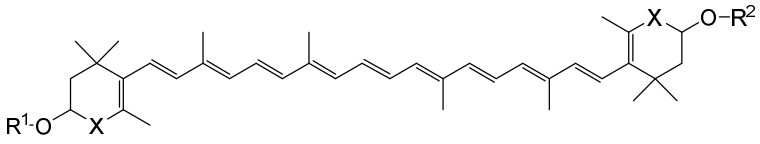
Claims

Claim 1: A carotenoid derivative having a general formula (I):



(I)

,

wherein:

X represents a carbonyl group or a methylene group;

at least one of R^1 and R^2 in the general formula (I) is -CO-A-B-D and the other is -CO-A-B-D or a hydrogen atom;

A is $-CH_2-$, $-CH(CH_3)-$, $-CH(C_2H_5)-$, $-CH(n\text{-}C_3H_7)-$, $-CH(i\text{-}C_3H_7)-$, $-CH(n\text{-}C_4H_9)-$, $-CH(i\text{-}C_4H_9)-$, $-CH(s\text{-}C_4H_9)-$, $-CH_2CH_2-$, $-CH_2CH_2CH_2-$, $-CH_2CH(CH_3)-$, $-CH_2CH_2CH_2CH_2-$, $-CH(CH_3)CH_2CH_2-$, $-CH_2CH(CH_3)CH_2-$, $-CH_2CH(i\text{-}C_4H_9)CH_2-$, $-CH_2C(CH_2CH_2CH_2CH_2CH_2)CH_2-$, $-CH_2CH_2CH_2CH_2CH_2-$, $-CH(CH_3)CH_2CH_2CH_2-$, $-CH_2CH(CH_3)CH_2CH_2-$, $-CH_2CH(CH_3)CH(CH_3)-$, $-CH_2CH_2CH_2CH_2CH_2CH_2-$, $-CH(CH_3)CH_2CH_2CH_2CH_2-$, $-CH(C_2H_5)CH_2CH_2CH_2-$, $-CH(CH_3)CH(CH_3)CH_2CH_2-$, $-CH(CH_3)CH(CH_3)CH(CH_3)-$, $-CH_2CH_2CH_2CH_2CH_2CH_2CH_2-$, $-CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2-$, $-CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2-$, $-CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2-$, $-CH(CH(CH_3)_2)CH_2CH_2CH_2CH_2CH_2CH_2-$, -6-$CH_2$-3-ethylbicyclo[3,2,0]hepta-3-ene-6-yl-CH_2-, $-CH(CH_2SCH_3)-$, $-CH(CH_2CH_2SCH_3)-$, -CH(CH_2Phenyl)-, -CH[CH_2(4-hydroxyphenyl)]-, -CH[CH_2(4-imidazolyl)]-, $-CH(CH_2CONH_2)-$, $-CH(CH_2CH_2CONH_2)-$, $-CH(CH_2OH)-$, $-CH[CHOH(CH_3)]-$, $-CH(CH_2CH_2CH_2NH_2)-$, $-CH(CH_2CH_2CH_2CH_2NH_2)-$, $-CH[CH_2CH_2CH_2NHC(=NH)NH_2]-$,

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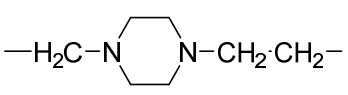
-CH(CH_2CO_2H)-, -CH($CH_2CO_2Bu^t$)-, -CH($CH_2CH_2CO_2H$)-, -CH($CH_2CH_2CO_2Bu^t$)-, -CH(NH_2)CH_2-, -CH(COOH)-, -CH(COOH)CH_2-, -CH(CH_2SCH_3)CH_2-, -CH(CH_2S-n-hexyl)-, -CH(CH_2-2-imidazolyl)-, -CH_2NHCH_2-, -$CH_2CH_2NHCH_2CH_2$-, -$CH_2CH_2N(CH_3)CH_2CH_2$-, -$CH_2CH_2N(i\text{-}C_3H_7)CH_2CH_2$-, -$CH_2CH_2N$(4-Methoxyphenyl) CH_2CH_2-, -$CH_2CH_2N(CH_2Ph)CH_2CH_2$-, -$CH_2CH_2N(n\text{-}C_4H_9)CH_2CH_2CH_2$-, -$CH_2CH_2N(n\text{-}C_4H_9)CH_2CH_2CH_2CH_2$-, -$CH_2CH(OH)CH_2NHCH_2CH_2$-, -$CH_2NHCH_2CH_2$-, -$CH_2CH_2NHCH_2CH_2CH_2$-, -$CH_2CH_2NHCH_2CH_2CH_2CH_2CH_2CH_2$-, -$CH_2N(CH_3)CH_2CH_2$-, -$CH_2CH_2N(CH_3)CH_2CH_2CH_2$-, -$CH_2N(C_2H_5)CH_2CH_2$-, -$CH_2CH_2N(C_2H_5)CH_2CH_2$-, -$CH_2CH_2N(C_2H_5)CH_2CH_2CH_2$-, -$CH_2N(C_2H_5)CH_2CH_2CH_2CH_2$-, -$CH_2N(i\text{-}C_3H_7)$ $CH_2CH_2CH_2CH_2$-, -$CH_2N(CH_3)CH_2NHCH_2$-, -$CH_2N(Ph)CH_2CH_2$-, -CH_2N(4-Cl-Ph)CH_2CH_2-, -CH_2N(4-Cl-3-CH_3-Ph)CH_2CH_2-, -$CH_2N(CH_2Ph)CH_2CH_2$-, -$CH_2CH_2N(CH_2Ph)CH_2CH_2$-, -$CH_2CH_2SCH_2CH_2$-, -$CH_2CH_2SCH_2$-, -$CH_2CH(OH)CH_2SCH_2CH_2$-, -$CH_2CH_2S(O)_2CH_2CH_2$-, -$CH_2COCH_2$-, -$CH_2CH_2COCH_2CH_2$-, -NH-, -N($CH_3$)-, -N($CH_2CH_3$)-, -N($CH_2CH_2CH_3$)-, -N($CH_2CH_2Ph$)-, -N($i\text{-}C_3H_7$)-, -N($CH_2CH_2CH_2CH_3$)-, -N($i\text{-}C_4H_9$)-, -N($s\text{-}C_4H_9$)-, -N(Ph)-, -N(3-Bromo-Ph)-, -N(3-Nitro-Ph)-, -N(4-Ethyl-Ph)-, -N(4-Butyl-Ph)-, -N(4-Chloro-Ph)-, -N(3-Chloro-Ph)-, -N(2-Chloro-Ph)-, -N(4-Fluoro-Ph)-, -N(4-Benzyl-Ph)-, -N(2,4-Dichloro-Ph)-, -N(4-Trifluoromethyl-Ph)-, -N(4-Hydroxy-Ph)-, -N(4-Cyano-Ph)-, -N(4-Ph-Ph)-, -N(4-CHO-Ph)-, -N(4-Carbamoyl-Ph)-, -N(4-Amino-Ph)-, -N(3-(N,N-Dimethylamino)-Ph)-, -N(4-Me-Ph-Ph)-, -N(4-Benzyloxy-Ph)-, -N(4-Ethoxycarbonyl-Ph)-, -N(4-Carboxy-Ph)-, -N(3-Carboxy-Ph)-, -N(2-Carboxy-Ph)-, -N(CH_2Ph)-, -N(4-Carboxyphenylmethyl)-,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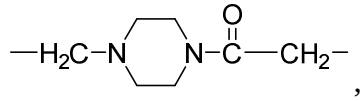
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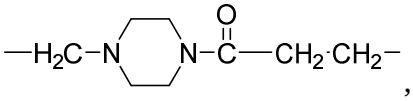
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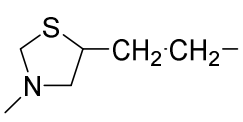
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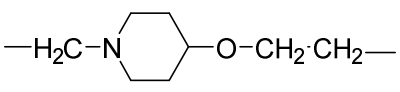
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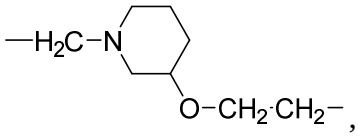
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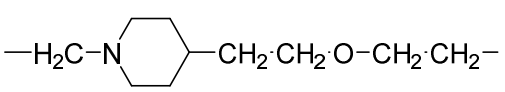
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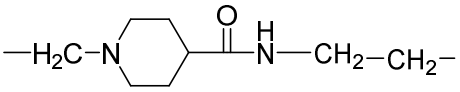
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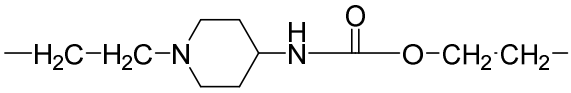
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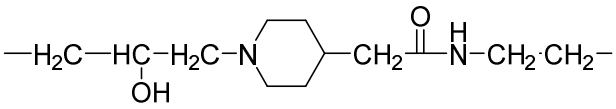
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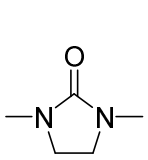
-NHCH$_2$CONHCH$_2$CH$_2$-, -N(CH$_3$)CH$_2$CONHCH$_2$CH$_2$-, -N(CH$_2$Ph)CH$_2$CONHCH$_2$CH$_2$-, -NHCH$_2$CON(CH$_3$)CH$_2$CH$_2$-, -NHCH$_2$CH$_2$SCH$_2$CH$_2$-, -CH$_2$CH$_2$CONHCH$_2$CH$_2$-, -CH$_2$COCH$_2$SCH$_2$-, -CH(CH$_2$CH$_2$SCH$_3$)CONHCH$_2$CH$_2$-, -CH$_2$CH$_2$CH$_2$CH$_2$CH(NH$_2$)-, -NHCH$_2$CH$_2$CH$_2$CH$_2$CH(COOH)-, -NHCH$_2$CH$_2$CH$_2$CH(COOH)-, -NHCH$_2$CH$_2$CH(COOC$_2$H$_5$)- or -NHCH$_2$CH$_2$CH$_2$CH(COOC$_2$H$_5$)-;

B is -NHCONH-, -N(CH$_3$)CONH-, -NHCON(CH$_3$)-, -N(CH$_3$)CON(CH$_3$)-, -N(C$_2$H$_5$)CONH-, -N(n-C$_3$H$_7$)CONH-, -N(i-C$_3$H$_7$)CONH-, -N(n-C$_4$H$_9$)CONH-, -N(n-C$_6$H$_{13}$)CONH-, -N(n-C$_4$H$_9$)CON(CH$_3$)-, -N(Ph)CONH-, -NHCON(4-Chlorophenyl)-, -NHCON(CH$_2$Phenyl)-, -N(i-C$_3$H$_7$)CON(4-Methoxyphenyl)-, -N(4-Chlorophenyl)CON(4-Methoxyphenyl)- or a group of formula: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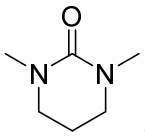
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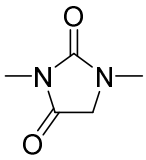
; and

D is -CH$_2$COOH, -CH$_2$CH$_2$COOH, -CH$_2$CH$_2$CH$_2$COOH, -CH$_2$CH(i-C$_4$H$_9$)CH$_2$COOH, -CH$_2$CH(i-C$_4$H$_9$)CH$_2$CONHCH$_2$CH(i-C$_4$H$_9$)CH$_2$COOH, -CH$_2$C(CH$_2$CH$_2$CH$_2$CH$_2$CH$_2$)CH$_2$COOH, -CH$_2$C(CH$_2$CH$_2$CH$_2$CH$_2$CH$_2$)CH$_2$CONHCH$_2$C(CH$_2$CH$_2$CH$_2$CH$_2$CH$_2$)CH$_2$COOH, -CH(CH$_2$SCH$_3$)COOH, -CH(CH$_2$CH$_2$SCH$_3$)COOH, -CH(CH$_2$Phenyl)COOH, -CH[CH$_2$(4-hydroxyphenyl)]COOH, -CH[CH$_2$(4-imidazolyl)]COOH, -CH(CH$_2$CONH$_2$)COOH, -CH(CH$_2$CH$_2$CONH$_2$)COOH, -CH(CH$_2$OH)COOH, -CH[CHOH(CH$_3$)]COOH, -CH(CH$_2$CH$_2$CH$_2$NH$_2$)COOH, -CH(CH$_2$CH$_2$CH$_2$CH$_2$NH$_2$)

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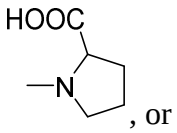
COOH, -CH[$CH_2CH_2CH_2NHC(=NH)NH_2$]COOH, -CH(CH_2CO_2H)COOH, -CH($CH_2CO_2Bu^t$)COOH, -CH($CH_2CH_2CO_2H$)COOH, -CH($CH_2CH_2CO_2Bu^t$)COOH, -$CH_2CH_2CH_2CH(NH_2)$COOH, -$CH_2CH_2CH_2CH_2CH(NH_2)$COOH, -CH(COOH)CH_3, -$CH_2CONHCH_2$COOH, -$CH_2CONHCH(CH_2CH_2SCH_3)$COOH, -$CH_2CONHCH[CH_2$(4-imidazolyl)]COOH, -$CH_2CONHCH(CH_2CONH_2)$COOH, -$CH_2CONHCH(CH_2CH_2CONH_2)$COOH, -$CH_2CH_2CONHCH_2$COOH, -$CH_2CH_2CONHCH(CH_2CH_2SCH_3)$COOH, -$CH_2CH_2CONHCH[CH_2$(4-imidazolyl)]COOH, -$CH_2CH_2CONHCH(CH_2CONH_2)$COOH, -$CH_2CH_2CONHCH(CH_2CH_2CONH_2)$COOH, -$CH_2CH_2CH_2CONHCH_2$COOH, -$CH_2CH_2CH_2CONHCH(CH_2CH_2SCH_3)$COOH, -$CH_2CH_2CH_2CONHCH[CH_2$(4-imidazolyl)]COOH, -$CH_2CH_2CH_2CONHCH(CH_2CONH_2)$COOH, -$CH_2CH_2CH_2CONHCH(CH_2CH_2CONH_2)$COOH, -6-$CH_2$-3-ethylbicyclo-[3,2,0]hepta-3-en-6-yl-CH_2COOH or a group of a formula described below, formed together with a moiety of -NH- in B:



, or

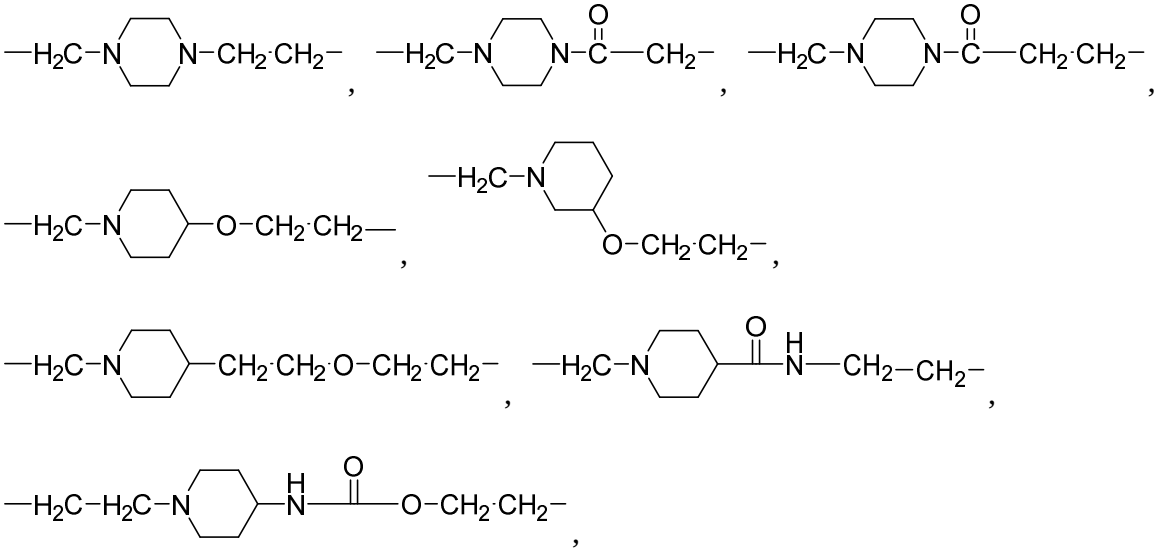
a pharmaceutically acceptable salt thereof.

Claim 2: The carotenoid derivative according to claim 1, or a pharmaceutically acceptable salt thereof, wherein:

R^1 and R^2 in the general formula (I) are same and each is -CO-A-B-D;

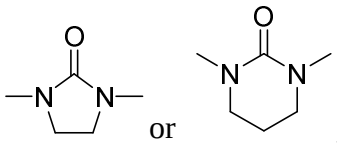
A is -CH_2-, -CH(CH_3)-, -CH(C_2H_5)-, -CH(n-C_3H_7)-, -CH(i-C_3H_7)-, -CH(n-C_4H_9)-, -CH(i-C_4H_9)-, -CH(s-C_4H_9)-, -CH_2CH_2-, -$CH_2CH_2CH_2$-, -$CH_2CH(CH_3)$-, -$CH_2CH_2CH_2CH_2$-, -$CH(CH_3)CH_2CH_2$-, -$CH_2CH(CH_3)CH_2$-, -CH_2CH(i-C_4H_9)CH_2-, -$CH_2C(CH_2CH_2CH_2CH_2CH_2)CH_2$-, -$CH_2CH_2CH_2CH_2CH_2$-, -$CH(CH_3)CH_2CH_2CH_2$-, -$CH_2CH(CH_3)CH_2CH_2$-, -$CH_2CH(CH_3)CH(CH_3)$-, -$CH_2CH_2CH_2CH_2CH_2CH_2$-, -$CH(CH_3)CH_2CH_2CH_2CH_2$-, -$CH(C_2H_5)CH_2CH_2CH_2$-, -$CH(CH_3)CH(CH_3)CH_2CH_2$-,

-CH(CH_3)CH(CH_3)CH(CH_3)-, -$CH_2CH_2CH_2CH_2CH_2CH_2CH_2$-, -CH($CH_2SCH_3$)-, -CH($CH_2CH_2SCH_3$)-, -CH($CH_2$Phenyl)-, -CH[$CH_2$(4-hydroxyphenyl)]-, -CH[CH_2(4-imidazolyl)]-, -CH(CH_2CONH_2)-, -CH($CH_2CH_2CONH_2$)-, -CH(CH_2OH)-, -CH[CHOH(CH_3)]-, -CH($CH_2CH_2CH_2NH_2$)-, -CH($CH_2CH_2CH_2CH_2NH_2$)-, -CH[$CH_2CH_2CH_2NHC(=NH)NH_2$]-, -CH(CH_2CO_2H)-, -CH($CH_2CH_2CO_2H$)-, -CH_2NHCH_2-, -$CH_2CH_2NHCH_2CH_2$-, -$CH_2CH_2N(CH_3)CH_2CH_2$-, -$CH_2CH_2N(i\text{-}C_3H_7)CH_2CH_2$-, -$CH_2CH_2$N(4-Methoxyphenyl)$CH_2CH_2$-, -$CH_2CH_2N(CH_2Ph)CH_2CH_2$-, -$CH_2CH_2N(n\text{-}C_4H_9)CH_2CH_2CH_2$-, -$CH_2CH_2N(n\text{-}C_4H_9)CH_2CH_2CH_2CH_2$-, -$CH_2NHCH_2CH_2$-, -$CH_2CH_2NHCH_2CH_2CH_2$-, -$CH_2CH_2NHCH_2CH_2CH_2CH_2CH_2CH_2$-, -$CH_2N(CH_3)CH_2CH_2$-, -$CH_2CH_2N(CH_3)CH_2CH_2CH_2$-, -$CH_2N(C_2H_5)CH_2CH_2$-, -$CH_2CH_2N(C_2H_5)CH_2CH_2$-, -$CH_2CH_2N(C_2H_5)CH_2CH_2CH_2$-, -$CH_2N(C_2H_5)CH_2CH_2CH_2CH_2$-, -$CH_2N(i\text{-}C_3H_7)$ $CH_2CH_2CH_2CH_2$-, -$CH_2N(CH_3)CH_2NHCH_2$-, -$CH_2N(Ph)CH_2CH_2$-, -CH_2N(4-Cl-Ph)CH_2CH_2-, -CH_2N(4-Cl-3-CH_3-Ph)CH_2CH_2-, -$CH_2N(CH_2Ph)CH_2CH_2$-, -CH_2CH_2N (CH_2Ph)CH_2CH_2-, -$CH_2CH_2SCH_2CH_2$-, -$CH_2CH_2SCH_2$-, -$CH_2CH_2S(O)_2CH_2CH_2$-, -CH_2COCH_2-, -$CH_2CH_2COCH_2CH_2$-, -NH-, -N(CH_3)-, -N(CH_2CH_3)-, -N($CH_2CH_2CH_3$)-, -N(CH_2CH_2Ph)-, -N($i\text{-}C_3H_7$)-, -N($CH_2CH_2CH_2CH_3$)-, -N($i\text{-}C_4H_9$)-, -N($s\text{-}C_4H_9$)-, -N(Ph)-, -N(3-Bromo-Ph)-, -N(3-Nitro-Ph)-, -N(4-Ethyl-Ph)-, -N(4-Butyl-Ph)-, -N(4-Chloro-Ph)-, -N(3-Chloro-Ph)-, -N(2-Chloro-Ph)-, -N(4-Fluoro-Ph)-, -N(4-Benzyl-Ph)-, -N(2,4-Dichloro-Ph)-, -N(4-Trifluoromethyl-Ph)-, -N(4-Hydroxy-Ph)-, -N(4-Cyano-Ph)-, -N(4-Ph-Ph)-, -N(4-CHO-Ph)-, -N(4-Carbamoyl-Ph)-, -N(4-Amino-Ph)-, -N(4-Me-Ph-Ph)-, -N(4-Benzyloxy-Ph)-, -N(4-Carboxy-Ph)-, -N(3-Carboxy-Ph)-, -N(2-Carboxy-Ph)-, -N(CH_2Ph)-, -N(4-Carboxyphenylmethyl)-,



-NHCH$_2$CONHCH$_2$CH$_2$-, -N(CH$_3$)CH$_2$CONHCH$_2$CH$_2$-, -N(CH$_2$Ph)CH$_2$CONHCH$_2$CH$_2$-, -NHCH$_2$CON(CH$_3$)CH$_2$CH$_2$-, -NHCH$_2$CH$_2$SCH$_2$CH$_2$-, -CH$_2$CH$_2$CONHCH$_2$CH$_2$-, -CH$_2$COCH$_2$SCH$_2$-, -CH(CH$_2$CH$_2$SCH$_3$)CONHCH$_2$CH$_2$-, -NHCH$_2$CH$_2$CH$_2$CH$_2$CH(COOH)-, or -NHCH$_2$CH$_2$CH$_2$CH(COOH)-;

B is, -NHCONH-, -N(CH$_3$)CONH-, -NHCON(CH$_3$)-, -N(CH$_3$)CON(CH$_3$)-, -N(C$_2$H$_5$)CONH-, -N(n-C$_3$H$_7$)CONH-, -N(i-C$_3$H$_7$)CONH-, -N(n-C$_4$H$_9$)CONH-, -N(n-C$_6$H$_{13}$)CONH-, -N(n-C$_4$H$_9$)CON(CH$_3$)-, or a group of a formula:

 or ; and

D is a -CH$_2$COOH, -CH$_2$CH$_2$COOH, -CH$_2$CH$_2$CH$_2$COOH, -CH$_2$CH(i-C$_4$H$_9$)CH$_2$COOH, -CH$_2$CH(i-C$_4$H$_9$)CH$_2$CONHCH$_2$CH(i-C$_4$H$_9$)CH$_2$COOH, -CH$_2$C(CH$_2$CH$_2$CH$_2$CH$_2$CH$_2$)CH$_2$COOH, -CH$_2$C(CH$_2$CH$_2$CH$_2$CH$_2$CH$_2$)CH$_2$CONHCH$_2$C(CH$_2$CH$_2$CH$_2$CH$_2$CH$_2$)CH$_2$COOH, -CH(CH$_2$SCH$_3$)COOH, -CH(CH$_2$CH$_2$SCH$_3$)COOH, -CH(CH$_2$Phenyl)COOH, -CH[CH$_2$(4-hydroxyphenyl)]COOH, -CH[CH$_2$(4-imidazolyl)]COOH, -CH(CH$_2$CONH$_2$)COOH, -CH(CH$_2$CH$_2$CONH$_2$)COOH, -CH(CH$_2$OH)COOH, -CH[CHOH(CH$_3$)]COOH, -CH(CH$_2$CH$_2$CH$_2$NH$_2$)COOH, -CH(CH$_2$CH$_2$CH$_2$CH$_2$NH$_2$)COOH, -CH[CH$_2$CH$_2$CH$_2$NHC(=NH)NH$_2$]COOH, -CH(CH$_2$CO$_2$H)COOH,

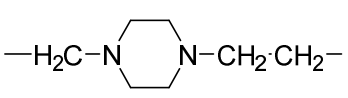
-CH($CH_2CH_2CO_2H$)COOH, -$CH_2CH_2CH_2CH(NH_2)$COOH, -$CH_2CH_2CH_2CH_2CH(NH_2)$COOH, -CH(COOH)CH_3, -$CH_2CONHCH_2$COOH, -$CH_2CONHCH(CH_2CH_2SCH_3)$ COOH, -$CH_2CONHCH[CH_2$(4-imidazolyl)]COOH, -$CH_2CONHCH(CH_2CONH_2)$COOH, -$CH_2CONHCH(CH_2CH_2CONH_2)$COOH, -$CH_2CH_2CONHCH_2$COOH, -$CH_2CH_2CONHCH(CH_2CH_2SCH_3)$COOH, -$CH_2CH_2CONHCH[CH_2$(4-imidazolyl)]COOH, -$CH_2CH_2CONHCH(CH_2CONH_2)$COOH, -$CH_2CH_2CONHCH(CH_2CH_2CONH_2)$COOH, -$CH_2CH_2CH_2CONHCH_2$COOH, -$CH_2CH_2CH_2CONHCH(CH_2CH_2SCH_3)$COOH, -$CH_2CH_2CH_2CONHCH[CH_2$(4-imidazolyl)]COOH, -$CH_2CH_2CH_2CONHCH(CH_2CONH_2)$COOH or -$CH_2CH_2CH_2CONHCH(CH_2CH_2CONH_2)$COOH.

Claim 3: The carotenoid derivative according to claim 1, or a pharmaceutically acceptable salt thereof, wherein:

R^1 and R^2 in the general formula (I) are same and each is -CO-A-B-D;

A is -CH_2-, -$CH(CH_3)$-, -$CH(C_2H_5)$-, -CH(n-C_3H_7)-, -CH(i-C_3H_7)-, -CH(n-C_4H_9)-, -CH(i-C_4H_9)-, -CH(s-C_4H_9)-, -CH_2CH_2-, -$CH_2CH_2CH_2$-, -$CH_2CH(CH_3)$-, -$CH_2CH_2CH_2CH_2$-, -CH_2CH(i-C_4H_9)CH_2-, -$CH_2C(CH_2CH_2CH_2CH_2CH_2)CH_2$-, -$CH(CH_2SCH_3)$-, -$CH(CH_2CH_2SCH_3)$-, -$CH(CH_2$Phenyl)-, -$CH[CH_2$(4-hydroxyphenyl)]-, -$CH[CH_2$(4-imidazolyl)]-, -$CH(CH_2CONH_2)$-, -$CH(CH_2CH_2CONH_2)$-, -$CH(CH_2OH)$-, -$CH[CHOH(CH_3)]$-, -$CH(CH_2CH_2CH_2NH_2)$-, -$CH(CH_2CH_2CH_2CH_2NH_2)$-, -$CH[CH_2CH_2CH_2NHC(=NH)NH_2]$-, -$CH(CH_2CO_2H)$-, -$CH(CH_2CH_2CO_2H)$-, -$CH_2NHCH_2$-, -$CH_2CH_2NHCH_2CH_2$-, -$CH_2CH_2N(CH_3)CH_2CH_2$-, -$CH_2CH_2N$(i-$C_3H_7$)$CH_2CH_2$-, -$CH_2CH_2N$(4-Methoxyphenyl)$CH_2CH_2$-, -$CH_2CH_2N(CH_2Ph)CH_2CH_2$-, -$CH_2CH_2N$(n-$C_4H_9$)$CH_2CH_2CH_2$-, -$CH_2CH_2N$(n-$C_4H_9$)$CH_2CH_2CH_2CH_2$-, -$CH_2NHCH_2CH_2$-, -$CH_2CH_2NHCH_2CH_2CH_2$-, -$CH_2N(CH_3)CH_2CH_2$-, -$CH_2CH_2N(CH_3)CH_2CH_2CH_2$-, -$CH_2N$($C_2H_5$)$CH_2CH_2$-, -$CH_2CH_2N(C_2H_5)CH_2CH_2$-, -$CH_2CH_2N(C_2H_5)CH_2CH_2CH_2$-, -$CH_2N(C_2H_5)$

$CH_2CH_2CH_2CH_2$-, -$CH_2N(i\text{-}C_3H_7)CH_2CH_2CH_2CH_2$-, -$CH_2N(CH_3)CH_2NHCH_2$-, -$CH_2N(Ph)CH_2CH_2$-, -$CH_2N(4\text{-}Cl\text{-}Ph)CH_2CH_2$-, -$CH_2N(4\text{-}Cl\text{-}3\text{-}CH_3\text{-}Ph)CH_2CH_2$-, -$CH_2N(CH_2Ph)CH_2CH_2$-, -$CH_2CH_2N(CH_2Ph)CH_2CH_2$-, -$CH_2CH_2SCH_2CH_2$-, -$CH_2CH_2SCH_2$-, -$CH_2CH_2S(O)_2CH_2CH_2$-, -$CH_2COCH_2$-, -$CH_2CH_2COCH_2CH_2$-, -NH-, -$N(CH_3)$-, -$N(CH_2CH_3)$-, -$N(CH_2CH_2CH_3)$-, -$N(CH_2CH_2Ph)$-, -$N(i\text{-}C_3H_7)$-, -$N(CH_2CH_2CH_2CH_3)$-, -$N(i\text{-}C_4H_9)$-, -N(Ph)-, -N(3-Nitro-Ph)-, -N(4-Ethyl-Ph)-, -N(4-Butyl-Ph)-, -N(4-Chloro-Ph)-, -N(3-Chloro-Ph)-, -N(2-Chloro-Ph)-, -N(4-Fluoro-Ph)-, -N(4-Benzyl-Ph)-, -N(2,4-Dichloro-Ph)-, -N(4-Trifluoromethyl-Ph)-, -N(4-Hydroxy-Ph)-, -N(4-Cyano-Ph)-, -N(4-Ph-Ph)-, -N(4-CHO-Ph)-, -N(4-Carbamoyl-Ph)-, -N(4-Amino-Ph)-, -N(4-Me-Ph-Ph)-, -N(4-Benzyloxy-Ph)-, -N(4-Carboxy-Ph)-, -N(3-Carboxy-Ph)-, -N(2-Carboxy-Ph)-, -$N(CH_2Ph)$-, -N(4-Carboxyphenylmethyl)-,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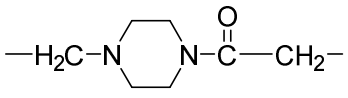
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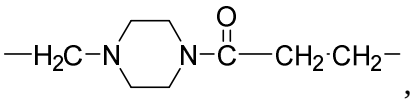
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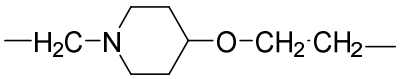
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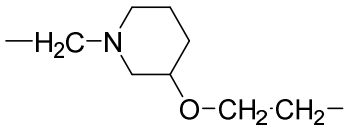
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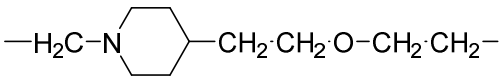
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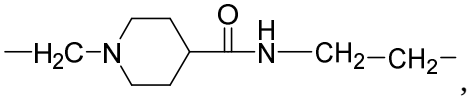
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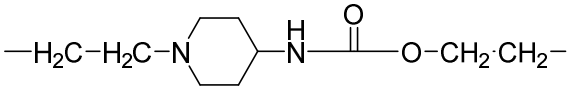
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-$NHCH_2CONHCH_2CH_2$-, -$N(CH_3)CH_2CONHCH_2CH_2$-, -$N(CH_2Ph)CH_2CONHCH_2CH_2$-, -$NHCH_2CON(CH_3)CH_2CH_2$-, -$NHCH_2CH_2SCH_2CH_2$-, -$CH_2CH_2CONHCH_2CH_2$-, -$CH_2COCH_2SCH_2$- or -$CH(CH_2CH_2SCH_3)CONHCH_2CH_2$-;

B is -NHCONH-, -$N(CH_3)CONH$-, -$NHCON(CH_3)$-, -$N(C_2H_5)CONH$-, -$N(n\text{-}C_3H_7)CONH$- or -$N(i\text{-}C_3H_7)CONH$-; and

D is -CH_2COOH, -CH_2CH_2COOH, -$CH_2CH_2CH_2COOH$, -

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$CH_2CH(i\text{-}C_4H_9)CH_2COOH$, $-CH_2CH(i\text{-}C_4H_9)CH_2CONHCH_2CH(i\text{-}C_4H_9)CH_2COOH$, $-CH_2C(CH_2CH_2CH_2CH_2CH_2)CH_2COOH$, $-CH_2C(CH_2CH_2CH_2CH_2CH_2)$ $CH_2CONHCH_2C(CH_2CH_2CH_2CH_2CH_2)CH_2COOH$, $-CH(CH_2SCH_3)COOH$, $-CH(CH_2CH_2SCH_3)COOH$, $-CH(CH_2Phenyl)COOH$, $-CH[CH_2(4\text{-hydroxyphenyl})]COOH$, $-CH[CH_2(4\text{-imidazolyl})]$ $COOH$, $-CH(CH_2CONH_2)COOH$, $-CH(CH_2CH_2CONH_2)COOH$, $-CH(CH_2OH)COOH$, $-CH[CHOH(CH_3)]COOH$, $-CH(CH_2CH_2CH_2NH_2)COOH$, $-CH(CH_2CH_2CH_2CH_2NH_2)$ $COOH$, $-CH[CH_2CH_2CH_2NHC(=NH)NH_2]COOH$, $-CH(CH_2CO_2H)COOH$, $-CH(CH_2CH_2CO_2H)COOH$, $-CH(COOH)CH_3$, $-CH_2CONHCH_2COOH$, $-CH_2CONHCH(CH_2CH_2SCH_3)$ $COOH$, $-CH_2CONHCH[CH_2(4\text{-imidazolyl})]COOH$, $-CH_2CONHCH(CH_2CONH_2)COOH$, $-CH_2CONHCH(CH_2CH_2CONH_2)COOH$, $-CH_2CH_2CONHCH_2COOH$, $-CH_2CH_2CONHCH(CH_2CH_2SCH_3)COOH$, $-CH_2CH_2CONHCH[CH_2(4\text{-imidazolyl})]COOH$, $-CH_2CH_2CONHCH(CH_2CONH_2)COOH$, $-CH_2CH_2CONHCH(CH_2CH_2CONH_2)COOH$, $-CH_2CH_2CH_2CONHCH_2COOH$, $-CH_2CH_2CH_2CONHCH(CH_2CH_2SCH_3)COOH$, $-CH_2CH_2CH_2CONHCH[CH_2(4\text{-imidazolyl})]COOH$, $-CH_2CH_2CH_2CONHCH(CH_2CONH_2)COOH$ or $-CH_2CH_2CH_2CONHCH(CH_2CH_2CONH_2)COOH$.

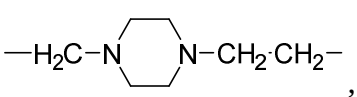
Claim 4: The carotenoid derivative according to claim 1, or a pharmaceutically acceptable salt thereof, wherein:

X in the general formula (I) is a carbonyl group;

R^1 and R^2 in the general formula (I) are same and each is -CO-A-B-D;

A is $-CH_2-$, $-CH(CH_3)-$, $-CH(C_2H_5)-$, $-CH(i\text{-}C_3H_7)-$, $-CH(n\text{-}C_4H_9)-$, $-CH(i\text{-}C_4H_9)-$, $-CH_2CH_2-$, $-CH_2CH_2CH_2-$, $-CH_2CH(i\text{-}C_4H_9)CH_2-$, $-CH_2C(CH_2CH_2CH_2CH_2CH_2)CH_2-$, $-CH(CH_2SCH_3)-$, $-CH(CH_2CH_2SCH_3)-$, $-CH(CH_2Phenyl)-$, $-CH[CH_2(4\text{-hydroxyphenyl})]-$, $-CH[CH_2(4\text{-imidazolyl})]-$, $-CH(CH_2CONH_2)-$, -

CH($CH_2CH_2CONH_2$)-, -CH(CH_2OH)-, -CH[$CHOH(CH_3)$]-, -CH($CH_2CH_2CH_2NH_2$)-, -CH($CH_2CH_2CH_2CH_2NH_2$)-, -CH[$CH_2CH_2CH_2NHC(=NH)NH_2$]-, -CH(CH_2CO_2H)-, -CH($CH_2CH_2CO_2H$)-, -CH(CH_2SCH_3)CH_2-, -CH_2NHCH_2-, -$CH_2CH_2NHCH_2CH_2$-, -$CH_2CH_2N(CH_3)CH_2CH_2$-, -CH_2CH_2N(4-Methoxyphenyl)CH_2CH_2-, -$CH_2CH_2N(CH_2Ph)CH_2CH_2$-, -$CH_2NHCH_2CH_2$-, -$CH_2CH_2NHCH_2CH_2CH_2$-, -$CH_2N(CH_3)CH_2CH_2$-, -$CH_2CH_2N(CH_3)CH_2CH_2CH_2$-, -$CH_2N(C_2H_5)CH_2CH_2$-, -$CH_2CH_2N(C_2H_5)CH_2CH_2$-, -$CH_2CH_2N(C_2H_5)CH_2CH_2CH_2$-, -$CH_2N(CH_3)CH_2NHCH_2$-, -$CH_2N(Ph)CH_2CH_2$-, -$CH_2N$(4-Cl-Ph)$CH_2CH_2$-, -$CH_2N$(4-Cl-3-$CH_3$-Ph)$CH_2CH_2$-, -$CH_2N(CH_2Ph)CH_2CH_2$-, -$CH_2CH_2N(CH_2Ph)CH_2CH_2$-, -$CH_2CH_2SCH_2CH_2$-, -$CH_2CH_2SCH_2$-, -$CH_2CH_2S(O)_2CH_2CH_2$-, -$CH_2COCH_2$-, -$CH_2CH_2COCH_2CH_2$-, -NH-, -$N(CH_3)$-, -$N(CH_2CH_3)$-, -$N(CH_2CH_2CH_3)$-, -$N(CH_2CH_2Ph)$-, -N(Ph)-, -N(3-Nitro-Ph)-, -N(4-Ethyl-Ph)-, -N(4-Chloro-Ph)-, -N(3-Chloro-Ph)-, -N(2-Chloro-Ph)-, -N(4-Fluoro-Ph)-, -N(4-Benzyl-Ph)-, -N(2,4-Dichloro-Ph)-, -N(4-Trifluoromethyl-Ph)-, -N(4-Hydroxy-Ph)-, -N(4-Cyano-Ph)-, -N(4-Ph-Ph)-, -N(4-CHO-Ph)-, -N(4-Carbamoyl-Ph)-, -N(4-Amino-Ph)-, -N(4-Me-Ph-Ph)-, -N(4-Benzyloxy-Ph)-, -N(4-Carboxy-Ph)-, -N(3-Carboxy-Ph)-, -N(2-Carboxy-Ph)-, -$N(CH_2Ph)$-, -N(4-Carboxyphenylmethyl)-,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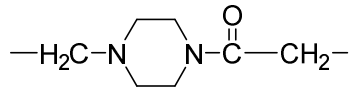
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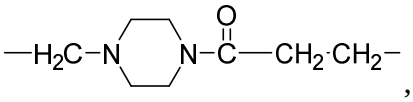
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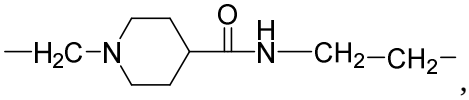
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-$NHCH_2CONHCH_2CH_2$-, -$N(CH_3)CH_2CONHCH_2CH_2$-, -$N(CH_2Ph)CH_2CONHCH_2CH_2$-, -$NHCH_2CON(CH_3)CH_2CH_2$-, -$NHCH_2CH_2SCH_2CH_2$-, -$CH_2CH_2CONHCH_2CH_2$-, -$CH_2COCH_2SCH_2$- or -$CH(CH_2CH_2SCH_3)CONHCH_2CH_2$-;

B is -NHCONH-, -$N(CH_3)CONH$-, -$NHCON(CH_3)$- or -$N(C_2H_5)CONH$-; and

D is -CH_2COOH, -CH_2CH_2COOH, -$CH_2CH_2CH_2COOH$, -$CH_2CH(i\text{-}C_4H_9)CH_2COOH$, -$CH_2CH(i\text{-}C_4H_9)CH_2CONHCH_2CH(i\text{-}C_4H_9)CH_2COOH$, -$CH_2C(CH_2CH_2CH_2CH_2CH_2)CH_2COOH$, -$CH_2C(CH_2CH_2CH_2CH_2CH_2)CH_2CONHCH_2C(CH_2CH_2CH_2CH_2CH_2)CH_2COOH$, -$CH(CH_2SCH_3)COOH$, -$CH(CH_2CH_2SCH_3)COOH$, -$CH(CH_2Phenyl)COOH$, -$CH[CH_2(4\text{-hydroxyphenyl})]COOH$, -$CH[CH_2(4\text{-imidazolyl})]COOH$, -$CH(CH_2CONH_2)COOH$, -$CH(CH_2CH_2CONH_2)COOH$, -$CH(CH_2OH)COOH$, -$CH[CHOH(CH_3)]COOH$, -$CH(CH_2CH_2CH_2NH_2)COOH$, -$CH(CH_2CH_2CH_2CH_2NH_2)COOH$, -$CH[CH_2CH_2CH_2NHC(=NH)NH_2]COOH$, -$CH(CH_2CO_2H)COOH$, -$CH(CH_2CH_2CO_2H)COOH$, -$CH(COOH)CH_3$, -$CH_2CONHCH_2COOH$, -$CH_2CONHCH(CH_2CH_2SCH_3)COOH$, -$CH_2CONHCH[CH_2(4\text{-imidazolyl})]COOH$, -$CH_2CONHCH(CH_2CONH_2)COOH$, -$CH_2CONHCH(CH_2CH_2CONH_2)COOH$, -$CH_2CH_2CONHCH_2COOH$, -$CH_2CH_2CONHCH(CH_2CH_2SCH_3)COOH$, -$CH_2CH_2CONHCH[CH_2(4\text{-imidazolyl})]COOH$, -$CH_2CH_2CONHCH(CH_2CONH_2)COOH$, -$CH_2CH_2CONHCH(CH_2CH_2CONH_2)COOH$, -$CH_2CH_2CH_2CONHCH_2COOH$, -$CH_2CH_2CH_2CONHCH(CH_2CH_2SCH_3)COOH$, -$CH_2CH_2CH_2CONHCH[CH_2(4\text{-imidazolyl})]COOH$, -$CH_2CH_2CH_2CONHCH(CH_2CONH_2)COOH$ or -$CH_2CH_2CH_2CONHCH(CH_2CH_2CONH_2)COOH$.

Claim 5: The carotenoid derivative according to claim 1, or a pharmaceutically acceptable salt thereof, wherein the carotenoid derivative is selected from the group consisting of

3-{2-[4-(18-{4-[3-(3-carboxymethylureido)propionyloxy]-2,6,6-trimethyl-3-oxocyclohexa-1-enyl}-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl)-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonyl]ethyl}-ureidoacetic acid,

3-[4-(18-{4-(3-carboxymethylureidoacetoxy)-2,6,6-trimethyl-3-oxocyclohexa-1-enyl}-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl)-3,5,5-trimethyl-2-

oxocyclohexa-3-enyloxycarbonylmethyl]-ureidoacetic acid,

3-{3-[4-(18-{4-[3-(2-carboxyethyl)ureidoacetoxy]-2,6,6-trimethyl-3-oxocyclohexa-1-enyl}-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl)-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonylmethyl]-ureido}propionic acid,

4-(3-{4-[18-(4-[3-(3-carboxypropyl)ureidoacetoxy]-2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonylmethyl}-ureido)butyric acid,

3-[3-(3-{4-[18-(4-{4-[3-(2-carboxyethyl)ureido]-butyryloxy}-2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonyl}propyl)ureido]propionic acid,

4-[3-(3-{4-[18-(4-{4-[3-(3-carboxypropyl)ureido]-butyryloxy}-2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonyl}propyl)ureido]butyric acid,

2-{3-[4-(18-{4-[3-(1-carboxyethyl)ureidoacetoxy]-2,6,6-trimethyl-3-oxocyclohexa-1-enyl}-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl)-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonylmethyl]-ureido}propionic acid,

3-phenyl-2-{3-[4-(18-{4-[3-(2-phenyl-1-carboxyethyl)-ureidoacetoxy]-2,6,6-trimethyl-3-oxocyclohexa-1-enyl}-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl)-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonylmethyl]ureido}propionic acid,

4-methylthio-2-{3-[4-(18-{4-[3-(3-methylthio-1-carboxypropyl)ureidoacetoxy]-2,6,6-trimethyl-3-oxocyclohexa-1-enyl}-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl)-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonylmethyl]ureido}butyric acid,

6-amino-2-{3-[4-(18-{4-[3-(5-amino-1-carboxypentyl)-ureidoacetoxy]-2,6,6-trimethyl-3-oxocyclohexa-1-enyl}-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl)-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonylmethyl]ureido}hexanoic acid,

2-amino-6-{3-[4-(18-{4-[3-(5-amino-5-carboxypentyl)-ureidoacetoxy]-2,6,6-trimethyl-3-oxocyclohexa-1-enyl}-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl)-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonyl methyl]ureido} hexanoic acid,

2-amino-5-{3-[4-(18-{4-[3-(4-amino-4-carboxybutyl)-ureidoacetoxy]-2,6,6-trimethyl-3-oxocyclohexa-1-enyl}-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl)-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonylmethyl]ureido}pentanoic acid,

5-guanidyl-2-{3-[4-(18-{4-[3-(1-carboxy-4-guanidyl- butyl)ureidoacetoxy]-2,6,6-trimethyl-3-oxocyclohexa-1-enyl}-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl)-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonylmethyl]ureido}pentanoic acid,

3-[3-(2-{4-[18-(4-{3-[3-(2-carboxyethyl)ureido]-propionyloxy}-2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonyl}ethyl)ureido]propionic acid,

4-[3-(2-{4-[18-(4-{3-[3-(3-carboxypropyl)ureido]-propionyloxy}-2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxy-carbonyl}ethyl)ureido]butyric acid,

3-(3-{4-[18-(4-{4-[3-carboxymethylureido]butyryloxy}-2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonyl}propyl)-ureidoacetic acid,

4-carboxy-4-(3-<2-{4-[18-(4-{3-(3-[1,3-dicarboxypropyl]-ureido)propionyloxy}-2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonyl}ethyl>ureido)butyric acid,

3-carboxy-3-(3-<2-{4-[18-(4-{3-(3-[1,2-dicarboxyethyl]-ureido)propionyloxy}-2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonyl}ethyl>ureido)propionic acid,

2-amino-6-(3-<2-{4-[18-(4-{3-(3-[5-amino-5-carboxypentyl]ureido)propionyloxy}-

2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonyl}-ethyl>ureido)hexanoic acid,

4-carboxy-4-(3-<3-{4-[18-(4-{4-(3-[1,3-dicarboxypropyl]-ureido)butyryloxy}-2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxy-carbonyl}propyl>ureido)butyric acid,

3-carboxy-3-(3-<3-{4-[18-(4-{4-(3-[1,2-dicarboxyethyl]-ureido)butyryloxy}-2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxy-carbonyl}propyl>ureido)propionic acid,

2-amino-6-(3-<3-{4-[18-(4-{4-(3-[5-amino-5-carboxypentyl]ureido)butyryloxy}-2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonyl}propyl>ureido)hexanoic acid,

2-amino-5-(3-<2-{4-[18-(4-{3-(3-[4-amino-4-carboxybutyl]ureido)propionyloxy}-2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonyl}-ethyl>ureido)pentanoic acid,

2-amino-5-(3-<3-{4-[18-(4-{4-(3-[4-amino-4-carboxybutyl]ureido)butyryloxy}-2,6,6-rimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonyl}-propyl>ureido)pentanoic acid,

3-isobutyl-4-(3-{4-[18-(4-[3-(2-isobutyl-3-carboxypropyl)-ureidoacetoxy]-2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonylmethyl}ureido)butyric acid,

1-(3-{4-[18-(4-[3-(1-carboxymethylcyclohexylmethyl)-ureidoacetoxy]-2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonylmethyl} ureidomethyl)

cyclohexylacetic acid,

3-isobutyl-4-[3-{2-isobutyl-3-[4-(18-[4-{3-isobutyl-4-[3-(2-isobutyl-3-carboxylpropyl)ureido]butyryloxy}-2,6,6-trimethyl-3-oxocyclohexa-1-enyl]-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl)-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonyl]propyl}-ureido]butyric acid,

1-(3-[1-{4-(18-[4-{1-(3-[1-carboxymethylcyclohexylmethyl]-ureidomethyl)cyclohexylacetoxy}-2,6,6-trimethyl-3-oxocyclohexa-1-enyl]-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl)-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonylmethyl}cyclohexylmethyl]-ureidomethyl)cyclohexylacetic acid,

6-(3-{4-(18-[4-{3-(6-carboxymethyl-3-ethylbicyclo[3,2,0]-hepta-3-en-6-ylmethyl)ureidomethylacetoxy}-2,6,6-trimethyl-3-oxocyclohexa-1-enyl]-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl)-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonylmethyl}ureidomethyl)-3-ethylbicyclo[3,2,0]hepta-3-en-6-ylacetic acid,

6-(3-[3-{4-(18-[4-[4-{3-(6-carboxymethyl-3-ethylbicyclo[3,2,0]hepta-3-en-6-ylmethyl)ureido}-butyryloxy]-2,6,6-trimethyl-3-oxocyclohexa-1-enyl]-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl)-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonyl}propyl]ureidomethyl)-3-ethylbicyclo[3,2,0]hepta-3-en-6-ylacetic acid, and

6-(3-[6-{4-(18-[4-[6-{3-(6-carboxymethyl-3-ethylbicyclo[3,2,0]hepta-3-en-6-ylmethyl)ureidomethyl}-3-ethylbicyclo[3,2,0]hepta-3-en-6-ylacetoxy]-2,6,6-trimethyl-3-oxocyclohexa-1-enyl]-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl)-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonylmethyl}-3-ethylbicyclo[3,2,0]hepta-3-en-6-ylmethyl]ureidomethyl)-3-ethylbicyclo[3,2,0]hepta-3-en-6-ylacetic acid.

Claim 6: The carotenoid derivative according to claim 1, or a pharmaceutically acceptable salt thereof, selected from the group consisting of

4-(3-{4-[18-(4-[3-(3-carboxypropyl)ureidoacetoxy]-2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonylmethyl}-ureido)butyric acid disodium salt, and

4-(3-{4-[18-(4-[3-(3-carboxypropyl)ureidoacetoxy]-2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonylmethyl}-ureido)butyric acid dilysine salt.

Claim 7: The carotenoid derivative according to claim 1, or a pharmaceutically acceptable salt thereof, which is 4-(3-{4-[18-(4-[3-(3-carboxypropyl)ureidoacetoxy]-2,6,6-trimethyl-3- oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonylmethyl}-ureido)butyric acid.

Claim 8: The carotenoid derivative according to claim 1, or a pharmaceutically acceptable salt thereof, which is 4-(3-{4-[18-(4-[3-(3-carboxypropyl)ureidoacetoxy]-2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonylmethyl}-ureido)butyric acid dilysine salt.

Claim 9: The carotenoid derivative according to claim 1, or a pharmaceutically acceptable salt thereof, which is 3-[3-(2-{4-[18-(4-{3-[3-(2-carboxyethyl)ureido]-propionyloxy}-2,6,6-trimethyl-3-oxocyclohexa-1-enyl)-3,7,12,16-tetramethyloctadeca-1,3,5,7,9,11,13,15,17-nonaenyl]-3,5,5-trimethyl-2-oxocyclohexa-3-enyloxycarbonyl} ethyl)ureido]propionic acid or a pharmaceutically acceptable salt thereof.

Claim 10: A pharmaceutical composition, comprising the carotenoid derivative

according to claim 1, or a pharmaceutically acceptable salt thereof, as an active ingredient.

Claim 11: The pharmaceutical composition according to claim 10, for treating hyperlipidemia, obesity, impaired glucose tolerance, hypertension, insulin resistance, a metabolic syndrome, fatty liver disease, diabetes, diabetic complication, steatohepatitis, non-alcoholic steatohepatitis, Type C hepatitis, arteriosclerosis, gestational diabetes, polycystic ovary syndrome, a cardiovascular disease, heart failure, atherosclerosis, vascular insufficiency, cell damage caused by an ischemic cardiac disease, gout, an inflammatory disease, stomach ulcer, cancer, osteoporosis, cataract, glaucoma, age-related macular degeneration, dry eye, eyestrain, Alzheimer's disease, depression, bipolar disorder, schizophrenia, chronic fatigue, disuse muscle atrophy, amyotrophic lateral sclerosis, amyotrophy, sarcopenia, cachexia, uric acid suppression action, hair growth promotion action, wound improvement, or improvement after surgery.