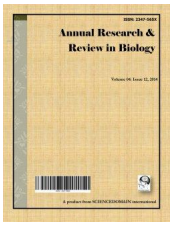

*Annual Research & Review in Biology*

*30(4): 1-8, 2018; Article no.ARRB.46933*
*ISSN: 2347-565X, NLM ID: 101632869*

# Effect of Seaweed Liquid Fertilizer on Antioxidant and Enzyme Activity of Different Vegetables Seeds

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***Authors' contributions***

*This work was carried out in collaboration among all authors. Author RVP designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author NB wrote the protocol and wrote the first draft of the manuscript and guided the analyses of the study. Author KYP helped in the literature searches. All authors read and approved the final manuscript.*

***Article Information***

DOI: 10.9734/ARRB/2018/v30i430021
Editor(s):
(1) Dr. George Perry, Dean and Professor of Biology, University of Texas at San Antonio, USA.
Reviewers:
(1) Iwona Rybakowska, Medical University of Gdansk, Poland.
(2) E. Siva Rami Reddy, Tantia University, India.
Complete Peer review History: http://www.sdiarticle3.com/review-history/46933

***Original Research Article***

***Received 20 November 2018***
***Accepted 06 February 2019***
***Published 08 March 2019***

## ABSTRACT

The aim of the study was to find the antioxidant activity and enzyme activity of catalase and peroxidase of vegetable plants. The results indicated that the use of seaweed liquid fertilizer can enhance the antioxidant activity of *Solanum melongena* L., *Lycopersicon esculentum* Mill., *Capsicum annuum* L., *Brassica oleracea* var. *Capitata* L. and *Allium cepa* L. The 1,1-diphenyl-2-picrylhydrazyl (DPPH) assays were used to determine the antioxidant properties of seaweeds by measuring the decrease in absorbance at 517 nm. The DPPH activity was highest in brown seaweed liquid fertilizer. This study implied that impacts on vegetable plantlets by seaweed liquid fertilizer extracted with enzymes is better in brown seaweed liquid fertilizer as compared to control.

*Keywords: Seaweed liquid fertiliz; antioxidant activity; catalase and peroxidase activity; vegetables.*

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## 1. INTRODUCTION

Vegetables and fruits are an excellent source of natural antioxidants which contain many antioxidant components that offer fortification towards free radicals and are associated with health [1]. Organic fertilizer is said to improve the antioxidant levels, while inorganic fertilizer has been tested to decrease antioxidant level in plants [2]. The fertilizer effect on vegetative growth is well documented. However, the several research have been investigated the fertilizer rates and sources on phytochemical quality in *L. pumila* Benth [3,4,5], but only limited research overlaying the reaction of secondary metabolites and antioxidant activities beneath distinct fertilizer resources and rates. Applying fertilizers, especially in the inorganic form, in extra of plant necessities can increase the chances of fertilizer loss and environmental pollutants. Seaweeds extracts have been measured as prospective natural antioxidants during the last decade [6,7, 8,9,10,11,12,13]. Seaweeds have turned out to be great possibility for the source of natural antioxidants due to a number of studies newly discovered [14,15,16]. The investigation related to natural antioxidants is motivating in more than one way because it could direct to the making of natural substitutes to potentially poisonous artificial antioxidants that are utilized in the maintenance of certain foods [17,18]. Seaweed extracts (SWE) provide an alternative, as they not only contain nitrogen, phosphorus, and potassium, but also present molecules with a very wide range of structures and can be composed of phytohormones or metabolically active plant extracts such as amino acids and organic acids [19,20,21]. Natural antioxidants have precautionary action in opposition to unrelieved diseases like diabetes, obesity and hypertension [22, 23]. Free radicals are liable for aging and inflicting diverse human diseases. The antioxidant activity indicates that free radicals scavenger, hydrogen-donating compounds and to oxidize metal ion play main role in the anticipation of free radical diseases [24,25,26]. Polyphenols, carotenoid and vitamin C and E of the major groups of phytochemicals that have been advised as a natural source of antioxidants and it enhance at low concentration of an oxidisable substrate [27,28]. In these study, selected vegetables of *Solanum melongena* L., *Lycopersicon esculentum* Mill., *Capsicum annuum* L., *Brassica oleracea* var. *Capitata* L. and *Allium cepa* L. antioxidant activity and enzyme activity impacted by seaweed liquid fertilizer were measured.

## 2. MATERIALS AND METHODS

Selected seaweeds such as *Ulva lactuca* (A1), *Ulva reticulata* (A2), *Gracillaria corticata* (A3), *Kappaphycus alvarezii* (A4), *Sargassum johnstonii* (A5) and *Padina pavonica* (A6) were collected from Okha port and Bet- Dwarka, Gujarat, India. Seaweeds were washed with water 3-4 time to remove other impurities and sand particles. Seaweed liquid fertilizer prepared in 1: 20 (w/v) ratio with water and the prepared extract was standard 100% concentrated. In this study, a mixture of both green (A1+A2), red (A3+A4) and brown (A5+A6) and all selected seaweeds mixture (AM) also used and without fertilizer used as a control. In this experiment, 4% concentration was used in the antioxidant activity and enzyme activity of selected vegetables seed such as *Solanum melongena* L., *Lycopersicon esculentum* Mill., *Capsicum annuum* L., *Brassica oleracea* var. *Capitata* L. and *Allium cepa* L. Seeds were collected from Vegetable Scientific research center, Anand Agriculture University and Gandhi Agro, Anand, Gujarat.

### 2.1 Antioxidant Activity-DPPH Assay

Selected vegetable seed of *Solanum melongena* L., *Lycopersicon esculentum* Mill., *Capsicum annuum* L., *Brassica oleracea* var. *Capitata* L. and *Allium cepa* L. soaked up to 3 days and 0.1 ml sample extract prepared for reaction with 1, 1-diphenyl-2- picrylhydrazyl (DPPH) [29]. This method is based on the ability of the antioxidant to scavenge activity and formula was:

$$\%\ \text{Antioxidant activity} = \frac{(\text{absorbance at blank} - \text{absorbance at test})}{(\text{absorbance at blank})} \times 100$$

### 2.2 Enzyme Activity

21 days plantlets of *Solanum melongena* L., *Lycopersicon esculentum* Mill., *Capsicum annuum* L., *Brassica oleracea* var. *Capitata* L. and *Allium cepa* L. were used for measuring the catalase and peroxidase activity of vegetables. Catalase and peroxidase activity was measured by a modified procedure [30,31], respectively.

## 3. RESULTS AND DISCUSSION

### 3.1 DPPH Radical Activity

The DPPH (1,1- Diphenly -2- Picryl- hydrazyl) radical scavenging activity of the seaweed liquid fertilizers on selected different vegetable seeds shown in Fig. 2 A free radical to assess

decreasing substance by extensively used of DPPH. The DPPH scavenging activity was observed highest in treatment of A5 seaweed liquid fertilizer such as 0.5925 mg/g followed by 0.5895 mg/g in treatment of A5+A6 and 0.5835 mg/g in treatment of A6 in *Solanum melongena* L. In *Lycopersicon esculentum* Mill., maximum radical scavenging activity was received from the treatment of A5+A6 (0.7635 mg/g) followed by treatment of A5 (0.7625 mg/g), A6 (0.7595 mg/g) and A1 (0.7585 mg/g). Minimum antioxidant activity was concluded 0.8100 mg/g with the treatment of A4 which was followed by treatment of A3+A4 (0.813 mg/g) and A3 (0.8135 mg/g) in *Capsicum annum* L. Similar effect was indicated in *Brassica oleracea* var. *Capitata* L. and comparison of the treatment of both Chlorophyceae seaweed liquid fertilizer A1 was highest as compared to A2. Highest radical activity was recorded in AM. that was 0.8245 mg/g followed by 0.8230 mg/g and 0.8225 mg/g with the treatment of A5 and A5+A6, respectively. In accordance with our study, the brown seaweed contained maximum effect on DPPH radical scavenging activity than green and red seaweed [32,33,34,35]. The reduction of the species may be facilitated through the hydrogen donors to a free radical scavenging activity of the DPPH effective by phenolic compounds which are reduced to a nonreactive species [36], its purple colour changes fast to yellow to deposition of diminished DPPH-H (hydrogen) [25] and makes good antioxidants [37]. The water-soluble antioxidant activity was measured by DPPH assay [38]. Higher the rate of absorption, more effective is the antioxidant. The strong scavenging activity was shown in young leaves, which affected by plant phenolic compound of phytochemicals that work as a primary antioxidant [39]. The combination of phenolic, flavonoids and ascorbic acid formed a positive effect on DPPH radical scavenging activity [40, 41,42,43,44].

## 3.2 Enzyme Activity

Fig. 3 shows the catalase activity of all selected vegetables which was treated by seaweed liquid fertilizer. Maximum and minimum catalase activity was received with the treatment of A5+A6 and A4 seaweed liquid fertilizer that was observed 28.000 mg/g and 22.500 mg/g in *Solanum melongena* L. Highest catalase activity was conducted with the treatment of AM which was 25.950 mg/g, 26.500 mg/g, 26.225 mg/g and 30.250 mg/g found in *Lycopersicon esculentum* Mill., *Capsicum annum* L., *Brassica oleracea* var. *Capitata* L. and *Allium cepa* L., respectively. Minimum catalase activity was concluded with the treatment of A4 in *Lycopersicon esculentum* Mill., *Capsicum annum* L., *Brassica oleracea* var. *Capitata* L. and *Allium cepa* L. that was 20.100 mg/g, 21.700 mg/g, 20.900 mg/g and 20.950 mg/g, respectively but it was higher than the

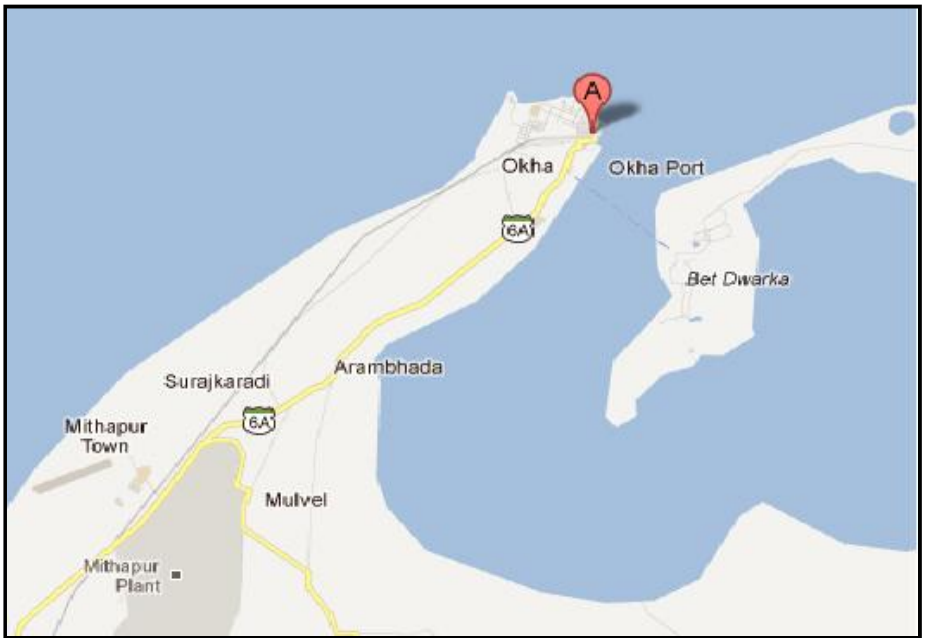


**Fig. 1. Map of collection site (Source of Google)**

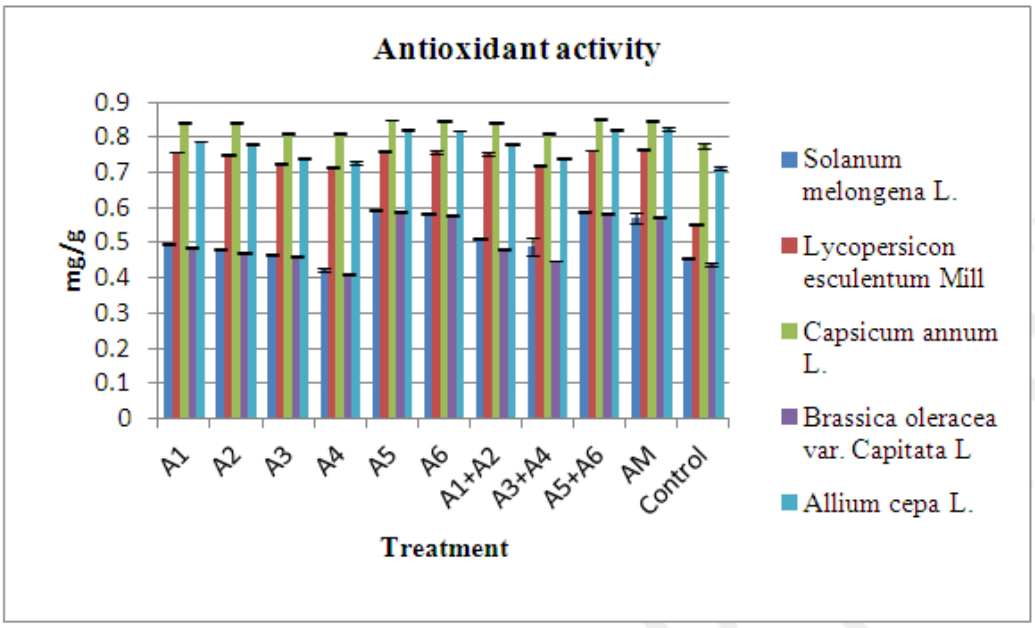


**Fig. 2. Effect of different seaweed liquid fertilizer on DPPH radical activity of selected vegetable seeds**

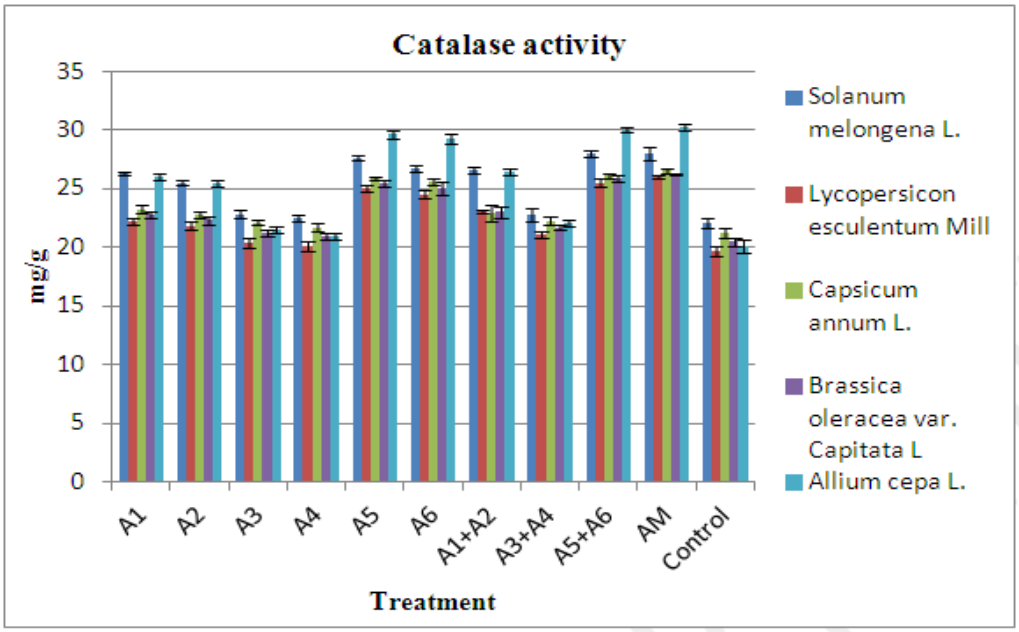


**Fig. 3. Effect of different seaweed liquid fertilizer on catalase activity of selected vegetable seeds**

control. Fig. 4 shows the peroxidase activity of vegetables. Minimum activity was found with the treatment of A4 seaweed liquid fertilizer that was recorded 0.950 mg/g, 1.200 mg/g, 0.672 mg/g, 0.921 mg/g and 0.659 mg/g in *Solanum melongena* L., *Lycopersicon esculentum* Mill., *Capsicum annum* L., *Brassica oleracea* var. *Capitata* L. and *Allium cepa* L., respectively. Maximum peroxidase activity was received with the treatment of AM that was calculated 1.624 mg/g, 1.675 mg/g, 1.506 mg/g, 1.594 mg/g and 1.688 mg/g, respectively.

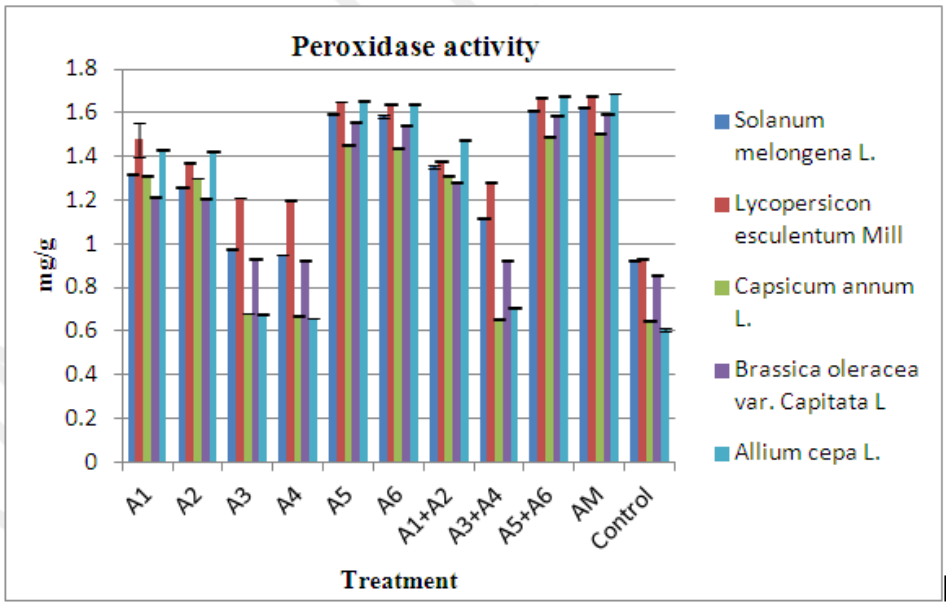


**Fig. 4. Effect of different seaweed liquid fertilizer on the peroxidase activity of selected vegetable seeds**

Lowest percentage of germination can be decreased in enzyme activity [45,46,47,48]. Enzyme activities of catalase, peroxidase and glutathione peroxidase were concluded maximum with the treatment of seaweed liquid fertilizer on *Helianthus annuus* L. [49] and *Zea mays* [50]. The catalase enzyme is closely interconnected with peroxidase in its structure and function and both enzyme formed during oxidative metabolism and in the oxidation used $H_2O_2$ from alcohol, phenol and another hydrogen donor [51]. Catalase and peroxidase activity observed in *Vigna* [52] and in pumpkin [53]. Seaweed extract treatment increased peroxidase, catalase and superoxide dismutase activities of wheat [54,55,56,57]. The affirmative effect micronutrient of Zn of seaweed extract on antioxidant enzymes activity [58]. Seaweed extract was enhanced the antioxidant enzyme activity in pea [59], in cotton [60] and in barley [61]. The peroxidase activity was enhanced by the production of oxygen species in plant tissue [62]. The DPPH radical scavenging activity of every sample in different seaweeds extracts used would affect the radical scavenging activity [63].

## 4. CONCLUSION

The study noticeably indicates the antioxidant activity using DPPH radicals while evaluating the antioxidant potential of vegetable plantlets extracts and significant value of antioxidant activity was found in brown seaweed liquid fertilizer. This study concluded the seaweed liquid fertilizer to enhance the antioxidant activity and enzyme like catalase and peroxidase activity of vegetable plant. The principle of this concept is basically to apply a method that is environmentally friendly and favourable for human interest as well.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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