Constituents of "teabacco": A forensic analysis of cigarettes made from diverted nicotine replacement therapy lozenges in smoke-free prisons

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ABSTRACT

Background: Following the implementation of prison smoke-free policies, there have been reports of prisoners creating substitute cigarettes made from nicotine replacement therapy patches or lozenges infused with tea leaves ("teabacco"). No studies have analysed the chemical constituents of teabacco made from nicotine lozenges, so as to document any potential related health hazards.

Method: Teabacco samples were made by a participant who reported creating teabacco while incarcerated in a smoke-free prison in Queensland, Australia, and the process was video-recorded for replication in a laboratory. A simple linear smoking system captured the teabacco smoke for analysis. Inductively coupled plasma optical emission spectroscopy (ICP-OES) was used to analyse elemental composition and gas chromatography coupled with a mass spectrometer (GC-MS) analysed the captured smoke using the National Institute of Standards and Technology mass spectral library.

Results: Analyses determined that quantities of copper, aluminium and lead concentrations, and levels of inhaled total particulate matter, were above recommended guidelines for safe ingestion. Analysis of teabacco smoke using GC-MS identified potentially toxic compounds catechol and nicotine. However, our findings show that smoking this form of teabacco is less harmful than smoking teabacco made from nicotine patches, or smoking traditional tobacco cigarettes.

Discussion: Considering the limited potential health harm of smoking teabacco made from lozenges, and that nicotine lozenges represent the only form of smoking cessation support for individuals entering smoke-free prisons, we caution against the removal of nicotine lozenges from Queensland's prisons, at least until further research directly establishes health harms associated with this form of teabacco.

Keywords: Smoke-Free Policy, Prisoners, Nicotine, Tobacco Use Cessation Products

BACKGROUND

Smoke-free policies are increasingly being implemented in prisons around the world in response to high levels of tobacco use among people who cycle through prisons,[1–3] high levels of exposure to second-hand smoke among non-smokers,[4,5] and risk of litigation from those exposed to second-hand smoke.[4,6] Such policies have been introduced in prisons in Canada,[7] most states of the United States (US),[8] several European countries,[2,9] New Zealand,[10] and in England and Wales.[9] In Australia, complete smoke-free policies have been introduced in all prisons in the Northern Territory, Queensland, Tasmania, Victoria, and New South Wales.[11]

While evidence from the US shows that these smoke-free policies have significantly improved the health of people in prison,[3,12] these policies have resulted in some unintended consequences. One such example is the diverted use of nicotine replacement therapy (NRT), where prisoners are substituting traditional cigarettes by creating their own cigarettes out of NRT supplied by correctional authorities. This practice has been reported in smoke-free prisons in Australia,[13] New Zealand,[14] and in the United Kingdom.[15] The few published studies[13,14,16,17] reporting diverted use of NRT in prison describe how prisoners first mix provided nicotine patches with tea leaves — earning this substance the nickname "teabacco"— then roll the mixture in paper (typically from standard-issue prison Bibles or toilet paper tissue), and finally ignite the created cigarettes using batteries or electronic appliances. Two qualitative studies with Australian prisoners have described the use of teabacco made from nicotine patches,[13,16] and one study has analysed the chemical constituents of teabacco made from tea leaves and nicotine patches.[17] This forensic analysis found that smoking teabacco cigarettes made from nicotine patches released nicotine, as well as harmful toxins formaldehyde, acetaldehyde, acrolein, toluene, xylene, and heavy metals—providing clear evidence for the potential of this form of teabacco to result in short- and long-term health harm. Participants in both qualitative studies also described fellow prisoners experiencing negative health effects as a result of smoking teabacco made from nicotine patches, including nose bleeds, seizures, and strokes.[13,16]

The state of Queensland in Australia is one jurisdiction in which anecdotal reports of teabacco use in prison have emerged. In Queensland, a smoke-free policy was implemented in all prisons on the 5th May 2014, and prisoners were provided with a free 12-week supply of nicotine patches (consistent with standard community practice). Nine months later, this was reduced to one week of free patches provided to all people entering prison. Unsubstantiated reports of teabacco made from nicotine patches emerged in the media,[18] leading to Queensland correctional authorities removing all nicotine patches from their facilities. However, despite the withdrawal of formal NRT provision, prisoners are still able to buy nicotine lozenges (but not patches) from the prison shop in most prisons. It became known to us that prisoners in Queensland then began creating teabacco from nicotine lozenges instead, with this practice also reported in the media in other states.[19] There are no studies reporting the health effects of smoking teabacco made from nicotine lozenges. The aim of this study is to identify the chemical constituents of teabacco made from nicotine lozenges, so as to document any by-products that may constitute health hazards for smokers of this form of teabacco.

METHOD

Recruitment

During data collection for a broader study investigating return to smoking following release from smoke-free prisons in Queensland,[20] reports of teabacco use in Queensland's prisons emerged among several participants. One participant who described making teabacco cigarettes from nicotine lozenges while incarcerated, and who was no longer serving a community corrections order, agreed to meet with researchers in a private location in the community to create samples for analysis. After informed consent procedures, the participant created several samples of teabacco cigarettes. The participant agreed to the filming of his hands while creating the samples so that the process could be replicated in the laboratory, whilst assuring the participant's anonymity. The participant was provided with a supermarket voucher as a reciprocity payment for his time. This study received approval from Griffith University's Human Research Ethics Committee (2015/581).

Production of Teabacco

All materials provided to the participant were the same brand as those he described using in prison. Based on instructions provided by the participant to the research team prior to the video recording, the provided tea leaves (Bushells Blue Label brand, removed from teabags) had already been rinsed in running cold tap water until the water ran clear, and then left to dry overnight. The participant began by sucking the sugar coating off of the nicotine lozenges (Nicorette Cool Drops 2mg). He then crushed the lozenges in a bowl until they resembled powder. The crushed lozenges were then mixed with the rinsed and dried tea leaves at a ratio of three lozenges to one teabag. The participant stirred the mixture thoroughly until the tea leaves were covered in a white residue. The participant then created a cigarette filter using a small piece of cardboard. He assembled the teabacco cigarette by placing the teabacco mixture and a cardboard filter onto a piece of Bible paper, which he then rolled into a cigarette. He used saliva to seal the teabacco cigarette and concluded by twisting each end of the cigarette to enclose the contents. In a prison setting, paper would be placed in a microwave to create a flame, which would then be used to ignite the teabacco cigarette. Screenshots from the video of the participant creating the teabacco samples are available as a supplementary file.

Analysis

A simple linear smoking system[21] (Figure 1) was designed by authors CM and AW in order to capture the teabacco smoke for analysis. The smoking chamber designed was based on Klus and colleagues'[22] adaption of the original design by von Neurath et al.[23] The result was an aluminium chamber (side and rear views shown in Figures 2 and 3 respectively) with a polytetrafluoroethylene (PTFE) cigarette holder (Figure 4). Table 1 describes the components of the smoking system used to capture the teabacco cigarette smoke for analysis.

Adjacent to the smoking chamber was a solvent based trap[24]; consisting of a liquid solvent (methanol or toluene) in a Dreschel bottle or impinger. This allowed the smoke to be bubbled through a liquid and captured by either cooling or chemical interaction with the chosen solvent. As this style of trap is susceptible to breakthrough of high concentration compounds,[24] the trap was cryogenically cooled[24] with dry ice in isopropanol (-78°C).[25]

In order to simulate a person smoking a cigarette, consideration of variables such as puff frequency (puff duration and inter-puff interval), puff volume, puff duration and puff flow rate[26] was required. The Massachusetts regime[27] for smoking was selected, as it was deemed the closest to the human average[28] (Table 2). A timing and switching system was designed to mimic the preferred smoking cycle. Two timers were interconnected and used to control a solenoid valve (Figure 5). A manual switch was also installed to simulate the quick and short puffs smokers employ until the cigarette is completely lit.

Table 3 describes the materials used to create teabacco samples in the laboratory. Cigarettes were constructed similar in size and concentrations to those created by the participant, with the exception of the rolling method; to ensure consistency when rolling multiple teabacco cigarettes, the Bible paper casing was rolled around a hexagonal Allen key (4.5 mm) before saliva was applied (as adhesive) using a cotton Q-tip swab. The casing was then left to dry, before a section of one end was twisted to enclose the cigarette. The teabacco mixture was then created by mixing crushed nicotine lozenges (Nicorette Cool Drops 2mg) with rinsed tea leaves (Bushells blue label) at a ratio of three lozenges to one teabag. The paper casing was then filled with teabacco, with occasional tapping, before the rolled cardboard filter was inserted. The cigarette was then smoked by the linear smoking system. Four cigarettes were smoked per trap, with three replicate traps per solvent.

Gravimetric determination of the total particulate matter (TPM; includes water, nicotine and condensable tar) 'inhaled' by the linear smoking system occurred through use of a second cigarette filter tip located inside the PTFE cigarette holder. During smoking, recorded outcomes included the overall smoke time, number of puffs, and the weight of the second filter both before and after smoking. The difference in weight was used to calculate TPM/puff. A cigarette was considered successfully 'smoked' if a range of 12-15 puffs was achieved (as per average use of a commercial cigarette).

Prior to analysis, the liquid captured from each solvent trap was freeze dried to remove solvent. The sample residues were then placed back into solution at a concentration of approximately 3000 mg/L; in either methanol or dichloromethane (substituted for toluene). Analysis of the captured smoke was conducted by gas chromatography coupled with a mass spectrometer (GC-MS); compounds were identified using the National Institute of Standards and Technology (NIST) mass spectral library (Version 2.2, 2014). Retention indexing was used to constrain the search parameters to improve library identification results. Samples were run on a GC-MS with a 240◦C injection port at an initial temperature of 85◦C, held for two minutes, and the temperature was then ramped at 20◦C/min until 180◦C and then held for a further minute. The oven was then ramped again at 40◦C/min and held isothermally at 280◦C for eight minutes. Carrier gas flow was controlled by linear velocity at 1.10mL/min. Mass spectral information was gathered from 40 to 600 m/z with single ion monitoring (SIM) channels of 84, 133 and 162 m/z being used to monitor and quantify the nicotine within the sample.

Elemental composition of the teabacco cigarette materials (shown in Table 3), along with other identified potential materials used, were analysed by inductively coupled plasma optical emission spectroscopy (ICP-OES). Each sample was run in triplicate and involved digestion using concentrated nitric acid and a microwave sample preparation system, before being analysed for the presence of 23 elements, including various toxic heavy metals. Table 4 describes the instruments used for analysis. The analysis was conducted using a Perkin Elmer Optima 8300 ICP-OES which was operated at 1450 watts with flowrates of 10L/min, 0.3L/min and 0.7L/min for plasma, auxiliary and nebulising gases respectively. Sample flow rate was set at 1.5mL/min.

Tea cigarettes (washed and unwashed), containing only tea and no nicotine lozenges, were analysed by GC-MS and TPM was determined gravimetrically, as a comparison to the teabacco cigarettes; in order to identify components that originated specifically from the lozenges, rather than those from the tea and the bible paper. Winfield Original Blue cigarettes (a common brand available for commercial purchase) were also analysed by GC-MS and ICP-OES as a comparison to teabacco cigarettes.

RESULTS

Elemental Analysis by ICP-OES

Elemental compositions of the teabacco cigarette materials (Table 3), along with other identified potential materials used were determined by ICP-OES (Table 5). The 23 elements tested include macro and trace minerals required for healthy function and development, along with toxic heavy metals that can be potentially consumed through dietary intake. Considering that individuals may smoke a pack of 20 cigarettes in one day, the total potential exposure of each element was calculated (Table 6) for a minimum of 20 cigarettes (being the smallest sized ‘pack’ of commercially-produced cigarettes available).

Results from ICP-OES were compared to recommended daily intakes/recommended dietary allowances and upper intake limits, preferably from the World Health Organization (WHO). These analyses pertain to the potential exposure of a person to the concentrations determined in Table 5. The maximum risk of exposure possible by smoking teabacco cigarettes was considered, compared to guidelines and deemed excessive or not (Table 7).

Gravimetric Determination of Total Particulate Matter

Total particulate matter (TPM) was collected for each different type of handmade cigarette (teabacco, washed and unwashed tea) by using a separate Ranch cigarette filter tip per cigarette. The average experimental weights of total particulate matter were recorded by collecting 12 data points per trap polarity (equivalent to 24 points per tobacco/teabacco product; see Table 8) and compared to an established maximum limit and literature value for Winfield Original Blue cigarettes.

Identification of Compounds by GC-MS

The identity of several possible compounds collected by both the methanol and toluene solvent-based traps was determined by GC-MS using the NIST mass spectral library (Table 9, Table 10). Figures 6 and 7 show representative GC-MS chromatograms of trap residues captured in methanol and toluene, respectively, for the smoking of washed teabacco cigarettes. A number of compounds were identified by GC-MS from the smoke captured in the methanol solvent-based traps from all samples (Table 9). Compounds identified in the teabacco samples (both filtered and unfiltered) include (Z)-9-octadecenamide, 1,6-anhydro-β-D-glucopyranose, catechol, dianhydromannitol, DL-glucitol, nicotine and octadecanoic acid. In the toluene solvent-based trap (Table 10), the compounds identified in the teabacco samples (both filtered and unfiltered) by GC-MS included 5-methyl-2-(1-methylethyl)-cyclohexanol, dianhydromannitol, diethyl phthalate, nicotine, and octadecanoic acid. Compounds identified in teabacco cigarettes, along with washed and unwashed tea cigarettes, including the likely source and potential toxicity of each are collated for comparison in Table 11.

Nicotine levels in the teabacco cigarette were monitored to determine whether this non-standard form of cigarette could deliver a reasonable level of nicotine, as opposed to the user ingesting the supplied lozenge as intended (2mg nicotine), or smoking commercial cigarettes (reported nicotine levels in Winfield Blue 0.86 mg[29] (tar 9.1mg) [29]). Nicotine levels were determined using single ion monitoring GC-MS, and a standard curve was generated in a range from 1 to 250mg/L in dichloromethane, with the samples processed against this. Nicotine levels accessible via the smoking process were calculated based on nicotine per gram of smoking product and nicotine per gram of trap residue. Tables 12 and 13 show the resulting nicotine recovered in methanol traps via the smoking process for tobacco and ‘teabacco’ products (represented graphically in Figures 8 and 9). It was determined that as a function of grams of smoking material, the washed tea product and Winfield Blue cigarette deliverable comparable values (0.092mg/g vs 0.85mg/g), with the teabacco product delivering significantly less nicotine at 0.014mg/g of product. In comparison, the mass of nicotine recovered from the trap residues were determined to be 3.98mg/g (Winfield Blue cigarettes), 3.77mg/g (washed tea) and 2.00mg/g (teabacco). Noted is the mass of the trap residues for Winfield and washed tea, delivering on average 47.6mg and 31.5mg of residue, and the teabacco residues yielding 14.7mg of residue.

DISCUSSION

Our analyses identified a number of compounds present in teabacco made from nicotine lozenges. First, when comparing results from inductively coupled plasma-optical emission spectroscopy (ICP-OES) to recommended dietary allowances and upper intake limits, typically from the World Health Organization (WHO), only copper and aluminium were identified in amounts that may be of health concern. 2932.56 µg/g (2.9 mg) of copper was identified in samples of the Gideon's Holy Bible inked pages, which surpasses the recommended dietary allowance of copper (0.9 mg per day)[30] and has the potential to cause general gastric irritation in sensitive individuals.[31] Two other Bible paper samples (The Shire of Pine Rivers and New International Version; both inked and non-inked) were found to have between 16208.56 µg/g (16.2 mg) and 27558.84 µ/g (27.5 mg) of aluminium, surpassing the provisional weekly intake of 2 mg per kg[32] of body weight when smoking more than a 'pack-a-day' (>20 cigarettes). A possible link between increased ingestion of aluminium and Alzheimer's disease has been identified, but not established.[31,33] However, it is important to note that these analyses pertain to the potential exposure of a person to the concentrations determined by ICP-OES for each element, and that full exposure is extremely unlikely, as consumption through inhalation depends on several parameters.[34]

In our comparison of the upper limits of potential elemental exposure (teabacco cigarettes versus traditional tobacco cigarettes), we identified 190µg (0.19 mg) of lead per 20 teabacco cigarettes smoked. While there is currently no universally-accepted allowance for safe lead ingestion,[35,36] a previous tolerable weekly intake of 25µg per kg body weight was deemed unacceptably high.[31,37,38] As a result, any individuals smoking a 'pack-a-day' of teabacco each week are at risk of some negative health effects due to potential exposure nearing the withdrawn weekly intake. Potential health effects from lead exposure include headaches and irritability, anaemia, tremors, or paralysis.[31,37,38] Lead has also been classified as a possible carcinogen to humans.[31,37,38]

Total particulate matter (TPM) varied for each teabacco cigarette, which may be due to the tightness of the rolled filter or the consistency of the tea. In 2001, a maximum limit of 10 mg per cigarette[39] was established for TPM, but it can vary between 4.9 - 13.2 mg per cigarette.[40,41] While the Winfield Original Blue cigarettes comply[42] with this imposed limit, the upper TPM range for a teabacco cigarette is slightly higher than the limit at 10.91 mg per cigarette. Inhaled TPM poses an unknown aspirated risk, which could be detrimental to individuals smoking teabacco cigarettes. General health effects from the deposition of particulate matter in the respiratory system include irritation, inflammation, and decreased lung function.[43,44] This does not take into account any health effects that could occur from the absorption of constituents contained within the total particulate matter of teabacco cigarettes.

Compounds identified by gas chromatography coupled with a mass spectrometer (GC-MS) in the teabacco samples (both filtered and unfiltered) include (Z)-9-octadecenamide, 1,6-anhydro-β-D-glucopyranose, 5-methyl-2-(1-methylethyl)-cyclohexanol, catechol, dianhydromannitol, diethyl phthalate, DL-glucitol, nicotine, and octadecanoic acid. None of these compounds are considered toxic to humans,[45–51] with the exception of catechol and nicotine. Catechol is one of the major products from pyrolysis of catechin,[52]which is present in black tea.[53] Catechol is considered a tumour promoter,[54] and has been previously identified in mainstream tobacco smoke.[55,56] Nicotine is a highly addictive[57] psychoactive substance[58]present in commercially available tobacco.[106] Exposure to nicotine promotes lung tumour progression and metastasis,[59] and development of emphysema.[59] Octadecanoic acid, also known as stearic acid,[50] was also identified. Octadecanoic acid is a saturated fatty acid which contributes to the aroma and flavour of black tea,[60,61] and while inhalation of octadecanoic acid may cause respiratory tract irritation, the compound is not considered toxic.[62]

Review of the nicotine levels in teabacco demonstrated that teabacco is on a similar scale to commercial tobacco with respect to delivery of nicotine. Noted are the high levels of nicotine reported in smoking of unwashed black tea. This is not to be unexpected as levels as high as 1.66μg/g have been reported by Siegmund and colleagues, in tea varieties.[63] Large discrepancies between measured and reported values may lie in three areas; the variable nature of the tea product, as described by Siegmund,[63] the way the nicotine is sampled (i.e. smoking), and the potential signal noise in the SIM signal due to the complex nature of the tea sample.

While a number of potentially harmful compounds were identified in our analyses of teabacco made from nicotine lozenges, our findings show that smoking of this form of teabacco is still less harmful than smoking teabacco made from nicotine patches,[17] or smoking traditional tobacco cigarettes. However, considering the presence of these potentially harmful compounds, we recommend the implementation of prison-based awareness programs highlighting the potential harmful effects of smoking teabacco, and that the nicotine lozenge be consumed by oral ingestion instead (as per dosage instructions). Nicotine replacement therapies, when used as intended, are designed to give the therapeutic relief achieved from smoking, but without the added detrimental health effects and with significantly lower toxicity.[64,65] With nicotine lozenges currently being the only smoking cessation support available to people entering Queensland's prisons—a population with one of the highest levels of tobacco use in Australia[1,66] and of all global prison populations[2,8]—our findings question the wisdom of automatically removing nicotine lozenges from correctional facilities in response to the creation and use of teabacco, at least until further research directly establishes the health harms resulting from smoking teabacco made from nicotine lozenges.

Limitations

While this is the first study to analyse the chemical constituents of teabacco made from nicotine lozenges, and as such lays groundwork for future research, this study suffers four main limitations. First, we were limited to a single operational sample of teabacco cigarette, and as such the samples received from the participant and recreated in the laboratory may not be representative of other samples of teabacco created and smoked by prisoners. Second, TPM was determined gravimetrically as a whole, and the composition was not analysed to determine individual constituents. Composition of the TPM would assist with determining the unknown aspiration risk. Third, GC-MS analysis was qualitative not quantitative, and quantitation of the compounds present would assist with determining the overall potential toxicity of the handmade teabacco cigarettes. While the quantitation of nicotine in the unwashed black tea showed a substantial amount of nicotine, further exploration needs to be undertaken due to the complex and variable nature of the tea leading to interference in the sample matrix. Finally, there were four cigarettes per solvent (methanol or toluene) trap, with three traps per cigarette type (teabacco, washed and unwashed tea) analysed by GC-MS for this study. More replicate traps per cigarette sample type would increase the reliability of the compounds identified.

Conclusion

While our analysis identified a number of compounds present in the smoke produced from teabacco made from nicotine lozenges, the only identified compounds of potential health concern were catechol and nicotine. Quantitation of nicotine across the samples showed that teabacco includes a quantity of nicotine comparable to commercial cigarettes, however more work needs to be done to investigate potential interferences present in our analytical methodologies. Elemental composition determined that copper, aluminium and lead concentrations also raised potential health concerns, with the identified quantities of these three elements being above recommended guidelines for safe ingestion. Inhaled total particulate matter poses limited potential risk to the respiratory system. Overall, the potential of teabacco made from nicotine lozenges to result in health harm is much lower than the risk of harm resulting from smoking teabacco made from nicotine patches, or from smoking traditional tobacco cigarettes, and with nicotine lozenges representing the only form of smoking cessation support to individuals entering smoke-free prisons, we caution against the removal of nicotine lozenges from Queensland's correctional facilities, at least until further research directly establishes the health harms associated with the use of this form of teabacco.

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Table 1. *Components of the smoking system used to capture the teabacco cigarette smoke for analysis*

Equipment	Use
Smoking chamber and cigarette	Holds the cigarette during smoking
Solvent based trap	Collects the cigarette smoke for analysis
Timer and switch system	Controls the flow of smoke through the system to mimic the puffing cycle
SKC AirCheck TOUCH 220-5000TC pump	Pulls the cigarette smoke through the system at a constant rate

Table 2. *Comparison of various smoking regimes published in literature.*

Smoking Regime	Puff Volume	Puff Duration	Inter-puff Interval
ISO Standard[67]	35 mL	2 sec	60 sec
Massachusetts[41]	45 mL	2 sec	30 sec
Human Average[68]	>35 mL	1.8 sec	34 sec

Table 3. *Materials used to create the teabacco cigarette samples.*

Material	Brand	Use	Quantity
Inked Bible Paper	God's Word	Cigarette paper	~36 mm x ~80 mm
Cardboard	Bushells Blue Label (box)	Makeshift filter or 'roach'	~20 mm x ~25 mm
2 mg Nicotine Lozenge	Nicorette Cool Drops	In teabacco	3 lozenges/1 teabag
Black Tea (Washed)	Bushells Blue Label	In teabacco	3 lozenges/1 teabag

Table 4. *Instruments used for analysis.*

Instrument	Use
Vacuum Freeze Dryer Lab-1 Series	Freeze dry smoke samples to remove solvent
Shimadzu GC-MS TQ8040 *Gas Chromatography Mass Spectrometry*	Separates individual components in the smoke sample and identifies components using a mass spectral library
Perkin Elmer Titan MPS Microwave Sample Preparation System	Digests the raw materials used in teabacco cigarettes for elemental analysis
Perkin Elmer Optima 8300 ICP-OES *Inductively Coupled Plasma Optical Emission Spectroscopy*	Determines the elemental composition in the digested raw materials

Table 5. *Average elemental concentration (μg/g) determined by ICP-OES from the raw materials.*

	Gideon's Holy Bible						God's Word					
	Inked	**STD**	**% error**	**No Ink**	**STD**	**% error**	**Inked**	**STD**	**% error**	**No Ink**	**STD**	**% error**
Na	311.74	73.88	23.70%	400.75	10.73	2.68%	607.97	24.28	3.99%	622.71	31.54	5.07%
K	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	46.92	12.51	26.67%
Mg	3625.95	869.43	23.98%	2718.68	609.76	22.43%	281.13	7.72	2.75%	272.23	6.40	2.35%
Ca	1332.28	130.11	9.77%	2096.06	365.23	17.42%	15952.24	1279.42	8.02%	16012.11	237.23	1.48%
Mn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zn	BDL	BDL	BDL	22.00	14.84	67.44%	63.80	62.76	98.36%	149.60	158.81	106.16%
Si	192.88	85.85	44.51%	185.48	153.79	82.92%	BDL	BDL	BDL	BDL	BDL	BDL
Al	2983.78	583.05	19.54%	4157.25	1403.80	33.77%	1176.15	43.87	3.73%	1047.33	44.99	4.30%
Cu	**2932.56**[a]	5784.49	197.25%	10.56	4.92	46.60%	2.05	0.95	46.19%	1.10	0.70	64.18%
Sn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Ni	2.06	0.20	9.82%	2.27	0.09	4.15%	1.37	0.05	4.00%	1.31	0.06	4.77%
Co	0.50	0.33	65.82%	0.59	0.10	17.93%	0.65	0.02	3.57%	0.68	0.05	6.89%
Cr	1.27	0.11	8.77%	1.78	0.12	6.62%	1.65	0.18	10.92%	1.49	0.07	4.72%
Pb	8.66	8.03	92.73%	5.08	0.36	7.06%	9.22	0.23	2.52%	8.90	0.21	2.39%
As	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cd	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hg	11.80	2.16	18.30%	12.21	0.45	3.69%	BDL	BDL	BDL	BDL	BDL	BDL
Se	1.74	0.16	9.03%	BDL	BDL	BDL	4.08	0.30	7.28%	BDL	BDL	BDL
Fe	86.91	18.73	21.55%	76.85	5.99	7.79%	106.21	10.50	9.89%	98.97	27.38	27.66%
Ag	3.15	4.12	130.74%	1.25	0.14	11.55%	2.39	0.07	3.07%	2.43	0.03	1.07%
S	BDL	BDL	BDL	BDL	BDL	BDL	543.40	46.81	8.61%	576.26	115.10	19.97%
P	34.00	6.59	19.38%	27.36	6.83	24.95%	48.89	5.73	11.72%	37.45	3.27	8.72%
Au	29.72	1.73	5.83%	30.57	0.38	1.23%	1.69	0.25	14.63%	1.82	0.06	3.56%

[a] Elements have the potential to cause minor adverse effect if consumed in large quantities; [b] Elements have the potential to cause major adverse effects if consumed in large quantities; BDL: below detectable limits.

Table 5 cont. *Average elemental concentration (µg/g) determined by ICP-OES from the raw materials.*

	Holy Bible New International Version						Holy Bible Share of Pine Rivers					
µg/g	Inked	STD	% error	No Ink	STD	% error	Inked	STD	% error	No Ink	STD	% error
Na	341.86	17.72	5.18%	400.91	43.05	10.74%	1796.42	91.27	5.08%	1804.32	28.01	1.55%
K	1117.99	252.06	22.55%	1135.85	72.15	6.35%	627.71	28.89	4.60%	617.04	23.99	3.89%
Mg	178.36	38.01	21.31%	161.19	2.50	1.55%	584.10	6.83	1.17%	602.67	10.61	1.76%
Ca	97.16	10.50	10.81%	113.72	22.71	19.97%	26788.37	879.02	3.28%	26203.91	460.00	1.76%
Mn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zn	14.14	1.99	14.10%	18.44	7.62	41.35%	4.59	0.19	4.19%	BDL	BDL	BDL
Si	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Al	**16208.56**[a]	4138.12	25.53%	**16741.69**[a]	760.15	4.54%	**27558.84**[a]	349.90	1.27%	**27395.70**[a]	450.41	1.64%
Cu	5.46	1.31	24.04%	8.33	4.21	50.61%	2.26	0.37	16.19%	1.55	0.11	7.38%
Sn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Ni	0.97	0.17	17.88%	1.29	0.35	27.31%	1.16	0.17	14.84%	1.19	0.09	7.42%
Co	0.56	0.12	21.70%	0.58	0.05	8.18%	0.63	0.06	8.85%	0.55	0.07	12.36%
Cr	6.20	1.17	18.95%	6.35	1.69	26.67%	4.26	0.21	4.89%	4.09	0.09	2.25%
Pb	BDL	BDL	BDL	BDL	BDL	BDL	5.15	1.25	24.31%	4.97	0.52	10.39%
As	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cd	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Se	4.23	0.93	22.04%	4.65	0.32	6.90%	6.27	0.87	13.93%	6.09	0.24	4.01%
Fe	344.82	76.59	22.21%	679.15	632.20	93.09%	236.25	4.21	1.78%	230.90	6.95	3.01%
Ag	1.97	0.04	2.18%	2.09	0.33	15.60%	2.19	0.22	10.13%	2.15	0.14	6.71%
S	247.01	17.20	6.96%	260.82	19.97	7.66%	111.92	0.96	0.86%	105.75	7.74	7.32%
P	61.06	12.87	21.07%	59.03	1.57	2.67%	135.27	1.92	1.42%	129.73	2.49	1.92%
Au	BDL	BDL	BDL	BDL	BDL	BDL	1.15	0.12	10.54%	2.16	1.41	65.39%

[a] Elements have the potential to cause minor adverse effect if consumed in large quantities; [b] Elements have the potential to cause major adverse effects if consumed in large quantities; BDL: below detectable limits.

Table 5 cont. *Average elemental concentration (µg/g) determined by ICP-OES from the raw materials.*

	New Testament Psalms and Proverbs						New World Translation of the Holy Scriptures					
µg/g	Inked	STD	% error	No Ink	STD	% error	Inked	STD	% error	No Ink	STD	% error
Na	2103.88	208.87	9.93%	1855.80	248.69	13.40%	1016.64	5.33	0.52%	955.98	56.31	5.89%
K	BDL	BDL	BDL	BDL	BDL	BDL	429.59	32.16	7.49%	377.12	64.57	17.12%
Mg	715.94	95.22	13.30%	639.58	9.46	1.48%	208.49	15.56	7.46%	284.35	53.43	18.79%
Ca	97935.07	2676.03	2.73%	93979.35	1786.13	1.90%	26013.60	1017.07	3.91%	23612.08	583.90	2.47%
Mn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	15.14	6.76	44.62%
Si	41.45	10.44	25.18%	44.13	20.29	45.99%	173.80	70.26	40.43%	280.41	67.68	24.13%
Al	265.73	29.19	10.99%	618.00	641.20	103.75%	9597.30	1845.77	19.23%	10093.33	2366.28	23.44%
Cu	36.00	7.07	19.65%	1.59	0.58	36.70%	5.30	0.94	17.68%	3.77	0.91	24.06%
Sn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Ni	0.95	0.09	9.42%	0.96	0.09	8.91%	1.34	0.11	8.51%	1.62	0.24	14.66%
Co	1.00	0.26	25.66%	0.58	0.05	7.84%	0.69	0.16	23.88%	0.92	0.15	16.59%
Cr	1.81	0.05	2.83%	3.94	4.66	118.29%	3.97	0.21	5.41%	3.95	0.25	6.45%
Pb	6.12	0.63	10.25%	6.18	0.24	3.94%	7.08	0.33	4.72%	7.83	1.07	13.71%
As	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cd	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Se	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fe	67.02	10.73	16.01%	79.61	21.15	26.57%	250.67	28.60	11.41%	229.21	24.70	10.78%
Ag	2.01	0.07	3.35%	1.97	0.02	1.16%	2.07	0.07	3.31%	2.51	0.12	4.64%
S	76.75	19.55	25.47%	BDL	BDL	BDL	408.16	8.76	2.15%	360.71	13.67	3.79%
P	42.43	3.08	7.25%	46.46	0.53	1.14%	109.25	0.85	0.78%	95.95	1.95	2.03%
Au	1.94	0.00	0.04%	BDL	BDL	BDL	3.39	1.48	43.66%	BDL	BDL	BDL

[a] Elements have the potential to cause minor adverse effect if consumed in large quantities; [b] Elements have the potential to cause major adverse effects if consumed in large quantities; BDL: below detectable limits.

Table 5 cont. *Average elemental concentration (µg/g) determined by ICP-OES from the raw materials.*

	Winfield Original Blue Cigarette			**Nicorette Cool Drops**			**Bushells Blue Label Black Tea**					
µg/g	**(Filter Cut Off)**	**STD**	**% error**	**Nicotine Lozenge**	**STD**	**% error**	**Washed**	**STD**	**% error**	**Unwashed**	**STD**	**% error**
Na	502.45	49.35	9.82%	4800.30	90.25	1.88%	294.70	2.39	0.81%	BDL	BDL	BDL
K	25602.75	1021.21	3.99%	1239.42	34.39	2.77%	BDL	BDL	BDL	15870.31	180.43	1.14%
Mg	5176.49	200.16	3.87%	940.42	14.33	1.52%	1625.71	23.42	1.44%	1885.64	25.99	1.38%
Ca	2580.72	79.02	3.06%	75.62	0.95	1.26%	1450.41	13.24	0.91%	480.48	11.26	2.34%
Mn	126.47	12.02	9.50%	BDL	BDL	BDL	250.29	4.35	1.74%	1148.51	21.53	1.87%
Zn	9.10	2.96	32.53%	BDL	BDL	BDL	69.34	34.89	50.32%	BDL	BDL	BDL
Si	46.32	18.08	39.02%	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Al	419.11	32.19	7.68%	53.27	1.34	2.51%	1150.54	120.70	10.49%	1267.43	15.90	1.25%
Cu	9.86	0.31	3.13%	0.28	0.14	49.69%	178.96	3.02	1.69%	14.01	0.36	2.58%
Sn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Ni	2.57	0.08	3.14%	0.89	0.02	2.06%	6.22	0.07	1.19%	6.76	0.40	5.93%
Co	0.21	0.06	28.91%	0.58	0.02	3.88%	BDL	BDL	BDL	BDL	BDL	BDL
Cr	1.20	0.05	4.53%	1.68	0.06	3.59%	6.30	0.27	4.33%	7.65	0.84	10.98%
Pb	3.19	0.00	0.08%	5.26	0.22	4.25%	7.65	0.12	1.62%	2.93	0.75	25.44%
As	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cd	0.51	0.10	19.91%	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hg	**9.01**[b]	1.58	17.55%	BDL	BDL	BDL	10.45	0.17	1.66%	7.32	0.36	4.95%
Se	BDL	BDL	BDL	3.19	0.18	5.52%	BDL	BDL	BDL	BDL	BDL	BDL
Fe	235.86	11.08	4.70%	11.86	0.40	3.39%	198.59	5.19	2.61%	206.92	9.06	4.38%
Ag	0.70	0.03	3.91%	2.16	0.08	3.88%	1.08	0.05	4.20%	1.16	0.05	4.17%
S	3602.50	133.32	3.70%	364.20	6.77	1.86%	2352.38	19.25	0.82%	2644.22	24.42	0.92%
P	1795.80	96.56	5.38%	20.80	0.84	4.02%	1823.18	27.11	1.49%	2359.13	46.22	1.96%
Au	22.09	1.21	5.49%	BDL	BDL	BDL	26.42	0.17	0.65%	26.06	0.13	0.51%

[a] Elements have the potential to cause minor adverse effect if consumed in large quantities; [b] Elements have the potential to cause major adverse effects if consumed in large quantities; BDL: below detectable limits.

Table 5 cont. *Average elemental concentration (µg/g) determined by ICP-OES from the raw materials.*

	Nerada Organics Green Tea					
µg/g	Washed	STD	% error	Unwashed	STD	% error
Na	353.68	15.20	4.30%	BDL	BDL	BDL
K	BDL	BDL	BDL	10769.17	1626.92	15.11%
Mg	1376.04	30.20	2.19%	1314.83	177.46	13.50%
Ca	1459.22	48.45	3.32%	572.76	92.89	16.22%
Mn	156.97	5.44	3.47%	451.01	75.02	16.63%
Zn	27.56	13.63	49.44%	9.08	2.18	23.95%
Si	BDL	BDL	BDL	BDL	BDL	BDL
Al	1379.93	30.13	2.18%	1336.11	259.50	19.42%
Cu	76.82	2.05	2.67%	12.24	0.89	7.24%
Sn	BDL	BDL	BDL	BDL	BDL	BDL
Ni	2.59	0.21	8.09%	6.51	0.89	13.72%
Co	BDL	BDL	BDL	BDL	BDL	BDL
Cr	0.76	0.10	13.48%	0.92	0.08	8.76%
Pb	5.15	0.46	8.87%	2.08	0.21	10.27%
As	BDL	BDL	BDL	BDL	BDL	BDL
Cd	BDL	BDL	BDL	BDL	BDL	BDL
Hg	10.57	0.92	8.70%	9.48	0.39	4.16%
Se	BDL	BDL	BDL	BDL	BDL	BDL
Fe	121.84	4.92	4.04%	103.74	13.45	12.97%
Ag	1.06	0.05	4.61%	1.08	0.05	4.47%
S	2336.39	72.52	3.10%	2243.04	320.58	14.29%
P	1564.42	41.75	2.67%	1566.53	193.33	12.34%
Au	26.40	0.41	1.54%	26.44	0.07	0.26%

[a] Elements have the potential to cause minor adverse effect if consumed in large quantities; [b] Elements have the potential to cause major adverse effects if consumed in large quantities; BDL: below detectable limits.

Table 6. *Comparison between teabacco and commercial cigarettes by examination of the upper limits for each element.*

mg/20 Cigarettes	Teabacco Cigarettes	Winfield Cigarettes
Na	105.69	10.04
K	26.69	484.56
Mg	32.05	97.85
Ca	43.08	48.41
Mn	1.78	2.52
Zn	0.96	0.22
Si	BDL	1.17
Al	12.24	8.21
Cu	1.29	0.19
Sn	BDL	BDL
Ni	0.07	0.05
Co	0.01	0.00
Cr	0.09	0.02
Pb	**0.19**[b]	0.06
As	BDL	BDL
Cd	BDL	0.01
Hg	0.07	**0.19**[b]
Se	0.08	BDL
Fe	1.89	4.49
Ag	0.06	0.01
S	25.41	67.99
P	13.47	34.44
Au	0.19	0.42

[a] Elements have the potential to cause minor adverse effect if consumed in large quantities; [b] Elements have the potential to cause major adverse effects if consumed in large quantities; BDL: below detectable limits.

Table 7. *Elemental guidelines for recommended daily consumption and upper limits, used to determine if smoking teabacco cigarettes results in excessive, potentially harmful exposure.*

Macro Minerals	Dietary Allowance	Upper Limit	Excessive Exposure from Teabacco
Sodium	2.0 g/day[69]	-	No
Potassium	3.5 g/day[70]	-	No
Magnesium	190-260 mg/day[71]	-	No
Calcium	1 g/day[71]	-	No
Phosphorous	700 mg/day[72]	-	No
Sulphur	4.4 mg/kg[73]	-	No
Trace Minerals	**Dietary Allowance**	**Upper Limit**	**Excessive Exposure from Teabacco**
Manganese	1.8-2.3 mg/day[74]	11 mg/day[74]	No
Zinc	1.0-1.4 mg/day[71]	8.8-14.4 mg/day[75]	No
Copper	0.9 mg/day[76]	10 mg/day[76]	Yes
Selenium	20-200 μg/day[31]	-	No

Iron	8 mg/day[74]	-	No
Other Elements	**Dietary Intake and Ranges**	**Upper Limit**	**Excessive Exposure from Teabacco**
Silicon	20-204 mg/day[77]	-	No
Aluminium	2 mg/kg/week[78]	-	Yes
Tin	14 mg/kg/week[31,79] (2 mg/kg/day[79])	-	No
Nickel	12 µg/kg/day [80]	-	No
Cobalt	5-40 µg/day[81]	-	No
Silver	7-88 µg/day[82]	-	No
Gold	<0.01-1.32 µg/kg[83]	-	No
Toxic Heavy Metals	**Tolerable Intake and Dietary Ranges**	**Upper Limit**	**Excessive Exposure from Teabacco**
Chromium	50 - 200 µg/day[84]	>250 µg/day[31]	No
Lead	2 - 64 µg/kg per week[31]	Previously 25 µg/kg/week[31,37,38]	Maybe
Arsenic	15 µg/kg/week[85]	-	No
Cadmium	25 µg/kg/month[86]	-	No
Mercury	-	2 µg/kg/day[87,88]	No

Table 8. *Average experimental values for the gravimetric determination of total particulate matter (TPM).*

	Average TPM (mg)	**TPM Range** (mg)	**Average Puffs**	**TPM/Puff** (mg/Puff)
Teabacco Cigarette	6.56 ± 4.35	0.90 - 15.70	13.92 ± 1.91	0.46 ± 0.30
Washed Tea Cigarette	13.08 ± 6.99	0.50 - 21.90	15.04 ± 0.20	0.87 ± 0.47
Unwashed Tea Cigarette	9.32 ± 2.33	5.60 - 13.10	15.00 ± 0.00	0.62 ± 0.16

Table 9. *Compounds identified by GC-MS, from the smoke captured in the methanol solvent-based trap.*

Compound Identified	**Teabacco (Filtered)**	**Teabacco (Unfiltered)**	**Tea (Washed)**	**Tea (Unwashed)**	**Winfield Original Blue**
(Z)-9-Octadecenamide	Identified				
1,2,3-Benzenetriol			Identified	Identified	
1,2-Diacetate Glycerol			Identified	Identified	Identified
1,6-Anhydro-β-D-Glucopyranose	Identified	Identified	Identified	Identified	Identified
2,3-Dihydro-Benzofuran				Identified	
3-Pyridinol				Identified	
Caffeine			Identified		
Catechol		Identified		Identified	Identified
Dianhydromannitol	Identified	Identified			
DL-Glucitol		Identified			

Hydroquinone				Identified	Identified
Nicotine	Identified	Identified			Identified
Octadecanoic Acid	Identified				
Succinimide				Identified	
Triacetin			Identified	Identified	Identified

Table 10. *Compounds identified by GC-MS, from the smoke captured in the toluene solvent-based trap.*

Compound Identified	Teabacco (Filtered)	Teabacco (Unfiltered)	Tea (Washed)	Tea (Unwashed)	Winfield Original Blue
1,2,3-Benzenetriol				Identified	
1,2-Diacetate Glycerol				Identified	Identified
1,6-Anhydro-β-D-Glucopyranose			Identified		
3-Methoxy-1,2-Benzenediol				Identified	
3-Pyridinol				Identified	
5-Methyl-2-(1-Methylethyl)-Cyclohexanol	Identified				
Caffeine				Identified	
Catechol				Identified	
Dianhydromannitol	Identified				
Diethyl Phthalate	Identified				
Hydroquinone				Identified	
Nicotine	Identified				Identified
Octadecanoic Acid	Identified				
Theobromine				Identified	
Triacetin				Identified	

Table 11. *Compounds identified for each type of handmade cigarette, by GC-MS, the source of the compound and potential toxicity.*

Compounds Teabacco Cigarettes	Source	Potential Toxicity
(Z)-9-Octadecenamide	Nicotine lozenge - dispersion aid in surface coatings. [45]	Not toxic
1,6-Anhydro-β-D-Glucopyranose	Bible paper and tea - pyrolysis of carbohydrates, such as starch[89] and cellulose[90,91]	Not toxic,[92] excreted in urine[93]
5-Methyl-2-(1-Methylethyl)-Cyclohexanol	Nicotine lozenge - produced from peppermint, and is used as mint flavouring plastic.	Not toxic
Catechol	Tea - pyrolysis of catechin,[94] present in black tea[53]	Tumour promoter, increases cell metastasis[95]

Dianhydromannitol	Nicotine lozenge - non-toxic[96] plasticiser[97] which is dispersed throughout the soluble-fibre matrix and coating[51]	Not toxic
Diethyl Phthalate	Highly volatile[49] plasticiser[98] used in pharmaceutical products[99]	Not toxic, excreted in urine[99]
DL-Glucitol	Nicotine lozenge - (sorbitol)[100] sugar alcohol[51,100]used as a sweetener and bulking agent[51]	Not toxic
Nicotine	Nicotine lozenge	Role in development of emphysema, lung tumor progression and metastisis[57]
Octadecanoic Acid	Tea - stearic acid[50] saturated fatty acid, contributes to aroma and flavour of black tea[60,101]	Inhalation may cause respiratory irritation, compound is not toxic[102]
Compounds Washed Tea Cigarettes	**Source**	**Potential Toxicity**
1,2,3-Benzenetriol	Tea - pyrolysis product[62] from Gallic acid (from tannins)[53]	Inhalation may cause respiratory irritation, genetic mutations[62]
1,2-Diacetate Glycerol	Cellulose acetate cigarette filters[103–105] (TPM analysis)	-
1,6-Anhydro-β-D-Glucopyranose	Bible paper and tea - pyrolysis of carbohydrates, such as starch[89] and cellulose[90,91]	Not toxic,[92] excreted in urine[93]
Caffeine	Tea[106]	Not toxic
Triacetin	Cellulose acetate cigarette filters[103–105] (TPM analysis)	-
Compounds Unwashed Tea Cigarettes	**Source**	**Potential Toxicity**
1,2,3-Benzenetriol	Tea - pyrolysis product[62] from Gallic acid (from tannins)[53]	Inhalation may cause respiratory irritation, genetic mutations[62]
1,2-Diacetate Glycerol	Cellulose acetate cigarette filters[103–105] (TPM analysis)	-
1,6-Anhydro-β-D-Glucopyranose	Bible paper and tea - pyrolysis of carbohydrates, such as starch[89] and cellulose[90,91]	Not toxic,[92] excreted in urine[93]
2,3-Dihydrobenzofuran	Tea - found in *Camellia sinensis* plant[107,108]	Not toxic[109]
3-Methoxy-1,2-Benzenediol	Tea - found in *Camellia sinensis* plant[107]	Inhalation may cause respiratory irritation[110]
3-Pyridinol	Tea - found in *Camellia sinensis* plant[60,111]	Inhalation may cause respiratory irritation[110]
Caffeine	Tea[106]	Not toxic
Catechol	Tea - pyrolysis of catechin,[94] present in black tea[53]	Tumour promoter, increases cell metastasis[95]

Hydroquinone	Tea - pyrolysis product from lignin[112]	Tumour promoter, increases cell metastasis[95]
Succinimide	Tea - pyrolysis product[113] from glutamic acid[114]	Inhalation may cause respiratory irritation, compound is not toxic[115]
Theobromine	Tea[106]	Not toxic
Triacetin	Cellulose acetate cigarette filters[103–105] (TPM analysis)	-

Table 12. *Nicotine in Trap Residue - Methanol Trap*

	mg/g	STD	Std. Error
Winfield Cigarette[†]	3.96568	0.74949	0.43273
Washed Tea Cigarette	3.76561	1.97926	1.14276
Teabacco Cigarette[†]	2.00381	0.371	0.21421
Unwashed Tea Cigarette[*]	22.23242	0.62352	0.36

Table 13. *Nicotine Extracted by Smoking Product - Methanol Trap*

	mg/g	STD	Std. Error
Winfield Cigarette[†x]	0.08495	0.0065	0.00375
Washed Tea Cigarette[*]	0.09159	0.08352	0.04822
Teabacco Cigarette[†]	0.01368	0.00488	0.00282
Unwashed Tea Cigarette[*]	0.52299	0.04087	0.0236

[†] Represent samples acquired without TPM filter in place.
[*] Represent samples acquired with TPM filter in place
[x] based on commercial average mass of 0.6145g of tobacco per cigarette[116]