

平成 27 年度厚生労働科学研究費補助金（化学物質リスク研究事業）  
分担報告書

研究課題名：化学物質のヒト健康リスク評価における（定量的）構造活性相関および、  
カテゴリーアプローチの実用化に関する研究

**分担研究課題名：In vivo 遺伝毒性試験 QSAR の開発**

In vivo 遺伝毒性試験のデータベース構築と発がん性感受性の検証

研究分担者 森田 健 国立医薬品食品衛生研究所安全性予測評価部 第三室室長  
研究協力者 増村 健一 国立医薬品食品衛生研究所変異遺伝部 第三室室長

**要旨**

大規模な in vivo 遺伝毒性試験（赤血球小核試験(in vivo MN)およびトランスジェニック齧歯類遺伝子突然変異試験(in vivo TGR)）データベースを構築し、各試験単独ならびに他の試験と組合せた場合の発がん物質検出性、および遺伝毒性指標を同じくする in vitro 試験と in vivo 試験間の一致性を評価した。CGX DB による 756 の齧歯類発がん物質と 183 の非発がん物質について、in vivo MN では 379 物質（293 の発がん物質、86 の非発がん物質）、in vivo TGR では 80 物質（76 の発がん物質、4 の非発がん物質）の知見が得られ、感受性および特異性は、in vivo MN で 41.0%および 60.5%、in vivo TGR で 72.4%および“計算せず(nc、あまりにも少ない非発がん物質データのため)”であった。また、各種の遺伝毒性試験との組合せにおける感受性/特異性は、Ames + in vivo MN で 68.7%/45.3%、Ames + in vivo TGR で 83.8%/nc、Ames + in vitro 染色体異常試験(CA) + in vivo MN で 80.8%/21.3%、Ames + in vitro CA + in vivo TGR で 89.1%/nc、Ames + in vivo MN + in vivo TGR で 87.5%/nc、Ames + in vitro CA + in vivo MN + in vivo TGR で 89.3%/nc であった。Ames + in vitro CA に比べ、Ames + in vivo MN は、比較的バランスのとれた感受性/特異性(74.3%/37.5%)を示した。また、in vivo MN と in vitro CA の一致性は 50.3%、in vivo TGR と Ames の一致性は 79.5%であった。これらの in vivo 知見あるいは in vitro/in vivo 試験間の相違に関する知見を(定量的)構造活性相関(QSAR)に組み込むことが精度向上に必要と考えられた。

**A. 研究目的**

遺伝毒性の 1 つの指標である染色体異常誘発性については、in vitro 試験では陽性を示すものの in vivo 試験では陰性となるケースが多く知られている。そのため、より精度の高い染色体異常予測率を示す QSAR

モデルの構築には、in vivo 試験の発がん物質感受性を評価し、in vitro と in vivo 試験間のギャップの要因を検証することが必要と考えられる。そのため、756 の齧歯類発がん物質および 183 の非発がん物質(計 939 物質)を網羅したカークランドの CGX デー

データベースに、2種の in vivo 遺伝毒性試験、すなわち MN と TGR のデータを加え、拡張 CGX データベースを構築し、それら in vivo 遺伝毒性試験の単独あるいは他の試験との組合せによる発がん物質検出の感受性・特異性を評価する。付随的に、Ames 試験および in vitro 染色体異常試験 (CA) のデータも収集し、これまでに構築した CGX データベースの更新を図る。さらに、遺伝毒性指標を同じくする in vitro/in vivo 試験間のデータ比較から、より信頼性の高い in vitro および in vivo 遺伝毒性試験 QSAR の開発を目指す。

## B. 研究方法

### B.1. 使用データベース

カークランドらによる発がん性・遺伝毒性データベース (CGX DB、ver. 2、2007 年 4 月、<https://eurl-ecvam.jrc.ec.europa.eu/databases/genotoxicity-carcinogenicity-db>) を用いた。CGX DB は、756 の齧歯類発がん物質と 183 の非発がん物質について、CAS 番号、構造式、化学物質クラス、DEREK アラートおよび 4 種の in vitro 遺伝毒性試験結果 (Ames, MLA, in vitro MN, in vitro CA) が収載されている。

### B.2. In vivo 遺伝毒性試験データの検索

In vivo MN に関するレビュー論文あるいは大規模試験報告書、EU リスク評価書や OECD SIDS 文書などの国際的化学品評価文書、US NTP のデータベースサーチ、ならびに PubMed 文献サーチを用いた (表 1)。また、in vivo TGR については、OECD のレビュー文書 (Detailed review paper on transgenic rodent mutation assays, Series on testing and assessment, Number 103, OECD, Paris, July 23, 2009. ENV/JM/MONO(2009)7,

[http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono\(2009\)7&doclanguage=en](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2009)7&doclanguage=en)) および食品添加物の遺伝毒性試験報告書 (厚生労働省、2008~2012 年、非公表) ならびに PubMed 文献サーチを用いた。なお、in vivo 遺伝毒性試験に関するデータ収集の過程で、新たに Ames および in vitro CA のデータが認められた場合には、CGX DB に追加、更新して反映させた。

### B.3. データの評価

試験結果は CGX DB (2005 年版) における記載に基づき以下の 4 つに分類した。すなわち、+ : 陽性、- : 陰性、E (equivocal、不明確) : 反応が弱いものや試験間あるいは試験施設間での再現性が認められないなどのあいまいな結果、および TC (technically compromised、技術的に問題あり) : 試験の適切性において、本質的な基準的規範に適合していないことなどにより試験結果に疑問がある。なお、in vivo 試験において TC に該当する要因の 1 つに、標的臓器の曝露が挙げられるが、今回利用した情報源のすべてが標的臓器曝露に関する知見を収載しているものではないため、in vivo 試験に対しては、TC は適用しなかった。また、in vivo TGR における陽性 (+) の意味は、少なくとも 1 つの発がん標的部位で陽性、陰性 (-) の意味は、TGR で評価したすべての発がん標的部位で陰性、である。なお、陽性および陰性は、その内容によって細分化した。すなわち、+^ : TGR で陽性だが発がん標的部位ではない、-^ : TGR 陰性だが発がん標的部位ではない。なお、in vitro CA において、10 mM 超および 2 mg/mL 超の濃度での陽性の知見は、現行のガイドライン規定を超える過剰な高用量における陽性知見のため、陰性と判断した。すなわち、CGX DB (2005 年版) で in vitro CA 陽性と評価さ

れた 12 物質(7 つの発がん物質および 5 つの非発がん物質)は、本解析では陰性と評価した。

## C. 研究結果

### C.1. 収集された in vivo 遺伝毒性試験データ

CGX データセットについて認められた in vivo 遺伝毒性試験データは、in vivo MN においては 379 物質(発がん物質 293、非発がん物質 86)であり、うち、発がん物質および非発がん物質について、それぞれ陽性が 120 および 24 物質、陰性が 162 および 52 物質、不明確が 11 および 10 物質であった(表 2)。また、in vivo TGR おいては 80 物質(発がん物質 76、非発がん物質 4)が認められたが、非発がん物質のデータは極めて少なくそれらはすべて陰性であった。76 の発がん物質については、陽性が 55 物質、陰性が 21 物質であった(表 2)。なお、収集・整備したデータを CGX DB の発がん物質については Appendix 1 に、非発がん物質については Appendix 2 にまとめた。

In vivo MN における特記すべき個別物質の評価は以下のとおり：

#### 発がん物質

- ID C17, Acrylonitrile (陰性)  
ラット静脈内(iv)投与による陽性知見が認められたが、マウス iv 投与を始め他の試験で陰性であったことから、陰性と評価した。
- ID C179, Chlorpromazine hydrochloride (陽性)  
低体温による陽性知見とされており、閾値のある二次的な遺伝毒性作用様式(MOA)と考えられるが、ハザードとしては陽性と評価した。
- ID C197, C.I. Sovent yellow 3 (o-aminoazotoluene) (陽性)  
種差が認められ、マウスで陽性、ラッ

トで陰性であった。マウスの陽性知見をハザードとして重視した。

- ID C246, 1,2-dibromoethane(不明確、E)  
投与経路差が認められ、経口投与および腹腔内(ip)投与では陰性であったが、吸入投与では陽性であった。標的臓器曝露や代謝などの妥当性評価が困難であることから不明確とした。
- ID C285, 3,3'-dimethoxybenzidine 2HCl (陰性)  
本物質のデータは認められなかったが、遊離塩基(119-90-4)の陰性知見に基づいた。
- ID C378, Haloperidol (陽性)  
マウスでは低体温による陽性知見とされている。ラットでは陰性知見がある。ハザードとして陽性と評価した。
- ID C439, Mercuric chloride (陽性)  
種差が認められ、マウスで陽性、ラットで陰性であった。マウスの陽性知見をハザードとして重視した。
- ID C466, 4,4'-methylenedianiline 2HCl (陽性)  
本物質についての陽性知見に基づいたが、遊離塩基(101-77-9)については陰性とされている。
- ID C478, 4-(methylnitrosamino)-1-(3-pyrridyl)-1-(butanone) (NNK) (不明確)  
陰性と陽性の知見がそれぞれ 1 つずつある。陽性知見は、マウスにおける 52 週間の皮下投与によるものであり、妥当性評価が困難であることから不明確とした。
- ID C509, Sodium nitrite (不明確)  
陰性と陽性の知見がそれぞれ 1 つずつあり、妥当性評価が困難であることから不明確とした。なお、OECD の SIDS では陽性と評価している。

- ID C631, Phenylhydrazine HCl (陽性)  
本物質のデータは認められなかったが、遊離塩基 (100-63-0) の陽性知見に基づいた。
- ID C657, Pyrimethamine (陽性)  
種差が認められ、マウスで陰性、ラットで陽性であった。ラットの陽性知見をハザードとして重視した。
- ID C660, Reserpine (陽性)  
マウスでは低体温による陽性知見とされている。ラットでは陰性知見がある。ハザードとして陽性と評価した。
- ID C672, Sodium dichromate (陽性)  
投与経路差が認められ、ip 投与では陽性であったが、経口投与では陰性であった。標的臓器曝露や代謝などの妥当性評価は困難であるものの、ハザードとして陽性と評価した。
- ID C676, Styrene (陽性)  
種差が認められ、マウスで陽性、ラットで陰性であった。マウスの陽性知見をハザードとして重視した。
- ID C711, o-Toluidine (陽性)  
種差が認められ、マウスで陰性、ラットで陽性であった。ラットの陽性知見をハザードとして重視した。

#### 非発がん物質

- ID NC8, dl-Amphetamine sulfate (陽性)  
本物質のデータは認められなかったが、遊離塩基 (300-62-9) の陽性知見に基づいた。
- ID NC73, EDTA, trisodium salt trihydrate (陰性)  
本物質のデータは認められなかったが、disodium salt (6381-92-6) の陰性知見に基づいた。なお、disodium salt において陽性知見も認められたが、EURAR では信頼性の低い知見とし、

陰性と結論付けている。

- ID NC91, Sodium fluoride (不明確)  
カークランドらの総説<sup>3)</sup>での評価は単一の陽性知見に基づき陽性と評価しているが、他に3つの陰性知見が認められたため、不明確とした。
- ID NC138, Phenol (陽性)  
低体温による陽性知見とされている。ハザードとして陽性と評価した。

また、in vivo TGR において+^(TGR で陽性だが発がん標的部位ではない)とされた6物質ならびに-^(TGR 陰性だが発がん標的部位ではない)とされた4物質(計10物質、いずれも発がん物質)の評価対象臓器は以下のとおり：

+^(TGR で陽性だが発がん標的部位ではない)

- ID C244, 1,2-dibromo-3-chloropropane  
TGR は、精巣で陽性だが、肝臓で陰性。発がん標的臓器は、ラットでは鼻腔、口腔、胃、副腎および乳腺、マウスでは肺、鼻腔および胃。
- ID C246, 1,2-Dibromoethane  
TGR は、鼻粘膜および精巣で陽性だが、肺および肝臓で陰性。発がん標的臓器は、鼻腔、腹腔、下垂体、胃、肝、肺および乳腺。
- ID C340, Ethyl methanesulphonate  
TGR は、骨髄、精巣上体精子および肝臓で陽性だが、脳および小腸で陰性。発がん標的臓器は、腎、肺および胸腺。
- ID C457, 3-methylcholanthrene  
TGR は、肝臓で陽性。発がん標的臓器は、肺、および胸腺。
- ID C492, Mitomycin C  
TGR は、骨髄および肝臓で陽性だが、小腸および精巣で陰性。発がん標的臓器は、小腸、乳腺および腹腔。

- ID C702, Thio-tepa  
TGR は、脾臓リンパ細胞で陽性。発がん標的臓器は、耳/ジンバル腺、造血系、皮膚、乳腺および包皮腺。

-( TGR陰性だが発がん標的部位ではない )

- ID C17, Acrylonitrile  
TGR は、骨髄、脳、肺および脾臓リンパ細胞および精巣生殖細胞で陰性。発がん標的臓器は、耳/ジンバル腺、神経系、口腔、小腸、乳腺および鼻腔。
- ID C257, 1,2-Dichloroethane  
TGR は、肝臓および精巣で陰性。発がん標的臓器は、胃、皮下組織、血管系、乳腺、肺および子宮。
- ID C489, Metronidazole  
TGR は、胃で陰性。発がん標的臓器は、下垂体、精巣、肝、乳腺、肺および造血系。
- ID C683, SX Purple  
TGR は、肝臓および胃で陰性。Carcinogenic Potency Database では、明確な発がん標的臓器は示されていない。

## C.2. 感受性・特異性解析

Ames および in vitro CA の感受性、特異性および一致性を表 3 に示す。E ( 不明確 ) を陽性にも陰性にも計数しなかった場合、Ames の感受性は 59.0% ( 321/544 )、特異性は 73.9% ( 130/176 )、一致性は 62.6% ( 451/720 ) であった。In vitro CA では、それぞれ 62.8%( 225/658 ) 48.5%( 66/136 ) および 58.9%( 291/494 ) であった。で良好といえるものではなかった。これらの値はカークランドらによる最初の CGX DB に基づく報告と同様であった ( Ames ではそれぞれ 58.8%、73.9% および 62.5%、in vitro CA ではそれぞれ 65.6%、44.9% および 59.8% )。In vivo MN および in vivo TGR

の感受性、特異性および一致性を表 2 に示す。E ( 不明確 ) を陽性にも陰性にも計数しなかった場合、in vivo MN の感受性は 41.0%( 120/293 )、特異性は 60.5%( 52/86 )、一致性は 45.4% ( 172/379 ) であった。一方、in vivo TGR の感受性は、72.4%( 55/76 ) と比較的高いものであった。なお、in vivo TGR においては、非発がん物質に対するデータが合計 4 件と極めて少なかったため、特異性ならびに一致性については計算しなかった。

また、Ames と in vitro CA を組合せた場合の感受性および特異性をそれぞれ表 4 および表 5 に示した。発がん物質について Ames と in vitro CA の両試験を実施して、少なくとも 1 つの試験で陽性となる感受性は 74.3% であった。一方、非発がん物質について Ames と in vitro CA の両試験を実施して、両方の試験で陰性となる特異性は 37.5% であった。Ames と in vivo MN を組合せた場合の感受性および特異性をそれぞれ表 6 および表 7 に示した。発がん物質について Ames と in vivo MN の両試験を実施した場合の感受性 ( 少なくとも 1 つ試験で陽性 ) は 68.7% で、カークランドらが 2005 年に報告した Ames と他の in vitro 試験 ( MLA, in vitro MN, in vitro CA ) との組合せによる感受性の 75.3% ~ 81.0% に比べると低かった。一方、非発がん物質について Ames と in vivo MN の両試験を実施した場合の特異性 ( 両方の試験で陰性 ) は 45.3% で、Ames と他の in vitro 試験との組合せによる特異性の 12.0% ~ 34.6% に比べると高かった。Ames と in vivo TGR を組合せた場合の感受性を表 8 に示した。Ames + in vivo TGR の感受性は高く、83.8% であった。特異性は、非発がん物質のデータが極めて少ないため、算出しなかった。これらをもとに、Ames、in vitro CA、in vivo MN あるいは in vivo TGR のうち、Ames を含む 3

あるいは4試験の組合せによる感受性を算出した(表9)。3試験の組合せによる感受性は、Ames + in vitro CA + in vivo MNで80.8%、Ames + in vitro CA + in vivo TGRで89.1%、Ames + in vivo MN + in vivo TGRで87.5%であった。また4試験すべての組合せ(Ames + in vitro CA + in vivo MN + in vivo TGR)では89.3%であった。3あるいは4試験の組合せによる特異性は、Ames + in vitro CA + in vivo MNでのみ算出されたが、21.3%と低いものであった(表10)。

### C.3. In vitro – in vivo 試験間の比較

CGX DBではin vitro MNのデータが収載されているが、発がん物質に対する試験データ数は89件であり、in vitro CAの352件に比べ圧倒的に少ない。そこで、in vivo MNに対する染色体異常を指標とするin vitro試験との比較においてはin vitro CAを選択した。In vivo MNとin vitro CAの一致性を表11に示した。両試験の一致性は50.3%(151/300)であった。多くの物質(70の発がん物質と21の非発がん物質)がin vitro CAで陽性、in vivo MNで陰性を示す一方、27物質(17の発がん物質および10の非発がん物質、表12)がin vitro CAで陰性、in vivo MNで陽性を示した。また、CGX DBでは遺伝子突然変異を指標とするin vitro試験としてAmes試験とMLAのデータが収載されている。MLAは遺伝子突然変異に加え染色体異常誘発性をも検出可能な試験系とされていることから、Ames試験をin vivo TGRの対照in vitro試験として選択した。In vivo TGRとAmesの一致性を表13に示した。評価対象物質数はin vivo MNと比べ少ないものの、高い一致性(79.5%、62/78)を示した。Amesにおける不明確(E)の1物質を除く15物質が不一致となり、そのうち、5つの発がん物質

がAmesで陰性だがTGRで陽性、8つの発がん物質がAmesで陽性だがTGRで陰性、2つの非発がん物質がAmesで陽性だがTGRで陰性を示した(表14)。

### D. 考察

CGX DBの化学物質セットについて、in vivo MNとin vivo TGRのデータを収集・解析した結果を表15および図1に要約した。In vivo MNの感受性は41.0%、特異性は60.5%、in vivo TGRの感受性は72.9%であった(特異性は、非発がん物質に対するTGRのデータが極めて少なかったため、評価しなかった)。In vivo MNの感受性は、カーランドらによるin vitro試験の報告(Ames 58.8%、MLA 73.1%、MN 78.7%、CA 65.6%)と比較して低いものであったが、一方、特異性はAmesに次いで高いものであった(Ames 73.9%、MLA 39.0%、MN 30.8%、CA 44.9%)。また、Amesとin vivo MNを組合せた場合の感受性は68.7%、特異性は45.3%を示し、一般的なin vitro試験の組合せであるAmes + in vitro CAの感受性74.3%、特異性37.5%と同程度であった。ICHにおける医薬品の遺伝毒性試験の組合せにおけるオプション2(Ames試験および2種のin vivo試験、1種は通常in vivo MN)において検討される可能性のあるAmes + in vivo MN + in vivo TGRは高い感受性(87.5%)を示し、ICHのオプション1であるAmes + in vitro CA + in vivo MNの感受性(80.8%)よりも若干高かった。オプション1でin vitro陽性の場合に想定される4試験の組合せであるAmes + in vitro CA + in vivo MN + in vivo TGRの感受性も同様に高かった(89.3%)。これらの知見は、2つめのin vivo試験を適切に選択すれば、オプション2は、オプション1と同様、発がん物質の検出に有効に働くことを示唆している。In vivo TGRの感受性

(72.9%)はAmes(58.8%)よりも高く、偽陽性が多いとされるin vitro哺乳類細胞試験(65.6%~78.7%)と同程度であった。TGRをより適切に利用するためには、発がん性との比較において、発がん標的臓器と遺伝子突然変異標的臓器の相違の要因、例えば、動物種、系統、投与期間、投与経路、ならびにそれらに関連する化学物質の吸収や代謝について検討することが必要と考えられる。

In vivo – in vitro 試験間の比較では、Amesとin vivo TGRの一致性は79.5%、in vitro CAとin vivo MNの一致性は50.3%であった。In vivo MNは、ジアルキルニトロソ化合物、金属化合物、芳香族アミン類、ハロゲン化合物に対する感受性が低いことが示されているが、in vitro 陰性だがin vivo 陽性となる物質(体温変化などの遺伝毒性メカニズムによらないin vivo 陽性を除く)の特徴やそのメカニズムの検証が必要である。In vivo – in vitro 試験間のそれぞれの比較において、不一致を示した化学物質の特性等の解明が、より精度の高いQSARの開発につながるものと考えられる。

#### **E. 結論**

CGX DBを利用し、これまでにない大規模なin vivo 遺伝毒性試験(in vivo MNおよびin vivo TGR)のデータベース(拡張CGX DB)を構築した。構築したデータベースをもとに感受性および特異性を評価した結果、in vivo MNの感受性は41.0%、特異性は60.5%、in vivo TGRの感受性は72.4%であった。試験を組合せた場合の感受性/特異性は、Ames + in vivo MNで68.7%/45.3%で、Ames + in vitro CAの74.3%/37.5%と同程度であり、また、Ames + in vivo TGRでは83.8%/ncと、高い感受性を示した。また、in vivo MNとin vitro

CAの一致性は50.3%、in vivo TGRとAmesの一致性は79.5%であった。これらのin vivo 知見あるいはin vitro/in vivo 試験間の相違に関する知見を(定量的)構造活性相関(QSAR)に紐込むことが精度向上に必要と考えられた。

#### **F. 健康危機情報**

なし

#### **G. 研究発表**

##### **論文発表**

T. Morita, Y. Uno, M. Honma, H. Kojima, M. Hayashi, R.R. Tice, R. Corvi, L. Schechtman, The JaCVAM International Validation Study on the in vivo Comet Assay: Selection of Test Chemicals, Mutation Research 786–788 (2015) 14–44.

Y. Uno, H. Kojima, T. Omori, R. Corvi, M. Honma, L.M. Schechtman, R.R. Tice, B. Burlinson, P. Escobar, A.R. Kraynak, Y. Nakagawa, M. Nakajim, K. Pant, N. Asano, D. Lovell, T. Morita, Y. Ohno, M. Hayashi, JaCVAM-organized international validation study of the in vivo rodent alkaline comet assay for the detection of genotoxic carcinogens: I. Summary of pre-validation study results, Mutation Research 786–788 (2015) 3–13.

Y. Uno, H. Kojima, T. Omori, R. Corvi, M. Honma, L.M. Schechtman, R.R. Tice, C. Beevers, M. De Boeck, B. Burlinson, C.A. Hobbs, S. Kitamoto, A.R. Kraynak, J. McNamee, Y. Nakagawa, K. Pant, U. Plappert-Helbig, C. Priestley, H. Takasawa, K. Wada, U. Wirnitzer, N. Asano, P. Escobar, D. Lovell, T. Morita, M.

Nakajim, Y. Ohno, M. Hayashi,  
JaCVAM-organized international  
validation study of the in vivo rodent  
alkaline comet assay for detection of  
genotoxic carcinogens: II. Summary of  
definitive validation study results,  
Mutation Research 786–788 (2015)  
45–76.

S. Hamada, W. Ohyama, R. Takashima, K.  
Shimada, K. Matsumoto, S. Kawakami, F.  
Uno, H. Sui, Y. Shimada, T. Imamura, S.  
Matsumura, H. Sanada, K. Inoue, S.  
Muto, I. Ogawa, A. Hayashi, T.  
Takayanagi, Y. Ogiwara, A. Maeda, E.  
Okada, Y. Terashima, H. Takasawa, K.  
Narumi, Y. Wako, K. Kawasako, M. Sano,  
N. O., T. Morita, H. Kojima, M. Honma,  
M. Hayashi, Evaluation of the  
repeated-dose liver and gastrointestinal  
tract micronucleus assays with 22  
chemicals using young adult rats:  
Summary of the collaborative study by  
the Collaborative Study Group for the  
Micronucleus Test (CSGMT)/The  
Japanese Environmental Mutagen  
Society (JEMS) – Mammalian  
Mutagenicity Study Group (MMS),  
Mutation Research 780-781 (2015) 2–17.

森田 健 , LD50 値による毒性評価手法の  
変遷 , 中毒研究 , 28, 388-391, 2015.

J.T. MacGregor, R. Frötschl, P.A. White,  
K.S. Crump, D.A. Eastmond, S.  
Fukushima, M. Guérard, M. Hayashi, L.  
Soeteman-Hernandez, T. Kasamatsu, D.  
Levy, T. Morita, L. Müller, R. Schoeny,  
M.J. Schuler, V. Thybaud, G.E. Johnson,  
IWGT Report on Quantitative

Approaches to Genotoxicity Risk  
Assessment I. Methods and metrics for  
defining exposure-response relationships  
and points of departure (PoDs), Mutation  
Research 783 (2015) 55–65.

J.T. MacGregor, R. Frötschl, P.A. White,  
K.S. Crump, D.A. Eastmond, S.  
Fukushima, M. Guérard, M. Hayashi, L.  
Soeteman-Hernandez, G.E. Johnson, T.  
Kasamatsu, D.D. Levy, T. Morita, L.  
Müller, R. Schoeny, M.J. Schuler, V.  
Thybaud, IWGT report on quantitative  
approaches to genotoxicity risk  
assessment II. Use of point-of-departure  
(PoD) metrics in defining acceptable  
exposure limits and assessing human  
risk, Mutation Research 783 (2015)  
66–78.

Y. Uno, T. Morita, M. Luijten, C. Beevers,  
S. Hamada, S. Itoh, W. Ohyama, H.  
Takasawa, Recommended protocols for  
the liver micronucleus test: report of the  
IWGT working group, Mutation Research  
783 (2015) 13–18.

Y. Uno, T. Morita, M. Luijten, C. Beevers,  
S. Hamada, S. Itoh, W. Ohyama, H.  
Takasawa, Micronucleus test in rodent  
tissues other than liver or erythrocytes:  
report of the IWGT working group,  
Mutation Research 783 (2015) 19–22.

○S. Canipa, A. Cayley, W.C. Drewe, R.V.  
Williams, S. Hamada, A. Hirose, M.  
Honma, T. Morita, Using in vitro  
structural alerts for chromosome damage  
to predict in vivo activity and direct  
future testing, Mutagenesis, 31, 17-25,



2016.

○T. Morita, S. Hamada, K. Masumura, A. Wakata, J. Maniwa, H. Takasawa, K. Yasunaga, T. Hashizume, M. Honma, Evaluation of the sensitivity and specificity of in vivo erythrocyte micronucleus and transgenic rodent gene mutation tests to detect rodent carcinogens, Mutation Research, 802 (2016) 1-29.

#### 学会発表

T. Morita, GHS classification of CMR substances in EU and Japan, AsiaTox 2015、済州島、韓国、2015年6月23-26日。

森田 健、CMR物質のGHS分類比較：EUと日本、第42回日本毒性学会、金沢、2015年6月29日-7月1日。

森田 健、LD50値による毒性評価と行政利用、第37回日本中毒学会合同シンポジウム、和歌山、2015年7月17-18日。

○T. Morita, S. Hamada, K. Masumura, M. Honma, Detection of rodent carcinogens and non-carcinogens by in vivo erythrocyte micronucleus and transgenic rodent mutation tests, EEMS 2015, 23-27 August 2015, Prague, Czech Republic.

S. Hamada, T. Morita, K. Narumi, Y. Wako, K. Kawasaki, W. Ohyama, M. Honma, M. Hayashi, Detection of hepatocarcinogens by combination of liver micronucleus assay and

histopathological examination in 2-week or 4-week repeated dose studies, 46th Annual EMGS (Environmental Mutagenesis and Genomics Society) meeting, September 26-30, 2015, New Orleans, Louisiana.

Horibata K, Yamada M, Ukai A, Kimoto T, Chikura S, Miura D, Itoh S, Muto S, Uno Y, Sanada H, Takashima R, Shigano M, Takasawa H, Hamada S, Yamamoto M, Hori H, Tsutsumi E, Wada K, Maeda A, Kikuzuki R, Ogiwara Y, Kyoya T, Adachi H, Uematsu Y, Yoshida I, Narumi K, Fujiishi Y, Fukuda T, Suzuki Y, Goto K, Morita T, Honma M, Interlaboratory Trial of the PIGRET Assay As a Short-term Genotoxicity Test: Collaborative Study by Mammalian Mutagenicity Study (MMS) Group of Japanese Environmental Mutagen Society (JEMS). 46th Annual EMGS (Environmental Mutagenesis and Genomics Society) meeting, September 26-30, 2015, New Orleans, Louisiana.

Hamada S, Morita T, Narumi K, Wako Y, Kawasaki K, Ohyama W, Honma M, Hayashi M, Detection of hepatocarcinogens by combination of liver micronucleus assay and histopathological examination in 2-week or 4-week repeated dose studies, 46th Annual EMGS (Environmental Mutagenesis and Genomics Society) meeting, September 26-30, 2015, New Orleans, Louisiana.

濱田修一, 森田健, 成見香瑞範, 涌生ゆみ, 川迫一史, 大山ワカ子, 本間正充, 林真, 4週間の反復投与毒性試験結果(肝臓小核試験および病理組織学的検査)から肝発がん性を予測する、関西実験動物研究会第128回研究会、平成27年12月4日(金) 京都大学楽友会館。

○増村健一、森田健、本間正充、トランスジェニック動物遺伝子突然変異試験におけるin vivo変異原性と発がん性の相関に関する研究、第74回日本癌学会学術総会、2015年10月8日~10日、名古屋国際会議場。

○森田健、濱田修一、増村健一、本間正充、In vivo赤血球小核試験とトランスジェニック齧歯類突然変異試験による齧歯類発がん物質の検出、日本環境変異原学会第44回大会、2015年11月27~28日、九州大学。

森田健、畝山智香子、カラメル色素中の4-メチルイミダゾールのリスク評価、日本環境変異原学会第44回大会、2015年1月27~28日、九州大学。

堀端克良, 山田雅巳, 鶴飼明子, 木本崇文, 千藏さつき, 三浦大志郎, 伊東悟, 武藤重治, 宇野芳文, 真田尚和, 高島理恵, 志賀野美幸, 高沢博修, 濱田修一, 山本美佳, 堀妃佐子, 堤絵梨, 和田邦生, 前田晃央, 菊月隆太, 荻原庸介, 京谷恭弘, 足立秀樹, 上松泰明, 吉田唯真, 成見香瑞範, 藤石洋平, 福田隆之, 鈴木裕太, 後藤玄, 森田健, 本間正充、PIGRETアッセイの短期試験としての有用性: MMS共同研究報告、日本環境変異原学会第44回大会、2015年11月27~28日、九州大学。

本田大士、藤田侑里香、松村奨士、川本泰輔、伊藤勇一、森田健、西山直宏、染

色体異常試験の陽性物質リストから有用な偽陽性原料を救え II、数学的手法を用いた大規模遡及評価、日本環境変異原学会第44回大会、2015年11月27~28日、九州大学。

公刊図書・書籍

なし

#### H. 知的財産権の出願・登録状況

なし

表1 In vivo 小核試験データの収集に用いた主な資料

<p><b>レビュー論文</b></p> <ul style="list-style-type: none"> <li>➤ Mavournin et al (1990) The in vivo micronucleus assay in mammalian bone marrow and peripheral blood. A report of the U.S. Environmental Protection Agency Gene-Tox Program. <i>Mutat Res.</i> 239, 29-80.</li> <li>➤ Kirkland et al (2008) Recommended lists of genotoxic and non-genotoxic chemicals for assessment of the performance of new or improved genotoxicity tests: a follow-up to an ECVAM workshop. <i>Mutat Res.</i> 653, 99-108.</li> <li>➤ Kirkland et al (2008) Evaluation of the ability of a battery of three in vitro genotoxicity tests to discriminate rodent carcinogens and non-carcinogens III. Appropriate follow-up testing in vivo. <i>Mutat Res.</i> 654, 114-132.</li> <li>➤ Kirkland et al (2011) A core in vitro genotoxicity battery comprising the Ames test plus the in vitro micronucleus test is sufficient to detect rodent carcinogens and in vivo genotoxins. <i>Mutat Res.</i> 721, 27-73.</li> </ul> <p><b>大規模試験報告書</b></p> <ul style="list-style-type: none"> <li>➤ Shelby et al (1993) Evaluation of a three-exposure mouse bone marrow micronucleus protocol: results with 49 chemicals. <i>Environ Mol Mutagen</i>, 21, 160-179.</li> <li>➤ Morita et al (1997) Evaluation of the rodent micronucleus assay in the screening of IARC carcinogens (Groups 1, 2A and 2B). The summary report of the sixth collaborative study by CSGMT/JEMS-MMS. <i>Mutat Res.</i> 389, 3-122.</li> <li>➤ Wakata et al (1998) Evaluation of the rat micronucleus test with bone marrow and peripheral blood: summary of the 9th collaborative study by CSGMT/JEMS. <i>Environ Mol Mutagen.</i> 32, 84-100.</li> <li>➤ Witt et al (2000) Micronucleated Erythrocyte Frequency in Peripheral Blood of B6C3F1 Mice from Short-Term, Prechronic, and Chronic Studies of the NTP Carcinogenesis Bioassay Program. <i>Environ. Mol. Mutagen.</i> 36, 163-194.</li> <li>➤ Hamada et al (2001) Evaluation of the rodent micronucleus assay by a 28-day treatment protocol: Summary of the 13th collaborative study group for the micronucleus test (CSGMT)/Environmental Mutagen Society of Japan (JEMS)-Mammalian Mutagenicity Study Group (MMS). <i>Environ Mol Mutagen</i> 37, 93-110.</li> </ul> <p><b>国際的化学品評価文書</b></p> <ul style="list-style-type: none"> <li>➤ EU RAR: EU RAR Search, <a href="http://esis.jrc.ec.europa.eu/index.php?PGM=ora">http://esis.jrc.ec.europa.eu/index.php?PGM=ora</a></li> <li>➤ SIDS: SIDS Search, <a href="http://www.chem.unep.ch/irptc/sids/OECD/SIDS/sidspub.html">http://www.chem.unep.ch/irptc/sids/OECD/SIDS/sidspub.html</a> OR ↓ OECD Existing Chemicals Database Search, <a href="http://webnet.oecd.org/hpv/UI/Search.aspx">http://webnet.oecd.org/hpv/UI/Search.aspx</a></li> <li>➤ EHC, CICAD, IARC: IPCS INCHEM Search, <a href="http://www.inchem.org/">http://www.inchem.org/</a></li> </ul> <p><b>NTP データサーチ</b></p> <ul style="list-style-type: none"> <li>➤ NTP Database Search Home Page, <a href="http://tools.niehs.nih.gov/ntp_tox/">http://tools.niehs.nih.gov/ntp_tox/</a></li> </ul> <p><b>PubMed 文献サーチ</b></p> <ul style="list-style-type: none"> <li>➤ PubMed: <a href="http://www.ncbi.nlm.nih.gov/pubmed/">http://www.ncbi.nlm.nih.gov/pubmed/</a> (検索語: CAS 番号あるいは化学物質名、micronucle*, rodent)</li> </ul>
---

**表 2 In vivo MN および in vivo TGR の感受性および特異性**

Carcinogenicity	<i>in vivo</i> MN				TGR			
	+	E	-	Total	+	E	-	Total
+	120	11	162	293	55	0	21	76
-	24	10	52	86	0	0	4	4
Total	144	21	214	379	55	0	25	80
Sensitivity <sup>a</sup>	41.0% (120/293)				72.4% (55/76)			
Specificity <sup>a</sup>	60.5% (52/86)				Not calculated due to small numbers of non-carcinogens			
Concordance <sup>a</sup>	45.4% (172/379)				Not calculated			

+, Positive; -, Negative; E, Equivocal

a: Equivocal (E) results were not counted either as positive or negative, but they were included in the total number.

If E results are considered positive, the performance is as follows:

*in vivo* MN: sensitivity, 44.7% (131/293); specificity, 60.5% (52/86), concordance, 48.3% (183/379)

If E results are considered negative, the performance is as follows:

*in vivo* MN: sensitivity, 41.0% (120/293); specificity, 72.1% (62/86), concordance, 48.0% (182/379)

**表 3 Ames および in vitro CA の感受性および特異性**

Carcinogenicity	Ames				<i>in vitro</i> CA			
	+	E	-	Total	+	E	-	Total
+	321	8	215	544	225	15	118	358
-	40	6	130	176	56	14	66	136
Total	361	14	345	720	281	29	184	494
Sensitivity <sup>a</sup>	59.0% (321/544)				62.8% (225/358)			
Specificity <sup>a</sup>	73.9% (130/176)				48.5% (66/136)			
Concordance <sup>a</sup>	62.6% (451/720)				58.9% (291/494)			

+, Positive; -, Negative; E, Equivocal

a: Equivocal (E) results were not counted either as positive or negative, but they were included in the total number.

If E results are considered positive, the performance is as follows:

Ames: sensitivity, 60.5% (329/544); specificity, 73.9% (130/176), concordance, 63.8% (459/720)

*in vitro* CA: sensitivity, 67.0% (240/358); specificity, 48.5% (66/136), concordance, 61.9% (306/494)

If E results are considered negative, the performance is as follows:

Ames: sensitivity, 59.0% (321/544); specificity, 77.3% (136/176), concordance, 63.5% (457/720)

*in vitro* CA: sensitivity, 62.8% (225/358); specificity, 58.8% (80/136), concordance, 61.7% (305/494)

**表 4 Ames と in vitro CA の組合せにおける感受性**

Ames	<i>in vitro</i> CA			Total
	+	E	-	
+	149	8	35	192
E	5	0	2	7
-	63	7	81	151
Total	217	15	118	350

No. of carcinogens tested in both tests (A): 350

No. (%) of clear positive results in both tests (B): 149 (42.6%)

No. (%) of clear positive results in only 1 of the two tests (C): 111 (31.7%)

Sensitivity (i.e., clearly positive in at least 1 test when both conducted ( $(B+C)/A$ )<sup>a</sup>: 74.3%

+, Positive; -, Negative; E, Equivocal

a: If E results are considered positive, the sensitivity is 76.9% (269/350).

**表 5 Ames と in vitro CA の組合せにおける特異性**

Ames	<i>in vitro</i> CA			Total
	+	E	-	
+	19	2	15	34
E	3	0	2	5
-	34	12	51	97
Total	56	14	66	136

No. of non-carcinogens tested in both tests (A): 136

No. of clear negative results in both tests (B): 51

Specificity (B/A)<sup>a</sup>: 37.5%

+, Positive; -, Negative; E, Equivocal

a: If E results are considered negative, the specificity is 47.8% (65/136).

**表 6 Ames と in vivo MN の組合せにおける感受性**

Ames	<i>in vivo</i> MN			Total
	+	E	-	
+	79	7	73	159
E	2	0	2	4
-	34	4	83	121
Total	115	11	158	284

No. of carcinogens tested in both tests (A): 284

No. (%) of clear positive results in both tests (B): 79 (27.8%)

No. (%) of clear positive results in only 1 of the two tests (C): 116 (40.8%)

Sensitivity (i.e., clearly positive in at least 1 test when both conducted ( $(B+C)/A$ )<sup>a</sup>): 68.7%

+, Positive; -, Negative; E, Equivocal

a: If E results are considered positive, the sensitivity is 70.8% (201/284).

**表 7 Ames と in vivo MN の組合せにおける特異性**

Ames	<i>in vivo</i> MN			Total
	+	E	-	
+	6	2	11	19
E	2	0	2	4
-	16	8	39	63
Total	24	10	52	86

No. of non-carcinogens tested in both tests (A): 86

No. of clear negative results in both tests (B): 39

Specificity ( $B/A$ )<sup>a</sup>: 45.3%

+, Positive; -, Negative; E, Equivocal

a: If E results are considered negative, the specificity is 60.0% (49/86).

**表 8 Ames と in vivo TGR の組合せにおける感受性**

Ames	TGR			Total
	+	E	-	
+	48	0	8	56
E	1	0	0	1
-	5	0	12	17
Total	54	0	20	74

No. of carcinogens tested in both tests (A): 74

No. (%) of clear positive results in both tests (B): 48 (64.9%)

No. (%) of clear positive results in only 1 of the two tests (C): 14 (18.9%)

Sensitivity (i.e., clearly positive in at least 1 test when both conducted ( $[B+C]/A$ )<sup>a</sup>): 83.8%

+, Positive; -, Negative; E, Equivocal

a: If E results are considered positive, the sensitivity is 83.8% (62/74).

**表 9 3 試験あるいは 4 試験の組合せにおける感受性**

	Test combination			
	Ames + <i>in vitro</i> CA+ <i>in vivo</i> MN	Ames + <i>in vitro</i> CA + TGR	Ames + <i>in vivo</i> MN + TGR	Ames + <i>in vitro</i> CA+ <i>in vivo</i> MN + TGR
No. of carcinogens tested in all three or four test systems	224	64	64	56
No. (%) of clear positive results in all three or four test systems	51/224 (22.8%)	36/64 (56.3%)	31/64 (48.4%)	25/56 (44.6%)
No. (%) of clear positive results in one or two of the three assays	130/224 (58.0%)	21/64 (32.8%)	25/64 (39.1%)	Not applicable
No. (%) of clear positive results in one, two or three of the four assays	Not applicable	Not applicable	Not applicable	25/56 (44.6%)
Sensitivity (i.e., clearly positive in at least one assay when all three or four conducted) <sup>a</sup>	181/224 (80.8%)	57/64 (89.1%)	56/64 (87.5%)	50/56 (89.3%)

a: If equivocal results are considered positive, the sensitivity of the combination of

Ames + *in vitro* CA + *in vivo* MN is 83.0% (186/224). The sensitivities of other test combinations are not changed.

**表 10 3 試験あるいは 4 試験の組合せにおける特異性**

	Test combination			
	Ames + <i>in vitro</i> CA+ <i>in vivo</i> MN	Ames + <i>in vitro</i> CA + TGR	Ames + <i>in vivo</i> MN + TGR	Ames + <i>in vitro</i> CA+ <i>in vivo</i> MN + TGR
No. of non-carcinogens tested in all three or four test systems (A)	75	4	3	3
No. (%) of clear negative results in all three or four test systems (B)	16	0	1	0
Specificity (B/A) <sup>a</sup>	16/75 (21.3%)	Not calculated	Not calculated	Not calculated

a: If equivocal results are considered negative, the specificity is 29.3% (22/75).

**表 11 In vitro CA と in vivo MN の一貫性**

<i>in vitro</i> CA	<i>in vivo</i> MN			Total
	+ (C, NC)	E (C, NC)	- (C, NC)	
+	82 (72, 10)	12 (6, 6)	91 (70, 21)	185
E	3 (1, 2)	0 (0, 0)	12 (7, 5)	15
-	27 (17, 10)	4 (3, 1)	69 (49, 20)	100
Total	112 (90, 22)	16 (9, 7)	172 (126, 46)	300
Concordance <sup>a</sup>	50.3% (151/300)			

+, Positive; -, Negative; E, Equivocal; C, Carcinogens; NC, Non-carcinogens

a: Equivocal (E) results not counted either as positive or negative, but they were included in the total number.

If E results are considered positive, the concordance is 55.3% (166/300).

If E results are considered negative, the concordance is 55.7% (167/300).



表 12 In vitro CA (陰性) と in vivo MN (陽性) 間で結果が不一致となった物質

ID	Chemical	Chemical Grouping	CAS	Carcino-genicity	<i>in vitro</i> CA	<i>in vivo</i> MN
C179	Chlorpromazine hydrochloride	Aromatic amine or amide	69-09-0	+	-	+a
C185	C.I. Direct black 38	Aromatic azo compound	1937-37-7	+	-	+
C198	C.I. Solvent yellow 14	Aromatic azo compound	842-07-9	+	-	+
C217	D&C Red 9	Aromatic azo compound	5160-02-1	+	-	+
C226	Decabromodiphenyl oxide	Polyhalogenated aromatic	1163-19-5	+	-	+
C240	Diazepam	Aromatic amine or amide	439-14-5	+	-	+
C277	3,4-Dihydrocoumarin	Glycidyl ether, amine, ester or amide	119-84-6	+	-	+
C305	Dimethylvinyl chloride	Halogenated alkene	513-37-1	+	-	+
C425	Isoprene	Alkene	78-79-5	+	-	+
C645	Procarbazine HCl	Mono- or di-alkylhydrazine	366-70-1	+	-	+
C660	Reserpine	Phenol or precursor	50-55-5	+	-	+b
C691	1,1,2,2-Tetrachloroethane	Gem-dihalide	79-34-5	+	-	+
C705	Titanium dioxide	Alkali, alkali earth, metal salt	13463-67-7	+	-	+
C706	Toluene	Benzene	108-88-3	+	-	+
C734	Trimethylphosphate	Alkyl ester of phosphoric or phosphonic acid	512-56-1	+	-*	+
C738	Tris(2-chloroethyl)phosphate	Alkylating agent	115-96-8	+	-	+
C744	Urethane	Alkyl carbamate	51-79-6	+	-*	+
NC8	dl-Amphetamine sulfate	Amine	60-13-9	-	-	+
NC13	L-Ascorbic acid	Carboxylic acid	50-81-7	-	-	+
NC49	Deltamethrin	Halogenated alkene	52918-63-5	-	-	+
NC59	1,1-Dichloroethane	Gem-dihalide	75-34-3	-	-	+
NC119	Methyl parathion	Alkyl ester of phosphoric or phosphonic acid	298-00-0	-	-	+
NC120	Monochloroacetic acid	Alkylating agent	79-11-8	-	-	+
NC133	Oxytetracycline HCl	Substituted vinyl ketone	2058-46-0	-	-	+
NC152	Resorcinol	Resorcinol or precursor	108-46-3	-	-*	+
NC173	Tolbutamide	Aryl sulphonamide	64-77-7	-	-	+
NC178	Triphenyltin hydroxide	Alkali, alkali earth, metal salt	76-87-9	-	-	+

\*: positive response at both >10 mM and 2 mg/mL.

a: due to hypothermia

b: mice, due to hypothermia; negative in rat

**表 13 Ames と in vivo TGR の一致性**

Ames	TGR			Total
	+ (C, NC)	E (C, NC)	- (C, NC)	
+	48 (48, 0)	0 (0, 0)	10 (8, 2)	58
E	1 (1, 0)	0 (0, 0)	0 (0, 0)	1
-	5 (5, 0)	0 (0, 0)	14 (12, 2)	19
Total	54 (54, 0)	0 (0, 0)	24 (12, 2)	78
Concordance <sup>a</sup>	79.5% (62/78)			

+, Positive; -, Negative; E, Equivocal; C, Carcinogens; NC, Non-carcinogens

a: Equivocal (E) results were not counted either as positive or negative, but they were included in the total number.

If E results are considered positive, the concordance is 80.8% (63/78).

If E results are considered negative, the concordance is 79.5% (62/78).

表 14 Ames と in vivo TGR 間で結果が不一致となった物質

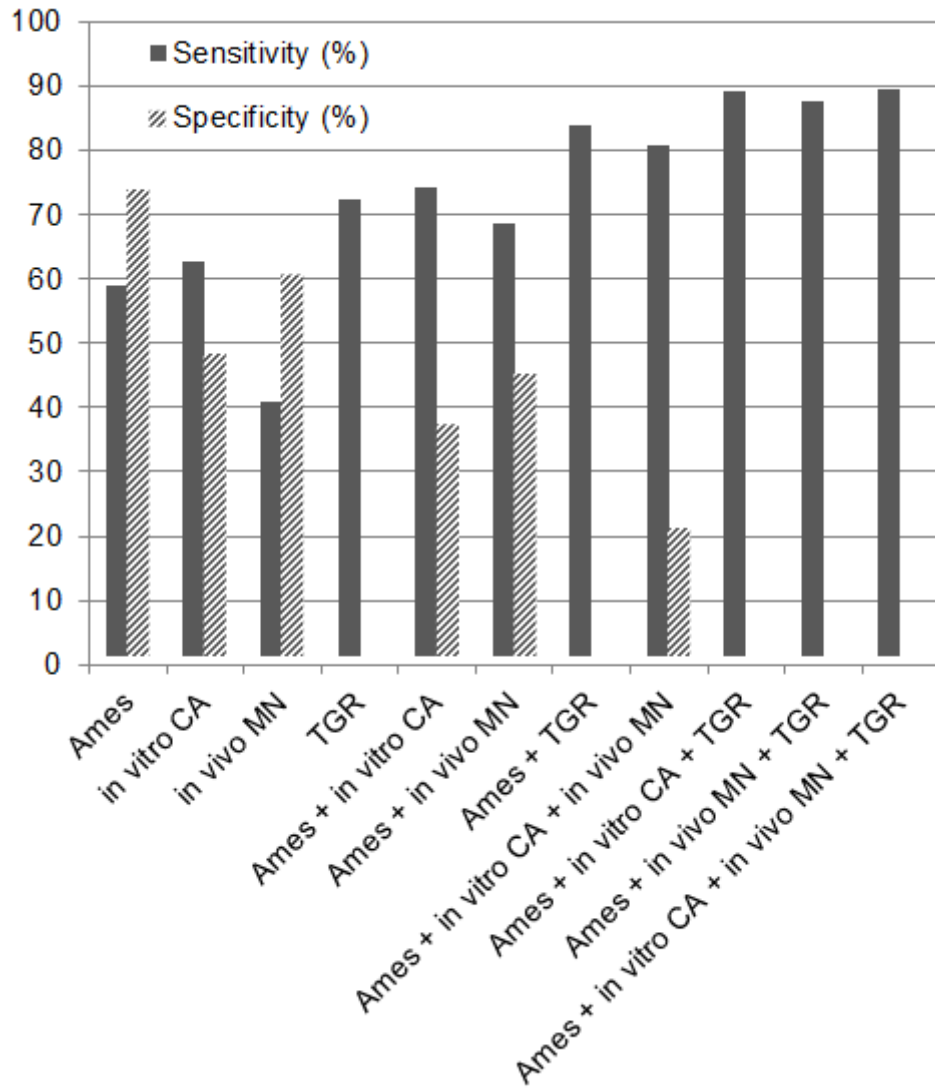
ID	Chemical	Chemical Grouping	CAS	Carcinogenicity	Ames	TGR
C84	Benzene	Benzene	71-43-2	+	-	+
C384	Hexachlorobutadiene	Halogenated alkene	608-73-1	+	-	+
C605	Oxazepam	Aromatic amine or amide	604-75-1	+	-	+
C645	Procarbazine HCl	Mono- or di-alkylhydrazine	366-70-1	+	-	+
C742	Uracil	Substituted pyrimidine or purine	66-22-8	+	-	+
C17	Acrylonitrile	Alpha-, beta-unsaturated nitrile	107-13-1	+	+	-
C137	Carbon tetrachloride	Halogenated methane	56-23-5	+	+	-
C160	Chloroform	Halogenated methane	67-66-3	+	+	-
C257	1,2-Dichloroethane	vic-Dihalide	107-06-2	+	+	-
C395	Hydrazine sulphate	Hydrazine or monoacyl- or monosulphonyl-hydrazine	10034-93-2	+	+	-
C489	Metronidazole	Aromatic nitro compound	443-48-1	+	+	-
C509	Nitrite, sodium	Alkyl nitrite, nitrous acid or nitrite salt	7632-00-0	+	+	-
C622	Phenobarbital	(Thio)urea	50-06-6	+	+	-
NC52	2,6-Diaminotoluene 2HCl	Aromatic amine or amide	15481-70-6	-	+	-
NC126	1-Nitronaphthalene	Aromatic nitro compound	86-59-7	-	+	-

表 15 各試験単独およびそれらの組合せによる感受性および特異性の要約表

Measure	Ames	<i>in vitro</i> CA	<i>in vivo</i> MN	TGR	Ames + <i>in vitro</i> CA	Ames + <i>in vivo</i> MN	Ames + TGR	Ames + <i>in vitro</i> CA + <i>in vivo</i> MN	Ames + <i>in vitro</i> CA + TGR	Ames + <i>in vivo</i> MN + TGR	Ames + <i>in vitro</i> CA + <i>in vivo</i> MN + TGR
Sensitivity (%)	59.0	62.8	41.0	72.4	74.3	68.7	83.8	80.8	89.1	87.5	89.3
Specificity (%)	73.9	48.5	60.5	NC	37.5	45.3	NC	21.3	NC	NC	NC
Concordance (%)	62.6	58.9	45.4	NC	NA	NA	NC	NA	NA	NA	NA

NC: Not calculated  
NA: Not applicable

図1 各試験単独およびそれらの組合せによる感受性および特異性の要約図



Appendix 1: Genotoxicity test results with rodent carcinogens								
ID	Chemical	CAS No.	Ames	<i>in vitro</i> CA	<i>in vivo</i> MN	<i>in vivo</i> MN Ref.	TGR	TGR Ref.
C1	Acetaldehyde	75-07-0	-	+	+	[11]		
C2	Acetaldehyde methylformylhydrazone	16568-02-8	-					
C3	Acetamide	60-35-5	-		-	[11]-		
C4	Acetaminophen	103-90-2	-	+	-	[64]	-	[16]-
C5	Acetone[4-(5-nitro-2-furyl)-2-thiazolyl]hydrazone	18523-69-8						
C6	Acetoxime	127-06-0	-					
C7	N-Acetoxy-2-acetylaminofluorene	6098-44-8	+	+				
C8	1'-Acetoxysafrole	34627-78-6	+					
C9	4-Acetylaminohiphenyl	4075-79-0						
C10	2-Acetylaminofluorene	53-96-3	+	+	+	[30]	+	[16]
C11	N'-Acetyl-4-(hydroxymethyl)phenylhydrazine	65734-38-5						
C12	1-Acetyl-2-isonicotinoylhydrazine	1078-38-2						
C13	1-Acetyl-2-phenylhydrazine	114-83-0	+					
C14	Acifluorfen	50594-66-6						
C15	Acronycine	7008-42-6						
C16	Acrylamide	79-06-1	E	+	+	[65, 66]	+	[16, 67]
C17	Acrylonitrile	107-13-1	+	+	-a	[11, 41]	-^	[16]-
C18	Actinomycin D	50-76-0	-	+	+	[50]		
C19	Aflatoxicol	29611-03-8	+					
C20	Aflatoxin B1	1162-65-8	+	+	+	[30]	+	[16]
C21	Aflatoxin, crude	-						
C22	Aldrin	309-00-2	-	+	-	[68]		
C23	Allyl glycidyl ether	106-92-3	+	+	+	[69]		
C24	Allyl isothiocyanate	57-06-7	E	+	-	[34]		
C25	Allyl isovalerate	2835-39-4	-	+				
C26	1-Allyl-1-nitrosourea	760-56-5						
C27	Allylhydrazine HCl	52207-83-7						
C28	2-Aminoanthracene	613-13-8	+	E				
C29	2-Aminoanthraquinone	117-79-3	+					
C30	4-Aminoazobenzene	60-09-3	+		+	[11]		
C31	4-Aminobiphenyl	92-67-1	+	+	+	[11]	+	[16]
C32	4-Aminobiphenyl HCl	2113-61-3	+		+	[70]		
C33	1-Amino-2,4-dibromoanthraquinone	81-49-2	+	-				
C34	2-Amino-3,4-dimethylimidazo[4,5-f]quinoline (MeIQ)	77094-11-2	+	+			+	[16]
C35	2-Amino-3,8-dimethylimidazo[4,5-f]quinoxaline (MeIQx)	77500-04-0	+		+	[71]	+	[16]
C36	3-Amino-1,4-dimethyl-5H-pyrido[4,3-b]indole acetate (Trp-P-1 acetate)	68808-54-8	+	+				
C37	2-Aminodiphenylene oxide	3693-22-9						
C38	2-Aminodipyrro[1,2-a:3',2'-d']imidazole (Glu-P-2)	67730-10-3	+	+				

ID	Chemical	CAS No.	Ames	<i>in vitro</i> CA	<i>in vivo</i> MN	<i>in vivo</i> MN Ref.	TGR	TGR Ref.
C39	3-Amino-4-ethoxyacetanilide	17026-61-2	+	-				
C40	3-Amino-9-ethylcarbazole HCl	6109-97-3	+	-				
C41	3-Amino-9-ethylcarbazole mixture	Mixture	+					
C42	2-Aminofluorene	153-78-6	+					
C43	2-Amino-6-methylpyrido[1,2-a:3',2'-d']imidazole (Glu-P-1)	67730-11-4	+	+				
C44	2-Amino-3-methylimidazo[4,5-f]quinoline (IQ)	76180-96-6	+		-	[72]	+	[16]
C45	2-Amino-3-methylimidazo[4,5-f]quinoline HCl (IQ.HCl)	-	+				+	[16]
C46	2-Amino-1-methyl-6-phenylimidazo-[4,5-b]pyridine hydrochloride (PhIP.HCl)	105650-23-5	+	+	+	[73]	+	[16]
C47	3-Amino-1-methyl-5H-pyrido[4,3-b]indole acetate (Trp-P-2 acetate)	72254-68-1	+	+				
C48	2-Amino-5-(5-nitro-2-furyl)-1,3,4-oxadiazole	3775-55-1						
C49	2-Amino-5-(5-nitro-2-furyl)-1,3,4-thiadiazole	712-68-5						
C50	2-Amino-4-(5-nitro-2-furyl)thiazole	38514-71-5	+					
C51	trans-5-Amino-3[2-(5-nitro-2-furyl)vinyl]-1,2,4-oxadiazole	28754-68-9						
C52	2-Amino-4-nitrophenol	99-57-0	+	+	-	[50]		
C53	2-Amino-5-nitrophenol	121-88-0	+	+				
C54	4-Amino-2-nitrophenol	119-34-6	+	+				
C55	2-Amino-4-(p-nitrophenyl)thiazole	2104-09-8						
C56	2-Amino-5-nitrothiazole	121-66-4	+	+				
C57	2-Amino-9H-pyrido(2,3-b)indole (A-alpha-C)	26148-68-5	+	+			+	[16]
C58	3-Amino-1,2,4-triazole (Amitrole)	61-82-5	-	-	-	[74]~		
C59	11-Aminoundecanoic acid	2432-99-7	-	-	-	[34]		
C60	1-Amyl-1-nitrosourea	10589-74-9		+				
C61	Amylopectin sulphate	9047-13-6						
C62	Aniline HCl	142-04-1	-	+	+	[75]		
C63	o-Anisidine HCl	134-29-2	+		-	[50]		
C64	Aramite	140-57-8						
C65	Arecoline HCl	61-94-9			+	[30]		
C66	Aristolochic acid	313-67-7	+++	+++	-	[76]	+	[16]
C67	Aroclor 1254	27323-18-8	-					
C68	Aroclor 1260	11096-82-5						
C69	Asbestos	12001-29-5	-	+	-	[11]~		
C70	Atrazine	1912-24-9	-	+	+	[77]		
C71	Auramine O	2465-27-2	+	+				
C72	5-Azacytidine	320-67-2	+	+	+	[50]		
C73	Azaserine	115-02-6	+		+	[11]		
C74	Azathioprine	446-86-6	+	+	+	[30]	+	[16]
C75	Azobenzene	103-33-3	+	E	+	[26]		
C76	Azoxymethane	25843-45-2	+					
C77	1-Azoxypropane	17697-55-1						
C78	2-Azoxypropane	17697-53-9						

ID	Chemical	CAS No.	Ames	<i>in vitro</i> CA	<i>in vivo</i> MN	<i>in vivo</i> MN Ref.	TGR	TGR Ref.
C79	Barbital, sodium	144-02-5		+				
C80	Bemtridine	86133-11-3	-					
C81	Benomyl	17804-35-2	-		+	[78]		
C82	Benzaldehyde	100-52-7	-	+				
C83	Benz[a]anthracene	56-55-3	+		+	[11]		
C84	Benzene	71-43-2	-	+	+	[30]	+	[16]
C85	Benzidine	92-87-5	+	+	+	[30]		
C86	Benzidine 2HCl	531-85-1	+	+	+	[50]		
C87	Benzofuran	271-89-6	-	-				
C88	Benzo[a]pyrene	50-32-8	+	+	+	[30]	+	[16]
C89	1,4-Benzoquinone	106-51-4	-		+	[79]		
C90	Benzotrichloride	98-07-7	+					
C91	Benzoyl hydrazine	613-94-5						
C92	Benzyl acetate	140-11-4	-	-	-	[34]		
C93	Benzyl chloride	100-44-7	+	+	-	[30]~		
C94	o-Benzyl-p-chlorophenol	120-32-1	-	-				
C95	Benzylhydrazine 2HCl	20570-96-1						
C96	2-Biphenylamine HCl	2185-92-4	+	+	-	[34]		
C97	2,2-Bis(bromomethyl)-1,3-propanediol, technical grade	3296-90-0	+	+	E	[50]		
C98	Bis(2-chloro-1-methylethyl)ether, technical grade	108-60-1	+	+				
C99	Bis-2-chloroethylether	111-44-4	+					
C100	Bis-1,2-(chloromethoxy)ethane	13483-18-6						
C101	Bis-1,4-(chloromethoxy)-p-xylene	56894-91-8						
C102	Bis-(chloromethyl)ether	542-88-1						
C103	Bis(2,3-dibromopropyl)phosphate, magnesium salt	36711-31-6	+	+				
C104	Bis(dimethylamino)benzophenone (Michler's ketone)	90-94-8	+	E				
C105	4-Bis(2-hydroxyethyl)amino-2-(5-nitro-2-thienyl)quinazoline	33372-39-3	TC					
C106	Bis-2-hydroxyethylthiocarbamic acid, potassium	23746-34-1						
C107	Bromate, potassium	7758-01-2	+	+	+	[30]	+	[16]
C108	Bromocriptine mesylate	22260-51-1			-	[60]		
C109	Bromodichloromethane	75-27-4	-	+	-	[50, 61]		
C110	Bromoethane	74-96-4	+	-				
C111	2-Bromoethanol	540-51-2	+					
C112	7-Bromomethyl-12-methylbenz[a]anthracene	16238-56-5	+					
C113	Budesonide	51333-22-3						
C114	1,3-Butadiene	106-99-0	+		+	[30]	+	[16]
C115	tert-Butyl alcohol	75-65-0	-	-	-	[36, 50]		
C116	Butylated hydroxyanisole	25013-16-5	-	+	-	[50]		
C117	Butylated hydroxytoluene	128-37-0	-	-	-	[50]		
C118	Butylbenzyl phthalate	65-68-7	-	-	-	[50]		

ID	Chemical	CAS No.	Ames	<i>in vitro</i> CA	<i>in vivo</i> MN	<i>in vivo</i> MN Ref.	TGR	TGR Ref.
C119	N-n-Butyl-N-formylhydrazine	16120-70-0						
C120	N-Butylhydrazine HCl	56795-65-4						
C121	N-Butyl-N-(4-hydroxybutyl)nitrosamine	3817-11-6	+					
C122	N-n-Butyl-N-nitrosourea	869-01-2	+	+				
C123	beta-Butyrolactone	3068-88-0	+		+	[11]		
C124	Cadmium chloride	10108-64-2	+	+	+	[82]		
C125	Cadmium sulphate	10124-36-4	-	+				
C126	Caffeic acid	331-39-5	-	+	-	[30]-		
C127	Calciferol	50-14-6		TC				
C128	Calcium chromate	13765-19-0	+	+	-	[83]		
C129	Calcium valproate	33433-82-8						
C130	Capsaicin	404-86-4	+	**	-	[22, 23]		
C131	Captafol	2425-06-1	+	+				
C132	Captan	133-06-2	+	+	+	[30]		
C133	Carbaryl hydrazine HCl	563-41-7	-		-	[84]		
C134	1-Carbaryl-2-phenylhydrazine	103-03-7						
C135	Carbaryl	63-25-2	+	+	+	[68]		
C136	Carbazole	86-74-8	-					
C137	Carbon tetrachloride	56-23-5	++	-	-	[11]	-	[16]-
C138	Carboxymethylnitrosourea	60391-92-6	-	+				
C139	Carrageenan, acid-degraded	9000-07-1						
C140	Catechol	120-80-9	-	+	+	[85]		
C141	Chloral hydrate	302-17-0	+	+	+	[50]		
C142	Chloramben	133-90-4	+	+				
C143	Chlorambucil	305-03-3	+	+	+	[11]	+	[16]
C144	Chlordane, technical grade	12789-03-6	+					
C145	Chlordane, analytical grade	57-74-9	-	-				
C146	Chlorendic acid	115-28-6	-	+				
C147	Chlorinated paraffins: C12	108171-26-2	-	+				
C148	Chlorinated paraffins: C23	63449-39-8	-					
C149	Chlomaphazine	494-03-1	+		+	[86]		
C150	Chloroacetaldehyde	107-20-0	+					
C151	4-Chloro-4'-aminodiphenylether	101-79-1						
C152	p-Chloroaniline HCl	20265-96-7	+		+	[50]		
C153	Chlorobenzene	108-90-7	-	+	-	[34]		
C154	Chlorobenzilate	510-15-6	-	-				
C155	Chlorodibromomethane	124-48-1	+	+	-	[50]		
C156	2-Chloro-5-(3,5-dimethylpiperidinophonyl)benzoic acid	37087-94-8						
C157	Chloroethane	75-00-3	+		-	[87]		
C158	1-Chloroethylnitroso-3-(2-hydroxypropyl)urea	-						



ID	Chemical	CAS No.	Amea	<i>in vitro</i> CA	<i>in vivo</i> MN	<i>in vivo</i> MN Ref.	TGR	TGR Ref.
C159	Chlorofluoromethane	593-70-4						
C160	Chloroform	67-66-3	+++	-	E	[88]	-	[16]~
C161	Chloromethyl methyl ether	107-30-2	-		E	[11]		
C162	3-Chloro-2-methylpropene, technical grade	563-47-3	-	+	-	[34]		
C163	3-(Chloromethyl)pyridine HCl	6959-48-4	+	+	-	[89]		
C164	1-Chloro-2-nitrobenzene	88-73-3	+	E				
C165	1-Chloro-4-nitrobenzene	100-00-5	+	+	+	[90]		
C166	3-(p-Chlorophenyl)-1,1-dimethylurea (AKA monuron)	150-68-5	-	+	+	[34]		
C167	4-Chloro-m-phenylenediamine	5131-60-2	+	+				
C168	4-Chloro-o-phenylenediamine	95-83-0	+	+	+	[11]	+	[16]
C169	1-(4-Chlorophenyl)-1-phenyl-2-propynyl carbamate	10473-70-8						
C170	2-Chloropropanal	683-50-1						
C171	1-Chloropropene	590-21-6						
C172	Chloroethalonil	1897-45-6	-	+	-	[91]		
C173	5-Chloro-o-toluidine	95-79-4	-	-				
C174	4-Chloro-o-toluidine HCl	3165-93-3	-	E				
C175	2-Chloro-1,1,1-trifluoroethane	75-88-7	-					
C176	4-Chloro-6-(2,3-xyldino)-2-pyrimidinylthio)acetic acid (AKA Wyeth 14,643)	50892-23-4					+	[16]
C177	4-Chloro-6-(2,3-xyldino)-2-pyrimidinylthio (N-beta-hydroxyethyl)acetamide	65089-17-0						
C178	Chlorozotocin	54749-90-5	+					
C179	Chlorpromazine hydrochloride	69-09-0	-	-	+ b	[42]		
C180	Chrysazin	81-55-0	+	+				
C181	C.I. Acid orange 3	6373-74-6	+	+				
C182	C.I. Acid red 26 (AKA D&C Red 5 and Ponceau MX)	3761-53-3	E					
C183	C.I. Acid red 114	6459-94-5	+	-				
C184	C.I. Basic red 9 (pararosaniline HCl)	569-61-9	+	-	-	[50]		
C185	C.I. Direct black 38	1937-37-7	+	-	+	[92]		
C186	C.I. Direct blue 6	2602-46-2	+	-				
C187	C.I. Direct blue 14 (Trypan blue)	72-57-1	+		-	[11]~		
C188	C.I. Direct blue 15	2429-74-5	+	-				
C189	C.I. Direct blue 218	28407-37-6	-	-				
C190	C.I. Direct brown 95	16071-86-6	+	-				
C191	C.I. Disperse blue 1	2475-45-8	+	+	-	[50]		
C192	C.I. Disperse orange 2 (1-amino-2-methyl-anthraquinone)	82-28-0	+	+				
C193	C.I. Disperse yellow 3	2832-40-8	+	-	-	[34]		
C194	Cinnamyl anthranilate	87-29-6	-	-	-	[34]		
C195	C.I. Pigment red 3	2425-85-6	+	-				
C196	Ciprofibrate	52214-84-3		+				
C197	C.I. Solvent yellow 3 (o-Aminoazotoluene)	97-56-3	+		+ c	[11]	+	[16]
C198	C.I. Solvent yellow 14	842-07-9	+	-	+	[35]		

ID	Chemical	CAS No.	Ames	<i>In vitro</i> CA	<i>In vivo</i> MN	<i>In vivo</i> MN Ref.	TGR	TGR Ref.
C199	Citrinin	518-75-2	-					
C200	C.I. Vat yellow 4	128-66-5	-	-				
C201	Cilvorine	33979-15-6						
C202	Clofbrate	637-07-0	-	+	-	[45]	-	[16]~
C203	Clophen A 30	55600-34-5						
C204	Cobalt Sulfate heptahydrate	10026-24-1	+					
C205	Compound LY171883	88107-10-2						
C206	Coumarin	91-64-5	+	+	-	[50]		
C207	m-Cresidine	102-60-1	+	+				
C208	p-Cresidine	120-71-8	+	E	-	[11]~	+	[16]
C209	Crotonaldehyde	123-73-9	+					
C210	Cupferron	135-20-6	+	+				
C211	Cyclamate, sodium	139-05-9						
C212	Cylochlorotine	12663-46-6						
C213	Cyclopenta[c,d]joyrene	27208-37-3	+					
C214	Cylophosphamide monophydrate	6055-19-2	+	+	+	[37]	+	[16]
C215	Cyclosporin A	59865-13-3	-		-	[30]~		
C216	Cytembena	21739-91-3	+	+	-	[34]		
C217	D&C Red 9	5160-02-1	+	-	+	[93]		
C218	D&C Yellow 11 (AKA C.I. Solvent Yellow 33)	8003-22-3	+	+	-	[36]		
C219	p,p'-DDD	72-54-8	-					
C220	p,p'-DDE	72-55-9	-	+				
C221	DDT	50-29-3	-	E**				
C222	Dacarbazine	4342-03-4	+		+	[11]		
C223	Daminozide	1596-84-5	-	-	E	[50]		
C224	Danthron	117-10-2	+	+	-	[50]		
C225	Dapsone	80-08-0	-	E				
C226	Decabromodiphenyl oxide	1163-19-5	-	-	+	[50]		
C227	Dehydroepandrosterone	53-43-0	-					
C228	Dehydroepandrosterone acetate	853-23-6						
C229	Dextran sulphate sodium	9011-18-1						
C230	N-1-Diacetamidofluorene	63019-65-8						
C231	Dilalate	2303-16-4	+					
C232	1,1-Diallylhydrazine	5164-11-4						
C233	1,2-Diallylhydrazine 2HCl	26072-78-6						
C234	Diallylnitrosamine	16338-97-9	+					
C235	2,4-Diaminoanisole sulphate	39156-41-7	+	+				
C236	4,6-Diamino-2-(5-nitro-2-furyl)-s-triazine	720-69-4	+					
C237	2,4-Diaminophenol 2HCl	137-09-7	+	-				
C238	2,4-Diaminotoluene	95-80-7	+	+	-	[11]~	+	[16]

ID	Chemical	CAS No.	Ames	In vitro C.A	In vivo MN	In vivo MN Ref.	TGR	TGR Ref.
C239	2,4-Diaminotoluene 2HCl	636-23-7	+					
C240	Diazepam	439-14-5	-	-	+	[94]		
C241	3-Diazotyramine HCl	-						
C242	Dibenz[a,h]anthracene	53-70-3	+		+	[11]		
C243	3-Dibenzofuranamine	4106-66-5						
C244	1,2-Dibromo-3-chloropropane	96-12-8	+	+	+	[11]	+^	[16]
C245	Dibromodulcitol	10318-26-0	+					
C246	1,2-Dibromoethane	106-93-4	+	+	E	+ [36]; - [44, 45]	+^	[16]
C247	Dibromomannitol	488-41-5	+	+	+	[50]		
C248	1,1-DI-N-butylhydrazine	7422-80-2						
C249	1,2-DI-N-butylhydrazine HCl	78776-28-0						
C250	1,3-Dibutyl-1-nitrosourea	56654-52-5	+	+				
C251	Dichloroacetic acid	79-43-6	+	+	-	[50]	+	[16]
C252	Dichloroacetylene	7572-29-4						
C253	1,4-Dichlorobenzene	106-46-7	-	-	-	[11, 36, 50]		
C254	3,3'-Dichlorobenzidine	91-94-1	+		E	[11]		
C255	trans-1,4-Dichlorobutene-2	110-57-6	+					
C256	3,5-Dichloro(N-1,1-dimethyl-2-propynyl)benzamide	23950-58-5						
C257	1,2-Dichloroethane	107-06-2	+	+	-	[11, 36]	-^	[16]~
C258	Dichloromethane	75-09-2	+	+	-	[11]~		
C259	2,6-Dichloro-p-phenylenediamine	609-20-1	+	+	-	[34]		
C260	1,2-Dichloropropane	78-87-5	+	+	-	[95]		
C261	1,3-Dichloropropene (AKA Telone II)	542-75-6	+	-	-	[11, 34]		
C262	Dichlorvos	62-73-7	+	+	-	[50]		
C263	Dicofof	115-32-2	-	-				
C264	Dieldrin	60-57-1	-	+	+	[96]		
C265	Diethanolamine	111-42-2	-	-	-	[36]		
C266	Diethylacetamide	685-91-6						
C267	Diethylene glycol	111-46-6	-					
C268	Di(2-ethylhexyl)adipate	103-23-1	-	E	-	[34]		
C269	Di(2-ethylhexyl)phthalate	117-81-7	-	-	-	[97]	-	[16]~
C270	N,N-diethyl-4-(4'-[pyridyl-1'-oxide]azo)aniline	7347-49-1						
C271	Diethylstilbestrol	56-53-1	-	+	E	[11, 50]		
C272	Diethylstilbestrol dipropionate	130-80-3	-		-	[98]		
C273	N,N'-Diethyl-2-thiourea	105-55-5	-	-				
C274	1,2-Diformylhydrazine	628-36-4						
C275	Diflalone	21626-89-1						
C276	Diglycidyl resorcinol ether, technical grade	101-90-6	+	+	-	[34]		
C277	3,4-Dihydrocoumarin	119-84-6	-	-	+	[36]		
C278	1,2-Dihydro-2-(5-nitro-2-thienyl)quinazolin-4(3H)-one	33389-33-2	+					

ID	Chemical	CAS No.	Ames	<i>In vitro</i> CA	<i>In vivo</i> MN	<i>In vivo</i> MN Ref.	TGR	TGR Ref.
C279	3,6-Dihydro-2-nitroso-2H-1,2-oxazine	3276-41-3						
C280	Dihydrosafrole	94-58-6	-					
C281	1,2-Dihydro-2,2,4-trimethylquinoline	147-47-7	-	-	-	[36]		
C282	Dimethoxane	828-00-2	+	+				
C283	2,5-Dimethoxy-4'-aminostilbene	5803-51-0						
C284	3,3'-Dimethoxybenzidine-4,4'-dilsocyanate	91-93-0	+	+				
C285	3,3'-Dimethoxybenzidine 2HCl	20325-40-0	+		- d	[11]~		
C286	5,6-Dimethoxystenigmatocystin	65176-75-2						
C287	N,N-Dimethyl-4-aminoazobenzene	60-11-7	+	+	-	[11]~		
C288	6-Dimethylamino-4,4-diphenyl-3-heptanol acetate HCl	43033-72-3						
C289	Dimethylaminoethylnitrosoethylurea, nitrile salt	142713-77-7						
C290	trans-2-[(Dimethylamino)methylimino]-5-[2-(5-nitro-2-furyl)vinyl]-1,3,4-oxadiazole	55738-54-0	+					
C291	N,N-Dimethylaniline	121-69-7	-	+				
C292	7,12-Dimethylbenz[a]anthracene	57-97-6	+	+	+	[30]	+	[16]
C293	3,3'-Dimethylbenzidine	119-93-7	+	+	-	[11]~		
C294	3,3'-Dimethylbenzidine 2HCl	612-82-8	+	+				
C295	Dimethylcarbamoyl chloride	79-44-7	+	+	-	[11]		
C296	1,1-Dimethylhydrazine	57-14-7	+		+	[11]		
C297	1,2-Dimethylhydrazine 2HCl	306-37-6	+		+	[11]		
C298	2-(2,2-Dimethylhydrazino)-4-(5-nitro-2-furyl)thiazole	26049-69-4	+					
C299	Dimethyl hydrogen phosphite	868-85-9	+	+	+	[34]		
C300	Dimethyl methylphosphonate	756-79-6	-	TC				
C301	Dimethyl morpholinophosphoramidate	597-25-1	-	E				
C302	Dimethylnitramine	4164-28-7	+					
C303	4,6-Dimethyl-2-(5-nitro-2-furyl)pyrimidine	59-35-8						
C304	1,2-Dimethyl-5-nitroimidazole	551-92-8	+					
C305	Dimethylvinyl chloride	513-37-1	+	-	+	[50]		
C306	Dinitrosomopiperazine	55557-00-1	+					
C307	Di-(N-nitroso)-perhydropyrimidine	15973-99-6						
C308	Dinitrosopiperazine	140-79-4	+					
C309	2,4-Dinitrotoluene	121-14-2	+	-	-	[30]~		
C310	2,6-Dinitrotoluene	606-20-2	+		-	[45, 99]		
C311	Dinitrotoluene, technical grade	25321-14-6	+					
C312	1,4-Dioxane	123-91-1	-	-	-	[11]~		
C313	Dipentylnitrosamine	13256-06-9						
C314	5,5-Diphenylhydantoin	57-41-0	-	E	-	[50]		
C315	Dipyrene	68-89-3						
C316	Doxylamine succinate	562-10-7	-	-	-	[100]		
C317	alpha-Ecdysone	3604-87-3						
C318	Enovid	8015-30-3						

ID	Chemical	CAS No.	Ames	<i>in vitro</i> CA	<i>in vivo</i> MN	<i>in vivo</i> MN Ref.	TGR	TGR Ref.
C319	Epichlorohydrin	106-89-8	+	+	-	[11]-		
C320	1,2-Epoxybutane	106-88-7	+	+	-	[50]		
C321	17- $\beta$ -Estradiol	50-28-2	-	-	-	[50, 101]	-	[16]-
C322	Estradiol mustard	22966-79-6						
C323	Estragole	140-67-0	-		-	[50]		
C324	Ethinyl estradiol	57-63-6	-	-	-	[50]		
C325	Ethlonamide	536-33-4	-	+				
C326	Ethionine	13073-35-3	-					
C327	DL-Ethionine	67-21-0	-	-				
C328	o-Ethoxybenzamide	938-73-8	-	+				
C329	Ethyl acrylate	140-88-6	-	+	-	[11]		
C330	Ethyl alcohol	64-17-5	-		-	[102]		
C331	Z-Ethyl-O,N,N-azoxyethane	16301-26-1						
C332	Z-Ethyl-O,N,N-azoxymethane	57497-29-7						
C333	Ethylbenzene	100-41-4	-	-	-	[36]		
C334	Ethylene glycol monobutyl ether	111-76-2	-	-	-	[36]		
C335	Ethylene imine (AKA Aziridine)	151-56-4	+					
C336	Ethylene oxide	75-21-8	+	+	+	[30]	+	[16]
C337	N,N'-Ethylenethiourea	96-45-7	E	-	-	[11]-		
C338	N-Ethyl-N-formylhydrazine	74920-78-8						
C339	Ethyldiazine HCl	18413-14-4						
C340	Ethyl methanesulphonate	62-50-0	+	+	+	[50]	+^	[16]
C341	N-Ethyl-N'-nitro-N-nitrosoguanidine	63885-23-4	+	+				
C342	Ethyl nitrosocyanamide	38434-77-4	+					
C343	1-Ethyl nitroso-3-(2-hydroxyethyl)-urea	-						
C344	1-Ethyl nitroso-3-(2-oxopropyl)-urea	110559-84-7						
C345	1-Ethyl-1-nitrosourea	759-73-9	+	+	+	[50]	+	[16]
C346	4-Ethylsulphonylnaphthalene-1-sulfonamide	842-00-2						
C347	FD&C Green 1	4680-78-8						
C348	FD&C Green 2	5141-20-8	-					
C349	FD&C Red 1 (Ponceau 3R)	3564-09-8	-		-	[11]		
C350	FD&C Red 2	915-67-3	-					
C351	FD&C Red 4 (AKA C.I. Food Red 1)	4548-53-2	-					
C352	FD&C Violet 1 (AKA Benzyl Violet 4B)	1694-09-3	+					
C353	Finasteride	98319-26-7						
C354	Fluconazole	86386-73-4						
C355	N-(2-Fluorenyl)-2,2,2-trifluoroacetamide	363-17-7						
C356	4'-Fluoro-4-aminobiphenyl	324-93-6						
C357	N-4-(4'-Fluorobiphenyl)acetamide	398-32-3						
C358	2-Fluoroethyl-nitrosourea	69112-98-7						

ID	Chemical	CAS No.	Ames	In vitro CA	In vivo MN	In vivo MN Ref.	TGR	TGR Ref.
C359	5-Fluorouracil	51-21-6	-	+	+	[30]		
C360	Fluvastatin	93957-54-1	-	-	-	[103]		
C361	Formaldehyde	50-00-0	+	+	-	[11]-		
C362	Formic acid 2-(4-methyl-2-thiazolyl)hydrazide	32852-21-4						
C363	Formic acid 2-[4-(5-nitro-2-furyl)-2-thiazolyl]hydrazide	3570-75-0	+					
C364	Formylhydrazine	624-84-0						
C365	Fosetyl Al	39148-24-8	-					
C366	Fumonisin B1	116355-83-0	-	+	+	[104]		
C367	Furan	110-00-9	-	+	E	[50]		
C368	Furfural	98-01-1	E	+				
C369	Furfuryl Alcohol	98-00-0	-	E	-	[50]		
C370	Furosemide	54-31-9	-	+	-	[50]		
C371	Furylfuramide (AF-2)	3688-53-7	+	+	+	[11]		
C372	Gallium arsenide	1303-00-0	-		-	[36]		
C373	Gentian violet (AKA Hexamethyl-p-rosaniline chloride)	548-62-9	E	-				
C374	N2-gamma-Glutamyl-p-hydrazinobenzolic acid	-						
C375	Glycidaldehyde	765-34-4	+					
C376	Glycidol	556-52-5	+	+	+	[50]		
C377	Griseofulvin	126-07-8	-	+	-	[11]-		
C378	Haloperidol	52-86-8		+	+ e	[46]		
C379	HC Blue 1 (Impure and purified)	2784-94-3	+	+	-	[105]		
C380	HCDD mixture	Mixture						
C381	Hematoxylin	517-28-2	-	TC				
C382	Heptachlor	76-44-8	-	+			-	[16]-
C383	Hexachlorobenzene	118-74-1	-	TC				
C384	Hexachlorobutadiene	87-68-3	-	-			+	[16]
C385	Hexachlorocyclohexane, technical grade	608-73-1						
C386	alpha-1,2,3,4,5,6-Hexachlorocyclohexane	319-84-6						
C387	beta-1,2,3,4,5,6-Hexachlorocyclohexane	319-85-7	-					
C388	gamma-1,2,3,4,5,6-Hexachlorocyclohexane (AKA Lindane)	58-89-9	-	-	-	[11]-		
C389	Hexachloroethane	67-72-1	-	-				
C390	Hexamethylmelamine	531-18-0	-					
C391	Hexanal methylformylhydrazone	57590-22-4						
C392	Hexanamide	628-02-4	-	-*				
C393	N-Hexylnitrosourea	18774-85-1	+					
C394	Hydrazine	302-01-2	+		+	[11]		
C395	Hydrazine sulphate	10034-93-2	+	+			-	[16]-
C396	2-Hydrazino-4-(p-aminophenyl)thiazole	26049-71-8						
C397	2-Hydrazino-4-(5-nitro-2-furyl)thiazole	26049-68-3						
C398	2-Hydrazino-4-(p-nitrophenyl)thiazole	26049-70-7						

ID	Chemical	CAS No.	Ames	<i>in vitro</i> CA	<i>in vivo</i> MN	<i>in vivo</i> MN Ref.	TGR	TGR Ref.
C399	p-Hydrazinobenzoic acid HCl	24589-77-3						
C400	Hydrazobenzene	122-66-7	+	+				
C401	Hydrogen Peroxide	7722-84-1	+	+	-	[106]		
C402	Hydroquinone	123-31-9	-	+	+	[50]	-	[107]
C403	N-Hydroxy-2-acetylaminofluorene	53-95-2	+	+			+	[16]
C404	4-Hydroxyaminoquinoline-N-oxide	4637-56-3	+					
C405	1-Hydroxyanthraquinone	129-43-1						
C406	3-Hydroxy-p-butyrophenetidine	1083-57-4						
C407	1'-Hydroxyestragole	51410-44-7	-					
C408	4-(2-Hydroxyethylamino)-2-(5-nitro-2-thienyl)quinazoline	33389-36-5	+					
C409	1-(2-Hydroxyethyl)-3-[(5-nitrofurfurylidene)amino]-2-imidazolidinone	5036-03-3	+					
C410	1-(2-Hydroxyethyl)-nitroso-3-ethylurea	-						
C411	1-(2-Hydroxyethyl)-1-nitrosourea	13743-07-2	+					
C412	2-Hydroxyethylhydrazine	109-84-2	+					
C413	1-(3-Hydroxypropyl)-1-nitrosourea	71752-70-0						
C414	1'-Hydroxysafrole	5208-87-7	-					
C415	ICR 170	146-89-8	+					
C416	ICRF 159	21416-87-5	-**		+	[24]		
C417	Indolidan	100643-96-7	-					
C418	Iodinated glycerol	5634-39-9	+	E	-	[50]		
C419	Isobutyl nitrite	542-56-3	+	+	+	[36]		
C420	Isomazole	86315-52-8	-					
C421	Isoniazid	54-85-3	+	+				
C422	Isonicotinic acid vannilylidenehydrazide	149-17-7						
C423	Isophorone	78-59-1	-	+	-	[108]		
C424	Isophosphamide	3778-73-2	+					
C425	Isoprene	78-79-5	-	-	+	[36]		
C426	Kepone (AKA Chlordecone)	143-50-0	-	-				
C427	Laslocarpine	303-34-4	+	+	+	[50]		
C428	Lead Acetate	301-04-2	-	+	-	[11]		
C429	Lead acetate, basic	1335-32-6						
C430	Leupeptin	24365-47-7						
C431	D-limonene	5989-27-5	-	-			-	[16]~
C432	Luteoskyrin	21884-44-6	-					
C433	Malonaldehyde sodium salt	24382-04-5	-	-				
C434	Manganese ethylenebisthiocarbamate	12427-38-2		+				
C435	MeA-alpha-C acetate	-	+					
C436	Melamine	108-78-1	-	-	-	[34]		
C437	Melphaian	148-82-3	+	+	+	[11]		
C438	2-Mercaptobenzothiazole	149-30-4	-	+	-	[50]		

ID	Chemical	CAS No.	Ames	<i>In vitro</i> C.A	<i>In vivo</i> MN	<i>In vivo</i> MN Ref.	TGR	TGR Ref.
C439	Mercuric chloride	7487-94-7	-	+	+f	[47, 48]		
C440	Mercurymethylchloride	115-09-3	-	+				
C441	Metepa	57-39-6			+	[109]		
C442	Methapyriene hydrochloride	135-23-9	E	+				
C443	Methidathion	950-37-8	-		-	[110]		
C444	Methimazole	60-56-0	-	+	-	[111]		
C445	3-Methoxy-4-aminoazobenzene	3544-23-8	+					
C446	2-Methoxy-3-aminodibenzofuran	5834-17-3						
C447	3-Methoxycatechol	934-00-9						
C448	4-Methoxyphenol (AKA Hydroquinone monomethyl ether)	150-76-5	-	+				
C449	6-Methoxypsoralen	298-81-7	+	+	E	[50]		
C450	Z-Methyl-O,N,N-azoxyethane	57497-34-4						
C451	Methylazoxymethanol acetate	592-62-1	+	+				
C452	alpha-Methylbenzyl alcohol	98-85-1	-	+				
C453	3-Methylbutanal methylformylhydrazone	57590-21-3						
C454	Methyl tert-butyl ether	1634-04-4	-	-	-	[50]		
C455	Methyl carbamate	598-55-0	-	-	-	[50]		
C456	4-Methylcatechol	452-86-8	-		-	[50]		
C457	3-Methylcholanthrene	56-49-5	+	+	+	[112]	+^	[16]
C458	Methyl clofenapate	21340-68-1	-**	-**	-	[25]	-	[16]-
C459	1-Methyl-1,4-dihydro-7-[2-(5-nitrofuryl)vinyl]-4-oxo-1,8-naphthyridine-3-carboxylate, potassium	-						
C460	3'-Methyl-4-dimethylaminoazobenzene	55-80-1	+	+				
C461	N-Methyl-N,4-dinitrosoaniline	99-80-9						
C462	4,4'-Methylenebis(2-chloroaniline)	101-14-4	+	+	-	[11, 35]-		
C463	4,4'-Methylene-bis(2-chloroaniline) 2 HCl	64049-29-2	+					
C464	4,4'-Methylenebis(N,N-dimethylaniline)	101-61-1	+	-				
C465	4,4'-Methylene-bis(2-methylaniline)	838-88-0	+					
C466	4,4'-Methylenedianiline 2HCl	13552-44-8	+	+	+g	[34]		
C467	Methyleugenol	93-15-2	-	-	-	[36]		
C468	N-Methyl-N-formylhydrazine	758-17-8						
C469	Methylhydrazine	60-34-4	-					
C470	Methylhydrazine sulphate	302-15-8						
C471	Methyl iodide	74-88-4	+					
C472	Methyl methanesulphonate	66-27-3	+	+	+	[30]	+	[16]
C473	Methylnitramine	598-57-2						
C474	2-Methyl-1-nitroanthraquinone	129-15-7	+	+				
C475	4-Methyl-1-[(5-nitrofurfurylidene)amino]-2-imidazolone	21638-36-8	+					
C476	N-Methyl-N'-nitro-N-nitrosoguanidine	70-25-7	+	+	+	[30]	+	[16]
C477	4-(Methylnitrosamino)-1-(3-pyridyl)-1-butanol	76014-81-8						
C478	4-(Methylnitrosamino)-1-(3-pyridyl)-1-(butanone) (NNK)	64091-91-4	+++	+++	E	+ [26, 51]; - [50]	+	[16]



ID	Chemical	CAS No.	Ames	In vitro CA	In vivo MN	In vivo MN Ref.	TGR	TGR Ref.
C479	4-(4-N-Methyl-N-nitrosaminostryl)quinoline	16699-10-8						
C480	(N-6)-(Methylnitroso)adenine	21928-82-5						
C481	(N-6)-(Methylnitroso)adenosine	41286-73-1						
C482	N-Methyl-N-nitrosobenzamide	63412-06-6	+					
C483	N-(N-Methyl-N-nitrosocarbonyl)-L-ornithine	63642-17-1						
C484	Methylnitrosocyanamide	33868-17-6	+	+				
C485	R(-)-2-Methyl-N-nitrosopiperidine	14026-03-0						
C486	S(+)-2-Methyl-N-nitrosopiperidine	36702-44-0						
C487	N-Methylacrylamide	924-42-5	-	+	-	[113]		
C488	Methylphenidate HCl	298-59-9	-	+	-	[50]		
C489	Metronidazole	443-48-1	+	+	-	[11]-	- <sup>A</sup>	[16]-
C490	Mirex	2385-85-5	-	-				
C491	Mirex, photo-	39801-14-4						
C492	Mitomycin C	50-07-7	+	+	+	[30]	+ <sup>A</sup>	[16]
C493	Molybdenum trioxide	1313-27-5	-	-				
C494	Monocetyl hydrazine	1068-57-1			+	[114]		
C495	Monocrotaline	315-22-0	-	+	+	[11]		
C496	L-5-Morpholinomethyl-3-[(5-nitrofurfurylidene) amino]-2-oxazolidinone HCl	3031-51-4						
C497	4-Morpholino-2-(5-nitro-2-thienyl)quinazoline	58139-48-3	+					
C498	Nafenopin	3771-19-5	-	+				
C499	Nalidixic acid	389-08-2	+	-				
C500	Naphthalene	91-20-3	-	+	-	[32]-		
C501	1,5-Naphthalenediamine	2243-62-1	+	+				
C502	2-Naphthylamine	91-59-8	+	+	-	[11]-		
C503	Nickel sulfate heptahydrate	10101-98-1						
C504	Nicotinic acid hydrazide	553-53-7						
C505	Nitiazide	139-94-6	+	-				
C506	Nitriotrtaoetic acid	139-13-9	-	-	-	[115]		
C507	Nitriotrtaoetic acid, trisodium salt	5064-31-3						
C508	Nitriotrtaoetic acid, trisodium salt, monohydrate	18662-53-8	-	-				
C509	Nitrite, sodium	7632-00-0	+	- <sup>A</sup>	E	+ [30, 52]; - [50]	-	[38]
C510	5-Nitroacenaphthene	602-87-9	+	E	-	[11]-		
C511	3-Nitro-p-acetophenetide	1777-84-0	+					
C512	5-Nitro-o-anisidine	99-59-2	+	-				
C513	o-Nitroanilole	91-23-6	+	+				
C514	Nitrobenzene	98-95-3	-	- <sup>A</sup>	-	[116]		
C515	6-Nitrobenzimidazole	94-52-0	+	+				
C516	p-Nitrobenzoic acid	62-23-7	+	+	-	[36]		
C517	4-Nitrophenyl	92-93-3	+					
C518	Nitrofen	1836-75-5	+	-	-	[11]-		

ID	Chemical	CAS No.	Ames	In vitro C.A	In vivo MN	In vivo MN Ref.	TGR	TGR Ref.
C519	5-Nitro-2-furaldehyde semicarbazone (AKA Nitrofurazone)	59-87-0	+	+	-	[50]		
C520	1-[(5-Nitrofurfurylidene)amino]hydantoin (AKA Nitrofurantoin)	67-20-9	+	+	-	[50]	+	[16]
C521	1-[(5-Nitrofurfurylidene)amino]-2-imidazolidinone	555-84-0						
C522	3-(5-Nitro-2-furyl)-imidazo[1,2-alpha]pyridine	75198-31-1						
C523	5-(5-Nitro-2-furyl)-1,3,4-oxadiazole-2-ol	2122-86-3						
C524	N-[3-(5-Nitro-2-furyl)-1,2,4-oxadiazole-5-yl]-methylacetamide	36133-88-7	+					
C525	N-[5-(5-Nitro-2-furyl)-1,3,4-thiadiazol-2-yl]acetamide	2578-75-8	+					
C526	4-(5-Nitro-2-furyl)thiazole	53757-28-1	+					
C527	N-[4-(5-Nitro-2-furyl)-2-thiazolyl]acetamide	531-82-8	+					
C528	N-[4-(5-Nitro-2-furyl)-2-thiazolyl]formamide	24554-26-5	+					
C529	N,N'-[6-(5-Nitro-2-furyl)-s-triazine-2,4-diy]bisacetamide	51325-35-0	+					
C530	Nitrogen mustard	51-75-2	+	+	+	[11]		
C531	Nitrogen mustard N-oxide	126-85-2						
C532	3-Nitro-3-hexene	4812-22-0						
C533	Nitromethane	75-52-5	-	-	-	[36]		
C534	2-Nitro-p-phenylenediamine	5307-14-2	+	+	-	[117]	+	[16]
C535	1-Nitropyrene	5522-43-0	+	+				
C536	8-Nitroquinoline	607-35-2	+					
C537	4-Nitroquinoline-N-oxide	56-57-5	+	+	+	[30]	+	[16]
C538	N-Nitrosoallylethanolamine	91308-69-9						
C539	N-Nitrosoallyl-2,3-dihydroxypropylamine	88208-16-6						
C540	N-Nitrosoallyl-2-hydroxypropylamine	91308-70-2						
C541	N-Nitrosoallyl-2-oxopropylamine	91308-71-3						
C542	Nitrosoamylurethan	64005-62-5						
C543	Nitrosoanabasine	1133-64-8						
C544	Nitroso-Baygon	38777-13-8	+					
C545	N-Nitrosobenzthiazuron	51542-33-7						
C546	N-Nitrosobis(2-hydroxypropyl)amine	53609-64-6						
C547	N-Nitrosobis(2-oxopropyl)amine	60599-38-4						
C548	N-Nitroso-bis-(4,4,4-trifluoro-N-butyl)amine	83335-32-4						
C549	Nitrosodbutylamine	924-16-3	+		-	[11]-		
C550	N-Nitrosodlethanolamine	1116-54-7	+		-	[11]		
C551	N-Nitrosodilethylamine (diethylnitrosamine)	55-18-5	+	-*	-	[11]-	+	[16]
C552	1-Nitroso-5,6-dihydrouracil	16813-36-8	+					
C553	Nitroso-2,3-dihydroxypropylethanolamine	89911-78-4						
C554	N-Nitroso-2,3-dihydroxypropyl-2-hydroxypropyl-amine	89911-79-5	+					
C555	Nitroso-2,3-dihydroxypropyl-2-oxopropylamine	92177-50-9						
C556	N-Nitrosodimethylamine (dimethylnitrosamine)	62-75-9	+	+	+	[30]	+	[16]
C557	1-Nitroso-3,5-dimethyl-4-benzoylpiperazine	61034-40-0	-					
C558	N-Nitrosodiphenylamine	86-30-6	-	-				

ID	Chemical	CAS No.	Ames	<i>In vitro</i> CA	<i>In vivo</i> MN	<i>In vivo</i> MN Ref.	TGR	TGR Ref.
C559	p-Nitrosodiphenylamine	156-10-5	+	+				
C560	N-Nitrosodipropylamine	621-64-7	+		-	[11]~	+	[16]
C561	Nitrosododecamethylethylamine	40580-89-0	+					
C562	N-Nitrosoephedrine	17608-59-2						
C563	Nitrosoethylmethylamine	10595-95-6	+		-	[11]~		
C564	Nitrosoethylurethan	614-95-9	+					
C565	Nitrosoheptamethylethylamine	20917-49-1	+					
C566	N-Nitrosohexamethylethylamine	932-83-2	+					
C567	1-Nitrosohydantoin	42579-28-2	+					
C568	1-Nitroso-1-hydroxyethyl-3-chloroethylurea	96806-34-7						
C569	1-Nitroso-1-(2-hydroxypropyl)-3-chloroethylurea	96806-35-8						
C570	N-Nitroso-(2-hydroxypropyl)-(2-hydroxyethyl)amine	75896-33-2						
C571	N-Nitroso-3-hydroxypyrrolidine	56222-35-6	+					
C572	N-Nitroso-N-isobutylurea	760-60-1						
C573	2-Nitrosomethylaminopyridine	16219-98-0	+					
C574	Nitrosomethylaniline	614-00-6						
C575	N-Nitroso-N-methyldecylamine	75881-22-0						
C576	N-Nitrosomethyl-2,3-dihydroxypropylamine	86451-37-8						
C577	N-Nitroso-N-methyl-N-dodecylamine	55090-44-3	+					
C578	N-Nitroso-N-methyl-4-fluoroaniline	937-25-7						
C579	N-Nitrosomethyl-(2-hydroxyethyl)amine	26921-68-6						
C580	N-Nitrosomethyl-2-hydroxypropylamine	75411-83-5						
C581	N-Nitrosomethyl-(3-hydroxypropyl)amine	70415-59-7						
C582	N-Nitrosomethyl(2-oxopropyl)amine	55984-51-5						
C583	Nitroso-N-methyl-N-(2-phenyl)ethylamine	13256-11-6						
C584	N-Nitroso-N-methyl-N-tetradecylamine	75881-20-8						
C585	N-Nitrosomethyl-(2-tosyloxyethyl)amine	-						
C586	Nitrosomethylundecylamine	68107-26-6						
C587	N-Nitroso-N-methylurea	684-93-5	+	+	+	[50]	+	[16]
C588	N-Nitrosomorpholine	59-89-2	+		+	[11]		
C589	N'-Nitrosomonocotinine-1-N-oxide	78246-24-9						
C590	3-Nitroso-2-oxazolidinone	38347-74-9						
C591	Nitroso-2-oxopropylethanolamine	92177-49-6						
C592	N-Nitrosopiperazine	5632-47-3	+					
C593	N-Nitrosopiperidine	100-75-4	+		-	[11]~		
C594	N-Nitrosopyrrolidine	930-55-2	+		-	[11]~	+	[16]
C595	Nitroso-1,2,3,6-tetrahydropyridine	55556-92-8	+					
C596	N-Nitrosothialdine	81795-07-5						
C597	N-Nitrosothiomorpholine	26541-51-5	+					
C598	o-Nitrosotoluene	611-23-4						

ID	Chemical	CAS No.	Ames	<i>In vitro</i> CA	<i>In vivo</i> MN	<i>In vivo</i> MN Ref.	TGR	TGR Ref.
C599	N-Nitroso(2,2,2-trifluoroethyl)ethylamine	82018-90-4						
C600	N-Nitroso-2,2,4-trimethyl-1,2-dihydroquinoline polymer	29929-77-9						
C601	1-Nitroso-3,4,5-trimethylpiperazine	75861-18-4						
C602	5-Nitro-o-toluidine	99-55-8	+	+				
C603	Norelstrin	8015-12-1						
C604	Ochratoxin A	303-47-9	-	-				
C605	Oxazepam	604-75-1	-	-	-	[36]	+	[16]
C606	N-(9-Oxo-2-fluorenyl)acetamide	3096-50-2						
C607	Oxolinic acid	14698-29-4	+					
C608	4,4'-Oxydianiline	101-80-4	+	+	+	[34]		
C609	N-Oxydiethylene thiocarbamyl-N-oxydiethylene sulphenamide	13752-51-7		+				
C610	Oxymetholone	434-07-1	-	-	-	[50, 118]		
C611	Ozone	10028-15-6	+	+				
C612	Pentachloroanisole	1825-21-4	+	-				
C613	Pentachloroethane	76-01-7	-	+	-	[50]		
C614	Pentachloronitrobenzene	82-68-8	-	+				
C615	Pentanal methylformylhydrazone	57590-20-2						
C616	n-Pentylhydrazine HCl	1119-68-2						
C617	Petasitenine	60102-37-6		+				
C618	Phenacetin	62-44-2	+	+	+	[30, 35]		
C619	Phenazone	60-80-0	-					
C620	Phenazopyridine HCl	136-40-3	E	+	+	[11]		
C621	Phenesterin	3546-10-9	-					
C622	Phenobarbital	50-06-6	+	+	+	[30]	-	[16]-
C623	Phenobarbital, sodium	57-30-7	-		-	[11]-		
C624	Phenolphthalein	77-09-8	-	+	+	[36, 50]		
C625	Phenoxybenzamine HCl	63-92-3	+	+	-	[11]		
C626	Phenylbutazone	50-33-9	-	+	-	[50]		
C627	1-Phenyl-3,3-dimethyltriazene	7227-91-0	+		+	[119]		
C628	o-Phenylenediamine 2HCl	615-28-1	+					
C629	Phenylethyldiazine sulphate	156-51-4	+					
C630	Phenylglycidyl ether	122-60-1	+	TC	-	[120]		
C631	Phenylhydrazine HCl	59-88-1	+		+ h	[30]		
C632	o-Phenylphenol, sodium	132-27-4	-	-**				
C633	o-Phenylphenol	90-43-7	+	+	-	[121]		
C634	Phorbol	17673-25-5		TC				
C635	Piperonyl butoxide	51-03-6	-	-				
C636	Piperonyl sulphoxide	120-62-7	-	-				
C637	Pivalolactone	1955-45-9	+					
C638	Polybrominated biphenyl mixture	67774-32-7	-		-	[34]		

ID	Chemical	CAS No.	Ames	<i>In vitro</i> CA	<i>In vivo</i> MN	<i>In vivo</i> MN Ref.	TGR	TGR Ref.
C639	Potassium bicarbonate	298-14-6						
C640	Prednimustine	29069-24-7						
C641	Prednisolone	50-24-8	-					
C642	Primacene (primidone)	125-33-7	+	-	-	[50]		
C643	Probenedid	57-66-9	-	-				
C644	Procarbazine	671-16-9	-					
C645	Procarbazine HCl (Natulan)	366-70-1	-	**	+	[30, 122]	+	[16]
C646	Progesterone	57-83-0	-	-				
C647	Propane sulfone	1120-71-4	+	+	+	[11]		
C648	beta-Propiolactone	57-57-8	+	+	-	[11]	+	[16]
C649	1,2-Propylene oxide	75-56-9	+	+	+	[11]		
C650	N-N'-Propyl-N-formylhydrazine	77337-54-3						
C651	Propylhydrazine HCl	56795-66-5						
C652	N-Propyl-N'-nitro-N-nitrosoguanidine	13010-07-6	+	+				
C653	N-Propyl-N-nitrosoourea	816-57-9	+	+	+	[123]	+	[16]
C654	Propylthiouracil	51-52-5	-	TC				
C655	Pyridine	110-86-1	-	-	-	[50]		
C656	Pyriamine maleate	59-33-6			-	[50]		
C657	Pyrimethamine	58-14-0	-	+	+ l	[45, 53]		
C658	Quercetin	117-39-5	+	+	-	[32]-		
C659	p-Quinone dioxime	105-11-3	+	+	-	[124]		
C660	Reserpine	50-55-5	-	-	+ e	[83]		
C661	Retinol acetate	127-47-9		+				
C662	Rifampicin	13292-46-1						
C663	Ripazepam	26308-28-1						
C664	Saccharin, sodium	128-44-9	-	-*	-	[125]	-	[16]-
C665	Safrole	94-59-7	-	+				
C666	Salbutamol	18559-94-9						
C667	SDZ 200-110	-						
C668	Selenium diethyldithiocarbamate	5456-26-0						
C669	Selenium sulphide	7446-34-6	+	+	-	[50]		
C670	Senkirkine	2318-18-5	+	TC				
C671	Sesamol	533-31-3	-					
C672	Sodium dichromate	10588-01-9	+	+	+ j	[126]		
C673	Sterigmatocystin	10048-13-2	+					
C674	Streptozotocin	18883-66-4	+		+	[127, 128]	+	[16]
C675	Strobane	8001-50-1						
C676	Styrene	100-42-5	-	+	+ k	[30, 32, 50]		
C677	Styrene oxide	96-09-3	+	+	-	[11, 32]		
C678	Succinic anhydride	108-30-5	-	-				

ID	Chemical	CAS No.	Ames	In vitro CA	In vivo MN	In vivo MN Ref.	TGR	TGR Ref.
C679	Sulfalate	95-06-7	+					
C680	Sulfamethazine	57-68-1	-	-				
C681	Sulfamethoxazole	723-46-6	-					
C682	4,4'-Sulfonylbisacetanilide	77-46-3						
C683	5X Purple	2611-82-7			-	[81]	- <sup>A</sup>	[39]
C684	Symphytine	22571-95-5						
C685	Tamoxifen citrate	54965-24-1			+	[129, 130]		
C686	Terbutaline	23031-25-6						
C687	Testosterone	58-22-0			-	[131]		
C688	3,3',4,4'-Tetraaminobiphenyl 4HCl	7411-49-6						
C689	2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	-	-	-	[132]	-	[16]-
C690	1,1,1,2-Tetrachloroethane	630-20-6	-	+	+	[50]		
C691	1,1,2,2-Tetrachloroethane	79-34-5	-	-	+	[50]		
C692	Tetrachloroethylene	127-18-4	-	-	-	[50]		
C693	Tetrachlorvinphos	961-11-5	-	-				
C694	12-O-Tetradecanoylphorbol 13-acetate	16561-29-8	-	+			-	[16]-
C695	Tetrafluoro-m-phenylenediamine 2HCl	63886-77-1						
C696	Tetrahydrofuran	109-99-9	-	-	-	[36]		
C697	Tetrahydro-2-nitroso-2H-1,2-oxazine	40548-68-3						
C698	Tertantrromethane	509-14-8	+	+				
C699	Thioacetamide	62-55-5	-	TC	+	[30]		
C700	4,4'-Thiodianiline	139-65-1	+	+				
C701	beta-Thioguanine deoxyriboside	64039-27-6						
C702	Thio-tepa	52-24-4	+	+	+	[119]	+ <sup>A</sup>	[16]
C703	Thiouracil	141-90-2						
C704	Thiourea	62-56-6	-		-	[133]		
C705	Titanium dioxide	13463-67-7	-	-	+	[34]		
C706	Toluene	108-88-3	-	-	+	[30]		
C707	2,4-Toluene diisocyanate	584-84-9	+	-				
C708	Toluene diisocyanate, commercial grade (2,4 and 2,6)	26471-62-5	+	-	-	[134]		
C709	o-Toluenesulfonamide	88-19-7	-		-	[135]		
C710	m-Toluidine HCl	638-03-9	-					
C711	o-Toluidine	95-53-4	+	+	+I	[49, 50]		
C712	o-Toluidine HCl	636-21-5	+	E	-	[89]		
C713	p-Toluidine HCl	540-23-8	+					
C714	p-Tolylurea	622-51-5	-					
C715	Toxaphene	8001-35-2	+					
C716	Trenimon	68-76-8	+	+	+	[136]		
C717	Triamcinolone acetonide	76-25-5						
C718	Triamterene	396-01-0	-	+				

ID	Chemical	CAS No.	Ames	In vitro CA	In vivo MN	In vivo MN Ref.	TGR	TGR Ref.
C719	Tribromomethane	75-25-2	+	+	-	[50]		
C720	Trichloroacetic acid	76-03-9	-	TC	-	[32]		
C721	2,4,6-Trichloroaniline	634-93-5	-					
C722	1,1,2-Trichloroethane	79-00-5	-	+	-	[137]		
C723	Trichloroethylene (with and without epichlorohydrin)	79-01-6	-	-	-	[34]	-	[16]~
C724	N-(Trichloromethylthio)phthalimide	133-07-3	+	+				
C725	2,4,6-Trichlorophenol	88-06-2	-	-				
C726	1,2,3-Trichloropropane	96-18-4	+	+				
C727	Triethanolamine	102-71-6	-	-	-	[36]		
C728	2,2,2-Trifluoro-N-[4-(5-nitro-2-furyl)-2-imidazolyl]acetamide	42011-48-3	+					
C729	Trifluralin, technical grade	1582-09-8	+	-				
C730	2,4,5-Trimethylaniline	137-17-7	+	+				
C731	2,4,5-Trimethylaniline HCl	21436-97-5	+					
C732	2,4,6-Trimethylaniline HCl	6334-11-8						
C733	1,2,4-Trimethylbenzene	95-63-6	-		-	[138]		
C734	Trimethylphosphate	512-66-1	+	-*	+	[139]		
C735	Trimethylthiourea	2489-77-2	-	-				
C736	2,4,6-Trinitro-1,3-dimethyl-5-tert-butylbenzene	81-15-2						
C737	Trinitroglycerin	55-63-0	+					
C738	Tris(2-chloroethyl)phosphate	115-96-8	-	-	+	[30]		
C739	Tris-1,2,3-(chloromethoxy)propane	38571-73-2						
C740	Tris(2,3-dibromopropyl)phosphate	126-72-7	+	+	+	[11]	+	[16]
C741	Tris(2-ethylhexyl)phosphate	78-42-2	-	-	-	[50]		
C742	Uracil	66-22-8	-				+	[16]
C743	Uracil (uracil mustard)	66-75-1	+					
C744	Urethane	51-79-6	+	-*	+	[30, 122]	+	[16]
C745	Vanadium Pentoxide	1314-62-1	-	+	-	[50]		
C746	Vinyl acetate	108-05-4	-		+	[30]		
C747	Vinyl bromide	593-60-2	+		-	[11]~		
C748	Vinyl carbamate	15805-73-9	+		+	[140]	+	[16]
C749	Vinyl chloride	75-01-4	+		+	[30]		
C750	4-Vinylcyclohexene	100-40-3	-	-	-	[141]		
C751	Vinylidene chloride (1,1-Dichloroethylene)	75-35-4	-	TC	-	[30]~		
C752	2,4-Xylidine HCl	21436-96-4	+					
C753	2,5-Xylidine HCl	51786-53-9	+					
C754	Zearalenone	17924-92-4	-	+	+	[142]		
C755	Zinc dimethyldithiocarbamate (Ziram)	137-30-4	+	+	-	[143]		
C756	Zinc ethylenebisthiocarbamate (Zineb)	12122-67-7	-		-	[144]		
	Ames, Ames test; CA, chromosome aberration test; MN, rodent erythrocytes micronucleus test; TGR, transgenic rodent mutation assay							

ID	Chemical	CAS No.	Ames	<i>In vitro</i> CA	<i>In vivo</i> MN	<i>In vivo</i> MN Ref.	TGR	TGR Ref.
	Results of genotoxicity data are given as follows:							
	+, positive; -, negative;							
	E, equivocal result, when response is weak or not reproduced between experiments or between laboratories;							
	TC, technically compromised;							
	*, positive response at both >10 mM and ~2 mg/mL [29];							
	**, new data or alteration of the results from the original CGX [10];							
	^, not in the target tissue(s) of carcinogenicity;							
	~, no information on target cell exposure in the review paper or database for negative result <i>in vivo</i> .							
	a, positive in rat treated by intravenous injection [11, 35]; b, maybe due to hypothermia; c, negative in rat [35]; d, as free base (119-90-4);							
	e, maybe due to hypothermia in mouse, but negative in rat; f, negative in rat [48];							
	g, negative as free base (101-77-9) [11, 49]; h, as free base (100-63-0); l, positive in rat, but negative in the mouse;							
	j, positive by intraperitoneal injection, but negative by oral gavage; k, negative in rat [32];							
	l, positive in rat, but negative in mouse [11, 50]							



Appendix 2: Genotoxicity test results with rodent non-carcinogens								
ID	Chemical	CAS No.	Ames	<i>in vitro</i> CA	<i>in vivo</i> MN	<i>in vivo</i> MN Ref.	TGR	TGR Ref.
NC1	Acetohexamide	968-81-0	-	+				
NC2	Acetonitrile [AKA ethyl nitrile]	75-05-8	-	E	+	[33]		
NC3	Acrolein	107-02-8	+	-	-	[50]		
NC4	Adipamide	628-94-4	-					
NC5	Agar	9002-18-0						
NC6	Aldicarb	116-06-3	-	-	E	[33]		
NC7	Aluminum potassium sulfate	10043-67-1	-	TC				
NC8	di-Amphetamine sulfate	60-13-9	E	-	+ a	[30]		
NC9	Ampicillin trihydrate	7177-48-2	-	-	-	[31]~		
NC10	Anilazine	101-05-3	-	-				
NC11	p-Anilidine HCl	20265-97-8	+					
NC12	o-Anthranilic acid	118-92-3	-	-*	-	[89]		
NC13	l-Ascorbic acid	50-81-7	E	-	+	[34]		
NC14	Aspirin, phenacetin, and caffeine	8003-03-0	-					
NC15	Azinphosmethyl [AKA gusathion]	86-50-0	+					
NC16	Barium chloride dihydrate	10326-27-9	-	-				
NC17	Benzoate, sodium	532-32-1	-	+				
NC18	Benzoin	119-53-9	-	+	-	[34, 135]		
NC19	1H-Benzotriazole	95-14-7	+	+				
NC20	Benzyl alcohol	100-51-6	-	-*	-	[81]		
NC21	Beryllium sulfate	13510-49-1	-		-	[146]		
NC22	Black PN [AKA Food Black 1]	2519-30-4						
NC23	Bromomethane	74-83-9	+	E	+	[36]		
NC24	n-Butyl chloride	109-69-3	-	-				
NC25	N-Butylurea	592-31-4	-	TC				
NC26	gamma-Butyrolactone	96-48-0	-		-	[147]		
NC27	Caffeine	58-08-2	-	+	E	[33]		
NC28	Caprolactam	105-60-2	-	E	-	[148]		
NC29	Carbomal	77-65-6	-	+				
NC30	2-Chloroacetophenone	532-27-4	-	E				
NC31	4-(Chloroacetyl)-acetanilide	140-49-6	+	+				
NC32	p-Chloroaniline	106-47-8	+	+	E	[33]		
NC33	o-Chlorobenzalmonitrile [AKA malonitrile, o-chlorobenzylidene]	2698-41-1	E	+	-	[149]		
NC34	Chlorodifluoromethane [AKA fluorocarbon 22]	75-45-6	+					
NC35	(2-Chloroethyl)trimethylammonium chloride	999-81-5	-	-				
NC36	2-(Chloromethyl)pyridine HCl	6959-47-3	+	+	-	[50]		
NC37	3-Chloro-p-toluidine [AKA 4-methyl-5-chloro-1-aniline]	95-74-9	-	E				

ID	Chemical	CAS No.	Ames	<i>in vitro</i> CA	<i>in vivo</i> MN	<i>in vivo</i> MN Ref.	TGR	TGR Ref.
NC38	Chlorpheniramine maleate	113-92-8	-	+	-	[50]		
NC39	Chlorpropamide	94-20-2	-	+	E	[33]		
NC40	C.I. acid orange 10	1936-15-8	-	+	-	[34]		
NC41	C.I. food red 3 [AKA Acid red 14]	3667-69-9	+	-	-	[34]		
NC42	C.I. pigment red 23 [AKA pigment red 23]	6471-49-4	+	-				
NC43	C.I. pigment yellow 12	6356-85-6	-	-				
NC44	Codeine	76-57-3	-		-	[150]		
NC45	Coumaphos	56-72-4	-	-	-	[151]		
NC46	Cyanamide, calcium	156-62-7	+	-	-	[152]		
NC47	Cyclohexanone	108-94-1	-	-				
NC48	Cyclohexylamine HCl	4998-76-9	-					
NC49	Deltamethrin	52918-63-5	-	-	+	[33]		
NC50	Diallyl phthalate	131-17-9	-	+	-	[33, 34]		
NC51	4,4-Diamino-2,2-stilbenedisulfonic acid, disodium salt	7336-20-1	-					
NC52	2,6-Diaminotoluene 2HCl	15481-70-6	+	+	E	[33]	-	[16]~
NC53	2,5-Diaminotoluene sulfate	6369-59-1	+	+	-	[33]~		
NC54	Diazinon	333-41-5	-	+	+	[153]		
NC55	Dibenzo-p-dioxin	262-12-4	-					
NC56	1,2-Dichlorobenzene	95-50-1	-	-	-	[34, 50]		
NC57	2,7-Dichlorodibenzo-p-dioxin	33857-26-0	-					
NC58	Dichlorodifluoromethane	75-71-8	-					
NC59	1,1-Dichloroethane	75-34-3	-	-	+	[154]		
NC60	2,4-Dichlorophenol	120-83-2	E	+	-	[155]		
NC61	N,N-Dicyclohexylthiourea	1212-29-9	-	-				
NC62	Dieldrin, photo-	13366-73-9	+	-				
NC63	Dimethoate	60-51-5	+	+	+	[33]		
NC64	Dimethoxane, commercial grade [AKA acetic acid ester with 2,6-dimethyl-m-dioxan-4-ol]	828-00-2	+	+				
NC65	2,4-Dimethoxyaniline HCl	54150-69-5	+	+	-	[50]		
NC66	6-Dimethylamino-4,4-diphenyl-3-heptanone HCl	1095-90-5						
NC67	Dimethylformamide	68-12-2	-	-	-	[156]		
NC68	Dimethyl terephthalate	120-61-6	-	-	-	[34]		
NC69	Dioxathion [AKA phosphorodithioic acid, S,S'-p-dioxane-2,3-diy-O,O',O'-tetraethyl ester]	78-34-2	+	-				
NC70	Diphenhydramine HCl	147-24-0	-	+				
NC71	Diphenyl-p-phenylenediamine	74-31-7	+	+				
NC72	2,5-Dithiobiurea	142-46-1	-	-				
NC73	EDTA, trisodium salt trihydrate	150-38-9	-	-	- b	[55]		
NC74	Endrin	72-20-8	-	-				
NC75	Ephedrine sulphate	134-72-5	-	-				
NC76	Erythorbate, sodium	6381-77-7	-	-				

ID	Chemical	CAS No.	Amees	<i>in vitro</i> CA	<i>in vivo</i> MN	<i>in vivo</i> MN Ref.	TGR	TGR Ref.
NC77	Erythromycin stearate	643-22-1	-	-				
NC78	Estazolam	29975-16-4						
NC79	p,p-Ethy-DDD [AKA perthane]	72-56-0	+	-				
NC80	Ethyl tellurac	20941-65-5	-	+				
NC81	Etodolac	41340-25-4	-	-				
NC82	Eugenol	97-53-0	-	+	-	[34]	-	[16]
NC83	FD & C green no. 3 [AKA C.I. Food green 3]	2353-45-9	-	TC	E	[33]		
NC84	FD & C red no. 3 [AKA fluorescein, 2', 4', 5', 7'-tetralodo, disodium salt]	16423-68-0	-	+	E	[33]		
NC85	FD & C yellow no. 5 [AKA tartrazine]	1934-21-0	-	+				
NC86	FD & C yellow no. 6 [AKA Food yellow 3]	2783-94-0	-	-	-	[34]		
NC87	Fenaminosulf, formulated [AKA p-dimethylaminobenzenediazo sulphonic acid,	140-56-7	+	-				
NC88	Fenthion	55-38-9	E	+				
NC89	Fenvalerate [AKA cyano-3-phenoxyphenylmethyl-4-chloro-alpha-1-methylethylbenzene acetate]	51630-58-1	-	+	+	[33]		
NC90	Fluometuron [AKA urea, 1,1-dimethyl 3-(alpha, alpha, alpha-trifluoro-m-tolyl)-]	2164-17-2	-	-	-	[157]		
NC91	Fluoride, sodium	7681-49-4	-	+	E	+ [33]; - [50, 57, 58]		
NC92	Gemfibrozil	25812-30-0						
NC93	Guar gum	9000-30-0	-					
NC94	Gum arabic	9000-01-5	-					
NC95	HC blue no. 2 [AKA ethanol, 2,2'((4-(2-hydroxyethylamino)-3-nitrophenyl)imino)di-]	33229-34-4	+	-	-	[105]		
NC96	HC yellow 4	59820-43-8	+	-				
NC97	Hexachlorocyclopentadiene	77-47-4	-	+	-	[36]		
NC98	Hexachlorophene	70-30-4	-					
NC99	Hexamethylenetetramine	100-97-0	+					
NC100	4-Hexylresorcinol	136-77-6	-	-	-	[50]		
NC101	Hydrochlorothiazide	58-93-5	-	-				
NC102	8-Hydroxyquinoline [AKA 8-quinolinol]	148-24-3	+	+	-	[34]		
NC103	Iodoform [AKA methane, triiodo-]	75-47-8	+	-				
NC104	Isopropyl-N-(3-chlorophenyl)carbamate	101-21-3	-	E	-	[147]		
NC105	4,4'-Isopropylidenediphenol	80-05-7	-	+	-	[158]		
NC106	Lead dimethyldithiocarbamate	19010-66-3	+	+				
NC107	Levobunolol HCl	27912-14-7						
NC108	Lithocholic acid	434-13-9	-	+				
NC109	Locust bean gum	9000-40-2	-					
NC110	Malaoxon	1634-78-2	-	E				
NC111	Malathion	121-75-5	-	+	+	[33]		
NC112	Maleic hydrazide	123-33-1	-	E	-	[159]		
NC113	Manganese (II) sulfate monohydrate	10034-96-5	+	+	+	[33]		
NC114	d-Mannitol	69-65-8	-	-	-	[34]		
NC115	Methotrexate	59-05-2	-	+	+	[33, 122]		

ID	Chemical	CAS No.	Ames	<i>in vitro</i> CA	<i>in vivo</i> MN	<i>in vivo</i> MN Ref.	TGR	TGR Ref.
NC116	Methoxychlor	72-43-5	-	-				
NC117	alpha-Methylidopa sesquihydrate	41372-08-1	-					
NC118	Methyl methacrylate	80-62-6	-	+	-	[160]		
NC119	Methyl parathion [AKA phosphorothioic acid, O, O-dimethyl O-(p-nitrophenyl)ester]	298-00-0	+	-	+	[33]		
NC120	Monochloroacetic acid	79-11-8	-	-	+	[161]		
NC121	N-(1-Naphthyl)ethylenediamine 2HCl [AKA PL-89779]	1465-25-4	+	+				
NC122	Nickel (II) sulfate hexahydrate	10101-97-0	-	+	-	[11]		
NC123	p-Nitroaniline	100-01-6	+	+				
NC124	4-Nitroanthranilic acid	619-17-0	+	-*				
NC125	3-Nitro-4-hydroxyphenylarsonic acid (AKA roxarsone)	121-19-7	-	-				
NC126	1-Nitronaphthalene	86-57-7	+	+			-	[16]-
NC127	4-Nitro-o-phenylenediamine	99-56-9	+	+	-	[162]		
NC128	3-Nitropropionic acid	504-88-1	+	E				
NC129	Omeprazole	73590-58-6	-		E	[33]		
NC130	gamma-Oryzanol	11042-64-1	-					
NC131	Oxamyl	23135-22-0	-					
NC132	Oxprenolol HCl	6452-73-9	-		E	[33]		
NC133	Oxytetracycline HCl	2058-46-0	-	-	+	[163]		
NC134	Parathion	56-38-2	-	-	-	[110]		
NC135	Penicillin VK	132-98-9	-	+	-	[164]		
NC136	Pentaerythritol tetranitrate with 80% d-lactose monohydrate	78-11-5	-	-				
NC137	Phenformin HCl	834-28-6	-	-				
NC138	Phenol	108-95-2	-	+	+ c	[43, 59]		
NC139	p-Phenylenediamine 2HCl	624-18-0	+	+	-	[162]		
NC140	Phenylephrine HCl	61-76-7	-	-	-	[50]		
NC141	1-Phenyl-3-methyl-5-pyrazolone	89-25-8	-	-				
NC142	Phenyl-beta-naphthylamine [AKA N-phenyl-2-naphthylamine]	135-88-6	-	E				
NC143	N-Phenyl-p-phenylenediamine HCl [AKA C.I. Oxidation base 2A]	2198-59-5	-					
NC144	1-Phenyl-2-thiourea	103-85-5	-	-*				
NC145	Phthalamide	88-96-0	-	-				
NC146	Phthalic anhydride	85-44-9	-	+				
NC147	Picloram, technical grade	1918-02-1	-	TC				
NC148	Polysorbate 80	9005-65-6	-	TC				
NC149	Promethazine HCl	58-33-3	-	-				
NC150	Propylene [AKA propene]	115-07-1	+		-	[165]		
NC151	Propyl gallate	121-79-9	-	+	+	[33]	-	[40]
NC152	Resorcinol	108-46-3	-	-*	+	[50]		
NC153	Rhodamine 6G [AKA basic red 1]	989-38-8	-	TC				
NC154	Rotenone	83-79-4	-	-	-	[166]		

ID	Chemical	CAS No.	Ames	<i>in vitro</i> CA	<i>in vivo</i> MN	<i>in vivo</i> MN Ref.	TGR	TGR Ref.
NC155	Sodium chlorite	7758-19-2	+	+	+	[33]		
NC156	Sodium diethyldithiocarbamate trihydrate [AKA carbamic acid, diethyldithio, sodium salt]	148-18-5	-	-				
NC157	Sodium hypochlorite	7681-52-9	-	E	-	[81]		
NC158	Sorbic acid	110-44-1	-	TC	-	[167]		
NC159	Sotalol HCl	959-24-0						
NC160	Sulfisoxazole	127-69-5	-	-	-	[34]		
NC161	3-Sulfolene	77-79-2	-	-				
NC162	Tara gum	39300-88-4	-					
NC163	2,3,5,6-Tetrachloro-4-nitroanisole	2438-88-2	-	E				
NC164	Tetracycline HCl	64-75-5	-	+				
NC165	Tetraethylthiuram disulfide [AKA disulfide, bis(diethylthiocarbamoyl)]	97-77-8	-	+				
NC166	1-trans-delta-9-Tetrahydrocannabinol	1972-08-3	-		+	[33]		
NC167	Tetrakis(hydroxymethyl)phosphonium chloride	124-64-1	-	+	-	[50]		
NC168	Tetrakis(hydroxymethyl)phosphonium sulfate	55566-30-8	-	+	-	[168]		
NC169	Tetramethylthiuram disulfide	137-26-8	+		+	[33]		
NC170	4,4-Thiobis(6-tert-butyl-m-cresol) [AKA santonox-R]	96-69-5	-	-				
NC171	Tin (II) chloride	7772-99-8	-	+	-	[33, 34]		
NC172	Tolazamide	1156-19-0	E	TC				
NC173	Tolbutamide	64-77-7	-	-	+	[33]		
NC174	1,1,1-Trichloroethane, technical grade	71-65-6	-	E	-	[50]		
NC175	Trichlorofluoromethane	75-69-4	-					
NC176	2,4,5-Trichlorophenoxyacetic acid	93-76-5	-		-	[33]~		
NC177	Tricresyl phosphate	1330-78-5	-	-				
NC178	Triphenyltin hydroxide	76-87-9	-	-	+	[169]		
NC179	Triprolidine HCl monohydrate	6138-79-0	-					
NC180	L-Tryptophan	73-22-3	-	-				
NC181	Turmeric oleoresin (79%-85% curcumin)	8024-37-1	-	E				
NC182	Urea	57-13-6	-	TC				
NC183	Vinyl toluene (65-71% m- and 32-35% p-) [AKA benzene,ethenylmethyl-]	25013-15-4	-	+	+	[33]		
	For explanation of the <i>in vitro</i> results, <i>in vivo</i> MN and TGR results and other symbols see footnotes to Appendix 1.							
	a, as free base (300-62-9);							
	b, as disodium salt;							
	c, maybe due to hypothermia;							

