QUANTITATIVE ANALYSIS ON THE ELEMENTAL CONCENTRATIONS AND INTERMOLECULAR STRUCTURE OF SHAZAUNG-LET-PAT (*ALOE VERA* LINN.)

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Abstract

The purpose of this research work was to study the elemental cocentrationand mode of chemical group between the possible vibrational frequencies in parts of *Aloe vera* plant by using Energy Dispersive X-ray Fluoresence (EDXRF), Fourier Transform Infra-Red (FTIR) and Ultraviolet and Vissible (UV-vis) Spectroscopy techniques. Hydrogel films composed of polyvinyl alcohol(PVA) and *Aloe vera*(AV) gel were prepared and characterized by different ratio of PVA/AV hydrogel films 1:1, 1:2and 1:3 variations in the *Aloe vera* content. From the the results obtained that *Aloe vera* improves the water absorption rate of the films. and average equilibrium water content is 84.67%. The morphological characterization of the film by Scanning Electron Microscopy (SEM) analysis.

Keywords: *Aloe vera,* PVA, EDXRF, FTIR ,UV and SEM

Introduction

Aloe is the genus plants that contains over 400 species. The widely known species is *Aloe vera* ,which is grown for its unusual shape as well as for medical purposes. *Aloe vera* plant has been known and used for its health, beauty, medicinal and skin care properties. *Aloe vera* gel play an important role in the treatment of tumars, diabetes, ulcer and cancer. Traditional herbal medicines are used for treatment of various illness, but sometimes they could turn out to be toxic because of the present of some heavy metals and other impurities apart from the pharmacological effect. The objective of the present study is to perform elemental concentration of *Aloe vera* analysis by (EDXRF). Elemental analysis of medicinal plants is also helpful for knowing the quantity of heavy toxic metals and quality of that medicinal plant. The medicinal plant depend on the presence of elements, therefore quantitative assessment of elemental concentration is important and essential to understand

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their nutritive and pharmacological value. The work also investigates the usefulness of (FTIR) analysis and UV-visspectroscopy technique for more aknowledge of constituents and chemical structure. Hydrogel films composed of polyvinyl alcohol (PVA) and *Aloe vera* (AV) gel were prepared and morphological of the film by SEM analysis. And also determine by characterization of the water absorption rate in films.

Materials and Methods

Collection and Identification

Shazaung-let-pat (*Aloe vera* Linn.) fresh plants belongs to the family aloaceae have been collected from Mawlamyine Township in Mon State. The classification and identification of *Aloe vera* plant was analysed by Botany Department, University of Yangon.

Preparation of *Aloe vera* Extracts

An *Aloe vera* leaf was obtained by surface sterilized with ethanol. The outer, green dermis of the leaf was peeled off using a sterile blade. Fillets were extensively washed with distilled water to remove the exudes from their surfaces. The fillets were homogeneized in a blender and then the homogenized mass was filtered. After that the flesh gelwas weighed and 25 g of this was added 50 ml of distilled water to it. This mixture was then boiled for 15 minutes. After cooling to room temperature. It was filtered. The green dermis of *Aloe vera* leaves and roots were dried at room temperature. The dried sample are crushed and grounded into powder by using grinding machine for homogeneous dense material. And then, these powdered sample were weighed with scientific balance to get about 5 grams. Then poured into a disc made of steel and pressed into pellet by using 3-ton weight of Hydraulic press. The diameter of each pellet is 1.2 cm.

Preparation of films

Solvent casting technique

3 ml of the 3% Polyvinyl Alcohol(PVA) solution and the *Aloe vera*(AV) gel extract was incorporated to the ratio of 1:1, 1:2, and 1:3 (v/v) respectively. PVA solutions were prepared varying the concentration for 3%

(v/v), dissolving PVA in distilled water under constant stirring for 2 hours at 70Ć. To prepare films, solution of PVA and *Aloe vera* (AV) were mixed for each concentration of PVA with magnetic stirrer during 30 min, to which relations ratio 1:1, 1:2, 1:3 (v/v) were varied then the mixtures were isolated at room temperature for 6 or 7 days to remove bubbles formed during the process. All films were made in triplicate for each ratio of PVA/AV used. Finally, dried mambranes are removed from petri dishes and labeled in Figure 5.

Characterizations of films

Water absorption of capacity

It is used to measure the capacity of the PVA/AV films and 1:1, 1:2, 1:3 films was measured by swelling the films in distilled water at room temperature. They were pre-weighed and then immersed in 15 ml distilled water. The films were withdrawn from the water every half hour upto 4 hour.The wet weight of the films were determined after first blotting with a filter followed by blowing with a stream of air to remove surface water and immediately weighing the films. Every time after noting the weight. The swelling ratio was calculated using the equation:

$$(\%)\ E_{sr} = ((W_s - W_d)/W_d) \times 100$$

Where, Esr is the water absorption (%) of the films. Wd and Ws are weight of the samples in the dry and swollen states respectively.

The equilibrium water content (EWC)

EWC was calculated from the following equation:

$$\%\ EWC = ((We - Wd)/ We) \times 100$$

Where, We represents the weight of the swollen states at equilibrium.

Results and Discussion

EDXRF Analysis

The measurements of elements concentration in *Aloe vera* leaves, gel and root sample are shown in Table (1).From EDXRF analysis, the maximum

concentrations of Calcium, Potassium, and Iron have been found in *Aloe vera* leaf is 76.300,14.648,2.069(%), in *Aloe vera* root is 70.343,10.973,0.975(%), and in *Aloe vera* gel is 75.350,6.722,17.100(%) respectively. Calcium, Potassium are macro elements present in high amount in leaf of *Aloe vera*. Calcium (Ca) is main component in bone growth and healful for regulating skeletal and cardiac muscle contractions. Potassium (K) is regulates water balance levels of acidity, blood pressure, muscles and nervous system, prevent diabetes. Iron (Fe) is the function to combine with protein and copper in making haemoglobin, the component of the blood that carries oxygen from the lungs to the tissue. An the other elements such as Mn, Cu, Zn, Sr, Rb found as minor elements and they detected as a very few weight percent. All organic compounds are mostly containing hydrocarbons. The element concentrations in EDXRF spectrum of *Aloe vera* gel, leaves and root are shown in Figure (6 to 8) and graph of Figure 9.

FTIR Analysis

The result from FTIR were shown twelve peak in absorbance wave number spectrum range from 4000 cm^{-1} to 400cm^{-1}. The FTIR spectra of the green dermis of *Aloe vera* leaf, gel and root in Figure (10 to 12). Astrong broad absorption band around 3450-3420 cm^{-1} found in all the samples may be due to the presence of hydrogen bounded N – H stretching, characteristic of amino acids group. The absorption band at 1750-1630 cm^{-1} is characteristic of C=O stretching indicates the presence of carbonyl groups. The absorption band at 1250-1240 cm^{-1} is due to the strecthing vibrations of C-O groups of esters and phenols. The strong absorption band at 1630-1620 cm^{-1} is due to C=C stretching which indicates the presence of vinyl ether and aloin compound. All constituent of chemical status in Aloe gel is greater than root and leaf. Since amino acids is the building blocks of protein, it's considered to be the main functional group in tissue by human body. Phenolic compounds is medicinal herbs and to exert preventive activity against infectious and degenerative diseases.

Optical Analysis

The absorption spectrum of *Aloe vera* was obtained from UV-vis spectroscopy. The wavelength range of spectrum lie between 190 nm to

1100 nm. The UV-vis spectra of the green dermis of *Aloe vera* leaf, root and gel due to chemical status. These wavelengths corresponds to the presence of amino, aloin, phenolic compound and carbonyl groups were shown in Figure(13 to 15) and Table (3).

Film Forming

It was revealed that the *Aloe vera* plant extract do not form films. All the composite that involved polyvinyl alcohol (PVA) were able to form film. It was porve that PVA had film forming characteristics. The water absorption capacity of PVA/AV films decreased with increasing concentration of the plant extract.The EWC (equilibrium water content) of the films containing *Aloe vera* extract in PVA reduced gradually as the propotion of *Aloe vera* extract in the films increased. All the films reach their respective maximum water absorption within the 2 hours of introduction into the aqueous enviroment. From the results, it is possible to observe that the film containing 1:3 of PVA/AV film presented a quickly absorption of water along the first 30 min after immersion, reaching the equilibrium in approximated 120 min. The film with higher *Aloe vera* content exhibited a quickly absorption of water after immersion which was followed by a progressive and slower absorption of water, not reaching the equilibrium during the 24 hour of the test. The EWC of the sample 3, PVA/AV(1:3) film is (85.2%) higher than that of other films sample 2 and sample 3 are 84.2% and 84.8% respectively. These results clearly showed that the water absorption capacity of the films in Table (3) and Figure 17.

SEM Analysis

The SEM micrograph of the surface structure of *Aloe vera* hydrogel film sample 3 is shown in figure 18. This image confirms that the material is forming micro- size agglomerates. The surface structure of the hydrogel film image were taken of 1000 magnification at an operating voltage of 15 kV.

Figure 1: *Aloe vera* plants

Figure 2: The green dermis of *Aloe vera* leaves and gel

Figure 3: Collection of gel

Figure 4: Roots of *Aloe vera*

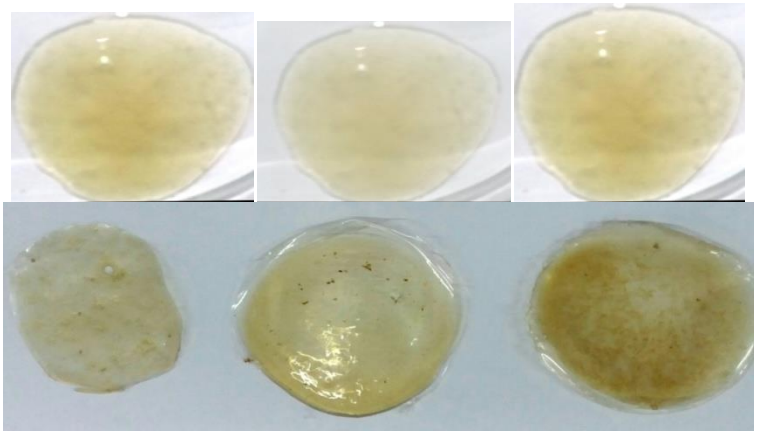

Figure 5: PVA/AV(1:1,1:2,1:3) films

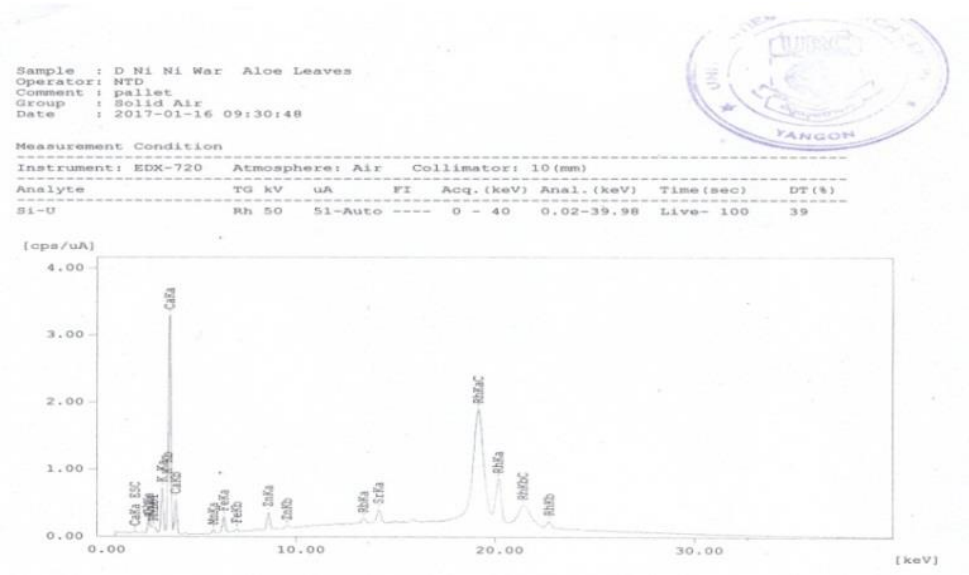

Figure 6: EDXRF Spectrum of *Aloe vera* leaves

Figure 7: EDXRF Spectrum of *Aloe vera* gel

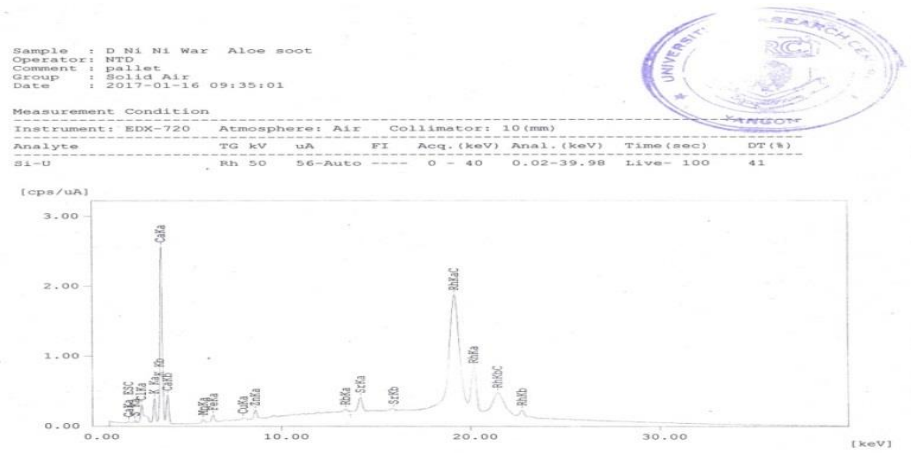

Figure 8: EDXRF Spectrum of *Aloe vera* root

Table 1: Elemental concentration in sample for various parts of *Aloe vera* (%)

Element	Average Elemental Concentration (W%) of three samples		
	Gel (%)	**Leaves (%)**	**Root (%)**
Ca	75.35	76.300	70.343
K	6.722	14.648	10.973
Fe	17.1	2.069	0.975
Mn	0.821	0.601	0.630
Cl	-	4.754	14.330
S	-	-	1.572
Cu	0.0032	-	0.152
Zn	0.0038	1.078	0.526
Sr	-	0.386	0.402
Rb	-	0.165	0.095

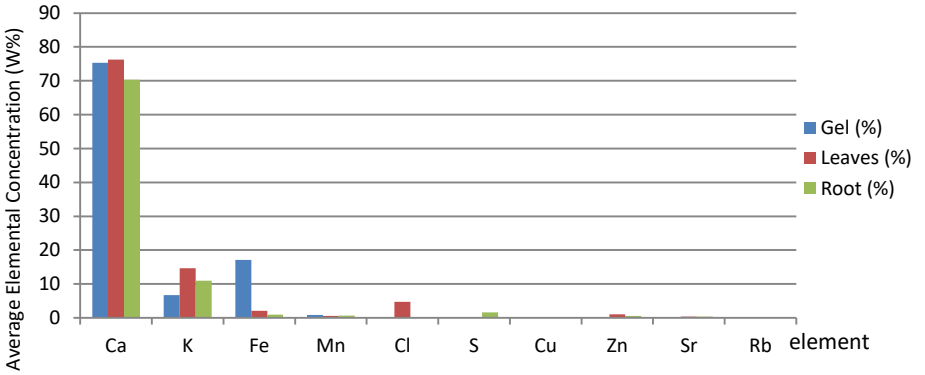

Figure 9: Element concentrations in *Aloe vera*leaves,gel and root

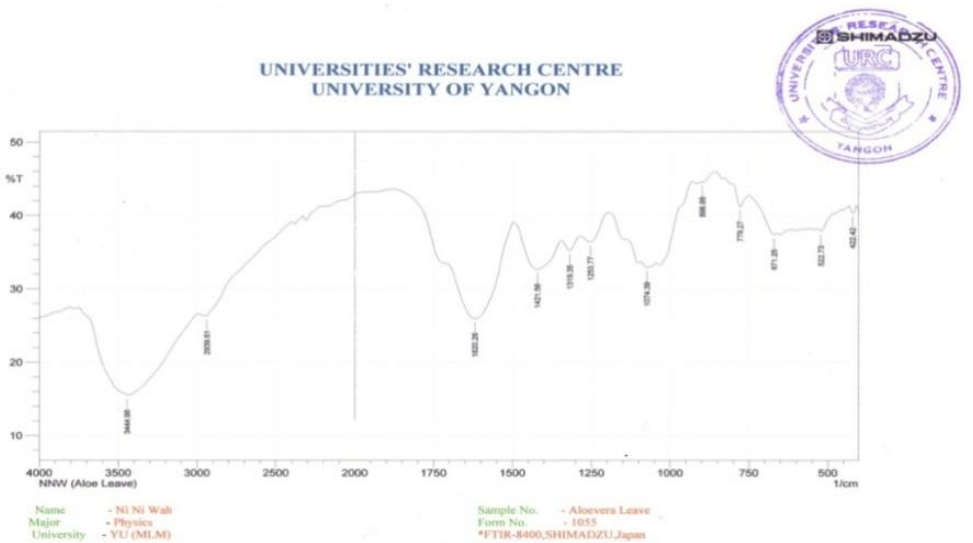

Figure 10: FTIR spectrum of *Aloe vera* leaves

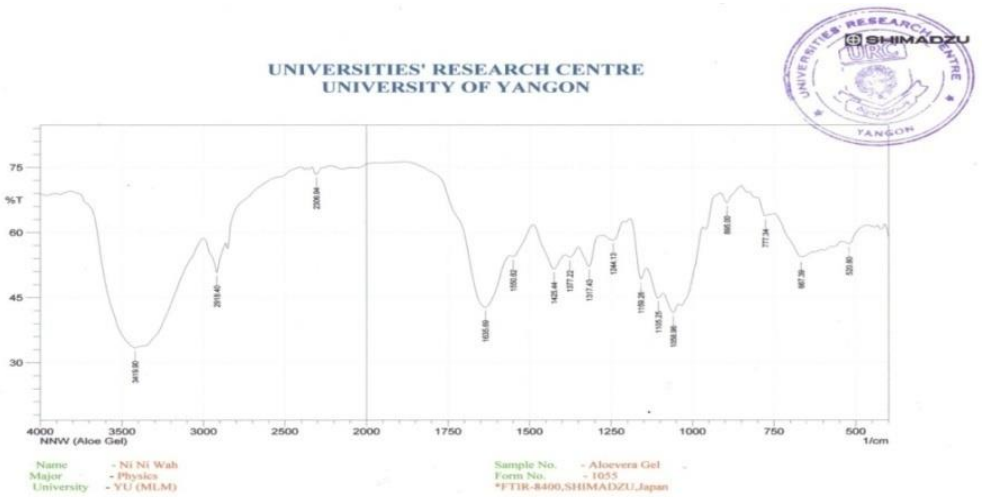

Figure 11: FTIR spectrum of *Aloe vera* gel

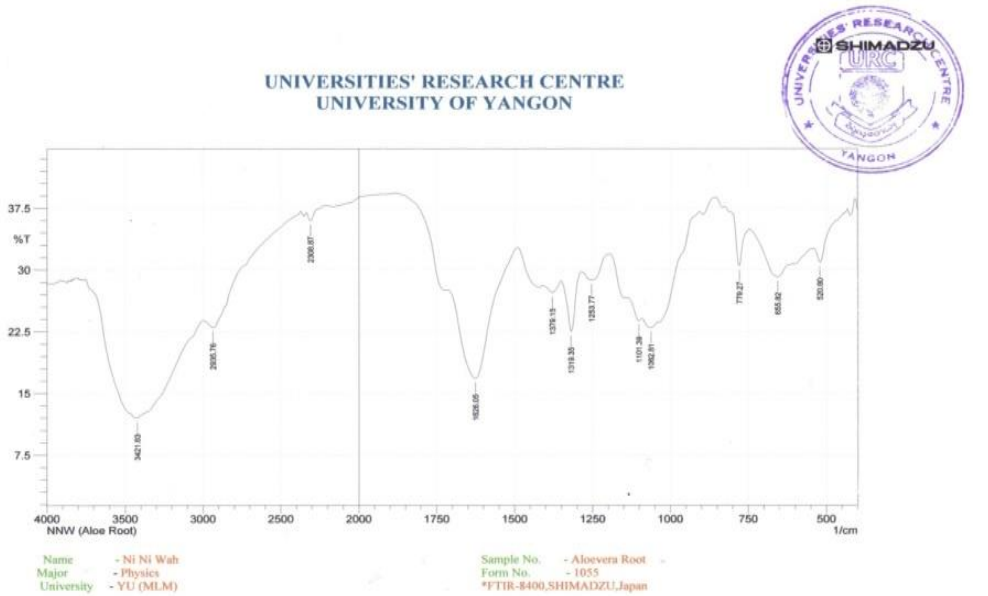

Figure 12: FTIR spectrum of *Aloe vera* root

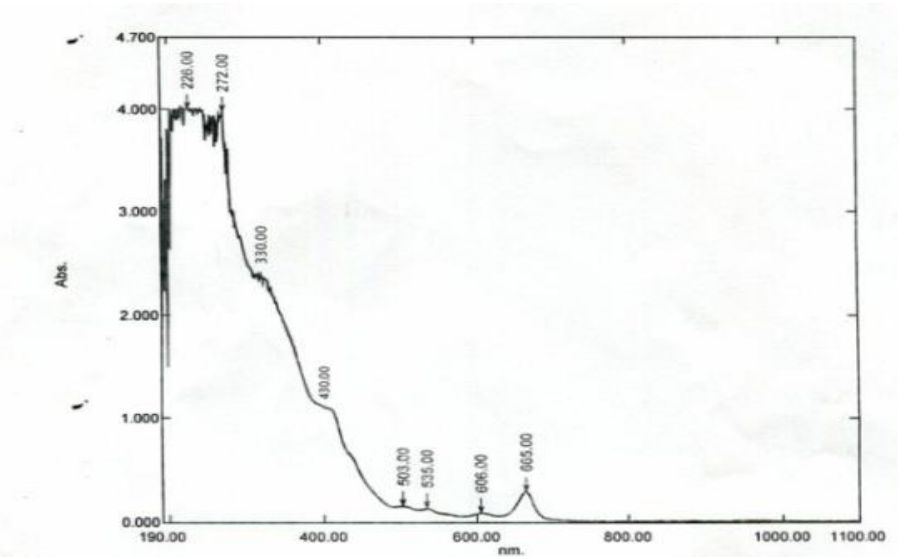

Figure 13: UV absorption spectrum of the *Aloe vera* leaves

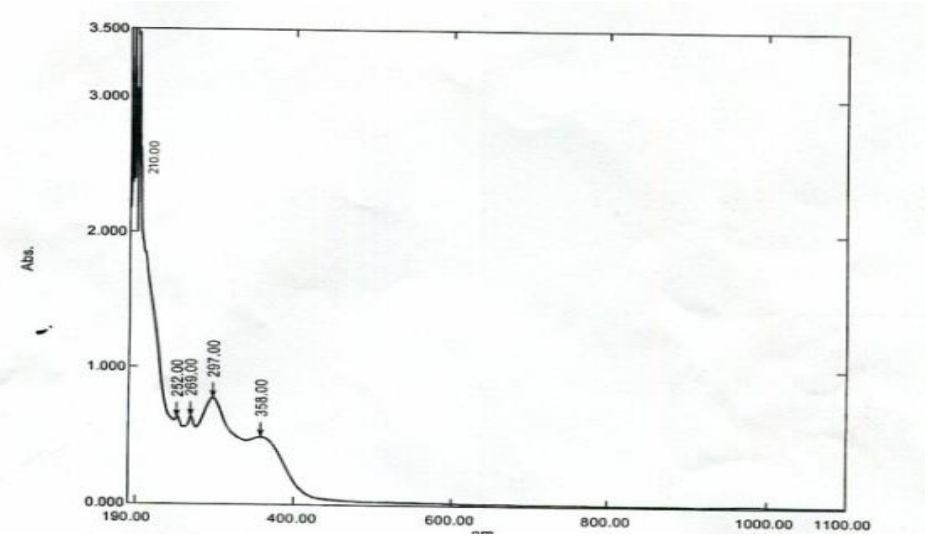

Figure 14: UV absorption spectrum of *Aloe vera*gel

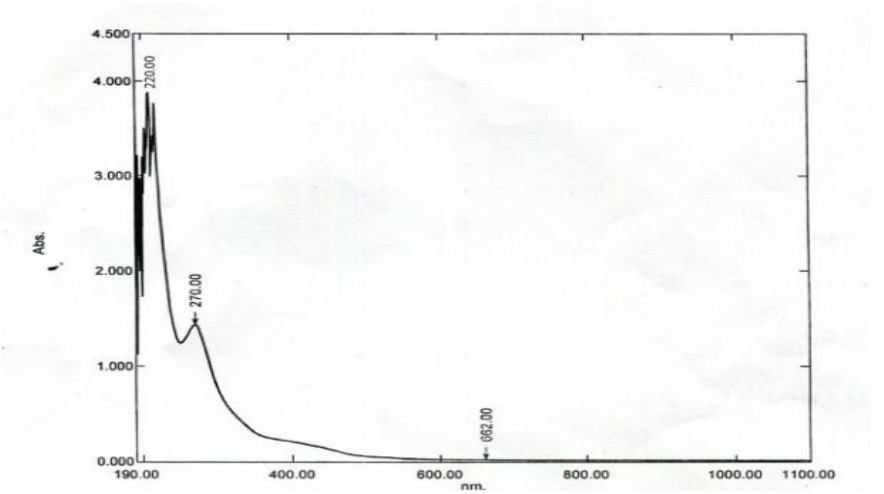

Figure 15: UV absorption spectrum of *Aloe vera* root

Table 2: UV spectral studies of *Aloe vera* samples

Sr No.	Chemical Status	Wavelength (nm)	leaf	gel	root
1	Aloin	272	Present	present	present
2	Phenolic compound	330	present	present	Absent
3	Carbonyl group	420	Absent	present	Absent
4	Amino group	220	Present	present	Present

Table 3: Water absorption capacity of *Aloe vera* film samples (swelling ratio)

Time (hours)	Sample 1(1:1)	Sample 2(1:2)	Sample 3(1:3)
0.5	278.95	305.26	368.42
1	368.42	373.68	405.26
1.5	431.58	447.37	505.26
2	531.58	557.80	573.68
2.5	500.00	547.37	563.16
3	494.74	536.84	552.63
3.5	489.74	536.84	552.63
4	487.74	536.84	552.63

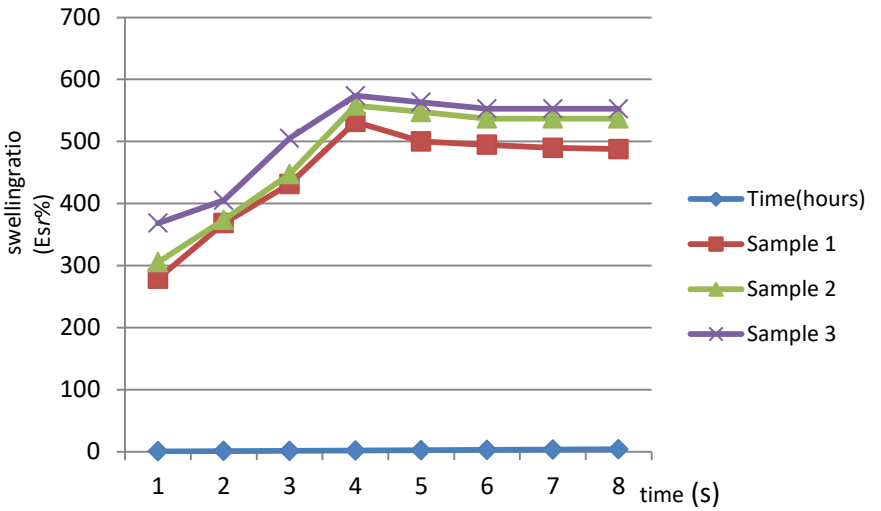

Figure 16: Water absorption capacity of *Aloe vera* film samples

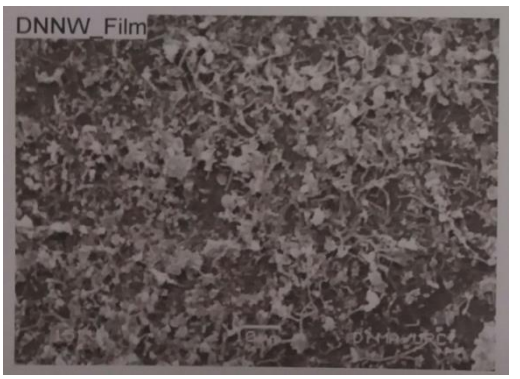

Figure 17: The SEM micrograph of the *Aloe vera* hydrogel (1:3)film

Conclusion

From the result showed the macro elements like Ca,K were found in maximum concentration and also found microelements like Fe, Mn, Cu, Zn in *Aloe vera* plant.The radiative elements to be Strontium contributed only a very few percentage (0.386% in leaves, 0.402% in root).The heavy and toxic metals which have not been detected in *Aloe vera* plant.From the FTIR and UV-vis analysis,it is found that all organic constituents of chemical statusis

present in *Aloe vera* gel. The water absorption properties of the films are depend on the *Aloe vera* content. That increase on the *Aloe vera* content significantly improved due to the high water absorption properties of the films. The EWC of the sample 3, PVA/AV(1:3) film is (85.2%) higher than that of other films sample 1 and sample 2 are 84.2% and 84.8% respectively. However, all of the films have been found good swelling characteristics by reaching t heir maximum water absorption capacity within the second hour. The surface structure of the hydrogel film image confirms micro- size agglomerates. This study indicated that the *Aloe vera* hydrogel films may be suitable for applications that help wound healing and heat absorption as well as radiation burns.

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