ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 9, Issue, 06, pp.52905-52908, June, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

PIGMENT LEVELS OF THE SELECTED GLVS GROWN IN FRESH WATER, 75% SILK DYEING EFFLUENT AND BIOTREATED EFFLUENT

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ARTICLE INFO

Article History:
Received 03rd March, 2017
Received in revised form
07th April, 2017
Accepted 27th May, 2017
Published online 30th June, 2017

Key words:
Mustard, Fenugreek, Sirukeerai, Araikeerai, Agati, Chlorophyll a, Chlorophyll b, Chlorophyll ab and Carotenoids.

ABSTRACT

The Green Leafy Vegetables (GLVs) such as *Brassica juncea* (mustard), *Trigonella foenum* (fenugreek), *Amaranthus polygonoides* (sirukeerai), *Amaranthus tristis* (araikeerai) and *Sesbania grandiflora* (agati) were grown to study their pigment levels in fresh water, 75% of silk dyeing effluent and biotreated effluent conditions as pot study. The pigments such as chlorophyll a, chlorophyll b, Total chlorophyll ab and carotenoids were evaluated on its 45th day of its growth. The total chlorophyll and carotenoids were significantly high in biotreated *S.grandiflora* and *B.juncea*. The total chlorophyll level was highly reduced in the *T.foenum* grown in 75% effluent. In case of carotenoids the most affected plant was *S.grandiflora* and the least affected was *A.tristis* grown in 75% effluent. The biotreated *B.juncea* has an elevated level of carotenoids when compared to other GLVs grown in biotreated effluent.

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Citation: Dr. Sumayya, A. R. and Dr. Sivagami Srinivasan, 2017. "Pigment levels of the selected GLVS grown in fresh water, 75% silk dyeing effluent and Biotreated effluent", *International Journal of Current Research*, 9, (06), 52905-52908.

INTRODUCTION

Photosynthesis is the process, which can harvest solar energy to convert it into chemical energy (starch) in plants. The key molecule for photosynthesis is chlorophyll, which absorbs photon, goes to the excited state and transfer the energy to the other pigment molecules, which are in close proximity and in perfect orientation via some membrane protein complex. These are the prior requirements to funnel the energy (Kubola *et al*., 2011). Carotenoids have attracted immense interest due to their value as antioxidants which have been related to their capacity to reduce cancer and other degenerative diseases (Djaelani *et al.,* 2000). In this study, the pigment levels of the selected green leafy vegetables on the 45th day of growth in fresh water. 75% effluent and biotreated effluent were analysed.

MATERIALS AND METHODS

Collection of silk dyeing effluent: The silk dyeing effluent was collected from the effluent disposal site of small scale silk dyeing industry in airtight plastic containers, located at Seelanaickenpatti in Salem district.

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Collection of Biofertilizers: The biofertilizer *Pseudomonas fluorescens* was collected from the Tamil Nadu Agricultural University, Coimbatore.

Soil preparation for the study: The red soil and the sand were mixed at the ratio of 3:1. Each pot was filled with 7 kg of soil. The five GLVs were grown with four replicates in fresh water, 75% of silk dyeing effluent and the biofertilizer treated effluent (The biofertilizer *Pseudomonas fluorescens* was mixed at the rate of 5 tonnes ha-1 in 75% of crude effluent. The bacterial concentration of the biofertilizer was 10^8 Colony forming units (CFU) ml^{-1}.

Collection of Seeds: Seeds of mustard (*Brassica juncea*), fenugreek (*Trigonella foenum*), Sirukeerai (*Amaranthus polygonoides*), Araikeerai (*Amaranthus tristis)* and Agati (*Sesbania grandiflora*) were collected from Superseeds Nursery, Coimbatore.

Seed sowing and maintenance of plants: About 20 seeds were sown in each pot and were allowed to germinate. Neem cake was mixed with water and poured around the pots as pest control. Fresh water, 75% of silk dyeing effluent and biotreated effluent with *Pseudomonas fluorescens* have been used as different treatments to the selected GLVs and plants were harvested on the 45th day.

Pigment analysis

The fresh leaves of *Brassica juncea* (mustard), *Trigonella foenum* (fenugreek), *Amaranthus polygonoides* (sirukeerai), *Amaranthus tristis* (araikeerai) and *Sesbania grandiflora* (agati) were collected on its 45th day of its growth. The individual plant extracts were prepared and the pigments such as chlorophyll a, chlorophyll b, total chlorophyll (Chl_a and Chl_b) and carotenoids were evaluated in the post harvested plants grown in fresh water, crude effluent (75%) and effluent biotreated water. The chlorophyll a, chlorophyll b and Total chlorophyll ab content was determined by the method of Witham *et al.,* (1971). The carotenoid content of the leaves are determined by the method of Zakaria *et al.,* (1979).

RESULTS AND DISCUSSION

Comparison of pigment levels of the selected GLV plants grown in fresh water, 75% effluent and biotreated effluent

The pigments such as Chl_a, $Chl_{b,}$ total chlorophyll (Chl_a and Chl_b) and carotenoids levels subjected to different treatments were illustrated in Figure 1a, 1b,1c and 2. BJN: *Brassica juncea*, TFN: *Trigonella foenum,* APN: *Amaranthus polygonoides,* ATN: *Amaranthus tristis,* SGN: *Sesbania grandiflora* were grown in fresh water. BJE: *Brassica juncea*, TFE: *Trigonella foenum,* APE: *Amaranthus polygonoides,* ATE: *Amaranthus tristis,* SGE: *Sesbania grandiflora* were grown in 75% effluent water.

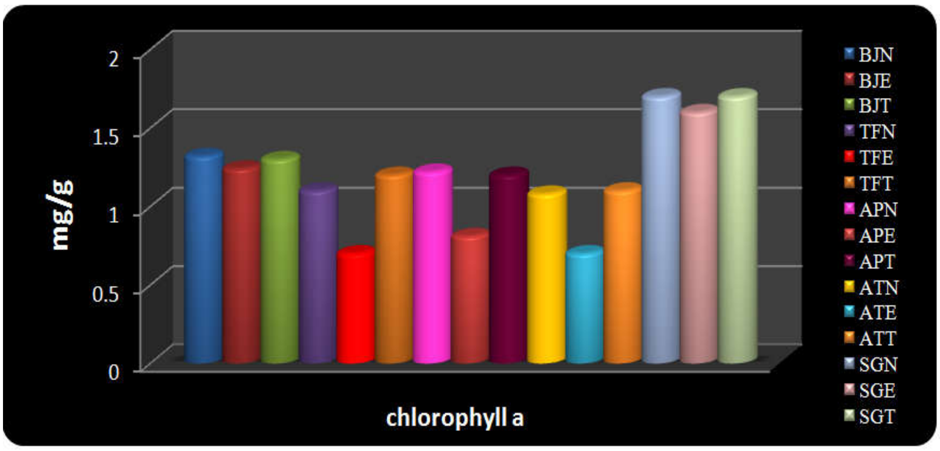

Figure 1a. Chlorophyll a of the selected GLVs in different treatments

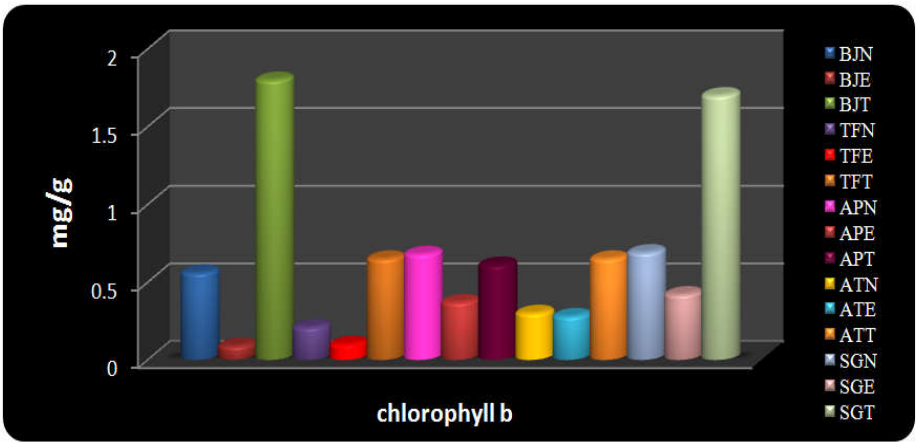

Figure 1b. Chlorophyll b of the selected GLVs in different treatments

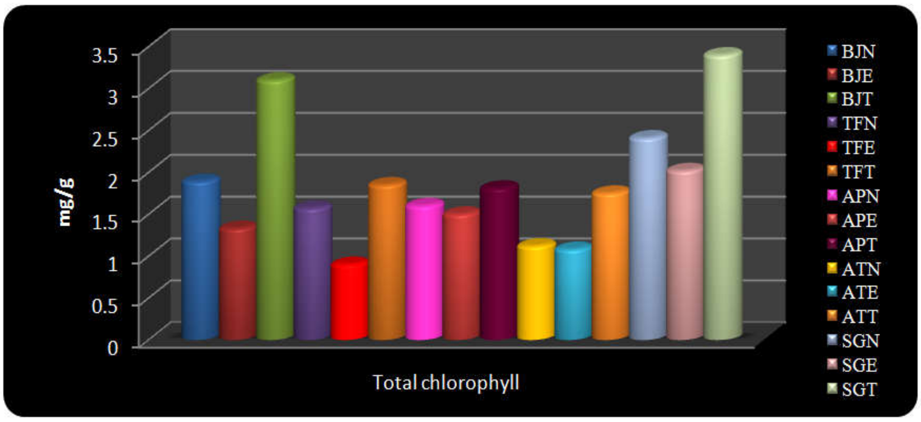

Figure 1c. Total chlorophyll of the selected GLVs in different treatments

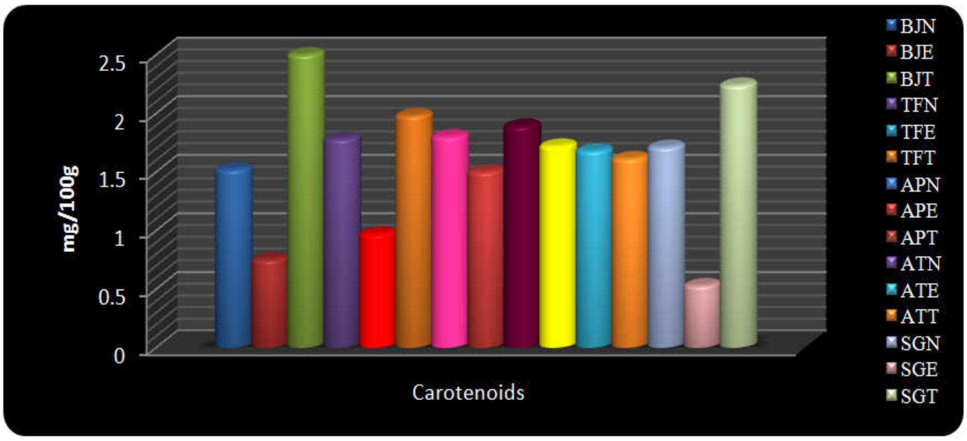

Figure 2. Carotenoids of the selected GLVs in different treatments

BJT: *Brassica juncea*, TFT: *Trigonella foenum,* APT: *Amaranthus polygonoides,* ATT: *Amaranthus tristis,* SGT: *Sesbania grandiflora* were grown in biotreated effluent. Among the selected GLVs grown in fresh water, *S.grandiflora* was found to be rich in total chlorophyll followed by *B.juncea*. *T.foenum* and *A.polygonoides* were found to be on par with each other. A study by Vassilev and Ivanova, 2003 had shown a similar level of chlorophyll content in chrysanthemum plant. The carotenoid content of all the selected GLVs were found to be comparable to each other. Similar carotenoid content was recorded in Calunga by Simao *et al.*, 2013. Thus in the present study, the selected GLVs grown in fresh water were found to be rich sources of chlorophyll and carotenoid contents (Fig 1c & 2). Leafy vegetables also contain several types of photosynthetic pigments that are chlorophylls and carotenoids (Kimura and Rodriguez-Amaya, 2002).Carotenoids and chlorophylls have an important role in the prevention of various diseases associated with oxidative stress, such as cancer, cardiovascular diseases and other chronic diseases (Sangeetha and Baskaran, 2010). The total chlorophyll content grown in 75% silk dying effluent was increased in the order of *A.tristis*<*A.polygonoides*<*T.foenum*<*B.juncea*<*S.grandiflora* (Fig 1c). Among the GLVs, *S.grandiflora* recorded a significantly ($p<0.05$) maximum level of total chlorophyll. The carotenoid level was maximum in *B.juncea* which was followed by *S.grandiflora*, *T.foenum* and *A.polygonoides*. *A.tristis* recorded a minimum level of carotenoids (Fig 1c). Thus the GLVs grown in biotreated effluent soil has increased the chlorophyll and carotenoid levels, which in turn reveals that the biotreatment of the effluent with *Pseudomonas fluorescens* had degraded the toxic compounds present in the crude effluent. Velmurugan *et al.* (2007) also reported that the total chlorophyll content in cauliflower was maximum by the application of biofertilizers. A study by Upadhyay *et al.* (2007) had also shown the maximum total carotenoid content in cabbage (*Brassica oleracea*) grown in soil treated with biofertilizers.

The results of the study showed that the total chlorophyll and carotenoids were significantly high in biotreated *S.grandiflora* and *B.juncea* (Fig 1c & 2). The total chlorophyll level was highly reduced in the *T.foenum* grown in 75% effluent. In case of carotenoids the most affected plant was *S.grandiflora* and the least affected was *A.tristis* grown in 75% effluent. The biotreated *B.juncea* has an elevated level of carotenoids when compared to other GLVs grown in biotreated effluent. The results are in accordance with the findings of Selvarathi *et al.* in 2010 that the photosynthetic pigments such as Chl_a, Chl_b, total chlorophyll and carotenoid contents were increased in the plant *Lycopersium esculentum* grown in soil treated with biofertilizers.

Conclusion

Overall findings of this study concludes that the selected GLVs grown in the biotreated effluent had a good amount of pigment levels compared to the control GLVs grown in fresh water and 75% Silk dyeing effluent exposed GLVs. The results obtained thus validate the biotreated GLVs due to their value as antioxidants which have been related to their capacity to reduce cancer and other degenerative diseases. It can be used on a regular basis as efficient food which persuade eating them every day which encourage fitness benefits.

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