THE STRUCTURE AND ULTRASTRUCTURE OF SECRETORY GUM DUCTS IN TWO ASTRAGALUS SPEICES

F. Zarrinkamar

Zarinkamar, F. 1996 12 25: The structure and ultrastructure of secretory gum ducts in two *Astraglus* species. *-Iran. Journ. Bot. 7(1): 117-124.* Tehran.

The anatomy of the *Astragalus gossypinus* and *A. keyserlingii* was studied under OM, SEM and MET. Observations show that the structure of ray parenchyma changes and cell walls partially or totally gelatinized which is the origin of the gum. Schizolysigene ducts are formed and some preclinal divisions allow continuation of gum produciton.

The gum is amorphus, and microtests prove the existence of protein, pectat and starch grain in the content.

Fatemeh Zarrinkamar, Research Institute of Forests and Rangelands, P. O. Box 13185-116, Tehran, Iran.

تشریح ساختمان کانالهای تولیدکننده کتیرا و چگونگی تشکیل کتیرا در دو گونه گون

فاطمه زرین‌کمر

ساختمان تشریحی کانالهای مولد کتیرا در دو گونه *Astragalus gossypinus, A. keyserlingii* با استفاده از دوربین چشمی، میکروسکوپ نوری و میکروسکوپ الکترونی مطالعه گردید و منشا کانالهای تولیدکننده کتیرا مشخص شد. مشاهدات در برشهای عرضی و طولی در ساقه و ریشه در مراحل مختلف رشد نشان می‌دهد که تولید کتیرا نتیجه مجموعه‌ای از تغییرات متوالی در ساختمان سلولی و یاخته‌های پارانشیمی اشعه می‌باشد. درواقع کتیرای تولیدشده از طرفی نتیجه ژلاتینی شدن دیواره و از طرف دیگر نتیجه فعالیت پروتوپلاسم می‌باشد. ابتدا این تغییرات در سلولهای پارانشیمی اشعه روی می‌دهد و به تدریج همین تغییرات در سلولهای پارانشیمی مغز و پوست صورت می‌گیرد. بعد از طی مراحل قبل، در مرکز بعضی از اشعه‌ها، ابتدا یک جدایی در ناحیه دیواره میانی صورت می‌گیرد که منشاء ایجاد نوعی از کانالهای ترشحی به نام شیزوژن (Schizogene) می‌باشد، به‌تدریج به علت دخالت فرآیندهای آنزیمی در مراحل پیشرفته‌تر کانالها بزرگتر و کاملتر می‌گردند. نهایتاً باتوجه به این شرایط می‌توان گفت که منشأ کانالهای ترشحی شیزولیزیژن (Schizolysigene) می‌باشد.

درحاشیه کانالها به روشنی تقسیمات سلولی مشاهد گردیدند که تولید سلولهای جدید را برای ادامه تولید کتیرا امکان‌پذیر می‌نمایند.

کتیرا از نظر ساختمانی بی‌شکل است و آزمایشها وجود پروتئین، پکتات و دانه‌های نشاسته را در آن تأیید می‌نماید.

INTRODUCITON

This is ther firt report on the structure and ultrastructure of the gum ducts in the *Astragalus* species. Approximately about 280 families in the *Angiospermae* are described as gum producers. In this study anatomical characters of the two gum producers, namely *Astragalus gossypinus* Spach and *A. keyserlingii* Bge. were studied. These plants were collected from "Mussiabad" in Isfahan, area at an altitude of 1500 m. Average annual rainfall of the area varies between 200 and 400 mm. Temperature ranges between -6°C and +35°C. Vegetation is low and hardly ever it does fully cover the land, soil is very poor and scarcely formed. The numerous studies made by investigators such as Mohl (1857; see Solereder 1908); Evans (1967), James (1984), Zargari (1990), show that by the hydrolisation of gum two main compounds are produced.

a) Tragacanthin

Which is soluble in water and constitute glucuronic acid and arabinose.

b) Bassorin

Which is not soulube in water but it is very hydroscopic. It is chemically, compound of polymetoxilic acid, which is composed of galactronic acid united to galactose and xilose.

The tragacanthin constitute %30 and bassorin %70 of the gum. Moreover, some nitrogenic and polysaccharid compounds are found in the gum content. The gum production in *Astragalus* is economically very valuable and has been used from very old times because of viscosity property and the ability to become emulsion. It is highly used in many pharmaceuticals and as an adhesive in odontology. In cosmetic industries, it is agreable in lotions and moisturizing creams. In the textil industries the gum is used for the fixation of dyeing.

MATERIALS AND METHODS

In order to study the histological characteristic of the root and the stem, material fixed in "FAA". Material were sectioned with a sliding microtome, sections were cleard with sodium hypochlorite, dehydrated and stained in Fastgreen and safranine and mounted in canadian blasame.

To identify cell contents, different histochemical tests were developed. For

observing the ultrastructural characters under "SEM" and "MET". Photomicrographics were taken with "Axiophan-Zeiss" photomicroscope, material was prepared according to conventional techniques.

The studied materils were collected by the author from Isfahan area "Musiabad" on Septamber 30th 1993, the fixed material were conserved in the Anatomy Laboratory of the Faculty of Natural Sciences of the University of Buenes aires (UBA) as follows:

a) *Astragalus gossypins* Fischer in FAA No. 544; b) *A. keyserlingii* Bge. in FAA No. 545.

OBSERVATIONS

The observations from the stem and the root in different stages of development illustrate that the ray structures is under the gradual changes. First of all, there are some changes which appear in the structure of ray parenchyma. The changes produce the partial or total gelatinization of the cell wall, which is the origin of the gum. Separation in lamina media happened between some of parenchyma cell rays, which seems to be the origin of schizogen ducts (Fig. 1. G. J; shows medulla in *A. glaucacanthus*). The parenchyma cells are destroyed by lysogenous process and form schizolysigene ducts (Fig. 1. A-F, H, I). In the border of the ducts, some preclinal divisions in parenchyma cells are created. These cells allow continuation of gum production (Fig. 2. C-E, G, H).

The production of gum is mostly in early ages of the plant. For example in a young stem of *A. gossypinus*, which is 2 mm in diameter, the ducts of gum production are present, and the same observation is made in the root of *A. gossypinus* and *A. keyserlinigii.*

The microscopic characteristics of the gum

A cut of the gum was prepared, hydrated and observed through optical microscope and "TEM". It is clear that the gum is an amorphous substance and there is no sign of cell organells in it. (Fig 3, A-D).

The microtests strongly give a positive result which proves the existence of starch grain, either simple or aggregated in two or four protein and pectat. Most of the starch grain grannuls are globular with a diameter of 3.25 μm. (Fig3, E, F).

Discussion and Result

The anatomical studies of stem and roots of *Astragalus gossypinus* and *A. keyserlingii, A. glaycacanthus A. ebenoides* in different stages of growth proved that the gum production is a process which is the result of a series of changes in ray parenchyma cells in main axes of the plant. (Fig2, A-B, F). In the first stage in very young cells, several cellular rays have very thin walls, concentrated cytoplasm and big nucleus which proves the cells being active. Later special changes occur in many rays. First the cell wall is thickened and hydrated gradually. Then it is gelatinized in particles and eventually the wall is separated from the cell ingrediants. In fact the produced gum is partly because of the gelatinisation of cell wall and also the activity of the protoplasm. These changes then gradually happen in medula and cortex. Actually the mucillage compounds are sedimented between cell wall and plasmalemma.

It could be concluded that the origin of gum production in these ducts, are in the process of Schizolysigen in the rays, cortex and the medula.

The production of gum is seen in very young stage of the plant life. The existence of gum in the plant (referring to the hard living conditions) is proteclive and produces humid conditions inside the plant organs. Also it has an important role in covering the accidental injury or the cuts which are made by man for gum production, to prevent the water stress conditions in the plant.

ACKNOWLEDGEMENT

I would like to thank Dr. E. Anchior for the guide and constant supervision over the anatomic research.

REFERENCES

Evan, W. C. 1976: Farmacognosia, p. 514-523. -Company editorial continental, Barcelona.

James, S. 1984: Lignotubers and burls. Their structure, function and ecological significence in Mediterranean ecosystems. -Bot. Rev. 50: 225-266.

Metcalfe C. R. & Chalk: L. 1950, Anatomy of dicotyledones vol 1: 512-533. -Oxford at the Claredon Press.

Solereder, H. 1908: Systmatic anatomy of the Dicotyledones vol. 1: 253-301. -Oxford at the Claredon Press.

Zargari, A. 1990: Medicinal plants vol. 1: 660-663. -Tehran University Publication.

Fig. 1. A-J. Gum ducts in the different stages of the stem development (A & B, observation under binocular; C-J, under optical microscope). -A-F. *Astragalus gossypinus*; A & B, ray ducts; C & D, ducts in the gelification process of the young stem; E, a duct; F, young stem in the stage of medular and ray duct formation. -G, medula in *A. glaucacanthus*. -H, ray ducts and J longitudinal section of medula in *A. ebenoides*; I, gum duct in *A. keyserlingii* (c= duct; cip= perifeicus cells; d= periclinal divisions. Bar; A and B=1 mm; D, G-J=50 μm; C, E and F=100 μm).

Fig. 2. Gum ducts in the stem of *Astraglus* species (A-D, observation under SEM; F, under TEM; E, G in *A. gossipinus*, A, ray ducts in xilem (transversal section); B, rary ducts in longitudinal section; C, some periclinal divisions in the border of the duct; E and G, periclinal divisions; F, formation duct with destruction cells. -D and H in *A. keyserlingii*: D, ray ducts in longitudinal section; H, the border of the duct(al= starch grain; C= duct; d= cell division. Bar: A= 0.1 mm; B and D= 0.5 mm; C= 10 μm; H and G= 50 μm; F= 5 μm; E= 100 μm).

Fig. 3. Cell contents in *Astragalus gossypinus* (observation under TEM). -A, border of the ducts; B-D gum; E and F periferic cells in duct with starch grain (al=starch grain; c= duct; cpp= primary pit fields; g= gum; p= protein. Bar: A, E and F= 5 μm; B, C and D= 1 μm).

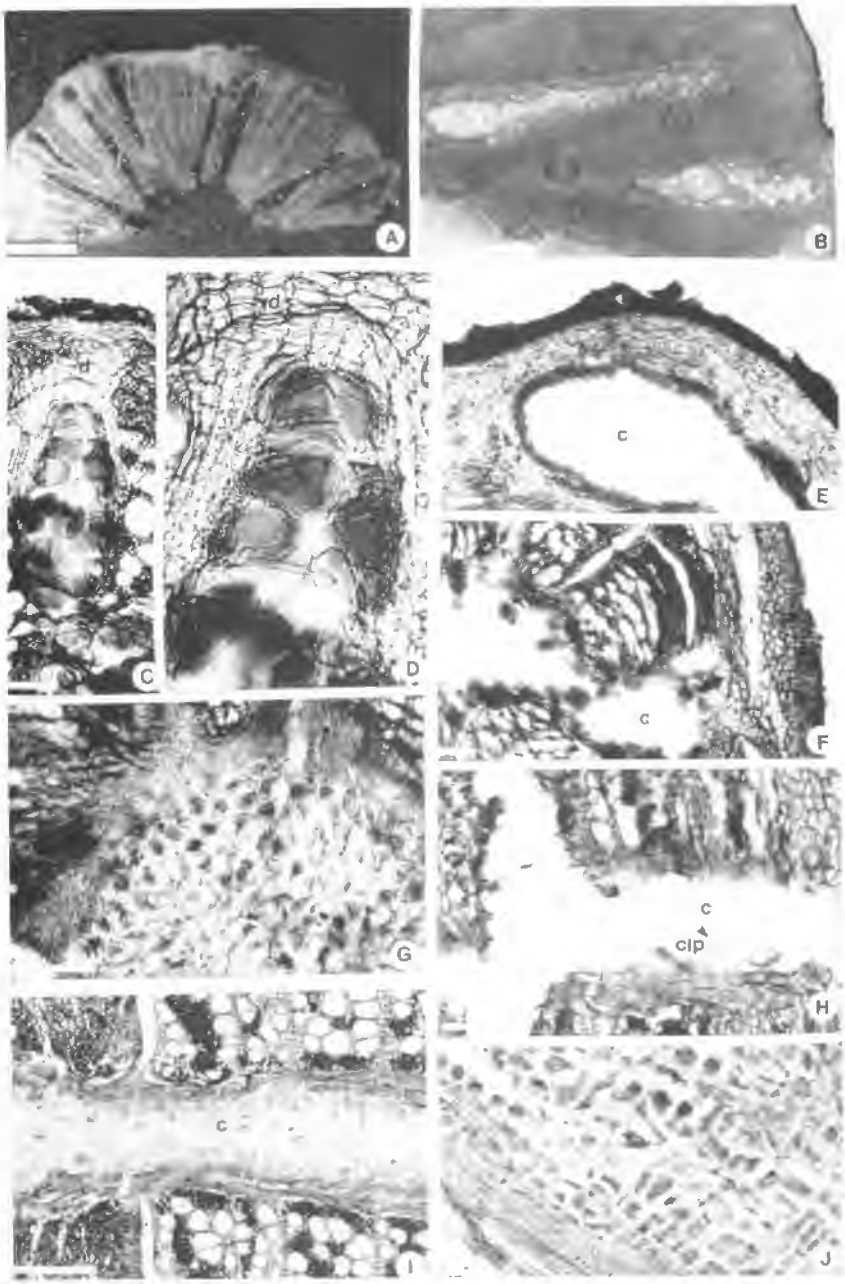

Fig. 1.

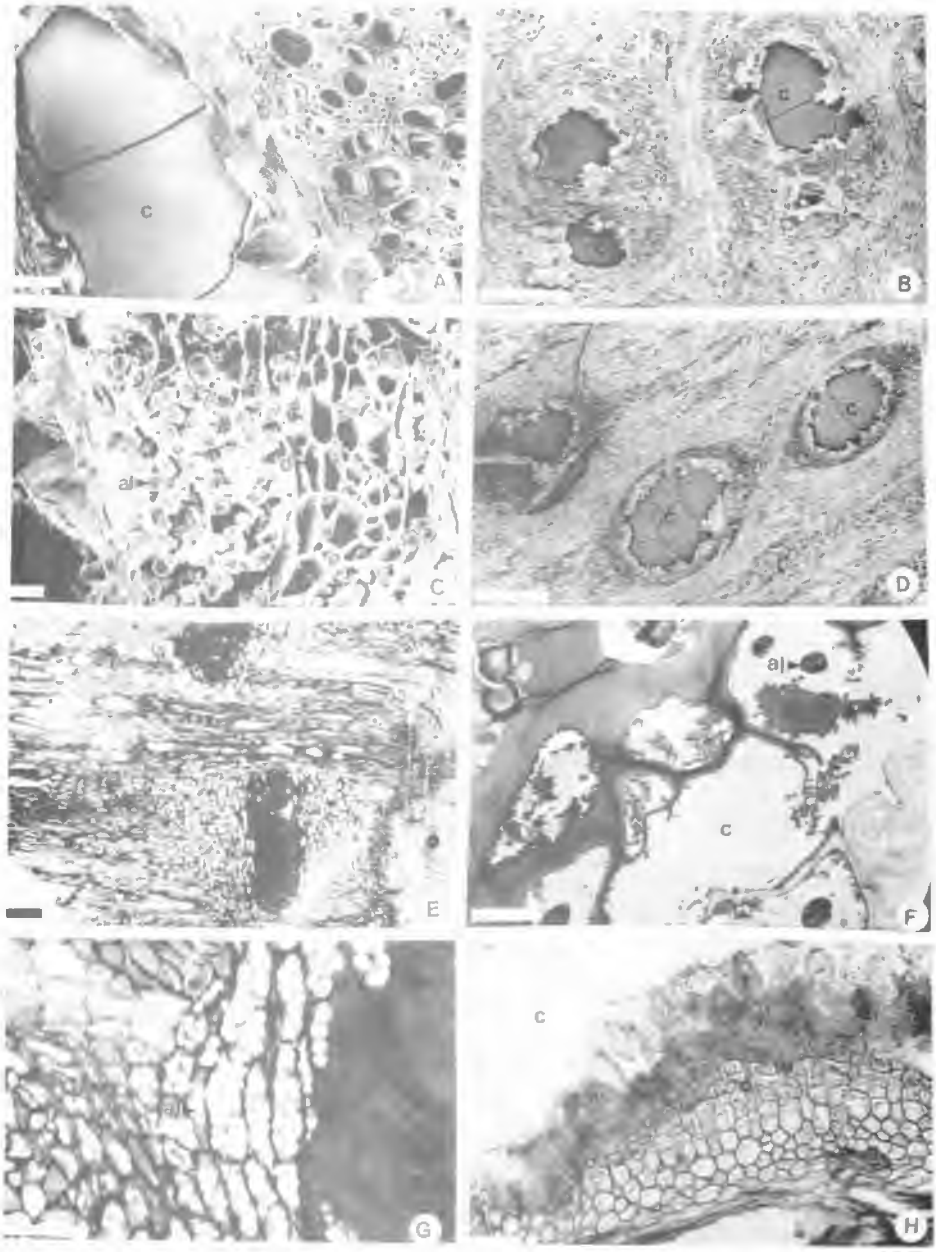

Fig. 2.

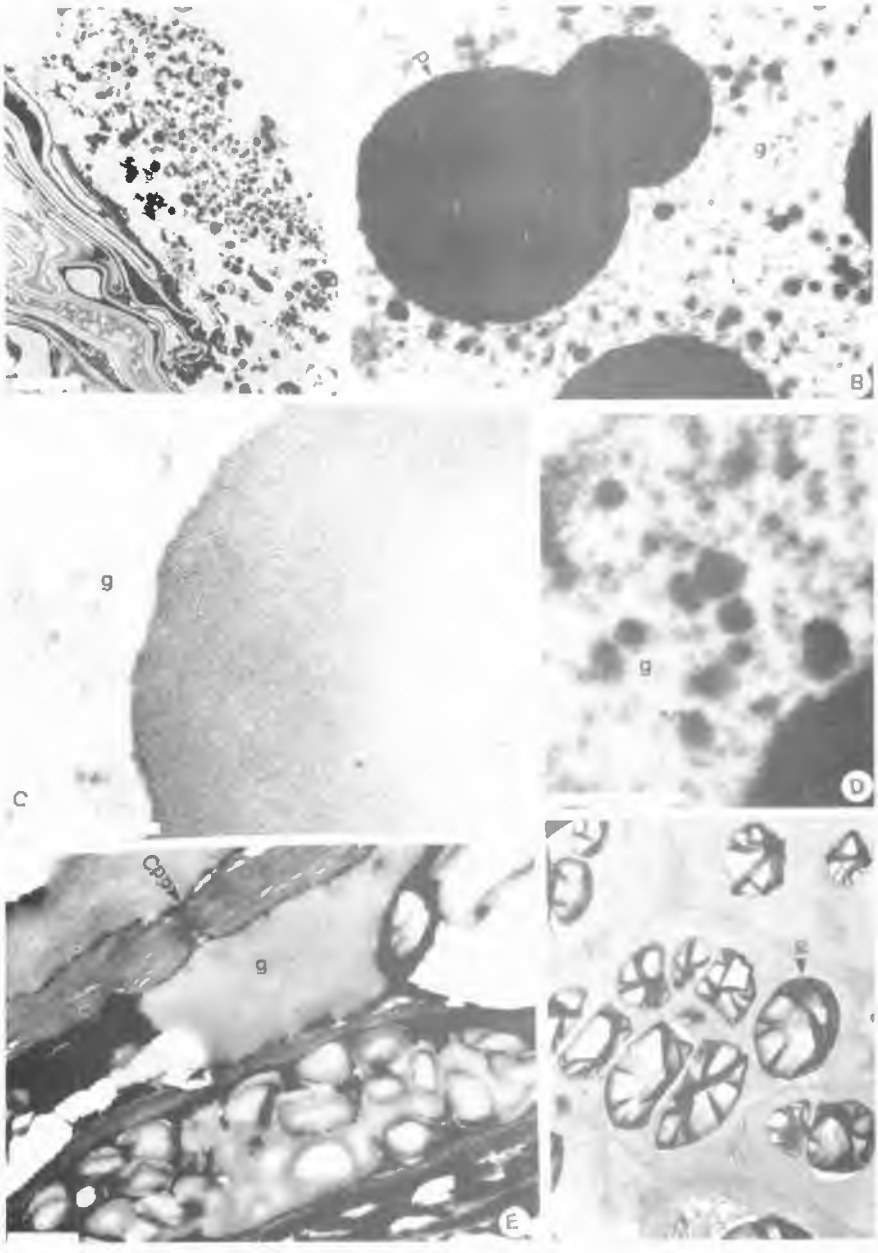

Fig. 3.