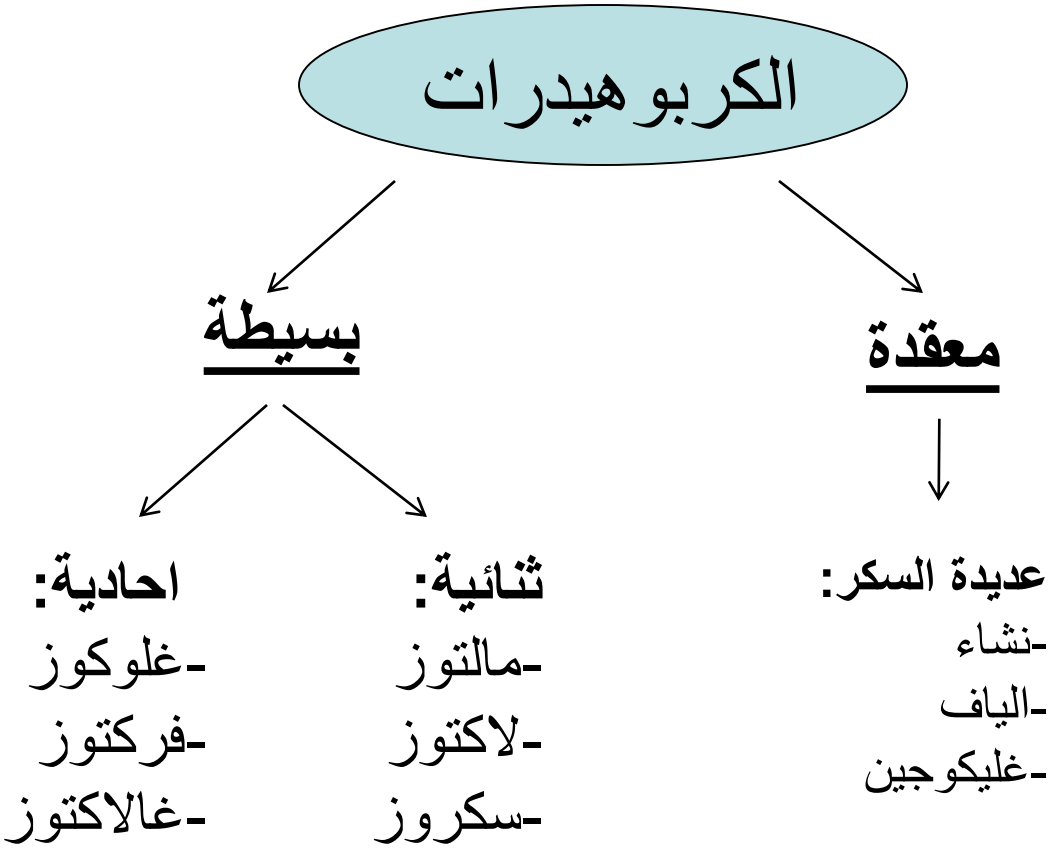
Carbohydrates

1

Carbohydrates الكربوهيدرات

- Carbohydrates consist of carbon, hydrogen and oxygen.
  - تتكون من الكربون والهيدروجين والاوكسجين
  - يمكن كتابة الصيغة العامة للكربوهيدرات بالصيغة: $C_x(H_2O)_y$
- Of special pharmacognostical importance are the sugar units, which connected to other compounds to form glycosides .
- تعمل كمصدر للطاقة (مثل الغلوكوز)، وكمخزن للطاقة (مثل النشا والجليكوجين)، وكوحدات هيكلية (مثل السيليلوز في النباتات والكيتين في الحشرات).
- They constitute large proportion of the plant biomass كتلة حيوية , as cellulose سللوز , starch نشا , sugars سكاكر , mucilage لثأ , gums صموغ .


الكربوهيدرات
بسيطة
معقدة
احادية:
-غلوكوز
-فركتوز
-غالاكتوز
ثنائية:
-مالتوز
-لاكتوز
-سكروز
عديدة السكر:
-نشاء
-الياف
-غليكوجين

عديدات السكاكر Polysaccharides

- Polysaccharides are derived from mono-saccharides.
- The name ‘oligosaccharide’ (Greek *oligo*, few), saccharides containing from two to 10 units.
- The hydrolysis of polysaccharides, by enzymes or reagents, often results in a succession of cleavages, but the final products are hexoses or pentoses or their derivatives.

Polysaccharides

- The term polysaccharide may usefully be taken to include polysaccharide complexes which yield in addition to monosaccharides their sulphate esters, uronic acids or amino sugars.
- In general polysaccharides from fungi الفطرياتexhibit anti-tumor activity فعالية مضادة للأورام , those from higher plants are immune-stimulatory منشطة للمناعة and the algal polysaccharides, which often contain sulphate, are good anticoagulants مضادات تخثر .

Commercial plant-derived fibres and products

Cotton, Raw cotton

- Cotton consist of the epidermal trichomes of the seeds (الاشعار) يتكون القطن من أوبار البشروية) بذور القطن
- Latin name: *Gossypium herbaceum* and other cultivated species of *Gossypium.*
- Family: Malvaceae
- Plant: shrub or small trees produce three to five-celled capsules containing numerous seeds.

- تكتسب بعض الالياف النباتية اهمية في الصيدلة، خاصة لانتاج الضمادات الجراحية ولاجل تصنيع الالياف الاصطناعية والضمادات المرقئة

Gossypium

Morphology of Cotton, Raw cotton
القطن ، القطن الخام

- The cellulose wall of the hair is covered with a waxy cuticle.
- Bleached cotton yarn (خيط غزل القطن المبيض)and absorbent cotton (القطن الطبي الماص) are readily wetted by water.

Chemical nature

- Raw cotton consist of: cellulose approximately 90%, and moisture 7%, the remainder being wax, fat, remains of protoplasm and ash.
- يتكون القطن الخام من السللوز ٩٠%، ورطوبة حوالي ٧%، والباقي مكون من الشمع والدسم وبقايا البروتوبلاسما ورماد
- Absorbed cotton is a very pure cellulose.
- تستخدم الياف القطن بوصفها عامل ادمصاصي، كما يحضر منها القطن الشاش الطبي والقطن الجراحي

(خیش)Jute

- Jute consists of the strands of phloem fibres from the stem bark of *Corchorus capsularis.*
- Family: Tiliaceae
- The plant is annual about 3-4m high which is cultivated in Bengal.
- The fibres are separated from the plant material (phloem)

Corchorus

Flax(ألياف الكتان)

- Flax is prepared from the pericyclic fibres of the stem of *Linum usitatisimum* from the family of Linaceae.
- يحضر من الالياف المحيطية الدائرية لساق النبات من الفصيلة الكتانية

Linum usitatisimum

Hemp(قنب)

- Hemp is prepared from the pericyclic fibres of the stem of *Cannabis sativa* from the family of Cannabinaceae.
- تحضر الياف القنب من الياف المحيط الدائر لنبات القنب الهندي
- The fiber is composed chiefly of cellulose, but the percentage of cellulose is lower than in flax.
- يتكون الليف بشكل اساسي من السللوز، والنسبة المئوية للسللوز أخفض من تلك التي في الكتان

Cannabis sativa

Regenerated carbohydrate material and chemically modified Fibres

الكربوهيدرات المولدة والالياف المعدلة كيميائيا

Regenerated carbohydrate material

- Regenerated fibres: are those produced from naturally occurring, long – chain molecules which have been isolated, controlled and, if necessary, modified to give a suitable fiber form. The term ‘rayon”, as in viscose, acetate and cuprammonium rayon, is applied to those derived from the polysaccharide cellulose.
- الالياف المولدة : هي تلك التي تنتج من الجزيئات ذات السلسلة الطويلة، التي تتواجد بشكل طبيعي ، والتي تم عزلها ومراقبتها، اذا كان ضروريا، تعديلها لتعطي شكل الليف المناسب مثل الفسكوز والاسيتات والكبرامونيوم وينطبق ذلك على تلك المشتقة من السللوز.

Pyroxylin BP (Cellulose nitrate)

- Pyroxylin is prepared by the action of nitric and sulphuric acids on wood pulp or cotton linters that have been freed from fatty materials.
- When dry it is explosive and must be carefully stored, dampened with not less than 25% its weight of isopropyl alcohol or industrial methylated spirits.
- It is used for making Flexible Collodion BP

Absorbable haemostatic dressings
الضمادات الممتصة المرقئة

- The control of bleeding is of vital concern in surgery, and the great disadvantage of the old-type dressing such as a cotton gauze plug is that it has to be removed after bleeding has been checked with a consequent danger of a recurrence of hemorrhage.
- Gelatin sponge, oxidized cellulose and alginate dressing overcome this (no need to remove them after the bleeding has been checked, since they are absorbed by the tissues).

Oxidized cellulose

- Oxidized cellulose originated in the USA as a result of the work published in 1942.
- Production of Oxidized cellulose: Cotton wool is treated with nitrogen dioxide until the number of carboxyl groups formed by the oxidation of the primary alcohol groups of glucose residue units of the cellulose molecules reaches 16-22%.

ألياف الألجينات Alginate fibres

- Alginic acid is composed of polymers of both mannuronic and guluronic acids.
- The properties of the two are variable and alginates of different origin have different compositions and properties.

Alginate fibres

- This is illustrated by the two haemostatic dressings- Kalostat and Sorbsan.
- Kalostat is derived from the seaweed *Laminaria hyperborea* collected off the Norwegian coast and yields an alginate with a guluronic: mannuronic ratio of 2:1.
- Sorbsan is prepared from *Laminaria* and *Ascophyllum* species collected off the west coast of Scotland and gives an alginate with a guluronic: mannuronic acid ratio of about 1:2.

Alginate fibres

- On a wound surface the α-linkages of the guluronic acid polymer are not easily broken so that the fiber strength is retained and a strong gel is formed on contact with the wound exudate.
- A high ratio mannuronic acid polymer yields a product giving a weaker gel and less retention of fiber strength.

Alginate fibres

- Calcium alginate fibers of commerce contain substainal traces of substances used to inhibit mould and bacterial growth in the sodium alginate spinning solution.

Before use as an absorbable haemostatic dressing some calcium alginate dressing must be immersed in sodium chloride to give a fiber of the calcium alginate covered by sodium alginate.

Uses and Properties of Alginate fibers

1- The alginate absorbable haemostatic dressing are non-toxic and non-irritant.

2- They have advantages over oxidized cellulose, which include selective rate of absorption, sterilization and resterilization by autoclaving or dry heat and compatibility with antibiotics such as penicillin.

Uses of Alginate fibres

3- They may be used internally in neurosurgery and dental surgery to be subsequently absorbed.

4- Externally, they may be used to arrest bleeding and to form a protective dressing which may be left or later removed in a manner appropriate to the type of dressing employed .

Uses of Alginate fibres

5- Protective films of calcium alginate may also be used by painting the injured surface with sodium alginate solution and then spraying it with calcium chloride solution.

Uses of Alginate fibres

Calcium alginate wool it can be used as:

- Swab for pathological work, it has the great advantage over cotton wool in that it permits release of all the organisms by disintegration and solution of the swab (ringer’s solution).

Starch النشا

- Starch constitutes the principal form of carbohydrate reserve in the green plant and is to be found especially in seeds and underground organs.
- النشاء : هو الشكل الرئيسي من الاحتياطي الكربوهيدراتي في النبات الاخضر، يتواجد في البذور والاعضاء الموجودة تحت سطح التربة.

- تتشكل حبيبات النشاء الصغيرة في الاقسام الخضراء أثناء عملية التركيب الضوئي وتسمى حبيبات نشاء انتقالية، وفي ساعات الظلام ينتقل النشاء الى اعضاء التخزين.
- المكونان الرئيسيان للنشاء هما الاميلوز والاميلوبكتين، ويختلف شكل وحجم حبيبات النشاء ونسبة محتوى الاميلوز والاميلوبكتين حسب النوع النباتي
- The green parts of plants exposed to sunlight contain small amount of starch. During the hours of darkness these are removed to the storage organs.

Starch

- Starch occurs in the form of granules (starch grains) the shape and size of which are characteristic of the species as is also the ratio of the content of the principal constituents, amylose and amylopectines.
- A number of starch of pharmaceutical use: include maize (*Zea mays* L.)نشا الذرة , rice (*Oryza sativa* L.)نشا الرز, wheat (*triticum sativum* L.) نشا القمحand potato (*solanum tuberosum* L.) نشا البطاطا (EP, BP).

Starch

- Tapioca or cassava starch (tubers of *Manihot utilissima*), may be used in place of the above in tropical and subtropical countries.

Fructans الفركتونات

- Fructans are D-fructose polymers, each chain being terminated by a single D-glucosyl residue.
- هي بلمرات تنتهي في كل سلسلة بثمالة D-glucoseyle مفردة
- They are found in nature as oligosaccharides and as polysaccharides. توجد في الطبيعة بشكل قليلات السكاريد ذات وحدات تصل الى ٥٠ وحدة.

Fructans

- The most important pharmaceutically, is inulin, a reserve carbohydrate found in many roots members of the Compositae الفصيلة المركبة and Campanulaceae الفصيلة الكمبنولية .
  - يعد الاينولين والفروكتان الاكثر اهمية من الناحية الصيدلانية
  - توجد في درنات الفصيلة المركبة والجرسية وبشكل خاص جذور الارضي شوكي وجذور الهندباء
- The tubers of the Jerusalem artichoke (*Helianthus tuberoses*) عباد الشمسand roots of chicory (*Cichorium intybus*) الهندبة البرية are particularly rich sources.
- Other Fructans : 1-Phleins 2-Agropyrone 3-Sinistrin

Inulin

- Inulin BP is obtained from the tubers of *Dahlia variabilis* الأضاليا , *Helianthus tuberosus* عباد الشمسand other genera of the Compositae الفصيلة المركبة .
- It occurs either in solution or as sphaero crystalline masses.
- It is sparingly soluble in cold water but readily dissolve at around 70 C without gel هلام

Dandelion root

- The root of the dandelion (*Taraxacum officinale*) أسنان الأسد is an important drug of herbal medicine.
- It contains about 40% of carbohydrates, particularly inulin.
- The fructose content reaches about 18% in the spring.

Algal Gelling Agents
العوامل المهلمة الطحلبية

- The two most important pharmaceutical products in this class are the alginate الألجيناتand agar الأغار .
- تعد الالجينات والاغار الاكثر اهمية في المنتجات الصيدلانية

Alginic Acid الحمض الألجيني

- Present in brown seaweeds.
- يتم الحصول على حمض الالجينيك من الطحالب البحرية البنية، وهو يتركب من ثمالات حمض المانورونيك، وحمض الغولورونيك
- Alginic acid, a hard, horny polysaccharide بولي سكريد متقرن وقاسي.
- Alginic acid is composed of residues of D-mannuronic and L-guluronic acids.

Uses of Alginates
استخدام الألجينات

- Stabilizer مثبت , thickening agent مسمك , emulsifying agent مستحلب , deflocculating agent مبعثر, gelling agent مهلم and film- and filament-forming agents لتشكيل الفلم in the rubber المطاط , paint الدهان , textile النسيج , dental الأسنان , food (including ice-cream), cosmetic مواد التجميل and other formulation such as creams الكريمات , ointments المراهم , pastes المعاجين , jellies الهلاميات and tablets المضغوطات .

Uses of Alginates and Alginic acid

- Alginic acid is also used in tablet and liquid preparation for the control of gastro-oesophageal reflux لضبط المنعكس البلعومي المريئي .

Agar الأغار

- Agar is the dried colloidal concentrate from a decoction of various red algae
- هو مكثف غرواني يستحصل عليه من مغلي الطحالب الحمراء , particularly species of *Gelidium,* (Gelidacea), and *Gracilaria* (Gracilariaceae).
- Agar is obtained from Japan, Korea, South Africa, Atlantic…..

Constituents of Agar

- Agar yield on hydrolysis galactose and sulphate ions..
- Agarose and agaropectin are the chains.
- Agarose is a neutural galactose polymer (free from sulphate) which is principally responsible for the gel strength قوة التهلم of agar (disacharide agarabiose).

- يتكون الاغار من مكونين رئيسين الاغاروز والاغاروبكتين وعند حلمهته يعطي L.D غالاكتوز وايونات السلفات
- الاغار: عبارة عن عديد سكاريد متغاير، والاغاروز هو بلمر غالاكتوز متعادل (خال من السلفات) وهو مسؤول عن القوام الهلامي للاغار.
- أما الاغاروبكتين مسؤول عن القوام اللزج للاغار.
- يستعمل الاغار في تحضير أواسط الزرع (الاستنبات)، وكعامل استحلابي في معالجة الامساك المزمن.

Constituents of Agar

- The structure of agaropectin, responsible for the viscosity of agar solutions لزوجة محاليل الآغار , is sulphonated polysaccharide.
- Pure agarose and its gels are recommended for the electrophoresis of proteins and others.

Irish Moss طحلب ايرلندا

- Chondrus (*Carrageen*) is obtained from red alga *Chondrus crispus* and *Gigartina stellata* (Gigartinaceae) (Irish Moss).
- يستحصل على الكاراجيين من انواع مختلفة لطحالب حمراء من نوع *Chondrus crispus* and *Gigartina stellata*
- Native in Ireland
- The constituents of chondrus resemble those of agar.
- عامل استحلابي

Irish Moss

- *C. crispus* produces different carrageenans in the two phases of its life cycle.
- The drug is rich in halogen salts غنية بأملاح الهالوجينات, and the extract differs from that of agar in that it has a higher sulphate and ash content. وتختلف الخلاصة عن تلك في الاغار بانها ذات محتوى اعلى من السلفات والرماد

Uses of Irish Moss

- Chondrus is used as an:

1- Emulsifying agent for cod-liver oil and other oil

عامل استحلابي لزيت كبد الحوت غيره من الزيوت ,

2- As a gelling agent عامل مهلم

3- As a binder in toothpastes

عامل رابط في معاجين الأسنان .

4- In the food industryفي صناعة الغذاء .

Gums and Mucilages

الصموغ والمواد اللعابية

- Gums and mucilages have similar constituents and on hydrolysis yield a mixture of sugars and uronic acids.
- تعطي بالحلمهة مزيج من السكاكر واحماض اليورونيك
- وهي منتجات طبيعية للاستقلاب تتشكل ضمن الخلية النباتية، وتتواجد بخلايا بشرة النبات (السنا)، او في أغلفة البذور (بذور الكنان)، والجذور (الختمية)، أو في لحاء الاشجار (لحاء الدردار)
- Gums are considered to be pathological products formed upon injury of the plant or owing to unfavorable conditions (extracellulare formation منتج خارجي ; gummosis).

Gums and Mucilages

- Mucilages are generally normal products of metabolism formed within the cell (intracellular formation منتج داخلي) and may represent storage material, a water-storage reservoir or a protection for germinating seedsانتاش البذور .
- They are often found in quantity in the epidermal cells of leaves, in seed coats, in the root and barks.

Tragacanth صمغ الكثيراء

- The EP/BP define Tragacanth as ‘the air-hardened gummy exudate, flowing naturally or obtained by incision, from the trunk and branches of *Astragalus gummifera* and certain species of *Astragalus* from Western Asia’
- Shrubs found in Anatolia, Syria, Iraq, Iran…
- The gum exuding immediately after injury and therefore being performed in the plant.

Constituents of Tragacanth

- Tragacanth consist of a water –soluble fraction known as tragacanthin and a water-insoluble fraction known as bassorin. Both are insoluble in alcohol.
- Like other gums, tragacanth is composed of sugar and uronic acid units.

Constituents of Tragacanth

- Peroxidase enzymes are usually considered to be absent.
- The presence of peroxidase enzymes appears to be related to a high starch content.

Uses of Tragacanth

- Tragacanth is used in pharmacy as

1. Suspending agent for insoluble powders.
2. Binding agent in pills and tablets.

Sterculia gumصمغ الكرايا

- Sterculia (Karaya Gum) is the dried gummy exudate obtained from the tree *Sterculia urens* (Sterculiaceae).
- It is produced in India, Pakistan…
- Good-quality of gum occurs colorless, translucent, striated masses weighing up to 25 kg or more.

Sterculia gum

- Karaya gum has a marked odor of acetic acid.
- In water, sterculia gum has low solubility but swells to many times its original volume.

Constituents of Sterculia gum

- Partial acid hydrolysis of sterculia yields galactose, rhamnose….., and Uronic acid residue represent about 37% of the gum.

Uses of Sterculia gum

- The granular grades are used as a bulk laxative, being second only to psyllium seed in use in this respect.
- The powdered gum is used in lozenges, pastes and denture fixative powders.
- As a bulk laxative and stimulant it is available, with frangula, as granules.

الصمغ العربي Acacia Gum

- Acacia (*Gum Arabic*) is a dried gum obtained from the stem and branches of *Acacia senegal*, and of some other species of Acacia from the family of Leguminosae.
- *A. senegal* is a tree about 6 m high, abundant in the Sudan.

Constituents of Acacia Gum and its uses

- Acacia Gum consist mainly of arabin, the calcium salt of arabic acid.
- Acacia Gum is also contains an oxidase enzyme and 14% water and 4%ash
- It has widespread use in the food, drinks and other industries.

Uses of Acacia Gum

- As a general stabilizer in emulsions مثبت في المستحلباتand as a pharmaceutical necessity in lozengesحبوب المص .
- Its demulcent properties خواصه المطريةare employed in various coughالسعال , diarrhoeaالاسهال and throat الحلق preparations but it is incompatibleمتوافقwith readily oxidized materials such as phenols, and vitamin A of cod-liver oil.

Guar Gum

- Obtained from the ground endosperms of the Indian leguminous plant *Cyamopsis tetragonolobus.*
- It can be used orally as hypoglycaemic drug.
- It can produce changes in gastric emptying and in the gastrointestinal transition time, which can delay absorption of sugars and oligosaccharides from the gut.

Guar Gum

- Guar lowers cholesterol levels, by binding bile salts in the gut

  بارتباطه معه الأملاح الصفراوية في الغائط.

- The gum has 5-6 times the thickening power of starch.قوة التسميك أعلى من النشا
- Guar Gum is used in the food industry.
- The principal constituent of the gum is a galactomannan, which readily forms a viscous gel with water.

Xanthan Gum

- This gum is produced artificially by the pure culture fermentation تخمير of the bacterium *Xanthomonas campestris* on glucose.
- It consist of glucose units.
- Xanthan gum is used as a pharmaceutical aid عامل مساعد في الصيدلة , and also finds use in the food and cosmetics industries.

Dextran

- Microbial product, produced by species of *Leuconostoc, Klebsiella, Acetobacter and Streptococcus*.
- It is used as a replacement for blood plasmaكبديل عن البلاسما الدموية and as an absorbent in biochemical analysis عامل ماص في الكيمياء الحيوية.

Psyllium القطونة، لسان الحمل

- Psyllium or Flea Seed, the used part is the dried, ripe seeds of *Plantago afra* (*P. psyllium*), *P. indica* (*P. arenaria*) and *P. ovata* from the family of Plantaginaceae الحملية .
- The seeds contain mucilage لثأ.
- Plantago seeds are used as demulcent مطري and in the treatment of chronic constipation لمعالجة الامساك المزمن.

Marshmallow Root الختمي

- Marshmallow Root is derived from *Althaea officinalis* from the family of Malvaceae الخبازية ,
- a perennial herb which is found wild in moist situations in Europe,
- up to 30 cm in length.

Marshmallow Root

- Marshmallow Root contains about 10% of mucilage.
- It contains a polysaccharide giving on hydrolysis galactose, rhamnose, galacturonic acid and glucuronic acid.
- Marshmallow Root, and also the leaves, are used as demulcent مطري, particularly for irritable coughs السعالand throat and gastric inflammation التهاب الحلق و المعدة .

التين Figs

- Fig *BP* is the sun dried succulent fruits of *Ficus carica* L. (Moraceae التوتية).
- Habitat: Mediterranean countries.
- Figs contain 50% sugars, vitamins A, B, C, and D, and enzymes (protease, lipase and diastase).
- There is an official requirement for a water-soluble extractive of not less than 60%.
- Figs are used by the BP and BPC in laxative preparations المستحضرات الملينة .

Cetraria شيبية ايسلندا

- Cetraria or Iceland moss, Cetraria islandica (Parmeliaceae).
- The drug consists of irregularly lobed, leafy thalli.
- The drug contains carbohydrates, known as lichenin and iso-lichenin.
- يحتوي على كربوهيدات تعرف باسم ليشنين وايزو ليشنين

Cetraria

- Lichenin is only soluble in hot water and is not coloured blue by iodine, while iso-lichenin is soluble in cold water and gives a blue colour with iodine.
- Cetraria also contains a very bitter depsidone, cetraric acid, and other acids such as lichestearic and usnic acids (antibiotic).
- It has been used as a bitter tonic and for disguising الستر the taste of nauseous medicines المذاق المقئي للأدوية.