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A REVIEW ON EXTRACTION TECHNIQUES

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Abstract:

This discussion is concerned primarily with basic extraction procedures for crude drugs to obtain the active therapeutic ingredients and eliminate the unwanted material by treating with the selective solvents. A wide range of technologies are available for the extraction of active components and essential oils from medicinal and aromatic plants. The choice depends on the economic feasibility and suitability of the process to the particular situation. Techniques of extraction continue to be investigated and applied to obtain higher yields of the active substances from natural resources. Some of these methods are maceration, percolation, infusion, decoction etc, by using methods we can isolate the active constituents from raw materials of plant and animal sources.

Keywords: *Solvents Maceration, Percolation, Infusion & Decoction.*

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INTRODUCTION:

Extraction

The process of isolation of active ingredients or active substances or active medicaments from raw materials of either plants or animals or directly from the natural sources with the help of solvent is called extraction.(or) The removal of desired soluble constituents from a substance leaving out those which are unwanted with the aid of solvent is called Extraction.

Purpose for Extraction

- To obtain the therapeutic portion of dosage form from raw materials and to eliminate the unwanted or inert material by treatment with solvent
- They play a decisive role in the determination of qualitative and quantitative composition of extracts
- The extracts obtained are also utilized for the isolation and characterization of therapeutically active chemical constituents.

General Terms

Marc:

The unwanted or insoluble substances left behind after the process of extraction is called marc. These are not used for further purpose in the process of extraction.

Menstrum

The solvent used in the process of extraction is called solvent. The most commonly used menstrum is water.

Choice of Menstrum

The menstrum should have the following properties

1. Highly selective for the compound to be extracted
2. High capacity of extraction
3. Should not react with the extracted compound or any other compound in the raw material.
4. Should have low price and easily available
5. Should be harmless to man and environment
6. Completely volatile

Expression

When the extraction process is done with the help of machine then it is also referred to as expression. (or)The accomplishment of extraction by means of mechanical aids is called expression.

Solvents used in Extraction

The solvents play an important role in the method of extraction. The main solvents used in the process of extraction are:

1. Water
2. Alcohol
3. Ether
4. Chloroform
5. Light petroleum

Water

It is the most common type of solvent used in the process of extraction. It is suitable for the extraction of proteins, Coloring matter, Gums, Anthraquinone derivatives, Alkaloids, Glycosides, Sugars, Tannins, Enzymes, Organic derivatives.

It dissolves many substances in it and is often described as universal solvent. The main substances that dissolve in this are Organic salts, Organic acids, Enzymes, Volatile oils.

Advantages Water

i. It is very cheap
ii. It has wide solvent action
iii. It is non-toxic
iv. It is inflammable

Disadvantages Water

i. Microbial contamination will occur
ii. It is non-selective
iii. It promotes hydrolysis
iv. It also promotes enzymatic degradation

Alcohol

It is a suitable solvent used for the extraction of Alkaloids, Alkaloidal bases, Glucosides, Volatile oils, Tannins, Resins. The substances soluble in alcohol are Coloring matter, Anthraquinonoid derivatives, Tannins, Organic salts, Organic acids, Alcohol is not suitable for the extraction of the following because they are not soluble in the alcohol: Fats, Fixed oils, Waxes, Sugars like sucrose.

Advantages of Alcohol

1. Has wide solvent action
2. No chance for the bacterial growth
3. It is non-toxic
4. Neutral in nature and also show compatibility with the pharmaceutical product
5. Absorption of constituents is more than water
6. It is selective
7. No additional preservatives were required
8. Requires less heat when compared to water

Disadvantages of Alcohol

1. It is costly

Ether

It is used as a solvent for the extraction of fats, fixed oils, waxes, resins, alkaloids.

Advantages of Ether

a. It is inflammable

Disadvantages of Ether

a. It is costly
b. It has a physiological effect
c. It is unsuitable for internal administration.

Chloroform

It is used as a solvent for the extraction of Fats, fixed oils, waxes, resins, alkaloids.

Advantages of Chloroform

1. it is inflammable

Disadvantages of Chloroform

a. It is costly
b. It has a physiological effect
c. It is unsuitable for internal administration.

Light Petroleum

It is used as a solvent for the extraction of Fats, fixed oils, waxes, resins, alkaloids,

Advantages of Light Petroleum

1. It is inflammable

Disadvantages of Light Petroleum

a. It is costly
b. It has a physiological effect
c. It is unsuitable for internal administration

Theory of Extraction

The general procedure employed in the extraction of organized drugs like tissues differs from that of unorganized drugs like gums, resins, gum resins or oleo gum resins. All the factors which help in accomplishing, facilitating or enhancing the solubility of desired constituents in the menstrum explain theory of drug extraction.

In case of organized drugs, the cells constituting tissues contain various plant constituents in the fluid called cell sap either in solution form or dispersed in a colloidal state. on drying the drug, such dissolved or colloidal dispersed matter is either precipitated, crystallized and deposited in a amorphous in cell structure.

The cell wall consists of cellulose and these molecules being polar, there is a natural affinity for polar solvents, In the presence of polar solvents, the cellulose walls get hydrated or solvated and swell. This is why moistening of the drug with the menstrum is an important stage in extraction. Swelling or Imbibition is maximum in polar solvents. Mobility of liquids through a crude drug is generally diffusion controlled.which may be termed as "Endosmoisis".

As the solution with in the cell becomes stronger, a differential concentration is set up with in and out of the cell. This causes the stronger solution to diffuse out of the cell until equilibrium is reached and this phenomenon is called "Exosmosis". The movement of molecules through pores and capillaries present in natural system depend on:

a. Surface tension
b. Wetting properties of liquid
c. Displacement of air entrapped in capillaries

The Entire process of drug extraction can be divided into four steps

1. Penetration of the solvent into the drug.
2. Dissolution of constituents
3. Outward diffusion of the solution from the cells
4. Separation of dissolved portion and the exhausted drug

The Efficiency of drug extraction depends on following steps

a. Nature and properties of drug and its extractable constituents
b. Particle size of powdered drug
c. Nature of solvent
d. State of contact between the solvent and drug particles.

The physical properties which effect the drug extraction are:

1. Gravitation
2. Diffusion
3. Osmosis
4. Adhesion
5. Capillarity
6. Convection
7. Solubility
8. Surface tension

Wetting property of solvent can be improved by displacing the air entrapped in the capillaries and also by using surface active agent. Surfactant can increase the solubility by means of solubilization. The advantages of performing the extraction at the higher temperatures are:

a. Decreases viscosity which decreases the boundary layers
b. Convection currents have similar effects to agitation which increases the solubility
c. Solubility increases due to rise in temperature.

Different Methods of Extraction Processes (1)

There are many types of extraction processes and these are selected based on the type of drug to be isolated and the flow chart for the types of extraction is given below

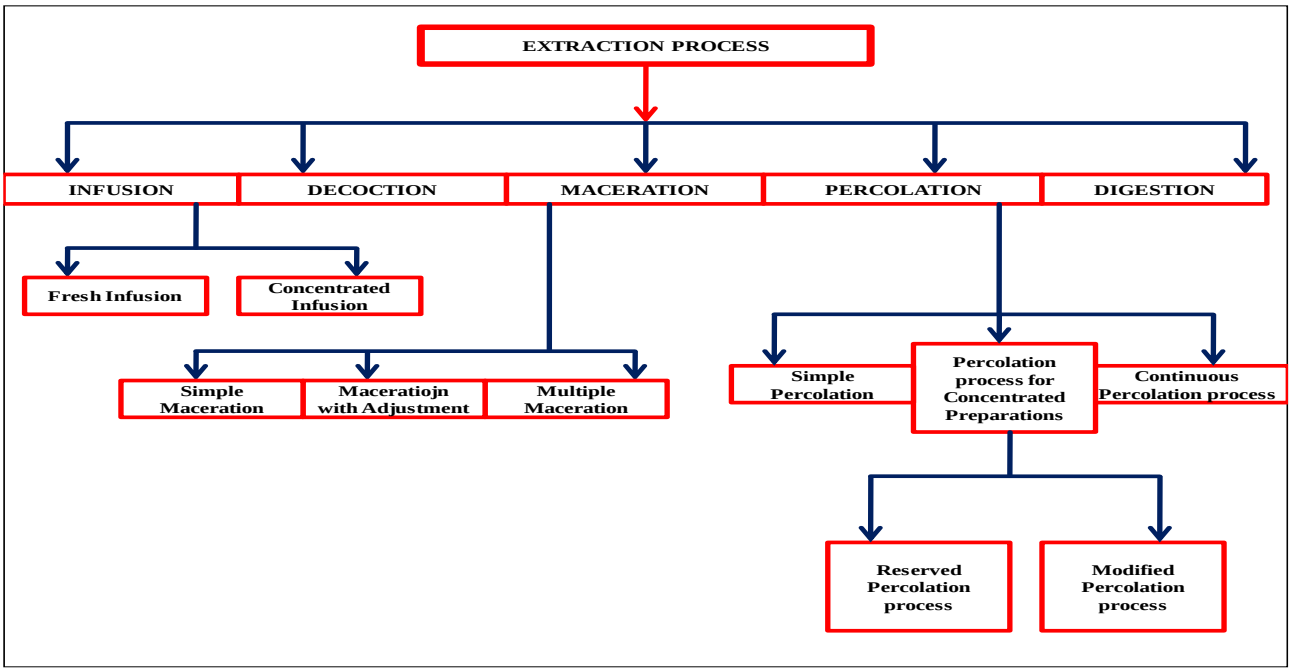

Fig 1: Different Methods of Extraction Processes

1. Maceration

Principle:

In this process solid ingredients are placed in a stoppered container with the whole of the solvent and allowed to stand for a period of at least 3 days (3 - 7 days) with frequent agitation, until soluble matter is dissolved. The mixture is then strained (through sieves / nets), the marc pressed and the combined liquids clarified (cleaned by filtration) or by decantation, after standing. Stoppered container is generally taken to reduce the loss of solvents by evaporation. If the volume of solvent is reduced by evaporation then the extract may become concentrated, which may not be desired [3].

The drug is allowed to stand for few days

i) To help the solvent to penetrate the cells of the drugs,

ii) To provide the time for partitioning the active ingredient into the solvent and

iii) To transfer the drug out of the cells into the bulk of the solvent.

Frequent agitation is required to reduce the localized concentration around the cells and tissues.

As indicated in the pharmacopoeia the process consists of the following:

- Placing the solid materials with whole menstrum in the closed vessel and allowed to stand for 7 days shaking occasionally.
- Strained, pressed the marc and the liquid is obtained.
- Liquid (i.e. the extract) is clarified by subsidence or filtration.

Fig 2: Maceration Process

The process is normally used for the preparation of tinctures or extracts and menstrum is usually alcoholic, hydro alcoholic (in case of tinctures) or may be aqueous.

A. Simple maceration - a process for tinctures made from organized drugs e.g. roots, stems, leaves etc.

B. Maceration with adjustment - a process for tinctures made from unorganized drugs such as oleo-resins and gum resins.

C. Multiple maceration - a process to prepare concentrated extract. It includes 'Double maceration' and 'Triple maceration'.

A. Simple Maceration

Organized drugs having specific cell structures like roots, stems, leaves, flowers etc. are extracted by this procedure.

Apparatus

A wide mouthed bottle or any other container which can be well stoppered can be used for maceration process. A closed container is essential to prevent the evaporation of menstruum which is mostly concentrated alcohol. Otherwise this may lead to variation in strength as no adjustment in volume is made.

Method

Water or alcohol is used as menstruum and the drug menstruum ratio is 1: 10.

- The drug is placed with the whole of the menstruum in a closed vessel for seven days. During this period shaking is done occasionally.
- After 7 days the liquid is strained and marc is pressed.
- The expressed liquid is mixed with strained liquid.
- It is then filtered to make a clear liquid.
- The final volume is not adjusted.

Explanation

1. Shaking of the drug during maceration is essential in order to replace the saturated layers around the drug with fresh menstruum.
2. After straining, the marc is pressed in a filter press, hydraulic press or hand press etc. The marc can be squeezed out of a fine muslin piece, when the quantity of the drug is very small.
3. The pressed liquid is mixed with the strained liquid and then filtered. No final adjustment is made, since the volume of pressed liquid is likely to vary with the process of pressing the marc. If the final adjustment in volume is made, it will give variation in the concentration of active principle although the volume of the final preparation may be the same.
4. Filtration is necessary to remove insoluble cell contents obtained during the pressing of marc.

Examples: The tinctures made by simple maceration process are-

1. Tincture of Orange
2. Tincture of Lemon
3. Tincture of Squill

B. Maceration with Adjustment

The process is used for **unorganized** drugs.

Apparatus: Same as simple maceration.

Method:

- In this process the unorganized drug is placed with 4/5 th of the menstruum in a closed vessel for a period of 2-7 days. During this period, shaking is done occasionally .
- After the stated period, the liquid is filtered and the volume is made up by passing the remaining 1 / 5 the of the menstruum through the filter.
- The marc is not pressed.

Explanation

1. The period of maceration is reduced from 7 to 2 days in some cases, because the unorganized drugs behave like simple chemicals that dissolve in the solvent very easily and quickly.
2. 4/5th of the menstruum is used to keep the drug in contact with it in order to take into account the increase in volume after dissolving the soluble matter of the drug. The volume is made up at the end with 1/5th of the menstruum remained.
3. The marc left is a compact gummy matter. It does not retain the menstruum and hence it is not necessary to press the marc.
4. The final volume is made up because all the active constituents of drug get dissolved in the menstruum. Marc is not pressed. hence, there is no change in the concentration of the preparation in case the final volume is made up.

Example

1. Tincture of Tolu
2. Compound tincture of Benzoin.

C. MULTIPLE MACERATION

Multiple maceration process is carried out in the same way as simple maceration process, but the menstruum used is divided into two parts in double maceration process and three parts in triple maceration process

I. Double maceration process:

In this process, the drug is macerated twice by using the menstruum which is divided into two parts in such a manner that the same volume is used for each maceration. The quantity of menstruum required for two macerations are calculated as follows:

Volume of menstrum required for first maceration= Total vol. of menstrum – Vol. to be retained by the drug/2 + Vol. to be retained by the drug

Volume of menstruum required for second maceration =Total vol. of menstruum – Vol. of menstruum used in first maceration

The volume of menstruum to be retained by the drug is determined by experiment, in a test batch of drug by adding a known volume of menstruum to known weight of the drug. After maceration, straining and pressing of the marc, measured volume volume of liquid is obtained. Difference in the volume and the volume used represents the volume retained by the weighable quantity of the drug used.

- In double maceration process, the whole of the drug is macerated for 48 hours with the quantity of the menstruum required for first maceration.
- The liquid is strained and the marc is pressed.
- The marc is macerated again for 24 hours with the remaining menstruum required for second maceration.
- The liquid is strained and and the marc is pressed.
- First and the second liquid is mixed and allowed to stand for 14 days and then filter.

Examples:

The following concentrated infusions are prepared by double maceration process:

1. Concentrated infusion of orange.
2. Concentrated compound infusion of chirata.
3. Concentrated compound infusion of gentian.

II. Triple maceration process

In this maceration process, the drug is macerated thrice by using the menstruum which is divided into three parts in such a manner that the same volume for three parts in such a manner that the same volume is used for each maceratin.The quantity of menstruum required for three macerations is calculateas follows:

Volume of menstruum required for first maceration = Total vol. of menstruum – Vol. to be retained by the drug / 3 +Vol. to be retained by the drug

Volume of menstruum required for 2nd and 3rd maceration= Total vol. of menstruum – Vol. of menstruum used in first maceration/2

- The whole of the drug is macerated for one hour with part of menstruum required for first maceration and strained.
- The marc is macerated again for one hour with the part of the menstruum required for 2nd maceration and strained.
- The marc is macerated again for one hour with the part of the menstruum required for 3rd maceration and strained.
- The marc is pressed lightly.
- The liquid obtained from 2nd and 3rd maceration is pooled and evaporated to a specified concentration. This concentrated liquid is mixed with the liquid obtained from the 1st maceration.
- 90 % alcohol equal to 1/4th of the volume of the finished product is added.
- Volume adjusted with water and allowed to stand for 14 days and then filtered.

Examples

The following concentrated infusions are prepared by triple maceration process:

1. Concentrated Infusion of Quassia
2. Liquid Extract of Senna

2. PERCOLATION PROCESS [5-8]

A. Simple percolation process

B. Percolation process for concentrated preparations

I) Reserved percolation

II) Modified percolation

C. Continuous hot percolation / Soxhlet Extraction / Soxhlation

A. SIMPLE PERCOLATION

Apparatus:

Three types of apparatus are generally used,

i) Conical percolator

ii) Cylindrical percolator

iii) Steam jacketed percolator [for higher temperature extraction]

Conical Percolator

It is generally made of glass (or) metal usually copper which is tinned inside. It is conical in shape having the lower diameter not less than half of the upper diameter. There are less chance of choking of conical percolator incase the drug swells up, because a drug can slope against the walls of the percolator.

Fig 3: Conical Percolator

Disadvanges

1. Loss of menstrum due to evaporation because of its uppe4r bigger diameter.

Cylindrical Percolator

This percolator is cylindrical in shape. It is having two diameters i.e. upper and lower diameter. The chances of choking are very less when the drug swells up. Higher alcohol (or) any volatile solvents is used as menstrum.

Fig 4: Cylindrical Percolator

Steam Jacketed Percolator

The percolator is subjected to high temperature in order to increase the solvent action of menstrum. The percolator is heated by steam.

Fig 5: Steam Jacketed Percolator

Stages:

1.**Size Reduction:**

The drug to be extracted is subjected to suitable degree of size reduction, usually from coarse powder to fine powder, to

i) Increase the surface area of the drug exposed to the menstrum,
ii) For uniform packing of the percolator,
iii) To slow down the movement of the menstrum and
iv) To ensure complete exhaustion of the drug.

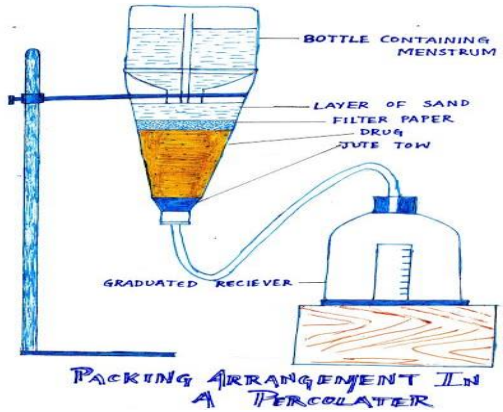

Fig 6: Packing of Percolator

2.Imbibition:

During imbibition the powdered drug is moistened with a suitable amount of menstruum and allowed to stand for four hours in a well closed container. During this period the drug swells up as the menstruum penetrates the cell walls. The preliminary moistening of the drug is necessary because:

the dried tissue swells when it comes in contact with the menstruum but if packed in the dry condition subsequent swelling will reduce the porosity of the material and choke the percolator, the air present in the interstices is removed by menstruum, which will otherwise disturb the packing of the percolator due to which the menstruum will run through the channels results in inefficient extraction,

i) it does not allow the fine particles to be washed out of the percolator during percolation.

3.Packing:

After imbibition the moistened drug is evenly packed into the percolator. Cotton wool or fibres of flax; previously moistened with menstrum is placed on the perforated plate of the percolator.

The packing should not be too tight, it will lead to slow extraction rate. Similarly, loose packing will allow the menstrum to pass through quickly resulting in incomplete contact with the drug.

The drug should occupy 2/3rd capacity of the percolator. After packing , a piece of filter paper is placed over top of the bed, on which small quantity of washed sand is placed to prevent disturbance of the packed material.

4. Maceration:

After packing sufficient menstrum is added to saturate the material. When the liquid begins to drip from the bottom of the percolator, the tap fitted at its bottom is closed. More menstrum is added if required, so that a shallow layer of menstrum is maintained over the drug bed.

The percolator is allowed to stand for 24 hours to macerate the drug.

5.Percolation:

After 24 hours maceration, the lower tap is opened and liquid collected therein is allowed to drip slowly at a controlled rate until 3/4th volume of the finished product is obtained.

Sufficient amount of menstrum is simultaneously added over the drug because at no time packed material should be allowed to become dry. After collecting 3/4 th volume, the percolate is tested for complete exhaustion of the drug by various tests.

Tests to check complete exhaustion of the drug:

i) Take a few ml of the last percolate and evaporate to dryness, it no residue remains - it shows that the drug is completely exhausted.
ii) The specific gravity of last few ml of percolate is measured. If it is equal to the specific gravity of the fresh menstrum the exhaustion is taken to be complete.
iii) Specific chemical tests may be performed on the percolate for the drugs containing alkaloids, glycosides, tannins, resins or bitter constituents.

- The marc is then pressed and the expressed liquid is added to the already collected percolate.
- More menstruum is added to produce the required volume.
- The liquid is then allowed to stand to settle the suspended particles, decanted or clarified by filtration.

Examples:
i) Tincture of belladonna
ii) Compound tincture of cardamom
iii) Strong tincture of ginger etc.

2. Percolation process for concentrated preparations

Fig 7: Percolation Process

I) RESERVE PERCOLATION

- In this process, the first portion (about 3/4 th of the final product) of the percolate which contains the maximum amount of active constituents is reserved. Subsequently, percolation is completed as usual until the drug is exhausted but the last part (about 1/4th of the final product) is collected separately.
- The second dilute part is then evaporated to get a syrupy consistency which is then mixed with the reserved first portion of the percolate.
- Finally volume is adjusted by adding more menstrum.

Example:
Liquid extract of liquorice

Advantages:
i) The reserved part of the percolate which contains the maximum amount of dissolved active principles is not subjected to heat, only the dilute portion is evaporated. Hence, the major portions of the active constituents of the drug are saved from deterioration.
ii) The process is economical as the whole of the percolate is not evaporated.

II) MODIFIED PERCOLATION

In percolation process for preparation of tinctures the drug/percolate (d/p) ratio is about 1:4. The d/p ratio is reduced to 1:3 by modifying the percolation process and hence, there is a lot of saving in heat, time and menstrum.

Percolation is a displacement process. The strong solution of active constituents of drug formed during maceration is displaced by the fresh menstrum when percolation process is started. It is proved that stationary menstruum (menstruum remaining in contact with the drug) dissolves more menstruum is required to exhaust the drug when simple percolation is used. But if continuous percolation stage has suitable breaks by short maceration stages, the d/p ratio can be reduced to 1:3.

Example:

In simple percolation process:

Drug (1000 g)	Imbibition (for 4 hrs)	Maceration (for 24 hrs)	Percolation and collect the percolate, i.e. 3/4 the of the volume of finished pre

Drug : Percolate = 1000 g : 4000 ml = 1 : 4

In modified percolation process:

Drug (1000g)	Imbibition(for 4 hrs)	Maceration (for 24 hrs) Maceration (for 12 hrs) Maceration (for 12 hrs)	Percolation and collect 1000 ml of percolate Percolation & collect 1000 ml of percolate Percolation & collect 1000 ml of percolate

Drug: Percolate = 1000 g: 3000 ml = 1: 3

3. CONTINUOUS HOT PERCOLATION PROCESS / SOXHLET EXTRACTION / SOXHLATION [2]

This process is used for those drugs

- where the penetration of the menstruum into the cellular tissues is very slow and
- the solute is not readily soluble into the solvent and
- the quantity of the menstruum is very less.

In such cases Soxhlet extractor is used where small volume of hot menstruum is passed over the drug time and again to dissolve out the active constituents until the drug is exhausted. The process is known as Soxhlation.

Apparatus:

i) A flask in which the menstrum is boiled,

ii) an extraction chamber in which drug is filled, is fitted with side tube and a siphon.

iii) a condenser.

The drug to be extracted, in suitably comminuted form is usually packed in a '**thimble**' made of filter paper which is then placed into the wider part of the extractor.

N.B. thimble is used to prevent choking of the lower part of the extractor.

Menstruum is placed in the flask and boiled. The vapor rises through the side tube to the condenser, where the vapor is condensed and fall on the packed drug, through which it percolates and extract out the active constituents.

As the volume of menstruum in the extractor increases, the level of liquid in the siphon also increases till it reaches the maximum point from where it is siphoned out into the flask.

On further heating the menstruum vaporizes while the dissolved active constituents remain behind in the flask. The alternate filling and emptying of the body of the extractor goes on continuously till the drug is exhausted. Thus the same quantity of menstruum is made to percolate repeatedly, about 14 to 15 times through the drug and the active constituents are collected in the flask.

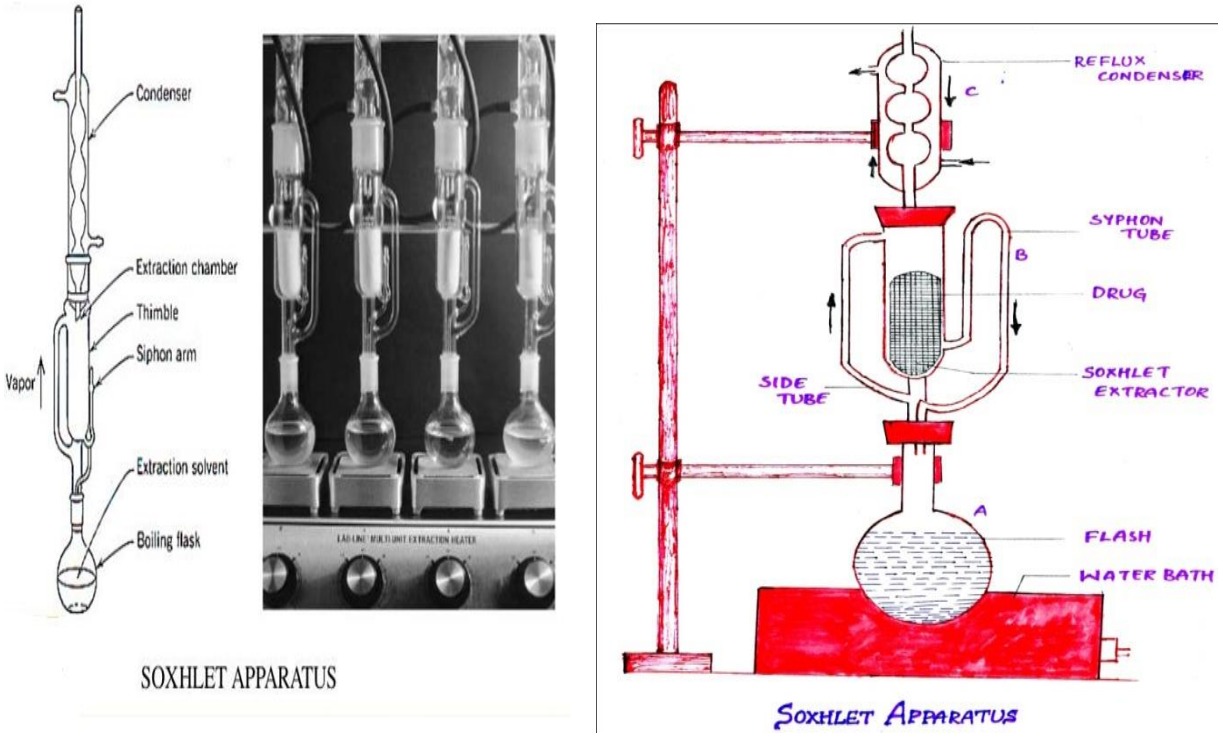

Fig 8: Soxhelet Extractors

Limitations of continuous hot percolation process:

1. Physical character of the drug: If the physical character of the drug is such that it would block the soxhlet apparatus then this method is not suitable. e.g opium, gum, resin, orange peel etc.
2. Solvent: Only pure solvents or constant boiling mixtures (like alcohol-water)can be used for this purpose.
3. Chemical constituents of the drug: The process is unsuitable for thermolabile active constituents, e.g. enzymes, alkaloids, anthraquinone derivatives, esters etc.

Examples:

Soxhlation process of extraction is used to

i) Extract cantharidins from cantharides with benzene
ii) Alkaloids from the seeds.

3. INFUSION [4]

This method is used for those drugs

i) which are soft in nature so that water may penetrate easily to the tissues and
ii) the active constituents are water soluble.

Apparatus:

Coffee-pot or tea-pot is the simplest form of apparatus used for preparing infusion. Sometimes special pots known as **infusion pots** are used for the preparation of infusions. It consists of a loose perforated shelf resting on a projection near the top of the pot.

Method:

In coffee-pot or tea-pot:

i) The drug is placed at the bottom of the pot. Water is added and it is well stirred three or four times during the period of infusion.
ii) Infusion can also be prepared by enclosing the drug in a muslin bag and then suspending it just below the level of water in a beaker. Stirring is not required in this case because the water slowly circulates due to the increase in specific gravity of water near the drug.

In infusion pot:

The drug is placed on the perforated shelf. The pot is filled with water and the perforated shelf is adjusted below the surface of water.

Fig 8: Infusion Apparatus

<u>Final volume is not adjusted.</u>

There are two types of infusions:

1. Fresh infusion, 2. Concentrated infusion

I. Fresh infusions:

A fresh infusion is an aqueous solution of active constituents of a vegetable drug prepared by the process of infusion e.g. Fresh infusion of Quassia.

Coarse powder of drug is used in the preparation of infusion. Water is used as menstruum.

Pharmacopoeia states that fresh infusion should be used within 12 hours after its preparation because it gets spoiled due to fungal or bacterial growth.

II.Concentrated infusions

Concentrated infusions differ from fresh infusions in that the concentrated infusions are prepared by maceration or percolation process and alcohol is used either as a menstruum or as a preservative.

An infusion containing 20 - 25 % alcohol can be stored for sufficiently long time.

e.g. Concentrated compound infusion of chirata and
Concentrated compound infusion of gentian.

3. DECOCTION [4]

Decoction is the process in which the water soluble and heat stable constituents of hard and woody crude drugs are extracted out.

Water is used as menstrum and the drug, cut in small pieces, is boiled with the menstrum for 10 to 15 minutes.

After boiling, the liquid is cooled and filtered, more water is passed through the marc to produce the required volume.

Adjustment to final volume is necessary to get a uniform product.

A freshly prepared decoction should only be dispensed and the same must be consumed within 24 hours.

At present no decoction is official in IP or BP.

4. DIGESTION [4]

This process is a modified form of maceration where the drug is extracted by heating at a particular pressure. This will increase the penetration power of the menstruum, so that there is complete extraction of the drug.

Apparatus: The apparatus is known as 'Digestor' is a vessel made up of metal. The whole of the drug is placed in the body of the digestor placed the cover over it and bolted it with the help of nuts.

The drug is treated with menstrum for a definite period under specified condition of temperature and pressure.

ii) No solvent residues.
iii) Environmentally friendly extraction procedure.

The largest area of growth in the development of SFE has been the rapid expansion of its applications. SFE finds extensive application in the extraction of pesticides, environmental samples, foods and fragrances, essential oils, polymers and natural products. The major deterrent in the commercial application of the extraction process is its prohibitive capital investment.

Table 1: Difference between Maceration and Percolation

SNO	MACERATION	PERCOLATION
1	Both drug and solvent are mixed together &kept aside for 7-14 days.	The solvent is allowed to pass through the column of the drug
2	Duration time is more	Duration time is Less
3	There is no necessity of the drug to be packed	The drug should be packed in layer to get rid of air gaps
4	More amount of menstrum is required	Less amount of menstrum is required
5	Doesn't require temperature, Except Digestion	Heat is required
6	More API cannot be extracted	Maximum possible amount of API can be extracted
7	The clarity of the preparation is low	The clarity of the preparation is low

Table 2: Differences between Infusion and Decoction

SNO	ITEM	INFUSION	DECOCTION
1	Plant	Soft structures (Eg:Senna Leaves)	Hard Woody structures(Eg:cinchona bark)
2	Menstrum	Boiling (or) Cold Water	Boiling Water
3	Procedure	Infusing the drug with cold or hot water	Boiling the drug with water
4	Time	Calculated as soon as water is added	Calculated as soon as water begins to boil.
5	Adjustment of final volume	No adjustment	Adjustment is necessary
6	Apparatus	Infusion earthware pot	Any covered apparatus
7	Storage	Used fresh within 12 Hours	Used fresh and when stored in refrigerator used within few days

Table 3: Difference between Organized Drugs and Unorganized Drugs

SNO	MACERATION FOR ORGANIZED DRUGS	MACERATION FOR UNORGANIZED DRUGS
1	Drug + entire volume of menstrum	Drug + 4/5 of menstrum
2	Shake occasionally for 7 Days	Shake occasionally for 2-7 Days
3	Strain the liquid, press the marc	Decant liquid, marc is not pressed
4	Mix the liquids clarify by filtration. final volume is not adjusted.	Filter the liquid final volume is adjusted by adding remaining amount of menstrum
5	Examples : Vinegar of squill,oxymel of squill,tincture of orange, tincture of lemon, tincture of squill	Examples: Tincture of benzoin, Tincture ofMyrrh, Tincture of tolu.

FACTORS AFFECTING THE CHOICE OF AN EXTRACTION PROCESS [9-10]

The final choice of the process to be used for the extraction of a drug will depend on a number of factors. They include:

1. Character of the drug
2. Therapeutic value of the drug
3. Stability of the drug
4. Cost of the drug
5. Solvent
6. Concentration of the drug

Character of the Drug

Knowledge of pharmacognosy of the drug to be extracted is essential for the selection of the extraction process that will give the best results.

- If the drug is hard and tough (such as *Nux vomica*), use percolation process.
- If the drug is soft and parenchymatous (such as *Gelatin*), use maceration process.
- If the drug cannot be powdered easily (such as *Squill*), use maceration process.
- If the drug is unorganized (such as *Benzoin*), use maceration process.

Therapeutic Value of the Drug

Maceration is considered suitable if the drug has little therapeutic value.

E.g. flavors (*Lemon*) and bitters (*Gentain*)

Percolation is used if the drug has considerable therapeutic value and maximum extraction is required.

E.g. *Belladonna*

Stability of the Drug

Continuous extraction should be avoided when the constituents of the drug are thermos-labile.

Cost of the Drug

In the case of costly drugs (e.g. *Ginger*), percolation is economical but for cheaper drugs maceration is good enough. Due consideration has to be given to the cost of the drug and the cost involved in communication for the best possible extraction of the constituents.

Solvent

If water is used as a solvent, then maceration process should be recommended. The percolation process should be preferred if non-aqueous solvents are used for extraction. If the desired active constituents of drug demand a solvent other than a pure boiling solvent or an azeotrope, then continuous extraction should be avoided and reserve percolation process may be used.

Concentration of the Product

- Dilute products such as Tinctures can be made by using maceration or percolation process, depending on the other factors.
- For semi-concentrated preparations, such as concentrated infusions, double or triple maceration process can be used.
- For liquid extracts or dry extracts which are concentrated preparations, percolation process is used.

However, continuous extraction can be used if the solvent is suitable and the constituents are heat stable.

CONCLUSIONS:

In present review both maceration and percolation are suitable methods for the isolation active constituents from crude drugs by using various solvents.mucilages obtained by this methods are used as pharmaceutical excipients in Pharmaceutical Formulations.

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