

# Sea Buckthorn Juice: Nutritional Therapeutic Properties and Economic Considerations

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## ABSTRACT

In recent years sea buckthorn (*Hippophae rhamnoides* L.) juice has become a commercially desirable product due to inevitable nutritional and therapeutic benefits. The juice extracted from the fresh berries of the plant had an extraordinary amount of vitamin C and carotenoids and is also rich in other bioactive nutrients components like amino acids, sugars, volatile compounds, phenolics and antioxidants. Variations in these components are highly influenced by factors like origin of the subspecies, population, genetic background and individuals. The existence of such vital constituents in the sea buckthorn berries has made sea buckthorn juice a popular demanded product in the international market. It effectively adds to the economic growth of a country.

However, low awareness about these benefits, restrict wide acceptance of Sea buckthorn juice. Current review emphasize on the nutritional benefits and production strategies of Sea buckthorn juice with a broader perspective of its acceptance as a nutritional and therapeutic supplement world over and to explore the commercialization strategies of the juice and derived products.

**Keywords:** Sea buckthorn berries, juice, nutrients, economic.

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## INTRODUCTION

The growing interest worldwide, to explore novel and cost effective nutraceutical has brought about a paradigm shift toward validating the ethno-pharmacological importance and exploring the nutritional and therapeutic benefits of Sea buckthorn (*Hippophae rhamnoides* L.), traditionally used since 618 AD in China<sup>1</sup>. Sea buckthorn (SBT) derived its botanical name *Hippophae*, from ancient Greece, because the leaves of the plant were fed to horses for shiny hair and improvement in weight<sup>2</sup>. This wonder plant is a berry-bearing, hardy, dioecious shrub of the family Elaeagnaceae, naturally distributed in Europe and Asia and also introduced in South and North America<sup>3,4</sup>. The plant is reported to be domesticated at high altitude of 2500-4300 m in south Asian countries viz. Pakistan, China, India, Nepal and Myanmar along with Russia, Britain, Romaina, France, Germany and Finland<sup>6</sup>. The plant can withstand scorching heat (40-50 °C) to extreme cold weather with minimum air of (- 43 °C). Sea buckthorn has gained worldwide attention because of its high nutritional and therapeutic benefits<sup>3</sup>. The plant is also well known world over by different names viz. Oblepikha (Russia), Sanddorn (Germany), Rokitnik (Poland), Espino Amarillo (Spain), Argousier (France), Finbar (Sweden), Tindved (Denmark), Yashildoo Chatsargana (Mongolia), Sibü (China) and Leh berries (India)<sup>3</sup>. In India, the plant naturally grows in Ladakh, Arunachal Pradesh, Sikkim, Jammu and Kashmir, Himachal Pradesh and Uttrakhand regions<sup>7</sup>. There are 7 species and 12 subspecies of this plant and *Hippophae*

*rhamnoides* L. is the most extensively distributed variety world over<sup>8,9</sup>. The three most widely distributed species in India are *Hippophae rhamnoides* L., *H. salicifolia* and *H. tibitana*<sup>10</sup>. Apart from its nutraceutical applications, the plant has also been reported to play a pivotal role in water and soil conservation in eroded areas due to actinorhizal symbiotic association between strong and complex roots of the plant and nitrogen fixing bacteria *Frankia* sp., in root nodules<sup>4,5</sup>.

### *Nutraceutical Benefits of Sea buckthorn*

The SBT plant is valued for their nutraceutical benefits, veterinary uses and fuel. The leaves and fruits of the plant have been explored for nutritional and therapeutically important phytoconstituents. The leaves of the plant are silver-grey in color, lanceolate, alternate and narrow. They have been reported to be an excellent source of nutritional components viz.  $\beta$ -carotene and vitamin E having high antioxidant properties. Other antioxidants in leaves are catechins, ferulic acid and folic acid along with bioactive phytochemicals viz. flavonoids, tannins, carotenoids, polyphenols along with calcium, potassium and magnesium<sup>10</sup>.

The SBT female plant produces berries, orange to red in color, of 6-9 mm diameter. the berries are known to contain 190 compounds including fat soluble vitamins (A, E and K), amino acids, carbohydrates, organic acids, fatty acids, lipids, phenolics, tannins, flavonoids and terpenes. The juice extracted from the berries of sea buckthorn are effective in preventing coronary heart diseases, fights cell damaging free radicals and slows the aging process<sup>25</sup>.

Table 1: Amino acids profile of sea buckthorn juice<sup>1</sup>.

Sr.no	Amino acid	<i>H. rhamnoides</i>	Chinese
		subsp. <i>Sinensis</i> Quantity (mg/100g)	origin <i>H. rhamnoides</i> L. Quantity (mg/100g)
1	Alanine	2.50	21.2
2	Ammonia	-	41.8
3	Arginine	0.47	11.3
4	Aspartic acid	3.72	426.6
5	Cysteine	0.82	3.3
6	Glutamic acid	2.65	-
7	Glutamine	-	19.4
8	Glycine	0.64	16.7
9	Histidine	1.06	13.7
10	Isoleucine	0.97	17.4
11	Leucine	1.94	-
12	Lysine	3.49	27.2
13	Methionine	1.12	2.3
14	Phenylalanine	3.21	20.0
15	Proline	12.28	45.2
16	Serine	5.31	28.1
17	Threonine	6.24	36.8
18	Tryptophan	0.51	-
19	Tyrosine	1.79	13.4
20	Valine	2.85	21.8
Total		51.57	766.2

*Composition of sea buckthorn juice*

The SBT juice is extracted from the soft, juicy orange fleshy pericarp around the brown seed. The weight of sea buckthorn fruit is in the range of 270 - 480 mg<sup>5</sup>. The fruit juice is gaining worldwide attention due to its nutritional and therapeutic benefits. The chemical composition of SBT berries derived juice varies in nutritional aspects depending on its habitat, maturity and cultivar, weather conditions and technique of juice extraction. The extracted juice is highly acidic having a pH of around 3.0<sup>19</sup>. Moisture content of the berries depends on habitat and climate conditions and it varies from 20% to 87%. The total soluble sugar (TSS) content ranges from 9.3 to 27.9° Brix<sup>19</sup>. Both environmental and genotypic factors

play a crucial role in determining moisture and total soluble sugars in the berries.

*Mineral elements in SBT juice*

There are at least 24 mineral elements in the juice from the berries of SBT with potassium being most abundant. On consumption, it aids in regulating the ionic balance of the human body as well as maintains the excitability of the tissues<sup>6</sup>. Table 1 compares the mineral elements present in SBT fruit juices of Chinese and Indian origin. The amount of potassium in the SBT berries juice of Indian and Chinese origins were 647.2mg/L and 100-806mg/L respectively (Stobdan *et al.*, 2011; Alam Zeb, 2004). Other two important mineral, present in relatively higher amount are sodium and calcium. Selenium (0.53mg/L) and copper (0.7mg/L) were reported in least amount in Indian origin juice extract and were not reported in juice Chinese origin. The variation in the minerals may be due to cultivation conditions, cultivars, age and time of harvest and processing method for analysis<sup>1,7</sup>.

*Vitamins in SBT juice*

SBT juice is an enriched source of vitamin C<sup>8</sup>. The concentration of vitamin C in the juice (per 100 g) is much higher (360mg) than other fruit *viz.* mango (27.7mg), apricot (10.0mg), banana (8.7mg), orange (50.0mg) and peach (6.6mg) [22]. The juice is also rich in other vitamins like vitamin A, Riboflavin, vitamin E, niacin and pantothenic acid (Table 2)<sup>1</sup>.

*Amino acid profile of seabuckthorn juice*

There are 18 different kinds of amino acids present in sea buckthorn juice (Table 3). Eight out of these 18 amino acids are essential for human body. Those eight amino acids (isoleucine, leucine, lysine, threonine, methionine, tryptophan, valine and phenylalanine) play a crucial role in body processes like fat loss, mood regulation, functioning of brain, energy production, building of muscle and brain cells<sup>8</sup>.

*Sugar content of sea buckthorn juice*

Glucose, fructose, xylose are the main sugar components of sea buckthorn berries. Glucose is present in abundance in all the species of SBT from different origins. Table 4 compares the sugar content among SBT berries juice from the plants of Chinese and Finnish origin with the

Table 2: Sugar content of sea buckthorn juice of different origin<sup>1</sup>.

Sr.no	Sugar (units)	Chinese Origin	Finnish Origin	<i>Hippophae</i> Spices		
				<i>sinensis</i>	<i>Rhamnoides</i>	<i>mongolica</i>
1	Glucose (g/100ml)	5.5	0.9	5.8±1.9	1.4±0.7	5.3±1.6
2	Fructose (g/100ml)	3.8	0.2	4.6±1.8	0.3±1.8	2.4±1.2
3	Mannitol (mg/g)	-	17	-	-	-
4	Sorbitol (mg/g)	-	314	-	-	-
5	Xylose(% of total)	0.42	-	-	-	-
6	Xylitol (mg/g)	-	39.2	-	-	-
7	Ethyl glucopyranose (g/100ml)	-β-D-	-	-	0.6±0.6	0.1±0.1
8	Methyl inositol(g/100ml)	-	-	0.8±0.3	0.3±0.1	0.2±0.0

Table 3: Organic acids profile of sea buckthorn juice of Chinese origin<sup>7</sup>.

S.No.	Organic acid(units)	Range	Average
1	Citric acid	0.042-0.234	0.111
2	D- malic acid	0.015-0.054	0.033
3	L- malic acid	1.11-2.34	1.85
4	Tartaric acid	2.82-6.08	0.0135
5	Succinic acid	0.236-0.643	0.474

Table 4: Volatile compounds in SBT juice of Chinese and Finnish origin<sup>7,26</sup>.

S. No.	SBT berries juice (Chinese origin)	SBT berries juice (Finnish origin)
1.	Ethyl-3-methylbutanoate	Ethyl-2-methylbutanoate
2.	Butyl pentanoate	Ethyl-3-methylbutanoate
3.	2-methylpropyl-3-methylbutanoate	Ethyl hexanoate
4.	Pentyl-3-methylbutanoate	

Table 5: Commercially available sea buckthorn beverages in India<sup>11-17</sup>.

S. No.	Product Name	Manufacturer
1	ArboAmrit Plus	Himalaya Naturals, Dehradun
2	SeAmrit 7	Himalaya Naturals, Dehradun
3	Hillberry Health Drink	Hillberry , New Delhi
4	Mantra Wild Seabuckthorn concentrate	Biosash , Haryana
5	Sea buckthorn Juice	Herbo Nutra , New Delhi
6	Sea buckthorn Juice	Nature's Blessings for Life Care , New Delhi
7	Sea buckthorn Juice	Herbal India , Bengaluru
8	Himalayan berry juice	IMC herbal world , Jaipur

three cultivars cultivated in India. Total sugar content of sea buckthorn juice (2.86%) is quite low compared to other fruit crops like mango, apricot, banana, orange and peach having concentrations of 14.8%, 9.24%, 12.23%, 8.4% and 8.39% respectively<sup>1</sup>. Sugar and fruit acids may also effectively influence sensory properties of sea buckthorn juice, playing an important role in market acceptance by the consumers. Low levels of sugar alcohols like mannitol, sorbitol and xylitol are being observed. Relative sugar abundance and absolute sugar

content are influenced by factors like type of subspecies, harvesting dates and year. Sugar content pattern can vary during harvesting period depending upon the genetic background of the berries<sup>1</sup>.

#### *Organic acids and Volatile compounds profile of Sea buckthorn juice*

The SBT juice is also rich in organic acids such as malic acid and quinic acid, which are the major organic acids reported in SBT berries. They together make up around 90% of all fruit acids of the origin<sup>7</sup>. Subspecies origin, genotype, harvesting dates and year can greatly influence organic acid content in all species. Subspecies *mongolica* have the least organic acid content (3.2g/100ml juice), species *H. sinensis* have the most organic acid content (7.9g/100ml juice) and species *H. rhamnoides* have the moderate amount of organic acid content (5.3g/100ml juice). Table 5 shows the organic acids present in Chinese sea buckthorn juice, though not much information is available in the berries juices of cultivars from other countries<sup>7</sup>. Sea buckthorn juice also has an unusual profile of volatile compounds (Table 6). It mainly consists of short ester chains, alcohols, branched and chain fatty acids. Harvesting time of berries greatly influence the volatile compound profile of sea buckthorn juice<sup>7,8</sup>. *Processing of seabuckthorn juice*

The process of extraction of sea buckthorn juice begins with harvesting the ripe berries. Harvesting takes place in the fall. It is a tough and a time consuming process. Berries are tightly attached to the plant along with thorns on entire body makes it difficult to obtain the ripe fruit. Certain harvesting techniques are studied and being applied in different countries to retrieve the fruit. Several techniques used to retrieve fruits from plant are (i) Hand picking, (ii) Cutting of branches, (iii) beating the branches using sticks, (iv) mechanical harvesting and (harvesting using forks<sup>4</sup>. It is important to harvest the fruit at correct stage to avoid this problem. Quick processing and refrigeration at lower temperatures around 4-6°C can prevent microorganism growth<sup>9</sup>. The pressing technology is the standard used to extract the liquid mash. The decanter centrifuge technology is a recent technology for continuous extraction of the liquid from a vegetable or fruit. Pressing of fruits gives us approx 40% or more of juice and rest includes the seed, peel and pulp mash. Sea buckthorn juice normally remains pearlescent, to very turbid juice due to the presence of suspended solids that remains even once through with centrifugation. However, ultrafiltration is an alternative to remove all particulate and obtain a clear juice<sup>10</sup>.

#### *Commercially available sea buckthorn beverages*

the importance of Sea buckthorn is realized in third world countries a bit late with major market from first world countries. In India, with the persistent support and monitoring from MSME and Ministry of Commerce, Government of India Sea buckthorn products are thriving the international market and are generating revenue and employment for people of Himachal Pradesh, Sikkim, Ladakh, Jammu and Kashmir, Uttarakhand and Arunachal Pradesh. Some of the Sea buckthorn beverages,

manufactured by Indian manufacturers, are listed in Table 7.

Compilation revealed that major manufacturing companies are located in tier I cities (Delhi, Bangalore) of India, suggesting the possible role of market demand, export and knowledge based demand of product in these cities of India.

#### *Economic Analysis of Sea buckthorn Juice*

The growth of the economy of a country is equally contributed by international trade and trade surplus is often the target. For third world countries like India, agro- and plant derived food products are second highest exported product after animal products. According to the information available, the revenue generation from the export of SBT products has seen substantial growth from 2010 to 2011 with export to countries like Vietnam, Spain, Thailand and The Netherlands. Sea buckthorn product can be a economic boast for third world countries including India and its importance need to be appended to masses. Limited report on economic potential of SBT revealed the role of economic potential of SBT products on the socio-economic growth of the society, however there is still a potential to explore the efficient utilization of residual plant mass for higher recovery and exploration of novel or unexplored phytoconstituents of nutritional and therapeutic benefits<sup>27</sup>.

#### CONCLUSION

Previous studies suggest the therapeutic, nutritional and economic benefit of Sea buckthorn derived products. Sea buckthorn Juice is one such product from the berries of the plant that is an excellent source of nutritional supplement and therapeutically important and bioactive biomolecules. It has an incredible amount of vitamin C compared to most of the food sources naturally available. There are different methods of harvesting the berries and extraction of juice and it affect the juice yield. The content of carotenoids, vitamin C, total soluble solids and acidity varied according to juicing technique. Sea buckthorn juice from berries also has high pharmacological value and used to treat stomach and lung problems, healthy blood circulation and facilitate the functioning of spleen. Sea buckthorn juice has high economic value and incorporation of it in our diet is highly beneficial. However, an urgent need to popularize the benefits of the Sea buckthorn products, establishing state of the art product manufacturing units and cultivating the plant will provide socio-economic benefits also.

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