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Bubbling hookah smoke through heat-solubilized curcumin/turmeric and incorporation of the curry spice as an additive or filter in cigarettes to minimize tobacco smoke-related toxicants

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In this space-age [1], rampant with high-flying advances in medicine and science many still find themselves enslaved to the vice of smoking, be it cigarettes, pipe, cigar, bidis or hookah. The adverse effects of smoking are well known [2–5]. There has been a surge in the use of hookah worldwide, contributed in part by the introduction of sweetened/flavoured tobacco and also by the misconception that the passage of smoke through water reduces its toxicity [3].

Cigarette smoke consists of a particular-matter (tar) phase and a gas-phase smoke. The tar contains more than 10^{17} stable, long-lived radicals per gram gas-phase smoke contains more than 10^{15} free radicals per puff [6]. The tar and the gas phase place an oxidative stress on the entire organism and also the lungs. Plasma vitamin C and lung lavage vitamin E are low in smokers compared to non-smokers [7]. Free radical mediated oxidative damage has been implicated in a variety of diseases including autoimmune disorders [8].

Therefore, it is vital to have countermeasures to control and reduce the health burden caused by these tobacco toxins. We hypothesize that the polyphenol curcumin (1,7-bis[4-hydroxy-3-methoxyphenyl]-1,6-heptadiene-3,5-dione), a potent antioxidant that is efficacious against a variety of disorders, including cancers [2,9–12] and tobacco smoke related illnesses [2,12] would minimize the deleterious effects of cigarette/hookah smoke if the curry spice is included as an ingredient in the cigarette itself or incorporated into the cigarette/hookah filter. We also hypothesize that bubbling the hookah tobacco smoke through water containing curcumin/turmeric solubilized by the use of heat would minimize the carcinogenic potential of toxic tobacco smoke ingredients. Studies have shown a dose-dependent depletion of free radicals by the addition of the bioflavonoid pycnogenol from pine bark extract to cigarette filters [5].

Curcumin is practically insoluble in water. However, we have shown that the solubility of curcumin/turmeric could be increased 12-fold/3-fold respectively with the use of heat [10, 13]. Heat-solubilized curcumin is bioactive, as demonstrated by an *in vitro* ELISA that used 4-hydroxy-2-nonenal (lipid peroxidation by-product) mediated solid phase modification of a

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[14] multiple antigenic peptide [15] antigen substrate. This assay showed that curcumin brought about an 80% inhibition of 4-hydroxy-2-nonenal mediated oxidation of the multiple antigenic peptide substrate. Matrix assisted laser desorption ionization time of flight mass spectrometric and spectrophotometric profiling (400–700 nm) of the heat-extracted curcumin did not reveal any heat-induced disintegration of curcumin. Heat treatment appears to protect curcumin against degradation compared to curcumin solubilized in mild alkali (pH 7.2, PBS) [10]. Heat-solubilized curcumin has been suggested for use in human clinical trials [16].

We suggest adding 5 mg turmeric or curcumin per ml of water and boiling it for 10 min and adding it to the hookah. In our earlier experiments we had centrifuged the samples following heating [10]. However, for adding to hookah, this step can be avoided. In addition, curcumin/turmeric (heat-solubilized or non-heat treated) could be used also in cigarettes or as a major part of the cigarette filter as a trap to neutralize or minimize the carcinogenic potential of toxic cigarette tobacco ingredients. The ill-effects, if any, of turmeric/curcumin (when added directly to the tobacco in the cigarette) derived smoke is unknown. Perhaps, until this is known, it may be prudent to use the curry spice as part of the filter. There have been several attempts to reduce the toxicity of cigarettes.

The tobacco industry has investigated a number of methods, including selective filtration using charcoal filters, changes to curing practices and the use of rod additives to reduce specific toxicants [17]. The types of fertilizers used, the curing method used (flue-cured vs. air-cured), the characteristics of the plant used (in terms of protein or nicotine content), the blending of tobacco (e.g. American blend compared to Virginian blend) and design of cigarette (paper, filters, additives) play a role in the formation and reduction of specific toxicants in the smoke.

Current medical evidence suggests that there is little or no risk reduction associated with light and ultra-light cigarettes use compared to regular cigarettes, even though the majority of smokers think to the contrary [18]. Using curcumin/turmeric in the cigarette itself or dissolved in water (for hookah) may well change this on account of the well documented anti-oxidant and anti-cancer properties of curcumin [2,9–12]. Perhaps curcumin/turmeric may even help smokers to quit by minimizing nicotine dependence. Spicyness, thus, could even apply to hookah and cigarettes.

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