Characterization of flavor transfer during smoking of cigarette with flavor capsules and aromatized tobacco cigarettes using SPME-GC/MS

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INTRODUCTION

Flavored tobacco has been used in cigarettes for many decade, but since cigarette filters containing menthol capsules appeared on the Japanese market in 2007, flavor caps are taking more importance when manufacturing flavored cigarettes. Flavor caps give the smoker the option of choosing to smoke the cigarette with or without flavor or to choose between two or more different flavors. Capsules have been included in flavored and regular cigarettes, incorporated into diverse stick sizes (eg, longs, superslims), and some new varieties include two or more differently flavored capsules in one filter.

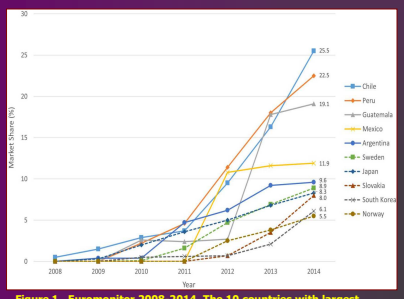

Figure 1. Euromonitor 2008-2014. The 10 countries with largest market share for flavor capsules in 2014. Ten additional countries with market share ranging between 3% and 4% in 2014, are: Costa Rica, Finland, South Africa, Denmark, Czech Republic, Austria, Romania, UK, France and Slovenia.

According to 2014 Euromonitor data, six of the ten top countries with the largest market share for flavor capsule cigarettes are in the Latin American region: Chile, Peru, Guatemala, Mexico and Argentina (figure 1). For example, flavor capsule cigarette sales are estimated to account for more than a quarter of the cigarette market share in Chile. Flavor capsule cigarettes are also likely to be perceived as lesser harm compared to other cigarettes with flavors added to the tobacco leaf.

OBJECTIVE

The aim of the present work is to analyze if there is a difference in flavor deliver between flavor capsules and aromatized tobacco to cigarette smoke, if the components of the aroma in tobacco leaf suffer any kind of decomposition that could change the original flavor.

MATERIALS AND METHODS

Ten brands of cigarettes with flavor capsules and seven brands of aromatized tobacco cigarettes were used to test how flavors components transfer to smoke after smoking. The flavors were analyzed on the tobacco or in the liquid within the capsule directly with a SPME fiber to identify their components.

Brand	capsule color	Abbrev.
LUCKY61	green	LVE
	yellow	LAM
LUCKY63	yellow	LAM
	green	LVE
	violet	LVI
	red	LR63
LUCKY60	green	LVE
	black	LNE
MARLBORO58	blue	DCVE
	violet	DCVI
CHESTERFIELD	green	CHE
LUCKY64	red	LR64
	blue	LVE
CAMEL	violet	CVI
	blue	CAZ
MARLBORO	blue	MAZ
DOUBLE CLICK	violet	DCVI
	green	DCVE
DUO CAPS	violet	CDV
	blue	CDA

Brand	Tobacco flavor	Abbrev.
Ark Royal	Captain ark wineberry	TWB
Ark Royal	Wild card	TWC
Ark Royal	Sweet	ARS
Ark Royal	Paradise tea	TPT
Ark Royal	Premium	TRP
NIAGARA	Menthol	NIA
Ark Royal	Apple mint	TAM

To determinate aroma components in aromatized tobacco an American blend tobacco with no additives was set as a blank and two cigarettes with this tobacco where smoked to set the blank components of cigarette smoke..

In cigarettes with capsules, flavor components where determined directly form the capsule and the blank for the smoke components was done with the cigarette without breaking the capsule.

Two cigarettes of each type were smoked with intensive regime using Cambridge filters and methanol traps at -20 ° C after the cigarette holder to capture more volatile flavor components.
Cambridge filter and methanol were put in different flask and flavor components were captured with a SPME. The SPME fiber was analyzed by GC/MS and spectrums were processed manually with Palisade and NIST libraries and with AMDIS using Varian library.

Smoking machine Cerulean SM450	HCI smoking regime, 2 cigarettes
SPME fiber	Supleco DVB/CAR/PDMS 50/30 µ m
Adsorption time	10 minutes
Adsorption temperature	40° C
GC conditions Varian 3800	Injector : 250° C
	Flow Helium 1.0 ml/min
	Column: Agilent VF-5ms 30m * 0.25 mm* 1.0 um df
	In.temp: 50° C hold 3 min
	Ramp1: 5.0° C/min
	Final temp1: 195 ° C
	Ramp2: 40.0° C/min
	Final temp2: 195 ° C hold 5.13 ° C
	Total time 39 min
MS conditions Varian 2100T	EI AGC scan 40-250 m/z
	Tramp 150° C
	Manifold: 80° C
	Transfer line: 250° C
	Emission current 20 uA
	Electro multiplier 1400 volts

RESULTS

Between one and thirty principal components were identified in the different flavors, and an average of 40% of them were identified as transferred to the smoke from the capsule flavor cigarette and also from the flavored tobacco cigarette, the rest of the components were already present in the tobacco smoke of a non flavored cigarette.

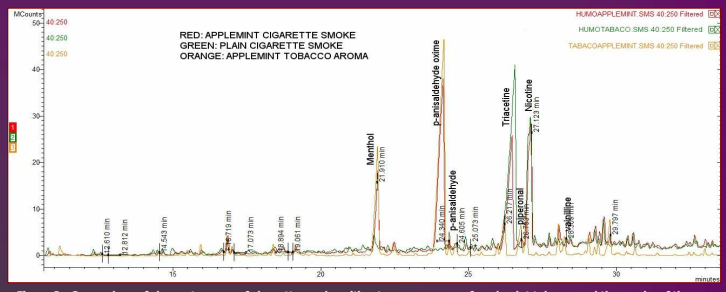

Figure 2 -Comparison of chromatograms of cigarette smoke without aroma, aroma of applemint tobacco and the smoke of the applemint cigarette.

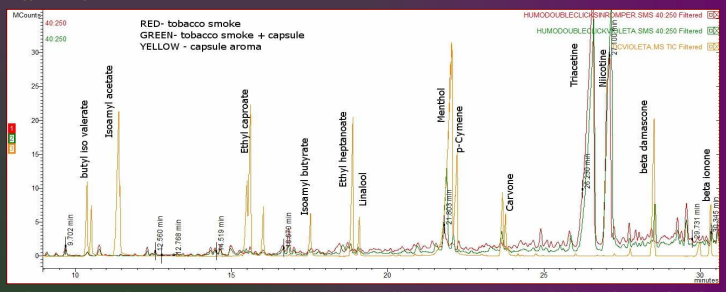

Figure 3 -Comparison of chromatograms of cigarette smoke without aroma, aroma of red fruits +mint capsule and the smoke of the cigarette with the crushed capsule.

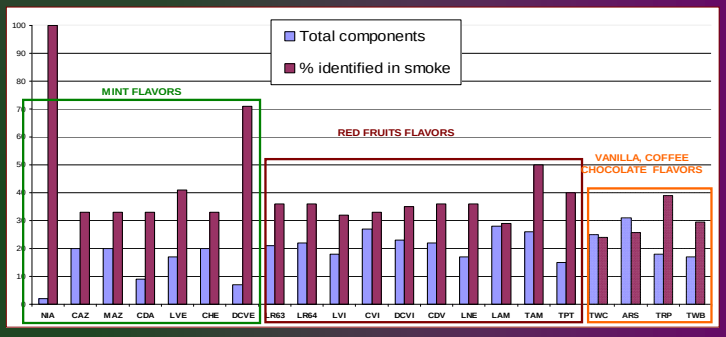

Figure 4 -Number of principal components in each flavor and % of components of the aroma identified as transferred to the cigarette smoke.

Components of mint flavors were more easy to identified as transfer to smoke, then red fruit flavors and the more difficult were all sweet flavors like vanilla, coffee and chocolate that have more compounds in common with the smoke of tobacco.

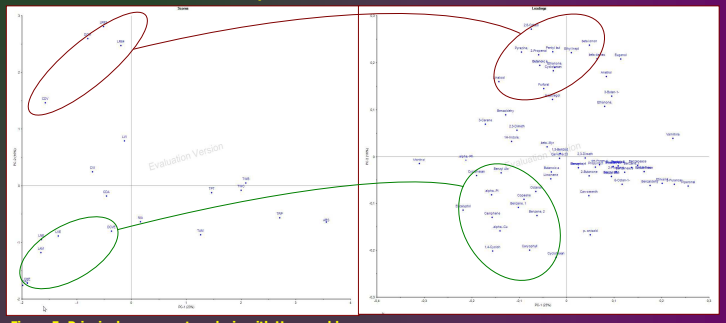

Figure 5- Principal component analysis with Unscrambler.

Components associated to mint flavors were: menthol, eucalyptol, copaene, and beta pinene, caryophylene, camphene, cubene. While fruit flavors relate to esters (penthyl butyrate, ethyl heptanoate, ethyl butanoate), beta ionone, linalool, beta damascone and pyrazine.

CONCLUSIONS

- Flavor components of capsules and tobacco were retained principally in the cambridge filter in a percentage between 30-50 %.
- Between 33-60 % of the components identified in cigarette smoke, as transferred form the flavored tobacco or capsules, were already present in the tobacco smoke of a non flavored cigarette.
- No differences in flavor components deliver between flavor capsules and aromatized tobacco was found, being both system equivalents in transferring flavor from the cigarette to the smoke.
- 45% of the flavor capsules analyzed contained spearmint, peppermint or a mixture of both, 35% of the capsules contained red fruits essence with menthol, 5 % menthol, 10 % citric essences and 5% other fruit.

REFERENCES

1.Euromonitor 2008-2014

2.Market share for flavor capsule cigarettes is quickly growing, especially in Latin America - James F Thrasher1, Farahnaz Islam2, Joaquin Barnoya3, Raul Mejia4, Maria Teresa Valenzuela5, and Frank J Chaloupka. Tob Control. 2017 July ; 26(4): 468–470. doi:10.1136/tobaccocontrol-2016-053030.

3., Abad-Vivero EN, Moodie C, et al. Cigarette brands with flavor capsules in the filter: trends in use and brand perceptions among smokers in the USA, Mexico and Australia, 2012-2014. Tobacco control 2015:1-9.