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Determination of Paracetamol in pharmaceutical dosage form using p-dimethylaminobenzaldehyde

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ABSTRACT
Paracetamol is a common analgesic and antipyretic drug used for the treatment of headaches and mild fever. It is also found in cold and flu medications. It is importance to ascertain its actual amount in pharmaceutical dosage. In this work a colorimetric method was employed for the determination of paracetamol in dosage form. This method involved the use of p- dimethylaminobenzaldehyde to form acoloured complex. The paracetamol in HCl is hydrolysed, the acetamide group is converted to amino group to give p- hydroxyaniline, which was then reacted with p- dimethylaminobenzaldehyde to form a coloured product, chromogen. Measurement of the absorbance of the product formed was done at wavelength 500nm with spectrometer 217. The result of the analysis shows that brand1 has the highest (470mg), while brand 4 has the lowest (290mg) amount of paracetamol of all the four brands examined.

I. INTRODUCTION

Paracetamol or acetaminophen is a popular analgesic and antipyretic drug that is used for the relief of fever, headaches and other minor aches and pains. It is a major ingredients in numerous cold and flu medication and many prescription analgesics. Paracetamol action is similar to that of aspirin and is most commonly used in paediatric (Hamm2000) but unlike aspirin and ibuprofen, has no anti-inflammatory properties, and so it is not a member of the class of drugs known as non- steroidal anti-inflammatory drugs (NSAIDs).In normal doses, paracetamol does not irritate the lining of the stomach nor affect blood coagulation, the kidney or the fetal dutus arterious (as NSAIDs does). At recommended doses, paracetamol is safe for use, however, at higher doses, it is reported to cause acute gastrointestinal problems(Lorhemen et al., 2017). The synthesis of prostaglandin in the hypothalamus is blocked by paracetamol through the inhibition of cyclooxygenase – 3 found throughout the brain and the spinal cord, hence the mechanism of paracetamol (Vu et al. 2014), in the pain and fever processes. Paracetamol has the benefit of being completely free of problems with addiction, dependence, tolerance and withdrawal.

Paracetamol (acetaminophen) is 4-acetamidophenol, other synthetic names include: 4-hydroxyacetanilide or N-acetyl-para-aminophenol. In the U.S pharmacopoeia, it is called acetaminophen while in British pharmacopoeia it is known as paracetamol.It is official in the United States (United States Pharmacopoeia, 2013) and British (British Pharmacopoeia, 2009). European, (European Pharmacopoeia, 2014) and Japanese (Japanese Pharmacopoeia, 2016). The pharmacopoeias are widely used for minor analgesic and antipyretic agent (Sharma and Mehta, 2014). Paracetamol is a synthetic non opiate derivative of p-aminophenol and is hydrolyzed in inappropriate storage conditions such as high temperatures and acidic or basic media to p-aminophenol (Chen et al., 2002). Paracetamol is a white crystalline powder. It is odourless with a slight bitter taste, sparingly soluble in water (1g/10mL) and slightly soluble in dichloromethane and ether. Its molecular formula is $C_8H_9NO_2$, molecular weight of 151.17g, melting point of 168-172℃ and density of 1.263g/cm^3.

II. LITERATURE

Awad(2019) stated that analytical methods that involved highly sophisticated instruments have been employed in the determination of paracetamol. The methods include HPLC (Darak et al., 2012; Pastorini et al., 2008), voltammetry (Tungkananuruk et al., 2005; Nigoviæ and Simuniæ, 2003), chemoluminescence

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(Ruengsitagoon et al., 2006; Easwaramoorthy et al., 2001),nuclear magnetic resonance – mass spectrometry (Shockcor et al. 1996), capillary electrophoresis (Heitmeier & Blaschke 1999), novel atomic absorption spectrometric methods (Issa et al. 2008), electrochemical methods (Silver et al. 2005), reversed phase high-performance liquid chromatography (Suzen et al. 1998, Chandra et al. 2013), infra-red spectroscopy (Baptistao et al. 2011) and spectrofluorometric method based on the oxidation with Sodium hypochlorite (Vilchez et al. 1995). Other methods used are spectrophotometric methods (Mohamed et al. 1997, Criado et al. 2000a, Criado et al. 2000b, Rodenas et al. 2000, Ruiz-Medina et al. 2000, Fatibello-Filho & Vieira 2008, Pavan et al. 2012, Sharma et al., 2013. Paracetamol can also be determined simultaneously with other drugs based on multivariate calibrations and ultraviolet spectrophotometric measurements (Marcelo & Ronei 2004). Even without separation (Wefaa 2008). A chemometric approach using UV spectrophotometry has also been reported (Issa et al. 2011). The Spectrophotometric determination of paracetamol is based on its hydrolysis to P-aminophenol (Buddha & Raja 2009, Pavan et al. 2012). The latter is reacted with specific reagents to produce a coloured substance which is monitored spectrophotometrically. The conversion of the hydrolyzed product to coloured species has been used to estimate paracetamol (Usifoh et al., 2002, Xu and Li 2004, Buddha and Raja 2009). The absorbance of that coloured species formed is measured in the visible region at the wavelength of maximum absorption.

A simple but fast spectrometric method as reported by Usifoh et al.,(2002) is employed in this work to determine the paracetamol in dasage form.

III. MATERIALS AND METHOD

The reagents used are of analytical grade. Paracetamol powder, obtained from Nomagbon pharmaceuticals Ltd. Benin city. P-dimethylaminobenzaldehyde from BDH chemical Ltd. England. 0.2% solution of p–dimethylaminobezaldehyde, prepared by dissolving 0.2g in 100mL ethanol. Four different brands of paracetamol tablets were purchased from the open market based on availability and hence most consumed. The apparatus used include: Measuring cylinders, standard volumetric flasks,test tube, spatula, pipette, weighing balance, beakers, retort stand, test tube rack, reagent bottles, Bunsen burner and Spectrophotometer 712.

Preparation of solution (standard).

1g of the paracetamol powder was accurately weighed, dissolved in sufficient water and made up to 100mLin a standard volumetric flask to produce 1% solution of paracetamol.

Development of coloured complex

A yellow complex was developed by transferring a 10mL of the prepared solution of paracetamol into a test tube and 2ml of 2M HCl was added, and the mixture was heated for 10mins. 5ml of 0.2% p – dimethylaminobenzaldehyde was then added, a yellow colour resulted. The coloured solution was cooled and made up to 20ml with distilled water. Scanning of the solution was done(absorbance was read at various wavelengths in the visible region 350-750nm with visible spectrophotometer 712 and wavelength of maximum absorption was obtained.

Preparation of different concentration of paracetamol

Serial dilution of the stock of paracetamol were made to obtain the concentrations in the range 1 to 5mg/mL. 10mL of each solution was treated as described under development of complex. The absorbance of each solution was read at wavelength 500nm against a blank with the aid of the spectrophotometer and a graph of absorbance against concentration was plotted to obtain a calibration curve.

Treatment of the brands of paracetamol

Solution of the different brands of Paracetamol were prepared by dissolving 500mg tablet in 100ml water in a standard volumetric flask, filtered and treated as described under development of complex and absorbance of each was read at wavelength 500nm against a blank and their concentration were determined from the calibration curve.

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IV. RESULTS AND DISCUSSION

Table 1 shows the absorbance obtained when known concentrations (standard) of paracetamol were read at wavelength 500nm

TABLE 1

Concentration(mg/ml)	Absorbance
5	0.360
4	0.281
3	0.220
2	0.140
1	0.070

Table 2 shows the concentration and absorbance obtained for the different brands of paracetamol

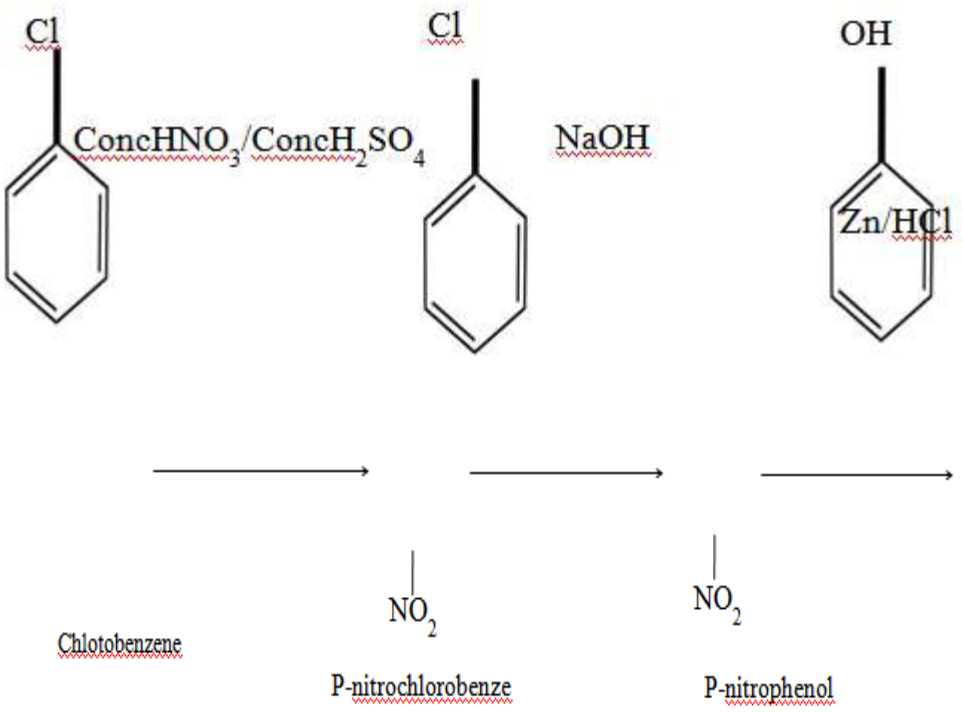
Brand	Absorbance	Concentration(mg/ml)	Amountof paracetamol in 500mg tablet
1	0.341	4.7	470
2	0.303	4.2	420
3	0.270	3.8	380
4	0.207	2.9	290

Discussion

Observation

The different brands of paracetamol tablet were slightly soluble in water. A yellow colour was observed when the solutions of paracetamol were treated with 2M HCl and p-dimethylaminobenzaldehyde. This was due to the conversion of the acetamide group by HCl to amino group to give p-hydroxyaniline which is then converted to chromogen by p-dimethylaminobenzaldehyde with the elimination of water. Chromogen absorbs in the visible region (500nm).

Synthesis of paracetamol



From table 1 it can be seen that absorbance is directly proportional to the concentration, this implies that absorbance either increases or decreases with concentration. And this is in accordance with Beer's law. The intensity of the solution was found to be proportional to the concentration of the paracetamol.

A calibration curve was obtained by plotting absorbance against concentration, which yields a straight line passing through the origin. The concentration of the different brands were read from the calibration curve and the amount of paracetamol in the brands were shown in table 2.

From table 2 it could be deduced that Brand1 has the highest concentration (4.7mg/ml), thatmeans it contains 470mg, though this is lower than the pharmaceutical dosage, while Brand 4 (2.9mg/ml), that is 290mg is the lowest.

V. CONCLUSION

From the analysis carried out it can be inferred that most brands of paracetamol in the Nigeria market are substandard. And that colorimetric method can be applied for routine quantitative determination of parecetamol due to its simplicity (in that extraction from the tablet is not necessary), and high sensitivity.

REFERENCES

[1]. Baptistao M, Rocha WFC & Poppi RJ (2011), Quality control of the paracetamol drug by chemometrics and imaging spectroscopy in the near infrared region. Journal of Molecular Structure 1002, 167-171.

[2]. British Pharmacopoeia CD, (1998), Version 2, the Stationery Office Ltd., Norwich.

[3]. Buddha RS & Raja RP (2009), Spectrophotometric method for the determination of Paracetamol Journal of Nepal Chemical Society 24.

[4]. Chandra R, Verma D, Sharma KD, Kumar S, Naushad Alam MD & Singh S (2013), Comparative quantitative determination of paracetamol by RP-HPLC and UV Spectrophotometry from its formulated tablets. International Journal of Pharmacy and Pharmaceutical Sciences 5, 3.

[5]. Chen, G., Ye, J., Bao, H., Yang, P. 2002. Determination of the rate constants and activation energy of acetaminophen hydrolysis by capillary electrophoresis. Journal of Pharmaceutical and Biomedical Analysis, 29: 843-850.

[6]. Criado A, Cárdenas S, Gallego M & Valcárcel M (2000), Continuous flow spectrophotometric determination of paracetamol in pharmaceuticals following continuous microwave assisted alkaline hydrolysis. Talanta 53, 417-423. https://doi.org/10.1016/S0039-9140(00)00509-9.

[7]. Criado A, Cárdenas S, Gallego M, Valcárcel M (2000), Fast urinary screening for paracetamol using on-line microwave assisted hydrolysis and spectrophotometric detection. Analyst 125, 1179 - 1183.

[8]. Darak, V., Karadi, A.B., Raju, S.A., Arshad, M.D., Ganure, A.L. 2012. Development and validation of HPLC method for determination of mesalamine in tablet dosage forms. Pharmaceutical Science Monitor, 3: 74-81

[9]. Easwaramoorthy D, Yu Y & Huang H (2001), Chemiluminescence detection of paracetamol by a luminol-permanganate based reaction. Analytica Chimica Acta 439, pp. 95.

[10]. European Pharmacopoeia (1997), Convention on the Elaboration of a European Pharmacopoeia, third edition. European Treaty. 50, 748– 749.

[11]. Fatibello-Filho O & Vieira HJ (2008), Spectrophotometric flow injection procedure to indirect determination of paracetamol in pharmaceutical formulations using O-tilidine as reagent. Ecletica Quimica 33(2), 47 – 54

[12]. .Firas Hassan Awad (2020), Colorimetric determination of paracetamol using 9—chloroacridine reagent. Application to pharmaceutical formulations. Pak.J.sci.ind.res.ser.A:phys.sci.2020 63A (2) 71-78.

[13]. Hamm, J. 2000. Acute acetaminophen overdose in adolescents and adults. Critical Care Nurse, 20: 69-74.

[14]. Heitmeier S & Blaschke G (1999), direct determination of paracetamol and its metabolites in urine and serum by capillary electrophoresis with ultraviolet and mass spectrometric detection. Journal of Chromatography B 721(1), 93 – 108.

[15]. Issa MM, Najem RM, El-Abadla NS, Alkholy M & Akila AS (2008), Novel Atomic Absorption Spectrometric and Rapid Spectrophotometric Methods for the Quantitation of Paracetamol in Saliva: Application to Pharmacokinetic Studies. Indian Journal of Pharmaceutical Sciences, 70

[16]. Issa YM, Zayed SIM & Habib IHI (2011), Simultaneous determination of ibuprofen

and paracetamol using derivatives of the ratio spectra method. Arabian Journal of Chemistry B (3), 259–263.

[17]. Marcelo MS & Ronei (2004), N-way PLS applied to Simultaneous Determination of acetylsalicylic acid, Paracetamol and caffeine. Journal of Pharmaceutical and Biomedical Analysis 34(1), 27 – 34.

[18]. Mohamed FA, AbdAllah MA & Shannat SM (1997), Selective spectrophotometric determination of p-aminophenol and acetaminophen. Talanta 44, 61 – 68.

[19]. Nigovic, B., Simunic, B. 2003. Determination of 5- aminosalicylic acid in pharmaceutical formulation by differential pulse voltammetry. Journal of Pharmaceutical and Biomedical Analysis, 31: 169-174.

[20]. Pastorini, E., Locatelli, M., Simoni, P., Roda, A., Roda, G. 2008. Development and validation of an HPLCESI-MS/MS method for the determination of 5- aminosalicylic acid in human plasma. Journal of Pharmaceutical Sciences Sciences, 872: 99-106.

[21]. Pavan Kumar GVSR, Bhuvan Kumar G, Chandra Sekhar T & Murthy BS (2012), Spectrophotometric Determination of Paracetamol Using Sodium bismuthate as Chromogen. International Journal of Research in Chemistry and Environment 2(1), 231-235.

[22]. Rodenas V, Garc´ıa MS, Sánchez-Pedreo C & Albero MI (2000), Simultaneous determination of propacetamol and paracetamol by derivative spectrophotometry. Talanta 52(3), 517 - 523.

[23]. Ruiz-Medina A, Fernández-de córdova ML, Ayora-Ca˘nada MJ, Pascual-Reguera MI & Molina-Diaz A (2000), A flow-through solid phase UV spectrophotometric biparameter sensor for the sequential determination of ascorbic acid and paracetamol. Analytica Chimica Acta 404(1), 131 – 139.

[24]. Sharma, C.V., Mehta, V. 2014. Paracetamol: mechanisms and updates. BJA Education, 14: 153-158.

[25]. Shockcor JP, Unger SE, Wilson ID, Foxall PJD, Nicholson JK & Lindon JC (1996), Combined HPLC, NMR Spectroscopy, and IonTrap Mass Spectrometry with Application to the Detection and Characterization of Xenobiotic and Endogenous Metabolites in Human Urine. Analytical Chemistry 68(24), 4431 – 4435.

[26]. Silva MLS, Garcia MBQ, Lima JLFC & Barrado E (2005), Flow System with electrochemical detection for determination of paracetamol in pharmaceutical preparations. Port Electrochimica Acta 24, 261-271.

[27]. Suzen S, Cernal A, Senol T, Serder ER, Atilla O & Semsating C (1998), Quantitation of acetaminophen in pharmaceutical formulations using High Performance Liquid Chromatography. Journal of Faculty of Pharmacy of Ankara, 27(2), 93 – 100

[28]. Ruengsitagoon, W., Liawruangrath, S., Townshend, A. 2006. Flow injection chemiluminescence determination of paracetamol. T

[29]. Tungkananuruk, K., Tungkananuruk, N., Burns, D.T. 2005. Cyclic voltammetric determination of acetaminophen in paracetamol tablets. KMIT Science and Technology Journal, 5: 547-551.

[30]. Usifoh CO, Adelusi SA & Adebamco RF (2002), Colorimetric determination of paracetamol in raw material and in pharmaceutical dosage forms Pak. Journal of Scientific and Industrial Research 45(1), 7 – 9.

[31]. Vilchez JL, Blanc R, Avidad R & Navalon A (1995), Spectrofluorometric determination of paracetamol in pharmaceuticals and biological fluids. Journal of Pharmaceutical and Biomedical Analysis 13(9), 1119 - 1125.

[32]. Vu DH. Dong THL. Nguyen HT & Hue MTN (2014), UV Spectrophotometric Simultaneous Determination of Paracetamol and Ibuprofen in Combined Tablets by Derivative and Wavelet Transforms. The Scientific World Journal 2014, 313609.

[33]. Wefaa SH (2008), Determination of Ibuprofen and paracetamol in binary mixture using chemometric assisted spectrophotometric methods. American Journal of applied sciences 5(8), 1005-1012.

[34]. Xu C & Li B (2004), Spectrophotometric determination of paracetamol with microwave assisted alkaline hydrolysis. Spectrochimica Acta. Part A. Molecular and Biomolecular Spectroscopy 60, 186.