

Supplementary file 10. Characteristics of equivalence surveys of cardiovascular medicines

Reference / country of collection	Active pharmaceutical ingredient (API)	Brand name	Outlet	Reference standard	Test(s) performed and analytical technique for API content/Impurities	Failure frequency n/N (%)
Julide Akbuga, 1987 [1] Turkey	Furosemide	Unknown	Unknown	USP 20	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>Thin-Layer Chromatography TLC</i>	2 /9(22.2%)
S Sakolkhai, 1991 [2] Thailand	Spironolactone	Generic	Hospital and drug stores	USP	API content and Dissolution <i>HPLC (unknown detector)</i>	2/3 (66.7%)
L. Nikolic, 1994 [3] Serbia	Acetylsalicylic acid	Unknown	Unknown	USP 1985	API content, dissolution, weight variation, disintegration time, crushing strength and friability <i>HPLC-DAD</i>	6/6 (100.0%)
Baloglu , 2001 [4] Turkey	Enalapril	Generic	Pharmacies	USP	API content, Weight Variation, Hardness, Disintegration, Diameter-Thickness Ratio, Friability, Content Uniformity, Dissolution <i>UV-Spectrophotometry</i>	8/8 (100.0%)
Ming-shin L, 2010 [5] Taiwan	Hydrochlorothiazide	Unknown- 15 domestic products and one imported from the UK	Unknown	USP	Dissolution, Content Uniformity <i>HPLC-UV</i>	10/16 (62.5%)
Gomez , 2003 [6] Asia and South America	Clopidogrel	Plagril Clodrel® Orawis® Noklot® Clopigrel® Preva® Clavix® Clopilet® Stromix® Cloplat-75® Deplatt® Cerugin	Unknown	European Pharmacopeia 2002 + USP 2000	API content, Dissolution, Impurity <i>HPLC (unknown detector)</i> <i>LC (unknown detector)</i>	16 /19 (84.2%)

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		Cloplatic® Plagrel® Nefazan® Talcom® Clopifran®				
Karl-Uwe Petersen, 2003 [7] Germany	Felodipine	Generic	Pharmacies	USP 22	API content and Dissolution <i>UV- Spectroscophotometry</i>	0 /7(0.0%)
C Longstaff, 2004 [8] Multicountry L/MIC countries	Streptokinase	Unknown	Unknown	European pharmacopeia BP	API content <i>Chromogenic methods</i>	15 /18(83.3%)
Teshome Dires, 2005 [9] Ethiopia	Methyldopa Propranolol Furosemide	Generic Aldomet Dopegyt Inderal Emforal Lasix Fusix	Private pharmacies	BP 2001, USP 27	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>UV/Vis spectrophotometry</i>	1/9 (11.1%)
Smith, 2005 [10] Serbia and Montenegro	Carvedilol	Carbetalol Carloc Carvedilol Carvista Coritensil Diola Karvedilol Talliton Vivacor Coryol Karvileks Milenol Talliton Coronat Longcardio V-Block-PT	Distributors	European Pharmacopeia + Roche specifications + USP	API content, Dissolution, Impurity, Hardness <i>HPLC-UV UV-spectrophotometry</i>	17/35 (44.7%)
Hermentin, 2005 [11] Brazil, India, Jordan, Pakistan	Streptokinase	Akinase Unitinase Kabikinase Durakinase	Distributors	European Pharmacopoeia 2002	API content , impurity <i>UV-Spectrophotometry</i>	18/20 (90.0%)

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		Streptokinase Eskinase Icikinase Thrombosolv Strek Solustrep Streptonase Icikinase Heberkinase STPase				
Vetchy, 2007 [12] Czech Republic	Felodipine	Plenil® Presid®	Unknown	European Pharmacopoeia 4.0 Czech Pharmacopoeia 2002 USP 26	Dissolution test <i>UV spectrophotometry</i>	4/6 (66.7%)
R. Panchagnula, 2007 [13] India	Nifedipine	Adalat retard OROS Calbloc retard Calcigard retard Cardules retard Depicor SR Depin retard Nicardia retard Nifedine SR Nifelet retard	Pharmacies	Unspecified	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>UV/Vis spectrophotometry</i>	0/15 (0.0%)
Veronin, 2008 [14] Canada, United Kingdom, India, Mexico, Spain, Thailand, Fiji	Simvastatin	Zocor Apo-Simvastatin Co-Simvastatin Novo-Simvastatin Pms-Simvastatin Simlo-20 SIMLIP-20 Starstat Simi-20 Zorced Simvastatina Simastin 20	Website	USP 2003	API content, API identification, Appearance, Content uniformity, Disintegration, Dissolution, Hardness, Mass uniformity <i>HPLC -DAD</i>	7/19 (36.8%)

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		Bestatin 20 Simlup-20				
Dione M Lima, 2008 [15] Brazil	Enalapril	Unknown	Unknown	USP	API content and Dissolution <i>HPLC-UV</i>	2 /9(22.2%)
Angeli, 2009 [16] Thailand, Hungary, Czech Republic, Panama, South Africa, Belgium, Brazil, India, Pakistan, Dominican Republic, China	Ramipril	Generic	Unknown	European Pharmacopeia 2007 Sanofi-Aventis specification USP	API content, Dissolution, Stability, Impurities <i>HPLC (unknown detector)</i>	16/21 (76.2%)
De Braekeleer, 2009 [17] Belgium	Nifedipine	Adalat Adalat Oros Adalat Retard Docnifedipine Hypan Nifedipine Ratiopharm	Unknown	BP 2009 USP 2009 European Pharmacopeia 2005	API content, Related Substances, Dissolution, Content Uniformity <i>HPLC-UV</i>	0/ 9 (0.0%)
Okoye, 2009 [18] Nigeria	Nifedipine	Generic	Unknown	BP USP 2002	API content, Disintegration, Dissolution, Friability, Hardness, Thickness, Weight, Diameter <i>UV/Vis spectrophotometry</i>	0/7 (0.0%)
Benkovic , 2010 [19] Croatia	Lisinopril	Amicor Iruimed Laaven Lizinopril-Farmal Lizinopril Lek Optimon Skopryl Vitopril Lisinolex	Unknown	European Pharmacopeia 2007	Impurities <i>HPLC (unknown detector)</i>	0/9 (0.0%)
Bunhak, 2010 [20] Brazil	Acetylsalicylic acid	Generic	Basic pharmacies	USP 23, BP 1999,	API content, Content uniformity, Disintegration, Dissolution,	6/ 8 (75.0%)

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				Brazilian Pharmacopeia	Friability, Hardness, Mass uniformity <i>Titrimetry</i> <i>UV-Spectrophotometry (dissolution)</i>	
Patel, P, 2010 [21] India	Telmisartan	Unknown	Unknown	USP	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>UV/Vis spectrophotometry</i>	0/12 (0.0%)
Mus'ab M. Khalaf, 2010 [22] Iraq	Furosemide	Apix Desal Lasimex Salex	Private pharmacies	BP, USP	API content, Disintegration, Dissolution, Hardness, Weight uniformity <i>Unstated technique</i>	0/5 (0.0%)
Eichie, 2011 [23] Nigeria	Amlodipine	Amlovar Amlovasc Swivasc Lofra Novasc Amlovasc Amlodipine Asomex Amlosam	Pharmacies	BP 2003	API content, Disintegration, Friability, Hardness, Weight uniformity, Dissolution <i>UV/Vis spectrophotometry</i>	3 /10 (33.3%)
Walde 2011 [24] India	Acetylsalicylic acid	Apisafe Caresprin. Ecosporin Nusprin Sprintas	Private pharmacies	Indian Pharmacopeia USP	API content, Content uniformity, Disintegration, Dissolution, Friability, Hardness, Mass uniformity <i>Spectrophotometry</i>	1/6 (16.7%)
Olajide, 2011 [25] Nigeria	Amlodipine	Norvasc Amlovasc Amlovar Amlong-10 Fepilat Cardiosave-10	Retail pharmacies	USP 2000 Chinese Pharmacopeia 2005	Visual inspection, API Identification, Weight uniformity, Hardness, Friability, Disintegration, Dissolution, API content <i>UV/Vis spectrophotometry</i>	4/6 (66.7%)
Oyeniya, 2011 [26] Nigeria	Amlodipine	Generic	Manufacturer	BP 1998 + BP 2010	API content, Disintegration, Dissolution, Friability, Hardness	0/5 (0.0%)

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					<i>UV/Vis-Spectrophotometry</i>	
Jinat Ashrafi, 2011 [27] Bangladesh	Atenolol- Amlodipine	Camlodin® Amlovas®	Pharmacy shops	BP USP	API content, Content uniformity, Disintegration, Dissolution, Friability, Hardness, Mass uniformity <i>UV/Vis-Spectrophotometry</i>	1/4 (25.0%)
T Shams Oishi, 2011[28] Bangladesh	Atorvastatin	Unknown	Local drug stores	USP	API content, Disintegration, Dissolution, Friability, Hardness, Thickness, Weight, Diameter <i>HPLC-UV</i>	6/10 (60.0%)
MNA Ameri, 2011 [29] , unstated country	Simvastatin Nifedipine	Generic	Unknown	BP USP European pharmacopeia	Dissolution <i>UV-Vis spectrophotometry</i>	0/3 (0.0%)
Akinleye M O , 2011 [30] Nigeria	Amlodipine	Generic	Pharmacies	BP	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>UV/Vis spectrophotometry</i>	0/2 (0.0%)
Osadebe P.O, 2011 [31] Nigeria	Lisinopril	Generic	Local pharmacies	USP 22 BP 2001 European pharmacopeia	API content, hardness, friability, weight uniformity, disintegration time and dissolution <i>UV/Vis spectrophotometry</i>	3/3 (100.0%)
Oyetunde, 2012 [32] Nigeria	Propranolol	Generic	Manufacturer locally Wholesaler	BP 2007	Dissolution, API content <i>UV/Vis spectrophotometry</i>	0/2 (0.0%)
Giri, 2012 [33] India	Diltiazem	Dilzem CD 90 Angizem CD 90 Channel CD 90	Retail pharmacies	USP 2000 BP	API content, dissolution, disintegration and weight variation <i>UV-spectrophotometry</i>	0/3 (0.0%)
Walenga, 2012 [34] USA	Enoxaparin	Lovenox	Pharmacy and other hospital systems	Unspecified	API content <i>Anti-Factor Xa assay</i>	0 /10 (0.0%)

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Akinleye, 2012 [35] Nigeria	Atorvastatin	Generic	Registered pharmacy	USP 2004 BP 2007	API content, Content uniformity, Disintegration, Dissolution, Friability, Hardness, Mass uniformity <i>HPLC-UV</i>	1/3 (33.3%)
Oyeniya YJ, 2012 [36] Nigeria	Nifedipine	Unknown	Pharmacies	USP BP 2004	API content, Content uniformity, Disintegration, Dissolution, Friability, Hardness, Mass uniformity <i>UV/Vis spectrophotometry</i>	6/10 (60.0%)
M A Noman, 2012 [37] Yemen	Captopril	Unknown	Retail pharmacies	BP 2007	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>HPLC-UV spectrophotometry</i>	9/15 (60.0%)
Sani Ali. Audu, 2012 [38] Nigeria	Lisinopril	Lisiofil Lisoril Lizopril Makinga Ranopril Stripril Takapril Teva Zestril	Unknown	USP	API Content <i>HPLC-UV</i>	4/9 (44.4%)
Chandra Dinda S, 2012 [39] India	Losartan	Generic	Unknown	Unknown	API Content <i>UV/Vis spectrophotometry</i>	0/6 (0.0%)
S.O. Olayemi, 2012 [40] Nigeria	Amlodipine	Generic	Pharmacies	BP, USP	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>HPLC-UV-PDA</i>	4/8 (50.0%)
Haruna, 2013 [41] Nigeria	Methyldopa	Unknown	'Pharmaceutical shops'	USP 2000	API content <i>Titrimetry</i>	1/4 (25.0%)

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Lichanda,B , 2013 [42] China	Telmisartan	Generic	Unknown	USP	API content, Dissolution, Impurity <i>HPLC-UV</i>	6 /10(60.0%)
M Antonio de Oliveira, 2014 [43] Brazil	Hydrochlorothiazide	Generic	Compounding pharmacies	Brazilian pharmacopoeia 2010	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>UV-Spectrophotometry</i>	1/3 (33.3%)
Poonguzhali, 2014 [44] India	Atenolol	Tenolol Ziblok Itel Atecard Tenormin	Unknown	Indian Pharmacopeia	API content, Disintegration, Friability, Hardness, Weight uniformity, Dissolution, <i>HPLC, colorimetry, spectrophotometry</i>	0/5 (0.0%)
Sylvester O. Eraga, 2014 [45] Nigeria	Amlodipine	Amlovar Junvasc Amlovasc Amlodipine Novasc Amlodipine C-T Lofra Amlocard Swivasc – 5 Hyercla	Pharmacies	BP 2007 USP 2003	API content, Disintegration, Dissolution, Friability, Hardness, Thickness, Weight, Diameter <i>UV Spectrophotometry</i>	2/10 (20.0%)
Senthil Rajan, 2014 [46] Malaysia	Atenolol	Generic	Retail pharmacies	BP USP	Visual inspection, API Identification, Weight uniformity, Hardness, Friability, Disintegration, Dissolution, API content <i>UV/Vis spectrophotometry</i>	0/5 (0.0%)
Safila Naveed, 2014 [47] Pakistan	Atenolol	Tenormin Blokium Atenolol Cardiolyte	Unknown	BP USP	Uniformity of weight, friability, hardness, disintegration, dissolution <i>UV/Vis spectrophotometry</i>	0/4 (0.0%)
Safila Naveed, 2014 [48] Pakistan	Lisinopril	Zestril Trupril Novatec Lame 5	Unknown	BP USP	Uniformity of weight, friability, hardness, disintegration, dissolution <i>UV/Vis spectrophotometry</i>	0/4 (0.0%)

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Huma Dilshad, 2014[49] Pakistan	Captopril	Capoten Capril Acetopril Capace	Unknown	BP USP	Uniformity of weight, friability, hardness, disintegration, dissolution <i>UV/Vis spectrophotometry</i>	0/4 (0.0%)
Mahwish Feroz, 2014 [50] Pakistan	Amlodipine	Unknown	Retail pharmacies	USP 2006 European Pharmacopeia 2007	Weight variation, hardness, thickness, length, breadth, friability, disintegration, dissolution and assay <i>UV spectrophotometry</i>	0/6 (0.0%)
Tapas K Pal, 2014 [51] India	Telmisartan	Unknown	Pharmacies	USP	API content, API identification, Disintegration, Friability, Hardness, Mass uniformity, Visual inspection <i>UV/Vis spectrophotometry</i>	2 /6(33.3%)
Han,Y, 2014 [52] Argentina	Furosemide	Generic	Pharmacies	USP	Dissolution <i>UV/Vis spectrophotometry</i>	0/8 (0.0%)
Gamil Q. Othman, 2014 [53] Yemen	Lisinopril	Cipril Lisistril Lotensin zenoril Zestril	Pharmacies	BP, USP	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>HPLC-UV</i>	0/5 (0.0%)
Rehana Begum, 2014 [54] Bangladesh	Losartan	Generic	Local drug store	USP	Dissolution, Hardness, Friability, Disintegration	0/3 (0.0%)
Sharifa Sultana, 2014 [55] Bangladesh	Furosemide	Generic	Unknown	BP, USP	API content, Disintegration, Dissolution, Friability, Hardness, Thickness, Weight, Diameter, Appearance <i>UV/Vis spectrophotometry</i>	1/6 (16.7%)
Basha, 2015 [56] Albania	Olmesartan	Unknown	Pharmacies	USP 2009	API content, Disintegration, Dissolution, Friability, Hardness, Thickness, Weight, Diameter <i>HPLC-DAD</i>	0/4 (0.0%)
Abdelkarim, 2015 [57] Sudan	Atenolol	Unknown	Unknown	USP BP 2013	API content, Disintegration, Dissolution, Friability, Hardness, Thickness, Weight, Diameter	0 /3(0.0%)

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					<i>UV/Vis spectrophotometry</i>	
Siaan, 2015 [58] Libya	Furosemide	Duresan® <i>Generic</i> Furosemide	'Local market' (not detailed)	Unspecified	API content, API identification, Appearance, Content uniformity, Disintegration, Dissolution, Hardness, Mass uniformity <i>HPLC-UV/Vis</i>	0/5 (0.0%)
Zhang, 2015 [59] China	Nifedipine	Unknown	Local pharmacies	USP 34 2011	Impurity <i>HPLC-UV</i>	0/14 (0.0%)
Osei-Asare, 2015 [60] Ghana	Nifedipine	<i>Generic</i>	Community and hospital pharmacies	BP 2011 USP 2007	API content, Weight uniformity, Dissolution Test <i>HPLC-UV</i>	6/12 (50.0%)
G O. Okpanachi, 2015 [61] Nigeria	Methyldopa	Unknown	Unknown	BP	API content, Disintegration, Dissolution, Friability, Hardness, Thickness, Weight, Diameter <i>UV- Spectrophotometry</i>	6/8 (75.0%)
Ogochukwu , 2015 [62] Nigeria	Valsartan	Unknown	Registered wholesale	USP	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>HPLC- UV</i>	0 /4(0.0%)
T Locatelli, 2015 [63] Brazil	Propranolol-Hydrochlorothiazide	<i>Generic</i>	Pharmacies	Brazilian pharmacopoeia	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>UV/Vis spectrophotometry</i>	1/6 (16.7%)
Ming-Yuan Zhang, 2015 [64] China	Nifedipine	<i>Generic</i>	Unknown	USP	Impurity, Weight <i>HPLC-UV</i>	0/14 (0.0%)
Md. Abir Khan, 2015 [65] Bangladesh	Atorvastatin	<i>Generic</i>	Local pharmacies	USP	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution	2/5 (40.0%)

Reference / country of collection	Active pharmaceutical ingredient (API)	Brand name	Outlet	Reference standard	Test(s) performed and analytical technique for API content/Impurities	Failure frequency n/N (%)
					<i>UV/Vis spectrophotometry</i>	
Shawahna, 2016 [66] Palestine	Atorvastatin	<i>Generic</i>	Local retail pharmacies	USP 2005	API content, Hardness <i>HPLC (unknown detector)</i>	0/4 (0.0%)
Mansour, 2016 [67] Syrian Arab Republic	Furosemide	Unknown	Registered pharmacies	BP USP	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>Spectrophotometry</i>	1/3 (33.3%)
Karmoker , 2016 [68] Bangladesh	Amlodipine	<i>Generic</i>	Local drug store	Unspecified	API content, Content uniformity, Disintegration, Dissolution, Friability, Hardness, Mass uniformity <i>UV/Vis spectrophotometry</i>	3/4 (50.0%)
Alnuhait, MA , 2016 [69] Saudi Arabia	Atenolol	Tenormin Tenolol Tenol Atormin Apo-Atenol Hypoten Cardol	Retail pharmacies	BP 2013	API content, Disintegration, Dissolution, Friability, Hardness, Thickness, Weight, Diameter <i>UV spectrophotometry</i>	0/7 (0.0%)
Elghnimi,TY, 2016 [70] Libya	Simvastatin	Simvastatin® Simvastatin-1A Pharma® Vascor® Simvastatina Normon®	Pharmacies	BP USP	Visual inspection, API Identification, Weight uniformity, Hardness, Friability, Disintegration, Dissolution, API content, <i>HPLC</i>	0/4 (0.0%)
Hameed A, 2016 [71] Pakistan	Losartan	<i>Generic</i>	Unknown	BP	API content, Disintegration, Dissolution, Friability, Hardness, Thickness, Weight, Diameter <i>Unstated technique</i>	0/2 (0.0%)
Tapas K Pal, 2016 [72] India	Rosuvastatin	Rozucor Rozumac Rosuvas Zyrova Crestor	Unknown	USP Indian pharmacopeia	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>UV/Vis spectrophotometry</i>	2/5 (40.0%)

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Nesar, 2017 [73] Pakistan	Atenolol	<i>Generic</i>	Retail pharmacies	USP	API content, Disintegration, Dissolution, Friability, Hardness, Thickness, Weight, Diameter <i>UV/Vis spectrophotometry</i> <i>HPLC</i>	2/6 (33.3%)
Wajiha, 2017 [74] Pakistan	Atorvastatin	<i>Generic</i>	Registered pharmacies	USP 2011 BP	API content, Disintegration, Friability, Hardness, Weight uniformity, Dissolution <i>HPLC-UV</i>	0/7 (0.0%)
Orfao, 2017 [75] Brazil	Hydrochlorothiazide	<i>Generic</i>	Unknown	Brazilian pharmacopoeia	API content, Content uniformity, Disintegration, Dissolution, Friability, Hardness, Mass uniformity <i>UV/VIS-spectrophotometry</i> <i>FTIR</i>	1/5 (20.0%)
Mohamed M. Siaan, 2017 [76] Libya	Atenolol	<i>Generic</i>	Manufacturer	USP BP	Visual inspection, API Identification, Weight uniformity, Hardness, Friability, Disintegration, Dissolution, Uniformity dosage unit, API content, <i>UV/Vis spectrophotometry</i>	0/3 (0.0%)
Mustafa Beesh, 2017 [77] Syrian Arab Republic	Atenolol	<i>Generic</i>	Pharmacies	BP 2009 USP 2013	API content, Content uniformity, Disintegration, Dissolution, Friability, Hardness, Mass uniformity <i>UV- Spectrophotometry</i>	3/4 (75.0%)
A Ali Bassam, 2017 [78] Yemen	Clopidogrel	<i>Generic</i>	Pharmacies	USP	API content, Content uniformity, Disintegration, Dissolution, Friability, Hardness, Mass uniformity <i>UV- Spectrophotometry</i>	6 /8(75.0%)

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C. N. Chinaka , 2017 [79] Nigeria	Furosemide	Unknown	Pharmacies	BP 2012 USP 2009	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution, Packaging <i>UV/Vis spectrophotometry</i>	2/5 (40.0%)
Lovely Z, 2017 [80] Bangladesh	Clopidogrel	Unknown	Retail pharmacies	USP 2013	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>UV spectrophotometry</i>	3 /9(33.3%)
M Isbera, 2017 [81] Syrian Arab Republic	Warfarin	Unknown	Registered pharmacies	USP	API content, Content uniformity, Disintegration, Dissolution, Friability, Hardness, Mass uniformity <i>UV-spectrophotometry</i>	1/3 (33.3%)
F Hasin, 2017 [82] Bangladesh	Valsartan	Unknown	Pharmacies	USP	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>HPLC (unknown detector)</i>	0/3 (0.0%)
T Tasnim, 2017 [83] Bangladesh	Olmesartan	Unknown	Retail pharmacies	BP 2013 USP	API content, Disintegration, Dissolution, Friability, Hardness, Thickness, Weight, Diameter <i>UV Spectrophotometry</i>	0/9 (0.0%)
H Jung-Cook, 2017 [84] Mexico	Amlodipine	<i>Generic</i>	Unknown	USP	Dissolution <i>UV/VIS spectrophotometry</i>	0/3 (0.0%)
Promit Das, 2018 [85] Bangladesh	Spironolactone	<i>Generic</i>	Pharmacies	USP	API content, Disintegration, Dissolution, Friability, Hardness, Thickness, Weight, Diameter <i>UV/Vis spectrophotometry</i>	0/6 (0.0%)
Aivalli, 2018 [86] India	Atenolol Amlodipine	Unknown	Government and private pharmacies	Indian Pharmacopeia 2014	API content, API Identification, Dissolution, Impurity, Weight uniformity	0/10 (0.0%)

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					<i>HPLC, infrared spectroscopy</i>	
Agune, 2018 [87] Ethiopia	Nifedipine	<i>Generic</i>	Retail outlets	USP 2013	Weight Uniformity, Hardness, Disintegration, Dissolution <i>HPLC (unknown detector)</i>	2/6 (33.3%)
Mehnaz Ali, 2018 [88] Bangladesh	Valsartan	Unknown	Local drug store	USP	API content, Disintegration, Dissolution, Friability, Hardness, Thickness, Weight, Diameter <i>UV/Vis spectrophotometry</i>	1/3 (33.3%)
M Rahamathulla, 2018 [89] Saudi Arabia	Atorvastatin	Lipitortm Lorvast Lipomax Astatin	Community pharmacies	USP	API content, Content uniformity, Disintegration, Dissolution, Friability, Hardness, Mass uniformity <i>UV/Vis spectrophotometry</i>	0/4 (0.0%)
Adefolarin A Amu, 2018 [90] Swaziland	Nifedipine	Unknown	Retail pharmacies and central medical stores	USP	Weight variation, diameter, hardness, friability, drug content and disintegration <i>UV spectrophotometry</i>	4/4 (100.0%)
M. A. Varillas, 2018 [91] Argentina	Hydrochlorothiazide	Unknown	Pharmacies	Argentine Pharmacopeia	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>UV- spectrophotometry</i>	1/4 (25.0%)
Marques de Andrade, 2018 [92] Brazil	Verapamil	<i>Generic</i>	Pharmacies	Brazilian pharmacopoeia	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>UV/Vis spectrophotometry</i>	0/4 (0.0%)
R F Naddour, 2018 [93] Syrian Arab Republic	Warfarin	<i>Generic</i>	Unknown	USP BP	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>UV- VIS spectrophotometry</i>	0/8 (0.0%)

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M Gayathri Devi, 2018 [94] India	Propranolol	Pronol Propochem Inderal Ciplar	Unknown	Indian pharmacopeia USP	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>UV/Vis spectrophotometry</i>	0/4(0.0%)
Manal AL-Yosofy, 2018 [95] Sudan	Amlodipine	<i>Generic</i>	Registered Pharmacies	USP	API content, Disintegration, Dissolution, Friability, Hardness, Thickness, Weight, Diameter <i>UV/Vis spectrophotometry</i>	0/2 (0.0%)
Pabitra Thapa, 2018 [96] Nepal	Amlodipine	<i>Generic</i>	Unknown	Indian Pharmacopeia	API content, Disintegration, Dissolution, Hardness, Weight uniformity <i>HPLC-UV</i>	0/11 (0.0%)
M Kumar, 2018 [97] India	Enalapril	<i>Generic</i>	Unknown	Indian Pharmacopeia	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>UV/Vis spectrophotometry</i>	0/2 (0.0%)
Sanja Kecman, 2018 [98]	Amlodipine	<i>Generic</i>	Unknown	European Pharmacopoeia	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>HPLC-UV-PDA</i>	0/2 (0.0%)
A Bayoumi, 2019 [99] Iraq	Irbesartan	Aprovel Converium Gizlan	Unknown	USP	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>UV spectrophotometry</i>	1/3 (33.3%)
J S Bayasa, 2019 [100] India	Telmisartan	Unknown	Retail pharmacies	USP Indian pharmacopeia	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>UV/Vis spectrophotometry</i>	0/4 (0.0%)
Marta I.V. Brevedan, 2019 [101] Argentina	Furosemide	<i>Generic</i>	Unknown	Argentine Pharmacopeia, USP	API Content, Weight, Hardness, Friability, Disintegration, Dissolution, Packaging	0/7 (0.0%)

Reference / country of collection	Active pharmaceutical ingredient (API)	Brand name	Outlet	Reference standard	Test(s) performed and analytical technique for API content/Impurities	Failure frequency n/N (%)
					<i>UV spectrophotometry</i>	
Arnold C. I, 2019 [102] Nigeria	Lisinopril	Unknown	Pharmacies	BP, USP	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>UV/Vis spectrophotometry</i>	9/10 (90.0%)
Rehana Begum, 2019 [103] Bangladesh	Atenolol	<i>Generic</i>	Unknown	BP + USP	Dissolution, Hardness, Friability, Disintegration	0/3 (0.0%)
A S Zaek, 2019 [104] Libya	Metoprolol Verapamil Spironolactone	Aldactone Apo metoprolol Isoptin Lachipres	Unknown	BP	API Content, Thickness, Hardness and Disintegration time <i>UV/Vis spectrophotometry</i>	0/6 (0.0%)
K.S. Salako, 2019 [105] Nigeria	Methyldopa	<i>Generic</i>	Pharmacies	BP, USP	API content, Disintegration, Dissolution, Friability, Hardness, Thickness, Weight, Diameter, Appearance <i>HPLC-UV</i>	6/10 (60.0%)
Elias Sakkal, 2019 [106] Syrian Arab Republic	Acetylsalicylic acid Captopril Furosemide	Asiapiirin Aspirex Capotal Capoten Captophen Furosemid <i>Generic</i> Obarsix Rasperine	Pharmacies	USP	API content <i>HPLC-DAD - MS/MS</i>	0/10 (0.0%)
Maryana S, 2019 [107] Syrian Arab Republic	Amlodipine	Unknown	Manufacturers	USP	API content, Content uniformity, Disintegration, Dissolution, Friability, Hardness, Weight uniformity <i>HPLC-UV</i>	3/5 (60.0%)
Bilawal Shaikh, 2020 [108] Pakistan	Captopril	Unknown	Local pharmacies	USP	API content, Disintegration, Dissolution, Friability, Hardness, Thickness, Weight, Diameter, Appearance	2/6 (33.3%)

Reference / country of collection	Active pharmaceutical ingredient (API)	Brand name	Outlet	Reference standard	Test(s) performed and analytical technique for API content/Impurities	Failure frequency n/N (%)
					<i>HPLC-UV</i>	
Arnold C. I, 2020 [109] Nigeria	Amlodipine	Unknown	Pharmacies	BP, USP	API Content, Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>UV spectrophotometry</i>	3/10 (30.0%)
Akasha, A, 2020 [110] Libya	Amlodipine	Amady Amlodipine Amlor	Unknown	USP	Weight uniformity, Hardness, Friability, Disintegration, Dissolution, Visual inspection <i>Infrared (IR) spectroscopy</i>	5/5 (100.0%)
D Basava Raju, 2020 [111] India	Losartan	Cosart Losakind Losar	Retail pharmacies	USP	API content, Dissolution, Friability, Hardness, Thickness, Weight <i>UV/Vis spectrophotometry</i>	0/3 (0/0%)
Silvia Farfan, 2020 [112] Argentina	Clopidogrel	<i>Generic</i>	Pharmacies	USP	Appearance, Dissolution, Weight variation	0/8 (0.0%)
Varghese George, 2020 [113] India	Clopidogrel	Unknown	Unknown	Indian Pharmacopeia	API Content <i>HPLC-UV</i>	8/11 (72.7%)
I Haque, 2020 [114] India	Atenolol	A-AtenololIP Acord Plus HIPRES-50	Private pharmacies	Indian Pharmacopeia	API content, Disintegration, Dissolution, Friability, Hardness, Thickness, Weight <i>UV/Vis spectrophotometry</i>	0/3 (0.0%)
Mosab Arafat, 2020 [115] United Arab Emirates	Furosemide	Lasix Furosemide	Pharmacies	USP , European Pharmacopeia	Comparative compositional analysis (vs authentic or other brands), Weight uniformity, Hardness, Friability, Disintegration, Dissolution <i>Fourier Transform Infrared Spectrometry (FTIR)</i>	0/2 (0.0%)
Dalia Gaber, 2020 [116] Saudi Arabia	Atenolol	<i>Generic</i>	Pharmacies	USP	API content, Disintegration, Dissolution, Hardness, Weight uniformity	0/4 (0.0%)

Reference / country of collection	Active pharmaceutical ingredient (API)	Brand name	Outlet	Reference standard	Test(s) performed and analytical technique for API content/Impurities	Failure frequency n/N (%)
					UV/Vis spectrophotometry	
HPLC, High-performance liquid chromatography; MS, Mass spectrometry; UV, Ultraviolet; TLC, Thin Layer Chromatography; FTIR, Fourier transformed infrared spectroscopy; LC, Liquid Chromatography; DAD, Diode-Array Detection; PDA, Photo diode array; BP, British Pharmacopeia; USP, United States Pharmacopeia; API, Active Pharmaceutical Ingredient						

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