

**Evaluation Summary of  
High fructose corn syrup  
for Use as a Cigarette Ingredient**

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## **INTRODUCTION**

Currently, high fructose corn syrup (CAS # 8029-43-4) is used worldwide at levels below **50,000 ppm** in selected cigarette brands manufactured and/or distributed by Philip Morris International. High fructose corn syrup is applied directly to the tobacco as a flavoring material. As such, high fructose corn syrup may be subject to pyrolysis-type reactions when smoked. High fructose corn syrup may also be applied to the filter as a flavoring material where it would not be subjected to pyrolysis temperatures. This document summarises our internal studies and current published toxicology information on high fructose corn syrup abstracted from online toxicity databases.

## **TOXICITY DATA ON UN-BURNED MATERIAL**

### ***Overview***

High fructose corn syrup has been given the status generally recognized as safe (GRAS) by the United States Food and Drug Administration (21 CFR § 184.1866). Corn syrups comprise a number of carbohydrate based sweetening agents which are prepared through the enzymatic and chemical conversion of the complex carbohydrate constituents of corn starch to simpler di- (maltose) and mono- (glucose) saccharides. Enzymatic conversion of glucose leads to the formation of still other di-(maltose) and mono- (fructose) saccharides (high fructose corn syrups).<sup>1-3</sup> Corn syrup is widely used by the food industry and can be found in foods such as baked goods, beverages, catsup, canned foods, desserts, frozen foods, ice cream, jams and jellies and prepared mixes.<sup>4</sup>

### ***Health hazard data***

When considering the metabolism and toxicity of various corn syrups, the impact of both glucose and fructose has to be taken into consideration, since high fructose corn syrups contain significant levels of both fructose and glucose. According to all conventional tests, corn syrups are of low toxicity to both animals and humans.<sup>5-15</sup> Studies on the effects of corn syrup on glucose tolerance, diabetes, cardiovascular disease (including hypertension), blood lipids and incidence of cancer in both human and animal studies point to only transient effects seen with dosages of corn syrup which far exceed the normal dietary intake in humans.<sup>16-69</sup> Factors which weigh heavily on the results of these studies, and are considered confounding factors, are the contribution of excessive calories with resulting obesity, which itself is a contributing factor to hypertension, cardiovascular diseases and diabetes. Thus, there are no studies which have been conducted that provide scientific evidence that consumption of corn syrup at concentrations which occur in the average diet directly causes diabetes, hypertension, cardiovascular disease, blood lipid diseases, reproductive abnormalities or cancer.<sup>10,14,44,70-131</sup>

## **TOXICITY DATA ON BURNT MATERIAL**

### ***Combustion studies***

PM USA purge and trap studies conducted with high fructose corn syrup suggest that high fructose corn syrup would not be expected to transfer intact to the smoke in front of the burning cone.<sup>132</sup> At the higher temperatures used in the PM USA pyrolysis studies, the major chemicals identified were furfural, 5-(hydroxymethyl)-2-furfural, levoglucosan and 1,6-anhydro-beta-d-glucofuranose. Therefore, high fructose corn syrup would not be expected to transfer to the smoke intact and would pyrolyze extensively.<sup>133</sup>

### ***Philip Morris ingredient testing program***

High fructose corn syrup was part of a PM USA testing program that was designed to evaluate the potential effects of 333 ingredients added to typical commercial blended test cigarettes on selected biological and chemical endpoints. Three pairs of test cigarettes were produced, each containing different groups of ingredients. High fructose corn syrup was added to one pair of test cigarettes at target levels of 41,671 ppm and 62,507 ppm. No significant effects were noted in cytotoxicity, mutagenic studies or in respiratory tract endpoints in 90-day rat inhalation studies. In addition, smoke chemistry studies from cigarettes containing a mixture of flavors including high fructose corn syrup did not significantly alter the smoke chemistry profile compared to control cigarettes. Based on the results of these studies, the authors concluded that these ingredients (including high fructose corn syrup) added to tobacco do not add significantly to the overall toxicity of cigarettes.<sup>134-139</sup>

### **CONCLUSION**

Cigarette smoking causes lung cancer, heart disease, emphysema and other serious diseases in smokers. Smokers are far more likely to develop serious diseases, like lung cancer, than non-smokers. There is no "safe" cigarette. Government health warnings about smoking apply to all cigarettes, regardless of the ingredients added, including those containing only tobacco and paper.

Currently, information is only available for tests utilizing high fructose corn syrup in a mixture of ingredients applied to cigarette tobacco. Studies are ongoing to address the use of high fructose corn syrup as a single ingredient. Published studies show there is no meaningful difference in the composition or toxicity of smoke from cigarettes with added ingredients (including high fructose corn syrup) compared to the smoke from cigarettes without added ingredients.<sup>134-139</sup> It is our scientific judgement, based on the best available data, that high fructose corn syrup used in our cigarettes does not increase the overall toxicity of cigarette smoke.

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