



Journal of Mountain Research

(A Peer Reviewed Journal of Society for Himalayan Action Research and Development)

ISSN: 0974-3030

CRUSTACEAN EXOSKELETON PIGMENT AS BIO BASED PRODUCT

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Manuscript Info

Manuscript History

Received: 15.11.2016

Revised: 20.12.2016

Accepted: 25.12.2016

Key words:

*Sustainable utilization,
Crustacean shell waste,
Astaxanthin.*

Abstract

The positive economic development of any country lies in the sustainable utilization of the natural resources and also by greatly reducing the carbon foot printing. Indian subcontinent has a huge untapped human resource and along with this resource if natural bio resources are also managed in a judicious manner a true positive GDP can be achieved. In today's scenario human resources are pushed to an extreme level and as the result of which human race is facing quite a number of disorders. If these stress levels are greatly reduced, just by diet management, health status can be improvised and thus this will lead to a positive economic growth. Due to the increase in the crustacean cuisines, the shell waste of these has also increased. When it is let undegraded in our environment undergoes putrefaction and leads to health concerns. These shell waste are good source of a good bioactive compound called as astaxanthin. Astaxanthin has been proven to exhibit 6000 time better antioxidant property than vitamin C. The commercial products which contain astaxanthin is sold at sky rocketing price, which is mainly due to the extraction process. Thus astaxanthin even though has good biological applications is not available to develop more bioactive products. When astaxanthin is extracted from the crustacean exoskeleton waste, then waste management is achieved, the commercial products that contain astaxanthin can be produced at low price. Thus a high value product can be sold at low price.

INTRODUCTION:

We are living in an era where we have utilized fossil fuel and generated increased carbon foot printing. This has resulted in climate mitigation. The only way to curtail the climate change and protect our mother earth is by switching over to the bio-based economy. A bio-based economy is one in which the economy of a country is based upon sustainable utilization of the natural resources and through which the carbon foot printing can be immensely reduced ([http:// www. auri.org /assets /2012 /08/Biobased-Study-Inforna.pdf](http://www.auri.org/assets/2012/08/Biobased-Study-Inforna.pdf)). The bio-based economy focuses on biological tools and products from renewable resources to create wealth and sustainability in the production of medical treatments, diagnostics, more-nutritional foods, energy, chemicals, and materials, while improving the quality of the environment. Every Country

in world has realized about harmful effects of the carbon foot printing and thus they are in a verge to shift to the bio-based economy. In the bio-based economy the carbon emission and the carbon absorption by the life forms for their growth is balanced. Thus there is no carbon or any of its forms available in the atmosphere to cause any harm.

BIOPRODUCTS:

The bio-based products are called as the value added products, which do not result in the carbon foot printing and they replace all the existing petroleum based products. Bio-based products generally do not contain synthetics, and are biodegradable. Since bio-based ingredients such as enzymes often replace harsh chemicals, they help reduce impact on the environment and in some cases reduce reliance on nonrenewable resources (. In addition, the use of enzymes in the processing of textiles & apparel can lower energy and water consumption. The bio-based products are developed from the biotechnological based techniques, which do not cause any ill-effects to the any life form on our earth. The bio-based products are not new to our civilization, but it was ignored by us as we found the use of non-biobased products easy and thus we increased the pollution in all forms on our earth.

ASTAXANTHIN:

Aquaculture industry during recent years has emerged as one of the largest food resource systems in the world with huge number of potentials and its benefits. It is estimated that in India an area of 1.2 million ha. is suitable for the development of brackish water aquaculture. The high demand and the value of the commodity, the price of shrimp are high in the international market made aquaculture to be the most dominant sector. Sustainable use of aquatic resources and by judiciary application and diversified farming practices can ensure food security and increased socio-economic upliftment of coastal rural folk. In India the total aquaculture shrimp production has increased from 30, 000 tonnes in 1990 to 1, 02, 000 tonnes in 1999 (Pramod Kiran *et al.*, 2012). During 2014-15 the exports of marine products is about USD 5511.12 million (www.mpeda.com). The economic importance of the shrimp sector is in terms of export earnings and employment is that about 1.6% of the total value of Indian aquatic export is shrimp.

According to European research media center, 2013; in Europe alone about 7, 50,000 tons of crustacean shell waste was produced every year (Barratt and Montano, 1986). Only 40% of whole shrimp is edible, whereas rest of the 60% of the whole shrimp is discarded by the processing units (Shahidi *et al.*, 1992). The biological importance of these waste materials generated by these industries is an important environmental concern (Shahidi *et al.*, 1992).When crustacean shell wastes are left to decay on the sea shore it putrefies and becomes a useless alkaline compound (Prabu and Natarajan, 2012). But instead, crustacea waste can be used to develop a wide range of products. According to Thirunavukkarasu and Shanmugam (2009), the crustacean processing industries throughout world generated 60,000 tonnes of waste every year.

According to Todd (1998) crustaceans' exhibits wide range of colours in their exoskeleton like red, blue, green, brown, yellow which is due to the presence of xanthophylls, carotenes, within the chromophores which are in turn present within the cuticle. The chromophores are associated with inter- and intraspecific communications like species recognition, mating, breeding and other animal behaviors as well as to the survival of the individual such as camouflage and protection (Anna *et al.*, 2008). The exoskeleton pigment also provides innate immune response to these crustaceans. Astaxanthin is closely related to other well-known carotenoids, such as β -carotene, zeaxanthin and lutein, thus they share many of the metabolic and physiological functions attributed to carotenoids. The presence of the hydroxyl and keto-

endings on each ionone ring, explains some unique features, such as the ability of astaxanthin to be esterified, a higher anti-oxidant activity and a more polar configuration when compared to other carotenoids.

The series of double bonds present in the structure of astaxanthin generates the antioxidant capacity of the molecule. High energy electrons which are liberated from free radicals (eg. ROS), result in disruption of the electronic energy is through the carbon-carbon central skeleton of the astaxanthin molecule. Thus this property contributes to the antioxidant property of astaxanthin. The other associated protective properties, which are related to astaxanthin molecules are functions like protection against UV-light photo-oxidation, inflammation, cancer, ulcers due to *Helicobacter pylorii* infection, aging-related diseases, or the promotion of the immune response and even to helps in improvisation of prostate health (Martin *et al.*, 2003; Pashkow *et al.*, 2008). Astaxanthin present in *Haematococcus* algae, has a protective role against ultraviolet (UV) light which generates oxidative stress in the algae. It has been observed that the astaxanthin present in mature cysts of *H.pluvialis* generates 6-fold higher tolerance to UV-B light than immature cysts.

Reactive oxygen species like $[O]^-$, $[OH]^-$ and NO^- species which are liberated during various metabolism or during photochemical reactions results in aging and degenerative diseases such as cancer, atherosclerosis, neurodegenerative disorders, myocardial infarctions, muscular degeneration, retinopathy and metabolic disorders through the oxidation of DNA, proteins and other signaling molecules and metabolic intermediates (Papas, 1999). Reactive oxygen species (ROS) plays an important role in the occurrence of diseases at both cellular and molecular levels (Nordberg and Amer, 2001). Oxidative damages are the result of many diseases like rheumatoid arthritis, heart diseases, Parkinson's disease, Alzheimer's disease, stroke and cancer (Cross, 1987).

The young people of age group 10-24 years old are much valuable human resource of our country, due to the fact that during this period youth gains suitable educational experience to increase economic status of our country. Their health, nutrition and socio-economic status have to be given much importance. But nearly 10-30% of youth in India suffer from health, impacting their behaviors like tobacco and alcohol addicts, nutritional disorders leading to physiological stress, common mental disorders, further leading to multiple ill-behaviors. This further complicates mortality- morbidity ratio, disability and socio-economic losses (Sunitha and Gopalkrishna, 2014). Among youngsters depression anxiety scale (DASS) was observed as 20%, life stress scale among adolescent girls was 47.5% family stress and 72.5% financial stress (Dubat *et al.*, 2007), social stress accounted for 85% and academic stress among adolescents is about 90.6% (Sharma and Sindhu, 2011).

According to Krishnan *et al.*, (2015), cumulative risk among both the sexes of all age groups is 1 in 9 are affected with cancer and death rate is about 5,38,585 people based upon the occurrence of mortality data available at Chennai and Mumbai. The crude incidence rate of cancer was calculated as 153.7 among the age group 34 to 65 years old in both the sexes. Among male the most common cancer is oral cancer, followed by lung and among woman cervix and breast cancer occurs at highest incident rate. The causative agent is multifactorial. The high incidences of cancer have thus become major societal and familial consequences.

In the European diet, astaxanthin is primarily consumed through seafood, with wild and farmed salmons (EFSA, 2014). Astaxanthin brands available in India are Astagold (Sunways), Aurel active (Aurel), Bestage (Gatle), Carni-Q (TTK), Fortify and Multivite Vision (Medicare), Gv-24 (Nutra Wellness), Hi-Q 300 and Orovit- Active (Biomiicron), Lenova-M (Intra labs), Lycocare and Lycofact plus (Ritz

pharma), Prorac (Premier), Rqual-Gold (Genesis) and Zoyalife-M (Intra life) (<http://www.drugupdates.com/brand/showavailablebrands/1168>). Through the on-line shopping Indiamart, astaxanthin powder is sold at a rate of Rs.15, 000/- per gm. in form of powder, oil or soft gel capsules by many manufactures like Triveni Interchem Pvt., of Vapi, A.B.enterprises of Mumbai, The Bangalore sales corporation, Bengaluru, S2m Nutraceuticals, Chennai, Pelican Biotech and chemicals lab, Alappuzha etc. Zenith nutrition sells 6 mg of 60 capsules at a rate of Rs.1050/- (<http://dir.indiamart.com/impact/astaxanthin.html>). The astaxanthin used in all of above mentioned commercial products are extracted from *H.pluvialis* (FAS, 2010).

GREEN PREMIUM:

When the astaxanthin extracted from the crustacean exoskeleton waste instead of from the marine algae, the cost of the astaxanthin based products can be greatly reduced and high concentration of the astaxanthin will be available to do further research especially in terms of cancer based research (Abirami *et al.*, 2015). When the cost of such life saving drugs can be minimized, its pharmaceutical formulations will be available for all people and thus we can improve our health status of our country's population.

CONCLUSION:

When astaxanthin from the crustacean shell waste is extracted, the shell waste management can be achieved and also commercial significant product can also be obtained.

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