SEABUCKTHORN – A VALUABLE RESOURCE OF THE COLD DESERT (LADAKH)

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Abstract: Seabuckthorn grows extensively throughout Ladakh region of J&K state (India). Its distribution extends from Nubra (District Leh) on one side upto Drass (District Kargil) on the other and encompasses Zanskar valley. It is a dioecious thorny shrub and if left undisturbed, attains the size of a small tree. The plant has gained tremendous importance by virtue of its pharmaceutical, cosmaceutical and nutraceutical value. Despite having such a potential, the plant is still under utilized in this region.

Keywords: Cosmaceutical, Dioecious, Ladakh, Nutraceutical, Pharmaceutical, Seabuckthorn, Underutilized

INTRODUCTION

The existing literature lacks clarity about the real identity of Seabuckthorn; the plant that has assumed tremendous importance during last few decades because of its multiple uses. It has earned several epithets such as the Golden Bush of Himalaya, Ladakh Gold and Wonder Plant. What is not clear from the existing literature is whether the name Seabuckthorn refers to all taxa of the genus *Hippophae* L. (Erkkola and Yang 2003; Naithani 2004) or specifically to *Hippophae rhamnoides* L. (Rousi 1971; Li 1999, Jeppsson *et al.*1999; Gao *et al.* 2000). A member of family Eleagnaceae (Oleaster family), Seabuckthorn is native to Europe and Asia (Hooker 1878).

Seabuckthorn holds the potential of changing the face of Ladakh, if exploited the way it has been in China, Russia, Mongolia, Canada, etc. China is the largest producer of SBT products; the total value of which is a little over 20 million US dollars. It is therefore not surprising that the area under cultivation of Seabuckthorn in different regions of China, has been extended from 6, 67,000 ha in 1985 to about 1,000,000 ha in 1990 (Rongsen, 1992). There are more than 200 SBT processing factories in China, developing more than 100 products including foodstuffs, beverages, medicines, cosmetics, healthcare products, chemicals, industrial material and so on. The annual yield of fresh SBT leaves in China is 15,945 kg/ha, which is 2.5 times that of alfalfa. In Northern China, every 0.13 ha of land under SBT provides fodder sufficient for rearing one sheep or goat. Fed with SBT a sheep or goat produces 5 kg more of mutton and 30% more cashmere. In a 4 year old man-made SBT forest each ha can produce 7.8 to 10.5 tons of firewood that roughly equals 6-8 tons of standard coal (Rongsen In: google/ISAexpert forum.com).

The plant can feed and sustain pharmaceutical, cosmaceutical and nutraceutical industries. To achieve this ultimate goal some basic problems need to be sorted out; foremost among these is the resolution of the taxonomic complexity of the genus *Hippophae* L., establishing the economic potential of specific taxa constituting the *Hippophae* species complex, undertaking survey for raw material availability for use in industry.

Taxonomy

Genus *Hippophae* is represented by 6 species [*H. rhamnoides* L., *H. salicifolia* D. Don, *H. tibetana* Schlecht, *H. goniocarpa* Lian, *H. neurocarpa* S. W. Liu et T. N. He and *H. gyantsensis* (Rousi 1971; Lian 2000) and 12 subspecies (Lian 2000; Naithani 2004). Of these, *Hippophae rhamnoides* is highly variable for which reason it has been split into 8 subspecies viz ssp. *rhamnoides, fluviatilis, carpatica, caucasica, turkestanica, mongolica, sinensis* and *yunnanensis.* Only 4 of these are considered economically useful. For example, *Hippophae rhamnoides* ssp. *mongolica* is extensively utilized in Russia, *H. rhamnoides* ssp. *sinensis* in China, *H. rhamnoides* ssp. *rhamnoides* in Germany, Finland, Sweden, Switzerland, Italy, etc; and *H. rhamnoides* ssp. *turkestanica* in India, Pakistan, Turkmenistan and Kirghistan (Lian 2000). Table1 summarizes the distribution range of different taxa and their present and prospective uses.

Indian Seabuckthorn

In India species of *Hippophae* grow in five states; 3 in the North-West (Himachal Pradesh, Uttaranchal and J&K) and 2 in the North-East (Sikkim and Arunachal Pradesh) Himalaya (Dwevidi *et al.* 2006) over a vast stretch of harsh, inaccessible, temperate area roughly 74,809 sq. km (Awasthi and Sankhyan In: google /Hippophae.com). Four species, namely *H. rhamnoides* ssp *turkestanica*, *H. salicifolia*, *H. tibetana*, and *H. gyantsensis* represent the genus in the country (Naithani 2004). In J&K, Seabuckthorn grows over more than 11,000 ha of land in five valleys of Ladakh viz. Leh, Nubra, Zanskar, Suru and Changthang. As per literature (Singh and Dogra 1996; Dwivedi *et al.*, 2004) Ladakh hosts *H. rhamnoides* ssp *turkestanica* and *H. salicifolia.* The two are easily distinguishable. *H. salicifolia* is a tree,

and *H. rhamnoides* is mostly bushy, but at many places, it attains the size of a tree.

Magnitude of Variability

Morphologically plants of *H. salicifolia* are less thorny with long straight or curved willow like branches. Its bark is reddish-brown with deep longitudinal furrows. Leaves are alternate, oblong-lanceolate and when young stellately pubescent on upper surface. Fruits are ovoid and yellow, longest among all the species, acidic to taste. *H. gyantsensis* (Rousi) Lian is similar to *H. salicifolia* but for its white bark, narrower leaves with whitish under surface and elliptical fruits. *H. tibetana* is densely branched shrub bearing thick, knobby tortuous thorny stem. Leaves 3 per node are whorled. Upper leaf surface is green with silvery rust coloured scales. Fruits borne on short peduncles are longer than broad.

As pointed out before also, *H. rhamnoides* is extremely variable which is attributed to its dioecious and cross pollinated nature; it can be arboreal or bushy. The 8 constituent subspecies of *H. rhamnoides* tend to intergrade with one another making their distinction arbitrary. Branching pattern, leaf size, shape, number and density; distribution of stomata, intensity of colour, pubescence of leaves and stem; shape, diameter, colour and distribution of hairs vary from plant to plant. Similarly, reproductive features like perianth shape and size, stylar length and thickness, stigma size and shape; fruit shape, size, number, colour, taste and vitamin C content; seed shape, size, texture, weight and germinability also differ considerably. *H. rhamnoides* Sp. *turkestanica* is a stiff shrub with erect or decumbent stems. Branches frequently dieback at the tips and become spiny. Twigs and young shoots bear silvery-brown scales. Leaves are sessile unlike the other three species, densely clothed with silvery brown scales along both the surfaces. Fruits are globose, orange-yellow or scarlet.

The plant species was exploited for the first time by the Field Research Laboratory, Leh for greening the mountainous terrain under Cold Desert Afforestation Programme and preparation of a herbal beverage under different trade names - Leh Berry, Ladakh Berry, Power Berry or Sindhu Berry (Dwivedi *et al.*, 2006). Except for this, no other major attempt has been made in India to tap and exploit this Nature's gift to mankind. Earlier, it was considered a weed and burnt off to clear the fields for cultivation (Brahma Singh 2004). The local populace does not know the full potential of this plant even now.

Uses

Because of its varied applications the plant is sometimes considered 'Kalptaru,"* (Duhoon *et al.* 1996; Naithani 2004). The main uses of the plant are briefly listed below to highlight the promise it holds. The nodulated roots bear *Frankia* sps. which fix nitrogen @80 kg/hectare/year. The quantity can be as high as 180 kg/hectare/year (Akkernans *et al.* 1983).

a) Stem is used as fuel which is a rare commodity in the alpine regions and burns without smoke. Its calorific value is 4785 cal/kg (Chaurasia 2003- 04).
b) Stem and branches are used for fencing fields, orchards and dwellings.
c) Bark is an effective blood purifier (Naithani 2004)
d) Leaves are utilized in preparing antioxidant rich beverage which is nutritious and refreshing (www.seabuckthorn.com). The protein rich leaves (23.9%) are used as fodder (Chaurasia 2003- 04).

   * Legendary tree of the epics - providing fruit as desired
e) SBT juice is fibrous and does not freeze at sub zero temperature and is nutritious and refreshing. Russian cosmonauts were supplied SBT beverages to enhance their health and resistance to stress. In fact, SBT juice is the first fruit juice that entered space (In www.seabuckthorn.com).
f) Fruits are used in making juice, jams, jellies, marmalades, pickles, snacks, S.B.T. milk and yoghurt (www.seabuckthorn.com; Dwivedi *et al.* 2006).
g) Seeds and fruits yield valuable oil which is in great demand for in pharmaceutical and cosmetic industries. Known to block UV radiation the oil is used in the preparation of sun screen lotions, hand and body creams, lip balm and lip gloss, SBT shampoos and conditioners and radio protective creams (Delabays and Slocanins 1995, Xu *et al.*, 2001).
h) The plant is a rich reservoir of 190 compounds present in its seed, fruit pulp and juice (Denise Code. In: www.seabuckthorn.com).These include a rare combination of fat soluble and other vitamins like C, B1 and B2, folic acid, 22 fatty acids (Chen *et al.*,1990), 42 lipids, organic acids, amino acids, carbohydrates, tocopherols and flavonoids (Yuzhen & Fuheng 1997), phenol, quercetin, terpenes and tannins and about 20 mineral elements (Denise Code. In: www.seabuckthorn.com).

i) Presence of omega-3 fatty acids (i.e linolenic acid) in SBT seed in quantities relatively higher than most other plant sources makes this plant appropriate for decreasing the risk of heart disease. The omega-3 fatty acids act by lowering triglycerides. It is also useful in treating rheumatoid arthritis, psoriasis, multiple sclerosis and systemic lupus – disorders in which the immune response is hyper-stimulated. Linolenic

acid acts on membrane phospholipids and thereby influences the immune system.

j) It finds use in medicine as anti-inflammatory, anti-irritant, anti-microbial, anti-ageing agent, as auto- immune moderator and skin conditioner. Its potential against atopic dermatitis, aphonia, cardio vascular disease, cancer, Parkinson's and Alzheimer's diseases have also been reported (www.seabuckthorn.com).

k) Under landscape management programmes the plant is used as popular garden and landscaping shrub because of its silvery leaves and stem. Florists for ornamentation use the branches (www.wikipedia/hippophae.com).

l) Considered a pioneer species, it colonizes open sites like abandoned agricultural lands, infertile wastelands, riversides, hilltops, slopes and rocky lands (Rongsen 1992).

m) It enhances ecosystem welfare by enriching oxygen deficient atmosphere of high altitudes; adding Nitrogen to infertile soils thereby promoting growth of vegetation in the scantily vegetated area; binding loose soil with its extensive root system, preventing erosion and conserving soil moisture (Rongsen 1992; Dhyani *et al.*, 2007).

With the present international market for Seabuckthorn products valued at over 60 billion US dollars per year, it is high time to utilize this forgotten gold mine lying unattended in an area otherwise poor in natural resources. The government needs to realize the importance of this plant, so that people can harness it for the economic development of Ladakh. To achieve this objective a strategy needs to be devised immediately.

Challenges

The first challenge lies in establishing which subspecies of *H. rhamnoides* is the true Seabuckthorn; followed by resolving the taxonomic wrangle of this species complex. At the same time, identification and prospecting of other species/ subspecies also need attention.

Other challenges follow. Quantification and availability of raw material that can be made available to the industry need to be determined. Similarly, morphological, cytological and molecular markers need to be employed to assess genetic variation for subsequent exploitation in breeding elite types. Hunt for spineless plants in nature as well as by induced mutation should be pursued vigorously because spines are a serious impediment for harvesting fruits. Detailed studies on reproductive biology, pollination ecology and seed-to-seed cycle need to be carried out, which will ultimately lay the foundation for selection and improvement of this nature's gift.

An initiative in this direction was taken in 2007 by the Department of Biotechnology, Govt. of India, with the identification of *Hippophae rhamnoides* as a promising bio-resource. A brainstorming session on "Sea buckthorn-problems, prospects and biotechnological interventions" was held on September 7, 2007 wherein a dire need to evolve a network programme was earnestly felt. Under the aegis of this programme, 14 research projects with funding to the tune of Rs 6.04 crore have been sanctioned to various groups engaged in Seabuckthorn research.

Table 1. Distribution and, known uses of *Hippophae* in different countries (as cited in Lu Rongsen In: google/ISAexpert forum.com)

Taxon	Areas of Distribution	Status of Utilization
1. *H. rhamnoides* subsp. *Rhamnoides*	Scandinavian countries, Baltic Sea countries, Germany, Belgium, Netherlands, Ireland, Poland, U.K, France, Russia.	Many varieties are cultivated in Canada and some European countries.
2. *H. rham.* subsp. *Sinensis*	The North, Northwest, Southwest of China.	Wild resources are used for ecological restoration and berries are processed for products. Some new varieties are in tests.
3. *H. rham.* subsp. *Yunnansis*	Sichuan, Yunnan, Tibet of China	Wild resources are used for ecological restoration only
4. *H. rham.* subsp. *Mongolica*	Siberia of Russia, Mongolia, Xinjiang of China.	More than 60 varieties are cultivated in Russia, Mongolia, and many East European countries. Many West European countries, Canada and China introduced the varieties for test
5. *H. rham.* subsp. *Turkistanica*	India, Pakistan, Afghanistan, Turkmenistan, Kirghistan, Uzbekistan, Kazakhstan, Iran, Turkey, Xinjiang, Tibet of China.	Wild resources are used for ecological restoration and berries are processed for various products
6. H. *rham* subsp. Fluviatilis	Around Alps Mountains: Germany, France, Switzerland, Austria, Czech, Slovakia, Italy.	Most of wild resources are protected as forest species. Some berries are collected for processing products

7. H. *rham* subsp. Carpatica	The Capathinan Mountains, Transsylvanian Alps, the valley and the mouths of the Donube and its tributary.	Most of wild resources are protected as forest species. Some selected varieties are cultivated for test
8. H. *rham* subsp. Caucasica	The Caucasus Mountains, Georgia, Azerbaijan, Armenia, Ukraine, Romania, Turkey, Bulgaria, Iran, Russia.	Most of wild resources are protected as forest species. Some varieties are cultivated for processing products
9. *H. gonocarpa*	Sichuan, Qinghai of China.	Most of wild resources are protected as forest species
10. *H. gonocarpa* subsp. *Litangensis*	Sichuan, Qinghai of China.	Most of wild resources are protected as forest species. Very few studies have been done on it
11. *H. neurocarpa*	Sichuan, Qinghai, Gansu of China.	Most of wild resources are protected as forest species. Very few studies have been done on it
12. *H. neurocarpa* subsp. *Stellatopilosa*	Sichuan, Qinghai, Tibet of China.	Most of wild resources are protected as forest species. Very few studies have been done on it
13. *H. tibetana*	Sichuan, Qinghai, Gansu of China Tibet of China.	Most of wild resources are protected as grassland species. Very few studies have been done on it
14. *H. gyantsensis*	Tibet of China.	Most of wild resources are protected as forest species. Some berries are collected for producing Tibetan medicine.
15. *H. salicifolia*	The Southern slope of Himalayan Mt. Tibet of China, Bhutan, Nepal, India.	Most of wild resources are protected as forest species. Some berries are collected for producing products.

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