DYE PLANTS OF EAST ANATOLIA REGION (TURKEY)[1]

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DYE PLANTS OF EAST ANATOLIA REGION (TURKEY). *Economic Botany 57(4):454–460, 2003.*
Dye plants that are commonly used by the regional people of East Anatolia were studied. The following information was collected: local name of plants, the part of plants containing dye, obtained color, dying substances, and extraction of colors. As a result of area investigations carried out between 1994 and 2000, 50 taxa (used for dying wool yarns in the region) belonging to 38 genera and 26 families were determined from collected specimens.

By using the dying plants and mediator substances, 15 different colors and tones can be obtained. The main colors are yellow, green, olive green, black, red, blue, dark blue, brown, gray, beige, orange, khaki, mustard, purple, and smoke. The colors and their many different tones were observed on kilims and carpets that are woven in the East Anatolia region of Turkey.

DOĞU ANADOLU BÖLGESI'NIN (TÜRKIYE) BOYA BITKILERI. *Bu çalışmada çok zengin bir floraya sahip olan Doğu Anadolu Bölgesi'nde halkın yaygın olarak yün boyamada kullandığı boya bitkileri, bu bitkilerin yöresel isimleri, boya elde edilen bitki kısmı ve elde edilen renk, boyar maddeler ve renklerin elde edilme şekli araştırılmıştır.*

1994–2000 yılları arasında gerçekleştirilen araştırma sonunda bölgede boya eldesinde kullanılan 26 familyaya ait 38 cins ve bu cinslere ait 50 takson tespit edilmiştir. Bu taksonların farklı mordanlar kullanılması ile 15 ayrı renk ile tonlarının eldesi kaydedildi. Bunlar sarı renk ve tonları, yeşil ve tonları, kahverengi ve tonları, kırmızı ve tonları, gri ve tonları, bej ve tonları, mavi ve tonları, zeytin yeşili, turuncu, haki ve hardal renkleri, siyah, mor, lacivert ve füme renkleri'dir.

Key Words: East Anatolia region; dye plant; Turkey.

The objective of this study was to identify plants used as dyes in East Anatolia. Most people in the region live in rural areas and recognize and use wild plants.

The production of dyes from natural sources has been well known for several centuries. Natural dyes are an old tradition in Anatolia. There are three kinds of natural dyes: vegetable, animal, and metallic (Öztürk 1982). The natural dying processes are conducted in one of three ways: directly dying, cubic dying, or dying with mediator substances. Wool fibers are dyed in one of those three ways. The dyes were used until the end of the 18th century by local people. Wool fibers that were used to weave carpets and kilims were dyed mostly with vegetal dye substances (Öztürk and Özçelik 1991).

In the 19th century, synthetic dyes began to be used and dying with natural sources was abandoned. In general, natural dyes are rarely used in Anatolia, but they are common in some parts of the East Anatolia region. Research on natural dyes was started in 1930, but it did not continue because most people preferred the synthetic dyes. People preferred synthetic dyes for the following two reasons: first, they are inexpensive and easy to find; second, they have a basic dying procedure (Enez 1987).

Later it was seen that when carpets and kilims were dyed with synthetic dyes, their colors changed over the course of time. They could not endure the effects of sunlight, washing, and friction. On the other hand, when carpets and kilims were dyed with natural dyes, they could endure environmental conditions without changes in their color and the dying process does not pollute the environment. Therefore, the importance of natural dyes has been increasing over the past several years.

Most natural dyes are vegetable dyes. Roots, flowers, leaves, seeds, and fruit bark or the whole plant can be used for dying. At the same time, some mediator natural or chemical sub-

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stances can be used during dying, such as valonia oak, euphorbium gum, root of the walnut tree, wood ash, dough yeast, ash, lime, alum, iron sulphate, copper sulphate, calcium carbonate, and potassium bichromate (Öztürk 1999).

Natural dyes have been used for centuries. Economic and social reforms have altered people's habits resulting in the loss of cultural values. Because of the cultural and economic transformation in society in the past two decades, natural dyes were replaced with synthetic dyes. Synthetic dyes are economically cheap, easy to produce, more profitable, and are abundantly available, but they are not as valuable as natural dyes. The aim of this research was to protect and hand over the natural coloring culture to future generations.

Materials and Methods

This research covers plant samples that are used by regional people for natural dye production. The local name of the plants, the parts used for dye production, obtained colors, used mediator substances, collection time, storage, and preparation of plants for use were determined by collecting information from regional villagers. The research was conducted in Van, Hakkari, Bitlis, Ağrı, Siirt, Erzurum, Tunceli, Malatya, Muş, Elazığ, and other cities of the East Anatolia region. Plant samples were collected by asking regional people. Information about dye plants was registered during field tours, then the plants were pressed, dried according to herbarium techniques, and identified by *Flora of Turkey* (Davis 1965–1988; Güner et al. 2000). All plant specimens were kept (with collector number F Özgökçe: F) in the herbarium VANF. Also, local names of plants, their parts used for dying purposes, obtained color, and coloring matter were determined. All taxa in species, genus, and family levels were written in alphabetical order.

Results

Anacardiaceae

Pistacia terebintus L. subsp. ***palaestiana*** (Boiss.) Engler (Menengiç)

B9 Van: Bahçesaray, east of Ünlüce Village, sloping area, 2300 m, 10 vi 2001, F 9191.

Dried leaves are kept in water. Later, wool yarns treated with alum are added to the colored water and boiled about one hour so they become yellow.

Asteraceae

Anthemis tinctoria L. var. ***tinctoria*** (*Boyacı papatyası*)

B8 Erzurum: north of Tekman, steppe, 1450 m, 10 vi 1997, F 4971.

Dried capitulums are kept in water for one day. Then wool yarns that were treated with alum are boiled in the colored water for two hours; wool yarns become a light yellow color.

Olive green color is obtained if wool yarns treated with iron sulfate are boiled with the colored water. When wool yarns are treated with chrome, the color becomes cinnamon-yellow.

Effective substances are myricetin, luteolin, apigenin, isorhamnetin, and quercetin (Öztürk 1999).

Carthamus glaucus Bieb. subsp. ***glaucus*** (Aspir)

B9 Van: Özalp, south of Emek Village, steppe, 2000 m, 29 vii 1999, F 8603-b.

One kilogram of flowers is used for 1 kg wool yarns. Dried plant flowers are kept in water overnight, then wool yarns are boiled for one hour in the colored water. If wool yarns are treated with alum, yarns become yellow; if they are treated with chrome, yarns become mustard color. Also, when copper sulfate is used, the color becomes light khaki; iron sulfate turns color to olive-green.

Effective substances are rhamnatinin, rhamnazin, quercetin, and carthemin (Öztürk 1999).

Berberidaceae

Berberis vulgaris L. (Kadın tuzluğu)

B9 Van: Yüzüncü Yıl University, garden, 1950 m, 27 vii 2001, F 9939.

Roots are kept in water for one week. Then wool yarns that were treated with alum are boiled with the colored water for two hours and the color of the yarns becomes olive-green.

Effective substance is berberin (Öztürk 1999).

Betulaceae

Alnus glutinosa (L.) Gaertner. (Kızılağaç), Observation

Dried trunk fruit barks and ash are boiled in water, wool yarns are added to the colored water, and after five hours the color of the yarns becomes dark brown.

Boraginaceae

Alkanna orientalis (L.) Boiss. var. ***orientalis*** (Havaco, Havacıva otu)

C10 Hakkari: Mor mountain, steppe, 2700 m, 21 viii 1997, F 5353.

Rhisomes are kept in water for 12 hours, then wool yarns that were treated with alum are boiled with the colored water for one hour and the yarn color becomes a tone of red.

When wool yarns are treated with calcium carbonate, the color becomes smoke; when iron sulfate is used, the color becomes light green. Also, copper sulfate turns the color to green. When mediator substances are not used, the color of yarns becomes dark brown.

Effective substance is alkanin (Öztürk 1999).

Anchusa azurea Miller. var. ***azurea*** (Mıjmıjoka Şin)

B9 Ağrı: Suluçem, east of Balık Lake, steppe, 2300 m, 24 vi 1995, F 3319.

Dried above ground, the biomass is kept in water overnight, then wool yarns that were treated with alum are boiled in the colored water for one hour and the color becomes blue.

Brassicaceae

Isatis tinctoria L. subsp. ***tomentalla*** (Boiss.) Davis (Çivit otu)

B7 Tunceli: Ovacık, Munzur mountain, steppe, 2000 m, 15 vi 1996, F 4653.

I. glauca Aucher ex Boiss. subsp. ***iconia*** (Boiss. & Heldr.) Davis (Çivit otu)

B9 Van: Özalp, Emek Village, steppe, 2200 m, 17 vii 1999, F 8541.

Dried above ground biomass of *Isatis* spp. and non-extinguished lime are mixed in water and kept for one week. Wool yarns are added to the colored water and stirred. It is kept until it takes proper color. The color becomes yellow, then it turns to blue when the wool yarns are taken out of the colored water.

Effective substance is indican.

Corylaceae

Corylus avellana L., var. ***avellana*** (Fındık)

B9 Bitlis: Hizan, Nurs Village, steppe, 2400 m, 27 vi 2001, F 9850-b.

Dried leaves are kept in water for three days. Then wool yarns that were treated with alum are boiled in that water for two hours and the color of yarns becomes yellow pastel.

If fresh fruit barks are kept in water for three days and wool yarns that were treated with chrome are boiled in the colored water, the yarn color becomes green.

Cupressaceae

Cupresus sempervirens L. (Servi), Cultivated

Pounded *C. sempervirens* kozas are kept in water for a week. Wool yarns that were treated with alum are boiled for two hours in colored water and the yarn color becomes light brown.

Euphorbiaceae

Euphorbia cheiradenia Boiss. & Hohen (Sütleğen, Şirker)

B9 Muş: 20 km from Muş to Tatvan, steppe, 1300 m, 02 vi 1998, F 5674.

E. orientalis L. (Sütleğen, Şirker)

B10 Ağrı: Ağrı mountain, steppe, 2450 m, 21 vii 1997, F 5306.

E. heteradena Jaub. & Spach. (Sütleğen)

B7 Malatya: Hekimhan to Malatya, steppe, 2400 m, 05 vii 1997, F 5115.

The dried above ground biomass of *Euphorbia* spp. and wool yarns that were treated with iron sulfate are boiled in water for two hours and the yarn color becomes dirty yellow.

If wool yarns are treated with alum, the color becomes light green. If yarns are not treated with mediator substances, they do not get color.

Effective dying substance is quercetin (Öztürk 1999).

Fabaceae

Genista tinctoria L. (Boyacı katırtırnağı) Observation

Flowered stems are kept in water overnight, then wool yarns that were treated with alum are boiled in the colored water for one hour and the yarn colors become yellow. If same procedure is done with only stems, yarns become green-yellow.

Effective dying substance is Genistein (Öztürk 1999).

Hypericaceae

Hypericum thymbrifolium Boiss. & Noe (Sarı piren)

C10 Hakkari: north of Şemdinli, steppe, 1600 m, 04 v 1996, F 4610.

Dried above ground biomass is kept in water overnight, then wool yarns treated with alum are

boiled in colored water for one hour and the color becomes yellow. If wool yarns are treated with chrome, color becomes green.

Effective substance is quercetin (Öztürk 1999).

H. perforatum L. (Binbir delik otu)
B7 Elazığ: south of Palu, steppe, 1350 m, 12 vi 1998, F 5893.

H. venustum Fenzl. (Koyun kıran)
B9 Van: Muradiye, Pirreşit mountain, steppe, 2600 m, 18 vi 2000, F 8793.

Dried and pounded leaves are kept in water for two days, then wool yarns are boiled in the colored water for two hours and the yarns become brown.

Iridaceae

Crocus biflorus Miller. subsp. ***tauri*** (Hov) Mathew (Berfan)
B9 Bitlis: Alacabük mountain, by melting snow slopes, 2300 m, 20 vi 1998, F 5921.

Flowers are used for dying. Yellow color is obtained when wool yarns are treated with alum.

Effective substance is Crocin (Öztürk 1999).

Iris iberica Hoffm. subsp. ***elegantisima*** (Sosn.) Takht. & Fedorov. (Sosen)
B9 Van: south of Ahta mountain, steppe, 2400 m, 02 vi 1994, F 754.

Flowers are used to dye wool. Usually, wool yarns turn to violet color when yarns are treated with alum.

I. paradoxa Steven (Süsen)
B9 Van: Saray, Keçikayası Village, roadside, 2100 m, 05 vi 1995, F 3180.

Wool yarns become blue color when flowers of *I. paradoxa* are used for dying.

Juglandaceae

Juglans regia L. (Ceviz)
B9 Van: east of Bahçesaray, garden, 2200 m, 09 viii 2000, F 8759.

Fruit barks are used for dying purposes. *J. regia* fruit barks can directly dye wool yarns without using mediator substances. Usually, wool yarns become a brown color when they are directly dyed with fruit barks. When salt is used as mediator substance, yarn color turns to black.

Effective substance is juglon (Öztürk 1999).

Lamiaceae

Menta longifolia (L.) Hudson subsp. ***longifolia*** (Punk)
C9 Hakkari: Zap gorge, streamside, 1000 m, 28 vii 1994, F 1390.

M. pulegium L. (Nane, punk)
B9 Ağrı: east side of Tahir pass, roadside, 2400 m, 10 vi 1998, F 5888.

Dried aboveground biomass of *Menta* spp. is wetted in water; wool yarns that are treated with alum are boiled in that water for two hours and color becomes gray. If iron sulfate is used as mediator, color turns to light brown.

Effective dying substances are mentol, karvon, and limonen (Öztürk 1999).

Salvia multicaulis Vahl. (Kaşgatenik)
B6 Sivas: 30 km north of Gürün, steppe, 2100 m, 17 vi 1996, F 4685.

S. nemorosa L. (Adaçayı)
A9 Ardahan: east of Çıldır lake, slopes, 1850 m, 04 vii 1995, F 3575.

Dried aboveground biomass of *Salvia* spp. is retained in water. Later, wool yarns treated with alum are boiled in that water and yarn colors become gray. If onion shells are used as the mediator substance, the color becomes lemon yellow.

Effective substance is luteolin (Öztürk 1999).

Thymus kotschyanus Boiss. & Hohen subsp. ***kotschyanus*** (Kekik)
C10 Hakkari: 15 km from Şemdinli to Yüksekova, 1560 m, 28 vii 1995, F 3639.

T. transcaucasicus Ronniger (Kekik, Catır)
B8 Erzurum: Palandöken mountain, 30 km from Çat to Erzurum, steppe, 2200 m, 24 viii 1995, F 3810.

Dried aboveground biomass of *Thymus* spp. is kept in water, then wool yarns treated with iron sulfate are boiled in colored water for two hours and the yarn color becomes khaki. If alum is used as mediator, yarn color turn to gray.

Effective dying substances are thymol and karvakrol (Öztürk 1999).

Liliaceae

Allium cepa L. (Soğan)
B9 Van: Gevaş, Altınsaç Village, slopes, 2100 m, 23 viii 1997, F 5360.

Dried onion shells are kept in water for one week, then wool yarns treated with alum are boiled in that water for one hour and the yarns become bright red.

Effective dying substances are pirokatesin and benzokatesin acids and quercetin (Öztürk 1999).

Pinaceae

Pinus brutia Ten. (Kızıl çam), Cultivated.

Shells of *P. brutia* are pounded and kept in water for two weeks. Wool yarns treated with alum are boiled in colored water for three hours. Yarns are left in water overnight and the color becomes dark beige.

Polygonaceae

Rheum ribes L. (Ribes, Uçkun)
B9 Bitlis: Alacabük mountain, rocky slopes, 2600 m, 07 vii 1996, F 4832.

Rhisomes are kept in water. Later wool yarns are added to the colored water and boiled for one hour. Then the yarns are washed and dried and the color becomes blue.

Rumex caucasicus Rech. (Trişoğ, Evelik)
C9 Siirt: Eruh, Üzümlük Village, streamside, 670 m, 02 vii 1997, F 5052.

R. tuberosus L. subsp. ***horizontalis*** (Koch) Rech. (Trişoğ, Evelik)
B9 Van: Özalp, Damlacık Village, streamside, 2000 m, 09 vii 1997, F 4717.

Roots and seeds are kept in water for a week. Later, wool yarns treated with alum are boiled in that colored water for three hours and a beige color is obtained.

Aboveground biomass of *Rumex* spp. had quercetin; roots have chrysophan acide and emodin dying substances (Öztürk 1999).

Ranunculaceae

Caltha polypetala Hochst ex Lorent (Kıral fincanı)
B7 Tunceli: Pertek to Tunceli, streamside, 1150 m, 19 viii 1994, F 1564.

Whole plants are kept in water for a week, then wool yarns treated with copper sulfate are boiled in the colored water for one half hour and a yellow color is obtained.

Resedaceae

Reseda lutea L. (Muhabbet çiçeği)
B8 Muş: 10 km from Çaylar to Karlıova, steppe, 2450 m, 05 v 1995, F 2594.

Above ground biomass is used for dying. Plant parts and wool yarns treated with alum are boiled in water and the color usually becomes light yellow. By changing mediator substances and boiling time, different tones of yellow can be obtained.

Rhamnaceae

Rhamnus kurdicus Boiss. & Hohen. (Cehri)
B9 Bitlis: Alacabük mountain, steppe, 2400 m, 10 v 1996, F 4620.

Fruits of *R. kurdicus* have been commonly used for dying wool yarns for many years. Fruits of this plant are kept in water overnight, then wool yarns are boiled in the colored water. If yarns are treated with alum, the color becomes yellow. If yarns are treated with iron sulfate, the color becomes olive green. If yarns are treated with potassium bichrome, the yarn becomes mustard color.

Rosaceae

Agrimonia eupatoria L.
B7 Tunceli: west of Ovacık Village, garden, 1100 m, 27 vii 1994, F 1387.

Aboveground biomass is used for dying. Plant parts are kept in water overnight, then wool yarns treated with alum are boiled in that water for one hour and the yarns become yellow.

Amygdalus communis L. (Badem)
B9 Van: Gevaş, Akdamar island, rocky slopes, 1800 m, 28 viii 1994, F 1926.

Leaves are used for dying. Dried leaves are kept in water; later, wool yarns treated with alum are boiled in that water and the color becomes yellow.

Cerasus avium (L.) Moench (Kiraz), Cultivated.

Leaves are used for dying wool yarns. Without using mediator substances, wool yarns can be dyed with *C. avium* leaves. Light or dark yellow colors can be obtained from the leaves of this plant.

Cydonia oblonga Miller (Ayva)
B9 Bitlis: Tatvan to Küçüksu Village, roadside, 1700 m, 25 viii 1998, F 6960.

Dried leaves are kept in water for one day, then wool yarns treated with alum are boiled for one hour in that water and the color usually becomes yellow.

Filipendula ulmaria (L.) Maxim, (Keçi sakalı)
B9 Van: Özalp, Ahta mountain, east of Yarımkaya Village, streamside, 2500 m, 12 vii 1999, F 8263.

Aboveground biomass of *F. ulmaria* is used for dying yarns. Dried plant parts are kept in water for one day, then wool yarns treated with alum are boiled in the colored water for one hour. Yarn color becomes between green and yellow. Also, a black color can be produced from the roots of this plant.

Prunus divaricata Ledeb. (Erik)
B9 Van: east of Eğlence Village, garden, 2100 m, 28 viii 2000, F 9064.

Dried shells are pounded and kept in water for 15 days. Wool yarn treated with alum is boiled in that water for three hours and the yarns become a brown color.

Rubiaceae

Galium verum L. subsp. ***verum*** (Yoğurt otu)
C10 Hakkari: Yüksekova, roadside, 1800 m, 29 viii 1996, F 2694.

Dried above ground biomass is kept in water overnight. The following day, wool yarns treated with alum are boiled in that water for one hour and the yarn becomes red.

Rubia tinctorium L. (Runas, Kök boya), Cultivated.

The famous ''Turkish red'' color (in Turkish carpet and kilim) is produced from rhizomes of *R. tinctorium*. Rhizomes of this plant have been used for dying wool yarn for many years (Özkahraman 1997). Rhizomes from a three- or four-year-old plant are collected for dying. Dried rhizomes are ground and kept in water overnight, then wool yarn treated with mediator substances are boiled in the colopred water. Depending on which mediator substances are used, the color of the yarns change. When calcium carbonate is used, color becomes tile red; with sodium carbonate, light tile red; with alum, light orange color; with potassium bichromate, dark orange color; with copper sulfate, light brown; and with iron sulfate, dark brown.

Effective dying substances in Runas roots are rubiritrik acide, alizarin, rubiadin, Purpurin, ksantopurpurin, pseudopurpurin, and munjistin (Öztürk 1999).

Scrophulariaceae

Verbascum oreodoxum Hub.- Mor. (Merijenk, Sığır kuyruğu)
A9 Kars: south of Kısır mountain, steppe, 2100 m, 01 vii 1997, F 5024.

V. orientale (L.) All. (Merijenk, Sığır kuyruğu)
B8 Erzurum: Pasinler to Horasan, steppe, 1650 m, 25 viii 1994, F 1794.

Aboveground biomass of *Verbascum* spp. is used for dying. Dried plant parts are kept in water for three days. Then wool yarn treated with alum is boiled in that colored water for one hour and the color becomes yellow. If copper sulfate is added to the colored water, the yarn turns to green.

Effective dying substance is luteolin (Öztürk 1999).

Urticaceae

Urtica dioica L. (Isırgan, Gezgezk)
A9 Kars: above Susuz Village, streamside, 2000 m, 015 vii 1997, F 5027.

Fresh aboveground biomass of *U. dioica* and wool yarn treated with alum are boiled for one hour, then the yarn is left in the colored water overnight and the yarn becomes a pastel yellow color.

Vitaceae

Vitis vinifera L. (Asma)
B9 Bitlis: Hizan, Nurs Village, steppe, 2500 m, 27 vi 2001, F 9852-b.

Dried leaves are kept in water for three days, then wool yarn treated with alum is boiled in the colored water for one hour. Next, iron sulphate is added to the water and the yarn is left in overnight. The yarn becomes green.

Effective dying substances are quercetin, quercitrin, and karotin (Öztürk 1999).

Zygophyllaceae

Peganum harmala L. (Üzerlik)
C9 Siirt: 20 km from Eruh to Şırnak, steppe, 690 m, 02 vii 1997, F 5056.

Dried fruits are kept in water overnight, then

wool yarn treated with alum is boiled in the water for one hour and a red color is obtained.

Discussion

Since their discovery during the second part of the 19th century, artificial dyes were preferred to natural dyes. However, it was found that with artificial dyes the color of handicrafts changes over time, and the value of handicraft goes down when they exposed to light, washing, and friction. On the other hand, when handicrafts are dyed with natural dyes, the bright color will endure for a long time and the dyes are not harmful to the environment (Baytop 1984). For these reasons, the importance of natural dyes is increasing.

This study was conducted in the Eastern Anatolia region of Turkey, especially Van, Hakkkari, Bitlis, Siirt, Erzurum, Tunceli, Malatya, Muş, Elazığ, and Ağrı cities of the region. During the studies, 50 taxa were determined belonging to 38 genera and 26 families. Those taxa have been used for dying handicrafts in the region.

Most of people in the region are using mediator substances, such as alum, iron sulfate, copper sulfate, lime, salt, ash, and lemon salt during dying. Those substances function as a bridge between dying substances and wool fibers. Also, they change the tones of color.

Interestingly, child and cow urine are rarely narreted to be used as mordant. However this statement has never been confirmed by old people. In contrast they suggested that urine is not permitted to be used because of religious reasons.

Plants used for coloring purposes are an important part of Turkish flora. We hope that this work will help the researchers and people who are interested in plant-originated natural dyes. Companies or businesses could be established for the propagation of plants used for dyes. Also new employment facilities will be provided.

Regional people use usually 1 kg dried plant part for 1 kg wool yarn. Also, 20–30 liters of water is used for 1 kg of wool yarn. Wool yarn should be stirred during dying, washing, and drying.

Regional people used many wild plants for dyes. Species of ***Rubia, Juglans, Isatis, Anthemis,*** and ***Euphorbia*** were most widely used for their dyes.

Carpets and kilims will be dyed with natural permanent and eye-catching dyes with the otantic pattern. Thus very valuable arts will be emerge and these arts will take their own old place in the world market.

Plant-originated natural dyes have been used since the old ages (Baylav 1963). In the 16th century, two thirds of natural dyes in the world market were provided from Anatolia (Baytop 1984). However in this century most carpets, kilims, and textiles are colored with synthetic dyes.

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