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INFLUENCE OF SALINITY ON AUTOCATALYTIC ION EFFLUX CONSTANT OF *VIGNA MUNGO* (BLACK GRAM) SEED

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Abstract: The paper reports autocatalytic ion efflux constant of seed *Vigna mungo* (Black gram) placed in imbibitions medium water and NaCl solution of different concentration in the range of 0.9 to 0.056 % in water. The method of ion efflux involving the measurement of specific conductance of imbibition medium is more advantageous than the measurement of the water content of the seed.

Keywords: Ion Efflux, Autocatalytic Ion Efflux Constant, Black gram, Electrical Conductivity.

1. Introduction

The study of seed germination is considered to be useful biophysical phenomenon to understand the seeds kinetics, which may be assessed from the knowledge of the electrical behavior of the imbibition medium. The process of germination is mainly governed by Autocatalytic ion efflux. Hence, the present study is an attempt to assess the effect of salinity of the imbibition medium on autocatalytic ion efflux constant. Here, *Vigna mungo* (Black gram) is selected for the study.

Simon [1] found that dry seeds lost appreciable amount of solutes such as sugars and amino acids when brought into contact with water during the process of imbibition. Mckersie and Senaratna [2] used solute efflux to study the effect of dehydration injury to soyabean seeds and they also studied the effect of external pH on the efflux of potassium ions and sugar. Gopala Krishna et al [3] used the concept of ion efflux to determine the kinetics of imbibitions in bengal gram and wheat, by measuring the changes in the specific conductance of imbibition medium as a function of time. Shanmuga Sundaram et al [4] reported that the ion efflux from whole seedling increases the specific conductance of the bathing medium. Simon [5] reported the increase in electrical conductivity in leachates of imbibing seeds is due to the increased leakage of electrolytes. Blacklow [6] proposed a mathematical equation to predict germination in corn based on the rate of water uptake in relation to time. Blackman [7] altered the index parameter effectively for plant growth from simple mathematical

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function, fitted to series of experimental observation. Gregory [8] discusses the review article of Williams on relative growth rate and the process of increased dry weight in short affix end leaf growth. Tinker [9] studied, on an empirical basis, uptake rate of Potassium, Aluminum, and water in roots, in order to determine the nutrient ion efflux and water flux into the root. Gopala Krishna and Latha [10] showed that water uptake by seeds resulted in an efflux of ion into the imbibition medium, causing an increase in the specific conductance of water from its initial value. Maguire [11] observed high conductivity of imbibitions medium and poor germination in the case of bleached pea seeds, compared to unbleached seeds.

2. Material and Methods

Vigna mungo (Black gram) seeds were cleaned with wet cloth and dried at room temperature then allowed to imbibe in water. Then specific conductance of imbibition medium (water) was measured for a period of time 3 hours with an interval of 0.25 hour. From the data on specific conductance of imbibition medium as a function of time, autocatalytic ion efflux constant can be calculated using that differential equation,

$$d\sigma/dt = k_i \sigma_t (\sigma_\infty - \sigma_t)$$

where σ_t is the specific conductance at any time t, and σ_∞ is the specific conductance at infinite time.

10 gm of *Vigna mungo* (Black gram) seeds were taken. They were cleaned with wet muslin cloth and dried at room temperature and were allowed to imbibe in 40 ml of distilled water and NaCl solution of different concentration in the range of 0.9 to 0.056 % in water. The specific conductance of imbibition medium was determined with the help of electrical conductivity meter (ELICO – CM 180), at an interval of 0.25 hour of imbibition. The increase in the specific conductance at every 15 min was determined as a percentage of the conductance of taken NaCl solution at time at t = 0.

3. Results and Discussion

The rate of water uptake (dw/dt) was assumed to be controlled by osmosis and at the rate of ion efflux ($\frac{d\sigma t}{dt}$) from the seed system to the imbibition medium could be a differential equation. A plot of log (σ_t /(σ_∞ -σ_t)) against time 't' should be a straight line.

Fig.1. shows plots between $\ln(\frac{\sigma}{\sigma t - \sigma})$ and t, when the seeds are placed in water and NaCl solutions of concentrations in % of 0.9, 0.45, 0.225, 0.112, and 0.056 as imbibition medium so that the effect of salinity autocatalytic ion efflux constant can be assessed. The graphs are straight lines and slopes of which are used for the calculation of k_i. it is interesting to note that

the values of k_i in the present salinity range is more or less the same. But k_i value of seeds in water is more than that in NaCl solution (Table 1). It seems that the small concentration of NaCl solution has no effect on k_i of the seeds of the investigation.

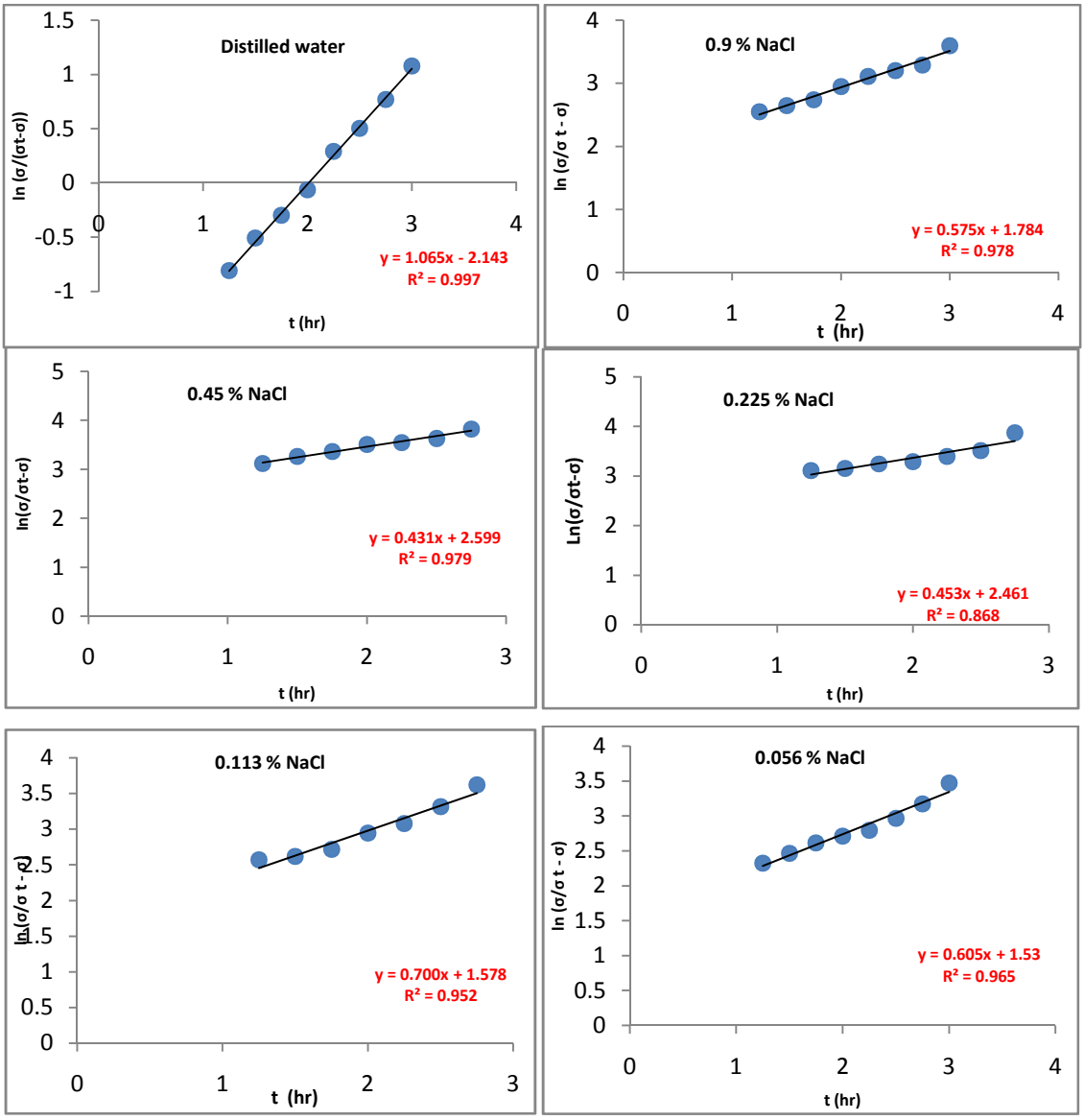

Table 1: Autocatalytic Ion Efflux Constant of *Vigna mungo* (Black gram) with different NaCl solutions

NaCl solution (%)	Autocatalytic ion efflux constant (hr^{-1})
Distilled water	1.065
0.056	0.605
0.113	0.700
0.225	0.453
0.450	0.431
0.900	0.575

The study suggests when seeds are immersed in distilled water for imbibition, water enters the seed due to osmotic imbalance. Due to this entry of water, seeds being polyelectrolyte, electrolysis takes place resulting in the efflux of ions from the seed to the imbibitions medium. This is detected as a variation in the specific conductance of the imbibition medium further, the phenomenon of autocatalytic ion efflux may perhaps depends on chemical composition of imbibitions medium.

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