НАУЧНИ ТРУДОВЕ НА
УНИВЕРСИТЕТ ПО ХРАНИТЕЛНИ
ТЕХНОЛОГИИ - ПЛОВДИВ
2019 г.
ТОМ 66, КНИЖКА 1

SCIENTIFIC WORKS OF
UNIVERSITY OF FOOD
TECHNOLOGIES
2019
VOLUME 66 ISSUE 1

Research Article

Comparative study of physical and chemical characteristics of two brands of cigarillos on Bulgarian market

Violeta Nikolova[1], Venelina Popova[1✉], Nikolay Nikolov[1]

[1] *Department of Tobacco Processing. Tobacco and Tobacco Products Institute. Bulgarian Agricultural Academy. Markovo, Bulgaria*
[2]*Department of Tobacco, Sugar, Vegetable and Essential Oils. Technological Faculty. University of Food Technologies. Plovdiv, Bulgaria*

Abstract

The increased consumption of cigar-like smoking products (cigars, little cigars, filter-tipped cigars, cigarillos) in the last decade and the factors determining this trend have focused considerable research interest. It is considered that the attractiveness of these products, especially to younger people, is connected to the addition of distinctive flavors, the unawareness of the risks of their consumption, and the lower, more affordable price compared to that of conventional cigarettes. The shift towards the consumption of smoking products different from conventional cigarettes recently observed in Bulgaria rationalizes systematic investigations on the issue. The aim of this study was to investigate and compare the physical and chemical characteristics of two brands of cigarillos legally distributed on Bulgarian market, i.e. „Agio Tip Filter" and „Agio Tip Sweet". The basic physical and chemical indexes of tobacco and smoke were determined, according to the respective ISO methods. The results showed no distinctive differences in the physical characteristics of the studied brands, with the exception of draw resistance, which was higher for „Agio Tip Filter". No substantial difference was found in the chemical indexes between the filler, binder and wrapper layers of the respective brands. In both of them the highest levels of total nitrogen and nicotine were observed in the filler tobaccos. The integrated evaluation of the chemical composition of tobacco smoke (nicotine, tar and CO) showed significant variation within the single brand. It was confirmed that smoke from cigar-like products had higher emissions of nicotine, tar and CO than the smoke from conventional cigarettes, combined with a much wider range of variation.

Keywords: cigarillos, little cigars, tobacco, tobacco smoke

✉*Corresponding author: Assoc. Prof. Venelina Popova, DSC, Department of Tobacco, Sugar, Vegetable and Essential Oils, Technological Faculty, University of Food Technologies, 4002 Plovdiv, Bulgaria, tel.: +359 32 603 666; E-mail: vpopova2000@abv.bg*

Article history:
Received: 14 September 2019
Reviewed: 29 October 2019
Accepted: 19 November 2019
Available on-line: 16 March 2020

© 2019 The Authors. UFT Academic publishing house, Plovdiv

Introduction

The increased consumption of cigar-like smoking products (cigars, little cigars, cigarillos, filter-tipped cigars, cigarillos) in the last decade and the driving factors of this trend have already focused considerable research interest (Leatherdale et al., 2011; Schuster et al., 2013; Messer et al., 2015; Cohn et al., 2015; Sterling et al., 2016; Casseus et al., 2016; Pickworth et al., 2018; Nyman et al., 2018). In a series of recent studies, it has been pointed out that the attractiveness of these products, especially to younger people, is connected to the addition of distinctive flavors, the unawareness of the risks of their consumption, and the lower, more affordable price compared to that of conventional cigarettes. For example, the study of Sterling et al. (2016) emphasizes that it is the attractive flavoring that boosted the increase of the consumption of cigar-like products. Another reason, as stated by Casseus et al. (2016), is that the perception and the smoking manner of filter-tipped cigarillos are quite similar to those of conventional cigarettes. All studies cited above highlighted the urgent need for a review of the current definitions of tobacco products, their regulation and taxation by the relevant authorities.

Kostygina et al. (2016) provide a description of the changing strategies used by the tobacco companies to encourage the consumption of little cigars and cigarillos. The authors stated that the attractiveness of these items to the consumers is related to the reduced size (length, circumference), matching to that of common cigarettes, as well as to the wider use of filters and flavors that mask the harsher taste, smoothen the irritation and facilitate the smoking of dark-type tobaccos. The authors recommended extending the current ban on flavoured cigarettes by including flavoured cigar-like products in its scope.

In that same connection, Feirman et al. (2016) carried out a comparative research on certain chemical compounds and their levels in a brand series of candies, soft drinks and cigar-like products, all marked as “cherry”, “grapes”, “apple” and “peach” flavored. They demonstrated that in some cases the levels of the studied flavor-shaping additives were even higher in the tobacco products than in the candies. The authors found out that the chemical compounds used in the most popular sweets and soft drinks were widely used in flavored cigar products, as well, and therefore they defined the latter as “tobacco flavored candies”.

The review and analysis of specific data in a number of recent studies revealed that younger people, who naturally tend to turn to “less hazardous”, “less harmful” or “cheaper” alternatives of conventional cigarettes and readily combine the use of multiple tobacco products (McQuoid et al., 2018; Pickworth et al., 2017), are in fact the most vulnerable by the undisclosed risks of the consumption of cigar-like products (Nyman et al., 2018).

The implementation of Directive 2014/40/EC (in force of May 2016) engaged the adoption of a number of legal and administrative documents in Bulgaria and the rest of the EU countries, with the common focus of health protection, especially that of younger people. Still, some aspects of tobacco products and smoking regulation remain uncovered and need to be expanded on the basis of careful and focused research. All of the considerations stated above, as well as the changing trends in the consumption of smoking products, other than conventional cigarettes, rationalize the carrying out of current study, which is aimed at the investigation of the physical and chemical indices of selected cigarillos brands distributed legally on Bulgarian market.

Materials and Methods

Materials. The general investigation on the cigarillos sold legally on Bulgarian market was carried out with 12 individual brands: „Mehari’s Filter”, „Mehari’s Sweet Orient Filter”, „Agio Tip Clair”, „Agio Tip Filter”, „Agio Tip Sweet”, „Colts Filter”, „Colts Cherry Filter”, „Colts Rum Filter”, „Colts Vanilla Filter”, „Neos Feelings Mango Filter”, „Neos Feelings Vanilla Filter”, and „Neos Exotic Filter”. Brand selection was guided by the following basic principles:

i) The brands had been reported as significantly popular on the market by the merchants (preliminary survey data are not given here);
ii) The brands represented filter or tipped small cigars/cigarillos, which made them lighter and more convenient for smoking;
iii) The brands were characterized by the highest sales growth for the period;
iv) The brands represented different flavor profiles, which had been preferred by younger people;
v) The brands belonged to the middle price range.

In this study, results from the analysis of two of the brands are presented, in particular „Agio Tip Filter" and „Agio Tip Sweet" (Royal Agio Cigars, 5525 AR Duizel, Netherlands) (Fig. 1).



Figure 1. Cigarillos brands used in the study.

Left - „Agio Tip Filter"; right - „Agio Tip Sweet" (Royal Agio Cigars, 5525 AR Duizel, Netherlands)

Methods. Cigarillos in the study were characterized in terms of the following indices:

a) Appearance – by visual assessment of the structural elements of the cigarillos. Physical parameters:
- Weight of the intact item (g) and weight of the tobacco part (g) – using an analytical balance (Sartorius 1702, ±0.001 g);
- Total length (mm), length of the plastic mouth-tip (mm) and length of the filter plug (mm) – using an electronic gauge (±0.01 mm);
- Diameter (mm) – using a non-contact laser beam gauge (Beta LaserMike, Filtrona), according to ISO 2971;
- Draw resistance of intact cigarillos and draw resistance of the filter plug (mm WG) – using a draw resistance meter (Borgwaldt KC, Germany), according to ISO 6565;
- Firmness (mm) – using a density meter (Borgwaldt KC, Germany), according to BDS 16258;
- Number of puffs per cigarillo – using an automated 12-port linear smoking machine (Filtrona 302), according to ISO 3308.

All measurements were done with 20 cigarillos per brand and the average values were presented.

b) Chemical composition of tobacco:
- nicotine (%) – according to ISO 15152;
- reducing sugars (%) – according to ISO 15154;
- total nitrogen (%) – according to BDS 15836.

c) Chemical composition of tobacco smoke (smoke emissions) – using an automated 12-port linear smoking machine (Filtrona 302):
- nicotine (mg/cig) – according to ISO 10315;
- tar (mg/cig) – according to ISO 4387;
- carbon monoxide (CO) (mg/cig) – according to ISO 8454.

Results and Discussion

Visual assessment. The visual inspection of the samples taken from the market gave the following description.

The single cigarillos of the two studied brands were wrapped individually and grouped by five in a cardboard hard pack (slide box). Each cigarillo consisted of three layers – filler, binder and wrapper. The wrapper leaves were light brown, thin, smooth, tender, and thinly-veined. The binder layer represented a reconstituted tobacco sheet. The filler of both brands consisted mostly of small-size lamina strips, with a few individual particles of

unprocessed stems. The upper end of the cigarillos was covered by a plastic mouth-tip, containing a built-in acetate filter with activated carbon.

Physical characteristics of cigarillos. The results from the measurements of the physical characteristics of the studied cigarillos are presented in Table 1.

Table 1. Physical indices of two brands of cigarillos (n=20)

Index	Brand	
	Agio Tip Filter	Agio Tip Sweet
Weight, total (g)	1.343	1.267
Weight, tobacco part (g)	0.807	0.729
Length, total (mm)	97.51	97.00
Length, mouth-tip (mm)	29.00	29.00
Length, filter plug (mm)	8.27	8.54
Diameter (mm)	8.73	8.61
Draw resistance, total (mm WG)	168	149
Draw resistance, filter plug (mm WG)	60	59
Draw resistance, tobacco part (mm WG)	134	130
Firmness (mm)	6.90	6.54

Data in Table 1 shows that „Agio Tip Sweet" cigarillos were characterized by lower weight (both in terms of the weight of the intact items and that of the separated tobacco part) compared to the second brand, „Agio Tip Filter". There were no significant differences between the cigarillos with regard to length (total and filter plug), diameter and firmness. Both brands were with identical mouth-tips, which length was equal to 29.00 mm. The total draw resistance showed slight numerical variation (168 mm WG for „Agio Tip Filter" and 149 mm WG for „Agio Tip Sweet"), although there was no significant difference between the brands in the individual draw resistances of the filter and the tobacco part, respectively. Therefore, it can be summarized that there were no significant differences between the two brands with respect to their physical characteristics, with the partial exception of the total draw resistance, which was higher in „Agio Tip Filter" cigarillos.

Chemical composition of tobacco. Data from the chemical analyses of the tobaccos constituting the filler, the binder and the wrapper sections of the studied cigarillos are presented in Table 2.

The analytical results about the chemical composition of the tobaccos in „Agio Tip Filter" cigarillos revealed that the indices nicotine and total

Table 2. Chemical composition of tobacco in two brands of cigarillos

Index	Brand					
	Agio Tip Filter			Agio Tip Sweet		
	Filler	Binder	Wrapper	Filler	Binder	Wrapper
Nicotine (%)	1.30	0.69	0.85	1.31	0.80	0.88
Reducing sugars (%)	0.43	-*	-	0.55	-	-
Total nitrogen (%)	3.63	1.75	2.78	3.52	1.75	2.66

* not determined

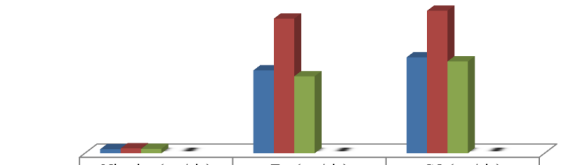
nitrogen took the highest value for the filler tobacco, medium value for the wrapper, and the lowest value – for the binder tobacco (representing reconstituted tobacco sheet). Practically, the numerical difference

in the nicotine content of the binder and wrapper layers was below the significance level. Data in Table 2 reveal a similar pattern of the chemical indices for the tobacco structural elements of „Agio Tip Sweet" cigarillos.

In a parallel between the two studied brands, it could be found that the filler tobaccos were characterized by high nitrogen content (both above 3.50%) and characteristically low contents of nicotine (about 1.30%) and reducing sugars (below 1%). Data suggest that the filler tobacco of the brands were identical in terms of the evaluated chemical indices. Similarly, no significant differences were found in the respective binder tobaccos. Nicotine content was considerably low (not exceeding 0.80% in both brands) and total nitrogen levels were identical (1.75%). With regard to the wrapper tobaccos, nicotine levels were again low (below 1%) and the two brands were practically undistinguishable.

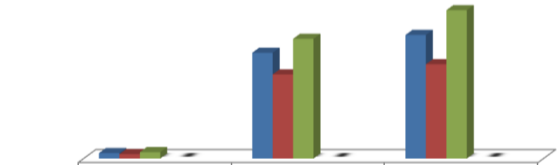
The overall assessment of the basic chemical indices of the tobacco in the two brands helped the finding that there were no significant differences between the respective filler, binder and wrapper layers of the cigarillos studied.

Chemical composition of tobacco smoke. Data about the tar, nicotine and CO emissions in the smoke of the studied cigarillos are presented on Fig. 2 and Fig. 3. For the sake of statistical analysis, the analytical procedure was carried out in triple repetition, each of which included the parallel smoking of two cigarillos. The cigarillos in each pair were pre-selected by total weight and draw resistance (i.e. with minimal deviation within the pair) in order to eliminate the influence of the variation of the major physical parameters on smoke composition. The average emissions for the three pairs, as well as the standard deviation and the coefficient of variation (%) are also shown in the figures.



	Nicotine (mg/cig)	Tar (mg/cig)	CO (mg/cig)
Pair No1	1,32	26,84	31,07
Pair No2	1,59	43,60	46,14
Pair No3	1,44	24,93	29,73
AVG	1,45	31,79	35,65
SD	0,14	10,27	9,11
V (%)	9,33	32,31	25,56

Figure 2. Tar, nicotine and CO in the smoke of „Agio Tip Filter" cigarillos



	Nicotine (mg/cig)	Tar (mg/cig)	CO (mg/cig)
Pair No1	1,81	35,24	41,17
Pair No2	1,47	28,02	31,42
Pair No3	2,13	39,89	49,42
AVG	1,80	34,38	40,67
SD	0,33	5,98	9,01
V (%)	18,30	17,40	22,15

Figure 3. Tar, nicotine and CO in the smoke of „Agio Tip Sweet" cigarillos

It can be seen from Figure 2 that smoke nicotine of „Agio Tip Filter" cigarillos varied in a relatively narrow range (from 1.32 mg/cig to 1.59 mg/cig) between the three pairs. The levels of tar and CO, however, showed considerable deviation, with coefficients of variation being 32.31% and 25.56%, respectively. Considering the fact that the pairs were created on the grounds of equal weight and draw resistance, it was found that pair No2 had significantly higher levels of smoke nicotine, tar and CO than the other two pairs.

Data on Figure 3 show greater variation of nicotine in the smoke of „Agio Tip Sweet" cigarillos – from 1.47 mg/cig to 2.13 mg/cig, with a coefficient of variation 18.30%. The rest of the smoke emissions also varied considerably, the respective ranges being from 28.02 mg/cig to 39.89 mg/cig (tar), and from 31.42 mg/cig to 49.42 mg/cig (CO). As in the case of the first brand, there were considerable differences in smoke indices between the pairs, although they were relatively less pronounced. The highest levels of smoke emissions were found for pair No3, and the lowest – for pair No2.

The summarized results from the studied smoke emissions reveal considerable variation of each of the indices within the respective brand, which is a significant problem in terms of human exposure to cigarillo smoke emissions and has to be considered in much more detail by the respective regulation policies. Additionally, this study confirmed previous findings stating that the smoke of cigar-like products contains higher concentrations of nicotine, tar and CO in comparison to conventional cigarettes, no matter of the similar size and smoking manner (Bryan and Evans, 2004; O'Connor, 2012; Rickert et al., 2011; Goel et al., 2018; Gosh et al., 2017).

Table 3. Number of puffs during the standardized smoking of „Agio Tip Filter" and „Agio Tip Sweet" cigarillos

Brand	Pair No			AVG	SD	V (%)
	1	2	3			
Agio Tip Filter	11.00	10.80	12.00	11.27	0.64	5.71
Agio Tip Sweet	10.50	12.35	12.00	11.62	0.98	8.46

Table 3 presents data about the number of puffs registered during the automated smoking of the studied cigarillos brands to a butt length of 32 mm, equal for all samples. The minimal number of puffs (as an absolute value) was found in pair No1 and the maximal – in pair No2 of „Agio Tip Sweet" cigarillos. The number of puffs, however, varied little both between the pairs and between the two brands.

Conclusions

The results from the comparative study of two cigarillos brands on Bulgarian market – „Agio Tip Filter" and „Agio Tip Sweet", provide grounds for making the following conclusions:

a) The physical parameters of the studied cigarillos showed insignificant differences between the brands, with the exception of the draw resistance, which was bigger for „Agio Tip Filter" cigarillos.
b) There were no significant differences between the brands with respect to the chemical composition of the filler, binder and wrapper parts of the cigarillos. The filler tobacco had the highest content of nicotine and total nitrogen in both brands.
c) The general assessment of smoke emissions revealed considerable variation within the respective brand, which raises significant concerns about human exposure and has to be taken into account.
d) It is confirmed that cigar-like products produce a tobacco smoke with much higher concentrations of nicotine, tar and CO than those in smoke of conventional cigarettes, which are strictly regulated.

References

Casseus M., Garmon J., Hrywna M., Delnevo C.D. Cigarette smokers' classification of tobacco products. *Tobacco Control*, 2016, 25(6): 628-630. http://dx.doi.org/10.1136/tobaccocontrol-2015-052535

Cohn A., Cobb C.O., Niaura R.S., Richardson A. The other combustible products: prevalence and correlates of little cigar/cigarillo use among cigarette smokers. *Nicotine & Tobacco Research*, 2015, 17(12): 1473-1481. https://doi.org/10.1093/ntr/ntv022

Feirman S., Lock D., Cohen J., Holtgrave D., Li T. Flavored tobacco products in the United States: a systematic review assessing use and attitudes. *Nicotine & Tobacco Research*, 2016, 18(5): 739-749. https://doi.org/10.1093/ntr/ntv176

Ghosh A., Abdelwahab S.H., Reeber S.L., Reidel B., Marklew A.J., Garrison A.J., Lee S., Dang H., Herring A.H., Glish G.L. Little cigars are more toxic than cigarettes and uniquely change the airway gene and protein expression. *Scientific Reports*, 2017, 7: article number 46239. https://doi.org/10.1038/srep46239

Goel R., Trushin N., Reilly S.M., Bitzer Z., Muscat J., Foulds J., Richie J.P.(Jr.). A survey of nicotine yields in small cigar smoke: influence of cigar design and smoking regimens. *Nicotine & Tobacco Research*, 2018, 20(10): 1250-1257. https://doi.org/10.1093/ntr/ntx220

Kostygina G., Glantz S.A., Ling P.M. Tobacco industry use of flavours to recruit new users of little cigars and cigarillos. *Tobacco Control*, 2016, 25(1): 66-74. https://doi.org/10.1136/tobaccocontrol-2014-051830

Leatherdale S.T., Rios P., Elton-Marshall T., Burkhalter R. Cigar, cigarillo, and little cigar use among Canadian youth: are we underestimating the magnitude of this problem? *The*

Journal of Primary Prevention, 2011, 32(3-4): 161-170. https://doi.org/10.1007/s10935-011-0248-6

McQuoid J., Keamy-Minor E., Ling P.M. A practice theory approach to understanding poly-tobacco use in the United States. *Critical Public Health*, 2020, 30(2): 204-218. https://doi.org/10.1080/09581596.2018.1541226

Messer K., White M.M., Strong D.R., Wang B., Shi C., Conway K.P., Pierce J.P. Trends in use of little cigars or cigarillos and cigarettes among US males, 2002-2011. *Nicotine & Tobacco Research*, 2015, 17(5): 515-523. https://doi.org/10.1093/ntr/ntu179

Nyman A.L., Sterling K.L., Majeed B.A., Jones D. M., Eriksen M.P. Flavors and risk: perceptions of flavors in little cigars and cigarillos among US adults, 2015. *Nicotine & Tobacco Research*, 2018, 20(9): 1055-1061. https://doi.org/10.1093/ntr/ntx153

O'Connor R.J. Non-cigarette tobacco products: what have we learnt and where are we headed? *Tobacco Control*, 2012, 21(2): 181-190. http://dx.doi.org/10.1136/tobaccocontrol-2011-050281

Page J.B., Evans S. Cigars, cigarillos, and youth. *Journal of Ethnicity in Substance Abuse*, 2004, 2(4): 63-76. https://doi.org/10.1300/J233v02n04_04

Pickworth W.B., Rosenberry Z.R., Yi D., Pitts E.N., Lord-Adem W., Koszowski B. Cigarillo and little cigar mainstream smoke constituents from replicated human smoking. *Chemical Research in Toxicology*, 2018, 31(4): 251-258. https://doi.org/10.1021/acs.chemrestox.7b00312

Pickworth W.B., Rosenberry Z.R., O'Grady K.E., Koszowski B. Dual use of cigarettes, little cigars, cigarillos, and large cigars: smoking topography and toxicant exposure. *Tobacco Regulatory Science*, 2017, 3(Suppl 1): S72-S83. https://doi.org/10.18001/trs.3.2(suppl1).8

Rickert W.S., Trivedi A.H., Momin R.A., Wagstaff W.G., Lauterbach J.H. Mutagenic, cytotoxic, and genotoxic properties of tobacco smoke produced by cigarillos available on the Canadian market. *Regulatory Toxicology and Pharmacology*, 2011, 61(2): 199-209. https://doi.org/10.1016/j.yrtph.2011.07.009

Schuster R.M, Hertel A.W., Mermelstein R. Cigar, cigarillo, and little cigar use among current cigarette-smoking adolescents. *Nicotine & Tobacco Research*, 2013, 15(5): 925-931. https://doi.org/10.1093/ntr/nts222

Sterling K.L., Fryer C.S., Fagan P. The most natural tobacco used: a qualitative investigation of young adult smokers' risk perceptions of flavored little cigars and cigarillos. *Nicotine & Tobacco Research*, 2016, 18(5): 827-833. https://doi.org/10.1093/ntr/ntv151