Phytochemical Analysis and Biological Activity of *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus*

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Abstract: The high percentage of water content in aerial parts of *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus* observed in leaf which can be affected the metabolic processes in plant. The percentage of total carbohydrates and total lipid of *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus* plants reached its maximum values in leaf decreasing gradually in flower to reach the lowest percentage in stem. Investigation of the free sugars showed that, galactose have maximum values in flower, galactose and glucose in leaf, glucose and galactose in stem in both plant respectively. The highest amount of total nitrogen and protein content was recorded in winter. The percentage of total nitrogen of *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus* plants reached its maximum values in flower decreasing gradually in leaf to reach the lowest percentage stem; amino acid analyzer showed that, plants contains 15 free amino acids, respectively. Successive extraction showed that, methanol extracts have maximum values in flower, water extract have maximum values in leaf and stem respectively. Antimicrobial studies by used 6 bacterial strain and 5 fungal strains showed that, *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus* plants can be used as antimicrobial agents, no Anti-virulence activity in both plant under investigation.

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1. Introduction

Phytochemical constituents are the basic source for the establishment of several pharmaceutical industries. The chemical constituents present in the plant play a significant role in the identification of crude drugs (Akindele & Adeyemi, 2007).

Medicinal plants play a major role in the treatment of human diseases and have various effects on living systems. *Convolvulus* is a genus of about 250 species of flowering plants of family Convolvulaceae, (Boulos, 2009), Kampferol and Scopoletin were isolated from the leaves of Convolvulus pluricaulis by (Agarwa *et al.,* 2014), Two aglycones flavonoid compounds were isolated from Convolvulus fatmensis Ktz. using column and preparative paper chromatography and identified by using 1HNMR, 13CNMR and UV shift reagent, these compounds were kaempferol and quercetin. Four coumarin compounds were also isolated from Convolvulus fatmensis Ktz. and identified as umbelliferone, scopoletin, asculetin and scopoline for the first time by (Atta *et al.,* 2007).

So it is of interest to choose *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus* as herbal plants belong to this family. *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus* are a perennial shrub growing in north coast habitats. The aim of the study was evaluated some metabolomic parameters also biologically evaluation activity of the methanol extracts (70%) of both plant under investigation.

Current empirical models. It should consider more complete complexities process of composting and supply interactive relationship of temperature, oxygen, FAS, moisture and microbial biomass growth to instruct the design of composting system and determine the optimal operation conditions for the process.

The primary objective of this study is to develop an integrated simulation model, which can be used for engineering analysis and design. The dynamic kinetics of the whole composting processes and all key factors, which limit the kinetics, will be considered. The model describes substrate degradation, microbial growth, moisture change, oxygen concentration and aeration on-off situation as a function of substrate and oxygen concentration in the exhaust air, compost temperature and moisture content. Realistic economic aeration will be included to evaluate and optimize a rotation vessel composting process with the numerical simulation results. At the same time optimal composting conditions will be identified.

2. Materials and Methods

2.1. Plant Materials

The fresh flower, leaf, stem and 70% methanol extracts of aerial parts of *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus* were collected from north coast habitats during the period of investigation in March 2013.

2.2. Methods

2.2.1. Eco-physiological study including determination of the percentage of plant water content of *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus* (Rowell, 1994). Determination of certain pharmacopoeial constants of plant material, including inorganic (ash) and organic matter (Brower and Zar, 1984), acid-soluble and acid-insoluble ash, water-soluble and water- insoluble ash (Askar and Treptow, 1993) and crude fibers (British pharmacopoeia, 1980).

2.2.2. Investigation of metabolic products including determination of total carbohydrates, soluble and insoluble carbohydrates (Chaplin & Kennedy, 1994), Free and combined sugars were investigated using HPLC for determination free and combined sugars.

2.2.3. Total nitrogen and protein content determined by using Kjeldahl method (James, 1995).

2.2.4. Free amino acids and protein-amino acids were accomplished according to Pellet and Young (1980) using Amino Acid Analyzer (Beakman system 7300 High Performance analyzer).

2.2.5. Total lipids content according to British Pharmacopoeia (1993). Phytochemical study including preliminary phytochemical screening, including steam distillation of volatile oils (Balbaa *et al.,* 1981), Test for Alkaloids (Woo *et al.,* 1977), Test for Glycosides and Test for Cardiac Glycosides (Treare & Evan, 1985), Test for Saponins (Kokate *et al.,* 2001) & (Kokate, 1994), Test for phenols (Ahmad *et al.,* 2005), Test for Phytosterols (Brieskorn & Klinger-Hand Polonius, 1961) & (Fieser and Fieser, 1959), Test for Tannins (Treare & Evan 1985), Test for Flavonoids (Khandeal, 2008).

2.2.6. Antimicrobial activity was carried out using the paper disc technique (Duguid *et al.,* 1978), anti-tumor Activity according to Skehen and Storage, (1990) and anti-virulence activity by used Hemolysis Assay according to Larzabal *et al.* (2010).

2.2.7. Quantitative method for anti-virulence activity (Hemolysis Assay): Hemolysis analysis was modified from the previous method .The lysis efficacy of human red blood cells was measured with whole cultures of staphylococcus isolates grows. In brief, staphylococcus cells were diluted at 1:100 with an overnight culture in TSB and cultured at 37^{O}C for 16 h with shaking at 250 rpm. The cell cultures (100µL including cells and culture supernatant) were added into diluted human red blood cells that had previously been separated by centrifugation at 900g for 5 min, washed with PBS buffer three times and diluted at 3% of red blood cells in PBS buffer. For hemolytic activity, the mixture was incubated at 37^{O}C for 1h with 250 rpm shaking. The supernatant was collected by centrifugation at 16,600g for 10 min, and the optical density was measured at 543 nm (Larzabal *et al.,* 2010).

3. Results and Discussion

Metabolomics parameters of *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus* flower, leaf and stem contents are summarized in tables (1-4). Results indicated that, the percentage of water content, organic matter, total and insoluble carbohydrates and total lipid reached maximum values in leaf and minimum values in stem due to water supplement in winter, which lead to normal plant growth also; this may be due to the increase in carbohydrate concentration which is converted to lipids by oxidation reaction. This result is in agreement with Meyer and Anderson (1952). Total nitrogen, total protein and total lipid reached maximum values in winter and minimum values in summer for both plant under investigation and this maybe the ability of leaf to storage water to completed metabolic process. The percentage of inorganic matter (ash), acid soluble ash, acid insoluble ash, water soluble ash, water insoluble ash and crude fibers reached maximum values in stem and minimum values in leaf for both plant under investigation. This may be due to the increase of total ion accumulation as a result of increasing soil moisture stress and soil salinity, which agreed with the results obtained by Larcher 1995 & Alli Smith (2009). Meanwhile, the percentage of soluble carbohydrates, total nitrogen and total protein reached maximum values in flower and minimum values in leaf for both of *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus.*

The highest amount of total nitrogen and protein content was recorded in winter which may be due to the increase in metabolic rate of the studied plant as a result of high water resources of the soil during winter than during that of dry period in summer season which is in agreement with Stocker's (1960) who reported that, the metabolic rate increased in the presence of high water resources, total N_2 and protein contents of decreased during the ripping month (summer) may be attributed to the decrease in the water content, which was found to be linked with an accumulation of some amino acids (e.g. proline), this may play an important role in increasing

cell osmoregulation (Ali *et al.,* 1992). In the present study (Table 2) the percentage of Free and Combined Sugars showed that; that rhamnose, arabinose, sucrose and raffinose were undetected in flower, leaf and stem respectively, and the concentration of galactose was the highest one of the separated free sugars in flower and stem respectively., also the concentration of glucose was the highest one of the separated combined sugars in leaf. on the another hand the concentration of ribose, galactose, glucose was the highest one of the separated combined sugars in flower, leaf and stem respectively., also the concentration of fructose, ribose and glucose was the lower values one of the separated free sugars in flower, leaf and stem respectively., also the concentration of glucose, ribose and galactose was the lower values one of the separated combined sugars in flower, leaf and stem respectively, Investigation of free sugars showed that, the observed a considerable increase in glucose (reducing sugars) as well as sucrose (non-reducing sugar) with water stress. Also, some conversion of glucose to sucrose may have occurred during overnight rehydration in prestressed leaves.

Table 1. Metabolomics parameter of *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus* aerial parts

Item (%)	*Convolvulus althaeoides*			*Convolvulus stachydifolius* var. *villosus*		
	Flower	Leaf	Stem	Flower	Leaf	Stem
Water content	56.26±0.76	61.03±0.3	50.9 ±0.35	62.82±0.41	67.7±0.46	58.7±0.3
Total ash	15.2±0.29	12.46±0.2	17.2±0.37	11.4±0.17	9.7± 0.26	13.7±0.3
Organic matter	84.78±0.29	87.5±0.27	82.7±0.37	88.5±0.17	90.2±0.26	86.2±0.3
Acid soluble ash	10.3±0.17	8.8± 0.19	10.8±0.23	7.76±0.12	6.8± 0.18	8.6±0.19
Acid insoluble ash	4.8± 0.09	3.6± 0.07	6.3±0.13	3.6±0.05	2.8± 0.07	5.09±0.11
Water soluble ash	10.9±0.12	9.3± 0.2	11.4±0.24	8.2±0.12	7.2± 0.19	9±0.2
Water insoluble ash	4.2± 0.08	3.11±0.06	5.8±0.12	3.19±0.04	2.4± 0.06	4.6± 0.1
Crude fibers	18.31±0.05	15.8±0.08	20.5±0.1	15.3±0.07	12.6±0.19	18.4±0.2
Total carbohydrate	24.6±0.18	27.2±0.22	19.3±0.24	27.3±0.22	30.5±0.23	22.4±0.19
Soluble carbohydrate	11.1±0.08	10.8±0.08	8.3±0.1	12.3±0.1	12.2±0.09	9.6±0.08
Insoluble carbohydrates	13.6±0.09	16.6±0.13	11.04±0.13	15±0.12	18.3±0.13	12.7±0.1
Total nitrogen	2.6±0.15	2±0.03	1.3±0.66	1.9±0.06	1.7±0.03	1±0.04
Total protein	16.3±0.96	12.6±0.24	9.5±0.85	12±0.4	10.6±0.22	6.77±0.25
Total lipids	1.6±0.04	2.2±0.02	1.2±0.01	2±0.03	2.4±0.04	1.5±0.05

Table 2. Free and combined sugars of *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus* aerial parts

Sugar name	RT	*Convolvulus althaeoides*						*Convolvulus stachydifolius* var. *villosus*					
		Flower		Leaf		Stem		Flower		Leaf		Stem	
		F	C	F	C	F	C	F	C	F	C	F	C
Rhamnose	2.35	12.3	10.5	13.5	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Arabinose	2.65	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Undetected	2.70	3.4	2.5	1.7	1.9	-ve	1.7	10.5	1	-ve	11.7	-ve	-ve
Ribose	2.75	1.6	0.2	-ve	14.1	-ve	0.8	11.2	12.9	12.7	11.6	-ve	1.5
Fructose	3.4	1.2	4.5	0.8	-ve	2.1	1.8	7.2	11	15.2	12.1	10.9	12.6
Glucose	3.65	12.5	13.7	-ve	14.5	19.2	13.4	1.2	1.5	19.9	12.3	10.4	15.2
Galactose	3.7	15.1	10.7	19.7	23.2	-ve	15.8	19.7	-ve	13.1	12.5	14.3	9.1
Undetected	4.4	13.7	12.8	-ve	-ve	-ve	-ve	13.7	12.5	-ve	12.1	10.8	13.5
Undetected	5.3	14.6	13.4	19.2	18.7	-ve	-ve	11.4	-ve	15.8	-ve	-ve	-ve
Sucrose	6.9	12.8	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Raffinose	10.3	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve

3.1. Free amino acids of *Convolvulus althaeoid*

The separation of free amino acids of the different parts (flower, leaf, and stem) of the *Convolvulus althaeoides* was achieved using amino acid analyzer, and each component. The obtained results were calculated and tabulated in table (3) and Fig. (1), where fifteen free amino acids were presented in flower, leaf and stem. It was obvious that glutamic was the highest amino acid of the separated free amino acids at flower and stem; proline was the highest amino acid of the separated free amino acids at leaf. On the another hand Isoleucine was the lowers amino acid concentration of the separated free amino acids at flower, leaf and stem respectively.

Table 3. free amino acids of *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus* aerial parts

Name of amino acids	*Convolvulus althaeoides*			*Convolvulus stachydifolius* var. *villosus*		
	Flower	Leaf	Stem	Flower	Leaf	Stem
Aspartic	1.268	0.315	0.085	1.458	0.649	0.046
Theronine	0.417	0.147	0.035	0.910	0.654	0.034
Serine	0.401	0.185	0.120	0.682	0.421	0.097
Glutamic	1.335	0.209	0.606	1.844	0.504	0.710
Proline	0.809	0.354	0.391	1.202	0.819	0.488
Glycine	0.369	0.139	0.280	0.669	0.417	0.313
Alanine	0.569	0.165	0.506	0.848	0.324	0.454
Valine	0.468	0.211	0.270	0.788	0.402	0.091
Isoleucine	0.022	0.016	0.015	0.084	0.059	1.0021
Leucine	0.351	0.120	0.209	0.573	0.110	0.425
Tyrosine	0.606	0.212	0.312	0.712	0.386	0.517
Phenyl alanine	0.184	0.046	0.129	0.533	0.194	0.316
Histidine	0.317	0.164	0.140	0.883	0.248	0.211
Lysine	0.123	0.053	0.052	0.310	0.098	0.083
Arginine	0.334	0.109	0.21	0.568	0.106	0.118

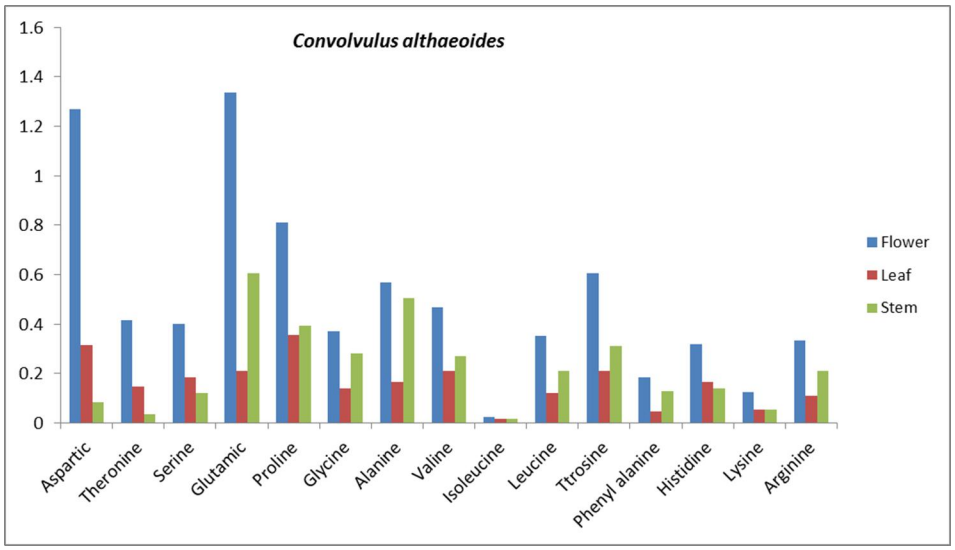

Figure 1. Free amino acids (mg/gm) in aerial parts of *Convolvulus althaeoides* and during March 2013

3.2. Free amino acids of *Convolvulus stachydifolius* var. *villosus*

The separation of free amino acids of the different parts (flower, leaf, and stem) of the *Convolvulus stachydifolius* var. *villosus* was achieved using amino acid analyzer, and each component. The obtained results were calculated and tabulated in table (3) and Fig. (2), where fifteen free amino acids were presented in flower, leaf and stem. It was obvious, that Glutamic was the highest amino acid of the separated free amino acids at flower and stem; proline was the highest amino acid of the separated free amino acids at leaf. On the another hand lysine was the lowers amino acid concentration of the separated free amino acids at flower, leaf and stem

respectively. Nikolopoulos & Manetas (1991) reported that, amino acids could play a role as osmotic regulators and as protective agents for cytoplasmic enzymes. Serrano & Gaxiola (1994) recorded that, proline accumulation plays a role as nitrogen reserve, to protect protoplasm from dryness and to play an important role in osmoregulation imbalance as a buffer against osmotic imbalance caused by salinity and drought stresses. In plants, proline is accumulated under environmental stresses. Proline accumulation is a common metabolic response of higher plants to water deficits, and salinity stress (Delauney & Verma, 1993). The responses of plants to environmental stresses were varied and generally involve some alternation in protein synthesis. Quantitative and qualitative changes in the synthesis of protein have been reported to occur in plants in response to water deficit (Artlip & Wisniewski, 2002).

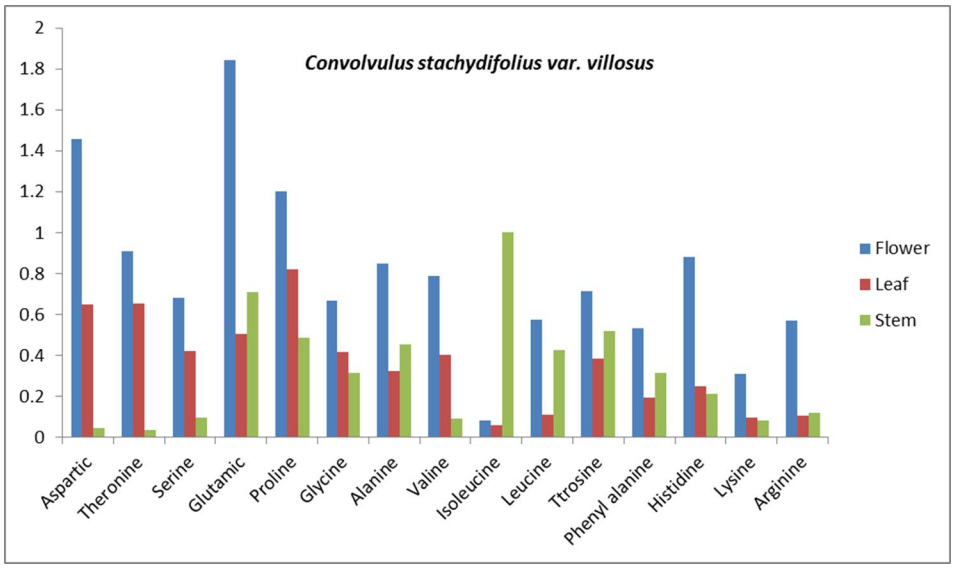

Figure 2. Free amino acids (mg/gm) in aerial parts of *Convolvulus stachydifolius* var. *villosus* during March 2013

The physiological significance of proline accumulation may be due to its role in osmoregulation, provision of both carbon and nitrogen for post–stress relief or to the removal of ammonia (Sharma and Dietz, 2006), Proline amino acid also stands out as an osmotic regulator, and is linked to stress both by water deficit and salinity .Moreover, proline accumulation is important for cell growth (Molinari *et al.,* 2004 and Zhu *et al.,* 2005).

In addition, *Okuma et al.* (2000) found that, proline improved the growth of salt stressed to cell cultures and the improvement was attributed to the role of proline as an osmoprotectant for enzymes and membranes against salt inhibition rather than as a compatible.

3.3. Phytochemical screening of different extracts of *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus* plants

Table (4) showed that preliminary phytochemical screening of different extracts of *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus* plants of different parts (flower, leaf and stem) to investigate alkaloids, glycosides, cardiac glycosides, saponins, phenol, sterol, tannins, flavonoids, amino acid and volatile oil present in two species under investigation. Table 4 showed that volatile oil absent in all plant parts also cardiac glycoside absent in *Convolvulus althaeoides* leaf and *Convolvulus stachydifolius* var. *villosus* stem, sterol was absent in *Convolvulus althaeoides* stem.

Tables (5 & 6) show antimicrobial activity of *Convolvulus althaeoides*, smallest amount of antimicrobial compounds necessary to inhibit growth of the tested organisms. MIC of total aerial part of *Convolvulus althaeoides* extract of the tested medicinal plant was studied against bacterial strains (*S. aureus, Bacillus subtilis, Enterococcus faecalis, K. pneumonia, Escherichia coli* and *Pseudomonas aeruginosa*) and fungail strains (*F. oxysporum, R. solani, A. niger, A. flavus and C. albican*). The results in bacterial strains showed that *Enterococcus faecalis* and *Escherichia coli* were the most sensitive test organisms with MIC concentration 6.25 mg/ml with inhibition zone 6.5 and 7.3 mm respectively, on another hand the results in fungal strains shoed that *C. albican* was the most sensitive test organisms with MIC concentration 12.5 mg/ml with inhibition zone 32 mm.

Table 4. the preliminary phytochemical screening in aerial parts *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus* during March 2013

Group	Test	*Convolvulus althaeoides*			*Convolvulus stachydifolius* var. *villosus*		
		Flower	Leaf	Stem	Flower	Leaf	Stem
Alkaloids	Wagner,s test	+ve	+ve	-ve	+ve	+ve	+ve
	Dragndorrf test	+ve	+ve	-ve	+ve	+ve	+ve
Glycosides	Glycosides test	+ve	+ve	+ve	+ve	+ve	+ve
	Modified borntrager,s test	+ve	+ve	+ve	+ve	+ve	+ve
Cardiac glycosides	Legal,s test	+ve	-ve	-ve	+ve	+ve	-ve
Saponins	Foam test	+ve	+ve	+ve	+ve	+ve	+ve
	Blood hemolysis test	+ve	+ve	+ve	+ve	+ve	+ve
Phenol	Ferric chloride test	+ve	+ve	+ve	+ve	+ve	+ve
Sterol	Salkawskis test	+ve	+ve	-ve	+ve	+ve	-ve
	Libermann burchard,s test	+ve	+ve	-ve	+ve	+ve	-ve
Tannins	Lead acetate test	+ve	+ve	+ve	+ve	+ve	+ve
	Gelatin test	+ve	+ve	+ve	+ve	+ve	+ve
Flavonoids	Shinoda,s test	+ve	+ve	+ve	+ve	+ve	+ve
	NaOH test	+ve	+ve	+ve	+ve	+ve	+ve
Amino acid	Xanthoproteic test	+ve	+ve	+ve	+ve	+ve	+ve
Volatile oil	Stem distillation	-ve	-ve	-ve	-ve	-ve	-ve

Table 5. Antibacterial activit+ve with *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus*. during March 2013

Plants	Concentration Per mg/ml	*Staphylococcus aureus*	*Bacillus subtilis*	*Enterococcus faecalis*	*Klebsiella pneumonia*	*Escherichia coli*	*Pseudomonas aeruginosa*
Convolvulus althaeoides	50	20	23	30	27	31	26
	25	09	12	16	13	19	12
	12.5	00	7.2	11	6.3	10.8	6.3
	6.25	00	00	6.5	00	7.3	00
	3.125	00	00	00	00	00	00
	MIC	25	12.5	6.25	12.5	6.25	12.25
Convolvulus stachydifolius var. *villosus*.	50	22	22	32	33	35	31
	25	14	9.3	24	26	22	25
	12.5	9.4	00	17	19	16	19
	6.25	00	00	9.1	9.7	11	10
	3.125	00	00	00	00	7.2	6.7
	1.563	00	00	00	00	00	00
	MIC	12.5	25	6.25	6.25	3.123	3.123

From the above results of antimicrobial effect showed that Escherichia *coli, C. albican* were the most sensitive test organism with (31 and 32) mm inhibition zone respectively. In addition, gram negative bacteria more sensitive than gram positive bacteria, tables (5 & 6) show that antimicrobial activity of *Convolvulus stachydifolius* var. *villosus,* smallest amount of antimicrobial compounds necessary to inhibit growth of the tested organisms. MIC of total aerial part of *Convolvulus stachydifolius* var. *villosus* extract of the tested medicinal plant was studied against bacterial strains (*S. aureus, Bacillus subtilis, Enterococcus faecalis,* K. *pneumonia, Escherichia coli* and *Pseudomonas aeruginosa*) and fungal strains (*F.*

oxysporum, R. solani, A. niger, A. flavus and C. albican). The results in bacterial strains showed that, the most sensitive test organisms with MIC concentration 3.123 mg/ml with inhibition zone 7.2 and 6.7 mm respectively, on another hand the results in fungal strains shoed that *F. oxysporum and C. albican* were the most sensitive test organisms with MIC concentration 12.5 mg/ml with inhibition zone 31 and 38 mm respectively.

From the above results of antimicrobial effect showed that Escherichia *coli* and *C. albican* was the most sensitive test organism with (35 and 38) mm inhibition zone. In addition, gram negative bacteria more sensitive than gram positive bacteria.

Figure (3) showed that "inhibitory activity against hepatocellular carcinoma cells was detect under these experiment condition with IC $_{50}$ = 2.2µg & 39.3 µg" in *Convolvulus althaeoides* and *Convolvulus stachydifolius* var. *villosus* total aerial parts and according to that we can used *Convolvulus stachydifolius* var. *villosus* total aerial part as antitumor agent.

Tables (7 & 8) showed that blood hemolysis increased and this result due to the presence of saponines and according to that we can see "No Anti-virulence activity of both plants under investigation".

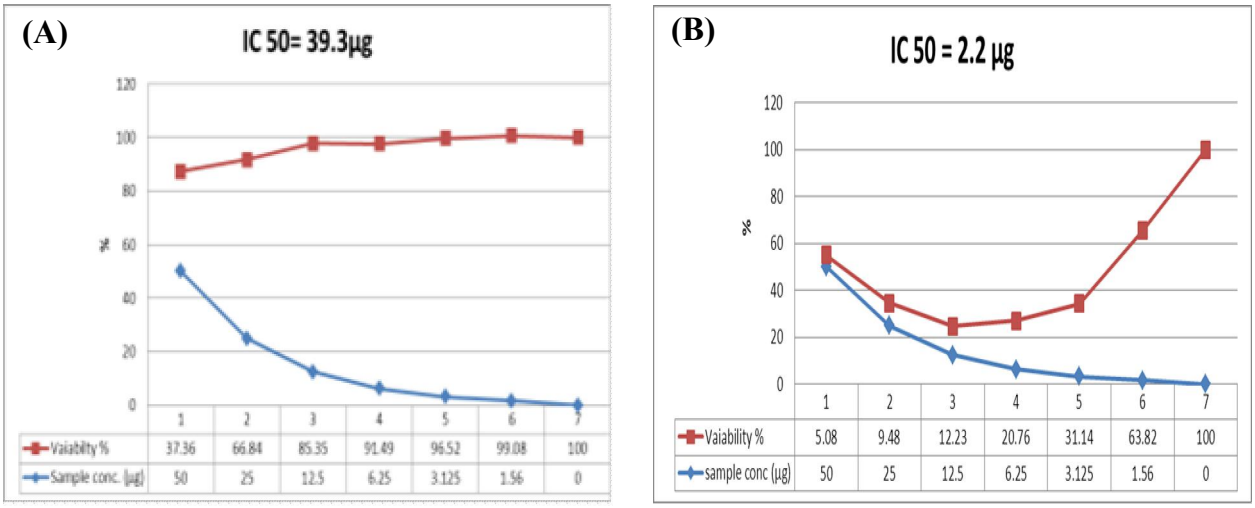

Figure 3. (A) Evaluation of cytotoxicity against HepG-2 cell line of *Convolvulus althaeoides* total aerial part. (B) Evaluation of cytotoxicity against HepG-2 cell line of *Convolvulus stachydifolius* var. *villosus* total aerial part.

Table 6. Anti-fungal activity *with Convolvulus althaeoides and Convolvulus stachydifolius* var. *villosus*. during March 2013

Plant name	Concentration Per mg/ml	*F.oxysporum*	*R.solani*	*A. niger*	*A.flavus*	*c.albican*
Convolvulus althaeoides	100	17	18	15	10.5	32
	50	10	11	8.4	7.8	25
	25	07	8.8	00	00	19
	12.5	00	00	00	00	13
	6.26	00	00	00	00	00
	MIC	25	25	50	50	12.5
Convolvulus stachydifolius var. villosus.	100	30	17	17	14	38
	50	19	9.0	10	00	30
	25	12	00	07	00	21
	12.5	7.8	00	00	00	14
	6.26	00	00	00	00	00
	MIC	12.5	50	25	100	12.5

Table 7. Anti-hemolysis effect of methanol *Convolvulus althaeoides* extract

Concentrations	Strain code			
	S1		S2	
	Blood hemolysis	Growth 16 h	Blood hemolysis	Growth 16 h
	%	OD 600nm	%	OD 600nm
0	100	2.5	100	2.1
500 µg/ml	302	2.53	289	2.08
250 µg/ml	170	2.52	155	2.08
125 µg/ml	132	2.57	120	2.01
62.5 µg/ml	108	2.51	105	2.1

Table 8. Anti-hemolysis effect of methanol *Convolvulus stachydifolius* var. *villosus* extract

Concentrations	Strain code			
	S1		S2	
	Blood hemolysis	Growth	Blood hemolysis	Growth
	%	OD 600nm	%	OD 600nm
0	100	2.5	100	2.1
500 µg/ml	407	2.57	390	2.08
250 µg/ml	325	2.51	289	2.08
125 µg/ml	255	2.58	180	2.01
62.5 µg/ml	125	2.51	130	2.1

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