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IMPACT OF MICROWAVE HEATED WATER ON GERMINATION OF SEEDS AND GROWTH OF PLANT SYSTEMS

Dr. K. Radha[1], Dr. B.V. Mrudula Rao[1], M. Sujatha[1], *Dr. D. Sirisha[2]

[1]Department of Chemistry, St. Ann's College for Women, Hyderabad-A.P.

[2]Center for Environment and Climate Change, School of Environmental Sciences, Jawaharlal Nehru Institute of Advanced Studies (JNIAS-JNTUA), Hyderabad – A.P.

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***Corresponding Author**
Dr. D. Sirisha
Center for Environment and Climate Change, School of Environmental Sciences, Jawaharlal Nehru Institute of Advanced Studies (JNIAS-JNTUA), Hyderabad – A.P.

ABSTACT

Present study deals with the impact of microwave heated water on the germination of seeds and plant systems. The influence of microwave heated water, distilled water and tap water were studied in different seed samples with respect to seed germination and the stem length. For the study a microwave oven was used. The distilled water was produced from Millipore distillation unit and the tap water supplied by Municipal Corporation of Hyderabad was used. The seed samples of mustard, fenugreek and green gram were used for comparing the different sources of water. The microwave power, exposure time on water samples was maintained as 180watts and 15 minutes. The study on seed germination and stem length was carried out for a period of 21 days. The results indicated that germination of plants was less with microwave heated water in comparison to tap water and distilled water. The decay of plants was high in distilled water.

KEYWORDS: Germination, microwaves, distilled water, microwave treated water, tap water.

A. INTRODUCTION

Microwave heating is considered as an advantageous technique compared to conventional heating methods. In microwave heating, heat is generated inside the food and it penetrates through the food[1] depth and it leads to rapid heating rate and reduces the processing time and minimizes the temperature difference.[2,3] Microwave causes polar molecules in food to constantly rotate and couple with the electromagnetic field.[4] Molecular friction resulting

from dipolar rotation generates heat. Heat is also generated by the migration of positive negative ions of dissolved salts and they may interact with the electric field and move towards the appropriately charged regions of electric field and disrupt the hydrogen bonds.[5,6] After II world war Russians have experimented in microwave oven and gave certain concepts that.

1. Cancer causing free radicals are formed within certain trace mineral molecular formulation in raw root vegetables.
2. Higher incidence in stomach and intestinal cancers
3. Alterations in catabolic behavior of glucose
4. Decrease in bioavailability of B complex vitamins, vitamin C and vitamin E and other essential minerals and lipoproteins.

Microwaves are electromagnetic waves and their frequencies are in between 300 MHz and 300 GHz. Microwaves are the form of energy and it manifested in the form of heat through its interaction with molecules. Microwave treated water brings changes in pH and mobility of water molecules.[8-17] The effects of microwaves on seeds and soil were studied by various investigators. Taking the above studies into consideration, the objective of the present paper is to investigate the effect of microwave heated water, distilled water, tap water on germination of seeds and growth rate for a period of 12 days.

B. OBJECTIVES

1. Environmental conditions that effect the plant growth are light, temperature and water resources etc were well documented and extensively available in the literature. The studies related to microwave bio effects is a new approach and it involves the interdisciplinary research of biotechnology, physics of microwave irradiation effects on living organisms is a new phenomenon which is put forward by the investigators in the present studies.
2. The adverse biological effects due to the microwave irradiation were well documented at high level radiation and they were not studied earlier at lower level of microwave power radiation.The studies were not carried out with microwave irradiated water samples in comparison with distilled water, tap water and the comparison is not carried out for different seeds earlier.

3. This study envisages in studying the effects of microwaves on seed germination and growth of seedling of commercial crops. It relates the interdisciplinary research and it has societal benefits.

C. METHODS AND MATERIALS

Seeds: Seeds contain three primary parts for the growth and development of the plant. The primary parts of plant which helps in the development of the plant are embryo, endosperm and seed coat. In the present study three in on different types of seeds in also with different types of water to have a comparison.

Mustard Seeds

Mustard Seeds are fruit pods obtained from mustard plant they belong to the family of Brassica. Three varieties of mustard seeds are available. They are white mustard, black mustard and brown mustard. Mustard seeds are rich in phyto nutrients, minerals vitamins and antioxidants mustard seeds can grow in arid conditions and it can improve the quality of polluted soils and it has tendency to take the heavy metals from the soils.

Figure: 1 Mustard plant and seeds.

1. Fenugreek seeds or Methiseeds

Fenugreek seeds are an annual plant belongs to the family Fabaceae. It is cultivated all over the world and is a semiarid crop. Fenugreek seeds are act as to different medicinal herb as it consists of many vitamins, minerals and nutrients.

Figure: 2. Fenugreek plant and seeds

2. Moong Dal

The moong bean (Vigna radiate) known as moong bean and it belongs to legume family and is a native of Indian continent. It can be cultivated both in hot and cold regions all over the world. It contains carbohydrates, sodium, potassium, vitamin D, C and B_{12}. As it can be grown in different climatic conditions they were selected for the studies.

Figure 3.Moong Dal pod and seeds

Selection of seeds

Twenty seeds each type were counted and selected for germination. These seeds were selected on the basis of floatation method.[18] The seeds were dropped into water and seeds that floated were rejected and seeds which sank were selected for germination.

Experimental set up for germination of seeds

Soil samples were taken in 9 different earthenpots. These pots were named according to their seeds. In these pots three pots seeds were added with the mustard seeds, three pots using Moong Dal, fenugreek seeds in remaining three pots were added. The germination of seeds in the pots was checked with the three different types of water. (Microwave treated water, distilled water and tap water) the germination of seeds and growth of seeds were checked for 21 days.

Description of microwave oven

A house hold type of microwave of 650W was used for the study. The energy output into the microwave oven was determined by measuring the rise in temperature 24^{o}C in a Borosil glass beaker placed the centre of the instrument. The water is heated for 150 seconds and it is calculated by using the following equation.

$$P=Cp\ K\Delta T\ (m/t)$$

Where p is the apparent power absorbed by water sample and Cp is the heat capacity (J/ml/K) of water

$$P=693$$

K= 4.814 (Converts thermal chemical energy to watts).

$\Delta T(^{o}C)$ = difference in the temperatures.

To investigate the germination and growth rate, the soil used had the following characteristics: Total organic carbon - 20.6g/kg, clay content -1.2g/cm^3, bulk density -1.26 g/$cm^3$and apH of 5.2-6.8.

RESULTS AND DISCUSSIONS

The results of seed germination with different water samples at low microwave power density on the stem length for 21 days and germination was put forth in the present studies.

1. The germination of seeds was started after 24hours for green grams, 48 hours for fenugreek, and 72 hours for mustard seeds. Order of germination is green gram>fenugreek>mustard seeds.
2. The growth period for microwave treated water is 15days for green gram, 10days for fenugreek and mustard seeds.
3. The decay of the plants started on 3rd day with microwave treated water, 5th day with tap water and 8th day for distilled water.
4. The decay of plants is more in distilled water in comparison to microwave water and tap water.

Growth of the plants Day-1

Green gram

Fenugreek

Mustard

Growth of the plants Day-3

Green gram

Fenugreek

Mustard

Growth of the plants Day-11

Green gram

Fenugreek

Mustard

GREEN GRAM

Table: 1. Details of germination of Green gram seed

S. No	Days	Plant growth in tap water (cms)	% of growth in tap water	Plant growth in distilled water (cms)	% of growth in distilled water	Plant growth in Microwave water (cms	% of growth in Microwave water
1	Day 1	2	6.25	1	4.1	4	14.8
2	Day 2	4	12.5	4	16.6	5	18.5
3	Day 3	9	28.1	9	37.5	7	25.96
4	Day 4	13	40.6	13	54.12	8	29.6
5	Day 5	14	43.7	14	58.33	9	33.33
6	Day 6	17	53.1	17	70.8	10	37.03
7	Day 7	19	59.3	18	75	12	44.44
8	Day 8	19	59.3	19	79.16	14	51.8
9	Day9	19	59.3	20	83.33	20	74.09
10	Day 10	20	62.5	22	91.7	20	74.09
11	Day 11	22	68.7	24	100	21	77.77
12	Day 12	23	71.8	-		23	85.18
13	Day 13	27	84.3	-		23	85.18

14	Day 14	30	93.7	-		25	92.59
15	Day 15	32	100	-		27	100
16	Day 16	-	-	-	-	-	-
17	Day 17	-	-	-	-	-	-
18	Day 18	-	-	-	-	-	-
19	Day 19	-	-	-	-	-	-
20	Day 20	-	-	-	-	-	-
21	Day 21	-	-	-	-	-	-

Table: 2. Details of germination of Fenugreek seed

S. No	Days	Plant growth in tap water (cms)	% of growth in tap water	Plant growth in distilled water (cms)	% of growth in distilled water	Plant growth in Microwave water (cms	% of growth in Microwave water
1	Day 1	-	-	-	-	-	-
2	Day 2	0.5	5.2	0.5	5.2	0.5	5.2
3	Day 3	1	10.0	1	10.5	1	10.5
4	Day 4	1	10.0	1	10.5	1	10.5
5	Day 5	3	30.0	3	31.57	3	31.57
6	Day 6	3	30.0	3	31.57	3	31.57
7	Day 7	5	50.0	5	52.6	5	52.6
8	Day 8	8	80.0	8	84.2	8	84.2
9	Day9	9	90.0	9	94.7	9	94.7
10	Day 10	10	100	9.5	100	9.5	100
11	Day 11	-	-			-	-
12	Day 12	-	-			-	-
13	Day 13	-	-			-	-
14	Day 14	-	-			-	-
15	Day 15	-	-			-	-
16	Day 16	-	-	-	-	-	-
17	Day 17	-	-	-	-	-	-
18	Day 18	-	-	-	-	-	-
19	Day 19	-	-	-	-	-	-
20	Day 20	-	-	-	-	-	-
21	Day 21	-	-	-	-	-	-

Table: 3. Details of germination of Mustradseed

S. No	Days	Plant growth in tap water (cms)	% of growth in tap water	Plant growth in distilled water (cms)	% of growth in distilled water	Plant growth in Microwave water (cms	% of growth in Microwave water
1	Day 1	-	-	-	-		
2	Day 2	-	-	-	-	-	-
3	Day 3	1	10	0.5	8.3	-	-
4	Day 4	3	30.0	1	16.6	1	16.0
5	Day 5	4	40.0	2	33.3	2	33.3
6	Day 6	4.5	45.0	4	66.6	2.5	41.7
7	Day 7	5	50.0	4	66.6	2.5	41.7
8	Day 8	7	70.0	5	83.3	3	50.0

9	Day9	8.5	85.0	5	83.3	4.5	75.0
10	Day 10	10	100	6	100	5.0	83.3
11	Day 11	-	-	-	-	6	100
12	Day 12	-	-	-	-	-	-
13	Day 13	-	-	-	-	-	-
14	Day 14	-	-	-	-	-	-
15	Day 15	-	-	-	-	-	-
16	Day 16	-	-	-	-	-	-
17	Day 17	-	-	-	-	-	-
18	Day 18	-	-	-	-	-	-
19	Day 19	-	-	-	-	-	-
20	Day 20	-	-	-	-	-	-
21	Day 21	-	-	-	-	-	-

CONCLUSIONS

Seeds were treated with microwave treated water ,distilled water and tap water. The number of seeds germinated with the microwave treated water is less in comparison to distilled water. The effect of microwave treated water on plant growth(height) rootlength varied with the nature of seeds. This study has been carried out to understand the influence of microwaves used for various purposes by human being.The low power microwave radiation upto180 watts can be used in cooking ranges as it is not effecting the plant growth to greater extent. Investigations suggest that low micro wave radiation can be used for minimum exposure duration. These results can be enhanced further by carrying out studies with different microwave radiation power, with soils ,with direct heating of seeds.

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