

## Supplementary Appendix

This appendix has been provided by the authors to give readers additional information about their work.

Supplement to: Brown JE, Luo W, Isabelle LM, Pankow JF. Candy flavorings in tobacco. *N Engl J Med* 2014;370:2250-2. DOI: 10.1056/NEJMc1403015

## Candy Flavorings in Tobacco

Jessica E. Brown, B.S.  
Wentai Luo, M.S., Ph.D.  
Lorne M. Isabelle, M.S.  
James F. Pankow, M.S., Ph.D.

From: Portland State University, Department of Civil & Environmental Engineering (J.E.B., L.M.I., W.L., J.F.P.); Portland State University, Department of Chemistry, (L.E.M., W.L., J.F.P.). Address reprint requests to Dr. Pankow at Department of Civil & Environmental Engineering, Portland State University, Portland, Oregon, 97207-0751; [pankowj@pdx.edu](mailto:pankowj@pdx.edu).

<i>Table of Contents</i>	<i>page</i>
<a href="#">Flavored Tobacco Products in the World</a>	S-1
<a href="#">Cigarettes vs. "Cigars"</a>	S-2
<a href="#">Selling Tobacco to Youth</a>	S-2
<a href="#">Methods: Analyses of Candies and Kool-Aid</a>	S-3
<a href="#">Methods: Analyses of Tobacco Products</a>	S-3
<a href="#">Results</a>	S-4
<a href="#">References</a>	S-6
<a href="#">Table S1. List of 70 Flavor Chemicals</a>	S-8
<a href="#">Table S2. Compounds in "Cherry" Products</a>	S-16
<a href="#">Table S3. Compounds in "Grape" Products</a>	S-19
<a href="#">Table S4. Compounds in "Apple" Products</a>	S-23
<a href="#">Table S5. Compounds in "Peach" Products</a>	S-25
<a href="#">Table S6. Compounds in "Berry" Products</a>	S-27

**Flavored Tobacco Products in the World.** In the U.S., the Family Smoking Prevention and Tobacco Control Act of 2009 banned cigarette brands such as *Camel "Twista Lime"*, clove cigarettes, and cigarettes with any "characterizing flavor" other than menthol.<sup>1</sup> Current law allows continued use of non-menthol flavor chemicals in cigarettes provided that the levels do not become "characterizing" (aka, "overt"). U.S. manufacturers admit the possible addition of many flavor chemicals in their cigarettes<sup>2,3</sup>

Overtly flavored cigarettes are widely available in the world. DJ Tobacco Company, Ltd. (Hong Kong) markets flavored cigarettes to Asia and the Pacific; its brands include *DJ Mix* (e.g., "strawberry", "apple green", "menthol apple") and *Peel* (e.g. "menthol orange", "sweet melon"). *Esse* cigarettes (Korea Tomorrow & Global Corp., South Korea) are available in Asia and Europe;

flavors include "green apple" and "strawberry". *Sutra* cigarettes (C.H. Graphics, India) are available in "grape", "cherry", and "vanilla". *Sweet Dreams* cigarettes (Donskoy Tabak JSC, Russia) are available in a vanilla/cherry/chocolate mix, and in "double apple". *Kiss* cigarettes (Donskoy Tabak JSC) are available in "strawberry" and "fresh apple". *Black Devil* cigarettes (Huepink & Bloeman Tabak BV, Netherlands) are available in "chocolate" and "rose". *Pink Elephant* cigarettes (Huepink & Bloeman Tabak BV) are vanilla flavored. In the U.S., although overt flavoring is banned for cigarettes, it is not banned for the wide range of tobacco products that are not "cigarettes" under U.S. tax law.

World interest in limiting the use of flavor chemicals in tobacco products is growing. On September 16, 2013, a ruling by the Brazil national health surveillance agency ANVISA banned all flavor chemicals (including menthol) at any level in cigarettes, and in any tobacco product as of March 16, 2014.<sup>4</sup> In Australia, state and territory governments have sought to prevent the retail sale of tobacco products that have a distinctive fruity, sweet or confectionery-like flavor. All but two of the six states and two internal territories have existing legislative controls on the sale and/or marketing of overtly fruity or confectionery-flavored cigarettes. In Canada, total bans of flavored tobacco products are under consideration in Alberta and Ontario. The EU parliament passed a draft law on

October 8, 2013 to ban cigarettes with characterizing flavors, to be effective three years after the rules are finalized, with menthol cigarettes to be banned eight years after rules finalization.<sup>5</sup>

Morris *et al.*<sup>6</sup> examined the websites of internet tobacco retailers and reported in 2013 that the percentages of the available products available for sale in the U.S. in flavored form were 52.3% for “cigarette-sized cigars”, 81.3% for “cigar wraps” (aka “blunt wraps”, “tobacco wraps”, and “wraps”), 55.1% for moist snuff, 86.1% for shisha (aka “hookah”), and 81.5% for “dissolvables”.

**Cigarettes vs. “Cigars”.** A 2013 CDC study<sup>7</sup> reported that for U.S. middle and high school students that self-identify as smokers, with “flavors” defined as including menthol, 42.4% reported using flavored “little cigars” or flavored cigarettes; 60% of the 42.4% group were smokers of products in fla-

vors other than menthol, *e.g.*, “cherry”, “grape”, etc.; 9.8% of the users of flavored products expressed plans to quit, vs. 18.4% for the users of unflavored products. A conventional 100 mm filtered cigarette presently weighs close to 1.0 g. Under U.S. tax law, a “little cigar” is to weigh less than 1.36 g (“3 pounds per 1000”); a “large cigar” must only weigh slightly more than 1.36 g.<sup>8</sup> The result is that in the U.S., many “little cigars” and “large cigars” are

*cigarette-like products* (CLPs) (Figure S1). They are of the same size and of similar weights; they usually have filters; they are filled with cut/shredded tobacco material (though usually of dark tobacco not typically used in cigarettes<sup>9</sup>); and they use a paper wrap (albeit made from tobacco). Typically, the only design feature that visually distinguishes these products from most cigarettes is the darker color of the outer paper. Given that menthol is the only “characterizing flavor” presently allowed in cigarettes in the U.S, many of the students in the CDC study that reported being smokers of flavored cigarettes were likely actually smokers of flavored CLP “little-” and “large-cigars”.

**Selling Tobacco to Youth.** In a 1972 tobacco trade magazine article on flavoring and sales, an industry consultant stated:<sup>10</sup>

*“...I could probably find more reasons, but they all add up to one sentence. ‘To make the product sell better.’ ...Developing new consumers means, basically, interesting the new generation reaching smoking age who have not yet started to smoke.”*

Regarding the 1970s meaning of “smoking age”, consider the March 8, 1973 marketing-report from John H. McCain (William Esty Co.) to J.O. Watson (R.J. Reynolds Tobacco Co.):<sup>11</sup>

*“Many manufacturers have “studied” the 14-20 market in hopes of uncovering the “secret” of the instant popularity some brands enjoy to the almost complete exclusion of others (as shown above). Creating a “fad” in this market can be a great bonanza...”*

Tobacco use continues to begin at a young age in the U.S. and globally. King *et al.*<sup>7</sup> argue that flavors in tobacco increase appeal to adolescents, and that the associated advertising is aimed at youth. The Miami Dade County Health Department<sup>12</sup> has described flavored tobacco as “candy flavored tobacco” targeted at youth.



**Figure S1.** A 100 mm Marlboro cigarette vs. 100 mm “grape” Cheyenne “large cigar”.

Photo: A.C. Evans.

**Methods: Analyses of Candies and Kool-Aid.**

Individually wrapped Life Saver hard candies in a multi-flavor package (“cherry”, “raspberry”, “watermelon”, “pineapple” and “orange”) were purchased in a retail store in Portland, OR in August 2013. Individually wrapped Jolly Rancher hard candies in a multi-flavor package (“cherry”, “blue raspberry”, “watermelon”, “grape” and “apple”) and packages of various flavors of unsweetened Kool-Aid drink mix purchased at the same time. “Cherry”, “grape”, “apple”, and “blue raspberry” Zotz candies were purchased in February 2014. Analyses were carried out in triplicate. For the candy and Kool-Aid products, sample sizes were: Life Savers, 2 candies; Jolly Ranchers, 1 candy; Zotz, 1 candy; and Kool-Aid, 0.5 to 0.8 g. For each analysis, 50  $\mu\text{L}$  of surrogate standard (SS) solution (1,3,5-trichlorobenzene (1,3,5-TCB) at 4000 ng/ $\mu\text{L}$  in MTBE) was included to monitor recoveries. Also included in the vials were: 1) 450 mg, 700 mg, 800 mg or 350 mg, respectively, of trisodium citrate to raise the pH of each water extract from an otherwise rather acidic value (to reduce hydrolysis of some flavor chemicals); and 2) 2.0 g of sodium chloride. Sample processing proceeded in a 40 mL amber VOA vial using 10 mL of deionized water for dissolution, and 10 mL of MTBE for extraction. Zotz and Kool-Aid sample vials were placed on a shaker for 0.5 h.

Candy sample vials were allowed to sit for 8 h (4 °C) for dissolution, then placed on a shaker for 0.5 h. Every vial was then subjected to vortex mixing 3 $\times$  for 10 s each. Sample material that had not fully dissolved were shaken vigorously until no visible solids remained. All sample vials were then allowed to sit for 2 h for phase separation. 1 mL of each extract was placed in an autosampler vial with 10  $\mu\text{L}$  of an internal standard (IS) solution (1,2,3-trichlorobenzene (1,2,3-TCB) at 2000 ng/ $\mu\text{L}$  in MTBE). The target analyte list included 85 authentic compounds from Sigma Aldrich Inc. (St. Louis, MO), the Good Scents Company, Inc. (Oak Creek, WI), and other vendors. 70 of the chemicals (Table S1) were found in one or more

of the samples. Analyses proceeded using an Agilent (Santa Clara, CA) 7690 autosampler, 7890A gas chromatograph (GC), and 5975C mass spectrometer (MS). The GC column type was Agilent DB-5MS UI, of 30 m length, 0.25 mm i.d., and 0.25  $\mu\text{m}$  film thickness. 1.0  $\mu\text{L}$  of each extract was injected with a 5:1 split. With minor variations, the GC temperature program for all analyses was: 45 °C hold for 3 min; 5 °C/min to 100 °C; 2 °/min to 130 °C; 5 °C/min to 160 °C; then 20 °C/min to 300 °C. All SS recoveries were in the range 83 to 114%; no SS-based adjustments were made.

Quality assurance (QA) steps besides the use of the SS and IS compounds in each analysis included: a) for some of the sample extracts, removal of as much of the 1<sup>st</sup> extract as possible and conducting a 2<sup>nd</sup> extraction with MTBE to verify good extraction efficiencies; and b) spike-recovery efficiency tests with the actual products. For (a), with all of the above-trace compounds in Table 2 and in the Supplementary Tables, the 1<sup>st</sup> extraction efficiencies were >88% for all compounds for Jolly Rancher candies; >94% for Life Saver candies except for furfural (85%) and furfuryl alcohol (88%); 100% for Kool-Aid. For (b), spiking occurred into samples that already contained some amounts of the analytes being spiked. The pre-spike levels were estimated as the averages reported here. The average spike recoveries for Jolly Ranchers were in the range 82-116% for all analytes, with most >90%. For Zotz, the spike recoveries were 82-115%, with most >90%, except for furfuryl alcohol and  $\alpha$ -terpineol, at 71% and 78% respectively. Adjustments for extraction/recovery efficiency were not made.

**Methods: Analyses of Tobacco Products.** The Cheyenne brand “large cigars” were purchased in January 2013 from an on-line retailer. All other tobacco products were purchased in retail stores in Portland, OR during August 2013, except for the Kayak “grape” moist snuff and the “Grape” Zig Zag wraps which were purchased in February

2014. The products were stored at 4 °C in zip lock bags until analyzed. An unflavored reference moist snuff (“CRP2”)<sup>13</sup> was obtained from North Carolina State University (July 2012) for use as an unflavored tobacco control material; it was stored as received (in cans) at 4 °C until analyzed. The commercial tobacco products were stored at 4 °C in zip lock bags until analyzed. Sample amounts were: a) 1 stick for Cheyenne “cigars” (filter and rod analyzed separately; final values given as filter+rod); b) 1 cigarillo for the Swisher Sweet products (plastic tip not included); c) 1.0 g from the center of the Phillies Blunt cigars; d) 1 wrap for blunt wraps; and e) 1.0 g for moist snuff products. Each non-snuff sample was cut into small pieces with a clean suture scissors. Each extraction proceeded in a 40-mL amber glass VOA vial with screw cap and Teflon septum. For most samples, added to each vial were 50 µL of the 4000 ng/µL 1,3,5-TCB SS solution, plus 10 mL MTBE. For the Cheyenne filters, the amounts were 25 µL of SS solution and 5 mL MTBE; for the Swisher Sweet cigarillos (2.3-2.7 g each, tobacco only), 100 µL of the SS solution and 20 mL MTBE.

Extraction steps were: 1) gentle shaking for 1 h; 2) quiescence for 8 h (4 °C); and 3) gentle shaking for 0.5 h (room temperature). Analyses were by GC/MS as with the candy/Kool-Aid samples. All SS recoveries were in the range 87-114%. 1<sup>st</sup> extraction efficiencies were: for Skoal Cherry moist snuff, >92% for all compounds except amyl butyrate (83%) and isoamyl butanoate (86%); for Zig Zag Apple blunt wraps, >98% for all compounds; for Cheyenne Xotic Berry “large cigars”, >81% for all compounds (as the net for the separate rod and filter extractions). Spike-recovery efficiency values for the tobacco samples were 88-115%. Adjustments were not made for SS recovery, extraction efficiency, or spike recovery.

Some of the compounds found in the analyses here can arise naturally in tobacco.<sup>14</sup> Vanillin has been reported at 0.9 to 1.8 µg/g in a range of types of tobacco leaf.<sup>15</sup> Since we did not have access to

the unflavored versions of the tobacco products we examined, the CRP2 reference moist snuff was analyzed as an unflavored tobacco control.

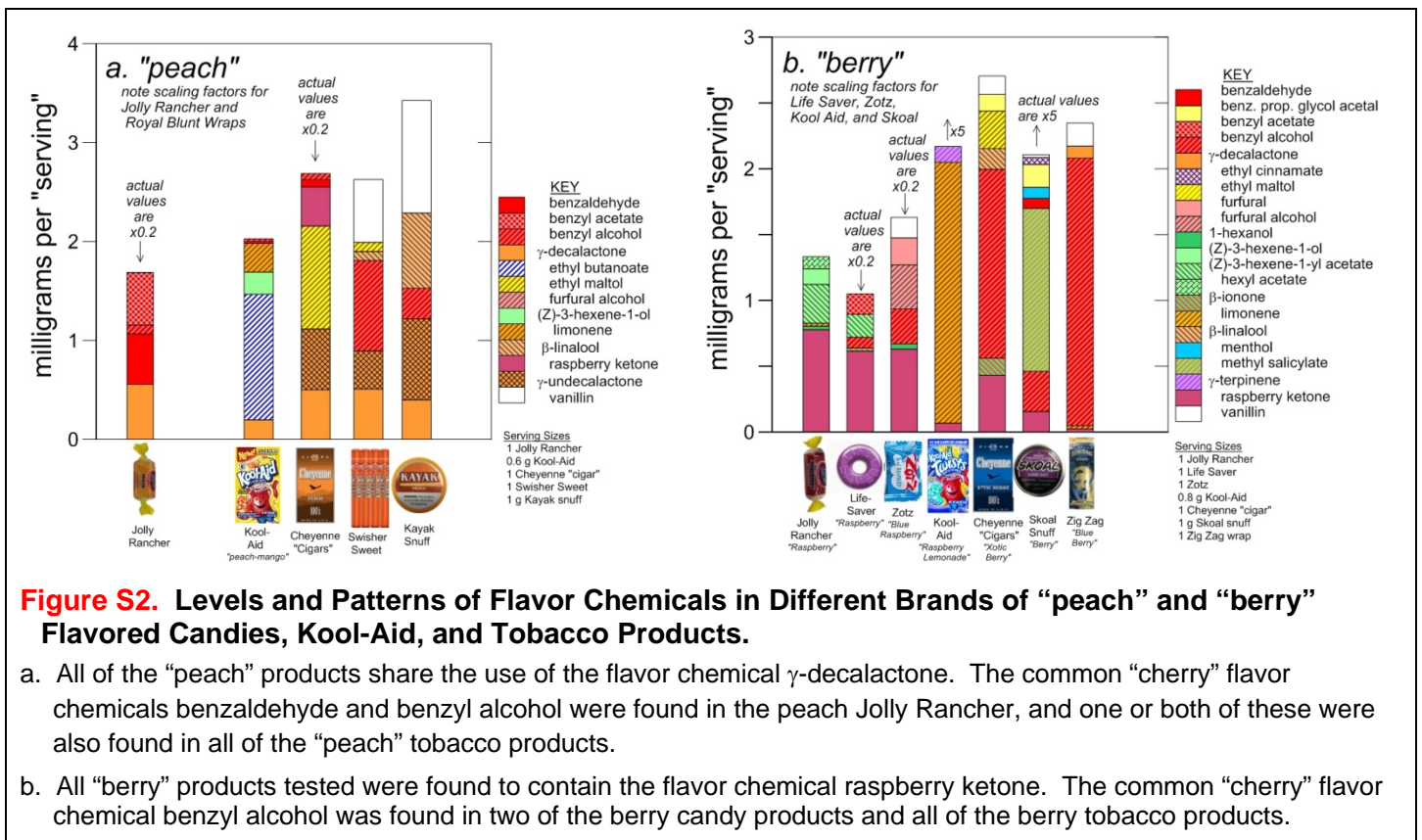
**Results.** A total of 59 flavor chemicals were found in one or more tobacco products; 63 were found in one or more candy/Kool-Aid products; 52 were found in both tobacco and candy/Kool-Aid products. Results in micrograms (µg) per “serving” are given in Tables S2-S6. Stacked bar graphs are given in Figure 1 in the main Letter for “cherry”, “grape”, and “apple” products; graphs for “peach” and “berry” products are given here in Figure S2. In CRP2, of the 59 compounds found in the commercial tobacco products, all were “not detected” except *cis*-linalool oxide, *trans*-linalool oxide, methyl salicylate, and phenethyl alcohol at 0.3, 0.5, 0.5, and 2.7 µg/g. Overall, low values (*e.g.*, less than very roughly 5 µg/g) reported here for tobacco products may be considered candidates for consideration as being due to natural presence in tobacco.

For the tobacco products considered here with flavor names (“cherry”, “peach”, “grape”, “berry”, “apple”, etc.), the mixes of chemicals being used to accomplish the flavors bear considerable similarities to the candy/beverage products considered. Most of the flavor chemicals in Figure 1 (Letter) and Figure S2 (here) are listed in the compendium of flavor chemicals by Burdock<sup>16</sup>, and many are well known as candy flavorants, and the compendium provides “usual” and “maximum” levels as added to products such as hard candy, soft candy, non-alcoholic beverages, etc.

While “characterizing flavors” (other than menthol) are not legal in the U.S., of the 59 compounds found in the tobacco products analyzed here, many are acknowledged flavor additives for cigarettes made by U.S. manufacturers: about 20 for both R.J. Reynolds Tobacco Company,<sup>2</sup> and Philip Morris USA.<sup>3</sup> It would seem worthwhile to undertake a broad investigation of the levels of flavor chemicals in current U.S. cigarettes. Such a task could not be undertaken

lightly given the documented interest within the tobacco companies in compounds that release active flavor chemicals *only on heating*, as with the glucoside of ethyl vanillin. A search on vanillin + glucoside currently gives ~1600 document hits on the Legacy Tobacco Documents

Library website (<http://legacy.library.ucsf.edu/>). One example is “*Release Compound Products*”<sup>17</sup>. Some number of the documents remain unavailable to the public, e.g., “*Application for Authorization for Using the Additive “Ethyl Vanillin Glucoside”*”<sup>18</sup>.



**Figure S2. Levels and Patterns of Flavor Chemicals in Different Brands of “peach” and “berry” Flavored Candies, Kool-Aid, and Tobacco Products.**

- All of the “peach” products share the use of the flavor chemical  $\gamma$ -decalactone. The common “cherry” flavor chemicals benzaldehyde and benzyl alcohol were found in the peach Jolly Rancher, and one or both of these were also found in all of the “peach” tobacco products.
- All “berry” products tested were found to contain the flavor chemical raspberry ketone. The common “cherry” flavor chemical benzyl alcohol was found in two of the berry candy products and all of the berry tobacco products.

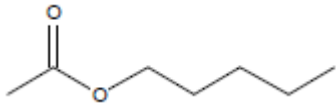
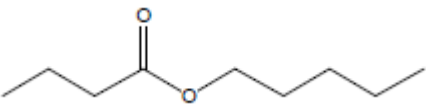
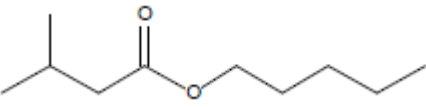
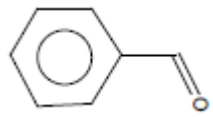
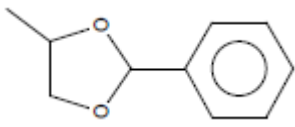
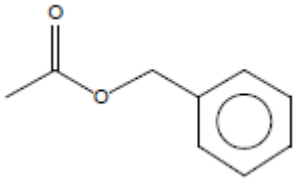
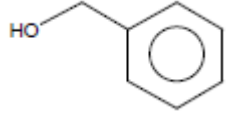
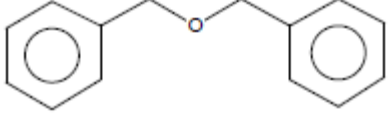
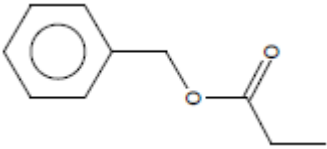


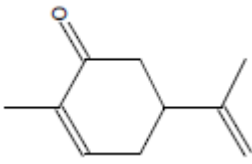
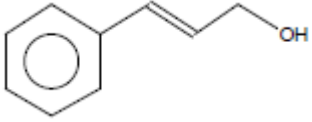
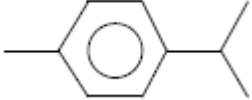
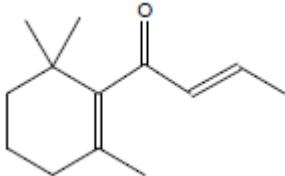
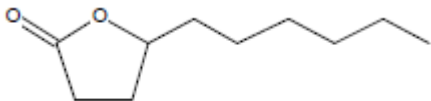
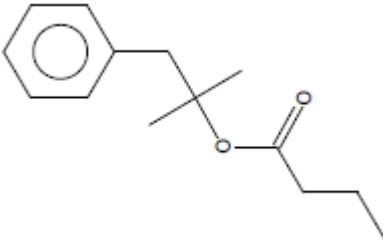
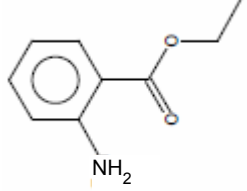
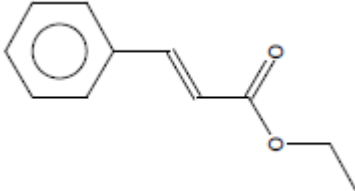
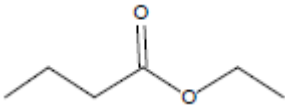
**References**

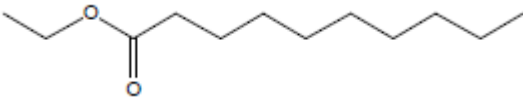
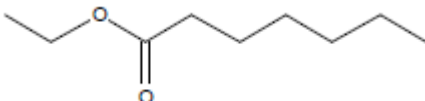
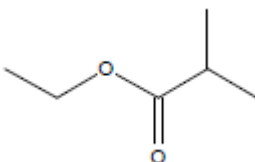
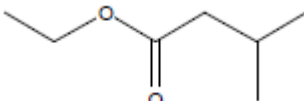
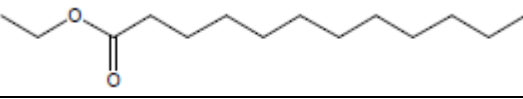
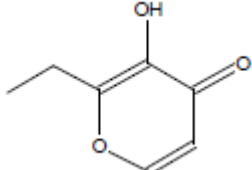
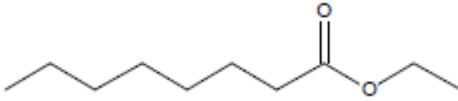
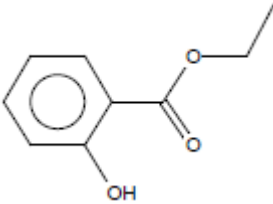
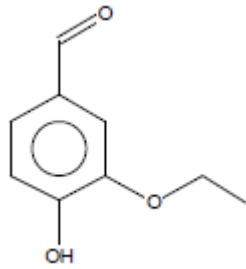
1. Family Smoking Prevention and Tobacco Control Act. June 22, 2009. Public Law 111-31. 111<sup>th</sup> Congress, United States of America. <http://www.gpo.gov/fdsys/pkg/PLAW-111publ31/pdf/PLAW-111publ31.pdf>. Accessed December 7, 2013.
2. R.J. Reynolds. R.J. Reynolds List of Ingredients. 2012. <http://www.rjrt.com/tobaccoingredients.aspx>. Accessed December 16, 2013.
3. Phillip Morris USA: An Altria company. Cigarettes: Ingredients. [http://www.philipmorrisusa.com/en/cms/Products/Cigarettes/Ingredients/Tobacco\\_Flavor\\_Ingredients/default.aspx](http://www.philipmorrisusa.com/en/cms/Products/Cigarettes/Ingredients/Tobacco_Flavor_Ingredients/default.aspx). Accessed December 16, 2013.
4. ANISA - Brazil National Health Protection Agency. Resolução - Rdc N° 14, De 15 De Março De 2012. <http://www.brasilsus.com.br/legislacoes/anvisa/112525-14.html>. Accessed December 7, 2013. See also: WHO Framework Convention on Tobacco Control. Brazil – Flavoured cigarette banned. [http://www.who.int/fctc/implementation/news/news\\_brazil/en/](http://www.who.int/fctc/implementation/news/news_brazil/en/). Accessed December 7, 2013.
5. European Parliament /News. Tobacco: larger warnings, flavours banned, e-cigarettes regulated. October 8, 2013. <http://www.europarl.europa.eu/news/en/news-room/content/20131004IPR21539/html/Tobacco-larger-warnings-flavours-banned-e-cigarettes-regulated>. Accessed December 7, 2013.
6. Morris DS, Fiala SD. Flavoured, non-cigarette tobacco sale in the USA: an inventory analysis of internet retailers. *Tob. Control* 2013; Epub ahead of print; doi:10.1136/tobaccocontrol-2013-051059.
7. King AB, Tynan MA, Dube SR, Arrazola, R. Flavored-little-cigar and flavored-cigarette use among U.S. middle and high school students. *J. Adolesc. Health*. 2013, Sep 17. pii: S1054-139X(13)00415-1. doi: 10.1016/j.jadohealth.2013.07.033. [Epub ahead of print].
8. Internal Revenue Code, Title 26, Chapter 52, Tobacco Products and Cigarette Papers and Tubes. Section 5701, Rate of Tax. <http://www.gpo.gov/fdsys/granule/USCODE-2011-title26/USCODE-2011-title26-subtitleE-chap52-subchapA-sec5701/content-detail.html>. Accessed December 12, 2013.
9. Internal Revenue Code, Title 26, Chapter 52, Tobacco Products and Cigarette Papers and Tubes. Section 5702, Definitions. <http://www.gpo.gov/fdsys/granule/USCODE-2011-title26/USCODE-2011-title26-subtitleE-chap52-subchapA-sec5702/content-detail.html>. Accessed December 12, 2013.
10. Felton RE. What flavoring can do to improve sales of tobacco products. *World Tobacco*. 1972; 38:147-148. <http://legacy.library.ucsf.edu/tid/bao74a99/pdf>. Accessed December 7, 2013.
11. McCain, JH. Re : NFO Preference Share Data -"Youth" Market-. Letter to Mr. J.O. Watson, Marketing Department, R.J. Reynolds Tobacco Company. <http://legacy.library.ucsf.edu/tid/fyy49d00/pdf>. Accessed December 7, 2013.
12. Miami-Dade County. Candy-Flavored Tobacco Products. Miami-Dade County Tobacco Update. January-March, 2012. [http://www.healthymiamidade.org/system/js/ba ck/ckfinder/userfiles/files/Tobacco/Candy-Flavored%20Tobacco%20Newsletter%20Q3\\_2012.pdf](http://www.healthymiamidade.org/system/js/ba ck/ckfinder/userfiles/files/Tobacco/Candy-Flavored%20Tobacco%20Newsletter%20Q3_2012.pdf). Accessed December 11, 2013.
13. North Carolina State University, Smokeless tobacco reference products, *Composition of CRP2 - Moist Snuff*. <http://www.tobacco.ncsu.edu/strp/CORESTA%20CRP2%20Composition.pdf>. Accessed December 20, 2013.
14. Rodgman A, Perfetti TA. *The Chemical Components of Tobacco and Tobacco Smoke*, CRC Press, 2008, Boca Raton, FL.

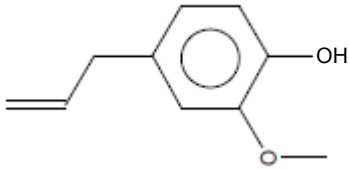
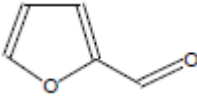
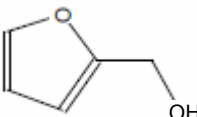
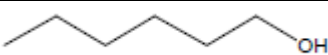
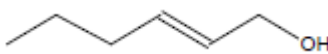
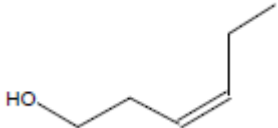
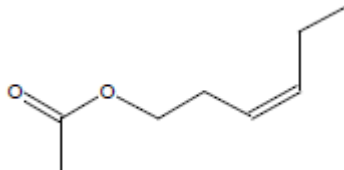
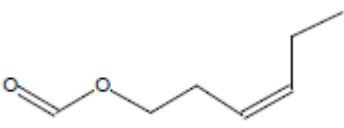
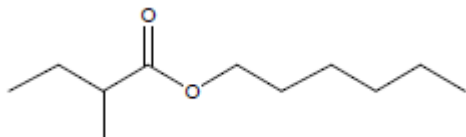
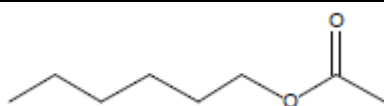
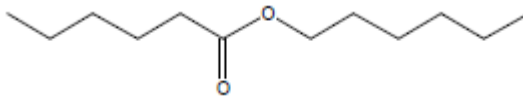
15. Demian B. Trace analysis of vanillin in tobacco. *J. Liquid Chromatography* 1993;16(16):3563-3574.  
<http://legacy.library.ucsf.edu/tid/uql46e00/pdf>. Accessed December 30, 2013.
16. Burdock GA. *Fenaroli's Handbook of Flavor Ingredients, Sixth Edition*. CRC Press, Boca Raton, FL. 2009.
17. Demian, B. "Release Compound Products". October 1994. Legacy Tobacco Documents Library.  
<http://legacy.library.ucsf.edu/tid/bhz83c00/pdf>. Accessed December 29, 2013.
18. Author unknown. "Application for Authorization for Using the Additive "Ethyl Vanillin Glucoside". December 18, 1996.  
<http://legacy.library.ucsf.edu/tid/xqs53h00>. Accessed December 29, 2013.

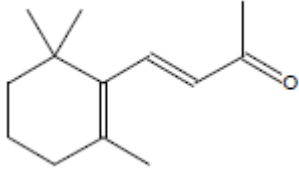
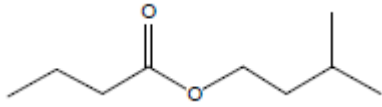
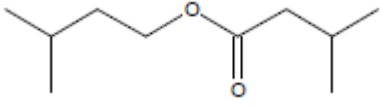
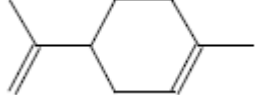
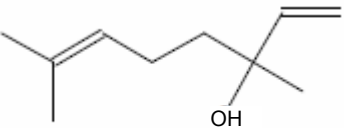
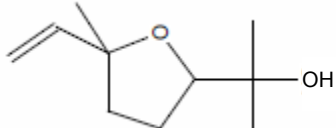
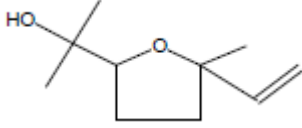
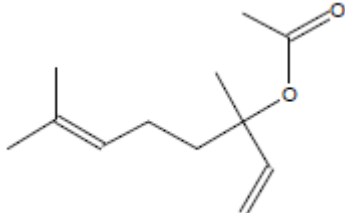
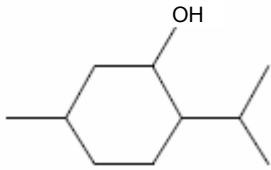


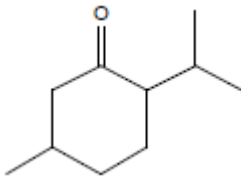
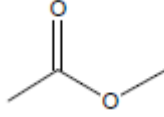
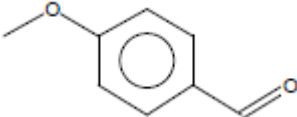
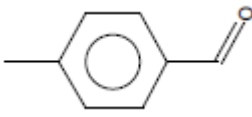
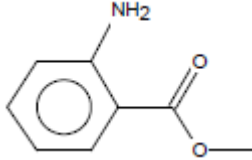
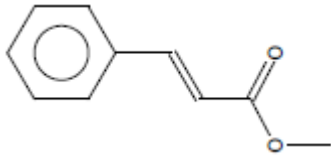
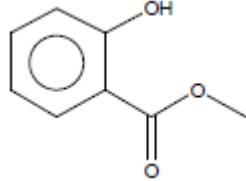
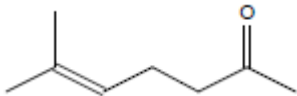
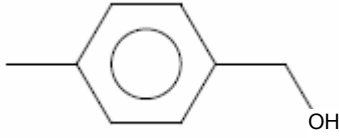
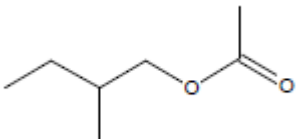
<b>Table S1.</b> List of 70 compounds determined in selected candy, Kool-Aid, and tobacco products. For analytes with chirality, differentiation by chirality was not carried out. The Chemical Abstract Services Registry Number (CASRN) values given are those used to prepare the analytical standards.		
compound	CASRN for standard	structure
1 amyl acetate	628-63-7 C <sub>7</sub> H <sub>14</sub> O <sub>2</sub>	
2 amyl butanoate	540-18-1 C <sub>9</sub> H <sub>18</sub> O <sub>2</sub>	
3 amylisovalerate	25415-62-7 C <sub>10</sub> H <sub>20</sub> O <sub>2</sub>	
4 benzaldehyde	100-52-7 C <sub>7</sub> H <sub>6</sub> O	
5 benzaldehyde propylene glycol acetal, mixture of isomers	2568-25-4 C <sub>10</sub> H <sub>12</sub> O <sub>2</sub>	
6 benzyl acetate	140-11-4 C <sub>9</sub> H <sub>10</sub> O <sub>2</sub>	
7 benzyl alcohol	100-51-6 C <sub>7</sub> H <sub>8</sub> O	
8 benzyl ether	103-50-4 C <sub>14</sub> H <sub>14</sub> O	
9 benzyl propionate	122-63-4 C <sub>10</sub> H <sub>12</sub> O <sub>2</sub>	

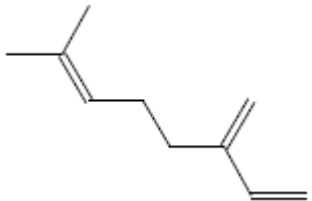
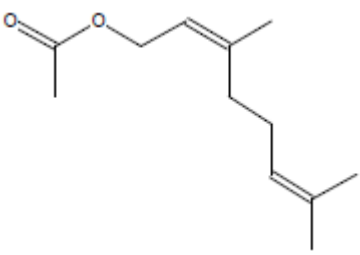

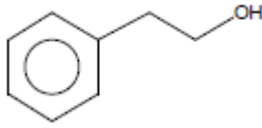
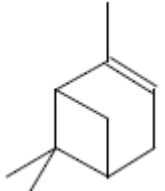
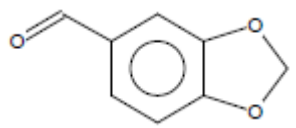
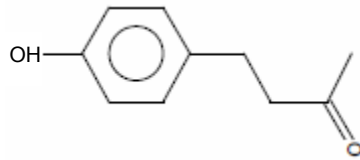
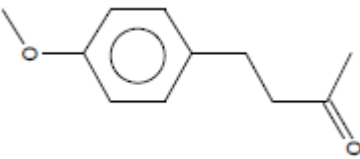
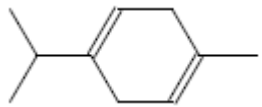
10	carvone	6485-40-1 C <sub>10</sub> H <sub>14</sub> O	
11	cinnamyl alcohol	104-54-1 C <sub>9</sub> H <sub>10</sub> O	
12	p-cymene	99-87-6 C <sub>10</sub> H <sub>14</sub>	
13	β-damascone	23726-91-2 C <sub>13</sub> H <sub>20</sub> O	
14	γ-decalactone	706-14-9 C <sub>10</sub> H <sub>18</sub> O <sub>2</sub>	
15	dimethyl benzyl carbonyl butanoate	10094-34-5 C <sub>14</sub> H <sub>20</sub> O <sub>2</sub>	
16	ethyl anthranilate	87-25-2 C <sub>9</sub> H <sub>11</sub> NO <sub>2</sub>	
17	ethyl cinnamate	103-36-6 C <sub>11</sub> H <sub>12</sub> O <sub>2</sub>	
18	ethyl butanoate	105-54-4 C <sub>6</sub> H <sub>12</sub> O <sub>2</sub>	

19	ethyl decanoate	110-38-3 C <sub>12</sub> H <sub>24</sub> O <sub>2</sub>	
20	ethyl heptanoate	106-30-9 C <sub>9</sub> H <sub>18</sub> O <sub>2</sub>	
21	ethyl isobutanoate	97-62-1 C <sub>6</sub> H <sub>12</sub> O <sub>2</sub>	
22	ethyl isovalerate	108-64-5 C <sub>7</sub> H <sub>14</sub> O <sub>2</sub>	
23	ethyl laurate	106-33-2 C <sub>14</sub> H <sub>28</sub> O <sub>2</sub>	
24	ethyl maltol	4940-11-8 C <sub>7</sub> H <sub>8</sub> O <sub>3</sub>	
25	ethyl octanoate	106-32-1 C <sub>10</sub> H <sub>20</sub> O <sub>2</sub>	
26	ethyl salicylate	118-61-6 C <sub>9</sub> H <sub>10</sub> O <sub>3</sub>	
27	ethyl vanillin	121-32-4 C <sub>9</sub> H <sub>10</sub> O <sub>3</sub>	

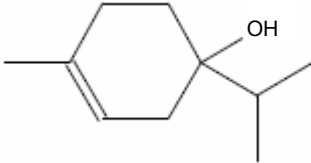
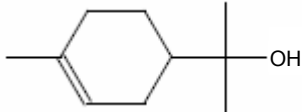
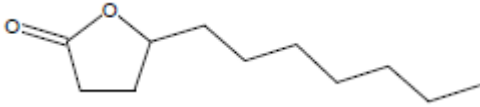
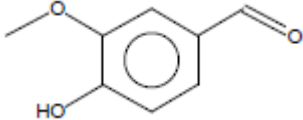
28	eugenol	97-53-0 C <sub>10</sub> H <sub>12</sub> O <sub>2</sub>	
29	furfural	98-01-1 C <sub>5</sub> H <sub>4</sub> O <sub>2</sub>	
30	furfuryl alcohol	98-00-0 C <sub>5</sub> H <sub>6</sub> O <sub>2</sub>	
31	1-hexanol	111-27-3 C <sub>6</sub> H <sub>14</sub> O	
32	(E)-2-hexen-1-ol	928-95-0 C <sub>6</sub> H <sub>12</sub> O	
33	(Z)-3-hexen-1-ol	928-96-1 C <sub>6</sub> H <sub>12</sub> O	
34	(Z)-3-hexen-1-yl acetate	3681-71-8 C <sub>8</sub> H <sub>14</sub> O <sub>2</sub>	
35	(Z)-3-hexen-1-yl formate	33467-73-1 C <sub>7</sub> H <sub>12</sub> O <sub>2</sub>	
36	hexyl 2-methylbutanoate	10032-15-2 C <sub>11</sub> H <sub>22</sub> O <sub>2</sub>	
37	hexyl acetate	142-92-7 C <sub>8</sub> H <sub>16</sub> O <sub>2</sub>	
38	hexyl hexanoate	6378-65-0 C <sub>12</sub> H <sub>24</sub> O <sub>2</sub>	

39	$\beta$ -ionone	14901-07-6 $C_{13}H_{20}O$	
40	isoamyl butanoate	106-27-4 $C_9H_{18}O_2$	
41	isoamyl isovalerate	659-70-1 $C_{10}H_{20}O_2$	
42	limonene	138-86-3 $C_{10}H_{16}$	
43	$\beta$ -linalool	78-70-6 $C_{10}H_{18}O$	
44	<i>cis</i> -linalool oxide	5989-33-3 $C_{10}H_{18}O_2$	
45	<i>trans</i> -linalool oxide	23007-29-6 $C_{10}H_{18}O_2$	
46	linalyl acetate	115-95-7 $C_{12}H_{20}O_2$	
47	menthol	2216-51-5 $C_{10}H_{20}O$	

48	menthone	14073-97-3 C <sub>10</sub> H <sub>18</sub> O	
49	menthyl acetate	79-20-9 C <sub>3</sub> H <sub>6</sub> O <sub>2</sub>	
50	<i>p</i> -methoxy benzaldehyde ( <i>p</i> -anisaldehyde)	123-11-5 C <sub>8</sub> H <sub>8</sub> O <sub>2</sub>	
51	<i>p</i> -methyl benzaldehyde ( <i>p</i> -tolualdehyde)	104-87-0 C <sub>8</sub> H <sub>8</sub> O	
52	methyl anthranilate	134-20-3 C <sub>8</sub> H <sub>9</sub> NO <sub>2</sub>	
53	methyl cinnamate	103-26-4 C <sub>10</sub> H <sub>10</sub> O <sub>2</sub>	
54	methyl salicylate	119-36-8 C <sub>8</sub> H <sub>8</sub> O <sub>3</sub>	
55	6-methyl-5-hepten-2-one	110-93-0 C <sub>8</sub> H <sub>14</sub> O	
56	4-methylbenzyl alcohol	589-18-4 C <sub>8</sub> H <sub>10</sub> O	
57	2-methylbutyl acetate	624-41-9 C <sub>7</sub> H <sub>14</sub> O <sub>2</sub>	

58	myrcene	123-35-3 C <sub>10</sub> H <sub>16</sub>	
59	neryl acetate	141-12-8 C <sub>12</sub> H <sub>20</sub> O <sub>2</sub>	
60	1-pentanol	71-41-0 C <sub>5</sub> H <sub>12</sub> O	
61	phenethyl alcohol	60-12-8 C <sub>8</sub> H <sub>10</sub> O	
62	α-pinene	80-56-8 C <sub>10</sub> H <sub>16</sub>	
63	piperonal	120-57-0 C <sub>8</sub> H <sub>6</sub> O <sub>3</sub>	
64	raspberry ketone	5471-51-2 C <sub>10</sub> H <sub>12</sub> O <sub>2</sub>	
65	raspberry ketone methyl ether	104-20-1 C <sub>11</sub> H <sub>14</sub> O <sub>2</sub>	
66	γ-terpinene	99-85-4 C <sub>10</sub> H <sub>16</sub>	



67	4-terpineol	20126-76-5 $C_{10}H_{18}O$	
68	$\alpha$ -terpineol	10482-56-1 $C_{10}H_{18}O$	
69	$\gamma$ -undecalactone	104-67-6 $C_{11}H_{20}O_2$	
70	vanillin	121-33-5 $C_8H_8O_3$	

<b>Table S2.</b> Compounds Found in “Cherry” Products			
product	compound	CASRN <sup>1</sup> for standard	micrograms (μg) per “serving”
Jolly Rancher “Cherry” 1 serving = 1 candy (~6.1 g)	benzyl alcohol	100-51-6	25 ± 1
	furfural	98-01-1	25 ± 1
	furfuryl alcohol	98-00-0	8 ± 1
	<i>p</i> -methoxy benzaldehyde ( <i>p</i> -anisaldehyde)	123-11-5	14 ± 1
	<i>p</i> -methyl benzaldehyde ( <i>p</i> -tolualdehyde)	104-87-0	47 ± 2
	piperonal	120-57-0	6 ± 0
	vanillin	121-33-5	13 ± 1
Life Saver “Cherry” 1 serving = 1 candy (~3.6 g)	amyl acetate	628-63-7	33 ± 1
	amyl butanoate	540-18-1	34 ± 1
	benzaldehyde	100-52-7	469 ± 8
	benzyl acetate	140-11-4	9 ± 0
	benzyl alcohol	100-51-6	2231 ± 61
	eugenol	97-53-0	8 ± 0
	furfural	98-01-1	46 ± 1
	furfuryl alcohol	98-00-0	2 ± 0
	β-ionone	14901-07-6	Trace <sup>2</sup>
	limonene	138-86-3	24 ± 2
	β-linalool	78-70-6	3 ± 0
	methyl salicylate	119-36-8	2 ± 0
	<i>p</i> -methyl benzaldehyde ( <i>p</i> -tolualdehyde)	104-87-0	140 ± 4
	2-methylbutyl acetate	624-41-9	38 ± 2
	raspberry ketone	5471-51-2	2 ± 1
γ-terpinene	99-85-4	Trace	
γ-undecalactone	104-67-6	Trace	
Zotz “Cherry” 1 serving = 1 candy (~5.1 g)	amyl acetate	628-63-7	170 ± 7
	amyl butanoate	540-18-1	Trace
	benzaldehyde	100-52-7	241 ± 11
	benzaldehyde propylene glycol acetal§	2568-25-4	78 ± 6
	ethyl butanoate	105-54-4	14 ± 0
	ethyl decanoate	110-38-3	5 ± 0
	ethyl laurate	106-33-2	25 ± 1
	eugenol	97-53-0	15 ± 1
	furfural	98-01-1	30 ± 0
	furfuryl alcohol	98-00-0	120 ± 7
	limonene	138-86-3	3 ± 0
vanillin	121-33-5	91 ± 5	
Kool-Aid Mix “Cherry” 1 serving = 0.5 g as for 8 oz of drink	amylisovalerate	25415-62-7	33 ± 8
	benzaldehyde	100-52-7	3338 ± 623
	benzyl acetate	140-11-4	185 ± 34
	benzyl alcohol	100-51-6	356 ± 60
	benzyl ether	103-50-4	51 ± 7
	ethyl butanoate	105-54-4	377 ± 89

	ethyl laurate	106-33-2	Trace
	ethyl vanillin	121-32-4	126 ± 18
	eugenol	97-53-0	Trace
	isoamyl butanoate	106-27-4	215 ± 53
	isoamyl isovalerate	659-70-1	78 ± 19
	<i>p</i> -methoxy benzaldehyde ( <i>p</i> -anisaldehyde)	123-11-5	133 ± 22
	<i>p</i> -methyl benzaldehyde ( <i>p</i> -tolualdehyde)	104-87-0	72 ± 13
	piperonal	120-57-0	185 ± 28
	vanillin	121-33-5	194 ± 34
Cheyenne	benzaldehyde	100-52-7	3937 ± 251
“large cigars”	benzaldehyde propylene glycol acetal§	2568-25-4	42 ± 3
“Wild Cherry”	benzyl acetate	140-11-4	Trace
1 serving = 1 “cigar” (~1.4 g)	benzyl alcohol	100-51-6	19 ± 1
	ethyl maltol	4940-11-8	25 ± 1
	ethyl vanillin	121-32-4	119 ± 5
	eugenol	97-53-0	42 ± 2
	β-ionone	14901-07-6	32 ± 1
	isoamyl butanoate	106-27-4	8 ± 1
	β-linalool	78-70-6	Trace
	menthol	2216-51-5	5 ± 0
	<i>p</i> -methoxy benzaldehyde ( <i>p</i> -anisaldehyde)	123-11-5	649 ± 36
	phenethyl alcohol	60-12-8	Trace
	piperonal	120-57-0	333 ± 17
	vanillin	121-33-5	219 ± 8
Swisher Sweet	benzaldehyde	100-52-7	Trace
cigarillos	benzaldehyde propylene glycol acetal§	2568-25-4	Trace
“BLK Cherry”	benzyl acetate	140-11-4	39 ± 2
1 serving = 1 “cigarillo” (~2.3 g)	benzyl alcohol	100-51-6	372 ± 53
	γ-decalactone	706-14-9	653 ± 35
	ethyl cinnamate	103-36-6	206 ± 12
	ethyl maltol	4940-11-8	Trace
	ethyl vanillin	121-32-4	1012 ± 43
	β-ionone	14901-07-6	15 ± 1
	menthol	2216-51-5	Trace
	<i>p</i> -methoxy benzaldehyde ( <i>p</i> -anisaldehyde)	123-11-5	55 ± 6
	4-methylbenzyl alcohol	589-18-4	Trace
	phenethyl alcohol	60-12-8	Trace
	raspberry ketone	5471-51-2	241 ± 7
	γ-undecalactone	104-67-6	9 ± 1
	vanillin	121-33-5	2778 ± 128
Skoal moist snuff	amyl acetate	628-63-7	7 ± 0
“Cherry”	amyl butanoate	540-18-1	Trace
1 serving = 1.0 g	benzaldehyde	100-52-7	2632 ± 43
	benzyl alcohol	100-51-6	35 ± 0
	ethyl butanoate	105-54-4	34 ± 3
	ethyl salicylate	118-61-6	3923 ± 67
	ethyl vanillin	121-32-4	112 ± 2

	eugenol	97-53-0	25 ± 1
	furfuryl alcohol	98-00-0	3 ± 0
	1-hexanol	111-27-3	31 ± 1
	hexyl acetate	142-92-7	23 ± 0
	isoamyl butanoate	106-27-4	8 ± 0
	methyl salicylate	119-36-8	4227 ± 93
	<i>p</i> -methoxy benzaldehyde ( <i>p</i> -anisaldehyde)	123-11-5	360 ± 3
	2-methylbutyl acetate	624-41-9	13 ± 0
	<i>p</i> -methyl benzaldehyde ( <i>p</i> -tolualdehyde)	104-87-0	381 ± 6
	1-pentanol	71-41-0	19 ± 1
	phenethyl alcohol	60-12-8	37 ± 0
	piperonal	120-57-0	279 ± 2
	vanillin	121-33-5	426 ± 7
Zig Zag Wraps	benzaldehyde	100-52-7	92 ± 2
blunt wraps	benzaldehyde propylene glycol acetal <sup>§</sup>	2568-25-4	3 ± 0
“Cherry”	benzyl acetate	140-11-4	6 ± 2
1 serving = 1 wrap (~0.7 g)	benzyl alcohol	100-51-6	2391 ± 664
	benzyl propionate	122-63-4	Trace
	γ-decalactone	706-14-9	17 ± 6
	ethyl butanoate	105-54-4	3 ± 1
	ethyl cinnamate	103-36-6	149 ± 52
	ethyl vanillin	121-32-4	19 ± 7
	β-ionone	14901-07-6	222 ± 91
	isoamyl butanoate	106-27-4	10 ± 2
	limonene	138-86-3	21 ± 2
	β-linalool	78-70-6	13 ± 3
	<i>p</i> -methoxy benzaldehyde ( <i>p</i> -anisaldehyde)	123-11-5	Trace
	<i>p</i> -methyl benzaldehyde ( <i>p</i> -tolualdehyde)	104-87-0	71 ± 14
	piperonal	120-57-0	276 ± 89
	raspberry ketone	5471-51-2	321 ± 126
	α-terpineol	10482-56-1	Trace
	γ-undecalactone	104-67-6	230 ± 87
	vanillin	121-33-5	944 ± 346

<sup>1</sup>CASRN = Chemical Abstracts Services Registry Number.

<sup>2</sup>“Trace” indicates the compound was confirmed as present but detected at <0.3 ng/μL in solution. This corresponds to <3 μg/serving for all Jolly Ranchers, Zotz, moist snuff and tobacco wrap products, <1.5 μg/serving for Life Savers, <4.5 μg/serving for Cheyenne cigars, <6 μg/serving for Swisher Sweet cigarillos, and <15 μg/serving for “cherry” Kool-Aid.

<sup>§</sup>Sum of syn and anti isomers of the acetal.

<b>Table S3. Compounds Found in “Grape” Products</b>			
product	compound	CASRN <sup>1</sup> for standard	micrograms ( $\mu\text{g}$ ) per “serving”
Jolly Rancher “Grape” 1 serving = 1 candy (~6.0 g)	benzaldehyde	100-52-7	134 $\pm$ 2
	cinnamyl alcohol	104-54-1	837 $\pm$ 13
	ethyl anthranilate	87-25-2	47 $\pm$ 1
	ethyl butanoate	105-54-4	736 $\pm$ 8
	ethyl decanoate	110-38-3	25 $\pm$ 0
	ethyl isobutanoate	97-62-1	85 $\pm$ 2
	ethyl isovalerate	108-64-5	6 $\pm$ 0
	ethyl laurate	106-33-2	87 $\pm$ 1
	ethyl maltol	4940-11-8	57 $\pm$ 0
	ethyl octanoate	106-32-1	Trace <sup>2</sup>
	furfural	98-01-1	11 $\pm$ 0
	(E)-2-hexen-1-ol	928-95-0	9 $\pm$ 0
	hexyl acetate	142-92-7	34 $\pm$ 0
	limonene	138-86-3	483 $\pm$ 7
	$\beta$ -linalool	78-70-6	Trace
	linalyl acetate	115-95-7	51 $\pm$ 1
	methyl anthranilate	134-20-3	1019 $\pm$ 2
	2-methylbutyl acetate	624-41-9	Trace
	myrcene	123-35-3	Trace
	neryl acetate	141-12-8	Trace
phenethyl alcohol	60-12-8	5 $\pm$ 0	
raspberry ketone	5471-51-2	29 $\pm$ 1	
raspberry ketone methyl ether	104-20-1	315 $\pm$ 2	
$\alpha$ -terpineol	10482-56-1	Trace	
Zotz “Grape” 1 serving = 1 candy (~5.0 g)	cinnamyl alcohol	104-54-1	15 $\pm$ 1
	ethyl butanoate	105-54-4	32 $\pm$ 7
	ethyl cinnamate	103-36-6	3 $\pm$ 0
	ethyl decanoate	110-38-3	7 $\pm$ 0
	ethyl heptanoate	106-30-9	25 $\pm$ 2
	ethyl octanoate	106-32-1	3 $\pm$ 0
	ethyl salicylate	118-61-6	Trace
	furfural	98-01-1	35 $\pm$ 2
	furfuryl alcohol	98-00-0	98 $\pm$ 50
	(Z)-3-hexen-1-ol	928-96-1	11 $\pm$ 0
	(Z)-3-hexen-1-yl acetate	3681-71-8	4 $\pm$ 0
	hexyl acetate	142-92-7	Trace
	$\beta$ -linalool	78-70-6	Trace
methyl anthranilate	134-20-3	26 $\pm$ 1	
Kool-Aid Mix “Grape” 1 serving = 0.5 g as for 8 oz of drink	benzaldehyde	100-52-7	Trace
	ethyl butanoate	105-54-4	897 $\pm$ 134
	ethyl decanoate	110-38-3	Trace
	ethyl isobutanoate	97-62-1	330 $\pm$ 49

	ethyl isovalerate	108-64-5	22 ± 3
	ethyl octanoate	106-32-1	Trace
	(E)-2-hexen-1-ol	928-95-0	80 ± 11
	limonene	138-86-3	33 ± 4
	methyl anthranilate	134-20-3	1137 ± 153
Cheyenne	benzaldehyde	100-52-7	34 ± 1
"large cigars"	benzaldehyde propylene glycol acetal§	2568-25-4	40 ± 1
"Grape"	benzyl acetate	140-11-4	Trace
1 serving = 1 "cigar" (~1.4 g)	benzyl alcohol	100-51-6	18 ± 0
	β-damascone	23726-91-2	7 ± 0
	dimethyl benzyl carbinyl butanoate	10094-34-5	232 ± 5
	ethyl butanoate	105-54-4	Trace
	ethyl cinnamate	103-36-6	5 ± 0
	ethyl maltol	4940-11-8	346 ± 33
	1-hexanol	111-27-3	41 ± 1
	hexyl 2-methylbutanoate	10032-15-2	Trace
	hexyl acetate	142-92-7	Trace
	β-linalool	78-70-6	88 ± 1
	menthol	2216-51-5	844 ± 8
	menthone	14073-97-3	Trace
	menthyl acetate	79-20-9	Trace
	methyl anthranilate	134-20-3	1790 ± 40
	methyl cinnamate	103-26-4	374 ± 6
	methyl salicylate	119-36-8	Trace
	p-methyl benzaldehyde (p-tolualdehyde)	104-87-0	26 ± 1
	vanillin	121-33-5	Trace
Phillies Blunt	benzaldehyde	100-52-7	77 ± 13
"large cigar"	benzaldehyde propylene glycol acetal§	2568-25-4	244 ± 16
"Grape"	benzyl acetate	140-11-4	28 ± 6
1 serving = 1 "cigar" (~7.6 g)	benzyl alcohol	100-51-6	5808 ± 655
	β-damascone	23726-91-2	486 ± 11
	dimethyl benzyl carbinyl butanoate	10094-34-5	2634 ± 85
	ethyl cinnamate	103-36-6	Trace
	ethyl maltol	4940-11-8	2950 ± 277
	ethyl vanillin	121-32-4	317 ± 123
	1-hexanol	111-27-3	441 ± 86
	β-ionone	14901-07-6	55 ± 3
	β-linalool	78-70-6	424 ± 15
	menthol	2216-51-5	1559 ± 180
	menthyl acetate	79-20-9	Trace
	methyl anthranilate	134-20-3	17552 ± 2135
	methyl cinnamate	103-26-4	Trace
	piperonal	120-57-0	41 ± 11
	raspberry ketone	5471-51-2	624 ± 75
	4-terpineol	20126-76-5	775 ± 82
	vanillin	121-33-5	673 ± 120

Kayak Moist Snuff "Grape" 1 serving = 1.0 g	amyl acetate	628-63-7	Trace
	amyl butanoate	540-18-1	43 ± 2
	benzaldehyde	100-52-7	10 ± 0
	benzaldehyde propylene glycol acetal§	2568-25-4	16 ± 0
	benzyl acetate	140-11-4	Trace
	benzyl alcohol	100-51-6	78 ± 14
	cinnamyl alcohol	104-54-1	56 ± 4
	ethyl butanoate	105-54-4	193 ± 11
	ethyl decanoate	110-38-3	8 ± 0
	ethyl heptanoate	106-30-9	31 ± 1
	ethyl laurate	106-33-2	8 ± 0
	ethyl maltol	4940-11-8	54 ± 1
	ethyl octanoate	106-32-1	8 ± 0
	ethyl salicylate	118-61-6	Trace
	eugenol	97-53-0	5 ± 0
	furfuryl alcohol	98-00-0	69 ± 2
	isoamyl butanoate	106-27-4	93 ± 4
	limonene	138-86-3	171 ± 7
	β-linalool	78-70-6	547 ± 15
	cis-linalool oxide	5989-33-3	4 ± 1
	trans-linalool oxide	23007-29-6	4 ± 0
	menthol	2216-51-5	80 ± 15
	methyl anthranilate	134-20-3	1195 ± 27
	methyl salicylate	119-36-8	51 ± 1
	6-methyl-5-hepten-2-one	110-93-0	Trace
	2-methylbutyl acetate	624-41-9	10 ± 1
	1-pentanol	71-41-0	31 ± 2
	phenethyl alcohol	60-12-8	14 ± 3
	piperonal	120-57-0	4 ± 0
	raspberry ketone	5471-51-2	163 ± 6
raspberry ketone methyl ether	104-20-1	77 ± 2	
4-terpineol	20126-76-5	14 ± 25	
vanillin	121-33-5	2046 ± 49	
Zig Zag	benzaldehyde	100-52-7	8 ± 0
"blunt wrap"	benzyl acetate	140-11-4	23 ± 5
"Grape"	benzyl alcohol	100-51-6	2163 ± 99
1 serving = 1 wrap (~0.7 g)	γ-decalactone	706-14-9	4 ± 2
	ethyl maltol	4940-11-8	72 ± 11
	ethyl vanillin	121-32-4	70 ± 4
	1-hexanol	111-27-3	19 ± 7
	(Z)-3-hexen-1-ol	928-96-1	151 ± 17
	(Z)-3-hexen-1-yl acetate	3681-71-8	6 ± 0
	hexyl acetate	142-92-7	Trace
	β-ionone	14901-07-6	9 ± 2
	β-linalool	78-70-6	51 ± 7
	methyl anthranilate	134-20-3	82 ± 19
methyl cinnamate	103-26-4	5 ± 1	



<i>p</i> -methoxy benzaldehyde ( <i>p</i> -anisaldehyde)	123-11-5	25 ± 2
phenethyl alcohol	60-12-8	6 ± 2
piperonal	120-57-0	Trace
raspberry ketone	5471-51-2	745 ± 162
$\alpha$ -terpineol	10482-56-1	8 ± 1
$\gamma$ -undecalactone	104-67-6	22 ± 9
vanillin	121-33-5	240 ± 58

<sup>1</sup>CASRN = Chemical Abstracts Services Registry Number.

<sup>2</sup>"Trace" indicates the compound was confirmed as present but detected at <0.3 ng/ $\mu$ L in solution. This corresponds to <3  $\mu$ g/serving for all Jolly Ranchers, Zotz, moist snuff and tobacco wrap products, <4.5  $\mu$ g/serving for Cheyenne cigars, <21  $\mu$ g/serving for Phillies Blunt cigars, and <15  $\mu$ g/serving for "grape" Kool-Aid.

<sup>§</sup>Sum of syn and anti isomers of the acetal.

<b>Table S4. Compounds Found in “Apple” Products</b>			
product	compound	CASRN <sup>1</sup> for standard	micrograms ( $\mu\text{g}$ ) per “serving”
Jolly Rancher “Apple” 1 serving = 1 candy (~6.1 g)	ethyl decanoate	110-38-3	121 $\pm$ 6
	ethyl laurate	106-33-2	67 $\pm$ 3
	ethyl maltol	4940-11-8	40 $\pm$ 2
	ethyl octanoate	106-32-1	68 $\pm$ 4
	furfural	98-01-1	9 $\pm$ 1
	1-hexanol	111-27-3	968 $\pm$ 54
	hexyl acetate	142-92-7	12 $\pm$ 0
	2-methylbutyl acetate	624-41-9	376 $\pm$ 30
	1-pentanol	71-41-0	3 $\pm$ 0
Zotz “Apple” 1 serving = 1 candy (~5.0 g)	dimethyl benzyl carbonyl butanoate	10094-34-5	Trace <sup>2</sup>
	ethyl butanoate	105-54-4	31 $\pm$ 9
	furfural	98-01-1	19 $\pm$ 8
	furfuryl alcohol	98-00-0	104 $\pm$ 27
	1-hexanol	111-27-3	53 $\pm$ 11
	(Z)-3-hexen-1-ol	928-96-1	35 $\pm$ 5
	(Z)-3-hexen-1-yl acetate	3681-71-8	72 $\pm$ 8
	hexyl acetate	142-92-7	95 $\pm$ 14
	isoamyl butanoate	106-27-4	29 $\pm$ 25
	$\beta$ -linalool	78-70-6	Trace
	6-methyl-5-hepten-2-one	110-93-0	Trace
	2-methylbutyl acetate	624-41-9	26 $\pm$ 1
$\gamma$ -undecalactone	104-67-6	14 $\pm$ 2	
Kayak moist snuff “Apple” 1 serving = 1.0 g	benzaldehyde	100-52-7	37 $\pm$ 2
	benzaldehyde propylene glycol acetal§	2568-25-4	37 $\pm$ 1
	benzyl acetate	140-11-4	3 $\pm$ 0
	benzyl alcohol	100-51-6	143 $\pm$ 3
	cinnamyl alcohol	104-54-1	10 $\pm$ 0
	ethyl butanoate	105-54-4	16 $\pm$ 2
	ethyl heptanoate	106-30-9	31 $\pm$ 2
	ethyl vanillin	121-32-4	1530 $\pm$ 41
	1-hexanol	111-27-3	231 $\pm$ 7
	(E)-2-hexen-1-ol	928-95-0	4 $\pm$ 0
	(Z)-3-hexen-1-ol	928-96-1	1435 $\pm$ 66
	(Z)-3-hexen-1-yl acetate	3681-71-8	81 $\pm$ 4
	(Z)-3-hexen-1-yl formate	33467-73-1	Trace
	hexyl 2-methylbutanoate	10032-15-2	78 $\pm$ 4
	hexyl acetate	142-92-7	859 $\pm$ 38
	hexyl hexanoate	6378-65-0	Trace
	isoamyl isovalerate	659-70-1	329 $\pm$ 17
	limonene	138-86-3	72 $\pm$ 5
	$\beta$ -linalool	78-70-6	142 $\pm$ 4
	methyl salicylate	119-36-8	55 $\pm$ 2
	phenethyl alcohol	60-12-8	4 $\pm$ 0
piperonal	120-57-0	13 $\pm$ 0	
vanillin	121-33-5	189 $\pm$ 8	

Skoal moist snuff "Apple" 1 serving = 1.0 g	benzaldehyde	100-52-7	43 ± 0
	benzaldehyde propylene glycol acetal <sup>§</sup>	2568-25-4	425 ± 7
	benzyl alcohol	100-51-6	42 ± 0
	β-damascone	23726-91-2	7 ± 0
	ethyl cinnamate	103-36-6	Trace
	ethyl heptanoate	106-30-9	9 ± 0
	ethyl vanillin	121-32-4	477 ± 21
	1-hexanol	111-27-3	486 ± 4
	(Z)-3-hexen-1-ol	928-96-1	124 ± 1
	(Z)-3-hexen-1-yl acetate	3681-71-8	9 ± 0
	hexyl acetate	142-92-7	176 ± 2
	hexyl hexanoate	6378-65-0	25 ± 1
	isoamyl isovalerate	659-70-1	395 ± 4
	2-methylbutyl acetate	624-41-9	Trace
	phenethyl alcohol	60-12-8	8 ± 0
	piperonal	120-57-0	112 ± 2
	raspberry ketone	5471-51-2	452 ± 21
vanillin	121-33-5	Trace	
Royal Blunt Wraps XXL "blunt wraps" "Sour Apple" 1 serving = 1 wrap (~0.9 g)	1-hexanol	111-27-3	144 ± 23
	menthol	2216-51-5	Trace
	1-pentanol	71-41-0	15 ± 4
	phenethyl alcohol	60-12-8	Trace
vanillin	121-33-5	123 ± 12	
Zig Zag Wraps "blunt wraps" "Apple" 1 serving = 1 wrap (~0.9 g)	benzaldehyde	100-52-7	20 ± 3
	benzaldehyde propylene glycol acetal <sup>§</sup>	2568-25-4	Trace
	benzyl acetate	140-11-4	9 ± 1
	benzyl alcohol	100-51-6	3341 ± 150
	cinnamyl alcohol	104-54-1	5 ± 1
	γ-decalactone	706-14-9	13 ± 6
	ethyl cinnamate	103-36-6	Trace
	ethyl maltol	4940-11-8	46 ± 7
	ethyl vanillin	121-32-4	Trace
	eugenol	97-53-0	205 ± 18
	1-hexanol	111-27-3	142 ± 15
	hexyl 2-methylbutanoate	10032-15-2	Trace
	β-linalool	78-70-6	3 ± 1
	methyl cinnamate	103-26-4	12 ± 1
	phenethyl alcohol	60-12-8	Trace
	piperonal	120-57-0	Trace
	raspberry ketone	5471-51-2	19 ± 5
γ-undecalactone	104-67-6	31 ± 22	
vanillin	121-33-5	139 ± 10	

<sup>1</sup>CASRN = Chemical Abstracts Services Registry Number.

<sup>2</sup>"Trace" indicates the compound was confirmed as present but detected at <0.3 ng/μL in solution. This corresponds to <3 μg/serving for all Jolly Rancher, Zotz, moist snuff and tobacco wrap products.

<sup>§</sup>Sum of syn and anti isomers of the acetal.

<b>Table S5.</b> Compounds Found in “Peach” Products			
product	compound	CASRN <sup>1</sup> for standard	micrograms ( $\mu\text{g}$ ) per “serving”
Jolly Rancher “Peach” 1 serving = 1 candy (~6.1 g)	benzaldehyde	100-52-7	102 $\pm$ 2
	benzyl acetate	140-11-4	106 $\pm$ 2
	benzyl alcohol	100-51-6	18 $\pm$ 0
	<i>p</i> -cymene	99-87-6	Trace <sup>2</sup>
	$\gamma$ -decalactone	706-14-9	111 $\pm$ 1
	furfural	98-01-1	10 $\pm$ 0
	furfuryl alcohol	98-00-0	5 $\pm$ 0
	(E)-2-hexen-1-ol	928-95-0	7 $\pm$ 0
	limonene	138-86-3	25 $\pm$ 1
	$\beta$ -linalool	78-70-6	Trace
	linalyl acetate	115-95-7	4 $\pm$ 0
	menthone	14073-97-3	5 $\pm$ 0
$\gamma$ -terpinene	99-85-4	Trace	
Kool-Aid Mix “Peach Mango” 1 serving = 0.6 g as for 8 oz of drink	benzaldehyde	100-52-7	20 $\pm$ 7
	benzyl alcohol	100-51-6	27 $\pm$ 8
	carvone	6485-40-1	Trace
	$\gamma$ -decalactone	706-14-9	198 $\pm$ 70
	ethyl butanoate	105-54-4	1268 $\pm$ 377
	1-hexanol	111-27-3	60 $\pm$ 21
	(Z)-3-hexen-1-ol	928-96-1	225 $\pm$ 79
	(Z)-3-hexen-1-yl acetate	3681-71-8	38 $\pm$ 13
	hexyl acetate	142-92-7	17 $\pm$ 5
	hexyl hexanoate	6378-65-0	24 $\pm$ 10
	limonene	138-86-3	288 $\pm$ 66
	$\beta$ -linalool	78-70-6	Trace
	menthol	2216-51-5	Trace
$\alpha$ -pinene	80-56-8	Trace	
$\gamma$ -undecalactone	104-67-6	Trace	
Cheyenne “large cigars” “Peach” 1 serving = 1 “cigar” (~1.4 g)	benzaldehyde	100-52-7	15 $\pm$ 0
	benzaldehyde propylene glycol acetal§	2568-25-4	11 $\pm$ 0
	benzyl alcohol	100-51-6	12 $\pm$ 0
	$\gamma$ -decalactone	706-14-9	100 $\pm$ 4
	ethyl maltol	4940-11-8	208 $\pm$ 3
	ethyl vanillin	121-32-4	20 $\pm$ 1
	(Z)-3-hexen-1-ol	928-96-1	23 $\pm$ 0
	$\beta$ -linalool	78-70-6	30 $\pm$ 1
	menthol	2216-51-5	Trace
	phenethyl alcohol	60-12-8	Trace
	raspberry ketone	5471-51-2	79 $\pm$ 4
	$\gamma$ -undecalactone	104-67-6	123 $\pm$ 4
vanillin	121-33-5	Trace	

Swisher Sweet cigarillos "Peach" 1 serving = 1 "cigarillo (~2.7 g)	benzaldehyde	100-52-7	Trace
	benzaldehyde propylene glycol acetal <sup>§</sup>	2568-25-4	30 ± 3
	benzyl acetate	140-11-4	Trace
	benzyl alcohol	100-51-6	914 ± 88
	γ-decalactone	706-14-9	503 ± 9
	ethyl maltol	4940-11-8	72 ± 8
	1-hexanol	111-27-3	Trace
	(Z)-3-hexen-1-ol	928-96-1	35 ± 8
	β-linalool	78-70-6	92 ± 11
	linalyl acetate	115-95-7	54 ± 4
	menthol	2216-51-5	14 ± 4
	phenethyl alcohol	60-12-8	Trace
	raspberry ketone	5471-51-2	Trace
	γ-undecalactone	104-67-6	384 ± 3
	vanillin	121-33-5	635 ± 34
Kayak moist snuff "Peach" 1 serving = 1.0 g	benzaldehyde	100-52-7	Trace
	benzyl acetate	140-11-4	Trace
	benzyl alcohol	100-51-6	308 ± 4
	benzyl propionate	122-63-4	70 ± 1
	β-damascone	23726-91-2	19 ± 0
	γ-decalactone	706-14-9	398 ± 3
	ethyl cinnamate	103-36-6	Trace
	β-linalool	78-70-6	761 ± 13
	cis-linalool oxide	5989-33-3	5 ± 0
	trans-linalool oxide	23007-29-6	4 ± 0
	menthol	2216-51-5	185 ± 2
	methyl salicylate	119-36-8	6 ± 0
	phenethyl alcohol	60-12-8	4 ± 0
	γ-undecalactone	104-67-6	821 ± 7
vanillin	121-33-5	1137 ± 5	

<sup>1</sup>CASRN = Chemical Abstracts Services Registry Number.

<sup>2</sup>"Trace" indicates the compound was confirmed as present but detected at <0.3 ng/μL in solution. This corresponds to <3 μg/serving for all Jolly Ranchers and moist snuff products, <4.5 μg/serving for Cheyenne cigars, <6 μg/serving for Swisher Sweet cigarillos and <18 μg/serving for "peach-mango" Kool-Aid.

<sup>§</sup>Sum of syn and anti isomers of the acetal.

<b>Table S6.</b> Compounds Found in “Berry” Products			
product	compound	CASRN <sup>1</sup> for standard	micrograms ( $\mu\text{g}$ ) per “serving”
Jolly Rancher “Raspberry” 1 serving = 1 candy (~6.1 g)	benzaldehyde	100-52-7	Trace <sup>2</sup>
	$\beta$ -damascone	23726-91-2	7 $\pm$ 0
	ethyl butanoate	105-54-4	Trace
	furfural	98-01-1	14 $\pm$ 1
	1-hexanol	111-27-3	26 $\pm$ 1
	(Z)-3-hexen-1-ol	928-96-1	120 $\pm$ 3
	(E)-2-hexen-1-ol	928-95-0	30 $\pm$ 1
	(Z)-3-hexen-1-yl acetate	3681-71-8	294 $\pm$ 7
	(Z)-3-hexen-1-yl formate	33467-73-1	20 $\pm$ 2
	hexyl acetate	142-92-7	91 $\pm$ 3
	$\beta$ -ionone	14901-07-6	Trace
	limonene	138-86-3	24 $\pm$ 32
	raspberry ketone	5471-51-2	777 $\pm$ 24
Life Saver “Raspberry” 1 serving = 1 candy (~3.6 g)	benzyl acetate	140-11-4	31 $\pm$ 2
	benzyl alcohol	100-51-6	16 $\pm$ 3
	$\beta$ -damascone	23726-91-2	3 $\pm$ 0
	furfural	98-01-1	Trace
	furfuryl alcohol	98-00-0	2 $\pm$ 1
	1-hexanol	111-27-3	Trace
	(Z)-3-hexen-1-ol	928-96-1	5 $\pm$ 0
	(Z)-3-hexen-1-yl acetate	3681-71-8	35 $\pm$ 2
	(Z)-3-hexen-1-yl formate	33467-73-1	14 $\pm$ 1
	hexyl acetate	142-92-7	13 $\pm$ 1
	$\beta$ -ionone	14901-07-6	5 $\pm$ 0
	limonene	138-86-3	Trace
	methyl salicylate	119-36-8	Trace
raspberry ketone	5471-51-2	123 $\pm$ 4	
Zotz “Blue Raspberry” 1 serving = 1 candy (~4.9 g)	amyl butanoate	540-18-1	Trace
	benzyl acetate	140-11-4	4 $\pm$ 0
	benzyl alcohol	100-51-6	53 $\pm$ 9
	$\gamma$ -decalactone	706-14-9	16 $\pm$ 1
	ethyl butanoate	105-54-4	4 $\pm$ 0
	furfural	98-01-1	41 $\pm$ 3
	furfuryl alcohol	98-00-0	67 $\pm$ 6
	1-hexanol	111-27-3	8 $\pm$ 1
	(Z)-3-hexen-1-ol	928-96-1	17 $\pm$ 2
	$\beta$ -ionone	14901-07-6	Trace
	2-methylbutyl acetate	624-41-9	17 $\pm$ 2
	raspberry ketone	5471-51-2	126 $\pm$ 8
	4-terpineol	20126-76-5	Trace
vanillin	121-33-5	31 $\pm$ 3	

Kool-Aid Mix "Raspberry Lemonade" 1 serving = 0.8 g as for 8 oz of drink	<i>p</i> -cymene	99-87-6	40 ± 4
	β-ionone	14901-07-6	Trace
	limonene	138-86-3	9911 ± 583
	myrcene	123-35-3	104 ± 8
	neryl acetate	141-12-8	31 ± 2
	α-pinene	80-56-8	130 ± 11
	raspberry ketone	5471-51-2	340 ± 44
	γ-terpinene	99-85-4	595 ± 51
	4-terpineol	20126-76-5	Trace
	α-terpineol	10482-56-1	Trace
vanillin	121-33-5	92 ± 16	
Cheyenne "large cigars" "Xotic Berry" 1 serving = 1 "cigar" (~1.4 g)	benzaldehyde	100-52-7	31 ± 2
	benzaldehyde propylene glycol acetal§	2568-25-4	127 ± 9
	benzyl acetate	140-11-4	23 ± 1
	benzyl alcohol	100-51-6	1434 ± 118
	benzyl propionate	122-63-4	Trace
	ethyl cinnamate	103-36-6	5 ± 0
	ethyl maltol	4940-11-8	284 ± 19
	ethyl vanillin	121-32-4	44 ± 3
	1-hexanol	111-27-3	21 ± 1
	β-ionone	14901-07-6	131 ± 3
	β-linalool	78-70-6	158 ± 7
	menthol	2216-51-5	Trace
	phenethyl alcohol	60-12-8	Trace
raspberry ketone	5471-51-2	431 ± 22	
vanillin	121-33-5	139 ± 8	
Skoal moist snuff "Berry Blend" 1 serving = 1.0 g	benzaldehyde	100-52-7	375 ± 12
	benzaldehyde propylene glycol acetal§	2568-25-4	869 ± 25
	benzyl acetate	140-11-4	6 ± 0
	benzyl alcohol	100-51-6	1519 ± 10
	ethyl butanoate	105-54-4	34 ± 2
	ethyl cinnamate	103-36-6	262 ± 9
	ethyl isovalerate	108-64-5	26 ± 0
	1-hexanol	111-27-3	20 ± 0
	(Z)-3-hexen-1-ol	928-96-1	128 ± 3
	(Z)-3-hexen-1-yl acetate	3681-71-8	21 ± 0
	hexyl acetate	142-92-7	4 ± 0
	β-ionone	14901-07-6	4 ± 0
	isoamyl butanoate	106-27-4	88 ± 4
	limonene	138-86-3	17 ± 1
	β-linalool	78-70-6	103 ± 3
	menthol	2216-51-5	424 ± 13
	<i>p</i> -methyl benzaldehyde ( <i>p</i> -tolualdehyde)	104-87-0	111 ± 4
	methyl salicylate	119-36-8	6195 ± 149
	2-methylbutyl acetate	624-41-9	4 ± 2
	phenethyl alcohol	60-12-8	7 ± 0
piperonal	120-57-0	63 ± 2	



	raspberry ketone	5471-51-2	784 ± 39
	4-terpineol	20126-76-5	61 ± 3
	γ-undecalactone	104-67-6	8 ± 0
	vanillin	121-33-5	108 ± 3
Zig Zag	benzaldehyde	100-52-7	5 ± 0
“blunt wrap”	benzyl acetate	140-11-4	3 ± 1
“Blueberry”	benzyl alcohol	100-51-6	2032 ± 29
1 serving = 1 wrap (~0.7 g)	γ-decalactone	706-14-9	92 ± 12
	ethyl cinnamate	103-36-6	Trace
	ethyl isovalerate	108-64-5	Trace
	ethyl maltol	4940-11-8	14 ± 2
	ethyl vanillin	121-32-4	5 ± 4
	(Z)-3-hexen-1-ol	928-96-1	7 ± 3
	limonene	138-86-3	23 ± 4
	β-linalool	78-70-6	16 ± 3
	methyl anthranilate	134-20-3	4 ± 2
	methyl cinnamate	103-26-4	3 ± 0
	piperonal	120-57-0	Trace
	raspberry ketone	5471-51-2	25 ± 24
	α-terpineol	10482-56-1	Trace
	γ-undecalactone	104-67-6	9 ± 7
	vanillin	121-33-5	175 ± 36

<sup>1</sup>CASRN = Chemical Abstracts Services Registry Number.

<sup>2</sup>“Trace” indicates the compound was confirmed as present but detected at <0.3 ng/μL in solution. This corresponds to <3 μg/serving for all Jolly Ranchers, Zotz, moist snuff and tobacco wrap products, <1.5 μg/serving for Life Savers, <4.5 μg/serving for Cheyenne cigars, and <24 μg/serving for raspberry lemonade Kool-Aid.

<sup>§</sup>Sum of syn and anti isomers of the acetal.