**EMULSION**

DEFINITION

An emulsion is a thermodynamically unstable dispersed system consisting of at least two immiscible liquid phase, one of which is dispersed as globules in the other liquid phase.

The system is stabilized by the presence of an *emulsifying agent*.

Emulsified systems range from lotions of relatively low viscosity to ointments and creams, which are semisolid in nature.

The particle diameter of the dispersed phase generally extends from about 0.1 to 10 μm and as 100 μm are not uncommon in some preparations.

TYPES OF EMULSIONS

(I) Ordinary emulsion systems / Primary emulsion systems / Simple emulsion systems

(i) o/w type − oil dispersed in water

oil → dispersed phase

water → continuous phase

(ii) w/o type − water dispersed in oil

water → dispersed phase

oil → continuous phase

(II) Special emulsion systems

(i) Multiple emulsions → w/o/w − type

o/w/o − type

(ii) Micro emulsion

**Simple emulsion type:**

o/w- type of emulsion is a system in which the oil is dispersed as droplet throughout the aqueous phase. Most pharmaceutical emulsions designed for oral administration are of the o/w type; emulsified lotions and creams either of o/w or w/o type depending on their use.

Certain foods such as butter and some salad creams are w/o type emulsions.

**Multiple emulsion type**



These multiple emulsions have been developed with a view to delay the release of an active ingredient. In this type of emulsions three phases are present, i.e. the emulsion has the form w/o/w or o/w/o. In these “emulsions within emulsions”, any drug present in the innermost phase now has to cross two phase-boundaries to reach the external continuous phase.

I : Continuous phase (External aqueous phase)

II: Middle oil phase

III: Inner aqueous phase*Advantages of multiple emulsions*

(i) Prolongation of drug action

(ii) Location of drug in the body.

**Micro emulsions**

Microemulsions are liquid dispersion of water and oil that are made homogeneous, transparent and stable by the addition of relatively large amount of a surfactant and a co-surfactant. They appear to represent a state intermediate between thermodynamically unstable emulsions and solubolised systems.

Unlike emulsions, they appear as clear transparent solution, but unlike solubilised systems micro-emulsions may not be thermodynamically stable.

Microemulsions containing droplets (w/o or o/w types) with the globule size 10 to 200nm and the volume fraction of the dispersed phase varies from 0.2 to 0.8.

DETERMINATION OF EMULSION TYPE

Several methods are commonly used to determine the type of emulsion. The types of emulsion determined by one method should always be confirmed by means of second method.

**(1) Dye solubility test**

A small amount of a water soluble dye (e.g. methylene blue or brilliant blue) may be dusted on the surface of the emulsion.

If water is the external phase (i.e. o/w type) then the dye will be dissolved uniformly throughout the media.

If the emulsion is of the w/o -type then particles of dye will lie in clumps on the surface.

**(2) Dilution test**

This method involves dilution of the emulsion with water. If the emulsion mixes freely with the water, it is of o/w -type. Generally, addition of disperse phase will crack an emulsion.

**(3) Conductivity test**

This test employs a pair of electrodes connected to an external electric source and immersed in the emulsion. If the external phase is water, a current will pass through the emulsion and can be made to deflect a volt-meter needle or cause a light in the circuit to glow. if the oil is the continuous phase then the emulsion will fail to carry the current.

*Methods for determination of emulsion type:*

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| --- | --- | --- |
| **Test** | **Observation** | **Comments** |
| 1. Dilution test  2. Dye test  3. Conductivity test  4. Fluorescence test  5. CoCl2 / filter paper test | Emulsion can be diluted only with external phase.  Water-soluble solid dye tints only o/w emulsion and reverse. Microscopic observation usually is helpful.  Electric current is conducted by o/w emulsions, owing to the presence of ionic species in water.  Since oils fluoresce under UV-light, o/w emulsions exhibit dot pattern, w/o emulsions fluoresce throughout.  Filter paper impregnated with CoCl2 and dried (blue) changes to pink when (o/w) emulsion is added. | Useful for liquid emulsions only.  May fail if ionic emulsifiers are present.  Fails in nonionic o/w emulsions.  Not always applicable  May fail if emulsion is unstable or breaks in presence of electrolyte. |