

# Nutritional module of sea buckthorn

Sweety Kumari and Sujata Pandit Sharma

Seabuckthorn is proved to have industrial, medicinal, cosmetic and nutraceutical value. It contains various extravagant chemical compounds which makes it useful as unconventional provenance in the global market. Sea buckthorn berries are prospects provenience of metabolites which comprises vitamins, carotenoids, phytosterols, antioxidants, tannins, organic acids, fatty acids (saturated and unsaturated fatty acids), amino acids (Leucine, Valine and Alanine), sterols and because of these dynamic bio-active phyto-chemicals sea buckthorn plant parts could play a vital role in improving human health. It has an extensive diapason of nutritional and medicinal repercussions. Being an ancient crop, sea buckthorn is used as supplements and a nutritive source commercially. Not only in human health, but also have ecological and economic benefits. This review paper consists and deals for the fundamental nutritional attributes of sea buckthorn.

**Key Words :** Seabuckthorn, Bioactive compounds, Metabolites, Functional food, Polyphenol

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## INTRODUCTION

Sea buckthorn crop has wide effect on the lives of poor and rural population as their diets depends on broader diversity of plantation associated with zoological and botanical species. Sea buckthorn as an ancient plant species present in Himalayan regions has vital role in the various ancient diets as food as for therapeutic use or as functional food. Sea buckthorn berry belongs to the family Elaeagnaceae having 6 species and 12 subspecies grown. Although the harvesting of sea buckthorn is already been one of the agricultural practices over there in cold and arid regions (Himalayan regions) (Dhyani *et al.*, 2007). Present review study revealed the perception for nutrients

like amino acids (Aspartic, Proline, Threonine, Serine, Lysine, Valine, Alanine, Phenylalanine, Histidine, Tyrosine, Arginine, Cystidine, Methionine), vitamins (C, E, K, A, B<sub>1</sub> and B<sub>2</sub>), fatty acids (Palmitic acid, Oleic acid, Linoleic acid, Linolenic acid, Palmitoleic acid, Stearic acid), dietary minerals specifically potassium, sodium, calcium, magnesium, iron, phosphorus, zinc, copper, manganese as well as nutrients. Hence, producing and harvesting these types of species of Himalayan regions commercially on large scale would be having positive effects on human welfare. Further, this could be one of the major bioresources from those areas.

Sea buckthorn plant parts like leaves, berries, stem, and bark have nutraceutical and cosmeceuticals properties. For an instance, berries have other organic acids including oxalic, malic, tartaric, ascorbic acid (present in large amount), flavonoids, polyphenols and polysaccharides (Aleksandra *et al.*, 2017). Bark (branch) and leaves have starch, vitamin E (a lipo-soluble vitamin), riboflavin, niacin and pyridoxine (water-soluble vitamins), polyphenols, crude fibre, protein and carbohydrates (Gradt

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*et al.*, 2017).

Moreover, the consideration of nutraceutical characteristic of sea buckthorn, it has been proven with anti-cancerous (Olas *et al.*, 2018), anti-atherogenic (Basu *et al.*, 2007), anti-bacterial, antioxidant and cytoprotective (Upadhyay *et al.*, 2010), anti-proliferative (Grey *et al.*, 2010), anti-inflammatory (Yuan *et al.*, 2016), anti-diabetic effects (Bhardwaj *et al.*, 2015) and dermatological effects (Hou *et al.*, 2017). Now, these effects are shown because of some of the nutrients and the presence of many bio-active compounds. Like for antioxidant property, phenolic compounds, tannins and flavonoids are accountable (Ciesarova *et al.*, 2020).

Additionally, in dehydrated or desiccated sea buckthorn berries, vitamin C is conserved over time as it is lacking the enzyme ascorbic acid oxidase that leads to oxidation. These molecules and compounds lead to development of organoleptic properties of products produce from Sea buckthorn plant parts (Xueying *et al.*, 2021).

The availability and presence of many nutrients in sea buckthorn berries, leaves, and bark are depended on various factors which include botanical specie, geographical area, climatic conditions, soil composition, chemicals like pesticides and fertilizers used, the standard of full growth of a plant and many more (Ciesarova *et al.*, 2020).

### Nutritional characteristics of sea buckthorn (*Hippophaerhamnoides*):

Sea buckthorn contains major nutrients that are required by human beings in a good amount. Macronutrients and micronutrients like carbohydrates, various vitamins, fatty acids, fibres, proteins, organic acids, etc. And this is the reason berries of holy fruit are believed to one of the most nutrient-rich fruit.

### Carbohydrates:

One of the dominant nutrients in Seabuckthorn is carbohydrates. It ranges from 400-600g/kg DW concluded by Bie and Jaroszewska, 2017; Marsiñach and Cuenca, 2019 in their studies (Table 1). Berries contain cellulose (polysaccharide), hemicellulose, hydrocolloids, and pectin. And they constitute dietary fibres which have a health-promising effect when it comes to digestion.

Dispersal of carbohydrate molecules in sea buckthorn berry is very particular. For example, starch is

found in its seeds of fruit in concentration of 45-50 g/kg DW. While the concentration of raw fibre present in seeds is 125-130 g/kg, in peel 60-66 g/kg DW and the pulp, it is 45-50 g/kg DW. Pectin was found in pulp and peel of fruit in a very low concentration (Pitát *et al.*, 2014).

**Table 1: Carbohydrates and its derivatives content in sea buckthorn in g/kg DW**

Total carbohydrate		400-600g/kg DW ***		
Compound	Seeds	Peel	Pulp	References
Starch	45-50			*
Raw fibre	125-130	60-670	45-50	*
Glucose			12-15	**
Fructose			1.7-6.7	**
Mannitol			1.5-6.0	**

\*(Pitát *et al.*, 2014); \*\* (Ficzek *et al.*, 2019)

\*\*\*Biel and Jaroszewska, 2017 ; \*\*\* Marsiñach and Cuenca, 2019

### Vitamins :

Sea buckthorn possesses a high amount of vitamin C in its berry pulp. Hence, it is used for the production of juice and other blended beverages. And the amount of this micronutrient is between 2-30 g/kg according to Ranjith *et al.*, 2006. Moreover, a comparative study took place between sea buckthorn and other citrus fruits and vegetable researchers concluded that the quantity of vitamin C is 5-100 times more than that of fruits and vegetables. Further, this is also been compared to those species which are believed to be an affluent fount of Vitamin C like rose hips, black currant and black pepper. Even they are having vitamin C concentration ranges from 3-10 g/kg, 1.1-3.0 g/kg, and 0.5-3.0 g/kg, respectively which is much less than sea buckthorn (Velíšek, 2019).

**Table 2 : Vitamin content**

Vitamin	Content in berry	References
Vitamin C	0.25-25g/kg	*
	900 mg %	**
	5 g/kg	***
Vitamin E	0.03-0.21g/kg	*
Vitamin K	1.12-2.5 g/kg	*
Vitamin A	60 mg%	**
Vitamin B1	0.03 5 mg%	**
Vitamin B2	0.05 6 mg%	**

\*(Bal *et al.*, 2011); \*\* (Aleksandra *et al.*, 2017);

\*\*\* (Marsiñach and Cuenca, 2019)

**Table 3 : Mineral composition of sea buckthorn of different origins**

Mineral Origin	K	Na	Ca	Mg	Fe	P	Zn	Cu	Mn
Pakistan (in ppm) Sabir <i>et al.</i> , 2005	140-360	20-80	70-98	150-240	40-150	110-133			
Ladakh (in ppm) Nazir <i>et al.</i> , 2017	247.14		169.02	19.04	26.15		1.27		
Germany mg/100g Gutzeit <i>et al.</i> , 2008	302.34	1.25	4.67	12.30	370.12		224	101.17	320.15
Turkey (in ppm) Ercisli <i>et al.</i> , 2007	7260		1960	1465		7100	32	24	22
W. Poland (mg/100g) Beil <i>et al.</i> , 2017	1.83		0.32	0.28	4.60	0.52	3.7		
Luthania mg/kg Vaitkevičienė <i>et al.</i> , 2019	420			30-700	0.3-36	60	0.2-9	0.28-3	0.1-12

### Minerals compounds:

The main mineral compounds present in sea buckthorn nitrogen, phosphorus, iron, manganese, boron, calcium, aluminum, silicon and many more. A total of 24 minerals are comprised of seabuckthorn berry juice. We know potassium is much responsible for ionic stability in the human body. And potassium is one of the plentiful compounds present in sea buckthorn. The concentration of the same ranges from 10-15 ppm in the pulp of berry while in seed it is 9-13 ppm (Dhyani *et al.*, 2007). The quantity of mineral metals listed as like of potassium is 1330 mg/kg, of calcium, is 420 mg/kg, of phosphorus, is 86 mg/kg and magnesium is 86 mg/kg (Souci *et al.*, 2008).

### Fatty acids :

Oil of sea buckthorn can be unsheathing from its seeds, skin and pulp. They have different concentrations of oil in them (23%, 8%, and 68% w/w, respectively, García, 2019). The amount of oil that can be extracted from seeds is 100-160 g/kg whereas from soft plant parts 20-105 g/kg (Kallio *et al.*, 2002; Yang and Kallio, 2002 and Yang *et al.*, 2001). According to Yang and Kallio, 2002 certain subspecies of *Hippophae* like *turkestanica* and ssp. *Mongolica* have oil concentration is more as like about 160-350 g/kg DW while in other species that may increase up by 440g/kg DW (Jaroszewska *et al.*, 2018).

A study conducted by Li and Berveridge (2003), oil extracted from fruit pulp has 48 per cent of palmitic acid along with linoleic acids, palmitoleic acid, oleic acid and linolenic acid having concentration 4 per cent, 29 per cent, 18 per cent and 2 per cent, respectively. As stated by many researchers in their studies like Hou *et al.*, 2017 and Patel *et al.*, 2012 fatty acid like palmitoleic acid is a major component of the mucosal layer of skin in human beings, therefore, sea buckthorn is extensively used in beauty products. Sea buckthorn oil also helps in

ameliorating in the humidification of the dermal layer of humans. It resulted in a lessening of loosening of skin. The berry oil can also be used as sunscreen lotion to mitigate the dermal layer of skin (García, 2019; Gêgotek *et al.*, 2017 and Poljšak *et al.*, 2019). Significantly, the table 4 shows the presence of stearic acid in pulp oil only. While Linoleic acid and linolenic acid is only found in seed oil.

**Table 4: Content of fatty acid in sea buckthorn in %**

Fatty acid	Seed oil	Pulp oil	References
Palmitic acid	7.9-10.3		*
	31.7		**
		29.1%	***
Oleic acid	47.8-23.8		*
	21.3		**
	20.3	16.6	**
Linoleic acid	33.6-37.8		*
	37.4		***
Linolenic acid	24.1-29.3		*
Palmitoleic acid	29.4		**
		38.6	***
Stearic acid		1.37	****

\*Li *et al.*, 2016 ;\*\*Bialek *et al.*, 2016; \*\*\*Yang *et al.*, 2011  
\*\*\*\*(Zheng *et al.*, 2017)

### Proteins:

Not only berries of holy fruit exhibit protein content even its seeds also have. In Mongolia geographically area-specific sea buckthorn berries, Uransanaa *et al.*, 2003 found that in total per cent of plant proteins, 38 per cent of it is present in the seeds of berries. And this makes sea buckthorn a distinctive protein center. Some older studies also stated that other parts of plants like stem, branches, leaves, barks of trunks also have protein content even more than berries. And proteins which are available in leaves is much useful for feeding the animal.

Additionally, sea buckthorn leaves can also be utilized as a protein source for human beings. 18 different amino acids are been investigated in Holy fruit juice extracted from its pulp. In distinct amino acids, valine, leucine, tryptophan, methionine, threonine are some important for the body for facilitating different functions (Dhar *et al.*, 2013). And the noticeable point is some amino acids like lysine and leucine which are lacking in other plants, sea buckthorn is having in enough amount.

### Organic acids in sea buckthorn:

The total content of organic acids found in sea buckthorn ranges from 0.96-4.22 g/100g FW in which malic and quinic acid is principal ones (Tkacz *et al.*, 2019). Malic acid prevents sea buckthorn plant roots against some type of diseases as it prevents pathogenic pounce.

Both linear and cyclic carboxylic acids are present in sea buckthorn. The concentration of these organic acids varies and contingent upon external conditions including maturing environment, soil conditions, climatic conditions, etc and species of plant sea buckthorn.

Organic acid	Content (g/100 g FW)	References
Oxalic acid	0.01 ± 0.00	*
Citric	0.05 ± 0.00	*
Isocitric	0.21 ± 0.0	*
Malic	0.96 ± 0.07	*
Quinic	0.09 ± 0.19	*

\*Tkacz *et al.*, 2019

### Conclusion:

Sea buckthorn plant parts possess various biological activities. From the above discussion, we can conclude that the content of various bioactive compounds present in sea buckthorn may be dependent on factors like geographical area, soil composition and type of soil used for cultivation, species of plant, harvesting time, level of blossoming of the plant at the time of harvesting, etc. It has its pungency because of the high acidic content in berries. While these berries are oval or egg shaped and its colors may varies from yellow to orange. Its antioxidant properties are because of the presence of various functionalized compounds including tannins, flavonoids, phenolic compounds, etc. Content of vitamin C in its berries is dominating one as it is one of the major nutrients present in its berries. Moreover, it is somehow exceptional and different from other berries as its ascorbic acid content

does not affect through any type of processing. On the other hand, other vitamins including A and E are also present in a good amount in sea buckthorn plant products. Also, it has a high content of flavonoids, carotenoids, flavonol glycosides, phytosterols in different plant parts. Further, required amino acids are also present in an abundant amount which makes the berries a good source of protein as well. Various mineral compounds including zinc, manganese, iron, etc are present in the same. These attributes of sea buckthorn make a good choice of industries for the production of various nutraceutical, cosmeceutical and pharmaceutical products. As it is considered to be guarded and safe to consume because there is no such contaminant or toxic compound is been presented.

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