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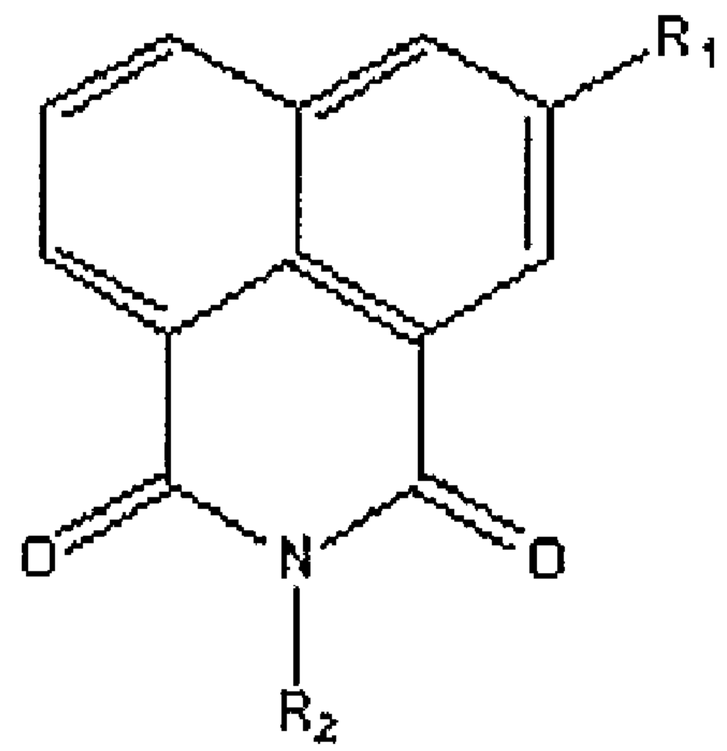

Amonafide:
$R_1 = NH_2$

$R_1 =$

(57) Abrégé/Abstract:
A method of treatment of a host with a cellular proliferative disease, comprising contacting the host with a naphthalimide and an antiproliferative agent, each in an amount sufficient to modulate said cellular proliferative disease, is described. In some

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(57) Abrégé(suite)/Abstract(continued):
embodiments, the naphthalimide comprises amonafide (5-amino-2-[2-(dimethylamine)ehtyl]-1H-benz[de-]isoquinoline-1,3-(2H)-dione). Antiproliferative agents of the invention comprise alkylating agents, intercalating agents, metal coordination complexes, pyrimidine nucleosides, purine nucleosides, inhibitors of nucleic acid associated enzymes and proteins, and agents affecting structural proteins and cytoplasmic enzymes. The invention comprises the described methods as well as compositions comprising a naphthalimide and an antiproliferative agent.

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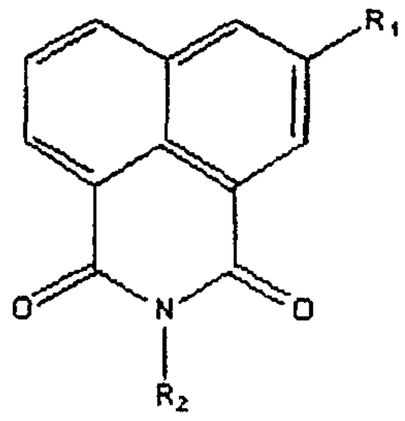
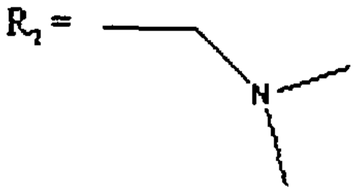
(54) Title: COMPOSITIONS CONTAINING A NAPHTHALMIDE AND AN ANTIPROLIFERATIVE AGENT



Amonafide:
$R_1 = NH_2$
$R_2 =$



(57) Abstract: A method of treatment of a host with a cellular proliferative disease, comprising contacting the host with a naphthalimide and an antiproliferative agent, each in an amount sufficient to modulate said cellular proliferative disease, is described. In some embodiments, the naphthalimide comprises amonafide (5-amino-2-[2-(dimethylamine)ehtyl]-1H-benz[de-]isoquinoline-1,3-(2H)-dione). Antiproliferative agents of the invention comprise alkylating agents, intercalating agents, metal coordination complexes, pyrimidine nucleosides, purine nucleosides, inhibitors of nucleic acid associated enzymes and proteins, and agents affecting structural proteins and cytoplasmic enzymes. The invention comprises the described methods as well as compositions comprising a naphthalimide and an antiproliferative agent.

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NAPHTHALIMIDE COMPOSITIONS AND USES THEREOF

This application claims the benefit of U.S. Provisional Application Number 60/197,103, filed April 12, 2000.

FIELD OF THE INVENTION

The technical field of the invention is the use of naphthalimides with antiproliferative agents to treat a host with a cellular proliferative disease.

BACKGROUND OF THE INVENTION

There is considerable interest in modulating the efficacy of currently used antiproliferative agents to increase the rates and duration of antitumor effects associated with conventional antineoplastic agents.

Conventional antiproliferative agents used in the treatment of cancer are broadly grouped as (1) chemical compounds which affect the integrity of nucleic acid polymers by binding, alkylating, inducing strand breaks, intercalating between base pairs or affecting enzymes which maintain the integrity and function of DNA and RNA; (2) chemical agents that bind to proteins to inhibit enzymatic action (*e.g.,* antimetabolites) or the function of structural proteins necessary for cellular integrity (*e.g.,* antitubulin agents). Other chemical compounds that have been identified to be useful in the treatment of some cancers include drugs which block steroid hormone action for the treatment of breast and prostate cancer, photochemically activated agents, radiation sensitizers, and protectors.

Of special interest to this invention are those compounds that directly affect the integrity of the genetic structure of the cancer cells. Nucleic acid polymers such as DNA and RNA are prime targets for anticancer drugs. Alkylating agents such as nitrogen mustards, nitrosoureas, aziridine containing compounds directly attack DNA. Metal coordination compounds such as cisplatin and carboplatin similarly directly attack the nucleic acid

structure resulting in lesions that are difficult for the cells to repair which, in turn, can result in cell death. Other nucleic acid affecting compounds include anthracycline molecules such as doxorubicin, which intercalates between the nucleic acid base pairs of DNA polymers, bleomycin, which causes nucleic acid strand breaks, fraudulent nucleosides such as pyrimidine and purine nucleoside analogs, which are inappropriately incorporated into nucleic polymer structures and ultimately cause premature DNA chain termination. Certain enzymes that affect the integrity and functionality of the genome can also be inhibited in cancer cells by specific chemical agents and result in cancer cell death. These include enzymes that affect ribonucleotide reductase (*e.g.*, hydroxyurea, gemcitabine), topoisomerase I (*e.g.*, camptothecin) and topoisomerase II (*e.g.*, etoposide).

One of the most broadly used of these DNA targeted anticancer drugs is cisplatin (cis-diamminedichloroplatinum II, CDDP). This compound is active against several human cancers including testicular, small-cell lung, bladder, cervical and head and neck cancer.

Although the clinical activity of currently approved antiproliferative agents against many forms of cancers can be shown, improvements in tumor response rates, duration of response and ultimately patient survival are still sought. The invention described herein demonstrates the novel use of the naphthalimides and analogs thereof, including amonafide, which can potentiate the antitumor effects of chemotherapeutic drugs, in particular, agents affecting the integrity of nucleic polymers such as DNA.

SUMMARY OF THE INVENTION

Methods and compositions are provided for the treatment of a host having a cellular proliferative disease, particularly a neoplasia. In the subject methods, pharmaceutically acceptable naphthalimide and an antiproliferative agent are administered in an amount sufficient to modulate the cellular proliferative disease..

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According to one aspect of the present invention, there is provided use of amonafide (5-amino-2-[2-(dimethylamine)-ethyl]-1H-benz[de-]isoquinoline-1,3-(2H)-dione) and an antiproliferative agent in the formulation of a medicament for the treatment of a cellular proliferative disease, wherein the amount of the amonafide and the antiproliferative agent is sufficient to modulate the cellular proliferative disease, with the proviso that the antiproliferative agent is not homoharringtonine.

According to another aspect of the present invention, there is provided use of amonafide (5-amino-2-[2-(dimethylamine)-ethyl]-1H-benz[de-]isoquinoline-1,3-(2H)-dione) and an antiproliferative agent for the treatment of a cellular proliferative disease, wherein the amount of the amonafide and the antiproliferative agent is sufficient to modulate the cellular proliferative disease, with the proviso that the antiproliferative agent is not homoharringtonine.

According to still another aspect of the present invention, there is provided a pharmaceutical composition comprising amonafide (5-amino-2-[2-(dimethylamine)ethyl]-1H-benz[de-]-isoquinoline-1,3-(2H)-dione) and an antiproliferative agent selected from the group consisting of an alkylating agent, an intercalating agent, a metal coordination complex, a pyrimidine nucleoside, a purine nucleoside, an inhibitor of nucleic acid associated enzymes, and an inhibitor of nucleic acid associated proteins, with the proviso that said antiproliferative agent is not homoharringtonine.

According to yet another aspect of the present invention, there is provided a pharmaceutical composition comprising amonafide (5-amino-2-[2-(dimethylamine)ethyl]-1H-

benz[de-]-isoquinoline-1,3-(2H)-dione) and an antiproliferative agent selected from the group consisting of cisplatin, paclitaxel, vinblastine, etoposide, 5-fluorouracil, colchicine, curcumin, and parthenolide.

According to a further aspect of the present invention, there is provided a commercial package comprising the pharmaceutical composition of the invention together with a written matter describing instructions for the use thereof for modulating a cellular proliferation disease.

DETAILED DESCRIPTION OF THE FIGURES

Figure 1 depicts the general structure of a naphthalimide analog. R_1 and R_2 represent substitution groups. The structures of R_1 and R_2 for the naphthalimide analog, amonafide, are shown.

Figure 2 depicts the structure of the naphthalimide analog, amonafide.

Figure 3 shows tumor growth delay, as tumor volume on days after treatment with the naphthalimide analog, amonafide, amonafide followed by CDDP, or CDDP alone.

DETAILED DESCRIPTION OF THE INVENTION

Methods and compositions are provided for the treatment of a host with a cellular proliferative disease, particularly a neoplasia. In the subject methods, a pharmaceutically acceptable naphthalimide is administered, preferably systemically, in conjunction with an antiproliferative agent to improve the anticancer effects. In a preferred embodiment, the naphthalimide provides a chemopotentiator effect.

The agents are provided in amounts sufficient to modulate a cellular proliferative disease. In one embodiment, modulation of a cellular proliferative disease comprises a reduction in tumor growth. In another embodiment, modulation of a disease comprises inhibition of tumor growth. In another embodiment, modulation of a cellular proliferative disease comprises an increase in tumor volume quadrupling time (described below). In another embodiment, modulation of a cellular proliferative disease comprises a chemopotentiator effect. In another embodiment, modulation of a disease comprises a chemosensitizing effect. In other embodiments, modulation of a disease comprises cytostasis. In still other embodiments, modulation of a disease comprises a cytotoxic effect.

A chemical agent is a "chemopotentiator" when it enhances the effect of a known antiproliferative drug in a more than additive fashion relative to the activity of the chemopotentiator or antiproliferative agent used alone. In some cases, a "chemosensitizing" effect may be observed. This is defined as the effect of use of an agent that if used alone would not demonstrate significant antitumor effects but would improve the antitumor effects of an antiproliferative agent in a more than additive fashion than the use of the antiproliferative agent by itself.

As used herein, the term "naphthalimide" includes all members of that chemical family including benzisoquinolinedione and analogs thereof. The naphthalimide family is defined by chemical structure as depicted in Figure 1.

A naphthalimide analog is further defined but not limited to substituent changes in R_1 and R_2 (Figure 1). Examples of R_1 and R_2 include those listed in Table 1. In a preferred embodiment, a naphthalimide analog has the structure of amonafide, shown in Figure 2.

Table 1

Group	Substitution	Length

R_1	Alkyl	$C_1 \rightarrow C_5$
	Amino	
	Nitro	
	Cyano	
	Alkoxy	$OC_1 \rightarrow OC_5$
	Hydrogen	
R_2	Alkyl	$C_1 \rightarrow C_5$

A naphthalimide analog is a further chemical refinement. A specific example of a naphthalimide analog is amonafide which is also known by the following chemical synonyms: Nafidamide; Benzisoquinolinedione; 5-amino-2-[(dimethylamine)ethyl]-1H-benz[de-]isoquinoline-1,3-(2H)-dione (Figure 2).

As used herein, antiproliferative agents are compounds which induce cytostasis or cytotoxicity. "Cytostasis" is the inhibition of cells from growing while "cytotoxicity" is defined as the killing of cells.

Specific examples of antiproliferative agents include: antimetabolites, such as methotrexate, 5-fluorouracil, gemcitabine, cytarabine, pentostatin, 6-mercaptopurine, 6-thioguanine, L-asparaginase, hydroxyurea, N-phosphonoacetyl-L-aspartate (PALA), fludarabine, 2-chlorodeoxyadenosine, and floxuridine; structural protein agents, such as the vinca alkaloids, including vinblastine, vincristine, vindesine, vinorelbine, paclitaxel, and colchicine; agents that affect NF-κB, such as curcumin and parthenolide; agents that affect protein synthesis, such as homoharringtonine; antibiotics, such as dactinomycin, daunorubicin, doxorubicin, idarubicin, bleomycins, plicamycin, and mitomycin; hormone antagonists, such as tamoxifen and luteinizing hormone releasing hormone (LHRH) analogs; nucleic acid damaging agents such as the alkylating agents mechlorethamine, cyclophosphamide, ifosfamide, chlorambucil, dacarbazine, methylnitrosourea, semustine (methyl-CCNU), chlorozotocin, busulfan, procarbazine, melphalan, carmustine (BCNU), lomustine (CCNU), and thiotepa, the intercalating agents doxorubicin, dactinomycin, daurorubicin and mitoxantrone, the topoisomerase inhibitors etoposide, camptothecin and teniposide, and the metal coordination complexes cisplatin and carboplatin

The following examples are offered by way of illustration and not by way of limitation.

Example 1

Chemopotentiation of Cisplatin by Amonafide

Transplantable experimental murine fibrosarcomas ($2x10^5$ RIF-1 cells) were grown intradermally in the flanks of 3 month old female C3H mice (Charles River, Holister, CA). When the tumors reached a volume of approximately $100mm^3$, the mice were randomly assigned to each experimental group (4 mice per group).

The experimental compositions were prepared as described in Table 2.

Table 2

Agent	Dose	Solvent	Supplier
Amonafide	50 mg/kg	DMSO	NCI
Cisplatin	4 mg/kg	Water for injection	David Bull Labs

The chemopotentiator, amonafide, was obtained from NCI and was made to the appropriate concentration in DMSO. Cisplatin (David Bull Laboratories- Mulgrave, Australia, lot. 5201844x) was made to the appropriate concentration in water for injection. The compositions were injected systemically (i.e., intraperitoneally, i.p.), in a volume of 100 microliters. For the treatment of group 3, the chemopotentiator, amonafide, was injected 30 minutes prior to the injection of cisplatin. After treatment, the growth of the tumors was monitored three times per week by caliper measurements of three perpendicular diameters of the tumor and calculation of tumor volume from the formula:

$$V = \pi / 6 \times D_1 \times D_2 \times D_3,$$

where D_{1-3} is in mm.

The tumors were followed until they reached a size of four times their day zero treatment volume (TVQT), or up to 30 days after treatment, whichever came first. The data is expressed as the "tumor volume quadrupling time" (TVQT) mean and as the "delay." Mean TVQT is the mean days required for individual tumors to grow to four times the tumor volume at the initial treatment day. The "delay" is the median of days required for a tumor to grow to four times the mean size of the treated group, minus the median of days required to grow to four times the mean size of the control group. The data is also expressed as the ratio of the tumor volume quadrupling time of the treated tumor over the untreated control group (TVQT/CTVQT). Increasing values of this ratio indicate increased antitumor response.

The data is presented in Table 3 below and in Figure 2.

Table 3

Group	Treatment	Dose (mg/kg)	Mean TVQT ± S.E.	TVQT/ CTVQT	Median (TVQT)	Delay (Days)
1	Untreated Control	-	6.3 ± 0.3	1.0	6	0.00
2	Amonafide	50	9.7 ± 0.6	1.5	9.0	2.94
3	Amonafide ⇒ Cisplatin	50 ⇒ 4	17.9	2.8	17.9	11.81
4	Cisplatin	4	8.4 ± 0.3	1.3	8.1	2.10

The arrow (⇒) in Group 3 indicates administration 30 minutes following administration of amonafide.

The results of Table 3 indicate that the antiproliferative activity of cisplatin is enhanced by the use of the chemopotentiator, amonafide in that a more than additive effect was observed when both compounds were used to treat the tumor bearing mice (group 3) in comparison to the use of cisplatin alone (group 4) or amonafide alone (group 2).

Example 2

Effect of Amonafide, Alone and in Combination with Other Chemotherapeutics on RIF-1 Tumor Growth in C3H Mice

The RIF-1 murine fibrosarcoma tumor model was used to evaluate the antitumor activity of amonafide, alone and and in combination with various antiproliferative agents. The antiproliferative agents used include those that affect nucleic acid (*e.g.*, DNA) integrity (*e.g.*, cisplatin, etoposide, 5-fluorouracil), agents that affect structural or cytoplasmic proteins or their synthesis (e.g., homoharringtonine, paclitaxel, vinblastine, colchicine, curcumin or parthenolide).

Amonafide-NCI was obtained from NCI as a powder. Amonafide-Penta was obtained from Penta Biotech (Union City, CA), Lot No.039-01, as a powder. Cisplatin for Injection, USP, was obtained from David Bull Labs (Mulgrave, Australia), Lot No.5201844x, as a lypholized powder. Paclitaxel was obtained from Bristol Myers Squibb Co. (Princeton, NJ), Lot No. 9J16241, exp. Sep 2001, prediluted to 6 mg/mL in Cremaphor/EL. Vinblastine was obtained from Bedford Labs (Bedford, OH), Lot No.112647, as a lypholized powder. Etoposide was obtained from Pharmacia (Kalamazoo, MI), Lot No. ETA013, exp. 5/99, as a liquid prediluted to 20 mg/mL. 5-Fluorouracil was obtained from Pharmacia (Kalamazoo, MI), Lot No.FFA191, exp. 7/00, as a liquid prediluted to 50 mg/mL. Curcumin was obtained from

Sigma (St. Louis, MO), Lot No. 69H3457. Parthenolide was obtained from Tocris (Ballwin, MO) Lot No. 7/18089. DMSO was obtained from Sigma (St. Louis, MO), Lot No.80K3695. 0.9% Sodium Chloride for Injection, USP (saline) was manufactured by Abbott Laboratories (Lot No. 55-199-DK). Sterile Water for Injection, USP (WFI) was manufactured by Lyphomed, Inc. (Lot No. 390849).

Formulations: Test preparations (treatment groups) are summarized in Table 4.

For preparation of formulation 1 and 2, amonafide was weighed into vials and dissolved in DMSO at 12.5 mg/mL.

For formulation 3, amonafide was weighed into vials and dissolved in saline.

For formulation 4, the contents of a 10-mg vial of lyophilized CDDP (Cisplatin for Injection) was resuspended with 10 mL WFI to produce a 1 mg/mL CDDP suspension.

For formulation 5, paclitaxel, prediluted in Cremaphor/EL and dehydrated alcohol to 6 mg/mL was further diluted to 3.3 mg/mL with WFI.

Formulation 6 was made by adding 0.9% Sodium Chloride for Injection to a vial of 10 mg of vinblastine lypholized powder.

Formulations 7-10 were prepared by diluting the appropriate amount of each test agent into saline (7- 2.5 mg/mL etoposide, 8- 7.5 mg/mL 5-fluorouracil, 9- 3.75 mg/mL 5-fluorouracil 10- 2.5 mg/mL colchicine,).

Formulation 11 was undiluted HHT-Clin, used as received.

Formulations 12 and 13 were prepared by diluting the appropriate amount of each test agent into DMSO (12- 6.25 mg/mL curcumin and 13- 5 mg/mL parthenolide).

Animals: Female C3H mice (Charles River Laboratories, Holister, CA), approximately 3 months old, were used for the study. The average body weight was approximately 25 g. Animals were maintained in isolator cages on a 12-hour light-and-dark cycle. Food and water were available *ad libitum*.

Tumors: The RIF-1 murine fibrosarcoma cell line was maintained in *in vitro* culture (Waymouth medium supplemented with 20% fetal bovine serum) at 37°C in a humidified 5% CO_2 incubator. Log-phase RIF-1 cells were trypsinized and harvested from cell culture flasks to yield a concentration of 4×10^6 cells/mL, then injected intradermally in a volume of

50 μL (equivalent to 2 x 10^5 cells per injection) into both flanks of each mouse. Nine days later, when tumors reached approximately 100 mm^3 in size, the animals were randomized to different treatment groups.

Treatment Groups: Treatment groups are summarized in Table 4. Four to five animals were assigned to each treatment group. The intraperitoneal injection volume was 100 μL. The oral administration volume was 100 μL. Combination treatments using two test agents were administered as two separate injections, with the second one following the first either immediately or after 30 minutes.

Evaluation of Tumor Growth Delay: Tumors were measured three times weekly for up to 22 days with Vernier calipers. Tumor volume (cubic millimeters, mm^3) was calculated according to the formula:

$$V = \pi / 6 \times D_1 \times D_2 \times D_3$$

in which D_{1-3} are perpendicular diameters measured in millimeters (mm).

Tumor volume quadrupling time (TVQT), defined as the time required for a tumor to grow to four times (4X) its initial volume (at the time of treatment), was used as a study endpoint. The TVQT was determined for each treatment group and expressed in days as the mean ± standard error (SE).

Antitumor activity or modulation of tumor growth (as measured by delayed tumor growth, i.e. increases in TVQT values) by amonafide administered as a single agent or in combination with other chemotherapeutics is presented in Table 5.

Results from five separate experiments are included in this study. Untreated control animals quadrupled in size in an average of 7.0 days. Intraperitoneal administration of amonafide-NCI formulated in DMSO at 50 mg/Kg had a TVQT of 9.7 days. The additional intraperitoneal administration of CDDP further extended the mean TVQT to 17.9 days. Intraperitoneal administration of amonafide-Penta formulated in DMSO at 50 mg/Kg had a TVQT of 9.3 days. While paclitaxel (10 mg/Kg), alone, demonstrated a TVQT of 7.9 days, the addition of amonafide (50 mg/kg) extended the TVQT to 9.8 days.

Amonafide-Penta formulated in saline at 30 mg/Kg was used for the remainder of the combination studies.

At 30 mg/Kg, amonafide had an average TVQT of 7.3 days. Combination administration of cisplatin (4 mg/Kg) with amonafide (30 mg/Kg) yielded a TVQT of 11.0 days, which was

greater than amonafide (TVQT= 7.3 days) or cisplatin (TVQT= 9.2 days), alone.

Administration of amonafide (30 mg/Kg) in combination with 5-fluorouracil (30 mg/Kg) resulted in a TVQT of 20.2 days versus 13.6 days for 5-fluorouracil, alone. At a dose of 15 mg/Kg, 5-fluorouracil gave a TVQT of 6.7 days versus 7.7 days when it was combined with amonafide at 30 mg/Kg. Combination administration of amonafide (30 mg/Kg) and vinblastine (2 mg/Kg) yielded a TVQT of 9.5 days versus 8.6 days for vinblastine, alone. Combination administration of amonafide (30 mg/Kg) and homoharringtonine (4 mg/Kg) yielded a TVQT of 10.2 days, versus 8.5 for homoharringtonie, alone. Amonafide in combination with etoposide(10 mg/Kg) gave a TVQT of 8.5 days which was the same as the TVQT for etoposide, alone. Combinations of amonafide with curcumin or parthenolide yielded TVQT's of 8.2 days and 7.6 days, respectively, which was less than curcumin (TVQT= 9.7 days) or parthenolide (TVQT= 8.5) as individual agents.

Orally administered colchicine (10 mg/Kg) yielded a TVQT of 6.3 days. Amonafide in combination with colchicine increased the TVQT to 7.1 days.

There were animal deaths in some groups that were recorded as follows: Two of four mice died after treatment of amonafide-NCI formulated in DMSO at 12.5 mg/mL.

In summary, intraperitoneal administration of amonafide had antitumor activity in the RIF-1 murine fibrosarcoma tumor model. Intraperitoneal administration of amonafide in combination with cisplatin, paclitaxel, vinblastine, 5-fluorouracil and homoharringtonine had antitumor activity levels greater than amonafide alone, or the individual test agents. The best combinatorial activities used cisplatin, 5-fluorouracil, and homharringtonine. Amonafide in combination with colchicine had antitumor activity less than amonafide alone. Amonafide in combination with etoposide, curcumin or parthenolide was greater than that of amonafide alone, but less than that of the test agents, individually.

Table 4

Summary of Treatment Groups

Formulation	Treatment	Concentration (mg/mL)	Route of Administration	Injection Volume (µL)
1	Amonafide-NCI in DMSO	12.5	IP	100
2	Amonafide-Penta in DMSO	12.5	IP	100
3	Amonafide-Penta in Saline	7.5	IP	100
4	CDDP in WFI	1	IP	100
5	Paclitaxel in WFI	2.5	IP	100
6	Vinblastine in saline	0.5	IP	100
7	Etoposide in saline	2.5	IP	100
8	5-Fluorouracil in saline	3.75	IP	100
9	5-Fluorouracil in saline	7.5	IP	100
10	Colchicine in saline	2.5	PO	100
11	HHT-Clin in WFI	1	IP	100
12	Curcumin in DMSO	6.25	IP	100
13	Parthenolide in DMSO	5	IP	100

Table 5

Effect of Amonafide and Amonafide in Combination with Other Chemotherapeutics on RIF-1 Tumor Growth in C3H Mice

Group	Treatment	Drug Dose (mg/Kg)	Route of Administration	Number of Tumors	TVQT
1	Untreated Control	---	---	40	7.0 ± 0.2
2	Amonafide-NCI/DMSO	50	IP	8	9.7 ± 0.6
3	Amonafide-Penta/DMSO	50	IP	8	9.3 ± 0.3
4	Amonafide-Penta /Saline	30	IP	12	7.3 ± 0.2
5	Cisplatin/WFI	4	IP	16	9.2 ± 0.4
6	Paclitaxel/CremaphorEL	10	IP	8	7.9 ± 0.3
7	Vinblastine/Saline	2	IP	8	8.6 ± 0.4
8	Etoposide/Saline	10	IP	8	8.5 ± 0.5
9	Fluorouracil/Saline	15	IP	8	6.7 ± 0.4
10	Fluorouracil/Saline	30	IP	8	13.6 ± 1.9
11	Homoharringtonine/WFI	4	IP	8	8.5 ± 0.5
11	Colchicine/Saline	10	PO	8	6.3 ± 0.3
12	Curcumin/DMSO	25	IP	8	9.7 ± 1.1
13	Parthenolide/DMSO	20	IP	8	8.5 ± 0.8
14	Amonafide-NCI/DMSO-30 -CDDP/WFI	50,4	IP, IP	4	17.9 ± 0.4
15	Amonafide-Penta/Saline-10sec-CDDP/WFI	30,4	IP, IP	8	11.0 ± 0.4
16	Amonafide-Penta/DMSO-10sec-Paclitaxel/CremaphorEL	30/10	IP, IP	8	9.8 ± 0.4
17	Amonafide-Penta/Saline - 10 sec- Vinblastine/Saline	30,2	IP, IP	8	9.5 ± 1.1
18	Amonafide-Penta/Saline - 10 sec- Etoposide/Saline	30,10	IP, IP	8	8.5 ± 0.9

19	Amonafide-Penta/Saline - 10 sec- 5-Fluorouracil/Saline	30,15	IP, IP	8	7.7 ± 0.8
20	Amonafide-Penta/Saline - 10 sec- 5-Fluorouracil/Saline	30,30	IP, IP	8	20.2 ± 1.0
21	Amonafide/WFI -10 sec- THT-Clin/WFI	30,4	IP, IP	8	10.2 ± 0.5
22	Amonafide-Penta/Saline - 10 sec- Colchicine/WFI	30,10	IP, PO	8	7.1 ± 0.3
23	Amonafide-Penta/Saline - 10 sec- Curcumin	30/25	IP, IP	8	8.2 ± 0.2
24	Amonafide-Penta/Saline- 10 sec- Parthenolide	30/20	IP, IP	8	7.6 ± 0.3

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CLAIMS:

1. Use of amonafide (5-amino-2-[2-(dimethylamine)-ethyl]-1H-benz[de-]isoquinoline-1,3-(2H)-dione) and an antiproliferative agent in the formulation of a medicament for the treatment of a cellular proliferative disease, wherein the amount of the amonafide and the antiproliferative agent is sufficient to modulate the cellular proliferative disease, with the proviso that the antiproliferative agent is not homoharringtonine.

2. The use of claim 1 wherein the antiproliferative agent comprises an agent that interacts with nucleic acids.

3. The use of claim 1 wherein the antiproliferative agent is selected from the group consisting of an alkylating agent, an intercalating agent, a metal coordination complex, a pyrimidine nucleoside, a purine nucleoside, an inhibitor of nucleic acid associated enzymes, and an inhibitor of nucleic acid associated proteins.

4. The use of claim 1 wherein the antiproliferative agent is selected from the group consisting of cisplatin, paclitaxel, vinblastine, etoposide, 5-fluorouracil, colchicine, curcumin, and parthenolide.

5. The use of claim 1 wherein the antiproliferative agent comprises cisplatin.

6. The use of any one of claims 1 to 5, wherein the amonafide is for administration before the antiproliferative agent.

7. The use of any one of claims 1 to 5, wherein the amonafide is for co-administration with the antiproliferative agent.

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8. The use of any one of claims 1 to 5, wherein the amonafide is for administration after the antiproliferative agent.

9. The use of any one of claims 1 to 8, wherein the modulation of the disease with the amonafide and the antiproliferative agent is greater than the modulation of the disease with the antiproliferative agent alone.

10. The use of any one of claims 1 to 9, wherein the cellular proliferative disease is a solid tumor.

11. The use of claim 10 wherein the modulation comprises the reduction of tumor growth.

12. The use of claim 10 wherein the modulation comprises inhibition of tumor growth.

13. The use of claim 10 wherein the modulation comprises an increase in tumor volume quadrupling time.

14. The use of claim 10 wherein the modulation comprises a chemopotentiating effect.

15. A pharmaceutical composition comprising amonafide (5-amino-2-[2-(dimethylamine)ethyl]-1H-benz[de-]-isoquinoline-1,3-(2H)-dione) and an antiproliferative agent selected from the group consisting of an alkylating agent, an intercalating agent, a metal coordination complex, a pyrimidine nucleoside, a purine nucleoside, an inhibitor of nucleic acid associated enzymes, and an inhibitor of nucleic acid associated proteins, with the proviso that said antiproliferative agent is not homoharringtonine.

16. A pharmaceutical composition comprising amonafide (5-amino-2-[2-(dimethylamine)ethyl]-1H-benz[de-]-isoquinoline-1,3-(2H)-dione) and an antiproliferative agent

selected from the group consisting of cisplatin, paclitaxel, vinblastine, etoposide, 5-fluorouracil, colchicine, curcumin, and parthenolide.

17. The pharmaceutical composition according to claim 15 or 16, which is for modulating a cellular proliferative disease.

18. The pharmaceutical composition according to claim 17, wherein the cellular proliferative disease is a solid tumor.

19. The pharmaceutical composition of claim 18 wherein the modulating comprises the reduction of tumor growth.

20. The pharmaceutical composition of claim 18 wherein the modulating comprises inhibition of tumor growth.

21. The pharmaceutical composition of claim 18 wherein the modulating comprises an increase in tumor volume quadrupling time.

22. The pharmaceutical composition of claim 18 wherein the modulating comprises a chemopotentiating effect.

23. Use of amonafide (5-amino-2-[2-(dimethylamine)-ethyl]-1H-benz[de-]isoquinoline-1,3-(2H)-dione) and an antiproliferative agent for the treatment of a cellular proliferative disease, wherein the amount of the amonafide and the antiproliferative agent is sufficient to modulate the cellular proliferative disease, with the proviso that the antiproliferative agent is not homoharringtonine.

24. The use of claim 23 wherein the antiproliferative agent comprises an agent that interacts with nucleic acids.

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25. The use of claim 23 wherein the antiproliferative agent is selected from the group consisting of an alkylating agent, an intercalating agent, a metal coordination complex, a pyrimidine nucleoside, a purine nucleoside, an inhibitor of nucleic acid associated enzymes, and an inhibitor of nucleic acid associated proteins.

26. The use of claim 23 wherein the antiproliferative agent is selected from the group consisting of cisplatin, paclitaxel, vinblastine, etoposide, 5-fluorouracil, colchicine, curcumin, and parthenolide.

27. The use of claim 23 wherein the antiproliferative agent comprises cisplatin.

28. The use of any one of claims 23 to 27, wherein the amonafide is for administration before the antiproliferative agent.

29. The use of any one of claims 23 to 27, wherein the amonafide is for co-administration with the antiproliferative agent.

30. The use of any one of claims 23 to 27, wherein the amonafide is for administration after the antiproliferative agent.

31. The use of any one of claims 23 to 30, wherein the modulation of the disease with the amonafide and the antiproliferative agent is greater than the modulation of the disease with the antiproliferative agent alone.

32. The use of any one of claims 23 to 31, wherein the cellular proliferative disease is a solid tumor.

33. The use of claim 32 wherein the modulation comprises the reduction of tumor growth.

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34. The use of claim 32 wherein the modulation comprises inhibition of tumor growth.

35. The use of claim 32 wherein the modulation comprises an increase in tumor volume quadrupling time.

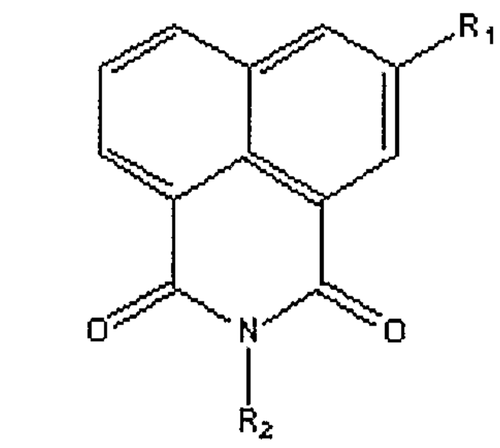
36. The use of claim 32 wherein the modulation comprises a chemopotentiating effect.

37. A commercial package comprising the pharmaceutical composition as defined in claim 15 or 16, together with a written matter describing instructions for the use thereof for modulating a cellular proliferative disease.

SMART & BIGGAR

OTTAWA, CANADA

PATENT AGENTS



Amonafide:

$R_1 = NH_2$

$R_2 =$ 

Figure 1

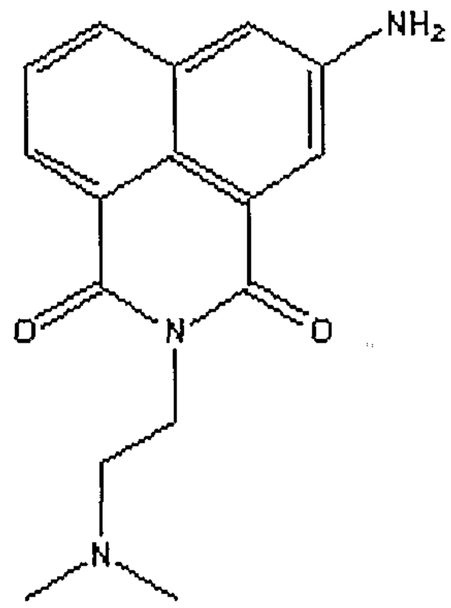


Figure 2

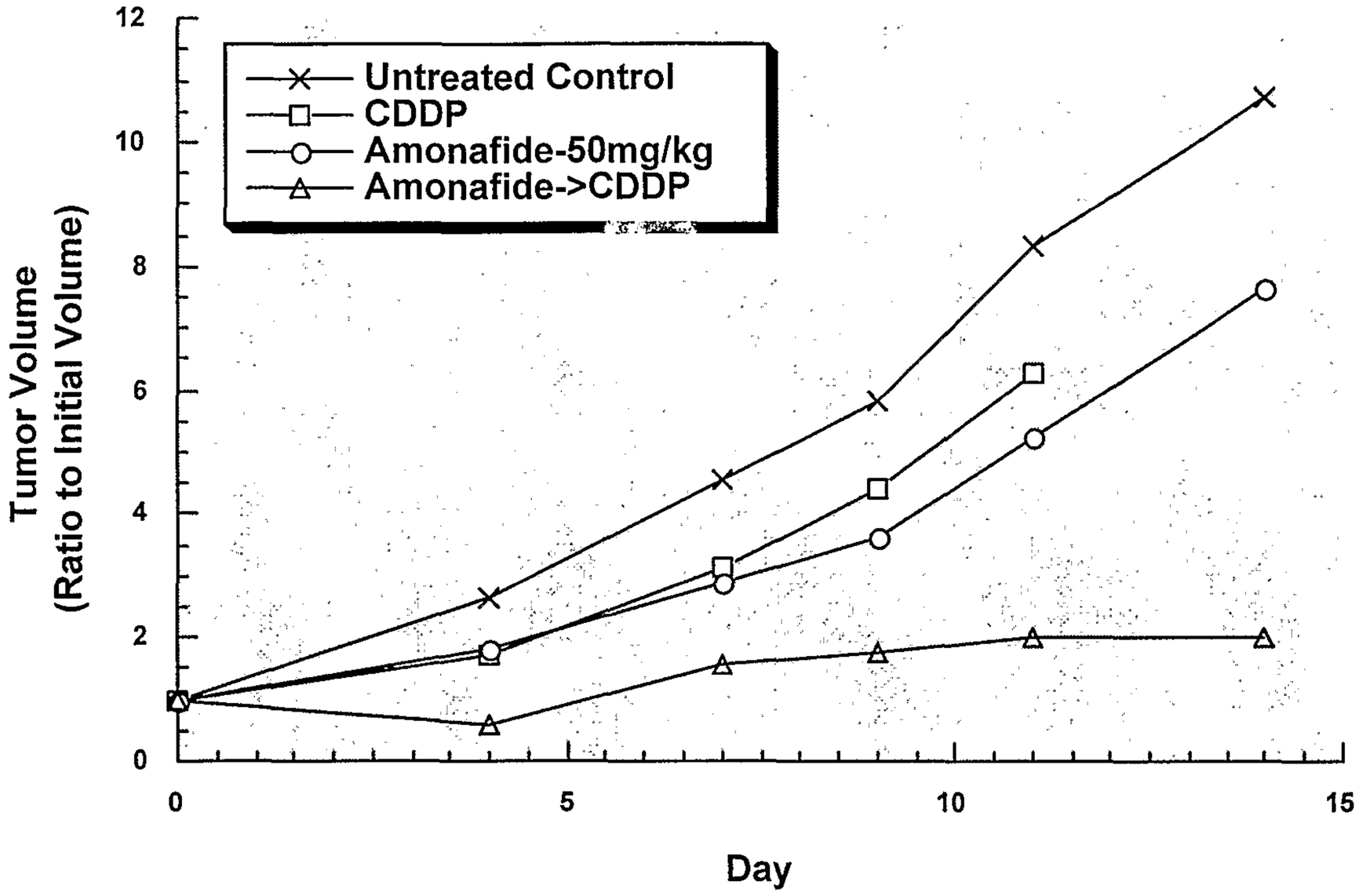
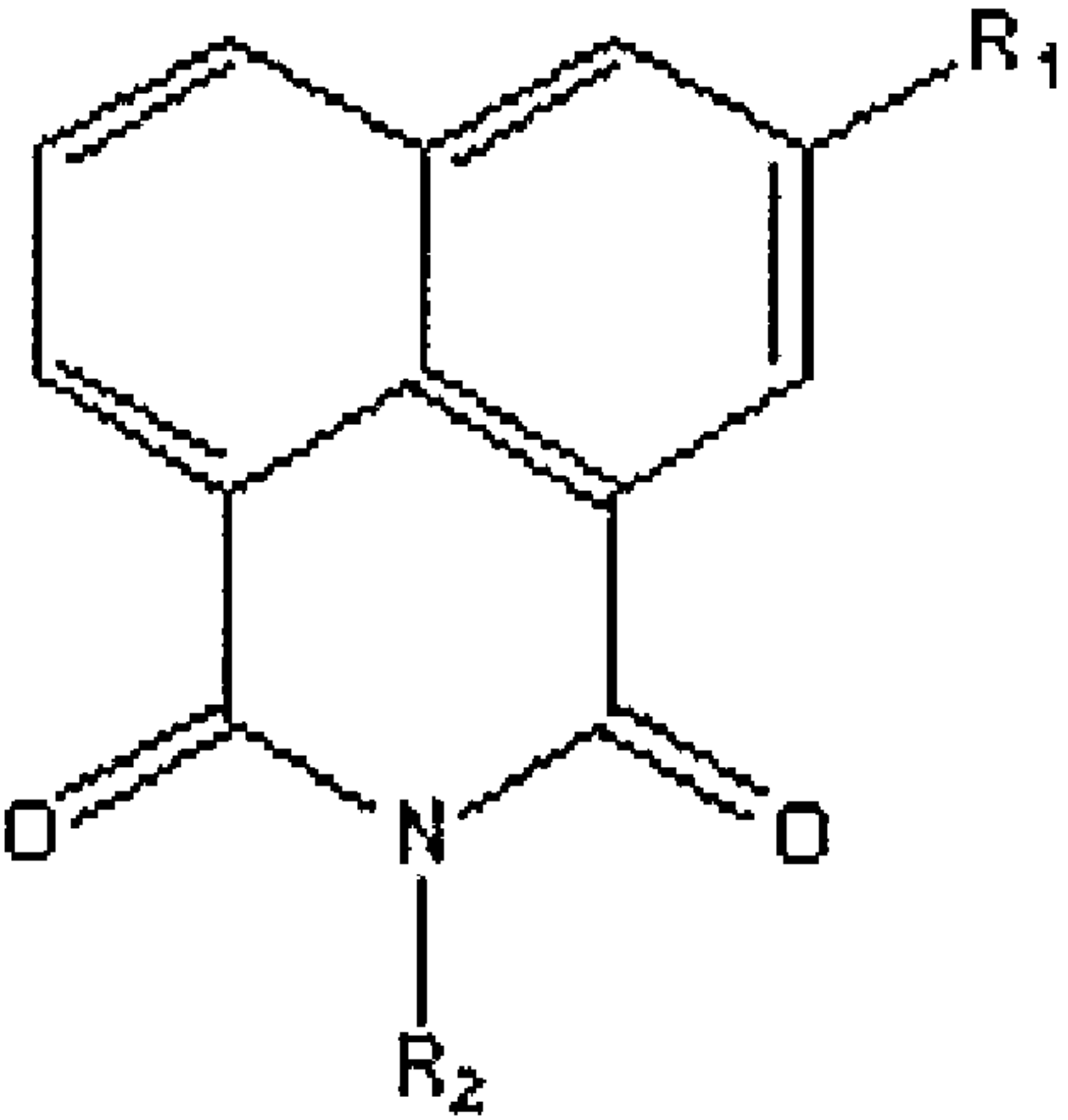

Untreated Control
CDDP
Amonafide-50mg/kg
Amonafide->CDDP
Tumor Volume
(Ratio to Initial Volume)
Day
0
2
4
6
8
10
12
0
5
10
15

Figure 3



Amonafide:

$R_1 = NH_2$

$R_2 =$