VOLUME 16 NUMBER 3

Secundum Artem

Current & Practical Compounding Information for the Pharmacist.

An ongoing CE Program provided by a grant from Perrigo Pharmaceuticals

Stability of Extemporaneously Prepared Oral Liquid Formulations - Part VIII

GOALS AND OBJECTIVES

Goal: To provide information from the peer-reviewed literature on stability studies of oral liquids.

Objectives: After reading and studying the article, the reader will be able to:

1. Briefly discuss the reasons for the lack of pediatric formulations,
2. Determine whether or not the active pharmaceutical ingredient is in solution or is suspended,
3. Analyze the tabulated results and assign an appropriate beyond-use date, and
4. Describe the physical observation factors and chemical factors studied in these stability experiments.

INTRODUCTION

Despite the large amount of money the federal government has invested in the development of pediatric formulations, the lack of such formulations is still a major problem in the United States. Millions and millions of dollars have been provided to the National Institutes of Health through the Best Medicines for Children Act and the Pediatric Formulation Initiative with little to show for the investment. Exclusivity and patent extensions for developing pediatric formulations have been offered to the pharmaceutical industry with limited success.

The U.S. Pharmacopeia has funded a number of pediatric stability studies which have resulted in many formulations that now have official monographs in the USP. Some pharmaceutical companies have funded numerous stability studies that have been conducted by academic institutions and by private laboratories to develop compounding formulations.

The most productive and cost-efficient use of funds in the past 20 years has been by the private sector with publication of results in science and practice journals. This has provided pharmacists with the information needed to provide physicians and patients with the pediatric dosage forms that are desperately needed. The need is great for hundreds of additional studies as the ones summarized in this paper.

For this issue, the individual drugs and concentrations reported here are shown in Table 1 and are the result of the process used in this last group mentioned in the previous paragraph.

Table 1: Concentrations of the various drugs in the studies reported in this paper.

Drug	Concentration (mg/mL)
Carbamazepine	25 and 50 mg
Clopidogrel	5
Nitrofurantoin	10
Norfloxacin	20
Oseltamivir	15
Quinapril	1
Rufinamide	40
Sumatriptan	5
Temozolomide	10
Tiagabine	1

STABILITY OF EXTEMPORANEOUS FORMULATIONS

Carbamazepine

Carbamazepine ($C_{15}H_{12}N_2O$, MW 236.27, Tegretol®) occurs as a white to off-white powder that is practically insoluble in water and soluble in alcohol. Carbamazepine is an iminostilbene

Loyd V. Allen, Jr., Ph.D., R.Ph.

- *Professor Emeritus, University of Oklahoma College of Pharmacy*
- *Editor in Chief, International Journal of Pharmaceutical Compounding*
- *Dr. Allen is not affiliated with Perrigo Pharmaceuticals*

Quest Educational Services Inc. is accredited by the Accreditation Council for Pharmacy Education as a provider of continuing pharmacy education.
ACPE No. 0748-0000-11-001-H04-P (0.1 CEU)
The initial release for this lesson is 05/15/11.
This lesson is no longer valid for CE credit after 05/15/14.

derivative used both as an anticonvulsant and for the relief of pain associated with trigeminal neuralgia and for other psychiatric disorders, including schizophrenia and bipolar disorder.[1]

Carbamazepine oral suspension (25 and 50 mg/mL) was prepared using carbamazepine powder in a vehicle of Ora-Plus® and Ora-Sweet® SF. The carbamazepine powder was pulverized and the vehicle added with thorough mixing. The preparations were placed in amber glass containers and stored at room temperature and samples obtained after 2, 4 and 6 months. Physical observations, organoleptic properties, chemical stability, microbiological assays and pH were determined. There were no changes in physical properties and no culture growths were observed during the study period. The pH of the preparations was 4.5. Both oral suspensions are physically, chemically and microbiologically stable for at least 6 months at room temperature in amber glass containers.[3]

Table 2: Stability of carbamazepine 25 mg/mL and 50 mg/mL in Ora-Plus:Ora-Sweet SF in glass amber bottles stored at 23° C.

Preparation	Initial	2 months	4 months	6 months
25 mg/mL	23.1 mg/mL	101.7%	110.8%	99.1%
50 mg/mL	49.5 mg/mL	101.6%	104.7%	92.7%

Clopidogrel

Clopidogrel bisulfate ($C_{16}H_{16}ClNO_2S{\cdot}H_2SO_4$, MW 419.90, Plavix®) occurs as a white to off-white powder that is freely soluble in water. It is a thienopyridine antiplatelet drug used in thromboembolic disorders. It acts by inhibiting adenosine diphosphate-mediated platelet aggregation and is given as an alternative to aspirin in patients with atherosclerosis who are at risk of thromboembolic disorders such as myocardial infarction, peripheral arterial disease and stroke. It is given orally as the bisulfate, but the dose is expressed in terms of the base (75 mg of base is equivalent to 97.86 mg of clopidogrel bisulfate).[1,2]

Clopidogrel oral suspension was prepared using clopidogrel bisulfate tablets. The tablets were pulverized in a glass mortar. Ora-Plus and Ora-Sweet 1:1 was mixed and used as the vehicle. The vehicle was added in portions geometrically to final volume and mixed well. The preparation was placed in amber plastic containers with child-resistant caps. Samples were sonicated in a water bath for 10 minutes to ensure clopidogrel dissolution. The preparations were stored at either room or refrigerated temperatures and sampled initially and at 7, 14, 28, and 60 days.

At least 97% of the initial concentration of clopidogrel remained throughout the 60 day study period at both temperatures. There was no detectable change in color, odor or taste and no visible microbial growth in any sample. No appreciable change in the pH occurred in any of the samples at either temperature (pH 2.65).

In summary, clopidogrel 5mg/mL in a 1:1 mixture of Ora-Plus and Ora-Sweet is stable for at least 60 days when stored in 2-oz amber plastic containers at either room or refrigerated temperatures.[4]

Table 3: Stability of clopidogrel 5 mg/mL oral suspension at room and refrigerated temperatures in amber plastic containers.

Temperature	% Initial Concentration Remaining*				
Days	Initial[a]	7	14	28	60
25° C	4.97 (0.08)	98.4 (1.1)	96.7 (1.9)	96.3 (2.0)	97.3 (1.4)
5° C	5.04 (0.05)	98.9 (1.9)	98.1 (2.2)	98.6 (1.3)	99.5 (1.4)

* (Mean ± S.D.)
[a] Initial Drug Concentration (mg/mL)

Nitrofurantoin

Nitrofurantoin ($C_8H_6N_4O_5$, MW 238.16) is an antimicrobial used in the treatment of urinary tract infections. It occurs as lemon yellow, odorless crystals or as a fine powder. It has a bitter aftertaste and is very slightly soluble in water and in alcohol.[1]

Nitrofurantoin 10 mg/mL was studied in a 1:1 mixture of Ora-Sweet and Ora-Plus in amber plastic prescription containers. It was prepared by crushing commercially available nitrofurantoin 50 mg tablets and suspending in a 1:1 mixture of Ora-Plus and Ora-Sweet. The preparation was stored at both refrigerated and room temperatures and exposed to fluorescent light. The physical appearance, pH, resuspendability, viscosity and chemical analysis was evaluated at weekly intervals for up to 91 days.

For the first 14 days, there was no change in physical appearance, odor, color or taste. Afterward, a very slight change in taste and smell occurred and these characteristics remained stable until day 91. The pH remained reasonably stable at 4.45 (refrigerated) and 4.41 (room temperature). Chemically, nitrofurantoin samples retained over 90% of their initial concentrations throughout the duration of the study.

In summary, nitrofurantoin 10 mg/mL oral suspension prepared with Ora-Plus and Ora-Sweet and stored in amber plastic prescription bottles is stable at both room and refrigerated temperatures for up to 91 days.[5]

Table 4: Stability of nitrofurantoin 10 mg/mL stored at 4° C and 25° C and packaged in amber plastic containers.

Temperature	% Mean Percentage Remaining*					
Days	0	7	14	28	56	91
4° C	0.861 (0.034)	93.4	100.1	111.0	99.4	97.8
25° C	0.859 (0.045)	91.7	100.2	94.9	98.6	104.1

* (Mean ± S.D.)

Norfloxacin

Norfloxacin ($C_{16}H_{18}FN_3O_3$, MW 319.33, Noroxin®) is a synthetic, broad-spectrum fluoroquinolone antimicrobial. It is effective against a broad range of gram-positive and gram-negative aerobes but is not active against anaerobes. It occurs as a white to pale yellow, crystalline powder that is sensitive to light and moisture. It is slightly soluble in water and in alcohol and freely soluble in acetic acid.[1] The solubility in water increases sharply at acidic pH values less than 5 or at pH values above 10. The commercial norfloxacin ophthalmic solution has a pH in the range of 5.0 to 5.4.[1]

Noroxin® tablets contain, in addition to norfloxacin, cellulose, croscarmellose sodium, hydroxypropyl cellulose, hydroxypropyl methylcellulose, iron oxide, magnesium stearate and titanium dioxide.

Norfloxacin 20 mg/mL oral suspension was prepared by crushing commercially available tablets in a glass mortar and gradually adding the vehicle with mixing to final volume. The vehicle consisted of 1:1 Ora-Plus and strawberry syrup. The preparation was placed in amber plastic prescription bottles and stored at either refrigerator or room temperature with normal fluorescent lighting. Samples were evaluated initially and after 7, 14, 28 and 56 days of storage.

At least 93% of the initial norfloxacin concentration remained at each of the time periods and there was no detectable change in color or odor and no visible microbiological growth in any sample. The pH was 5.88 and there was no appreciable change during the study.

In summary, norfloxacin 20 mg/mL oral suspension packaged in amber plastic prescription bottles is stable for up to 56 days when stored at either room or refrigerated temperature.[6]

Table 5: Stability of norfloxacin 20 mg/mL stored in amber plastic containers at either room or refrigerated temperature.

Temperature	% Initial Concentration Remaining*				
Days	0	7	14	28	56
4° C	20.46[a] (0.09)	98.31 (1.55)	98.19 (0.71)	94.65 (1.16)	93.38 (0.46)
25° C	19.79[a] (0.36)	101.76 (1.03)	100.12 (1.54)	97.69 (1.81)	101.92 (0.69)

* (Mean ± S.D.)
[a] Initial Drug Concentration (mg/mL)

Oseltamivir

Oseltamivir is a neuraminidase inhibitor that is active against all subtypes of influenza A and B viruses. Influenza epidemics account for more morbidity in the developed world than all other respiratory diseases combined. Oseltamivir (Tamiflu®) is commercially available as 75 mg capsules and as a powder for suspension. After reconstitution, the suspension contains 300 mg oseltamivir base per 25 mL.

In the event of a pandemic, there could be a shortage of the suspension for those patients (pediatric and geriatric) that cannot swallow the capsules. Larger quantities of the capsules can be stored in a smaller space than the powder for suspension; consequently, many pharmacies may have on hand sufficient capsules but insufficient powder for suspension product. In this situation, the current formula can be used to provide a suitable dosage form for these patients that can be compounded from the oral capsules.

Oseltamivir phosphate ($C_{16}H_{28}N_2O_4 \cdot H_3PO_4$, MW 410.4) occurs as a white crystalline solid with a bitter taste. It has an aqueous solubility of 588 mg/mL at 25° C. Oseltamivir capsules also contain pregelatinized starch, talc, povidone K30, croscarmellose sodium, and sodium stearyl fumarate. The powder for suspension also contains xanthan gum, monosodium citrate, sodium benzoate, sorbitol, saccharin sodium, titanium dioxide and tutti-frutti flavor.[7]

Oseltamivir 15 mg/mL oral suspension was prepared by emptying the commercial capsules of their powder into a clean mortar and pulverizing to a fine powder. Sufficient Ora-Sweet SF is added geometrically to final volume and mixed well. The preparation is packaged in amber glass or amber PET containers and stored at room or refrigerated temperatures and sampled for up to 35 days.

Table 6: Stability of oseltamivir 15mg/mL stored at 5°C and 25°C.

Temperature	% Initial Concentration Remaining*			
Days	5	13	25	35
5° C	98.1	97.7	98.7	98.2
25° C	97.9	96.9	98.2	97.7

The results showed that oseltamivir 15 mg/mL in Ora-Sweet SF was stable for up to 35 days at room or refrigerated temperatures.[8]

Quinapril

Quinapril is an ACE inhibitor used in the treatment of hypertension, congestive heart failure and diabetic nephropathy. It is generally unstable in aqueous solution but is most stable in the narrow pH range of 5.5 to 6.5. The current formulation was developed at Pfizer Global Research and Development. The group developed three formulas that were stable for 6 weeks when stored at 5° C. In addition to the two formulas present here (one each using Ora-Sweet and Ora-Sweet SF), simple syrup was also used as a vehicle.

Quinapril hydrochloride ($C_{25}H_{30}N_2O_5 \cdot HCl$, MW 474.98) occurs as a white to off-white powder with a pink cast at times. It is freely soluble in aqueous solvents. One mg of quinapril is approximately equivalent to 1.08 mg of quinapril hydrochloride. K-Phos® Neutral tablets contain 852 mg dibasic sodium phosphate anhydrous, 155 mg monobasic potassium phosphate and 130 mg monobasic sodium phosphate monohydrate. Inactive ingredients include magnesium stearate, microcrystalline cellulose, povidone, sodium starch glycolate and sugar.[1]

Quinapril 1 mg/mL oral liquid is prepared by pulverizing K-Phos Neutral and quinapril tablets in a mortar with a pestle. Purified water is added along with Bicitra and mixed well. Finally either Ora-Sweet or Ora-Sweet SF is added to final volume and mixed well. The Bicitra is added to keep the pH less than 6.5; otherwise, a higher pH value may occur due to the magnesium carbonate in the quinapril tablets. Samples were stored under refrigerated conditions and sampled for up to 6 weeks.[9]

In summary, quinapril oral suspension was stable when stored in a refrigerator for up to six weeks.

Rufinamide

Rufinamide ($C_{10}H_8F_2N_4O$, MW 238.19, Banzel®) is a triazole-derivative anticonvulsant used in the treatment of seizures associated with Lennox-Gastaut Syndrome and in partial seizures. It occurs as a white, crystalline, odorless and slightly bitter tasting neutral powder that is practically insoluble in water and very slightly soluble in ethanol.

It is available as 200 mg and 400 mg of drug along with colloidal silicon dioxide, corn starch, croscarmellose sodium, hypromellose, lactose monohydrate, magnesium stearate, microcrystalline cellulose, and sodium lauryl sulfate. The film coating consist of hypromellose, iron oxide red, polyethylene glycol, talc, and titanium dioxide.[2]

Rufinamide 40 mg/mL oral suspension was prepared from commercial tablets which were thoroughly pulverized in a glass mortar. Ora-Plus was added with mixing to half the final volume. Either Ora-Sweet or Ora-Sweet SF was added to final volume and mixed well. The preparation was placed into amber polypropylene plastic containers closed with child-resistant caps and stored at room temperature. Samples were obtained and analyzed initially and after 7, 14, 28, 56 and 90 days of storage. The results showed that both suspensions remained stable throughout the 90 day study period at both temperatures. The pH of the Ora-Sweet preparation was 4.43 and with Ora-Sweet SF was 4.32 and remained unchanged throughout the study.

In summary, rufinamide 40 mg/mL in a 1:1 mixture of Ora-Plus and Ora Sweet or Ora-Sweet SF are stable for at least 90 days when stored in amber plastic containers at room temperature.[10]

Table 7: Stability of rufinamide suspension 40 mg/mL in two vehicles at room temperature.

Vehicle	% Initial Concentration Remaining*					
Days	0	7	14	28	56	90
Ora-Plus and Ora-Sweet	41[a] (1.7)	103 (1.4)	99 (0.0)	97 (1.4)	100 (1.4)	92 (1.4)
Ora-Plus and Ora-Sweet SF	41[a] (0.0)	104 (6.5)	100 (1.4)	100 (2.9)	100 (3.8)	101 (0.0)

* (Mean ± S.D.)
[a] Initial Drug Concentration (mg/mL)

Sumatriptan

Sumatriptan succinate ($C_{14}H_{21}N_3O_2S{\cdot}C_4H_6O_4$, MW 413.49) occurs as a white or almost white powder that is freely soluble in water. A 1% solution in water has a pH of 4.5 to 5.3 and it should be protected from light. Fifty mg of sumatriptan is contained in approximately 70 mg of sumatriptan succinate.[1,2]

Orally administered, sumatriptan is rapidly, but incompletely absorbed, and undergoes first-pass metabolism resulting in a low absolute bioavailability of only about 14%. Intranasally, bioavailability is 16% relative to subcutaneous administration. Sumatriptan has an elimination half life of about 2 hours. Rectal administration may increase the bioavailability of sumatriptan relative to oral administration.

Sumatriptan 5 mg/mL oral suspension was prepared by using the commercial tablets and pulverizing in a porcelain mortar with a pestle to a fine powder. Small portions of the suspension vehicle were added with mixing thoroughly between additions to final volume. The preparation was placed in amber glass bottles and stored at refrigerated temperature. Samples were removed initially and after 2, 7, 14, 21, 28, 35 and 60 days.

The results showed that sumatriptan 5 mg/mL in Ora-Sweet:Ora-Plus and Ora-Sweet SF:Ora-Plus stored in a refrigerator are stable for at least 21 days. The pH of the preparations was 4.0 and 4.1 and remained essentially unchanged throughout the study.[11]

Table 8: Stability of sumatriptan 5 mg/mL oral liquid packaged in amber glass bottles at refrigerated temperatures.

Vehicle	% Initial Concentration Remaining*							
Days	0	2	7	14	21	28	35	60
Ora-Plus with Ora-Sweet	5.155[a] (0.149)	94.6 (2.9)	95.3 (0.5)	97.1 (3.1)	94.9 (1.8)	88.6 (2.7)	89.1 (2.4)	82.9 (2.4)
Ora-Plus with Ora Sweet SF	5.242[a] (0.225)	96.7 (2.4)	94.6 (1.9)	99.5 (7.2)	92.5 (4.8)	87.5 (2.4)	82.7 (4.8)	80.4 (1.9)

* (Mean ± S.D.)
[a] Initial Drug Concentration (mg/mL)

Temozolomide

Temozolomide ($C_6H_6N_6O_2$, MW 194.15, Temodar®) is an imidazotetrazine derivative that is a prodrug used in the treatment of glioblastoma multiforme and refractor anaplastic astrocytoma. After oral administration, it undergoes rapid non-enzymatic conversion to its active form. Temozolomide is available in 5, 20, 100 and 250 mg capsules. The capsules also contain anhydrous lactose, colloidal silicon dioxide, sodium starch glycolate, tartaric acid and stearic acid.[2]

Using containment and personnel protection for handling hazardous substances, temozolomide 10 mg/mL oral liquid was prepared by emptying the contents of temozolomide capsules into a suitable mortar. Povidone K-30 is added and mixed well. Citric acid is dissolved in a small amount of purified water and added to the powder mixture. A small amount of Ora-Plus is added to form a smooth mixture. The remainder of the Ora-Plus is added geometrically. Sufficient Ora-Sweet or Ora-Sweet SF is added to final volume and mixed well. The preparation is placed in amber plastic screw-cap prescription bottles and stored at room or refrigerated temperatures. Samples were obtained initially and after 1, 7, 14 and 21 days at both temperatures as well as after 30, 45 and 60 days at refrigerated temperatures. The results showed that the temozolomide suspensions showed little or no loss when stored in the refrigerator after 60 days. At room temperature, however, there was significant loss after shorter time periods when stored at room temperature. Therefore, storage at refrigerated temperature is recommended.[12]

Table 9: Stability of temozolomide 10 mg/mL oral suspensions.

Vehicle/Temp	% Initial Concentration Remaining*						
Days	1	7	14	21	30	45	60
Ora-Plus:Ora-Sweet							
4° C	-	100.0 (1.2)	99.5 (1.1)	-	98.7 (0.6)	100.8 (1.2)	99.2 (1.4)
23° C	98.3 (1.4)	94.4 (1.0)	86.3 (2.3)	79.0 (2.1)	-	-	-
Ora-Plus:Ora-Sweet SF							
4° C	-	99.2 (0.7)	100.9 (0.1)	-	101.5 (1.5)	101.0 (0.9)	100.3 (1.6)
23° C	97.0 (0.6)	95.4 (0.9)	92.6 (0.3)	89.9 (0.7)	-	-	-

* (Mean ± S.D.)

Tiagabine

Tiagabine hydrochloride ($C_{20}H_{25}NO_2S_2{\cdot}HCl$, MW 412.02, Gabitril®) is a nipecotic acid derivative used as an anticonvulsant. It differs structurally from other currently available anticonvulsant agents. It occurs as a white to off-white powder that is sparingly soluble in water. Tiagabine hydrochloride is administered orally; food will delay but not decrease the extent of tiagabine absorption. The manufacturer of the commercial tablets states that tiagabine should be taken with food. It is commercially available as 2 mg, 4 mg, 12 mg, 16 mg and 20 mg film-coated tablets. The tablets also contain ascorbic acid, colloidal silicon dioxide, crospovidone, hydrogenated vegetable oil wax, hydroxypropyl cellulose, hydroxypropyl methylcellulose, lactose, magnesium stearate, microcrystalline cellulose, pregelatinized starch, stearic acid and titanium dioxide, along with a FD&C or D&C dye, depending upon the tablet strength.[1,2]

Tiagabine 1 mg/mL oral liquid was prepared from the commercial tablets. The tablets were pulverized in a mortar and mixed with a 1:1 mixture of Ora-Sweet:Ora-Plus. The suspension was placed in amber plastic prescription bottles and stored at either refrigerator or room temperature conditions. Samples were collected initially and after 7, 14, 28, 42, 56, 70 and 91 days of storage.

At refrigerated temperature, the tiagabine was stable for at least 91 days and at room temperature, the preparation of Ora-Plus:Ora-Sweet was stable for 70 days.[13]

Table 10: Stability of tiagabine at both refrigerated and room temperatures.

Temperature	% Initial Concentration Remaining*						
Days	0	7	14	28	56	70	91
4° C	1.1[a]	100.7	100.5	100.1	99.2	98.7	98.1
	(0.1)	(1.09)	(1.33)	(1.30)	(1.18)	(2.03)	(2.18)
25° C	1.1[a]	101.7	100.9	100.1	96.6	92.3	87.6
	(0.0)	(1.47)	(1.59)	(0.95)	(1.41)	(2.19)	(2.71)

* (Mean ± S.D.)
[a] Initial Drug Concentration (mg/mL)

REFERENCES

1.USP Pharmacists Pharmacopeia, 2nd ed., U.S. Pharmacopeial Convention, Inc., Rockville MD, 2008, pp 105, 134, 258, 260, 304, 331, 341, 1428, 1432, 1450, 1458, 1463, 1465.

2.Physicians' Desk Reference, 65th Ed., 2011. Montvale NJ. PDR Network, LLC. 2011, pp 962, 1011, 1415, 2188, 2311, 3506.

3.Burckart GJ, Hannond RW, Akers MJ. Stability of extemporaneous suspensions of carbamazepine. Am J Hosp Pharm. 1981 Dec;38(12)1929-31.

4.Dentinger pJ, Swenson CF, Anaizi NH. Stability of famotidine in an extemporaneously compounded oral liquid. Am J Health-Syst Pharm. 2000;57:1340-2.

5.Ensom MHH, Decarie D. Stability of nitrofurantoin in extemporaneously compounded suspensions. Can J Hosp Pharm 2006;59:29-33.

6.Johnson CE, Price J, Hession JM. Stability of norfloxacin in an extemporaneously prepared oral liquid. Am J Health-Syst Pharm. 2001;58:477-9.

7.Tamiflu® [package insert]. Nutley, N.J.; Roche Pharmaceuticals; revised 02/2011. Accessed at www.gene.com/gene/products/information/tamiflu/pdf/pi.pdf, May 4, 2011.

8.Winiarski AP, Infeld MH, Tesherne R, Bachynsky M, Rucki R, Nagano-Mate K. Preparation and stability of extemporaneous oral liquid formulations of oseltamivir using commercially available capsules. J Am Pharm Assoc. 2007;47:747-755.

9.Freed AL, Silbering SB, Kolodsick KJ et al. The development and stability assessment of extemporaneous pediatric formulations of Accupril. Int J Pharm. 2005;304(1-2):135-144.

10. Hutchinson DJ, Liou Y, Best R, Zhao F. Stability of extemporaneously prepared rufinamide oral suspensions. The Annals of Pharmacotherapy. 2010;44:462-5.

11. Fish DN, Beall HD, Goodwin SD, Fox JL. Stability of sumatriptan succinate in extemporaneously prepared oral liquids. Am J Health-syst Pharm. 1997;54:1619-22.

12. Trissel LA, Zhang Y, Koontz SE. Temozolomide stability in extemporaneously compounded oral suspensions. Int J Pharm Cmpdg 10(5) Sept/Oct 2006, 396-399.

13. Nahata MC, Morosco RS. Stability of tiagabine in two oral liquid vehicles. Am J Health-Syst Pharm. 2003;60:75-7.