WHAT IS CLAIMED IS:

1. A pharmaceutical composition comprising a liposome, the liposome encompassing a weakly basic anticancer compound and an acid or salt thereof, wherein the acid is oxalic acid or tartaric acid.

2. The pharmaceutical composition of claim 1, wherein the weakly basic anticancer compound is doxorubicin, irinotecan, mitoxantrone or a combination thereof.

3. The pharmaceutical composition of claim 1, wherein the liposome comprises a poloxamer.

4. The pharmaceutical composition of claim 3, wherein the poloxamer is poloxamer 188.

5. The pharmaceutical composition of claim 1, wherein the liposome comprises a plurality of lipids and the weight ratio of the lipids to the weakly basic anticancer compound and an acid or salt thereof is at least 10 to 1.

6. The pharmaceutical composition of claim 1, wherein the liposome comprises a plurality of lipids and the weight ratio of the lipids to the weakly basic anticancer compound and an acid or salt thereof is about 10 to 1 to about 100 to 1.

7. The pharmaceutical composition of claim 1, wherein the liposome comprises a plurality of lipids and the weight ratio of the lipids to the weakly basic anticancer compound and an acid or salt thereof is 20 to 1 to about 50 to 1.

8. The pharmaceutical composition of claim 1, wherein the liposome comprises a plurality of free cholesterols.

9. The pharmaceutical composition of claim 1, wherein the liposome comprises a plurality of phospholipids.

10. The pharmaceutical composition of claim 9, wherein said pharmaceutical composition comprises phospholipids and a molar ratio of the phospholipids to the free cholesterols is at least 0.5 to 1.

11. The pharmaceutical composition of claim 9, wherein said pharmaceutical composition comprises phospholipids and a molar ratio of the phospholipids to the free cholesterols is at least 0.5 to 1 to about 4 to 1.

12. The pharmaceutical composition of claim 9, wherein said pharmaceutical composition comprises phospholipids and a molar ratio of the phospholipids to the free cholesterols is in the range of about 0.86 to 1 to about 3.68 to 1.

13. The pharmaceutical composition of claim 1, wherein the weakly basic anticancer compound is substantially released from the liposome at pH < 7.4.

14. The pharmaceutical composition of claim 1, wherein at least 40% of the weakly basic anticancer compound is released from the liposome at pH 5 under standard assay conditions.

15. The pharmaceutical composition of claim 1, wherein less than 5% of the weakly basic anticancer compound is released from the liposome at pH 7.4 under standard assay conditions.

16. The pharmaceutical composition of claim 1, wherein at least 80% of the weakly basic anticancer compound is released from the liposome at pH 5 under standard assay conditions.

17. The pharmaceutical composition of claim 1, wherein at least 10% of the weakly basic anticancer compound is released from the liposome at about pH 6.0 under standard assay conditions.

18. The pharmaceutical composition of claim 1, wherein at least 50% of the weakly basic anticancer compound is released from the liposome at pH 6.0 under standard assay conditions.

19. The pharmaceutical composition of claim 1, wherein at least 7% of the weakly basic anticancer compound is released from the liposome at pH 6.7 under standard assay conditions.

20. The pharmaceutical composition of claim 1, wherein at least 30% of the weakly basic anticancer compound is released from the liposome at pH 6.7 under standard assay conditions.

21. The pharmaceutical composition of claim 1, wherein the liposome comprises a plurality of weakly basic anticancer compounds and retains greater than 35-50% of the plurality of weakly basic anticancer compound for up to about 8 hrs of incubation in serum or blood when tested under standard assay conditions.

22. The pharmaceutical composition of any one of claims 14-21, wherein the standard assay conditions comprise 20X or 50X dilution of the liposomes in PBS buffer.

23. The pharmaceutical composition of any one of claims 14-21, wherein the standard assay conditions comprise incubation at pH 7.4, pH 6.7, pH 6.0 or pH 5.0.

24. The pharmaceutical composition of any one of claims 14-21, wherein the standard assay conditions comprise incubation at about 25 °C or about 37 °C.

25. The pharmaceutical composition of any one of claims 14-21, wherein the standard assay conditions comprise incubation for about 2, about 4 or about 8 hours.

26. The pharmaceutical composition of any one of claims 14-21, wherein the standard assay conditions comprise 50X dilution of the liposomes in serum or blood and incubation at 37 °C for 2, 4, or 8 hours at a physiological pH (pH 7.4).

27. The pharmaceutical composition of claim 1, wherein the liposome is substantially spherical.

28. The pharmaceutical composition of claim 1, wherein the pharmaceutical composition comprises a plurality of the liposome having a mean longest dimension of about 60-80nm determined by the intensity-averaged particle diameters (Z-average) measured by Dynamic Light Scattering.

29. The pharmaceutical composition of claim 1, wherein the pharmaceutical composition comprises a plurality of the liposome having a mean longest dimension of about 10-30 nm determined by the number-based particle diameters measured by Dynamic Light Scattering.

30. The pharmaceutical composition of claim 1, wherein the pharmaceutical composition comprises a plurality of the liposome having a mean longest dimension from 10-30 nm determined by Cryo-Transmission Electron Microscopy.

31. The pharmaceutical composition of claim 1, wherein the liposome comprises about 500-1000 μg/mL of the weakly basic anticancer compound and an acid or salt thereof.

32. The pharmaceutical composition of claim 1, wherein the liposome comprises about 700-850 μg/mL of the weakly basic anticancer compound and an acid or salt thereof.

33. The pharmaceutical composition of claim 1, wherein the liposome comprises a plurality of the weakly basic anticancer compound forming a disorganized non-crystalline aggregate.

34. The pharmaceutical composition of claim 1, wherein the liposome comprises a plurality of the weakly basic anticancer compound and retains greater than 90% of the plurality of weakly basic anticancer compound after 40 days when stored at 2-8°C under standard storage conditions.

35. The pharmaceutical composition of claim 1, wherein the liposome does not comprise a cholesterol or a poloxamer 188.

36. The pharmaceutical composition of claim 1, wherein the liposome does not comprise an acidic organic compound other than oxalic acid, tartaric acid, or salts thereof.

37. The pharmaceutical composition of claim 1, wherein the liposome does not comprise the weakly basic anticancer compound and an acid or salt thereof other than oxalic acid, tartaric acid or salts thereof.

38. The pharmaceutical composition of claim 1, wherein the liposome encompassing the weakly basic anticancer compound and an acid or salt thereof is formed by loading the weakly basic anticancer compound into an unloaded liposome containing an encapsulated acid or salt thereof, followed by incubation at a room temperature.

39. The pharmaceutical composition of claim 38, wherein the unloaded liposome after 180 and/or 540 days of storage at 2-8°C under standard storage conditions retains greater than 90% of the weakly basic anticancer compound and an acid or salt thereof upon loading.

40. The pharmaceutical composition of claim 39, wherein about 40-80% of the loaded weakly basic anticancer compound and an acid or salt thereof is released from the liposome at pH 5.0 under standard assay conditions.

41. The pharmaceutical composition of claim 39, wherein about 20-60% of the loaded weakly basic anticancer compound and an acid or salt thereof is released from the liposome at pH 6.0 under standard assay conditions.

42. The pharmaceutical composition of claim 39, wherein about 7-30% of the loaded weakly basic anticancer compound and an acid or salt thereof is released from the liposome at pH 6.7 under standard assay conditions.

43. The pharmaceutical composition of claim 39, wherein less than 5% of the weakly basic anticancer compound and an acid or salt thereof is released from the liposome at pH 7.4 under standard assay conditions.

44. The pharmaceutical composition of claim 1 further comprising a compound selected from the group consisting of ascorbic acid (AA), or N-Acetylcysteine (NAC), ascorbil palmitate (AP), ubiquinone (CoQ10), and ethylenediaminetetraacetic acid (EDTA).

45. A method for preparing a liposome encompassing a weakly basic anticancer compound and an acid or salt thereof, wherein the acid is oxalic acid or tartaric acid, the method comprising

mixing a solution comprising a weakly basic anticancer compound with a suspension comprising a plurality of liposomes, wherein each of the liposomes comprise an oxalic acid or tartaric acid or salts thereof.

46. The method of claim 45, wherein further comprising incubating the solution and the suspension.

47. The method of claim 45, wherein about 85-100% of the weakly basic anticancer compound is incorporated within the plurality of liposomes subsequent to said mixing.

48. The method of claim 45, wherein about 95-100% of the weakly basic anticancer compound is incorporated within the plurality of liposomes subsequent to said mixing.

49. The method of claim 46, wherein the incubating step occurs at room temperature (RT).

50. The method of claim 49, wherein the incubating step is about 10 – 30 minutes.

51. The method of claim 49, wherein the incubating step is about 5 – 25 minutes.

52. The method of claim 46, wherein the incubating step occurs at room temperature (RT) followed by incubation at 2-8°C.

53. The method of claim 52, wherein the incubating step at RT is about 10-30 minutes.

54. The method of claim 52, wherein the incubating step at 2-8 °C is about 60-960 minutes.

55. The method of claim 46, wherein the incubating step occurs at 70°C.

56. The method of claim 55, wherein the incubating step is about 10-30 minutes.

57. A kit comprising a first container comprising a weakly basic anticancer compound, and a second container comprising a suspension, said suspension comprising a plurality of liposomes, wherein each of said plurality of liposome comprise an acid or salt of said weakly basic anticancer compound, wherein the acid is oxalic acid or tartaric acid.

58. The kit of claim 57, wherein the weakly basic anticancer compound is a lyophilized weakly basic anticancer compound.

59. The kit of claim 57, wherein the suspension is an aqueous suspension.

60. A method of using the kit of claim 57, comprising mixing the contents of the first container with the contents of the second container.

61. The method of claim 60, wherein the mixing is at room temperature.

62. A method for preparing a liposome comprising a weakly basic anticancer compound and an acid or salt thereof, wherein the acid is citric acid, the method comprising

mixing a solution comprising the weakly basic anticancer compound with a suspension comprising a plurality of liposomes, wherein each of aid plurality of liposome comprise an acid or salt thereof.

63. The method of claim 62 further comprising incubating the solution with the suspension.

64. The method of claim 63, wherein the incubating step occurs at room temperature (RT).

65. The method of claim 64, wherein the incubating step is about 10 – 30 minutes.

66. The method of claim 64, wherein the incubating step is about 5 – 25 minutes.

67. The method of claim 63, wherein the incubating step occurs at room temperature (RT) followed by incubation at 2-8 °C.

68. The method of claim 67, wherein the incubating step at RT is about 10-30 minutes.

69. The method of claim 67, wherein the incubating step at 2-8 °C is about 60-960 minutes.

70. The method of claim 63, wherein the incubating step occurs at 70 °C.

71. The method of claim 70, wherein the incubating step is about 10-30 minutes.

72. A pharmaceutical composition comprising a liposome, the liposome comprising a weakly basic anticancer compound and an acid or salt thereof, wherein the acid is citric acid.

73. The pharmaceutical composition of claim 72, wherein the liposome comprises a plurality of lipids and the weight ratio of the plurality of lipids to the weakly basic anticancer compound and an acid or salt thereof is at least 10 to 1.

74. The pharmaceutical composition of claim 72, wherein the liposome comprises a plurality of free cholesterols.

75. The pharmaceutical composition of claim 74, wherein the liposome comprises phospholipids, wherein the molar ratio of the phospholipid to the free cholesterols is at least 1 to 1.

76. The pharmaceutical composition of claim 72 further comprising a compound selected from the group consisting of ascorbic acid (AA), or N-Acetylcysteine (NAC), ascorbil palmitate (AP), ubiquinone (CoQ10), and ethylenediaminetetraacetic acid (EDTA).

77. A method of treating a cancer in a subject, the method comprising:

administering an effective amount of the pharmaceutical composition of claim 1 to the subject in need of the treatment.

78. The method of claim 77, wherein the weakly basic anticancer compound is doxorubicin, irinotecan, mitoxantrone or a combination thereof.

79. The method of claim 77, wherein the liposome comprises a poloxamer.

80. The method of claim 77, wherein the poloxamer is poloxamer 188.

81. The method of claim 77, wherein the liposome comprises lipids and the weight ratio of the lipids to the weakly basic anticancer compound is at least 10 to 1.

82. The method of claim 77, wherein the liposome comprises a lipids and the weight ratio of the lipids to the weakly basic anticancer compound is about 10 to 1 to about 100 to 1.

83. The method of claim 77, wherein the liposome comprises a plurality of lipids and the weight ratio of the lipids to the weakly basic anticancer compound is about 20 to 1 to about 50 to 1.

84. The method of claim 77, wherein the liposome comprises a plurality of free cholesterols.

85. The method of claim 77, wherein the liposome comprises a plurality of phospholipids.

86. The method of claim 84, wherein said liposome comprises phospholipids and a molar ratio of the phospholipids to the free cholesterols is at least 0.5 to 1.

87. The method of claim 84, wherein said liposome comprises phospholipids and a molar ratio of the phospholipids to the free cholesterols is at least 0.5 to 1 to about 4 to 1.

88. The method of claim 84, wherein said liposome comprises phospholipids and a molar ratio of the phospholipids to the free cholesterols is in the range of about 0.86 to 1 to about 3.68 to 1.

89. The method of claim 77, wherein the weakly basic anticancer compound is substantially released from the liposome at pH < 7.4.

90. The method of claim 77, wherein at least 40% of the weakly basic anticancer compound is released from the liposome at pH 5 under standard assay conditions.

91. The method of claim 77, wherein less than 5% of the weakly basic anticancer compound is released from the liposome at pH 7.4 under standard assay conditions.

92. The method of claim 77, wherein at least 80% of the weakly basic anticancer compound is released from the liposome at pH 5 under standard assay conditions.

93. The method of claim 77, wherein at least 10% of the weakly basic anticancer compound is released from the liposome at about pH 6.0 under standard assay conditions.

94. The method of claim 77, wherein at least 50% of the weakly basic anticancer compound is released from the liposome at pH 6.0 under standard assay conditions.

95. The method of claim 77, wherein at least 7% of the weakly basic anticancer compound is released from the liposome at pH 6.7 under standard assay conditions.

96. The method of claim 77, wherein at least 30% of the weakly basic anticancer compound is released from the liposome at pH 6.7 under standard assay conditions.

97. The method of claim 77, wherein the liposome comprises a plurality of weakly basic anticancer compounds and retains greater than 35-50% of the plurality of weakly basic anticancer compound for up to about 8 hrs of incubation in serum or blood when tested under standard assay conditions.

98. The method of any one of claims 90-97, wherein the standard assay conditions comprise 20X or 50X dilution of the liposomes in PBS buffer.

99. The method of any one of claims 90-97, wherein the standard assay conditions comprise incubation at pH 7.4, pH 6.7, pH 6.0 or pH 5.0.

100. The method of any one of claims 90-97, wherein the standard assay conditions comprise incubation at about 25 °C or about 37 °C.

101. The method of any one of claims 90-97, wherein the standard assay conditions comprise incubation for about 2, about 4 or about 8 hours.

102. The method of any one of claims 90-97, wherein the standard assay conditions comprise 50X dilution of the liposomes in serum or blood and incubation at 37 °C for 2, 4, or 8 hours at a physiological pH (pH 7.4).

103. The method of claim 77, wherein the liposome is substantially spherical.

104. The method of claim 77, wherein the liposome comprises about 500-1000 µg/mL of the weakly basic anticancer compound and an acid or salt thereof.

105. The method of claim 77, wherein the liposome comprises about 700-850 µg/mL of the weakly basic anticancer compound and an acid or salt thereof.

106. The method of claim 77, wherein the liposome comprises a plurality of the weakly basic anticancer compound forming a disorganized non-crystalline aggregate.

107. The method of claim 77, wherein the liposome does not comprise a cholesterol or a poloxamer 188.

108. The method of claim 77, wherein the liposome does not comprise an acidic organic compound other than oxalic acid, tartaric acid, or salts thereof.

109. The method of claim 77, wherein the liposome does not comprise the weakly basic anticancer compound and an acid or salt thereof other than oxalic acid, tartaric acid or salts thereof.

Claims

1. A pharmaceutical composition comprising a liposome, wherein the liposome comprises a plurality of lipids; a weakly basic anticancer compound; and oxalic acid or a salt of oxalic acid; wherein the weight ratio of the lipids to the weakly basic anticancer compound is from about 50:1 to about 100:1.

2. The pharmaceutical composition of claim 1, wherein the weakly basic anticancer compound is doxorubicin, irinotecan, mitoxantrone, or a combination of two or more thereof.

3. The pharmaceutical composition of claim 1, wherein the plurality of lipids comprise a poloxamer.

4. The pharmaceutical composition of claim 1, wherein the plurality of lipids comprise a plurality of free cholesterols; a plurality of phospholipids; or a combination thereof.

5. The pharmaceutical composition of claim 4, wherein the plurality of lipids comprise a plurality of free cholesterols and a plurality of phospholipids, and wherein the molar ratio of the phospholipids to the free cholesterols is at least 0.5 to 1 to about 4 to 1.

6. The pharmaceutical composition of claim 1, wherein the weakly basic anticancer compound is substantially released from the liposome at pH < 7.4.

7. The pharmaceutical composition of claim 1, wherein at least 40-80% of the weakly basic anticancer compound is released from the liposome at pH 5 under standard assay conditions; wherein at least 10-50% of the weakly basic anticancer compound is released from the liposome at pH 6.0 under standard assay conditions; wherein at least 7-30% of the weakly basic anticancer compound is released from the liposome at pH 6.7 under standard assay conditions; or wherein less than 5% of the weakly basic anticancer compound is released from the liposome at pH 7.4 under standard assay conditions.

8. The pharmaceutical composition of claim 1, wherein the liposome comprises a plurality of weakly basic anticancer compounds and retains greater than 50% of the plurality of weakly basic anticancer compound for up to about 8 hours of incubation in serum or blood when

tested under standard assay conditions.

9. The pharmaceutical composition of claim 7, wherein the standard assay conditions comprise 50 times dilution of the liposomes in serum or blood and incubation at 37 °C for 2, 4, or 8 hours at pH 7.4.

10. The pharmaceutical composition of claim 1, wherein the pharmaceutical composition comprises a plurality of the liposome having a mean longest dimension of about 40 nm to about 100 nm determined by the intensity-averaged particle diameters measured by dynamic light scattering; or wherein the pharmaceutical composition comprises a plurality of the liposome having a mean longest dimension from about 1 nm to about 50 nm determined by cryo-transmission electron microscopy.

11. The pharmaceutical composition of claim 1, wherein the liposome comprises about 500 μg/mL to about 1,000 μg/mL of the weakly basic anticancer compound.

12. The pharmaceutical composition of claim 1, wherein the liposome comprises about 750 μg/mL to about 850 μg/mL of the weakly basic anticancer compound.

13. The pharmaceutical composition of claim 1, wherein the liposome comprises a plurality of the weakly basic anticancer compound and retains greater than 90% of the plurality of weakly basic anticancer compound after 40 days when stored at 2-8°C under standard storage conditions.

14. The pharmaceutical composition of claim 1, further comprising a compound selected from the group consisting of ascorbic acid, N-acetylcysteine, ascorbyl palmitate, ubiquinone, and ethylenediaminetetraacetic acid.

15. The pharmaceutical composition of claim 1, wherein the weakly basic anticancer compound has a pKa from about 7.5 to about 9.0.

16. The pharmaceutical composition of claim 5, wherein the molar ratio of the phospholipids to the free cholesterols is from about 1 to 1 to about 4 to 1.

17. A pharmaceutical composition comprising a liposome, wherein the liposome comprises a plurality of lipids; a weakly basic anticancer compound; and tartaric acid or a salt of tartaric acid;

wherein the weight ratio of the lipids to the weakly basic anticancer compound is from about 50:1 to about 100:1.

18. The pharmaceutical composition of claim 17, wherein the weakly basic anticancer compound is doxorubicin, irinotecan, mitoxantrone, or a combination of two or more thereof.

19. The pharmaceutical composition of claim 17, wherein the plurality of lipids comprise a poloxamer.

20. The pharmaceutical composition of claim 17, wherein the plurality of lipids comprise a plurality of free cholesterols; a plurality of phospholipids; or a combination thereof.

21. The pharmaceutical composition of claim 20, wherein the plurality of lipids comprise a plurality of free cholesterols and a plurality of phospholipids, and wherein the molar ratio of the phospholipids to the free cholesterols is at least 0.5 to 1 to about 4 to 1.

22. The pharmaceutical composition of claim 17, wherein the weakly basic anticancer compound is substantially released from the liposome at pH < 7.4.

23. The pharmaceutical composition of claim 17, wherein at least 40-80% of the weakly basic anticancer compound is released from the liposome at pH 5 under standard assay conditions; wherein at least 10-50% of the weakly basic anticancer compound is released from the liposome at pH 6.0 under standard assay conditions; wherein at least 7-30% of the weakly basic anticancer compound is released from the liposome at pH 6.7 under standard assay conditions; or wherein less than 5% of the weakly basic anticancer compound is released from the liposome at pH 7.4 under standard assay conditions.

24. The pharmaceutical composition of claim 17, wherein the liposome comprises a plurality of weakly basic anticancer compounds and retains greater than 50% of the plurality of weakly basic anticancer compound for up to about 8 hours of incubation in serum or blood when tested under standard assay conditions.

25. The pharmaceutical composition of claim 23, wherein the standard assay conditions comprise 50 times dilution of the liposomes in serum or blood and incubation at 37 °C for 2, 4, or 8 hours at pH 7.4.

26. The pharmaceutical composition of claim 17, wherein the pharmaceutical composition comprises a plurality of the liposome having a mean longest dimension of about 40 nm to about 100 nm determined by the intensity-averaged particle diameters measured by dynamic light scattering; or wherein the pharmaceutical composition comprises a plurality of the liposome having a mean longest dimension from about 1 nm to about 50 nm determined by cryo-transmission electron microscopy.

27. The pharmaceutical composition of claim 17, wherein the liposome comprises about 500 µg/mL to about 1,000 µg/mL of the weakly basic anticancer compound.

28. The pharmaceutical composition of claim 17, wherein the liposome comprises about 750 µg/mL to about 850 µg/mL of the weakly basic anticancer compound.

29. The pharmaceutical composition of claim 17, wherein the liposome comprises a plurality of the weakly basic anticancer compound and retains greater than 90% of the plurality of weakly basic anticancer compound after 40 days when stored at 2-8°C under standard storage conditions.

30. The pharmaceutical composition of claim 17, further comprising a compound selected from the group consisting of ascorbic acid, N-acetylcysteine, ascorbyl palmitate, ubiquinone, and ethylenediaminetetraacetic acid.

31. The pharmaceutical composition of claim 17, wherein the weakly basic anticancer compound has a pKa from about 7.5 to about 9.0.

32. The pharmaceutical composition of claim 21, wherein the molar ratio of the phospholipids to the free cholesterols is from about 1 to 1 to about 4 to 1.