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Review Article

Using chlorophyll as gamma absorber

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Abstract

Chlorophyll extracted from celery using 50% v/v water – methyl alcohol as a solvent. By this method the concentration of chlorophyll was 22.6% with yellowish-green color. This solution showed strongly absorption at 400 – 210 nand maximum was at the end of ultra-violet region. This absorption appeared in water, methyl alcohol, and acetone, but strongest absorption was in water. No emission spectra was detected in the ultra-violet and visible regions which means that chlorophyll absorbs radiation and dissipate it as a heat.Several samples of the above solution was radiated by gamma ray from cesium-137 with energy of 0.7 Mev for different intervals (0.5, 1, 2, 4, 24 hours). The color of the solution disappeared after two hours radiation while the pH decreases from 6.38 for unradiated to radiated celery solution 4.17 after 24 hours radiation with liberation of carbon dioxide which indicates destroying of chlorophyll but the absorption at 400 – 210 nm still exist which reflects the high stability of the group magnesium-four nitrogen atoms (tetrapyrrole) its energy about 3500 kJ mol-1. The resulted carbon dioxide carries by hemoglobin to expel via lungs similar to that produces by biological activity of the body.Calculation showed that the dosage of two hours radiation in which color of the solution disappeared (Compton effect) was 5.6 killogray (1 gray = 1 Joule per 1 kg sample) absorbed by chlorophyll before color disappear is enough to kills 1120 people weight 75 kg each within 14 days when the whole bodies exposure at one time.The samples glass containers and their white plastic covers of the radiated samples for 4 and 24 hours changed their color to violet may be due to the rearrangement of their physical structures. Others interesting points will appear in the full article.Capsules used as carrier for the chlorophyll to take it by children.

Keywords: Chlorophyll, Gamma Ray, pH, Celery, EnergyIntroductionThe traping of light energy is the key tophotosynthesis[1,2].

Introduction

The first event is the chloroplasts ofmost green plants is the pigment molecule chlorophyll.Chlorophylls are very effective photoreceptors becausethey contain networks of conjugated double bonds –alternating single and double bonds. Such compounds arecalled conjugated polyenes. In polyenes, the electrons arenot localized to a particular atomic nuclens andconsequently can more readily absorb light energy.Chlorophylls have very strong absorption bands in thevisible and ultra-violet regions of the spectrum, where thesolar output reaching Earth is maximum. Chlorophyll's peakmolar extinction coefficient, a measure of a compound'sability to absorb light, is higher than 105 M-1cm-1, among aschlorophyll, the energy from the light excites an electronfrom its ground energy level to an excited energy level. Thishigh energy electron can have one of two fates[3]. For mostcompounds that absorb light, the electron simply returns tothe ground state and the absorbed energy is converted intoheat. However, if a suitable electron acceptor is nearby, theexcited electron can move from the initial molecule to theacceptor. A positive charge forms on the initial molecules,owing to the loss of an electron, and a negative charge formson the acceptor, owing to the gain of electron.

Experimental

Clean celery plant by distill water first then by saltywater and finally by water.2) Extrude clean celery and capsulated.3) o.4855 g celery extruded and dissolved in one liter of50% v/v water : methyl alcohol solvents usingultrasonic waves with slightly bath heating foragitation. Yellowish green solution obtained, as stock-solution[5].4) Magnesium in celery solution determined by inductioncoupling plasma jy 2000 system with a temperaturerange 6000-10000 °C.Standard solutions of 1,2,4 ppmmagnesium are used for standardization. Thesesolutions are prepared from mag-

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nesiummetal in 3%nitric acid. The result shows the magnesium-concentration is 3 ppm.5) Also atomic absorption instrument is used to determinethe magnesium concentration. The result shows 3.04part per million (ppm)

Absorptivity Concentration of magnesium/ppm0.2520.5040.9 081.4690.6871247.2Unknown (3.04)6) Iron in celery solution is determined using atomic.Absorptivity Concentration of iron/ ppm0.0350.0740.1610.0171410Unknown (0.5 ppm)7) Iron in celery solution was in divalent valency Fe2+like its valency in hemoglobin.8) Sample of celery solution exposed to air for long time,-no change in the valency of iron observed.9) Sample of celery solution exposed to ultraviolet lightat 210 nm for long time, no change in the valency ofiron observed.10) Several experiments are performed on absorption andemission of celery solution in the visible andultraviolet regions in different solvents such as water,acetone, methyl alcohol, 50% v/v water : methylalcohol. No emission light is observed as shown infigures 1 and 2 respectively.SolutionDistilled water50% water+50%methyl alcoholCelery stock solution12) Two celery stock solutions are radiatedfrom cesium 137 (0.7 Mev) one for 1/2 hour and thesecond one for one hour. Their visiblespectra show no change in the shape of the peaks areobserved, as well as the color of the solutions notchanged.13) Five sample of celery stock solutions aregamma ray from the same source in item 12 for2, 4, 24 hours. Samples were in glass tube (16.886 g with the plastic cap) while the weightcelery solution is 18 g the capacity of the tBox nuclear reactor is used. Radiation was from alldirections by rotating the isotopearounddosages are shown in table 4. Color of the solutiondisappeared after two hours.2015; 4(2-1): 37-exposed to 1/2 hr. gamma.H H pH7.157.857.25by gamma ray– ultravioletradiated byfor1/2, 1,s. weightof thetube is 18 ml.around the sample. TheTable 4. shows the dosages and its time.Dosages/(kGray*) Time/hour1.62.6□5.610.462.40.51.02.0 □4.024.0*Gray (Gy) is the metric (SI) measurement unit of absorbed radiation doseof ionizing radiation, e.g. x-rays or gamma ray. The gray is defined as theabsorption of one joule of ionizing radiation by one kilogram (1J/kg) ofmatter, e.g. human tissue.14) The PH of theradiated solutions are measured asshown in table 5.Table 5. shows the pH of theradiatedTime of radiation/hrSolvent (unradiated)celery solution (unradiated)0.5 radiated1 radiated2radiated4 radiated24radiated-42 39color disappearedH stock solutions.pH7.806.386.065.885.204.554.17 with libration of stronglycarbon dioxide40 Jaleel Kareem Ahmed15) No effect of gamma radiation on the stability of ironvalance Fe2+.16) No emission of light from radiated solution atultraviolet or visible regions.

Result and Discussion

To dissolve chlorophyll from extruded celery used mixedsolvents (50% v/v water + 50% methyl alcohol) to dissolvechlorophyll and other organic materials by methyl alcoholwhile inorganic materials such as iron salt dissolves in water.The color of the resulted solution was yellowishis due to the present of chlorophyll (b) extruded celery aged[6-10]. From the visiblespectra for different celery solutions the order ofwere[11] methyl alcohol> acetone > 50% v/vmethyl alcohol > water.Chlorophyll structure consists of tetrapyrrole ring with acentral magnesium ion and a long hydrophobic phyTwo types of chlorophyll, (a) and (b) arealgae and terrestrial plants. The difference between thesetwo chlorophylls is a methyl moiety in chlorophyllreplaced by a formyl group in chlorophyllchlorophyll (a) to chlorophyll (b) in higher plants isapproximately 3:1. Thus there is no significant differencebetween the two molecular weights (the average molecularweight taken in consideration the ratio 3:1 equal to 892.32g), this enhance the idea of determination chlorophyllconcentration via determination of magnesium amount inthe stock solution using Induction Coupling Plasma andAtomic Absorption Technologies. The results show 3.0 and3.04 respectively. From the atomic mass ofthe average molecular weight of chlorophyll, the percent ofchlorophyll in the stock solution = (892.32 * 3.02 *1024.3 = 0.11 gChlorophyll % = (0.11/ 0.4855) * 100 = 22.6 %From the atomic absorption the concentration of iron isdetermined. It was o.5 ppm , thus the percent of iron in thecelery =[(0.5*10-3) / 0.4855] * 100 = 0.1 %Iron present in celery as ferrous ionaffected by gamma or ultraviolet radiations or by air, onlydrops of concentrated nitric acid transfer the ferrous ion toferric which gives red color with potassium thiocyanateKSCN. Thisreflect the high chemical stabilityions in the celery.A comprehensive study was done on the absorptionregion with different solvents and for raunradiated samples. All spectra show an absorption startingfrom 400nm and continue out of scale at 210nm (seefigure1). This reflect the high stability of mnitrogen structure (tetrapyrrole) in which four nitrogenatoms bonded to the magnesium ion with thebond energy of ~ 3500 kJ mol-1.Also emissiontaken in the ultraviolet region show no significant lightemission, this mean that chlorophyll absorbs light andAhmed: Using Chlorophyll as Gamma Absorbers ted yellowish-green. Thisand some of the– ultravioletnt solubilities> water + 50%phytol chain.present in green(a)(b). The ratio ofation ation magnesium andlecular -3)/s fe2+ and do notof the ferrousradiated andll magnesiumnitrogentheoreticalspectra wasconverted to unharmfull heat (see figure 2).Afive chlorophyll stock solution samples aretubes (capacity 18 ml and itscap 16.886 gradiated with different time (table 4) and fromdifferent angles (box nuclear reactor). The color of solutiondisappeared after two hours radiation (figure 3) whichmeans that the responsible electrons for the colordisappeared this is due to the collision ofelectrons (compton effect). In case of 4 and 24 hoursradiation the glass containertheir colors to the violet color. This may be due to thechange in their physical structures. Also carbon dioxideliberated from the decomposition of the chlorophylcauses decrease in the pH of the solutionradiation time increases (table 5) results from dissolvingcarbon dioxide in water forming carbonic acid, but thesolution still shows absorption(400-210 nm)4 for the unradiattetrapyrrole ring exist after 0.5 and(figures 4 and 5) respectively.Carbon dioxide results from decomposition ofchlorophyll by _-ray inside the human bodysimilar to the carbon dioxide results from the biologicalactivity of human body by carrying it on hemoglobin toexpel vialungs. The radiated stockIf whole body exposure to 5 or more gray [1Gray = (sample)] of

high energy radiation at one time usually lead todeath within 14 days. This dosage represents 375 Joules[5(J/kg) *75 kg] for 75 kg adult (equivalent to chemicalenergy in 20 mg of sugar) since gray are suchof radiation, medical use of radiation is typically measuredin milligray (mGy), Thus after two hours radiation (Table 4)in which the solution lost its color and starts chlorophyll todecompose, the dosage was 5.6 kGy since 5 Gyadult during two weeks 5.6 kGy killed [(5.6*10and the energy absorbed by the chlorophyll sample (16.886g the weight of container with its cap + 18 g weight of thechlorophyll

solution)equal to = 5.6*103(J/kg) * 0.034886 kg = 195.3 Jin glassemptyweight with its plastic_-ray with theseect). and their plastic caps changechlorophyll and thisH up to 4.17 as theof light at the same positionunradiated sample, i.e. still thepyrrole 24 hours radiationwill be treatedsample with different time.J/kglarge amountsedical killed one3) / 5] = 1120 AdultsndInternational Journal of Materials Science and Applications 2015; 4(2-1): 37-42 41. Chorophyllstock solution exposed to 1/2 hr. gamma radiation. Chorophyllstock solution exposed to 24 hr. gamma radiation.42 Jaleel Kareem Ahmed: Using Chlorophyll as Gamma Absorber

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