

Free Radicals in Tobacco Smoke

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Over the last twenty years, there has been a growing interest in the presence of free radicals in tobacco smoke - the Reference Section lists 19 citations since 1967, of which half have appeared since 1980. Although almost all of these papers have been in specialist scientific journals, the popular journal New Scientist had an article on the subject in early 1985 [19].

Mechanisms have been proposed which link the presence of free radicals in tobacco smoke to the development of emphysema in smokers [15, 20-23] and which implicate the development of cancer with free radicals in general [24, 25]. From the trends in the scientific literature, there seems every likelihood that future research will attempt to confirm and quantify the proposed mechanisms, especially Pryor's group at Louisiana State University. A review by Pryor at a Free Radical Meeting in Dusseldorf in July 1986 confirms his determination in extending studies on the biological implications of radicals in smoke. Furthermore, it has been privately stated by Dr. A.A. Noronha-Dutra of the Histopathology Department of Middlesex Hospital, London, that changes in animal cells exposed to cigarette smoke are very similar to those that are observed when cells are exposed to free radicals [26]. Up until now, most criticisms of tobacco smoke in relation to ill-health have been based on epidemiological arguments. The involvement of species in tobacco smoke (free radicals) with physico-chemical and biological mechanisms of disease propagation, if it could be demonstrated, would be a new development. The general literature on Smoking and Health and the implications of free radicals in smoke have been reviewed by Colin Greig [27].

Attempts have been made in R&D, Southampton in the past to determine free radicals in smoke condensate [28] using electron spin resonance facilities at Southampton University. These studies were not extensive and were conducted on smoke condensate and not the whole smoke that would be relevant to the smoker. Free radicals are extremely reactive, lasting for less than a second. Recent work has indicated that the radicals must be forming in the smoke itself, i.e. that they are created in smoke as fast as they are destroyed [18]. The implication is that "smoke in a smoker's lung ... is almost certainly producing free radicals" [19]. Because of their reactivity, radicals can readily attach themselves to other molecules and, according to New Scientist [19], they "can cause considerable damage to molecules within cells".

There are very many different free radicals in tobacco smoke. The intriguing possibility is that it is the free radical nature itself (i.e. the unpaired electron in the molecule) that is involved in the postulated biological mechanisms rather than the type of individual radical.

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A measurement of the total free radicals in smoke can be made using a chemiluminescence technique. Because of the relative ease of this technique, coupled with a growing interest in biological mechanisms involving free radicals in smoke, it is anticipated that free radicals will become a very real issue for the tobacco industry. In particular, some League Table ranking of cigarettes could be produced.

At present, BAT has no idea on the level of free radicals in smoke from its products

- are they high or low compared to competitors' products?
- What is the effect of tobacco type and cigarette design parameters?
- do filters, in particular carbonfilters, remove radicals selectively? (Dr. Noronha-Dutra believes they do [26])
- how can we modify the levels of radicals?
- what is the level in sidestream and how is this affected with low sidestream prototype cigarettes?

It is proposed that chemiluminescence facilities will be set up in Southampton in order to measure the levels in smoke and provide answers to the above type of question. Dr. Noronha-Dutra is acting as a consultant on the measuring techniques.

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