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A Review of Edelweiss

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Introduction

Endangered species are one of the largest worries for any of us concerned about the future of certain precious plants. Techniques vary and cell culture is one method that was examined to preserve edelweiss (1).

Following demands by drug, food and cosmetics industries, attempts have been made, since 1995, to cultivate edelweiss (*Leontopodium alpinum*) in Bruson (Valais, Switzerland, 1100 m a.s.l.). Some growers in the neighbouring mountains also tested this new crop on a small scale, with satisfactory results. A broad phenotypic variability was observed among the various populations. The average fresh inflorescence yield was 1.3 kg/m² in the second year of cultivation for the best selection (2).

Edelweiss is a protected species, but it is good to see that the plant is being selectively bred in order to produce a commercial crop. The cultivar grows vigorously and abundantly and is now a source of raw material for cosmetic and food extraction. Although the new selectively bred cultivar grows with ease, it will not be released into the wild for fear of damaging the native strain.

Background

Edelweiss (*Leontopodium alpinum* Cass.) is the symbol of the Alps that conjures up the name of Heidi, cuckoo clocks and cow bells. The common name is derived from the German name »edel« which means »noble« and »weiss« meaning »white«. The Latin name *Leontopodium* comes from the Greek meaning lion's foot. On the Austrian euro coins, a picture of Edelweiss is used on the two euro cent coins. In Austria, Edelweiss is also a brand of beer named after the flower. In Switzerland, the Edelweiss Air AG is an international airline named after the flower, who also uses it as their logo. It is the national flower of Switzerland.

Edelweiss often called the queen of the mountain flowers, is a small, white and woolly flowering plant that grows high in the rocky cliffs of the Austrian and Bavarian alps. In one alpine saying, »Nur die Elite kann Edelweiss erreichen« (only the elite can reach the Edelweiss) implies that only the experienced mountain climbers (the elite) are able to scale their way to the Edelweiss.

In Alpine folklore there are many tales of young men climbing the steep cliffs to pick an Edelweiss and bring it to his beloved (his Mädchen). Needless to say there are many stories of tragic love that go hand in hand with the dangers of climbing the Alps, in order to fetch that pure symbol of pure love and worthiness - the Edelweiss.

The origins of Edelweiss are in the mongolian steps. Only after the end of the last ice-age many thousand years ago, Edelweiss succeded in populating the alps.

In magic, the herb was said to be used for invisibility and bullet-proofing.

Common names

Lion's Foot, Beautiful Star, Glacier Star, Alpine Everlasting Flower, Glacier Queen.

Distribution

Mountains of Europe, from the Jura and the Carpathians to the Pyrenees.

Habitat

The high altitudes at which this plant grows means that it has to withstand high levels of UV radiation, low atmospheric pressure and great extremes of temperature and humidity.

-Traditional Medicine

One of the oldest uses of edelweiss was

for the treatment of rheumatic pain and was a traditional remedy used in the Tyrol (3). The old German names of »Strahlendes Ruhrkraut« (radiant dysentery herb) and »Bauchwehblume« (stomach ache flower) leave no doubt as to the traditional use of the plant to treat diarrhoea and dysentery (4), as well as an astringent and tonic for use in coughs and diphtheria also anti-tussive (5). There is mention of edelweiss being used in the treatment of breast cancer, however, this may be for the plant's soothing properties (6). The powder, infusion or tincture are used (7).

Uses

The ability of the plant to protect itself from climatic extremes are the very properties that were needed for protection of the skin, especially for those living in urban areas.
Extracts and individual constituents of *Leontopodium alpinum* Cass. (8) were tested for their antimicrobial activity in two different assays. Extracts were screened in agar diffusion assays, whereas the minimum inhibitory concentrations (MIC) of single compounds were determined by the microbroth dilution method according to NCCLS criteria. Significant antimicrobial activities were found against various strains of *Enterococcus faecium*, *Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus, Streptococcus pneumoniae*, and *Streptococcus pyogenes* strains. These results support the ethnomedicinal use of *Leontopodium alpinum* for the treatment of respiratory and abdominal disorders (9).

Chemistry

For years there was hardly anything known about the chemical composition of edelweiss and it was said to contain tannin, gum, salts, and a bitter substance (7).
Subsequently flavonoids, phenolic acids, terpens, a chromane derivate and some bisabolane derivates have been isolated from edelweiss. For their investigations of the anti-inflammatory effects of *Leontopodium alpinum* Prof. Dr. *H. Stuppner* (University of Innsbruck) provided several constituents isolated from the roots of edelweiss, namely two bisabolane sesquiterpenoids called bisabolane A and bisabolane CD and one plant-lignan called MAB F7 (10).
Phytochemical analysis showed the presence of tannins, flavonoids and phenylpropanoids, which are of interest as constituents of drugs and cosmetics (2).
Three new compounds, including a benzofuran, 1-{(2*R**,3*S**)-3-(β-D-glucopyranosyloxy)-2,3-dihydro-2-[1-(hydroxymethyl)vinyl]-1-benzofuran-5-yl}ethanone, a lignan, [(2*S*,3*R*,4*R*)-4-(3,4-dimethoxybenzyl)-2-(3,4-dimethoxyphenyl)tetrahydrofuran-3-yl]methyl (2*E*)-2-methylbut-2-enoate, and a silphiperfolene-type sesquiterpene, [(1*S*,2*Z*,3a*S*,5a*S*,6*R*,8a*R*)-1,3a,4,5,5a,6,7,8-octahydro-1,3a,6-trimethylcyclopenta[c]pentalen-2-yl]methyl acetate, together with the known coumarins obliquin and its 5-methoxy derivative were isolated from the roots of *Leontopodium alpinum*. Another known coumarin derivative, 5-hydroxyobliquin, was isolated from the roots of *L. leontopodioides*. The structures of these compounds were established by spectroscopic studies (11).
Five hairy root lines of *Leontopodium alpinum* were induced by infection with *Agrobacterium rhizogenes*. Transformed roots were grown as batch cultures in a phytohormone-free modified MS medium. A time-course experiment with the most productive line showed that a culture period of 6 weeks was optimum for biomass production yielding a 70-fold increase in fresh weight. A 70% enhancement of anthocyanin formation was induced by addition of benzyladenine (to a final concentration of 0.5 mg l-1) to the culture medium 14 days before harvest. The presence in the cultures of chlorogenic acid as well as other hydroxycinnamic (coumaric) acid esters was confirmed by thin layer chromatography. An essential oil (ca. 0.6%) was separated from hairy roots by steam distillation, a high variability in oil yield being observed between the lines. Gas chromatography analyses showed the oils to be complex mixtures of >30 compounds, with 2 of these consistently representing ca. 60% of the oils. Essential oils isolated from hairy roots were qualitatively similar to the natural root oil, although quantitative differences in oil components were apparent. Oil yields were increased by growing roots in the dark (12).
(S)-(-)-2,3-Dihydro-2,6-dimethyl-4H-benzopyran-4-one was isolated from the essential oil produced by roots and cultured hairy roots (transformed by *Agrobacterium rhizogenes*) of *L. alpinum*. This is the first reported natural occurrence of (S)-(-)-2,3-dihydro-2,6-dimethyl-4H-benzopyran-4-one. Its structure was determined on the basis of spectral data and by comparison with a synthetic sample (13).
The cultivated plants (14) was extracted and found to contain chlorogenic acid **(Fig. 1)** a material previously found in apple seeds and discovered to have antioxidant activity and so useful as a free-radical scavenger.

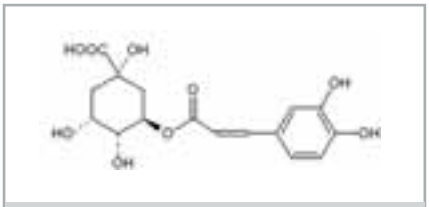

Fig. 1 Chlorogenic acid.

The flavonoid luteolin **(Fig. 2)** was discovered to be present as was its derivative luteolin-4'-O-glucoside. Luteolin is well documented for its hyaluronidase inhibition and antineoplastic activity. The glucosidic derivative present has interleukin-5 inhibition.

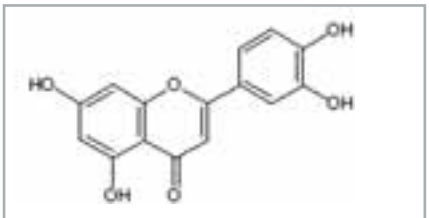

Fig. 2 Luteolin.

Amongst these flavonoid glucosides is found apigenin-7-glucoside **(Fig. 3)**, which was first detected as one of the anti-inflammatory components of Roman Camomile or *Anthemis nobilis*.

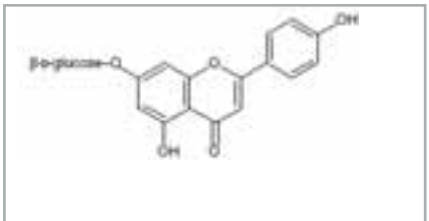

Fig. 3 Apigenin-7-glucoside.

It is likely that much of the plants anti-inflammatory activity comes form the presence of β-sitosterol **(Fig. 4)**, a material which according to some reports is also responsible for some of the anti-fungal and antibacterial activity.

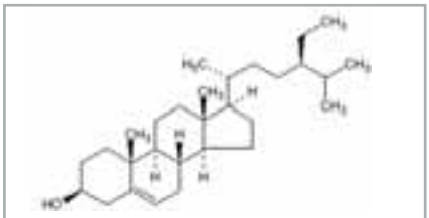

Fig. 4 β-sisterol.

Closely related to the chemical β-bisabolol, there are a series of bisabolane derivatives which also possess anti-inflammatory activity (and mainly found in the roots). The presence of tannins provide some of the antiseptic and inhibition of lipid peroxidation properties. There is also present a brand new phytochemical never before found or isolated in any plant – we are not permitted to reveal the structure at this moment.

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