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Review Article

Review: Solid Dispersion Technique for Enhancement of Solubility of Poorly Soluble Drug

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Abstract

Nearly 40% of novel drugs comes in pharmaceutical industries are showing poor capability of solubilization in water. Therefore enhancing the solubilization of such drugs in water to enhance their bioavailability be the major challenge to formulation scientists. So the preparation of solid dispersion from the drug which shows poor solubility in water with carriers having good water solubility has decrease the occurrence of such problems and increase dissolution. Hence solid dispersion found to be attention-grabbing method for solubility enhancing of drugs which showing poor solubility in water. This review, shows an overview on the different solid dispersion types, rationale, their advantages, limitations, manufacturing processes as well as its characterization methods.

Introduction

The most simple, easy and convenient path drug administration is through the oral route of administration due to its better stability, dose accuracy, lesser bulk and easy manufacturing.[1,2] Mainly the bioavailability of drugs from oral route depends on their solubility as well as permeability. On the basis of this two parameter drugs are classified into the four classes which known as Biopharmaceutical Classification System (BCS) which are mention below [3,4,5]

Table no.1: BCS classification

BCS Class	Solubility in aqueous environment	Permeation over (intestinal) membrane
Class I	High soluble	High permeable
Class II	Low soluble	High permeable
Class III	High soluble	Low permeable
Class IV	Low soluble	Low permeable

Nearly 40% from the novel drugs in pharmaceutical industries shows poor solubility in water.(1,6) Therefore major problems of these drugs is their poor bioavailability due to its poor water solubility.(7) Hence dose of drug require larger to produce therapeutic effect which may produce toxic effect of these drug.(1) If drugs in gastrointestinal area shows incomplete release, it will show a less bioavailability and it is essential to enhance the solubility alternatively increases dissolution rate of such drugs to improve its bioavailability.(8)

Noyes Whitney equation, which gives some hints of different parameters which may helpful in enhancing the bioavailability of the poorly soluble drugs.

$$Dc/Dt = AD(Cs-C)/h$$

where, dc/dt- is the rate of dissolution
A- Surface area available for dissolution
D- Diffusion coefficient of the compound
Cs- solubility of the compound in the dissolution medium
C- Concentration of drug in the medium at time t
h- Thickness of diffusion boundary layer adjacent to the surface of dissolving compound. (9,10,11)

Various techniques for Solubility Enhancement [1,5,12,13,14,15]

1) Physical Modifications

i. Particle size reduction
ii. Complexation
iii. Modification of the crystal habit
iv. Drug dispersion in carriers
   a. Solid solution
   b. Eutectic mixtures
   c. Solid dispersion
v. Solubilization by surfactants

2) Chemical Modification

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i. Salt Formation
ii. Solubilizing agent
iii. Co-solvency
iv. Co-crystallization
v. Nanotechnology
vi. Hydrotropic

3) Other:

i. Hot melt extrusion
ii. High- Pressure Homogenization
iii. Solvent evaporation method
iv. Polymeric Alteration
v. Supercritical fluid method
vi. Electrostatic spinning method
vii. Spray freezing into liquid and Lyophillization
viii. Lyophilization technique
ix. Evaporative precipitation into aqueous solution
x. Direct capsule filling
xi. Inclusion Complexes:

a. Kneading Technique
b. Co-precipitation
c. Spray-Drying Method

Solid Dispersion

Various technique were used for enhancement of drug solubility consequently the dissolution rate and bioavailability of drug. Among this the solid dispersion is common technique used to enhancing the drug solubility. Many solid dispersion formulation have been formulated since from the 1960's.(1,16) In 1961, a method which shows promising enhancement in bioavailability of drug which shows poor solubility in water was developed by Obi and Sekiguchi. Later on it known as solid dispersion which involve preparation of eutectic mixture of drug with carrier which gives solubility in water.(15) In 1971, Chiou and Reigelman, first defined solid dispersion as "dispersion of one or more active ingredients in an inert carrier or matrix (hydrophilic) at solid state prepared by fusion, solvent or melting solvent method."(9,16)

Table no.2:Example of commercial product prepared by using solid dispersion technology(2,17,18)

Product name	Drug	Carrier molecule	Technique for preparation
Orkambi	Lumacaft	HPMCAS/SLS	Spray drying
Novir	Ritonavir	PVP-VA	Melt extrusion
Onmel	traconazole	HPMC	Melt extrusion
Samsca	Tolvaptan	N/A	Granulation
Gris-PEG	Griseofluvin	HPMCAS/SLS	Spray drying

HPMC—hydroxypropyl methylcellulose; HPMCAS—hydroxypropyl methylcellulose acetate succinate;PVPVA— povidone-vinyl acetate (copovidone); SLS—Sodium Lauryl sulfate; N.A.—Not available;

Classification of Solid Dispersion(6,11,14,19,20,21)

Solid dispersion are classified on basis of

A] Their molecular arrangement

B] Carrier used for solid dispersion

A] Their molecular arrangement

In this solid dispersion again subdivided into the subsequent six types on the basis of its molecular arrangement.

1) Simple eutectic mixture
2) Amorphous precipitations in crystalline matrix
3) Solid solutions
   a) Continuous Solid Solutions
   b) Discontinuous solid solutions
   c) Substitutional solid solutions
   d) Interstitial solid solutions
4) Glass suspension
6) Glass solution

1) Simple eutectic mixture

It is first described by Sekiguchi& Obi in1961 as solid dispersion.(19) It is formed by rapid solidification of miscible molten state of drug and polymer which shows negligible miscibility when they crystallize just like two distinct components on their cooling.(1,19) Both drug and polymer exist in crystalline state.(14) It shows the enhanced release because the drug dispersion found as fine crystals and increase in wetting due to the carrier presence, in some cases dissolved drug solubilization occurs in some cases.(18)

2) Amorphous precipitations in crystalline matrix

It is same as simple eutectic mixture only difference in this is that the drug occurs in precipitated form instead of the crystalline form.(1)

3) Solid solutions

This is defined as a solid dispersion which is miscible not only in its solid state but also in their fluid state. The solid solutions either be of crystalline or amorphous type.(19) Solid solution shows better dissolution rate compare to the eutectic mixture due to reduction occurs in particle size of the drug. In this rate of dissolution is depend on the rate of dissolution of carrier.(10) Solid solutions subdivided into the two methods based on the i) miscibility extent of two components and ii) distribution way of solvate molecules in the solvendum.(1,6)

i) Miscibility extent of two components

It either be a) Continuous type b) Discontinuous type

a) Continuous type

It concern about the miscibility in the solid state of two component is in all proportions which mean that the individual components strength of bonding is weaker than that of the two components strength of bonding.[1]

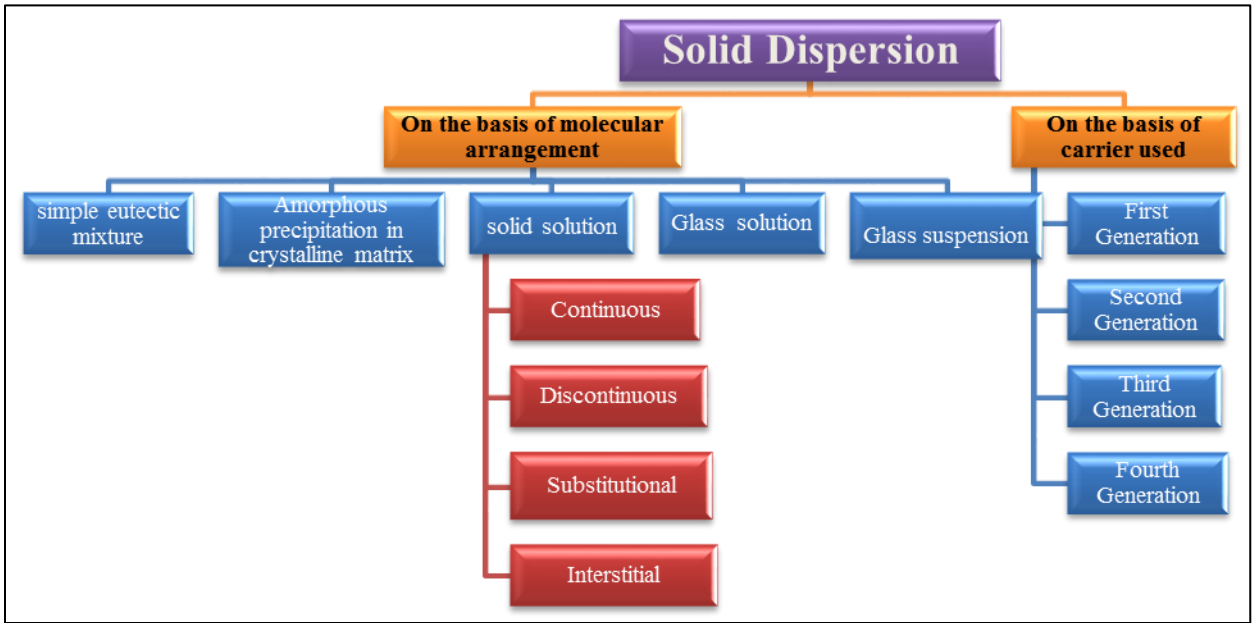

Fig. no.1:Classification of Solid dispersion

b) Discontinuous type

It concern that each of the components had limited solubility in the other component. On the basis of Goldberg et al. suggestion the term `solid solution' can be applicable only when the two components mutual solubility exceeds 5%.[6,11,18]

ii) Distribution way of solvate moleculesin the solvendum

It may a) Substitutionalsolid solutions or b) Interstitial solid solutions

a) Substitutional solid solution

In this, the solvent molecule substitutes by the solute molecule in the crystal lattice.(19) For such substitution the particle size of solute molecule differ by not more than 15% than that of solvent molecule.(6,11)

b) Interstitial solid solutions

In such solid solutions the interstitial space in the solvent lattice occupies by the solute molecule.(18,19) In such cases the difference between the diameters of solute molecule and solvent molecule should be not more than 0.59 times.[6,11]

4) Glass suspension and solution

The mixture containing suspended precipitated particles in a glassy solventis known as glass suspension and glass solution forms homogeneous glassy system by dissolving the solute molecule in glass carrier. (1,6) Carriers that are used for the preparation of glass solutions are sugars, like galactose, dextrose, trehalose, fructose or amorphous polymers like HPMC, Polyvinyl-pyrrolidone-co-vinylacetate (PVPVA) and PVP.(18) A pure chemical or a mixture of pure chemicals in the glassy state refer as glass. (9) The lattice energy which act as barrier in dissolution is much greater in solid solution than the glass solution. Brittleness and transparency below the glass transition temperature is the characteristic of glassy state. (1)

B] Carrier used for solid dispersion [1,6,8,9,16,19,20,21,22,23]

1) First generation
2) Second generation
3) Third generation
4) Fourth generation

1) First generation

These type of solid dispersions were formed by using the crystalline carriers such as sugar, urea and mannitol. (9,21) It is mainly concern with the concept of eutectic mixture which were described by Sekiguchi and Obi in 1961.(1)The first generation solid dispersion posses the good thermodynamical stability due to crystalline carrier and it shows less solubility as compare to the amorphous form which lead as a main disadvantage of first generation solid dispersion.[16,22]

2) Second generation

In the late sixties it was observed that solid dispersions of crystalline form of drug was less efficient than amorphous form of drug because of their high thermodyanamical stability. Hence the second

generation solid dispersion appeared which contain amorphous carriers rather than the crystalline carriers which are mostly polymers. (8,21) These polymeric carrier includes synthetic polymers like polyethyleneglycols (PEG), polymethacrylates and povidone (PVP) and natural polymers like cellulose derivatives, such as hydroxypropylmethylcellulose, hydroxypropylcellulose or ethylcellulose and starch derivates, such as cyclodextrins 21.(6,9) In second generation because of forced solubilization, the drug found at its supersaturated state in carrier.(8,16) Amorphous solid dispersions on the basis of molecular interaction of carrier and drug are classified as solid solutions, solid suspension or mixture of both. Examples amorphous carriers are polyvinylacetate, polyethyleneglycol, polymethacrylate, cellulose derivatives, povidone,.[(1)]

3) Third generation

Third generation solid dispersion appeared because it was seen that if the carrier shows any surface activity or self-emulsifying properties the dissolution rate of drug is increases.(19) Hence solid dispersion contain a surfactant or a mixture of polymers and surfactants as carriers which shows improve dissolution rate of poorly soluble drugs ultimately shows increase in bioavailability such drugs.(9) The surfactants as carriers include poloxamer , compritol 888 ATO, , inutec SP1 and soluplus. Other surfactants and emulsifiers such as sodium lauryl sulfate (SLS), Tween 80 ,polyoxyethylene hydrogenated sucrose laurate and castor oil.(21) The drawback of solid dispersion like precipitation and recrystallization was avoided due to incorporation of surface active carrier or self-emulsifing carriers. It also shows improvement in the drug stability.[(8,20,21)]

4) Fourth generation

It is mainly concern with solid dispersion having controlled release of poor water-soluble drugs with a short biological half-life. It has two targets: enhancement in solubility and prolonged release with controlled manner. In CRSD, drug can be released by two mechanism: diffusion and erosion. Drug release retarded polymer in CRSD include ethyl cellulose (EC), HPC, poly(ethylene oxide) (PEO) and Eudragit RS RL (21)

Rationale for using solid dispersion technique[(16)]

- To enhance the drug solubility of poorly soluble drug
- To masking the taste of bitter drug
- To obtain required release profile
- To improve drug stability

Advantages of solid dispersion [(1,16,21,22,24, 25)]

Solid dispersion is one of the advantageous technique for enhancement of solubility of poorly soluble drug consequently the rate of dissolution and the bioavailability drug.

Particles with reduced particle size

The drug particle size can reduce into molecular levels due to the preparation of solid dispersions.(21) After dissolution of carrier the drug get dispersed in the dissolution medium which increase the surface area of drug to the dissolution media which results an increased rate of dissolution consequently increase the bioavailability of drug.[(1,22)]

Particles with better wettability:

The enhancement in the solubility of the drug is associated with the wettability of drug which may increase by using surface active carriers such as cholic acid and bile salts.(24,25)

Particles with higher porosity

Solid dispersion have high porous structure and porosity depend on the properties of the carrier used.(25) Solid dispersion can be prepared by linear and reticular polymer. Comparatively linear polymer shows higher porosity. (21,22).

Drugs in amorphous state

Amorphous state of drug require less or no energy to breakup the crystal lattice during the process of dissolution. Hence it shows higher degree of solubility than the crystalline state of drug.(1)

Aggalomeration:

The risk of drug particles agglomeration in the dissolution media was reduced by using surfactants or emulsifiers which improve the rate of dissolution of drug.(21)

Limitations of solid dispersion [(1,24)]

Limitations of solid dispersion involve

i. The chemical and physical stability of drugs and vehicles,
ii. Scale-up of manufacturing processes
iii. Formulation of solid dispersions into the dosage form and
iv. Reproducibility of its physicochemical properties

Mechanism of drug release from solid dispersions [(1,7,21,22,24,26,27)]

Drug release from the solid dispersion was observed by two mechanisms

A) Carrier-controlled Release

B) Drug-controlled Release

A) Carrier-controlled release

Corrigan (1986) suggested carrier-controlled dissolution in which the inert carrier control the rate of dissolution of drug. Further, Dubois and Ford finding supported to this work (1985) who noted that the rate of dissolution of drugs in a single carrier, prepared under comparable

conditions, were identical in most cases. This again shows that it is the rate of dissolution of the carrier which dominate the process and not by the rate of dissolution of drug. In this case, when solid dispersion disperse into water, due to hydrophilic property of carrier it dissolve or absorb water rapidly and form concentrated layer of carrier. If the drug dissolves in this layer and the viscosity of this layer is high enough to prevent the diffusion of the drug through it, the rate limiting step will be the diffusion of the carrier into the bulk phase and this mechanism is carrier-controlled release. (1,24,26)

B) Drug-controlled Release

Nystrom and Sjokvist (1991) measured the griseofulvin particle size released from the dispersions which prove that the enhancement in the rate of dissolution was a directly related to the released particle size. Further, Craig and Sjokvist-Saers (1992) used a drugs homologous series and authors suggested that there was a linear relationship between the intrinsic dissolution rate of the model drugs in the dispersions and the drug solubility, clearly link with the drug properties (and not the polymer) to the rate of dissolution;whichhelps to refer such behavior as drug controlled dissolution.(1,26) Here the drug is sparingly soluble or insoluble in diffusion layer, released as solid particles and dissolution rate will associated with the drug particle properties like drug solubility, polymorphic state and particle size.(1,24)

METHOD FOR PREPARATION OF SOLID DISPERSION(1,3,6,7,8,9,15,21,28,29,30)

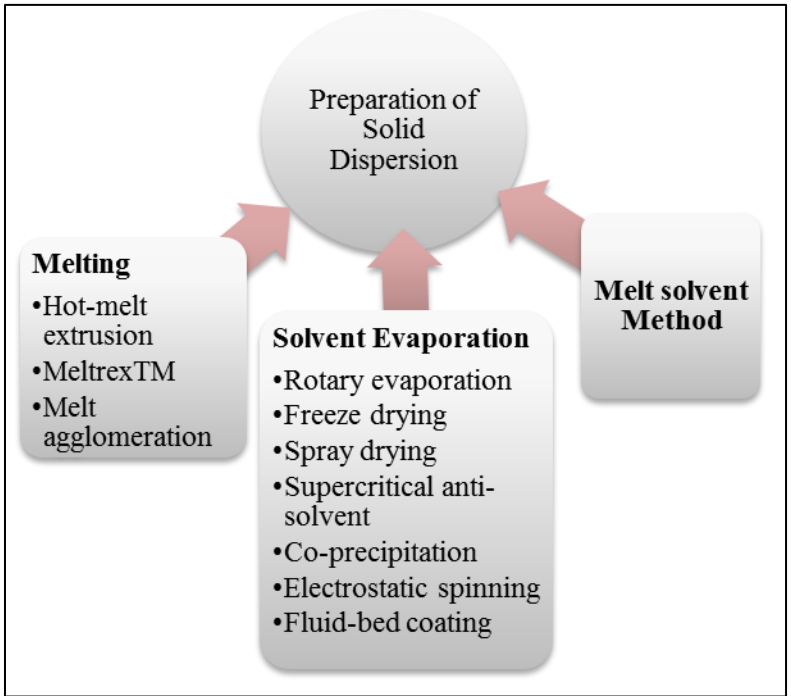

Fig. no.2: Preparation method for Solid dispersion

There are three major method of manufacturing of solid dispersions viz; melting method, solvent evaporation method and melt solvent method. Mostly melt method and solvent evaporation method are used.

Melting method

Sekiguchi et al. is the first who use a melting method or fusion method consisting oftogether melting the carrier and drug over the temperature of eutectic point, which is the lowest possible melting point of the mixture. Then the melted liquid was cooled or solidified by several processes like ice bath agitation, immersion in liquid nitrogen, solidify in petri dishes at room temperature inside a dessicator or spreading on plates placed over dry ice.(8,21)Then obtained mass of solid is crushed, then pulverized and sieved. (1) This method does not need any solvent is the main advantage of this method and the important requirement of this method is carrier and drug miscibility in their molten state to form a homogenous mixture.(21) The limitation of these method are i) due to the use of high temperatures drug degradation may occur. ii) carrier and drug incomplete miscibility occurs because of polymeric carrier shows high viscosity in their molten state. iii) during cooling the phase separation may occur due to change in drug–carrier miscibility. (8,30) To avoid such limitations of melting method various modified methods like hot-stage

extrusion, MeltrexTM and melt agglomeration were introduced.(8)

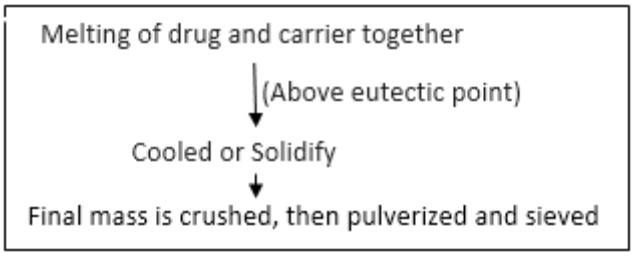

Fig. no.3: Flow diagram of melting method

1.Hot-stage extrusion

In recent years, hot melt extrusion has become the most common method used for the manufacturing of solid dispersions. In this method the carrier and drug are simultaneously mixed, heated, melted, homogenized and extruded in a form of rods, tablets, milled, or pellets. It is more advantageous than other melting method because it decrease the degradation risk of thermolabile drugs due the low residence time of the carrier and drug in the extruder at elevated temperature and method is also efficient, continuous, easy scale up and produce higher thermodynamic stability products than other methods. (8,21)

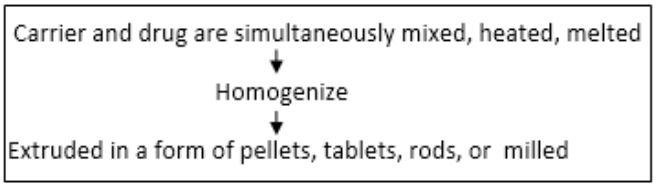

Fig.no.4: Flow diagram of Hot-stage extrusion

2. MeltrexTM

It is a patented solid dispersions preparation process based on the hot melt extrusion principle. It associated with the special extruder having twin screw and two independent hoppers which can vary the temperature over a broad range which reduced residence time of the drug in the extruder and avoid thermal stress to the drug and excipients. It also protect the oxidation and hydrolysis of susceptible drugs by complete removal of oxygen and moisture from the mixture.(8)

3. Melt agglomeration

Melt agglomeration allows the manufacturing of solid dispersions in conventional high shear mixers. In this technique binder act as carrier and solid dispersion prepared by adding the drug with molten carrier to the heated excipients at a temperature within or above the melting range of the carriers. Rotary processor might be preferable to produce stable solid dispersions by melt agglomeration because higher binder content can be incorporated in the agglomerates and the temperature can be more easily controlled. (1,3)

Solvent Evaporation

This method is also known as solvent method in which solid dispersions can be formed by the evaporation of solvent from the drug and carrier solution.(21) In this method volatile solvent which dissolve the maximum amount of drug–carrier physical mixture and solvent having low boiling point like methanol, ethanol, dichloromethane, acetone and chloroform or their mixtures are chosen for the shorten solvent removal process.(27) This method overcome the main limitation of melting method that is the thermal decomposition of drugs or carriers at high temperature and due to which a few polymers used as carriers in the melting method.(1,21) The disadvantages of this method are difficulty in removing residual solvent which may cause toxicity, finding a appropriate non-toxic solvent or their mixture in which drug and carrier are dissolve and cost of production is high.(6,21,29) For these reasons, hot melt extrusion method is more preferable than solvent method. A rapid solidification method is always preferred and therefore there are various methods developed for fast solvent removal such as rotary evaporation, freeze drying, spray drying, supercritical anti-solvent, co-precipitation, electrostatic spinning, fluid-bed coating(21)

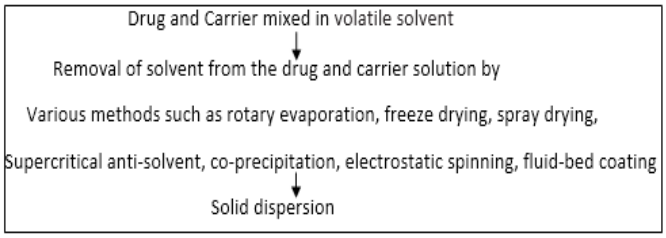

Fig. no.5: Flow diagram of Solvent Evaporation

1. Rotary Evaporation

The risk of phase separation is avoid by using rotary evaporation method at a moderate temperature and also avoid the drugs and carriers degradation at high temperature. The final solid dispersions are stored in a vacuum desiccator after solvent evaporation process, for removal of complete residual solvent. Though the method are easy to perform but the processes are time consuming.(21)

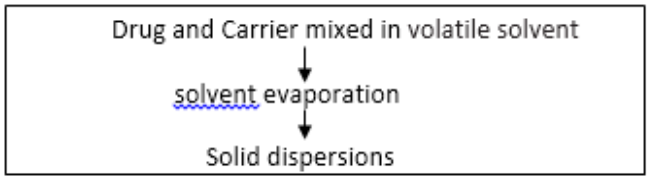

Fig. no.6: Flow diagram of Rotary Evaporation

2. Freeze Drying

It is also known as Lyophilization technique. In this method carrier and drug dissolve in same solvent and immerse the solution into the liquid nitrogen until it frozen fully. Lyophilized molecular dispersion is obtain after lyophilization of frozen solution.(1,27) The most important advantage of the system is that it reduces the chances of drug degradation and phase separation by operating the system at low temperature. The disadvantage of the system is difficult to maintain the organic solvents into the frozen state during sublimation due to low freezing temperature of solvent.(21,27)

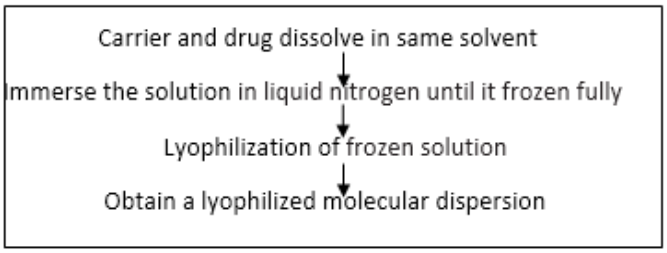

Fig. no.7: Flow diagram of Freeze drying

3. Spray drying

Spray drying is the most common and an efficient evaporation method for preparation of solid dispersion because it consist of rapid evaporation solvent to minimize the chances of phase separation and forms more homogenous system.(3,21) In this method drug–carrier solutions were atomized into fine droplets and sprayed into a stream of heated gas flow to remove the solvent. Rapid evaporation of solvent occurs due to large specific surface area of droplets and obtain the fine particles of solid dispersion within seconds.(21,27) Particle size reduction and rapid evaporation are the main advantages of this technique. The particle size of solid dispersion by this method is directly depend on the size of droplets which can be changed by the atomizer easily.(27)

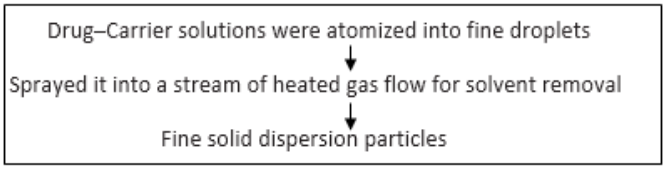

Fig. no.8: Flow diagram of Spray drying

4. Supercritical anti-solvent (SAS)

In this method supercritical carbon dioxide (CO2) used as a solubilizing solvent or anti-solvent. When CO2 used as a solvent, dissolve the drug and carrier in supercritical CO2 and sprayed it through a nozzle into an expansion vessel at lower pressure. The rapid nucleation is occurs due to the rapid expansion of the dissolved drugs and carriers, leading to form the particles of solid dispersions with a desirable size distribution in a very quick time. When using supercritical CO2 as anti-solvent, it is introduce into the nozzle simultaneously with solution of drug and carrier in an organic solvent. When the solution is sprayed, the precipitation of solid dispersion occurs due to is rapid extraction of solvent by the supercritical CO2.(21)

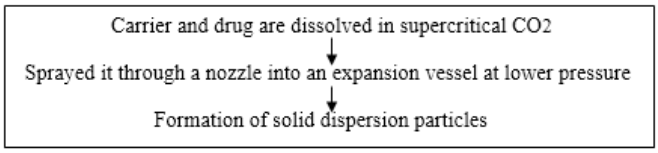

Fig.no.9: Flow diagram of SAS

5. Co-precipitation

In this method, a drug and carrier are completely dissolved in an organic solvent.The precipitation of the drug and carrier occurs after drop wise addition of an anti-solvent in the solution. Then filtered the resulting suspension and washed it to remove residual solvents. The final co-precipitated material forms after filtration and drying is called as microprecipitated bulk powder (MBP) which is a solid dispersion of the drug and carrier.(3,21) The advantages of this method are it reduce the risk of phase separation, it does not require high temperature which may cause degradation of the drug or carrier and the less volatile solvents can be used.(27)

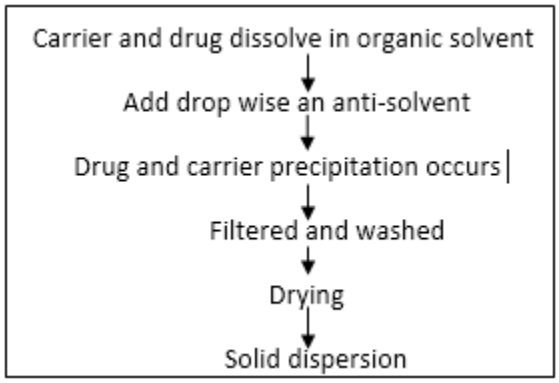

Fig. no.10: Flow diagram of Co-precipitation

6. Electrostatic spinning

Electrostatic spinning is a combination of nanotechnology and solid dispersion technology.(4) In which solid fibers are produced from a polymeric fluid stream solution or melt delivered through a millimeter-scale nozzle.(1,21) In this method, a drug–polymer solution is placed into a spinneret connected with a microsyringe pump and a high voltage was applied between 5 and 30 kV to the needle tip for inducing a

charge on the surface of the solution and fixed electrical potential is also applied. When electrical forces overcome the surface tension of the solution at the air interface, polymer jets are ejected. Due to applied electric field the jet get accelerates and the solvent evaporates quickly to form fibers at micron or submicron diameter which are collected on the screen. This collected fibers can be used in oral dosage forms.(21,25) The rapid and efficient solvent evaporation leading to the formation of amorphous dispersions which shows improved dissolution rate of incorporated drug in these fibers is the main advantage of this method.(21)

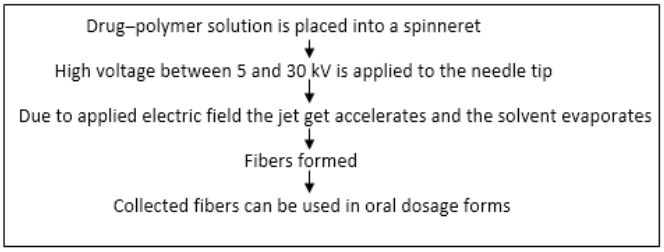

Fig. no.11: Flow diagram of Electrostatic spinning

7. Fluid-bed coating

In this method carrier and drug dissolve in common solvent and this solution was sprayed onto
the surface of nonpareil pellet in the fluid-bed coater through a nozzle. Co-precipitate deposited simultaneously on the surface of nonpareil pellets after evaporation of solvent by drying airflow. These solid dispersions pellets or granules can be directly used for or encapsulating into capsules or tableting.(21)

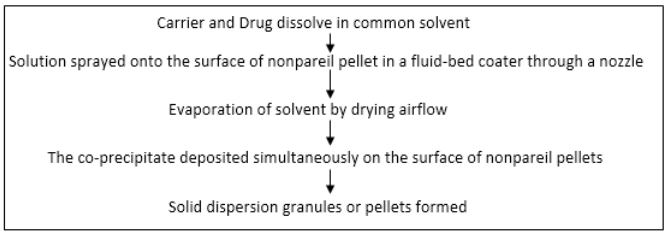

Fig. no.12: Flow diagram of Fluid-bed coating

Melting solvent method

This method is combination of both solvent method and melting method. Firstly drug is dissolve in suitable solvent and then mixed with molten carrier after that evaporation of solvent and solidifies to form solid dispersions. The advantage of this method is that it avoids the risk of thermal degradation of drug. (21)

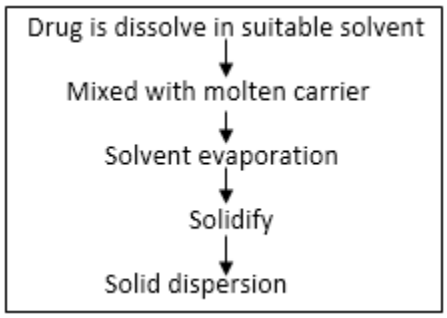

Fig.no.13: Flow diagram of Melting solvent method

Method of preparation for solid dispersion are shown in fig.2 From this listed method spray drying and hot melt extrusion are most preferable methods due to their high scalability and applicability.(21)

Characterization of solid dispersion[1,9]

Various method for characterization of solid dispersion are mention below

Physical structure

- Scanning electron microscopy
- Raman microscopy
- Atomic force microscopy
- Surface properties
- Surface area analysis

Drug -carrier miscibility

- Powder X-ray diffraction
- Hot stage microscopy
- Differential scanning calorimetry

Stability

- DSC (Tg, Temperature recrystallization)
- Humidity studies
- Isothermal Calorimetry
- Saturated solubility studies

Amorphous content

- Polarised light optical microscopy
- Powder X-ray diffraction
- DSC (MTDSC)

Dissolution enhancement

- Dissolution
- Dynamic solubility
- Intrinsic dissolution
- Intrinsic dissolution

Practical limitation in solid dispersion technique[1,22,31])

1. Problem related with the dosage form development

A. Poor flow and compressibility:

Solid dispersion shows difficulty in pulverization and sieving. It also shows poor stability and compressibility.

To overcome such problem in- situ drug granulation method is used.

B. Sticking of granules of solid dispersion to die and punches:

Sticking was observed during compression to die and punches. This problem can be solve by using the small pieces of grease proof paper which placed between metal surface and granules. Hence the direct contact between granules and metal surface was avoided.

2. Problem related with scale up and manufacturing

A. During cooling chance of moisture condensation over solid dispersion:

There is chance of moisture condensation over solid dispersion during evaporation. This problem can be overcome by using the surface moving belt or rotating belt were the continuous cooling operation is done.

B. Reproducibility of physicochemical properties:

The preparation conditions like heating rate, maximum temperature used, cooling rate and method, pulverization method, and particle size shows great influence on the physicochemical properties of solid dispersions formed.

3. Problem related with stability

Solid dispersion prepared by the hot melt method, a certain fraction of drug may remain molecularly dispersed in carrier if such extent of drug is high it may give rise to phase separation i.e. the crystalline and amorphous phase are get separate to avoid this some polymer like HPMCAC, HPMC, PVP are used now days . The polymer acts as a stabilizer in the preparation of solid dispersion by retarding crystallization of drug at low humidity and the preventing mechanism of crystallization is reducing the nucleation rate.

Conclusion

Nowadays, enhancing the solubility of poorly water soluble drug for enhancement in their bioavailability is major challenge for formulation scientists. So solid dispersion is one of the better technique which is used for improvement of solubility of poorly water soluble drugs. But it require to overcome some problem related to flow properties and the stability of drug. It also require some research for better implementation on industrial scale as it one of the better technique for enhancing the solubility of poorly soluble drugs.

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