

Sea buckthorn: A novel feed opportunity for livestock and poultry health, production & welfare

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Keywords:

Aflatoxin
Bio-Resource
Dioecious
Hippophae
Sea Buckthorn
Therapeutic

Abstract

Sea buckthorn commonly known as “Cold Desert Gold” due to its high potential as a bio-resource for land reclamation, reducing soil erosion, medicinal and nutritional properties in the leaves & fruits. In India, its fruit is also known as Leh berries or miracle fruits. In ancient Greece, the leaves of Sea buckthorn when added to horse fodder were found to result in weight gain and shiny hair, thus the Latin name ‘Hippo’ means Horse and ‘Phaos’ means Gloss or flare i.e. ‘Hippophae’ meaning shining horse is an ancient plant with modern virtues, due to its nutritional and medicinal value. All parts of Sea buckthorn e.g. berries, leaves, and seed or pulp oils contain many bioactive compounds. They are a rich source of natural antioxidants such as ascorbic acid, tocopherols, carotenoids, flavonoids, while they contain proteins, vitamins (especially vitamin C), minerals, lipids (mainly unsaturated fatty acids), sugars, organic acids and phytosterols. Livestock and human studies suggest that sea buckthorn may have various beneficial effects: cardioprotective, anti-atherogenic, antioxidant, anti-cancer, immunomodulatory, anti-bacterial, antiviral, wound healing and anti-inflammatory. Several studies showed that the leaves & fruit residues of SBT could be used to feed poultry and livestock without accumulation of toxins and the feed also had a stimulating effect on growth and performance of poultry birds & livestock. Therefore, it would be worthwhile to perform more scientific research on this medicinal plant and to promote its large-scale utilization for livestock and poultry health, production & welfare.

Introduction

Now a days there has been a growing interest by consumers, researchers, and the food industry about the ways in which some foods can help maintain human and animal health beyond their traditional nutritive value. The market for functional foods is increasing annually at a rate of 15% to 20%. The WHO considered that 80% of earth’s population trust on traditional medicines for their prime health care, needs and utmost of this therapy involves the use of numerous plant extracts or their active constituents. Herbal supplementation can be serve as safer alternative as growth promoter, lower cost of

production, reduced mortality, reduced risk of disease, minimum health hazards and environment friendliness. A number of medicinal plants have been investigated throughout the world for their efficacy in wound healing. Sea buckthorn is one such medicinal plants which has been proved to be a good wound dressing material in man and animals.

Sea buckthorn (*Hippophae rhamnoides*) is a thorny, dioecious, wind pollinated, multipurpose temperate bush plant bearing yellow or orange berries with nitrogen fixing abilities. It is commonly known as “cold desert gold” due to its various beneficial effects over plant, animal, human & soil health. Sea buckthorn is an important medicinal resource and is

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found in abundance in Indian subcontinent especially the North Western Himalayan regions (Dhanze *et al.*, 2013). The plant inhabits dry temperate region and high altitude regions of Himachal Pradesh, Jammu & Kashmir and Uttrakhand. The native of this plant is European and Asian countries. In India, it is widely distributed at high altitude, cold arid condition of Ladakh and Lahul-Spiti, parts of chamba and upper Kinnaur districts of Himanchal Pradesh, Sikkim and Arunanchal Pradesh.

In ancient Greece, the leaves of Sea buckthorn when added to horse fodder were found to result in weight gain and shiny hair, thus the Latin name 'Hippophae' meaning shining horse, was ascribed to it (Rongsen, 1991a). Sea buckthorn (*Hippophae rhamnoides*) is a small shrub comprising of fruit and leaves that are rich in nutrients and bioactive components such as vitamins (Kudritskaya *et al.*, 1989), amino acids (Repyakh *et al.*, 1990), lipids (Goncharova and Glushenkova, 1993), sugars and acids (Yang, 2009), and flavonoids (Häkkinen *et al.*, 1999). Sea buckthorn has antioxidant (Geetha *et al.*, 2002a; Geetha *et al.*, 2002b; Chawla *et al.*, 2007; Püssa *et al.*, 2007; Geetha *et al.*, 2009), anti infective (Larmo *et al.*, 2008) function and exerts beneficial effects on liver fibrosis (Gao *et al.*, 2003) and immune function (Dorhoi *et al.*, 2006). The crude protein, lysine, methionine + cysteine, calcium, and phosphorous content of Sea buck thorn leaves and seeds are 20.7% and 26.4, 0.73% and 0.42, 0.13% and 0.59%, 1.18% and 0.31%, 0.18% and 0.34% respectively. However, the crude protein, methionine + cysteine, calcium and phosphorous content of Sea buckthorn fruit residues have been found to be lower than leaves and seeds (18.3%, 0.06%, 0.19%, 0.15%) where as the lysine content of Sea buckthorn fruit residues has been found to be higher (0.84%) than leaves or seeds (Lu *et al.*, 1991). Since, the leaves, seeds and fruit residues contain high crude protein, amino acid, calcium and phosphorus, they have advantages as basic materials for feed formulations for poultry. It has been observed that body weights of poultry have

increased greatly after feeding leaves, seeds and fruit residues of sea buckthorn (Wang, 1997). Sea buckthorn has a large content of vitamin C, several folds as compared to other fruits (Christaki, 2012). The levels and balance of amino acid in diets are all important nutritional variables that affect the economic efficiency of an egg laying enterprise.

Berries and Seed of Sea Buckthorn

Berries as well as other parts of sea buckthorn represent a rich source of biologically active compounds. For this reason the plant has been in the centre of attention virtually world-wide. The chemical and nutritional composition of sea buckhorn berries as well as the content of bioactive compounds depend on many factors. The most important factors include different subspecies, origin, climate conditions, time of harvesting, and methods of processing (Bal *et al.*, 2011). Sea buckthorn and especially its berries provide a rich source of many minerals, including, but not limited to Ca, P, Fe, and K. Sea buckthorn has a large content of vitamin C, several-fold compared to other fruits (Christaki, 2012). The vitamin C content in sea buckthorn ranges between 360 and 2500 mg/100 g (Bal *et al.*, 2011). The plant is a valuable source of the vitamin B group, mainly B1 (thiamine) and B2 (riboflavin). Other vitamins rich in sea buckthorn include, for example, vitamin E (Michel *et al.*, 2012), vitamins A and K (Bekker and Glushenkova 2001; Fatima *et al.*, 2012). The berries provide a good source of carotenoids, mainly β -caroten, lycopene, lutein, and zeaxantin (Michel *et al.*, 2012). The saccharide content is also high. The most common carbohydrates are glucose, fructose, and xylose. All parts of the plant contain many different proteins, mainly albumins and globulins (Li and Beveridge 2003). Sea buckthorn is a source of organic acids, mainly malic acid, quinic acid, oxalic acid, citric acid, and tartaric acid. Sea buckthorn is a good source of flavonoids too, mainly quercetin, kaempferol, myricetin, and isorhamnetin, and an important source of tocopherols (Fatima *et al.*, 2012).

Table 1: Major Component of Sea buckthorn and their principal therapeutic effects

(Michel *et al.*, 2012)

S. N.	Component	Therapeutic effect
1.	Tocopherols	Antioxidant activity, Minimization of lipid oxidation
2.	Carotenoids	Antioxidant activity, Contribution in collagen & epithelium synthesis
3.	Vitamin K	Haemorrhage prevention, Positive effects against ulceration
4.	Vitamin C	Antioxidant activity, Maintenance of cell integrity
5.	Vitamin B complex	Nerve tissue regeneration, Cellular renewal stimulation
6.	Phytosterols	Anticarcinogenic effect, Antiatherogenic effect, Prevention of ulceration Regulate inflammatory processes
7.	Polyphenolic compounds	Antioxidant activity, Cyto-protective effect, Cardio-protective effect
8.	Poly unsaturated Fatty acid (PUFA)	Immunomodulating effect, Neuroprotective agents Anti-carcinogenic effect
9.	Organic acids	Wound healing support, Anti-carcinogenic effect Reduction of risk of arthritis
10.	Zinc	Blood circulation increase, Increased utilization of vitamin A Enzyme cofactor function

Sea buckthorn is a good source of mainly unsaturated fatty acids (Christaki 2012). The pulp oil contains 180–240 mg of carotenoids in 100 g, of them 40–100 mg in form of carotene, 110–330 mg of vitamin E and unsaturated fatty acids, mainly linoleic and linolenic acids. Specific types of acids include ursolic acid and oleanolic acid, with anti-inflammatory, wound healing, toning and blood pressure reducing effects (Valièek and Havelka 2008). The pulp oil contains the highest concentration of palmitoleic acid (16:1, n-7), up to 43% (Fatima *et al.*, 2012). Sea buckthorn seeds contain 8–20% oil (Kumar *et al.*, 2011). The oil content is mainly affected by the harvest time, size, and colour of berries (Yang and Kallio 2002). Seed oil mainly includes unsaturated fatty acids – 90% (linoleic 47 mg, linolenic 18 mg, oleic 16 mg) and saturated palmitic acid (Valièek and Havelka 2008). Seed oil is the only oil with the linoleic acid to linolenic acid ratio of 1:1 (Yang and Kallio 2002; Kumar *et al.*, 2011). Sea buckthorn is also a good source of oleic acid (Christaki 2012).

Sea Buckthorn Leaves

The leaves contain a remarkable quantity of proteins (20.7%) amino acids (0.73% Lysine, 0.13% methionine and Cystine), and other bioactive substances. They contain on average 3.8% of saccharides, 0.2% of protopectin, 1% of organic acids, 170 mg/100 g of catechin, polyphenols, carotenoid lycopene, bioflavonoids, and coumarins. The leaves also contain a significant concentration of vitamin C (up to 370 mg/100 g) and about 8% tannins (Valièek and Havelka, 2008).

Beneficial Effect of Sea buckthorn on Livestock & Poultry

Several studies showed that the leaves & fruit residues of SBT could be used to feed poultry and livestock without accumulation of toxins and the feed also had a stimulating effect on growth and performance of poultry birds & livestock (Biswas *et al.*, 2010).

SB oil has a potent hepato-protective activity, reducing the concentration of aflatoxins in liver and diminishing their adverse effects in chicken broiler (Solcan *et al.*, 2013). There is various beneficial effect of SBT on livestock & poultry birds are as -

Anti-Visceral Obesity & Anti-Oxidant Effect

The potential health benefits of SBT leaf tea (SLT) in high-fat diet-induced obese mice for six week duration and it was observed that SLT suppressed body weight gain in a dose-dependent manner and

significantly reduced visceral fat, plasma levels of leptin, triglyceride and total cholesterol and ALT activity compared with the high-fat-fed control mice. SLT also decreased hepatic triglyceride and cholesterol concentrations and lipid accumulation, whereas elevated fecal lipid excretion. These results indicate that SLT has potential anti-visceral obesity and antioxidant effects mediated by the regulation of lipid and antioxidant metabolism in high-fat diet-induced obese mice (Lee *et al.*, 2011).

Oxidative Stress & UV Radiation

Oxidative stress & oxidative photo-damage induced by UV radiation can cause serious skin damage characterized by wrinkling, roughness, laxity & pigmentation (Hwang *et al.*, 2012). Intrinsic aging is characterized by fine wrinkling & reduced elasticity whereas extrinsically aged skin exposed to UV light is associated with induction of both deep wrinkles & a significant loss of elasticity.

Wound Healing

Wound healing is a fundamental process in nature to store normal functions of body. Wound healing may be hastened by providing ideal environment which result in optimum response to healing. Wound healing properties of SBT oil are well established. (Vlasov, 2001; Gupta *et al.*, 2001). Wound healing property of SBT is due to early formation of collagen which is exerted by rich content of vitamin A, C & E and micro-elements S, Se, Zn, Cu etc along with triterpene components which have regenerative & epitheliotropic properties (Xu, 1993).

Hepatoprotective Effect

Sea buckthorn extracts are effective as Nutraceuticals or food supplements against liver diseases or CCl₄ induced liver injury in male albino rats (Geetha *et al.*, 2008) while Feeding of SBT berries @400 ppm & 800 ppm significantly improved the growth performance, immune response, histopathological, haematological, haematobio-chemical parameters & liver peroxidation (Ramasamy, 2010).

Anti-cold, Hypoxia & Restraint Stress

SBT extracts causes shift from anaerobic to aerobic metabolism during exposure of cold, hypoxia, restraint stress and post stress recovery in rat may be due to its anti-oxidant activity, sustained body glucose levels, better utilization of free fatty acids & improved cell membrane permeability. Polyphenols/

Flavonoids present in SBT helpful in protection of mitochondrial & genomic DNA from radiation induced damage. Alcoholic extracts of fruit & leaves of SBT have cryoprotective action against sodium nitroprusside induced oxidative stress (Geeta *et al.*, 2002).

Immunomodulatory Effect

Compound extracts of SBT has a prophylactic effect through stimulation of macrophage function and enhancement of serum lysosome activity in Mice & Guinea Pig (Zhong *et al.*, 1989). SBT extracts have positive effect to enhancing cellular & humoral immunity to animals (Li, 1993). SBT seed oils also helpful in restoring NK cells activity which is responsible for non-specific immune defense mechanism. SBT berries having immunoprotective effect against T2-toxin induced immuno depression in broiler chickens (Ramsamay *et al.*, 2010). Essential oils extracted from SBT fruits improves the immune response of broilers (Lavania *et al.*, 2009)

Growth Performance

Supplementation of 0.5% & 1% SBT leaves was beneficial to improve growth performance & deposition of calcium and phosphorus. Feeding of SBT leaves in pigs increases the body weight by 9.4-21.3% and in goat raised their milk output by 6.2-6.8% while in poultry egg laying increased by 8.7-13.3%

Egg Production

SBT have potential effect for increase in egg production rate & body weight gain in laying hens (Wang, 1997). Twenty percent replacement of SBT cake in poultry layer bird significantly increased the fortnightly egg production (Hasanuzzaman, 2015).

Conclusion

- Sea buckthorn is a good feed opportunity to improve food security as well as to improve livestock health, production & welfare.
- Sea buckthorn is a store house of many bio-active substances.
- Sea buckthorn oil can be used as mild antimicrobial & anti-inflammatory agent in wound healing.
- Having diverse pharmacological activities.
- Dietary supplementation of SBT increases the cell

mediated immune response of broilers.

- Have a Great Nutritional value.
- Useful for Prevention of diseases, Egg production and Welfare of livestock & poultry birds.

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