CLAIMS

1. A pharmaceutical composition, comprising
one or more liposomes, said liposome comprising
(a) a lipid bilayer, comprising at least one vesicle-forming lipid; and
(b) an internal aqueous medium inside the lipid bilayer, comprising a bicarbonate salt with a concentration about 50 mM to about 800 mM and a weak acid drug with a pK_a between 1 to about 6,
wherein the liposomes are suspended in an external aqueous medium which is substantially free of bicarbonate salt, the pH of the external aqueous medium is above the pK_a of the weak acid drug to about 7 and the pH of the internal aqueous medium is at least one unit higher than the pH of the external aqueous medium.

2. The pharmaceutical composition of claim 1, wherein the molar ratio of the weak acid drug to the bicarbonate salt is from about 0.1: 1 to about 1: 1.

3. The pharmaceutical composition of claim 1 or claim 2, wherein the concentration of the bicarbonate salt is about 250 mM to about 800 mM.

4. The pharmaceutical composition of any one of claims 1 to 3, wherein the encapsulation efficiency of the weak acid drug is at least 80%.

5. The pharmaceutical composition of any one of claims 1 to 4, wherein the vesicle-forming lipid is a mixture of a first phospholipid and a second phospholipid or a mixture of a first phospholipid and a charged lipid.

6. The pharmaceutical composition of claim 5, wherein the first phospholipid is selected from the group consisting of phosphatidylcholine (PC), phosphatidylglycerol (PG), phosphatidylinositol (PI), phosphatidic acid (PA), phosphatidylethanolamine (PE), phosphatidylserine (PS) and any combination thereof, the second phospholipid is a PEG modified phospholipid, a positively charged or a negatively charged phospholipid, and the charged lipid is a positively charged or a negatively charged lipid.

7. The pharmaceutical composition of claim 6, wherein the first phospholipid is selected from HSPC, DSPC, DPPC, DMPC or combination thereof and the second phospholipid selected from DSPG, DPPG, DMPG, PEG-DSPE, or combination thereof.

8. The pharmaceutical composition of claim 6, wherein the first phospholipid is selected from HSPC, DSPC, DPPC, DMPC or combination thereof and the charged lipid is stearylamine, 1,2-dioleoyl-3-trimethylammonium-propane (DOTAP), 3ß-[N-(N',N'-dimethylaminoethane)-carbamoyl]cholesterol (DC-Cholesterol), N^4-Cholesteryl-Spermine (GL67), dimethyldioctadecylammonium (DDAB), 1,2-di-O-octadecenyl-3-trimethylammonium propane (DOTMA), ethylphosphocholine (ethyl PC) or combination thereof.

9. The pharmaceutical composition of any one of claims 1 to 8, wherein the lipid bilayer further comprising a sterol selected from the group consisting of cholesterol, cholesterol hexasuccinate, ergosterol, lanosterol, and combination thereof.

10. The pharmaceutical composition of claim 9, wherein the mole percent of the first phospholipid: cholesterol: the second phospholipid or the charged lipid is 50-70: 20-45: 0.1-10.

11. The pharmaceutical composition of any one of claims 1 to 10, wherein the bicarbonate salt is selected from the group consisting of potassium bicarbonate, sodium bicarbonate, calcium bicarbonate, magnesium bicarbonate, cesium bicarbonate, lithium bicarbonate, nickel bicarbonate, ferrous iron bicarbonate and combination thereof.

12. The pharmaceutical composition of any one of claims 1 to 11, wherein the weak acid drug is a prostaglandin, a steroid, a non-steroidal anti-inflammatory drug (NSAID), or an anticoagulant.

13. A pharmaceutical composition, comprising
one or more liposomes, said liposome comprising
(a) a lipid bilayer comprising at least one vesicle-forming lipid; and

(b) an internal aqueous medium inside the lipid bilayer, comprising a bicarbonate salt with a concentration about 50 mM to about 800 mM and prostacyclin,

wherein the liposomes are suspended in an external aqueous medium which is substantially free of bicarbonate salt, the pH of the external aqueous medium is above the pK_a of prostacyclin to about 7, and the pH of the internal aqueous medium is at least one unit higher than the pH of the external medium.

14. The pharmaceutical composition of claim 13, wherein the bicarbonate salt is selected from the group consisting of potassium bicarbonate, sodium bicarbonate, calcium bicarbonate, magnesium bicarbonate, cesium bicarbonate, lithium bicarbonate, nickel bicarbonate, ferrous iron bicarbonate and combination thereof.

15. The pharmaceutical composition of claim 13 or claim 14, wherein the vesicle-forming lipid is a mixture of a first phospholipid and a second phospholipid or a mixture of a first phospholipid and a charged lipid.

16. The pharmaceutical composition of any one of claims 13 to 15, wherein the lipid bilayer further comprising a sterol selected from the group consisting of cholesterol, cholesterol hexasuccinate, ergosterol, lanosterol, and combination thereof.

17. A pharmaceutical composition of any one of claims 1 to 16 for use in therapy.

18. Use of a pharmaceutical composition of any one of claims 1 to 16 in the manufacture of a medicament for the treatment of a respiratory disease, wherein the respiratory disease is pulmonary hypertension, chronic obstructive pulmonary disease (COPD), asthma, cystic fibrosis, lower respiratory tract infection, bronchiectasis, bronchitis, bronchiolitis or croup.