




dkfz.

ADDITIVES - SWEET TEMPTATION


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Industry's definition of a cigarette! dkfz.

"The cigarette should be conceived not as a product but as a package. The product is nicotine. **Think of the cigarette pack as a storage container for a day's supply of nicotine....** Think of the cigarette as the dispenser for a dose unit of nicotine..... **Smoke is beyond question the most optimised vehicle of nicotine and the cigarette the most optimised dispenser of smoke.**"
(Philip Morris 1972)



Major chemical classes of compounds and carcinogens identified in cigarette smoke dkfz.

<p style="text-align: center; color: green;">~ 4800 tobacco smoke constituents have been identified</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Class</th> <th style="text-align: right;">No.</th> </tr> </thead> <tbody> <tr><td>Amides, Imides, Lactams</td><td style="text-align: right;">237</td></tr> <tr><td>Carboxylic acids</td><td style="text-align: right;">227</td></tr> <tr><td>Lactones</td><td style="text-align: right;">150</td></tr> <tr><td>Esters</td><td style="text-align: right;">474</td></tr> <tr><td>Aldehydes</td><td style="text-align: right;">108</td></tr> <tr><td>Ketones</td><td style="text-align: right;">521</td></tr> <tr><td>Alcohols</td><td style="text-align: right;">379</td></tr> <tr><td>Phenols</td><td style="text-align: right;">282</td></tr> <tr><td>Amines</td><td style="text-align: right;">196</td></tr> <tr><td>N-Heterocyclics</td><td style="text-align: right;">921</td></tr> <tr><td>Hydrocarbons</td><td style="text-align: right;">705</td></tr> <tr><td>Nitriles</td><td style="text-align: right;">106</td></tr> <tr><td>Anhydrides</td><td style="text-align: right;">11</td></tr> <tr><td>Carbohydrates</td><td style="text-align: right;">42</td></tr> <tr><td>Ethers</td><td style="text-align: right;">311</td></tr> <tr><td>Inorganics</td><td style="text-align: right;">50</td></tr> <tr><td>Total</td><td style="text-align: right;">4720</td></tr> </tbody> </table>	Class	No.	Amides, Imides, Lactams	237	Carboxylic acids	227	Lactones	150	Esters	474	Aldehydes	108	Ketones	521	Alcohols	379	Phenols	282	Amines	196	N-Heterocyclics	921	Hydrocarbons	705	Nitriles	106	Anhydrides	11	Carbohydrates	42	Ethers	311	Inorganics	50	Total	4720
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<p style="text-align: center; color: red;">~81 IARC carcinogens reported in cigarette smoke</p> <p style="text-align: center; color: yellow;">12 Group 1 (known human carcinogens)</p> <p style="text-align: center; color: yellow;">14 Group 2A (probable human carcinogens)</p> <p style="text-align: center; color: yellow;">55 Group 2B (possible human carcinogens)</p>	<small>from Dube and Green (1982) In Hoffmann, D and Wynder, E.L., (1986) In Smith, C.J. et al (2004) Fd Chem. Tox. 42:9-15 (Tobind). ~ 4865 ~ 4600</small>																																				



Definition: Additives / Ingredients-1 dkfz.

WHO Scientific Advisory Committee on Tobacco Product Regulation (SACTob):

- Ingredients include all product components, materials used to manufacture those components, residual substances from agricultural practices, storage and processing, and substances that can migrate from packaging into the product. The term ingredients is preferred to terms such as "additives" and "processing aids"

 Definition: Additives / Ingredients - 2 



Directive 2001/37/EC of the European Parliament and of the Council

➤ 'ingredient' means any substance or any constituent except for tobacco leaf and other natural or unprocessed tobacco plant parts used in the manufacture or preparation of a tobacco product and still present in the finished product, even if in altered form, including paper, filter, inks and adhesives.

 EU Tobacco Products Directive - 2001/37/EC 

 • EU Tobacco Products Directive regulates manufacture etc. establishes maximum tar, nicotine and CO yields etc.


• **Requires manufacturers and importers to submit yearly a list of all ingredients and their quantities used.**

 **Cigarette Additives** 

- More than 600 additives are allowed but only the tobacco manufacturers know which additives are used in which brands.
- Neither Governments nor the European Commission have the actual break-up for individual brands.


 THE CIGARETTE 

- The cigarette is designed around smoker's vulnerabilities: e.g. BAT uses additives and design to play to the smokers largely unconscious smoking desires.
- The very first puff on a cigarette is engineered to have the greatest impact -- both relieving the pent up nicotine withdrawal symptoms and providing the best taste.



Additives : Analysis **dkfz.**


A scientifically competent analysis of cigarette additives therefore requires consideration of their chemical by-products during heating, burning, and chemical cracking that occurs during smoking.



Additives: Specific Uses **dkfz.**


Cigarette Additives ~10% w/w
RECON tobacco 20-28% w/w

- Humectants – increase tobacco moisture-holding capacity
- Preservatives – protect from microorganisms
- Binders and strengtheners – maintain physical state of product
- Fillers – contribute to volume but not to odor, taste or flavor
- Flavors - Impart a specific taste, flavor or aroma
- Casings - applied to pre-cut tobacco - often known foodstuffs
- Top flavors - applied to cut and processed tobacco (ppm levels, can be mixture)
- Combustion modifiers - e.g. K / Na citrate



Additive Technology **dkfz.**

- Ammonia Technology
- Sugars
- Menthol
- Licorice and Glycrrhizin
- Chocolate, cocoa, theobromine
- Various Flavours



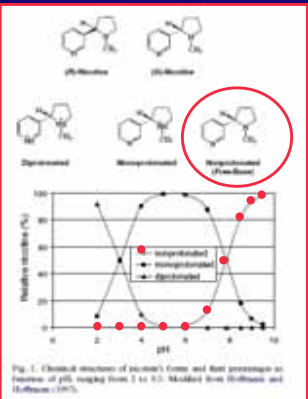
**Ammonia Technology-1
Enhancing Impact** **dkfz.**

Success of Philip Morris's 'Marlboro' brand is interwoven with their ammonia technology.

"The main technical challenge was to decrease the yield of tar in a cigarette while maintaining a level of nicotine acceptable to the smoker."

- (Farone, W.A, 1996 former Philip Morris scientist.)

Ammonia Technology-2
Free-basing nicotine



Ammonia or ammonium salts speed delivery of 'free base' or unbound nicotine in gas phase to smokers by raising pH

Fig. 1. Chemical structure of nicotine's forms and their percentage as function of pH, ranging from 1 to 10.5. Modified from Hoffmann and Hoffmann (2007).

Ammonium Technology-3
Effects

- Free nicotine is more rapidly absorbed by the body and more quickly gives a 'kick' to the smoker
- The actual increased levels, which have a strong pharmacological effect escape measurement by the FTC / ISO method, resulting in erroneous low values.


Willems et al., 2006

Additives : Sugars-1


- “Sweetness can impart a different delivery taste dimension which younger adult smokers may be receptive to, as evidenced by their taste wants in other product areas.”
R.J Reynolds, 1985. Bates No. 505520121/0126
- “It is a well-known fact that teenagers like sweet products. Honey might be considered.”
Brown & Williamson, 1972. Bates No. 170042014

Additives: Sugars - 2

- Sugars e.g. glucose and fructose, sucrose or mixtures like corn syrup, honey are used in casings of Burley tobacco to compensate for sugar loss during fermentation.
- Sugars are used to neutralize irritating substances in tobacco making the facilitating the habit and eventually addiction.




Additives: Sugars - 2
Acetaldehyde and Formaldehyde formation




- Sugars and cellulose on **pyrolysis** give rise to high amounts of acetaldehyde and formaldehyde.
- Acetaldehyde: very volatile, causes irritation and inhibition of the movements of the cilium in the respiratory passages, inhibits transport of phlegm and dirt particles away from the respiratory passages
- These compounds are classified as being **very toxic** in case of inhalation, ingestion, and through skin contact.


Acetaldehyde is possibly carcinogenic to humans (IARC-Group 2B)
Formaldehyde is a human carcinogen (IARC-Group 1)




Additives: Sugars - 3




- **Acetaldehyde** can act synergistically with **nicotine** on the central nervous system, and influence smoking behavior, potentiate the rewarding effect and addiction caused by nicotine. **e.g. Sugar levels were increased in Marlboro to achieve the required increase in acetaldehyde levels.**




Additive : Menthol-1



- 'Mild local anesthetic' reduce irritant effects of nicotine
- Protects against the pain and the throat itching making it easier even for the very young to inhale deeply.
- Stimulates temperature sensitive receptors creating chilling and refreshing sensation as smoke passes through the respiratory passages.



Additive : Menthol-2



- Increases the permeability of chemicals through the skin and the plasma membrane, oral mucosa
- Masks side effects of smoking, e.g. nausea in new smokers
- Inhibits nicotine metabolism


All these properties increase nicotine availability



Additive : Menthol-3 **dkfz.**


Pyrolysis products of menthol included carcinogens **Benzene & B(a)P** IARC-Group1 human carcinogens and co-carcinogens e.g. phenols

- **Actively advertised by the cigarette industry**
- **Present in almost all cigarette**
- **Facilitates smoking, faster and stronger addiction**




Additives : Licorice-1 **dkfz.**

- **Licorice and its derivatives are (GRAS)**
- **Used (1–4%) as flavour and casing material**
- **Boosts sweetness in tobacco products, mellow sweet woody**
- **Glycyrrhizin is the the primary flavour constituent of licorice**





Additives : Licorice-2 **dkfz.**

- **Bronchodilator, facilitating the inhalation of smoke & nicotine**
- **Reduces dryness in the mouth and throat**
- **Minimizes rough smoke character**
- **Glycyrrhizin is an effective demulcent**



Additives : Licorice-3 **dkfz.**



- **Pyrolysis of licorice at tobacco burning temperatures yields among other compounds:**
 - **Benzene (human carcinogen- Group 1)**
 - **Toluene**
 - **Phenol**
 - **Acetaldehyde**
 - **Formaldehyde (IARC- Group 1)**
 - **PAHs such as B(a)P (IARC-Group 1)**
 - **As, Pb**

 **Additive – Cocoa** 

- Cocoa used in casing, as flavouring. Smoothing agent, better mouth feel.
- Theobromine: primary alkaloid in cocoa beans (~2.6 %)
- Theobromine is a bronchodilator and vasodilator facilitating smoke inhalation and nicotine uptake.

 **Additives: More Flavours** 

- Midnight Berry, Mandarin Mint, Cherry Cheesecake or Chocolate Mocha ... flavours you never thought you would find in cigarettes....
- Flavours are added in the cigarette with an aim to recruit new and young smokers.
- They are added to the tobacco or as a polyethylene pellet in the filter to disguise the taste of smoking.
- Many of these flavouring compounds on **pyrolysis** can give rise to noxious / carcinogenic compounds

 **Additives & Flavours: Other Tobacco Products** 

Smokeless Tobacco e.g. Snus
Citrus, icemint, whisky aroma, bergamot, cranberry, salt and liquorice sweet anis and liquorice, wintergreen, anise etc; and even a flavour called **taste of Christmas**.


Hookah/ Sheesha/ Narghil/ Water Pipe:
Flavoured Tobacco molasses such as Double Apple, Strawberry, Mint, Lemon, Orange, Cherry, Cola, Aniseed, Banana, Apricot, Chewing gum, Bubble gum etc

 **Additives & Flavours: Other Products - 2** 

Electronic Cigarettes




Some flavours:
Orange, Mint, Peach, Coffee etc



Additives : Recap **dkfz.**


- **Manipulate & enhance the delivery of nicotine**
- Anaesthetize the throat so the smoker cannot feel the smoke's irritating components
- Enhance taste of tobacco smoke, mask harshness of nicotine and make it more palatable and appealing for initiation
- Dilate airways, easier and deeper passage of smoke into the lung
- Mask the smell and visibility of side stream smoke
- Thus, contribute extensively but surreptitiously to the global smoking epidemic



Additives: Effect on Cessation **dkfz.**


YES:

- ***The multi-pronged actions of additives cause easy initiation, sustainance and addiction and make it hard to QUIT***
- ***“To cease smoking is the easiest thing I ever did. I ought to know, I've done it a thousand times.”***
Mark Twain




Additives Regulation-2 **dkfz.**

- Systematic evaluation of additives in unburnt and burnt form
- Chemical, biochemical, pharmacological, sensory and addiction causing/enhancing effects



Additives Regulation-2 **dkfz.**

Evidence has accumulated that additives even if lacking direct toxicity, could prolong the use of cigarettes by making them more palatable, attractive or addictive, thus greatly adding to the burden of harm caused by tobacco use.




Additives Regulation-3 **dkfz.**

Additives that qualify into any of these categories should not be cleared for use in tobacco products simply based on the criteria for food or flavour as currently practised.



Additives : Regulation-4 **dkfz.**

- Research and evaluation in all these areas required to be conducted by Independent unbiased scientists
- The Industry should finance these studies through EU or individual governments
- However, until such information is available, additives should not be allowed in these products



Thank You

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