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Research

Nutraceutical Properties of Indian Seaweed Porphyra

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Abstract

In India, if we go by our fastest consumable food articles which are highly consumed in different regions from several decades without considering their nutritional values and hence cause certain heath issues. Focus of this write up is to encourage the consumption of Indian seaweed especially Porphyra (Red algae) and its related products. Most popular food articles in India like vada pao,medu vada, sabudana vada, parathas, puri bhaji, missal pav, samosa, kachori, fafda, tikki are highly consumed with their questionable nutritional values. Indian Ocean contains diverse flora in the form of different seaweeds. Some of them are frequently consumed in different nations in different forms of food article such as Sushi. The nutritional properties of Indian seaweeds are incompletely known, and studies on nutrient bioavailability are scarce, although such information is required to evaluate seaweed as a foodstuff. To encourage cultivation and consumption of Porphyra in India, this article covers the brief introduction about the nutritional values of Porphyra to aware the nationals about its nutritional values.

Keywords: Porphyra; Nutrition; Nori; Sushi; Seaweed; India.

Introduction

Alga is defined as non-vascular aquatic organism with non-flowering and seedless characteristics however contain pigments. They also lack morphological features like true stems, roots and leaves. Macro-algae also called as “seaweeds” are multicellular organism’s well adapted in salt or fresh water environment. In the suitable conditions most of the macro-algae grows fast and can reach sizes of up to 60 m in length [1]. Based on their pigmentation broadly algae are divided into three groups: Phaeophyceae (brown seaweed), Rhodophyceae (red seaweed), Chlorophyceae (green seaweed). For meeting industrial requirements most of the seaweeds are utilized for the production of food and the extraction of hydrocolloids. In addition to the macro-algae, this kingdom also include microalgae, these are microscopic organisms that grow in salt as well as fresh water. Micro-algae broadly divided into three classes: Bacillariophyceae (diatoms), Chlorophyceae (green algae) and Chrysophyceae (golden algae) and one of the excellent sources Spirulina (Arthrospira platensis and A. maxima) i.e. Cyanophyceae (cyanobacteria or blue-green algae). One of abundant class present among microalgae is diatoms as they are the abundantly in form of phytoplankton and perhaps symbolize the prevalent group of biomass producer’s over earth. It has been projected that more than 100,000 species exist over this earth. Most of the diatoms cell wall is made up of polymerised silica and they

also produce oils and chrysolaminarin. Another class, green algae are widely present in fresh water. Green algae are made up of polysaccharide called as starch and they also accumulate oils. Haematococcus pluvialis, fresh water green algae, commercially important for its components called as astaxanthin, another fresh water green algae, Chlorella vulgaris, is known for its nutritional value and considered as supplementary food product. Similarly halophilic algae belong to Dunaliella species acts as a source of β-carotene. Alike diatoms, golden algae are having typical characteristics and produce oils and carbohydrates. Cyanobacteria also called as blue-green algae are present in a diverse environments and are often identified for their poisonous water polluting products. Most of the macro algae are having their considerable nutritional properties as mentioned in Figure 1.

Every country has its own share of popular snack items which are consumed by most people on a regular basis. But not everything that is popular is necessarily healthy. The fact is, they are tasty, easily available and cheap so people eat them without giving a thought of how many calories they are consuming and how they are made. 'Most of these snacks are deep-fried, contain refined flour, and are normally cooked in hydrogenated oil at high temperature. This causes free radical damage which leads to increase in cholesterol and the risk of cancer. The caloric content is very high leading to weight gain increasing the risk of high blood pressure, diabetes, knee and joint pains. These foods are nutrient robbers, I would label them as legalised illegal food as they are damaging our brains, lowering our IQ , increasing the risks of mental disorders and are slowly, torturously and steadily killing us,' opines well-known nutritionist Naini Setalvad.

Indian seaweeds are attached to the bottom in shallow coastal waters and grouped under three divisions namely; chlorophyceae (green algae), phaeophyceae (brown algae) and rhodophyceae (red algae). About 20,000 marine algae species are distributed throughout the world, out of which only 221 species are utilized commercially. Seaweeds are the important source of food, feed, fodder fertilizers and medicines since ancient times. They are the raw material for many industrial productions like agar agar, alginic acid, mannitol, and carrageenan. Marine algae are nutritionally valuable as they contain significant amount of protein, carbohydrate, lipids, fatty acids, amino acids, minerals and vitamins. The species like Porphyra, Ulva, Caulerpa, Sargassum, Laurencia, Codium, and Eucheuma are used as food in Japan, China, Philippines and other Indo pacific countries. But in India the scientific approach to this line of study is rare. The nutritional properties of seaweeds are incompletely known, and studies on basic nutrient profile are scarce, although such information is required to evaluate seaweed as a foodstuff. Evaluation of nutritional properties of the edible seaweeds, especially Porphyra, requires rigorous attention. Porphyra contains vital amount of carbohydrate, protein lipid, dietary fiber, ash and vitamin c. But the whole compositional analysis was dependent on the surrounding environmental conditions of these seaweeds e.g dissolved gasses, pollutants, light availability, temperature, pH, turbidity salinity, reproduction, salt content, nutrient level, surface area of intertidal zone, composition of substratum, wild algae, rainfall, algal bloom, nutrient balance: anthropogenic effect (sudden excess in nutrient), global warming, overfishing, high tide and low tide, microbial association, nitro and phosphorous content in sea water, habitat availability and heterogeneity, sand inundation, photosynthesis efficiency, osmotic potential of algae, hydrodynamic motions, emersion periods (desiccation, chilling , removal of nutrients), thermocline, age, phenotype, genotype, shape of substratum. Therefore currently much focus has been given towards the development of various aqua cultural concepts and technologies. Current marine science has considered various seaweeds as vital source of bioactive compounds characterized by a broad spectrum of biological activities.

Porphyra

Porphyra (Bangiales, Rhodophyta) popularly known by 'Nori' in Japan, 'Kim' in Korea and 'Zicai' in China has an annual value of over US$ 1.8 billion. It is an excellent taste traditional Chinese medicine and consumed by local inhabitants as a marine vegetable in Asia. It has been authorized for human consumption by French authorities due to nutritional interests, i.e. rich vitamins, oligoelements, minerals, and dietary fibers [2-5]. Numerous reports related with its anti-oxidant, anti-cancer, anti-aging, antifatigue, anti-coagulants, anti-hyperlipidimic, sunscreen agent, immune-modulation and anti-tumor and anti-viral activities have been found. Various species have been explored so far; however P. vietnamensis still needs more attention. Apart from certain potent constituents like MAAs, it contains large amount of sulfated polysaccharide (porphyran), one of the active principle in Porphyra which is having multitude of activities like anticancer, anti-aging, anti-oxidant etc. Currently porphyran has been explored as natural polymer from various species of Porphyra[6-10]. To improve its further utilization as a potential biopolymer there is an urgent need to evaluate its biological and pharmaceutical properties. Here in this report we have

effort fully evaluated certain essential biological and pharmaceutical properties of porphyran (Figure 2). These all properties are discussed separately below.

Health Benefits of Nori

Porphyra is having dominant morphological features which is usually varies from species to species (Figure 3). Nori is edible red seaweed that is popular in East Asia, especially Japan. In the West, it is perhaps best known as the seaweed that wraps pieces of sushi, although it is also used as a garnish, for flavoring noodle dishes and soups, or as a health supplement. Indeed, as the nutritional value of nori continues to come to light, more and more health food stores worldwide are beginning to sell it in fresh or dried form. It is a staple in most Asian diets - especially the Japanese. As a matter of fact, the Japanese manufacture and consume up to 3 times more in volume than do the Chinese with a population of only 125 million whereas China has a population of around 1.3 billion. So it stands to reason that the average person in Japan consumes a lot more than the average person in China. And probably more per person than any other country in the Asian world. It is very rich in vitamins and minerals. Especially iodine --- but also contains A, B1, B2, B6, niacin, and C. And it is also known to help curb the formation of cholesterol deposits in the blood vessels and is high in protein (up to 50% of its dry weight). Now whether or not it contributes very little or a whole lot to the overall health and wellbeing of the average Japanese person. The Japanese people do eat a lot more Nori on average than any other people in the world and the average life expectancy of both men and women in Japan are amongst the highest of any people in the world. The obesity rate is just 3.2%; about 10 times LESS than it is here in the United States. Is there a connection? Maybe. In 2010, a study found that algae can actually reduce our rate of fat absorption by almost 75 percent. This is due to algae's inhibitory effect on a digestive enzyme called lipase (which catalyzes the breakdown of fats). And as surprising as this may sound, one sheet of nori contains as much fiber as a cup of spinach and more omega 3 fatty acids than a cup of avocado while providing all of this nutritional power on less 10 calories per sheet. By comparison, the avocado contains 368 calories.

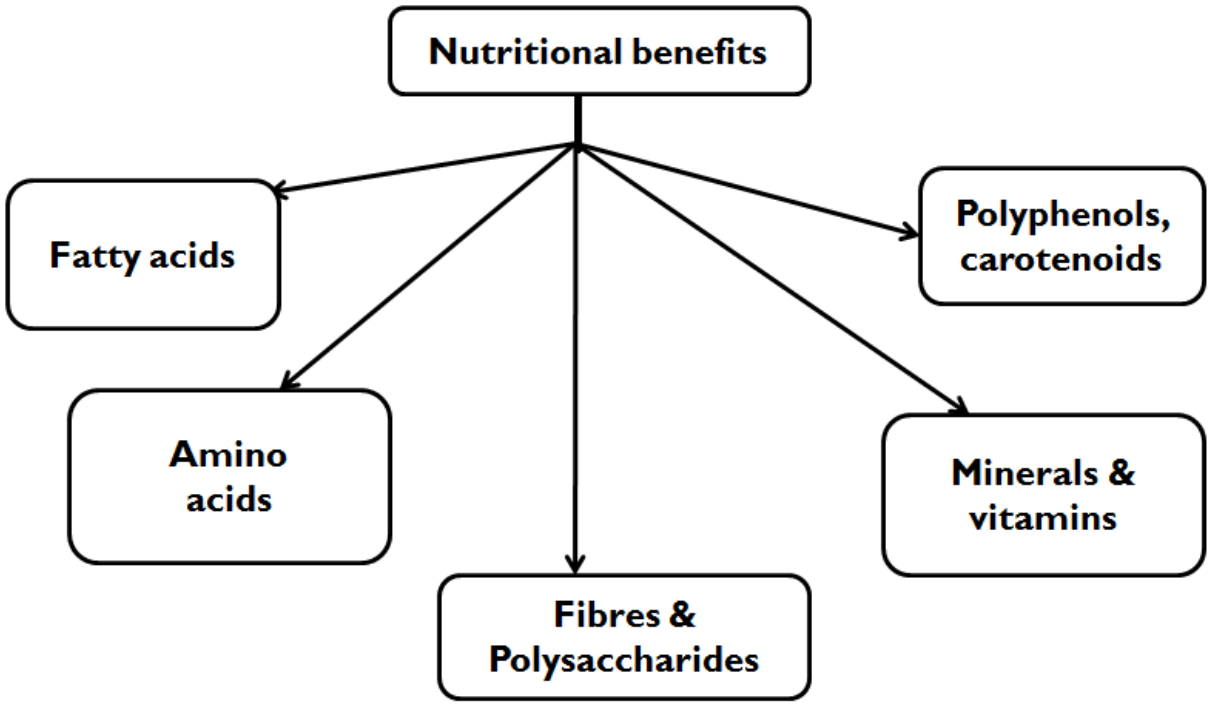

Figure 1: Nutritional value of seaweeds

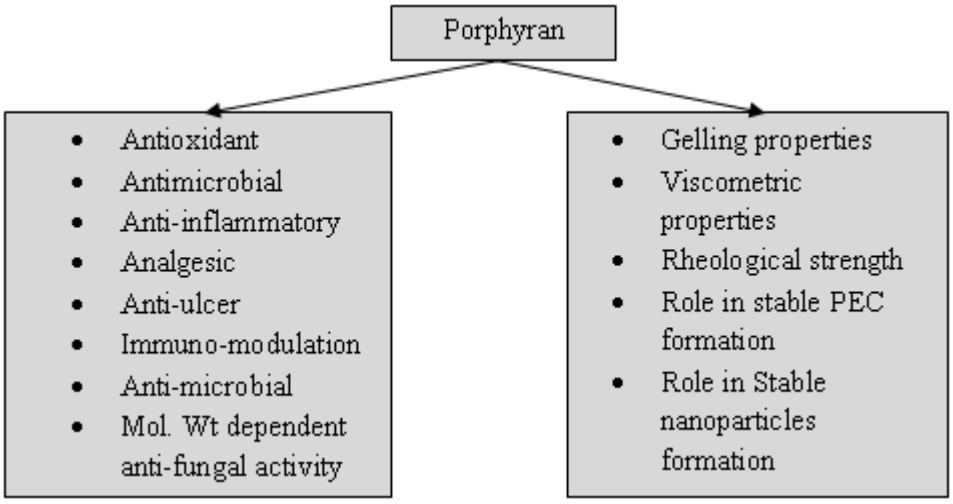

Figure 2: Pharmaceutical properties of porphyran

Figure 3: Porphyra vietnamensis (three different varieties)

Materials and Methods

For the study the P. vietnamensis was collected from Ratnagiri, India and samples were preserved by removing epifauna and epiphytes. For taxonomic studies samples were preserved in 4% formalin. P. vietnamensis was analyzed for Carbohydrates, Protein, Lipids, ash, Moisture, Dietary Fiber, Vitamin C, Fatty acids and Minerals. Carbohydrate content was analyzed by Anthrone reagent method by [11]. Protein content was determined by [12]. Lipid content was determined by method of lipid extraction and purification by [13]. Ash, moisture and dietary fiber contents are determined by [14,15].Fatty acids are analyzed by fatty acid methyl esters (FAME) analysis, the composition of fatty acid was analyzed by using Bruker 436 GC Gas chromatograph. Mineral content was determined by using Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP AES).

Result and Discussion

General nutritional analysis

Nutritional analyses were carried out according to standard procedures. General nutritional analysis reveals that Porphyra

vietnamensis contains maximum amount of dietary fiber, carbohydrates, protein and vitamin C [16]. Whereas in contrast with these components it contains very less amount lipids as mentioned in figure 4.

Mineral Analysis

Seaweeds are a rich source of minerals, especially macro and micronutrients necessary for human nutrition; however, the nutritional properties of seaweeds are usually determined from their biochemical composition alone viz. proteins, carbohydrates, vitamins, amino acids, etc [17]. The mineral fraction of some seaweed even accounts for up to 40% of dry matter; however, in some cases, the mineral content of the seaweeds is recorded even higher than that of land plants and animal products. As mentioned in figure 5, it contains large amount of sulphur, magnesium and calcium.

Heavy Metal Analysis

The variation in proximate composition and heavy metal content was high among two varieties collected at different times or locations and between different species. As far as the heavy metal analysis is concerned Porphyra vietnamensis contains significant amount of nickel, chromium, lead, cadmium and arsenic (Figure 6).

FATTY ACID ANALYSIS

The fatty acid compositions P.vietnamesnsis is mentioned in Figure 7. As far as the fatty acid analysis is concerned P.vietnamesnsis contains high amount of methyl palmitate and behenate.

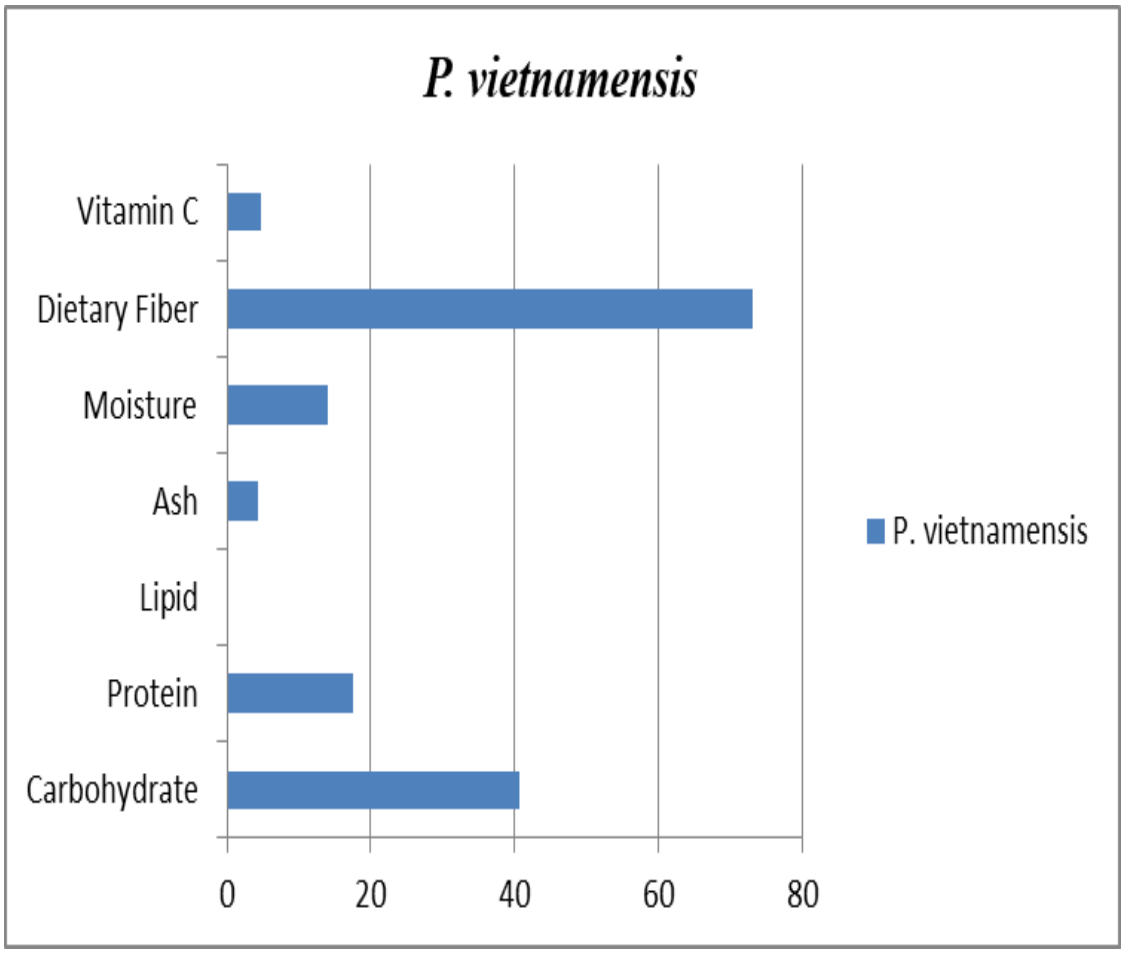

Figure 4: Nutritional analysis of Porphyra vietnamensis

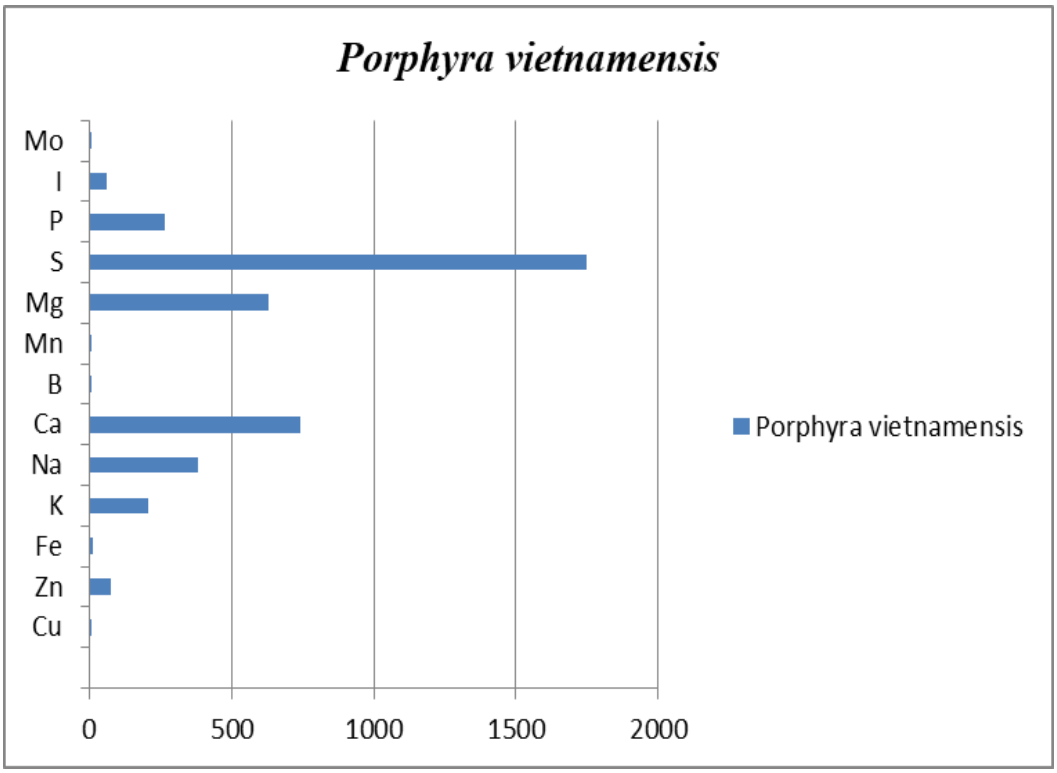

Figure 5: Mineral analysis of Porphyra vietnamensis

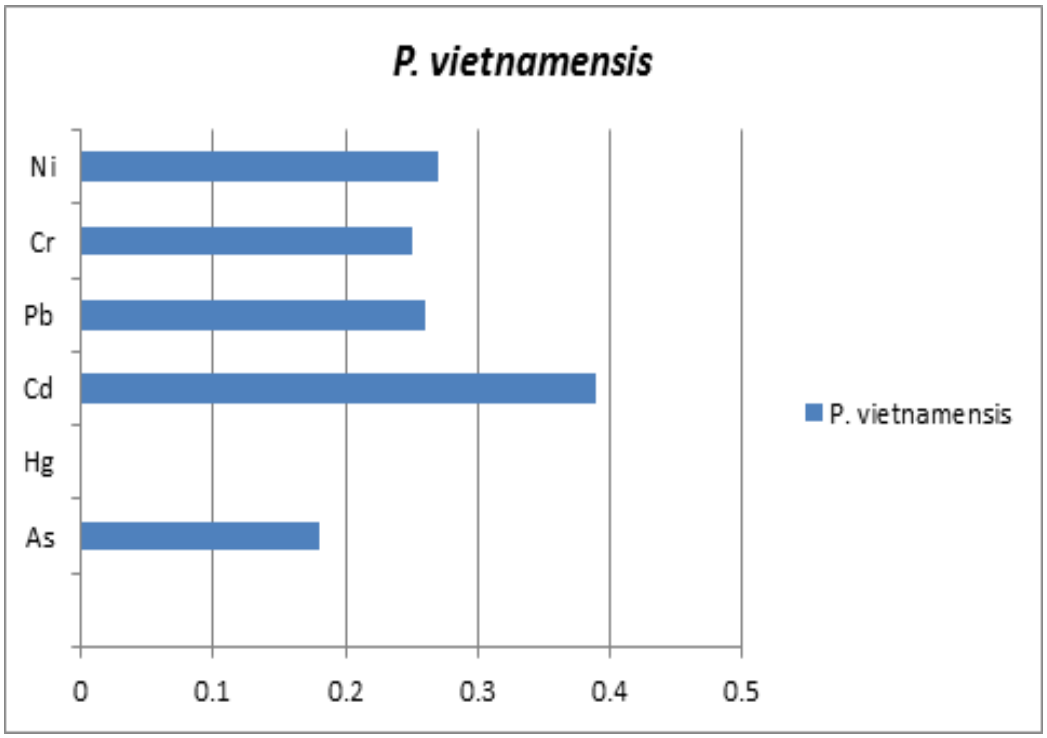

Figure 6: Heavy metal analysis of *Porphyra vietnamensis*

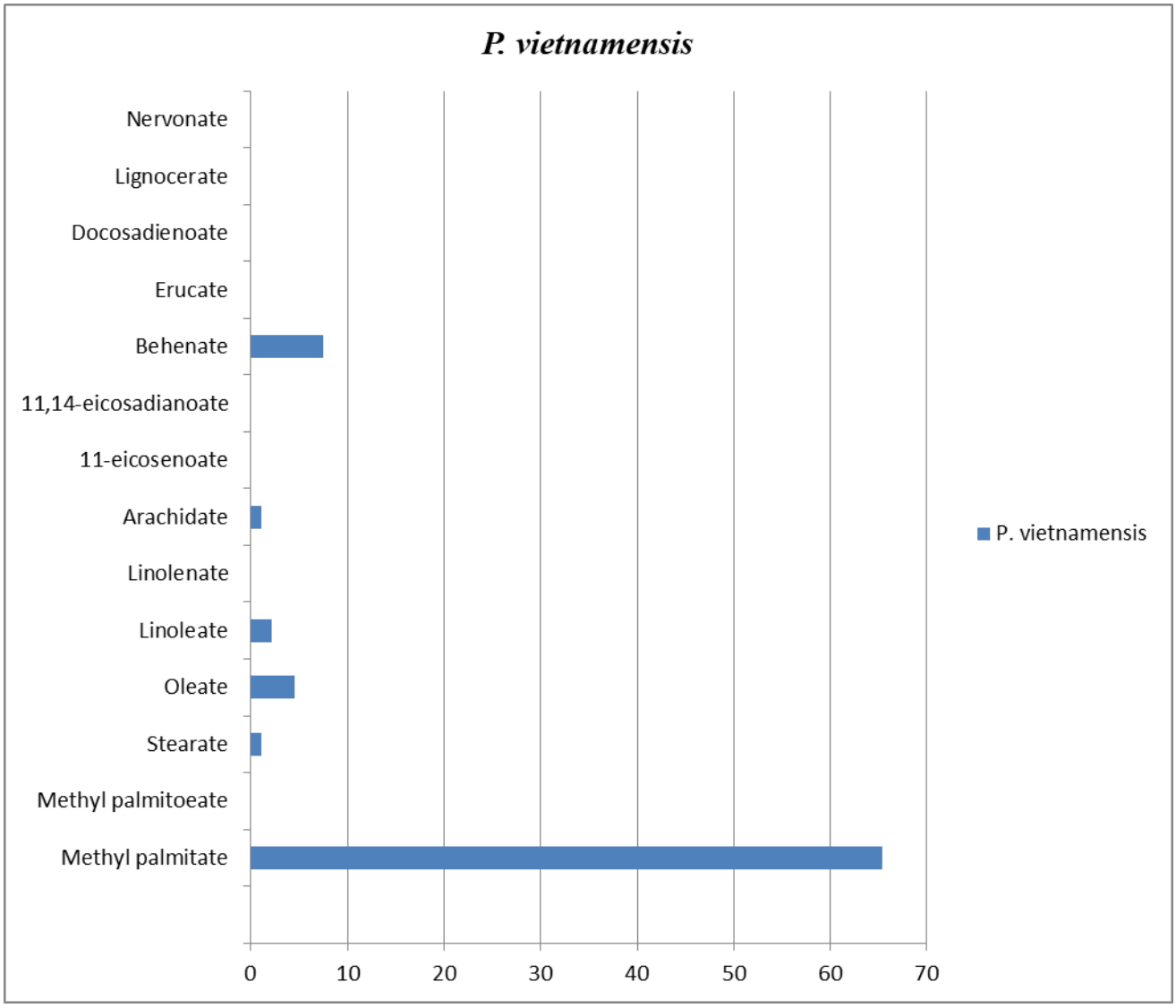

Figure 7: Fatty acid analysis

Summary

Porphyra made sushi is not a particularly fattening food, and a low calorie meal is not out of the cards if you have a craving for sushi. While the rice in sushi contains a fair amount of carbohydrates, sushi can be eaten without rice (as sashimi) and in moderation, even a standard sushi item can be a healthy treat without breaking the calorie bank. Main features of Nori are highlighted below:

- Rich in protein – 100 grams of nori contain between 30 and 50 grams of protein, making it one of the plant world's richest sources of protein and comparable in density to spirulina, chlorella, and soybeans
- Lowers cholesterol: rich in omega-3 fatty acids, which are well-known for reducing LDL cholesterol. They also help lower blood pressure, therefore making nori excellent for the cardiovascular system.
- Dietary fiber – Nori is comprised of approximately 33 percent dietary fiber, making it an effective laxative and a good cure for constipation.
- High in iron – 100 grams of nori contain approximately 88 percent of our recommended daily intake of iron, making it an extremely rich source of this much-needed mineral.
- Improves bone health – 100 grams of nori contain 280 milligrams of calcium (28 percent of our RDI) and 300 milligrams of magnesium (85 percent of our RDI).

- Lowers cancer risk: It is rich in antioxidants such as vitamin C that help neutralize the cancer-causing effects of free radicals.

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