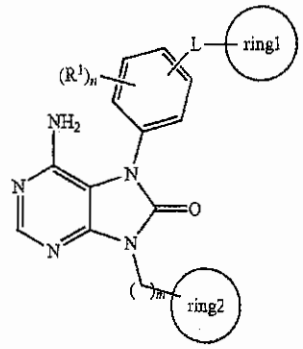
CLAIMS

1. A compound represented by general formula (I)

[C 1]



(in the formula,

L represents (1) —O—, (2) —S—, (3) —SO—, (4) $-SO_2-$ (5) —NH—, (6) —C(O)—, (7) $-CH_2-O-$, (8) $-O-CH_2-$, (9) $-CH_2-$, or (10) —CH(OH)—;

R^1 represents (1) a halogen atom, (2) a C_{1-4} alkyl group, (3) a C_{1-4} alkoxy group, (4) a C_{1-4} haloalkyl group, or (5) a C_{1-4} haloalkoxy group;

ring1 represents a benzene, cyclohexane, or pyridine ring, which may be substituted by from one to five substituents each independently selected from the group consisting of (1) halogen atoms, (2) C_{1-4} alkyl groups, (3) C_{1-4} alkoxy groups, (4) nitrile, (5) C_{1-4} haloalkyl groups, and (6) C_{1-4} haloalkoxy groups, wherein when two or more substituents are present on ring1, these substituents may form a 4- to 7-membered cyclic group together with the atoms in ring1 to which these substituents are bound;

ring2 represents a 4- to 6-membered nitrogenous saturated heterocycle, which is substituted by from one to three $-K-R^2$;

K represents C(O), (wherein the bond on the left is bound to the ring2);

R^2 represents (1) a C_{1-4} alkyl, (2) a C_{2-4} alkenyl, or (3) a C_{2-4} alkynyl group, each of which may be substituted by from one to five substituents each independently selected from the group consisting of (1) NR^3R^4, (2) halogen atoms, (3) $CONR^5R^6$, (4) CO_2R^7, and (5) OR^8;

R^3 and R^4 each independently represent (1) a hydrogen atom, or (2) a C_{1-4} alkyl group which may be substituted by OR^9 or $CONR^{10}R^{11}$;

R^3 and R^4 may, together with the nitrogen atom to which they are bound, form a 4- to 7-membered nitrogenous saturated heterocycle, which may be substituted by an oxo group or a hydroxyl group;
R^5 and R^6 each independently represent (1) a hydrogen atom, (2) a C_{1-4} alkyl group, or (3) a phenyl group;
R^7 represents (1) a hydrogen atom or (2) a C_{1-4} alkyl group;
R^8 represents (1) a hydrogen atom, (2) a C_{1-4} alkyl group, (3) a phenyl group, or (4) a benzotriazolyl group;
R^9 represents (1) a hydrogen atom or (2) a C_{1-4} alkyl group;
R^{10} and R^{11} each independently represent (1) a hydrogen atom or (2) a C_{1-4} alkyl group;
n represents an integer from 0 to 4;
m represents an integer from 0 to 2; and
when n is two or more, the R^1's may be the same as each other or may differ from one another),
an optical isomer thereof or their mixture, a salt thereof, a solvate thereof, or an N-oxide thereof.

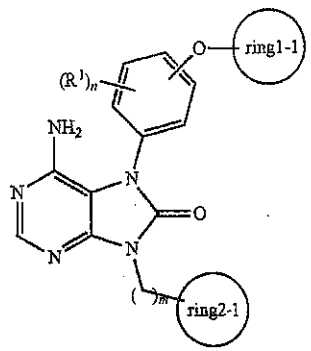
2. The compound according to claim 1, wherein R^2 is a C_{2-4} alkenyl group or a C_{2-4} alkynyl group, each of which may be substituted by from one to five substituents each independently selected from the group consisting of (1) NR^3R^4, (2) halogen atoms, (3) $CONR^5R^6$, (4) CO_2R^7, and (5) OR^8.

3. The compound according to claim 1, wherein the 4- to 6-membered nitrogenous saturated heterocycle is an azetidine, pyrrolidine, or piperidine ring.

4. The compound according to claim 1, represented by general formula (I-1)

[C 2]

(I-1)



(in the formula, ring1-1 represents a benzene, cyclohexane, or pyridine ring, each of which may be substituted by from one to five substituents each independently selected from the group consisting of (1) halogen atoms, (2) C_{1-4} alkyl groups, (3) C_{1-4} alkoxy groups, (4) nitrile, and (5) CF_3, and ring2-1 represents a 4- to 6-membered nitrogenous saturated heterocycle, which is substituted by from one to three $-K-R^2$, wherein the other symbols have the same definitions as above).

5. The compound according to claim 4, wherein R^2 is a C_{2-4} alkenyl group or a C_{2-4} alkynyl group, each of which may be substituted by from one to five substituents each independently selected from the group consisting of (1) NR^3R^4, (2) halogen atoms, (3) $CONR^5R^6$, (4) CO_2R^7, and (5) OR^8.

6. The compound according to claim 1, which is
(1) 9-(1-acryloyl-3-azetidinyl)-6-amino-7-(4-phenoxyphenyl)-7,9-dihydro-8H-purin-8-one,
(2) 6-amino-9-{(3R)-1-[(2E)-4-(dimethylamino)-2-butenoyl]-3-pyrrolidinyl}-7-(4-phenoxyphenyl)-7,9-dihydro-8H-purin-8-one,
(3) 9-[(1-acryloyl-4-piperidinyl)methyl]-6-amino-7-(4-phenoxyphenyl)-7,9-dihydro-8H-purin-8-one,
(4) 6-amino-9-{(3S)-1-[(2E)-4-(dimethylamino)-2-butenoyl]-3-pyrrolidinyl}-7-(4-phenoxyphenyl)-7,9-dihydro-8H-purin-8-one,
(5) 6-amino-7-[4-(3-chlorophenoxy)phenyl]-9-{(3R)-1-[(2E)-4-(dimethylamino)-2-butenoyl]-3-pyrrolidinyl}-7,9-dihydro-8H-purin-8-one,
(6) 6-amino-9-[1-(2-butynoyl)-3-pyrrolidinyl]-7-(4-phenoxyphenyl)-7,9-dihydro-8H-purin-8-one, or
(7) 6-amino-9-{1-[(2E)-4-(dimethylamino)-2-butenoyl]-3-pyrrolidinyl}-7-(4-phenoxyphenyl)-7,9-dihydro-8H-purin-8-one, or an optical isomer thereof or their mixture.

7. A pharmaceutical composition comprising a compound represented by general formula (I) according to claim 1, an optical isomer thereof or their mixture, a salt thereof, a solvate thereof, or an N-oxide thereof.

8. 5The pharmaceutical composition according to claim 7, that is a Btk inhibitor.

9. The pharmaceutical composition according to claim 8, that is a therapeutic agent for a non-Hodgkin's lymphoma.

10. The pharmaceutical composition according to claim 7, which is an inhibitor of B-cell activation.

11. A ~~method of treating a Btk-related disease, comprising administering to a mammal of an effective amount of a~~ compound represented by general formula (I) according to claim 1, an optical isomer thereof or their mixture, a salt thereof, a solvate thereof, or an N-oxide thereof, for use in treating a Btk-related disease, wherein the Btk-related disease is a non-Hodgkin's lymphoma.