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Variation of β-radiation counts with water content in Ocimum Tenuiflorumand AzadirachtaIndica Plant Leaves

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ABSTRACT

Our aim is to study the changes in β-radiation counts with water content in OcimumTenuiflorum (Tulasi) and AzadirachtaIndica(Kadunimb) plant leavesusing beta source Tl204. Counts were measured for one minute (60 seconds) using Geiger Muller counter. The same leaf was observed for ten days. Counts vary as the amount/percentage of water content in the leaf gets changed. It was observed that leaf absorbs more radiation when it is fresh than dry. This study will useful for quantitative evaluation of interaction of radiations with leaves of plants.Keyword: Counter, leaf, radioactive sources, water, etc.
Keywords: GM Counter, leaf, radioactive sources, water, etc.

I. INTRODUCTION

In India, Tulasi and Kadunimb plants both have medicinal as well as religious importance. Tulasi is called as 'Queen of Herbs of India'. Various parts of tulasi are used in ayurvedic medicines. Its extracts is used for common cold & cough, headache, soreness, stomach disorder, heart sickness, in some poisoning cases and is also in malaria disease. It is also useful to reduce ill effects of radiotherapy of cancer. Extracts of tulasi is helpful in reducing swelling and pain. It can cure skin rashes, itching and is also effective in insects bite. Its leaves act as nerving tonic. Extracts of tulasi leaves is used to reduce pimples, acne and scars. It is valuable in constipation, indigestion and intestinal parasites. It acts as cardiac tonic and purifies blood. Seeds of it are valuable in impulsive ejaculation and mild aphrodisiac. Dried leaves of it are mixed with stored grains to repel insects. And most importance, these days, it is effective in reducing the effects of stress on the body as tulasi is abundant in essential oils and antioxidants[1].

The Kadunimb tree is called as 'Wonder Tree of India' as it's every part is useful in almost all fields such as medicinal, industrial, agricultural areas and has veterinary uses and plays an important role in environment protection. Its oiland leaves are act as anticlotting, antiulcer, antituberculosis, antitumor, anti-inflammatory, antiviral agent, etc. and in making soaps, shampoos, toothpastes, cosmetics, etc. Twigs are used as tooth cleaner. It is natural source of pesticides, insecticides and agrochemicals. It increases soil fertility and water holding capacity of soil. It has high rate of photosynthesis and liberates significant amount of oxygen. Its product can be used in water purifying activity[2].

The measurement of leaf water content has very much importance in field of farming as well as to horticulturists, plant physiologists or biochemists. This information is useful in irrigation management and helps to avoid plant drought stress.Leaves are heterogeneous matter containing water and other solid organic matter. Water content of the leaves of the plants varies with their type and the environmental conditions. When leaves dried up, they mainly loss their water content.Geiger Muller counter is a fundamental device and very simple to operate in radiation detection technique. We studied the changes in beta radiation counts of fresh and dry leavesof*OcimumTenuiflorum*and*AzadirachtaIndica*plants using beta source Tl^{204}.

Chaudhari L.M.[3] studied the attenuation coefficient of leaves of Ashoka plant by using Cs and Tl sources. The results show that the water content in the leaves was used to determine their attenuating characteristics. The

linear and mass attenuation coefficients were obtained.Pattanashetti I.I. and GalagaliM.N.[4] studied the attenuation coefficient and water content of Almond leaves using beta radiation. The water content was determined based on their attenuating characteristics to beta particles. The mass attenuation coefficient was obtained.Kirandeep K., Bala P. and Sharma A.[5,6]studied water content in vegetable leaves and Broccoli leaves using beta attenuation technique. The mass attenuation coefficient was obtained from the slope of graph between leaf thickness and logarithm of relative transmission intensity. The interaction of beta radiation with material occurs at fundamental level of atoms or their elementary constituent like electron and the nucleus. The attenuation studies are very much useful in the field of physical sciences, bio-sciences, agricultural sciences and medicinal sciences for solving various problems. Beta particle attenuation gives basic information on material composition such as thickness, water content, etc.Havaraddi B.N.[7] determined radiation absorption of beta rays by different plant leaves of Banana, Mango, Custard Apple, Hibiscus and Teak wood. The radiation absorption coefficient was calculated.The work of C. Jördens,M. Scheller, B. Breitenstein, D. Selmar&M. Koch[8] demonstrated that the dielectric material parameters can be used to determine the leafwater status in plant leaves. They have developed an electromagnetic model for the permittivity of plant leaves in thefrequency range between 0.3 to 1.8 THz.Mahajan C.S.[9]measuredmass attenuation coefficients of beta particles in some of the elements and found to be in good agreement with empirical relation.Rocca P. and Riggi F.[10]measuredbeta radiation absorption for different materials used as absorbers (brass, Al and cardboard).Baldacci L., Pagano M., Masini L., Toncelli A., Carelli G., Storchi P. and Tredicucci A.[11]usedterahertzspectroscopic techniques for measuring leaf water content.Nakayana F. and Erhler W.[12] used beta ray gauging technique to measure water content in cotton leaf. Ram N., Rao I.S.S. and Mehta M.K.[13] studied the mass absorption coefficient of some elements Be, Al, Cu, Ag &Pb. Practical range of beta spectrum from mass absorption coefficient values was obtained. However, in present work the variation of beta radiation counts with water content of same leaf is observed for 10 days by using Geiger Muller counter.

II. Experimental Method

Geiger Muller Counter, a radiation detector based on ionization effect of radiation to count beta and gamma rays with radioactive sources $Tl^{204}$and Cs^{137}Nucleonix Hyderabad made is available in our college.We made standard connections and arrangement between G.M. Counting System, detector, absorber and source. Placed a beta source in the source tray at about 4 cm from the end window of the GM tube. Starting voltage and Upper threshold of plateau, Plateau length, Operating voltage and Slope (%) of plateau was determined (study of the characteristics of a GM Tube) as per the procedure given in the manual provided with the instrument. Set the GM voltage at the operating voltage (465V) of the GM tube. Leaves to be investigated were washed with water and then socked for a few minutes in layers of blotting paper. Then we took fresh leaf (absorber) of Tulasi and were cut for same dimension and were placed in the sample holder between end window detector and source holder. We measuredthe counts for a present time of 1 minute (60 sec) without any absorber (background counts) and then measured counts with absorber (fresh leaf) for the same period of time. The same leaf was studiedfor 10 days. The mass of leaf was determined by weighing with a single pan digital balance which has accuracy of 0.001.

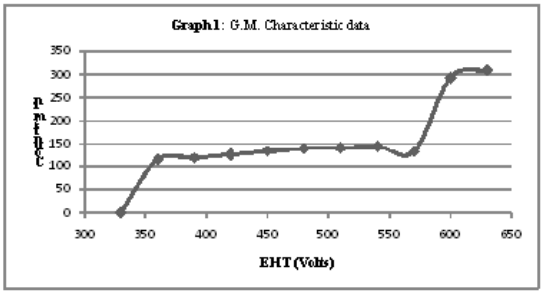
III. Result & Discussion

The variation of count rate with applied voltage (EHT) was studied and thereby plateau, operating voltage and slope of the plateau were determined using Table 1. Graph 1 shows the characteristics of G.M. tube.

Table 1. G.M. Characteristic data

Sr.No.	EHT (Volts)	Counts per minute (N)	Background counts (N_0)	Corrected counts ($N-N_0$)
1.	330	0	0	0
2.	360 (V_1)	119	05	114 (N_1)
3.	390	123	05	118
4.	420	131	06	125
5.	450	139	06	133
6.	480	147	08	139
7.	510	149	09	140
8.	540	155	11	144
9.	570 (V_2)	145	13	132 (N_2)

10.	600	308	15	293
11.	630	325	15	310



1. Starting voltage of plateau V_1 = 360 V

2. Upper threshold of the plateau V_2 = 570 V

3. Plateau length = $(V_2 - V_1)$ = 570 – 360 = 210 V

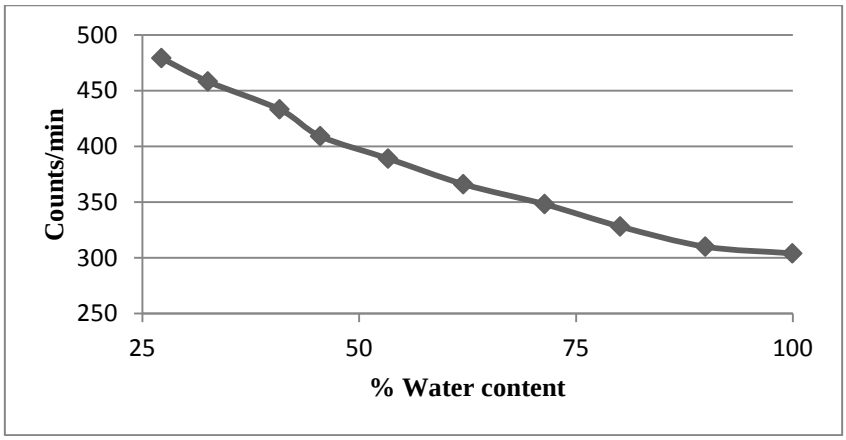
4. Operating voltage $V_0 = (V_2 + V_1)/2$ = 465 V

5. Slope (%) = $[(N_2-N_1)/N_1] \times [100/(V_2 - V_1)] \times 100$ = 7.58%

Table 2 and Table 3 shows the variation of counts of fresh and dry OcimumTenuiflorum (Tulasi) Leaf and AzadirachtaIndica (Kadunimb) Leaf respectively.Graph-2 and Graph-3 shows decrease in counts as amount of water in plant leaf increases. It is observed that leaf absorbs more radiation when it is fresh than dry hence number of counts for fresh leaf are less. Percentage of water in the leaf is calculated by using the formula:

Table 2. Ocimum Tenuiflorum (Tulasi) Leaf

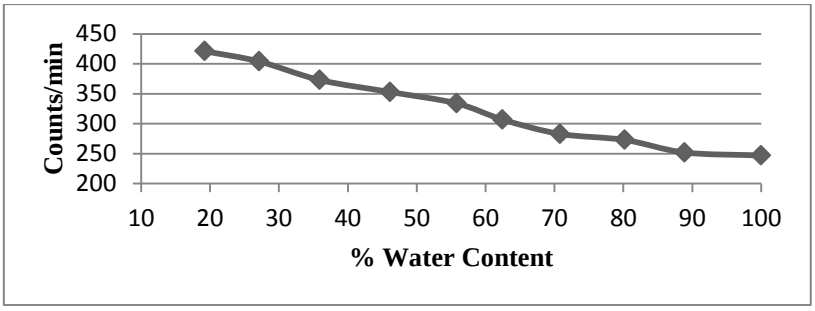
Days	Counts per minute				Corrected Counts/min	% Water content
	I	II	III	Mean		
1 (Fresh Leaf)	308	313	312	311	304	100.00
2	316	317	318	317	310	89.95
3	334	334	336	335	328	80.13
4	353	356	354	355	348	71.43
5	374	372	372	373	366	62.05
6	398	391	400	396	389	53.35
7	418	420	411	416	409	45.53
8	443	436	441	440	433	40.85
9	461	467	466	465	458	32.59
10	487	482	490	486	479	27.23



Graph 2. Ocimum Tenuiflorum Leaf Data

Table 3. AzadirachtaIndica (Kadunimb) Leaf

Days	Counts per minute				Corrected Counts/min	% Water content
	I	II	III	Mean		
1 (Fresh Leaf)	253	255	253	254	247	100.00
2	256	262	260	259	252	88.89
3	281	276	282	280	273	80.17
4	289	292	290	290	283	70.79
5	319	310	312	314	307	62.44
6	337	341	343	340	334	55.78
7	360	359	362	360	353	46.11
8	382	379	378	380	373	35.91
9	409	413	410	411	404	27.10
10	423	432	429	428	421	19.23



Graph 3. Azadirachta Indica Leaf

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