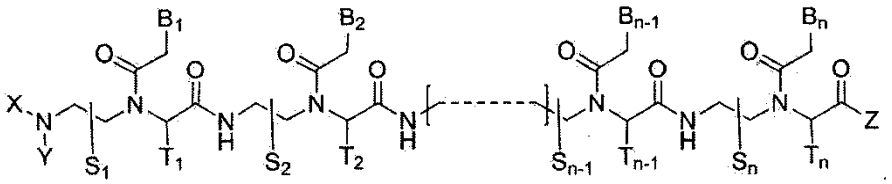
Claims

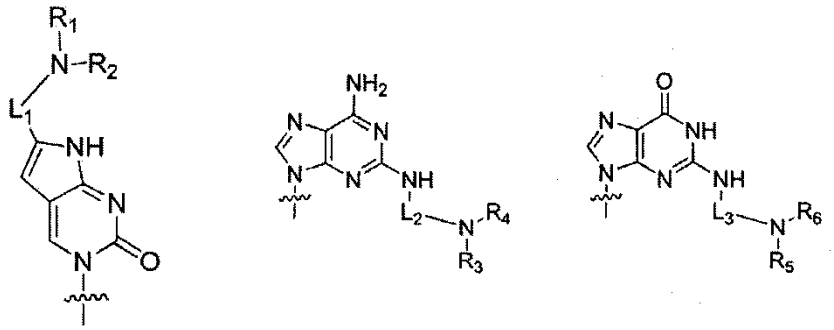
1. A peptide nucleic acid derivative represented by **Formula I,** or a pharmaceutically acceptable salt thereof: **[Formula I]**



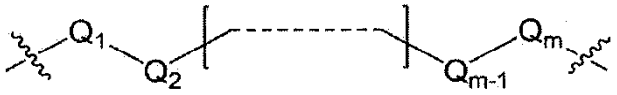
wherein, n is an integer between 10 and 21; the compound of **Formula I** possesses at least a 10-mer complementary overlap with the 18-mer pre-mRNA sequence of [(5' → 3') GGCCAUUUCGUCAGUAUC] in the human ACC2 pre-mRNA; the compound of **Formula I** is fully complementary to the human ACC2 pre-mRNA, 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, …, 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, …, S_{n-1}, S_n, T_1, T_2, …, 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, …, 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, …, 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, …, 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.

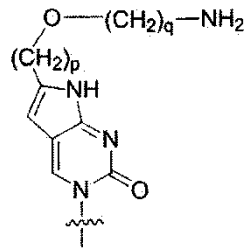
3. The peptide nucleic acid derivative according to claim 2, or a pharmaceutical salt thereof: wherein, n is an integer between 11 and 16; the compound of **Formula I** possesses at least a 10-mer complementary overlap with the 18-mer pre-mRNA sequence of [(5' → 3') GGCCAUUUCGUCAGUAUC] in the human ACC2 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.

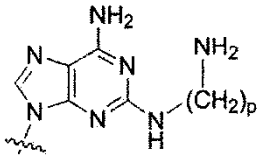
4. The peptide nucleic acid derivative according to claim 3, or a pharmaceutical salt thereof: wherein, n is an integer between 11 and 16; the compound of **Formula I** possesses at least a 10-mer complementary overlap with the 18-mer pre-mRNA sequence of [(5' → 3') GGCCAUUUCGUCAGUAUC] in the human ACC2 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_1represents -(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)$_8$-.

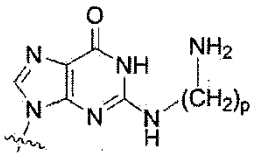
5. The peptide nucleic acid derivative according to claim 4, which is selected from the group of peptide nucleic acid derivatives provided below, or a pharmaceutically acceptable salt thereof: (N→C) Fethoc-CTG(6)-ACG(6)-AA(5)A-TG(6)G-C(1O2)C-NH_2; (N→C) Fethoc-TA(5)C(1O2)-TGA(5)-CGA(5)-AA(5)T-G(6)GC(1O2)-C-NH_2; (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**

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







, respectively; 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. Use of the peptide nucleic acid derivative according to claim 1, or a pharmaceutically acceptable salt thereof, in the manufacture of a medicament for the treatment of a therapeutic condition or disorder associated directly with the human ACC2 gene transcription through downregulation of the ACC2 gene transcription, wherein the therapeutic condition or disorder is the treatment of obesity related skin aging.

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

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

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

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