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Conservation Strategies of *Saussurea Costus*, Critically Endangered Medicinal Herb Growing in Kashmir Himalaya- A Review

Sumeet Kour[1], Seema Singh[2], Zahoor A Kaloo[3]

Department of Botany, University of Kashmir, Hazratbal, Srinagar, J&K, India

Abstract: ***Saussurea Costus (Falc.) Lipsch is an important endangered medicinal plant species naturally growing in the Suru valley, kishenganga and the upper reaches of the Chenab valleys in Jammu and Kashmir. It is an endemic species of Indian Himalayan region growing at an attitude of 2600-4000masl. It has anti-inflammatory, anti-cancer, anti-ulcer properties. It is used for the treatment of various ailments, like asthma, ulcer, stomach problems etc. The roots are used as insecticides to protect shawls and woollen fabrics. In the Indian systems of medicine several preparations prepared from the roots are used by Ayurvedic physicians for the treatment of cough and cold, stomach ache, toothache, typhoid, fever etc. It is one of the important medicines for gout, erysipelas and promotes spermatogenesis.***

Keywords: Anti-inflammatory, Anti-cancer, Erysipelas, Gout, spermatogenesis

1. Introduction

Among dicotyledons, family Asteraceae is the second largest family of flowering plants comprising 11, 000 genera and about 23, 000 species. Genus *Saussurea* DC. belonging to Asteraceae comprises of about 300 species in the world (Bremer, 1994) of which 61 species are found in India. (Hajra, 1988;Hajraet. al. 1995).

S. costus(Falc.)Lipschitz, syn *S. lappa* C. B Clarke, the most important species within this genus is known by different vernacular names such as Kustha(Sanskrit), kut(Gujrati), postkhai(Kashmiri), kur(Bengali), kot(Punjabi), kostum(Tamil), sepuddy(Malayalam), koshta(kannada) and kuth in Hindi (Kritikar and Basu, 2001).

Saussureacostus(Falc.) lipschlocally known as kuth is a perennial herb of western Himalayas, distributed in India and Pakistan. It grows at an altitude of 2600-4000masl(Shah, 2006) and (Hajraet. al. 1995). Its natural populations are reported from the higher elevations of Jammu and Kashmir and Himachal Pradesh (Aswal and Mehrotra, 1994) and now cultivated in Kashmir, Himachal Pradesh and in some parts of Uttarakhand.

The perennials reach a height of 1-2m having simple alternate leaves. The leaves are ovate, dentate and petiolate. Roots are Stout, dark brown or grey in colour up to 40 cms long (Hajraet. al. 1995). *Saussureacostus* produces corymbs of purple flowers from july to August. The perennials produce achenes (Hortipedia). The export of *S. Costus* is prohibited as it comes under the category of red list

Species according to Appendix 1 of CITES (CITES 2003). The Jammu and Kashmir has enforced a special Act, **The Kuth Act, *1978***for the regulation of trade *of S. costus* (Jain, 2001). The medicinal properties of *Saussureacostus* are well documented in different systems of medicine since time immemorial.

Its most widespread uses include treatment of cough, cold, stomachache, toothache, ulcer and rheumatism. In the Himalayan states the root is used as an insecticide to protect shawls and woollen fabrics. The oil extracted from the roots, known as costus oil, is used in the preparation of hair oil and in high quality perfumes. Costus oil is pale yellow to brownish in colour and is valuable in treating leprosy. High medicinal importance and critically endangered status have led to the comprehensive collection of conservation strategies used in *saussureacostus* which will be discussed in the review.

2. Discussion

Keeping in mind the critically endangered status and immense potential medicinal value the review aims to provide an in depth comparative assessment of invitro stratergies used for the conservation of *S. costus.* It is a well-known medicinal plant frequently used in various indigenous systems of medicine all over the globe. Costunolide, dehydrocostus lactone and cyanopicrin isolated from costus have been identified to have potential to be developed as bioactive molecules.

The ethanolic extract of *saussureacostus* showed antiinflamatory effects when screened on mice and rat. These experimental results support the rationale behind the traditional use of this plant in inflammatory conditions (Gokhaleet. al. 2002).

Roots of saussureacostus are known to contain various important chemical constituents like costinolide, dehydrocostus lactone, cynaropicrin, lappadilactone, germacrenes such as (+)-germacrene A, germacra-1, 4, 11-trien-12-ol, germacra 1, 4, 11-trien-12 al and germacra-1, 4, 11-trien-12-oic acid (Taniguchi et. al. 1995; de Krakeret. al. 2001).

Singh et. al. (1992) and Talwaret. al. (1992) isolated 4α, 4β methoxydehydrocostus lactone and saussureal from the petroleum extract of *S. lappa*roots. From the essential oil 12-methoxydihydrodehydrocostuslactone was isolated (Dhillon et. al. 1987) and from the hexane extract B-cyclocostunolidedihydrocostunolide (14) were isolated (Robinson et. al. 2008). saussuramines and a lignin glycoside (−)-massoniresinol 4′′-O- β-D-glucopyranoside (Matsuda et. al. 2000) and through activity-guided fractionationbetulinic acid, betulinic acid methyl ester and mokko lactone (Choi et. al. 2009) were also isolated. From the acidic fraction of the costus oil α-Amorphenic acid was isolated and studied for its spectral studies (Ruke et. al. 1978). Under the group of guainolides, isodehydrocostus lactone, isozaluzanin C were isolated from the plant and confirmed by the correlation with dehydrocostus lactone (Kalsi et. al. 1984). The sesquiterpene lactones belonging to guaiane type, sulfocos- tunolide A and sulfocostunolide B (Wang et. al. 2008) and with sulfonic acid group named 13-sulfo-dihydrosantamarine and 13-sulfo-dihydro reynosin were also isolated (Yin et. al. 2005).

Several experiments were performed to investigate the different biological activities of *Saussureacostus*. The extracts of this plant have been found to exhibit anti- ulcer, anti-inflammatory, anti-cancer, hepatoprotective andpesticidal activities. Duttaet. al. 1960; conducted preliminary experiments to study the effect of different extracts of *S. costus* against chronic bronchitis and asthma which seemed to justify the reputation of the drug as a useful remedy against the above mentioned ailments. Tincture saussureaprepared from roots would be considered a useful drug for chronic bronchitis and asthma(Sastry and dutta, 1961).

Chen et. al. 1995 reported that costinolide and dehydrocostus lactone showed strong suppressive effect on the expression of hepatitis B surface antigen in human hepatoma cells. various experiments suggested that both compounds possess the potential to be developed as medicines for anti –HBVin future. Upadhyayet. al. 1996 found *saussureacostus* to be most effective for obese diabetes by carrying out detailed survey and clinical study on hypoglycaemic plants from different regions of India used in Indian folklore.

Jung et. al. 1998 reported that C-17 polyene alcohol isolated from *Saussureacostus* exhibited moderate cytotoxicities against human tumor cell lines. Costunolide, a compound isolated from roots was tested for its effect on apoptosis in HL -60 human cells and found it to be a potent inducer of apoptosis. Another study found that water extract of *S. lappa* inhibits spread of intestinal cancer due to Costunolide. Mokkolactone, an alkaloid isolated from *S. lappa* induces apoptosis in leukaemic cells (Umadevi et. al. 2013) Huntoseet. al. 1999 reported that inhalation of essential oil of costus by women in labour minimized the symptoms related to pain duringthe course of labour without having any adverse effect on mother and foetus.

Hsu et. al. 2009 reported that *s. lappa* possess antiperoxidative effects due to the presence of sesquiterpene lactones. Saussureamines A, B, C, Costunolide and dehydrocostus lactone isolated from *S. lappa* showed the gastro protective effect on acidified ethanol –induced gastric mucosal lesions in rats in a dose dependent manner (5 and 10 mg/kg). (Matsuda et. al. 2000)

Ko et. al. 2005 carriedout a study to understand the molecular basis underlying the antitumor effects of *Saussureacostus* and found that extracts of *S. costus* root may be used for the treatment of gastric cancers either by traditional herbal therapy or by combinational therapy with conventional chemotherapy. Shikokiols isolated from *S. Lappa* reveals anticancer activity by arresting cancer cell division in G2 phase of cell cycle and inducing apoptosis.

S. lappa was tested for in-vitro anti-bacterial activity using five different strains of Helicobacter pylori. The study suggests that the anti-bacterial activity of the plant is mainly due to the volatile oils present (Li et. al. 2005). Yu et. al. 2007 studied ethanolic extract of *S. lappa* for its antimicrobial activity using S. mutans which shows significant inhibition on the growth, acid production and on the formation of water-insoluble glucan. It also lowered the adherence of S. mutans in water-soluble glucan synthesis assay. *S. lappa* root extracts prepared from petroleum, ether, water were evaluated for the anticonvulsant activity and found that the petroleum extract of *S. lappa* roots at a dose of 100 and 300 mg/kg i. p. showed potent anticonvulsant activity. (Shirishkumar*et al.* , 2009)

S. lappa helps migraine patients by decreasing calcium, magnesium and serotonin concentrations and increasing phosphorus and alkaline phosphatase concentrations.

It is one of the 37 Himalayan endangered medicinal plants that have been prioritized for in situ and ex situ conservation (Kuniyal et. al. 2005). Owing to its great medicinal value various conservation stratergies have been proposed by different workers. Johnson et. al. 1997 achieved rapid micropropagation of *S. lappa* C. B. Clarke by culturing shoot tips (0. 5–1 cm) of 2 week old seedlings on Murashige and Skoog's medium (MS) supplemented with thidiazuron (TDZ, 0. 45 µ*M*). callusfree multiple shoots were obtained on media supplemented with N^6-benzyladenine- (BA) and TDZ. TDZ was most effective (90%) in inducing multiple shoots. Micropropagated plantlets after rooting were successfully transferred to the soil.

Snehlataet. al. 2013 used different explants of *S. costus* on MS media for mass propagation. In vitro micropropagation was achieved on MS medium supplemented with 2. 0 mg/1 BAP in MS media. Rooting was obtained on MS half strength medium with 1 mg/l NAA. The rooted plantlets were successfully transferred to field.

Aroraand Bhojwani, 1989 developed the protocol for in vitro multiplication of *Saussurealappa*. MS medium containing BAP and GA3. 5-fold shoot multiplication occurred every three weeks. Shoots rooted on MS containing 0. 5 µM NAA survived with 90% efficiency and Shoot cultures stored at 5°C in the dark for 12 months without an intervening subculture survived with 100% viability.

Sheret. al. 2010 conducted ex situ experiments in order to evaluate the growth performance of some medicinal plants including *S. costus* by planting small pieces of rhizomes collected from the natural habitat and observed very low sprouting percentage and survival of *S. costus.*

Parmaret. al. 2012 explored the effect of altitude on seed germination and survival percentage diversity in *S. costus*. High altitude favoured high survival and seed germination percentage. Various pharmacologically important sesquiterpene lactones have been reported from this plant. Out of total 175 formulations reported in' Handbook of traditional Tibetian drugs' this species is one of the main ingredients in 71 formulations (Tsarong, 1986).

3. Conclusions

Medicinally important biochemical compounds synthesized by *saussureacostus* have been established beyond doubt. The National Medicinal Plants Board has prioritized 32 and planning commission has enlisted 24 medicinal plant species for research and development in order to meet desired aim of medicinal plant sector and both lists include *saussureacostus* (Kala *et al.* , 2006). The valley of Kashmir is very rich in high value and high altitude aromatic and medicinal plants. The secondary metabolites found in plants are known to play a major role not only in the adaptation of plants to their environment, but also represent an important source of pharmaceuticals. Thus the need of the hour is to conserve this prized possession of Kashmir valley.

References

[1] Arora R. and Bhojwani S. S. , (1989) "In vitro propagation and low temperature storage Sassurealappa C. B. Clarke – an endangered medicinal plant". Plant Cell Reports. **8**: 44-47.
[2] Aswal, B. S. and B. N Mehrotra. (1994). "Flora of Lahaul-Spiti (A Cold Desert in North West Himalaya)". Bishen Singh Mahendra Pal Singh, Dehradun, India.
[3] Bremer, K. (1994). "Asteraceae: Cladistics and Classification". Timber Press, Portland, Oregon, U. S. A.
[4] Bhandari. S. , Dobhal. U. , Bisht. S and Bisht. N. S (2013) " in vitro conservation of*saussureacostus*- An Endangered Medicinal plant". Vegetos. **26 :** 67-71.
[5] Chen, H. C. , Chou, C. K. , Lee, S. D. , Wang, J. C. , andYeh, S. F. , (1995) "Active compounds from *Saussurealappa* Clarke that supress hepatitis B virus surface antigen gene expression in human hepatoma cells". Antiviral Research **27:**99-109.
[6] Choi, J. Y. , Na MK, Hyun Hwang I, Ho Lee S, Young Bae E, Yeon Kim B, and Seog, Ahn. J (2009) "Isolation of betulinic acid, its methyl ester and Guaianesesquiterpenoids with protein Tyrosine phosphatase 1B inhibitory activity from the roots of *saussurealappa* C. B Clarke. Molecules"**14**:266–272.
[7] CITES(2003). Conventionon International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendices I, II and III. (CITES Appendices). www. cites. org/eng/disc/text. php
[8] de Kraker J. W, Franssen M. C, de Groot A, Shibata T, Bouwmeester H. J (2001) "Germacrenes from fresh costus roots. *Phytochemistry*"**58**:481–487.
[9] Dhillon R. S, KalsiP. S, Singh W. P, Gautam V. K, Chhabra B. R (1987) "Guaianolide from SaussureaLappa". *Phytochemistry***26**: 1209– 1210.
[10] Dutta, N. K. , Sastry, M. S. , Tamhane, R. G. , 1960. "Pharmacological actions on an alkaloidal fraction isolated from *saussurealappa* (Clarke)". *Indian journal of pharmacy***22**: 6-7.
[11] Gokhale, A. B. , Damre, A. S. , Kulkarni, K. R. , and Saraf, M. N. , (2002) "Preliminary evaluation of anti inflammatorya and anti-arthritic activity of *S. lappa, A. speciosa*and *A. asoara".* phytomedicine**9**:433-437
[12] Hajra, P. K. , Rao, R. R. , Singh, D. K. , Uniyal, B. P. , (1995) Flora of India. Vols. 12 & 13: Asteraceae. Botanical Survey of India, Calcutta, India.
[13] Hajra, P. K. , 1988, " Brahmkamal and its allies (the genus saussurea)"Jughal Kishore and co. , Dehradun, India.
[14] Hsu, Y. L, Wu L. Y, Kuo P. L. "Dehydrocostuslactone, a medicinal plant derived sesquiterpene lactone induces apoptosis coupled to endoplasmic reticulum stress in liver cancer cells". J PharmacolExpTher 2009; 329: 809-819.
[15] Huntose, Y. , Pandey, K. K. , and Dwivedi, M. , (1999) "Response of herbal drug (Kustha) on psychological and neurobehaviour changes during labour". In:South-East Asian Seminar on Herbs and Herbal Medicines, Patna, India63-68
[16] Jain, P. , (2001). CITES and India. TrafficIndia, WWF India and Ministry of Environment and Forests, New Delhi, India.
[17] Johnson T. S, BadariNaryan S. and Narayana DBA (1997). "Rapid in vitro propagation of *Saussurealappa*, an endangered medicinal plant, through multiple shoot induction". In vitro Cellular and De- velomental Biology Plant **33**(2): 128-130.
[18] Jung, I. H. , Kim, Lee, Co. , Kang, S. S. , Park, J. H. , Im, K. S. (1998). "Cytotoxic constituents of saussurealappa". *Archives of Pharmacological Research***21:**153-156.
[19] Kala, C. P. , Dhyani, P. P. , andSajwan, B. K. (2006). " Developing the medicinal plants sector in northern India":Challenges and opportunities *Journal of Ethnobiology and Etnomedicine***2**:32-47.
[20] Kalsi P, Gurdeep K, Sunila S, and Talwar K. K (1984). "Dehydrocostuslac- tone and plant growth activity of derived guaianolides". *Phytochemistry* **23**:2855–2861.
[21] Ko, S. G. , Kim, H. P. , Jin, D. H. , Bae, H. S. , Kim, S. H. , Park, C. H. , Lee, J. W. (2005). "*Saussurealappa*induces G-2 growth arrest and apoptosis in AGS gastric cancer cells"*Cancer Letter* **220:**11-19.
[22] Kritikar, K. R. , Basu, B. D. , 2001. Indian medicinal plants, **6** second ed. Oriental enterprises, 1961-1965.
[23] Kuniyal, C. P. , Rawat, Y. S. , Oinam, S. S. , Kuniyal, J. C. , Vishvakarma, S. C. R. (2005)"*S. costus* (*Saussurealappa*) cultivation in the cold desert environment of the Lahaul valley, northwestern Himalaya, India: arising threats and need to revive socio-economic values". *Biodiversity and Conservation***14**:1035 1045.

[24] Li Y, Xu C, Zhang Q, Liu JY, Tan R. X (2005). "In vitro anti-helicobacter pylori action of 30 Chinese herbal medicines used to treat ulcer diseases". JEthnopharmacol**98**:329–333.
[25] Matsuda H, Kageura T, Inoue Y, Morikawa T, Yoshikawa M (2000) "Absolute stereo structures and syntheses of Saussureamines A, B, C, D and E, amino acid-sesquiterpene conjugates with gastro- protective effect from the roots of Saussurealappa". Tetrahedron **56**:7763–7777.
[26] Robinson A, Kumar TV, Sreedhar E, Naidu VG, Krishna SR, Babu KS, Srinivas PV, Rao JM (2008). "A new sesquiterpene lactone from the roots of Saussurealappa: structure–anticancer activity study". Bioorg Med ChemLett**18**:4015–4017.
[27] Ruke, D. D, Traas P. C, Heide R. T, Boelen H, Takken H. J (1978) "Acidic components in essential oils of costus root, patchouli and olibanum". *Phytochem***17**:1664–1666.
[28] Sastry, M. S. , Dutta, N. K, (1961). "A method for preparing tincture saussurea", Indian journal of pharmacy **23,** 247-249.
[29] Shah, R. (2006) Nature's Medicinal Plants of Uttaranchal:(Herbs, Grasses and Ferns). Vol. 1 and2. Gyanodaya Prakashan, Nanital. Uttarakhand. India.
[30] Sher. H, Hussain. FSher. H(2010) "Ex situ management study of some high value medicinal plant species in Swat, Pakistan. "A journal of plants, people and applied research. **8:**17-24.
[31] Shirishkumar D. A, Nilesh A. M, Amol P. M, Subhash LB (2009). "Pharmacological evaluation of anticonvulsant activity of root extract of saussurealappa in mice". Eur J Integ Med **1**:131– 137.
[32] Singh, I. P, Talwar K. K, Arora J. K, Chhabra B. R, Kalsi P. S (1992) "A biologically active guaianolide from *SaussureaLappa". Phytochemistry* **31**:2529–2531.
[33] Parmar. M. P. S. , Negi. L. . S and Ramola. S(2012) 'Seeds germination and seedlings Benth. In High and Low altitudinal villages of district Uttarkashi (Uttarakhand)''IOSR Journal of pharmacy **2:**25-30.
[34] Taniguchi M, Kataoka T, Suzuk H, Uramoto M, Ando M, Arao K, Magae J, Nishimura T, Otake N, Nagai K (1995) "Costunolide and dehydrocostus lactone as inhibitors of killing function of cytotoxic T lymphocytes". BiosciBiotechnolBiochem**59**:2064–2067.
[35] Umadevi M, Sampath K. P. , Bhowmik D, Duraivel S. "Traditionally used Anticancer Herbs in India". Journal of Medicinal Plants Studies. 2013; 1(3):56-74.
[36] Upadhyay, O. P. , Singh, R. H. , Dutta, S. K. , (1996). "Studies on antidiabetic medicinal plants used in Indian folklore". Aryavaidyan 9:159-167.
[37] Wang F, Xie ZH, Gao Y, Xu Y, Cheng XL, Liu JK (2008). "Sulfonatedguaianolides from Saussurealappa". Chem Pharm Bull **56**:864– 865.
[38] Yin H. Q, Fu H. W, Hua H. M, Qi X. L, Li W, Sha Y, Pei Y. H (2005) "Two new Sesquiterpene lactones with the sulfonic acid group from SaussureaLappa". Chem Pharm Bull **53**:841–842.
[39] Yu H. H, Lee J. S, Lee K. H, Kim K. Y, You YO (2007) "Saussurealappa inhibits the growth, acid production, adhesion, and water- insoluble glucan synthesis of Streptococcus mutans". J Ethno-pharmacol**111**:413–417.