FORMATION OF HETEROCYCLIC AMINES DURING MEAT EXTRACT PROCESSING AND COOKING

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ABSTRACT

Standardized biological in vitro systems and in particular those used for cancer prediction are being used to monitor the development of food products in order to ensure the absence of potential mutagens or carcinogens. Maillard reactions occurring during meat extract production was followed in order to reduce the formation of heterocyclic amines. Possibilities to reduce the content of heterocyclic amines during meat extract processing have been proposed. However, several aspects, such as interaction with food-borne mutagen or carcinogen inhibitors, keeping quality, and organoleptic properties have also be taken into consideration. Whenever possible, food contaminants must be analytically determined and compared to total intake exposure and tolerated levels of other comparable food contaminants to establish realistic "tolerated" contamination levels.

INTRODUCTION

Deleterious effects on health such as allergies, obesity, diabetics, osteoporosis etc, have been associated with diet. However, the main worry today is the possible presence of food contaminants with mutagenic or carcinogenic potential (U.S. Dept. of Health 1988). Therefore toxicological screening tests (mutagenicity tests) are widely being used to evaluate food products. Such approaches in particular for in vitro tests require extraction and/or purification of complex substances such as food products. This intervention, however, can alter the outcome of the results by introducing artefacts (Aeschbacher et al., 1983) or by loosing components with potential antimutagenic or anticarcinogenic property. Furthermore are in vitro results which only cover one aspect of risk assessment too often used to directly predict cancer risks. However, their cancer predictability is less appropriate than had previously been expected (Tennant et al., 1987). Although this depends on the chemical class and their characteristics (Aeschbacher, 1990). The complexity of this aspect is therefore greater than generally is admitted. This is presently being illustrated with heat processing of meat products which generates exceedingly low amounts of mutagenic heterocyclic amines.
The most efficient tool to detect traces of the various heterocyclic amines in heated food is the Ames-Salmonella mutagenicity test (De Meester, 1989; Sugimura et al., 1986, 1990). Due to the lack of adequate and simple analytical methods this test was so far widely used to estimate levels of heterocyclic amines by semi-quantitative means.

Mutagenic response to TA 98 by heterocyclic amines (Aminoimidazo Azaarenes). Some of the heterocyclic amines like protein pyrolysis products (Amino-carboline congeners) were shown to have even lower mutagenic responses in tester strain TA 98 e.g. 40 revertants/µg for Phe-P-1 (De Meester, 1989). *For MeIQ a very high reported value (De Meester, 1989), was not considered for calculating the mean number of revertants.

Such a semi-quantitative approach, however, has serious drawbacks and therefore standardized and objective evaluation is required. In fact the actual mutagenic activity of the various heterocyclic amines observed in the Ames test varied considerably (Felton et al., 1988; De Meester et al., 1990). Of the two major compounds in heated meat namely MeIQx and PhIP the difference in mutagenic response in Ames tester strain TA 98 is about a hundred fold. Hence an extracted heated meat sample of comparable mutagenic potential would contain about a hundred times less of one compound (MeIQx) than of the other (PhIP) (see fig. 1). Furthermore, considerable discrepancies between laboratories were observed for some compounds e.g. a 200 fold different response in TA 98 for MeIQ (De Meester, 1989).