

INFLUENCES OF LED LIGHT QUALITY TO RICE SEEDLINGS GREEN TEA GROWN IN A SEMI-CLOSED SYSTEM

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ABSTRACT

To assess the effects of light quality on 6 variety rice seedlings of *Oryza sativa* Linn. for develop the green tea product. Investigate the %germination for consistency of rice seedling per area. Using 14 days after germination of 3 white seed cultivars RD10, Thai Pathumthani fragrant, Khao Dawk Mali 105 and 3 red seed cultivars, RD69, Black Jasmin rice and Black Gluten Rice. The methods of green tea processing were studied in order to find out the most suitable way to produce green tea product under light quality control. The results showed that green tea products from all 6 rice cultivars were almost similar in term of color and size. Khao Dawk Mali 105 was greater aroma taste and β -glucan (2.7 g./100g.) under red light condition content than others. The seedling height yield, %dry weight and vitamin C content were varies in stain and have a little effect from light quality. Chlorophyll a and chlorophyll b content were show higher in red seedling green tea under white light condition with the highest value of 1.75 ± 0.03 mg.g⁻¹ in Black Gluten Rice and 0.99 ± 0.2 mg.g⁻¹ in Thai Pathumthani fragrant rice for chlorophyll b. Protein analysis of those of 6 rice cultivars showed that the highest value in white rice seed under red light condition with the value of 110.08 ± 14.6 mg.L⁻¹. The red light was shown more effect to red seedling cultivars than white seedling cultivars.

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In conclusion the influences of LED light quality to rice seedlings green tea grown in a semi-closed system have seem to be clear in chlorophyll a and chlorophyll b content in red rice seedling under white light condition.

Keywords: LED Light Quality, Rice seedling, Green tea

INTRODUCTION

The agriculture in Thailand is highly competitive, diversified and specialized and its exports are very successful internationally. Rice is the country's most important crop, with some 60 percent of Thailand's 13 million farmers growing it (Bangkok Post. 2017). The farm value in real dollars (adjusted by the Consumer Price Index, with 1982-1984 being the base years) has remained nearly constant, but the costs of processing and marketing have continued to increase. The global demand for rice is in direct consumption and in the form of processed products. Increasing the value of rice by way of nutrition. It's an important choice. Currently, people are more interested in health care than waiting for treatment when they are sick from the concept of Thailand 4.0, which is a development strategy. The Sufficiency Economy Philosophy (SEP) is a decision-making framework that can guide us in living sustainably, using both knowledge and virtues. SEP is based on the principles of moderation, reasonableness and prudence. They translate into appropriate ways to solve problems or take action in different situations. Thailand 4.0, which is an economic model based on creativity, innovation and high-level services, reflects SEP's focus on preparing for the future and is designed to transform the kingdom into a valued-based economy (Ministry of Foreign Affairs of the Kingdom of Thailand. 2016). Create value with interdisciplinary science. Effect on health. Livelihood and income Rice Tea is a popular and researched rice product. Value added with growth factors that increase nutritional value, safety, age and health benefits. Several studies have shown that β -glucan have positive effects on cholesterol, glucose and insulin metabolism (Traore et al., 2009). Unlimited drink Reduce production costs by using technology to control main growth factors and increase the amount of compounds in rice tea. This is a concept in this research. The objective is to obtain more nutritious and nutritious tea products. Tea is a well-known and popular product. Some countries have become a tradition or a social culture. And to the present. Tea production has been continuously studied. From cultivars, harvesting care and products, tea ingredients are well-studied and reported. Some substances in tea such as tannin and caffeine are restricted to people and ages. The idea is to find the tea that can solve the problem. Including increasing the value of tea. Rice tea is a new alternative and has been widely studied in the present. Rice leaf tea has been reported in many

flavors and flavors, such as jasmine rice 105, Pathum Thani 1 and Sakon Nakhon. It has been found to be rich in vitamins, minerals, and antioxidants, such as beta glucan. Useful compounds in rice leaves. To add value and it is useful to increase the ratio of valuable substances and reduce the bad substance. The use of certain environmental factors in the production of tea leaves. This is because of the composition and the process involved in the production of the desired substance, such as pigment in rice leaves. Together with the selection of quality rice varieties. And consumer satisfaction. Health is important and is something that everyone must pay attention to as a factor in order to live a long life. Health refers to the body without disease. No physical illness. Mental and behavioral In order to have good health, care must be taken. Health care is easy to do. From the need to consume 5 meals to exercise regularly. Get enough sleep and know how to deal with stress that is not what makes our health deteriorate. (Kannaud et al., 2009). The above mentioned factors help us to have good health. In addition to consuming five meals, we must consider whether the nutrients we consume each day are properly nutritional. In order not to deprive the body of food from the diet each day, they are supplemented with nutrients to replace what is missing. At present, there are many supplements to meet the needs of consumers because of the changing social times. The lifestyle of people who want to be convenient, fast, hassle, haste, easy and cheap, so it turned to the food for health. The tea leaves are an interesting and appropriate choice to consume.

Nowadays, light emitting diodes (LED) has been increasing used as a source of artificial light in controlled environmental system due to its energy-efficiency. LED light quality and intensity have an effect to the growth of plant in semi-closed system. (Sakhonwasri et al. 2017). Artificial light to rice because light affects plant growth. Because plants are used in the process of photosynthesis, which provides energy. Rice and light are related because light is the medium that causes rice to thrive and flowering and sunlight from day to day. The short and long days of daytime also affect the reproductive development of rice. White light is the light that human eyes see wavelengths between 400-800 nm and red light is the light that plants absorb most.

Artificial Light is a light that is invented to replace sunlight. It emits light in the same way as the sun. Nowadays, it is widely used in growing plants that require light as a result of some of the world's growing areas. There are problems and limitations in the sun, such as growing crops in winter with very little sunlight. Currently, artificial lighting is used in areas where production control or use is restricted. The use of artificial light is why it is used to stimulate the growth of seedlings in controlled-growing systems. Different artificial lighting will affect

the growth. And the nutritional value of the leaves of the rice. This problem was developed by using artificial light from the lamp to light the plant. (Anon Numin. 2012).

Production of rice in closed systems could be produce tea in the form of non-chemical control. Or organic. This may be called organic, ie, non-chemical planting that requires special care to ensure quality production. By using various inputs. The natural way to deal with the soil, fertilizer, water that needs to be sterilized before it is used in planting. Rice leaf tea was used as an organic grower for a period of 14 days. The value of tea leaf tea is higher. It also helps to ensure the safety of toxic residues and lead to the current popularity. Marketing education, as it currently produces more and more quality products. Although until now, there are a few similar studies systematically reporting the effects of light intensity and quality on the growth and PBP accumulation in some organism, the study provides a better understanding of light requirements that can be used to enhance the yield and quality of rice leaf green tea in industrial production.

The aim of this work was to investigate the influences of LED light quality to 6 red and white rice seeds (3 for each) green tea grown in a semi-closed system. The purpose was along with the study of the growth in term of high yield and % dry weight and also compare the effect of red light and white light on protein content.

II. MATERIAL AND METHODS

A. Green tea cultivation

This study was carried out at Maejo University, Interdisciplinary agriculture laboratory, Chiangmai Province, Thailand. The 6 variety rice seedlings of *Oryza sativa* Linn. 3 white seed cultivars RD10, Thai Pathumthani fragrant, Khao Dawk Mali 105 and 3 red seed cultivars: RD69, Black Jasmin rice and Black Gluten Rice. The rice seeds were planted in 30 x 60 x 4 cm. PVC trays and media was using 2 kg./tray compost soil and seed weight was follow the %germination off each variety under the purpose of the consistency of plant density(Fig.1). The irradiance source were LED with the intensity of $50 \mu\text{mol m}^{-2} \text{s}^{-1}$ in Red light and $250 \mu\text{mol m}^{-2} \text{s}^{-1}$ in white light by mean to focus the lower energy to compare higher energy in white light source which could to save the cost and may be high quality income. The treatments include watering a 100 ml. water once a day. The parameters measured include height, wet weight, dry weight, chlorophyll a, chlorophyll b, protein vitamin C and β -glucan content.

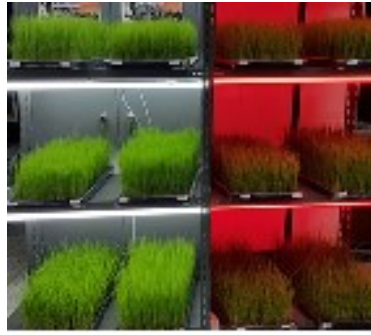


Fig.1. The cultivation shelf of rice under LED red light and white light condition

B. Weight measurements

The %germination was investigated to prepare the seed weight for cultivated. 14 days after germination of 10 rice seedlings were random to find the % dry weight. Weight the fresh sample and then to keep dry by heat in oven-dried of 60 °C for 1 hour or dry weights were determined when the specimens were at constant weights after continuous drying, and the dry matter content was calculated as a ratio of dry to fresh weight, expressed as percentage. The method for green tea products were done by cut the upper part of lowest node and use the same process as making dry weight.

C. Chlorophyll content determination

Chlorophyll is green pigment found in plants. Chlorophyll has the function of synthesizing or converting light energy into starch and sugar helping the human body to reduce its energy supply. The risk of liver cancer. Breast tumor Increase the number and performance of white blood cells. It also helps to detoxify (Laaosri. 2008). Chlorophyll content was determined on the flag leaf using methods of Arnon (1949) and Coombs et al (1987). One gram of the fresh leaf tissue was cut into small pieces and placed into a specimen bottle containing 10 ml of absolute ethanol and stored in the dark for two weeks. 1 ml of the filtered extract was then diluted with 6 ml of absolute ethanol and the absorbance of the chlorophyll solution measured using a spectrophotometer at 645 and 663 nm. The chl.a and chl. b content in milligrams (mg) were estimated using the formula of Arnon (1949).

D. Determination of total protein

Proteins are organic compounds that are essential to living organisms because they are structures of living cells. It consists of subunits of amino acids. (Duamala and Sritontae, 2014). Proteins can be found in meat, eggs and milk, and in plants such as wheat, soybeans, and other foods. It is found in a small proportion. In rice, different protein content was observed for each variety of rice. (Saiprajong and Pinitglang. 2012). It is a great help in the growth of life and a muscle-strengthening. Protein Estimation by Lowry's Method (Lowry et al., 1951) One gram of the sample powder was weighed then mixed with 10 ml of 2% anhydrous Sodium Carbonate in 0.1M NaOH and stored overnight. 0.5 ml. protein suspension extracted was mixed with 0.5 ml. of reagent containing 48 ml. of 2% anhydrous Na₂CO₃ in 0.1M NaOH, 1 ml of 0.5% CuSO₄, and 1 ml. of 1% Sodium potassium tartrate. The solution was allowed to stand at room temperature for 15 minutes after with 0.5 ml of folin-Ciocalteau reagent was added and vortexed and the mixer were allowed to stand at room temperature for 30-60 minutes. The absorbance of protein solution was measured using a spectrophotometer at 660 nm. The Standard curve of absorbance was plotted as a function of initial protein concentration and use it to determine the unknown protein concentration. Bovine serum albumin was used as a standard.

E. Vitamin C analyses

Vitamin C (l-ascorbic acid, ascorbate, AsA) is the most abundant water-soluble antioxidant in eukaryotes where it is vital whether obtained by synthesis or consumption (Dowdle et al.2007, Fukunaga et al. 2010). While humans rely on fresh produce as the main source of vitamin C, much of its metabolism and functions in plants are poorly understood (Wheeler and Smirnof. 2000, Lorence and Nessler. 2007). Ascorbate also serves as a cofactor for numerous enzymatic processes and is a modulator of plant development, senescence, cell division, and growth (Wheeler and Smirnof. 2000, Olmos et al. 2008). In plants, AsA is involved in electron transport and is considered to be an electron donor during photosynthesis (Wheeler and Smirnof. 2000). It has been reported that AsA is found in all plant tissues but is higher in photosynthetic tissues and young leaves (Dowdle et al.2007, Smirnof. 1996).

F. β-glucan analyses

Although all the possible mechanisms explaining the cholesterol-lowering effect of beta-glucans are not well known, the most likely explanation is that water-soluble fibers lower the re-absorption of bile acids (Kirby et al., 1981; Lia et al., 1995). As a result, the hepatic

conversion of cholesterol into bile acids increases and the hepatic pools of free cholesterol decrease. The β -glucan analyses, water was used as the extraction solvent at a temperature of 55.7 °C and pH 6.6 were found to be optimal for delivering a high yield (81.5%) and high MW (351.6 kDa) β -glucan product from barley (Gangopadhyay et al., 2014). The extraction method procedure was modified from methods of Wood et al.(1989) and Ahmad et al.Ahmad et al.(2010). 20 g of rice green tea powder were suspended in the desired volume of water, adjusting pH by 2 M (basic pH) at various extraction time and temperature. Mixture was continuously shaken at 200 rpm in a incubator shaker. The resultant mixture was added 2 M HCl to bring the pH to 5.0 to precipitate protein and centrifuged for 10 min at 6000 rpm. Solid material was separated and supernatant was adjusted to pH 7.0 by addition of 2 M NaOH. The residue in supernatant was removed by centrifuging. Beta-glucan was precipitated from the supernatant by the addition of the equal volume of ethanol (99.9% v/v) and left overnight at 4°C. The precipitate was collected after centrifugation for 15 min at 6000 rpm and dried in the vacuum oven at 50°C for 48 h. The dried rice bran beta-glucan extracts were weight and stored in a sealed plastic tube and kept in desiccators until the next process analysis.

G. Analytical procedures and Statistical analysis

To validate the results reproducibility, each treatments was done in triplicate. Statically of compare mean between treatments was done. All analyses were performed considering a level of 95% of confidence ($p < 0.05$). The correlation of yield, %Dry weight chlorophyll a, chlorophyll b and protein content between different light conditions in each varieties also discuss.

RESULT

The Biomass

The results of %germination was done to calculate among of seed cultivated for the consistency of plant density in the planting area. The highest %germination was RD69 with 97% and lowest at KDM105 and BGR with the value of 71 %(Fig. 2). The height of 6 variety rice seedlings of *Oryza sativa* Linn. for develop the green tea product. Using 14 days after germination of 3 white seed cultivars RD10, Thai Pathumthani fragrant, Khao Dawk Mali 105 and 3 red seed cultivars, RD69, Black Jasmin rice and Black Gluten Rice. The green tea product were carried to taste the odor and taste by 10 volunteers. KDM105 was the most prefer from the volunteers for both test. The results of height was show that Black Gluten Rice (BGR) green tea have the maximum height value as 23.97 ± 2.4 cm. under red light

condition and was the significant difference at .01 between red light and white light condition. The lowest height was shown in RD10 with the value of 15.1 ± 2.9 under red light condition (Fig 3). The total yield weight of RD69 green tea have the maximum yield value of $117.71 \text{ g} \cdot 100\text{g}^{-1}$ under red light condition. The lowest yield was shown in Black Jasmin rice (BJR) with the value of 50.77 under white light condition (Fig 4).

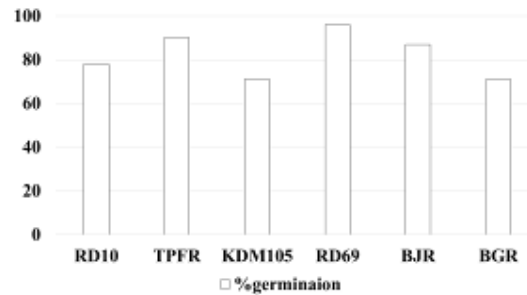
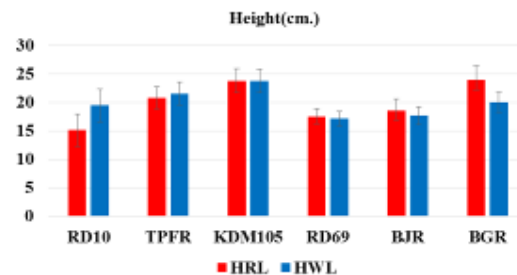
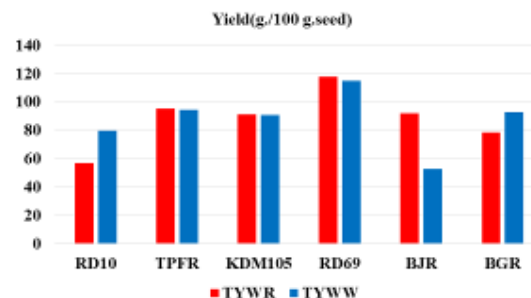


Fig.2. The % germination of rice



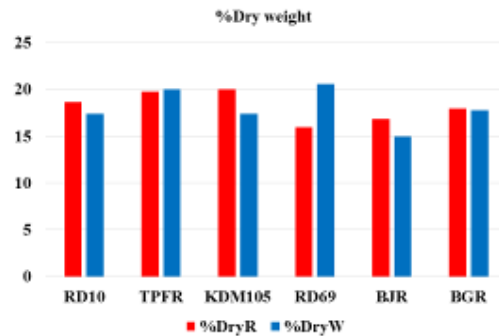
HRL =Height of Red light condition, HWL=Height of White light condition

Fig.3. The height of 14 days 6 rice seedling in red light and white light condition



TYWR =Total yield weight under Red light condition, TYWW= Total yield weight under white light condition

Fig.4. The total yield weight of 14 days 6 rice seedling in red light and white light condition



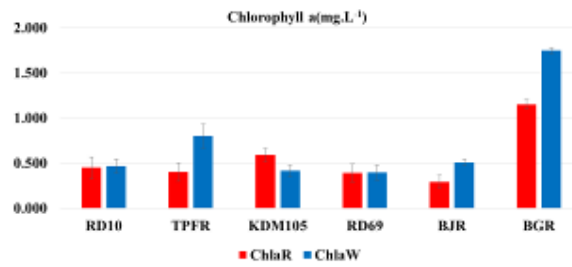
%DryR =%Dry weight under red light condition, %DryW =%Dry weight under white light condition

Fig.5. The %Dry weight of 14 days 6 rice seedling in red light and white light condition

In Black Gluten Rice (BGR) %Dry weight was significant similarly ($p>0.01$) between red light and white light condition. RD69 green tea have the maximum %dry weight of 20.59% under white light condition. The lowest %Dry weight was shown in Black Jasmin rice (BJR) with the value of 15% under white light condition. The dry weight of Black Gluten Rice (BGR) was shown the high significance similarity ($p>0.01$) between red light and white condition with (Fig 5).

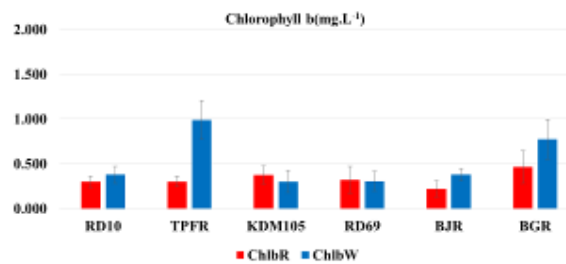
The chlorophyll content

Black Gluten Rice (BGR) green tea have the maximum chlorophyll a value of 1.75 ± 0.03 mg.g^{-1} . in white light condition and red light also show the high value than those of others samples in same red light condition with the value of 1.15 ± 0.05 mg.g^{-1} . The lowest chlorophyll a was shown in BJR with the value of 0.2 ± 0.07 mg.g^{-1} . under red light condition. TPFR, BJR, KDM105, BGR Chlorophyll a were significant difference at .05 between red light and white light condition (Fig 6). The chlorophyll b content was significant difference ($p>0.01$) in Thai Pathumthani fragrant (TPFR) between red light and white light condition. Thai Pathumthani fragrant (TPFR) green tea have the maximum chlorophyll b with the value of 0.99 ± 0.2 mg.g^{-1} . in white light condition 1. The lowest chlorophyll b was shown in BJR with the value of 0.22 ± 0.09 mg.g^{-1} . under red light condition. TPFR Chlorophyll b were significant difference at .05 between red light and white light condition. (Fig 7).



chlaR =chlorophyll a under red light condition, chlaW chlorophyll a under white light condition

Fig.6. The chlorophyll a of 14 days 6 rice green tea in red light and white light condition

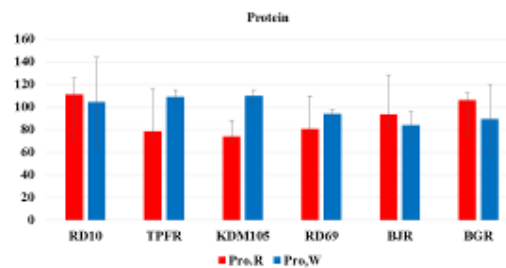


chlbW chlorophyll a under white light condition

Fig.7. The chlorophyll b of 14 days 6 rice green tea in red light and white light condition

The Protein content

The protein content of RD10 green tea have the maximum protein value of $110.8 \pm 14.6 \text{ mg.L}^{-1}$ under red light condition. The lowest protein concentration was shown in (KDM105) with the value of $73.8 \pm 14.1 \text{ mg.L}^{-1}$ under red light condition. Khao Dawk Mali 105 (KDM105) protein content was significant difference ($p > 0.01$) between red light and white light condition (Fig 8).



Pro.R =Protein under red light condition, Pro.W =Protein under white light condition

Fig.8. The Protein of 14 days 6 rice green tea in red light and white light condition

Vitamin C content

The vitamin C content of BJR green tea have the maximum value of 3.18 mg./100g. under red light condition. The lowest vitamin C content was shown in TPFR with the value of 1.42 mg./100g. under white light condition. The vitamin C content under difference light quality was varied in type of rice, although however the red rice green tea was seen more content or vitamin C than white rice green tea in this experiment (Fig 9).

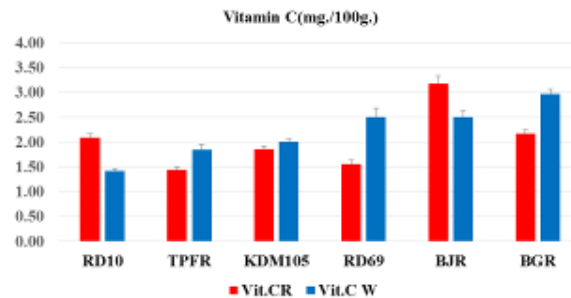


Fig.9. Vitamin C of 14 days 6 rice green tea in red light and white light condition

β -glucan content

The β -glucan content of KMD105 green tea have the maximum β -glucan content value of 2.7 g./100g. under red light condition. The lowest β -glucan content was shown in RD69 with the value of 1.1 g./100g. under white light condition. The β -glucan content under red light condition was shown the high volume than white light condition at all type of products. The difference of β -glucan content between red light and white was shown maximum at RD69 with the value of 2.5 and 1.1 g./100g. respectively (Fig 10).

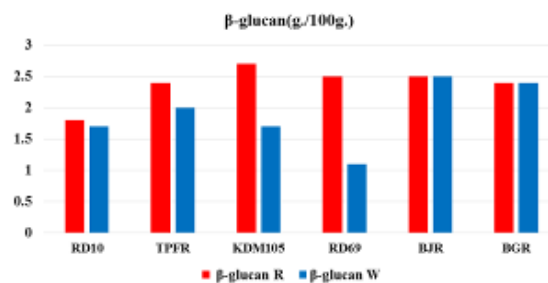


Fig.10. The β -glucan content of 14 days 6 rice green tea in red light and white light condition

CONCLUSION

In conclusion the influences of LED light quality to rice seedlings green tea grown in a semi-closed system have seem to be clear in chlorophyll a and chlorophyll b content in red rice seedling under white light condition. The present study have shown the similarity result to the previous study that the effects of light intensity on effect to chlorophyll and protein content in algae (Rui et al. 2015). The light effect could be useful for the purpose of product the white light could be significance increase the protein, vitamin C and the antioxidant in the form of beta-glucan under red light condition. The further study is analyses the chemical content as the form of amino acid.

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