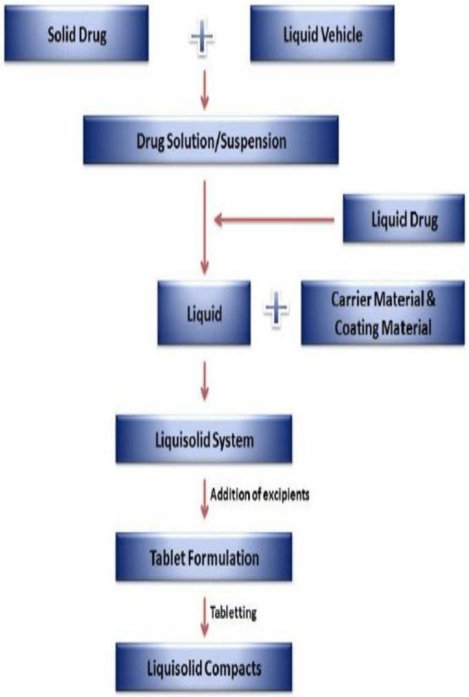
c. Determination of flowable liquid retention potential (Φ value)
The term "flowable liquid retention potential (Φ value) describes the ability of a powder material to retain a specific amount of liquid in order to maintain required flow properties.
Φ value can be calculated by the following equation
Φ= weight of liquid/weight of solid

d. Calculation of liquid load factor (Lf)
The drug is dissolved in a various different concentrations of Non-volatile solvents. Then carrier and coating materials are added to this system and it is the blended. The drug loading factors and amount of carrier and coating material is calculated by the following equation.[29]
LF=weight of liquid medication/weight of carrier material

e. Liquisolid compressibility test (LSC)
Liquid retention potential (Φ) is determined by this test and it involves the steps like preparing of carrier and coating material admixture systems, preparation of powder mixtures, powder mixtures to tablets, determination of hardness, and determination of liquid content of tablets as well as plasticity and LF.

Formulation of Liquisolid Compacts
Liquisolid compact technique is a novel technique used to increase solubility and bioavailability of poorly water soluble drugs.[30] It is also known as powdered solution technology and was first introduced by spires.

Steps Involved in Formulation of Liquisolid Compacts
- The drug candidate is dispersed in a non-volatile solvent having different drug: solvent ratios. E.g. polysorbate 80, PEG 200 etc.
- To this mixture carrier material along with other excipients are also added with continuous stirring in the mortar.
- Superdisintegrants such as sodium starch glycolate or crosspovidone are added to the above mixture. The prepared mixture is shaken continuously in a motor.
- To the above mixture coating materials along with other excipients are added. This coating material adsorbs the excess layer of non-volatile solvent over the carrier material, due to which conversion of liquid into solid layer occurs and it produces non adherent, dry, and free flowing powder particles.
- The above mixture is then compressed into tablets and is then evaluated for evaluation parameters.



Steps involved in formulation of liquisolid compacts.

Evaluation

Evaluation of liquisolid granules

Flow behavior

Flowability of a powder plays an important role in the production of pharmaceutical dosage forms to reduce excess dose variations. Angle of repose, Carr´s index and Hausner´s ratio were the methods used to ensure the flow properties of the liquisolid systems.

Angle of repose

Determination of Angle of repose is necessary to the flow of powder. Angle of repose is the maximum possible angle between the surface of a pile of powder and the horizontal plane. In this accurately weighed powder mixture was taken in a funnel.[31] The funnel was adjusted at some particular height in such a way that the tip of funnel just touches the apex of heap of powder. The powder was then allowed to flow through the funnel into the surface. The height of the pile and diameter of the base was measured and the angle of repose was calculated by using the formula;

$\tan \theta = h/r$

Where;

θ= angle of repose

h= height of pile (cms)

r= radius of base (cms)

Bulk Density

The bulk density was determined by using the apparatus known as bulk density apparatus. Accurately weighed quantity of powder which was previously sieved by sieve #40 was poured into a graduated cylinder. After the powder was poured into the graduated cylinder, the uniform powder bed was made without disturbing the powder volume and the volume was taken from the cylinder as (Vb) in ml. this is called as bulk volume and the weight of the powder was determined as (M) and the bulk density was calculated by using the formula;

Db= M/Vb

Where;

M is the weight of powder

Vb is the bulk volume of powder

Tapped Density

After bulk density was determined the Tapped density was measured by using the same apparatus. The apparatus containing the known amount of powder was tapped for a fixed time. This tapping was repeated several times until the powder reaches minimum volume and the minimum volume occupied by the powder was taken as (Vt) and the powder was weighed and weight was taken as (M).[32] The tapped density was calculated by using the formula

Dt= M/Vt

Where;

M is the weight of powder,

Vt is the tapped volume occupied the powder

Carr's Index (%)

Carr´s index is the important parameter to characteristic the nature of powders and granules. It has been proposed as an indirect measure of bulk density , size , surface area, shape cohesiveness and moisture content of the powder material because these al parameters influence the Carr´s index. Carr´s index is the simplest way fir the measurement of free flow of powder. Carr´s index is calculated by the following equation;

Carr's index = [(Tapped density-Bulk density) / Tapped density] x 100

Hausner's Ratio

Hausner´s ratio enhances the flow of powder. It is calculated by the following formula;

Hausner's Ratio = Tapped density / Bulk density

2: Precompression Studies Of The Prepared Liquisolid Powder Systems

In order to ensure the properties, toxicities, characteristics of the selected excipients, Differential scanning Calorimetry, X-ray Diffraction, FT-IR and Scanning Electron Microscope studies are performed.

a. Fourier transform infrared spectroscopy (FT-IR)

Fourier transform infrared spectroscopy is useful in determining any chemical interaction that occurs drug and the excipients which are used in the formulation.[33] The prepared melted granules are recorded on a FT-IR-8400 spectrophotometer. Potassium bromide (KBr) pellet method is involved, and background spectrum is collected. Every spectrum is derived from single average scans collected in the region 400 - 4000cm-1 at a spectral

resolution of 2cm-2 and the ratio against background interfereogram. Software is used to analyze spectra.

b. X-ray diffraction

For the identification of crystalline state, X-ray diffraction patterns are determined for prepared liquisolid compacts and the drugs and excipients used in the formulation. Absence of constructive specific peaks of the drug in the liquisolid diffractogram indicates that the crystalline form of drug has almost converted to solubilized form or amorphous form. The solubilization of the drug in the liquisolid compact leads to the improvement in solubility and also improves dissolution rate of the drug.[34]

c. Scanning electron microscopy

It is observed by Scanning electron microscopy that there is presence or absence of crystal form of the drug and excipients in the formulation. If SEM observes that there is absence of crystals of the drug then it refers that now the drug is completely solubilised in the carrier system. After completion of the formulation of liquisolid tablets they also get evaluated for wt. variation, thickness, friability, moisture content, disintegration test, dissolution test and content uniformity.

d. Contact angle measurement

For assessing the wettability, the contact angle of liquisolid tablets is measured by imaging method. The most commonly used method is used to measure contact angle directly for a drop of liquid resting on surface of the solid. A saturated solution of the drug in a dissolution media is prepared and out of which a drop of solution is put on to the surface of tablet.[35] contact angles are calculated by measuring height and diameter of sphere drop on the surface of tablet.

e. Stability studies

The drug content is determined by charging up the crystals of the drug to accelerate the stability conditions according to ICH guidelines Q1 R2. Samples are taken after regular intervals of the time. These samples are then analyzed by using infrared spectrophotometer.

f. *In vitro* release

In vitro release of liquisolid tablets is carried out by employing USP II apparatus at 37 ºC ± 2 ºC. During these studies many researchers observed that if the drug concentration is low in liquid formulation then rapid drug release can be expected from the formulation. If *In vitro* release rates for liquisolid tablets are higher than the absorption rate will also be higher which increases drug bioavailability.[36]

g. In vivo study

This liquisolid technology results in the enhancement of drug release of poorly soluble drugs. The absorption characteristics of Hydrochlorothiazide liquisolid compacts were compared with commercial tablets and it was studied in beagle dogs. Various differences in the area under the plasma concentration time curve, the peak plasma concentration and the absolute bioavailability and the commercial tablets were observed. For the mean residence time, the mean absorption time, and the rate of absorption no significant differences were found. The absolute bioavailability was 15% higher than that from the commercial formulation.[37]

h. Estimation of drug content

10mg of the powdered drug of liquisolid compacts is weighed and diluted using appropriate solvent. UV-Visible spectrophotometer is used to analyze the drug content.

Post evaluation parameters

Hardness (crushing strength)

Hardness can be defined as the resistance of the tablet against the force applied till it breaks.[38] Monsanto Hardness Tester or Stokes Hardness tester is used to test the hardness of the tablet Monsanto Hardness Tester or Stokes Hardness tester. The tablets are generally placed in between two platens, one of which applies sufficient force to the tablet to cause fracture. For conventional, round (circular cross-section) tablets, loading takes place across their diameter (sometimes referred to as diametric loading), and fracture occurs in that plane.

Friability

It is the phenomenon where surface of the tablet shows a site of damage due to mechanical shock. Procedure is carried out using Roche friabilator. This friabilator is made up of a plastic drum which is fixed with a machine which rotates at 25 rpm for 100 revolutions (25X4=100). Tablets tend to falls from 6 inches height in each turn within the apparatus. "Roche Friabilator" specification Internal diameter -283mm-291mm Depth -36mm-40mm Inside radius -75.5mm-85.5mm Outer diameter of central ring -24.5mm-25.5mm.[39]

Weight Variation

The test is performed to check out the manufactured tablets have a uniform weight.

Procedure

20 tablets are weighed individually select each unit randomly and calculate the average weight. More than two of the individual weights should not deviate from the average weight by more than the percentage given in the pharmacopoeia and no one deviates by more than twice that percentage.[40]

USP limits for the tablet weight variation are given below.

Average weight of tablet	Deviation (%)	Number of tablets
Less than 80 mg	±10.0	Minimum 18
	±20.0	Maximum 2
80mg to 250 mg	±7.5	Minimum 18
	±15.0	Maximum 2
More than 250 mg	±5.0	Minimum 18
	±10.0	Maximum 2

Disintegration

It is the first physical change observed for a drug when it enters into the body, this test helps in knowing the API solubility in the gastric fluids of the digestive system. According to USP the disintegration apparatus consist of 6 glass tubes (77.5mm±2.5mm long & 21.5mm internal diameter) with a 10 number mesh (1.8-2.2mm) at bottom. This arrangement of 6 tubes is placed in a medium simulated to the disintegration environment maintained at 37oC± 2 °C, in 1 liter vessel. System is made to move up and down through the distance of 5 to 6 cm at a frequency of 28 to 32 cycles per minute. Tablet remains 2.5 cm below the surface of liquid on their upward movement and not closer than 2.5 cm from the bottom of the beaker in their downward movement. The disintegration time of tablet is compared with the values in the monograph.[41]

Content Uniformity

This test for Content Uniformity is useful for assessing the consistency of Powder blends before filling or compressing, semi-solid and liquid bulk batches before filling and active content within individual units.[42] This testing involves using a content/potency assay to determine content of active material contained in multiple different samples collected throughout from the batch. Content uniformity is determined by U.V.

Procedure

10 capsules or tablets are selected randomly. Empty the contents of each capsule carefully in a suitable container. By suitable analytical method, assay the individual content of the active ingredient in each tablet. The preparation complies if not more than one individual content is exceeding the limits of 85 to 115% of the average content and no one is outside the limits of 75 to 125% of the average content. The preparation fails to comply with the test if more than 3 individual contents are exceeding the limits of 85 to 115% of the average content or if one or more individual contents are outside the limits of 75 % to 125 % of the average.

***In-Vitro* Drug Release**

The rate and extent of the drug release for the tablets is estimated by dissolution test (under standardized condition of temperature and solvent composition. It is a dynamic property that changes with time and describes the process by which a homogeneous mixture of solid or a liquid can be obtained in the solvent.[43] Drug Dissolution testing plays a vital role in the routine quality control test, for the characterization and quality of product. Different types of apparatus are incorporated or used to study the dissolution test of the tablet.

List of official dissolution apparatus

	I.P	U.S.P	B.P	E.P
TYPE 1	Paddle apparatus	Basket apparatus	Basket apparatus	Basket apparatus
TYPE 2	Basket apparatus	Paddle apparatus	Paddle apparatus	Paddle apparatus
TYPE 3		Reciprocating cylinder	Flow through cell	Flow through cell
TYPE 4		Flow through cell		
TYPE 5		Paddle over disk		
TYPE 6		Rotating cylinder		
TYPE 7		Reciprocating disk		

CONCLUSION

This liquisolid compact technique is a promising alternative for the formulation of water-insoluble solid drugs and liquid lipophilic drugs.[44] Increased rate of drug dissolution from liquisolid tablets is probably due to an increase in wetting properties and surface area of drug material available for dissolution. Rapid disintegration rates are seen compared to conventional tablets and thus they show improved release rates and hence greater bioavailability. Modification of formulation by use of certain agents cause sustained release of drugs from the liquisolid tablets. presently much research work still focuses on the formulation development of liquisolid systems and in vitro drug release profiles.[45]

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