Evaluation Summary of Citric Acid for Use as a Cigarette Ingredient

Citric acid occurs in many foods and has been used widely in the food industry for more than 125 years as an acidulent, sequestering agent, synergistic antioxidant, dispersing agent, flavor enhancer, and water-conditioning agent.[1] Both U.S. Food and Drug Adminstration (21 CFR §184.1033) and the Flavor and Extract Manufacturers Association (FEMA No. 2306)[2] have designated citric acid as generally recognized as safe (GRAS) for use in food.

Citric acid has a relatively low order of acute toxicity in rodents.[3-7] Long-term feeding studies in rats at concentrations up to 5% of the diet indicated slightly reduced growth, but no tissue abnormalities nor evidence of carcinogenicity.[4,7-11] Inhalation of high concentrations of citric acid aerosols has been reported to cause coughing in humans.[7,12] Citric acid has not been reported to be a reproductive or developmental toxicant.[3,7,8,11,13] Citric acid was not mutagenic in the Salmonella bacteria assay.[7,14-16] Citric acid did not induce chromosomal damage in cultured human or hamster cells.[7,14] In humans, direct application of citric acid crystals to the inside of the mouth has been reported to cause ulcers while skin irritation has been reported among occupationally exposed waiters and bakers.[7]

Citric acid is a natural component of tobacco.[17] Citric acid is also used in tobacco manufacturing as a flavoring agent, and may also be found as a minor component of adhesives and papers. As such, citric acid may be subject to pyrolysis-type reactions. Citric acid is currently used worldwide at levels below 8,000 ppm in selected cigarette brands manufactured and/or distributed by Philip Morris USA (PM USA) and/or Philip Morris Products SA (PMP SA).

As suggested by the purge and trap studies conducted by PM USA, citric acid applied to tobacco would not be expected to significantly distill at 100°C.[18] At the higher temperatures used in the PM USA pyrolysis studies; the two largest peaks were identified as carbon dioxide and citraconic anhydride. These peaks in addition to the smaller acetone peak suggest that citric acid would be pyrolyzed and would not be delivered to the smoke intact.[19]

Citric acid was a part of the PM USA ingredient testing program that was designed to evaluate the potential effects of ingredients added to typical commercial blended test cigarettes on selected biological and chemical endpoints. Citric acid was added to test cigarette tobacco at target concentrations of 5,000, 18,000 or 42,000 ppm above the natural background found in tobacco. Application of target levels of 42,000 ppm or 18,000 ppm citric acid to test cigarette tobacco increased the mainstream concentrations of some smoke constituents including hydrogen cyanide, formaldehyde, acrolein and polyaromatic hydrocarbons. Application of a target level of 5,000 ppm citric acid did not produce these increases. Although some statistically significant differences were noted between control cigarettes and cigarettes with high target levels of citric acid, the increased smoke constituent concentrations were considered to be within normal variation of cigarette products.[20] The mutagenic response of *Salmonella* bacteria exposed to mainstream smoke condensate samples obtained from cigarettes with citric acid was not significantly different from condensate from control cigarettes.[21] Similarly, the cytotoxic response of mouse embryo BALB/c 3T3 cells treated with mainstream smoke condensate preparations was not altered by citric acid addition.[22] The biological effects of inhaling smoke from cigarettes with citric acid was assessed in Sprague-Dawley rats exposed nose-only to

smoke for 6 hrs/day, 7 days/week for 13 weeks. The results of the smoke inhalation studies indicated that citric acid addition to cigarette tobacco at the levels tested did not discernibly alter the biological effects normally associated with cigarette smoke exposure in rodents.[23]

The results of this evaluation of citric acid involving a review of published information[24] and internal studies, suggests that addition of citric acid as a cigarette ingredient at levels below 8,000 ppm does not discernibly alter the biological effects normally associated with cigarette smoke exposure.

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