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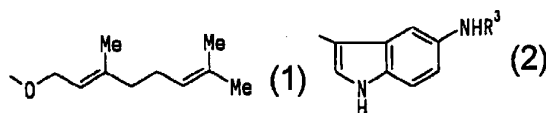
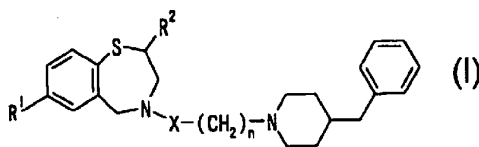
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(54) Title: USE OF 1,4-BENZOTHAZEPINE DERIVATIVES AS DRUGS OVERCOMING CARCINOSTATIC TOLERANCE

(54) 発明の名称: 1,4-ベンゾテアゼピン誘導体の抗癌剤耐性克服用医薬としての用途



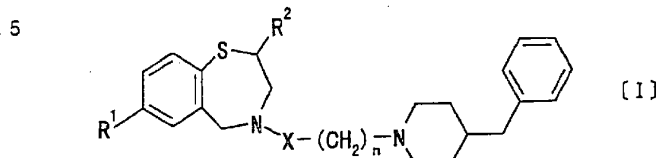
(57) Abstract: Use of compounds represented by general formula [I] or salts thereof or prodrugs of the same as drugs overcoming carcinostatic tolerance or drugs enhancing carcinostatics, wherein R¹ represents hydrogen or lower alkoxy; R² represents hydrogen, lower alkoxy, optionally substituted phenyl, (1) or (2) (wherein R³ represents acyl); X represents -CO- or -CH₂-; and n is 1 or 2. The compounds of the general formula [I] have not only an effect of overcoming the tolerance to various carcinostatics but also an effect of enhancing the effects of various carcinostatics on carcinostatic-sensitive cells. Therefore, these compounds exert excellent effects on both of tolerant cells and sensitive cells and are extremely efficacious particularly in treating cancer which has become tolerant to carcinostatics.

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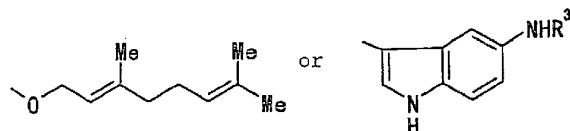
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ABSTRACT

The present invention relates to use of compounds represented by the following general formula [1] or salts or prodrugs thereof:



[where R¹ represents hydrogen atom or lower alkoxy group; R² represents hydrogen atom, lower alkoxy group, optionally substituted phenyl group,



(where R³ represents acyl group); X represents -CO- or -CH₂-; and n-represents 1 or 2], as drugs for overcoming a resistance to anticancer drugs or drugs for enhancing an effect of anticancer drugs. The compounds represented by the general formula [1] have not only a function of overcoming the resistance to various anticancer drugs but also a function of enhancing the effect of various anticancer drugs to anticancer-drug sensitive cells. Thus, these compounds have excellent effects on resistant cells and also on sensitive cells, and in particular effective in the treatment of a cancer having an acquired resistance to an anticancer drug.

to the cancer drug will appear in the living body, which always forces complicated chemotherapies for the cancer. Such a drug-resistance is generally classified into a spontaneous resistance and an acquired resistance. In a cancer treatment with an anticancer drug, a cancer cell having high sensitivity to the anticancer drug will disappear, while a cancer cell having low sensitivity to the anticancer drug will remain. Even in one cancer, both the cells having high and low sensitivities to the anticancer drug are included together. The cancer cell having high sensitivity to the anticancer drug is yielded with the acquired resistance by coming in contact with the anticancer drug. In view of clinical aspects, cancers can be classified into a first cancer group having relatively high sensitivity to anticancer drugs, such as small cell cancer, ovarian cancer and mammary cancer, and a second cancer group having lower sensitivity to anticancer drugs, such as non-small cell cancer, gastric cancer and colon cancer.

In the cell having a resistance to an anticancer drug, the following phenomenon is observed:

- 1) deterioration in a function of taking in drugs due to transformation in cell membrane,
- 2) acceleration of releasing drugs due to P-glycoprotein, multidrug-resistance associated protein (MRP) or the like,
- 3) degraded activity of drug activating enzyme, such as P-450,
- 4) enhanced activity of detoxication enzyme, such as glutathione S-transferase (GST), glutathione peroxidase (GSH-Px), DT-diaphorase, UDP-glucuronosyltransferase, metallothionein and



the like,

5) increased concentration of reduced glutathione (GSH) to be involved with detoxication of various anticancer drugs, and
6) enhancement in DNA repair activity (topoisomerase).

5 Among cells having a resistance to an anticancer drug, a part of the cells which have acquired a resistance to a specific anticancer drug can exhibit additional resistance to another drug. This is referred to as multidrug resistance (MDR). It is known that the cell acquired the multidrug resistance develops
10 a high amount of P-glycoprotein having a molecule weight of 170 kD. P-glycoprotein also exists in various normal cells, and is involved with various excretory mechanisms. With respect to anticancer drugs, P-glycoprotein has a pump function to release various anticancer drugs out of a cell by using ATP-energy, and
15 functions to lower the concentration of the anticancer drug in the cell so as to allow the cell to have the acquired resistance to the anticancer drug. The releasing function of P-glycoprotein has a limited selectability for anticancer drugs so that several kinds of anticancer drugs are released out of the cell. Thus,
20 it is believed that the cell having overdeveloped P-glycoprotein may acquire the multidrug resistance. Known cancers include one type, such as colon cancer, hepatic cancer, pancreatic cancer, or kidney cancer which has a highly developed P-glycoprotein, and another type, such as acute leukemia, malignant lymphoma
25 or neuroblastoma, in which P-glycoprotein will be increasingly developed along with recurrences thereof, as well as breast carcinoma, head and neck cancer, lung cancer, bladder cancer,



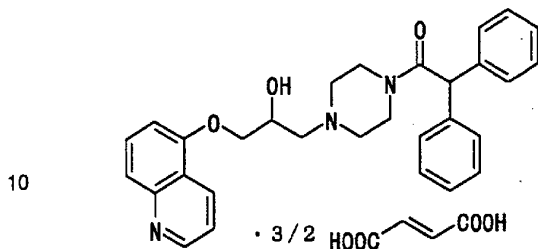
prostatic cancer, or melanoma, which has a small amount of developed P-glycoprotein.

In 1981, it was found that verapamil as a calcium antagonistic drug could overcome the multidrug resistance [Cancer Res., 41, 1967-1972, (1981)]. Thereafter, it has been verified that some calcium antagonistic drugs and calmodulin antagonistic drugs had the function of overcoming the resistance. It has also been verified that cyclosporin A as an immunosuppressive agent had the function of overcoming the resistance. It is assumed that verapamil or cyclosporin A overcomes the resistance by competing with P-glycoprotein in the site where the P-glycoprotein is bound with an anticancer drug to inhibit the function of P-glycoprotein. Further, it is also suggested that cyclosporin A has a possibility of providing the effect by affecting to drug-metabolizable enzymes represented by cytochrome P-450. The effect of the co-administration of cyclosporin A and etoposide has been clinically verified, and it has been reported that the co-administration of cyclosporin A and standard chemotherapeutics provided an excellent result in acute myelogenous leukemia and myeloma. However, these calcium antagonistic drugs and immunosuppressive agent have serious side effects caused by calcium antagonistic and immunosuppressive actions inherently involved therein, resulting in difficulty in their clinical application.

MS-209 having the following general formula is also known as a multidrug-resistance overcoming agent having a low calcium



antagonistic action [Cancer Chemother. Pharmacol., 35, 271-277 (1995), Cancer Chemother. Pharmacol., 36, 361-367 (1995)]. It is believed that MS-209 overcomes the resistance by binding directly with P-glycoprotein to prevent an anticancer drug from binding with P-glycoprotein.



In addition, tamoxifen as a hormone drug is supposed that when used in high dose, it acts to restrain the function of P-glycoprotein by suppressing protein kinase C, and tamoxifen or toremifene is considered to use as a drug for controlling the resistance. It has been reported that the effectiveness of these drugs generally depended on the kind of anticancer drugs independently of the existence of estrogen receptor of a cancer cell, and they were effective to vinblastine, adriamycin and etoposide but were not effective to cisplatin and melphalan.

On the other hand, a cell line has been found which has no overdeveloped P-glycoprotein but exhibits the multidrug resistance to anticancer drugs including vinca alkaloid. In 1992, Cole et al successively separated c DNA corresponding to overdeveloped m RNA in doxorubicin-resistant line H69AR of pulmonary parvocellular cancer cell line H69 having no developed



P-glycoprotein. They found a protein consisting of 1,531 amino acids coded by such c DNA, and called the protein as MRP (Multidrug Resistance-associated Protein) [Science, 258, 1650-1654, (1992)]. MRP is a membrane protein of 190kD and
5 belongs to ABC (ATP binding cassette) super family. MRP functions as a pump for releasing anticancer drugs as with P-glycoprotein. MRP is highly developed in a particular cell line, such as non-small cell lung cancer, thyroid gland cancer, glioma and neuroblastoma. It is indicated that these cancers
10 have poor response to chemotherapy. There is also a report describing that overdeveloped MRP was often observed in chronic lymphocytic leukemia. MRP releases various anticancer drugs each having no similarity in chemical structure as with P-glycoprotein, but the resistance level of MRP is lowered as the
15 concentration of glutathione in cells is reduced. In addition, glutathione conjugates such as leukotriene are transferred by MRP, therefore, it is possible to release anticancer drugs as hydrophilic compounds after metabolized and modified. MRP recognizes, as a substrate, glucuronic acid and sulfate
20 conjugates as well as glutathione conjugates. Further, it is believed that MRP also transfers a substrate having a multivalent negative charge, and a similarly modified heavy metal. There is some reports describing that a certain drug, such as verapamil and cyclosporin A, capable of overcoming the
25 multidrug resistance associated with P-glycoprotein partially overcame the multidrug resistance associated with MRP. However, no distinctive drug for the multidrug resistance associated with



MRP exists at present.

Recently, one glutathione-conjugate releasing pump other than MRP has been found. A cisplatin-resistance cell, KCP-4 cell, which was isolated from human nasopharyngeal cancer KB cells, exhibited about 63-fold resistance to cisplatin. The concentration of cisplatin in the KCP-4 cell was lowered, and an ATP-dependent cisplatin releasing pump was developed [Jpn. J.Cancer Res., 85, 423-433, (1994)]. In this KCP-4 cell, the concentration of glutathione was 4.7 times higher than its parental cell line. When the concentration of glutathione was reduced down to the value equal to or less than that of the parental cell line by using a glutathione synthetase inhibitor, the resistance to cisplatin is lowered to approximately half of the initial level. In the KCP-4 cell, MRP develops neither protein nor mRNA. Thus, it is believed that there is another glutathione-conjugate releasing pump different from MRP [BBRC, 256, 158-165, (1996)]. A CMOAT gene isolated from the KCP-4 cell has a homology with MRP. Comparing three cisplatin-resistant cells of KCP-4, PC 5 and T 24 with the corresponding parental cell lines, respectively, 4 to 6-fold mRNA is developed in the CMOAT. Thus, it is believed that CMOAT is a protein involved with the resistance to cisplatin.

A resistance mechanism by detoxifying anticancer drugs is also known. Glutathione S-transferase (GST) is one of detoxication enzymes. GST exists mostly in liver and is widely distributed over other organs, mainly as a dimer in the cytoplasm. Many molecular types are known, which includes molecular types



involved with glutathione (GSH) conjugating activity (GST activity) and glutathione peroxidase (GSH-Px) activity as well as molecular types participating in metabolism of leukotriene and prostaglandin. Many alkalizing agents such as nitrogen
5 mustard are detoxified by receiving GSH conjugation. Cisplatin and VP-16 are detoxified by GSH chelation and GSH conjugation, respectively [Biochem. Soc. Transact., 15, 728-730, (1987)].

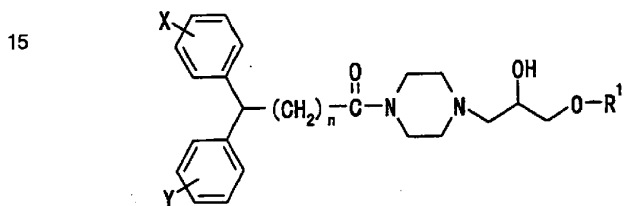
A drug resistance yielded by metallothionein is also known. Metallothionein was found in horse kidney as a cadmium-binding
10 protein, and is a relatively small protein having a molecular weight of 6000. Metallothionein has a characteristic structure including cysteine which accounts for approximately 1/3 of total constitutive amino acids and has no S-S binding. In 1981, Bakka et al discovered that cadmium-resistant cells containing a high
15 concentration of metallothionein also exhibited the resistance to cisplatin, and suggested that metallothionein had a possibility of acting as a resistance factor to cytotoxicity of cisplatin [Toxicol. Appl. Pharmacol., 61, 215-226, (1981)]. Further, it was clarified that a cell isolated from prepared
20 metallothionein-gene-deficient mice had a higher sensitivity to cisplatin [Cancer Res., 55, 2021-2023, (1995)]. In a study using mice with cancer, it has been verified that the anti-cancer effect not only of cisplatin but also of adriamycin, bleomycin, cyclophosphamide and melphalan were significantly
25 reduced by increasing the concentration of metallothionein in the cancer tissue twice through administering zinc. It is assumed that the resistance to plural anticancer drugs can be



acquired due to increased concentration of metallothionein. Amino acid derivatives of propargyl glycine for inhibiting metallothionein synthesis are being studied, but are now too toxic for clinical use.

5 Topoisomerase is an enzyme acting on alternating DNA topology. It is known topoisomerase having type I and II, wherein adriamycin and etoposide inhibit the type II, and camptothecin inhibit the type I. It is verified that a camptothecin-resistant cancer cell includes the structure of topoisomerase having
10 developed point mutation.

As to a multidrug-resistance overcoming drug, Japanese Patent Laid-Open Publication No. Hei 8-92218 describes a compound represented by the following general formula:

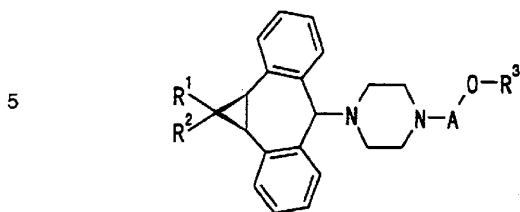


20 (where X and Y represent hydrogen atom or halogen atom, n represents an integer of 1-4, R¹ represents monocyclic or bicyclic aromatic chain which may include halogen atom, alkyl group with C atom numbers that vary from 1-4, alkyloxy group with C atom numbers that vary from 1-4, or nitrogen atom which
25 maybe substituted with nitro group.)

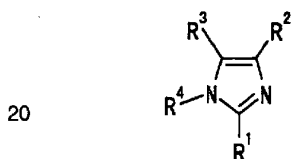
Japanese Patent Laid-Open Publication No. Hei 8-509223 (WO 94/24107, U.S. Patent No. 5,643,909, U.S. Patent No. 5,654,304,



European Patent 695,293) describes a compound represented by the following general formula:



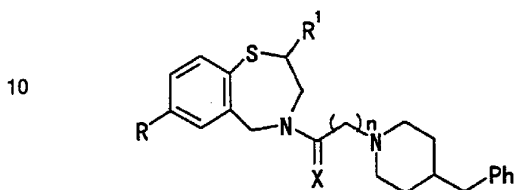
[where A is $-\text{CH}_2-\text{CH}_2-$, $\text{CH}_2-\text{CHR}^a-\text{CH}_2-$, or $-\text{CH}_2-\text{CHR}^a-\text{CHR}^b-\text{CH}_2-$ (where one of R^a or R^b is H, OH, or lower alkyloxy, and the other is H), R^1 and R^2 are H, F, Cl or Br; and R^3 is heteroaryl or phenyl optionally substituted with a substituent selected from the group consisting of F, Cl, Br, CF_3 , CN, NO, or OCHF_2], and Japanese Patent Laid-Open Publication No. Hei 10-7660 (U.S. Patent No. 5,700,826, European Patent 812829) describes a compound represented by the following general formula:



(where R^1 represents substituted alkyl, substituted alkenyl or the like, R^2 and R^3 represent aryl or the like, and R^4 represents hydrogen, substituted alkyl, substituted alkenyl or the like). However, the above publications do not describe any 1,4-benzothiazepine derivatives according to the present invention.

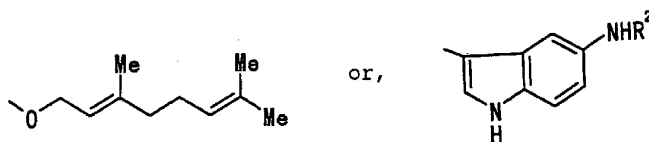


As to compounds according to the present invention, Japanese Patent Laid-Open Publication No. Hei 4-230681 (International Publication WO 92/12148, European Patent 565721, U.S. Patent No.5,416,060) describes 1,4-benzothiazepine derivatives
 5 represented by the following general formula or pharmaceutically acceptable salts thereof, and a manufacturing method of compounds thereof:



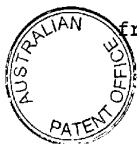
[where R represents hydrogen atom or a lower alkoxy group with
 15 C atom numbers that vary from 1-3; R¹ represents hydrogen atom, a lower alkoxy group with C atom numbers that vary from 1-3, a substituted phenyl group (where the substituent group is a hydroxyl group or a lower alkoxy group with C atom numbers that vary from 1-3),

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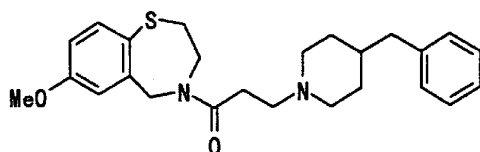
(where R² represents a acyl group with C atom numbers that vary from 1-3), X represents oxygen or H₂; n represents 1 or 2; and



Ph represents a phenyl group],

Japanese Patent Laid-Open Publication No. Hei 4-230681 describes that the myocardium of a myocardial infarction patient includes two necrosis forms [Static Cell Death (SD) and Kinetic
5 Cell Death (KD)], and KD is a dominant cause of myocardial infarction of human. This publication includes a description that the inventive compound has a KD suppressing effect and is thereby useful as drugs for preventing and treating myocardial infarction. However, there is no description about overcoming
10 the resistance to anticancer drugs.

Kaneko, one of the inventors of the present invention, has reported that the following compounds had an intracellular calcium blocking effect [Drug Dev. Res., 33, 429-438 (1994)], and is useful as a calcium channel inhibitor [J. Mol. Biol.,
15 274, 16-20 (1997)].



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However, the above documents include no description about the effect of overcoming the resistance to anticancer drugs, which is a subject matter of the present invention.

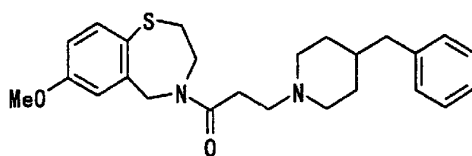
25 It is known that conventional calcium antagonistic drugs such as verapamil inhibit P-glycoprotein [Cancer Res., 49, 5002-5006 (1989)]. On the other hand, there is a report



describing that in an experimental test using a B16a cell, which is a melanin-deficient cell of a B16 cell, and a B16a-Pt cell line, which is a cisplatin-resistant mutant of the B16a cell, nifedipine as a calcium antagonistic drug enhances the antitumor
5 effect of cisplatin, but verapamil, diltiazem, nimodipine and nicardipine as well as trifluoperazine and calmidazolium as a calmodulin antagonistic drug do not exhibit any significant enhanced antitumor effect [Cancer Res., 49, 2844-2850 (1989)]. There is also a report describing that in an experimental test
10 using a GB-1 cell as a human glioblastoma cell and a U87-GM cell, none of verapamil, diltiazem, nimodipine, nicardipine, benidipine, nilvadipine and nisoldipine enhances any significant antitumor effect of cisplatin [J. Neurosurg., 82, 4469-474 (1995)].

15 In Drug Dev. Res., 33, 429-438 (1994), there is a description that diltiazem, a 1,5-benzothiazepine compound, and the following compound, 1,4-benzothiazepine, are analogous to each other,

20



25 and diltiazem does not enhance any significant antitumor effect of cisplatin. As long as the description of this report, it is assumed that the compounds according to the present invention



would not exhibit any effect of overcoming the resistance to cisplatin. However, the compounds according to present invention, which is represented by the general formula [1], have an extremely strong effect of overcoming the resistance to platinum complex such as cisplatin, as is clear from the aftermentioned example.

A tumor cell acquires the resistance to platinum complex such as cisplatin by a mechanism, such as reduced accumulation of the platinum complex in the tumor cell, detoxication yielded by glutathione, metallothionein and the like, and enhanced function of modifying damaged DNA [Jpn. J. Cancer Res., 79, 301-304 (1988), J. Biol. Chem., 265, 4296-4301 (1990), Jpn. J. Cancer Res., 81, 527-535 (1990), Br. J. Cancer, 67, 1171-1176 (1993), Cancer Res., 53, 5225-5232 (1993)], Cancer Res., 53, 3694-3699 (1993), Pharmacol. Ther., 52, 385-406 (1991)]. Thus, it may be difficult to overcome the resistance to cisplatin only by inhibiting P-glycoprotein. The compounds according to the present invention, which is represented by the general formula [I], overcome the resistance supposedly by a different mechanism from that in the conventional calcium antagonistic drugs, but the detail has not been known yet. Further, the compounds according to the present invention, which is represented by the general formula [I], surprisingly have a strong effect of overcoming the resistance to anticancer drugs such as taxol and adriamycin.

DISCLOSURE OF THE INVENTION



The present invention relates to providing a drug for overcoming a resistance to an anticancer drug and a drug for enhancing the effect of an anticancer drug, which are used for mammals such as human.

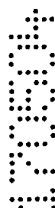
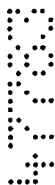
The present invention also relates to providing a pharmaceutical composition and a pharmaceutical kit, which are useful for treating cancer in mammals including human.

The present invention also relates to providing a drug for overcoming a resistance to an anticancer drug, a drug for enhancing an effect of an anticancer drug, a pharmaceutical composition, and a pharmaceutical kit, which are useful for treating cancer having the developed resistance to the anticancer drug.

The present invention also relates to providing a method for treating cancer, which is effective to cancers including one having a developed resistance to an anticancer drug.

In order to achieve the above, the inventors have continuously researched, and discovered that a specific compound represented by the following general formula [I] surprisingly have a function of overcoming a resistance to an anticancer drug and enhancing the effect of the anticancer drug, with low toxicity. Finally, the inventors have accomplished the present invention.

All of the conventional drugs for overcoming the resistance have been drugs for overcoming the resistance against so-called MDR associated with P-glycoprotein and multidrug-resistance



associated protein (MRP). As to calcium antagonistic drugs, it is reported that the effect of verapamil for overcoming the resistance is also associated with MDR, and verapamil has no effect on the resistance to cisplatin in an animal test. In addition, there is a report describing that a clinical test on MDR for children was attempted, but discontinued because of undesirably lowered blood pressure (bradycardia). It seems that the mechanism of the resistance to cisplatin is supposedly different from that of MDR, and thus it is a new and surprising knowledge that the compound according to the present invention, which is represented by the following general formula [I], has an ability of overcoming the resistance to cisplatin.

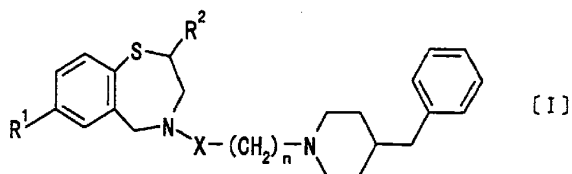
The present invention relates to a pharmaceutical composition for overcoming a resistance to an anticancer drug or enhancing an effect of an anticancer drug, which comprise a compound represented by the following formula [I] as an active ingredient. The detail is shown in the following (1)-(27):

(1) A pharmaceutical composition for overcoming a resistance to an anticancer drug, comprising a compound represented by the following general formula [I] or a pharmaceutically acceptable salt or prodrug thereof, together with a pharmaceutically acceptable carrier;

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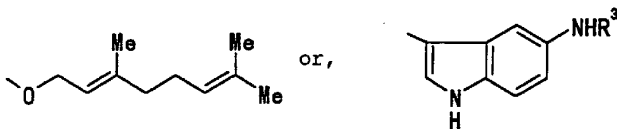
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[where R¹ represents hydrogen atom or lower alkoxy group; R² represents hydrogen atom, lower alkoxy group, or phenyl group (wherein said phenyl group may be substituted with 1-3 substituents selected from the group consisting of hydroxyl group and lower alkoxy group), or a group represented by the following formula,

15



(where R³ represents acyl group); X represents -CO- or -CH₂-; and n represents 1 or 2].

(2) A pharmaceutical composition described in the above (1), wherein said compound is 4-[3-(4-benzylpiperidine-1-yl)propionyl]-7-methoxy-2,3,4,5-tetrahydro-1,4-benzothiazepine, or a pharmaceutically acceptable salt or prodrug thereof.

(3) A pharmaceutical composition described in the above (1) or (2), wherein said anticancer drug is platinum complex, antitumor



substance derived from a plant, or antitumor antibiotic.

(4) A pharmaceutical composition described in the above (3), wherein said anticancer drug is cisplatin, carboplatin, nedaplatin, adriamycin or taxol.

5 (5) A pharmaceutical composition for enhancing an effect of an anticancer drug, comprising a compound represented by the above general formula [I] or a pharmaceutically acceptable salt or prodrug thereof, together with a pharmaceutically acceptable carrier.

10 (6) A pharmaceutical composition described in the above (5), wherein said compound is 4-[3-(4-benzylpiperidine-1-yl)propionyl]-7-methoxy-2,3,4,5-tetrahydro-1,4-benzothiazepine, or a pharmaceutically acceptable salt or prodrug thereof.

15 (7) A pharmaceutical composition described in the above (5) or (6), wherein said anticancer drug is platinum complex, antitumor substance derived from a plant, or antitumor antibiotic.

(8) A pharmaceutical composition described in the above (7), wherein said anticancer drug is cisplatin, carboplatin,

20 nedaplatin, adriamycin or taxol.

(9) A pharmaceutical composition for reducing a resistance of cancer to an anticancer drug, comprising a compound represented by the above general formula [1] or a pharmaceutically acceptable salt or prodrug thereof, together with a

25 pharmaceutically acceptable carrier.

(10) A pharmaceutical composition for increasing a sensitivity of cancer to an anticancer drug, comprising a compound



represented by the above general formula [1] or a pharmaceutically acceptable salt or prodrug thereof, together with a pharmaceutically acceptable carrier.

(11) A pharmaceutical composition comprising a compound
5 represented by the above general formula [I] or a pharmaceutically acceptable salt or prodrug thereof, and an anticancer drug.

(12) A method for overcoming a resistance to an anticancer drug, comprising administering an effective amount of a compound
10 represented by the above general formula [I] or a pharmaceutically acceptable salt or prodrug thereof.

(13) A method for enhancing an effect of an anticancer drug, comprising administering an effective amount of a compound represented by the above general formula [I] or a
15 pharmaceutically acceptable salt or prodrug thereof.

(14) A method for reducing a resistance of cancer to an anticancer drug, comprising administering an effective amount of a compound represented by the above general formula [1] or a pharmaceutically acceptable salt or prodrug thereof.

(15) A method for increasing a sensitivity of cancer to an anticancer drug, comprising administering an effective amount of a compound represented by the above general formula [1] or a pharmaceutically acceptable salt or prodrug thereof.

(16) A method for treating a cancer, comprising administering
25 an effective amount of a compound represented by the above general formula [1] or a pharmaceutically acceptable salt or prodrug thereof, together with an effective amount of an



anticancer drug.

(17) A method for treating a cancer having a resistance to an anticancer drug, comprising administering an effective amount of a compound represented by the above general formula [1] or
5 a pharmaceutically acceptable salt or prodrug thereof, together with an effective amount of an anticancer drug.

(18) A use of a compound represented by the above general formula [I] or a pharmaceutically acceptable salt or prodrug thereof, for manufacturing a drug for overcoming a resistance to an
10 anticancer drug.

(19) A use of a compound represented by the above general formula [I] or a pharmaceutically acceptable salt or prodrug thereof, for manufacturing a drug for enhancing an effect of an anticancer drug.

(20) A use of a compound represented by the above formula [1] or a pharmaceutically acceptable salt or prodrug thereof, for manufacturing a drug for reducing a resistance of cancer to an anticancer drug.

(21) A use of a compound represented by the above general formula
20 [1] or a pharmaceutically acceptable salt or prodrug thereof, for manufacturing a drug for increasing a sensitivity of cancer to an anticancer drug.

(22) A commercial package comprising a pharmaceutical composition described in any one of the above (1) to (4), and
25 a description about said pharmaceutical composition in which said pharmaceutical composition may or should be used for overcoming a resistance to an anticancer drug.



(23) A commercial package comprising a pharmaceutical composition described in any one of the above (5) to (8), and a description of said pharmaceutical composition in which said pharmaceutical composition may or should be used for enhancing
5 an effect of an anticancer drug.

(24) A commercial package comprising a pharmaceutical composition described in any one of the above (1) to (4), and a description of said pharmaceutical composition in which said pharmaceutical composition may or should be used for reducing
10 a resistance of cancer to an anticancer drug.

(25) A commercial package comprising a pharmaceutical composition described in any one of the above (1) to (4), and a description of said pharmaceutical composition in which said pharmaceutical composition may or should be used for increasing
15 a sensitivity of cancer to an anticancer drug.

(26) A pharmaceutical kit for treating a cancer, comprising two kinds of drugs, wherein a first drug is a drug for overcoming a resistance to an anticancer drug, which includes a compound represented by the above general formula [1] or a
20 pharmaceutically acceptable salt or prodrug thereof, wherein a second drug is said anticancer drug.

(27) A pharmaceutical kit for treating a cancer, comprising two kinds of drugs, wherein a first drug is a drug for enhancing an effect of an anticancer drug, which includes a compound
25 represented by the above general formula [1] or a pharmaceutically acceptable salt or prodrug thereof, wherein a second drug is said anticancer drug.



Preferably, the compound represented by the general formula [I] is 4-[3-(4-benzylpiperidine-1-yl) propionyl]-7-methoxy-2, 3, 4, 5-tetrahydro-1, 4-benzothiazepine.

The anticancer drug is preferably platinum complex, antitumor substance derived from a plant, or antitumor antibiotics, and more preferably cisplatin, carboplatin, nedaplatin, adriamycin or taxol.

DETAILED DESCRIPTION OF THE INVENTION

10 For the purpose of describing the present invention, terms used herein will be defined as follows.

The term "a drug for overcoming a resistance to an anticancer drug or an anticancer-drug-resistance overcoming drug" or "a pharmaceutical composition for overcoming a resistance to an anticancer drug or an anticancer-drug-resistance overcoming pharmaceutical-composition" refers to a drug which has no carcinostatic activity itself but has a function of reducing a resistance of cancer cells to an anticancer drug. In other words, it means a drug having a function for increase a sensitivity to an anticancer drug of cancer cells having an acquired resistance to the anticancer drug. In this case, the increase of the sensitivity means not only to increase an effect of an anticancer drug to anticancer-drug resistant cells in a higher level than that to anticancer-drug sensitive cells but also to increase the effect of the anticancer drug to the anticancer-drug resistant cells in approximately the same level as that to the anticancer-drug sensitive cells. Further, another



term equivalent to "overcoming a resistance" may include "restraining or inhibiting a resistance", "releasing resistance", "releasing tolerance" or "increasing or enhancing a sensitivity".

5 The term "a drug for enhancing a effect of an anticancer drug or an anticancer-drug-effect enhancing drug" or "a pharmaceutical composition for enhancing an effect of an anticancer drug or an anticancer-drug effect enhancing pharmaceutical-composition" refers to a drug which has no
10 carcinostatic activity itself but enhances an activity of an anticancer drug, i.e. an carcinostatic effect of an anticancer drug. In this case, the term "enhancing or increasing" means not only to increase an effect level of an anticancer drug to
15 anticancer-drug resistant cells in an equal to or higher than that to anticancer-drug sensitive cells but also to increase a sensitivity of cancer cells, which have not acquired any resistance, to the anticancer drug.

 Therefore, by using the anticancer-drug-resistance
20 overcoming drug or the anticancer-drug-effect enhancing drug according to the present invention, a sensitivity of cancer cells having an acquired resistance to an anticancer drug can be increased, and thereby the dosage of the anticancer drug can be reduced or the intervals of administration of the anticancer
25 drug can be extended.

 The term "a method for overcoming a resistance to an anticancer drug" means a method for reducing a resistance of



cancer cells to an anticancer drug, i.e. a method for increasing a sensitivity of cancer cells, which have acquired a resistance to an anticancer drug, to the anticancer drug.

The term "a method for enhancing or increasing an effect of an anticancer drug" means a method for enhancing or increasing an activity of an anticancer drug, in other word, a method for enhancing or increasing an carcinostatic effect of an anticancer drug itself.

The term "lower alkoxy group" includes straight or branched chain alkoxy group with one to six carbon atoms, such as methoxy, ethoxy, propoxy, isopropoxy, butoxy, tert-butoxy, pentyloxy, tert-pentyloxy or hexyloxy group, more preferably, methoxy, ethoxy, propoxy or isopropoxy group of one to three carbon atoms, most preferably, methoxy group.

The term "acyl group" includes formyl group with one carbon atom; alkanoyl group with two to six carbon atoms, such as acetyl, propionyl, butyryl, or pivaloyl group; or aroyl group, such as benzoyl group which may have substituents with one to three carbon atoms on aryl group. Preferably, it is formyl, acetyl, pivaloyl or benzoyl group.

The term "Salt" of the compound represented by the general formula [I] includes any pharmaceutically acceptable salts, preferably, any pharmaceutically acceptable acid addition salts including, for example, but not limited to, an inorganic acid addition salt, such as hydrochloride, hydrobromide, sulfate, phosphate or nitrate; an organic acid addition salt, such as acetate, propionate, succinate, glycolate, lactate, malate,



oxalate, tartrate, citrate, maleate, fumarate,
methanesulfonate, benzenesulfonate, p-toluenesulfonate or
ascorbate; or an amino acid addition salt, such as aspartate
or glutamate. Further, it may be a salt containing water or
5 hydrates.

The term "Prodrug" of the compound represented by the
general formula [I] includes any derivatives of the compound
according to the present invention, each of which has chemically
or metabolically degradable group and exhibits a pharmaceutical
10 activity by hydrolysis or solvolysis, or by degradation under
a physiological condition.

The term "Anticancer drug" includes, but not limit to,
alkalizing agent, such as busulfan, carboquone,
cyclophosphamide, ifosfamide, melfaran, nitrogen mustard,
15 thiotepa, uracil mustard, carmustine (BCUN), nimustine
hydrochloride (ACNU), estramustine phosphate; antimetabolite,
such as azathioprine, ancitabine, carmofur, doxifluridine,
fluorouracil (5-FU), mercaptopurine (6-MP), thioinosine,
tegafur, cytarabine (Ara-C), methotrexate (MTX),
20 hydroxycarbamide, cytarabine ocfosfate, pentostatin;
antitumor antibiotics, such as dactinomycin, mitomycin C,
bleomycin (BLM), daunorubicin, adriamycin (doxorubicin),
neocarzinostatin (NCS), idarubicin hydrochloride; antitumor
substance derived from a plant, such as etoposide (VP-16),
25 teniposide, vindesine, vincristine, vinblastine, taxol
(paclitaxel), irinotecan hydrochloride; platinum complex, such
as cisplatin (CDDP), carboplatin (CBDCA), nedaplatin (NDP);



hormone drug, such as predonisone, prednisolone, testosterone, estramustine, norethisterone, goserelin acetate, leuprorelin acetate, toremifene citrate, fadrozole hydrochloride, tamoxifen; anthracyclenic compound, such as mitoxantrone (MXT).

5 A preferred anticancer drug includes platinum complex, such as cisplatin, carboplatin, nedaplatin; antitumor antibiotics, such as dactinomycin, mitomycin C, bleomycin, daunorubicin, adriamycin, neocarzinostatin, idarubicin hydrochloride; and antitumor substance derived from a plant, such as etoposide,
10 teniposide, vindesine, vincristine, vinblastine, taxol, irinotecan hydrochloride. More preferably, it includes cisplatin, carboplatin, nedaplatin, adriamycin, and taxol, and most preferably, cisplatin.

The most preferred category of the anticancer drug is
15 platinum complex, and antitumor substance derived from a plant is the second place.

In the compound according to the present invention, which is represented by general formula [I], R¹ is preferably a lower alkoxy group with one to three carbon atoms, most preferably
20 a methoxy group. R² is preferably a lower alkoxy group with one to three carbon atoms or a hydrogen atom, most preferably a hydrogen atom. X is preferably -CO-, and n is preferably 2.

Preferably, the compound represented by the general formula [I] or the salt thereof may be used as an active ingredient in
25 the anticancer-drug-resistance overcoming drug, the anticancer-drug-effect enhancing drug and the pharmaceutical composition of the present invention.



The compound according to the present invention, which is represented by the general formula [I], may be made based on the method described in Japanese Patent Laid-Open Publication No. Hei 4-230681 (International Publication WO-92/12148, 5 European Patent 565721, U.S. Patent No.5,416,066).

The compound according to the present invention, which is represented by the general formula [I], has an effect excellent in overcoming a resistance to an anticancer drug and enhancing an effect of an anticancer drug. Specifically, by administering 10 the anticancer-drug-resistance overcoming drug or the anticancer-drug-effect enhancing drug together with an anticancer drug, the carcinostatic action of the anticancer drug may be effectively performed against cancer cells having the acquired resistance to anticancer drug. When used as the 15 anticancer-drug-resistance overcoming drug or the anticancer-drug-effect enhancing drug, the compound of the present invention is typically administered systemically or topically, through oral or parenteral route. Parenteral 20 administration includes intravenous (including drip infusion), intra-arterial, intramuscular, subcutaneous, intraperitoneal, intrathoracic, intravesical, intraspinal, percutaneous, mucosal, intrarectal and intratumoral administration. The anticancer-drug-resistance overcoming drug or the anticancer-drug-effect enhancing drug of the present invention 25 may be administered simultaneously with, or before or after administration of an anticancer drug, or may be administered during a cessation of the anticancer drug in some cases. An



administration route of the anticancer-drug-resistance overcoming drug or anticancer-drug-effect enhancing drug may be the same as or different from that of an anticancer drug.

The anticancer-drug-resistance overcoming drug or the
5 anticancer-drug-effect enhancing drug of the present invention may be used by administering together with an anticancer drug in treating cancer (malignant tumor), such as lung cancer (non-small cell lung cancer, small cell lung cancer), large intestine cancer (rectum cancer, colon cancer), small intestine
10 cancer, gastric cancer, esophageal cancer, hepatic cancer, pancreatic cancer, malignant melanoma, renal cancer, bladder cancer, uterine cancer (cervical cancer, corpus uteri cancer), ovarian cancer, mammary cancer, osteosarcoma, malignant lymphoma, prostatic cancer, leukemia (acute leukemia, chronic
15 leukemia), myeloma, neuroblastoma, head and neck cancer, skin cancer, and orchidocnus, in mammals including human.

The term "administrating together with" in the present invention means administering two kinds of drugs simultaneously, continuously or at intervals. The two kinds of drugs may be
20 administered as a mixture or as separate drugs. When administering as separate drugs, each administering route may be or may be not the same.

The dosage of the compound represented by the general formula [I] or the salt or prodrug thereof is varied depending
25 on age, weight, symptoms, therapeutic effects, administration route, treatment time and the like. Generally, it is administered orally or parenterally at an amount in the range



of 0.01mg to 1g per adult and one to several times a day.

A dosage of an anticancer drug administered together with the compound may be equal to or less than that for usual cancer treatments. A route of administration for the anticancer drug administered together with the compound may also be the same as that used for usual cancer treatments.

Further, a pharmaceutical composition containing the compound represented by the general formula [I] or the salt or prodrug thereof and an anticancer drug may be prepared and administered. In the composition, the weight ratio of the compound represented by the general formula [I] or the salt thereof or prodrug of the same to the anticancer drug may be arranged, but not limit to, in the range of 1:100 to 100:1.

According to the present invention, there is provided a pharmaceutical kit for treating cancer, including two drugs. In the pharmaceutical kit for treating cancer of the present invention, a first drug is a drug for overcoming a resistance of an anticancer drug or for enhancing an effect of an anticancer drug, which contains a compound represented by the general formula [I] or the salt or prodrug thereof, and a second drug is the anticancer drug. These two drugs may be used for treating cancer, especially cancer having an acquired resistance to the anticancer drug by administering the first drug together with the second drug. The anticancer-drug-resistance overcoming drug or anticancer-drug-effect enhancing drug as the first drug may be administered simultaneously with, or before or after administration of the anticancer drug as the second drug, or



may be administered during the cessation of the anticancer drug in some cases. An administration route of the anticancer-drug-resistance overcoming drug or anticancer-drug-effect enhancing drug may be or may be not the same as that of the anticancer drug.

When prepared as a solid composition for oral administration, the compound of the present invention may be formed in any suitable dosage form including tablet, pill, powder, and granule. In such a solid composition, one or more active substances are mixed with at least one of inactive diluent, dispersant, and adsorbent, such as lactose, mannitol, glucose, hydroxypropylcellulose, microcrystalline cellulose, starch, polyvinyl pyrrolidone, magnesium aluminate metasilicate, or silicic acid anhydride powder. In addition, the composition may be mixed with additives other than diluents based on common manner in the art.

When prepared as tablets or pills, they may be coated, if necessary, with one or more films of gastric or enteric coating substance, such as saccharose, gelatin, hydroxypropylcellulose or hydroxymethylcellulose phthalate. Further, they may be capsuled with substance, such as gelatin or ethyl cellulose.

When prepared as a liquid composition for oral administration, the compound of the present invention may be formed in any suitable dosage form including pharmaceutically acceptable emulsion, solvent, suspension, syrup, elixir or the like. A suitable diluent may include purified water, ethanol, vegetable oil, or emulsifier. Further, this composition may be



mixed with an auxiliary agent other than diluent, such as humectant, suspension, sweetening agent, flavor agent, fragrance agent, or antiseptic agent.

When prepared as injection for parenteral administration,
5 axenic aqueous or non-aqueous solution agents, solubilizing agents, suspensions or emulsifiers are used. Aqueous solution agent, solubilizing agents or solution agent may include water for injection, distilled water for injection, physiological saline; cyclodextrin and derivatives thereof, organic amines,
10 such as triethanolamine, diethanolamine, monoethanolamine, and triethylamine, inorganic alkali solution or the like.

For example, propylene glycol, polyethylene glycol, vegetable oils such as olive oil, or alcohols such as ethanol, may be used for preparing as the water-soluble solution. Further,
15 a surface-active agent (mixed micelle formation), such as polyoxyethylene hydrogenated castor oil or sucrose fatty acid ester, or lecithin or hydrogenated lecithin (liposome formation) may be used for preparing as the solubilizing agent. Further, the compound of the present invention may be prepared
20 as an emulsion drug comprising water insoluble solvent such as vegetable oils, and lecithin, polyoxyethylene hydrogenated castor oil or polyoxyethylene polyoxypropylene glycol.

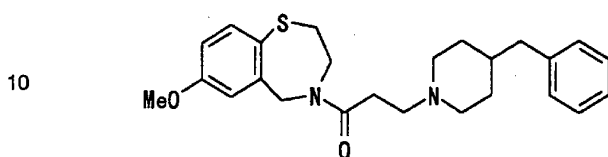
Alternately, for parenteral administration, the composition may be formed in lotion, liniment such as ointment,
25 suppository, or pessary, which contains one or more active substances and is prepared by well-known processes.



EXAMPLE

Examples of the compound of the present invention will now be described more specifically.

As a prepared compound, 4-[3-(4-benzylpiperidine-1-yl)propionyl]-7-methoxy-2,3,4,5-tetrahydro-1,4-benzothiazepine (hereinafter referred to as compound I) was used.



EXAMPLE 1

15 Injection

compound 1	10mg
D-sorbitol	1000mg
citric acid	10mg
sodium hydroxide	optimum dose

20 add water for injection to 20.0ml.

D-sorbitol and citric acid were dissolved in sufficient water for injection. The compound 1 was dissolved into the resulting solution and pH of the solution was adjusted to 3.2-3.3 by sodium hydroxide. While agitating, the rest of water for injection was added. The solution was filtered to fill in a 25 20.0ml ampule and enclosed. Then, the contents in the ampule were sterilized by using an autoclave.



EXAMPLE 2

A pharmaceutical kit for treating cancer was prepared which includes the following two drugs:

- a first drug the injection prepared in the example 1
5 a second drug cisplatin injection 20.0ml (0.5mg/ml)

The effect of the compound of the present invention will be described more specifically hereinafter. The compound 1 was used as a test compound.

10 EXAMPLE 3

Function of Test Compound for Enhancing Sensitivity to Anticancer Drug in Non-Small Cell Lung Cancer Cell Line having Cisplatin Resistant.

- PC-14 as a human non-small cell lung cancer cell line and
15 PC-14/CDDP as a cisplatin tolerant cell line thereof were used to examine an effect of overcoming each resistance to cisplatin, carboplatin, nedaplatin and taxol. PC-14 and PC-14/CDDP were made into a single cell in BPMI 1640 medium by trypsinization or by using a cell scraper, and prepared a cell suspension of
20 100 cells per 15 μ l. The compound 1 dissolved in dimethyl sulfoxide was added therein to make final concentration of 10 μ M, and then the resulting liquid was poured into a 96-perforated plate at 150 μ l per well. An anticancer drug was dissolved in sterilized distilled water. The resulting liquid
25 of 150 μ l per well was poured into the first row to transfer in turn from the second row to the next rows by 150 μ l for each row so as to form two-fold dilution rows. A group without the



cells was prepared as a negative control, and a group without the anticancer drug and the compound 1 was prepared as a positive control. After culturing at 37°C under carbon dioxide having a concentration of 5% and saturated vapor for 96 hours, an MTT [3-(4,5-dimethylthiazol-2-yl) -2,5-diphenyltetrazolium bromide] reagent of 20 μl dissolved in D-PBS (-) at a concentration of 5mg/ml was added to each of the groups, and the resulting liquid was cultured for another 4 hours at 37°C. After the completion of the culture, the entire plate was centrifuged, and the supernatant was removed. Dimethyl sulfoxide of 200 μl was added to dissolve formazan crystal generated by enzyme activities of mitochondria in the cells. Then, absorbed light of 562-630 nm was determined by using a multiplate reader. Given that the average growth rate of the negative control is 0% and the average growth rate of the positive control is 100%, a dose-growth curve was plotted to calculate 50% cell growth inhibiting concentration (IC₅₀). The result is shown in Table 1.

Table 1

anticancer drug	PC-14		PC-14/CDDP	
	without compound 1 (μM)	with compound 1 (μM)	without compound 1 (μM)	with compound 1 (μM)
cisplatin	2.40±1.05	1.77±0.89 (0.73)	18.6±2.83 (7.87)	2.16±1.12 (0.90)
carboplatin	37.1±10.8	29.5±11.3 (0.80)	143±39.1 (3.85)	26.1±7.78 (0.70)
nedaplatin	7.10±1.53	4.36±1.53 (0.61)	25.9±8.12 (3.64)	4.16±1.28 (0.59)
taxol	1.132*	0.663* (0.50)	5.295* (4.68)	1.728* (1.53)



Each figure in parentheses represents the resistance to IC₅₀ for the parental cell line (PC-14) without the compound 1.

As is apparent from the above result, the compound 1 shows the effect of reducing the resistance to and increasing the sensitivity to cisplatin, carboplatin, nedaplatin and taxol in the cisplatin resistant lung cancer cell line (PC-14/CDDP).

EXAMPLE 4

Function of Test Compound for Enhancing Effect of Anticancer Drug in Human Leukemia Cell Line having Adriamycin Resistant.

K562 as a human promyelocytic leukemia cell line and K562/ADM as an adriamycin resistant cell line thereof were used to examine the effect of overcoming the resistance to adriamycin.

The same process as the example 3 except using K562 and K562/ADM for cancer cells and adriamycin for an anticancer drug was carried out to calculate 50% cell growth inhibiting concentration (IC₅₀). The result is shown in Table 2.

Table 2

K562		K562/ADM	
without compound 1	with compound 1	without compound 1	with compound 1
0.008 μM	0.004 μM (0.50)	1.1525 μM (144)	0.1656 μM (20.7)

20

(n=1)

Each figure in parentheses represents the resistance to IC₅₀ of the parental cell line (K562) without the compound 1.



As is apparent from the above result, the compound 1 shows the effect of reducing the resistance to and increasing the sensitivity to adriamycin in the adriamycin resistant lung cancer cell line (K562/ADM).

5

EXAMPLE 5

Function for Enhancing Inhibit Tumor Cell Growth Effect of Cisplatin in Model of Nude Mice with Cancer.

10 Female nude mice BALB/c nu/nu (6-week-old) were implanted subcutaneously in each back with 2×10^7 of PC-14/CDDP and the parental cell line PC-14 suspended in physiological saline, then the progress of tumor were observed. On the 7th day from the implantation, tumor condition was checked to select and
15 randomize testable individuals not to cause any deviation, and the selected mice were then divided into a control group and a test group. After each tumor volume was determined based on the formula: (tumor short diameter)² x (tumor long diameter), administration of drug was started on the seventh day.

20 The compound 1 was used as a test compound, 1.2mg of which was dissolved in 0.05ml of dimethyl sulfoxide, and then combined with 0.95ml of 5% sorbitol - 0.2% citric acid 1 hydrate solution (pH3.3) to make uniform solution.

Cisplatin was used as an anticancer drug, and was dissolved
25 in distilled water to prepare 1.6 mg/ml solution.

The administration process is carried out by simultaneous intravenous injections of 0.05ml of the test compound and 0.05ml



of the anticancer-drug solution once a day on the 7th, 11th, 15th day after the tumor implantation. For the control group, 0.1ml of physiological saline was administered by intravenous injection, and for the group to be administered only the anticancer drug, 0.05ml of the anticancer-drug solution and 0.05ml of physiological saline were administered by intravenous injection. One dose of the test compound was 3 mg /kg, and one dose of the anticancer drug was 4mg/kg. During the administration of the drug, physical status of the whole body of the mice was observed, and the weight and the long/short lengths of tumor were measured. Tumor growth rate (GR) and effect of inhibiting cancer (lowest T/C) were calculated based on the following formulas, respectively. The result is shown in Table 3.

15

tumor growth rate(GR)

$$= \frac{\text{tumor volume on the 21th day after tumor implantation}}{\text{tumor volume on the 7th day after tumor implantation}} \times 100 (\%)$$

20 effect of tumor inhibiting (lowest T/C)

$$= \frac{\text{lowest volume of tumor of treated group during treatment}}{\text{volume of tumor of control group}} \times 100 (\%)$$

25



Table 3

		PC-14		PC-14/CDDP	
		without compound 1	with compound 1	without compound 1	with compound 1
GR (%)		874.30	753.32	478.43	190.52
lowest T/C (%)	11th day	13.33	9.76	20.64	9.81
	15th day	10.52	6.75	8.47	2.36

In the experimental test using the model of nude mice with cancer, by administering the compound 1 together with cisplatin, the effect of inhibiting tumor growth in the cisplatin resistant cancer cell line (PC-14/CDDP) was exhibited. This proves that the compound 1 has the effect of reducing the resistance of and increasing the sensitivity of cancer cells to cisplatin.

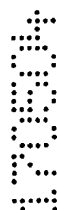
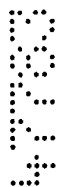
As apparent from above examples, the compound represented by the general formula [1] according to the present invention has not only the effect of overcoming the resistance to various anticancer drugs, but also the effect of enhancing the effect of various anticancer drugs on anticancer-drug sensitive cells. Thus, this compound has excellent effects not only on resistant cells but also on sensitive cells, and is expected to provide an extremely effective drug, particularly for treating a cancer having an acquired resistance to an anticancer drug. Thus, the pharmaceutical composition of the present invention, which contains the compound represented by the general formula [1] and an anticancer drug, is effective to the treatment of cancers,



particularly to the treatment of a cancer having an acquired resistance to an anticancer drug. Further, the pharmaceutical kit of the present invention is suitable for administration of a drug for overcoming a resistance to an anticancer drug or a drug for enhancing an effect of an anticancer drug together with the anticancer
5 drug, and is in particular effective to the treatment of a cancer having the acquired resistance to the anticancer drug. According to the method for treating cancer of the present invention, by administering the compound represented by the general formula [1] together with an anticancer drug, an excellent carcinostatic effect is exhibited even to a cancer having the acquire resistance to the cancer drug.

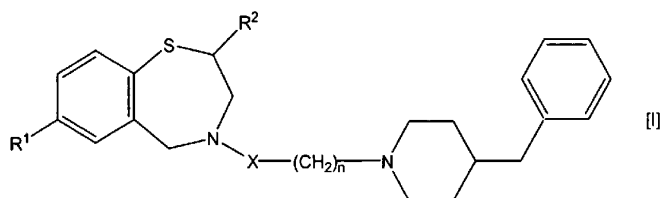
10 The present application is based on Japanese Patent Application No. Hei 11-139196 filed in Japan in 1999, and the entire disclosure thereof is incorporated hereinto.

As used herein, the term "comprise" and variations of the term, such as "comprising", "comprises" and "comprised", are not intended to exclude other
15 additives, components, integers or steps.

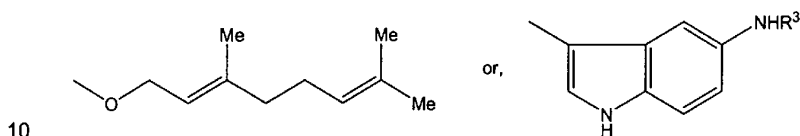


THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A compound when used for overcoming resistance to an anticancer drug, the compound being represented by the following general formula [I]



- 5 where R¹ represents hydrogen atom or lower alkoxy group; R² represents hydrogen atom, lower alkoxy group, or phenyl group, wherein said phenyl group may be substituted with 1-3 substituents selected from the group consisting of hydroxyl group and lower alkoxy group, or a group represented by the following formula,

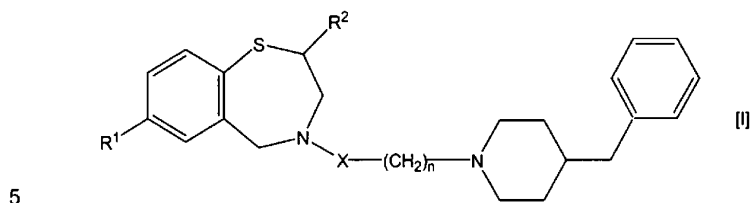


where R³ represents acyl group; X represents -CO- or -CH₂-; and n represents 1 or 2.

2. A compound when used as defined in claim 1, wherein said compound is 4-[3-(4-benzylpiperidine-1-yl)propionyl]-7-methoxy-2,3,4,5-tetrahydro-1,4-benzothiazepine, or a pharmaceutically acceptable salt or prodrug thereof.
3. A compound when used as defined in claim 1 or 2, wherein said anticancer drug is platinum complex, antitumor substance derived from a plant, or antitumor antibiotic.

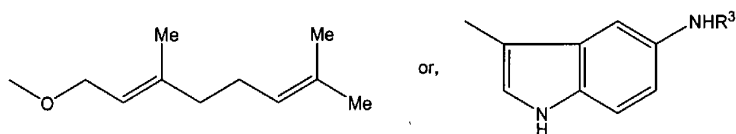
4. A compound when used as defined in claim 3, wherein said anticancer drug is cisplatin, carboplatin, nedaplatin, adriamycin or taxol.

5. A compound when used for enhancing an effect of an anticancer drug, the compound being represented by the following general formula [I]



where R^1 represents hydrogen atom or lower alkoxy group; R^2 represents hydrogen atom, lower alkoxy group, or phenyl group, wherein said phenyl group may be substituted with 1-3 substituents selected from the group consisting of hydroxyl group and lower alkoxy group, or a group represented by the following

10 formula,

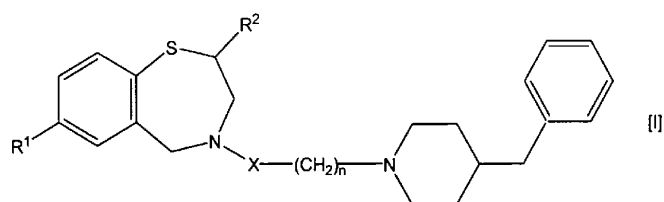


where R^3 represents acyl group; X represents $-\text{CO}-$ or $-\text{CH}_2-$; and n represents 1 or 2.

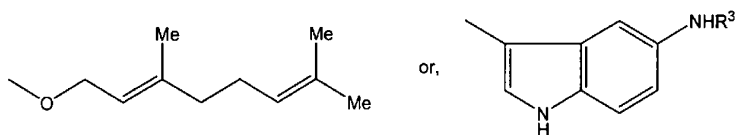
6. A compound when used for reducing resistance of cancer to an anticancer

15 drug, comprising a compound represented by the general formula [I]

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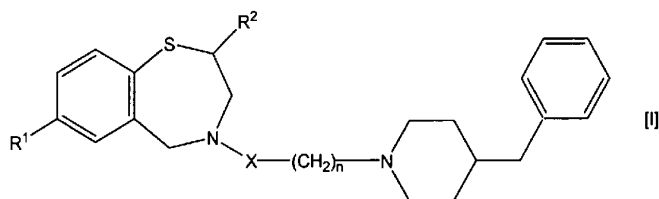


where R¹ represents hydrogen atom or lower alkoxy group; R² represents hydrogen atom, lower alkoxy group, or phenyl group, wherein said phenyl group may be substituted with 1-3 substituents selected from the group consisting of hydroxyl group and lower alkoxy group, or a group represented by the following formula,



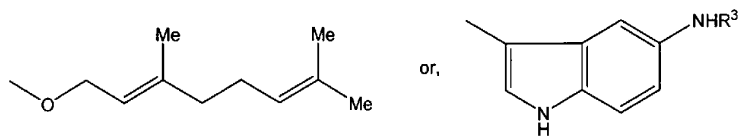
where R³ represents acyl group; X represents -CO- or -CH₂-; and n represents 1 or 2.

- 10 7. A compound when used for increasing sensitivity of cancer to an anticancer drug, comprising a compound represented by the general formula [I]



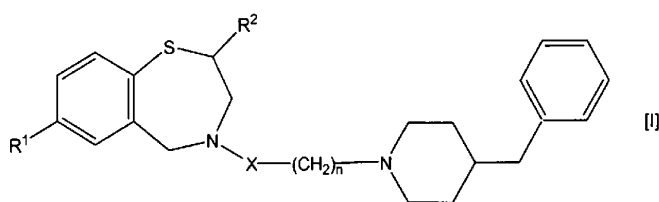
- 15 where R¹ represents hydrogen atom or lower alkoxy group; R² represents hydrogen atom, lower alkoxy group, or phenyl group, wherein said phenyl group may be substituted with 1-3 substituents selected from the group consisting of

hydroxyl group and lower alkoxy group, or a group represented by the following formula,

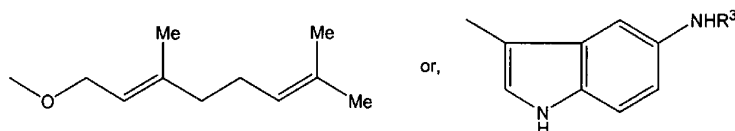


where R³ represents acyl group; X represents –CO– or –CH₂–; and n represents 1 or 2.

8. A compound when used as defined in any one of claims 5 to 7, wherein said compound is 4-[3-(4-benzylpiperidine-1-yl) propionyl]-7-methoxy-2,3,4,5-tetrahydro-1,4-benzothiazepine, or a pharmaceutically acceptable salt or prodrug thereof.
- 10 9. A compound when used as defined in any one of claims 5 to 8, wherein said anticancer drug is platinum complex, antitumor substance derived from a plant, or antitumor antibiotic.
10. A compound when used as defined in claim 9, wherein said anticancer drug is cisplatin, carboplatin, nedaplatin, adriamycin or taxol.
- 15 11. A pharmaceutical composition comprising a compound represented by the following general formula [I] or a pharmaceutically acceptable salt or prodrug thereof, and an anticancer drug and optionally a pharmaceutically acceptable carrier:



where R¹ represents hydrogen atom or lower alkoxy group; R² represents hydrogen atom, lower alkoxy group, or phenyl group, wherein said phenyl group may be substituted with 1-3 substituents selected from the group consisting of hydroxyl group and lower alkoxy group, or a group represented by the following
5 formula,



where R³ represents acyl group; X represents -CO- or -CH₂-; and n represents 1 or 2,

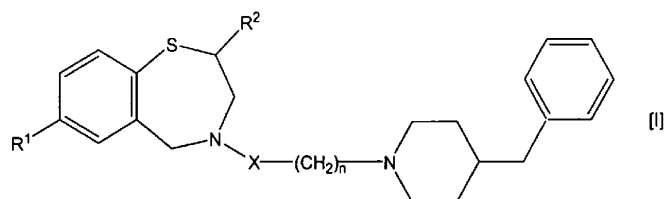
when used to overcome resistance to an anticancer drug, or enhance an
10 effect of an anticancer drug or reduce resistance to an anticancer drug, or increase sensitivity to an anticancer drug.

12. A pharmaceutical composition when used as defined in claim 11, wherein said compound is 4-[3-(4-benzylpiperidine-1-yl)propionyl]-7-methoxy-2,3,4,5-tetrahydro-1,4-benzothiazepine, or a pharmaceutically acceptable salt or prodrug
15 thereof.

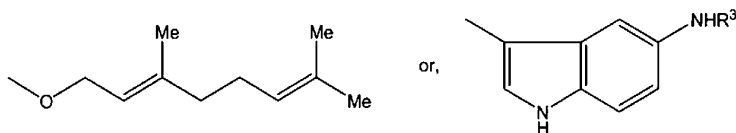
13. A pharmaceutical composition when used as defined in claim 11 or 12, wherein said anticancer drug is platinum complex, antitumor substance derived from a plant, or antitumor antibiotic.

14. A pharmaceutical composition when used as defined in claim 13, wherein
20 said anticancer drug is cisplatin, carboplatin, nedaplatin, adriamycin or taxol.

15. A method for overcoming a resistance to an anticancer drug, comprising administering an effective amount of a compound represented by the following general formula [I] or a pharmaceutically acceptable salt or prodrug thereof;

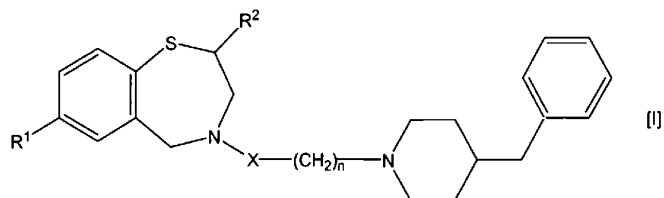


where R¹ represents hydrogen atom or lower alkoxy group; R² represents hydrogen atom, lower alkoxy group, or phenyl group, wherein said phenyl group may be substituted with 1-3 substituents selected from the group consisting of hydroxyl group and lower alkoxy group, or a group represented by the following formula,



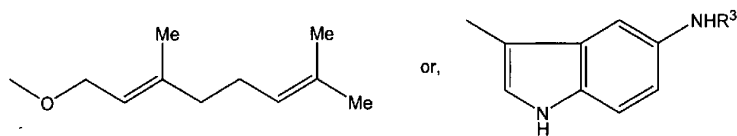
where R³ represents acyl group; X represents -CO- or -CH₂-; and n represents 1 or 2.

- 10 16. A method for enhancing an effect of an anticancer drug, comprising administering an effective amount of a compound represented by the following general formula [I] or a pharmaceutically acceptable salt or prodrug thereof;



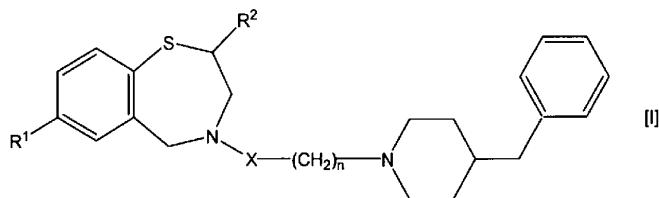
- 15 where R¹ represents hydrogen atom or lower alkoxy group; R² represents hydrogen atom, lower alkoxy group, or phenyl group, wherein said phenyl group may be substituted with 1-3 substituents selected from the group consisting of

hydroxyl group and lower alkoxy group, or a group represented by the following formula,

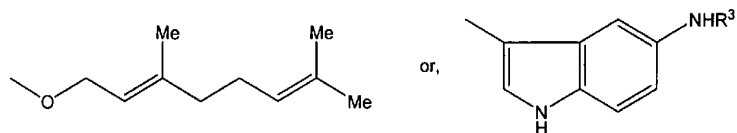


where R^3 represents acyl group; X represents $-\text{CO}-$ or $-\text{CH}_2-$; and n represents 1 or 2.

17. A method for reducing a resistance of cancer to an anticancer drug, comprising administering an effective amount of a compound represented by the general formula [I] or a pharmaceutically acceptable salt or prodrug thereof;

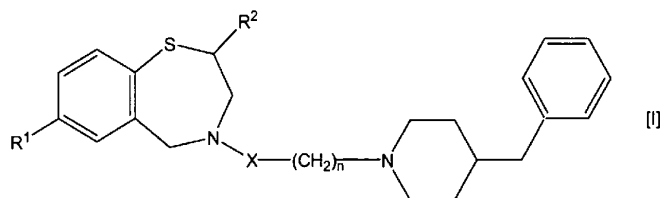


10 where R^1 represents hydrogen atom or lower alkoxy group; R^2 represents hydrogen atom, lower alkoxy group, or phenyl group, wherein said phenyl group may be substituted with 1-3 substituents selected from the group consisting of hydroxyl group and lower alkoxy group, or a group represented by the following formula,

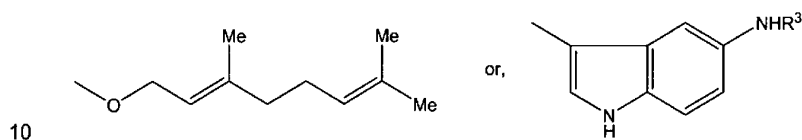


15 where R^3 represents acyl group; X represents $-\text{CO}-$ or $-\text{CH}_2-$; and n represents 1 or 2.

18. A method for increasing a sensitivity of cancer to an anticancer drug, comprising administering an effective amount of a compound represented by the general formula [I]

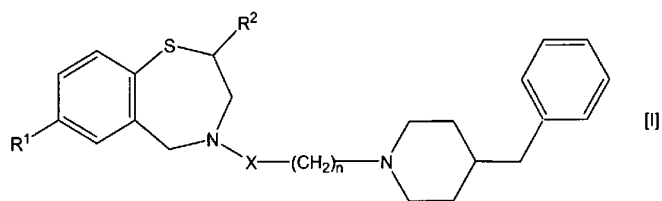


5 where R^1 represents hydrogen atom or lower alkoxy group; R^2 represents hydrogen atom, lower alkoxy group, or phenyl group, wherein said phenyl group may be substituted with 1-3 substituents selected from the group consisting of hydroxyl group and lower alkoxy group, or a group represented by the following formula,

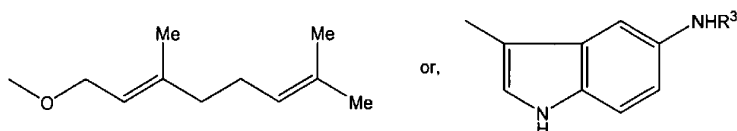


where R^3 represents acyl group; X represents $-\text{CO}-$ or $-\text{CH}_2-$; and n represents 1 or 2.

19. A method for treating a cancer, comprising administering an effective amount of a compound represented by the general formula [I]

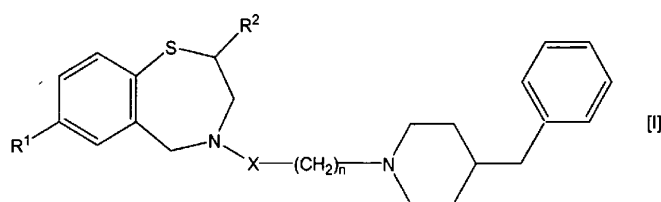


where R^1 represents hydrogen atom or lower alkoxy group; R^2 represents hydrogen atom, lower alkoxy group, or phenyl group, wherein said phenyl group may be substituted with 1-3 substituents selected from the group consisting of hydroxyl group and lower alkoxy group, or a group represented by the following
5 formula,

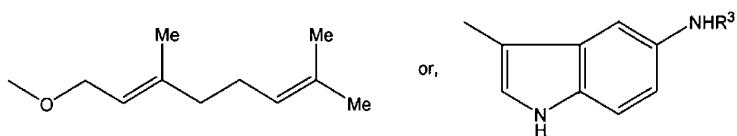


where R^3 represents acyl group; X represents $-CO-$ or $-CH_2-$; and n represents 1 or 2.

20. A method for treating a cancer having a resistance to an anticancer drug,
10 comprising administering an effective amount of a compound represented by the general formula [I]



where R^1 represents hydrogen atom or lower alkoxy group; R^2 represents hydrogen atom, lower alkoxy group, or phenyl group, wherein said phenyl group
15 may be substituted with 1-3 substituents selected from the group consisting of hydroxyl group and lower alkoxy group, or a group represented by the following formula,



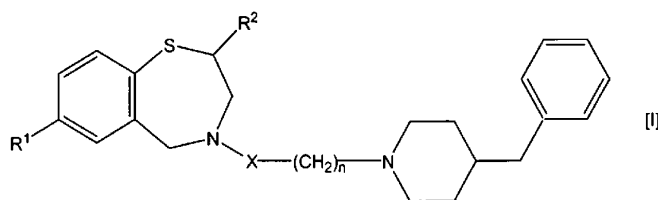
where R³ represents acyl group; X represents –CO– or –CH₂–; and n represents 1 or 2.

21. A method as defined in any one of claims 15 to 20, wherein said compound is 4-[3-(4-benzylpiperidine-1-yl)propionyl]-7-methoxy-2,3,4,5-tetrahydro-1,4-benzothiazepine, or a pharmaceutically acceptable salt or prodrug thereof.

22. A method as defined in any one of claims 15 to 21, wherein said anticancer drug is platinum complex, antitumor substance derived from a plant, or antitumor antibiotic.

23. A method as defined in claim 22, wherein said anticancer drug is cisplatin, carboplatin, nedaplatin, adriamycin or taxol.

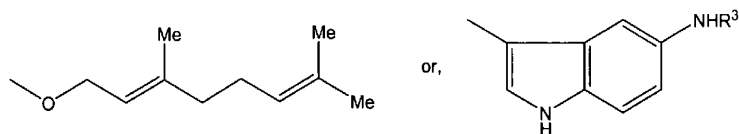
24. A use of a compound, or a salt or prodrug thereof, for manufacturing a drug for overcoming a resistance to an anticancer drug, comprising the compound represented by the following general formula [I] or a pharmaceutically acceptable salt or prodrug thereof;



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where R¹ represents hydrogen atom or lower alkoxy group; R² represents hydrogen atom, lower alkoxy group, or phenyl group, wherein said phenyl group may be substituted with 1-3 substituents selected from the group consisting of hydroxyl group and lower alkoxy group, or a group represented by the following

20 formula,



where R³ represents acyl group; X represents –CO– or –CH₂–; and n represents 1 or 2.

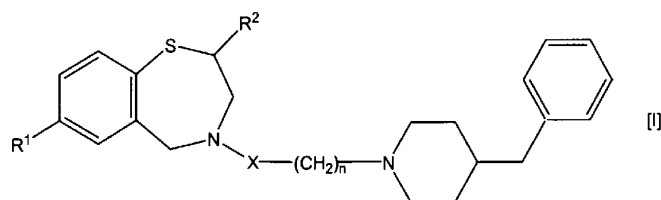
25. The use as defined in claim 24, wherein said compound is 4-[3-(4-benzylpiperidine-1-yl)propionyl]-7-methoxy-2,3,4,5-tetrahydro-1,4-benzothiazepine, or a pharmaceutically acceptable salt or prodrug thereof.

26. The use as defined in claim 24 or 25, wherein said anticancer drug is platinum complex, antitumor substance derived from a plant, or antitumor antibiotic.

27. The use as defined in claim 26, wherein said anticancer drug is cisplatin, carboplatin, nedaplatin, adriamycin or taxol.

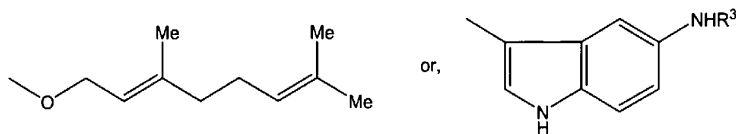
28. A use of a compound, or a salt or prodrug thereof, for manufacturing a drug for enhancing an effect of an anticancer drug, comprising a compound represented by the following general formula [I] or a pharmaceutically acceptable

15 salt or prodrug thereof;



where R¹ represents hydrogen atom or lower alkoxy group; R² represents hydrogen atom, lower alkoxy group, or phenyl group, wherein said phenyl group may be substituted with 1-3 substituents selected from the group consisting of

hydroxyl group and lower alkoxy group, or a group represented by the following formula,



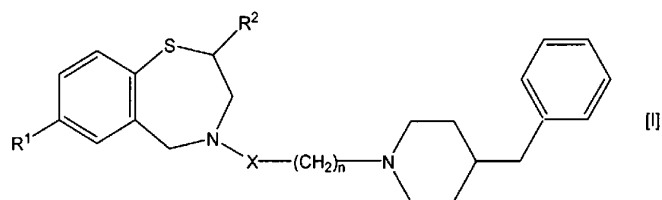
where R³ represents acyl group; X represents -CO- or -CH₂-; and n represents 1 or 2.

29. The use as defined in claim 28, wherein said compound is 4-[3-(4-benzylpiperidine-1-yl)propionyl]-7-methoxy-2,3,4,5-tetrahydro-1,4-benzothiazepine, or a pharmaceutically acceptable salt or prodrug thereof.

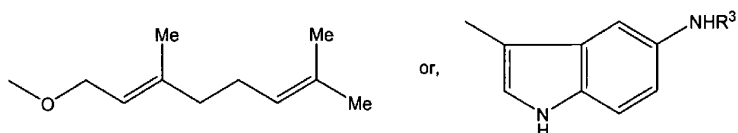
30. The use as defined in claim 28 or 29, wherein said anticancer drug is platinum complex, antitumor substance derived from a plant, or antitumor antibiotic.

31. The use as defined in claim 30, wherein said anticancer drug is cisplatin, carboplatin, nedaplatin, adriamycin or taxol.

32. A use of compound, or a salt or prodrug thereof for manufacturing a drug for reducing a resistance of cancer to an anticancer drug, comprising a compound represented by the general formula [I] or a pharmaceutically acceptable salt or prodrug thereof;

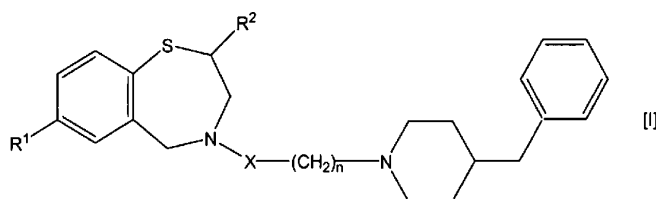


where R¹ represents hydrogen atom or lower alkoxy group; R² represents hydrogen atom, lower alkoxy group, or phenyl group, wherein said phenyl group may be substituted with 1-3 substituents selected from the group consisting of hydroxyl group and lower alkoxy group, or a group represented by the following
5 formula,

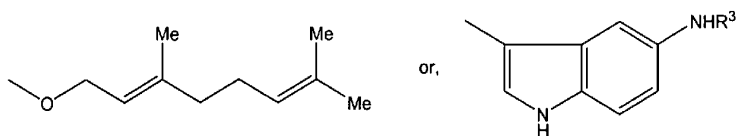


where R³ represents acyl group; X represents -CO- or -CH₂-; and n represents 1 or 2.

33. A use of compound, or a salt or prodrug thereof for manufacturing a drug
10 for increasing a sensitivity of cancer to an anticancer drug, comprising a compound represented by the general formula [I] or a pharmaceutically acceptable salt or prodrug thereof;



where R¹ represents hydrogen atom or lower alkoxy group; R² represents
15 hydrogen atom, lower alkoxy group, or phenyl group, wherein said phenyl group may be substituted with 1-3 substituents selected from the group consisting of hydroxyl group and lower alkoxy group, or a group represented by the following formula,



where R³ represents acyl group; X represents -CO- or -CH₂-; and n represents 1 or 2.

34. A pharmaceutical composition for treating a cancer, comprising two kinds of
5 drugs, wherein a first drug is a given drug for overcoming a resistance to an anticancer drug, said given drug including a compound represented by the general formula [I] as defined in claim 1, or a pharmaceutically acceptable salt or prodrug thereof, wherein a second drug is said anticancer drug.

35. A pharmaceutical composition for treating a cancer, comprising two kinds of
10 drugs, wherein a first drug is a given drug for enhancing an effect of an anticancer drug, said given drug including a compound represented by the general formula [I] as defined in claim 1, or a pharmaceutically acceptable salt or prodrug thereof, wherein a second drug is said anticancer drug.

36. A compound represented by general formula [I] as defined in claim 1, when
15 used for overcoming resistance to an anticancer drug, substantially as hereinbefore described with reference to any one of the examples.

37. A compound represented by general formula [I] as defined in claim 1, when
used for enhancing an effect of an anticancer drug, substantially as hereinbefore described with reference to any one of the examples.

20 38. A compound represented by general formula [I] as defined in claim 1, when used for reducing resistance of cancer an anticancer drug, substantially as hereinbefore described with reference to any one of the examples.

39. A compound represented by general formula [I] as defined in claim 1, when used for increasing sensitivity of cancer an anticancer drug, substantially as hereinbefore described with reference to any one of the examples.

40. A method for overcoming resistance to an anticancer drug, substantially as
5 hereinbefore described with reference to any one of the examples.

41. A method for enhancing an effect of an anticancer drug, substantially as hereinbefore described with reference to any one of the examples.

42. A method for reducing resistance of cancer to an anticancer drug, substantially as hereinbefore described with reference to any one of the examples.

10 43. A method for increasing sensitivity of cancer to an anticancer drug, substantially as hereinbefore described with reference to any one of the examples.

Noboru Kaneko

By their Registered Patent Attorneys

Freehills Carter Smith Beadle

14 May 2004

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