Mutagenic Potential of Green Chillies

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During the past few years many chemical compounds including food additives, drugs, pesticides, cosmetics, water and air pollutants, industrial and household products etc. have been tested and some of them have been found to possess mutagenic and/or carcinogenic ability (Drake *et al.* 1975, De Serres 1976). Substances with high mutagenic risks have been banned in many countries. The discovery that some of the chemicals which were found to be mutagenic can also be classified as supermutagens has created world wide concern over their effects on man.

Chilli is one of the main ingredients in the curry powder and paste that is made for the preparation of fish, meat and vegetables in many countries. Chilli is utilized both in the green and dried form in food. Green chilli possesses appreciable quantities of vitamin C. The characteristic feature of chilli is the burning pungency. The pungency of chilli is due to the crystalline volatile alkaloid called "capsaicin"— $C_9H_{14}O_2$ (MacGillivray 1961). Capsaicin occurs in the cross or septa wall and is generally considered to be present in the placenta. People often experience excessive salivation and burning sensation in the mouth after eating food spiced heavily with chillies. In many cases, excessive use of chillies has resulted in inflammation in the mouth. Nevertheless, nothing is known about the cellular damage produced by chillies. This paper reports the chromosome breaking capacity and cytotoxicity of green chillies.

Material and methods

Roots of *Allium cepa* were treated with extracts of green chillies (*Capsicum annuum*). Twenty three green chillies weighing 50 grams were crushed in a mortar and 24 cc of the extract thus obtained was diluted with distilled water to obtain desired concentrations. Roots of bulbs germinated in pure sand were immersed in varying concentrations of the extract (10%, 5%, 2.5% and 1%). The roots were treated by suspending the bulbs in the aerated extract for 6 hours and 24 hours. After treatment, the root tips which have been washed and cut from the bulb, were fixed in Carnoy's fluid. They were hydrolysed in 1 N HCl at 60°C for 8-10 minutes and squashed in hematoxylin. Control roots were grown under identical conditions to those of the experimental root except for the absence of the extract.

Observations

The cytogenetic damage produced by extracts of green chillies was determined from the mitotic preparation of the treated roots. For the assessment, the

Figs. 1-7. All figures $\times 1000$. 1, metaphase showing dissolution of the chromosome matrix. 2 and 3, metaphases showing chromosome clumping. 4 and 5, cells showing breakages and acentric lesions. 6, cell showing extreme fragmentation of the chromosomes. 7, anaphase showing acentric lesions and bridges.

percentage of cells showing abnormalities such as stickiness of chromosomes, achromatic lesions or 'gaps' and fragments were determined.

The untreated roots showed normal divisions and 0.53% of the metaphases showed fragments. Ten percent concentrations of the extract of green chillies have been found to be toxic to cells. In many cells, the matrix of the chromosomes gets dissolved away (Fig. 1). Stickiness or clumping of the chromosomes was observed in all the concentrations studied (Figs. 2 and 3). It may be noted from Table 1 that in roots treated with 10 percent concentration of the extract, 85.16% of the metaphases showed clumping of chromosomes. Extreme fragmentation of the chromosome type and chromatid type were observed in 5% treated cells (Fig. 4). Achromatic lesions or 'gaps' were noticed in many cells at the metaphase and anaphase stages of division (Fig. 5 and Fig. 7). In extreme cases, the chromosomes get broken up into tiny bits and in such cells, the linear outline of the chromosomes were scarcely retained (Fig. 6). The occurrence of high frequency of bridges at anaphase (Fig. 7) may be attributed to chromosome stickiness and consequent failure of free anaphase separation.

Table 1. Distribution of abnormalities at metaphase in root tip cells of onion treated with extracts of green chillies

Treatments	Total metaphases analysed	Percentage of metaphases showing		
		1-3 fragments	Multiple breaks and 'gaps'	Clumping of chromosomes
Control	380	0.53	—	—
0.5%— 6 hrs	190	2.11	5.26	30.53
1% — "	263	1.14	7.60	48.29
2.5%— "	170	1.76	23.53	30.00
5% — "	419	1.91	4.77	76.61
10% — "	411	1.95	8.27	85.16
0.5%—24 "	110	3.64	10.00	14.55
1% — "	116	6.90	13.79	43.10
2.5%— "	143	3.50	32.87	41.26
5% — "	141	0.71	16.31	53.19

Discussion

The interest in testing chillies stems from its widespread use as ingredient in the preparation of food items. The cytological studies showed that extracts of chillies produced severe chromosome breakage and clumping of chromosomes in root tip cells of onion.

The hypothesis that environmental factors play an important role in the induction of human cancer and other diseases is receiving wide support now. Vinyl chloride used in industry as a propellant in aerosol sprays, household products and as polyvinyl chloride in the plastic industry has both carcinogenic and mutagenic properties (Lee and Hary 1974, Bartch and Montesano 1975). Significant levels of chromosome damage have also been reported in the somatic cells of workers exposed to Vinyl chloride (Cravioto *et al.* 1975). The nitrofuran deriva-

tive AF-2 which has recently been banned in food industry in Japan is known to be a potent mutagen and has been found to induce chromosome aberrations in human lymphocytes *in vitro* (Tonomura and Sasaki 1974) and rat bone marrow cells *in vivo* (Sugiyama *et al.* 1975). The lathyrogens present in *Lathyrus* species have been found to induce chromosome breakage, stickiness and other abnormalities in the mitotic and meiotic cells of *Vicia faba* (Raj and Reddy 1971). As is well known, osteolathyrism and neurolathyrism occur in human beings due to consumption of 'Kesari dal'. The widely used condiments ginger and turmeric have also been found to induce heavy chromosome breakage and chromatid exchange in root tip cells of onion (Abraham *et al.* 1976).

Chillies are used excessively in the preparation of food in countries like India, Ceylon, Nepal, Thailand and South Vietnam. The amount of chillies consumed varies according to individual taste. The poor as well as the rich consume a lot of chillies in some parts of South India. Pindborg and Sirsat (1966) in their studies on the prevalence of oral submucous fibrosis have observed that this disease is common in countries like India, Ceylon, Nepal, Thailand and South Vietnam where chillies are commonly used in the diet. Positive evidence in favour of this was provided by them in their observation that on eating chillies, vesicles appear on the palates of some persons. Palatal vesicles were found to appear in a young man, 3 hours after he had eaten a meal spiced very strongly with chillies. The possible pre-cancerous nature of oral submucous fibrosis has also been mentioned by Paymaster (1956), Pindborg (1965), Pindborg and Zachariah (1965) and Pindborg and Sirsat (1966).

The present study has shown that green chillies used in the preparation of fish, meat and vegetable dishes can bring about irreparable cellular damage. The continued use of excessive quantities of chillies may be a matter of considerable concern as a potential human health hazard in countries where it is excessively used.

Summary

In a cytogenetic study on dividing root tip cells of onion, extract of green chillies was evaluated for cytotoxic and mutagenic effects in comparison with an untreated control group.

The occurrence of achromatic lesions or 'gaps', chromosome breakage, chromosome clumping etc. were noticed in the treated cells. The frequency of abnormal metaphases was determined in the different treatments.

The present study has shown that extract of green chillies (*Capsicum annum*) produces irreparable damage in root tip cells of onion. It is advisable to limit the use of chillies in food as far as possible.

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