



EFFECT OF MICROWAVES ON TEXTURE, COLOUR, AND GROWTH OF THE ALOE VERA PLANT

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ABSTRACT: Over the years, owing to rapid technological progress, radiation from man-made sources has overcome to that of natural origin. One such radiation is microwaves. Microwaves are waves with wavelengths ranging from as short as one millimetre to as long as one meter. The study of electromagnetic phenomena such as reflection, refraction, diffraction, polarization, and absorption is of significant consequence in the study of how these waves move in space and time. Microwaves are particularly suitable for the use since they are more easily focused into narrow beams than radio waves as they have relatively higher frequencies which allow broad bandwidth and high data flow. Microwaves may have both positive and negative effects on Aloe Vera plant. The investigation was carried out with Aloe Vera Leaf exposed to microwaves. Images of the exposed Aloe Vera Leaf as well as normal leaf were taken and texture, colour, as well as growth were studied for ten days. It was found that on exposure to microwaves the Aloe Vera Leaves did not showed any significant change in texture but the colour of the leaf was changed slightly from natural green to yellowish green. The growth of the leaf was affected significantly and showed some decrease in the length.

Keywords: Aloe Vera, effect of microwaves, klystron, microwave test bench.

I.INTRODUCTION

Microwaves are non-ionizing radiations which are the part of the electromagnetic spectrum. Its wavelength spans from 1 m (300 MHz) to 1 mm (300 GHz). Microwaves do not contain adequate energy to chemically alter substances by ionization, and so it is an example of non ionizing radiation. Electromagnetic radiation of frequency in the tens of MHz range and below cannot penetrate the ionosphere where as microwaves can. A number of studies have been carried out to investigate their effect on the plants and animals. Anna Aladjadjiyan [1] investigated the influence of microwave irradiation treatment on the development of lentil seeds. Some, but not all, studies suggest that long-term exposure may have a carcinogenic effect [2]. The plants play a significant role for living beings, as they are the primary producers of food and oxygen. They also consists of complex and well-organized both conductive and insulated elements. Therefore it is necessary to examine their interaction with increased exposure to radio and microwave frequencies [3]. Microwaves can affect the both animals and plants. Most common applications of microwaves are within the 1 to 40 GHz range. It is due to skin effect at these microwave frequencies that a piece of glass with an evaporated silver coating 5.40 μm thick is an excellent conductor at microwaves [4]. Radio Society of Great Britain (RSGB) has categorized the different regions of microwaves in the bands listed in Table I. Microwaves consist of electric and magnetic field perpendicular to each other, propagating together in the same direction. Microwave conduction may vary from plant to plant as plants comprise of complex and well-ordered both conductive and insulated elements. Microwaves also have an effect on soil moisture, which is a significant component of the hydrology of land surfaces [5]. The new and energetic area of scientific research is the studies associated to the microwave effects. The objective of this paper is to investigate the effect of microwaves on the texture, colour as well as on the growth of the Aloe Vera plants. The Aloe Vera has been chosen because of its numerous applications. The details of Aloe Vera are presented in Section II. The methodology is given in Section III and results and discussions in Section IV along with the conclusion in Section V.



Table I Classification of the microwave bands

Letter designation	Frequency range (GHz)
L band	1 to 2
S band	2 to 4
C band	4 to 8
X band	8 to 12
Ku band	12 to 18
K band	18 to 26.5
Ka band	26.5 to 40
Q band	33 to 50
U band	40 to 60
V band	50 to 75
E band	60 to 90
W band	75 to 110
F band	90 to 140
D band	110 to 170

II.ALOE VERA

Aloe Vera also called as the Lily of desert means the plant which possesses exquisite properties for healing different diseases [6]. Aloe Vera is a cactus-like plant that grows readily in hot, dry as well as humid climates and at present, because of its demand, is cultured in large quantities [7]. The knowledge about the plant’s physiological, growth, and yield responses under different conditions of stimuli is very limited. Although several plants are often used in, Aloe Vera appears in some or the other form in most of the countries. The Aloe Vera species does not have any naturally occurring populations; though the closely related Aloe Vera does occur in northern Africa [8]. Aloe Vera has a shallow and spreading root system. The Aloe Vera plant has a crassulacean acid metabolism (CAM) .This mechanism allows water conservation within the tissue, and hence resistance to high water stress [9]. It has several uses. Aloe Vera is assumed to contain 75 potentially active constituents out of which are vitamins, minerals, enzymes, sugars, lignin, salicylic acids, and amino acids [10]. Aloe Vera has extensive use in Ayurveda for its anti-burn effect and furthermore as a tonic, antiseptic, antibiotic, anti-diarrheal, anti-viral, anti-fungal, anti-compliment and fine hair conditioner [11]. Aloe Vera also has some cooling properties similar to menthol which makes it great to sooth sunburns. Aloe Vera plant gel is a lively ingredient in a number of different skin care products that facilitates to treat a wide variety of different problems of skin. It also acts as a defensive layer on the skin and helps replenish its moisture.

A. Taxonomy and Etymology of Aloe Vera Plant

The Aloe Vera has been classified into Kingdom Plantae and Order Asparagales. It belongs to family Xanthorrhoeaceae and sub family Asphodeloideae. The Aloe Vera species has number of synonyms *A. barbadensis* Mill., *A. vulgaris* Lam, *Aloe indica* Royle and *Aloe perfoliata* L. var. *vera* [12].The common names include Indian Aloe, Chinese Aloe, True Aloe, Burn Aloe and Barbados Aloe. The white spotted Aloe Vera is sometimes also known as Aloe Vera war. [12]. Fig.1 shows Aloe Vera war.



Fig.1 White spotted Aloe Vera known as Aloe Vera war



B. Inner Fleshy Gel of Aloe Vera Plant

The other main ingredient of Aloe Vera is called gel, it is the inner fleshy layer .In other words it is the inner portion of the leaves. It is clear, colourless, and tasteless. This gel contains 99% water and the rest is made of amino acids, lipids, sterols, and vitamins.



Fig.2 Inner fleshy gel of Aloe Vera plant

Although the commercially available products are based on the gel, the British Pharmacopoeia does not have an access for Aloe Vera gel but it does describe Aloes [13]. The Aloe gel has also been extensively used in gastrointestinal disorders, including peptic ulcer, and its clinical usefulness [14-15].

C. Use of Aloe Vera Plant

1. The Aloe Vera has anti-microbial activity e.g. fungal, viral and bacterial, healing activity, it helps the body in casting off dead tissues and stimulates the growth of new cells with little scar formation e.g. burns, analgesic and anti-purity effects like arthritis, astringent effect (cosmetics), anti-inflammatory action (e.g. bee stings).
2. Aloe Vera gel is used commercially as an ingredient available yogurt, lotions, beverages, and some desserts [12].



Fig.3 Aloe Vera gel used for making desserts

3. Aloe Vera is sometimes used on facial tissues to promote it as a moisturiser and anti-irritant to reduce rasping of the nose of user who is suffering from hay-fever or cold [16].
4. In Arabian medicine, the Aloe Vera gel is used on the forehead as a remedy for headache as well as being used for wound-healing, conjunctivitis, and as a disinfectant and laxative [17].



III.METHODOLOGY

The investigations were carried out on Aloe Vera plant to study the modification in the texture, colour and growth due to effect of microwaves on it. In this research, the photograph of Aloe Vera leaf before microwave exposure was taken and it was studied. After that the Aloe Vera plant was exposed to microwaves. The Klystron microwave test bench as shown in Fig. 4 consisted of Klystron power supply, Klystron along with the fixed attenuator and CRO.



Fig. 4 Klystron microwave test bench

Klystron is a specialized liner-beam vacuum tube which is used as an amplifier for high frequencies. The voltage across the Klystron power supply was 300 V. After that Aloe Vera leaf was kept at a distance of 40 cm from the Klystron transmitter antenna. The distance between the Aloe Vera leaf and the horn antenna was 5 cm. The length & width of the horn was 15 cm & 10 cm respectively. The microwaves experimental setup can be explained in the Fig. 5 below.

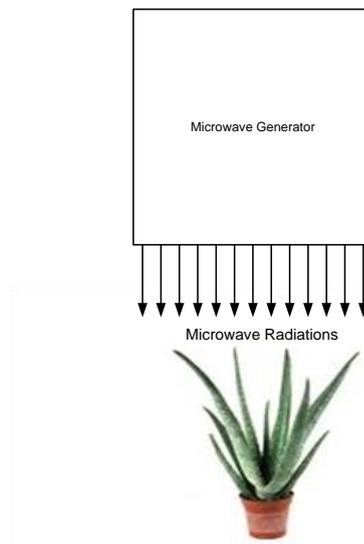


Fig.5 Schematic of the block diagram of the experiment



The exposed Aloe Vera leaf was kept under natural environmental condition for ten days. The plant was watered every day. The Aloe Vera leaf was observed with respect to change in physical properties like texture, colour and growth. The texture and colour was observed by taking images of the Aloe Vera leaf and the growth was recorded by a thick thread measured from the base of the leaf just above the root to the tip of the leaf. The setup to record the growth of the Aloe Vera leaf is shown in Fig.6 and the estimation for the growth of Aloe Vera leaf is shown in Fig.7.



Fig.6 Setup to record the growth of the Aloe Vera leaf



Fig.7 Estimation for the growth of the Aloe Vera leaf

IV.RESULT AND DISCUSSION

Investigations were carried out using both normal Aloe Vera leaf and microwave exposed Aloe Vera leaf for the determination of the change in texture, colour and growth. The texture of the leaf was smooth and the colour was natural green. The length was found to be 38 cm on the 1st Day with and without exposure. The analysis of the images shows that the texture of the Aloe Vera leaf does not have any noticeable effect but the colour of the Aloe Vera leaf was slightly faded to yellow green from natural green and the length of the leaf got shirked by 2 cm while the Aloe Vera leaves which were unexposed to microwaves shown in Fig. 8 (a) which did not showed any notable change in texture, colour and the growth. While Fig. 8 (b) to Fig. 8 (k) shows the images of the Aloe Vera leaf after the exposure to microwaves.

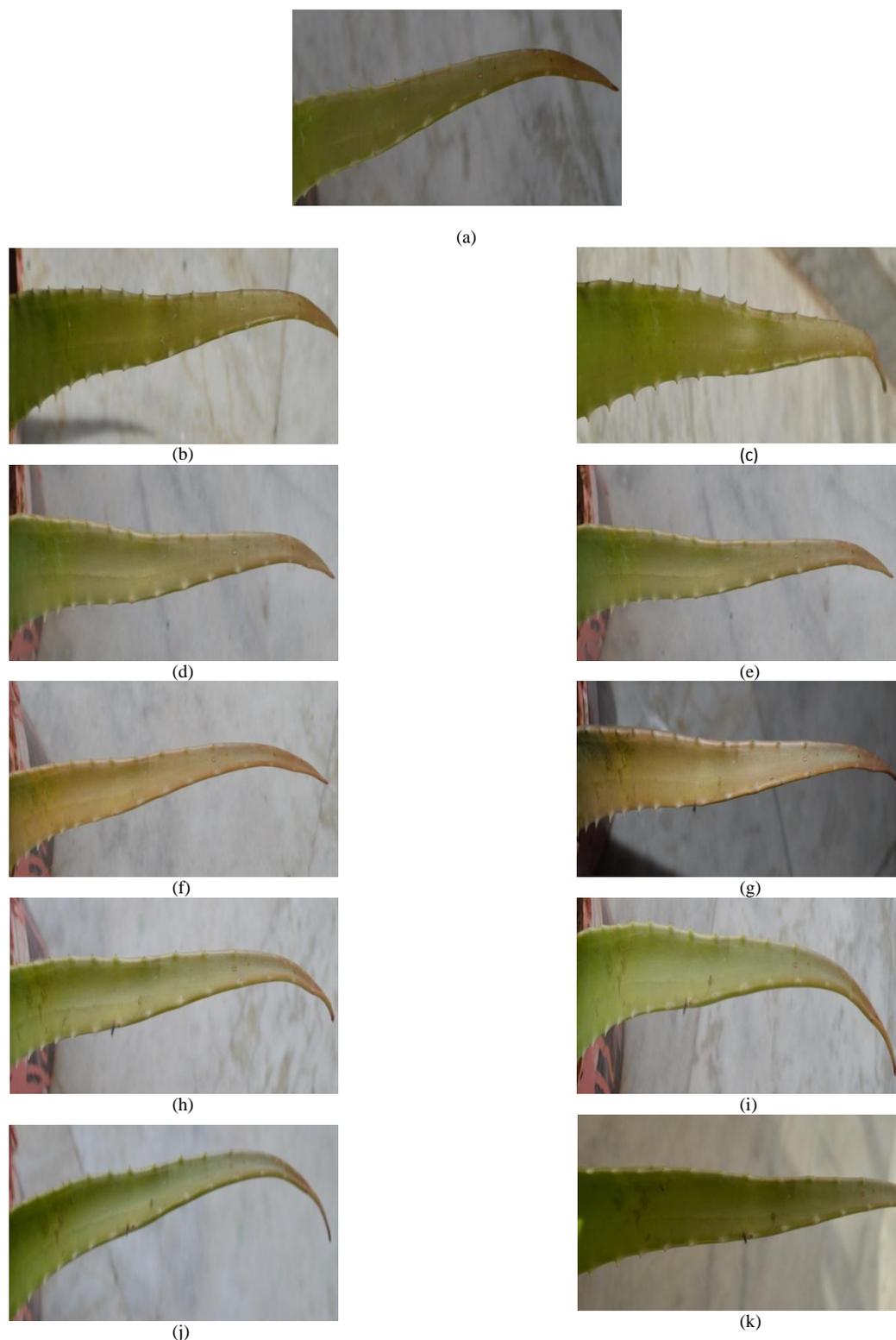


Fig.8 (a) Aloe Vera leaf without the exposure of microwaves, images b to k corresponds to microwave exposed from Day 1 to Day 10 respectively



The growth of the Aloe Vera leaf was recorded for ten days. The growth recorded is given in Table II below. The recorded growth is also shown in Fig. 9 with the help of the graph.

Table II showing the recorded growth of Aloe Vera plant for ten days:

No. of Days	0	1	2	3	4	5	6	7	8	9	10
Length of Leaf (cm)	38	38	38	38	37	37	37	36	36	36	36

From the below graph it is clear that the growth of the Aloe Vera plant before the exposure of the microwaves was 38 cm. And then the leaf was exposed to microwaves and the growth of the leaf remained constant for first three days at 38 cm. After that the growth was slightly decreased to 37 cm on fourth day and remained constant till sixth day. On the seventh day the growth was again recorded and it was seen that it further got decreased by 1 cm and the new growth was 36 cm till the end of the tenth day. This shrinkage may be due to the effect of microwaves on the Aloe Vera plant.

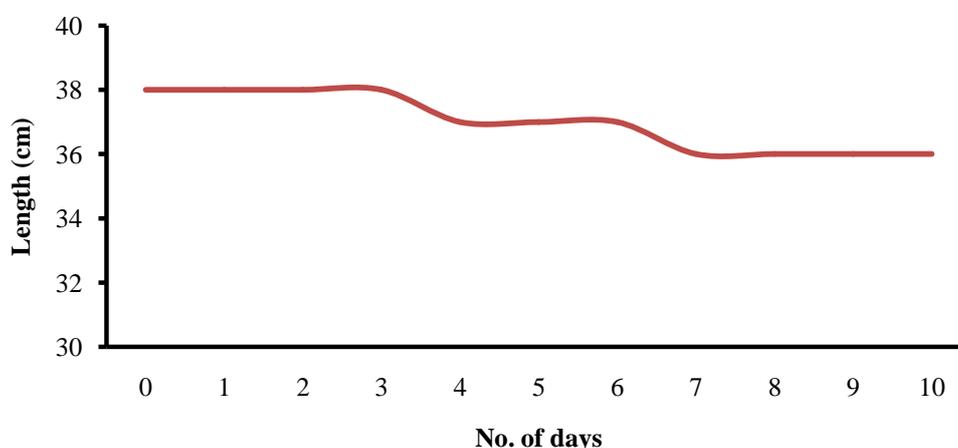


Fig. 9 Recorded growth pattern of Aloe Vera leaf exposed to microwaves

VI.CONCLUSION

Experiments were carried out to study the effect of microwaves on the physical properties like texture, colour and growth of the Aloe Vera Plant. The Aloe Vera leaf was exposed to microwaves. The analysis of the results showed that the microwave exposure to the Aloe Vera leaf does not show any marked change in the texture but the colour of the leaf was slightly faded from natural green to yellowish green. The leaf also got shrunked by 1 to 2 cms. On the other hand the unexposed Aloe Vera leaves did not show change in the physical properties. Hence microwaves alter the physical properties of the Aloe Vera plant. These results may be useful for researchers to evaluate the effects of microwaves on Aloe Vera plants. Also, the investigations may be exceptionally important for the evaluation of the health of the Aloe Vera and its leaves.

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