

Seaweed Pretreatment of Chickpea (*Cicer arietinum*) Enhances Post Harvest Preservation by Reducing Germination

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Abstract

The plant growth enhancer property of seaweeds has been studied in different crops. Seaweed (*Sargassum wightii* and *Uluva lectuca*) were collected from coastal region of Mangrol and studied for its effect on germination and storage of chickpea. Chickpea seeds were soaked in 1% seaweed extracts for 6 h and dried at room temperature before sowing for germination in the soil. Percentage of seeds germination was less in *S. wightii* (67%) and *U. lectuca* (65%) treated seeds as compared to control. Furthermore, the treatment also prolonged germination time as compared to untreated control. Seaweed extracts effects on seeds viability upon longer storage was affected by the storage conditions. For instance, storage of seeds treated with seaweeds extracts at room temperature was more affected as compared to 4-8°C and -20°C. These results showed that seaweed extract is possible to use for increasing post harvest shelf life of chickpea without affecting its natural texture.

Keywords: Seaweed; Chickpea; Longevity; Germination

Introduction

Seaweed is natural and domestic resource of plant growth promoter also in the Gujarat coastal region. Seaweed has been used to enhance the growth and germination of various plants [8-13]. Seaweeds like *Sargassum*, *Ulva*, *Caulerpa*, *Padina*, *Ecklonia* have been found to contain essential micronutrients such as potassium, zinc, molybdenum, nitrogen, copper, cobalt, etc. [1-3] as well as plant growth hormones like IAA, gibberellins, abscisic acid, auxins and other important phytochemical that support the growth and development of plants [4-7]. Many species of seaweeds have been found to stimulate the defense responses in the plants [8]. Many seaweeds have also been reported as a food ingredients and supplements [9-11].

Chickpea (*Cicer arietinum* L.) is one of most important pulse crops in the world. According to world Food and Agriculture Organization (FAO) survey published in 2011, India contributes 68% of global production of chickpea [12]. Total estimate of chickpea production has gone up to around 8567.8 thousand tones in the year 2013-14. Post harvest preservation of green chickpea is one of the hurdle that limits the full exploitation of this crop potential both in sustainable serving to people and in contributing to agriculture economy of the country as well as inaccessible warehouse facility, whereas some of them are accessible only in fair weather [13]. Therefore, a technology that provides a sustainable and reliable means for the post harvest storage of chickpea would be worth inventing. The present study reports findings that may prove to be beneficial in storage of chickpea for longer time. We have exploited the usefulness of seaweed known as plant growth promoter in post harvest of chickpea. We found that extracts of seaweeds could reduce germination, increased shelf life without altering the natural texture of chickpea.

Materials and Methods

Collection of seaweeds and preparation of cell free extracts

Two seaweeds *Sargassum wightii* and *Uluva lectuca* used in the present study were collected from the coast of Mangrol (21.1200° N, 70.1200° E), Junagadh District, Gujarat, India in last week of January,

2014. These were washed thoroughly with seawater to remove all the unwanted impurities including sediments, salts and macroscopic epiphytes. Samples were kept in an ice box during transportation. Samples were rinsed with sterile water and dried on Whatman 3MM blotting paper under shadow seven days followed by hot air oven for 24 h at 40°C. Dried seaweed samples were grounded to powder and 5 g powder was suspended in 500 ml of sterile phosphate buffered saline. Extract was allowed to settle down and supernatant was passed through four layers of muslin cloth. The extract was stored at low temperature and thawed before seed treatment.

Seed treatment with seaweed extracts and monitoring of germination

Chickpea seeds were soaked in aqueous extracts of *S. wightii* or *U. lectuca* for 6 h and dried at room temperature. These were sowed in soil around 0.5 cm deep and watered regularly. Control Chickpea seeds were soaked in sterile phosphate buffered saline. Seed germination was confirmed by observation of two primary leaves. For monitoring the effect of storage conditions on seed germination, the chickpea seeds were soaked in aqueous extracts of *S. wightii* or *U. lectuca* for 1 h and dried at room temperature. These seeds were kept for 10 days in room or -20°C deep freezer or 4-8°C refrigerator or open terrace in open petri-plates or in air tight plastic bag. Untreated seeds were also processed in parallel as control.

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Figure 1: Effect of seaweed treatment at different temperature and packing on chickpea storage. A: Control in air tight bag at 4-8°C; B: *S. wightii* in air tight bag at 4-8°C; C: *U. lectuca* in air tight bag at 4-8°C; D: Control in open at 4-8°C; E: *S. wightii* in open at 4-8°C; F: *U. lectuca* in open at 4-8°C; G: Control in air tight bag at -20°C; H: *S. wightii* in air tight bag at -20°C; I: *U. lectuca* in air tight bag at -20°C; J: Control in open at -20°C; K: *S. wightii* in open at -20°C; L: *U. lectuca* in open at -20°C; M: Control in air tight bag at room temperature; N: *S. wightii* in air tight bag at room temperature; O: *U. lectuca* in air tight bag at room temperature; P: Control in open at room temperature; Q: *S. wightii* in open at room temperature; R: *U. lectuca* in open at room temperature; S: Control in air tight bag in open terrace; T: *S. wightii* in air tight bag in open terrace; U: *U. lectuca* in air tight bag in open terrace; V: Control in open in open terrace; W: *S. wightii* in open in open terrace; X: *U. lectuca* in open in open terrace.

Statistical analysis

Data were analyzed using SPSS free trial version program and analysis of variance (ANOVA) was performed for result comparison among groups. Statistical property of results $p < 0.05$ was considered as significant.

Results and Discussion

Chickpea seeds treated with extract of seaweed delayed germination. Both the percentage of the seeds germinated and the time taken for germination were different from untreated controls. Seeds treated with *S. wightii* extract showed 67% ($p < 0.05$) germination and took 144 to 192 h to germinate in soil. The similar results were observed with *U. lectuca* extract treated seeds, 65% ($p < 0.05$) seeds were germinated after 144 h as compared to controls, which showed around 80% germination and could germinate within 24 to 72 h.

The effect of seaweed as a preservative was evaluated and results are shown in Figure 1. Results showed that the seeds kept in open petriplate at 4°C become dark in color which was not observed when these were kept in air tight bag at the same temperature. or However, the seeds coated with seaweed (*S. wightii* and *U. lectuca*) developed dark spotted / patches at room temperature as well as 4°C, whereas the chickpea seeds when kept at -20°C temperature in air tight bag as well as in petri plates did not show any change at least in color. We also observed a striking difference in the texture. For example, seed kept in open were more wrinkled as compared to seeds kept in air tight bag. Looking into the results of Figure 1 M, N, O, S, T and U chickpeas storage in air tight bag at room temperature as well in open environment leads to spoilage of seeds. Similarly, open container storage at room temperature and in open environment brings dryness/shrinkage and color darkness in seeds as shown in Figure 1 P, Q, R, V, W and X. Out of all studied groups chickpeas stored in air tight bag at -20°C remained fresh and unspoiled without any changes in texture.

Seaweed liquid fertilizer prepared by various methods [2,14-16] reported growth and germination stimulating effect [2,15,16]. We found contradictory results on pretreatment of chickpea seeds with seaweed extract, stimulates dormancy/delay in germination and

decrease germination percentage, before sowing in field. Seaweed contains various plant growth regulators i.e., Indole acetic acid, abscisic acid, gibberellin, Indole butyric acid [14]. Abscisic acid exhibits dormancy effect on seed in contrast to gibberellin and Indole acetic acid, growth promoting activity. We treated seaweed extract in autoclave at 121°C and 15 lbs, which may be responsible for loss of stability of growth promoting factors, IAA and IBA stability is vulnerable under autoclaving [17], gibberellins decomposes under autoclaving and produces inhibitory products [18] whereas, anti-germinating factors could be remained unaltered, leads to delayed/anti-germinating effect on chickpea seeds.

We found chickpeas stored at room temperature or on open terrace either in air tight bag or in open container showed spoilage and wrinkled texture ultimately decreased longevity in comparison to seeds stored at 4-8°C and -20°C temperature, our results are in support of earlier report regarding increasing temperature is responsible for high rate of loss of viability in chickpea seeds [19,20]. Moreover, seeds kept in open container showed darkness in color compared to seeds kept in air tight bag, whereas, least changes were found with the seeds stored at -20°C. These results indicate deleterious effect of high temperature and open container for storage of chickpeas.

In conclusion, autoclaved seaweed extract pretreatment to chickpea delays germination and temperature above 8°C and open container is not suitable for preservation of green chickpea irrespective of seaweed extract treatment.

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