

market. The production of transgenics if goes into the hands of few companies, the agricultural diversity in the farmers' field will be reduced to a few patented varieties and in the long term this is a threat to the world's food supplies.'

Hopefully, the collected genetic traits, maintained under storage or in germplasm centres or gene banks like NBPGR in India, will offer sustained free access to the farming community for use in the future. The government should also encourage the collection of such diversified

genetic traits to help the farmers in case the transgenics fail in their task.

We do need transgenics and research on them has to be encouraged. While it is necessary to clear any doubts on transgenics among the consumer-public, it is also necessary to develop genetically modified crops devoid of gene protection (terminator) technology and selectable markers.

Ultimately one should aim not to leave the human community (i) rely upon one or two crops/varieties for cultivation in

the future; (ii) lack self-sufficiency in the fields; (iii) rely upon monopolistic commercialization of essential crops.

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Herbal medicine – Some comments

While dealing with popularity of herbal medicines (HM) all over the world, Kamboj¹ has emphasized some widely used wrong concepts. The claims of safety and lesser side-effects of HM are in stark contrast with the reports published from time to time^{2,3}. The belief that constituents of HM 'have better compatibility with the human body' due to their origin in living systems appears dangerous, as exemplified by an observer: 'I have considerable respect for the potential toxicity of plants. Some of the most poisonous substances known – curare, digitalis, ricin, and many others – are hidden in seemingly innocent greenery'⁴. Other problems associated with the use of HM stem from their heterogeneous nature^{5,6} and admixing of synthetic drugs (like corticosteroids) to herbal formulations by the manufacturers². Simultaneous use of western and herbal remedies may lead to dangerous interactions^{7,8}. A recent systematic survey on some HM in

Canada revealed that most of them were unsafe or ineffective. In some cases sufficient information was not available for their evaluation⁹. Such objective attitude towards HM is, by and large, absent in our country. Most of the reviewers either selectively highlight the promising aspects of these traditional medicines or express skepticism about their efficacy¹⁰. The vast potential of HM to complement western medicines can be hardly denied but problems associated with their use cannot be winked at. As a matter of fact, regulation of HM to ensure their safe use, is a global problem at present. Measures, suggested by Kamboj, for their standardization are useful but the cost involved in maintaining the required research infrastructure is a discouraging factor to the manufacturers.

1. Kamboj, V. P., *Curr. Sci.*, 2000, **78**, 35–39.

2. Huxtable, R. J., *Drug Saf.*, Suppl. 1, 1990, **5**, 126–136.
3. Chattopadhyay, M. K., *Curr. Sci.*, 1999, **76**, 1415.
4. Savage, A., *Br. Med. J.*, 1993, **307**, 332.
5. Chattopadhyay, M. K., *Curr. Sci.*, 1996, **71**, 5.
6. Chattopadhyay, M. K., *Curr. Sci.*, 1997, **72**, 6.
7. Miller, L. G., *Arch. Intern. Med.*, 1998, **158**, 2200–2211.
8. Fugh-Berman, A., *Lancet*, 2000, **355**, 134–138.
9. Kozyrskyj, A., *Can. Fam. Physician*, 1997, **43**, 697–702.
10. Padayatty, S. J., *Curr. Sci.*, 1999, **77**, 627–628.

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Tropospheric ozone: An emerging problem in the urban environment

Chemistry of tropospheric ozone formation is a major complex and nonlinear problem of atmospheric research which is related to the public health, reduction in crop yield and climate change. This correspondence deals with the complex mechanisms of tropospheric ozone forma-

tion in the ambient environment, to identify the current challenges and strategies employed to control the vehicular emission at a national level.

Tropospheric ozone is a secondary air pollutant which is formed in the presence of sunlight by complex photochemical

mechanisms through its precursors like NO_x (oxides of nitrogen), VOC (volatile organic compounds), CO (carbon monoxide) and CH₄ (methane). NO_x and VOC are major precursors of ozone in the urban environment whereas CO and CH₄ are precursors of rural and oceanic enviro-

onments. The sources of these precursors are vehicular exhaust, industrial emissions, change in land use patterns and a large number of biological processes. In this respect, in the urban environment vehicular exhaust (which consists of NO_x and VOC) is the main source of tropospheric ozone formation. Therefore to reduce the tropospheric ozone concentration in the urban environment, it is necessary to cut down its precursors concentrations, namely the vehicular exhaust.

The maximum tropospheric ozone will be produced at the ratio $\text{VOC}/\text{NO}_x \sim 6$; this condition is described as maximum incremental reactivity, here reactivity meaning the ozone-forming potential. Therefore maximum or peak tropospheric ozone formation is a function of VOC/NO_x ratios and not any individual precursor concentration. It is important to reduce the concentrations of both VOC and NO_x to curtail the ozone concentrations. Because of this complex and nonlinear nature of the chemical system, the environment is classified as NO_x -limited, if VOC/NO_x ratio is greater than 6 and it is VOC-limited, if VOC/NO_x ratio is less than 6, depending upon the VOC and NO_x concentrations.

Atmospheric chemistry of tropospheric ozone formation in the NO_x -limited environment is linear and simple. As long as the chemical system is NO_x -limited, tropospheric ozone formation is a function of NO_x concentration. Therefore it is easy to reduce the ozone concentrations in such an environment by reducing NO_x

concentrations. This type of environment is found in the free troposphere (2 km to tropopause), (about 16 km altitude from the earth surface in tropics) level, remote and oceanic regions where NO_x concentration is low. If the chemical system becomes VOC-limited, then tropospheric ozone-forming mechanisms are more complex and nonlinear. This type of urban environment is characterized as highly polluted and is known as NO_x -saturated. Such high NO_x concentrations are experienced in the atmospheric boundary layer (from the surface of the earth to 2 km height) of the urban atmosphere. In such a situation the abatement policies of ozone become more complex, less effective and less economically viable. For example, after reducing 50% of VOC and NO_x , ozone reduces by 12% only. This indicates that ozone reduction is a highly nonlinear function of its precursor concentrations. Furthermore, because of nonlinearity in ozone-producing mechanisms in the NO_x -saturated environment, if the NO_x concentration is reduced, then ozone concentration will increase instead of decreasing. The VOC reduction is required first in such a type of environment and then NO_x . It is not an easy task to reduce VOC, because of a very large number of anthropogenic as well as natural sources. Because of this, cities like Los Angeles, London and Tokyo are experiencing ozone concentrations more than the prescribed permissible limit of 80 ppbv (parts per billion by volume) set by WHO. In fact, after spending billions

of dollars, these countries have failed to attain ozone concentration less than 80 ppbv in their environment because of the nonlinear and complex nature of chemical systems in the VOC-limited environment. At present, Asian and other developing countries are experiencing NO_x -limited environment and hence ozone abatement is easier in these regions than in developed countries. The concern is that major cities like New Delhi, Mumbai, Calcutta, Chennai and Hong Kong are approaching the VOC-limited environment. Therefore, at this stage, there is an urgent need to reduce the NO_x concentration by reducing the vehicular exhaust through stern legal action. Ozone abatement is easier as long as there is a NO_x -limited environment, but once the urban environment becomes VOC-limited, it is very difficult to reduce ozone concentrations.

The present research shows that ozone concentration is increasing at a rate of about 2% per year in the Asian region which is higher than that in developed countries (about 1 to 1.5%) because of ineffective pollution control policies. Effective pollution control policies, enforcement, effective combustion technologies and public awareness about the environment are needed to be undertaken at the earliest.

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NEWS

Diversification of agriculture for human nutrition*

Green revolution followed by white, yellow and blue revolutions has gone a long way in providing food security at the national level despite the marked increase in population. This however has

not ensured household nutrition security for a variety of reasons. The complex relationship between diversification of agriculture (food grains, horticulture, livestock) and its impact on human nutrition, demand for resources and socio-economic determinants of diversification was discussed at a symposium on 'Diversification of Agriculture for Human Nutrition'. Sobhanadreshwara Rao, Minister for Agriculture and Horticulture, Government of Andhra Pradesh, inaugurated the

conference and said that the new agricultural policy being formulated aimed at increasing the yields of food crops by making the optimum use of the available technologies. Mahtab Bamji, convener of the symposium, said that the true index of development of a country is the health and nutrition status of its people and not just industrial or economic growth. This requires close interaction between agriculture and nutrition scientists, planners and policy makers and the farmers.

*Report of a symposium on 'Diversification of Agriculture for Human Nutrition' organized by the National Academy of Agricultural Sciences (NAAS), at the National Institute of Nutrition, Hyderabad during 16-17 December 1999.