ISSN No:-2456-2165

Role of Chemicals in Pharmaceutical Research and Biological Science

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Abstract:- Aim of this research is to define the role of chemicals in pharmaceutical research There are several steps in pharmaceutical research. Some of them are choosing of raw material, formation of API and addition of excipient. In all these steps chemicals play essential role. Chemicals use in formation of API and also several chemicals are using as excipients to support medicine and provide stability. A large no. of chemicals are use as solvents, reagents and as catalysts also. Thus knowledge of chemicals and their availability is major condition in preparation of any medicine. Chemicals make pharmaceutical research easier and faster. In this article we will see some examples of chemicals form as API(paracetamol, Oxymetazoline hydrochloride etc), some example of chemicals use as anti-adherents(for example Talc and microcrystalline cellulose), lubricants(talc, glidants etc), fillers (lactose, sucrose etc)and preservatives etc. They are said to be excipients. Here we will see some examples of chemicals which use as catalyst, reagents and solvents. An important step of pharma research is analysis which is depend on analytical techniques like spectroscopy(UV-vis, IR, MASS etc.) and chromatography(GS , HPLC, HPAC etc.). Analysis techniques are carry out for various purpose like to identify raw materials, to purify drug and to remove all side affects which leads to the formation of very useful and desired medicine. Several chemicals are their which use in these analysis techniques. Thus in every step chemicals come out essential factor in pharmaceutical research. Role of chemicals are very vast.

Keywords:- *Essential, Chemicals, Analysis, APIs, Excipients.*

I. INTRODUCTION

Medicine manufacture in pharmaceutical research is very large and sophisticated process in which chemicals serve as estrade from initial to final step of drug manufacturing process. Hence knowledge of chemicals and their availability is foremost condition for pharma research. U.S.A is at foremost in chemical production. India is on sixth place in the world and third place in Asia in chemical production[1].From identification of disease till formation of medicine there are various steps in pharma research. Each step of drug manufacture must be conduct under full supervision because a little carelessness can cause huge damage. Aspirin, Paracetamol and chloroquine etc. are some examples of medicines which formed synthetically in pharmaceutical industry. In pharmaceutical research chemical use as API, excipients, catalyst, reagents, drug design and development etc. Chemicals play very important role and are uses in various steps during medicine manufacture. Formation of API and addition of excipients to support APIs are the important steps which result in formation of useful medicine. APIs can be formed by synthetic, semisynthetic or may be natural products. Most widely use APIs are produce by semisynthetic and synthetic chemical products. There are some chemicals also which work as solvent (for example**. Iso-octane, n-pentane** etc), reagents and catalyst (for example **platinum and palladium**).Chemicals are also play their role in various analytical techniques which carry out in pharma research in to form useful medicine. Role of chemical in pharmaceutical research is very wide.

[1] "Exports of India chemical register growth of 106% in 2021-2022 over 2013-2014"*pib.gov.in.*27 April 2022. Retrieved 6 January 2023.

II. VARIOUS STEPS IN PHARMACEUTICALS RESEARCH

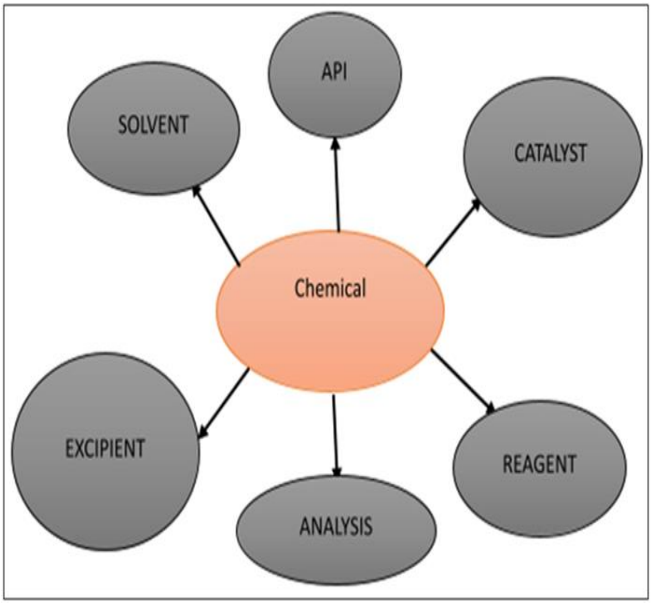

Fig 1 Chemical

A. Role of Chemicals in Formation of APIs:

In preparation of medicine API is the chief constituent. API is the active part of the medicine that actually work on disease and fix it. Choosing proper chemical as raw material and chemical reaction use to convert it into desired API must be accurate and done carefully. Here chemical and

chemistry both play essential role. An API manufacturer first develop the chemical compound in laboratory, after which production department manufacture a bulk amount of API using large size of reactors and before selling to drug seller they undergo purity check [2] .API forms major part of medicine. API is not directly converted into medicine infect some other chemical constituents are also associate. For examples hydrochloric acid with very high purity (37%) can be use in chemical synthesis of API and monochloroacetic acid can also be widely use in pharmaceutical research[3].

➢ *Let us Take a Look on Most Widely use Medicines and Chemical form as API:*

- *Some Medicines and their API*

Table 1 Some Medicines and their API

Medicine	API	Chemical Formula
Paracetamol	Paracetamol	C8H9NO2
Aspirin	Acetylselicylic acid	C9H8O4
M-spas	Two active salt- Dicyclomine hydrochloride and Mefenamic acid (in ratio 1:25)	C19H36ClNO2 and C15H15NO2
Afrin	Oxymetazoline hydrochloride	C16H25ClN2O
Tramadol	Tramadol hydrochloride	C16H25NO2

B. Role of Chemicals as Excipients:

These are other substances that mix with API to form useful medicine. Excipients are employed for safety purpose due to which API can work on target disease very easily without any problem and fix that in minimum time. They are inert; they do not react with the API and they have no side effects on patient body. Excipients includes binders, adjuvants, antiadherent, coatings, colours etc.Excipients provide safety and stability to the medicine. There are a no. of chemicals which use as excipients and they provide differet type of characteristics to the medicine. In this way there are many types of excepients:

➢ *Anti-Adherent –*

API is present in powder form, some chemicals are use as anti-adherent to keep API in powder form (prevent from sticking with punch surface) during the various steps in medicine formation. Some of those chemicals are:

- *Silicas:*

Silicon dioxide, calcium silicate are among the best performing anti—adherents. MCC and starch can also be count as anti-adherent due to its absorbent property[4]

- *Binders-*

It takes a long time to make the medicine and get it to the patients for use. There are many chemicals use as binders to bind the particles of medicine so that it does not spoil in the long process.Binders can be wet or dry.

- *Binders and their Method of Edition*

Table 2 Binders and their Method of Edition

Binders	Method of Addition
Starch	Wet
PVP	WET/DRY both
Glucose	Wet
HPMC	Dry/wet both
Cellulose	Dry/wet both
Polyethylene glycol	Dry/wet both
Alginic acid	Dry

- *Coating*:

There are many chemicals which use for coating purpose in medicine. Some examples are **cellulose acetate trimellitate (CAT), methylcellulose, ethylcellulose, hydroxyethylcellulose, polyvinyl pyrrolidone, shellac, zein etc.**

- *Disintegrants:*

Some medicines are make to act quickly in emergency. In those medicines some chemicals are use as disintegrants to provide immediate relief. These chemicals are add to API before granulation frequently. For ex; Table[5]

Table 3 Disintegrants

Disintegrants	Conc. in Granulation (%w/w)
Alginic acid	5-15
Guar gam	2-8

- *Filler/Diluters*:

Sometiomes to maintain the proper weight of medicine some chemicals are work as filler excipients[6].

- *Flavouring Agents*:

Chemicals are also use as flavouring agents like chloroform, aromatic oils like clove etc, synthetic flavours like **vaniline and benzaldehyde, chemicals like disodium adenylate and disodium succinate.**

- *Colouring Agents*:

Example are **curcumin, greens, patent blue, quinoline yellow WS, tetrazine etc.**

- *Lubricants*:

There are many chemicals which use as lubricants to decrease the adhesive force between the constituent particles. Thus lubricants increase the flowability by decrease the friction between the particles of medicine.

[2] IMPACT OF ACTIVE PHARMACEUTICAL INGREDIENTS (API) SCARCITY IN PHARMACEUTICAL SECTORS ADMIST COVID-19 PANDEMIC
[3] https://www.products.pcc.eu/en/k/pharmaceutical-inductry/
[4] https://www.imcdgroup.com
[5] Pharmaceutical Excipients Used In the Manufacture of Tablet
[6] https://www.americanpharmaceuticalrivew.com

ISSN No:-2456-2165

Examples of some chemicals are **magnesium stearate, stearic acid, mineral oil and talc** etc.

- *Preservatives:*

To avoid spoilage of drug and to increase lifetime of medicines some chemicals are also add as preservatives excipients.

- *Some Preservatives and their Activity*

Table 4 Some Preservatives and their Activity

Preservative	Activity
Benzoic acid	Antimicrobial
Sodium benzoate	Antibacterial or antifungal
Phenol	Vaccine preservative
Chlorobutanol	Antimicrobial at upto0.5%w/vconc
Ferulic acid	Moderate antimicrobial
Eugenol	Excellent antimicrobial

C. Role of Chemicals as Catalyst:

Catalyst provide extra stability to drug. Catalyst is also use to increase the rate of many chemical reactions. They increase the rate of reaction by decrease the activation energy. A wide range of chemicals are also use as catalyst for example **L-Dopa, naproxen, vitamin K, platinum and palladium etc.**

➢ *Catalyst and their uses*

Table 5 Catalyst and their uses

Catalyst	Use
L-Dopa	For treatment of perkinson"s disease
Naproxen	Use for cure of rheumatoid arthritis and acute muscle pain
Vitamin K	For blood clotting
Platinum	Catalytic hydrogenation

D. Role of Chemicals as Reagents:

There are many cemicals which have been use as reagents in many pharmaceutical research. Reagents are use to find out whether the particular substance is present or not and they do not affect the rate of that chemical reaction. A lot of organic chemicals are use in pharmaceutical research as reagents for example gibbs reagent, Folin Reagents, Froehde reagents, Lucas reagent[7] etc.

➢ *Lets take a Look on some Chemical Reagents and their use:*

Table 6 Role of Chemicals as Reagents

Reagents	Use
Lucas Reagent	To differentiate alcohols
Gibb's Reagent	For detection of phenolic compounds
Folin's reagent	To measure the level of amines and amino acids
Froehde reagents	To find out alkaloids

[7] International Journal of Medicine and Pharmaceutical Research

E. Role of Chemicals in Analyse:

Analysis of chemicals form as API or other chemicals which add as excipients in API is very important step in pharmaceutical research. Analysis of drug is basically carry out to check the purity of API and other characteristics like purity check , molecular structure determination, affinity determination etc. Analysis of pharmaceutical research is basically carry out by analytical techniques like spectroscopy techniques or other techniques like chromatography. Spectroscopy techniques is use for those information which can't obtain from other techniques. Those spectroscopy techniques include UV-vis. NMR, IR, MASS, ESR spectroscopy etc .All of these techniques provide important information regarding molecular structure, identification of binding sites, functional groups, hydrogen bonding etc. In all these spectroscopy techniques different-different chemicals use in instrumentation, as solvents and as reagents. In UV-vis spectroscopy some specific chemicals use are nitric acid (HNO_3) for washing holders and beryllium oxide (BeO) as detector. Similarly in IR chemical mercury cadmium telluride (MCT) is use as photoconductive detector, silicon carbide use as IR globar source, some chemicals use as solvents like chloroform, carbon tetrachloride and carbon disulfide. Hence many chemicals are required to carry out analysis. On the other side if any analysis is carry out by chromatography then that also have many liquid chromatography(LC) etc. In all these chromatography techniques many chemicals use. In HPLC technique reverse phase mode is basically consisting of acetonitrile/methanol and formic/acetic acid.[8]

III. RESEARCH METHODOLOGY

Research study is done by analysis of secondary data which includes books, journals, articles and reports. These sources are critically reviewed and analyzed that help to make me a base of study. The nature of study is descriptive.

IV. CONCLUSION

In pharmaceutical research a large no. of chemicals use for various purpose. Chemicals have interwined chemistry and pharmaceutical research and biological science with each other. In pharmaceutical process each step is related with chemicals. Some chemicals like cyclopentyl methyl ether, n-butanol, acetone etc. are use as solvents for raw material. Whether it is API or excipients, use of chemicals can be seen everywhere. Chemical like silicon dioxide, calcium silicate benzaldehyde, disodium adenylate and disodium succinate. Most of the things are need to complete pharmaceutical research like catalyst and reagents. There is need of chemicals for those things also like L-Dopa and naproxen use as catalyst. After the formation of it undergo for analysis to check purity or to eliminate side affects either by spectroscopy or chromatography techniques. We can't deny the use of chemicals even in those cases, whether it is

[8] http://www.ru.nl./systemchemistr/equipment/chromatography/hplc/#:~:text=High%2Dperformance%20liquid%20chromatography,individual%20components%20of%20the%20mixture

in instrumentation or whether it is in solvents their use can be seen everywhere. Hence we can say that chemicals play very important role in pharmaceutical research. Proper knowledge of chemicals and their availability is major condition for pharmaceutical research.

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