

Amprenavir

Brand Name: Agenerase

Drug Class: Protease Inhibitors



Drug Description

Amprenavir is a hydroxyethylamine sulfonamide derivative HIV protease inhibitor (PI). [1]

HIV/AIDS-Related Uses

Amprenavir was approved by the FDA on April 15, 1999, for use in combination with other antiretroviral agents for the treatment of HIV-1 infection.[2] Because of the risk of toxicity from the large amount of propylene glycol in amprenavir oral solution, this dosage form of amprenavir is contraindicated in children younger than 4 years old, pregnant women, patients with hepatic or renal failure, or patients being treated with disulfiram or metronidazole. Amprenavir oral solution should be used only when amprenavir capsules or other HIV PIs are not therapeutic options.[3]

The amprenavir prodrug fosamprenavir was approved by the FDA on October 20, 2003, for the treatment of HIV infection in combination with other antiretrovirals.[4] Fosamprenavir is rapidly converted to amprenavir in vivo.[5] Fosamprenavir has a lower pill burden than amprenavir, provides the choice of a once-daily regimen (ritonavir-boosted fosamprenavir), and has possibly better gastrointestinal (GI) tolerability than amprenavir.[6]

In October 2007, the manufacturer of amprenavir capsules and oral solution discontinued production of the drug for sale in the United States in favor of production of fosamprenavir, the prodrug of amprenavir. Because of approval of fosamprenavir oral solution and dosing recommendations for use in children and in patients with hepatic impairment, clinical demand for amprenavir had decreased. Amprenavir may continue to be available outside of the United States.[7] [8]

Pharmacology

Amprenavir is a selective, competitive, reversible inhibitor of HIV protease, an enzyme that plays an essential role in HIV replication. Amprenavir is pharmacologically related to other HIV PIs but is structurally different from these and other

antiretroviral drugs that are currently available. Amprenavir's structure inhibits the function of HIV protease, interfering with the formation of essential viral proteins. The drug is active in both acutely and chronically infected cells; chronically infected cells are not affected by nucleoside reverse transcriptase inhibitors (NRTIs). Although amprenavir does not affect early stages of the HIV replication cycle, it does interfere with the production of infectious HIV, limiting further spread of the virus.[9]

Amprenavir is active against HIV-1 and, to a lesser extent, HIV-2. Unlike nucleoside analogue antiretroviral agents, amprenavir's antiviral activity does not require intracellular conversion to an active metabolite. PIs, including amprenavir, act at a different stage of HIV replication than do NRTIs and non-nucleoside reverse transcriptase inhibitors (NNRTIs).[10]

Study results indicate that oral bioavailability of amprenavir is 14% greater when the drug is administered as liquid-filled capsules than when administered as oral solution. Amprenavir capsules and oral solution are not bioequivalent and are not interchangeable on a mg per mg basis.[11]

When given alone, amprenavir is not well absorbed from the GI tract; however, when formulated with vitamin E, amprenavir's bioavailability substantially increases. In HIV infected adults receiving a 1,200-mg dose of amprenavir capsules twice daily, peak plasma concentrations (C_{max}) averaged 7.66 mcg/ml at 1 hour after dosing, and the area under the concentration-time curve (AUC) averaged 17.7 mcg(h)/ml. In HIV infected children 4 to 12 years old who received 5 to 20 mg/kg as liquid-filled capsules, C_{max} were less than proportional; however, the increases in AUC were proportional. By contrast, HIV infected 4- to 12-year olds receiving 20 mg/kg of oral solution twice daily had an average AUC of 15.46 mcg(h)/ml and C_{max} of 6.7 mcg/ml at 1.1 hours after dosing. In patients with hepatic impairment, C_{max} may be increased. After receiving a single 600-mg dose of amprenavir, adults with moderate cirrhosis had an average AUC of 25.76 mcg(h)/ml and adults with severe cirrhosis had an average

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Pharmacology (cont.)

AUC of 38.66 mcg(h)/ml, compared with 12 mcg(h)/ml in healthy adults.[12]

Distribution of amprenavir into body tissues has not been fully characterized. The apparent volume of distribution in healthy adults is approximately 430 l. Cerebrospinal fluid concentrations are reportedly less than 1% of plasma concentrations. In vitro, amprenavir is approximately 90% bound to plasma or serum proteins.[13]

The plasma elimination half-life of amprenavir in HIV infected adults with normal renal and hepatic function ranges from 7.1 to 10.6 hours. The drug is metabolized principally by cytochrome P450 (CYP) 3A4. Less than 3% of amprenavir is eliminated unchanged in urine. After a single oral dose of radiolabeled amprenavir, approximately 14% of the dose is eliminated in the urine and 75% in feces, with two metabolites accounting for 90% of radioactivity in feces.[14]

Amprenavir is in FDA Pregnancy Category C. There are no adequate and controlled studies to date with amprenavir in pregnant women. Amprenavir should be used during pregnancy only when clearly needed. The oral solution form of amprenavir should not be used in pregnant women because the large amount of propylene glycol excipient used in the formulation presents a toxicity risk to the fetus. An Antiretroviral Pregnancy Registry has been established to monitor the outcomes of pregnant women exposed to antiretroviral agents, including amprenavir. Physicians may register patients by calling 1-800-258-4263 or online at: <http://www.APRegistry.com>. It is not known whether amprenavir is distributed into human milk; however, it is distributed into milk in rats. HIV infected mothers are advised not to breastfeed to prevent postnatal mother-to-child transmission of HIV. Mothers should be instructed not to breastfeed if they are receiving amprenavir.[15]

Because amprenavir is metabolized principally by the liver, the manufacturer recommends caution when administering the drug to patients with hepatic impairment.[16] While it is unknown whether amprenavir is removed by hemodialysis or peritoneal dialysis, it is unlikely that substantial

amounts would be removed by these procedures since the drug is metabolized by the liver and is highly protein bound.[17]

In vitro studies indicate that the antiretroviral effects of HIV PIs and some NRTIs or NNRTIs may be synergistic. Strains of HIV-1 with in vitro resistance to amprenavir have emerged during therapy when the drug is given alone or in combination with other antiretroviral agents. The initial mutation following exposure to amprenavir appears to occur at amino acid position 50. This mutation alone generally results in a two- to threefold decrease in susceptibility to the drug.[18]

Clinical evidence suggests that some degree of cross resistance occurs among various HIV PIs. Cross resistance between amprenavir and other PIs has not been fully explored. In initial studies, however, amprenavir and the investigational PI VB-11,328 exhibited a unique resistance pattern that may result in extensive cross resistance between these derivatives but less extensive cross resistance with other PIs. Cross resistance between amprenavir and NRTIs or NNRTIs is unlikely because these drugs have different target enzymes.[19]

Adverse Events/Toxicity

The most frequently reported serious side effects include hyperglycemia, hypercholesterolemia, hypertriglyceridemia, peripheral paresthesia, skin rash, and mood disorders. Other less serious side effects include GI disturbances, headache, oral paresthesia, fatigue, and taste disorders.[20]

In clinical studies, 22% of patients treated with amprenavir developed skin rash. Although most rashes were of mild to moderate intensity, approximately 1% of patients receiving amprenavir developed a severe or life-threatening rash (Grade 3 or 4), including Stevens-Johnson syndrome. Amprenavir should be discontinued in patients with severe or life-threatening rash or with moderate rash accompanied by systemic reactions.[21]

There have been reports of spontaneous bleeding in patients with hemophilia A and B treated with PIs. In some patients additional factor VIII was required. In many of the reported cases, treatment

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Adverse Events/Toxicity (cont.)

with PIs was continued or restarted. A causal relationship between PI therapy and these episodes has not been established.[22]

Immune reconstitution syndrome has been reported in patients treated with combination antiretroviral therapy, including amprenavir. During the initial phase of combination antiretroviral treatment, a patient whose immune system improves may develop an inflammatory response to indolent or residual opportunistic infections, such as *Mycobacterium avium* infection, cytomegalovirus infections, *Pneumocystis jirovecii* pneumonia, or tuberculosis. Symptoms of immune reconstitution syndrome necessitate further evaluation and treatment.[23]

Redistribution of body fat, peripheral wasting, facial wasting, breast enlargement, and cushingoid appearance have been observed in patients receiving antiretroviral therapy.[24]

Treatment with amprenavir alone or in combination with ritonavir has resulted in increases in the concentration of total cholesterol and triglycerides. Cholesterol and triglyceride testing should be performed prior to initiation of amprenavir therapy and at periodic intervals during treatment. Lipid disorders should be managed as clinically appropriate.[25]

Drug and Food Interactions

Amprenavir may be taken with or without food. However, high-fat meals should be avoided because they may decrease the absorption of amprenavir.[26] [27]

Because both the capsule and oral solution dosage forms of amprenavir contain vitamin E, patients receiving either amprenavir formulation should not take vitamin E supplements.[28] In addition, patients receiving amprenavir oral solution should not consume alcoholic beverages because of the potential risk of adverse effects related to the propylene glycol excipient contained in the oral solution.[29] Also, disulfiram is contraindicated in patients receiving amprenavir oral solution.[30]

Although amprenavir appears to be a less potent inhibitor of CYP3A4 than some other PIs, metabolism of amprenavir is mediated by this isoenzyme to some degree. Drugs that induce CYP3A4 may reduce amprenavir plasma concentrations. Conversely, drugs that inhibit this isoenzyme may increase plasma concentrations of amprenavir.[31]

Concomitant use of amprenavir with certain drugs that are highly dependent on CYP3A4 for clearance may raise the plasma levels of these drugs, potentially resulting in serious or life-threatening events. Drugs that are contraindicated with amprenavir include bepridil, cisapride, dihydroergotamine, ergonovine, ergotamine, methylergonovine, midazolam, pimozide, and triazolam. Rifampin is a potent inducer of CYP3A4 and can markedly reduce plasma concentrations of amprenavir.[32] If amprenavir is coadministered with ritonavir, flecainide and propafenone are also contraindicated.[33]

Amprenavir should not be coadministered with delavirdine, because it may lead to loss of virologic response and possible resistance to delavirdine.[34]

Concomitant use of abacavir and amprenavir may increase amprenavir serum concentrations.[35] Decreased concentrations of amprenavir and saquinavir were observed when these two drugs were taken concurrently.[36]

Concomitant use of amprenavir with lovastatin or simvastatin is not recommended. Caution should be used when any HIV PIs, including amprenavir, are used concurrently with other HMG-CoA reductase inhibitors that are metabolized by the CYP3A4 pathway (for example, atorvastatin or cerivastatin). The resulting increased concentration of statins may increase the risk of myopathy or rhabdomyolysis.[37]

Concomitant use of products containing St. John's wort (*Hypericum perforatum*) with amprenavir or other PIs is not recommended. St. John's wort is expected to substantially decrease drug plasma levels and may lead to loss of virologic response and possible resistance to amprenavir or other PIs.[38]

Serious or life-threatening events can occur if

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Drug and Food Interactions (cont.)

amprenavir is taken with amiodarone, lidocaine, tricyclic antidepressants, and quinidine. Patients receiving amprenavir concomitantly with any of these drugs should be carefully monitored.[39]

Caution should be used when prescribing sildenafil in patients receiving PIs, including amprenavir. Coadministration of a PI with sildenafil is expected to substantially increase sildenafil concentrations and, possibly, sildenafil-associated adverse effects, including hypotension, visual changes, and priapism.[40]

Concomitant use of amprenavir with certain other drugs may significantly increase or decrease plasma concentrations of amprenavir or of the coadministered drug. Adjustment in dosage or regimen should be considered when amprenavir is coadministered with any of the following drugs: antacids, didanosine, ketoconazole, itraconazole, methadone, rifabutin, and ritonavir.[41]

Concomitant use of amprenavir and oral or other contraceptives containing ethinyl estradiol/norethindrone may lead to loss of virologic response. Alternative methods of nonhormonal contraception are recommended.[42]

Amprenavir is a sulfonamide. The potential for cross-sensitivity between other sulfonamides and amprenavir is unknown. Amprenavir should be used with caution in patients with a known sulfonamide allergy.[43]

Amprenavir may increase serum concentrations of warfarin when these two drugs are taken together.[44]

Contraindications

Amprenavir is contraindicated in patients with clinically significant hypersensitivity to the drug or any components in either of the formulations.[45]

Because of potential toxicity from the large amount of propylene glycol excipient in amprenavir oral solution, this dosage form is contraindicated in children under 4 years old, pregnant women, patients with hepatic or renal failure, and patients being treated with disulfiram or metronidazole.

Amprenavir oral solution should only be used when amprenavir capsules or other HIV PIs are not therapeutic options.[46]

Clinical Trials

For information on clinical trials that involve Amprenavir, visit the ClinicalTrials.gov web site at <http://www.clinicaltrials.gov>. In the Search box, enter: Amprenavir AND HIV Infections.

Dosing Information

Mode of Delivery: Oral.[47]

Dosage Form: Liquid-filled capsules containing amprenavir 50 mg.[48]

Oral solution containing amprenavir 15 mg per ml.[49]

The recommended dose of amprenavir in capsule form is 1,200 mg (twenty-four 50-mg capsules) twice daily. If amprenavir and ritonavir are used in combination, the recommended dosage regimens are as follows: amprenavir 1,200 mg with ritonavir 200 mg once daily or amprenavir 600 mg with ritonavir 100 mg twice daily. For adolescents aged 13 to 16 years, the recommended dose is 1,200 mg (twenty-four 50 mg capsules) twice daily in combination. For patients aged 4 to 12 years or for patients aged 13 to 16 years weighing less than 50 kg (66 lbs), the recommended dose is 20 mg/kg twice daily or 15 mg/kg three times daily (to a maximum daily dose of 2,400 mg). Amprenavir capsules should be used with caution in patients with moderate or severe hepatic impairment. Patients with a Child-Pugh score ranging from 5 to 8 should receive a reduced dose of 450 mg twice daily, and patients with a Child-Pugh score ranging from 9 to 12 should receive a reduced dose of 300 mg twice daily.[50]

The recommended dose of amprenavir in oral solution for adults, adolescents aged 16 years and older, and adolescents aged 13 to 16 years who weigh more than 50 kg is 1,400 mg twice daily. For children aged 4 to 12 years or adolescents aged 13 to 16 years who weigh less than 50 kg, the recommended dose is 22.5 mg/kg twice daily (maximum dose, 2,800 mg per day) or 17 mg/kg

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Dosing Information (cont.)

three times a day (maximum dose, 2,800 mg per day).[51]

Storage: Store capsules and oral solution should be stored at controlled room temperature of 25 C (77 F).[52]

Chemistry

CAS Name: (3S)-tetrahydro-3-furyl N-[(1S,2R)-3-(4-amino-N-isobutylbenzenesulfonamido)-1-benzyl-2-hydroxypropyl]carbamate[53]

CAS Number: 161814-49-9[54]

Molecular formula: C₂₅H₃₅N₃O₆S[55]

C59.39%, H6.98%, N8.31%, O18.98%, S6.34%.[56]

Molecular weight: 505.64[57]

Physical Description: White to cream-colored solid.[58]

Stability: When stored as directed, the capsules have an expiration date of 1.5 years, and the oral solution has an expiration date of 1 year after manufacture.[59]

Solubility: Soluble as 0.04 mg/ml in water and 86 mg/ml in alcohol.[60]

Other Names

Vertex VX478[61]

VX-478[62]

APV[63]

Further Reading

Arvieux C, Tribut O. Amprenavir or fosamprenavir plus ritonavir in HIV infection: pharmacology, efficacy and tolerability profile. *Drugs*. 2005;65(5):633-59. Review.

Bartlett JA, Johnson J, Herrera G, Sosa N,

Rodriguez A, Liao Q, Griffith S, Irlbeck D, Shaefer MS; Clinically Significant Long-Term Antiretroviral Sequential Sequencing Study (CLASS) Team. Long-term results of initial therapy with abacavir and Lamivudine combined with Efavirenz, Amprenavir/Ritonavir, or Stavudine. *J Acquir Immune Defic Syndr*. 2006 Nov 1;43(3):284-92.

Manufacturer Information

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5 Moore Drive
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For More Information

Contact your doctor or an AIDSinfo Health Information Specialist:

- Via Phone: 1-800-448-0440 Monday - Friday, 12:00 p.m. (Noon) - 5:00 p.m. ET
- Via Live Help: http://aidsinfo.nih.gov/live_help Monday - Friday, 12:00 p.m. (Noon) - 4:00 p.m. ET

References

1. AHFS Drug Information - 2007; p. 625
2. FDA - Drugs Used in the Treatment of HIV Infection. Available at: <http://www.fda.gov/oashi/aids/virals.html>. Accessed 12/16/08.
3. FDA - Agenerase Oral Solution Prescribing Information, 11/04/05, p. 12. Available at: <http://www.fda.gov/cder/foi/label/2005/021039s0171bl.pdf>. Accessed 12/16/08.
4. FDA - Drugs Used in the Treatment of HIV Infection. Available at: <http://www.fda.gov/oashi/aids/virals.html>. Accessed 12/16/08.
5. FDA - Lexiva Prescribing Information, 02/07/07, p. 1. Available at: <http://www.fda.gov/cder/foi/label/2008/021548s017, 022116s0011bl.pdf>. Accessed 12/16/08.
6. AHFS Drug Information - 2007; p. 618
7. HIV InSite - Antiretroviral Drug Profiles: Amprenavir. Available at: <http://hivinsite.ucsf.edu/InSite?page=ar-03-05>. Accessed 12/16/08.
8. FDA - Discontinuation of Agenerase (amprenavir) Oral Solution and 50 mg Capsules in the US [Dear Healthcare Provider letter], August 2007. Available at: <http://www.fda.gov/CDER/Drug/shortages/AGN-DC%20DHP%20Letter.pdf>. Accessed 12/16/08.
9. AHFS Drug Information - 2007; p. 624
10. AHFS Drug Information - 2007; p. 624
11. AHFS Drug Information - 2007; p. 625
12. AHFS Drug Information - 2007; p. 625
13. AHFS Drug Information - 2007; p. 625
14. AHFS Drug Information - 2007; p. 625
15. Pharm GKB - Amprenavir Prescribing Information. Available at: <http://www.pharmgkb.org>. Accessed 12/16/08.
16. European Medicines Agency - Agenerase Capsules Prescribing Information, 11/04/05, p. 11. Available at: <http://www.fda.gov/cder/foi/label/2005/021007s0171bl.pdf>. Accessed 12/16/08.
17. AHFS Drug Information - 2007; p. 625
18. AHFS Drug Information - 2007; p. 624
19. AHFS Drug Information - 2007; p. 624
20. Wolters Kluwer Health, Inc. - Amprenavir, Facts and Comparisons 4.0. Available at: <http://online.factsandcomparisons.com>. Accessed 12/16/08.
21. FDA - Agenerase Capsules Prescribing Information, 11/04/05, p. 19. Available at: <http://www.fda.gov/cder/foi/label/2005/021007s0171bl.pdf>. Accessed 12/16/08.
22. FDA - Agenerase Capsules Prescribing Information, 11/04/05, p. 11. Available at: <http://www.fda.gov/cder/foi/label/2005/021007s0171bl.pdf>. Accessed 12/16/08.
23. FDA - Agenerase Capsules Prescribing Information, 11/04/05, p. 11. Available at: <http://www.fda.gov/cder/foi/label/2005/021007s0171bl.pdf>. Accessed 12/16/08.
24. FDA - Agenerase Capsules Prescribing Information, 11/04/05, p. 11. Available at: <http://www.fda.gov/cder/foi/label/2005/021007s0171bl.pdf>. Accessed 12/16/08.
25. FDA - Agenerase Capsules Prescribing Information, 11/04/05, p. 12. Available at: <http://www.fda.gov/cder/foi/label/2005/021007s0171bl.pdf>. Accessed 12/16/08.
26. FDA - Agenerase Capsules Prescribing Information, 11/04/05, p. 21. Available at: <http://www.fda.gov/cder/foi/label/2005/021007s0171bl.pdf>. Accessed 12/16/08.
27. FDA - Agenerase Capsules Prescribing Information, 11/04/05, p. 21. Available at: <http://www.fda.gov/cder/foi/label/2005/021039s0171bl.pdf>. Accessed 12/16/08.
28. Pharm GKB - Amprenavir Prescribing Information. Available at: <http://www.pharmgkb.org>. Accessed 12/16/08.

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29. AHFS Drug Information - 2007; p. 621
30. AHFS Drug Information - 2007; p. 623
31. AHFS Drug Information - 2007; p. 621
32. AHFS Drug Information - 2007; p. 621
33. AHFS Drug Information - 2007; p. 622
34. Pharm GKB - Amprenavir Prescribing Information. Available at: <http://www.pharmgkb.org>. Accessed 12/16/08.
35. Pharm GKB - Amprenavir Prescribing Information. Available at: <http://www.pharmgkb.org>. Accessed 12/16/08.
36. Pharm GKB - Amprenavir Prescribing Information. Available at: <http://www.pharmgkb.org>. Accessed 12/16/08.
37. Pharm GKB - Amprenavir Prescribing Information. Available at: <http://www.pharmgkb.org>. Accessed 12/16/08.
38. Pharm GKB - Amprenavir Prescribing Information. Available at: <http://www.pharmgkb.org>. Accessed 12/16/08.
39. Pharm GKB - Amprenavir Prescribing Information. Available at: <http://www.pharmgkb.org>. Accessed 12/16/08.
40. Pharm GKB - Amprenavir Prescribing Information. Available at: <http://www.pharmgkb.org>. Accessed 12/16/08.
41. Pharm GKB - Amprenavir Prescribing Information. Available at: <http://www.pharmgkb.org>. Accessed 12/16/08.
42. Pharm GKB - Amprenavir Prescribing Information. Available at: <http://www.pharmgkb.org>. Accessed 12/16/08.
43. Pharm GKB - Amprenavir Prescribing Information. Available at: <http://www.pharmgkb.org>. Accessed 12/16/08.
44. Pharm GKB - Amprenavir Prescribing Information. Available at: <http://www.pharmgkb.org>. Accessed 12/16/08.
45. AHFS Drug Information - 2007; p. 620
46. FDA - Agenerase Oral Solution Prescribing Information, 11/04/05, p. 10. Available at: <http://www.fda.gov/cder/foi/label/2005/021039s0171bl.pdf>. Accessed 12/16/08.
47. AHFS Drug Information - 2007; p. 627
48. AHFS Drug Information - 2007; p. 625
49. AHFS Drug Information - 2007; p. 625
50. FDA - Agenerase Capsules Prescribing Information, 11/04/05, pp. 21-2. Available at: <http://www.fda.gov/cder/foi/label/2005/021007s0171bl.pdf>. Accessed 12/16/08.
51. FDA - Agenerase Capsules Prescribing Information, 11/04/05, p. 21. Available at: <http://www.fda.gov/cder/foi/label/2005/021007s0171bl.pdf>. Accessed 12/16/08.
52. AHFS Drug Information - 2007; p. 625
53. ChemIDplus - Available at: <http://chem.sis.nlm.nih.gov/chemidplus/chemidlite.jsp>. Accessed 12/16/08.
54. ChemIDplus - Available at: <http://chem.sis.nlm.nih.gov/chemidplus/chemidlite.jsp>. Accessed 12/16/08.
55. ChemIDplus - Available at: <http://chem.sis.nlm.nih.gov/chemidplus/chemidlite.jsp>. Accessed 12/16/08.
56. Merck Index - 2006; p. 95
57. Merck Index - 2006; p. 95
58. FDA - Agenerase Oral Solution Prescribing Information, 11/04/05, p. 2. Available at: <http://www.fda.gov/cder/foi/label/2005/021039s0171bl.pdf>. Accessed 12/16/08.
59. AHFS Drug Information - 2007; p. 625

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60. AHFS Drug Information - 2007; p. 625

61. ChemIDplus - Available at: <http://chem.sis.nlm.nih.gov/chemidplus/chemidlite.jsp>. Accessed 12/16/08.

62. ChemIDplus - Available at: <http://chem.sis.nlm.nih.gov/chemidplus/chemidlite.jsp>. Accessed 12/16/08.

63. ChemIDplus - Available at: <http://chem.sis.nlm.nih.gov/chemidplus/chemidlite.jsp>. Accessed 12/16/08.