

وما أرى استنزافَ طاقتي في طلبِ
العِلمِ إلا جوابًا مَهذبًا ل: وَعَنْ شِبَابِهِ
فيما أفناه؟" 🙏❤️

اللهم صل على سيدنا محمد

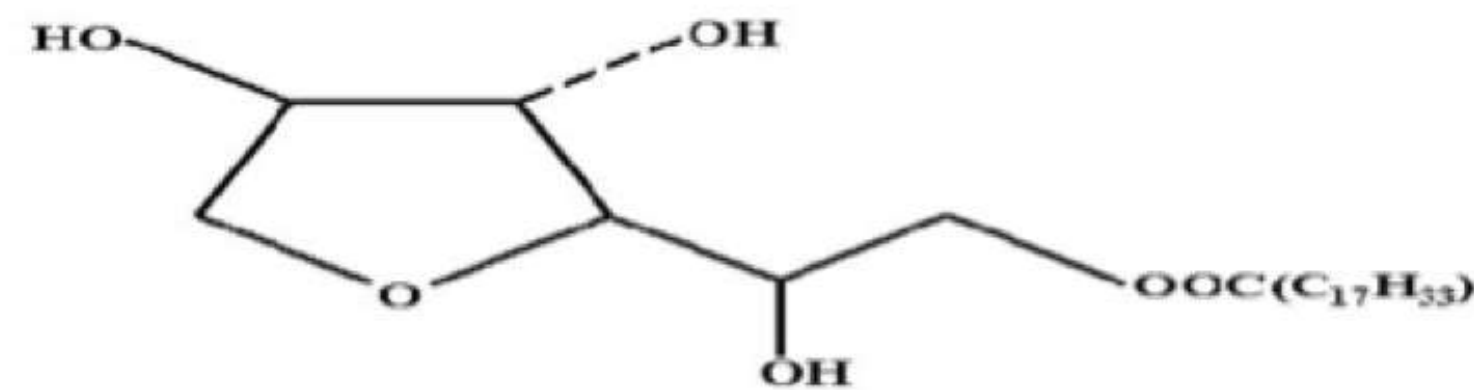
Synthetic emulsifying agents:

No charge on polar head

Nonionic surfactants N.C

أكثر safety وما يتفاعل مع الـ
drugs أو المواد المشحونة

- Most frequently used of all the surfactants
- Have a neutral pH and resist the addition of acids and electrolytes
 $= 7$
- Nonionic surfactants are effective over pH range of 3 to 10;
- They are superior in compatibility, stability, and lack of toxicity
- Example: Sorbitan esters (Spans) / Polyoxyethylene sorbitan esters (Tweens)
Hydrophobic (lipophilic)
Hydrophilic
- Divided into:
 1. Those that are more hydrophobic
 2. Those that are more hydrophilic



SPAN 80
hydrophobic

Bactericidal agent:

مبيد للبكتيريا لأنه البكتيريا عليها غلاف (Lipopolysaccharide) عليه شحنة سالبة (negative) فال cation surfactant يعمل complex مع البكتيريا ، فبتتغير خصائص الغلاف تبع البكتيريا وتموت .

Disadvantage:

إنه هي بتعمل complex مع أغلب الخلايا بالجسم لأنه شحنتهم سالبة فموتوا ، لهيك غالبًا بستخدمها topical وبستخدمها بتركيز صغيرة لأنها ممكن تعمل

Toxic effects on cells

* Hydrocolloid emulsifying agents

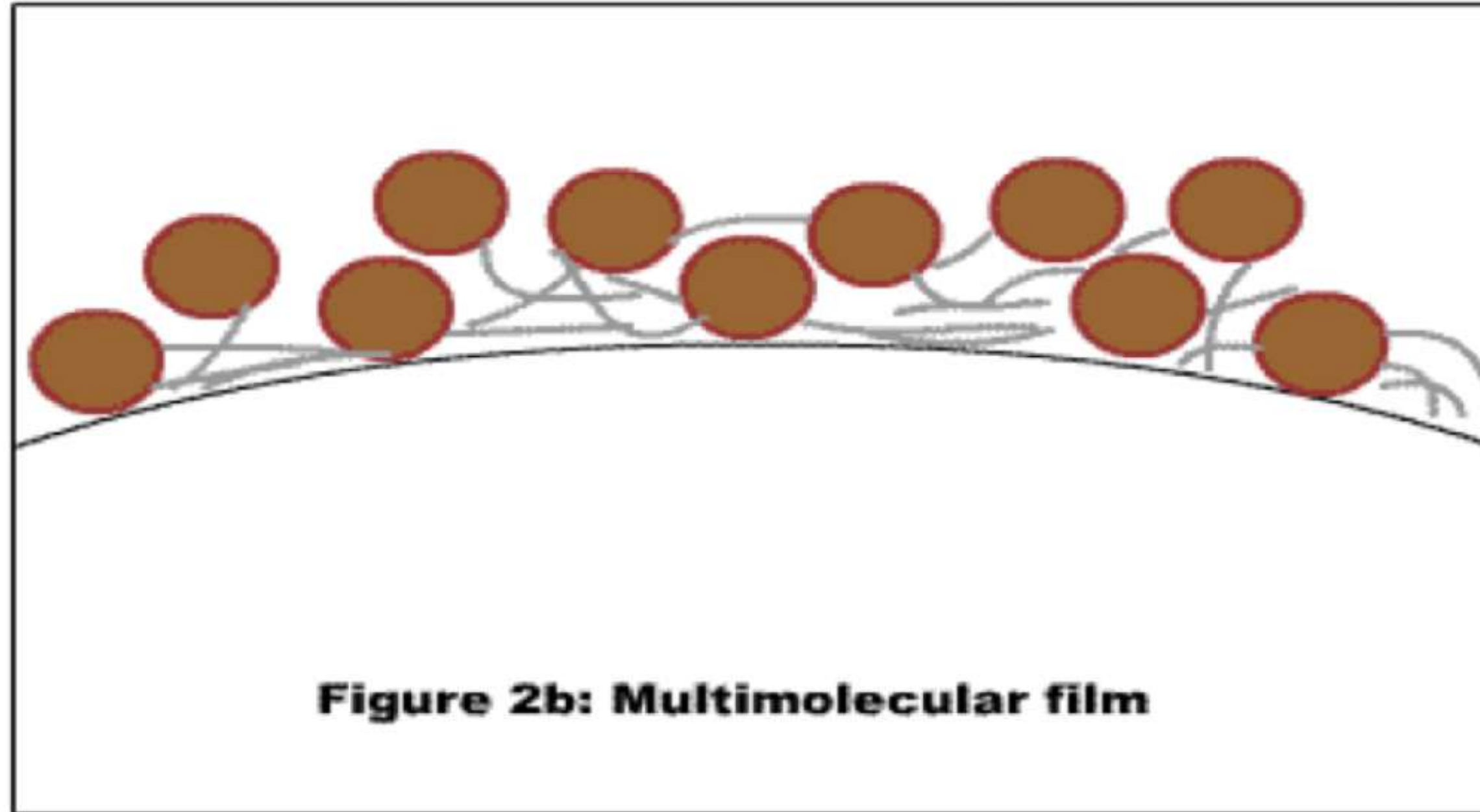
مثل الـ Acacia الي استخدمناها باللاب

Source

- Mainly they are natural products derived from plant or animal tissue.
- Most of them form hydrated lyophilic colloids (called hydrocolloids) that form multimolecular layers around emulsion droplets.
- Hydrocolloid type emulsifiers have little or no effect on interfacial tension
- They exert a protective colloid effect, reducing the potential for coalescence, by:
 - providing a protective sheath around the droplets
 - imparting a charge to the dispersed droplets (so that they repel each other) بتعطي شحنة للـ dispersion droplets فبتخليهم يتنافروا عن بعض **بتنافروا**
 - swelling to increase the viscosity of the system (so that droplets are less likely to merge)

ما بتذوب في الماء لكنها تقوم بامتصاصه فتزيد من الـ viscosity of medium فبتقول من الـ merge (coalescence)

Hydrocolloid emulsifying agents



Hydrocolloid emulsifying agents

Hydrocolloid emulsifiers may be **classified** as:

Subject to
microbial
growth

Natural emulsifying agents

A. **Vegetable derivatives** “ natural emulsifying agents”, e.g., acacia, tragacanth, agar, pectin, carrageenan
صمغ القثاد (كثيراء) الغراء

B. **Animal derivatives**, e.g., gelatin, lanolin, cholesterol, lecithin

less subject to
microbial
growth

2. **Semi-synthetic** agents, e.g., methylcellulose, carboxymethylcellulose → viscosity enhanced agent مرقوا علينا ك

Not supply to
microbial
growth

3. **Synthetic** agents, e.g., Carbopols®

↪ Gelling agent

Natural Emulsifying Agents: Vegetable hydrocolloids

- have the **advantages** of being inexpensive, easy to handle, and nontoxic.
- Their **disadvantages** are that they require relatively large quantities to be effective as emulsifiers, and they are subject to microbial growth and thus their formulations require a preservative.
- Vegetable derivatives are generally **limited to use as o/w emulsifiers**.
- **Form multimolecular film** around the droplets
- **Acacia** is the most commonly used in **extemporaneous preparations**.

عرق السوس

Disadvantage 1:

تأثيرها ضعيف فبالتالي بتضطر استخدم وأضيف كمية كبيرة منه (نصف كمية الماء أو ربع كمية الزيت) عشان اقدر استفيد منه ويعطيني stable emulsion

Natural Emulsifying Agents: Animal derivatives

- **Lecithin** and **cholesterol** form a **monomolecular layer** around the **emulsion droplet** instead of the typically **multimolecular layers**.
Derivatives of Single layer * O/W

Derivatives of **Cholesterol** is a major constituent of **wool alcohols** and it gives **lanolin** the capacity to absorb water and form a **w/o emulsion**.
Structure of cholesterol

- **Lecithin** (a **phospholipid** derived from egg yolk) produces **o/w emulsions** because of its **strong hydrophilic character**.
- **Animal derivatives** are more likely to cause allergic reactions and are subject to microbial growth and rancidity. تأكسد الزيت Disadvantages
- Their **advantage** is in their ability to support formation of **w/o emulsions**.
w/o emulsion يعطيني option لأحضر

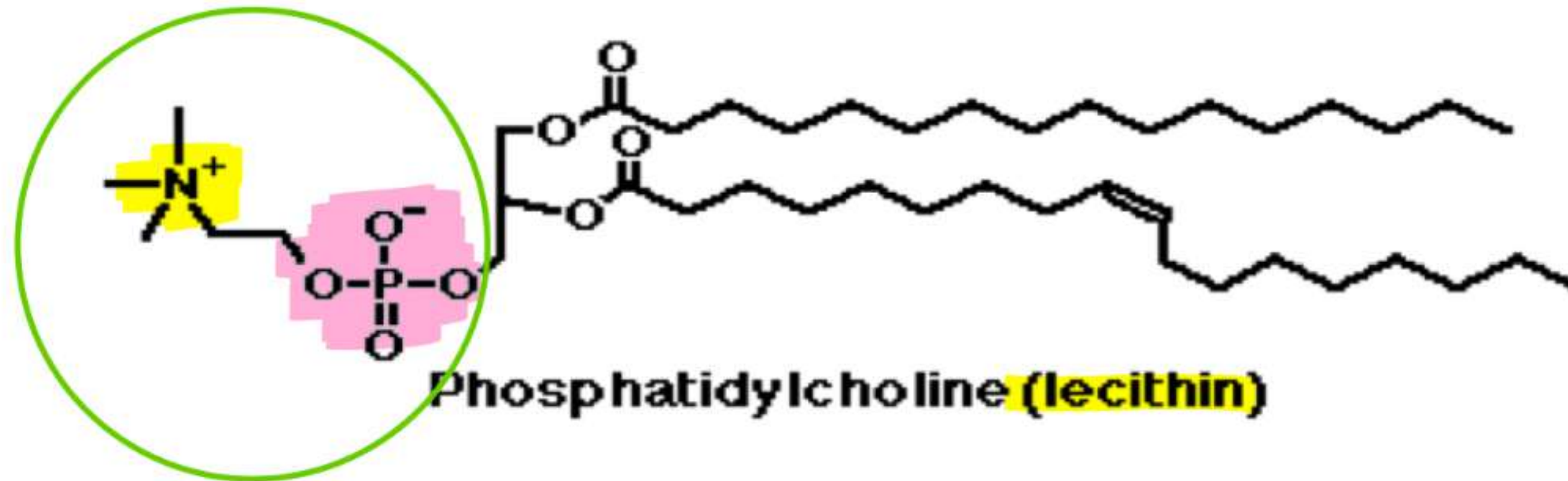
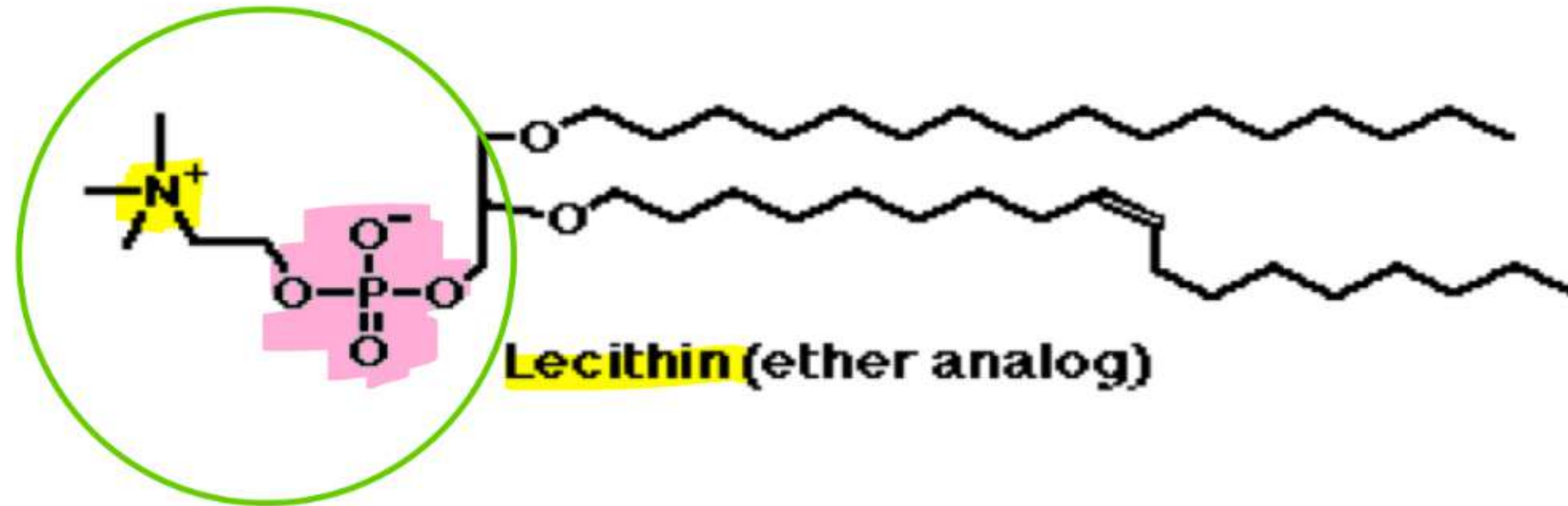
Natural Emulsifying Agents: Animal derivatives

- **Wool alcohols** are the principle component of **lanolin**
- **Lanolin** is a natural product obtained from the fleece of sheep.
- Sebum is extracted from the **wool**, cleaned and refined to produce Anhydrous lanolin



لا حول ولا قوة إلا بالله

Natural Emulsifying Agents: Animal derivatives



Natural Emulsifying Agents: Animal derivatives

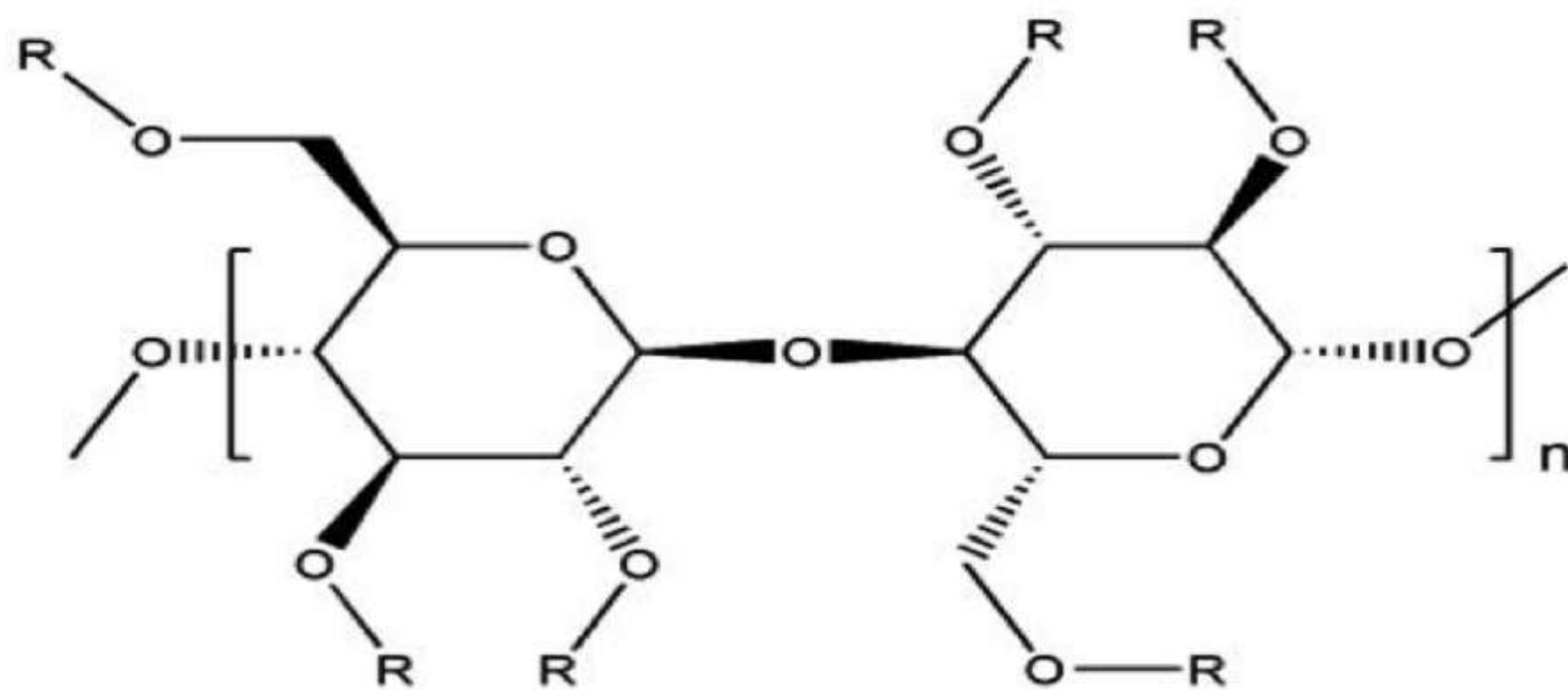
- **gelatin.**
- These substances produce **o/w emulsions.**
- The **disadvantage** of gelatin as an emulsifying agent is **that the emulsions produced from it are too fluid and become more fluid upon standing**

Too fluid = low viscosity

الـ viscosity قليلة فعشان اقدر استخدمه بحط منه كمية كبيرة لكن مع مرور الوقت الـ viscosity راح تقل تاني ويصير more and more fluid والـ emulsion راح يصير unstable ويمكن يفصل . breaking

Semi-synthetic agents

- Semi-synthetic agents are stronger emulsifiers
- are nontoxic,
- and are less subject to microbial growth



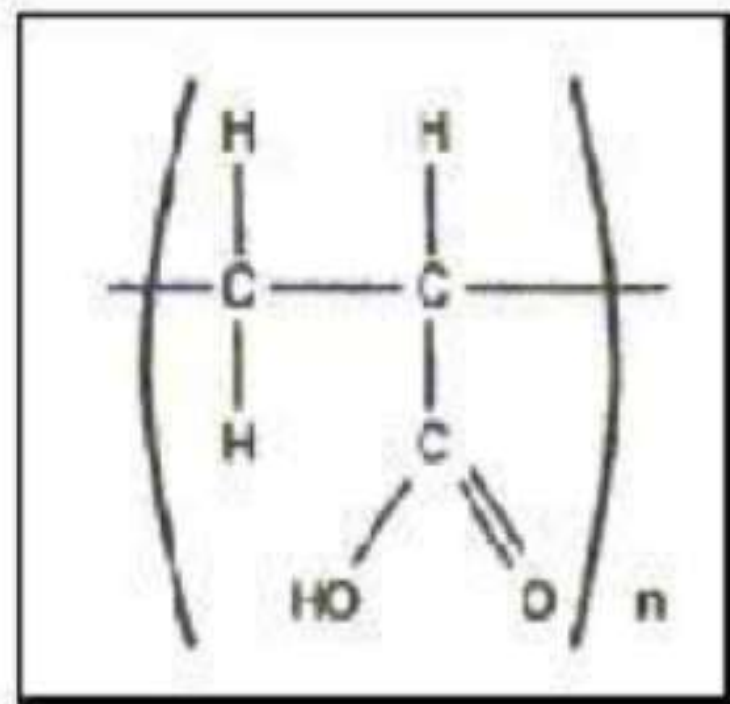
Cellulose: R = H
Methyl cellulose: R = CH₃ (40-90%) or H

Synthetic hydrocolloids

- Are the **strongest emulsifiers**,
- are **nontoxic**,
- and do **not support microbial growth**.
- However, **their cost may be prohibitive**.
- These synthetic agents are generally **limited to use as o/w emulsifiers**.

لأنها gelling agent فزيدوا
ال viscosity كثير فبكون
strongest emulsifiers

غالية



General structure of carbopol polymer

Finely divided or dispersed solid particle emulsifiers:

- These agents form a particulate layer around dispersed particles.
- Most will swell in the dispersion medium to increase viscosity and reduce the interaction between dispersed droplets.
- These agents include bentonite, veegum, hectorite, magnesium hydroxide, aluminum hydroxide and magnesium trisilicate.
- Most commonly they support the formation of o/w emulsions, but some may support w/o emulsions.

نفس ما بدأ ال hydrocolloid surfactants إنها ما بتأثر على ال interfacial tension تقوم بامتصاص ال

Dispersed droplets / وتقوم بتقليل التفاعلات بين ال external phase فتزيد ال viscosity

Finely divided or dispersed solid particle emulsifiers:

- These generally form o/w emulsions when the insoluble material is added to the aqueous phase if there is a greater volume of the aqueous phase than that of oleaginous phase.

aqueous

oil

$$V_{aq} > V_{oil}$$

- if the powdered solid is added to the oil and the oleaginous phase volume predominates bentonite is capable of forming w/o emulsions

$$V_{aq} < V_{oil}$$

* حسب النوع جند وين ائمنه

• emulsifying agent

ما بضيفهم لحالم (بخطهم مع emulsifying agent تانيين) لأنه ال Head group اهم صغير فبالتالي تأثيرهم قليل

Auxiliary emulsifying agents

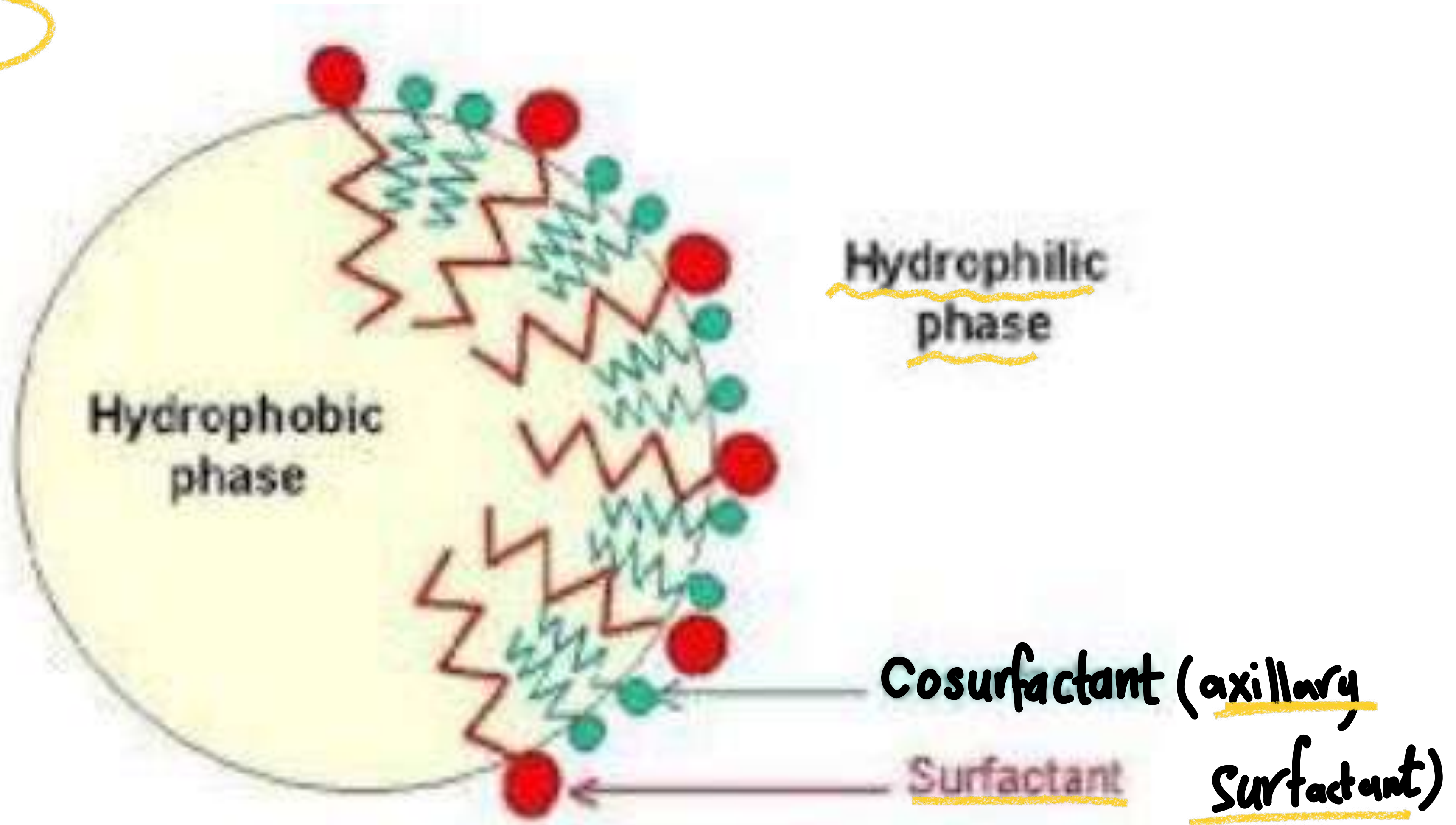
ما بقدر لحالم يعملوا protective layer فبنسبهم cosurfactant

- A variety of fatty acids (e.g., stearic acid), fatty alcohols (e.g., stearyl or cetyl alcohol), and fatty esters (e.g., glyceryl monostearate)
- Serve to stabilize emulsions through their ability to thicken the emulsion. → * ليس جابنق احطه لحاله
- Because these agents have only weak emulsifying properties, they are always use in combination with other emulsifiers.



مثال فرحتنا إياه الدكتور

الدكتورة عرضتها بالمحاضرة .



Surfactant:

Forms the interfacial film

CoSurfactant:

Ensures flexibility of interfacial layer
=> reduces the interfacial tension

Auxiliary emulsifying agents

Table 22-5. Auxiliary Emulsifying Agents

PRODUCT	SOURCE AND COMPOSITION	PRINCIPAL USE
Cetyl alcohol	Chiefly $C_{16}H_{33}OH$	Lipophilic thickening agent and stabilizer for O/W lotions and ointments
Glyceryl monoesterate	$C_{17}H_{35}COOCH_2CHOHCH_2OH$	Lipophilic thickening agent and stabilizer for O/W lotions and ointments
Methylcellulose	Series of methyl ethers of cellulose	Hydrophilic thickening agent and stabilizer for O/W emulsions; weak O/W emulsifier
Sodium carboxymethylcellulose	Sodium salt of the carboxymethyl esters of cellulose	Hydrophilic thickening agent and stabilizer for O/W emulsions
Stearic acid	A mixture of solid acids from fats, chiefly stearic and palmitic	Lipophilic thickening agent and stabilizer for O/W lotions and ointments. Forms a true emulsifier when reacted with an alkali

Auxiliary (secondary) emulsifying agents include those compounds that are normally incapable themselves of forming stable emulsion. Their main values lies in their ability to function as thickening agents and thereby help stabilize the emulsion.

لهون بكون خلص
emulsion part 1
وراح نبليش بـ 2 emulsion part

اللهم صل على سيدنا محمد

The Hydrophile-Lipophile balance (HLB) System خاص بال emulsifying agent

- A system was developed to assist in making systemic decisions about the amounts and types of surfactants needed in stable products.
- The system is called the HLB (hydrophile-lipophile balance) system and has an arbitrary scale of 1 - 20. اختراعهم
- HLB numbers are experimentally determined for the different emulsifiers

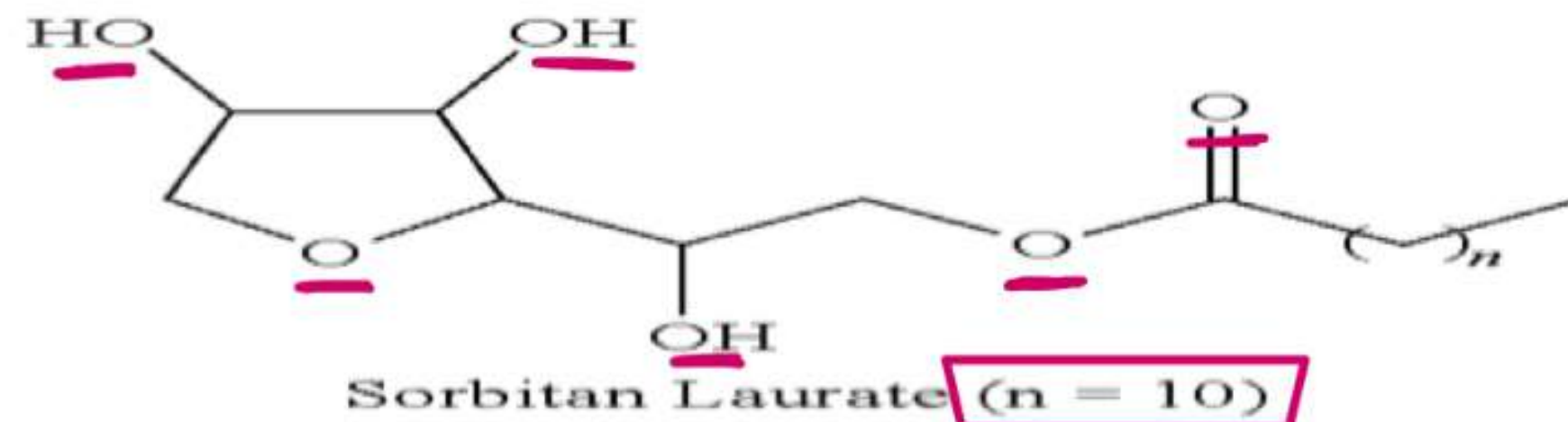
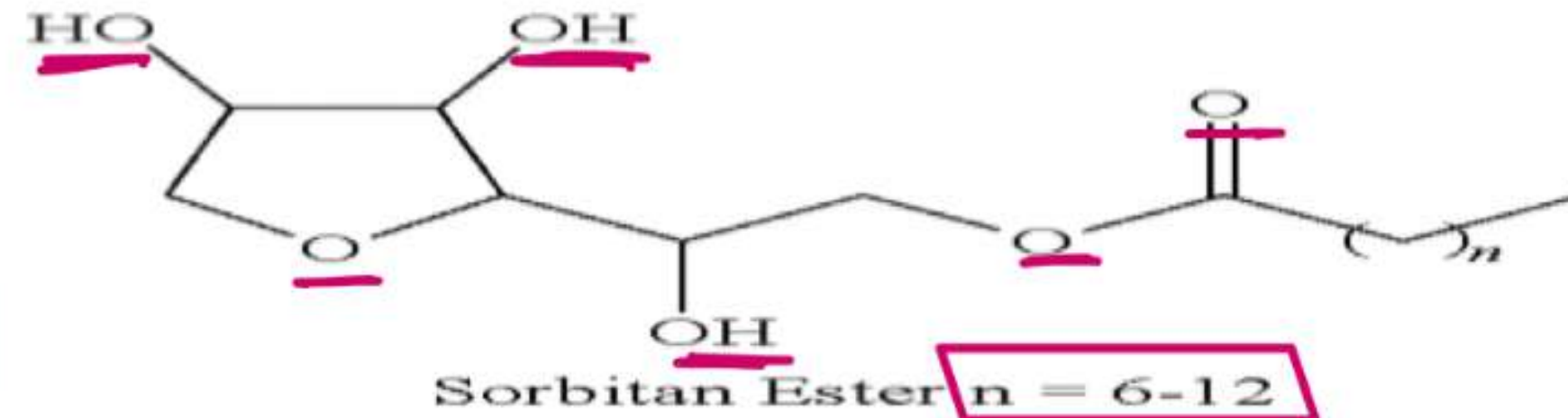
↓ ~~HLB~~ *

High HLB (above 9) = Hydrophilic
Low HLB (below 6) = hydrophobic

لو بدي احضر o/w emulsion فاله HLB number لازم يكون عالي
عشان يكون surfactant يكون Hydrophilic والعكس لله w/o

The Hydrophile-Lipophile balance (HLB) System

- If an emulsifier has a **low HLB number**, there is a **low number of hydrophilic groups** on the molecule and it will have **more of a lipophilic character**.
→ Hydrophobic surfactant (lipophilic) : this will be used for making W/O emulsion
- For example, the **Spans®** (sorbitan esters) generally have **low HLB numbers** and they are also **oil soluble**.
→ Hydrophobic
- **Because of their oil soluble character**, **Spans®** will cause the oil phase to predominate and **form an w/o emulsion**.

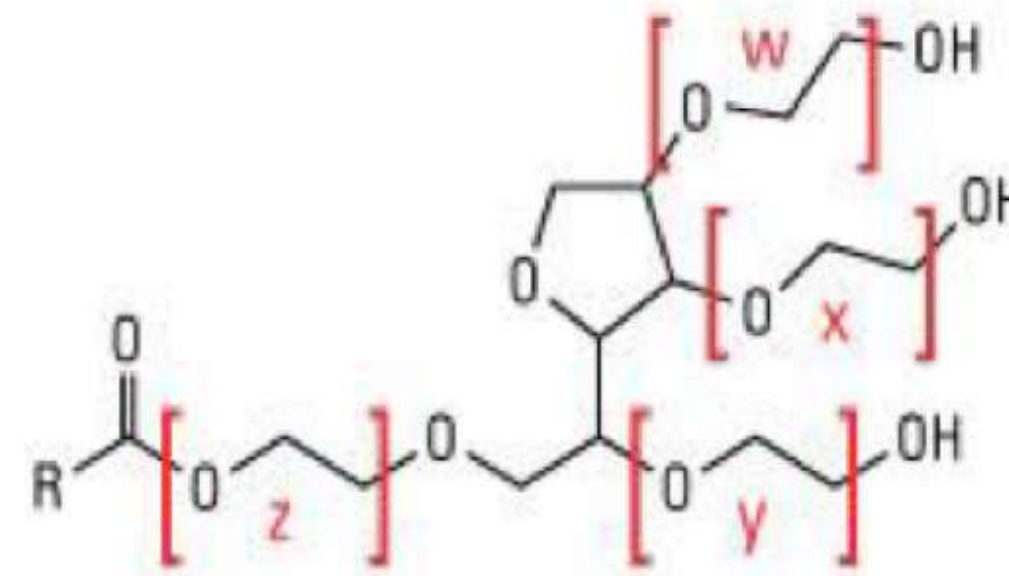


الـ chain عبارة عن كربونات وما في عليهم أوكسجين أو hydrophilic group فبالتالي ما بتزيد ذائبيتها بالماء

The Hydrophile-Lipophile balance (HLB) System

- The **higher HLB number** would indicate that the emulsifier has a **large number of hydrophilic groups** on the molecule and therefore should **be more hydrophilic** in character.
- The **Tweens**[®] (polyoxyethylene derivatives of sorbitan esters) have **higher HLB numbers** and they are also **water soluble**.
- Because of their **water soluble** character, **Tweens**[®] will cause the water phase to predominate and **form an o/w emulsion**.

Hydrophilic surfactant: this will be used for making O/W emulsion



Tween* 20 Detergent

$$w + x + y + z = 20$$



MW 1228

عدد ال hydrophilic كثير

- the phase in which the **emulsifying agent** is **more soluble** will become the continuous or **external phase**

Natural emulsifying agent :
 يمكن يشتغلوا hydrophobic أو hydrophilic
 ال (9-6) water dispersible بخلاطه مع
 another surfactant (hydrophobic or hydrophilic)
 حسب ايش نوع ال emulsion راح اعمله

من (3-6) & (8-16) هذول ال HLP المناسبين للـ emulsion غير
 هيك ممكن عملي مشاكل مثلاً لو زدت عن 16 (صح الـ emulsifying
 effect بتزيد) بس راح عملي foaming**

هدول يهمني

o/w
 Hydrophilic
 (water soluble)

Water (6-9)
 dispersible

Hydrophobic
 (oil soluble)
W/O



التدرجات هاي ما بتهمني

Solubilizing agents (15-18)

Detergents (13-15)

o/w Emulsifying agents (8-16)

Wetting and spreading agents (7-9)

w/o Emulsifying agents (3-6)

Antifoaming agents (2-3)

The Hydrophile-Lipophile balance

(HLB) System قلت بهمني ال concept وما بهمني كثير ال calculations

- **Combinations of emulsifiers can produce more stable emulsions than using a single emulsifier with the same HLB number.** The HLB value of a combination of emulsifiers can be calculated as follows:

$$HLB = \frac{(Quantity\ of\ surfactant\ 1)(HLB\ surfactant\ 1) + (quantity\ of\ surfactant\ 2)(HLB\ surfactant\ 2)}{quantity\ of\ surfactant\ 1 + quantity\ of\ surfactant\ 2}$$

بحدد من خلاله شو نوع الزيت الي استخدمته
(الجدول الثاني بالاسلايد الي بعده موجود قيم HLB بناءً على نوع الزيت)

ال emulsion يكون مستقر أكثر لو انا خلطت (combination) أكثر من emulsifying agent مع بعض حتى لو ال HLB is the same

HLP of single EA = 4

HLP of two EA = 4 (more stable)

لو بدى احضر emulsion
ومو عارفة شو اختار
surfactant فبرجع لنوع الزيت
الي بدى استخدمه
مثلاً :

بدى اعمل w/o emulsion
(oil =soft paraffin)
HLP of SP = 4
بالجدول 23-3

فال surfactant المناسب
حسب جدول 23-2
انه اعمل combination بين
span 85 & span80
عشان يعطيني surfactant
system with HLP =4

(بحسب HLP of system من خلال القانون
بالسلايد الي قبل)

Sorbitan trioleate (Span 85)	1.8
Oleic acid	4.3
Sorbitan mono-oleate (Span 80)	4.3
Sorbitan monostearate (Span 60)	4.7
Sorbitan monolaurate (Span 20)	8.6
Polysorbate 60 (polyoxyethylene sorbitan monostearate)	14.9
Polysorbate 80 (polyoxyethylene sorbitan mono-oleate) (Tween 80)	15.0
Polysorbate 20 (polyoxyethylene sorbitan mono-laurate) (Tween 20)	16.7
Potassium oleate	20.0
Sodium dodecyl (lauryl) sulphate	40.0

W/O

لو استخدمت span 20 لحاله ممكن
يعطيني emulsion بس ما
حيكون مستقر يعني لو تركته لفترة
فمعرض بنسبة كبيرة يصيرلي
inversion
من مثلاً o/w to w/o

فلهيك الأفضل اخلط معه surfactant
تاني عشان اقدر اطلع stable
emulsion وحسب شو نوع ال
emulsion يختار نوع ال surfactant

	For a w/o emulsion	For an o/w emulsion
Beeswax	5	12
Cetyl alcohol	-	15
Liquid paraffin	4	12
Soft paraffin	4	12
Wool fat	8	10

هاد الجدول الي قصده بالسلايد الي قبل وبتقدروا تفهموا قصدي بس تشوفوا المثال الي بالسلايدات الجاي

← بترطب من خلال تجعل اتصال ودي بين الجزيئات والسائل .

- **Wetting agents are surfactants with HLB values of 7 to 9. Wetting agents aid in attaining intimate contact** between solid particles and liquids.
- **Emulsifying agents are surfactants with HLB values of 4 to 6 or 8 to 18. Emulsifying agents reduce interfacial tension** between oil and water, minimizing surface energy through the formation of globules.
- **Detergents are surfactants with HLB values of 13 to 15. Detergents will reduce the surface tension and aid in wetting the surface and the dirt. The soil will be emulsified, and foaming generally occurs → washing away of the dirt.**
- **Solubilizing agents have HLB values of 15 to 20.**

← صنفات

- e.g. What is the **HLB** value of a **surfactant system** composed of **20 g Span 20 (HLB = 8.6)** and **5 g Tween 21 (HLB = 13.3)**?

$$HLB = \frac{(20g)(8.6) + (5g)(13.3)}{(20g) + (5g)}$$

= 9.54

→ o/w

Wool fat / water

لا حول ولا قوة إلا بالله

Methods of emulsion preparation

- Emulsions may be prepared using several methods **depending upon the nature of the emulsion components and the equipment available.**

Equipment used

- On **small scale**: كمية الـ emulsion صغيرة

- Dry Wedgwood or porcelain mortar and pestle
- Mechanical blender or mixer
- Milk-shake mixer
- Hand homogenizer
- Bench-type homogenizer

حجمه صغير

- On **large scale**
 - High speed impeller
 - Colloid mill
 - Industrial homogenizers

Extemporaneous (بدون أجهزة كبيرة)

Extemporaneous preparation of emulsions

- In the small scale preparation of emulsions, three methods may be used:

أول طريقتين باستخدام الـ mortar and pestle

Continental (dry gum method) بضيف E.A مع الزيت وبعدين بضيف الماء

- The emulsifying agent is mixed with oil before the addition of water.

English (wet gum method) بضيف الـ E.A مع المي وبعدين الزيت

- The emulsifying agent is added to the water (in which it is soluble) to form a mucilage and then the oil is slowly incorporated.

Bottle (Forbes bottle method)

Gum = Emulsifying agent

يفرقوا هذول الطرق عن بعض بطريقة إضافة المواد على بعض (ما إليها دخل بنوع الـ emulsion وبكمية المواد)

Methods of compounding emulsions:

O : W : E.A

1. Continental (Dry gum or 4:2:1) Method

- The continental method is used to prepare the initial or primary emulsion from oil, water, and a hydrocolloid or "gum" type emulsifier (usually acacia).
- The primary emulsion, or emulsion nucleus, is formed from 4 parts oil, 2 parts water, and 1 part emulsifier, so the method is also referred to as the "4:2:1" method.
- Some times, the amount of acacia needs to be adjusted upward to ensure an emulsion can be produced.
- For example: volatile oils, liquid petrolatum and linseed oils require a "3:2:1" or "2:2:1" ratio for adequate preparation.

في بعض التحضيرات بتضطر ازيد كمية ال gum فأنا نسبيًا قلت الزيت فالنسبة بتصير يا 3:2:1 or 2:2:1

4:2:1 is ratio of primary emulsion

||

Continental (Dry gum) method

Procedure:

- In a perfectly dry Wedgwood or porcelain mortar, the 1 part gum is levigated with the 4 parts oil until the powder is thoroughly wetted; then the 2 parts water are added all at once, and the mixture is vigorously and continually triturated until the primary emulsion formed is creamy white and produces a "cracking" sound as it is triturated (usually 3-4 minutes).
- Other liquid formulation ingredients that are soluble in the external phase may be then added to the primary emulsion with mixing.
- Solid substances (such as preservatives, stabilizers, colorants and any flavoring material) are usually dissolved in water.

بخط ال EA بال mortar and pestle وبعدين بضيف الزيت وجررك منيح كتير وضيف الماء (مرة وحدة ؛ لأنه لو ضفته بالتدريج بأثر على ال stability وممكن يفصل) ال emulsion الي تحضر معي مبدائياً هو أولي (primary or initial emulsion) ويكون w/o

لو بدى اضيف مواد سائلة (تكون ذائبة مع ال external phase) بضيفها مباشرة على ال primary emulsion

لو بدى اضيف مواد صلبة (solid) بدوهم بالماء وبعدين بضيفهم .

وبعدين ممكن اضيف ماء زيادة واحرك وبصير معي o/w (final emulsion)

Primary emulsion =

هو ال emulsion بدون أي additives بس زيت وماء و EA

Methods of compounding emulsions:

2. English (Wet Gum) Method

- In this method the order and techniques of mixing are different.
- The 1 part gum is triturated with 2 parts water to form a mucilage; then the 4 parts oil is added slowly, in portions, while triturating.
- After all the oil is added, the mixture is triturated for several minutes to form the primary emulsion.
- Generally speaking, the English method is more difficult to perform successfully, especially with more viscous oils, but may result in a more stable emulsion.
- The ratio of oil: water: emulsifier depend on oil and emulsifier being used

Methods of compounding emulsions:

3. Bottle (Forbes) Method

- This method may be used to prepare emulsions of volatile oils, or oleaginous substances of very low viscosities. It is not suitable for very viscous oils since they cannot be sufficiently agitated in a bottle.
- This method is a variation of the dry gum method.
- One part powdered acacia (or other gum) is placed in a dry bottle and four parts oil are added. The bottle is capped and thoroughly shaken. To this, the required volume of water is added all at once, and the mixture is shaken thoroughly until the primary emulsion forms.
- It is important to minimize the initial amount of time the gum and oil are mixed. The gum will tend to imbibe the oil, and will become more waterproof.

هي بتشبه الطريقة الأولى

بس إنها بـ bottle

بهاي الطريقة لازم اقلل الوقت تبع خلط الـ gum والـ oil عشان الـ gum ما تمتص الزيت وتصير أكثر مقاومة للماء وتخرب الـ emulsion

استغفر الله ، ادعونا 