**STATEMENT**

TITLE OF STUDY

Chromosomal Aberration Test of 13F-SFMA Using Cultured Mammalian Cells (Study Code: K06-1190)

I, the undersigned, hereby declare that this report provides a correct English translation of the final report (Study Code: K06-1190, issued on March 4, 2007) audited by Quality Assurance Unit of CERI Hita, Chemicals Evaluation and Research Institute, Japan.

September 15, 2009

Date

CERI Hita

Chemicals Evaluation and Research Institute, Japan

CERI

Receipt No.837-06-T-5257

STUDY CODE: K06-1190

# FINAL REPORT

## CHROMOSOMAL ABERRATION TEST OF 13F-SFMA USING CULTURED MAMMALIAN CELLS

March 2007

CERI Hita
Chemicals Evaluation and Research Institute, Japan

## GLP STATEMENT

CERI Hita
Chemicals Evaluation and Research Institute, Japan

Sponsor: DAIKIN INDUSTRIES, LTD
Title: Chromosomal Aberration Test of 13F-SFMA Using Cultured Mammalian Cells
Study Code: K06-1190

I, the undersigned, hereby declare that this study was conducted in compliance with "Concerning Standard of the Testing Facilities Conducting the Test Relating to the New Chemical Substances" on Japanese GLP (Notification No. 1121003 of the Pharmaceutical and Food Safety Bureau, MHLW, No. 3 (November 17, 2003) of the Manufacturing Industries Bureau, METI & No. 031121004 of the Environmental Health Department, MOE (November 21, 2003)) and "OECD Principles of Good Laboratory Practice" (November 26, 1997).

I also confirmed that this report accurately reflected the raw data and the test data were valid.

Study Director: Signed in original March 14, 2007

# QUALITY ASSURANCE STATEMENT

CERI Hita
Chemicals Evaluation and Research Institute, Japan

Sponsor: DAIKIN INDUSTRIES, LTD.
Title: Chromosomal Aberration Test of 13F-SFMA Using Cultured Mammalian Cells
Study Code: K06-1190

This study was inspected by Quality Assurance Unit of CERI Hita, Chemicals Evaluation and Research Institute, Japan. The dates inspected and the dates reported these results to the study director and management are as follows.

| Phase | Date of Inspection | Date Reported to Study Director and Management |
|---|---|---|
| Protocol | December 12, 2006 | December 12, 2006 |
| Preparation of Test Substance | December 13, 2006 | December 13, 2006 |
| Treatment of Cells | December 13, 2006 | December 13, 2006 |
| Reinspection of Protocol | December 22, 2006 | December 22, 2006 |
| Protocol Amendment | December 22, 2006 | December 22, 2006 |
| Protocol Amendment (No. 2) | January 19, 2007 | January 19, 2007 |
| Reinspection of Protocol Amendment (No. 2) | January 26, 2007 | January 26, 2007 |
| Protocol Amendment (No. 3) | January 26, 2007 | January 26, 2007 |
| Reinspection of Protocol Amendment (No. 3) | February 1, 2007 | February 1, 2007 |
| Protocol Amendment (No. 4) | February 1, 2007 | February 1, 2007 |
| Protocol Amendment (No. 5) | February 15, 2007 | February 15, 2007 |
| Raw Data and Draft Final Report | March 11, 2007 | March 12, 2007 |
| Reinspection of Raw Data and Draft Final Report | March 12, 2007 | March 12, 2007 |
| Draft Final Report (Second Time) | March 12, 2007 | March 12, 2007 |
| Reinspection of Draft Final Report (Second Time) | March 13, 2007 | March 13, 2007 |
| Final Report | March 14, 2007 | March 14, 2007 |

The inspection result of following phase was reported to the study director and management based on the report of process-based inspection relevant to this study type and timeframe.

| Phase | Date of Inspection | Date Reported to Study Director and Management |
|---|---|---|
| Preparation and Management of Positive Control Substance | November 24, 2006 | March 13, 2007 |
| Preparation of Medium and Reagent | December 6 and 7, 2006 | March 13, 2007 |
| Cell Pre-culture | November 27, 2006 | March 13, 2007 |
| Collection of Cells and Preparation of Specimens | December 5, 2006 | March 13, 2007 |

I, the undersigned, hereby declare that this report provides an accurate description of the methods and procedures used in this study and that the reported results accurately reflect obtained raw data.

Head, Quality Assurance Unit: Signed in original March 14, 2007

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TABLES AND FIGURES

Study Code: K06-1190
Test Substance Code: HR6852
Sponsor Code: D-0060

TITLE

Chromosomal Aberration Test of 13F-SFMA Using Cultured Mammalian Cells

SPONSOR

DAIKIN INDUSTRIES, LTD.
1-1, Nishi-Hitotsuya, Settsu, Osaka 566-8585, Japan

TESTING FACILITY

CERI Hita
Chemicals Evaluation and Research Institute, Japan
822, 3-chome, Ishii-machi, Hita, Oita 877-0061, Japan

PURPOSE OF STUDY

The ability of the test substance to induce chromosomal aberrations was examined by using Chinese hamster lung fibroblasts (CHL/IU cells).

TESTING METHOD

This study was conducted in accordance with "III Mutagenicity Test: Chromosomal Aberration Test Using Cultured Mammalian Cells" prescribed in "Concerning Testing Methods Relating to the New Chemical Substances" on Japanese Test Guideline (Notification No. 1121002 of the Pharmaceutical and Food Safety Bureau, MHLW, No. 2 (November 13, 2003) of the Manufacturing Industries Bureau, METI & No. 031121002 of the Environmental Health Department, MOE (November 21, 2003)).

GLP COMPLIANCE

This study was conducted in compliance with "Concerning Standard of the Testing Facilities Conducting the Test Relating to the New Chemical Substances" on Japanese GLP (Notification No. 1121003 of the Pharmaceutical and Food Safety Bureau, MHLW, No. 3 (November 17, 2003) of the Manufacturing Industries Bureau, METI & No. 031121004 of the Environmental Health Department, MOE (November 21, 2003)) and "OECD Principles of Good Laboratory Practice" (November 26, 1997).

PERIOD OF STUDY

| | |
|---|---|
| Commencement of Study: | December 8, 2006 |
| Initiation of Experiment (Initiation of Cell Growth Inhibition Test): | December 13, 2006 |
| Completion of Experiment (Completion of Observation of Specimens): | February 27, 2007 |
| Completion of Study: | March 14, 2007 |

STORAGE AND RETENTION PERIOD OF DATA

The raw data, protocol, protocol amendment, letter of test request, table of test substance information, final report, other record documents and specimens will be stored in the archive of this testing facility for 10 years after the date of receipt of the notification that they are applicable to Article 4, Paragraphs 1 or 2, Article 4-2, Paragraphs 2, 3 or 8, Article 5-4, Paragraph 2, Article 24, Paragraph 2 or Article 25-3, Paragraph 2 of the Japanese Chemical Substances Control Law No. 117 (1973). The sponsor will inform the date of receipt of the notification to the testing facility. After termination of the retention period, any measures taken will be done so with the approval of the sponsor.

The specimens to which the quality will be deteriorated will be retained only for the period when the quality can be secured. The sponsor's consent will be obtained before abandonment.

RETENTION OF ORIGINAL DOCUMENTS

An original protocol, original protocol amendments and an original final report will be retained at the testing facility. The copies of their original that the study director will be recognized to be accurate copy will be sent to the sponsor.

STUDY DIRECTOR AND PERSONS CONCERNED WITH THE STUDY AND THE OPERATION

Study Director:

Section 3, CERI Hita

Persons Concerned with the Study and Their Operation:

(Preparation of test substance solution, cell treatment and microscopic observation of specimens)

(Microscopic observation of specimens)

APPROVAL BY AUTHOR

Study Director: Signed in original March 14, 2007

## SUMMARY

The ability of 13F-SFMA to induce chromosomal aberrations was investigated by using Chinese hamster lung fibroblasts (CHL/IU cells).

Based on the result of cell growth inhibition test, the doses in the chromosomal aberration test were set at 33.8, 67.5, 135, 270, 540, 1080, 2160 and 4320 μg/mL in the short-term treatments without and with S9 mix and the 24 hours continuous treatment.

In chromosomal aberration test, three observation doses for evaluation were selected at 1080, 2160 and 4320 μg/mL in all treatment methods. Then, the frequencies of cells with structural aberrations and numerical aberration cells were examined.

As a result of observation of specimens, the frequencies of cells with structural aberration and numerical aberration cells were below 5% at all observation doses of the test substance in the short-term treatments without and with S9 mix and the 24 hours continuous treatment, therefore, structural aberration and numerical aberration were judged to be negative.

On the other hand, the frequencies of cells with structural aberrations or numerical aberration cells in the negative control treated with dehydrated acetone were below 5%, and the frequencies of cells with structural aberrations in the positive controls treated with mitomycin C or cyclophosphamide monohydrate were above 20%, indicating the proper performance of the present study.

It was concluded that 13F-SFMA did not induce the chromosomal aberration under the present test conditions.

## MATERIALS AND METHODS

1. TEST SUBSTANCE AND POSITIVE CONTROL SUBSTANCES

1.1 Test Substance (Information Provided by the Sponsor)

1) Name

3,3,4,4,5,5,6,6,7,7,8,8,8-Tridecafluorooctyl methacrylate

Other name: 13F-SFMA

CAS No.: 2144-53-8

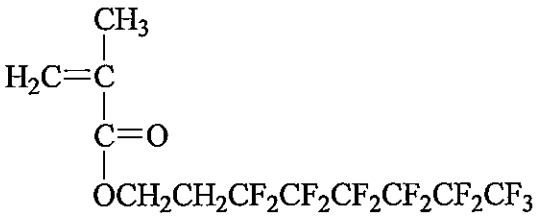
2) Lot No.

6Y002

3) Supplier

DAIKIN INDUSTRIES, LTD.

4) Structural formula



(Molecular formula: $C_{12}H_9F_{13}O_2$)

5) Purity

99.8%

6) Names and concentrations of impurities

Unknown 0.2%

7) Physicochemical properties

| | |
|---|---|
| Appearance at ordinary temperature: | Colorless transparent liquid |
| Molecular weight: | 432.18 |
| Stability: | – |
| Melting point: | – |
| Boiling point: | 92°C at 8 mmHg |
| Vapor pressure: | – |
| Partition coefficient (1-octanol/water): | – |
| Hydrolyzability: | Unknown |

($CH_2$=C($CH_3$)COO$CH_2CH_2C_6F_{13}$ → $C_6F_{13}CH_2CH_2OH$+$CH_2$=C($CH_3$)COOH)

| | |
|---|---|
| Solubility | – |
| Degree of solubility | |
| Water: | Insoluble |

| | |
|---|---|
| Dimethyl sulfoxide (DMSO): | <50.0 mg/mL (measured at the testing facility using dehydrated DMSO) |
| Acetone: | ≥432 mg/mL (measured at the testing facility using dehydrated acetone) |
| Others: | – |

8) Storage conditions

Stored in a dark place at room temperature (cabinet No. 1 in the test substance storage room, permissible range: 10-30°C).

9) Precautions

Gloves, a mask, a head cap and a lab coat were worn.

1.2 Positive Control Substances

1) Mitomycin C (MMC)

| | |
|---|---|
| Manufacturer: | Kyowa Hakko Kogyo Co., Ltd. |
| Lot No.: | 480AEL |
| Appearance: | royal purple powder |
| Content: | 99% |
| Grade: | for injection |

2) Cyclophosphamide monohydrate (CPA)

| | |
|---|---|
| Manufacturer: | Wako Pure Chemical Industries, Ltd. |
| Lot No.: | PKQ7031 |
| Appearance: | white crystals or crystalline powder |
| Content: | 99.0% |
| Grade: | for biochemistry |

3) Storage conditions

MMC was stored at room temperature (cabinet No. 2 in the test substance storage room, permissible range: 10-30°C) and CPA in a cold dark place (refrigerator No.13 in the test substance storage room, permissible range: 1-10°C).

4) Precautions

Gloves, a mask, a head cap and a lab coat were worn.

2. CELLS

2.1 Cell Line and Reason for Selection

Chinese hamster lung fibroblasts (CHL/IU cells) were supplied by Health Science Research Resources Bank, Japan Health Sciences Foundation on April 17, 2002. The modal number of chromosomes was 25 per cell. The doubling time was about 15 hours. It was confirmed in the testing facility that the cells were mycoplasma free and the spontaneous frequencies of cells with structural aberrations and the numerical

aberration cells were below 5%.

CHL/IU cells have been recommended the availability on *in vitro* chromosome aberration test prescribed in "Concerning Testing Methods Relating to the New Chemical Substances" on Japanese Test Guideline.

2.2 Storage

Cells were suspended in medium [Eagle's minimum essential medium (Nissui Pharmaceutical Co., Ltd.) and 10 vol% heat-inactivated newborn calf serum (NBCS, Sanko Junyaku Co., Ltd.)] including 10 vol% DMSO and were frozen in liquid nitrogen.

2.3 Culture Condition

Cells were cultured in a $CO_2$ incubator (MCO-345, SANYO Electric Co., Ltd. and Model 530, Wakenyaku Co., Ltd.), which was set at 37°C and 5% $CO_2$ under humid condition.

2.4 Subculture

Cells were subcultured in 90-mm diameter Petri dishes (Nunc A/S) twice a week. Passage number of cells was at 7 for the cell growth inhibition test, 9 for the first, 16 for the second, 18 for the third and 3 for the fourth chromosomal aberration test after the receipt.

3. MEDIUM AND S9 MIX

3.1 Medium

L-Glutamine (final concentration: 0.292 g/L) and sodium hydrogen carbonate (final concentration: approximately 1.85 g/L) were added to Eagle's minimum essential medium (Lot No. 54860611, Nissui Pharmaceutical Co., Ltd.) and basal medium (MEM) was prepared. This medium was then supplemented with 10 vol% heat-inactivated NBCS (Lot No. 27020859, Sanko Junyaku Co., Ltd.).

3.2 S9 Mix

1) Rat liver S9

S9 (Lot No. 06090106, manufactured on September 1, 2006, S9 protein content: 20.2 mg/mL, Oriental Yeast Co., Ltd.), which was prepared from livers of 7-week-old male SD rats (body weight: 215.1±10.7 g) administered intraperitoneally a combination of phenobarbital and 5,6-benzoflavone was used. S9 was frozen and preserved in an ultra-deep freezer (MDF-U481ATR, SANYO Electric Co., Ltd., the tolerance temperature: below -80°C) until use. S9 was used within six months after the day of manufacturing.

2) Composition of S9 mix

One milliliter of S9 mix consisted of 0.3 mL S9, 5 μmol $MgCl_2$, 33 μmol KCl, 5 μmol G-6-P, 4 μmol NADP and 4 μmol HEPES (pH 7.2) and S9 mix was prepared

just prior to use and was stored in ice until use.

4. CELL PRE-CULTURE

A 60-mm diameter plastic Petri dish (Asahi Techno Glass Corporation) was used for cell culture.

Five milliliter of a cell suspension of $1.5\times10^4$ cells/mL were seeded into a dish and were cultured continuously for 2 days in the cell growth inhibition test and the first chromosomal aberration test. Five milliliter of a cell suspension of $5.0\times10^3$ cells/mL were seeded into a dish and were cultured continuously for 3 days in the second, third and fourth chromosomal aberration tests.

5. PREPARATION OF TEST SUBSTANCE SOLUTION AND POSITIVE CONTROL SUBSTANCE SOLUTIONS

5.1 Preparation of Test Substance Solution

1) Solvent

Acetone (Lot No. EWJ5080, 100.0% in purity, special grade, Wako Pure Chemical Industries, Ltd.) dehydrated with Molecular Sieves 5A 1/8 (Lot No. CEQ7072, Wako Pure Chemical Industries, Ltd.) was used.

2) Reason for selection of solvent

Because the test substance was possibly hydrolyzable as preinformed by the sponsor, water solubility was not examined. The test substance was not soluble in dehydrated DMSO at 50.0 mg/mL, but dissolved in dehydrated acetone at 432 mg/mL. The test substance solution at 432 mg/mL in dehydrated acetone was not indicated any change in color nor exothermic at room temperature within 2 hours after preparation. Therefore, dehydrated acetone was selected as a solvent in this study.

3) Preparation method

After the test substance was weighed, dehydrated acetone was added to the test substance to make an original solution using a laboratory mixer. The test substance solutions of 100 times concentrations of the test substance in the medium were prepared with the solvent. The test substance solutions were prepared under the yellow light. It was prepared without correcting purity of the test substance because the purity of the test substance was above 95%.

4) Preparation time

The test substance solutions were prepared immediately before use. It was stored in ice and used within 1 hour after preparation under the yellow light.

5.2 Preparation of Positive Control Substance Solutions

1) Preparation method and storage

MMC and CPA were dissolved in distilled water at 0.01 mg/mL and 1 mg/mL, respectively. The positive control substance solutions were frozen in an ultra-deep freezer (MDF-U481ATR, SANYO Electric Co., Ltd., the tolerance temperature: below -80°C).

2) Preparation time and expiry in use

The positive control substance solutions were thawed at the time of use and used within 1 hour. The stock solutions were used within 6 months after preparation.

6. TEST PROCEDURE

6.1 Cell Growth Inhibition Test

1) Procedure

For the short-term treatment without S9 mix, the medium was removed from a pre-culture, and the cells were treated for 6 hours in well-mixed medium containing 30 μL of the test substance solution or the solvent and 3 mL of the fresh medium. For the short-term treatment with S9 mix, the medium was removed from a pre-culture, and the cells were treated for 6 hours in well-mixed medium consisting of 0.5 mL of S9 mix and 30 μL of the test substance solution or the solvent and 2.5 mL of the fresh medium. After treatment, the medium was removed, and the cells were rinsed 3 times with 2 mL of Dulbecco's physiological phosphate buffered solution without $Ca^{2+}$ and $Mg^{2+}$. Cells were then cultured for another 18 hours in 5 mL of fresh medium.

For the continuous treatment, the medium was removed from a pre-culture, and the cells were treated for the 24 hours with well-mixed medium containing 50 μL of the test substance solution or the solvent and 5 mL of the fresh medium.

In the short-term and the continuous treatments, 50 μL of a 10 μg/mL demecolcine solution was added to each dish at 2 hours before the end of the culture.

At the start and the end of the treatment and at the end of the culture, precipitation of the test substance, the color change of the medium and the corrosion of the dish were observed macroscopically.

At the end of the culture, a cell suspension was prepared to collect from each dish by a treatment with 2 mL of 0.25 w/v% trypsin. After 200 μL of the cell suspension was diluted with 10 mL of Cell Pack (Sysmex Corporation), the number of the cells was measured using a Microcell counter (CDA-500, Sysmex Corporation), and the cell growth rate and the 50% cell growth inhibition concentration ($IC_{50}$) was calculated. The $IC_{50}$ was obtained from a linear line drawn between 2 plots; the one being greater and the other lower than, and both closest to 50% of the cell

growth rate.

Remained cells were collected by a centrifugation at 1000 rpm (185×g) for 5 minutes and were treated hypotonically with 3 mL of 0.075 mol/L KCl at 37°C for 15 minutes. Following the hypotonic treatment, the cells were pre-fixed once with approximately 0.3 mL of a fixative solution (methanol : acetic acid = 3 : 1), and were completely fixed twice with 3 mL of fixative solution. Then, the cell suspension was prepared with a fixative solution, two drops of the suspension were placed on a glass slide, and stained about 15 minutes with 2 vol% Giemsa solution in 1/15 mol/L phosphate buffer solution (pH6.8). One specimen was prepared per dose.

2) Dose levels

In each treatment method, the highest dose was set at 4320 μg/mL equivalent to 10 mmol/L, as the maximum dose in the case of no cytotoxicity on the guideline, and 16.9, 33.8, 67.5, 135, 270, 540, 1080, 2160 and 4320 μg/mL were set based on a geometric progression of 2, respectively. Duplicate dishes were used for each dose.

3) Observation and scoring

Specimens were observed to check the presence or absence of mitotic metaphase cells, and the frequency of the cells with chromosomal aberrations was calculated by observed 50 metaphase cells per dose at which the dose setting of chromosomal aberration test was considered to be referred.

(1) Structural aberration

The number of cells with structural aberrations excluding gaps was recorded. Gaps were defined as an achromatic region smaller than the width of one chromatid.

(2) Numerical aberration

The number of cells showing triploid or more was scored.

6.2 Chromosomal Aberration Test

1) Procedure

Chromosomal aberration test was carried out using the same procedure as that of the cell growth inhibition test, with the following positive controls. Four specimens per dose (two specimens per dish) were prepared.

| Treatment method | | Substance | Dose |
|---|---|---|---|
| Short-term treatment | Without S9 mix | MMC | 0.1 μg/mL |
| | With S9 mix | CPA | 6 μg/mL |
| 24 hours continuous treatment | | MMC | 0.05 μg/mL |

In the positive control, each dish was added with 30 μL of a 0.01 mg/mL MMC solution and 18 μL of a 1 mg/mL CPA solution for the short-term treatments without and with S9 mix, respectively, and 25 μL of a 0.01 mg/mL MMC solution for the continuous treatment.

2) Dose levels of the test substance

As the results of the cell growth inhibition test, in the short-term treatment without S9 mix and the continuous treatment, because a cytotoxicity that the cell growth rate was below 50% was not obtained, the highest dose was selected at 4320 μg/mL equivalent to 10 mmol/L and the following 8 doses were set based on a geometric progression of 2. In the short-term treatment with S9 mix, although a cytotoxicity that the cell growth rate was below 50% was obtained and $IC_{50}$ was calculated at 120 μg/mL, the cell growth rate was over 50% at 1080 μg/mL or more. Therefore, the highest dose was selected at 4320 μg/mL and the following 8 doses were set based on a geometric progression of 2.

| Treatment method | | Setting doses of test substance |
|---|---|---|
| Short-term treatment | Without S9 mix | 33.8, 67.5, 135, 270, 540, 1080, 2160 and 4320 μg/mL |
| | With S9 mix | 33.8, 67.5, 135, 270, 540, 1080, 2160 and 4320 μg/mL |
| 24 hours continuous treatment | | 33.8, 67.5, 135, 270, 540, 1080, 2160 and 4320 μg/mL |

As the result of the chromosomal aberration test employed above doses, the dose that the lowest cell growth rate was observed was 135 μg/mL in the short-term treatment without S9 mix and reproducible results were obtained between the cell growth inhibition test and chromosomal aberration test.

The most suppressed cell growth was observed from 270 to 540 μg/mL in the short-term treatment with S9 mix and reproducible results were also obtained between the cell growth inhibition test and chromosomal aberration test.

However, $IC_{50}$ values in the short-term treatments without and with S9 mix were 130 and 4320 μg/mL, respectively, and variation from the cell growth inhibition test was observed in the chromosomal aberration test. Furthermore, decrease of cell growth rate at around 135 μg/mL was not observed in the 24 hours continuous treatment which the treatment period was longer than the short-term treatments. Then, the result obtained from the short-term treatment without S9 mix was questioned. It was possibly thought that the water-shedding property of the test substance caused cytotoxicity in this treatment because the test substance shed water when medium was discarded after the treatment. Therefore, the second chromosomal aberration test was carried out in the short-term treatments with an operation to prevent shedding of water when exchanging medium. Same eight doses were set as the first chromosomal aberration test.

In the second chromosomal aberration test, it was unable to prevent water-shedding in the short-term treatment without S9 mix. As a result, dose-related decrease of cell growth rate was not obtained at around 540 μg/mL and indexes of metaphase cells were different between dishes at 540 and 1080 μg/mL. Therefore, the third test was carried out in the short-term treatment without S9 mix. Same eight doses

were set as the first and second tests.

In the third chromosomal aberration test, shedding of water was successfully prevented and decrease of cell growth rate from 67.5 to 2160 μg/mL was reduced. However, it was unable to improve the fluctuation of indexes of metaphase cells between dishes at 1080 and 2160 μg/mL. Therefore, the fourth test, employed same doses as previous tests, was carried out in the short-term treatment without S9 mix. Additionally, in the second test in the short-term treatment with S9 mix, the cell growth rate deceased from 135 and 270 μg/mL, the chromosomal aberration test in this treatment was also carried out employing same doses as the first and second tests at the same time as the fourth test.

Duplicate dishes were used for each dose.

3) Observation

(1) Dose for observation

Specimens for observation were selected from the fourth test in the short-term treatments without and with S9 mix and from the first test in the 24 hours continuous treatment. All specimens of the negative and the positive controls set as the control groups in above tests were observed.

The observation doses of the test substance were selected the consecutive doses of three stages. The highest observation dose in each treatment and the reason for selection are shown below.

In the short-term treatments without and with S9 mix and the continuous treatment, because a cytotoxicity that the cell growth rate was below 50% was not obtained, and it was considered that chromosomal aberrations were observable at 4320 μg/mL set as the highest dose, the observation doses of the test substance were selected at 1080, 2160 and 4320μg/mL in all treatment methods.

After the selection of the observation doses, slide numbers were allocated randomly to all observed specimens. All specimens were observed in a blinded manner.

(2) Structural Aberration

Two hundred metaphase cells per dose (50 cells per specimen) containing 25±2 chromosomes were observed using a microscope. The total number of cells with structural aberrations and the number of aberrant cells in each aberration category were recorded. Gaps were defined as an achromatic region smaller than the width of one chromatid and were recorded separately from the structural aberrations.

(3) Numerical Aberration

The number of polyploid (cell with 38 or more chromosomes) cells among 200 metaphase cells per dose (50 cells per specimen) observed was recorded.

6.3 Confirmation Test

In the chromosomal aberration test for the short-term treatments without and with S9

mix and the 24 hours continuous treatment, the frequencies of cells with structural aberration and numerical aberration cells were below 5% and the result was judged to be negative, therefore, a confirmation test was not conducted.

7. JUDGEMENT CRITERIA OF RESULTS

The findings were judged to be positive when the frequencies of cells with structural aberrations or numerical aberrations were 10% or more with a dose-related increase, or the frequencies of aberrant cells were 5% or more both in the chromosomal aberration test and the confirmation test. The other cases were judged to be negative. No statistical analyses were used.

8. VALIDITY OF TEST

This study was regarded as valid as follows: 1) the frequencies of cells with chromosomal aberrations did not fluctuate markedly between two culture dishes, 2) the frequencies of aberrant cells in the negative control were below 5%, and 3) the frequencies of cells with structural aberrations in the positive controls were 20% or more.

## FACTORS AFFECTED RELIABILITY OF TEST

There were no factors, which might affect the reliability of the test.

## TEST RESULTS

1. CELL GROWTH INHIBITION TEST (Table 1 and Fig. 1)

The $IC_{50}$s were calculated more than 4320 μg/mL in the short-term treatment without S9 mix and the 24 hours continuous treatment and at 120 μg/mL in the short-term treatment with S9 mix.

In all treatment methods, precipitation of the test substance was observed at 2160 μg/mL or more at the start and end of the treatment. The color change of the medium and the corrosion of the culture dish were not observed at any doses.

Shedding of water in the culture dishes was observed at 135 μg/mL or more when exchanging treatment medium in the short-term treatments and when collecting cells in the continuous treatment.

The frequencies of numerical aberration cells were below 5% at all observation doses of the test substance in each treatment, but the maximum frequency of cells with structural aberrations was 8.0%.

2. CHROMOSOMAL ABERRATION TEST

2.1 Short-term Treatment

1) The first test (Table 2 and Fig. 2)

(1) Without S9 mix

a) Cell growth rate and $IC_{50}$

The cell growth rates at 33.8, 67.5, 135, 270, 540, 1080, 2160 and 4320 μg/mL of the test substance were 91.0, 80.7, 45.2, 64.8, 65.5, 65.3, 76.4 and 74.1%, respectively. The $IC_{50}$ was calculated at 130 μg/mL.

b) Precipitation of the test substance, color change of medium and corrosion of culture dish

Precipitation of the test substance was observed at 1080 μg/mL or more at the start and the end of the treatment and at 2160 μg/mL or more at end of the culture. The color change of the medium and the corrosion of the culture dish were not observed at any doses. Shedding of water in the culture dishes was observed at 135 μg/mL or more when exchanging treatment medium.

(2) With S9 mix

a) Cell growth rate and $IC_{50}$

The cell growth rates at 33.8, 67.5, 135, 270, 540, 1080, 2160 and 4320 μg/mL of the test substance were 94.6, 91.3, 68.1, 57.2, 53.2, 66.4, 72.0 and 64.7%, respectively. The $IC_{50}$ was calculated more than 4320 μg/mL.

b) Precipitation of the test substance, color change of medium and corrosion of culture dish

Precipitation of the test substance was observed at 1080 μg/mL or more at the start and the end of the treatment and at 2160 μg/mL or more at the end of the culture. The color change of the medium and the corrosion of the culture dish were not observed at any doses. Shedding of water in the culture dishes was observed at 135 μg/mL or more when exchanging treatment medium.

2) The second test (Table 3 and Fig. 3)

(1) Without S9 mix

a) Cell growth rate and $IC_{50}$

The cell growth rates at 33.8, 67.5, 135, 270, 540, 1080, 2160 and 4320 μg/mL of the test substance were 98.6, 64.1, 62.8, 57.9, 80.4, 67.6, 67.9 and 81.5%, respectively. The $IC_{50}$ was calculated more than 4320 μg/mL.

b) Precipitation of the test substance, color change of medium and corrosion of culture dish

Precipitation of the test substance was observed at 1080 μg/mL or more at the start and the end of the treatment. The color change of the medium and the corrosion of the culture dish were not observed at any doses. Shedding of

water in the culture dishes was observed at 135 μg/mL or more when exchanging treatment medium.

(2) With S9 mix

a) Cell growth rate and $IC_{50}$

The cell growth rates at 33.8, 67.5, 135, 270, 540, 1080, 2160 and 4320 μg/mL of the test substance were 95.2, 79.3, 43.3, 35.8, 53.8, 60.2, 68.9 and 59.9%, respectively. The $IC_{50}$ was calculated at 120 μg/mL.

b) Precipitation of the test substance, color change of medium and corrosion of culture dish

Precipitation of the test substance was observed at 1080 μg/mL or more at the start and the end of the treatment. The color change of the medium and the corrosion of the culture dish were not observed at any doses. Shedding of water in the culture dishes was observed at 135 μg/mL or more when exchanging treatment medium.

3) The third test (Table 4 and Fig. 4)

(1) Without S9 mix

a) Cell growth rate and $IC_{50}$

The cell growth rates at 33.8, 67.5, 135, 270, 540, 1080, 2160 and 4320 μg/mL of the test substance were 120.4, 99.3, 133.8, 123.9, 108.0, 115.9, 101.3 and 106.4%, respectively. The $IC_{50}$ was calculated more than 4320 μg/mL.

b) Precipitation of the test substance, color change of medium and corrosion of culture dish

Precipitation of the test substance was observed at 1080 μg/mL or more at the start and the end of the treatment and at 2160 μg/mL or more at the end of the culture. The color change of the medium and the corrosion of the culture dish were not observed at any doses.

4) The fourth test (Tables 5, 6, 7 and Figs. 5, 6)

(1) Without S9 mix

a) Cell growth rate and $IC_{50}$

The cell growth rates at 33.8, 67.5, 135, 270, 540, 1080, 2160 and 4320 μg/mL of the test substance were 94.0, 70.4, 82.4, 74.4, 87.9, 85.3, 79.7 and 75.7%, respectively. The $IC_{50}$ was calculated more than 4320 μg/mL.

b) Precipitation of the test substance, color change of medium and corrosion of culture dish

Precipitation of the test substance was observed at 2160 μg/mL or more at the start and the end of the treatment. The color change of the medium and the corrosion of the culture dish were not observed at any doses.

c) Frequency of cells with structural aberrations

The frequencies of cells with structural aberrations were 1.0% in the negative control and 66.5% in the positive control.

The frequencies of cells with structural aberrations at 1080, 2160 and 4320 μg/mL of the test substance were 0.5, 1.5 and 0.0%, respectively, therefore, the results were judged to be negative.

d) Frequency of numerical aberration cells

The frequencies of numerical aberration cells were below 5% at all doses including the negative and positive controls, therefore, the results were judged to be negative.

(2) With S9 mix

a) Cell growth rate and $IC_{50}$

The cell growth rates at 33.8, 67.5, 135, 270, 540, 1080, 2160 and 4320 μg/mL of the test substance were 93.8, 85.0, 55.5, 67.4, 71.2, 64.2, 61.2 and 61.6%, respectively. The $IC_{50}$ was calculated more than 4320 μg/mL.

b) Precipitation of the test substance, color change of medium and corrosion of culture dish

Precipitation of the test substance was observed at 2160 μg/mL or more at the start and the end of the treatment. The color change of the medium and the corrosion of the culture dish were not observed at any doses. Slight shedding of water in the culture dishes was observed at 135 μg/mL when exchanging treatment medium.

c) Frequency of cells with structural aberrations

The frequencies of cells with structural aberrations were 1.5% in the negative control and 58.5% in the positive control.

The frequencies of cells with structural aberrations at 1080, 2160 and 4320 μg/mL of the test substance were 2.5, 2.0 and 4.0%, respectively, therefore, the results were judged to be negative.

d) Frequency of numerical aberration cells

The frequencies of numerical aberration cells were below 5% at all doses including the negative and positive controls, therefore, the results were judged to be negative.

2.2 Twenty Four Hours Continuous Treatment (Tables 2, 8 and Figs. 2, 7)

1) Cell growth rate and $IC_{50}$

The cell growth rates at 33.8, 67.5, 135, 270, 540, 1080, 2160 and 4320 μg/mL of the test substance were 104.8, 83.8, 88.3, 75.7, 71.1, 70.6, 70.6 and 60.1%, respectively. The $IC_{50}$ was calculated more than 4320 μg/mL.

2) Precipitation of the test substance, color change of medium and corrosion of culture dish

Precipitation of the test substance was observed at 1080 μg/mL or more at the start of the treatment and at 2160 μg/mL or more at end of the treatment. The color change of the medium and the corrosion of the culture dish were not observed at any doses.

3) Frequency of cells with structural aberrations

The frequencies of cells with structural aberrations were 2.0% in the negative control and 83.5% in the positive control.

The frequencies of cells with structural aberrations were 1.0% at all three doses, 1080, 2160 and 4320 μg/mL, therefore, the results were judged to be negative.

4) Frequency of numerical aberration cells

The frequencies of numerical aberration cells were below 5% at all doses including the negative and positive controls, therefore, the results were judged to be negative.

## DISCUSSION AND CONCLUSION

In each treatment method in the chromosomal aberration test, the frequencies of cells with chromosomal aberrations did not fluctuate markedly between two culture dishes, and the frequencies of cells with aberrations were below 5% in the negative controls, and the frequencies of cells with structural aberrations excluding gaps were 20% or more in the positive controls, indicating that the present study was appropriately performed.

In the exchange of medium, when medium or phosphate buffered salt solution were discarded, water was shed in culture dishes at several doses and fluctuations in both cell growth rates and indexes of metaphase cells between dishes were observed in these doses.

It was considered that these fluctuations were resulted from the cytotoxicity including dehydration by the contact of the test substance with cells because the test substance was classified to fluorine compound. Therefore, the chromosomal aberration tests were carried out with an operation to prevent shedding of water when exchanging medium and specimens obtained from these treatments were observed.

As a result of observation of specimens, the frequencies of cells with structural aberration and numerical aberration cells were below 5% at all observation doses of the test substance in the short-term treatments without and with S9 mix and the 24 hours continuous treatment, therefore, both structural aberration and numerical aberration were judged to be negative.

In the cell growth inhibition test, the frequency of cells with structural aberration was found to be up to 8.0% and induction of chromosomal aberration was suspected in the short-term treatments without and with S9 mix. However, it was considered that the frequency of aberrant cells increased in the inappropriate test condition because shedding of water by the

test substance was found at the doses that the frequency of aberrant cells was 5% or more. Although the frequency of cells with structural aberration was also found to be up to 8.0% and induction of chromosomal aberration was suspected in the continuous treatment, increase of the frequency was not verified in the chromosomal aberration test. Therefore, it was thought that the result was obtained accidentally because the number of cells for observation was fifty and too small to evaluate.

Based on the above results, it was considered that 13F-SFMA did not induce the chromosomal aberration under the present test conditions.

## REFERENCES

1. Toshio Sofuni (ed.) (1999) Data book of chromosomal aberration test *in vitro*. Revised edition, 1998 (in Japanese). Life-science Information Center.
2. Japan Environmental Mutagenicity Society/Mammalian Mutagenicity Study Group (ed.) (1988) Atlas of chromosomal aberration induced with chemical substance (in Japanese). Asakura Publishing Co., Tokyo.

Table 1 Results of cell growth inhibition test of 13F-SFMA

| Substance | Dose (μg/mL) | Treatment-recovery time (hour) | S9 mix | Cell growth rate (%) | Precipitation of test substance in medium [a] | | | Frequency of cells with aberrations (%)[b] | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Treatment start | Treatment end | Culture end | Structural aberration | Numerical aberration |
| dehydrated acetone | 0 | 6-18 | - | 100 | - | - | - | 0.0 | 0.0 |
| 13F-SFMA | 16.9 | 6-18 | - | 112.2 | - | - | - | n.o. | n.o. |
| | 33.8 | 6-18 | - | 106.3 | - | - | - | n.o. | n.o. |
| | 67.5 | 6-18 | - | 76.3 | - | - | - | 0.0 | 4.0 |
| | 135 | 6-18 | - | 54.3 | - | - | - | 2.0 | 0.0 |
| | 270 | 6-18 | - | 64.2 | - | - | - | 4.0 | 2.0 |
| | 540 | 6-18 | - | 70.4 | - | - | - | 8.0 | 0.0 |
| | 1080 | 6-18 | - | 78.4 | - | - | - | 0.0 | 0.0 |
| | 2160 | 6-18 | - | 73.4 | + | + | - | 2.0 | 0.0 |
| | 4320 | 6-18 | - | 76.7 | + | + | - | 4.0 | 0.0 |
| | | | | $IC_{50}$ : >4320 μg/mL | | | | | |
| dehydrated acetone | 0 | 6-18 | + | 100 | - | - | - | 0.0 | 0.0 |
| 13F-SFMA | 16.9 | 6-18 | + | 99.0 | - | - | - | n.o. | n.o. |
| | 33.8 | 6-18 | + | 96.4 | - | - | - | n.o. | n.o. |
| | 67.5 | 6-18 | + | 82.6 | - | - | - | 2.0 | 2.0 |
| | 135 | 6-18 | + | 42.6 | - | - | - | 6.0 | 0.0 |
| | 270 | 6-18 | + | 33.4 | - | - | - | 8.0 | 0.0 |
| | 540 | 6-18 | + | 37.7 | - | - | - | 4.0 | 2.0 |
| | 1080 | 6-18 | + | 67.5 | - | - | - | 2.0 | 2.0 |
| | 2160 | 6-18 | + | 65.4 | + | + | - | 2.0 | 0.0 |
| | 4320 | 6-18 | + | 67.5 | + | + | - | 2.0 | 0.0 |
| | | | | $IC_{50}$ : 120 μg/mL | | | | | |
| dehydrated acetone | 0 | 24-0 | - | 100 | - | - | | 0.0 | 0.0 |
| 13F-SFMA | 16.9 | 24-0 | - | 93.6 | - | - | | n.o. | n.o. |
| | 33.8 | 24-0 | - | 90.2 | - | - | | n.o. | n.o. |
| | 67.5 | 24-0 | - | 81.5 | - | - | | n.o. | n.o. |
| | 135 | 24-0 | - | 74.0 | - | - | | 0.0 | 0.0 |
| | 270 | 24-0 | - | 73.4 | - | - | | 4.0 | 2.0 |
| | 540 | 24-0 | - | 70.9 | - | - | | 2.0 | 0.0 |
| | 1080 | 24-0 | - | 74.4 | - | - | | 2.0 | 0.0 |
| | 2160 | 24-0 | - | 61.1 | + | + | | 6.0 | 0.0 |
| | 4320 | 24-0 | - | 57.9 | + | + | | 8.0 | 0.0 |
| | | | | $IC_{50}$ : >4320 μg/mL | | | | | |

Acetone was dehydrated with molecular sieves 5A 1/8.

n.o.: not observed

a) Precipitation of the test substance: -, absence; +, presence.

b) The frequency of cells with chromosomal aberrations was calculated by observing 50 metaphases per dose.

The dose was set at 4320 μg/mL equivalent to 10 mmol/L of the test substance, which was the maximum dose in the guidelines, the dose levels based on a geometric progression of 2 were selected.

Table 2 Results of the first chromosomal aberration test of 13F-SFMA

| Substance | Dose (μg/mL) | Treatment-recovery time (hour) | S9 mix | Cell growth rate (%) | Precipitation of test substance in medium [a] | | | Frequency of cells with aberrations (%)[b] | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Treatment start | Treatment end | Culture end | Structural aberration | Numerical aberration |
| dehydrated acetone | 0 | 6-18 | - | 100 | - | - | - | n.o. | n.o. |
| 13F-SFMA | 33.8 | 6-18 | - | 91.0 | - | - | - | n.o. | n.o. |
| | 67.5 | 6-18 | - | 80.7 | - | - | - | n.o. | n.o. |
| | 135 | 6-18 | - | 45.2 | - | - | - | n.o. | n.o. |
| | 270 | 6-18 | - | 64.8 | - | - | - | n.o. | n.o. |
| | 540 | 6-18 | - | 65.5 | - | - | - | n.o. | n.o. |
| | 1080 | 6-18 | - | 65.3 | + | + | - | n.o. | n.o. |
| | 2160 | 6-18 | - | 76.4 | + | + | + | n.o. | n.o. |
| | 4320 | 6-18 | - | 74.1 | + | + | + | n.o. | n.o. |
| MMC | 0.1 | 6-18 | - | ND | - | - | - | n.o. | n.o. |
| | | | $IC_{50}$: | 130 μg/mL | | | | | |
| dehydrated acetone | 0 | 6-18 | + | 100 | - | - | - | n.o. | n.o. |
| 13F-SFMA | 33.8 | 6-18 | + | 94.6 | - | - | - | n.o. | n.o. |
| | 67.5 | 6-18 | + | 91.3 | - | - | - | n.o. | n.o. |
| | 135 | 6-18 | + | 68.1 | - | - | - | n.o. | n.o. |
| | 270 | 6-18 | + | 57.2 | - | - | - | n.o. | n.o. |
| | 540 | 6-18 | + | 53.2 | - | - | - | n.o. | n.o. |
| | 1080 | 6-18 | + | 66.4 | + | + | - | n.o. | n.o. |
| | 2160 | 6-18 | + | 72.0 | + | + | + | n.o. | n.o. |
| | 4320 | 6-18 | + | 64.7 | + | + | + | n.o. | n.o. |
| CPA | 6 | 6-18 | + | ND | - | - | - | n.o. | n.o. |
| | | | $IC_{50}$: | >4320 μg/mL | | | | | |
| dehydrated acetone | 0 | 24-0 | - | 100 | - | - | | 2.0 | 0.5 |
| 13F-SFMA | 33.8 | 24-0 | - | 104.8 | - | - | | n.o. | n.o. |
| | 67.5 | 24-0 | - | 83.8 | - | - | | n.o. | n.o. |
| | 135 | 24-0 | - | 88.3 | - | - | | n.o. | n.o. |
| | 270 | 24-0 | - | 75.7 | - | - | | n.o. | n.o. |
| | 540 | 24-0 | - | 71.1 | - | - | | n.o. | n.o. |
| | 1080 | 24-0 | - | 70.6 | + | - | | 1.0 | 1.0 |
| | 2160 | 24-0 | - | 70.6 | + | + | | 1.0 | 0.5 |
| | 4320 | 24-0 | - | 60.1 | + | + | | 1.0 | 2.0 |
| MMC | 0.05 | 24-0 | - | ND | - | - | | 83.5 | 0.5 |
| | | | $IC_{50}$: | >4320 μg/mL | | | | | |

Acetone was dehydrated with molecular sieves 5A 1/8.

MMC: mitomycin C, CPA: cyclophosphamide monohydrate

ND: not detected, n.o.: not observed

a) Precipitation of the test substance: -, absence; +, presence.

b) The frequency of cells with chromosomal aberrations was calculated by observing 200 metaphases per dose.

Table 3 Results of the second chromosomal aberration test of 13F-SFMA

| Substance | Dose (μg/mL) | Treatment-recovery time (hour) | S9 mix | Cell growth rate (%) | Precipitation of test substance in medium [a] | | | Frequency of cells with aberrations (%)[b] | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Treatment start | Treatment end | Culture end | Structural aberration | Numerical aberration |
| dehydrated acetone | 0 | 6-18 | - | 100 | - | - | - | n.o. | n.o. |
| 13F-SFMA | 33.8 | 6-18 | - | 98.6 | - | - | - | n.o. | n.o. |
| | 67.5 | 6-18 | - | 64.1 | - | - | - | n.o. | n.o. |
| | 135 | 6-18 | - | 62.8 | - | - | - | n.o. | n.o. |
| | 270 | 6-18 | - | 57.9 | - | - | - | n.o. | n.o. |
| | 540 | 6-18 | - | 80.4 | - | - | - | few meta | |
| | 1080 | 6-18 | - | 67.6 | + | + | - | few meta | |
| | 2160 | 6-18 | - | 67.9 | + | + | - | n.o. | n.o. |
| | 4320 | 6-18 | - | 81.5 | + | + | - | n.o. | n.o. |
| MMC | 0.1 | 6-18 | - | ND | - | - | - | n.o. | n.o. |
| | | | | $IC_{50}$ : >4320 μg/mL | | | | | |
| dehydrated acetone | 0 | 6-18 | + | 100 | - | - | - | n.o. | n.o. |
| 13F-SFMA | 33.8 | 6-18 | + | 95.2 | - | - | - | n.o. | n.o. |
| | 67.5 | 6-18 | + | 79.3 | - | - | - | n.o. | n.o. |
| | 135 | 6-18 | + | 43.3 | - | - | - | n.o. | n.o. |
| | 270 | 6-18 | + | 35.8 | - | - | - | n.o. | n.o. |
| | 540 | 6-18 | + | 53.8 | - | - | - | n.o. | n.o. |
| | 1080 | 6-18 | + | 60.2 | + | + | - | n.o. | n.o. |
| | 2160 | 6-18 | + | 68.9 | + | + | - | n.o. | n.o. |
| | 4320 | 6-18 | + | 59.9 | + | + | - | n.o. | n.o. |
| CPA | 6 | 6-18 | + | ND | - | - | - | n.o. | n.o. |
| | | | | $IC_{50}$ : 120 μg/mL | | | | | |

Acetone was dehydrated with molecular sieves 5A 1/8.

MMC: mitomycin C, CPA: cyclophosphamide monohydrate

ND: not detected

n.o.: not observed, few meta: the frequency of metaphases was extremely few

a) Precipitation of the test substance: -, absence; +, presence.

Table 4 Results of the third chromosomal aberration test of 13F-SFMA

| Substance | Dose (μg/mL) | Treatment-recovery time (hour) | S9 mix | Cell growth rate (%) | Precipitation of test substance in medium [a)] | | | Frequency of cells with aberrations (%) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Treatment start | Treatment end | Culture end | Structural aberration | Numerical aberration |
| dehydrated acetone | 0 | 6-18 | - | 100 | - | - | - | n.o. | n.o. |
| 13F-SFMA | 33.8 | 6-18 | - | 120.4 | - | - | - | n.o. | n.o. |
| | 67.5 | 6-18 | - | 99.3 | - | - | - | n.o. | n.o. |
| | 135 | 6-18 | - | 133.8 | - | - | - | n.o. | n.o. |
| | 270 | 6-18 | - | 123.9 | - | - | - | n.o. | n.o. |
| | 540 | 6-18 | - | 108.0 | - | - | - | n.o. | n.o. |
| | 1080 | 6-18 | - | 115.9 | + | + | - | n.o. | n.o. |
| | 2160 | 6-18 | - | 101.3 | + | + | + | few meta | |
| | 4320 | 6-18 | - | 106.4 | + | + | + | n.o. | n.o. |
| MMC | 0.1 | 6-18 | - | ND | - | - | - | n.o. | n.o. |
| $IC_{50}$ : >4320 μg/mL | | | | | | | | | |

Aceton was dehydrated with molecular sieves 5A 1/8.

MMC: mitomycin C, CPA: cyclophosphamide monohydrate

ND: not detected

n.o.: not observed, few meta: the frequency of metaphases was extremely few

a) Precipitation of the test substance: -, absence; +, presence.

Table 5 Results of the fourth chromosomal aberration test of 13F-SFMA

| Substance | Dose (μg/mL) | Treatment-recovery time (hour) | S9 mix | Cell growth rate (%) | Precipitation of test substance in medium [a] | | | Frequency of cells with aberrations (%) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Treatment start | Treatment end | Culture end | Structural aberration | Numerical aberration |
| dehydrated acetone | 0 | 6-18 | - | 100 | - | - | - | 1.0 | 1.5 |
| 13F-SFMA | 33.8 | 6-18 | - | 94.0 | - | - | - | n.o. | n.o. |
| | 67.5 | 6-18 | - | 70.4 | - | - | - | n.o. | n.o. |
| | 135 | 6-18 | - | 82.4 | - | - | - | n.o. | n.o. |
| | 270 | 6-18 | - | 74.4 | - | - | - | n.o. | n.o. |
| | 540 | 6-18 | - | 87.9 | - | - | - | n.o. | n.o. |
| | 1080 | 6-18 | - | 85.3 | - | - | - | 0.5 | 1.0 |
| | 2160 | 6-18 | - | 79.7 | + | + | - | 1.5 | 0.0 |
| | 4320 | 6-18 | - | 75.7 | + | + | - | 0.0 | 2.5 |
| MMC | 0.1 | 6-18 | - | ND | - | - | - | 66.5 | 0.5 |
| $IC_{50}$ : >4320 μg/mL | | | | | | | | | |
| dehydrated acetone | 0 | 6-18 | + | 100 | - | - | - | 1.5 | 0.5 |
| 13F-SFMA | 33.8 | 6-18 | + | 93.8 | - | - | - | n.o. | n.o. |
| | 67.5 | 6-18 | + | 85.0 | - | - | - | n.o. | n.o. |
| | 135 | 6-18 | + | 55.5 | - | - | - | n.o. | n.o. |
| | 270 | 6-18 | + | 67.4 | - | - | - | n.o. | n.o. |
| | 540 | 6-18 | + | 71.2 | - | - | - | n.o. | n.o. |
| | 1080 | 6-18 | + | 64.2 | - | - | - | 2.5 | 0.0 |
| | 2160 | 6-18 | + | 61.2 | + | + | - | 2.0 | 0.0 |
| | 4320 | 6-18 | + | 61.6 | + | + | - | 4.0 | 0.5 |
| CPA | 6 | 6-18 | + | ND | - | - | - | 58.5 | 0.0 |
| $IC_{50}$ : >4320 μg/mL | | | | | | | | | |

Acetone was dehydrated with molecular sieves 5A 1/8.

MMC: mitomycin C, CPA: cyclophosphamide monohydrate

ND: not detected, n.o.: not observed

a) Precipitation of the test substance: -, absence; +, presence.

b) The frequency of cells with chromosomal aberrations was calculated by observing 200 metaphases per dose.

Table 6 Results of the fourth chromosomal aberration test (short-term treatment without S9 mix)

Name of test substance : 13F-SFMA

K06-1190

| Treatment time (h) | S9 mix | Dose (μg/mL) | Number of cells with structural chromosomal aberrations (frequency%) | | | | | | | Number of gaps (frequency%) | Cell growth rate (%) | Number of cells with numerical chromosomal aberrations (frequency%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Number of cells observed | Chromatid break | Chromatid exchange | Chromosome break | Chromosome exchange | Others | Total number of cells with aberrations | | | Number of cells observed | Polyploids | Others | Total number of cells with aberrations |
| 6 - 18 | - | Negative control (Acetone) | 100 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | | 100 | 0 | 0 | 0 |
| | | | 100 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 100 | 100 | 3 | 0 | 3 |
| | | 0 | 200 | 1 ( 0.5) | 0 ( 0.0) | 0 ( 0.0) | 1 ( 0.5) | 0 ( 0.0) | 2 ( 1.0) | 2 ( 1.0) | | 200 | 3 ( 1.5) | 0 ( 0.0) | 3 ( 1.5) |
| 6 - 18 | - | 33.8 | 0 | | | | | | | | 92.8 | 0 | | | |
| | | | 0 | | | | | | | | 95.1 | 0 | | | |
| | | | 0 | | | | | | | | ( 94.0) | 0 | | | |
| 6 - 18 | - | 67.5 | 0 | | | | | | | | 65.7 | 0 | | | |
| | | | 0 | | | | | | | | 75.1 | 0 | | | |
| | | | 0 | | | | | | | | ( 70.4) | 0 | | | |
| 6 - 18 | - | 135 | 0 | | | | | | | | 81.4 | 0 | | | |
| | | | 0 | | | | | | | | 83.3 | 0 | | | |
| | | | 0 | | | | | | | | ( 82.4) | 0 | | | |
| 6 - 18 | - | 270 | 0 | | | | | | | | 76.2 | 0 | | | |
| | | | 0 | | | | | | | | 72.6 | 0 | | | |
| | | | 0 | | | | | | | | ( 74.4) | 0 | | | |
| 6 - 18 | - | 540 | 0 | | | | | | | | 90.0 | 0 | | | |
| | | | 0 | | | | | | | | 85.7 | 0 | | | |
| | | | 0 | | | | | | | | ( 87.9) | 0 | | | |
| 6 - 18 | - | 1080 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 82.5 | 100 | 1 | 0 | 1 |
| | | | 100 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 88.0 | 100 | 1 | 0 | 1 |
| | | | 200 | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) | 1 ( 0.5) | 0 ( 0.0) | 1 ( 0.5) | 0 ( 0.0) | ( 85.3) | 200 | 2 ( 1.0) | 0 ( 0.0) | 2 ( 1.0) |
| 6 - 18 | - | 2160 † | 100 | 2 | 0 | 0 | 0 | 0 | 2 | 2 | 75.8 | 100 | 0 | 0 | 0 |
| | | | 100 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 83.5 | 100 | 0 | 0 | 0 |
| | | | 200 | 3 ( 1.5) | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) | 3 ( 1.5) | 2 ( 1.0) | ( 79.7) | 200 | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) |
| 6 - 18 | - | 4320 † | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 78.1 | 100 | 2 | 0 | 2 |
| | | | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 73.2 | 100 | 3 | 0 | 3 |
| | | | 200 | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) | ( 75.7) | 200 | 5 ( 2.5) | 0 ( 0.0) | 5 ( 2.5) |
| 6 - 18 | - | Positive control (MMC) | 100 | 35 | 55 | 0 | 2 | 0 | 65 | 0 | | 100 | 0 | 0 | 0 |
| | | | 100 | 40 | 47 | 0 | 0 | 0 | 68 | 2 | | 100 | 1 | 0 | 1 |
| | | 0.1 | 200 | 75 ( 37.5) | 102 ( 51.0) | 0 ( 0.0) | 2 ( 1.0) | 0 ( 0.0) | 133 ( 66.5) | 2 ( 1.0) | | 200 | 1 ( 0.5) | 0 ( 0.0) | 1 ( 0.5) |

Treatment time comprised treatment-time and recovery-time.

The number of aberrant cells at each dish was shown at the first and second lines. The total number of them was shown at the third line.

Cell growth rate at each dish was shown at the first and second lines. The average of them was shown at the third line.

Acetone was dehydrated with molecular sieves 5A 1/8.

MMC: Mitomycin C

†:Precipitation of the test substance was observed at the start and the end of the treatment.

The specimens at 33.8, 67.5, 135, 270 and 540 μg/mL were not observed.



K06-1190

Table 7 Results of the fourth chromosomal aberration test (short-term treatment with S9 mix)

Name of test substance : 13F-SFMA

K06-1190

| Treatment time (h) | S9 mix | Dose (μg/mL) | Number of cells with structural chromosomal aberrations (frequency%) | | | | | | | Number of gaps (frequency%) | Cell growth rate (%) | Number of cells with numerical chromosomal aberrations (frequency%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Number of cells observed | Chromatid break | Chromatid exchange | Chromosome break | Chromosome exchange | Others | Total number of cells with aberrations | | | Number of cells observed | Polyploids | Others | Total number of cells with aberrations |
| 6 - 18 | + | Negative control | 100 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | | 100 | 1 | 0 | 1 |
| | | (Acetone) | 100 | 2 | 0 | 0 | 0 | 0 | 2 | 1 | 100 | 100 | 0 | 0 | 0 |
| | | 0 | 200 | 2 ( 1.0) | 0 ( 0.0) | 1 ( 0.5) | 0 ( 0.0) | 0 ( 0.0) | 3 ( 1.5) | 1 ( 0.5) | | 200 | 1 ( 0.5) | 0 ( 0.0) | 1 ( 0.5) |
| 6 - 18 | + | 33.8 | 0 | | | | | | | | 92.3 | 0 | | | |
| | | | 0 | | | | | | | | 95.2 | 0 | | | |
| | | | 0 | | | | | | | | ( 93.8) | 0 | | | |
| 6 - 18 | + | 67.5 | 0 | | | | | | | | 88.4 | 0 | | | |
| | | | 0 | | | | | | | | 81.6 | 0 | | | |
| | | | 0 | | | | | | | | ( 85.0) | 0 | | | |
| 6 - 18 | + | 135 | 0 | | | | | | | | 60.5 | 0 | | | |
| | | | 0 | | | | | | | | 50.4 | 0 | | | |
| | | | 0 | | | | | | | | ( 55.5) | 0 | | | |
| 6 - 18 | + | 270 | 0 | | | | | | | | 68.9 | 0 | | | |
| | | | 0 | | | | | | | | 65.8 | 0 | | | |
| | | | 0 | | | | | | | | ( 67.4) | 0 | | | |
| 6 - 18 | + | 540 | 0 | | | | | | | | 76.8 | 0 | | | |
| | | | 0 | | | | | | | | 65.6 | 0 | | | |
| | | | 0 | | | | | | | | ( 71.2) | 0 | | | |
| 6 - 18 | + | 1080 | 100 | 2 | 0 | 1 | 1 | 0 | 4 | 0 | 61.6 | 100 | 0 | 0 | 0 |
| | | | 100 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 66.7 | 100 | 0 | 0 | 0 |
| | | | 200 | 2 ( 1.0) | 0 ( 0.0) | 2 ( 1.0) | 1 ( 0.5) | 0 ( 0.0) | 5 ( 2.5) | 0 ( 0.0) | ( 64.2) | 200 | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) |
| 6 - 18 | + | 2160 † | 100 | 1 | 1 | 0 | 0 | 0 | 2 | 1 | 57.7 | 100 | 0 | 0 | 0 |
| | | | 100 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 64.7 | 100 | 0 | 0 | 0 |
| | | | 200 | 1 ( 0.5) | 3 ( 1.5) | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) | 4 ( 2.0) | 1 ( 0.5) | ( 61.2) | 200 | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) |
| 6 - 18 | + | 4320 † | 100 | 5 | 0 | 1 | 0 | 0 | 5 | 1 | 56.8 | 100 | 0 | 0 | 0 |
| | | | 100 | 0 | 2 | 1 | 0 | 0 | 3 | 0 | 66.4 | 100 | 1 | 0 | 1 |
| | | | 200 | 5 ( 2.5) | 2 ( 1.0) | 2 ( 1.0) | 0 ( 0.0) | 0 ( 0.0) | 8 ( 4.0) | 1 ( 0.5) | ( 61.6) | 200 | 1 ( 0.5) | 0 ( 0.0) | 1 ( 0.5) |
| 6 - 18 | + | Positive control | 100 | 19 | 55 | 0 | 1 | 0 | 58 | 2 | | 100 | 0 | 0 | 0 |
| | | (CPA) | 100 | 28 | 43 | 0 | 0 | 0 | 59 | 2 | | 100 | 0 | 0 | 0 |
| | | 6 | 200 | 47 ( 23.5) | 98 ( 49.0) | 0 ( 0.0) | 1 ( 0.5) | 0 ( 0.0) | 117 ( 58.5) | 4 ( 2.0) | | 200 | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) |

Treatment time comprised treatment-time and recovery-time.

The number of aberrant cells at each dish was shown at the first and second lines. The total number of them was shown at the third line.

Cell growth rate at each dish was shown at the first and second lines. The average of them was shown at the third line.

Acetone was dehydrated with molecular sieves 5A 1/8.

CPA: Cyclophosphamide monohydrate

†:Precipitation of the test substance was observed at the start and the end of the treatment.

The specimens at 33.8, 67.5, 135, 270 and 540 μg/mL were not observed.



K06-1190

Table 8 Results of the fourth chromosomal aberration test (continuous treatment)

Name of test substance : 13F-SFMA

K06-1190

| Treatment time (h) | Dose (μg/mL) | Number of cells with structural chromosomal aberrations (frequency%) | | | | | | | Number of gaps (frequency%) | Cell growth rate (%) | Number of cells with numerical chromosomal aberrations (frequency%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Number of cells observed | Chromatid break | Chromatid exchange | Chromosome break | Chromosome exchange | Others | Total number of cells with aberrations | | | Number of cells observed | Polyploids | Others | Total number of cells with aberrations |
| 24 - 0 | Negative control (Acetone) | 100 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | | 100 | 0 | 0 | 0 |
| | | 100 | 3 | 0 | 0 | 0 | 0 | 3 | 0 | 100 | 100 | 1 | 0 | 1 |
| | 0 | 200 | 4 ( 2.0) | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) | 4 ( 2.0) | 0 ( 0.0) | | 200 | 1 ( 0.5) | 0 ( 0.0) | 1 ( 0.5) |
| 24 - 0 | 33.8 | 0 | | | | | | | | 99.6 | 0 | | | |
| | | 0 | | | | | | | | 109.9 | 0 | | | |
| | | 0 | | | | | | | | (104.8) | 0 | | | |
| 24 - 0 | 67.5 | 0 | | | | | | | | 86.7 | 0 | | | |
| | | 0 | | | | | | | | 80.8 | 0 | | | |
| | | 0 | | | | | | | | ( 83.8) | 0 | | | |
| 24 - 0 | 135 | 0 | | | | | | | | 85.7 | 0 | | | |
| | | 0 | | | | | | | | 90.9 | 0 | | | |
| | | 0 | | | | | | | | ( 88.3) | 0 | | | |
| 24 - 0 | 270 | 0 | | | | | | | | 75.2 | 0 | | | |
| | | 0 | | | | | | | | 76.2 | 0 | | | |
| | | 0 | | | | | | | | ( 75.7) | 0 | | | |
| 24 - 0 | 540 | 0 | | | | | | | | 73.3 | 0 | | | |
| | | 0 | | | | | | | | 68.8 | 0 | | | |
| | | 0 | | | | | | | | ( 71.1) | 0 | | | |
| 24 - 0 | 1080 † | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 68.4 | 100 | 2 | 0 | 2 |
| | | 100 | 1 | 0 | 0 | 1 | 0 | 2 | 0 | 72.8 | 100 | 0 | 0 | 0 |
| | | 200 | 1 ( 0.5) | 0 ( 0.0) | 0 ( 0.0) | 1 ( 0.5) | 0 ( 0.0) | 2 ( 1.0) | 0 ( 0.0) | ( 70.6) | 200 | 2 ( 1.0) | 0 ( 0.0) | 2 ( 1.0) |
| 24 - 0 | 2160 † | 100 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 65.1 | 100 | 1 | 0 | 1 |
| | | 100 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 76.0 | 100 | 0 | 0 | 0 |
| | | 200 | 2 ( 1.0) | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) | 2 ( 1.0) | 0 ( 0.0) | ( 70.6) | 200 | 1 ( 0.5) | 0 ( 0.0) | 1 ( 0.5) |
| 24 - 0 | 4320 † | 100 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 59.8 | 100 | 0 | 0 | 0 |
| | | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60.4 | 100 | 4 | 0 | 4 |
| | | 200 | 0 ( 0.0) | 2 ( 1.0) | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) | 2 ( 1.0) | 0 ( 0.0) | ( 60.1) | 200 | 4 ( 2.0) | 0 ( 0.0) | 4 ( 2.0) |
| 24 - 0 | Positive control (MMC) | 100 | 48 | 63 | 0 | 0 | 0 | 78 | 0 | | 100 | 1 | 0 | 1 |
| | | 100 | 39 | 77 | 0 | 0 | 0 | 89 | 1 | | 100 | 0 | 0 | 0 |
| | 0.05 | 200 | 87 ( 43.5) | 140 ( 70.0) | 0 ( 0.0) | 0 ( 0.0) | 0 ( 0.0) | 167 ( 83.5) | 1 ( 0.5) | | 200 | 1 ( 0.5) | 0 ( 0.0) | 1 ( 0.5) |

Treatment time comprised treatment-time and recovery-time.

The number of aberrant cells at each dish was shown at the first and second lines. The total number of them was shown at the third line.

Cell growth rate at each dish was shown at the first and second lines. The average of them was shown at the third line.

Acetone was dehydrated with molecular sieves 5A 1/8.

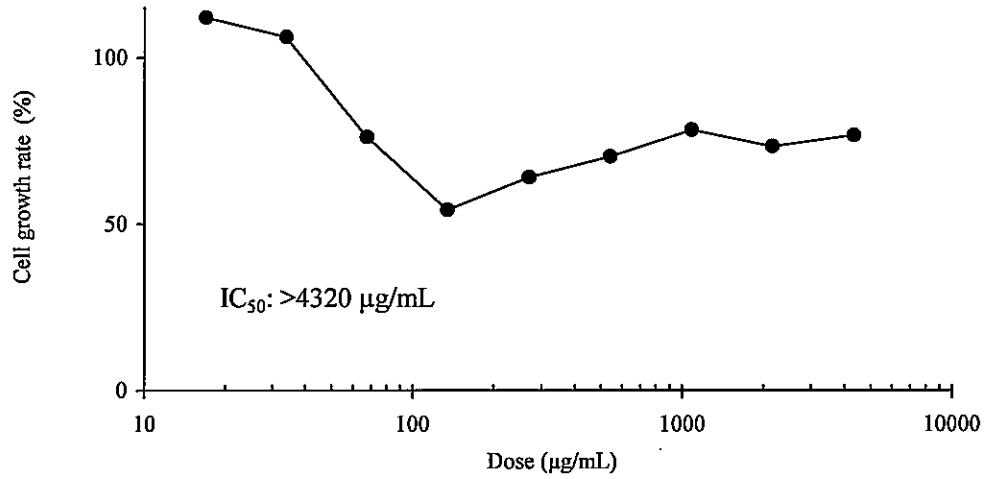
MMC: Mitomycin C

†:Precipitation of the test substance was observed at 1080 μg/mL or more at the start of the treatment, at 2160 μg/mL or more at the end of the treatment.

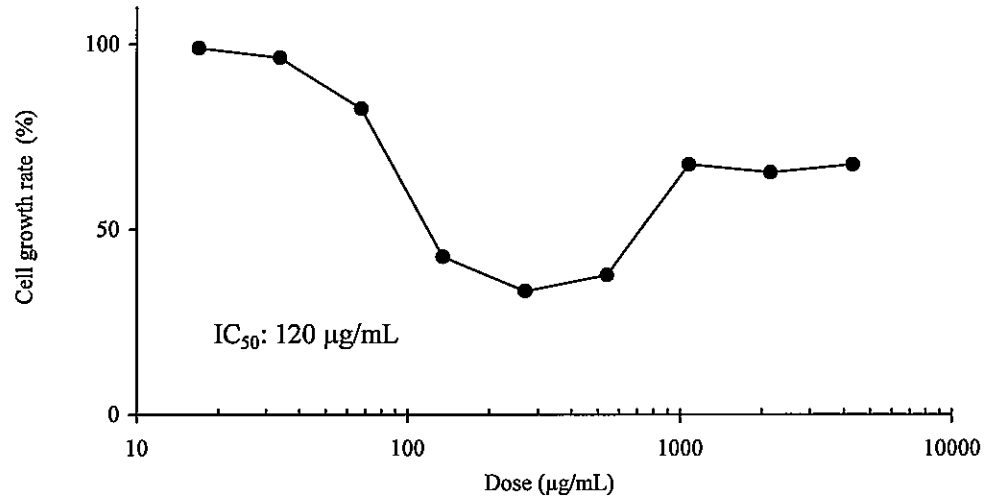
The specimens at 33.8, 67.5, 135, 270 and 540 μg/mL were not observed.



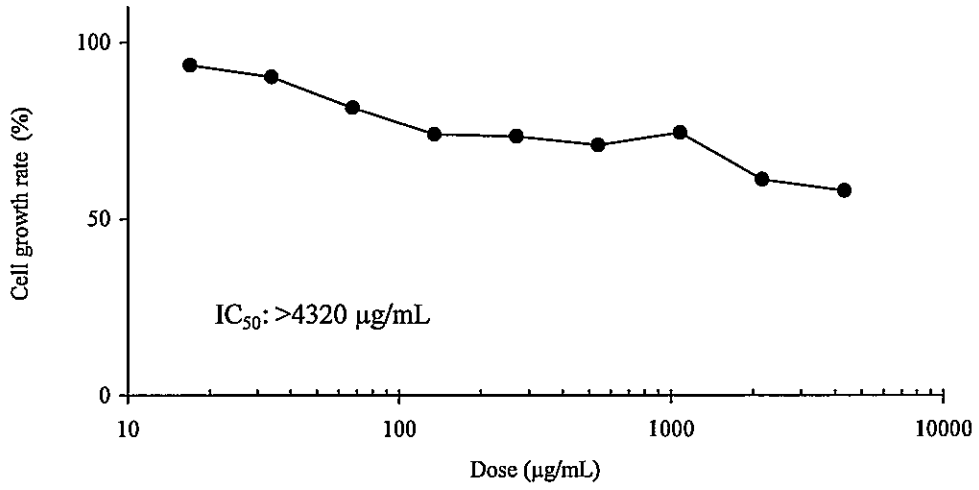
K06-1190




Short-term treatment without S9 mix

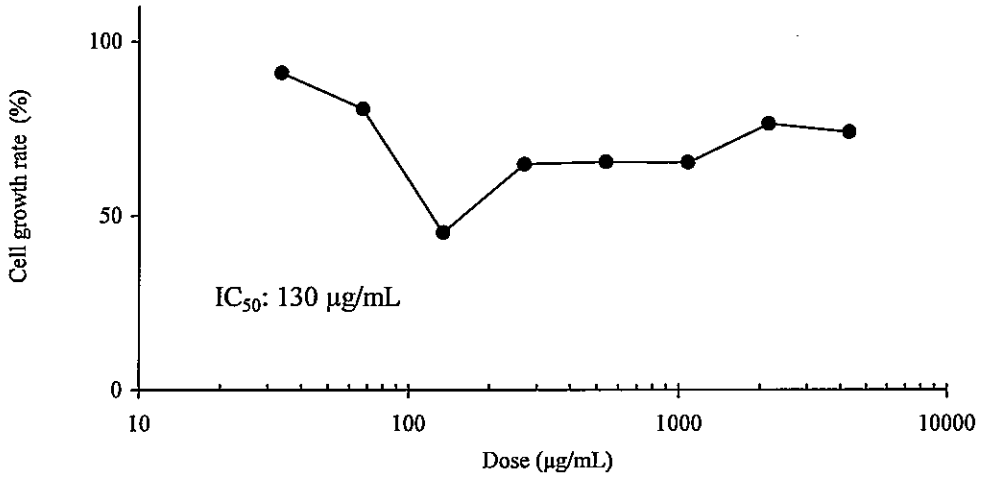



Short-term treatment with S9 mix

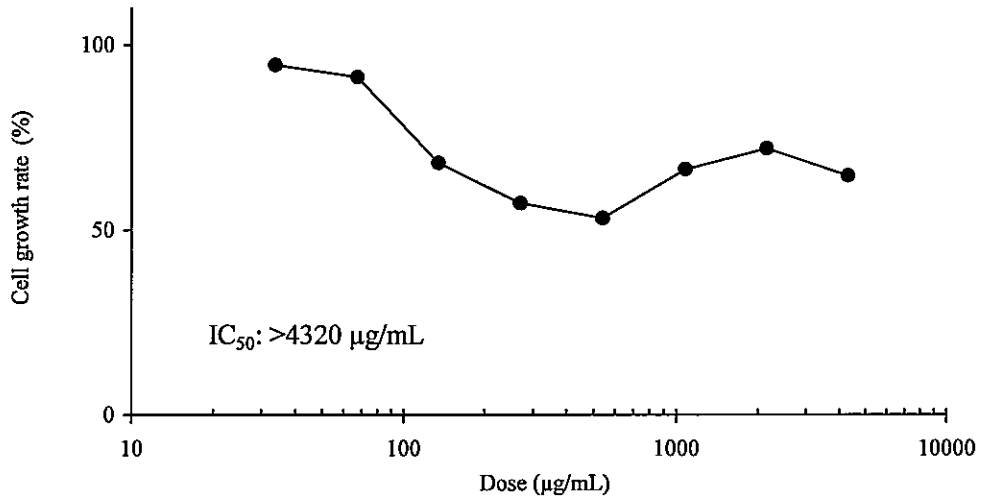



24 hours continuous treatment

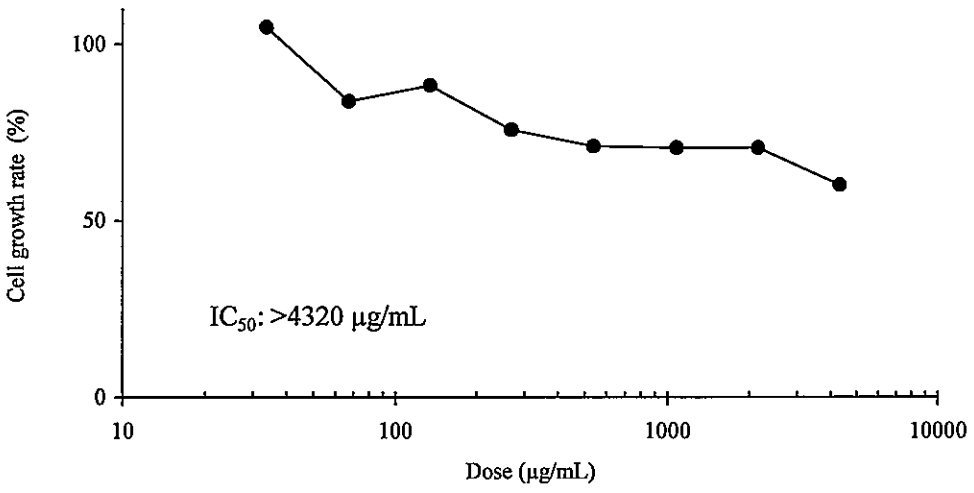
Fig. 1 Results of cell growth inhibition test of 13F-SFMA




Short-term treatment without S9 mix

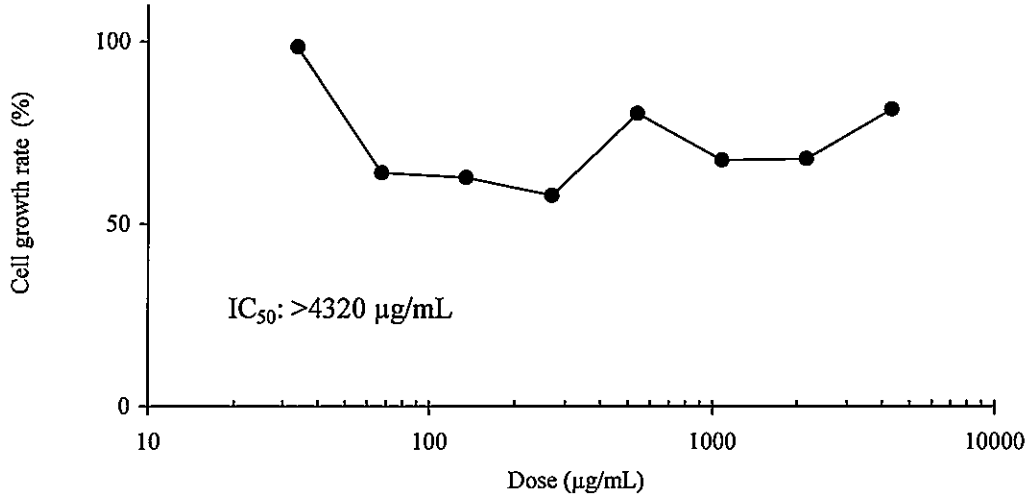



Short-term treatment with S9 mix

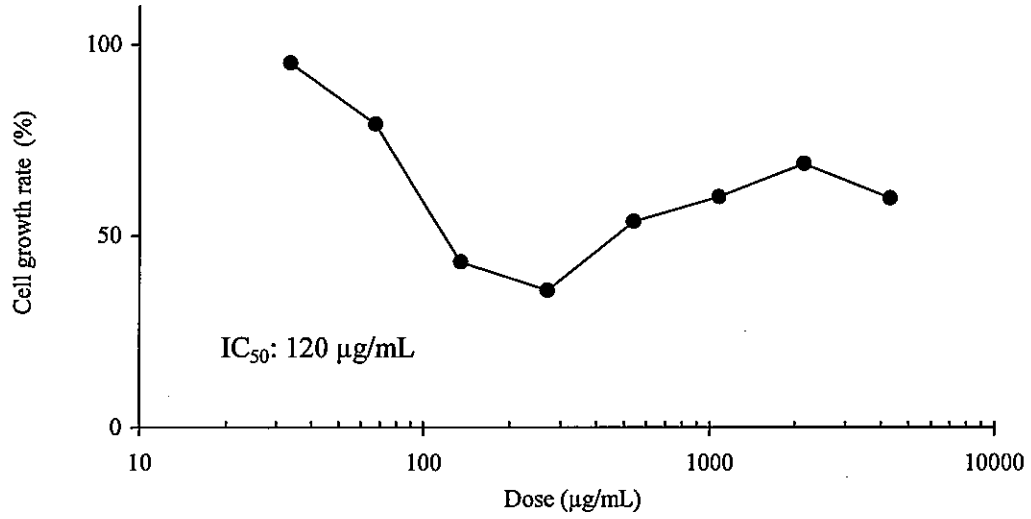



24 hours continuous treatment

Fig. 2 Cell growth rate of the first chromosomal aberration test of 13F-SFMA

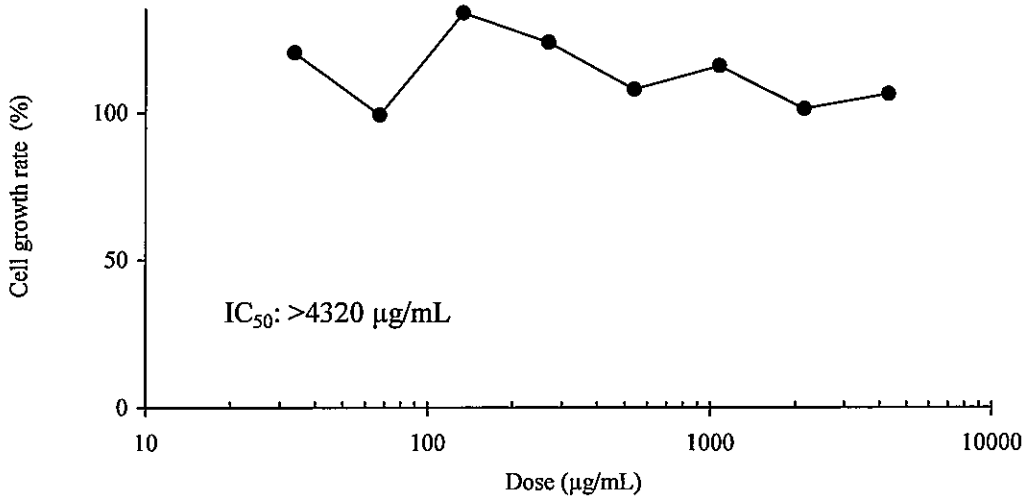



Short-term treatment without S9 mix



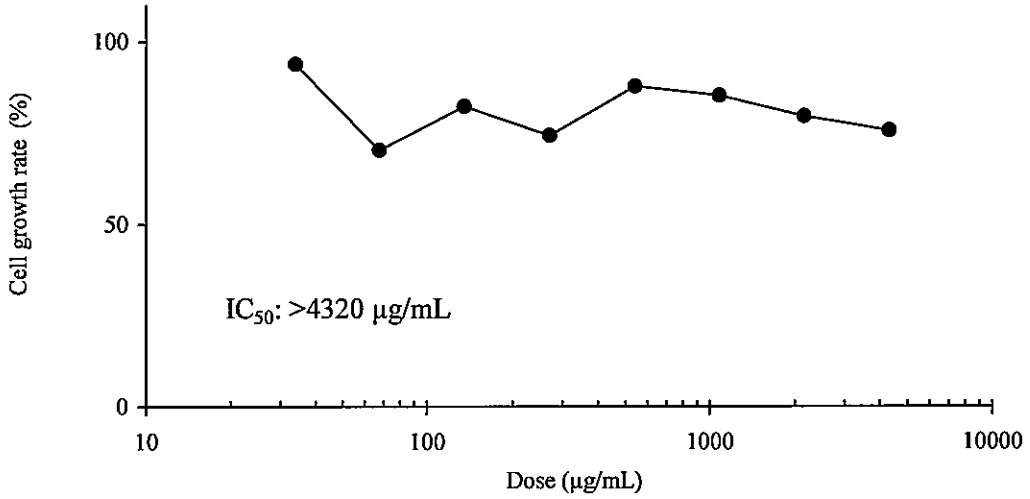

Short-term treatment with S9 mix

Fig. 3 Cell growth rate of the second chromosomal aberration test of 13F-SFMA

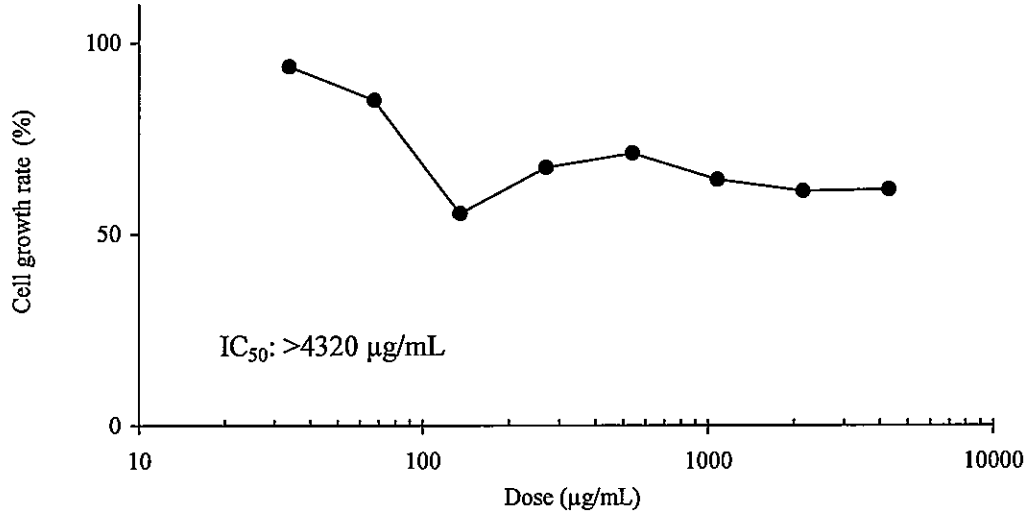



Short-term treatment without S9 mix

Fig. 4 Cell growth rate of the third chromosomal aberration test of 13F-SFMA

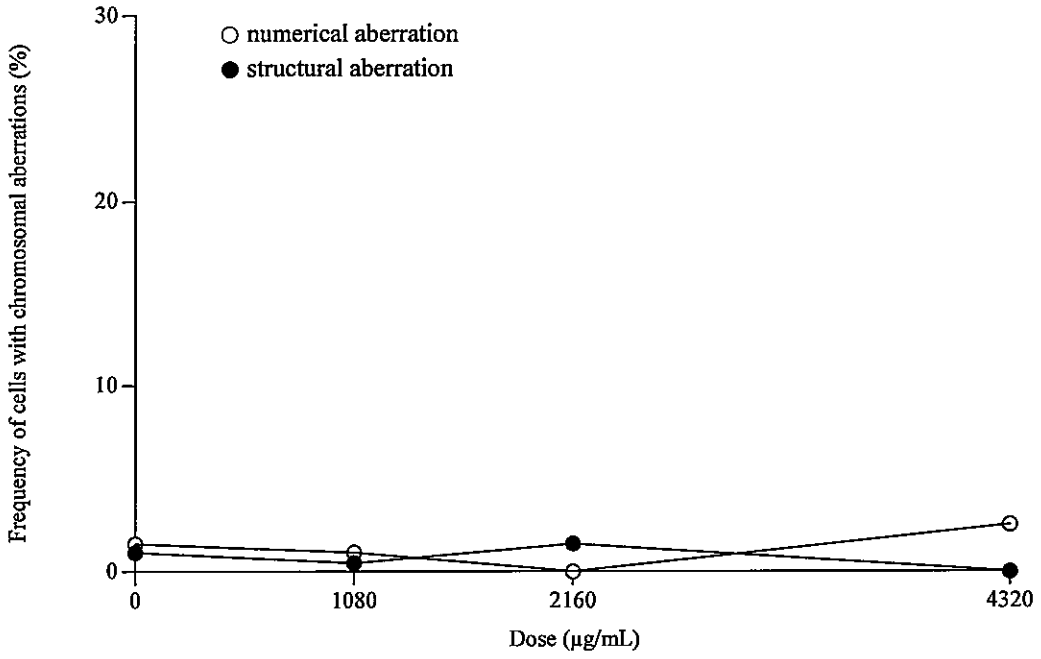



Short-term treatment without S9 mix

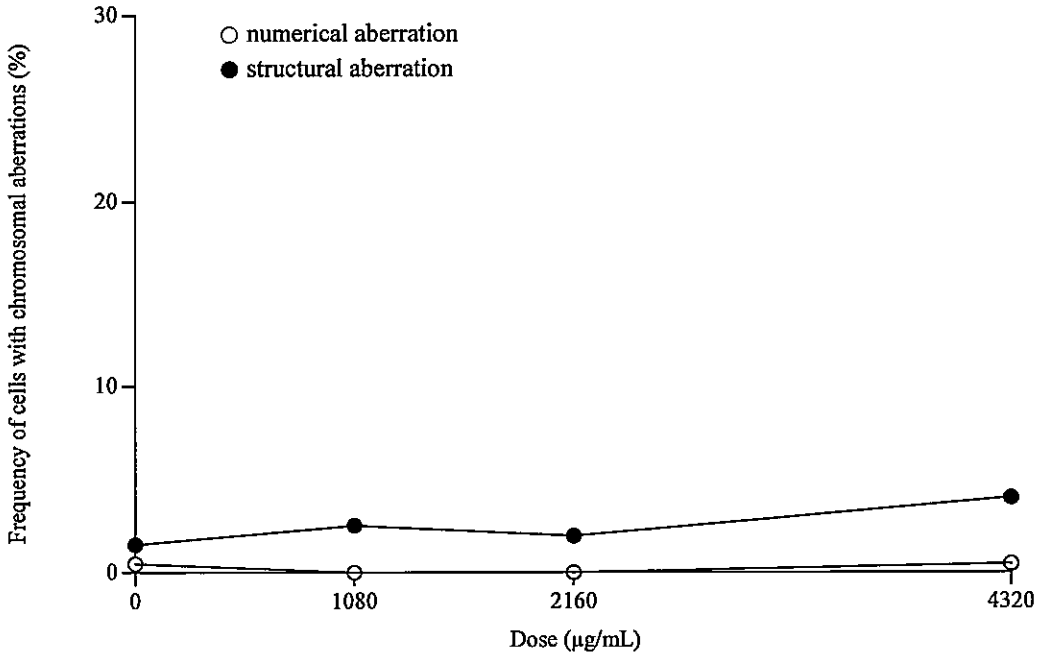



Short-term treatment with S9 mix

Fig. 5 Cell growth rate of the fourth chromosomal aberration test of 13F-SFMA




Without S9 mix




With S9 mix

Fig. 6 Results of chromosomal aberration test in short-term treatments of 13F-SFMA

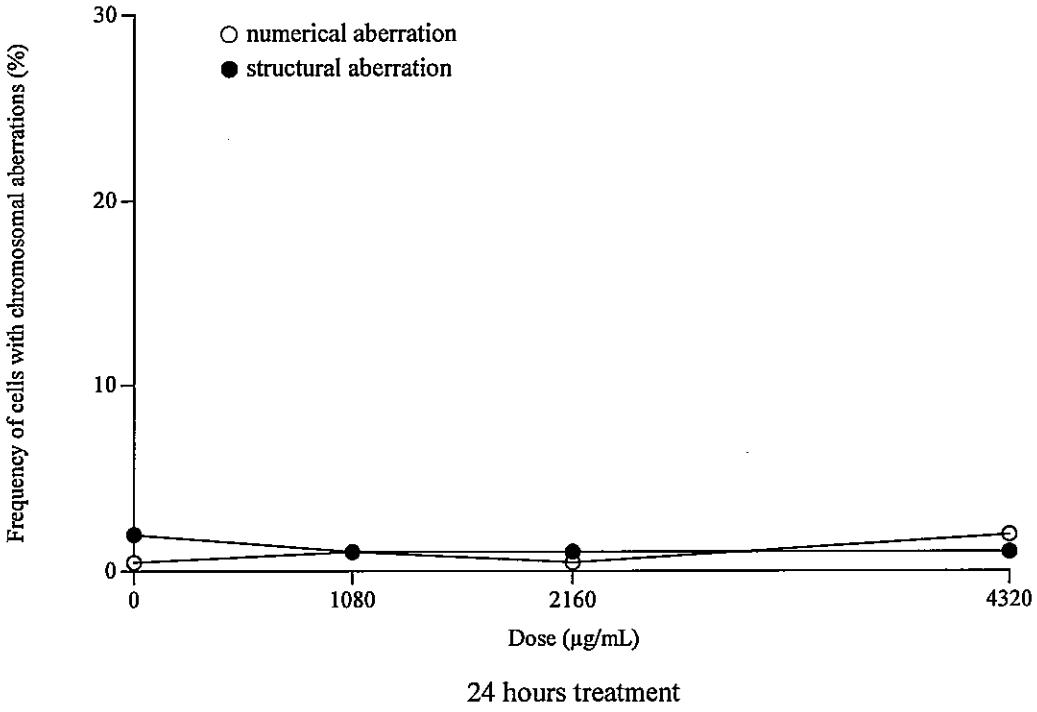



Fig. 7 Results of chromosomal aberration test in continuous treatment of 13F-SFMA