Annotated Bibliography: Additives in Tobacco Products

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This annotated bibliography, prepared by the Key Facilitators of the Working Group on the implementation of Articles 9 and 10, covers 21 documents that examine the use of additives in tobacco products and related design issues.

Additives

Additives other than flavours

1. Bates C, Connolly GN, Jarvis M (1999), "**Tobacco additives: cigarette engineering and nicotine addiction**", London, UK: Action on Smoking and Health. Available at: http://old.ash.org.uk/html/regulation/html/additives.html

   This paper examines the use of additives in cigarettes and their effects on health, nicotine delivery, and the social acceptability of cigarettes and smoking. The authors review internal tobacco industry documents in the US and UK, as well as the proceedings of the UK government's scientific advisory committees. They provide a history and rationale for the use of additives and an overview of the regulatory framework, largely in the UK.
   The authors argue that even though more than 600 additives are known to be used in cigarettes, most are unnecessary and have only been used since 1970.
   According to their research, additives, such as ammonia, successfully increase the delivery of nicotine in smoke thereby making them more addictive or attractive to smokers. Other additives, such as flavours, mask the harshness and taste of tobacco and nicotine making flavoured cigarettes more attractive to first time and younger users.
   They opine that that there is a need for increased regulatory scrutiny on additives used in tobacco products. They argue that additives which influence smoking behaviour should not be allowed in tobacco products.

2. British American Tobacco, 1982. **Evaluation of Commercial "Sidestream" Aroma Enhancing Agents (1) – Tobacco and paper additives**, Bates: 103522704/708. Available at: http://www.legacy.library.ucsf.edu/tid/rxf06a99

   This disclosed **British American Tobacco report details their internal testing of various unnamed additives in cigarettes to determine whether any would enhance the aroma of sidestream smoke** (to reduce 'the level of overall annoyance'). The report briefly describes the test methodology and identifies two additives for further study at a later date.

3. Connolly GN, Ferris Wayne G, Lymperis D, Doherty M (2000), "**How cigarette additives are used to mask environmental tobacco smoke**", *Tobacco Control*, 9:283-291.

   The authors review internal tobacco industry documents and information from the US Patent and Trademark Office database to determine how tobacco companies have used additives to mask sidestream smoke. They argue that **tobacco companies are interested in reducing or masking sidestream smoke to make cigarettes more socially acceptable**. The documents reviewed reveal that smokers are conscious of negative perceptions about smoking, second hand smoke, and odours that cling to hair and clothing. The authors conclude, according to documents reviewed, that **tobacco companies have modified products to successfully reduce this smoke through the use of additives**.
   The authors argue that reducing the aroma, visibility and irritation of second hand smoke makes it potentially more dangerous as it reduces the sensory perception of sidestream smoke that may prompt people to avoid exposure.
   They also argue that tobacco companies should be required to report to governments about the additives they use in their products and that health research is required to determine the toxicity of these additives, regardless of whether they are added to the tobacco, the paper or the filter

4. Danish Cancer Society, "**Tobacco additives: A study of the available literature**". 2008.

   This report is a short overview of a much larger report published in Danish by the Danish Cancer Society that studied the available literature on the use of tobacco product additives. Because little systematic information has been gathered about these additives, the authors compiled what information they could about nearly 250 additives that are added to the tobacco in cigarettes to determine their physiological, chemical and toxic effects. In this document, the authors have categorized the additives into main groups to determine their use, application, function and their impact on the smoker.
   The authors argue that the main function of additives in cigarettes is to make it easier for people to start smoking and to encourage addiction.
   The authors conclude that further independent scientific experimentation is necessary in order to better understand the function and effects of each additive. They offer options of how this research could be undertaken.

5. Fowles J, "**Chemical factors influencing the addictiveness and attractiveness of cigarettes in New Zealand**", Institute of Environmental Science and Research Ltd. 2001. Available at: http://www.moh.govt.nz/moh.nsf/pagescm/1004/$File/chemicalfactorsaddictivenessci garettes.pdf

The author reviews the types of additives in cigarettes sold in New Zealand. He describes the known and potential effects of these chemicals on the body, with a particular emphasis on ways in which they may contribute to nicotine addiction. He also looks at how **some additives are used to increase the attractiveness of cigarettes, such as sweeteners and additives that reduce throat irritation or deaden peripheral nerves**.
The author argues that not enough is known about additives in cigarettes, including the types and quantities used, their human health effects (especially when burned), their potential for increasing addiction, and any compounding or synergistic effects related to two or more additives reacting together to form new by-products. He argues that given the difficulty many smokers have with quitting, even with the availability of nicotine replacement therapies, nicotine alone is unlikely the sole contributor to cigarette addiction. He advocates for a systematic evaluation of health impacts from cigarette additives and their combustion products. He recommends a series of steps that should be taken in order to better understand the public health implications of additives, including specific tests that additives and ingredients should be required to undergo in order to be properly controlled.

6. Gonseth S, Conuz J, (2009) **" Modification de la composition des cigarettes Durant le XXe siècle : rôle de l'industrie du tabac et effet sur la dépendance tabagique."** Revue Médicale Suisse, 1er juillet 2009

   The authors of this French language paper describe the various chemicals added to cigarettes and their effects on tobacco dependence and addiction. This article is based on a qualitative review of available literature. The **authors conclude that while nicotine may be the responsible substance for dependence many other substances have been added by cigarette manufacturers to play a role in dependence and addiction. The taste, the smell of smoke, and the visual aspect of the pack of cigarettes are also sensory components that promote addiction**. The authors discuss how the addition of chemicals such as menthol, sugar, cocoa and liquorice play a role in dependence and addiction to cigarettes by, for instance, making an aesthetic effect on the airways.

7. Keithly L, Ferris Wayne G, Cullen DM, Connolly GN (2005), "**Industry research on the use and effects of levulinic acid: a case study in cigarette additives**", *Nicotine and Tobacco Research*, 7(5):761-71.

   The **authors examine the use of levulinic acid as an additive in cigarettes as a case study in how additives may be used by the tobacco industry to promote smoking initiation and addiction**. The authors review internal tobacco industry documents and report that tobacco companies have used levulinic acid to reduce the harshness of tobacco smoke and increase nicotine delivery.
   The authors discuss the chemical properties of the additive and its role in increasing capacity to bind nicotine to neurons in the brain and its impact on

smoke composition. Both of these factors raise questions about additional health concerns related to cigarette smoke.
The authors encourage continued government research by tobacco regulators into the additives in cigarettes and their potential health consequences (including how additives control or alter 'pharmacological and sensory effects of smoke'). Such research would be dependent on full disclosure by cigarette manufacturers of types and quantities of additives used in specific brands.

8. Rabinoff MD, Caskey N, Rissling A, Park C (2007), "**Pharmacological and Chemical Effects of Cigarette Additives**", *Am J Public Health*, 97:1981-1991.

   The authors examine internal tobacco industry documents and other sources to review the types of additives used in terms of their nicotine metabolism and addiction potential, their capacity for neuropsychological effects, their use as antioxidants and mitigants, and the genetic modification of tobacco to control nicotine levels and other aspects. The authors determine **that since the 1960s, tobacco companies have been manipulating the composition of commercial cigarettes to increase the product's addictive qualities**.
   The authors review of nearly 600 additives to cigarettes suggest that more than 100 are known to "have pharmacological actions that camouflage the odor of environmental tobacco smoke emitted from cigarettes, enhance or maintain nicotine delivery, could increase the addictiveness of cigarettes, and mask symptoms and illnesses associated with smoking behaviors."
   The authors call for further research in order to systematically understand the health implications of additives and their combustion products.

9. Talhout R, Opperhuizen A, van Amsterdam J (2006), "**Sugars as tobacco ingredient: Effects on mainstream smoke composition**", *Food Chem. Toxicol*, Nov 44(11):1789-98.

   The authors examine how, when and why sugars (naturally present and/or intentionally added) are used in tobacco products, and review research and studies that look at what happens to sugars when they are burned. The authors trace the chemical compounds that result from the combustion/pyrolysis of sugar compounds and the potential effects that these compounds have on human health. They raise concern that many of these compounds are known or suspected carcinogens. **Authors also conclude that sugars promote tobacco use since their combustion/pyrolysis products neutralize the harsh taste of smoke and have addictive properties**.
   The authors conclude that sugars in tobacco significantly contribute to the health effects of tobacco smoking and that sugars should be considered when evaluating tobacco ingredient regulation issues.

Flavours

10. Abdallah F (2003), "**What Flavors! Answers to the Most Frequently Asked Questions about Flavorings**", *Tobacco Reporter*, October: 52-56.

    The author provides **answers to frequently asked questions about tobacco flavourings and additives** including definitions of flavour, casings and additives; the history of the use of flavourings, additives, casings and methods such as toasting; regulations for use of additives; why and what flavourings and additives are used in tobacco products; and potential health risks. The article is written for the tobacco industry.

11. Carpenter CM, Ferris Wayne G, Connolly GN, Pauly J, Koh H (2005b), "**New Cigarette Brands with Flavors that Appeal to Youth: Tobacco Marketing Strategies**", *Health Affairs*, 24(6): 1601-10.

    The authors review industry documents, patent applications and patents awarded, as well as physically examine flavoured cigarettes to examine how tobacco companies are adding flavours to cigarettes and how and to whom these cigarettes are being marketed. The authors reveal that **flavour concepts have been explored by the tobacco industry and that these flavoured products appeal mostly to youth**. Because of this, they argue tobacco companies are marketing these products to minors, even though this is not explicitly stated by the industry. The internal tobacco industry documents reveal that these flavoured products are recognized as starter products for new smokers and that young adult smokers represent a priority for market growth for the tobacco industry.
    The authors research reveals that flavours have traditionally been added to cigarette paper or to the tobacco. New flavour technologies have been explored by the tobacco industry and led to the introduction of cigarettes that place a plastic pellet containing flavouring in the filter. These flavour pellets have been used in Camel Exotic Blends and are invisible to the smoker.
    The authors consider that **recent advertising and promotion restrictions may have prompted the tobacco industry to turn to product innovation such as flavoured cigarettes, and the design and imagery used in the packaging, as a means of promoting tobacco use and attracting new smokers**. The authors argue that coordinated public education and action are needed to increase awareness about the dangers of smoking flavoured cigarettes and all tobacco products (to counter industry 'deception'). They also raise health concerns related to the introduction of the flavour pellets into the filter, arguing for further research and regulation.

12. Dachille K, "**Pick Your Poison: Responses to the Marketing and Sale of Flavored Tobacco Products**", Tobacco Control Legal Consortium, 2009. Available at: http://tobaccolawcenter.org/documents/flavored-tobacco.pdf.

The author looks at flavoured tobacco products on the market and how they are promoted. She also reviews public health research in this area. She argues that the **tobacco industry is specifically targeting children and youth with fruit and candy flavoured products even though tobacco companies state they only market to people aged 18 or older**.
The author describes potential and existing federal and state legislation and how it could work to curb or ban the marketing and sale of these products in the US. She promotes a ban on the sale of tobacco products that "actually impart a characterizing flavor" and specifically highlights legislation in the State of Maine that could be used as a model for regulators elsewhere. The author also provides examples of effective public health messages that counter tobacco advertising.

13. Lewis MJ and Wackowski O (2006), "**Dealing With an Innovative Industry: A Look at Flavored Cigarettes Promoted by Mainstream Brands**", *Am J Public Health*, Feb, 96(2):244-51.

    The authors review scientific and popular literature as well as a collection of available tobacco products and industry promotions (including direct mail and advertising) to **examine the introduction of flavoured tobacco products to the market and how these have been promoted to smokers and other target populations such as youth**. The authors specifically look at specialty, flavoured lines of cigarette brands: Camel's Exotic Blends, Kool's Smooth Fusions and Salem's Silver Label. The authors discuss how these brands were marketed as sophisticated, luxury or innovative products that set the smoker apart, to be tried in special social situations. They note that "the tobacco industry denies that these products are targeted at youth" even though public health and tobacco control advocates claim that the flavours, which include fruit and candy, mask tobacco taste and appeal to teenagers. The authors cite research to the effect that tobacco marketing is shifting to young adults (18 to 24 year olds) and that more people in this age group are starting to take up smoking than before, and that there is a trend of increasing numbers of young adult smokers who only smoke periodically, not daily. The authors opine that **flavoured products may also entice current smokers and interfere with their quit attempts or lure past smokers to smoke again**. To help determine the impact of flavoured cigarettes, the authors suggest several possible areas for research to determine behaviour and attitude towards flavoured products and associated marketing strategies.

14. Manning KC, Kelly KJ, Comello ML (2009), "**Flavored Cigarettes, Sensation Seeking and Adolescents' Perceptions of Cigarette Brands**", *Tobacco Control*, 18:459-465.

    The authors constructed and carried out a survey of teenagers in two high schools in the US to determine their perceptions towards cigarette brands with flavour descriptors. The participants were shown images of tobacco packages displaying both traditional and flavoured cigarettes and then asked a series of questions to

determine which ones were more appealing. The participants were also asked a series of questions to determine whether their personality type was high sensation seeking or low sensation seeking. **The study found that the high sensation seeking participants were more likely to choose flavoured cigarettes; low sensation seekers were more likely to choose traditional, familiar flavours**. The authors raise concern about the susceptibility of high sensation seeking teenagers to product packaging and messages that appeal to their desires, such as flavoured cigarettes.

15. U.S. Food and Drug Administration, "**Flavored Tobacco Product Fact Sheet**", September 22, 2009. Available at: http://www.fda.gov/TobaccoProducts/GuidanceComplianceRegulatoryInformation/FlavoredTobacco/ucm183198.htm

    This fact sheet from the US FDA outlines the health hazards associated with smoking and facts and statistics about youth interest in, and smoking of flavoured cigarettes. It notes that the *Family Smoking and Prevention and Tobacco Control Act* bans the sale of cigarettes containing flavours other than menthol as of September 22, 2009. The US FDA is also looking into regulating menthol cigarettes and flavours in other tobacco products.

16. World Health Organization Study Group on Tobacco Product Regulation, "**Candy flavoured tobacco products: Research needs and regulatory recommendations**", The Scientific Basis of Tobacco Product Regulation, WHO Technical Report Series 945, 2007: 25-42. Available at: http://www.who.int/tobacco/global_interaction/tobreg/tsr/en/index.html

    This paper is a summary of international public health knowledge about flavourings added to cigarettes and other tobacco products and their attractiveness to youth and older smokers. The **authors raise concerns about unknown potential health effects related to flavourings in the products and in cigarette smoke that may make flavoured products even more toxic than traditional tobacco products**.
    The authors set out a series of ten topic areas for further research that would help the public health community and tobacco regulators better understand issues such as why and how these products are attractive to youth, the role flavours play in the transition from new smoker to established smoker, physiological and health effects associated with these products, and perceptions about advertisements for flavoured products.
    The article concludes with a series of regulatory recommendations including disclosure of ingredients by tobacco product manufacturers, banning claims of reduced health risk, banning flavours in new tobacco products, setting limits on the use of flavours in existing products, and incorporating strategies for controlling the use of flavours into overall strategies to regulate product design, function and disease reduction.

17. Klein SM, Giovino GA, Barker DC, Tworek C, Cummings, MK and O'Connor, RJ (2008) **"Use of flavored cigarettes among older adolescent and adult smokers: United States, 2004–2005"**, *Nicotine & Tobacco Research*, 10(7), 1209–1214.

    The authors used two US surveys, the National Youth Smoking Cessation Survey (NYSCS) and the Assessing Hardcore Smoking Survey (AHCSS) to determine use of flavoured cigarettes among current smokers. The authors reviewed data in surveys on the use of flavoured cigarettes among older adolescent and young smokers (17-26) and adult smokers aged over 25 years. The surveys were conducted during 2004 and 2005, a period that saw the introduction and marketing of several flavoured cigarette brands.
    The authors describe that the **survey results show that the overall use of flavoured cigarettes was low however their use had the highest prevalence rates among 17-19 year olds and that 17 year olds were twice as likely to have used flavoured cigarettes as 20-26 year olds**. The results also showed that use of flavoured cigarettes was infrequent, possible reserved for special occasions, and departed from the use of the smoker's usual brand.
    The authors argue that flavoured cigarettes seem to be most attractive to younger smokers and therefore should be prohibited.

18. Kreslake J, Ferris Wayne G, Alpert HR, Koh HK, Connolly GN (2008), "**Tobacco Industry Control of Menthol in Cigarettes and Targeting of Adolescents and Young Adults**", *Am J Public Health*, 98(9):1685-92.

    The authors review internal tobacco industry documents to determine how tobacco companies have used menthol flavouring as an additive in cigarettes to mask the harshness and irritating nature of tobacco smoke on the throat and therefore make cigarettes more attractive. They reveal how **the industry has manipulated menthol levels to create low-menthol products that are attractive to younger smokers (marketed as 'mild' cigarettes) and high-menthol cigarettes that appeal to established menthol cigarette smokers**.
    They describe how certain brands of menthol cigarettes are more popular among certain ethnic groups, age groups, and genders.
    The authors argue that the tobacco industry has a vested interest in hooking potential smokers at a young age and building the number of cigarettes they smoke until they are addicted, regular smokers. They argue that menthol cigarettes "facilitate nicotine dosing" which may potentially increase the addictive nature of the cigarettes. In this way, menthol cigarettes may act as a bridge product to stronger brands.
    The authors identify the following research needs: determining smoking incidence and prevalence of menthol cigarettes by target populations and determining long-term health outcomes and impacts on quitting related to the use of menthol in cigarettes.

Product Design

19. Ferris Wayne G, Connolly GN (2002), "**How cigarette design can affect youth initiation into smoking: Camel cigarettes 1983-93**", *Tobacco Control*, 11(Suppl I):i32-i39.

    The authors look at industry documents made available through a website maintained by the RJ Reynolds company to determine whether product changes to the design and advertising of Camel cigarettes from 1981 to 1991 had an impact on youth smoking. The authors argue that the **design changes to the Camel brand, which focused on making them 'smoother' or less harsh and irritating to the throat, made the product more appealing to new, 'younger adult' smokers**. Other brands made similar changes to appeal to youth. The authors link these changes to an increase in youth smoking rates in the 1990s.

20. Carpenter CM, Ferris Wayne G, Connolly GN (2007), "**The Role of Sensory Perception in the Development and Targeting of Tobacco Products**", *Addiction*, 102:136-147.

    The authors review internal industry documents and studies that look at the role of sensory perception in guiding smokers' choices and enjoyment of various brands of cigarettes. They outline how tobacco companies used this information to guide product development. The **tobacco industry has used colours, design changes that affect physical properties, tobacco blending and the use of additives and marketing strategies to target specific age, gender and ethnic groups**. The authors argue that understanding sensory research could guide the development of cessation strategies that address the sensory cues tied to smoking that smokers may seek when attempting to quit.

21. Ferris Wayne G and Henningfield JE, "**Tobacco Product Attractiveness as a Contributor to Tobacco Addiction and Disease**". 2008. Report to Health Canada, Ottawa, Canada.

    The authors look at factors that contribute to the attractiveness of tobacco products as the basis for product regulation and harm reduction initiatives. The authors make a distinction between addiction and attractiveness, arguing that the attractiveness of a product is closely tied to the rate of real world addiction (as opposed to addiction potential). They argue that regulators need to consider both when developing their regulatory approaches since product attractiveness is a factor in the initiation and development of addiction. The authors **describe how tobacco companies have used information from young and new smokers about what is important to them in order to design cigarettes that are attractive to them (for instance, smooth or less irritating smoke, milder flavours).** It is also posited that tobacco companies are developing products that promote experimentation which could then lead new smokers to try, and then

become regular users of, other products. The authors also discuss tobacco industry strategies to target populations with low smoking rates such as women and some ethnic groups by designing products with characteristics that are appealing to these groups. The authors describe strategies used by tobacco companies to reduce smokers' concerns about health risks and to refine product design to promote long term use by smokers (by making the act of smoking more pleasant and by reducing social concerns such as masking the smell and appearance of second-hand smoke).

The authors posit a number of implications of their research for regulation, including the need to address the totality of product design, ingredients, packaging and labelling, marketing, and sales.