Republic of Iraq
Ministry of Higher Education and Scientific Research
Diyala University / College of Science
Department of Chemistry

DETERMINATION OF PARACETAMOL IN SOME MANUFACTURED TABLETS IN IRAQ MARKET USING UV – VISB SPECTROSCOPY

SUBMETED TO THE COUNCIL OF THE CHEMISTRY COLLEGE OF SCIENCE UNIVERSITY OF DIYALA TO COMPLETE THE REQUIREMENTS OF OBTAINING THE DEGREE OF BACHELOR'S IN CHEMISTRY

SUBMETED BY

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SUPERVISED BY

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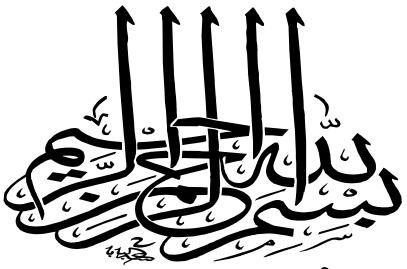
2016 AD **1437 AH**



أَلَمْ تَرَ أَنَّ اللَّهَ أَنْزَلَ مِنَ السَّمَاءِ مَاءً فَأَخْرَجْنَا بِهِ ثَمَرَاتٍ مُخْتَلِفًا أَلْوَانُهَا وَمِنَ الْجِبَالِ جُدَدٌ بِيضٌ وَحُمْرٌ مُخْتَلِفٌ أَلْوَانُهَا وَغَرَابِيبُ سُودٌ وَمِنَ النَّاسِ وَالدَّوَابِّ وَالْأَنْعَامِ مُخْتَلِفٌ أَلْوَانُهُ كَذَلِكَ إِنَّمَا يَخْشَى اللَّهَ مِنْ عِبَادِهِ الْعُلَمَاءُ إِنَّ اللَّهَ عَزِيزٌ غَفُورٌ

سورة فاطر

الاية

{28-27}

Gifting

To the secret of existence in every age, to the most compassionate man, to the messenger of Good (Allah bless him and his progeny).

To the martyrs of Iraq …… the Iraqi army…….the popular mobilization and to our Mujahidin people.

To my idol in my past and my future…. My dear father.

To the spring which fed me tenderness and under her feet my lord put paradise …….. My kind mother.

To my beloved brother who is my support in all time.

Saja Alaa Hameed **Noor Sadiq Abass** **Dalya Wady Getab**

2016

Acknowledgements

Thanks to Allah and peace be upon Mohammed, the last of prophets, and his immaculate family.

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Thanks are also due to University of Diyala, College of Science, head of Chemistry Department, and general laboratory staff.

A special indebted of gratitude is given to our family for their continuous support and encouragement during this study.

Finally, we would like to thank all others that their names are not mentioned here, and our apologized to everyone we forget him.

Saja Alaa Hameed **Noor Sadiq Abass** **Dalya Wady Getab**

2016

Declaration

I certify that this research has been prepared under my supervision in the Department of Chemistry, College of Science, University of Diyala to complete the requirements of obtaining the degree of bachelor's in Chemistry.

Signature:

Name : Assist. Prof. Dr. Ahmed M. Saeed

Title : College of Science- Diyala University

Data : / / 2016

Aim of the study:

The aims of this study were to investigate paracetamol from different pharmaceutical companies in Iraqi market to prove that:

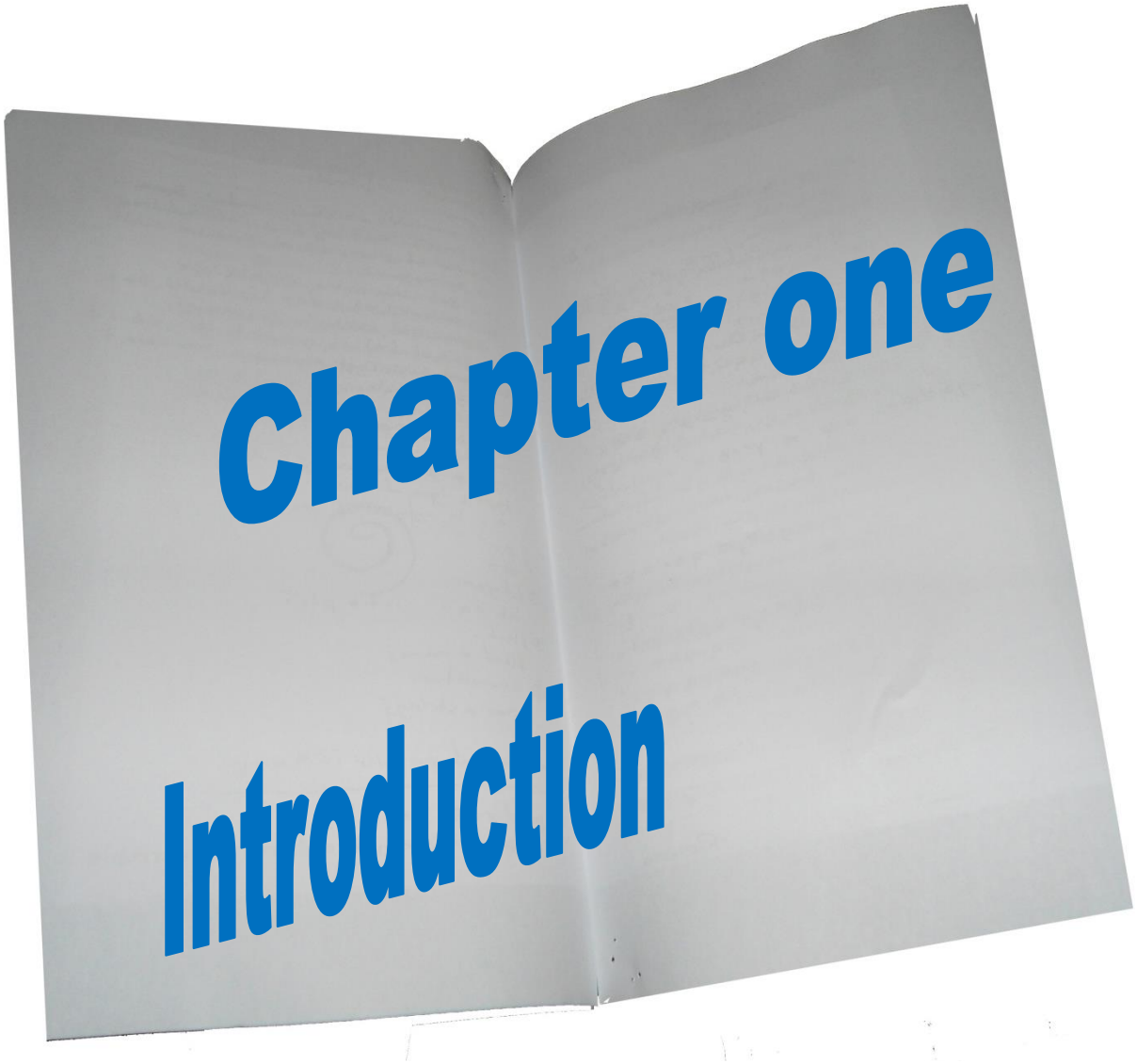
1- The weight of each tablet is within the range of maximum difference allowed.

2 - Assay the active constituent of different samples using UV method & comparing the results to obtain the most potent one from the tested samples.

3 - To get the information about the manufactured tablet samples from different sources in Iraq market.

4 - To make control and comparing the results obtain from this study of the samples under consider.

Contents:


Chapter one
Introduction

1 – Introduction:

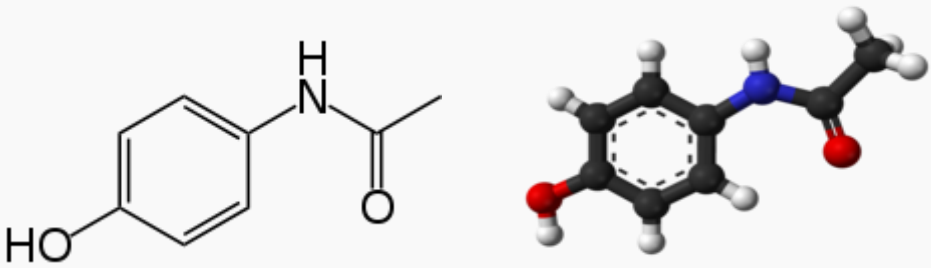
1.1- What is paracetamol?

Paracetamol, also known as **acetaminophen** or **APAP**, is a medication used to treat pain and fever.[1] It is typically used for mild to moderate pain. Evidence of benefit in fever for children is poor. It is often sold in combination with other ingredients such as in many cold medications. In combination with opioid pain medication, paracetamol is used for more severe pain such as cancer pain and after surgery.[2] It is typically used either by mouth or rectally, but is also available intravenously.

Paracetamol is generally safe at recommended doses. Serious skin rashes may rarely occur. Too high a dose can result in liver failure. It appears to be safe during pregnancy and when breastfeeding. In those with liver disease, it may still be used but lower doses should be taken.[3] Paracetamol is classified as a mild analgesic.

It does not have significant anti-inflammatory activity and how it works is not entirely clear.[4]

Paracetamol was discovered in 1877. It is the most commonly used medication for pain and fever in both the United States and Europe. It is on the WHO Model List of Essential Medicines, the most important medications needed in a basic health system. Paracetamol is available as a generic medication with trade names including Tylenol and Panadol among others.[5]

Paracetamol	
	
Systematic (IUPAC) name	
(4-hydroxyphenyl)ethanamide (N-(4-hydroxyphenyl)acetamide)	
Clinical data	
Pronunciation	Paracetamol (Acetaminophen)
Trade names	Tylenol, Panadol, others
Chemical data	
Formula	$C_8H_9NO_2$
Molar mass	151.163 g/mol
Physical data	
Density	1.263 g/cm^3
Melting point	169 °C (336 °F)
Boiling point	420 °C (788 °F)
Solubility in water	12.78 mg/mL (20 °C)

1.2 – Medical Uses:

1.2.1 - Fever:

Paracetamol is used for reducing fever in people of all ages. The World Health Organization (WHO) recommends that paracetamol be used to treat fever in children only if their temperature is greater than 38.5 °C (101.3 °F). The efficacy of paracetamol by itself in children with fevers has been questioned and a meta-analysis showed that it is less effective than ibuprofen.[6]

1.2.2 - Pain:

Paracetamol is used for the relief of mild to moderate pain.

1.2.3 - Osteoarthritis:

The American College of Rheumatology recommends paracetamol as one of several treatment options for people with arthritis pain of the hip, hand, or knee that does not improve with exercise and weight loss. A 2015 review, however, found it provided only a small benefit in osteoarthritis.[7]

Paracetamol has relatively little anti-inflammatory activity, unlike other common analgesics such as the aspirin and ibuprofen, but ibuprofen and paracetamol have similar effects in the treatment of headache. Paracetamol can relieve pain in mild arthritis, but has no effect on the underlying inflammation, redness, and swelling of the joint.[8]

1.2.4 - Low back pain:

Based on a systematic review, paracetamol is recommended by the American College of Physicians and the American Pain Society as a first-line treatment for low back pain. [9]

1.2.5 - Headaches:

A joint statement of the German, Austrian, and Swiss headache societies and the German Society of Neurology recommends the use of paracetamol in combination with caffeine as one of several first line therapies for treatment of tension or migraine headache. In the treatment of acute migraine, it is superior to placebo, with 39% of people experiencing pain relief at 1 hour compared to 20% in the control group.[10]

1.2.6 - Postoperative pain:

Paracetamol, when combined with NSAIDs, may be more effective for treating postoperative pain than either paracetamol alone or NSAIDs alone.[11]

1.2.7 - Other:

The efficacy of paracetamol when used in combination with weak opioids (such as codeine) improved for approximately 50% of people but increases in the number experiencing side effects. Combination drugs of paracetamol and strong opioids like morphine improve analgesic effect.[12]

The combination of paracetamol with caffeine is superior to paracetamol alone for the treatment of common pain conditions including dental pain, postpartum pain, and headache.[13]

1. 3 – Adverse effects:

Healthy adults taking regular doses of up to 4,000 mg a day show little evidence of toxicity (although some researchers disagree). They are more likely to have abnormal liver function tests, but the significance of this is uncertain.[7]

1.3.1 - Liver damage:

Acute overdoses of paracetamol can cause potentially fatal liver damage. In 2011 the US Food and Drug Administration launched a public education program to help

consumers avoid overdose warning: "Acetaminophen can cause serious liver damage if more than directed is used.[14]

According to the FDA, in the United States there were 56,000 emergency room visits, 26,000 hospitalizations, and 458 deaths per year related to acetaminophen-associated overdoses during the 1990s. Within these estimates, unintentional acetaminophen overdose accounted for nearly 25 percent of the emergency department visits, 10 percent of the hospitalizations, and 25 percent of the deaths.[15]

1.3.2 - Skin reactions:

On August, 2013, the U.S. Food and Drug Administration (FDA) issued a new warning about paracetamol. It stated that the drug could cause rare, and possibly fatal, skin reactions, such as Stevens–Johnson syndrome and toxic epidermal necrolysis. Prescription-strength products will be required to carry a warning label about skin reactions, and the FDA has urged manufacturers to do the same with over-the-counter products.[16]

1.3.3 - Asthma:

There is an association between paracetamol use and asthma but the evidence suggests that this likely reflects confounders rather than a causal role. A 2014 review found that among children the association disappeared when respiratory infections were taken into account.[17]

1.3.4 - Other factors:

In contrast to aspirin, paracetamol does not prevent blood from clotting (it is not an antithrombotic), and thus may be used in patients where failure of blood coagulation is a concern; and it does not cause gastric irritation. Unlike aspirin, paracetamol is generally considered safe for children, as it is not associated with a risk of Reye's syndrome in children with viral illnesses.[18]

1.3.5 - Overdose:

Untreated paracetamol overdose results in a lengthy, painful illness. Signs and symptoms of paracetamol toxicity may initially be absent or non-specific symptoms. The first symptoms of overdose usually begin several hours after ingestion, with nausea, vomiting, sweating, and pain as acute liver failure starts.[19] People who take overdoses of paracetamol do not fall asleep or lose consciousness, although most people who attempt suicide with paracetamol wrongly believe that they will be rendered unconscious by the drug.[20] The process of dying from an overdose takes between 3–5 days to 4–6 weeks.

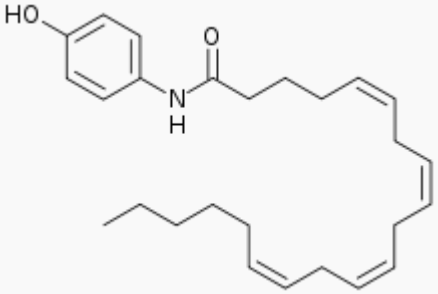
Untreated overdose can lead to liver failure and death within days. Treatment is aimed at removing the paracetamol from the body and replacing glutathione.[21]Activated charcoal can be used to decrease absorption of paracetamol if the patient presents for treatment soon after the overdose. While the antidote, acetylcysteine (also called N-acetylcysteine or NAC), acts as a precursor for glutathione, helping the body regenerate enough to prevent or at least decrease the possible damage to the liver, a liver transplant is often required if damage to the liver becomes severe.[22]

1.3.6 - Pregnancy:

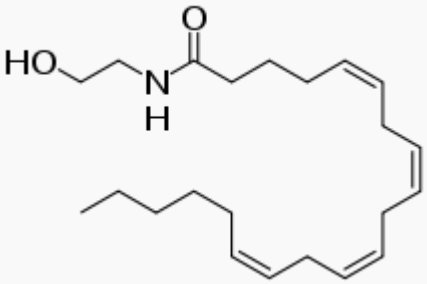
Experimental studies in animals and cohort studies in humans indicate no detectable increase in congenital malformations associated with paracetamol use during pregnancy. Additionally, paracetamol does not affect the closure of the fetal ductus arteriosus as NSAIDs can.[23]

Paracetamol use by the mother during pregnancy is associated with an increased risk of childhood asthma. It is also associated with an increase in ADHD but it is unclear whether the relationship is causal. Despite these concerns, paracetamol remains the recommended medication for pain and fever during pregnancy.[24]

1. 4 – Mechanism of action:



Metabolite of paracetamol



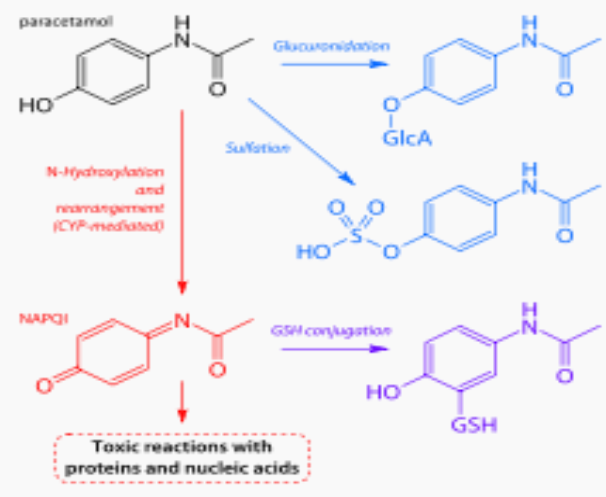
AM404 Anandamide – Endogenous cannabinoid

To date, the mechanism of action of paracetamol is not completely understood. The main mechanism proposed is the inhibition of cyclooxygenase (COX), and recent findings suggest that it is highly selective for COX-2. Because of its selectivity for COX-2 it does not significantly inhibit the production of the pro-clotting thromboxanes.[25] While it has analgesic and antipyretic properties comparable to those of aspirin or other NSAIDs, its peripheral anti-inflammatory activity is usually limited by several factors, one of which is the high level of peroxides present in inflammatory lesions. However, in some circumstances, even peripheral anti-inflammatory activity comparable to NSAIDs can be observed.

An article[26] in Nature Communications from researchers in London, UK and Lund, Sweden in November 2011 has found a hint to the analgesic mechanism of paracetamol, being that the metabolites of paracetamol e.g. NAPQI, act on TRPA1-receptors in the spinal cord to suppress the signal transduction from the superficial layers of the dorsal horn, to alleviate pain.

Paracetamol also modulates the endogenous cannabinoid system.[27] Paracetamol is metabolized to AM404, a compound with several actions; what is most important is that it inhibits the reuptake of the endogenous cannabinoid/vanilloid anandamide by neurons.

1. 5 – Pharmocokinetic:



Main pathways of paracetamol metabolism (click to enlarge). Pathways shown in blue and purple lead to non-toxic metabolites; the pathway in red leads to toxic NAPQI.

The concentration in serum after a typical dose of paracetamol usually peaks below 30 µg/ml, which equals 200 µmol/L. After 4 hours the concentration is usually less than 10 µg/mL, which equals 66 µmol/L.[28]

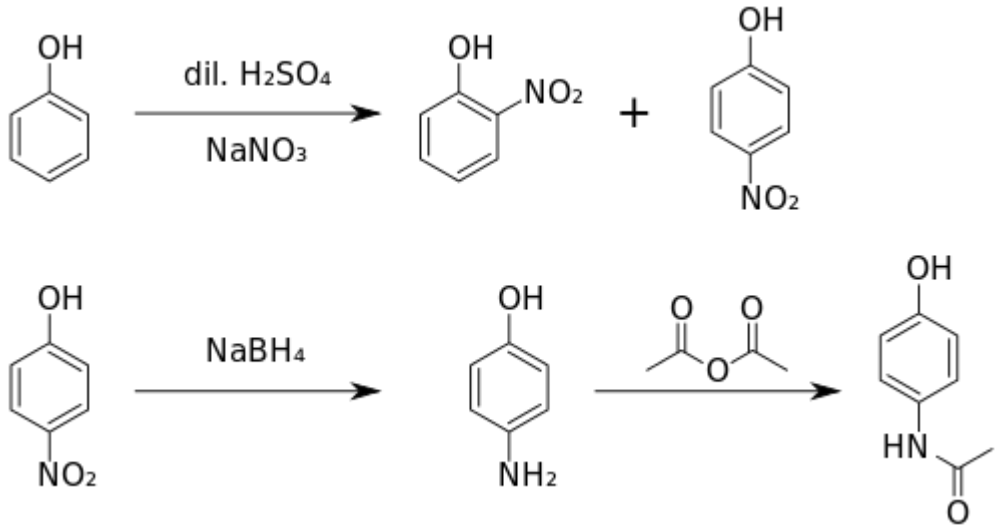
Paracetamol is metabolized primarily in the liver, into toxic and non-toxic products. Three metabolic pathways are notable:

- Glucuronidation (45-55%)[29]
- Sulfation (sulfate conjugation) accounts for 20–30%.[29]
- N-hydroxylation and dehydration, then GSH conjugation, accounts for less than 15%. The hepatic cytochrome P450enzyme system metabolises paracetamol, forming a minor yet significant alkylating metabolite known as NAPQI (N-acetyl-p-benzoquinone imine) (also known as N-acetylimidoquinone). NAPQI is then irreversibly conjugated with thesulfhydryl groups of glutathione.[30]

1. 6 – Synthesis:

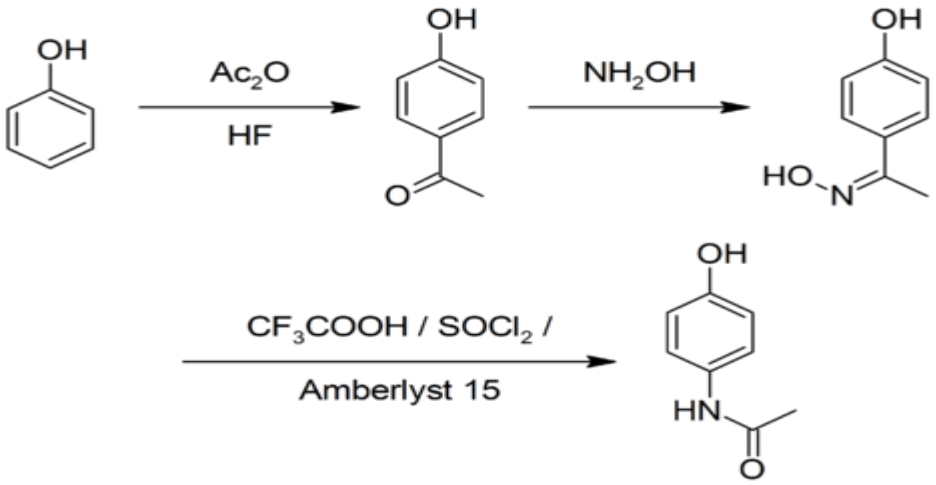
1.6.1 - Original method:

The original method for production involves the nitration of phenol with sodium nitrate gives a mixture of two isomers, from which the wanted 4-nitrophenol (bp 279 °C) can easily be separated by steam distillation. The nitro group is then reduced to an amine, giving 4-aminophenol. Finally, the amine is acetylated with acetic anhydride. Industrially direct hydrogenation is used, but in the laboratory scale sodium borohydride serves.[31]



1.6.2 - Green(er) synthesis

An alternative industrial synthesis developed by Hoechst–Celanese involves direct acylation of phenol with acetic anhydride catalyzed by HF, conversion of the ketone to a ketoxime with hydroxylamine, followed by the acid-catalyzed Beckmann rearrangement to give the amide.[32]



1.6.3 - Direct synthesis

More recently (2014) a "one-pot" synthesis from hydroquinone has been described before the Royal Society of Chemistry.[33] The process may be summarized as follows: Hydroquinone, ammonium acetate, and acetic acid are mixed in an argon atmosphere and heated slowly to 230 °C. The mixture was stirred at this temperature for 15 hours. After cooling the acetic acid was evaporated and the precipitate was filtered, washed with water and dried to give paracetamol as a white solid. The authors go on to claim an 88% yield and 99% purity.

1.7 - How to store:

1- Keep this medicine out of the sight and reach of children.

2- Do not use this medicine after the expiry date shown on the pack. The expiry date refers to the last day of that month.

3 - Store your medicine in the original packaging in order to protect from moisture.

4 -Do not throw away any medicines via wastewater or household waste. Ask your pharmacist how to throw away medicines you no longer use. These measures will help protect the environment.

1. 8 – History:

Paracetamol is the active metabolite of phenacetin and acetanilide, both once popular as analgesics and antipyretics in their own right. However, unlike phenacetin, acetanilide and their combinations, paracetamol is not considered carcinogenic at therapeutic doses.

Paracetamol was first marketed in the United States in 1950 under the name Triagesic, a combination of paracetamol, aspirin, and caffeine. Reports in 1951 of three users stricken with the blood disease agranulocytosis led to its removal from the marketplace, and it took several years until it became clear that the disease was unconnected. Paracetamol was marketed in 1953 by Sterling-Winthrop Co. as Panadol, available only by prescription, and promoted as preferable to aspirin since it was safe for children and people with ulcers. In 1955, paracetamol was marketed as Children's Tylenol Elixir by McNeil Laboratories. In 1956, 500 mg tablets of paracetamol went on sale in the United Kingdom under the trade name Panadol, produced by Frederick Stearns & Co, a subsidiary of Sterling DrugInc. In 1963, paracetamol was added to the British Pharmacopoeia, and has gained popularity since then as an analgesic agent with few side-effects and little interaction with other pharmaceutical agents.[34] Concerns about paracetamol's safety delayed its widespread acceptance until the 1970s, but in the 1980s paracetamol sales exceeded those of aspirin in many countries, including the United

Kingdom. This was accompanied by the commercial demise of phenacetin, blamed as the cause of analgesic nephropathy and hematological toxicity. In 1988 Sterling Winthrop was acquired by Eastman Kodak which sold the over the counter drug rights to SmithKline Beecham in 1994.[35]

1. 9 – Society and culture:

1.9.1 – Naming:

Acetaminophen is the name generally used in the United States (USAN) and Japan (JAN); paracetamol is used in international venues (INN, AAN, BAN). In some contexts, such as on prescription bottles of painkillers that incorporate this medicine, it is simply abbreviated as APAP, for acetyl-para-aminophenol.

The word acetaminophen is also used in Canada, Venezuela, and Colombia.[36] Both come from a chemical name for the compound: para-acetylaminophenol and para-acetylaminophenol.

1.9.2 - Available forms:

Tylenol 500 mg capsules

The pure drug is a white Crystalline powder

Panadol 500 mg tablets

Paracetamol is available as:

Tablets, caplets, capsules, soluble tablets (these dissolve in water, which you then drink), an oral suspension (liquid medicine), suppositories, which are inserted into your anus (the opening through which waste leaves your body).

Some types of paracetamol, such as liquid forms of paracetamol, are aimed specifically at children.

The common adult dose is 500 mg to 1000 mg. The recommended maximum daily dose, for adults, is 4000 mg. In recommended doses, paracetamol is generally safe for children

and infants, as well as for adults, although rare cases of acute liver injury have been linked to amounts lower than 2500 mg per day.[37]

Paracetamol is commonly used in multi-ingredient preparations for migraine headache, typically including butalbital and paracetamol with or without caffeine, and sometimes containing codeine.

Paracetamol is sometimes combined with phenylephrine hydrochloride. Sometimes a third active ingredient, such asascorbic acid,[38] caffeine,[39] chlorpheniramine maleate,[40] or guaifenesin[41] is added to this combination.

1.9.3 - Controversy:

In September 2013 an episode of the American Life entitled use only as directed highlighted deaths from Paracetamol overdose. This report was followed by two reports by ProPublica [42] alleging that the FDA has long been aware of studies showing the risks of acetaminophen. So has the maker of Tylenol, McNeil Consumer Healthcare, a division of Johnson & Johnson" and "McNeil, the maker of Tylenol, ... has repeatedly opposed safety warnings, dosage restrictions and other measures meant to safeguard users of the drug.

A report prepared by an internal FDA working group describes a history of FDA initiatives designed to educate consumers about the risk of paracetamol overdose, and notes that one challenge to the Agency has been "identifying the appropriate message about the relative safety of acetaminophen, especially compared to other OTC pain relievers (e.g., aspirin and other NSAIDs). The report notes that "Chronic use of NSAIDs is also associated with significant morbidity and mortality. NSAID gastrointestinal risk is substantial, with deaths and hospitalization estimated in one publication as 3200 and 32,000 per year respectively. Possible cardiovascular toxicity with chronic NSAID use has been a major discussion recently, finally noting that the goal of the educational efforts is not to decrease appropriate acetaminophen use or encourage substitution of NSAID use, but rather to educate consumers so that they can avoid unnecessary health risks.[43]

1. 10 – Analytical methods for determination of paracetamol in pharmaceutical formulations:

Numerous methods have been reported for the analysis of paracetamol and its combination in pharmaceuticals or in biological fluids. Dosage forms of acetaminophen and its combinations with other drugs have been listed in various pharmacopeias (44,45). Several methods (titrimetric, spectrophotometric and liquid chromatographic) are described in these pharmacopeias for acetaminophen in the raw material and in dosage forms.

Paracetamol has been determined in combination with other drugs using U.V spectrophotometry [46-49] and reverse phase high performance liquid chromatography [50-56] in pharmaceutical preparation. In combination with other drugs, acetaminophen has been quantitated using spectrophotometry (57, 58), derivative ultraviolet spectrophotometry (59), titrimetry (60), voltammetry (61), FTIR spectrometry (62), HPLC (63-66) and capillary electrophoresis (67).

Chapter two

Experimental

2 - Experimental:

2.1 - Chemicals and solutions:

All the chemicals used throughout this study were of analytical reagent grade unless otherwise stated, as shown in Table.2.1.

2.1.1 - Stock solutions for paracetamol (1000 ppm):

A - 0.1 g of pure solid paracetamol was dissolved in deionized water and completed to 100 mL with deionized water in a volumetric flask.

B - 0.1 g of pure solid paracetamol was dissolved in 5% (v/v) methanol/water solution and completed to 100 mL with the same solution in a volumetric flask.

C - 0.1 g of pure solid paracetamol was dissolved in 5% (v/v) ethanol/water solution and completed to 100 mL with the same solution in a volumetric flask.

More diluted solutions were prepared by simple dilution of stock solution for each type of above solutions.

Table.2.1 - The chemicals used throughout this study.

chemical	**purity**	**company**
paracetamol	**Medicine grade**	**SDI**
methanol	**HPLC grade**	**BDH**
ethanol	**HPLC grade**	**BDH**

2.2 - Apparatus:

The apparatus used throughout this study were:

- UV - VIB Spectrophotometer (Jasco V- 650 Japan) was used for UV spectra of the samples.
- Kern ACJ/ACS, max. 120 g, d 0.1 mg, was used for tablets weighing.
- Different type of glass wear were used for prepare and store the solution.
- Mechanical stirrer.

2.3 - Spectrophotometric scanning for paracetamol:

This study was carried out using UV-VIS spectrophotometer on a solution containing 100 ppm paracetamol as listed in Table 2.2 and Fig. 2.1- 2.3.

Table.2.2 – Results of scanning study.

No.	Solution type	Paracetamol conc. ppm	Wave number nm
1	water	100	243
2	5% methanol/water	100	243
3	5% ethanol/ water	100	243

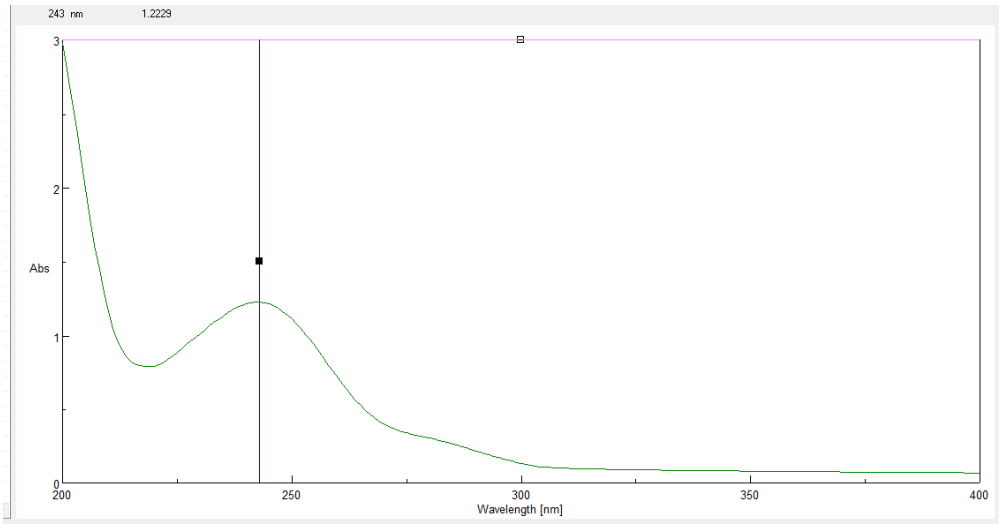


Fig: 2. 1: UV Spectrum for paracetamol in 5% methanol

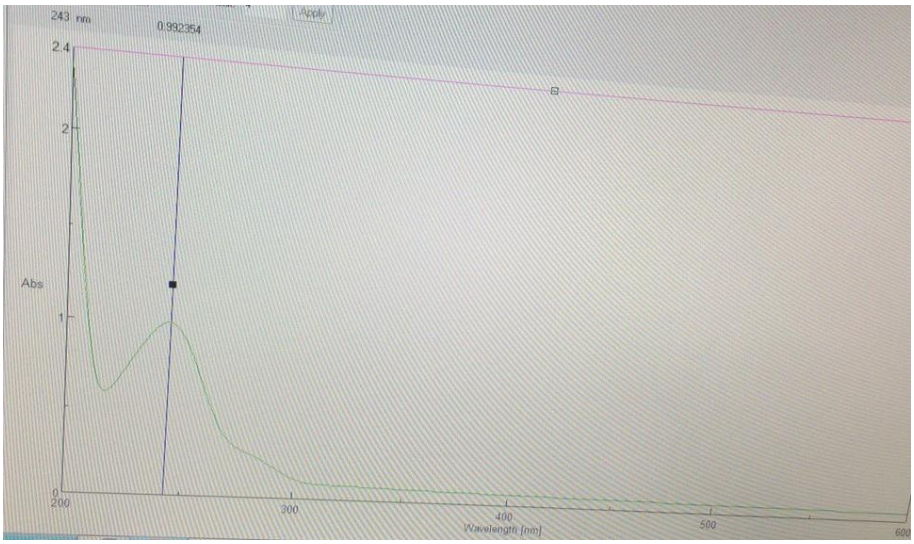


Fig: 2. 2: UV Spectrum for paracetamol in water

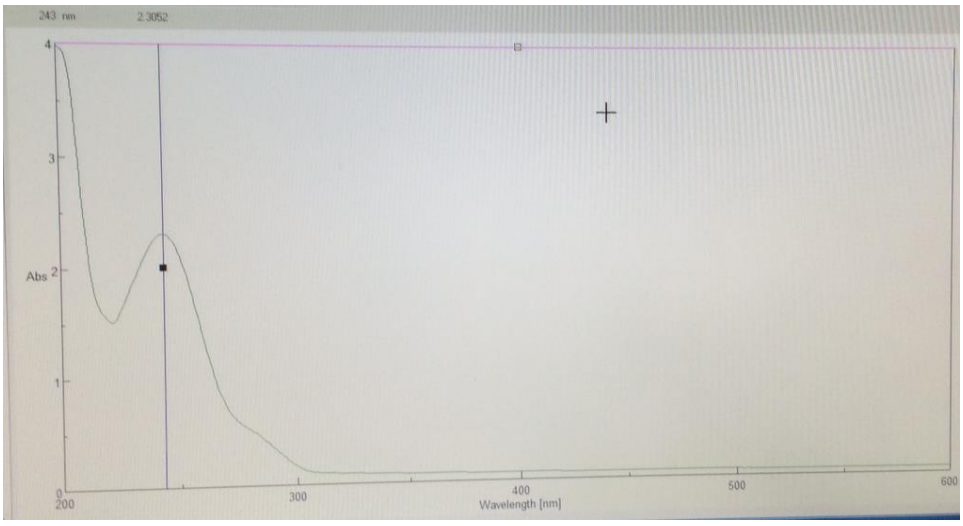


Fig: 2. 3: UV Spectrum for paracetamol in 5% ethanol

2.4 – Determination of paracetamol in different types of manufactured tablets:

The raw material that used for preparation of stock solution obtained from SDI, Iraq. But the samples (paracetamol tablets) were taken from the Iraq pharmaceutical market. Table 2.3, tabulated the data obtained concerning the proprietary name, source, M.D, E.D and paracetamol quantity.
This study was conduct out as following:

1 - Weigh and grind three tablets of each type or source of the drug (Table 3.1)

2 - Transfer an accurately weighed portion, equivalent to about 0.01g of sample powder, to 100 ml volumetric flask.

3 - Add about 50 ml of solvent, and shake by mechanical means for 20 min.

4 - Dilute with same solvent to volume, and mix.

5 - Pass the solution through a filter having 0.5 μm or finer porosity.

6 - Each one of the samples is tested using the same conditions that used in the standard in the UV system at the same wave number applied for standard measurements.

7 - Then the equation of straight line is applied to calculate Paracetamol concentration & its weight.

Table.2.3 – List of samples under study.

Name of sample	company	country	M.D	E.D	Paracetamol mg
Paracetamol	**Haditha**	**Iraq**	**2/2015**	**2/2018**	**500**
Panadol	**gsk**	**China**	**4/2105**	**4/2018**	**500**
Paracetamol	**MEHECO**	**China**	**12/2014**	**11/2017**	**500**
Panda	**JOSWE**	**Jordan – Sweden**	**3/2014**	**4/2017**	**500**
Pmol	**Oman**	**Jordan**	**8/2014**	**8/2017**	**500**
Piodol	**Pioneer**	**Iraq**	**8/2015**	**8/2018**	**500**
Paracetamol	**SDI**	**Iraq**	**8/2015**	**8/2018**	**500**
APMOL	**NKD**	**India**	**12/2014**	**11/2017**	**500**
adol	**Julphar**	**U.E.A**	**3/2015**	**3/2018**	**500**
Paracetamol	**TROGE**	**Germany**	**10/2013**	**10/2017**	**500**

The active substance is paracetamol. Each tablet contains 500mg of paracetamol as written on the samples. The other ingredients are maize starch, potassium sorbate, purified talc, stearic acid, povidone, and soluble starch.

Chapter three

Results and Disscusions

3 – Results and Discussion:

3.1 – Weighing of tablets samples:

Three tablets from each sample were weight (one, one), the mean of weight and RSD are illustrated in (Table 3.1). The results revealed that there is a significant difference in the weight off the tablets of the same company due to the high values of standard deviation.

Table.3.1 – The results of tablets weighing.

Name of sample	Company	Country	Mean of weight mg	Standard deviation	Coefficient of variation	R.S.D
Paracetamol	Haditha	Iraq	650	10.0	0.0178	1.785
Panadol	gsk	China	583	0.031	0.0053	0.530
Paracetamol	MEHECO	China	550	9.0	0.0163	1.630
Panda	JOSWE	Jordan – Sweden	557	11.0	0.0197	1.970
Pmol	Oman	Jordan	600	12.0	0.0200	2.000
Piodol	Pioneer	Iraq	547	3.5	0.00639	0.639
Paracetamol	SDI	Iraq	629	10.1	0.0160	1.600
APMOL	NKD	India	600	10.0	0.0166	1.660
adol	Julphar	U.E.A	630	10.0	0.0158	1.580
Paracetamol	TROGE	Germany	593	29.0	0.0489	4.890

3.2 – Preparation of calibration graph:

A serious solutions have a different paracetamol concentration rang of (1, 3, 5, 8, 10 mg/L) were prepared by simple dilution of stock solutions which were prepared in 2.1.1.Figurs 3.1 – 3.3, shown the plots of calibration graph for a solutions at different concentrations with R^2 of (1, 0.9999, 0.9999) for water, methanol and ethanol respectively.

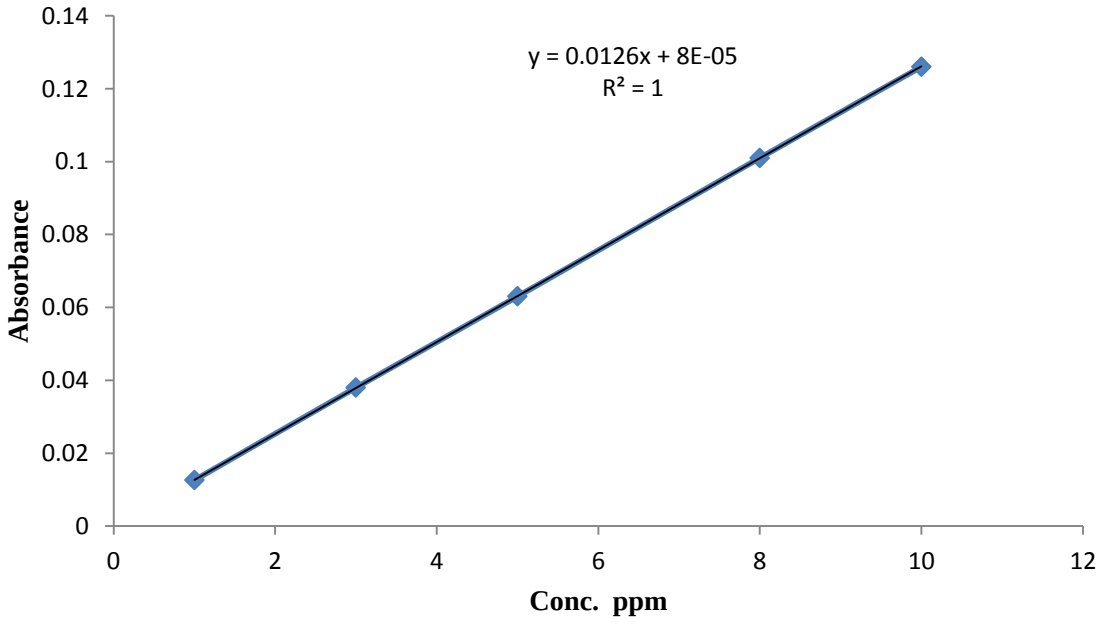


Fig:3.1:Calibration graph of paracetamol in water

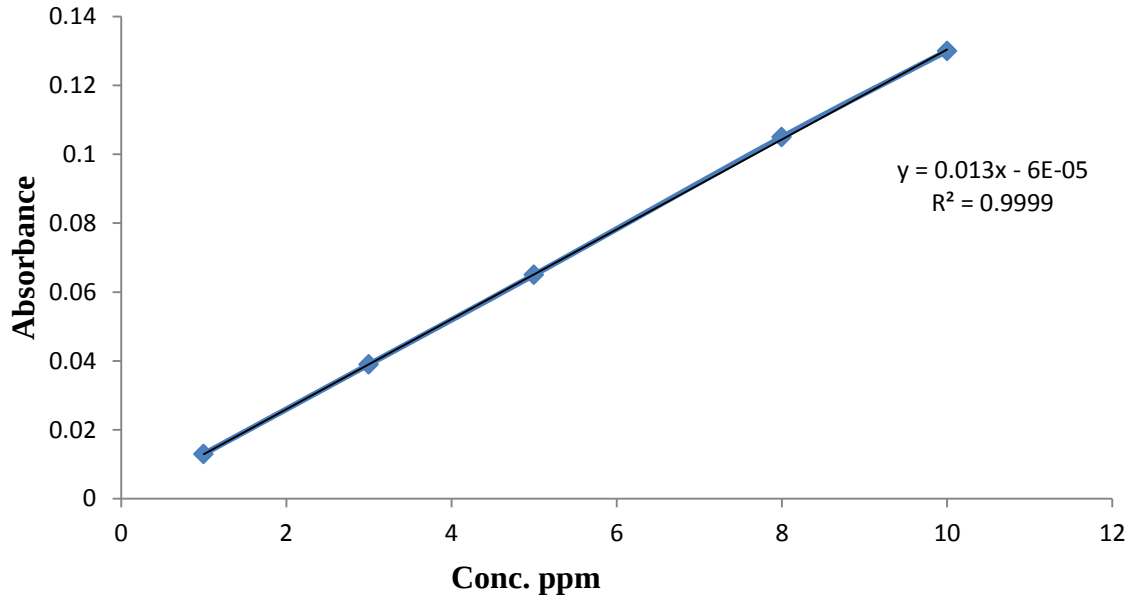


Fig: 3.2:Calibration graph of paracetamol in 5% methanol

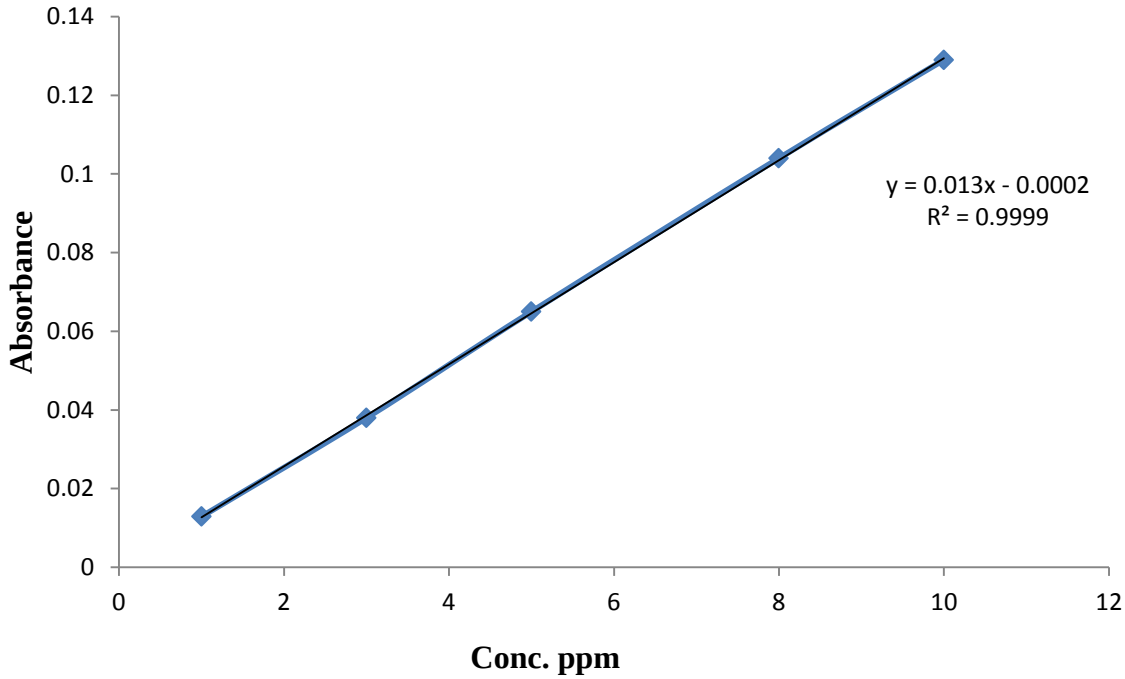


Fig: 3.3: Calibration graph of paracetamol in 5% ethanol

3.3 – Estimated of paracetamol quantity in samples:

A 0.01 g from each sample powder was weight and dissolved in 100 ml of different solutions used for recovery of paracetamol in this study, the absorbance was measured in the same λ_{max} which was measured in 2.3.Tables 3.2 – 3.4 tabulate the results obtained. The results indicate that the recovery percentages are with acceptable range of (98.2 – 104.16), and R.S.D range of (0.117 – 0.141).

Table.3.2 – The results obtain from the measurement of paracetamol in tablets using water as solvent.

company	Label Claim mg/ tab.	Mean amount found mg/tab.	% Mean amount found	R.S.D n = 3
Haditha	500	494.2	98.84	0.121
gsk	500	493.1	98.62	0.131
MEHECO	500	519.8	103.96	0.123
JOSWE	500	510.2	102.04	0.124
Oman	500	490.0	98.00	0.133
Pioneer	500	492.5	98.5	0.141
SDI	500	513.0	102.62	0.123
NKD	500	491.6	98.32	0.124
Julphar	500	495.5	99.10	0.132
TROGE	500	509.3	101.86	0.130

Table.3.3 – The results obtain from the measurement of paracetamol in tablets using 5% methanol as solvent.

company	Label Claim mg/ tab.	Mean amount found mg/tab.	% Mean amount found	R.S.D n = 3
Haditha	500	495.3	99.06	0.117
gsk	500	491.0	98.20	0.123
MEHECO	500	520.8	104.16	0.125
JOSWE	500	507.2	101.44	0.116
Oman	500	495.3	99.06	0.140
Pioneer	500	493.8	98.76	0.128
SDI	500	514.1	102.82	0.124
NKD	500	492.9	98.58	0.119
Julphar	500	498.7	99.74	0.118
TROGE	500	516.1	103.22	0.123

Table.3.4 – The results obtain from the measurement of paracetamol in tablets using 5% ethanol as solvent.

company	Label Claim mg/ tab.	Mean amount found mg/tab.	% Mean amount found	R.S.D n = 3
Haditha	500	495.05	99.01	0.123
gsk	500	492.70	98.54	0.121
MEHECO	500	518.40	103.68	0.127
JOSWE	500	510.00	102.00	0.118
Oman	500	495.60	99.12	0.128
Pioneer	500	494.75	98.95	0.125
SDI	500	511.65	102.33	0.119
NKD	500	494.35	98.87	0.128
Julphar	500	496.75	99.35	0.120
TROGE	500	513.15	102.63	0.117

Table 3 – 5 illustrated the obtained mean for each method, mean amount found for the three methods, % of mean found, standard deviation, coefficient of variation and R.S.D.

Table: 3.5: The final estimated quantity of paracetamol in tablets of different samples.

Company	Mean mg for water method	Mean mg for methanol method	Mean mg for ethanol method	Mean of mean mg for all methods	% of Mean found	Standard deviation	Coefficient of variation	R.S.D
Haditha	494.2	495.3	495.05	494.85	98.97	0.5766	0.00116	0.116
gsk	493.1	491.0	492.7	492.27	98.45	1.1151	0.00227	0.227
MEHECO	519.8	520.8	518.4	519.67	103.93	1.2055	0.00232	0.232
JOSWE	510.2	507.2	510.0	509.13	101.83	1.6773	0.00329	0.329
Oman	490.0	495.3	495.6	493.63	98.73	3.1501	0.00638	0.638
Pioneer	492.5	493.8	494.75	493.68	98.74	1.1295	0.00288	0.288
SDI	513.0	514.1	511.65	512.92	102.58	1.2270	0.00239	0.239
NKD	491.6	492.9	494.35	492.95	98.59	1.3757	0.00279	0.279
Julphar	495.5	498.7	496.75	496.98	99.40	1.6127	0.00324	0.324
TROGE	509.3	516.1	513.15	512.85	102.57	3.4099	0.00649	0.649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