

minutes of complexing, the DNA-lipid was added to cells. Cells were assayed for  $\beta$ -gal activity as described above.

LIPID	ACTIVITY (ng/ $\beta$ gal/cm <sup>2</sup> )				
	DNA	DNA and PLUS*	DNA and IN-SULIN	DNA and TRANS-FERRIN	DNA and INTEGRIN-TARGETING PEPTIDE**
LipofectAMINE	10.36	28.6	ND	17.4	ND
Compound of Formula X	ND	37.8	ND	ND	40.9
1:1.5 DOPE					
1 mg/ml					
Compound of Formula VII	29.4	637.9	195.7	21.7	587.9
1:1 DOPE					
2 mg/ml					

ND = no detectable activity  
 \*PLUS Reagent is available from Life Technologies, Inc., Rockville, Maryland.  
 \*\*Reference: S. L. HART, et al (1998), Human Gene Therapy, 9:575-585.

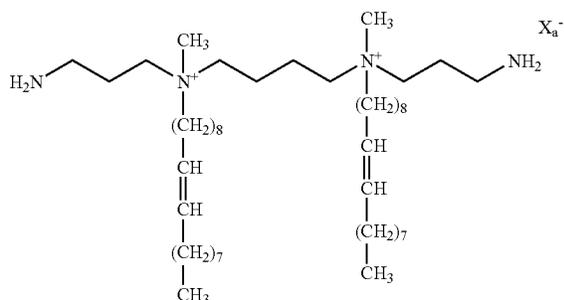
The results show that these cationic lipid formulations can deliver DNA molecules alone, but also that delivery, and ultimately gene expression, may be enhanced when the lipids are used in conjunction with peptides or proteins that bind DNA and/or act as ligands for cell surface receptors, or otherwise enhance cellular and/or nuclear uptake.

Having now fully described the present invention in some detail by way of illustration and examples for purposes of clarity of understanding, it will be obvious to one of ordinary skill in the art that the same can be performed by modifying or changing the invention within a wide and equivalent range of conditions, formulations and other parameters without affecting the scope of the invention or any specific embodiment thereof, and that such modifications or changes are intended to be encompassed within the scope of the appended claims.

All publications, patents and patent applications mentioned in this specification are indicative of the level of skill of those skilled in the art to which this invention pertains, and are herein incorporated by reference to the same extent as if each individual publication, patent or patent application was specifically and individually indicated to be incorporated by reference.

What is claimed is:

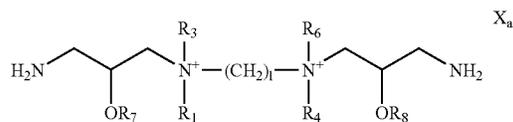
1. A compound having the formula:



wherein

X<sup>-</sup> is a physiologically acceptable anion; and a is the number of anions which is equal to the number of positive charges in the compound divided by the valence of the anion.

2. A compound having the formula:



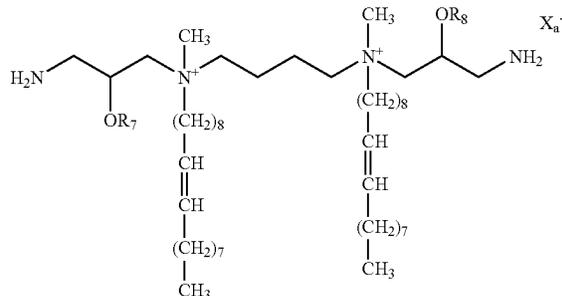
wherein

X<sup>-</sup> is a physiologically acceptable anion; a is the number of anions which is equal to the number of positive charges in the compound divided by the valence of the anion;

R<sub>1</sub>, R<sub>3</sub>, R<sub>4</sub>, and R<sub>6</sub>, independently of one another, are selected from the group consisting of H, an alkyl group, an alkenyl group, an alkynyl group, and an aryl group, wherein any one of R<sub>1</sub>, R<sub>3</sub>, R<sub>4</sub>, and R<sub>6</sub> are optionally substituted by one or more of an alcohol, an amine, an amide, an ether, a polyether, a polyamide, an ester, a mercaptan, a urea, a thiourea, a guanidyl, or a carbamoyl group, and at least two of R<sub>1</sub>, R<sub>3</sub>, R<sub>4</sub>, and R<sub>6</sub>, are straight-chain, branched, or cyclic alkyl, alkynyl, or alkenyl or aryl groups having from 8 to 24 carbon atoms attached to each N and R<sub>1</sub>, R<sub>3</sub>, R<sub>4</sub> and R<sub>6</sub> may optionally be covalently linked with each other;

R<sub>7</sub> and R<sub>8</sub> are independently H or a carbohydrate; and l is an integer from 1 to about 4.

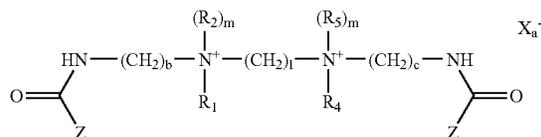
3. The compound as claimed in claim 2, which is:



wherein R<sub>7</sub> and R<sub>8</sub> are independently H or a carbohydrate.

4. The compound as claimed in claim 3, wherein R<sub>7</sub> and R<sub>8</sub> are H.

5. A compound having the formula:



wherein

R<sub>1</sub>, R<sub>2</sub>, R<sub>4</sub> and R<sub>5</sub>, independently of one another, are selected from the group consisting of H, an alkenyl group, an alkynyl group, and an aryl group, and an alkyl group optionally substituted by one or more of an