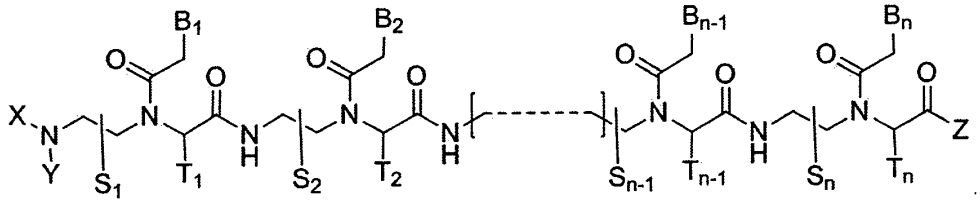
# CLAIMS

1. A peptide nucleic acid derivative represented by **Formula I**, or a pharmaceutically acceptable salt thereof:

**[Formula I]**



wherein,

n is an integer between 10 and 21;

the compound of **Formula I** possesses at least a 10-mer complementary overlap with the 18-mer pre-mRNA sequence of [(5' → 3') GGCCAUUUCGUCAGUAUC] in the human ACC2 pre-mRNA;

the compound of **Formula I** is fully complementary to the human ACC2 pre-mRNA, or partially complementary to the human ACC2 pre-mRNA with one or two mismatches;

$S_1$, $S_2$, ···, $S_{n-1}$, $S_n$, $T_1$, $T_2$, ···, $T_{n-1}$, and $T_n$ independently represent hydrido, deuterido, substituted or non-substituted alkyl, or substituted or non-substituted aryl radical;

X and Y independently represent hydrido, deuterido, formyl [H-C(=O)-], aminocarbonyl [$NH_2$-C(=O)-], aminothiocarbonyl [$NH_2$-C(=S)-], substituted or non-substituted alkyl, substituted or non-substituted aryl, substituted or non-substituted alkyloxy, substituted or non-substituted aryloxy, substituted or non-substituted alkylacyl, substituted or non-substituted arylacyl, substituted or non-substituted alkyloxycarbonyl, substituted or non-substituted aryloxycarbonyl, substituted or non-substituted alkylaminocarbonyl, substituted or non-substituted arylaminocarbonyl, substituted or non-substituted alkylaminothiocarbonyl, substituted or non-substituted arylaminothiocarbonyl, substituted or non-substituted alkyloxythiocarbonyl, substituted or non-substituted aryloxythiocarbonyl, substituted or non-substituted alkylsulfonyl, substituted or non-substituted arylsulfonyl, substituted or non-substituted alkylphosphonyl, or substituted or non-substituted arylphosphonyl radical;

Z represents hydrido, deuterido, hydroxy, substituted or non-substituted alkyloxy, substituted or non-substituted aryloxy, substituted or non-substituted amino, substituted or non-substituted alkyl, or substituted or non-substituted aryl radical;

$B_1$, $B_2$, ···, $B_{n-1}$, and $B_n$ are independently selected from natural nucleobases including

adenine, thymine, guanine, cytosine and uracil, and unnatural nucleobases; and,

at least four of $B_1$, $B_2$, $\cdots$, $B_{n-1}$, and $B_n$ are independently selected from unnatural nucleobases with a substituted or non-substituted amino radical covalently linked to the nucleobase moiety.

2. The peptide nucleic acid derivative according to claim 1, or a pharmaceutical salt thereof:

wherein,

n is an integer between 10 and 21;

the compound of **Formula I** possesses at least a 10-mer complementary overlap with the 18-mer pre-mRNA sequence of [(5' → 3') GGCCAUUUCGUCAGUAUC] in the human ACC2 pre-mRNA;

the compound of **Formula I** is fully complementary to the human ACC2 pre-mRNA, or partially complementary to the human ACC2 pre-mRNA with one or two mismatches;

$S_1$, $S_2$, $\cdots$, $S_{n-1}$, $S_n$, $T_1$, $T_2$, $\cdots$, $T_{n-1}$, and $T_n$ independently represent hydrido, deuterido radical;

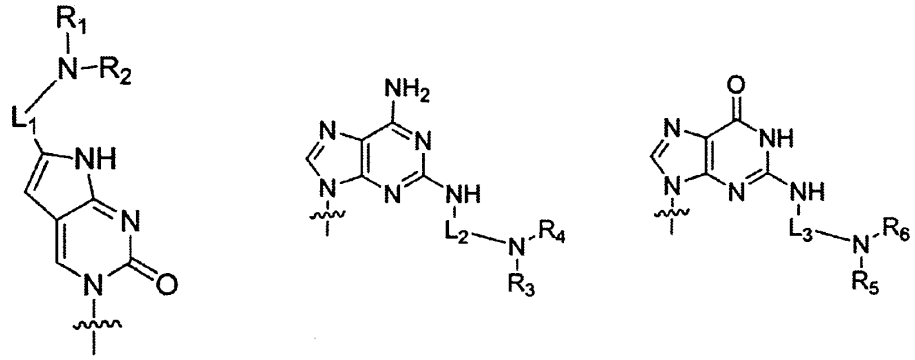
X and Y independently represent hydrido, deuterido, formyl [H-C(=O)-], aminocarbonyl [$NH_2$-C(=O)-], aminothiocarbonyl [$NH_2$-C(=S)-], substituted or non-substituted alkyl, substituted or non-substituted aryl, substituted or non-substituted alkyloxy, substituted or non-substituted aryloxy, substituted or non-substituted alkylacyl, substituted or non-substituted arylacyl, substituted or non-substituted alkyloxycarbonyl, substituted or non-substituted aryloxycarbonyl, substituted or non-substituted alkylaminocarbonyl, substituted or non-substituted arylaminocarbonyl, substituted or non-substituted alkylaminothiocarbonyl, substituted or non-substituted arylaminothiocarbonyl, substituted or non-substituted alkyloxythiocarbonyl, substituted or non-substituted aryloxythiocarbonyl, substituted or non-substituted alkylsulfonyl, substituted or non-substituted arylsulfonyl, substituted or non-substituted alkylphosphonyl, or substituted or non-substituted arylphosphonyl radical;

Z represents hydrido, hydroxy, substituted or non-substituted alkyloxy, substituted or non-substituted aryloxy, or substituted or non-substituted amino radical;

$B_1$, $B_2$, $\cdots$, $B_{n-1}$, and $B_n$ are independently selected from natural nucleobases including adenine, thymine, guanine, cytosine and uracil, and unnatural nucleobases;

at least four of $B_1$, $B_2$, $\cdots$, $B_{n-1}$, and $B_n$ are independently selected from unnatural nucleobases represented by **Formula II**, **Formula III**, or **Formula IV**:

[Formula II] [Formula III] [Formula IV]

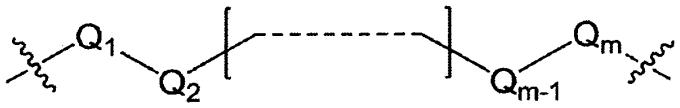


wherein,

$R_1$, $R_2$, $R_3$, $R_4$, $R_5$ and $R_6$ are independently selected from hydrido and substituted or non-substituted alkyl radical;

$L_1$, $L_2$ and $L_3$ are a covalent linker represented by **Formula V** covalently linking the basic amino group to the nucleobase moiety:

**[Formula V]**



wherein,

$Q_1$ and $Q_m$ are substituted or non-substituted methylene ($-CH_2-$) radical, and $Q_m$ is directly linked to the basic amino group;

$Q_2$, $Q_3$, $\cdots$, and $Q_{m-1}$ are independently selected from substituted or non-substituted methylene, oxygen (-O-), sulfur (-S-), and substituted or non-substituted amino radical [-N(H)-, or -N(substituent)-]; and,

m is an integer between 1 and 15.

3. The peptide nucleic acid derivative according to claim 2, or a pharmaceutical salt thereof:

wherein,

n is an integer between 11 and 16;

the compound of **Formula I** possesses at least a 10-mer complementary overlap with the 18-mer pre-mRNA sequence of [(5' → 3') GGCCAUUUCGUCAGUAUC] in the human ACC2 pre-mRNA;

the compound of **Formula I** is fully complementary to the human ACC2 pre-mRNA;

$S_1$, $S_2$, ···, $S_{n-1}$, $S_n$, $T_1$, $T_2$, ···, $T_{n-1}$, and $T_n$ are hydrido radical;

X and Y independently represent hydrido, substituted or non-substituted alkylacyl, or substituted or non-substituted alkyloxycarbonyl radical;

Z represents substituted or non-substituted amino radical;

$B_1$, $B_2$, ···, $B_{n-1}$, and $B_n$ are independently selected from natural nucleobases including adenine, thymine, guanine, cytosine and uracil, and unnatural nucleobases;

at least five of $B_1$, $B_2$, ···, $B_{n-1}$, and $B_n$ are independently selected from unnatural nucleobases represented by **Formula II**, **Formula III**, or **Formula IV**;

$R_1$, $R_2$, $R_3$, $R_4$, $R_5$ and $R_6$ are hydrido radical;

$Q_1$ and $Q_m$ are methylene radical, and $Q_m$ is directly linked to the basic amino group;

$Q_2$, $Q_3$, ···, and $Q_{m-1}$ are independently selected from methylene and oxygen radical; and,

m is an integer between 1 and 9.

4. The peptide nucleic acid derivative according to claim 3, or a pharmaceutical salt thereof:

wherein,

n is an integer between 11 and 16;

the compound of **Formula I** possesses at least a 10-mer complementary overlap with the 18-mer pre-mRNA sequence of [(5' → 3') GGCCAUUUCGUCAGUAUC] in the human ACC2 pre-mRNA;

the compound of **Formula I** is fully complementary to the human ACC2 pre-mRNA;

$S_1$, $S_2$, ···, $S_{n-1}$, $S_n$, $T_1$, $T_2$, ···, $T_{n-1}$, and $T_n$ are hydrido radical;

X is hydrido radical;

Y represents substituted or non-substituted alkyloxycarbonyl radical;

Z represents substituted or non-substituted amino radical;

$B_1$, $B_2$, ···, $B_{n-1}$, and $B_n$ are independently selected from natural nucleobases including adenine, thymine, guanine, cytosine and uracil, and unnatural nucleobases;

at least five of $B_1$, $B_2$, ···, $B_{n-1}$, and $B_n$ are independently selected from unnatural nucleobases represented by **Formula II**, **Formula III**, or **Formula IV**;

$R_1$, $R_2$, $R_3$, $R_4$, $R_5$ and $R_6$ are hydrido radical;

$L_1$ represents $-(CH_2)_2-O-(CH_2)_2-$, $-CH_2-O-(CH_2)_2-$, $-CH_2-O-(CH_2)_3-$, $-CH_2-O-(CH_2)_4-$, or $-CH_2-O-(CH_2)_5-$; and,

$L_2$ and $L_3$ are independently selected from $-(CH_2)_2-O-(CH_2)_2-$, $-(CH_2)_3-O-(CH_2)_2-$, $-(CH_2)_2-O-(CH_2)_3-$, $-(CH_2)_2-$, $-(CH_2)_3-$, $-(CH_2)_4-$, $-(CH_2)_5-$, $-(CH_2)_6-$, $-(CH_2)_7-$, and $-(CH_2)_8-$.

5. The peptide nucleic acid derivative according to claim 4, which is selected from the group of peptide nucleic acid derivatives provided below, or a pharmaceutically acceptable salt thereof:

(N→C) Fethoc-CTG(6)-ACG(6)-AA(5)A-TG(6)G-C(1O2)C-$NH_2$;

(N→C) Fethoc-TA(5)C(1O2)-TGA(5)-CGA(5)-AA(5)T-G(6)GC(1O2)-C-$NH_2$;

(N→C) Fethoc-TA(5)C-TG(5)A-C(1O2)GA(5)-AA(5)T-G(5)G-$NH_2$;

(N→C) Fethoc-AC(1O2)T-GA(5)C-GA(5)A-A(5)TG(5)-GC(1O2)-$NH_2$;

(N→C) Fethoc-CTG(6)-AC(1O2)G-A(5)AA(5)-TG(6)G-$NH_2$;

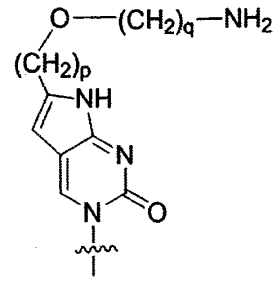
(N→C) Fethoc-CTG(6)-AC(1O2)G-A(5)AA(5)-TG(6)G-C(1O2)C-$NH_2$

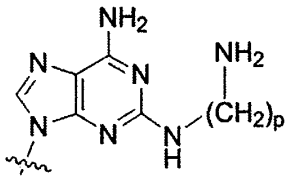
wherein,

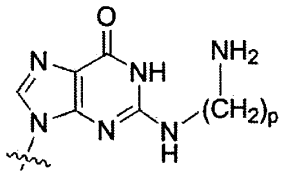
A, G, T, and C are monomers of peptide nucleic acid with a natural nucleobase of adenine, thymine, guanine and cytosine, respectively;

C(pOq), A(p), and G(p) are monomers of peptide nucleic acid with an unnatural nucleobase represented by **Formula VI**, **Formula VII**, and **Formula VIII**, respectively;

[Formula VI] [Formula VII] [Formula VIII]




wherein,

p and q are integers, and p is 1 or 5 and q is 2 in (N→C) Fethoc-AC(1O2)T-GA(5)C-GA(5)A-A(5)TG(5)-GC(1O2)-$NH_2$; and

"Fethoc-" is the abbreviation for "[2-(9-fluorenyl)ethyl-1-oxy]carbonyl".

6. A method to treat conditions or disorders associated with the human ACC2 gene transcription, comprising the administration of the peptide nucleic acid derivative according to claim 1, or a pharmaceutically acceptable salt thereof to a subject.

7. A method to treat skin aging, comprising the administration of the peptide nucleic acid derivative according to claim 1, or a pharmaceutically acceptable salt thereof to a subject.

8. A pharmaceutical composition for treating conditions or disorders associated with human ACC2 gene transcription, comprising the peptide nucleic acid derivative according to claim 1, or a pharmaceutically acceptable salt thereof.

9. A cosmetic composition for treating conditions or disorders associated with human ACC2 gene transcription, comprising the peptide nucleic acid derivative according to claim 1, or a pharmaceutically acceptable salt thereof.

10. A pharmaceutical composition for treating skin aging, comprising the peptide nucleic acid derivative according to claim 1, or a pharmaceutically acceptable salt thereof.

11. A cosmetic composition for treating skin aging, comprising the peptide nucleic acid derivative according to claim 1, or a pharmaceutically acceptable salt thereof.