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Research Article

Preparation and Evaluation of Telmisartan Solid Dispersion as Sublingual Tablets

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Abstract

Background: Telmisartan is an antihypertensive angiotensin II receptor antagonist drug commonly used to treat hypertension and renal disease. Based on the Biopharmaceutical Classification System. It's a Class II poorly soluble drug.

Objective: To prepare a sublingual tablet by increasing the dissolution and solubility of Telmisartan utilizing the solid dispersion method.

Methods: Three methods were obtained to prepare the solid dispersion of telmisartan: solvent evaporation, Kneading, and microwave method. Each method uses soluplus as a hydrophilic carrier in different ratios of 1%, 2%, and 3%. Preparation of ternary solid dispersion by adding potassium carbonate salt to the binary solid dispersion. After that preparation the sublingual tablets by applying a direct compression method, using different types and ratios of super disintegrants such as crospovidone, croscarmellose, and sodium starch glycolate in 5% and 10%.

Study the evaluation tests of sublingual tablets, such as friability, hardness, disintegration time, and dissolution time.

Results: The solid dispersion showed an improvement in solubility over the pure medication. The best result was obtained with the formula (Telmisartan, soluplus, and K2CO3 salt at 1:1:0.3 ratio) prepared by microwave method, in this method and the high ratio of soluplus, the solubility increased more than the solvent evaporation and kneading method. The selected tablet is prepared using crospovidone 10% as a super disintegrant that appears disintegration time in 5 seconds and releases in 1 min in dissolution media.

Conclusion: The solubility and dissolution of Telmisartan were improved by microwave-based ternary solid dispersion using hydrophilic carriers and salt in a ratio of 1:1:0.3 (drug: carrier: salt). The analysis exerts the increases in wettability, enhanced solubility, and dissolution due to conversion from crystal to amorphous state.

Keywords: Solid dispersion; Soluplus; Sublingual tablet; Potassium carbonate; Telmisartan.

Introduction:

Oral drug administration is the most preferred method due to its convenience and simplicity of ingestion (1). The administration of medication in a solid dosage form is convenient and well-known. There are many strategies to improve solubility and dissolving rates. When the rate-limiting stage for medication absorption is dissolution (2,3). Numerous approaches, such as salt creation, complexation, micronation, solid dispersions, micelles, emulsions, and nanonization that used to improve the solubility of poorly soluble drugs (4).

Solid dispersion (SD) is gaining great importance to make poorly soluble medications more soluble and dissolve more easily (5,6).

Solid dispersion contains one or more active chemicals suspended in a solid inert carrier. Methods of preparation include melting, microwaving, dissolving in a solvent, and kneading (4,7). Telmisartan is an antihypertensive angiotensin II receptor antagonist drug commonly used to treat hypertension, congestive heart failure, and renal disease (8). Telmisartan is a BCS Class II poorly soluble drug in the «Biopharmaceutical Classification System» (BCS) and has high permeability. It exhibits poor solubility in the pH range 3- 9 and increased solubility at alkaline pH 15-16. It is rapidly absorbed after oral administration with bioavailability depending on the dose, which is about 42%, It is metabolized and eliminated by the renal route (9,10) (Figure1).

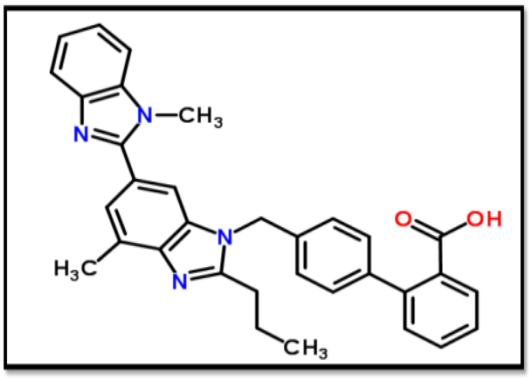

Figure (1): Structure of Telmisartan

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Soluplus® is an amphiphilic polymeric solubilizing agent. It is soluble in water and exhibits a greater degree of solubility in numerous organic solvents (11).

Sublingual administration generally results in a faster onset of action than orally administered tablets, and the amount absorbed via sublingual blood vessels bypasses the hepatic first-pass metabolic processes. The Sublingual absorption of the drug is 3–10 times higher than oral absorption (12,13).

The tablet should dissolve quickly so that the drug can be quickly absorbed. Represents the drugs used in the synthesis of sublingual tablets. It is designed to dissolve in a small amount of saliva, improving patient compliance and making it easier to administer than parenteral or oral drugs. The formulation of fast-disintegrating tablets can be done in a variety of ways. One such technique, direct compression, necessitates the addition of a super disintegrator to the formulation (14).

This study aimed to prepare Telmisartan sublingual tablets using different super disintegrants in different ratios, such as crospovidone, croscarmellose, and sodium starch glycolate in 5% and 10%.

Materials and methods

Materials: Telmisartan from NANIING AOCHENG CHEMICAL China, Soluplus from BASF Germany, Potassium Carbonate from RIEDEL-DE HAENAG, SEELZE-HANNOVER Germany, Mannitol from Gerhard Buchmann KG Germany, Magnesium stearate and Talc from Alpha chemika India, Stevia from Soham UK, Crospovidone, Croscarmellose, Sodium starch glycolate, and Avecil ph 102 from Pioneer Iraq.

Method preparation of Telmisartan solid dispersion (binary SD):

a- Solvent Evaporation Approach: Three formulas (SD1-SD3) of telmisartan (TEL)solid dispersion were prepared by a solvent evaporation technique, and 20 ml of the aqueous solution of soluplus (sol) 1,2, and 3 g as a carrier was added to 30 ml of methanolic solution of TEL(1g). The resulting mixture was stirred for 1 hr. Evaporation of the solvent was done at a temperature of 45ºC until dried. The dried bulk was crushed, sieved through sieve number 60, and then stored for further work (15). as shown in Table 1.

b-Kneading method: The kneading method prepared three formulas (SD4-SD6) of telmisartan solid dispersion. One gram of TEL was mixed with soluplus 1,2, and 3 g for SD4, SD5, and SD6 in a mortar for 5 min. A few drops of methanol were added drop by drop until the mixture became slurry, and this slurry mixture was kneaded for 20 minutes. The dried bulk was crushed, sieved through sieve number 60, and then stored for further work (16).

c-Microwave method: Three formulas (SD7-SD9) of a physical mixture were prepared by mixing TEL(1g) with 1,2 and 3 grams of soluplus as a carrier and then suspended in water: methanol mixture (1:1). The mixture was then subjected to microwave irradiation in a domestic microwave oven (DLC) at a power of 700 W for 2 min. The product was then rinsed with a mixture of water and methanol as a solvent to remove any residual components and allowed to dry. The dried bulk was crushed, sieved through sieve number 60, and then stored for further work (17).

Table (1): Composition of SD in Different Formulas Prepared by Solvent Evaporation, Kneading, and Microwave Methods

Formula code	TEL (g)	Soluplus (g)	Preparation method
SD1	1	1	Solvent evaporation Method
SD2	1	2	
SD3	1	3	
SD4	1	1	Kneading method
SD5	1	2	
SD6	1	3	
SD7	1	1	Microwave method
SD8	1	2	
SD9	1	3	

Preparation of TEL solid dispersion (ternary SD) by adding potassium carbonate salt (SDK): The same formulas (SD1-SD9) of TEL solid dispersion (binary SD) were prepared by adding potassium carbonate salt in constant concentration (0.3% for each formula) and completed the preparation in three methods as previously mentioned (18,19) and displayed in Table 2.

Table (2): Composition of SD after Adding Potassium Carbonate Salt at a Constant Ratio (0.3) in Different Formulas Prepared by Solvent Evaporation, Kneading, and Microwave Methods

Formula code	Solid dispersion (TEL: Sol)	Solid dispersion with K2CO3 0.3% (TEL: Sol: K carbonate) in mg	Preparation method
SDK1	(1:1)	(20:20:6)	Solvent evaporation method
SDK2	(1:2)	(20:40:6)	
SDK3	(1:3)	(20:60:6)	
SDK4	(1:1)	(20:20:6)	Kneading method
SDK5	(1:2)	(20:40:6)	
SDK6	(1:3)	(20:60:6)	
SDK7	(1:1)	(20:20:6)	Microwave method
SDK8	(1:2)	(20:40:6)	
SDK9	(1:3)	(20:60:6)	

Evaluation of SD and SDK

Saturation solubility measurement: Excessive amounts of pure TEL, SD, and SDK were added to 10 ml of water; the samples were grown in a shaker water bath at 37 ˚C for 48 h. After that, A 0.45 µm syringe filter was used to filter it, Samples were analyzed by UV spectrophotometer at 296 nm. The concentration of TEL was calculated by applying the calibration

curve equation which was previously estimated and then used to determine Telmisartan's dissolved quantity and only the formula that exhibited the best solubility was carried out for further study (20).

Determination of percentage yield (PY%)

The percentage yield was calculated for each formula of SD or SDK by using Equation 1(21).

PY%= [Actual weight of SD or SDK / Theoretical weight of SD or SDK] $x100$ …. Eq (1)

Determination of drug content for SD or SDK

According to saturated solubility results, the amount of the best formula of SD or SDK equivalent to 10mg of TEL was taken and it dissolved in 10 ml of methanol, and the volume was made up to 50 ml volumetric flask. Methanol was used to dilute a 1 ml sample of the solution ten times. The drug content of the solution was determined using UV spectrophotometry by detecting the absorbance at 296 nm. Drug concentration in the SD and SDK as a percentage was calculated by applying the calibration curve equation in methanol to calculate the drug content percentage of TEL (22).

***In-vitro* dissolution:** The accurate weight of formulas of SD or SDk was equivalent to 20mg Telmisartan was carried out by using USP paddle apparatus (type II) in 900 ml phosphate buffer (pH 6.8) at 37 ± 0.5˚C and 50 rpm. A 5 ml sample was withdrawn at regular intervals each 10 sec to 30 min and replaced by new dissolution media. Each sample was filtered and then analyzed spectrophotometrically at 296nm. The concentration of each sample was calculated by applying the calibration curve equation in phosphate buffer to calculate the percentage release of TEL (23).

Selection of best SD: Based on the solid dispersion parameters such as solubility and dissolution study. Selection of the best formula for SD or SDK to further study the preparation of TEL SLT.

Preparation SLTs of TEL: Six formulas of tablets for sublingual use were made (F1-F6) by use of direct compression. Tablets composed of 20 mg TEL, and super disintegrant agents such as croscarmellose (CCS), sodium starch glycolate (SSG), and crospovidone (CP) in a concentration of 5% for F1, F2, and F3 and 10% for F4, F5, and F6 respectively. All formulas contain the same composition; Avicel pH102 (19 mg) as a flowable agent, stevia (4 mg) as a sweetening agent, talc powder (1 mg) as a glidant agent, and magnesium stearate (1 mg) as a lubricant was added at the last before being compressed(25). All the formulas completed the weight to 100 mg with mannitol as a diluent as shown in table 3.

Table(3): Composition of Prepared Sublingual Tablets (F1-F6)

Formula Code / Ingredients (mg)	F1	F2	F3	F4	F5	F6
Selected SDk (20:20:6)	46	46	46	46	46	46
Cross carmellose (%)	5			10		
Sodium starch glycolate (%)		5			10	
Cross povidone (%)			5			10
Avicel pH102 (mg)	19	19	19	19	19	19
Stevia (mg)	4	4	4	4	4	4
Talc powder	1	1	1	1	1	1
Mg. stearate (mg)	1	1	1	1	1	1
Mannitol q.s 100 mg	100	100	100	100	100	100

Pre-compression evaluation of powder Flow properties: The flow characteristics for tablet blend powder (F1-F6) were determined and compared to pure drug powder and the selected SDK.

Measurement of angle of repose: The angle of repose is one technique for measuring powder flow characteristics.

The fixed funnel method was used to calculate it, in which a powder was allowed to flow freely through a funnel and onto a surface. The resulting cone's height and diameter were measured, and this equation was used to determine the angle of repose (25,26): Tan (θ) = h/r…. Eq (2)

where h is the height of the powder cone and r is its radius.

Hausner's ratio and Carr's index (compressibility index): The bulk and tapped densities must be measured to calculate Carr's index and Hausner's ratio.

The mass-to-volume ratio of powder is known as the powdered bulk density. The bulk density is influenced by particle size distribution, shape, and cohesion. The initial bulk volume was determined by pouring a measured quantity of powder through a large funnel into a graduated measuring cylinder and measuring its volume. Then, it was expressed in grams per milliliter.

The following equation was used to calculate bulk density.

Bulk density= Powder weight / Bulked volume …. Eq (3)

While Tapped density was measured by tapping the graduated cylinder containing a mixture of a known quantity. After measuring the volume, the following equation was used to calculate the tapped density (26).

Tapped density= Powder weight/ Tapped volume …. Eq (4)

Carr's index indicates the powder's flow properties. It was computed using the following formulas and expressed as a percentage (22).

Carr's index = [(Tapped density -Bulk density)/ (Tapped density)] ×100 …. Eq (5)

Powder flow can be measured indirectly using the Hausner Ratio (5,26). The following equation was used to get it: Hausner's ratio= (Tapped density / (Bulk density) …. Eq (6)

Evaluation of TEL sublingual tablets Hardness: The Monsanto hardness tester was used to measure the tablet's hardness. Three tablets were selected randomly for each formula, and measure ± SD was calculated (27). The tablet's hardness was expressed as the force necessary to crush them in kg/cm2.

Friability: The friability test was used to evaluate the influence of friction in the tablet, which may result in chipping, capping, or breaking. Roche Friabilator was employed to carry out the friability. The Friabilator included ten tablets that had been weighed (initial weight); afterward, it was operated for 4 minutes at 25 rpm. Then, I collected the tablets and weighed them (Final weight) (9,25). The following equation was used to determine the percentage of friability:

(Initial weight – Final weight) / Initial weight ×100 …. Eq (7)

The acceptable range is below 1% according to British Pharmacopeia.

The time of disintegration: A simple method was used to measure the wetting time of tablets. A double-folded filter paper was put in a petri dish containing 10 ml phosphate buffer pH 6.8. The tablet's soaking time was measured from the moment it was placed on the filter paper until it was completely wet. The test was carried out in triplicate (27).

Drug content: The equivalent of 10 mg TEL from five crushed tablets was measured, diluted in 50 ml of methanol, and filtered; 1 ml was withdrawn and diluted twice before being analyzed spectrophotometrically at 296 nm. The con. and then the quantity of TEL was calculated by using the calibration curve equation which was previously constructed (28).

***In-vitro* dissolution studies:** USP paddle apparatus (type II) was used to carry out the dissolution of the best TEL SLT in 900 ml phosphate buffer (pH 6.8) at 37±0.5˚C and 50 rpm. A 5 ml sample was withdrawn at regular intervals each 10 sec to 120 sec and replaced by new dissolution media. Each sample was filtered and then analyzed spectrophotometrically at 296nm. The concentration of each sample was calculated by applying the calibration curve equation in phosphate buffer to calculate the percentage release of TEL from the tablet formula (25,29).

Results

Saturation solubility of TEL SD and SDK

In this study are shown in Tables 4 and 5.

Table (4): Solubility of TEL SD Formulas Prepared by Solvent Evaporation, Kneading, and Microwave Methods using Different Carriers in Distilled Water (DW) at 37 ˚C

	Saturation solubility mg/ml of different methods					
Formula ratio (TEL: soluplus)	Formula code	Solvent Evaporation Method A	Formula code	kneading method B	Formula code	microwave method C
Pure TEL	0.002					
1:1(TEL: Sol)	SD1	0.099±0.021	SD4	0.086±0.005	SD7	0.107±0.005
1:2(TEL: Sol)	SD2	0.122±0.001	SD5	0.097±0.011	SD8	0.118±0.006
1:3(TEL: Sol)	SD3	0.134±0.001	SD6	0.111±0.005	SD9	0.216±0.005

Table (5): Solubility of TEL SDK Prepared by Adding Potassium Carbonate Salt 0.3 to All Formula of Telmisartan with Soluplus Using Different Ratio in DW at 37 ˚C

	Saturation solubility mg/ml by using k salt in different methods					
Formula ratio (TEL: sol)	Formula code	Solvent Evaporation Method A	Formula code	kneading method B	Formula code	microwave method C
1:1	SDK1	11.424±0.001	SDK4	6.206±0.006	SDK7	8.157±0.004
1:2	SDK2	16.318±0.006	SDK5	3.397±0.003	SDK8	16.347±0.005
1:3	SDK3	12.593±0.001	SDK6	3.55±0.002	SDK9	17.293±0.002

±SD(n=3)

Percentage yield (PY %) and TEL content of SDK: The prepared SDK (drug: soluplus: salt) of formulas showed a high percentage yield between 90-99%. These results showed that the techniques were appropriate (evaporated solvent, Kneading, and microwave) with the ingredients necessary to make these preparations (31). These formulae's medication content was been within 98-100% w/w, it complied with USP standards (98- 102%) (31). The results of percentage yield and drug content are shown in Table (6):

Table (6): Percentage Yield and Drug Content of SDK

SDK	PY%	Drug content
SDK1	99	100%
SDK 2	98	99%
SDK 3	98.2	98.8%
SDK 4	93	98.6%
SDK 5	92	98.2%
SDK 6	90	98%
SDK 7	98	100%
SDK 8	97	98.5%
SDK 9	97	98.2%

***In-vitro* dissolution** Comparative *in-vitro* dissolution of SDK is shown in Figure 2

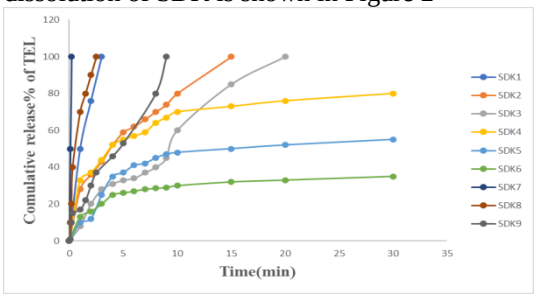

Figure (2): Dissolution of ternary solid dispersion prepared by solvent evaporation, kneading, and microwave method in pH 6.8 phosphate buffer at 37ºC

This result can be due to increased solubility by forming hydrogen bonding between the drug, soluplus, and salt. Improving wettability and amorphization of TEL.

Figure 3 shows that SDK7, SDK8, and SDK9 (TEL: soluplus: potassium carbonate) were prepared by microwave method.

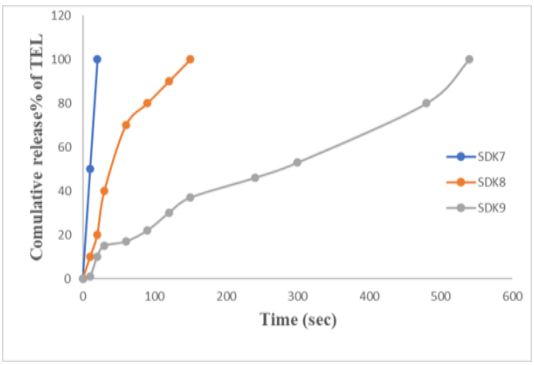

Figure 3: Dissolution of ternary solid dispersion prepared by microwave method in pH 6.8 phosphate buffer at 37ºC

Preparation of TEL SLTs

Pre-compression evaluation of powder: The type and concentration of the diluent influenced the powder mixture's pre-compression characteristics. The results are listed in table 7 below.

Table (7): Pre-Compression Evaluation of the Formula

Formula code	Angle of repose	Carr's index	Hausner's ratio
Pure drug	52.3±0.2	38 ±1.1	1.33±0.06
SDK7 (20:20:6) mg	42.07±0.1	33.5±1.3	1.3±0.1
F1	23.2±0.11	17.65±0.5	1.21±0.02
F2	13.98±0.02	18.75±0.21	1.23±0.03
F3	17.2±0.03	23±0.02	1.3±0.02
F4	22.9±0.02	17.68±0.12	1.214±0.05
F5	23.1±0.04	22±0.11	1.28±0.01
F6	21.6±0.01	10±0.03	1.1±0.01

±SD(n=3)

Avecil PH102, which possesses good compressibility and flow characteristics so tested to see whether the flow property could be improved. The powder mixture's flowability is further enhanced using magnesium stearate and talc besides the effect of the diluent.

Evaluation SLTs: Tablets were compressed from the formulations that passed pre-compression tests—evaluation of its hardness, friability, in-vitro disintegration time, and dissolution studies.

Hardness and friability: The range of hardness for each prepared SLT was acceptable (2.38- 4.28) kg/cm2, this is essential to avoid breaking when being handled and packaged and being hard enough to fast disintegration. Additionally, all the prepared SLTs had acceptable friability within the range of less than (1%) as shown in Table 8(31).

***In-vitro* disintegration time of SLTs**: According to Table 8, the type and concentration of super disintegrants significantly impacted their disintegration of SLTs and wetting time.

Drug content: According to USP requirements, the best TEL SLT tablets fell within the permissible range (90–110%), as indicated in Table 8(31).

Table (8): Friability, Hardness, Drug Content, and Disintegration Time of Prepared Formula

Formula code	Hardness Kg/cm2	Friability % N=10	Disintegration time	Drug content
F1	3.7±0.7	0.57	5 min±0.01	99.7%
F2	3.35±0.3	0.67	2 min±0.1	99,5%
F3	4.21±0.5	0.06	5 min±1.1	99.8%
F4	2.97±0.3	0.06	10 min±0.3	99.9%
F5	4.27±1.1	0.9	5 min±0.4	100%
F6	2.43±0.02	0.08	10 sec±0.001	100%

±SD(n=3)

***In vitro* dissolution of SLT of TEL:** The prepared tablets show rapid disintegration. The drug was released (100%) from the tablets and the % of drug dissolved is 40 sec.

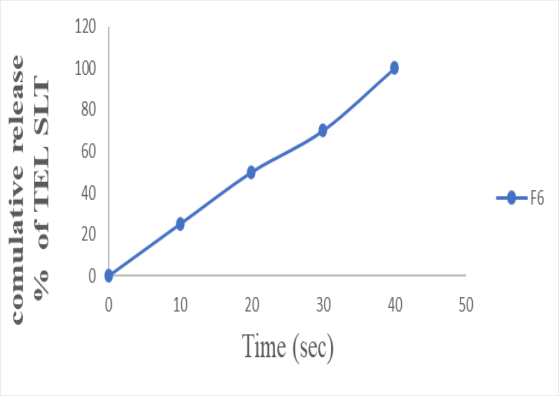

Figure (4): Dissolution of F6 in pH 6.8 phosphate buffer at 37ºC.

Discussion

Saturation solubility of TEL SD and SDK: In Table 4 there is a significant enhancement in the solubility of TEL obtained, which may be attributed to all the carriers' hydrophilic nature, besides «hydrogen bonding» that may be formed between TEL and carriers led to enhanced the solubility of TEL. The solubility enhancement of the various carriers and methods was found to be in the following descending order: microwave >solvent evaporation> kneading methods. The highest solubility was obtained when using soluplus in high conc. as a carrier due to its hydrophilic nature (32,33).

Table 5 shows the results of the solubility of TEL SDK. Further improvement in solubility was obtained when TEL was prepared as SDK compared to the SD of soluplus only that can be explained when K2CO3 salt to the TEL SD the dissolution rate was enhanced significantly. This increase in dissolution rate can be due to the drug's easily ionized nature and its solubility pH dependent also the addition of salt to the TEL SD of soluplus can increase the surface area of TEL that was exposed to the solvent, whereby the drug is bound to the salt, which results in enhanced wettability of the drug particles and its solubility.

This shows that the ternary solid dispersion system had a faster dissolving rate than the binary system. In the ternary system, salt has a significant effect on TEL solubility. This occurs because it facilitates the dispersion of drug molecules inside the polymer matrix, causing the drug to become wetter and more easily soluble (33).

***In-vitro* dissolution:**

The formula SDK7 which has TEL to soluplus 1:1 appears to drug release faster than SDK8 and SDK9 with soluplus 1:2 and 1:3 respectively which means increasing the concentration of soluplus where it tends to form a gel layer of the surface on SDK that prevent their rapid hydration and that restricts the drug release (34).

Evaluation SLTs

***In-vitro* disintegration time of SLTs:** F6 (10 % CP) decomposes the quickest (10 seconds) compared to F2 (10 % CCS) and F4 (10 % SSG); This rapid disintegration for SLTs having CP can be attributed to CP characteristics. It exhibits strong hydration, and little propensity for gel formation, Because of its high porosity, CP quickly disintegrates and makes it easier for a liquid to wick into tablets. reduction of the disintegration time to an advantageous value that is shorter than indicated in USP for preparation of TEL SLT (35).

Selection of the best formula: All the tablets from F1-F6 were within the acceptable range when observing the result of its dissolution, following USP requirements, but only F6 exhibited the shortest disintegration time (10 sec.) and release in (40 sec) So F6 was selected as the best formula for preparing TEL SLTs.

Conclusions

The solubility and dissolution of TEL were improved by making a solid dispersion of it by microwave technique using soluplus as a hydrophilic carrier and salt in a ratio of 1:1:0.3(TEL: soluplus: K salt). Its increased wettability and reduced crystallinity lead to improved drug solubility and dissolution. F6 was selected as the best formula with hardness, friability, drug content of 100%, and disintegration time of 10 sec. and dissolution in (40 sec) the in-vivo study was required as future work.

Authors' declaration:

Conflicts of Interest: None.

We hereby confirm that all the Figures and Tables in the manuscript are mine/ ours. Besides, the Figures and images, which are not mine /ours, have been given permission for re-publication and attached to the manuscript.

Authors contributions

Study conception & design: (Entidhar J. AL-Akkam). Literature search: (Hiba A. Aziz). Data acquisition: (Hiba A. Aziz). Data analysis & interpretation: (Entidhar J. AL-Akkam). Manuscript preparation: (Hiba A. Aziz). Manuscript editing & review: (Entidhar J. AL-Akkam).

References

1. Savjani KT, Gajjar AK, Savjani JK. Drug solubility: importance and enhancement techniques. ISRN. 2012. https://doi.org/10.5402/2012/195727

2. Abdulqader AA, Al-Khedairy EB. Formulation and valuation of fast dissolving tablets of taste-masked ondansetron hydrochloride by solid /dispersion. IJPS. 2017;26(1):50-60. https://doi.org/10.31351/vol26iss1pp50-60.

3. Ismail MY, Ghareeb MM. Enhancement of the solubility a10.5530/srp.2020.3.29nd dissolution rate of rebamipide by using solid dispersion technique

(Part I). IJPS. 2018:55-65. https://doi.org/10.31351/vol27iss2pp55-65.
4. Alkufi HK, Kassab HJ. Formulation and evaluation of sustained release sumatriptan mucoadhesive intranasal in-situ gel. IJPS. 2019;28(2):95-104. https://doi.org/10.31351/vol28iss2pp95-104.
5. Sabri LA, Hussien AA. Formulation and In-Vitro Characterization of Solidified Nebivolol Self-Nanoemulsion using Liquisolid Technique. Sys Rev Pharm..2020;11 (3). https://doi.org/10.5530/srp.2020.3.29.
6. Ahmed KK, Al-Jumaili AA, Mutlak SH, Hadi MK. Determinants of national drug products acceptance across patients, pharmacists, and manufacturers: A mixed method study. JGM. 2021;17(3):139-153. https://doi.org/10.1177/1741134320926625.
7. Yas LS. Effects of hypertension with and without smoking on salivary electrolytes concentration. JFacMed Baghdad. 2023;65(1).59-64. https://doi.org/10.32007/jfacmedbagdad.6512046.
8. Destro M, Cagnoni F, Dognini GP, Galimberti V, Taietti C, Cavalleri C, Galli E. Telmisartan: just an antihypertensive agent? A literature review. Expert opinion on pharmacotherapy. 2011;12(17):2719-35. https://doi.org/10.1517/14656566.2011.632367.
9. Zou Z, Xi GL, Yuan HB, Zhu QF, Shi XY. Telmisartan versus angiotensin-converting enzyme inhibitors in the treatment of hypertension: a meta-analysis of randomized controlled trials. JHH. 2009;23(5):339- 49. https://doi.org/10.1038/jhh.2008.132.
10. Kadam S, Boppana SS, Manna S, Datta S, Karande S. Management of hypertension: Comparison of Telmisartan with other antihypertensive drugs. MEDRECH. 2022;9(2):88-93. https://doi.org/10.26838/MEDRECH.2022.9.2.584.
11. Al-Akayleh F, Al-Naji I, Adwan S, Al-Remawi M, Shubair M. Enhancement of curcumin solubility using a novel solubilizing polymer Soluplus®. JPI. 2022; 17:142-154. https://doi.org/10.1007/s12247-020-09500-x.
12. Prajapati ST, Patel MV, Patel CN. Preparation and evaluation of sublingual tablets of zolmitriptan. Int J Pharm Investig. 2014 Jan;4(1):27-31. https://doi.org/10.4103/2230-973X.127737.
13. Aghera NJ, Shah SD, Vadalia KR. Formulation and evaluation of sublingual tablets of Losartan potassium. Asian Pacific J TroP. Dis. 2012;2:S130-5. https://doi.org/10.1016/S2222-1808(12)60138-8.
14. Toma NM, Khalil YI. Formulation and evaluation of bilayer tablets containing immediate release aspirin layer and floating clopidogrel layer. IJPS. 2013;22(1):40-9. https://doi.org/10.31351/vol22iss1pp40-49.
15. Alkhalidi MM, Jawad FJ. Enhancement of Aqueous Solubility and Dissolution Rate of Etoricoxib by Solid Dispersion Technique. IJPS. 2020;29(1):76-87. https://doi.org/10.31351/vol29iss1pp76-87.
16. Prajapati ST, Patel MV, Patel CN. Preparation and evaluation of sublingual tablets of zolmitriptan. Int J Pharm Investig. 2014;4(1):27-31. https://doi.org/10.4103/2230-973X.127737.
17. Bhairav BA, Jagtap LR, Saudagar RB. Solubility and dissolution enhancement of Pioglitazone using solid dispersion technique. Int J Curr Pharm Res. 2017;9(5):186-93. https://doi.org/10.22159/ijcpr.2017v9i5.22326.
18. Tian B, Ju X, Yang D, Kong Y, Tang X. Effect of the third component on the aging and crystallization of cinnarizine-soluplus® binary solid dispersion. IJPham. 2020; 580. https://doi.org/10.1016/j.ijpharm.2020.119240.
19. Akram A, Irfan M, Abualsunun WA, Bukhary DM, Alissa M. How to Improve Solubility and Dissolution of Irbesartan by Fabricating Ternary Solid Dispersions: Optimization and In-Vitro Characterization. Pharmaceutics. 2022;14(11):2264. https://doi.org/10.3390/pharmaceutics14112264.
20. Shi X, Xu T, Huang W, Fan B, Sheng X. Stability and bioavailability enhancement of telmisartan ternary solid dispersions: the synergistic effect of polymers and drug-polymer (s) interactions. AAPS pharmscitech. 2019;20:1-3. https://doi.org/10.1208/s12249-019-1358-3.
21. Ali SK, Al-Khedairy EB. Solubility and Dissolution Enhancement of Atorvastatin Calcium using Solid Dispersion Adsorbate Technique. IJPS. 2019;28(2):105-14. https://doi.org/10.31351/vol28iss2pp105-114.
22. Salih OS, Nief RA. Effect of natural and synthetic polymers on the properties of candesartan cilexetil matrix tablet prepared by dry granulation. Asian J Pharm Clin Res. 2016;9(3):161-70. https://doi.org/10.22159/ajpcr.2016.v9s3.14719.
23. Hussien MA, Essa E, El-Gizawy SA. Investigation of the effect of formulation additives on telmisartan dissolution rate: Development of oral disintegrating tablets. Eur. J. Biomed. Pharm. Sci. 2019;6(4):12-20. https://www.ejbps.com/ejbps/abstract_id/5594.
24. assim ZE. Formulation and evaluation of furosemide liquisolid compact. Int J Appl Pharm. 2017;9(6):39-48. https://doi.org/10.22159/ijap.2017v9i6.21458.
25. Abed KK, Hussein AA, Ghareeb MM, Abdulrasool AA. Formulation and optimization of orodispersible tablets of diazepam. AAPS Pharm scitech. 2010; 11:356-61. https://doi.org/10.1208/s12249-010-9387-y.
26. Jassim ZE, Rajab NA, Mohammed NH. Study the effect of wet granulation and fusion methods on preparation, characterization, and release of lornoxicam sachet effervescent granules. Drug Invent Today. 2018;10(9):1612-6.(PDF) Study the effect of wet granulation and fusion methods on preparation, characterization, and release of lornoxicam sachet effervescent granules.
27. Hasson KJ, Ghareeb MM. Long Term Stability and In-vitro Release Study of Telmisartan Complex included by Hydroxypropyl-beta-cyclodextrin in Directly Compressed Tablet Using Ion-pair Reversed

Phase High-performance Liquid Chromatography. International Journal of Drug Delivery Technology. 2021;11(0):974-979. file:///C:/Users/a/Downloads/IJDDTVol11Issue3Article54.pdf.

28. Jihad HM, Al-Akkam EJ. Formulation and in-vitro Evaluation of Carvedilol Gastroretentive Capsule as (Superporous Hydrogel). IJPS. 2021;30(2):196-207. https://doi.org/10.31351/vol30iss2pp196-207.

29. Nasser SJ, Sameen LH, Ghareeb MM. Preparation and Evaluation of Oral Disintegrating Tablets of Ketoprofen by Direct Compression. IJPS. 2012;21(2):63-8. https://doi.org/10.31351/vol21iss2pp63-68.

30. The United State Pharmacopeia (USP) 37 NF 32. 2014. Https://www.uspnf.com/official-text/proposal-statuscommentary/usp-37-nf-32.

31. Abduljabbar HH, Abd Alhammid SN.Enhancement of the solubility and the dissolution rate of tamoxifen citrate solid dispersion using Soluplus by solvent evaporation technique. Asian J Pharm Clin Res. 2019;12(1):216-21. https://doi.org/10.22159/ajpcr.2018.v12i1.28933.

32. Hadi, BM, Al-Khedairy, EBH. Preparation and Characterization of Atorvastatin Calcium Trihydrate-cyclodextrin Inclusion Complex. International Journal of Drug Delivery Technology. 2022;12(3):1171-1179. https://doi.org/10.25258/ijddt.12.3.41.

33. Borde S, Paul SK, Chauhan H. Ternary solid dispersions: classification and formulation considerations. Drug Development and Industrial Pharmacy. 2021;47(7):1011-28. https://doi.org/10.1080/03639045.2021.1908342.

34. Ganapuram BR, Alle M, Dadigala R, Kotu GM, Guttena V. Development, evaluation and characterization of surface solid dispersion for solubility and dispersion enhancement of irbesartan. JoPR. 2013;7(6):472-7. https://doi.org/10.1016/j.jopr.2013.06.012.

35. Rajab NA, Hussein AA. Formulation and in-vitro evaluation of darifenacin hydrobromide as buccal films. Iraqi Journal of Pharmaceutical Sciences. 2019;28(2):83-94. https://doi.org/10.31351/vol28iss2pp83-94

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تصنيع واختباراقراص التلميسارتان سريعة التفكك تحت اللسان

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الخلاصة

دواء التلميسارتان الخافض للضغط يستخدم عادة لعلاج ارتفاع ضغط الدم وأمراض الكلى. هو دواء لمستقبلات الأنجيوتنسين النوع الثاني. إنه دواء من الفئة الثانية ضعيف الذوبان في نظام تصنيف المستحضرات الصيدلانية الحيوية

الهدف: تحضير قرص تحت اللسان عن طريق زيادة قابلية ومعدل ذوبان التلميسارتان باستخدام طريقة التشتت الصلب

الطرق: تم استخدام ثلاث طرق لتحضير التشتت الصلب وهي طريقة تبخير مذيب التلميسارتان والعجن والميكروويف. تستخدم كل طريقة السوليبلاس كحامل محب للماء بنسب مختلفة تبلغ1%،2%و3%

وأيضا تأثير تشتت المواد الصلبة الثلاثية عن طريق إضافة ملح كربونات البوتاسيوم إلى التشتت الصلب الثنائي ثم تحضير الأقراص تحت اللسان عن طريق استخدام طريقة الضغط مباشر باستخدام أنواع ونسب مختلفة من التفكك الفائق مثل كروسبوفيدون ، كروسكارميلوز ، وجليكولات نشا الصوديوم بنسبة 5٪و 10٪ ثم دراسة اختبارات تقييم الأقراص تحت اللسان ، مثل التفتيت والصلابة ووقت التفكك ووقت الذوبان

النتائج: لوحظ أن التشتت الصلب يظهر زيادة في الذوبان بالمقارنة مع الدواء النقي.

تم الحصول على أفضل نتيجة باستخدام طريقة الميكروويف بتحضيرالصيغة (التلميسارتان،السوليبلاس وملح البوتاسيوم) بنسبة (1:1:0.3) و ثم تحضير حبوب تحت اللسان باستخدام كروسبوفيدون 10% كتفكك فائق السرعة وقت التفكك في 5 ثوان ويتم إطلاقه في 40 ثانية في وسط الذوبان

الاستنتاج: تم تحسين قابلية ذوبان وانحلال دواء التلميسارتان من خلال تحضيره كتشتت صلب ثلاثي بطريقة الميكروويف باستخدام ناقلات محبة للماء وملح بنسبة 1: 1: 0.3 (الدواء: الناقل: الملح) وثم تقييم تحضير أقراص تحت اللسان، وتم اختبار القرص المختار باستخدام كالوريمتر المسح الضوئي التفاضلي

والأشعة السينية لزيادة قابلية الذوبان وتقليل التبلور مما يؤدي إلى تحسين قابلية ذوبان الدواء وانحلاله

الكلمات المفتاحية: التلميسارتان ،كربونات البوتاسيوم ، التشتت الصلب، السوليبلاس و قرص تحت اللسان