

Supplemental information

Flavors and flavorings in waterpipe products: a comparison between tobacco, herbal molasses and steam stones

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249 waterpipe tobacco products were registered in EU-CEG in The Netherlands in March 2019. These products contain a total of 378 unique ingredients. The 25 most frequently added ingredients of waterpipe tobacco, as registered in the EU-CEG database, are listed below (Table S1).

Table S1. The 25 most frequently added ingredients in EU-CEG registered waterpipe tobacco products (March 2019, The Netherlands). Shown in this table are ingredient names, prevalence, median concentration per product (mg/g) flavor descriptions (from the Leffingwell database) and additive functions. N/A = not applicable.

Ingredient name	Prevalence	Median conc. (mg/g)	Flavor description	Function
Glycerol	100%	434	N/A	Solvent, humectant, bodying agent
Propylene glycol	62%	17.0	N/A	Solvent, humectant, bodying agent
Water	63%	1.27	N/A	Solvent, humectant
Vanillin	59%	0.31	Sweet, powerful, creamy, vanilla-like	Flavoring
Ethyl alcohol	49%	0.01	N/A	Solvent
Ethyl vanillin	47%	0.02	Intense, sweet, vanilla-like odor; creamy, vanilla taste	Flavoring
High fructose corn syrup	44%	357	Sweet	Bodying agent, flavoring (sugar)
Caramel	44%	0.006	Primarily used for coloring purposes; little taste as used	Flavoring (sugar), color
Potassium sorbate	44%	0.003	N/A	Preservative

Synthetic amorphous silica	44%	4.00	N/A	Anticaking agent
FD&C red	43%	0.25	N/A	Dye
Dihydrocoumarin	41%	0.001	Very, sweet, nut-like, hay-like, coumarin-tobacco like odor	Flavoring
Ethyl butyrate	40%	1.24	Ethereal, fruity with buttery-pineapple-banana, ripe fruit and juicy notes	Flavoring
Ethyl acetate	34%	0.49	Ethereal, sharp, wine-brandy-like	Flavoring
Unspecified flavors	31%	50.0	N/A	Mixture, various ingredients
Ethyl-2-methylbutyrate	31%	0.54	Strong, green, fruity, apple with strawberry notes	Flavoring
Maltol	27%	0.22	Sweet, fruity, berry, strawberry, caramellic	Flavoring
Isoamyl acetate	25%	1.10	Sweet, fruity, banana, pear odor & taste	Flavoring
Menthol	25%	0.76	String trigeminal cooling sensation with a slight mint note	Flavoring
Benzyl alcohol	24%	1.26	Faint, sweet, almond fruity, somewhat chemical	Flavoring
Benzaldehyde	23%	0.07	Floral, hay-like odor; sweet anisic-vanilla-fruity herbaceous	Flavoring
Sucrose	23%	280	Sweet	Flavoring (sugar)
Citric acid	23%	0.72	N/A	Preservative
Sodium benzoate	23%	0.70	N/A	Preservative
4-(4-Hydroxyphenyl)-2-Butanone (raspberry ketone)	20%	0.61	Very sweet, fruity odor and taste reminiscent of raspberry	Flavoring

Next, ingredients from EU-CEG were sorted from highest to lowest median concentration (mg/g). After exclusion of the following ingredients (non-flavorings and sugars): glycerol, high fructose corn syrup, glucose, molasses, sucrose, fructose, 1,2-propylene glycol, triethyl citrate, alpha-tocopherol, synthetic amorphous silica, sunflower oil, acetic acid, malt extract, carmoisine and water only flavorings (including mixtures such as oils and extracts) were left and a top 25 is depicted in Table S2.

Table S2. This table shows 25 flavorings sorted on their median concentrations (from high to low) for EU-CEG registered waterpipe tobacco products (March 2019, The Netherlands). Listed in this table are ingredient names, median concentration per product (mg/g), prevalence and flavor descriptions (from the Leffingwell database).

N/A = not applicable, ^a = not found in Leffingwell database, but flavor/taste descriptions obtained from thegoodscentscompany.com

Ingredient name	Median conc. (mg/g)	Prevalence	Flavor description
Unspecified flavors	50.0	30.9%	N/A
Pineapple essence	20.0	0.8%	Sweet pineapple
Allyl cyclohexyl propionate	19.6	0.8%	Sweet-fruity pineapple-like odor and taste
Dodecanal	12.0	2.4%	Sweet, clean floral waxy odor; somewhat fatty-citrus woody flavor
Terpineol	12.0	2.4%	Sweet, floral (lilac), lime odor; very sweet taste in dilution
Citronellal	10.0	3.6%	Fresh, green, citrus-lemon, woody; citronella oil-like
Banana distillates	10.0	0.4%	Taste: Estery banana character. Full ripe banana flavor.banana ^a
Licorice	10.0	0.4%	Sweet, caramel, spicy, "root-like" odor; very sweet flavor
Orange oil	8.2	16.5%	Fresh, sweet, terpeny citrus
Triacetin	3.8	16.9%	Very weak ethereal-fruity odor; a mild sweet taste; normal use as solvent
Turpentine oil	3.4	1.6%	Peculiar, pine solvent, warm-balsamic, refreshing odor
Hexyl acetate	2.8	0.4%	Sweet, fruity, pear-apple like odor; green, banana, apple-pear like taste
Commint oil	2.5	11.2%	Peppermint-like odor & flavor
Estragol	2.5	0.8%	Odor: sweet sassafrass anise spicy green herbal fennel; flavor: sweet licorice phenolic weedy spicy celery ^a
Cis-3-hexenyl propionate	2.3	0.8%	Sweet green, waxy, vegetable character, apple, pear, citrus notes
Anethole	2.2	11.2%	Sweet, herbaceous, anise (artificial Licorice) odor & taste
L-Carvone	2.1	5.2%	Spearmint odor & taste
Spearmint oil	1.9	5.2%	Warm characteristic spearmint herbaceous odor with a sharp taste
Mint oil	1.8	2.8%	Odor: cornmint ^a
Cocoa extract	1.5	0.8%	Cocoa/chocolate aroma and flavor
Peppermint oil	1.5	5.2%	Sweet, fresh, peppermint (minty) aroma and cooling taste
Cinnamyl acetate	1.4	0.4%	Sweet, balsamic, floral-fruity odor; slightly cinnamic spicy
Amyl butyrate	1.4	2.8%	Strong, fruity, apple, banana, apricot, mixed fruit flavor
Methyl 2-methylbutyrate	1.3	0.8%	Fruity, sweet, apple, berry, ripe tropical notes
Citral	1.3	15.3%	Strong, lemon-like aroma and taste