GENERAL REMARKS ON THE SUBSTANCES CONSIDERED

This fifty-first volume of *IARC Monographs* describes the evidence for possible carcinogenic effects of coffee, tea, mate, three methylated xanthines (caffeine, theophylline and theobromine) and methylglyoxal. Caffeine, other methylated xanthines and coffee drinking were recommended in June 1984 for evaluation in the *IARC Monographs* by an ad-hoc Working Group of scientists from many countries engaged in the study of human health problems (IARC, 1984). The topics for consideration were broadened by the IARC to include tea and mate because these are also methylxanthine-containing beverages which are consumed in large quantities. Serious consideration was also given to the inclusion of caffeinated soft drinks and chocolate, which are widely consumed thoughout the world, but these products have not been the specific object of any epidemiological or experimental studies.

Green coffee beans are one of the major commodities of world trade. More than five million tonnes are produced annually in some 50 coffee-growing nations, and coffee is second only to oil in international commerce. Green coffee is the second most important food commodity in the world after wheat (Viani, 1986). Approximately 1.5 billion cups of coffee are drunk every day throughout the world (Anon., 1987). The highest per-caput consumption of coffee prevails in the Scandinavian countries and amounts to four to five cups per person per day. Therefore, the safety of this product has major consequences for international public health as well as for the world economy.

Tea is presently the most popular beverage in the world. In parts of Asia and North Africa, green tea is the principal type consumed, whereas black tea is preferred elsewhere in the world. Mate, prepared from the dried leaves of a local tree, is a popular beverage in parts of South America.

The basis for preparing the monograph on coffee was the results of early case-control studies in which an association between bladder cancer and coffee consumption was suggested. In many parts of the world, an individual may drink coffee, tea and caffeine-containing soft drinks; therefore, the health effects of these beverages are difficult to isolate and assess. Some of the case-control studies that have been undertaken examined both tea and coffee consumption or estimated

total methylxanthine intake. Furthermore, coffee and tea are complex mixtures of hundreds of compounds of widely different chemical classes. Some components of these beverages have been the subject of long-term experiments in animals to study their potential carcinogenicity. Compounds that have been reported to occur in coffee and tea and which have been evaluated previously in the *IARC Monographs* series are listed in Table 1. Various strains of beans and of tea are grown under different conditions and are processed for consumption in a variety of ways. The beverages are then prepared according to different local customs, which may include boiling, filtration and the addition of other plant materials (e.g., lemon juice) or milk. A third problem is that it is difficult to quantify individual consumption of coffee and tea, as there is no standardized measure for a cup of either beverage. Lastly, the use of these beverages is associated with other widespread concomitant behaviours, such as cigarette smoking and certain dietary habits, and these associations may vary even within regions.

Table 1. Compounds that have been reported to occur in coffee and tea and which have been evaluated previously in the *IARC Monographs* series[a]

Compound	*IARC Monographs* (volume, year)	Evaluation		
		Humans	Animals	Overall
Coffee beverage				
Acetaldehyde	*36*, 1985[b]	I	S	2B
Catechol	*15*, 1977	ND	I	3
Formaldehyde	*29*, 1982[b]	L	S	2A
Hydrogen peroxide	*36*, 1985	ND	L	3
Hydroquinone	*15*, 1977	ND	I	3
Phenol	*47*, 1989	I	I	3
Black tea				
Hydrogen peroxide	*36*, 1985	ND	L	3
Kampferol	*31*, 1983	ND	I	3
Phenol	*47*, 1989	I	I	3
Quercetin	*31*, 1983	ND	L	3
Green tea				
Phenol	*47*, 1989	I	I	3
Additives in tea				
Bergamot oil (containing 5-methoxypsoralen)	*40*, 1986[b]	I	S	2A

[a] Possible contaminants are discusssed in the respective monographs.
[b] Also considered in Supplement 7

An important component of coffee is caffeine; its stimulatory action is considered to be one of the reasons for the popularity of coffee and other caffeine-containing beverages (Viani, 1986), although consumption of decaffeinated coffee is increasing in some parts of the world. Quantification of caffeine intake is difficult not only because of the lack of standardization of cups of tea or coffee but also because of the multiplicity of sources containing it; it is the dominant pharmacologically active constituent of coffee and tea and is also present in many nonprescription pharmaceutical preparations.

It has been suggested that excessive use of caffeine-containing beverages, particularly coffee, influences the risk for coronary heart disease. The question is still open, despite a vast body of research, reviewed only in part in this volume. Concern over the past 10-15 years about the potential of caffeine and caffeine-containing foods and beverages to cause adverse reproductive effects or birth defects in humans stemmed from a series of studies in laboratory animals, dating back to 1960. These showed that caffeine was teratogenic in animals at doses far in excess of the levels of consumption of caffeine by humans. Recent studies in which human exposure was mimicked more appropriately have been used to assess the potential reproductive and developmental toxicity from the use of caffeinated products by humans. The large number of animal studies in which reproductive and developmental toxicity was evaluated compared to other manifestations of toxicity, including cancer, reflects the concern over potential adverse reproductive effects.

Mate had been reported to be associated with increased risks of oesophageal cancer.

Carcinogenicity studies in experimental animals were available on coffee, tea (or tea fractions) and caffeine. With regard to theophylline and theobromine, experimental studies were available only on their modifying effects on carcinogenesis. Methylglyoxal, which is present in brewed and instant coffee, was the subject of a carcinogenicity study in animals which had been reported at the time the substances were selected. No monograph was prepared on glyoxal, which is also present in brewed and instant coffee and in many foods, because no carcinogenicity data were available. A recent study by Takahashi *et al.* (1989) examined only the potential modifying effects of glyoxal on carcinogenesis in the rat stomach and was not designed to investigate its carcinogenic potential in an adequate manner.

It is noteworthy that all these beverages, which have been consumed worldwide in large quantities for centuries, have been tested for carcinogenicity in experimental animals only recently. No proper carcinogenicity testing has been done for tea, the world's most commonly consumed beverage, or for mate.

References

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