Chapter 80
Cichorium glandulosum Bioss. Et Huet 菊苣 (Juju, Chicory)

Haji Akber Aisa and Xuelei Xin

80.1 Botanical Identity

Juju, a perennial herb in the family of Asteraceae is famous for its therapeutic and medicinal properties. It is used both in food, and traditional or modern medicine. Although there are 10–12 species of genus *Cichorium* in the world, only two of them, *Cichorium intybus* L. and *Cichorium glandulosum* Boiss. et Huet are familiar to us as medicine and edible food. *Cichorium intybus* L and *Cichorium glandulosum* Boiss. et Huet are major and legal sources recorded in The Pharmacopoeia of People's Republic of China [1], and many historical records of traditional Uyghur or Uighur medical works. Typical botanical traits of *Cichorium intybus* L are the tough, grooved, and somewhat hairy stems at a height of 30–100 cm. The leaves are stalked, lanceolate and unlobed. Flower heads are 2–4 cm (0.79–1.6 in.) wide. Flower petals are light blue, and sometimes white or pink [2]. *Cichorium glandulosum* Boiss. et Huet has very similar traits to *Cichorium intybus* L, except the stems are strigose [3].

The medicinal parts of the plant are the aerial part and root, and the edible parts are the root and leaf. The aerial part is taken in summer and autumn, and the root is harvested in late autumn. The main root of *Cichorium glandulosum* Boiss. et Huet is conical shaped with many fibrous roots and lateral roots. The main root is pale brown in color and has tiny, irregular wrinkles on the surface. This part of the root has a slightly bitter taste, and is about 10–20 cm long with a diameter of 0.5–1.5 cm. Sometimes, there are 2–3 forks at the top of *Cichorium intybus* L root. These roots are pale brown to dark brown, rough with deep longitudinal grain, and only few lateral roots and fibrous roots [1] (Fig. 80.1).

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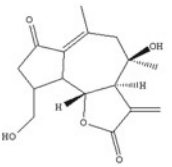
Fig. 80.1 Flowering plant (**a**) and dried roots (**b**) of *Cichorium glandulosum*

80.2 Chemical Constituents

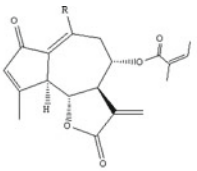
The study of the *Cichorium* genus mostly involves the study of *Cichorium intybus* L, while only a few papers reported covering *Cichorium glandulosum* Boiss. et Hue and other plants in this genus. Being a member of the asteraceae family, there are similarities to other plants in the asteraceae family, such as: terpenoids, flavones and coumarins et al. Up to now, coumarins, flavonoids, sesquiterpenoids, triterpenoids, steroids and organic acids were found in *Cichorium* genus, and here, some sesquiterpenoids and other new structure compounds were listed.

80.2.1 Sesquiterpenoids

Sesquiterpenoids are the main active components. Most sesquiterpenoids have the skeleton of guaiane sesquiterpenes, with few that are eudesmane sesquiterpene, referencing the structures of these below [4–14] (Fig. 80.2).

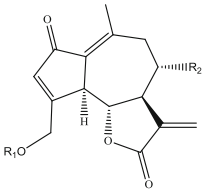


3, 4-dihydrolactucin[4], 1



Epi-8α-angeloxycichoralexin[5], 2, R=CH_3, αMe

8-O-methylsenecioylaustricin[5], 3, R=CH_3, βMe

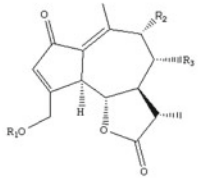


lactucin[6], 4, R_1=H, R_2=OH

8-deoxylactucin[6], 5, R_1=H, R_2=H

Lactucopicrin[6], 6, R_1=H, R_2=p-hydroxyphenlyacetoxy

crepidiaside A[7],7,R_1=Glc,R_2=H



jacquinelin[6], 8, R_1= H, R_2=H, R_3= H

crepidiaside B[6], 9, R_1= Glc, R_2=H, R_3=H

cichorioside D[6],10, R_1= Glc-Rha, R_2=H, R_3=H

cichorioside E[6], 11, R_1= Glc-Fru, R_2=H, R_3=H

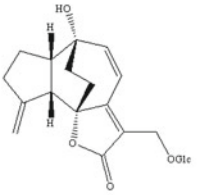
11β,13-dihydrolactucin[6],12,R_1=H,R_2=H,R_3= OH

cichorioside B[6], 13, R_1=Glc, R_2=H, R_3=OH

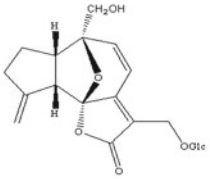
cichorioside F[6], 14, R_1= Fru, R_2=H, R_3=OH

cichorioside G[6], 15, R_1= H, R_2=H, R_3= OGlc

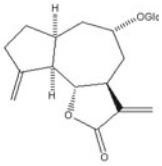
cichorioside H[6], 16, R_1= H, R_2=OGlc, R_3=H



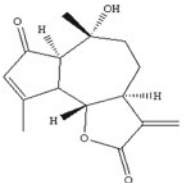
cichorioside J[6],17



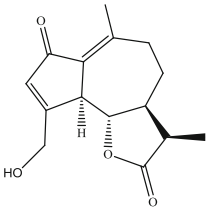
cichorioside K[6],18



Ixerisoside D[8], 19

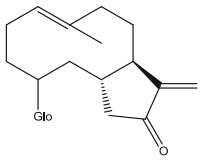


10α-hydroxycichopumilide[9], 20

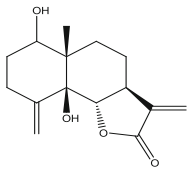


11-epijacquinelin[10], 21

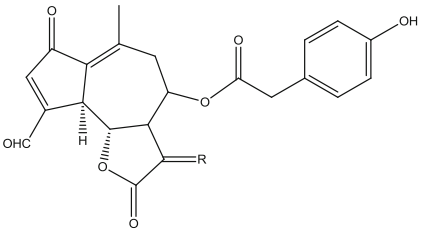
Fig. 80.2 Representative sesquiterpenoids isolated from *Cichorium* genus



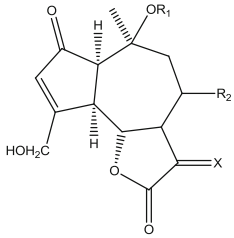
picriside B[7], 22,



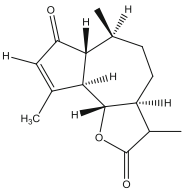
tanacetin[8] 23



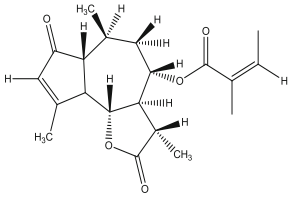
lactones lactupicrinal[8], 24, R=CH_2
11β,13-di-hydrolactupicrinal[10], 25
R=βH,αCH_3,



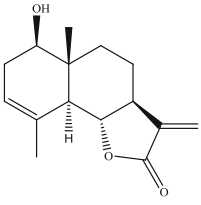
10β-methoxy-1α,11β,13 tetrahydrolactucin[11] 26, R_1=H, R_2=H,X=CH_2
hieracin II[1136],27, R1=CH_3, R_2=OH,X=H,Me
macrocliniside G[11] , 28,R_1=Glc,R_2=H,X=CH_2



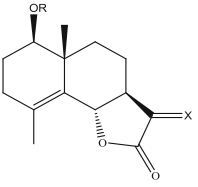
Cichoralexin[9], 29



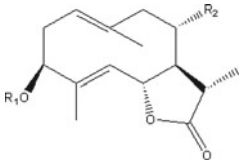
8α-angeloxycichoralexin[9], 30, R=CH_3



Santamarine[12] , 31



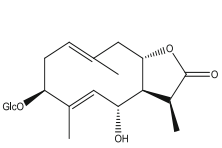
magnolialide[8], 32, R=H, X=CH_2
artesin[8], 33, R=H, X=H, α Me
11-epiartesin[12], 34 R=H, X=H, βMe
magnolialide-1-O-β-D-glucoside[8], 35, R=Glc,X=CH_2



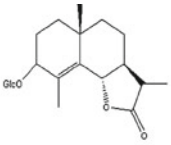
sonchuside A[6], 37, R_1=Glc, R_2=H
cichorioside C[6], 38, R_1=Glc, R_2=OH
hypochoeroside A[6], 39, R_1= H, R_2=OH
cichorioside L[6], 40, R_1= H, R_2= OGlc-Apl

11 β,13-dihydromagnolialide-1-O-β-D-glucoside[8] 36, R=Glc,X=H, α Me

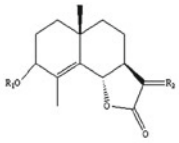
Fig. 80.2 (continued)



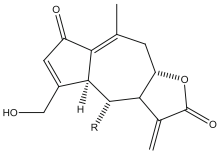
cichorioside M[6], 41



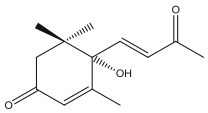
sonchuside C[8], 42



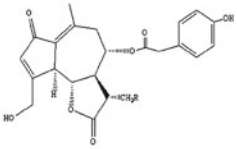
Cichoriolide [8], 43, R_1 =H, R_2=CH_2
CichoriosideA[8] , 434, R_1=Glc, R_2=CH_2,
eudesmanolide[8], 45,R_1 =H, R_2=H,α Me



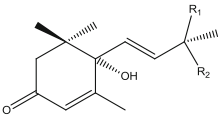
Intybulide[12], 46, R=OH



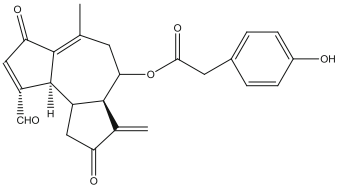
6S,7E-6-hydroxy-4,7-megastigmadien-
3,9-dione (S(+)- dehydrovomifoliol[13], 47



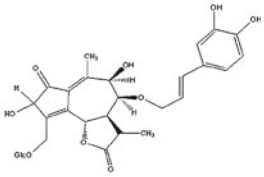
11β,13-dihydrolactucopicrin[6], 48, R=H
11β,13-dihydro-13-prolyl-lactucopicrin, [6]
49, R=prolyl



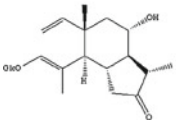
Roseoside, 50, R_1=CH_3, R_2=OGlc
6S, 7E, 9S-diastereomer[13], 51,
R_1=OGlc, R_2=CH_3



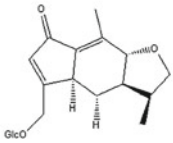
lactupicrin-15-al[8], 52



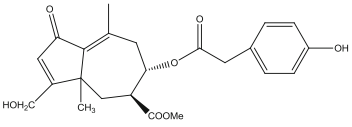
Cichotyboside[14],53



cichorioside N[6], 54



cichorioside I[6], 55

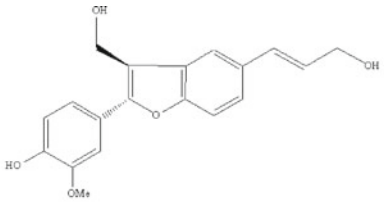


Lactupicrin methyl ester [8], 5 6

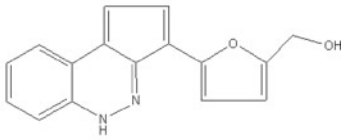
Fig. 80.2 (continued)

80.2.2 Some New Compounds Found Recently [7, 12, 15–19]

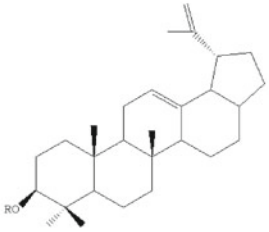
See Fig. 80.3.



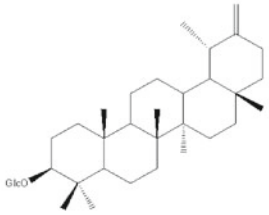
(7S, 8R)-3'-demethyl-dehydrodiconiferyl alcohol-3'-O-β-glucopyranoside, 57[15]



2-furanmethanol-(5→'11)-1,3-cyclo-pentadiene- [5,4-c]-1H-cinnoline[16], 58

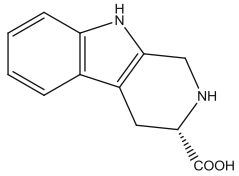


lup-12,20(29)-dien-3β-olyl hexadecanoate[17],59

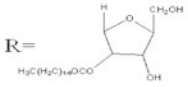


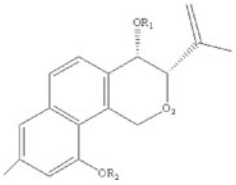
taraxasterol-3-O-β-D-glucoside[7], 61

lup-12,20(29)-dien-3β-ol-3β-L –arabino-furanosyl-2' –hexadecanoate[17], 60,



(3S)-1, 2, 3, 4-tetrahydro-β-carboline-3-carboxylic acid[18], 61





cichorin A[19], 63, R_1 =H, R_2= Me

cichorin B[12], 64, R_1 = R_2= Me

cichorin C[12], 65, R_1 = R_2= H

Fig. 80.3 New structures isolated from chicory

80.3 Pharmacological Studies

As an edible plant, *Cichorium intybus* L. is used in salads and a replacement for coffee in Europe. *Cichorium intybus* L. and *Cichorium glandulosum* Boiss. et Huet also have much bioactivity in traditional and modern medicine. Modern pharmacological studies have indicated they have the following bioactivities: hepatoprotective effect [14, 20], anti-diabetic and lipid lowering effects [21–23], antioxidant [23–25], anti-inflammation [25, 26], antifungal effect [27], antimalarial activity, antitumour activity [18, 28], etc.

80.4 TCM Applications and Dietary Usage

80.4.1 TCM Applications

Chicory is well known in Uyghur medicine, as medicinal plants have long been used in traditional Uyghur medicine. Chicory is labeled second class wet and cold; it has the ability to remove the obstacles, clean blood, relieve fever, reduce the function of abnormal sapra, as well as other conditions such as a cholagogic and diuretic agent to use for prevention and treatment of liver diseases, suppression and retention of urine, hypertension, and headache. There are four patent medicines that were collected in pharmaceutical standard-Uighur medicine part. Among those are granules of kasin which is made from chicory alone and is effective at prevention and treatment of urinary tract infections, liver function disorder, increasing urine, fever, psoriasis and cardiovascular diseases. In the other three Uighur medicine formulas, chicory is the principal drug widely used in the treatment of hepatic disorders such as hepatitis, fatty liver etc., also for treatment of hypertension, cholecystitis, rheumatism, prostatitis and adjustment of different abnormal Hilit disorders. The seed and root of *Cichorium glandulosum* Boiss.et Huet are used in the other folk recipes—Anti-inflammatory Syrup of Dinar, liver protection granules of Buzure, granules of Munziq [29].

80.4.2 Dietary Usages

80.4.2.1 Chicory Coffee

Chicory consumption has been associated with embargoes and cost cutting. The root of chicory could be roasted and as an alternative used in coffee, it is believed to have the effect on counteracting the stimulating effect of caffeine [30].

80.4.2.2 Chicory Salad

Chicory leaves are used in food as a kind of vegetable, and can be fried, boiled, steamed, braised. Salad is the commonest dish.

80.4.2.3 Chicory Tea

Chicory tea is a kind of tea which the main component is the shoot of chicory, it could be used alone or combined with the shoot of buckwheat, matrimony vine, asparagus and alfalfa, after cultivating, drying, roasting.

80.4.2.4 Chicory Used in Medicated Foods

Chicory coffee has repeatedly been assessed for resistance to thrombosis and inflammation due to its phenolics and caffeic acid content [31]. Chicory Capsule is consists of chicory, ramulusmori, tea polysaccharide, Juemingzi (seed of *Cassia obtusifolia*) and bee propolis; while the main functions are anti-diabetic, lipid lowering and hypouricemic effect etc. [32]. Inulin, which mainly comes from the root of chicory, is a mixture of oligo and polysaccharrides, it is also a kind of dietary fiber with health benefits including increased calcium and magnesium absorption, coordinating intestines and stomach etc. It could be used alone or in liquid products, semi-solid products and solid products [33].

80.5 Safety Evaluation and Toxicity Data

Few clinical reports on the toxicity or side effects are available that could be directly related to the use of chicory. In our study, toxicity of extraction from the air-dried aerial part of *Cichorium glandulosum* was examined in Kunming mice. A dose which is equal to 24.0 g *Cichorium glandulosum*/kg was given to mice, and repeated after 6 h for 3 days, no acute toxicity was observed in the mice following this treatment. So, a dose which is equal to 48.0 g *Cichorium glandulosum*/kg was orally administered to 2 groups of 10 mice. In the control animals, the vehicle of 0.5 % CMC was used. After the administration, animals were observed for 14 days, all mice were executed and dissected, no secretion was found in the mouth, eyes, nose and ears, no blood could be found in chest, abdominal, respiratory or digestive tract. No significant change had been found in volume, colour and character of viscera [34].

Subacute (4-week) oral toxicity was investigated by Johannsen FR, similar to lack of significant toxicity exhibited by other dietary carbohydrates (sorbitol, sucrose, glucose), oligofructoses (inulin/FOS) and carboxylated cellulose in repeated-dose rat studies, carboxymethyl inulin (CMI) did not found significant toxicity

at dosage of 0, 50, 150 and 1000 mg/kg/day too. No dermal sensitization was observed in groups of guinea pigs following CMI testing and no mutagenic activity was observed in TA1535, TA1537, TA98 and TA100-or in Escherichia coli WP2uvrA bacterial point mutation assays or in an in vitro Chinese hamster ovary cell chromosomal aberration assay [35].

No treatment-related toxic effects from chicory extract administered orally at 70, 350, or 1000 mg/kg/day was found by Schmidt BM inan Ames test and a 28 day subchronic toxicity study in SD rats. The NOAEL for the extract is 1000 mg/kg/day administered orally for 28 days [36].

Pirson F reported the side effect of chicory, rhino conjunctivitis, asthma and could be caused by it and a skin prick test results were positive to birch pollen and fresh/dry chicory, and negative for inulin [37].

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