AN OVERVIEW OF SPINACH APPLICATION FOR RENEWABLE ENERGY

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Abstract : Energy is the main element for most human activities. Most of the energy resources that exist nowadays are non-renewable and not eco-friendly that causes major concern to the environment, It is therefore to find out a new type of alternative energy resource to substitute the non-renewable type. The main objective of this study is to investigate the potential of chlorophyll that extracted from spinach leaves to be used as energy source in a battery cell. Spinach is used to study the proteins involved into carbohydrates used for power cellular process. After that, a protein complex called photo system II was taken out of it that is used in photosynthesis. It is used as a laser to reproduce light and measure the changes in the spinach molecules using advanced scanning techniques.

Index Terms - Spinach, Chlorophyll, Photo system, Battery cells, Solar energy.

I. INTRODUCTION

Energy is the main element for human activities. For example, energy is needed to create end products from natural resources. Since the use of energy resources has relieved us from much drudgery and made our efforts more productive, it is very important to the economic and technology development in the world. Unfortunately, most energy source brings a lot of negative effect to the ecosystem and earth climate such as pollution, global warming, acid rain and radioactive waste, The common consumption energy sources is non – renewable energy resource such as fossil energy. Those resources cannot be produced, regenerated or use. Since the non-renewable energy resource is non-sustainable nor eco-friendly, the solar energy and biomass and others renewable energy sources are developed as an effort to substitute the non – renewable energy source [1]. However, most of the solar energy as well as the biomass of alternative energy resource is needed to replace those existing energy resources.

Chlorophyll is a green pigment found in all plants, algae and cyanobacteria. It is the main component that contributed the process of photosynthesis of plant. It is capable to channeling the energy of sunlight into chemical energy. It tends to obtain energy by absorbing the sunlight through process photosynthesis. The molecules of chlorophyll absorb sunlight and use the sunlight energy to synthesize the carbohydrate and oxygen from carbon dioxide, CO2 and water. This process is known as photosynthesis which is the basis for sustaining the life process of all plants. The basic structure of chlorophyll is a porphyrin ring [1]. It is a stable-ring-shaped-molecule around which electron are free to migrate and transfer absorbed energy from sunlight by resource energy transfer to a specific chlorophyll pair their reaction center of photo system in which areas of leaf containing the molecule will appear green. This energy retained by the chlorophyll could potentially be used as a new type of renewable energy source and replace the common battery cell.

The average consumption of the battery in an individual country is about 10 batteries per man every year. Manufacturer of battery is now a multi-billion dollar industry as battery cells are widely used in world nowadays. However as convenient as the batteries are, they are not environment friendly since most of them contain toxic chemicals. The battery waste is an environmental concerned issue since it brings toxic metallic pollution and it may harmful or fatal if swallowed [1]. The manufacturing cost of chlorophyll cell will be estimated to be much lower than the renewable energy resources existing nowadays due to the abundance of chlorophyll in plants everywhere.

Section I deals with the Introduction, Section II deals with the materials and methods of spinach leaves. Section III presents the crop establishment of spinach. Section IV discusses about the crop management. Section V deal with the harvesting and handling. Section VI discusses about the benefits of spinach leaves. Section VII discuss about the medical uses of spinach. Finally, Conclusion is discussed in Section VIII.

II. MATERIALS AND METHODS OF SPINACH LEAVES

Using a simple membrane extract from spinach leaves, Bio-Photo-Electro-Chemical (BPEC) cell that produces electricity and hydrogen from water using sunlight. The raw material of the device is water and its products are electric current, hydrogen and oxygen.

The unique combination of man-made BPEC cell and plant membranes, which absorb sunlight and cover it into a few of electrons highly efficiently paves the way for the development of new technologies for the creation of clean fuels from renewable sources, water and solar energy.

The electric current can also be added to from hydrogen gas through the addition of electric power from a small photovoltaic cell that absorbs the excess light, this makes possible the conversion of solar energy into chemical energy that is stored as hydrogen gas formed inside the BPEC cell. This energy can be converted when necessary into heat and electricity by burning the hydrogen and hydrocarbon fuels [2].

The unlike of combustion hydrocarbon fuels - which emit greenhouse gases into the atmosphere and pollute the environment – the product of hydrogen combustion is clean water, Therefore, this is a cycle that begins with water and ends with water, allowing the conversion and storage of solar energy in hydrogen gas, which could be clean and sustainable substitute for hydrocarbon fuel.

A. Plant Material:

From the paper, Anil Kumar Sah, investigated that, the fresh spinach leaves was procured from the local market and authenticated by the Department of Botanical and Environmental Sciences.

B. Chlorophyll Extracted from Spinach Leaves:

Chlorophyll was extracted from fresh spinach leaves. Spinach leaves were weighted resources are not used commercially due to the high cost. Therefore, Cholorophyll as a new alternative energy sourcewas invented. The chlorophyll leaves were inserted into scre-cap container wrapping with aluminium foil and soaked it with enough amount of Isopropyl alchol. The Isopropyl alchol would break open the cell making the cell leaky or more permeable. This allows the chlorophyll toescape form the cell into the solutiom [2]. Sufficient soak ot time will yield a dark green isopropyl alcohol solution.

C. Measurement of absorption Spectrum:

From the paper, Hooi Ben Low proposed that, the absorption maxima of chlorophyll against the visible light from 350nm to 750nm were obtained using the scanning spectrophotometer to verify the existence of the chlorophyll-a and chlorophyll-b.. Concentrations of the total chlorophyll, i.e, chlorophyll-a, chlorophyll-b can be calculated from the equation below

$$Chlorophyll-b(mg/ml) = 22.9A_{645} - 4.67A_{663} \quad (1) \qquad Chlorophyll-a(mg/ml) = 12.7A_{663} - 2.69A_{645} \quad (2)$$

$$\text{Total Chlorophyll (mg/ml)=Chlorophyll-a + Chlorophyll-b} \quad (3)$$

Where,

A_{645} = Absorbance at a wavelength of 645nm

A_{663} = Absorbance at a wavelength of 663nm

The absorption peak of chlorophyll at the wavelength is 663nm. Fig.1 shows the spectrum of chlorophyll extract which consists of chlorophyll-a and chlorophyll-b.

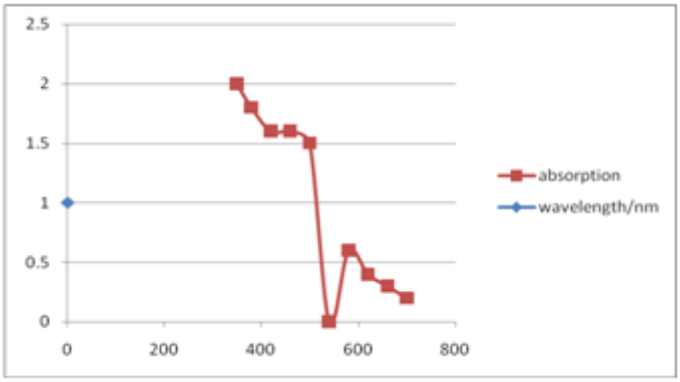

Fig.1: Absorption of chlorophyll waveform

From the Fig. 1, it is inferred that the absorption of chlorophyll increases linearly and steadily decreases and settles at one particular place of wavelength.

The light absorption of the extracted chlorophyll is measured by using spectophotometric technique. This extract was used to generate absorbance spectrum from the wavelength 350nm to 700nm by using the scanning spectrophotometer.

D. Physicochemical Analysis of Spinach:

The author Anil Kumar Sah [2], pointed out the various parameters and analyzed to find out the spinach values i.e., acid value, ash value, loss of drying and alcohol soluble extractive value. TABLE I indicates the physicochemical analysis of spinach.

TABLE I PHYSICOCHEMICAL ANALYSIS OF SPINACH

Physical Parameters	**Results**
Foreign matter	0
Loss of Drying	9.467±0.119
Ash value	29.65±0.720
Acid insoluble ash	6.01±0.244
Water soluble extraction value	54.02±0.574
Alcohol soluble extraction value	45.49±0.576

From the TABLE I, Anil Kumar Sah indicated that the physicochemical analysis of spinach were tested under different physical parameters and provided the results in a good condition.

E. Qualitative Analysis of Spinach:

The qualitative analysis of spinach was analyzed by the chemical parts of spinach which is test for alkaloid, glycoside, reducing sugar amino acid. Table II pointed out the qualitative analysis of spinach

Table II QUALITATIVE ANALYSIS OF SPINACH

Test	Chemical tests	Result	Observation
Alkaloids	Mayor's Reagent	Negative	NA
	Hager's Reagent	Negative	NA
Amino acids	Ninhydrin test	Negative	NA
Proteins	Bluret Test	Positive	Voilet Colour

From the Table II, Anil Kumar Sah indicated that the qualitative analysis of spinach were tested under different chemicals and provided the results.

Phytochemical screening is the qualitative analysis of spinach indicated the presence of reducing sugar, proteins, etc. These constituents are the main component of good nutraceuticals of spinach

F. Extraction of Spinach:

The fresh leaves of spinach were crushed into fine paste and extracted into ethanol. This extract was filtered and filtrate was evaporated on a rotary evaporator.

G. Proximal Value of Spinach:

The qualitative analysis of spinach was determined the actual value of parameters for spinach such as proteins, oil, fats, minerals and vitamins. Nutritional value of spinach was important as a nutraceuticals which was established by the process of vitamins, carbohydrates and proteins [2]. These are the best proximal values of spinach were given by the Anil Kumar Sah. TABLE III shows the nutritional value of spinach.

TABLE III NUTRITIONAL VALUES OF SPINACH

Nutritional Value	Results
Moisture content	1.97±0.053
Proteins	0.052±0.0068
Oils and Fats	0.72±0.036
Carbohydrates	61.95±0.382
Vitamins	19.66±0.21

From the Table III, it is inferred that the proximal value of spinach was found out and provided with the good results for the spinach.

III. CROP ESTABLISHMENT

A. Seed Treatment:

Seed can be sizes to be precision seeded. Fresh seed will terminate readily at soil temperature as low as 3 to 4 C and good results are obtained at 10 to 16 C. At higher temperatures there is a more rapid emergence but decreased percentage germination [3]. Spinach seed more than a year old rarely germinates over 90%. Older seed is even viable and germinates more slowly and irregularly.

B. Seeding/Planting:

Sees sow at a rate of 13 to 17 kg of seed per hectare when using non-precision seeders. Less than one-third of this will be needed if the crop is precision. Sow seed at a depth of 0.5 to 1 cm and at a spacing of 35 seeds per meter of row for processing

production [4]. Rows may be spaced 20 to 40 cm apart depending on cultivation equipment and plant population. Floating row cover can be used for winter protection.

C. Nutrient Content:

Very good source of vitamins A and C are edible for spinach and it provides with 42kilocalories, the raw supplies served about 8 kilocalories.

IV. CROP MANAGEMENT

A. Irrigation:

During sandy rains the irrigation should be provided if 3 cm per week of rainfall. If spinach leave is stressed by a lack of nutrient vegetative growth is retarded and the plants are more prone to boiling.

B. Manure:

Due to the weed seed contained in manures and the lack of effective herbicides, manures are not provided. Also the nitrogen availability from manure is erratic for such a short season crop [5]. Solids are also cold during the times spinach grows the best. The fertility from manure is most available when soil temperature is warm.

C. Lime:

Lime should be applied to maintain the soil pH in the range of 6.5 to 6.8.

D. Nitrogen:

Since spinach is such a short season crop and it is grown when sown are relatively cool at least half the nitrogen in the fertilizer should be in the nitrate foam.

E. Phosphorous:

Vegetable crops banded phosphorous, it would be ideal due to its close proximity to develop seeding crops. This crops has a high relatively high requirement for phosphorous.

V. HARVESTING AND HANDLING

The entire plant is usually harvested by cutting just above the ground level when there are at least 5 to 6 leaves, Cutting should be take place the coolest time during the day when the plants are dry. The crop should be harvested while the crop is lush and tender. Spinach may be extracted from hydro cooled or bagged into retail packs [6]. It is one of the highest respiration rates among fruits and vegetables, therefore cooling are critical. Forced air cooling can be used on this crop. Vacuum cooling may be used if it is available.

VI. BENEFITS OF SPINACH LEAVES

A. Diabetes management:

Spinach contains an antioxidant known as alpha – lipoid acid which has been given to lower glucose levels, increas4e the insulin sensitivity and prevent oxidative, stress – induces changes in patients and diabetes.

B. Lowering Blood Pressure:

Due to high potassium content, spinach is recommended for people with high blood pressure. Potassium can help the people to reduce the effects of sodium in the body. A low potassium intake might be a potent risk factor for developing high bold pressure as a high sodium intake [7].

C. Promotes Digestive Regularity:

Spinach is high in fiber and water both of which help to prevent constipation and promote a healthy digestive track.

D. Healthy Skin and Hair:

Spinach has large quantities of vitamin A. It is necessary for the growth of all body tissue, including skin and hair. Spinach has large quantities of vitamin A, which moderates the production of oil in the skin pores and hair follicles to moisturize the skin and hair [8] [9]. Oil can build up to cause acne. Vitamin A is also necessary for the growth of hair. Iron deficiency is a common of hair loss, which may be prevented by an adequate intake of iron-rich foods, such as spinach.

E. Diet:

Spinach is a versatile vegetable and it can be eaten raw or cooked. It is available fresh, frozen or canned. Light sauté spinach in a small amount of extra virgin olive oil. Spinach is the best consumed as part of a well-rounded, nutritious diet.

VII. MEDICAL USES OF SPINACH

The leaves of spinach are traditionally used in various medicines such as cooling, diuretic, laxative, digestible, urinary calculi, inflammation of lungs, thirst, joint pain, cold and sneezing [10] .

A. Antioxidant effects of Spinach:

Rao et al compared the effect of drying in fresh and dried spinach leaves with respect to phyto constituents. There was no change in phytochemical constituents present in fresh and dried leaves of spinach. Loss of water content on drying has no effect on the extractive values of leaves and phyto-constituents [9]. So the dried leaves can be used for its medicinal antioxidant values.

B. Anti-osteoarthritis effects of Spinach:

Spinach leaves were used as traditional medicine for joint pains, bone problems. Using the spinach leaves for that problem, the results indicated that spinach extract acts as a strong anti-oxidant and an anti-inflammatory agent.

C. Anti-bacterial activity:

Spinach extract can be used as a natural antibiotic and preservative in food industries and pharmaceuticals [11]. The polyphenols paracoumaric acid, ferulic acid concern the spinach plant responsible for the anti-bacterial activity.

D. Anti-inflammatory activity

The polyphenols have anti-inflammatory, anti-oxidant and anti-DNA damaging effects. It is suggested that routine consumption of these polyphenols may provide efficient protection. So, anti-inflammatory problem can be cure only by spinach leaves for the people in the world.

E. Anti-cancer effects:

Spinach is considered as a beneficial source for various extract problems [12]. Dietary intake of spinach extract has beneficial effects on various types of cancer. The spinach also inhibits the mammalian pol activity, human cultured cancer cell growth and in vivo solid tumor proliferation that could help to prevent cancer.

VIII. CONCLUSION

Leafy vegetables are the good source of nutrients. Spinach is an important leafy vegetable described in ayurvedic. It can cure all the disease for the person in the world. Spinach is a highly nutritious vegetable, rich in several vitamins and minerals, iron, magnesium, etc. Some qualitative analysis of spinach, physicochemical analysis of spinach, nutritional value of spinach was concluded with the good results for spinach process. In addition spinach contains two anti-oxidants beneficial for eye health, particularly to prevent muscular degeneration related to age, the leading cause of blindness in the elderly. Moreover, folates, largely present in spinach, may play an important role in preventing cardiovascular disease. Green is definitely synonymous with health!

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