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Toxicant contents of oral nicotine pouches (ONPs): comparative quantitative analysis with Swedish snus and cigarette smoke

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ORAL NICOTINE POUCHES

USE



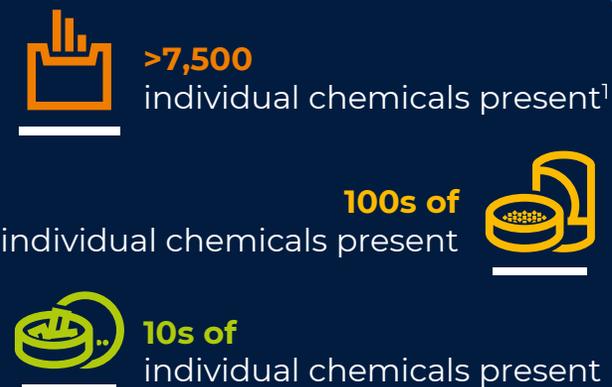
Consumers place the pouch between their gum and upper lip

COMPOSITION



ONPs mainly contain water, plant-based materials, flavourings, sweeteners and nicotine. All prepacked in small pouches

CHEMICAL COMPLEXITY



No external heating or tobacco makes Oral Nicotine Pouches BAT's **simplest Smokeless Product**

NO TOBACCO

NO COMBUSTION

NO SMOKE

NO TAR

BACKGROUND

- Significant changes in product style and preparation of smokeless products in recent years

- **Introduction of tobacco-free nicotine pouches**

- Several publications detail specific smokeless tobacco product chemistry

- **Gap in comprehensive nicotine pouch chemistry**

- Scientific discussion of health risks associated with the use of smokeless tobacco and nicotine products

> Chem Cent J. 2015 Oct 12:9:56. doi: 10.1186/s13065-015-0132-1. eCollection 2015.

The acrylamide content of smokeless tobacco products

Kevin McAdam¹, Harriet Kimpton¹, Carl Vas¹, David Rushforth¹, Andrew

Affiliations + expand

PMID: 26473006 PMCID: PMC4602115 DOI: 10.1186/s13065-015-0132-1

Abstract

Background: There is considerable interest from a regulatory and public health perspective in the chemical composition of smokeless tobacco products (STPs), including potentially harmful constituents in tobacco products, including products (STPs). A wide range of commercial STPs from the US and Sweden the 2010 market share for all the major STP categories in these two countries IARC Group 2A carcinogen acrylamide. These STPs comprised the following

McAdam et al. BMC Chemistry (2015) 9:56
https://doi.org/10.1186/s13065-015-0548-0

RESEARCH ARTICLE

Open Access

The composition of contemporary American and Swedish smokeless tobacco products

Kevin G. McAdam¹, Harriet Kimpton¹, Arif Faizi¹, Andrew Porter² and B

McAdam et al. Chemistry Central Journal (2018) 12:86
https://doi.org/10.1186/s13065-018-0454-x

Abstract

The major components of 70 brands of smokeless tobacco products (STPs) mined to provide greater understanding of the general chemical composition of STPs were examined: loose and portion snus from Sweden, and chewing tobacco, soft pellet and plug from the US. The components analysed were major STP sugars, humectants, sodium ions, chloride ions and ash. The relative quantities between different styles of STP. The major component of moist snuff and snus is water and pouch material comprise more than half of the product mass. By way of contrast, tobacco comprised the majority (around 60%) of the mass of the STPs, except for plug and chewing tobacco. Significant disagreements were found in the water/moisture content for STPs. In particular the oven method, commonly used for the analysis of STPs, gave significantly higher values than the Karl Fischer water method when similar differences were found using the Near-Infrared method. Choice of method has consequences for accuracy of toxicant levels when reporting on a dry-weight basis. Conversion of differences in the compositions of contemporary smokeless tobacco products to a common basis is essential for understanding the health risks associated with the use of smokeless tobacco products.

Keywords: Smokeless tobacco, Snus, Snuff, Water measurement, Moisture

RESEARCH ARTICLE

Open Access

Ethyl carbamate in Swedish and American smokeless tobacco products and some factors affecting its concentration

K. McAdam¹, C. Vas¹, H. Kimpton¹, A. Faizi¹, C. Liu¹, A. Porter², T. Synnerdahl³, P. Karlsson³ and B. Rodu⁴

Abstract

Background: We are interested in comparing the levels of harmful or potentially harmful constituents in Swedish and American smokeless tobacco products (STPs). We report here the concentrations of the IARC Group 2 A (probable human) carcinogen ethyl carbamate (EC) in seventy commercial STPs from the US and Sweden, representing 80–90% of the market share of the major STP categories in these countries. We also examine the effects of various additives, processing and storage conditions on EC concentrations in experimental snus samples.

Results: EC was determined from aqueous extracts of the STPs using ultra performance liquid chromatography tandem mass spectrometry (UPLC/MS/MS). EC was undetectable (< 20 ng/g wet weight basis WWB) in 60% of the commercial STPs, including all the chewing tobacco (CT), dry snuff (DS), hard pellet (HP), soft pellet (SP), and plug (PL) products. Measurable levels of EC were found in 11/76 (69%) of the moist snuff (MS) samples (average 154 ng/g in those samples containing EC) and 19/32 (59%) of the Swedish snus samples (average 35 ng/g). For the experimental snus samples, EC was only observed in ethanol treated samples. EC concentrations increased significantly with ethanol concentrations (0–4%) and with storage time (up to 24 weeks) and temperature (8 °C vs 20 °C). EC concentrations were lower at lower pHs but were unaffected by adding nitrogenous precursors identified from food studies (citrus and urea), increasing water content or by pasteurisation. Added EC was stable in the STP matrix, but evaporative losses were significant when samples were stored for several weeks in open containers at 8 °C.

Conclusions: EC was found in measurable amounts only in some moist STPs i.e. pasteurised Swedish snus and unpasteurised US MS; it is not a ubiquitous contaminant of STPs. The presence of ethanol contributed significantly to the presence of EC in experimental snus samples, more significantly at higher pH levels. Sample age also was a key determinant of EC content. In contrast, pasteurisation and fermentation do not appear to directly influence EC levels. Using published consumption rates and mouth level exposures, on average STP consumers are exposed to lower EC levels from STP use than from food consumption.

STUDY DESIGN SUMMARY

13 products

9 BAT ONPs

Representative commercial range:

- Nicotine 6 to 20mg
- Sweet and salt base formulations
- Mint, fruit and salt flavours
- 2 different pouch sizes, slim and large

2 Commercial competitor ONPs

2 Snus products

- TS4 – University of Kentucky reference product
- Commercially available product



STUDY DESIGN SUMMARY



TOXICANTS

129* toxicants selected from established lists including:



List of harmful and potentially harmful constituents (HPHCs) in tobacco products and tobacco smoke



IARC Monographs on the Evaluation of Carcinogenic Risks to Humans Volume 89 Smokeless Tobacco and Some Tobacco-specific N-Nitrosamines



GothiaTek® quality standard for snus

Toxicant groups assessed

Elements (9)	Carbonyls (4)	Major Components (3)	Hydrocarbons (5)
Aflatoxins (4)	Radionucleotides (27)	Alkaloids (9)	TSNAs (7)
Ash (1)	Nitrosoacids (11)	Polycyclic aromatic hydrocarbons (PAHs) (21)	Miscellaneous* (9)
Aromatic amines (4)	Microbiological counts (3)	Nitrosamines (12)	

*excluding water, mass & pH

SAMPLE GENERATION



**Data generated on a 'as is'
per pouch basis**

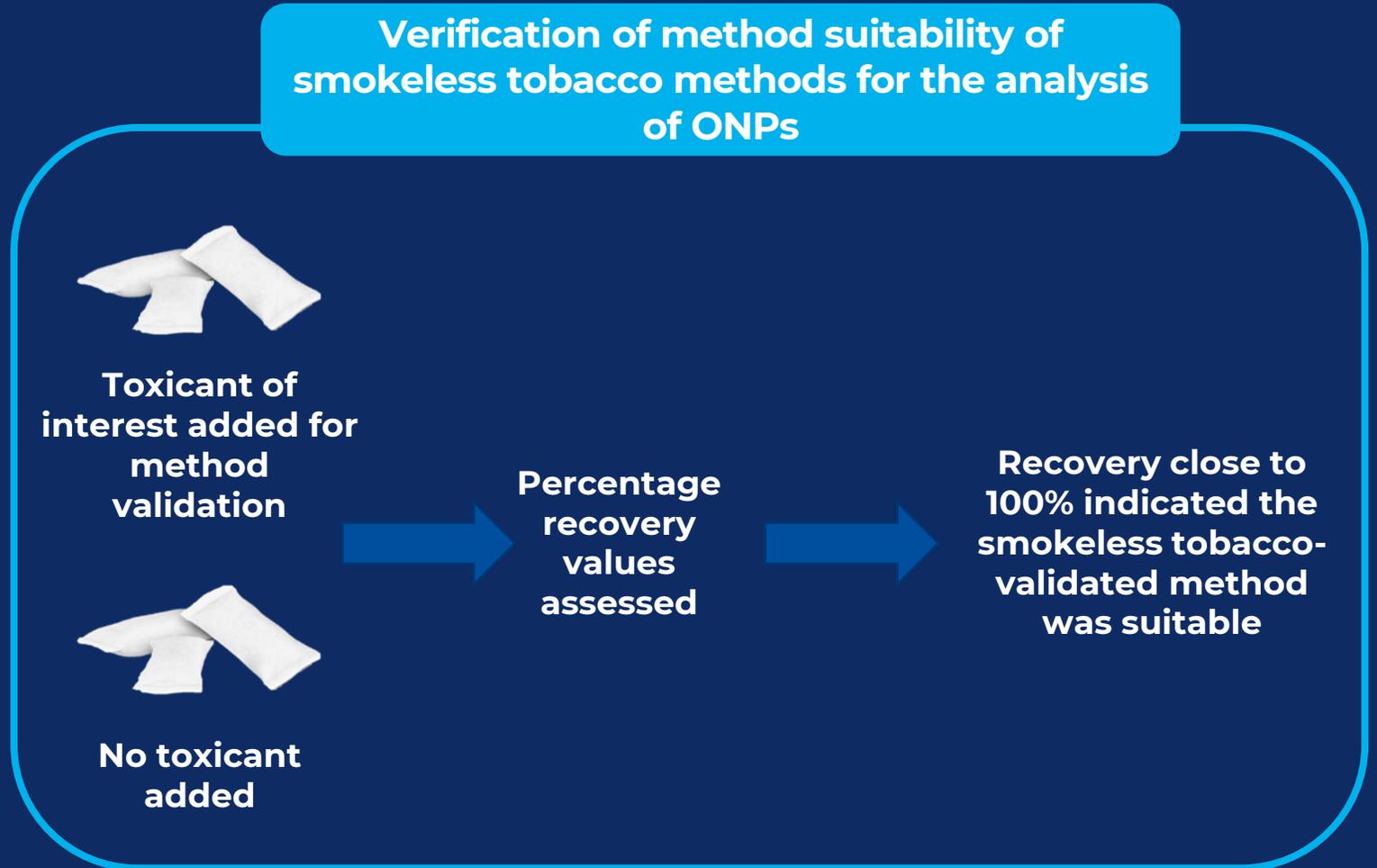
- ONPs were analysed as a combined sample of fleece material and pouch contents.
- Assumption that the pouch is fully exhausted during use



- One or more pouches per replicate (depending upon weight, 1g required per method test)
- Five replicates, one replicate per can
- Due to no aerosol emissions, CO, NO, NOx were not measured

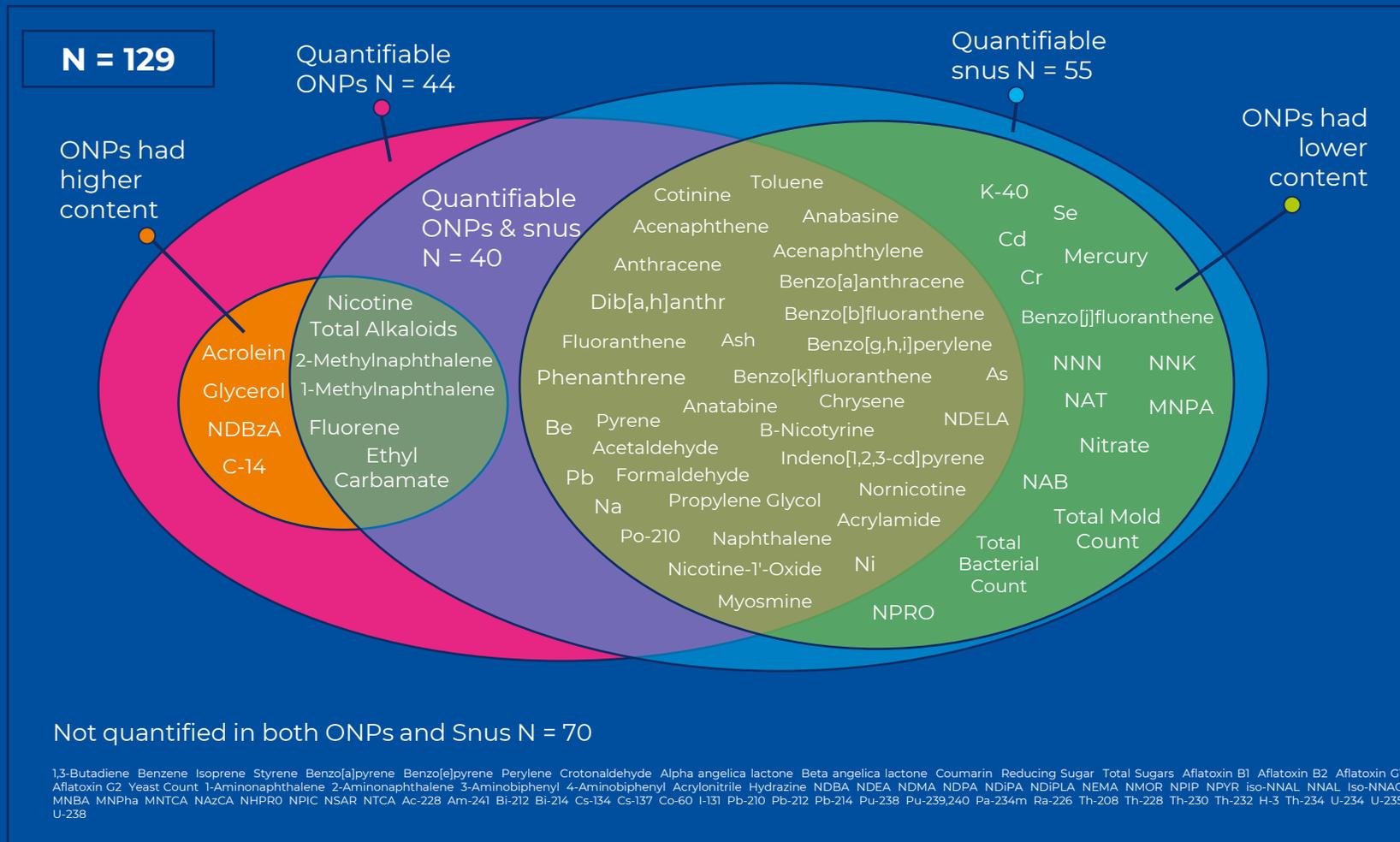
METHOD SUITABILITY

- For several of the toxicants no existing method had been validated for the analysis of ONPs.
- Methods validated for the analysis of smokeless tobacco were used.
- An unflavoured 0mg nicotine pouch was tested both with and without the toxicant of interest to assess recoveries



ONPs AND SNUS TOXICANT PROFILE

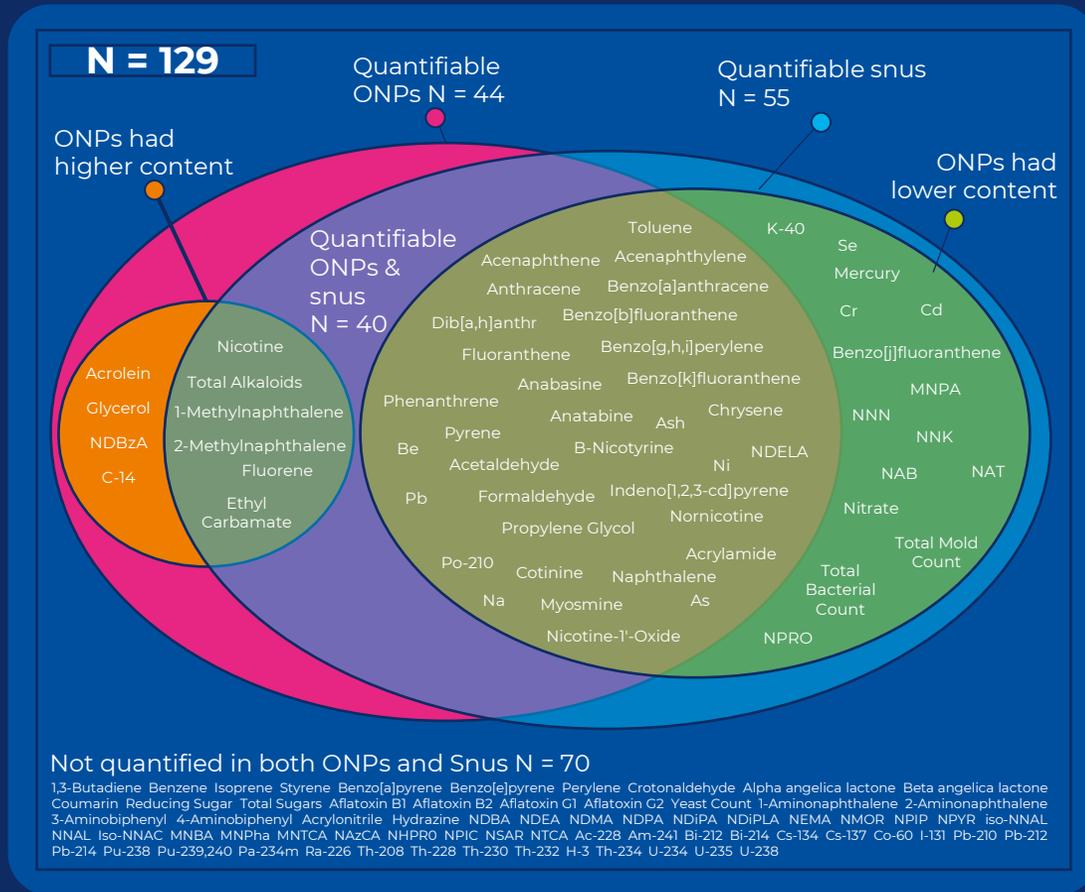
Data Summary



*excluding water, mass & pH

ONPs TOXICANT PROFILE - SUMMARY

Data Summary



- 70 toxicants of the 129* tested were not quantified in any sample
- The majority of toxicants detected in snus and ONPs were >90% reduced in ONPs
- Only 4 toxicants were quantified in 2 or less of the 11 ONPs tested, which were not quantified in either snus products tested

*excluding water, mass & pH

ONPs vs 1R6F TOXICANT PROFILE - SUMMARY



	Toxicants	% reduction of mean ONPs compared to 1R6F reference cigarette	% reduction of mean ONPs compared to 1S4 reference snus
Toxicants recommended for mandated lowering*	1,3-butadiene	99.9	ND in either
	Acetaldehyde	99.9	98.7
	Acrolein	99.9	+17.1
	Benzene	99.9	ND in either
	Benzo[a]pyrene	99.9	ND in either
	CO	NM in ONPs	NM in ONPs
	Formaldehyde	98.7	16.6
	NNK	99.7	99.3
	NNN	99.8	99.3
Toxicants considered high priority for disclosure and monitoring *	2-aminonaphthalene	97.7	ND in either
	4-aminobiphenyl	98.2	NQ in either
	Acrylonitrile	99.9	ND in either
	Cadmium	98.9	99.6
	Catechol	NM in ONPs	NM in either
	Crotonaldehyde	99.9	ND in either
	HCN	NM in ONPs	NM in either
	Hydroquinone	NM in ONPs	NM in either
	NOx	NM in ONPs	NM in either

Of the 18 toxicants recommended for mandated lowering and high priority for disclosure and monitoring in cigarette smoke*:

- 13 toxicants were tested in ONPs
- For those tested, all were lower in the tested ONPs compared to 1R6F

Abbreviation: NM, not measured. ND, not detected, NQ, not quantified

ONPs TOXICANT PROFILE

TobReg 9 reference product comparison¹



Oral Nicotine Pouches* had

99 – 99.8%



Less toxicants compared to 1R6F
reference cigarette 30-day average

*11 products tested



BAT ONPs* had

42 – 92%

Less toxicants compared to
snus reference product

*9 products tested



All samples were lower than the
GothiaTek[®] limits for toxicants tested



¹Hadley, S., et al., Toxicant contents of oral nicotine pouches: comparative quantitative analysis with Swedish snus and cigarette smoke. [Unpublished Manuscript]. British American Tobacco (BAT), 2025.

SUMMARY



ONPs tested contain **no tobacco**

Creates a **simpler** matrix than snus



Fewer toxicants quantified in ONPs compared to Snus

In most cases ONPs contained >90% lower levels than snus



All ONP samples tested comply with GothiaTek® limits for the toxicants tested

This study demonstrates that the studied ONPs have **significantly lower levels of toxicants compared to cigarette smoke** and **similar or lower toxicant profile compared to snus**



THANK YOU FOR YOUR TIME

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