

REVIEW

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# Most promising solid dispersion technique of oral dispersible tablet

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## Abstract

**Background:** The most common problem about conventional dosage form is dysphagia (difficulty in swallowing). So, we design a new approach in a conventional dosage form which is oral dispersible tablet. Oral dispersible tablet is also called as mouth dissolving tablet, fast dissolving tablet, or oral disintegrating tablet. Oral dispersible tablet has advantage as it quickly disintegrates into saliva when it is put on the tongue. The faster the drug disintegrates or is dissolved, the faster the absorption and the quicker the therapeutic effect of drug will be attained.

**Main text:** This review article focuses on the progress in methods of manufacturing and various latest technologies involved in the development of oral disintegrating tablet. The solid dispersion technique is one of the novel techniques to manufacturing the oral dispersible tablet. Solid dispersion is basically a drug polymer two component system.

**Conclusion:** This review article focuses on advantages, disadvantages, materials used as carrier for solid dispersions, methods of preparation of solid dispersion, classification of solid dispersion, promising drugs that can be incorporated into oral disintegrating tablet by solid dispersion techniques, and recent research in solid dispersion technique using polymers as carriers.

**Keywords:** Solid dispersion, Disintegration, Dissolution, Oral dispersible

## 1 Background

Now a day, tablet is a one of the most popular dosage form among all dosage form due to the advantage of its convenience of easy to administration and easy preparation procedure [1]. Oral disintegrating tablet forms are easy to disintegrate, dissolved by saliva in the mouth. Oral disintegrating tablet are useful in all types of patients like pediatric, geriatric, bedridden, mentally disabled, and the patient with dysphagia problem for conventional dosage form. Oral dispersible tablet are also used when local action in the mouth is desirable for example, local anesthetics for toothaches, mouth ulcers, cold sores, and to those who suffered from “dysphagia” for sustained action tablet or capsule [2]. So, one attempt is made towards to increase the solubility of certain class of drug. One of the most commonly used methods to increase disintegration

and bioavailability of that class of drug is the solid dispersion technique. Solid dispersion technique is the most useful method to increase the disintegration and its dissolution, as well as decrease their dosing frequency; therefore, toxicity also gets reduced. Solid dispersion technique has been used as the most useful method to increase the solubility property and bioavailability of certain classes of drugs [3].

## 2 Main text

### 2.1 Solid dispersion

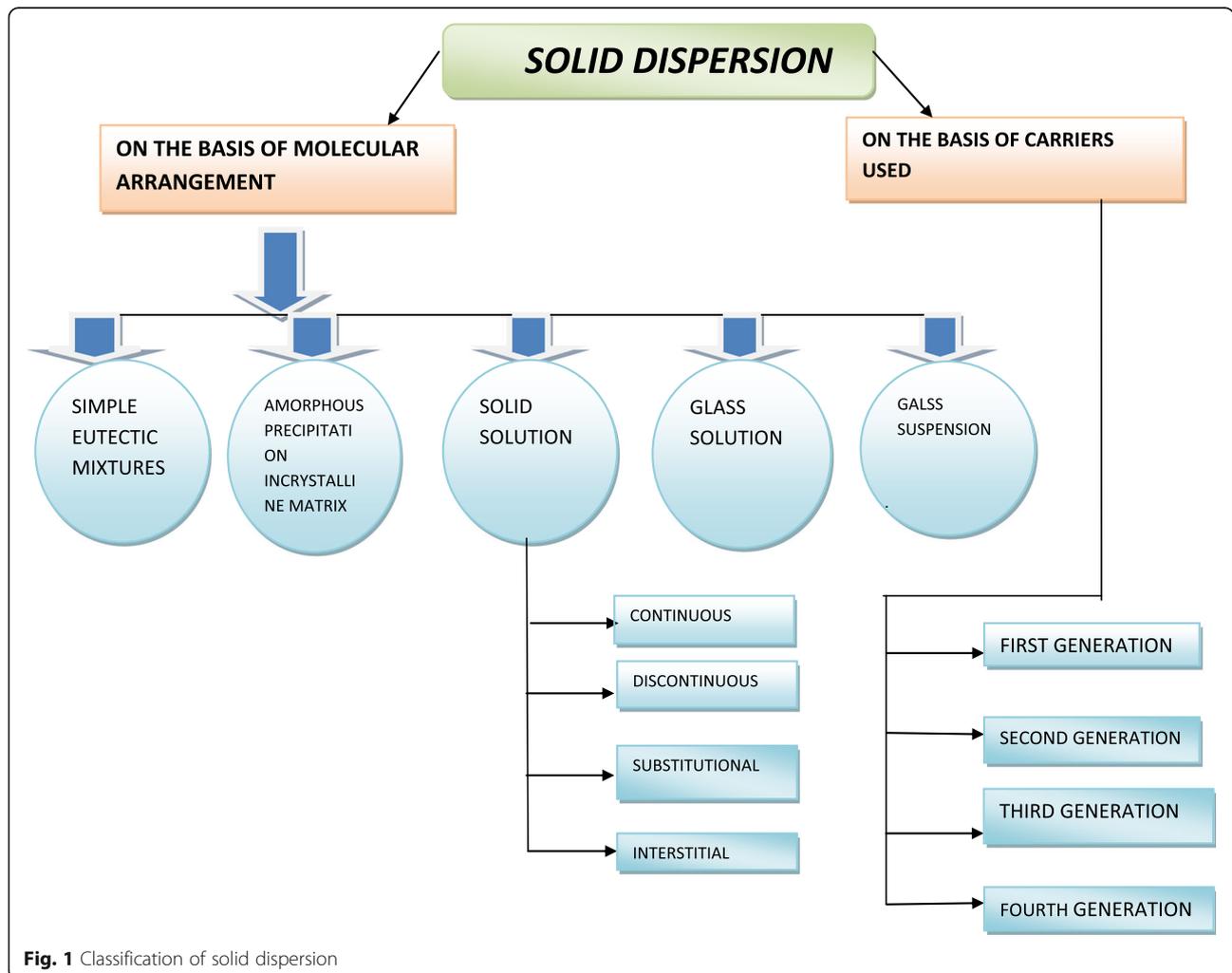
Chiou and Reigelman first defined solid dispersion as “dispersion of one or more active ingredients in an inert carrier or matrix (hydrophilic) at solid state prepared by fusion, solvent or melting solvent method” [4–6], or solid dispersion defined as “a dispersion that include the formation of eutectic mixtures of drug with carriers that soluble in water easily by melting of their physical mixtures” [7, 8].

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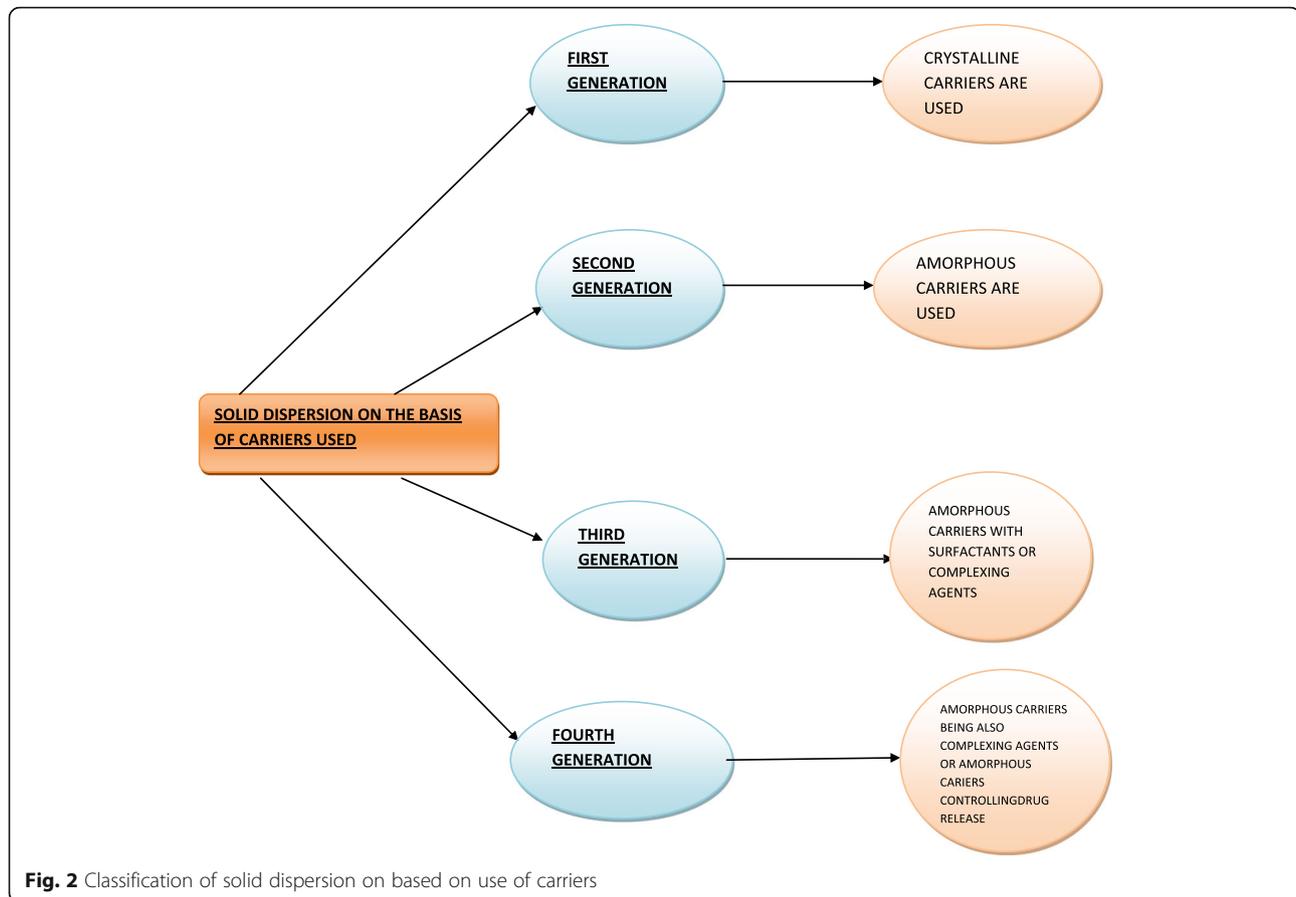
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**Table 1** Carriers used in solid dispersion

Sr. No	Category	Carriers	Examples
1	Sugars	Dextrose, sucrose, galactose, sorbitol, maltose, etc.	Rofecoxib
2	Acids	Citric acid, succinic acid, etc.	Felodipine
3	Polymers	PVP, PEG, HPMC, hydroxy ethyl cellulose, cyclodextrins, pectin, galactomanan, etc.	Temazepam, troglitazone, etc.
4	Insoluble or enteric polymer	HPMC pthalate, Eudragit L100, Eudragit E100, Eudragit RL, Eudragit RS, etc.	Indomethacin
5	Surfactants	Polyoxyethylene stearate, poloxamer 188, deoxycholic acid, Tweens, spans, etc.	Felodipine
6	Miscellaneous	Pentaerythritol, pentaerythritol tetraacetate, urea, urethane, hydroxy alkyl xanthins, etc.	Rofecoxib



**Fig. 1** Classification of solid dispersion



## 2.2 Merits of solid dispersion

- 1 Carrier which is used in formulation that reduces particle size so that increases solubility due to high surface area [9–11].
- 2 When the wettability of drug candidate is increased, the dissolving property also increased. Solid dispersion increases the wettability of drug [9, 11].
- 3 Solid dispersion is responsible for increasing porosity of drug. This characteristic of drug is also responsible for improving solubility [9, 12, 13].
- 4 Solid dispersion is responsible for converting insoluble drug into the amorphous state which is responsible for higher degree of dissolution. The drug candidates in its amorphous state are easy to release because no energy is required for breaking the crystal lattice in dissolution process [9, 14, 15].
- 5 Use of hydrophilic carrier like PEG and use of superdisintegrant like croscarmellose sodium is used in manufacturing of oral disintegrating tablet by solid dispersion technique which are responsible for increasing aqueous dissolution [7, 16].

## 2.3 Demerits of solid dispersion

- 1 Solid dispersion have drawback like poor scale-up for the manufacturing [7].
- 2 Sometimes it is difficult to handle due to tackiness problem [9].
- 3 Major disadvantage of solid dispersion technique is instability. Reason behind it is that most of the carriers used in formulation are polymers which can easily absorb the moisture due to this phase separation occurs which is responsible for instability [17–19].
- 4 Recrystallization of the amorphous drug and/or transitions occurs between polymers responsible for stability problems [18, 19].

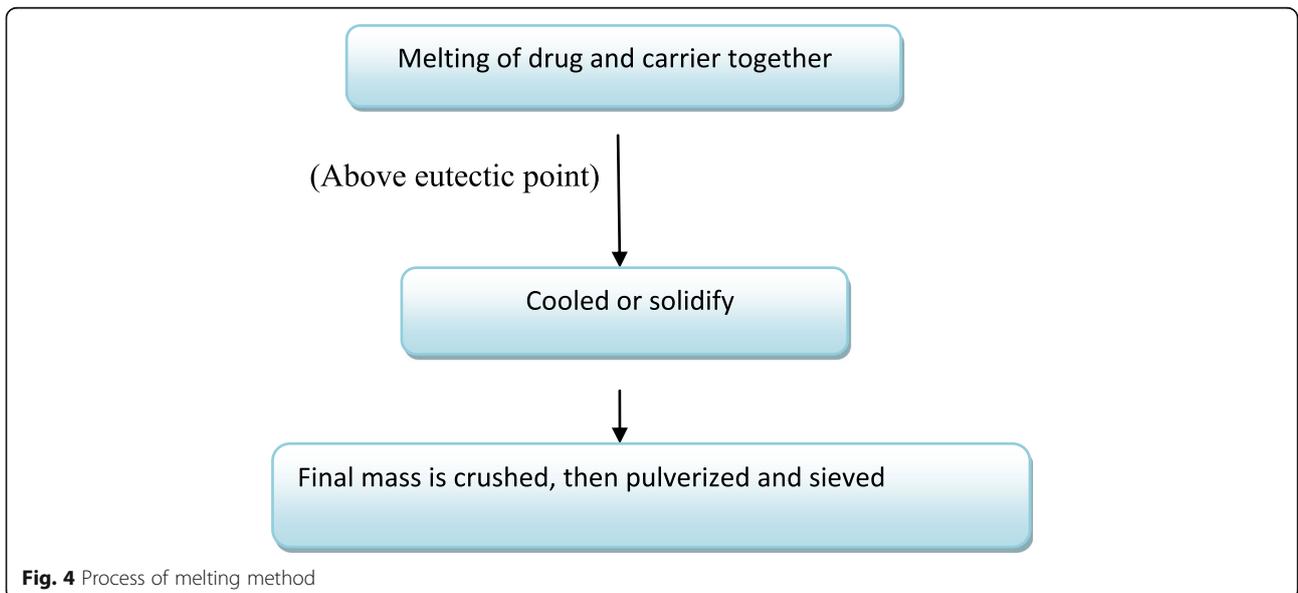
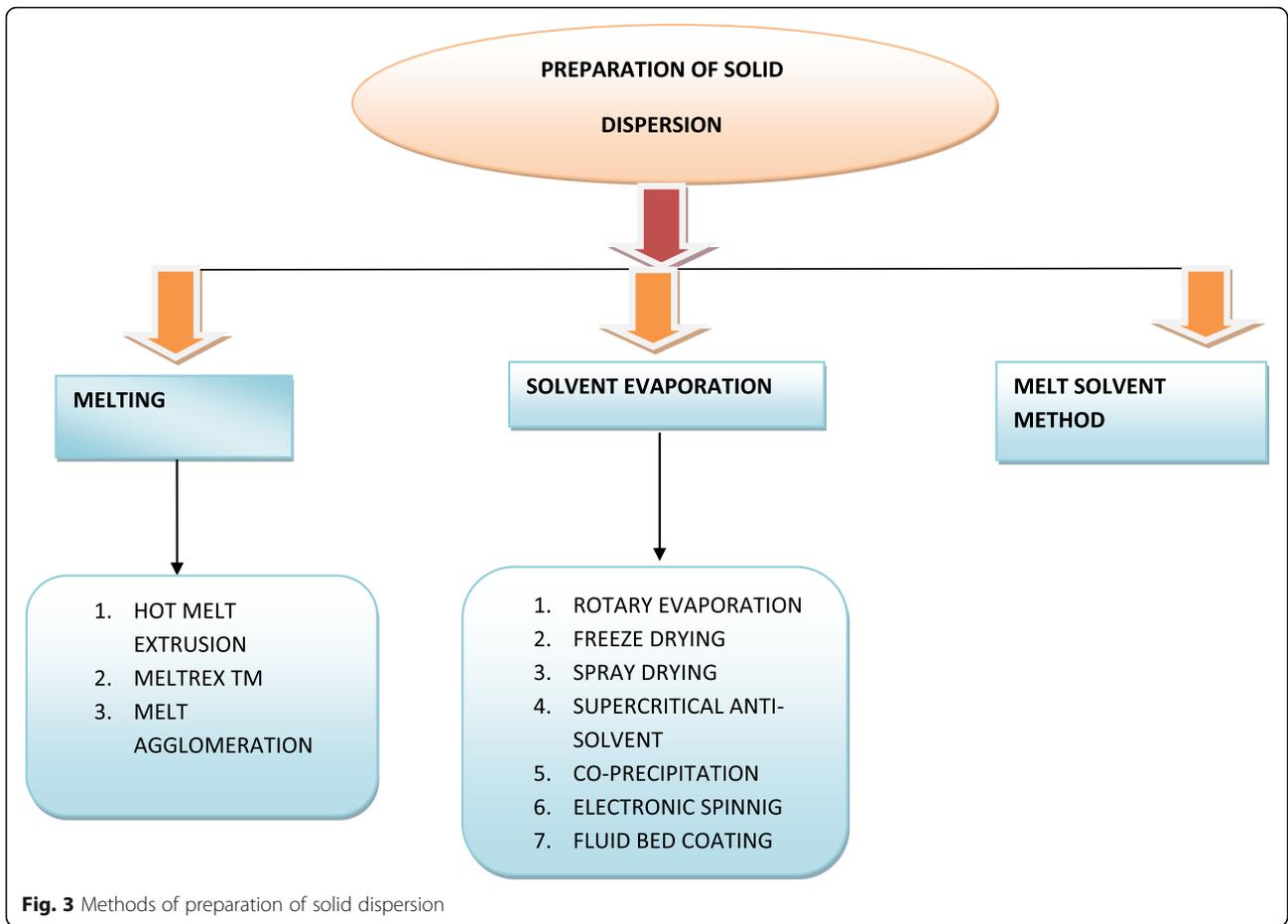
Carriers used in solid dispersion for improving dissolution rate [11, 18] are found in Table 1.

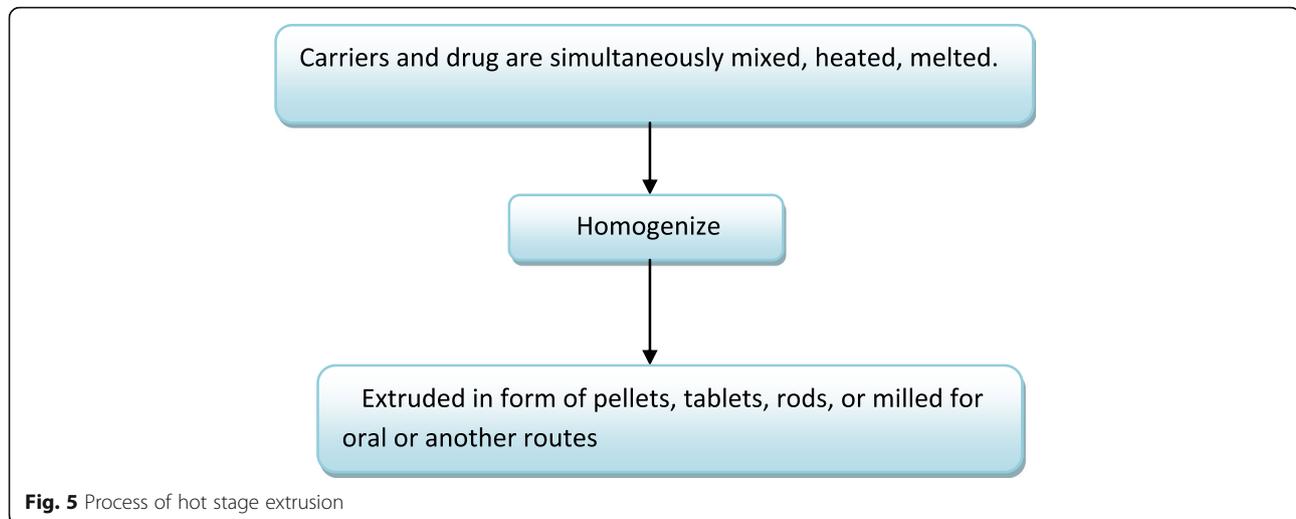
Classification of solid dispersion [4] is shown in Fig. 1.

## 3 On the basis of molecular arrangements [4]

### 3.1 Simple eutectic mixtures

This type of solid dispersion is formed by fast solidification of molten state of drug and polymer which do not





have miscibility when they try to crystallize just like two different components. It shows the increase in release pattern due to fine crystals, and it also shows increase in wettability due to the presence of carriers like polymers Eudragit EPO, PEG, etc.

### 3.2 Amorphous precipitation in crystalline matrix

It is the same as simple eutectic mixture but have minute difference as follows:

Amorphous precipitation method gives drug in precipitated form, and simple eutectic mixtures gives drug in crystalline form.

### 3.3 Solid solution

This type of solid dispersion is miscible in its solid state and also in its fluid state. It gives either crystalline or amorphous type. The major advantage of this type is a better dissolution rate compare to the eutectic mixture more reduced particle size of the drug. Dissolution rate of drug depends on dissolution of carriers.

#### 3.3.1 Continuous type

This type of solid dispersion concern about strength of bonding between the components i.e. individual component strength of bonding is weaker than the two component strength of bonding.

#### 3.3.2 Discontinuous type

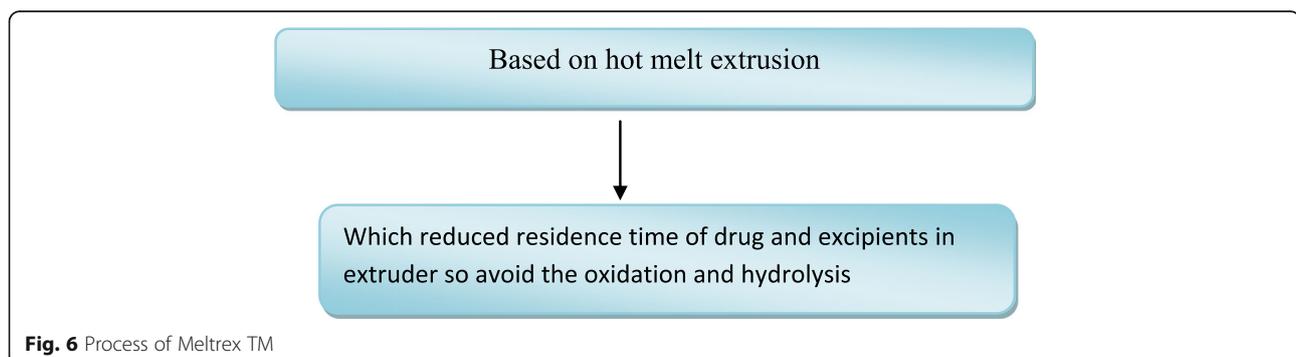
This type of solid dispersion concern about the component solubility, i.e., each of the components had limited solubility in the other component.

#### 3.3.3 Substitutional solid solution

In this type, one solvent molecule is substituted by another solute molecule in the crystal lattice.

#### 3.3.4 Interstitial solid solutions

In this type of solid dispersion, interstitial space of the solvent lattice is replaced by the solute molecule.



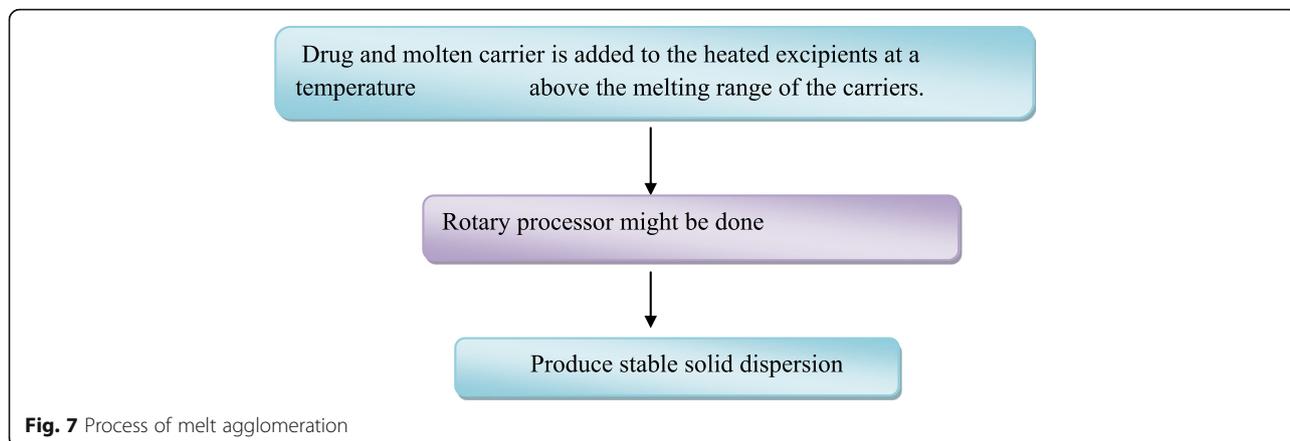


Fig. 7 Process of melt agglomeration

**4 On the basis of carriers used in solid dispersion [18, 20] (Fig. 2)**

**4.1 Methodology used or techniques of preparation of solid dispersion**

There are many methods developed for preparation of solid dispersions, these methods are based on the challenge of mixing of carriers and a drug [7] (Fig. 3).

**4.1.1 Melting method [21]**

Another name of this method is a fusion method. This method includes sulfathiazole and urea as a matrix which was melted with drug followed by cooling step (Fig. 4).

**4.1.1.1 Merits** This method does not require any solvent.

**4.1.1.2 Demerits**

- 1 Drug degradation occurs due to high temperature.
- 2 Incomplete miscibility between drug and polymer due to viscosity.
- 3 Phase separation also occurs during cooling step.

For overcoming these demerits, the following methods are designed:

**4.1.2 Hot stage extrusion [22]**

This method include the technique where the drug and carriers are simultaneously mixed, heated, melted, homogenized, and extruded into rods, tablets, milled or pellets. The merit of this technique is that it avoids the degradation of drug during the melting (Fig. 5).

**4.1.3 Meltrex TM [23]**

This type of solid dispersion method is patented and based on the hot melt extrusion principle. This technique is associated with special extruder with two screw and two independent hoppers which can vary the temperature over a broad range which reduces residence time of the drug in the extruder and avoid thermal stress to the drug and excipients. The major advantage of this technique is that it protects drug candidate from the oxidation and hydrolysis by complete removal of oxygen and moistures (Fig. 6).

**4.1.4 Melt agglomeration [24]**

This technique is based on conventional high shear mixers. This solid dispersion technique involves carrier as a binder and process followed by addition of drug with molten carriers to the heated excipients at a

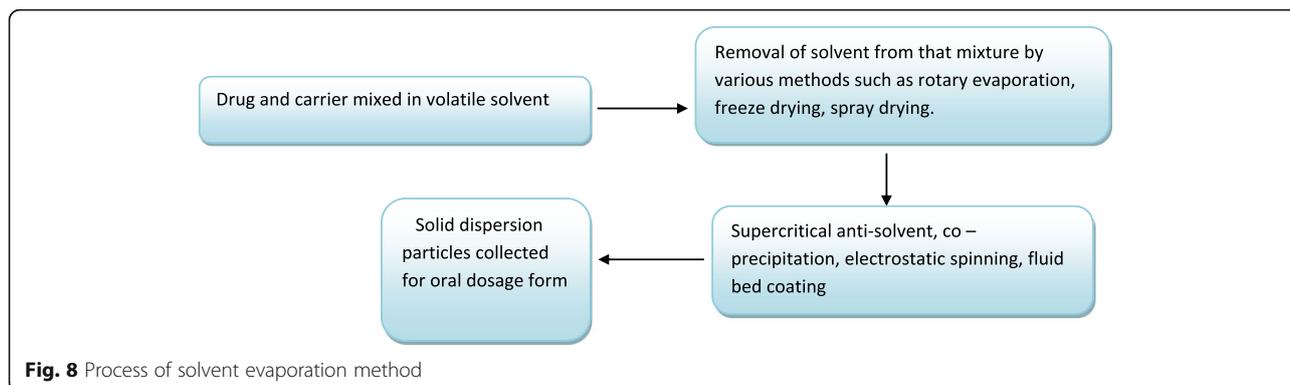
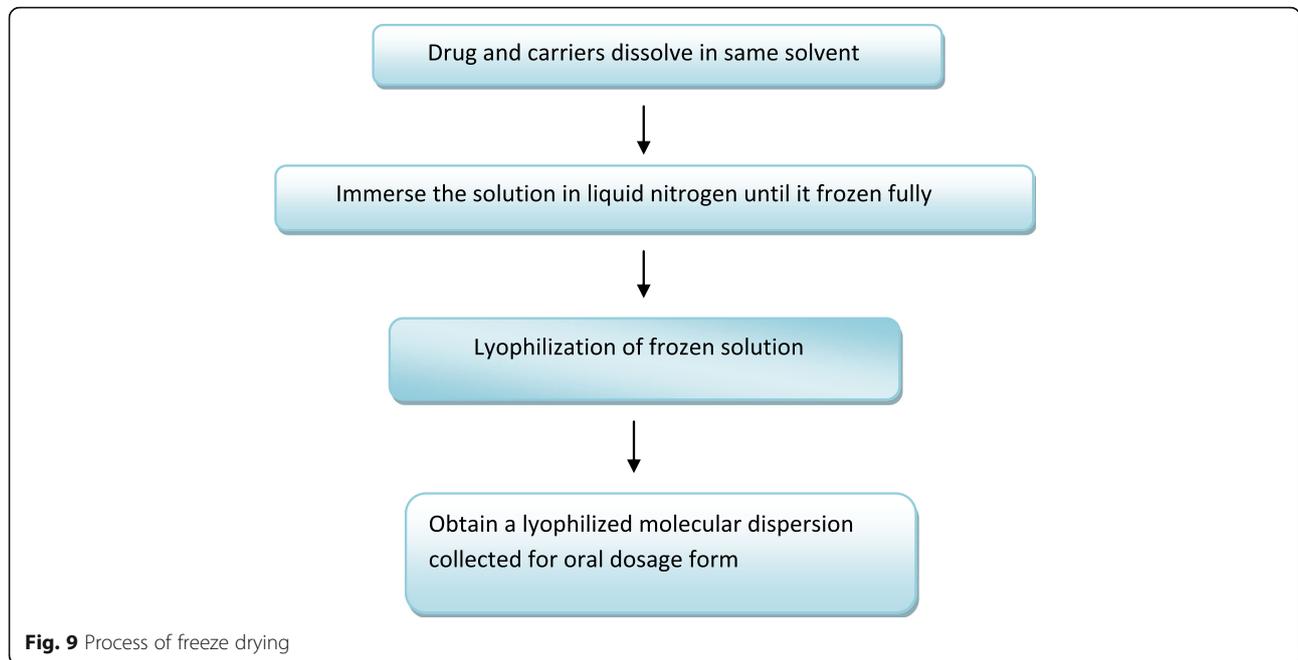


Fig. 8 Process of solvent evaporation method



temperature when the carriers present in melting range or above that temperature (Fig. 7).

#### 4.1.5 Solvent evaporation

Also known as solvent method in which solvent gets evaporated from drug and carrier solution and solid dispersion is formed. This method involves the volatile solvent that is able to dissolve the physical mixture of drug and carrier. Also, solvent contains low boiling point. The major advantage of this method is the thermal decomposition of drug and carriers is avoided at high temperature. Disadvantages: toxicity occurs due to difficulty in removal of residual solvent [25] (Fig. 8).

#### 4.1.6 Rotary evaporation [26]

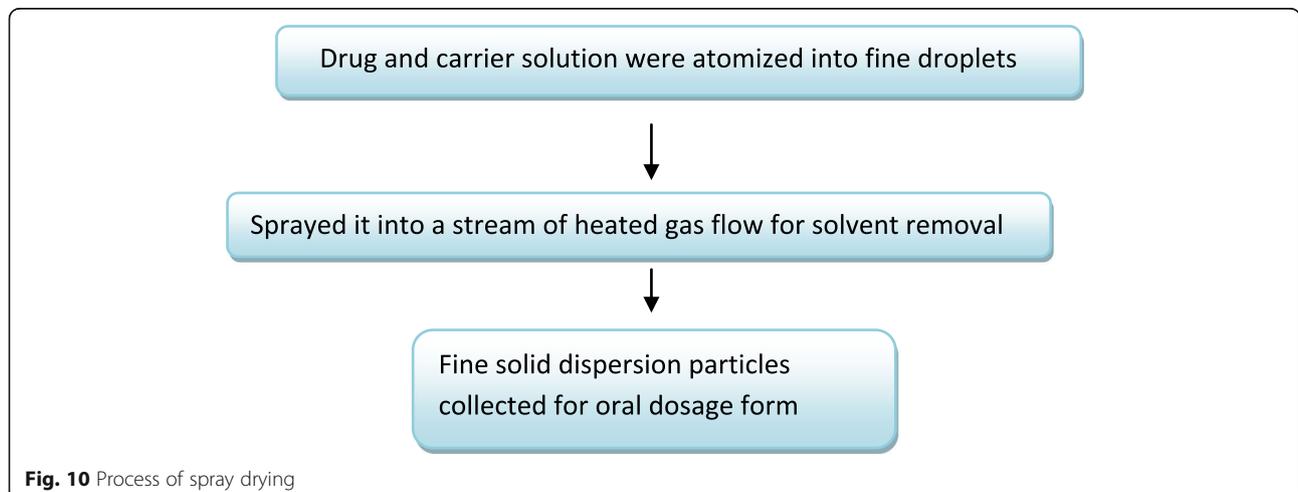
##### 4.1.6.1 Advantages

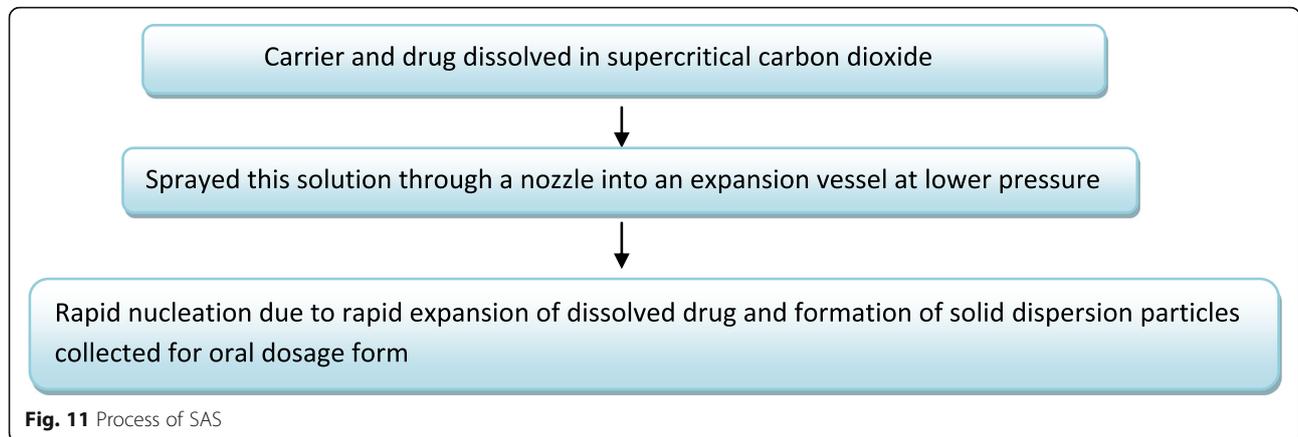
- 1 Risk of phase separation is minimized.
- 2 Avoid the degradation of drug and carrier at high temperature.

For complete removal of residual solvent the final solid dispersion is stored in vacuum desiccator after solvent evaporation.

#### 4.1.7 Freeze drying [27]

Another name of this method is lyophilization technique. The major advantage of this method is it decreases the chance of degradation of drug and phase





separation because this method tries to operate at low temperature (Fig. 9).

**4.1.8 Spray drying [28]**

The most commonly known and more efficient method of solid dispersion is spray drying method having the major advantage like it avoid the phase separation and is able for formation of homogeneous systems (Fig. 10).

**4.1.9 Supercritical anti-solvent [SAS] [29]**

This is only one method which uses the carbon dioxide as a solubilizing solvent or anti-solvent in the preparation of solid dispersion (Fig. 11).

**4.1.10 Co-precipitation [30]**

This method involves drop wise addition of anti-solvent in the organic solution of drug and carriers. The major disadvantage of this method is that it avoids the risk of

phase separation and degradation of drug due to avoiding the high temperature.

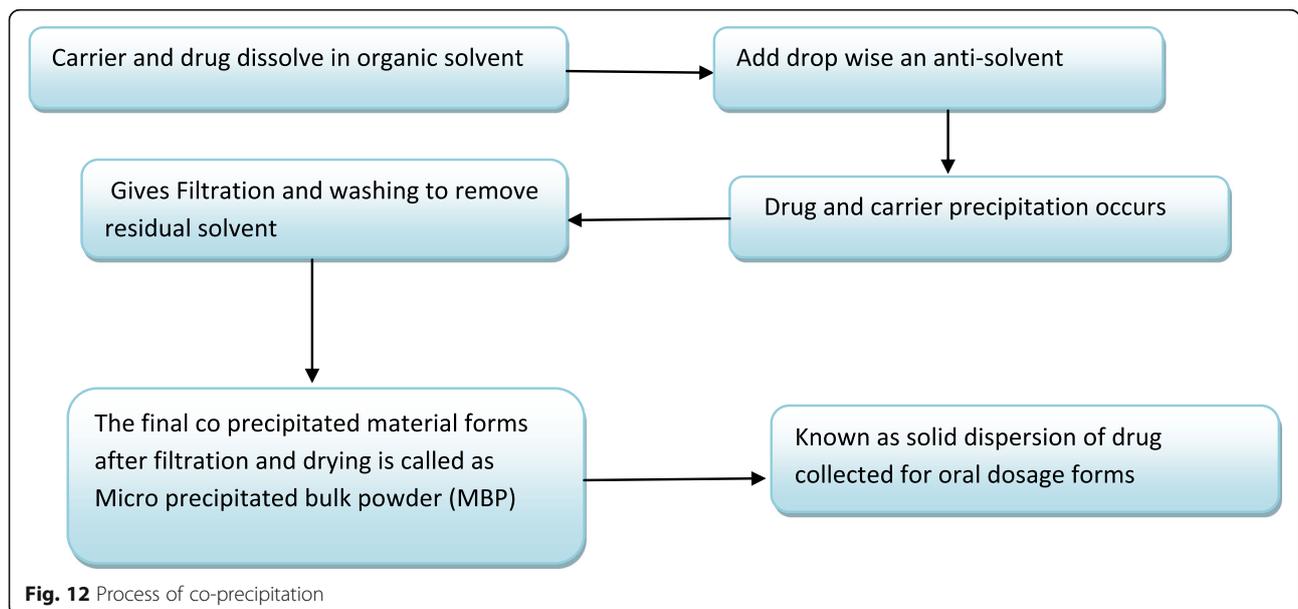
This method can be explained in Fig. 12.

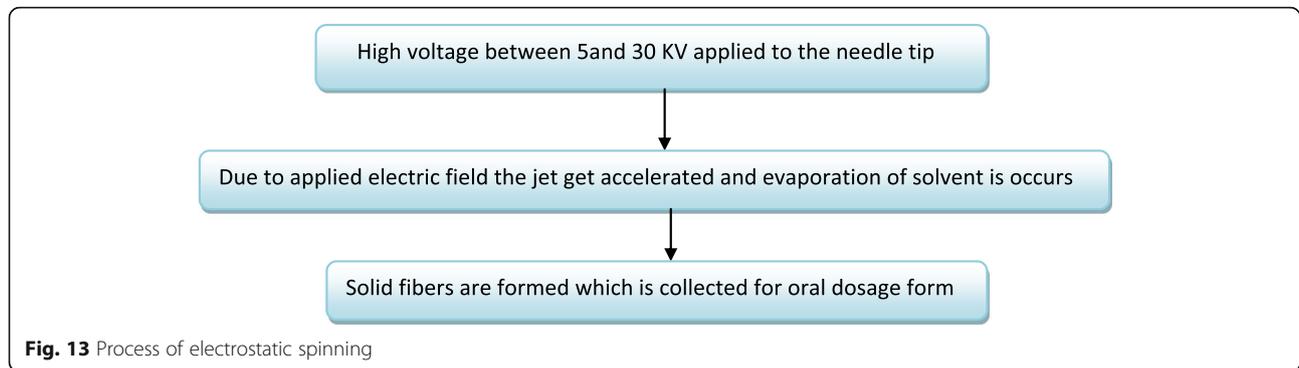
**4.1.11 Electrostatic spinning [31]**

This method of solid dispersion is a technique which is formed by the combination of two techniques which are nanotechnology and solid dispersion technology, which in turn called as electrostatic spinning. The major advantage of this technology is rapid evaporation of solvent occur, due to the amorphous particles that are obtained which show highest dissolution (Fig. 13).

**4.1.12 Fluid bed coating [32]**

Fluid bed coating method uses drug and carrier dissolved in a suitable solvent, and this solution is atomized into fluid bed coater (Fig. 14).





### 5 Melting solvent method [33–35]

Melting solvent method is a combination of solvent method and melting method. The major advantage of this technique is it avoids the risk of thermal degradation of drug (Fig. 15).

Recent study of oral dispersible tablets is shown in Table 2.

Promising therapeutic agents that can be incorporated in oral dispersible tablets are shown in Table 3.

### 6 Evaluation parameters for oral dispersible tablet [80]

Procedure for all evaluation parameter as follows:

#### 6.1 Evaluation of blends before compression

The various characteristics of blends to be tested before compression are the following:

##### 6.1.1 Angle of repose

Angle of repose is determined by using funnel method. The accurately weighed blend is taken in a funnel. The

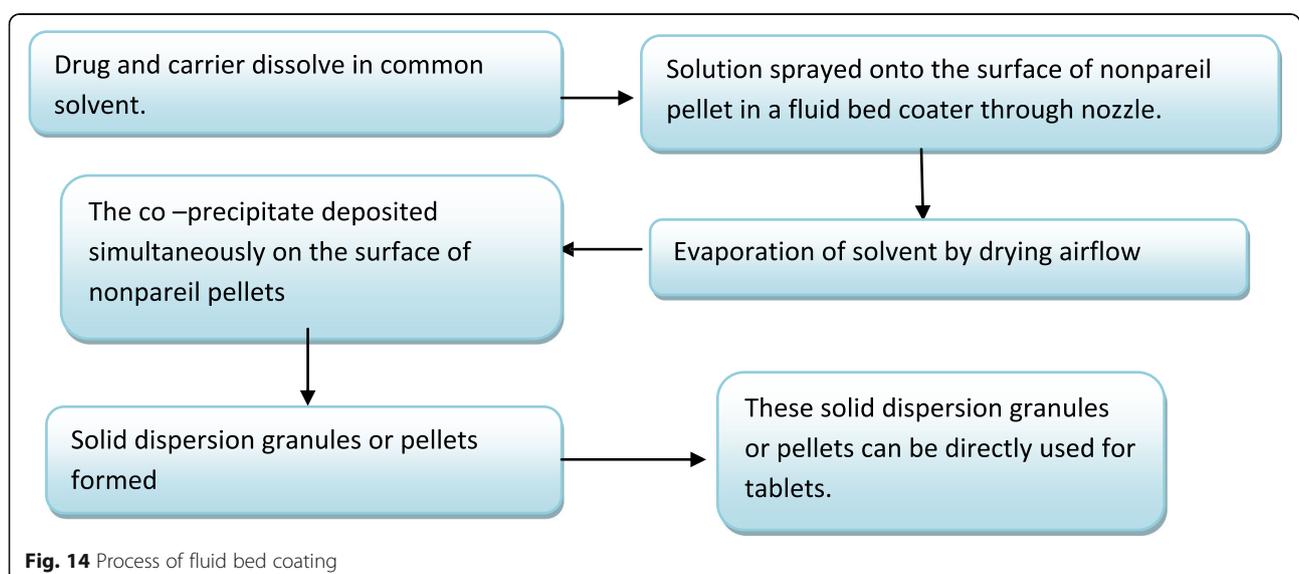
height of the funnel is adjusted in such a way that the tip of the funnel just touches the apex of the heap of blend. The drug (as solid dispersion) excipient blend is allowed to flow through the funnel freely on to the surface. The diameter of the powder cone is measured, and the angle of repose is calculated using the following equation:

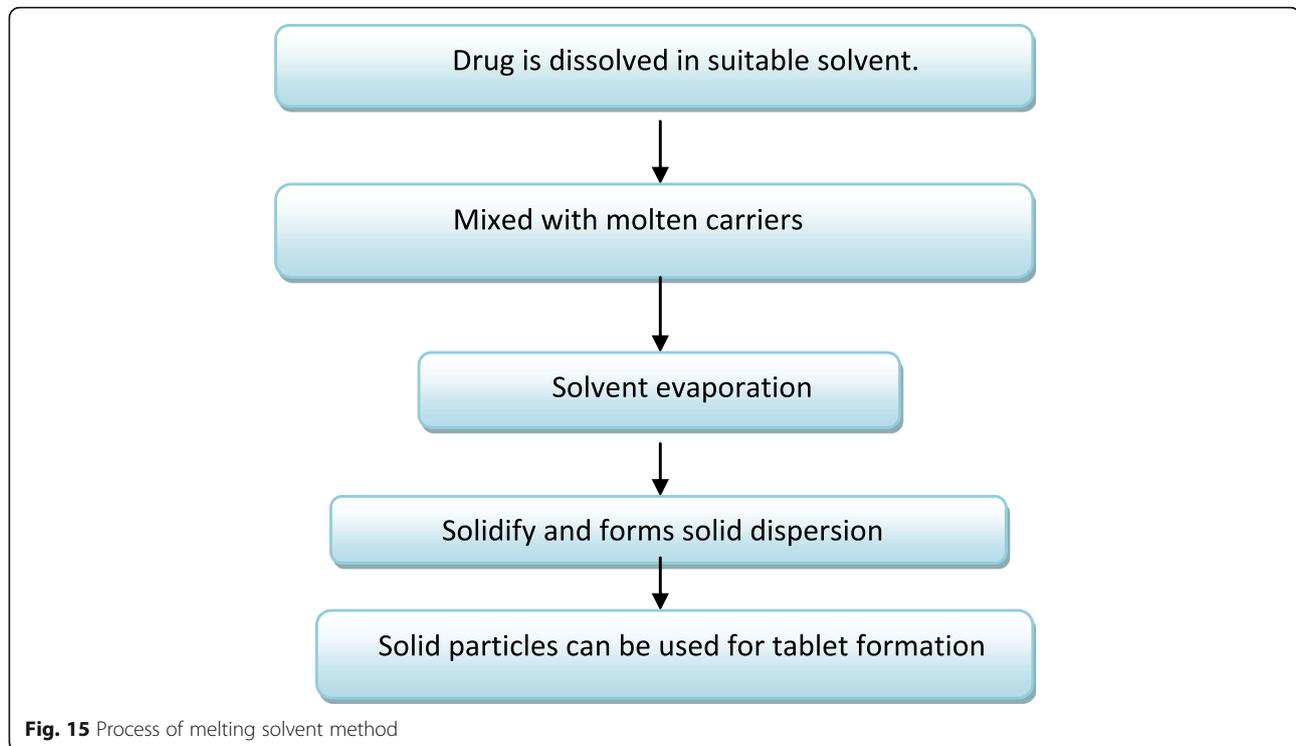
$$\tan \Theta = h/r$$

Where  $h$  and  $r$  are the height of cone and radius of cone base, respectively. Angle of repose less than  $30^\circ$  shows the free flowing of the material.

##### 6.1.2 Bulk density

Apparent bulk density is determined by pouring a weighed quantity of blend into graduated cylinder and measuring the volume and weight. Bulk density can be calculated by using following formula:





Bulk density = Weight of the powder/Volume of the packing

< 1.25 - Good flow = 20% compressibility index  
> 1.25 - Poor flow = 33% compressibility index

### 6.1.3 Tapped density

It is determined by placing a graduated cylinder, containing a known mass of drug-excipients blend. The cylinder is allowed to fall under its own weight onto a hard surface from the height of 10 cm at 2 s intervals. The tapping is continued until no further change in volume is noted. Tapped density can be calculated by using following formula:

Tapped Density = (Weight of the powder/volume of the tapped packing)

### 6.1.4 Compressibility index

The Compressibility Index of the blend is determined by compressibility index. Compressibility Index can be calculated by using following formula:

Compressibility Index (%) = [(TD - BD) × 100]/TD

### 6.1.5 Hausner's ratio

A similar index to indicate the flow properties can be defined by Hausner's ratio. Hausner's ratio can be calculated by using following formula:

Hausner's ratio = (Tapped density × 100)/(Poured density)

Hausner's ratio

### 6.1.6 Void volume

The volume of the spaces is known as the void volume "V" and is given by the formula

$$V = V_b - V_p$$

Where  $V_b$  = bulk volume (volume before tapping)

$V_p$  = true volume (volume after tapping)

### 6.1.7 Porosity

The porosity  $\epsilon$  of powder is defined as the ratio of void volume to the bulk volume of the packaging. The porosity of the powder is given by following formula:

$$\epsilon = V_b - V_p / V_p = 1 - V_p / V_b$$

Porosity is frequently expressed in percentage and is given as

$$\% \epsilon = (1 - V_p / V_b) \times 100$$

The porosity of powder indicates the types of packaging a powder when subject to vibrations, when stored, or in tablet machine when passed through hopper or feed frame

**Table 2** Recent study of oral dispersible tablets

Sr. no	Drug candidate	Carrier used	Solid dispersion technique used	Ref. no
1	Lumacaft	HPMC	Spray drying	[4]
2	Ritonavir	PVP	Melt extrusion	[4]
3	Traconazole	HPMC	Melt extrusion	[4]
4	Iloperavir and ritonavir	PVP or polyvinyl acetate	Melt extrusion	[9]
5	Torcetrapib	HPMC acetate succinate	Spray drying	[9]
6	Ibuprofen	Various like starch 1500 PVP K 30	Melt extrusion	[9, 36]
7	Verapamil	Various	Melt extrusion	[9]
8	Troglitazone	PVP	Melt extrusion	[9]
9	Tacrolimus	HPMC	Melt extrusion	[9]
10	Etravirine	HPMC	Spray drying	[9]
11	Everolimus	HPMC	Melt or spray drying	[9]
12	Nifedipine	PVP or polaxomer	Melt or absorb on carrier	[9]
13	Griseofulvin	PEG	Melt process	[9]
14	Itraconazole	HPMC, Gelucire 50/13, compritol 888ATOO	Spray drying	[9, 37]
15	Nabilone	Providone	–	[9]
16	Telaprevir	HPMC	Spray drying	[38]
17	Nilvadipine	HPMC	Solvent evaporation method	[38]
18	Vemurafinib	HPMC	Co-precipitation	[38]
19	Ivacaftor	HPMC	Spray drying	[38]
20	Tacrolimus	HPMC	Spray drying	[38]
21	Everolimus	HPMC	Spray drying	[38]
22	Silymarin	PVP K 17	Supercritical fluid technology	[39]
23	Polypeptide-K	Trehalose Tween 80	Spray drying	[40]
24	Valsartan	PEG 6000 HPMC-100 kV	Freeze drying	[41]
25	Curcumin	Eudragit EPO	Solvent evaporation method	[42]
26	Tadalafil	PVP, malic acid or meglumine and aerosil 200	Solvent evaporation method	[43]
27	Pseudomonas podoviridine phase PEV2	Trehalose, mannitol, L-leucine	Spray drying	[44]
28	Paracetamol	Ethyl cellulose, mesoporous silica	Fluid bed system	[45]
29	Itraconazole	Sucrose	Centrifugal spinning method	[46]
30	Olanzapine	Sucrose, pregelatinized starch, sodium starch, glycolate	Centrifugal spinning method	[46, 47]
31	Piroxicam	Sucrose	Centrifugal spinning method	[46]
32	Atrovastatin	Mannitol, PEG 4000, PVP K 30	Hot melt and solvent evaporation method	[48]
33	Alprazolam	PEG 6000, PVP K 30	Solvent evaporation	[49]
34	Aceclofenac	Starch phosphate, Gelucire 50/13	Kneading method	[50]
35	Carvedilol	PEG 6000, Polaxomer407, HPMC, SSG	Fusion and solvent evaporation	[51]
36	Cefdinir	PVP K 30, PEG 4000	Melt fusion and solvent evaporation	[52]
37	Diacerein	PVP K 30, HPMC	Solvent evaporation	[53]
38	Etoricoxib	Lactose, sucrose, mannitol	Solvent evaporation	[54]
39	Glipizide	HPMC, croscarmellose	Solvent evaporation	[55]
40	Mefenamic acid	PEG 6000, PVP K 30, HPMC, MCC	Kneading method	[56]
41	Nalidixic acid	PVP, beta cyclodextrin, SSG	Solvent evaporation method	[57]

**Table 2** Recent study of oral dispersible tablets (Continued)

Sr. no	Drug candidate	Carrier used	Solid dispersion technique used	Ref. no
42	Rofecoxib	PEG 6000, PVP K 30	Fusion and solvent evaporation method	[58]
43	Simvastatin	PEG 4000, PVP K 30	Solvent evaporation method	[59]
44	Stranidazole	PEG 4000, PVP K 30	Solvent evaporation method	[60]
45	Meloxicam	PVP PEG 6000	Solvent evaporation method	[61]
46	Telmisartan	Gelucire 43/01, polaxomer407, PVP-K 30, HPMC E4, PEG 6000	Fusion method	[62]
47	Gliclazide	PEG 4000, PEG 6000, PVP K 30	Fusion and solvent evaporation method	[63]
48	Proglitazone	PEG 4000, PEG 6000, PEG 20000	Hot melt method Microwave and kneading method	[64]
49	Carbamazepine	Croscarmellose, SSG	Solvent evaporation method	[65]
50	Mesalamine	SLS, urea, methanol	Kneading method	[66]
51	Ketoprofen	PVP K 30, urea, mannitol, Tween 80	Solvent evaporation method	[67]
52	Indomethacin	Lactose monohydrate, PEG 6000, HPMC, povdone	Kneading method	[68]
53	Clonazepam	PEG 6000, HPMC, polaxomer 407	Solvent evaporation method	[69]
54	Telmisartan	Beta cyclodextrin, MCC PH 102, polaxomer 188,400	Solvent evaporation method	[70, 71]
55	Carvediol	Beta cyclodextrin, MCC PH 102, polaxomer 188	Solvent evaporation method	[72]
55	Chlorpheniramine maleate	PEG 6000 and SSG	Fusion method	[73]
56	Nevirapine	Urea and PEG	Kneading method	[74]

### 6.1.8 Evaluation of tablets

All the formulated ODTs were subjected to the following quality control tests.

**6.1.8.1 Weight variation** The weight variation test is carried out in order to ensure uniformity in the weight of tablets in a batch. First, the total weight of 20 tablets from each formulation is determined and the average is calculated. The individual weight of the each tablet is also determined to find out the weight variation (Table 4).

**6.1.8.2 Hardness** The hardness of tablet is an indication of its strength. Measuring the force required to break the tablet across its tests. The force is measured in kilogram, and the hardness of about 3–5 kg/cm<sup>2</sup> is considered to be satisfactory for uncoated tablets. Hardness of 10 tablets from each formulation is determined by Monsanto hardness tester, Pfizer hardness tester, etc.

**6.1.8.3 Friability test** Friability is the loss of weight of tablet in the container due to removal of fine particles from the surface. Friability test is carried out to access the ability of the tablet to withstand abrasion in packaging, handling, and transport. Roche

friabilator is employed for finding the friability of the tablets. Weigh the 20 tablets from each batch and place in Roche friabilator that will rotate at 25 rpm for 4 min. Dedust all the tablets and weigh again. The percentage of friability can be calculated using the formula:

$$\% \text{Friability} = [(W1 - W2)100]/W1$$

Where W1 = weight of tablet before test

W2 = weight of tablet after test

**6.1.8.4 Mechanical strength** Tablets should possess adequate mechanical strength to bear shocks of handling in manufacturing, packaging, and shipping. Crushing strength and friability are two important parameters for the determination of mechanical strength. Crushing strength or tablet tensile strength is the force required to break a tablet by compression in the radial direction, and it is important to note that excessive crushing strength significantly reduces the disintegration time. The crushing strength of the tablet is measured by using Pfizer hardness tester. Tensile strength for crushing (T) is calculated using equation

**Table 3** Promising therapeutic agents used in solid dispersion techniques [75, 76, 77, 78, 79]

Sr. no	Agents	Examples
1	Analgesics	Aloxipirin, auranofin, azapropazone
2	Anthelmintics	Albendazole, bephenium hydroxynaphthoate, cambendazole
3	Anti-arrhythmic agents	Amiodarone, disopyramide, flecamide acetate
4	Anti-bacterial agents	Benethamine, penicillin, cinoxacin
5	Anti-coagulants	Dicoumarol, dipyridamole, nicoumalone
6	Anti-depressants	Amoxapine, ciclazindole, maprotiline
7	Anti-epileptic	Beclamide, carbamazepine, clonazepam, ethotoin
8	Anti-fungal	Amphotericin, butoconazole nitrate, clotrimazole, flucanazole
9	Anti-gout	Allopurinol, probenecid, sulphinpyrazone
10	Anti-hypertensive	Amlodipine, carvedilol, diltiazem, diazoxide, felodipine
11	Anti-malarials	Amodiaquine, chloroquine, chlorproguanil, halofantrine, mefloquine
12	Anti-migraine	Dihydroergotamine mesyiate, ergotamine tetrates, methysergide
13	Anti-neoplastic and immunosuppresant	Busulphan, chlorambucil, cyclosporin
14	Anti-protozoal	Benzindazole, decoquinatate, diiodohydroxyquinoline
15	Anti-thyroid	Carbimazole, propylthiouracil
16	Anxiolytic, sedatives, hypnotics, and neuroleptics	Alprazolam, amyio-barbitone
17	Cardiac ionotropic	Amrinone, digitoxin, digoxin, lantoside C
18	Corticosteroids	Beclomethasone, betamethasone, budesonide, cortisone acetate
19	Diuretics	Acetazolamide, amiloride, bumetanide, chiorothiazide
20	Enzymes	All the enzymes
21	Anti-Parkinsonian	Bromocriptine mesylate, lysuride maleate
22	Gastro-intestinal	Bisacodyl, cimetidine, domperidone, famotidine
23	Histamine H-receptor antagonist	Acrivastine, astemizole, cinnarizine, cyclizine
24	Lipid regulating	Bezafibrate, clofibrate, fenofibrate, gemfibrozil
25	Local anesthetics	Lidocaine
26	Neuro-muscular	Pyridostigmine
27	Nitrates and other anti-anginal	Amyl nitrate, glyceryl trinitrate
28	Nutritional	Betacarotene, vitamin A, vitamin B2, vitamin D, vita E
29	Opioid analgesics	Codeine, diamorphine, dihydrocodeine, meptazinol
30	Oral vaccines	Influenza, tuberculosis, hepatitis, polio, tetanus
31	Proteins and peptides	Insulin, glucagon, growth hormone
32	Stimulants	Amphetamine, dexamphetamine, dexfenfluramine, fenfluramine, pemoline

$$T = 2F/\pi*d*t$$

Where *F* is the crushing load, and *d* and *t* denote the diameter and thickness of the tablet respectively.

**6.1.8.5 Uniformity of dispersion** Keep the two tablets in 100 ml water and stir gently for 2 min. The dispersion is passed through 22 meshes. The tablets will be considered to have passed the test if no residue remained on the screen.

**6.1.8.6 Wetting time** The wetting time of the tablets is measure by using a simple procedure. Place five circular

**Table 4** Standard limit of weight variation

Sr. no.	IP/BP	Limit	USP
1	80 mg or less	10%	130 mg or less
2	80 mg to less than 250 mg	7.5%	130 mg to 324 mg
3	250 mg or more	5%	More than 324 mg

tissue papers of 10 cm diameter in a Petri dish containing 0.2% w/v solution (3 ml) of water-soluble dye. A tablet is carefully placed on the surface of the tissue paper. The time required for water to reach upper surface of the tablet is noted as the wetting time.

**6.1.8.7 Water absorption ratio** A small piece of tissue paper folded twice is placed in a small Petri dish containing 6 ml of water. Put a tablet on the paper and the time required for complete wetting is measured. The wetted tablet is then reweighed. Water absorption ratio,  $R$ , is determined by using following formula:

$$R = 100 \times (W_a - W_b) / W_b$$

Where  $W_b$  is the weight of tablet before water absorption

$W_a$  is the weight of tablet after water absorption.

**6.1.8.8 Taste/mouth sensation** Mouth-feel is critical, and patients should receive a product that feels pleasant. One tablet from each batch is tested for the sensation by placing the tablet on the tongue. The healthy human volunteers are used for evaluation of mouth feel. Taste evaluation is done by a panel of 5 members using time intensity method. Sample equivalent to 40 mg, i.e., dose of drug is put in mouth for 10 s and record taste instantly and then after 10 s, 1, 2, 4, and 6 min. Volunteer's opinion for the taste is rated by giving different score values, i.e., 0 = good, 1 = tasteless, 2 = slightly bitter, 3 = bitter, 4 = awful.

**6.1.8.9 In vitro disintegration test** In vitro disintegration time is measured by dropping a tablet in a beaker containing 50 ml of Sorenson's buffer pH 6.8. Three tablets from each formulation are randomly selected and in vitro disintegration test is carried out.

**6.1.8.10 In vitro dissolution test** In vitro dissolution study is performed by using USP Type II Apparatus (Paddle type) at 50 rpm. Phosphate buffer pH 6.8, 900 ml is used as dissolution medium which maintained at  $37 \pm 0.5$  °C. Withdraw aliquot of dissolution medium (10 ml) at specific time intervals (2 min) and filter. The amount of drug dissolved is determined by suitable analytical technique.

**6.1.8.11 Stability studies** The optimized formulation of ODTs is subjected to stability study as per ICH guidelines to assess their stability with respect to their physical appearance and release characteristics.

**6.1.8.12 Differential scanning calorimetry (DSC) [81]** DSC measurement were carried out using a Perkin/

Elmer, Pyris DSC instrument (Norwalk, USA). Approximately 5 mg of sample was analyzed at a heating rate of 5 °C/min from 50 to 250 °C (or 230 °C). After cooling to 20 °C, the sample was reheated to 250 °C (or 230 °C) at the same heating rate as used in the first cycle. The analysis was made in duplicate ( $n/2$ ) in vented aluminum pans, under nitrogen purge. Indium was used to calibrate enthalpy and temperature.

## 7 Conclusion

Therapeutic activity of drug mainly depends on the bio-availability of the drug and ultimately depends on the solubility. Solid dispersion is one of the most important techniques to increase solubility, dissolution, and bio-availability of drug. Oral dispersible tablet have significant advantage of immediate conversion of solid to liquid after administration. The development of oral dispersible tablet by solid dispersion also provides an opportunity for a line extension in market place, for wide range of drugs. Keeping in view the advantages of the delivery system, rapidly disintegrating dosage forms have been successfully commercialized, and because of increased patient demand, these dosage forms are expected to become more popular.

### Abbreviations

ODT: Oral dispersible tablets; DSC: Differential scanning calorimetry; ICH: International conference harmonization; USP: United State Pharmacopoeia; SAS: Supercritical anti-solvent

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### Authors' contributions

VKN is the first author contributing in writing of manuscript and gives their scientific suggestion. SKS is the second author contributing in collection of information and writing of manuscript. JPK is the third author contributing in grammatically molding of manuscript. All authors have read and approved the manuscript.

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The authors declare that they have no competing interests.

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