

الصيدلة	الكلية
الصيدلانيات	القسم
Pharmaceutical Technology	المادة باللغة الانجليزية
تقانة الصيدلة	المادة باللغة العربية
الثالثة	المرحلة الدراسية
م.م. عمار عبدالمجيد أحمد	اسم التدريسي
Preparation of Emulsions	عنوان المحاضرة باللغة الانجليزية
تحضير الايملشن	عنوان المحاضرة باللغة العربية
12	رقم المحاضرة
Pharmaceutical Dosage forms and Drug Delivery Systems By Haward A. Ansel; latest edition.	المصادر والمراجع
Sprowel's American Pharmacy.	

محتوى المحاضرة

Formulation Considerations

When a formulator is preparing a pharmaceutical emulsion, the choice of oil, emulsifier, and emulsion type (o/w, w/o, or multiple) depends on:

- Route of administration
- Clinical use
- Droplet size distribution and rheological properties (influence stability and therapeutic response)
- Toxicity, cost, chemical incompatibilities of excipients

Ingredient selection often requires trial and error and depends on the experience of the formulator.

Preparation of Emulsions

1. Selection of the Oil Phase

- Oil may be the medicament itself or a carrier for lipid-soluble drug.
 - Factors: desired physical properties, miscibility of phases, solubility of drug, desired consistency.
 - External (dermatological) emulsions: hydrocarbon oils widely used. Liquid paraffin (alone or with hard/soft paraffin) → vehicle + occlusive effect.
 - Oral emulsions: castor oil, liquid paraffin, fish liver oils (vitamins A & D), fixed vegetable oils (e.g., arachis oil).
 - Parenteral emulsions: oil choices limited due to toxicity. Purified mineral oil used in some w/o depot I.M. injections.
 - Intravenous/parenteral nutrition: purified vegetable oils widely used.
-

How Emulsion Types Are Formed?

- When oil, water, and an emulsifying agent are shaken: both phases form droplets.
 - Phase that persists longer as droplets becomes dispersed phase; continuous phase forms from faster coalescing droplets.
 - Phase volume: the greater volume forms the continuous phase (Bancroft rule).
 - Emulsifier solubility: determines continuous phase.
 - Sodium/potassium oleates (polar) → o/w.
 - Calcium/magnesium soaps (less polar) → w/o.
 - Sorbitan esters → w/o.
 - Polyoxyethylene sorbitan esters (Tween) → o/w.
-

Emulsifiers

- Increase stability by forming mechanical/electrostatic barrier at droplet interface (interfacial film) or rheological barrier in external phase.

- Mixtures of emulsifiers give stronger interfacial films.
-

Hydrophile–Lipophile Balance (HLB)

- Each emulsifier has an HLB number = relative polarity.
- Nonionic surfactants' HLB values:
 - $HLB = (E + P) / 5$
 - $HLB = E / 5$ (if only oxyethylene groups present)
 - $HLB = \Sigma \text{ hydrophilic group numbers} + \Sigma \text{ lipophilic group numbers} + 7.$

Required HLB value:

- Oils have specific “required HLB” for stable emulsions.
 - Usually given as two values: high for o/w, low for w/o.
 - Blends of surfactants (low + high HLB) often used.
-

HLB Calculation – Worked Example

- Required HLB of liquid paraffin = 10.5.
 - Tween 80 (HLB 15) + Span 80 (HLB 4.3).
 - Solve: fraction of Tween 80 (x) = 0.58; Span 80 = 0.42.
 - For 5 g emulsifier → 2.9 g Tween 80 + 2.1 g Span 80.
-

Gibbs Free Energy in Emulsions

$$\Delta G = \Delta A \gamma$$

- A = total surface area of droplets.
- γ = interfacial tension.
- Good emulsions: large A, small γ → minimize ΔG .

Emulsifying Agents – Classification

1. Synthetic / semisynthetic surface-active agents & polymers.
2. Natural materials & derivatives.

Properties of emulsifying agents:

- Compatible with other ingredients.
- Do not interfere with drug stability/efficacy.
- Stable in preparation.
- Nontoxic at intended dose.
- Minimal odor, taste, or color.

Identification of Emulsion Type

1. Miscibility test: mixes with continuous phase.
 - Water drop → disappears in o/w; remains on w/o.
2. Filter paper test: o/w spreads rapidly.
3. Conductivity test: o/w conducts electricity (lamp glows); w/o does not.
4. Dye solubility test: water-soluble dye colors o/w uniformly; oil-soluble dye colors w/o.

Emulsion Stability

A kinetically stable emulsion = droplets remain dispersed, maintain appearance, odor, consistency, no microbial contamination.

Physical instability processes:

- Creaming: droplets separate under gravity, form concentrated layer (reversible).

- Flocculation: weak, reversible droplet clustering, depends on emulsifier film.
- Coalescence: irreversible merging of droplets → cracking/breaking.
- Ostwald ripening: larger droplets grow at expense of smaller.
- Phase inversion: o/w ↔ w/o (e.g., sodium salt stabilized o/w → invert to w/o with Ca^{2+}).

