MeIQ (2-AMINO-3,4-DIMETHYLIMIDAZO[4,5-*f*]QUINOLINE)

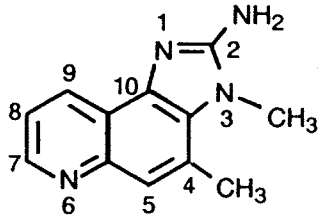
This substance was considered by a previous Working Group, in October 1985 (IARC, 1986). Since that time, new data have become available, and these have been incorporated into the monograph and taken into consideration in the present evaluation.

1. Exposure Data

1.1 Chemical and physical data

1.1.1 *Synonyms, structural and molecular data*

Chem. Abstr. Services Reg. No.: 77094-11-2
Chem. Abstr. Name: 3,4-Dimethyl-3*H*-imidazo[4,5-*f*]quinolin-2-amine
IUPAC Systematic Name: 2-Amino-3,4-dimethyl-3*H*-imidazo[4,5-*f*]quinoline



$C_{12}H_{12}N_4$ Mol. wt: 212.25

1.1.2 *Chemical and physical properties*

(*a*) *Description*: Brown crystalline solid (Lee *et al.*, 1982)
(*b*) *Melting-point*: 296–298 °C (Adolfsson & Olsson, 1983)
(*c*) *Spectroscopy data*: Ultraviolet, proton nuclear magnetic resonance (Kasai *et al.*, 1980a) and mass spectral data (Hargraves & Pariza, 1983) have been reported.
(*d*) *Solubility*: Soluble in methanol, ethanol and dimethyl sulfoxide (Lee *et al.*, 1982; Adolfsson & Olsson, 1983; Schunk *et al.*, 1984)
(*e*) *Stability*: Stable under moderately acidic and alkaline conditions and in cold dilute aqueous solutions protected from light (Sugimura *et al.*, 1983). Exposure of an acetone solution of MeIQ to sunlight for 1 h resulted in conversion of the 2-amino group to a 2-nitro group (Hirose *et al.*, 1990).
(*f*) *Reactivity*: Rapidly degraded by dilute hypochlorite; not deaminated by weakly acidic nitrite solutions (Tsuda *et al.*, 1985)

1.1.3 *Trade names, technical products and impurities*

No data were available to the Working Group.

1.1.4 *Analysis*

MeIQ was originally isolated from broiled, sun-dried sardines extracted with methanol. The neutral fraction obtained from the extract was subjected to Diaion HP-20 column chromatography, to chloroform–methanol–water partitioning and to Sephadex LH-20 column and silica-gel column chromatography. It was further purified by reverse-phase high-performance liquid chromatography. The structure was deduced mainly from data obtained by proton nuclear magnetic resonance and high-resolution mass spectral analysis (Kasai *et al.*, 1980b).

MeIQ was quantified in broiled fish (Yamaizumi *et al.*, 1986) after methanol extraction, acid/base partition and 'blue cotton' adsorption prior to analysis by high-performance liquid chromatography–thermospray–mass spectrometry. Extraction recoveries were determined using deuterium-labelled MeIQ.

1.2 Production and use

1.2.1 *Production*

The isolation and identification of MeIQ were first reported by Kasai *et al.* (1980b). Its structure was confirmed by chemical synthesis (Kasai *et al.*, 1980a).

Improved syntheses of MeIQ were devised by Lee *et al.* (1982), Adolfsson and Olsson (1983) and Waterhouse and Rapoport (1985). ^{14}C-Labelled MeIQ was synthesized by Adolfsson and Olssen (1983) and tritium-labelled MeIQ by Waterhouse and Rapoport (1985).

MeIQ is produced commercially in small quantities for research purposes.

1.2.2 *Use*

MeIQ is not used commercially.

1.3 Occurrence

MeIQ has been detected in grilled, sun-dried sardines at 20–72 ng/g (Kasai *et al.*, 1980b; Sugimura *et al.*, 1981), in broiled salmon at 0.6–3.1 ng/g, in broiled sardine at 16.6 ng/g (Yamaizumi *et al.*, 1986) and in fried cod at 0.03 ng/g (Wakabayashi *et al.*, 1992). MeIQ was found in fried ground beef cooked at 250 °C but at levels of less than 0.1 ng/g (Felton & Knize, 1990). As described in the monograph on IQ (p. 168), MeIQ is present in foods at lower levels than IQ, MeIQx and PhIP.

MeIQ was also detected but not quantified in fried ground pork (Gry *et al.*, 1986) and in beef extract used for bacteriological media (Hargraves & Pariza, 1983). It was reported in high-temperature-roasted coffee (Kikugawa *et al.*, 1989), but another study of commercial instant and roasted coffees did not demonstrate the presence of any MeIQ (Gross & Wolleb, 1991). A trace amount was found in a refluxed mixture of alanine, fructose and creatinine (Grivas *et al.*, 1985).

1.4 Regulations and guidelines

No data were available to the Working Group.

2. Studies of Cancer in Humans

No epidemiological study was available that addressed the carcinogenic risk to humans of MeIQ itself. Cancer risks associated with consumption of broiled and fried foods, which may contain MeIQ as well as other heterocyclic amines, have, however, been addressed in a number of case–control studies. Several of these are summarized in the monograph on IQ.

3. Studies of Cancer in Experimental Animals

3.1 Oral administration

3.1.1 *Mouse*

Groups of 40 male and 40 female CDF_1 (BALB/cAnN × DBA/2N) F_1 mice, six weeks old, were fed a diet containing 0, 100 or 400 mg/kg of diet MeIQ ('analytical grade') for 91 weeks. Animals that became moribund were killed and autopsied during the experiment. The first forestomach papilloma was detected on day 324 in a male mouse given the highest dose, and the numbers of mice that survived after that time were taken as the effective numbers: males—38/40 high-dose, 38/40 low-dose and 29/40 control; females—38/40 high-dose, 36/40 low-dose and 40/40 control. Significantly more treated female mice than controls had hepatocellular tumours (adenomas and carcinomas combined): 0/40, 4/36 and 27/38 in the control, low-dose and high-dose groups, respectively; there was no significant increase in the incidence of liver tumours in males: 4/29 in controls, 11/38 in low-dose and 7/38 in high-dose animals. The incidence of forestomach tumours (papillomas, carcinomas and one sarcoma) was significantly elevated in both treated males and females compared to controls: males, 0/29, 7/38 and 35/38; females—0/40, 19/36 and 34/38, in control, low-dose and high-dose animals, respectively. The incidence of squamous-cell carcinomas was also increased: males, 0/29, 3/38, 30/38; females, 0/40, 11/36, 24/38, in controls, low-dose and high-dose animals, respectively; one high-dose female had a sarcoma. Squamous-cell carcinomas of the forestomach, many of which metastasized to the liver, were observed in 30 males and 24 females in the high-dose group, in three males and 11 females in the low-dose group and in none of the control animals (Ohgaki *et al.*, 1986).

3.1.2 *Rat*

Groups of 20 male and 20 female Fischer 344 rats, seven weeks old, were fed a diet containing 0 or 300 mg/kg of diet MeIQ (purity, > 99%) for 286 days. Animals that became moribund were killed and autopsied during the experiment. The first tumours of the Zymbal gland, oral cavity and skin were seen independently in three rats on day 139; the numbers of rats that lived after that time being taken as the effective numbers. At termination of the experiment, none of the treated males and 4/20 treated females were still alive. Zymbal gland tumours were found in 19/20 ($p < 0.001$) treated males and 17/20 ($p < 0.001$) treated females; most of these tumours were squamous-cell carcinomas, one of which (in a female)

metastasized to the lung. Oral cavity tumours were observed in 7/20 ($p < 0.005$) treated males and 7/20 ($p < 0.005$) treated females and were diagnosed histologically as squamous-cell carcinomas or sebaceous squamous-cell carcinomas. Colonic tumours (adenomas or adenocarcinomas) were found in 7/20 ($p < 0.005$) treated males and 5/20 ($p < 0.025$) treated females. Skin tumours, mainly squamous-cell carcinomas, were found in 10/20 ($p < 0.001$) treated males and in 1/20 treated female. Mammary gland tumours (mostly adenocarcinomas) were found in 5/20 ($p < 0.025$) treated females. A few additional tumours were observed at different sites (males: one adenoma and two adenocarcinomas of the small intestine, one neoplastic nodule of the liver and one papilloma of the forestomach; females: two adenocarcinomas of the small intestine and one squamous-cell carcinoma of the clitoral gland). No tumour of the Zymbal gland, oral cavity, colon, skin or mammary gland was found in the controls (Kato *et al.*, 1989).

3.2 Administration with known carcinogens

3.2.1 *Sequential exposure*

Rat

As part of a mid-term carcinogenicity study on the synergistic effects of five heterocyclic amines, groups of 14–15 male Fischer 344 rats, six weeks of age, each received a single intraperitoneal injection of 200 mg/kg *N*-nitrosodiethylamine and, two weeks later, were fed a diet containing MeIQ at 12, 60 or 300 mg/kg. A two-thirds partial hepatectomy was performed in week 3 of the experiment; all animals were killed after eight weeks. Fifteen rats treated only with the nitrosamine served as controls. The effects were assessed by counting placental-form glutathione *S*-transferase-positive foci in the liver. MeIQ alone at the mid- and high-dose levels significantly increased the area of positive foci (Ito *et al.*, 1991).

3.2.2 *Prior exposure*

Rat

Groups of 50 male Wistar rats, six weeks old, were given MeIQ at 10 mg/kg bw or solvent (water, acidified to pH 3.5 with citric acid) by gavage every day for two weeks. One week later, the rats were divided into two groups and received either no additional treatment or 500 ppm [mg/l] phenobarbital sodium in the drinking-water until the end of the study at week 58. Interim sacrifice was performed on 10 animals from each group at week 42. Zymbal gland tumours were found in 5/40 rats that received MeIQ alone ($p < 0.05$) and in 3/40 that received MeIQ plus phenobarbital. One animal given MeIQ alone also had a lymphatic leukaemia and another a squamous-cell carcinoma of the skin. Two rats given MeIQ plus phenobarbital developed hepatocellular carcinomas, one, a sarcoma of unclassified histogenesis in the liver, one, lymphatic leukaemia and one, a cutaneous papilloma. One lipoma of the mesentery was found in untreated animals (Kristiansen *et al.*, 1989)

4. Other Relevant Data

4.1 Absorption, distribution, metabolism and excretion

The toxicology and metabolism of heterocyclic aromatic amines have been reviewed (Övervik & Gustafsson, 1990; Aeschbacher & Turesky, 1991).

4.1.1 *Humans*

No data were available to the Working Group.

4.1.2 *Experimental systems*

^{14}C-MeIQ was rapidly absorbed, metabolized and excreted following its oral administration to rats (Sjödin & Jägerstad, 1984; Størmer *et al.*, 1987); excretion occurred through the urine, bile and faeces, mostly within the first 24 h, regardless of the exposure route. The proportion of radiolabel excreted in the urine and faeces was about the same (Sjödin & Jägerstad, 1984).

In mice, intravenously administered ^{14}C-MeIQ was distributed rapidly to the liver, kidney, stomach, lymphomyeloid tissues and endocrine tissues. MeIQ crossed the placenta to reach the fetus in pregnant NMRI mice, but no radiobel was retained in fetal tissues after 24 h (Bergman, 1985). MeIQ is metabolized along a number of pathways, including *N*-hydroxylation, aromatic hydroxylation and conjugation reactions of acetylation, sulfation and glucuronidation, to produce a complex array of metabolites both *in vivo* and *in vitro* (Størmer *et al.*, 1987; Alexander *et al.*, 1989).

Once absorbed, MeIQ is activated through *N*-hydroxylation to its mutagenic and reactive form, mainly by the human hepatic cytochrome P450 isozyme P450 IA2 and to some extent by P450 IA1 (McManus *et al.*, 1990). Human liver microsomes can activate MeIQ into a DNA-reactive species. (See Fig. 1, in the monograph on IQ, p. 178.) The cytochrome P450 isozyme responsible has been identified tentatively as CYP IA2 (P450 IA2) (Shimada *et al.*, 1989). Other metabolic pathways appeared to result in detoxication (Alldrick *et al.*, 1986). MeIQ can also be activated by a prostaglandin hydroperoxidase-dependent pathway, as shown in microsomes isolated from ram seminal vesicles (Wild & Degen, 1987; Petry *et al.*, 1989).

In a study designed to provide information on the metabolic steps involved in the formation of the active mutagenic form, MeIQ was not mutagenic to *Salmonella typhimurium* TA98/1,8-DNP6 (defective in esterifying activity) in the presence of an exogenous metabolic system (S9 mix), but it was strongly mutagenic to the original TA98 with S9 mix, suggesting that the ultimate form of MeIQ is a reactive ester of its *N*-hydroxy derivative (Nagao *et al.*, 1983a). In the presence of a microsomal activation system, MeIQ bound to protein and DNA. Binding of MeIQ to protein was enhanced in the presence of microsomes from animals pretreated with Aroclor 1254 and β-naphthoflavone (Wallin & Alexander, 1988).

Certain species of colonic bacteria (i.e., *Eubacterium* and *Clostridium*) have been reported to activate MeIQ to 7-hydroxy-MeIQ, a highly mutagenic metabolite for *Salmonella typhimurium* strain TA98 (Van Tassell *et al.*, 1990). Diet may influence the metabolism and activation of MeIQ. Thus, hepatic postmitochondrial fractions from Ola:Sprague-Dawley rats fed high-fat diets showed increased metabolic activation of MeIQ (Alldrick *et al.*, 1987). MeIQ bound to various dietary fibres *in vitro* (Sjödin *et al.*, 1985).

4.2 Toxic effects

No data were available to the Working Group.

4.3 Reproductive and developmental toxicity

No data were available to the Working Group.

4.4 Genetic and related effects

The genetic effects of MeIQ have been reviewed (Sugimura, 1985; Hatch, 1986; de Meester, 1989).

4.4.1 *Humans*

No data were available to the Working Group.

4.4.2 *Experimental systems* (see also Table 1 and Appendices 1 and 2)

MeIQ induced prophage, SOS repair and mutation in bacteria and somatic mutations in *Drosophila melanogaster*. In cultured hepatocytes of rat, mouse, Syrian hamster and guinea-pig, MeIQ induced DNA strand breaks and unscheduled DNA synthesis. In mammalian cell lines, it induced mutations at the *hprt* locus as well as diphtheria toxin-resistant mutants; it induced sister chromatid exchange and micronucleus formation in one experiment but not in others.

After administration *in vivo*, MeIQ formed DNA adducts in multiple mouse organs and induced DNA strand breaks in several rat organs. It also induced sister chromatid exchange in the colonic mucosa of mice treated orally.

4.4.3 *Genetic changes in animal tumours*

Activated c-Ha-*ras* proto-oncogenes were found in four of seven squamous-cell carcinomas of the forestomach induced by MeIQ in mice as a result of G to T transversion at the second base of codon 13 (Makino *et al.*, 1992). Activated c-Ha-*ras* was also found in all of 15 Zymbal gland tumours induced in rats by MeIQ. The mutations were G to T transversions at the second base of codon 13 (10 tumours), a G to T transversion at the second base of codon 12 (one tumour) and a G to A transition at the second base of codon 12 (one tumour) (Kudo *et al.*, 1991).

5. Summary of Data Reported and Evaluation

5.1 Exposure data

MeIQ (2-Amino-3,4-dimethylimidazo[4,5-*f*]quinoline) has been found in cooked meat and fish. A few determinations indicated that the levels of MeIQ were lower than those of IQ, MeIQx and PhIP.

5.2 Human carcinogenicity data

No data directly relevant to an evaluation of the carcinogenicity to humans of MeIQ were available. Studies on the consumption of cooked meat and fish are summarized in the monograph on IQ.

Table 1. Genetic and related effects of MeIQ

Test system	Result		Dose (LED/HID)[a]	Reference
	Without exogenous metabolic system	With exogenous metabolic system		
PRB, Prophage induction, *Escherichia coli* K12	0	+	0.1000	Nagao *et al.* (1983b)
PRB, SOS repair, *Salmonella typhimurium* TA1535	0	+	0.5700	Nakamura *et al.* (1987)
PRB, *umu* expression, *Salmonella typhimurium* TA1535/pSK1002	0	+	2.0000	Shimada *et al.* (1989)
PRB, SOS repair, *Salmonella typhimurium* with human adult and fetal microsomes	0	+	2.0000	Kitada *et al.* (1990)
ERD, *Escherichia coli rec* strains, differential toxicity	-	+	0.0700	Knasmüller *et al.* (1992)
SA0, *Salmonella typhimurium* TA100, reverse mutation	0	+	0.0250	Nagao *et al.* (1981)
SA0, *Salmonella typhimurium* TA100, reverse mutation	-	+	0.0000	Grivas & Jägerstad (1984)
SA0, *Salmonella typhimurium* TA100, reverse mutation	0	+	0.0000	Felton & Knize (1990)
SA0, *Salmonella typhimurium* TA100, reverse mutation	+	+	0.0500	Lin *et al.* (1992)
SA0, *Salmonella typhimurium* TA100, reverse mutation	+[b]	+	0.0080	Lin *et al.* (1992)
SA2, *Salmonella typhimurium* TA102, reverse mutation	0	-	0.0000	Felton & Knize (1990)
SA4, *Salmonella typhimurium* TA104, reverse mutation	0	+	0.0000	Felton & Knize (1990)
SA5, *Salmonella typhimurium* TA1535, reverse mutation	(+)[b]	-	0.0080	Lin *et al.* (1992)
SA8, *Salmonella typhimurium* TA1538, reverse mutation	0	+	0.0400	Felton & Knize (1990)
SA9, *Salmonella typhimurium* TA98, reverse mutation	-	+	0.0000	Kasai *et al.* (1980b)
SA9, *Salmonella typhimurium* TA98, reverse mutation	0	+	0.0025	Nagao *et al.* (1981)
SA9, *Salmonella typhimurium* TA98, reverse mutation	0	+	0.0012	Nagao *et al.* (1983a)
SA9, *Salmonella typhimurium* TA98, reverse mutation	-	+	0.0000	Grivas & Jägerstad (1984)
SA9, *Salmonella typhimurium* TA98, reverse mutation	0	+	0.0020	Loury et al. (1985)
SA9, *Salmonella typhimurium* TA98, reverse mutation	0	+	0.0050	Howes *et al.* (1986)
SA9, *Salmonella typhimurium* TA98, reverse mutation	-	+[d]	0.0200	Holme *et al.* (1987)
SA9, *Salmonella typhimurium* TA98, reverse mutation	0	+	0.0005	Buonarati & Felton (1990)
SA9, *Salmonella typhimurium* TA98, reverse mutation[c]	0	+	0.0000	Ishida *et al.* (1987)
SA9, *Salmonella typhimurium* TA98, reverse mutation	0	+	0.0000	Felton & Knize (1990)
SA9, *Salmonella typhimurium* TA98, reverse mutation	+	+	0.0001	Lin *et al.* (1992)
SA9, *Salmonella typhimurium* TA98, reverse mutation	+[b]	+	0.0001	Lin *et al.* (1992)
SAS, *Salmonella typhimurium* TA98/1,8-DNP_6, reverse mutation	0	-	0.0050	Nagao *et al.* (1983a)

Table 1 (contd)

Test system	Result		Dose (LED/HID)[a]	Reference
	Without exogenous metabolic system	With exogenous metabolic system		
SAS, *Salmonella typhimurium* TA98/1,8-DNP_6, reverse mutation	0	–	0.0005	Buonarati & Felton (1990)
SAS, *Salmonella typhimurium* TA98/1,8-DNP_6, reverse mutation	0	–[d,e]	100.0000	Holme *et al.* (1988)
SAS, *Salmonella typhimurium* TA98NR, reverse mutation	0	+[d,e]	100.0000	Holme *et al.* (1988)
SAS, *Salmonella typhimurium* TA96, reverse mutation	0	+	0.0000	Felton & Knize (1990)
SAS, *Salmonella typhimurium* TA97, reverse mutation	0	+	0.0000	Felton & Knize (1990)
SAS, *Salmonella typhimurium* TA97, reverse mutation	+	+	0.0500	Lin *et al.* (1992)
SAS, *Salmonella typhimurium* TA97, reverse mutation	+[b]	+	0.0008	Lin *et al.* (1992)
DMM, *Drosophila melanogaster*, somatic mutation and recombination	+	0	25.0000	Yoo *et al.* (1985)
DIA, DNA strand breaks, rat hepatocytes[e] *in vitro*	+	0	20.0000	Holme *et al.* (1987)
DIA, DNA strand breaks, Chinese hamster lung V79 cells *in vitro*	–	–[d,e]	100.0000	Holme *et al.* (1987)
URP, Unscheduled DNA synthesis, rat primary hepatocytes *in vitro*	+	0	0.1000	Yoshimi *et al.* (1988)
URP, Unscheduled DNA synthesis, rat hepatocytes *in vitro*	+	0	1.0000	Liu *et al.* (1990)
UIA, Unscheduled DNA synthesis, Syrian hamster primary hepatocytes *in vitro*	+	0	1.0000	Yoshimi *et al.* (1988)
UIA, Unscheduled DNA synthesis, mouse primary hepatocytes (female) *in vitro*	+	0	1.0000	Yoshimi *et al.* (1988)
UIA, Unscheduled DNA synthesis, mouse primary hepatocytes (male) *in vitro*	+	0	10.0000	Yoshimi *et al.* (1988)
GCL, Gene mutation, Chinese hamster lung cells, DT^r *in vitro*	–	+	7.5000	Nakayasu *et al.* (1983)
GCL, Gene mutation, Chinese hamster lung cells *in vitro*	0	+	1.0000	Sugimura *et al.* (1989)
GCO, Gene mutation, Chinese hamster ovary cells (*uv5*) *in vitro*	0	+	75.0000	Thompson *et al.* (1987)
G9H, Gene mutation, Chinese hamster V79 cells *hprt* locus *in vitro*	–	(+)[d,e]	20.0000	Holme *et al.* (1987)
G90, Gene mutation, Chinese hamster lung V79 cells ouabain^r *in vitro*	0	–	50.0000	Takayama & Tanaka (1983)
SIC, Sister chromatid exchange, Chinese hamster V79 cells *in vitro*	–	+[d,e]	20.0000	Holme *et al.* (1987)

Table 1 (contd)

Test system	Result		Dose (LED/HID)[a]	Reference
	Without exogenous metabolic system	With exogenous metabolic system		
SIC, Sister chromatid exchange, Chinese hamster ovary (*uv5*) cells *in vitro*	0	(+)	200.0000	Thompson *et al.* (1987)
SIC, Sister chromatid exchange, IAR 20 cells *in vitro*	+	0	0.1000	Liu *et al.* (1990)
SIC, Sister chromatid exchange, Chinese hamster V79 cells *in vitro*	0	+	0.0035	Liu *et al.* (1990)
MIA, Micronucleus test, Chinese hamster V79 cells *in vitro*	0	+	0.0020	Liu *et al.* (1990)
CIC, Chromosomal aberrations, Chinese hamster ovary (*uv5*) cells *in vitro*	0	(+)	400.0000	Thompson *et al.* (1987)
HMM, Host-mediated assay, *Escherichia coli* in intrasanguinous mice *in vivo*	+		2.3 × 1 ip	Knasmüller *et al.* (1992)
DVA, DNA strand breaks, rat[e] liver, large intestine, kidney *in vivo*	+		5.00 × 1 ip (po)	Holme *et al.* (1991)
SVA, Sister chromatid exchange, mouse colonic epithelial cells *in vivo*	+		50.00 × 1 ip	Couch *et al.* (1987)
BID, Binding (covalent) to DNA in rat hepatocytes *in vitro*[f]	+	0	10.0000	Wallin *et al.* (1992)
BVD, Binding (covalent) to DNA in mice (multiple organs) *in vivo*[g]	+		25.00 × 1 po	Hall *et al.* (1990)

+, positive; (+), weakly positive; –, negative; 0, not tested; ?, inconclusive (variable response in several experiments within an adequate study)

[a]In-vitro tests, μg/ml; in-vivo tests, mg/kg bw

[b]MeIQ reacted with nitrite (not on profile)

[c]Rhesus liver S9

[d]Hepatocytes

[e]Polychlorinated biphenyl-treated

[f]^{14}C-Label

[g]^{32}P-Postlabel

5.3 Animal carcinogenicity data

MeIQ was tested for carcinogenicity by dietary administration in one study in mice and in one study in rats. In mice, hepatocellular adenomas and carcinomas were induced in females and papillomas and squamous-cell carcinomas of the forestomach in animals of each sex in a dose-dependent manner. In rats, oral administration of MeIQ produced squamous-cell carcinomas of the Zymbal gland and oral cavity and adenomas and adenocarcinomas of the colon in animals of each sex, squamous-cell carcinomas of the skin in male rats and mammary adenocarcinomas in female rats.

Sequential administration of MeIQ after *N*-nitrosodiethylamine enhanced the appearance of foci of altered hepatocytes in rat liver.

5.4 Other relevant data

No data were available on the genetic and related effects of MeIQ in humans.

MeIQ bound to DNA and induced DNA damage and sister chromatid exchange in rodents treated *in vivo*. It induced DNA damage and gene mutation in rodent cells *in vitro* and gene mutation in insects. It induced DNA damage and mutation in bacteria.

MeIQ can be metabolized by human liver microsomes to a species that damages bacterial DNA.

5.5 Evaluation[1]

There is *inadequate evidence* in humans for the carcinogenicity of MeIQ.

There is *sufficient evidence* in experimental animals for the carcinogenicity of MeIQ.

Overall evaluation

MeIQ (2-Amino-3,4-dimethylimidazo[4,5-*f*]quinoline) *is possibly carcinogenic to humans (Group 2B).*

6. References

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[1]For definition of the italicized terms, see Preamble, pp. 26-29.

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