DETERMINATION OF NICOTINE CONCENTRATION FROM TOBACCO CIGARETTE

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Abstract: Tobacco is a plant of night shaded family which possesses high nicotine concentration in its leaves, Nicotine is a naturally occurring alkaloid found primarily in the members of the Solanaceae family, which includes tobacco. Nicotine, ($C_{10}H_{12}N_2$) (S)-3-(1methyl-2-pyrrolidinyl) pyridine, is the most abundant of the volatile alkaloids in the tobacco leaf. Tobacco have different chemical characteristics and nicotine concentrations, based on that, this research analyse and compare the concentration of nicotine in fifteen different tobacco as claim by the manufacturers (cigarette) using UV-Spectrophotometer. The result of the analysis shows that there is inconsistency in the actual amount of nicotine and the stated concentration of nicotine on the manufacturer's package

Keywords: Tobacco, Cigarette, Nicotine, Concentration

INTRODUCTION

Tobacco is a plant of night shaded family which possesses high nicotine concentration in its leaves. Tobacco is a product prepared from the leaves of the tobacco plant by curing them. The plant is part of the genus *Nicotiana* and of the Solanaceae (nightshade) family. Tobacco contains the alkaloidnicotine, which is a stimulant. Dried tobacco leaves are mainly used for smoking in cigarettes, cigars, pipe tobacco, and flavouredshisha tobacco. They can be also consumed as snuff, chewing tobacco and snus(WHO 2008 and Omar 2007). Cigarette is a small cylinder of finely cut tobacco leaves rolled in thin paper for smoking. The cigarette is ignited at one end causing the cigarette to smoulder and allowing smoke to be inhaled from the other end, which is held in or to the mouth; in some cases, a cigarette holder may be used, as well. (Wigand 2006). Nicotine is a naturally occurring alkaloid found primarily in the members of the Solanaceae family, which includes tobacco. Nicotine,($C_{10}H_{12}N_2$) (S)-3-(1methyl-2-pyrrolidinyl) pyridine, is the most abundant of the volatile alkaloids in the tobacco leaf. The primary commercial source of nicotine is by extraction from the plant Nicotiniatabacum and Nicotiniarustica. Nicotine acts on nicotinic cholinergic receptors, affects most organ systems in the body and is a highly addictive drug (Benowitz 1996). Nicotine normally makes up about 5 percent of a tobacco plant, by weight. Cigarettes contain 8 to 20 milligrams (mg) of nicotine (depending on the brand), but only approximately 1 mg is actually absorbed in the human body.

Almost 70% of smokers who intend to quit smoking cannot and about 83% of smokers smoke every day (Duncan *at el* 2005). A study carried out by the Center for Health Policies and Services in Romania showed that 39.9% of Romanians smoke daily. The amount of information regarding nicotine content in cigarettes is trivial and only very little studies have been carried out to bring light to this subject (Wayne *at el* 1999)

The physiological effect of nicotine on human health depends on the amount inhaled as well as the tolerance level of smoker. It is being speculated that tobacco products may contain amount of nicotine that is more or less than normal, which can cause serious health problem (Laurian*at el* 2005). More so, in order to avoid the harmful and toxic effect of nicotine on human which could be caused by nicotine intake, the estimation of nicotine concentration is needed. Therefore, it is a very important to evaluate the concentration of nicotine in commercial tobacco products. Based on the information on available literature, great concern is claimed recently regarding the nicotine content in tobacco. A global concern on nicotine content in the international tobacco markets has been paid due to the quality of tobacco and quantity of nicotine present in each cigarette. However, 40 to 60 mg of nicotine is considered to be highly toxic for a lethal dosage for adult-human (Vesna*at el* 2009). The concentration of nicotine in cigarettes is an important factor for determination of absorbed nicotine by human over period of time. Many local and international tobacco cigarette brands are sold in Nigerian market. International tobacco brands are mainly imported while local brands are grown in different parts of Nigeria such as Sokoto. This research analyse and compare the concentration of nicotine in fifteen different tobacco (cigarette) using UV-Spectrophotometer.

MATERIAL AND METHOD
Material
Standard Nicotine with 98% purity was purchased from Sigma Aldrich (UK). Methanol, Sodium hydroxide, Zinc acetate, Potassium, Foric acid, Hexacyanoferrate (II), Activated carbon, were purchases and used without further purifications. Deionized water was used in this work. Fifteen different brand of tobacco cigarette were purchased from Sokoto Old Market, Sokoto State. Nigeria.

Chromatographic Condition and Apparatus
Ultraviolet-visible single beam spectrophotometer of JANWAY 6305 was used at wavelength of 602 nm and 1 cm plastic cell for all spectrophotometric analysis.The apparatus used were Volumetric Beaker, Measuring cylinder, Funnel, Filter paper, Conical flask, Pipette, Magnetic bar stirrer, Water bath, Retort stand, Centrifuge machine, Spatula and Chemical balance.

Preparation of Solutions

2 Molar solution of NaOH, 1Molar solution of Zinc acetate, 1Molar solution of Potassium hexacyanoferrate and also 0.01Molar solution of sodium hydroxide were all prepared for the research

Extraction of Nicotine from Tobacco Cigarette

The extraction method of nicotine used in this research was carried out according to the method presented by Suryani*et al* 2012 with a slight modification. 3.75g of cigarette was measured and transferred into a clean 100ml beaker, 25ml of methanol, magnetic stirrer was added and stir for 30min. 1ml of 2 molar solution of NaOH was added together with 25ml of water to the mixture and stir for another 30min. The mixture was placed on the water bath for 6min in other to evaporate the methanol, and then the mixture was filtered. The filtrate was taken to the UV-visible spectrophotometer for nicotine quantification.

RESULT AND DISCUSSION

Calibration Standard

Using a stock solution of concentration 10mg/ml, ten calibration standards of concentration 0.03,0.06,0.09,0.12,0.15,0.18,0.21,0.24,0.27,0.3,mg/ml was made by pipetting different concentration of stock solution and dilute it 25ml of internal standard in 50ml volumetric flask respectively.These calibration standards were analysed by UV-Spectrophotometer and the absorbance were plotted against the concentration which gives a linear line equation with a linear correlation coefficient, $R^2 = 0.9965$.

Nicotine Concentration (mg/ml)	Absorbance
0.3	0.03
0.6	0.06
0.9	0.09
1.2	0.12
1.5	0.15
1.8	0.18
2.1	0.21
2.4	0.22
2.7	0.27
3.0	0.3

Table 1. Showing the Absorbance of Nicotine Standards

Nicotine Standard Calibration Graph
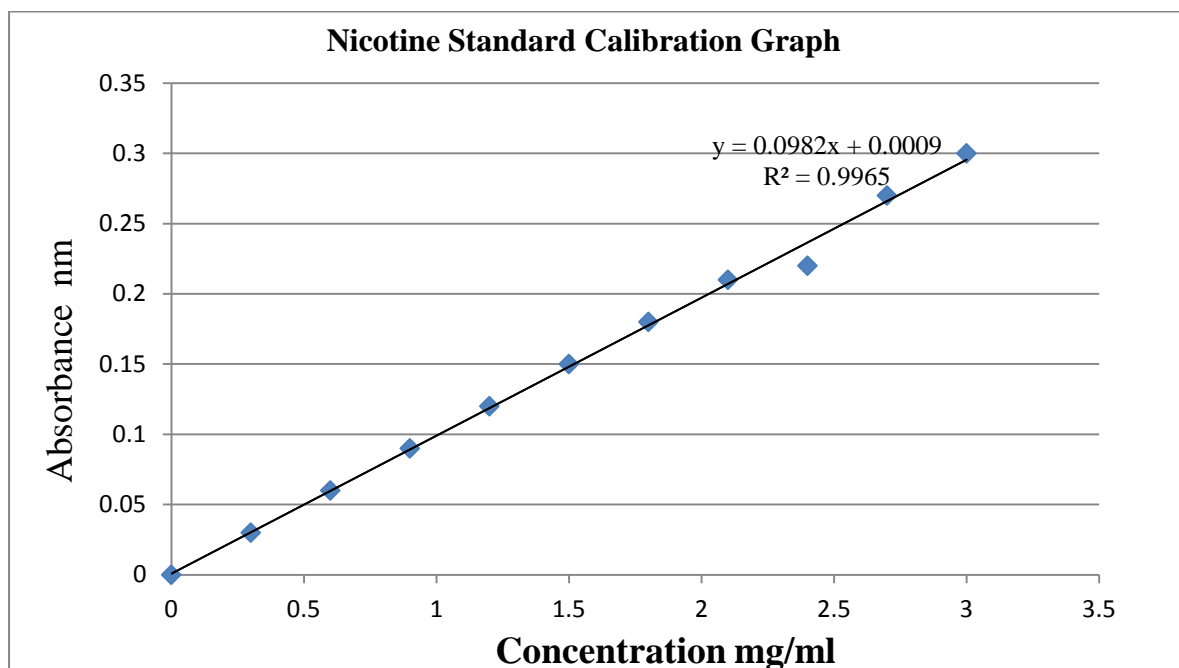
$y = 0.0982x + 0.0009$

$R^2 = 0.9965$

Table 2.Nicotine Standard Calibration Curve

Analysis of Nicotine

The lists of all the samples quantified are shown in the tables below, all the samples in experiment were run in triplicate. The main area investigated in this analysis was the accuracy of labelling of nicotine from the manufacturers. Based on the chromatograms result obtained from the analysis of tobacco, all the samples showed the presence of nicotine as will be discussed. For the first five samples labelled as 0.8 and 1.0mg/ml., 0.4,0.6 1.0 and1.3mg/mland 0.6, 0.8, and 1.0 mg/mlas presented in the table 3, 4and 5 below respectively. The results of the quantification showed some difference from the labelled concentrations to the actual concentrations of nicotine, all the quantified samples were found to be higher than manufactures claim.

Brand Name	Expected concentration (mg/ml)	Actual concentration (mg/ml)	Mean and standard deviation
Aspen	0.8	1.40	1.4 ± 0.1
Pall mall	1.0	1.90	1.9 ± 0.1
B & H Special	1.0	1.40	1.4 ± 0.1
B & H Switch	0.8	1.77	1.77 ± 0.06
Dun Hill	0.8	1.90	1.90 ± 0.1

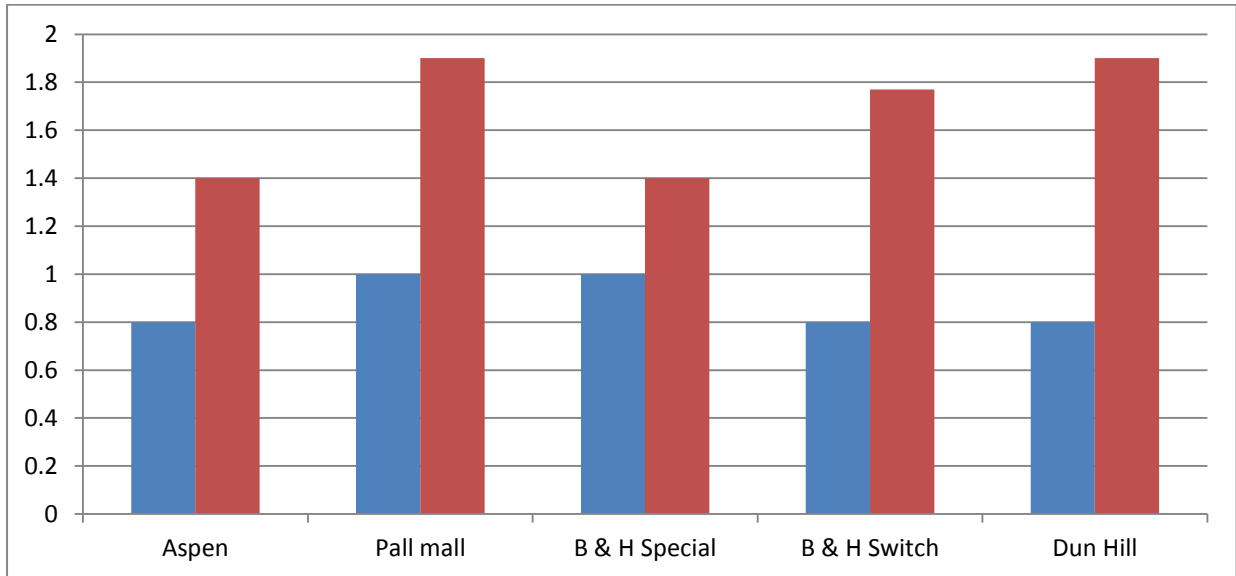Table 3. List of Quantified Brands with Manufacturers and Determine Concentration
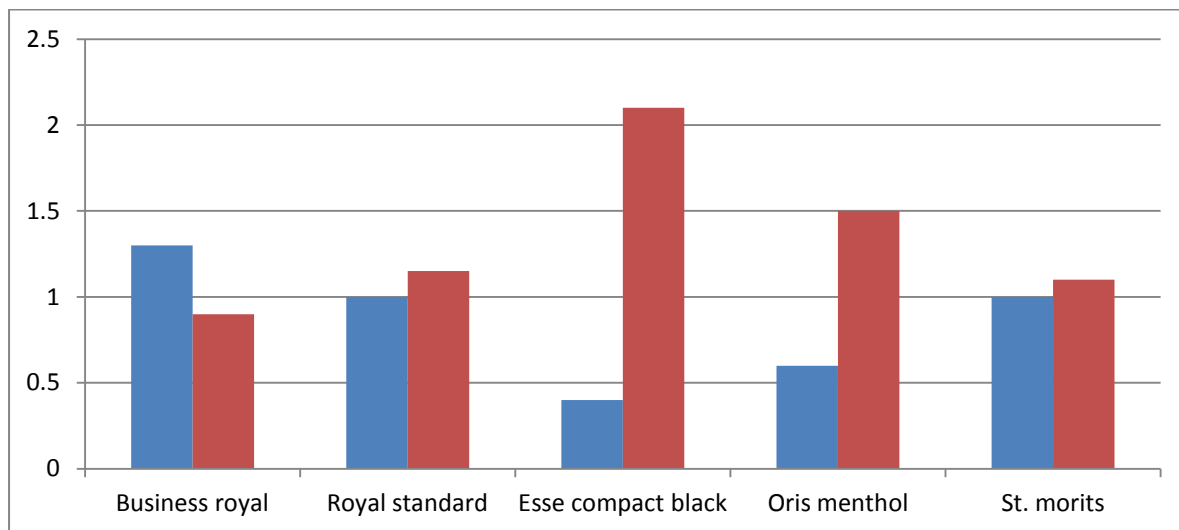

Figure 1. Chart Showing the Difference between the Actual and Label Concentration

Brand name	Expected concentration (mg/ml)	Actual concentration (mg/ml)	Mean and standard deviation
Business royal	1.3	0.90	0.9 ± 0.1
Royal standard	1.0	1.15	1.15 ± 0.05
Esse compact black	0.4	2.1	2.1 ± 0.1
Oris menthol	0.6	1.5	1.5 ± 0.1
St. morits	1.0	1.1	1.1 ± 0.1

Table 4. List of Quantified Brands with Manufacturers and Determine Concentration

Figure 2. Chart Showing the difference between the Actual and Label Concentration

Brand Name	Expected concentration (mg/ml)	Actual concentration (mg/ml)	Mean and standard deviation
Excel	1.0	1.1	1.1 ± 0.1
Rothmas Turkey product	0.6	1.0	1.0 ± 0.1
Rothmas Nigeria product	1.0	1.0	1.0 ± 0.1
Gold bond	0.8	0.9	0.9 ± 0.1
Orisstrauberry	0.6	1.4	1.4 ± 0.1

Table 5.List of Quantified Brands with Manufacturers and Determine Concentration
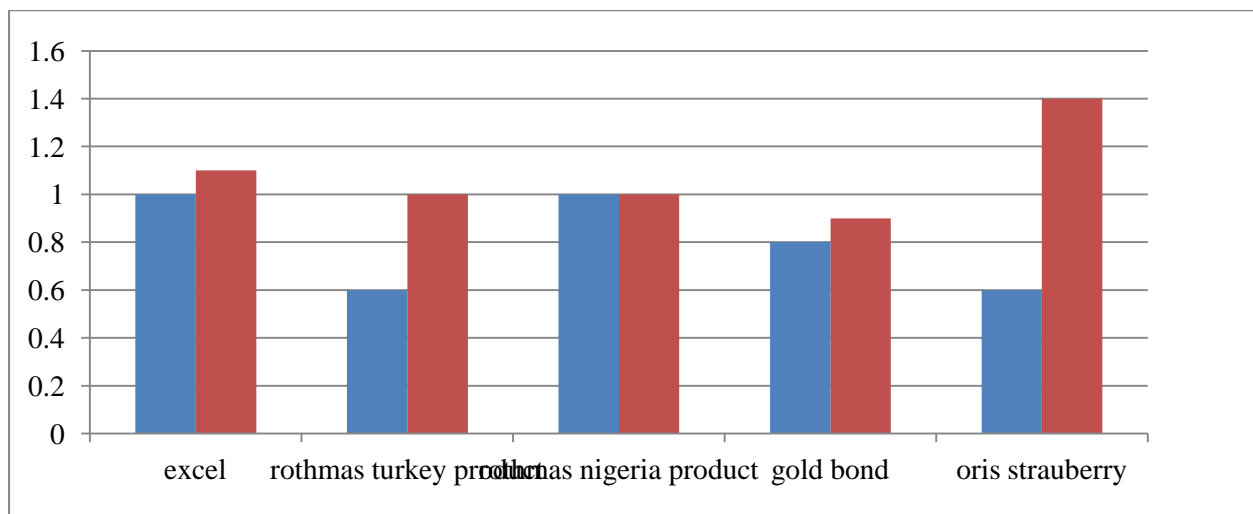

Figure 3. Chart Showing the Difference between the Actual and Label Concentration

The aims of this study was to determine the concentration nicotine in tobacco cigarette , the research also comparing the stated concentration of nicotine on the manufacturer's package and the actual concentration found in the tobacco. Still there is discrepancy about the safety of tobacco, with studies affirming its health effect there is a major inconsistency in the amount of nicotine compared to label claimed. Yet the results acquired revealed that the actual concentration of nicotine varies from the manufacturers claims in almost all brands except rothmas Nigeria and Business royal in which the manufacturers claim and actual concentrations were fund to be in agreement with each other. One of the problems on tobacco international market is trade with counterfeit cigarettes which contain more nicotine than normal, even with 28% higher content and 75% tar content, which may cause serious health problems. More so, the tobacco used by the smokers can be of poor quality and the nicotine content might be high. Levels of nicotine in tobacco cigarette are of important concern to health authorities.One of the major concerns Health experts has in relation to tobacco is nicotine overdose, high concentration of nicotine in the tobacco can cause accidental ingestion which may lead to death. Tobacco have different chemical characteristics and concentrations, based on this research most of tobacco cigarette concentration differs from the manufacturers labelled amount as will also differs in nicotine delivery. There are number of studies suggesting that tobacco manufacturers expose their users to nicotine. It is interesting that the inconsistency in the results obtained from this study agree with the investigation carried out at University of Silesia in Poland, the result of which shows that the actual amount of nicotine in the nine out of twenty samples quantified differs more than 20% from the manufacturers labelled claims. (Schaller *et al* 2003) Though in this analysis the actual concentration found was more than 23%.

The result obtained above shows the nicotine concentration present in different brand of cigarette in Nigeria market. The concentration determines shows that the actual value of nicotine concentration present in the cigarette brand is inconsistence with the label manufacturer's concentrations. The lethal dose of nicotine in the human body is less than 5 mg/kg or at least (less than 7 drops) for a 70kg person, it is assumed that ingestion of 40mg to 60mg of nicotine is lethal to human (USEPA 1987). Conclusively frequent smoking of most brand of cigarette analysed in this research can lead to death, as also prescribe on Catton cigarette, metabolic effect of nicotine can damage liver and causes cancer in the body especially liver cancer which spring death penalty for smokers.

RECOMMENDATION
It is recommend that the federal government should educate youth on the effect of the tobacco product in their body, and also make rules and regulation which

will govern the consuming of tobacco product in the nation. Or banned the importation of tobacco product in the country

REFERENCE

Al-Delaimy WK, Crane J, Woodward A. Is the Hair Nicotine Level a More Accurate Biomarker of Environmental Tobacco Smoke Exposure than Urine Cotinine? J Epidemiol Community Health 2002;56:66-71.

Yildiz D. Nicotine, its Metabolism and an Overview of its Biological Effects. Toxicon 2004;43:619-32.

US-EPA. Chemical Profile: Nicotine. US Environmental Protection Agency; 1987.

WHO.An International Treaty for Tobacco control. World Health Organization. Geneva; 2007.

U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health. DHHS Publication No. (CDC) 88-8406; 1988

Omar Geissi, Dimitrios Kotzias. Tobacco, cigarettes and cigarette Smoke an Overview, Institute for Health Consumer Protection 2007.

Duncan B. Clark, D. Scot t Wood, Christopher S. Mart in, Jack R. Cornelius , Kevin G. Lynch and Saul Shiffman, Multidimensional Assessment of Nicotine Dependence in Adolescents. Drug and Alcohol Dependence, 2005, 77 (3), 235242.

Wayne M., Edward P. C. and Borje S., Determination of Nicotine in Tobacco by Molecularly Imprinted Solid Phase Extraction with Differential Pulsed Elution, Anal. Commun., 1999, 36, 217–220.

"WHO Report on the Global Tobacco Epidemic, 2008 (Foreword and summary)" *(PDF).*World Health Organization.*2008: 8. Tobacco is the Single Most Preventable Cause of Death in the World Today.*

Wigand, J.S. Additives, Cigarette Design and Tobacco Product Regulation, A Report To: World Health Organization, Tobacco Free Initiative, Tobacco Product Regulation Group, Kobe, Japan, 28 June-2 July 2006

Benowitz N L. Pharmacology of Nicotine: Addiction and Therapeutics, Annu Rev Pharmacol Toxicol, 1996, 36,597613

Laurian Vlase, L.F., Ioana Mîndruţău, Sorin E. Leucuţa, Determination of Nicotine from Tobacco by LCMSMS. STUDIA UNIVERSITATIS BABEŞBOLYAI, PHYSICA, L, , 2005. 4b: p. 19-24.

VesnaRakic´, L.D., VladislavRac, Dusˇ anStosˇ ic´, Vera Dondur, and A. Auroux, The adsorption of nicotine from aqueous solutions on different zeolite structures. water research, 2010. 44: p. 2047-2057.

S. Suryani, T.I.a.A.M.N., ANALYSIS OF NICOTINE CONTENT IN SOME OF THE POPULAR CIGARETTE AND TOBACCO BRANDS IN MALAYSIA. Sci.Int.(Lahore), 2012. 24(2): p. 139-141.

W. D. Nesbitt, *J. Pers. Soc. Psychol.*, 2006, **25**, 137–144