International Journal of Soft Computing and Engineering (IJSCE)
ISSN: 2231-2307, Volume-3, Issue-2, May 2013

Effect of Microwaves Treated Brassica Seeds on IR Irradiated Spectrum

Akhil Gupta, Randhir Singh, Parveen Lehana

***Abstract*—Microwaves are non-ionizing electromagnetic radiation. With the growth of technology and increase in demand of cellular services day by day; the presence of microwaves in environment is also increasing. Mostly these services are operated at 945 MHz. The wavelength of microwaves spans from one meter to one millimeter, covering the spectrum from 300 MHz to 300 GHz. These frequencies may affect the quality of the microwaves treated plant seeds and may reduce their fertility. This paper presents the results of some investigations carried out using microwaves treated Brassica seeds on IR (Infra-Red) irradiation. The spectrum of both microwaves treated and untreated seeds was studied under visible and IR radiation. It was observed that increasing the duration or power of the microwaves significantly affected the irradiated spectrum. Increasing the microwaves exposure decreases the IR absorption coefficient of the seeds. Further, microwaves reduce the fluid content of the seeds, which may affect the fertility of the seeds. The results may be useful for the development of an automatic quality assessment system for seeds.**

***Index Terms*—Microwaves, IR, Brassica Juncea.**

I. INTRODUCTION

Microwave spectrum falls between the Infra-Red (IR) and the radio frequency section of the electromagnetic radiation. Its wavelength spans from 1 m (300 MHz) to 1 mm (300 GHz). The wavelength and frequency of microwaves are related by equation [1]

$$C = \lambda f$$

where C = speed of light $(3\times10^{8} ms^{-1})$, λ = wavelength in meter, and f = frequency in Hz. Microwaves consist of electric and magnetic field perpendicular to each other, propagating together in the same direction. The propagation is governed by Maxwell's equations, giving the relations between the electric field, the electric charge, the magnetic field, and the electric current.

Microwave has numerous effects on the human beings. For example; Nageswari [2] explained the effect of microwave and heating of tissues due to energy absorption leading to temperature rise which is manifested as thermal effects are based on intensity of exposure. Marjanovic [3] explained that microwave radiation from man-made resources exceeded that of natural origin and studied certain effects on human life.

Manuscript received on May, 2013.

Akhil Gupta, **Randhir Singh,** Department of Electronics Engineering Sri Sai College of Engineering & Technology Punjab, India.

***Dr. Parveen Lehana**, Dept. Physics & Electronics, University of Jammmu, Jammu, India.

The objective of this paper is to investigate the effect of microwave on the infrared irradiation of Brassica seeds. Brassica seeds are used because they have some medicinal properties and can also be used for cooking purposes and also cultivated throughout India. Infrared spectroscopy, radiations and its types are described in Section II and description of Brassica seeds are explained in Section III. Experimental methodology is described in Section IV. Results and Discussions are discussed in Section V and are concluded in Section VI.

II. INFRARED (IR) SPECTROSCOPY

The qualitative aspects of infrared spectroscopy are one of the most powerful attributes of this diverse and versatile analytical technique. Over the years, much has been published in terms of the fundamental absorption frequencies (also known as group frequencies) which are the key to unlocking the structure–spectral relationships of the associated molecular vibrations. Applying this knowledge at the practical routine level tends to be a mixture of art and science. While many purists will argue against this statement, this author believes that it is not possible to teach a person to become proficient as an interpretive spectroscopist by merely presenting the known relationships between structure and the observed spectra. Instead, the practical approach, which has been adopted in this text, is to help the reader appreciate the visual aspects of the spectroscopy and how to interpret these relative to the structure and chemistry of the sample. This is achieved by recognizing characteristic shapes and patterns within the spectrum, and by applying the information obtained from published group frequency data, along with other chemical and physical data from the sample [4].

Infrared radiation is emitted by any object that has a temperature (i.e. radiates heat). So, basically all celestial objects emit some infrared. The wavelength at which an object radiates most intensely depends on its temperature. In general, as the temperature of an object cools, it shows up more prominently at farther infrared wavelengths. This means that some infrared wavelengths are better suited for studying certain objects than others. The infrared spectrum is formed as a consequence of the absorption of electromagnetic radiation at frequencies that correlate to the vibration of specific sets of chemical bonds from within a molecule. The infrared lights can be categorized into three groups. They are the near infrared, mid infrared and thermal infrared. Near infrared is the nearest to visible light and has the wavelength between 0.7 to 1.3 microns. Mid

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

infrared has a wavelength between 1.3 to 3 microns. Both the near infrared and the mid infrared are being utilized in common electronic devices in our world today. Some of them are remote controls, cellular phones and electronic switches. Thermal infrared is the one that has the largest part of the “Spectrum of Light”, while near infrared is between 0.7 to 1.3 microns and mid infrared is between 1.3 to 3 microns (the thermal infrared is between 3 to 30 microns) [5], [6]. EM Spectrum showing Infrared, visible and microwave bands are shown in Fig. 1.

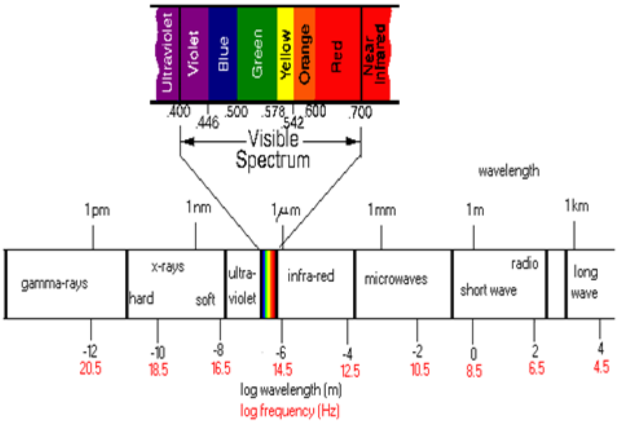

Fig. 1. Electromagnetic spectrum [7]

III. SEEDS

Seeds contain everything necessary for the growth and development of a new plant. The three primary parts of a seed are the embryo, endosperm, and seed coat. The embryo is the young multi cellular organism before it emerges from the seed. The endosperm is a source of stored food, consisting primarily of starches. The seed coat consists of one or more protective layers that encase the seed. The mature embryo consists of an embryonic root known as the radicle, an embryonic shoot, or plumule, and one or two cotyledons. The cotyledon is described as a seed leaf that stores food in the form of starch and protein for use by the embryo. An embryo of a monocotyledon (monocot) plant has one cotyledon, while that of a dicotyledon (dicot) plant has two cotyledons. At the frontier between physics and mechanics, the flow of granular materials has become a very active research domain [8]-[10].

The systematic exploration of mustard plant; botanical name of sarsu is Brassica juncea and it belongs to family Brassicaceae, and their germination rate has been observed under various conditions like natural environmental factors as well as additional passive factors involved within environment. Brassica is one of fifty one genera in the tribe Brassiceae belonging to the crucifer family. Brassica is one of the most ancient spices. It has three varieties namely black, brown and white. Brown mustard is largely cultivated. Brown mustard plant produces tiny yellow colored flowers, which almost cover the plant. The black mustard plant normally grows to a height of 10 feet. White mustard is the most mild among all the varieties of mustard. Mustard Seed has a fresh aroma and slightly biting flavor but when the seeds are dried they do give any fragrance. The leaves, the seeds, and the stem of this mustard variety are edible. The plant appears in some form in African, Indian, Chinese, Japanese, and Soul food cuisine [11]-[13]. Brown Mustard (*Brassica Juncea*) seeds are shown in Fig. 2 and Brassica leaves are shown in Fig. 3.

Fig. 2. Brassica seeds [14].

Fig. 3. Brassica leaves [15]

IV. METHODOLOGY

The experiment was carried out to investigate the IR spectrum of the brown mustard seeds, botanical known as Brassica Juncea. In this research, twenty different slides were taken on which the couple of brassica seeds were placed and these slides were microwaved using an IFB Company smart microwave oven with an output of 900 w for different exposure durations and different level of the power. Then these samples were put in the dark wooden box in order to avoid optical interference from other light sources and IR spectrum images were taken using the IR camera and visible spectrum images were taken using high resolution camera. The setup is shown in Fig. 4. Schematic of the block diagram of the experiment is shown in the Fig. 5. Interior of the wooden box is kept dark to receive irradiation spectrum only from the seeds. Flow chart of the steps used for the experiments are shown in Fig. 6.

The technical specifications of the IR camera includes resolution 600 TVL, fixed board 6 mm lens, 36 Pcs IR LEDs, and 30 m IR distance. Visible spectrum images of the heated Brassica seed were taken using Sony’s cybershot camera. The technical specifications of the camera include Carl Zeiss

Vario-Tessar lens, effective 14.1MP picture resolution, and 7.76 mm super HAD CCD imaging sensor. The irradiated spectrum of seeds was recorded at different exposure durations and different levels of microwave power.

Fig.4. IR camera along with enclosed wooden box.

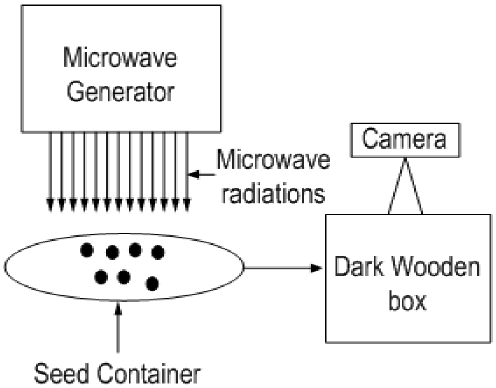

Fig.5. Block diagram of experiment.

V. RESULT AND DISCUSSIONS

Investigations were carried out using both captured IR and visible images for the determination of the reflexive properties of the Brassica seeds. From the captured IR and visible images, it was noted that as the duration of the exposure and the power of the microwave is increased, the reflection from the sample containing the Brassica seeds also increased i.e. absorption of the heat is reduced.

Fig. 7 shows the IR and visible image spectrum of the Brassica seeds after heating using 30 w microwave powers for 30 s, 60 s, 90 s, 120 s, and 150 s durations. The images in the first row are IR and visible images of the untreated seeds. The images in the remaining rows are at fixed power level but at different exposure durations.

Fig. 8 presents IR and visible image of the Brassica seeds which are treated with 50 w of the microwave power and exposure duration of 30 s to 150 s in steps size of 30 s. Fig. 9 show the IR and visible spectrum of the slide containing Brassica seeds with the microwave wattage of 70 w and the duration ranges from 30 s to 150 s. Fig. 10 shows the IR and visible images of the sample heated at 90 w microwave power and the duration of the exposure ranging from 30 s to 150 s with the step size of 30 sec. The analysis of these images shows that the reflection coefficient of the seeds treated with microwaves increases with microwave power and duration. This may be due to reduction in the fluid content of the seeds because of microwave heating. This effect may reduce the growth rate of the Brassica plants.

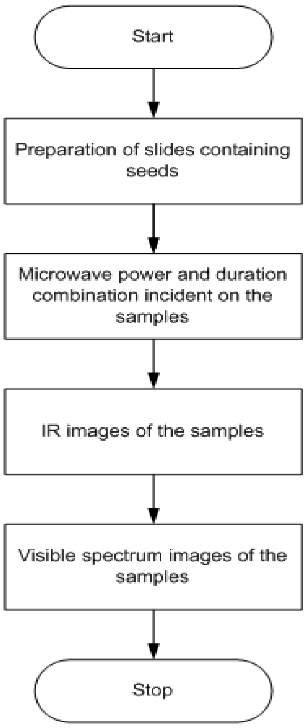

Fig.6. Flow Chart of Experiment.

VI. CONCLUSION

The investigations were carried out to study the effect of microwave power and exposure duration on the irradiated IR spectrum of *Brassica Juncea*. As the seeds may be considered as living organisms, the effect may reduce the growth of the seeds. These seeds were chosen because of there abundance and medicinal values. These seeds contain fresh aroma and slightly biting flavour and usually give fragrance when they are dried. The analysis of the results for the investigations related to IR spectrum of the microwave heated Brassica seeds showed an interesting behavior. From the captured IR and visible images, it was observed that as the duration of the exposure and the power of the microwave is increased the reflection coefficient increases. It may be due to reduction in fluid content of the seeds due to microwave heating. The results may be useful for estimating the quality and growth rate of the seeds.

VII. ACKNOWLEDGEMENT

The authors would like to express a deep sense of gratitude and thanks to Mr. Jang Bahadur Singh, research scholar, Dept of Physics and Electronics, University of Jammu, Jammu, for extending his knowledge and help in establishing the experimental setup and conducting the investigations.

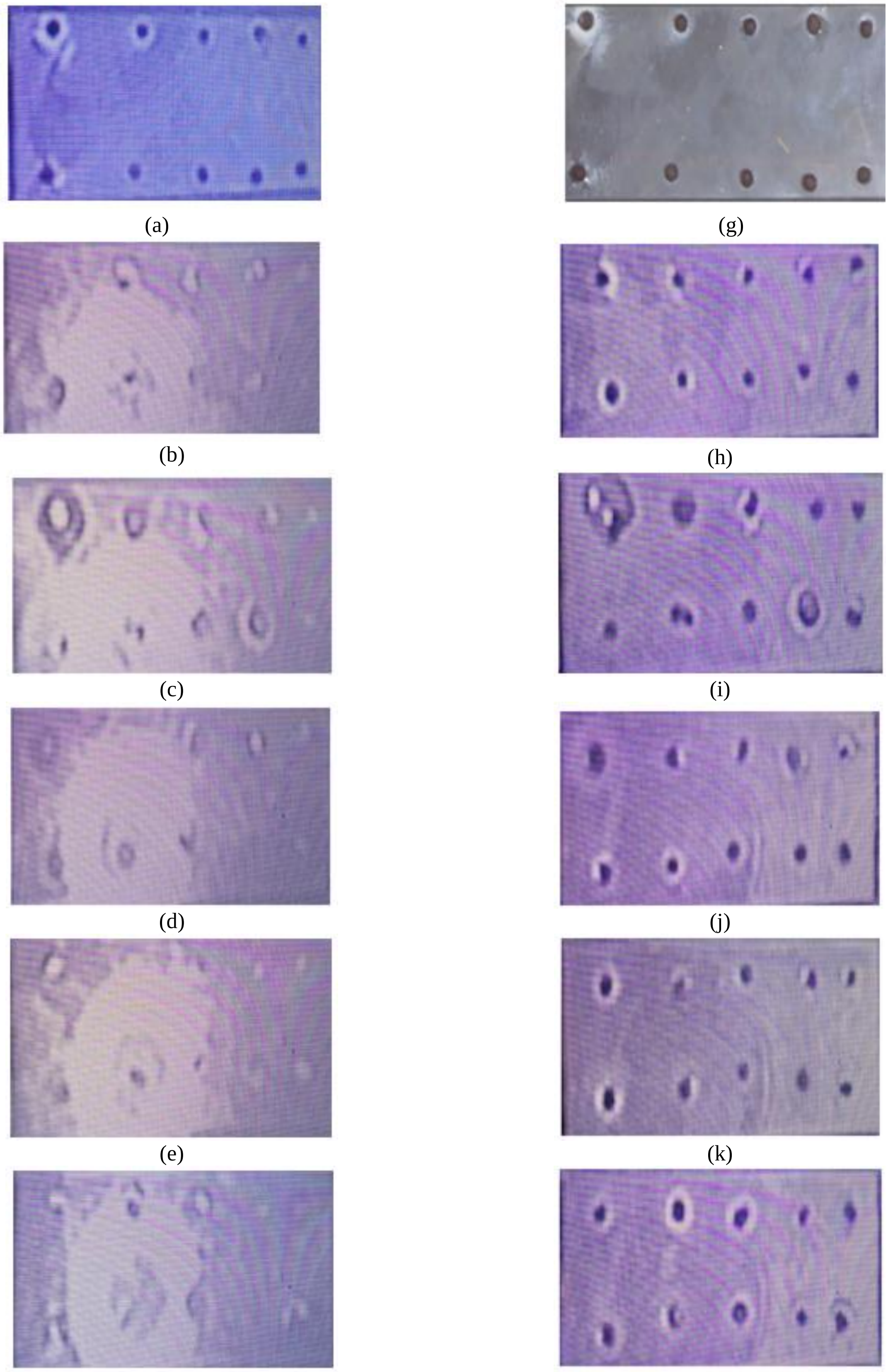

Fig. 7. IR and visible images. The first row is for untreated seeds. The first column is for IR images and the second column is for visible images. a) untreated IR, b) 30 w and 30 s, c) 30 w and 60 s, d) 30 w and 90 s, e) 30 w and 120 s, f) 30 w and 150 s, g) untreated visible, h) 30 w and 30 s, i) 30 w and 60 s, j) 30 w and 90 s, k) 30 w and 120 s, l) 30 w and 150 s.

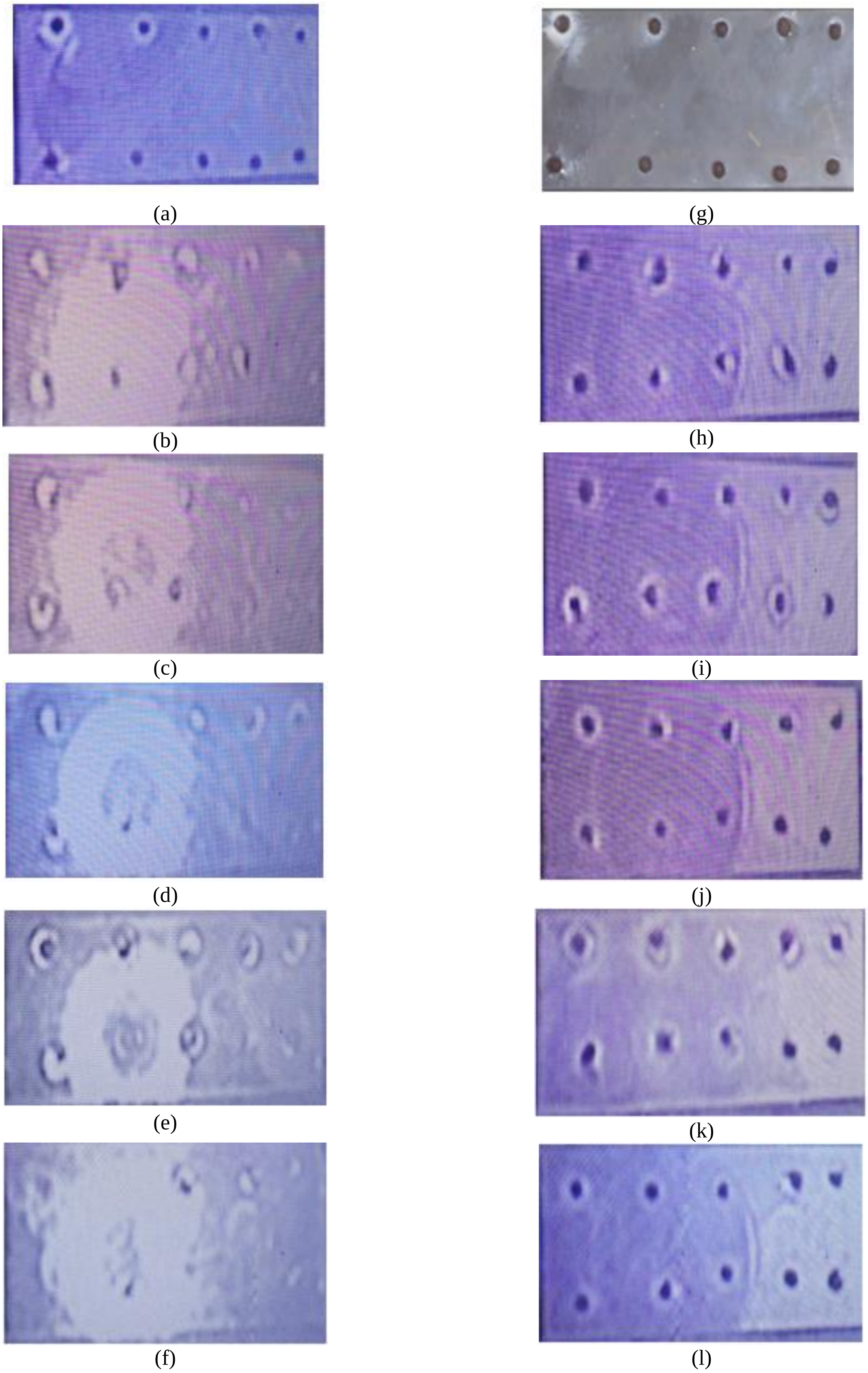

Fig. 8. IR and visible images. The first row is for untreated seeds. The first column is for IR images and the second column is for visible images. a) untreated IR, b) 50 w and 30 s, c) 50 w and 60 s, d) 50 w and 90 s, e) 50 w and 120 s, f) 50 w and 150 s, g) untreated visible, h) 50 w and 30 s, i) 50 w and 60 s, j) 50 w and 90 s, k) 50 w and 120 s, l) 50 w and 150 s.

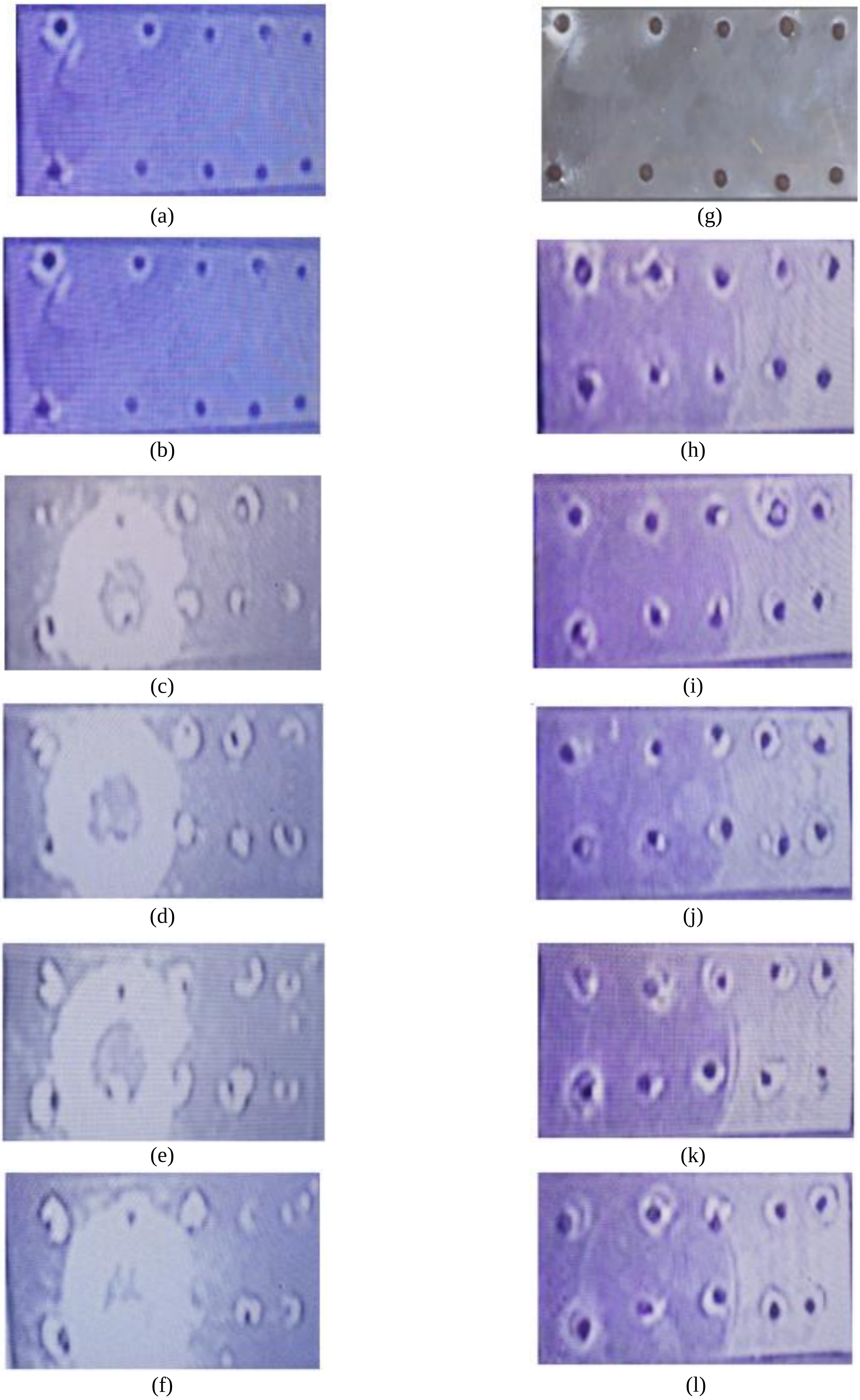

Fig. 9. IR and visible images. The first row is for untreated seeds. The first column is for IR images and the second column is for visible images. a) untreated IR, b) 70 w and 30 s, c) 70 w and 60 s, d) 70 w and 90 s, e) 70 w and 120 s, f) 70 w and 150 s, g) untreated visible, h) 70 w and 30 s, i) 70 w and 60 s, j) 70 w and 90 s, k) 70 w and 120 s, l) 70 w and 150 s.

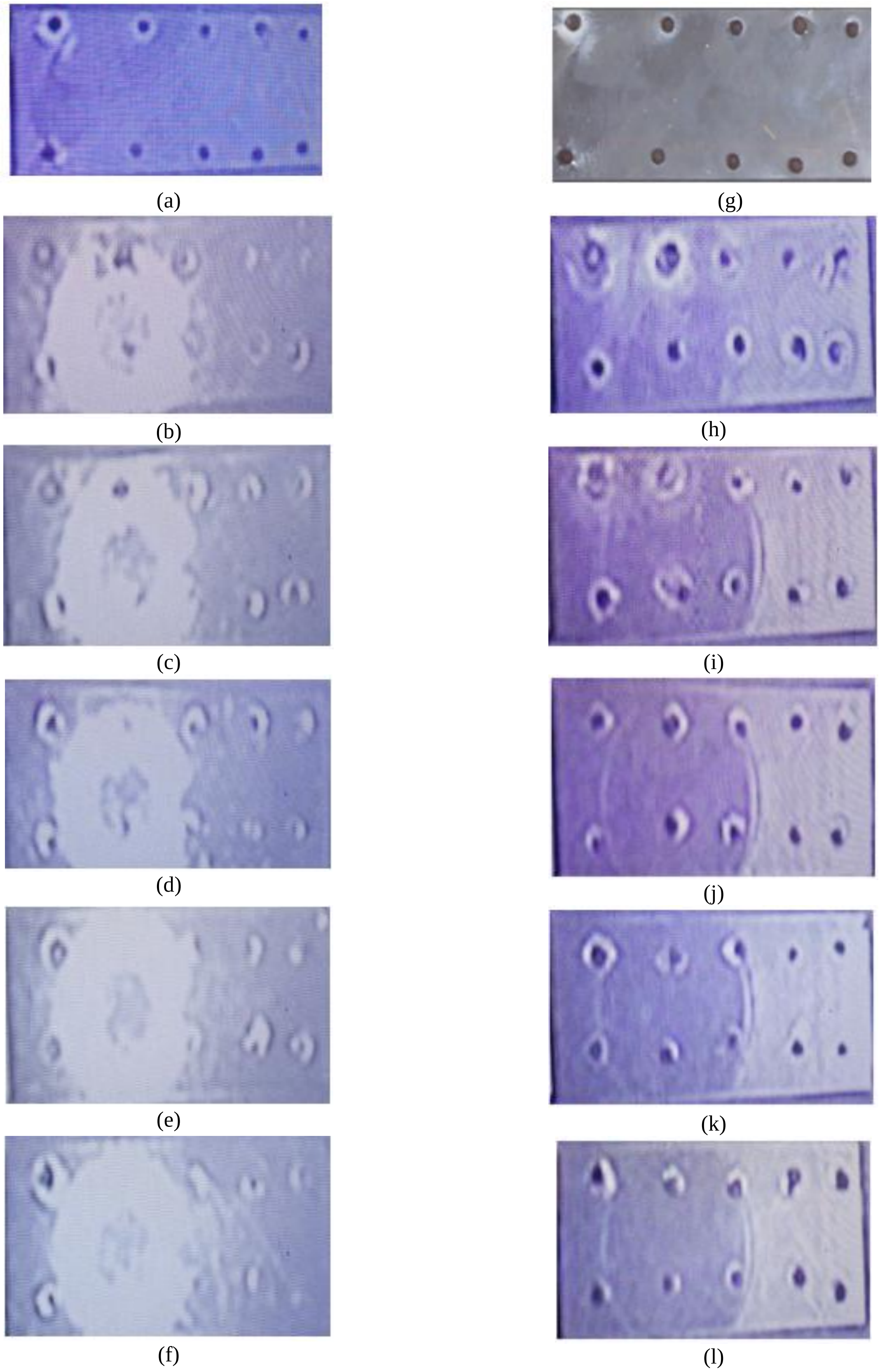

Fig. 10. IR and visible images. The first row is for untreated seeds. The first column is for IR images and the second column is for visible images. a) untreated IR, b) 90 w and 30 s, c) 90 w and 60 s, d) 90 w and 90 s, e) 90 w and 120 s, f) 90 w and 150 s, g) untreated visible, h) 90 w and 30 s, i) 90 w and 60 s, j) 90 w and 90 s, k) 90 w and 120 s, l) 90 w and 150 s.

REFERENCES

[1] Gupta, M. Wong, E., Microwave and Metal. Asia: John Wiley & Sons 2009, pp. 65-74.

[2] K. S. Nageswari, “Biological Effects of Microwaves and Mobile Telephony,” *in Proc. the International Conference on Non-Ionizing Radiation* , 2003, pp. 1-11.

[3] A. Marjanovic,I. Pavicic, and I. Trosic, “Biological indicators in response to radiofrequency/microwave exposure,” *Arh Hig Rada Toksikol*; vol. 63, pp. 407- 416, 2012.

[4] J. Coates, “Interpretation of Infrared Spectra,” Newtown, USA. John Wiley & Sons Ltd, Chichester, 2000, pp. 10815 – 10837.

[5] http://www.steves digicams.com/knowledge-center/how-tos/troubleshoot ing- repair/ how-an-infrared-thermal- imaging-camera-works.html

[6] http://www.ipac.caltech.edu.

[7] http://enchantingkerala.org/digital-photography-school/wavelengths-a nd-colors.php.

[8] J. C. Lin, “Evaluating Scientific Literature on Biological Effects of Microwave Radiation,” *IEEE Microwave Magazine*, Vol. 5, 2004, pp. 34-37.

[9] E. Ungureanu, C. L. Maniu, S. Vântu, and I. Cretescu, “Consideration on the Peroxidase Activity during Hippophae Rhamnoides Seeds Germination Ex-posed to Radiofrequency Electromagnetic Field Influ-ence,”*Analele stiintifice ale Universitattii, Alexandru Ioan Cuza, Sectiunea Genetica si Biologie Moleculara, TOM X*, pp. 29-34, 2009

[10] F. T. Ulaby, Fundamentals of Applied Electromagnetics, Medaia Edition, 2004.

[11] J. Grover, S. Yadav and V. Vats, “Hypoglycemic and antihyperglycemic effect of Brassicajuncea diet and their effect on hepatic glycogen content and the key enzymes of carbohydrate metabolism,” *Mol Cell Biochem*, pp. 101, 2002.

[12] S. Yadav, V. Vats, A. Ammini, and J. Grove, “Brassica Juncea (Rai) significantly prevented the development of insulin resistance in rats fed fructose-enriched diet,” *J. Ethnopharmacol*, pp. 113-116, 2004.

[13] M. S. Alam, G. Kaur, Z. Jabbar, K. Javed, and M. Athar, “Eruca sativa seeds possess antioxidant activity and exert a protective effect on mercuric chloride induced renal toxicity,” *Food Chem Toxicol*, vol. 45, pp. 910 – 920, 2007.

[14] http://www.answers.com/topic/mustard

[15] http://www.discoverlife.org

Er. Akhil Gupta received his B.E. Degree in Electronics and Communication Engineering from Model Institute of Engineering. and Technology, Kot Balwal Jammu (J&K) affiliated to Jammu University, Jammu(J&K). He is presently doing M-Tech in Electronics and Communicaton Engineering from Sri Sai College of Engineering and Technology, Pathankot (Punjab).

Er. Randhir Singh received his M.Tech. in Electronics and Communication Engineering from Beant College of Engineering and Technology, Gurdaspur (Punjab) affiliated to Punjab Technical University, Jalandhar (Punjab). He is presently working as (H.O.D, Electronics and Communicaton Engineering Department, Sri Sai College of Engineering and Technology, Pathankot (Punjab) and pursuing PhD in signal processing. His research interests include speech signal processing, digital signal processing, image processing, analog and digital communication, electronics and control systems, etc. He has more than dozen of research papers to his credit. He is guiding several M.Tech students in electronics.

Dr. Parveen Lehana received his Master’s degree in Electronics from Kurushetra University in 1992. He worked as lecturer in Guru Nanak Khalsa College, Yamuna Nagar, Haryana for next two years. He qualified UGC-CSIR-NET-JRF in Physical Sciences in 1994 and got selected as permanent lecturer in A. B. College, Pathankot, where he worked for one year. He also qualified UGC-NET-JRF in Electronic Science and presently working as Associate Professor in Physics and Electronics Department, University of Jammu. He did his research from IIT Bombay in the area of signal processing. He has good experience of guiding M.Tech., M.Phil., and Ph.D. students. He has more than 100 research papers to his credits. He fields of interests are speech signals processing, computer vision, nanotechnology, and microwaves.