IJPSR (2014), Vol. 5, Issue 8 (Research Article)

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 21 January, 2014; received in revised form, 23 April, 2014; accepted, 26 May, 2014; published 01 August, 2014

QUALITY EVALUATION OF PARACETAMOL TABLETS OBTAINED FROM THE COMMON SHOPS (KIOSKS) IN ADDIS ABABA, ETHIOPIA

Liya Teklu, Esubalew Adugna and Ayenew Ashenef

Department of Pharmaceutical chemistry and Pharmacognosy, School of Pharmacy, College of Health Sciences, Addis Ababa University, P.o.box. 1176, Addis Ababa, Ethiopia.

Keywords:

Paracetamol, Addis Ababa, Ethiopia, Counterfeit, quality

Correspondence to Author:
Ayenew Ashenef

Departmesnt of Pharmaceutical chemistry and Pharmacognosy, School of Pharmacy, College of Health Sciences, Addis Ababa University, P.O.box. 1176, Addis Ababa, Ethiopia.

Email: ayenew.ashenef@aau.edu.et

ABSTRACT: The effectiveness of drugs is directly related to the quality thus quality evaluations of medications throughout the production process and distribution are very essential. Counterfeit medications are known to have poor quality as the medications are in the market without the consent of the regulatory body. A total of 11 samples of paracetamol tablets were collected from kiosks, one from each sub city of Addis Ababa, Ethiopia except Addis Ketema where Merkato (the biggest open market in Africa) is located in which two sampling sites were selected. The tablets were assessed for different quality parameters; weight variation, friability, diameter, thickness, assay, disintegration and dissolution using compendial methods. The weight variation, friability, diameter and thickness results were in accordance with the British Pharmacopeia for all samples. The samples also comply with the BP disintegration requirements except a sample from Bole sub city, Paracetamol EPHARM (2110743). The dissolution profiles of the two brands (Asmol and Kelvin) and a generic Paracetamol, EPHARM were evaluated and the results show that all the samples investigated were within the limit set by the Pharmacopeia. All of the samples passed the assay test except Asmol (B0523). In general, the results are in accordance with the previous quality evaluation studies done for Paracetamol tablets obtained from legal markets thus the source of the medication in the illegal vendors might not be necessarily from counterfeiting. This could be due to the fact that Paracetamol tablets are relatively cheaper than other medicines and are over the counter (OTC) products. However, quality evaluation of medications available in the illegal markets in Ethiopia as well as law enforcement should be done to protect the society from counterfeited drugs.

INTRODUCTION: Paracetamol is a widely used over-the-counter analgesic, antipyretic and a mild anti inflammatory drug [1, 2]. It exerts its anti pyretic and mild anti inflammatory effects in several, not yet confirmed, mechanisms [3, 4]. The involvement of prostaglandins (PGs) in the analgesic mechanisms of action of paracetamol has been proposed, taking into account the controversial result of its inhibition of the central Cyclo-oxygenases (COX-1, COX-2, and COX-3) [3].

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.5(8).3502-10

Article can be accessed online on: www.ijpsr.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.5(8).3502-10

Acetaminophen is well absorbed from the proximal small bowel and is not subjected to significant first pass metabolism in the liver, with the oral bioavailability estimated to be between 63-89 % in adults. Following absorption of therapeutic doses, approximately 90 % is metabolized by glucouronidation and sulphation in the liver to form non-toxic metabolites, which are excreted in the urine.

Its volume of distribution is 0.7 L/kg to 1L/kg and peak plasma concentration (Cmax) is achieved approximately at 45 minute. It is eliminated by the kidney [5] acetaminophen is less plasma protein bound than the salicylates, although the amount bound varies from 20 to 50 % [6]. Side effects of Acetaminophen are rare, usually mild and

transient[7]. However; severe diarrhea, increased sweating, loss of appetite, nausea and vomiting, stomach cramps or severe pain, or swelling, tenderness and pain in the upper abdomen could all be signs of overdose [8].

As defined by the International Organization for Standardization(ISO) 8402-198, quality is "the totality of features and characteristics of a product or service that bears its ability to satisfy stated or desired needs "[9]. In order to fulfill these needs there should be a quality control mechanism in the production process. A quality control of drugs and drug products covers all measures taken, including the setting of specification sampling, testing and analytical clearance to ensure that starting material, intermediate, packaging materials and finished pharmaceutical product, identify the strength and purity of the drug [10]. The safety and efficacy of a pharmaceutical dosage form can be guaranteed when its quality is reliable [11].Weight variation, content uniformity, thickness, hardness, friability disintegration, and dissolution should be considered for validation of a tablet [9].

Quality of a product or a tablet is the collection of features and characteristics of a product that contribute to its ability to meet given requirements and also in creating standards for producing acceptable products [9]. Recent studies show that Adults are self-treating with over-the-counter (OTC) medications in record numbers [12]. And when patients choose their own drugs they may lack the specialized knowledge to detect whether the product they are buying is of good quality let alone be able to detect whether the product is forged or not [13].

The consumers inability to judge the quality of medicines they take becomes a big public health problem as such drugs can be ineffective and harmful. Fake drugs have capacity to deceive, particularly if they are copied to make it look like the original product so that purchasers are unlikely to be suspicious . According to WHO, (2007) the prevalence of fake medicines is higher in countries with weak regulations, enforcement, and scarcity of supply of basic medicines, unregulated markets and unaffordable prices. Because of these, the quality, safety and efficacy of drug products especially in developing countries cannot be guaranteed [9].

A study done in Nigeria by Olike Chinwendu, in 2008 recorded a dominant market of counterfeit drugs around the country. It also concluded the abundance of these markets could be due to weakness in the regulatory agency and the lack of support from the government [14]. Even though the study did not focus on the quality of drugs, it showed the availability of counterfeit medication and their abundance in the market. A quality investigation done by analyzing paracetamol samples from the Somalia region of Ethiopia has showed that there were unregistered medications in the market and the quality of Paracetamol tablets which were not registered by FMHACA, were substandard. Though the drugs contain the right API, it is below the percentage requirement set by standard books. Each illegal drug was failed to comply at least one test out of five [15].

Previous *in-vivo* and *in-vitro* studies with regard to paracetamol quality evaluation sourced from the legal market from Addis Ababa as well as a contraband product from Somali region of Ethiopia had documented the presence of some products which did not fulfill the requirements in the compendias[16]. Similar study in Addis Ababa from legal drug retail outlets about the quality of paracetamol tablets including other dosage forms suspensions and suppositories also demonstrated the presence of some products which do not comply with pharmacopoeial requirements[17.] Another study in Gondar for paracetamol tablets collected from pharmacies and non-pharmaceutical shops (also known as kiosks) comprising three brands also showed failure to comply with quality specifications in compendias for many products indicating the presence of poor quality products in the regions is very high[10]. Poor quality medicines do not meet official standard for strength, quality, purity, packaging and labeling.

Quality of medicines is an issue of concern as counterfeiting is increasing at an alarming rate recently. For example, about 61% of individuals included in a survey conducted by Pfizer on medicines counterfeiting believe that it presents a serious problem in their countries [18]. Counterfeiting and its threat had been invisible due to its nature as well as the neglect it has suffered over the years from the stakeholders involved in the pharmaceutical supply chain [19]. This problem is highly abundant in many developing countries

which are faced with an increased burden of both communicable and chronic diseases among other numerous public health issues. The health workforce in developing countries is overburdened, in short supply and are faced with the problem of poor quality medicines.

Chaotic drug distribution systems, leaky supply chain systems, scarcity and/or erratic medicines supply, high cost of medicines, vested interests both on the part of the regulatory officials and the counterfeiters, weak laws and lack of enforcement of existing laws, ignorance or low literacy rates, pervasive poverty, poorly equipped laboratories, underfunded regulatory authorities as well as poor handling and manufacturing practices and high level of corruption in the health care system has been identified as the common reasons for the preponderance of counterfeit medicines in many developing countries [20].

In Ethiopia every drug item imported to the country, in principle, is documented and its quality is checked in the central laboratory of the regulatory authority, FMHACA. All drugs imported had also to be distributed in both government and private health sectors in designated places mainly in pharmacies, drug stores and drug vendors which are handled by pharmacists or pharmacy technicians. Some designated emergency and other drugs are available in medical clinics which are handled by nurses or physicians too. But in practice, there may be some gaps in the overall capacity of the authority to implement its all mandates in assuring the quality of all drugs imported and produced in the country thus some illegal activities are present in the country which manipulate the pinholes in the legal system. These activities not only seek huge profits from the illegal drug distribution, supply of counterfeited medicines but also expose the population to countless health hazards.

The general shopping system of Ethiopia encompasses whole sales, open markets, supermarkets and small shops (Kiosks). The latter are small units managed by families or a single person in which they are distributed widely in the country i.e. their number is the highest and hence many people in Ethiopia depend on them in purchasing their daily consumables. The easy accessibility of the kiosks as they are located in the nearby places to home or work environment makes these shops an attractive place to purchase any items of interest including drugs although possession of drugs in these places is legally forbidden.

As there is no sufficient investigation done on Acetaminophen and its availability on illegal markets in the central area of the metropolitan Addis Ababa, Ethiopia, this study will try to identify the available brands, verify if the brands are recognized by the FMHACA and also provide information on the qualities of the samples of Acetaminophen taken from illegal markets; with respect to the standards set by USP, BP and International pharmacopeia (IP).

METHODS AND MATERIALS:

Reagents

Phosphate buffer (pH 5.80), Sodium Hydroxide, Liquid paraffin and Methanol all analytical grade and distilled water were used.

FIGURE 1: A MAP SHOWING SAMPLING SITES FOR PARACETAMOL COLLECTION

Sample collection

Different brands of paracetamol tablets with label claim of 500 mg were collected from Addis Ababa, Ethiopia from the 10 sub city local common shops (Kiosks). Sampling was based on quota of one sampling location per sub city and an additional one more in Addis ketema sub city as it houses the biggest open market in Africa, Merkato. Five well briefed collectors of age 21-27 of male gender were employed to purchase the medicines acting as mysterious clients. The localities for sample purchase were shown in the **Figure 1.** Purchasing was performed acting as mysterious client to the

shop keeper. Generally, the conditions of the shops where samples were purchased, they are stored like any other item and salesmen/women are aware that drugs should not be kept and sold here. The shop men/women also told the mysterious clients that customers prefer to purchase paracetamol from pharmacies than the kiosks but they informed the clients that even antibiotics like ampicillin were available to be sold in the shops.

TABLE 1. QUALITY INVESTIGATION OF ACETAMINOPHEN TABLETS FROM ILLEGAL SHOPS OF ADDIS, SAMPLES PURCHASED CHARACTERISTICS

Sub city	Brand	Manufacturer information	Batch number	Expiry date
Addis ketema1	Asmol	Astra life care ,India	B0523	09/14
Addis ketema 2	Paracetamol	EPHARM :Addis Ababa, Ethiopia	3110053	01-17
Arada	Asmol	Astra life care ,India	B0531	09/14
Bole	Paracetamol	EPHARM	2110743	11/16
Bole	Paracetamol	EPHARM	2040673	04/16
Gulele	Paracetamol	EPHARM,Addis Ababa Ethiopia	3010173	01-17
Kaliti	Paracetamol	EPHARM	3030203	03/17
Kaliti	Paracetamol	EPHARM	3110083	01/17
kirkos	Paracetamol	EPHARM	3030093	03/17
Kolfe	Kelvin	Leben laboratories, India	T-5441	01/2015
lideta	Paracetamol	EPHARM	1060073	06/15
lideta	Paracetamol	EPHARM	1101263	10/15
lideta	Paracetamol	EPHARM	3010253	01/17
lideta	Paracetamol	EPHARM	2080633	08/16
Neffassilk	Paracetamol	EPHARM	2120593	12/16
Yeka	Paracetamol	EPHARM	2120593	12/16

Methods

Identification test

The Paste method of sample preparation for IR was used to identify active pharmaceutical ingredient. Briefly, the tablets were powdered and weighed, 0.1mg of the powdered drug was taken and placed in a mortar then it was triturated with two drops of liquid paraffin to give a homogeneous paste. Then as stated on the USP the paste was spread, to form a thin film, in an optical plate. The optical plate was then placed in the sample holder. The spectrum of the sample was then recorded.

Weight variation and friability test

Twenty tablets of each sample were weighed using analytical balance. The average weight and standard deviation were calculated for weight variation test. In addition, twenty tablets for each sample were weighed on the analytical balance and then placed in the friability tester which rotated at 100 rpm. Finally the tablets were de dusted and reweighed again. The difference in weight was taken and percent loss in weight was calculated.

Hardness test

Five tablets of each sample were subjected for hardness tester and the crushing strength of the tablet was measured. Average hardness of the tablets was calculated and standard deviation was determined

Disintegration test

Six tablets of each sample were placed in disintegration apparatus, where the volume of disintegration medium was 900 ml of water maintained at 37±1°C. The time taken to break each tablet into small particles and pass through the mesh was recorded and average time was calculated.

Dissolution test

A potassium phosphate buffer (pH 5.8) was prepared and the temperature was maintained at 37±1 ^{o}c throughout the experiment for all samples following the USP procedure. Samples were withdrawn after 5, 10, 15, 20, 30, 45 and 60 minutes and an equivalent amount of fresh buffer solution were immediately introduced as replacement. The samples were filtered and suitably diluted with 0.1 N NaOH solutions and assayed for the drug content by measuring the absorbance at 257 nm using UV-1800 spectrophotometer. Phosphate buffer was used as a blank and necessary correction for dilution was made when calculating for drug content.

In addition, Dissolution profile of three brands was done using USP II apparatus with 50 rpm, 900ml of

phosphate buffer and temperature of 37±1 ^{o}C.

Assay: USP, HPLC method was used for determination of the content of studied samples

Standard preparation: Standard USP Acetaminophen was dissolved in a mobile phase, water: methanol (3:1 v/v)

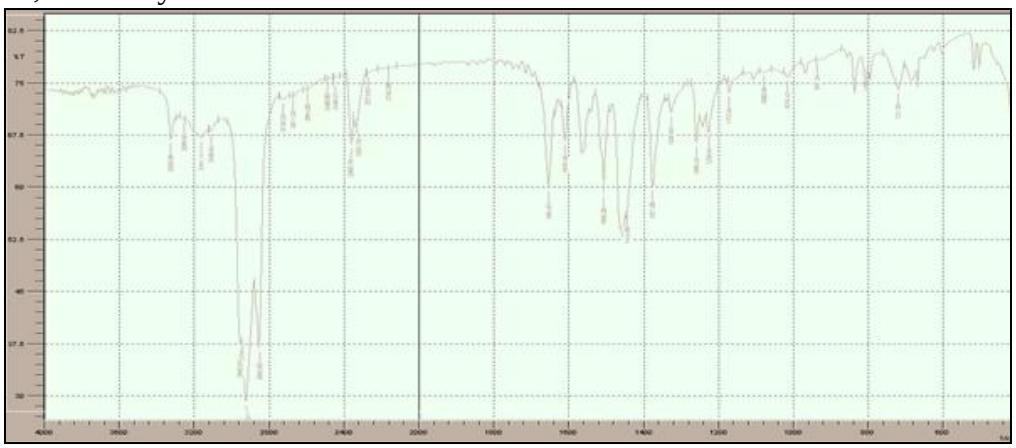
Assay preparation: For each sample 20 tablets were weighed and a quantity of powder equivalent to 0.1g was transferred to 200 ml of volumetric flask. 100 ml of mobile phase was added to the volumetric flask, the solution was then mechanically shaked for 10 minutes. The resulting solution was diluted to volume by mobile phase, water: methanol (3:1). Five ml of aliquot was transferred to 250 ml of volumetric flask and diluted to volume with mobile phase. The solution was then filtered, and assayed.

Chromatographic Conditions: The chromatographic conditions for the HPLC analysis were Reverse phase HPLC using C-18 Column. Flow rate was set up at 1.5ml/min, Mobile phase Water: Methanol (3:1), Injection volume 10 µl and UV- Detector, 243 nm.

RESULTS AND DISCUSSION:

Physical Properties

The results of the infrared spectrophotometer showed the absorbance spectrum of the samples were approximately similar to the standard used. All samples present a positive test for identification. The wave-numbers of the spectras are shown in **Table 2** for the samples analyzed and the standard used while IR peak for the standard is shown on **Figure 2**.



IR spectra of paracetamol Standard

FIGURE 2. IR PEAK FOR THE STANDARD

TABLE 2: INFRARED PEAKS TABLE OBSERVED AS WAVE NUMBERS (cm^{-1}):

	Standard	AK-1	AK-2	Arada	Bole	Gulele	Kaliti	Kirkos	Kolfe	Lideta	NS	Yeka
1	721	684	603	401	603	603	603	462	603	462	684	684
2	937	721	684	462	721	719	684	503	684	603	719	719
3	1016	837	719	503	968	968	719	516	837	684	837	837
4	1080	968	837	603	1014	1014	935	603	925	719	927	925
5	1172	1014	925	684	1080	1080	968	624	968	837	968	968
6	1226	1080	968	719	1170	1224	1014	648	1014	925	1014	1016
7	1259	1226	1014	796	1226	1259	1078	684	1080	968	1080	1033
8	1326	1326	1080	835	1259	1326	1172	715	1107	1014	1226	1080
9	1377	1377	1107	925	1326	1375	1226	796	1172	1080	1259	1226
10	1444	1456	1170	968	1377	1446	1259	835	1226	1107	1326	1259
11	1506	1506	1224	1014	1456	1458	1326	856	1259	1172	1375	1326
12	1610	1564	1259	1080	1506	1506	1375	925	1326	1226	1444	1375
13	1654	1610	1326	1107	1608	1560	1446	968	1375	1259	1506	1444
14	2162	1652	1377	1170	1650	1608	1456	1014	1444	1326	1564	1506
15	2273	2028	1446	1226	2152	1652	1506	1031	1506	1375	1610	1566
16	2331	2115	1506	1259	2273	2148	1562	1080	1564	1444	1654	1610
17	2358	2214	1562	1326	2331	2216	1608	1107	1610	1506	2119	1654
18	2455	2275	1608	1375	2358	2275	1652	1170	1654	1564	2216	2194
19	2488	2331	1650	1444	2422	2331	2179	1226	2017	1610	2275	2275
20	2594	2358	2028	1506	2455	2358	2273	1242	2113	1654	2331	2331

21	2671	2480	2119	1564	2592	2420	2331	1259	2181	2028	2358	2358
22	2725	2669	2216	1608	2671	2453	2358	1326	2275	2115	2457	2416
23	2852	2723	2277	1650	2725	2596	2459	1375	2331	2212	2491	2493
24	2923	2852	2331	2028	2852	2673	2594	1442	2358	2275	2594	2594
25	2952	2921	2358	2117	2923	2723	2667	1506	2493	2331	2669	2667
26	3109	2952	2493	2216	2952	2852	2725	1564	2590	2358	2723	2725
27	3161	3107	2594	2331	3107	2921	2852	1604	2667	2493	2852	2852
28	3255	3159	2671	2358	3159	2950	2923	1652	2721	2592	2923	2923
29	3325	3323	2721	2491	3323	3107	2952	1828	2852	2667	2952	2952
30			2852	2592		3159	3031	1851	2952	2721	3033	3033
31			2921	2669		3323	3066	1876	3033	2852	3066	3066
32			2950	2721			3109	1901	3109	2923	3109	3109
33			3107	2852			3161	1990	3161	2952	3116	3161
34			3157	2921			3323	2028	3292	3031	3292	3292
35			3288	2952				2079	3323	3064	3325	3325
36			3323	3029				2115		3109		
37				3064				2331		3161		
38				3109				2341		3292		
39				3161				2358		3323		
40				3294				2493		3500		

The different physical properties including weight variation, friability, hardness, thickness and diameter are summarized in **Table 3**.

TABLE 3: PHYSICAL QUALITY EVALUATION OF SAMPLES

Samples	Weight variation *	% Friability	Hardness (N) *	Thickness *	Diameter *
A	0.564 ± 1.4	0.19	135 ± 25	3.9 ± 0.05	13 ± 0.28
A1	0.627 ± 1.6	0.3	178 ± 38	5.5 ± 0.04	12.8 ± 0.04
B	0.550 ± 0.8	0.19	190 ± 43	3.8 ± 0.04	12.7 ± 0.05
C	0.639 ± 2.3	0.2	237 ± 41	5.5 ± 0.2	12.7 ± 0.05
D	0.631 ± 1.1	0.3	237 ± 20	5.4 ± 0.04	12.7 ± 0.04
E	0.654 ± 2.9	0.3	188 ± 25	5.6 ± 0.07	12.7 ± 0.09
F	0.632 ± 1.2	0.5	174 ± 49	5.5 ± 0.3	13.0 ± 0.3
G	0.591 ± 0.5	0.2	158 ± 05	4.1 ± 0.3	12.8 ± 0.3
H	0.626 ± 1.9	0.3	221 ± 15	5.6 ± 0.04	12.7 ± 0.05
I	0.636 ± 1.1	0.3	163 ± 21	5.6 ± 0.035	12.9 ± 0.15
J	0.646 ± 1.8	0.2	271 ± 35	5.7 ± 0.06	12.7 ± 0.15

*- Mean ± SD, A- Asmol (B0523), A1- Paracetamol EPHARM (3110053), B- Asmol (Bo531), C- Paracetamol EPHARM (2110743), D- Paracetamol EPHARM (3010173), E- Paracetamol EPHARM (3030203), F- Paracetamol EPHARM (3030093), G- Kelvin (T-5441), H- Paracetamol EPHARM (1060073), I- Paracetamol EPHARM (2120593).

The variation of the weight of individual tablet is a valid indication of the corresponding variation in the drug content [1]. According to the BP the acceptable deviation should not be more than 5% for a tablet to be accepted. As shown in the **Table 3**, all the samples in the study comply with the weight variation test.

The friability test results of all the samples ranges from 0.19 % Asmol (Bo531) to 0.5 % Paracetamol EPHARM (3030093), and have a record of not more than 1% weight loss thus the results are acceptable. The result further may indicate the resistance of the tablets to external pressure from manufacturing, shipping and transportation.

In order to withstand chipping, abrasion or breakage during transportation, storage and handling, tablets are required to have a certain degree of hardness. The hardness test is a measure of the compression force required to break a tablet. Hardness of not less than 50 N is considered satisfactory [21]. The results of the study showed that the average compression force recorded was in the range of 135 ± 25 N to 271± 35 N which is above the minimum requirement of 50 N. The thickness and diameter of the tablets were both in excellent state and no significant deviation is observed.

Disintegration Time

Disintegration is the break down process of tablet into smaller particles and is the first step towards dissolution, used to determine the disintegration time of the medication in the human body [22]. The official requirement in the British Pharmacopeia disintegration test is that uncoated tablets should disintegrate in less than 15 minutes.

As shown in **Table 4,** the disintegration time ranges from 0.6 ± 0.1 Asmol (Bo531) to 30 minutes Paracetamol EPHARM (2110743). Hence, all samples comply with the BP requirements except a sample from Bole sub city, Paracetamol EPHARM (2110743). Literatures support the direct relationship between hardness and disintegration time, which was observed in this study for a sample collected from Bole sub city Paracetamol EPHARM (2110743). In fact, the relationship between tablet hardness and disintegration is a complex one where drug particle size, difference in excipients used and the formulation process followed by different manufacturers could impart different characteristics to the tablet in its solid or hydrated solution form.

TABLE 4: DISINTEGRATION TIME, DISSOLUTION RELEASE AT 30 MINS AND ASSAY VALUES FOR THE PARACETAMOL TABLETS ASSESSED

	Disintegration time (Sec.)	Dissolution (Percent release at 30 min.)	Assay Retention time(Min)	Peak area (µV.S)	Percent assay
A	360	101	2.98	355343.23	88
A1	48	102	2.98	385555.4	95.6
B	360	101	2.98	384529.94	95
C	900	106.7	2.97	391809.97	97
D	72	97.6	2.96	387932.40	95
E	60	101	2.96	426274.52	105
F	66	109	2.96	405337.78	100.5
G	360	102	2.95	378588.58	93
H	66	105	2.99	412467.19	102.3
I	60	107	3.0	388352.79	96.3
J	198	105	2.99	391009.31	96
Standard	-	-	3.0	403167.5	100

A- Asmol (B0523), A1- Paracetamol EPHARM (3110053), B- Asmol (Bo531), C- Paracetamol EPHARM (2110743), D- Paracetamol EPHARM (3010173), E- Paracetamol EPHARM (3030203), F- Paracetamol EPHARM (3030093), G- Kelvin (T-5441), H- Paracetamol EPHARM (1060073), I- Paracetamol EPHARM (2120593).

Dissolution

A dissolution test was intended to determine the percent release of the samples in 30 minutes time and the results show that all are in accordance to the pharmacopeias standards. Thorough evaluation of **Table 4** showed that, highest percent release concentration was found in samples Collected from kirkos sub city, Paracetamol EPHARM (3030093), 109 % and the lowest percent release concentration was found in samples collected from Gulele sub city Paracetamol EPHARM (3010173) 97.6%. Even though the Paracetamol EPHARM (2110743) failed the Disintegration test it exhibited a good dissolution profile.

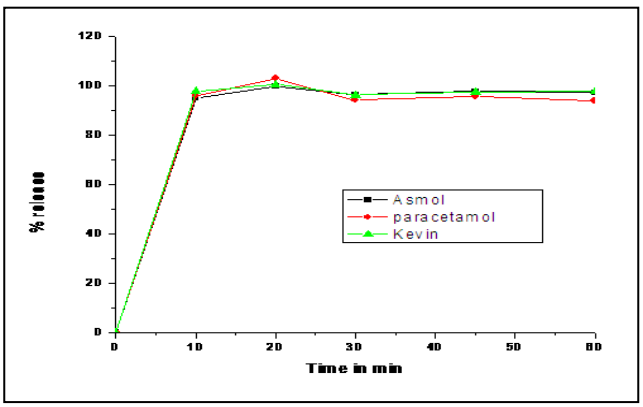


FIGURE 3: DISSOLUTION PROFILE OF THREE BRANDS OF PARACETAMOL TABLET, 500 mg

In this study, dissolution profile of three brands was also performed, to provide information regarding biological bioavailability and batch to batch consistency. The result complies with the requirement of USP which states at least 80% of drugs should be released within 30 minutes.

Assay

The assay determines the concentration of the API in a sample, according to the BP the concentration of acetaminophen is accepted if it is within the range of 90-110 % [23.] The assay was done by using the HPLC and samples were injected and the averages of the areas were calculated. Representative peaks are shown in **Figure 4**. The results of this experiment showed that all studied samples comply with the requirement of BP except sample collected from Addis Ketema, Asmol B0523: Even though this sample exhibited a good dissolution profile and acceptable concentration at 30 minutes, the assay results reveal the concentration of the API is below the limit, **Table 4**.

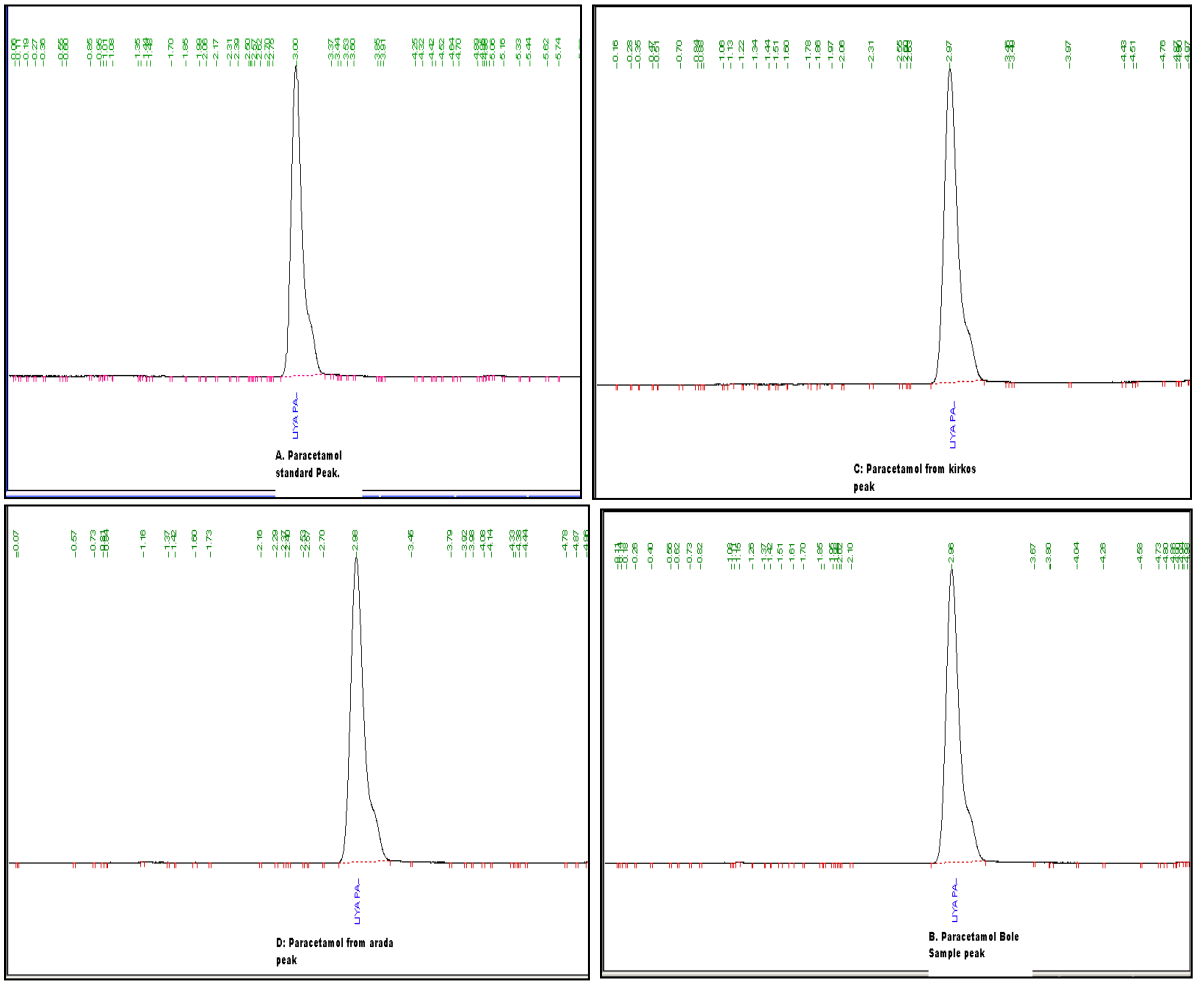


FIGURE 4: TYPICAL HPLC CHROMATOGRAM'S OBTAINED IN THE ASSAY

Paracetamol is an OTC product thus in Ethiopia, it can be purchased with-out prescription in un limited quantity from any drug retail outlets. The dispensing of it from the legal drug outlets in unlimited quantity might be one reason that predisposes it to the illegal market i.e. its availability in common shops. Although there is nothing harm for being an OTC product, its availability and dispensing in common shops is a health hazard as it is handled by a non-pharmacist with- out any knowledge about drugs like its storage, dosage, drug-drug and food interactions etc. Even in developed countries, paracetamol being associated with many harm effects like suicide when dispensed in unlimited quantities, they introduced a law prohibiting such ways of practice. Such pack limitations offered many advantages like decrease in suicide [24, 25.]

The overall quality of paracetamol tablets being assessed being of generally acceptable indicates, the legal sources are the suppliers of the drugs to

the illegal market thus such rules introduction to Ethiopia might help in reducing the presence of the drugs in Kiosks. Thus introducing a law that prohibits for paracetamol to be dispensed in some quantities might prevent subversion to the illegal market. However, black markets are usually very dynamic and are a head of in counteracting many laws and regulations thus designing sophisticated ways to contain them is crucial. Such holistic approaches may incorporate education (to health workers, general public and contrabandists) about the health and economical harms of illegal market, designing strict laws and enforcement of them ideally without any pin holes and penalizing those which break it.

CONCLUSION: Paracetamol tablets were available, in different brands, in illegal markets located around the city of Addis Ababa, Ethiopia. All samples analyzed passed the weight variation and friability test. Some of the samples failed the disintegration test while all samples were in accordance to the standard set by the pharmacopeia for the dissolution test. All the samples passed the test for assay except one sample in which itscontent was found to be less than the desired quantity.

Overall the quality evaluation results found in this research are similar to the results observed from the previous studies on quality evaluation studies of paracetamol tablets obtained from legal drug markets. This may help to infer a systemic counterfeiting of this drug in the black market may be absent which could be due to the price of paracetamol (relatively cheaper than other analgesics and drugs). Therefore the Pollen for the availability of paracetamol in the shops might not necessarily be from illegal drug outlets rather it may be sourced from the pharmacies, whole sales and other legal systems. Thus for the Drug regulatory authority(EFMHACA) to limit the presence of paracetamol in common shops, it might consider limiting the amount of paracetmol tablets to be dispensed to persons visiting pharmacies.

ACKNOWLEDGEMENT: The authors are very grateful to EPHARM S.C. for allowing us to use reagents and chemicals as well as the facilities in their quality control and assurance department.

REFERENCES:

1. Karmakar P and Kibria G. *In-vitro* comparative evaluation of quality control parameters between paracetamol and paracetamol/caffeine tablets available in Bangladesh. International Current Pharmaceutical Journal, 2012; 1(5): 103-109
2. Bloomfield M A sensitive and rapid assay for 4-aminophenol in paracetamol drug and tablet formulation, by flow injection analysis with spectrophotometric detection. Talanta. 2002; 580 :1301-131
3. Smith H. Potential Analgesic Mechanisms of Acetaminophen. Pain Physician. 2009;12:269-280
4. Anderson J. Paracetamol (Acetaminophen): mechanisms of action. Pediatric Anesthesia. 2008;18: 915–921
5. Shep D, Ojha A, Patel S, Rathod R, Nivsarkar M, Jaiswal Vand PadhH. Bioequivalence and pharmacokinetic evaluation of tw o formulations of Paracetamol ER 650 mg: a single-dose randomize d two-period crossover Comparison in healthy Indian adult voluntee rs 2010; International Journal of current pharmaceutical research, 2(4):28-31.
6. Craig R and Stitzel R. Modern pharmacology with clinical applications. Lippincott Williams and Wilkins: 2004; 48-56, 6th ed.
7. Oscier C, Bossley N and Milne Q. Paracetamol - A Review of Three Routes of Administration; Update in Anesthesia: 2007; 23.
8. Koppert W, Frotsch K, Huzurudin N, Boswald W, Griessinger N, Weisbach N, Schmieder E and Schuttler J. The Effects of Paracetamol and Parecoxib on Kidney Function in Elderly Patients Undergoing Orthopedic Surgery. International Anesthesia Analgesica. 2006; 103, 1170-1176.
9. Nasrin N, Asaduzzaman M, Mowla R, Rizwan F and Alam A. A comparative study of physical parameters of selected Ketorolac tromethamine tablets available in the market of Bangladesh. Journal of Applied Pharmaceutical Science. 2011; 01 (08): 101-103.
10. Ergetie Z, Wondimisgegne D and Tsega B (2013). Analysis and comparison of Paracetamol tablets dispensed in legal dispensaries and Non pharmaceutical shops in Gondar town, North West Ethiopia. International journal of Pharmacy and Industrial research, 03(02):144-151
11. Ahmed S, Pal N, Verma G and Singh A. Comparative in vitro release study of some commercially available paracetamol tablets. Der Chemical Sinica. 2012; 3(5):1075-1077
12. Blandino A, Engle P, Reedl E, and Tietze J. Appropriate Use of Common OTC Analgesics and Cough and Cold Medications. www.fda.gov/ohrms/dockets, Accessed on June 2008; 18,2013
13. Kishore K and Amarshewar P (2012). Quality evaluation on tablet formulation of different pharmaceutical companies. journal of current chemical pharmaceutical science, 2(1):24-31
14. Chinwendu O. The fight against fake drugs by NAFDAC in Nigeria.44 the International Course in Health Development (ICHD) 2008;
15. Sahle S, Ayanew A and Wabe N.Comparative quality evaluation of paracetamol tablet marketed in Somali region of Ethiopia. The international Journal of Pharmaceutical science and research. 2012; 3(2):540-550
16. Mikre W, Ashenef A and Mekonnen N.Comparative evaluation of the *in vitro and in vivo* characterstics of different brands of paracetamol tablets.Ethiopian pharmaceutical journal. 2000; 18;41-52
17. Hundie K, Debella A and Hymete A(2008). Comparative quality evaluation of some brands of paracetamol tablets, suppositories and syrups. Ethiopian Pharmaceutical Journal, 26(1); 59-64.
18. FIP. FIP and Pfizer Launch Joint Survey at the FIP Congress, Lisbon.2010;Availableathttp://www.fip.org/www/index.php?page=latest_news. Accessed on may, 2013
19. Lybecker KM (2007). Rx Roulette: Combating Counterfeit Pharmaceuticals in Developing Nations. Mangerial and Decision Economics: 28: 509-520
20. Erhun WO, Babalola OO, Erhun MO. Drug regulation and Control in Nigeria: The Challenge of Counterfeit Drug. Journal of Health and Population in Developing Countries. 2001; 4 (2): 23-24
21. Gillbert S.Tablets and Tablet production Design .7th edition. In sprowl's American Pharmacy An Introduction to Pharmaceutical Techniques and Dosage forms, J.B. lippincott company, Philadelphia 1974;
22. Cardot M, Beyssac E, and Aleri M (2007). *In Vitro–In Vivo* Correlation: Importance of Dissolution in IVIVC; Dissolutiontechnologies.www.dissolutiontech.com/DTresour200702 Articles/Accessed on.May20, 2013
23. British Pharmacopeia (BP).Version 11, Published on the Recommendation of Medicines Commission Pursuant to the Medicine Act 1968. Her Majesty's Stationary Office, London 2009;
24. Hawton K, Bergen H, Simkin S, Dodd S, Pocock P, Berna W, Gunnell D and Kapur N. Long term effect of reduced pack sizes of paracetamol on poisoning deaths and liver transplant activity in England and Wales: interrupted time series analyses BMJ 2013;346:f403 doi: 10.1136/bmj.f403 (Published 7 February 2013)
25. Hawton K, Simkin S, Deeks J, Cooper J, Johnston A, Waters K, Arundel M, Bernal W, Gunson B,, Hudson M, Suri D, Simpson K. UK legislation on analgesic packs: before and after study of long term effect on poisonings BMJ. 2004;doi:10.1136/bmj.38253.572581.7C (published 29 October 2004)

How to cite this article
Teklu L, Adugna E and Ashenef A: Quality Evaluation of Paracetamol Tablets Obtained From the Common Shops (Kiosks) In Addis Ababa, Ethiopia. *Int J Pharm Sci Res* 2014; 5(8): 3502-10.doi: 10.13040/IJPSR.0975-8232.5 (8).3502-10.