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ELEMENTAL ASSESSMENT OF *MOMORDICA CHARANTIA* BY DC ARC OPTICAL EMISSION SPECTROSCOPY

Nidhi Shukla[1] and K. N. Uttam[2]
[1]Department of Environmental Science, Amity University Madhya *Pradesh*
[2]Saha's Spectroscopy Laboratory, Department of Physics, University of Allahabad, Allahabad
Email: nidthesaviour@gmail.com

ABSTRACT

This work is intended to research the minerals present in the *Momordica charantia* by utilizing the Direct Current Arc Optical Emission Spectroscopy (D C Arc OES). Vegetables contain huge amounts of minerals, nutrients, starches, essential amino acids and dietary fibers that are needed for ordinary working of human metabolic cycles. It is consequently important to get the elemental assessment and their concentration in the *Momordica charantia*. The emission spectrum of the powder sample of the *Momordica charantia* has been procured in the spectral region 300-900 nm at a resolution of 0.3 nm. The investigation of recorded emission spectrum shows the presence of persistent atomic lines of chromium, nickel, titanium, molybdenum, magnesium, vanadium, calcium, aluminum, manganese, potassium, lead, strontium, mercury, tin, barium, beryllium, phosphorus, zinc, cadmium, sodium, and lithium indicating the presence of these elements. Curve fitting strategy has been applied for the assurance of spectrum of the spectral profile that has been utilized for the quantitative assessment of distinguished elements.
Keywords : Vegetables, *Momordica Charantia* DC Arc Optical Emission Spectroscopy, Elemental assessment. Curve fitting

Introduction

The elements have been accounted for a fundamental part in the development of active chemical constituents in vegetables. These days' edible vegetables have become an extremely powerful remedial medication in handling ailments. Minerals play a pivotal role in human life for healthy growth and maintaining health (Bernhoft, 2010). These are promptly accessible in consumable parts of plant tissue. Consequently, screening of elemental composition of the widely utilized vegetables is exceptionally significant for determining their adequacy in treatment of various diseases as well as understanding their pharmacological action.

Botanical name of bitter gourd is *Momordica charantia* and it belongs to the family *cucurbitaceae*. *Momordica charantia* has several medicinal properties and is used for the treatment of diabetes, cardiovascular diseases, abortifacient, anthelmintic, contraceptive, dysmenorrheal, eczema, emmenagogue, antimalarial, galactagogue, gout, jaundice, abdominal pain, kidney (stone), laxative, leprosy, leucorrhea, piles, pneumonia, psoriasis, purgative, rheumatism, fever and scabies etc. Its regular intake acts as a shield and prevents many complications like, hypertension, eye complications, neuritis, defective metabolism of carbohydrate, body resistant against infection (Bakare *et al.*, 2010 and Ocvirk *et al.,* 2013). Therefore, author focused the attention on this plant.

Thus, the investigation of essential and toxic metals in vegetables is of key significance in assessing the nutritional status of vegetables as well as identification of the risk of harmful components. In this manner an analytical technique is a basic advance in the investigations on minor component examination for determining the therapeutic viability of vegetables and forbidding heavy metal toxicity. For the examinations of major and minor elements present in vegetable species, various procedures, for example, atomic absorption spectrometry (AAS), inductively coupled plasma-mass spectrometry (ICP-MS), inductively coupled plasma-atomic emission spectrometry (ICP-AES), electrochemical methods, neutron activation analysis and total reflection X-ray fluorescence are accessible (Bakare *et al.*, 2010, Bain *et al.*, 1986 and Ocvirk *et al.,* 2013). All these techniques require time consuming sample digestion prior to analysis of sample and are expensive. Digestion procedures are complex, laborious, time consuming, and increases the chance of sample contamination during pretreatment (Bakkali *et al.*, 2009 and Zafar *et al.,* 2010). These digestion procedures often dilute the element of interest below detection limits obtainable with the technique being used to measure them. Therefore, a technique is required which is free from sample digestion and should be sensitive, reliable, inexpensive, user friendly, eco-friendly, free from spectral interference and having simultaneous multi elemental capability. One such technique is direct current (d c) arc optical emission spectroscopy and it works on the principle of detection of optical radiation emitted by the sample on excitation by direct current source (Shukla, 2019 and Sharma *et al.,* 2017). The direct current arc optical emission spectroscopy allows the sample to be analyzed without sample digestion. It can analyze variety of samples both qualitatively and quantitatively. The direct current optical emission spectroscopy unlike atomic absorption spectroscopy, is not limited by hollow cathode lamps, and does not involve explosive gases.

Since the role of vegetables in human health depends upon its constituents and their concentration, therefore direct current arc optical emission spectroscopy technique has been applied to investigate elemental constituents of the commonly used edible vegetable viz bitter gourd. The present account demonstrates the utility and potential of the direct current arc optical emission spectroscopy technique for the elemental investigation of bitter gourd (*Momordica Charantia*).

Materials and Methods

Elemental assessment of *Momordica Charantia* was carried out using direct current arc optical emission spectroscopy technique. The bitter gourds were procured from the local vegetable market Katara Allahabad. The collected samples were washed with tap water followed by distilled water then dried at room temperature. These clean samples were burn in a hot air oven at a temperature of 75°C until they were transformed into mineral ash. After that they were powdered in a mortar and pestle arrangement. This powder samples were used for the experimental purpose. Such process evaporates moisture and increases concentration of minerals for its studies. The experimental setup used for the recording of the arc spectrum of bitter gourd is shown in Figure 1.

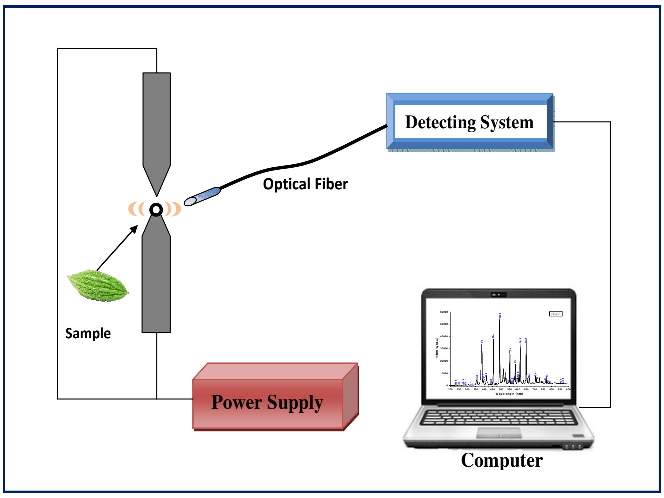

Fig. 1: Experimental setup used for the recording of direct current arc optical emission spectrum

The d c arc was formed across a 0.5 cm gap between two carbon electrodes connected with a d c voltage supply and ballast resistance. The arc current was controlled by the controlling (ballast) resistance and was ignited by mechanical contact of movable electrode with a sample. A small amount of the bitter gourd powder (0.5 gm) was kept inside the cavity of the carbon electrode. The radiation was produced between two carbon electrodes connected with d c source. As the current is built up across the electrodes it excited the sample. The excited sample emitted optical radiation. The emitted optical radiations were recorded using Photon Multichannel Fiber optic spectrometer equipped with three gratings and spec-soft MSS operating software at a resolution of 0.3 nm. About 10 scans were co-added together with integration time of 2 seconds in order to get noise free spectra in spectral region 300-900 nm. The procured spectra were processed for the analysis using origin 8.0 software package. The area of the spectral profile was evaluated by curve fitting using origin 8.0 software package that has been used for the relative comparison of the detected elements present in the selected vegetable. The intensity ratio of the detected spectral lines was used for the comparison purpose.

Results and Discussion

The recorded emission spectrum of the powder of the bitter gourd fruit in the spectral region 300-900 nm is reproduced in the Figure 2 (a, b, c).

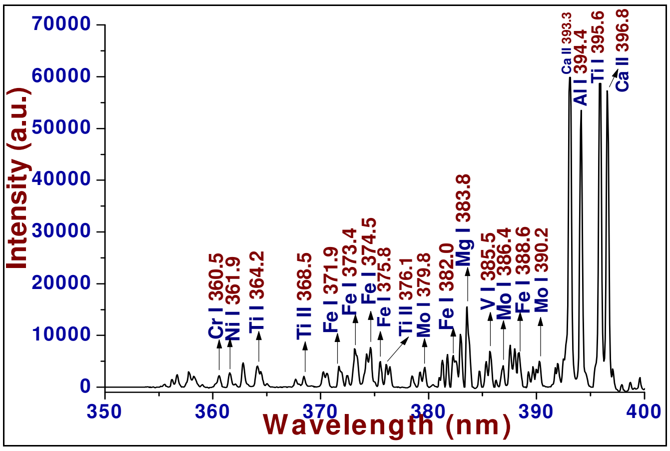

Fig. 2 a : Recorded emission spectrum of *Momordica Charantia* excited by d c arc

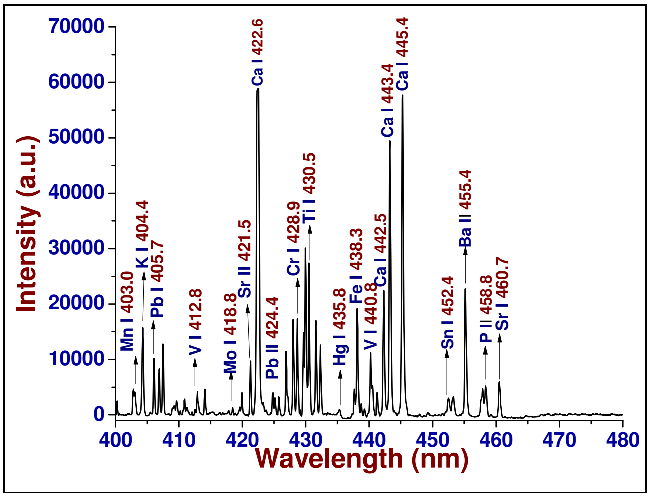

Fig. 2 (b) : Recorded emission spectrum of *Momordica Charantia* excited by d c arc

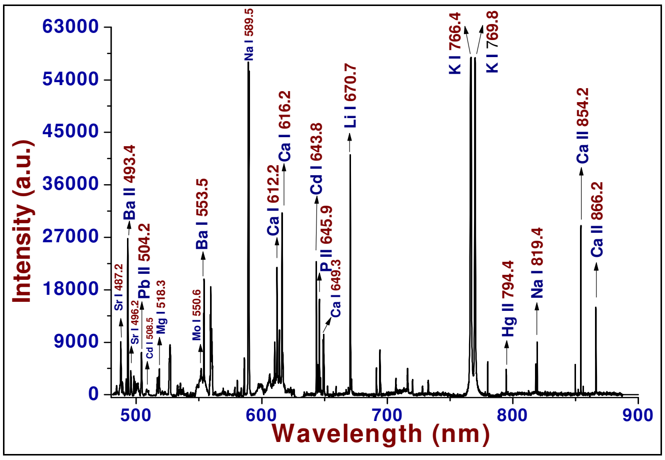

Fig. 2 (c): Recorded emission spectrum of *Momordica Charantia* excited by d c arc

The procured spectrum consists of spectral signatures of varying intensity of different wavelength thus showing the rich presence of elements in the ripe bitter gourd. The wavelength of the spectral signature corresponds to the element present in the specimen while the intensity is proportional to the concentration of the respective elements. The spectral signatures have been identified with the help of NIST spectral database (NIST). The identified elements along with their wavelengths were marked in the spectrogram (shown Figure 2-a,b,c).

The emission spectrum of the powder sample of bitter gourd shows the persistent atomic lines of chromium (360.5, 428.9, and 520.6 nm), nickel (361.9 nm), titanium (364.2, 368.5, 376.1, 395.6, 430.5, 498.1, and 501.4), iron (371.9, 373.4, 375.8, 374.5, 382.0, 388.6, and 438.3), molybdenum (379.8, 386.4, 390.2, and 550.6), magnesium (382.9, 383.8, 516.7, and 518.3), vanadium (385.5, 412.8, 437.9, 438.9, and 440.8), calcium (393.3, 396.8, 422.6, 442.5, 443.4, 445.4, 610.2, 612.2, 616.2, 649.3, 849.8, 854.2 and 866.2 nm), aluminum (394.4 nm), manganese (403.0 nm), potassium (404.7, 766.4 and 769.8 nm), lead (405.7, 424.4, and 504.2 nm), strontium (421.5, 460.7, 487.2, and 496.2 nm), mercury (435.8 and 794.4 nm), tin (452.4 nm), barium (455.4, 493.4, 553.5, and 614.1 nm), beryllium (457.2 nm), phosphorus (645.9 nm), zinc (492.4 nm), cadmium (508.5 and 643.8 nm), sodium (589.5, 818.3 and 819.4 nm), and lithium (670.7 nm). The presence of these persistent lines confirms the occurrence of the detected elements in the bitter gourd specimen.

According to Boltzmann's distribution law the intensity of the spectral line is proportional to the concentration of element present in the sample. The curve fitting analyses has been applied for the estimation of the concentration of different elements in terms of area of spectral signature of the respective elements. The reference element calcium is chosen due to its presence in the selected vegetable samples and it is a prominent nutrient required by the bio-organisms for its growth and development. the ratio of the intensity of the potassium to calcium (K/Ca), calcium to calcium (Ca/Ca), aluminum to calcium (Al/Ca), lithium to calcium (Li/Ca), barium to calcium (Ba/Ca), magnesium to calcium (Mg/Ca), titanium to calcium (Ti/Ca), cadmium to calcium (Cd/Ca), iron to calcium (Fe/Ca), strontium to calcium (Sr/Ca), (P/Ca), manganese to calcium (Mn/Ca), chromium to calcium (Cr/Ca), vanadium to calcium (V/Ca), lead to calcium (Pb/Ca), molybdenum to calcium (Mo/Ca), zinc to calcium (Zn/Ca), sodium to calcium (Na/Ca), tin to calcium (Sn/Ca), mercury to calcium (Hg/Ca), nickel to calcium (Ni/Ca) in bitter gourd has been evaluated from the obtained area of the spectral signature by curve fitting analysis and is obtained as 2.83, 1.0, 0.58, 0.45, 0.39, 0.32, 0.24, 0.23, 0.21, 0.19, 0.17, 0.16, 0.15, 0.14, 0.09, 0.08, 0.08, 0.06, 0.04, 0.04, and 0.03. The intensity ratio of the minerals potassium, calcium, aluminum, lithium, barium and magnesium are quite high compared with the other minerals therefore; their abundance is large in the fruit sample of the bitter gourd. This is also in agreement with the reported findings (Kosanovic *et al.*, 2009). A small deviation from the reported findings might be due to change in various factors like water quality, soil condition, and environmental factors. Figure 3 represents the relative distribution of the detected elements in the bitter gourd.

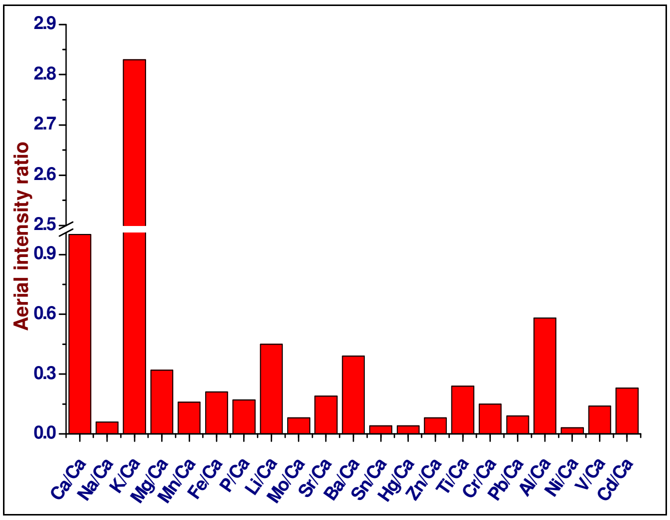

Fig. 3 : Relative distribution of the detected elements in the *Momordica Charantia*

Conclusion

The present study demonstrates potential of the direct current arc optical emission spectroscopy technique for the elemental investigation of the vegetables. The technique is cost effective, fast, and free from sample preparation, simultaneous multi-elemental, and eco-friendly. It can be used for the mineral analyses of any form of samples (concentrated solutions and solids). This technique has unique applications in spectral studies, diagnosis in plasma chemistry and in analytical analyses of the variety of environmental, biological and vegetable samples.

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