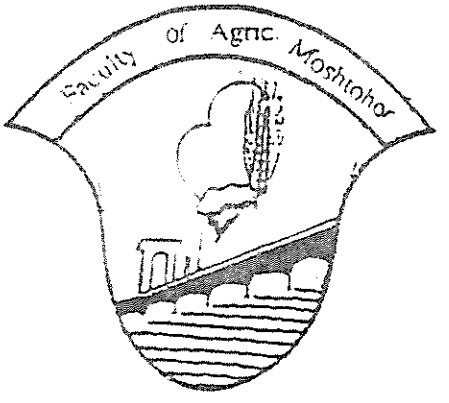
Annals Of Agricultural Science, Moshtohor

Faculty of Agriculture. Moshtohor ,Zagazig University (Banha - Branch)



VOL 32 Number 4 Dec. 1994

Annals of Agric. Sc., Moshtohor,
Vol. 32(4):2167-2177, 1994

STUDIES ON WATER-HYACINTH *(EICHHORNIA CRASSIPES)* GROWN IN EGYPT

By

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ABSTRACT

Samples of water-hyacinth were collected from the main stream of Nile river near the location of El-Kanater El-Khayria. Plant samples were taken at three intervals; March, August and December during growing seasons of 1992 and 1993. The harvested plants were divided into leaves, stems and roots and were subjected for general analysis of crude protein, ash, crude fat, fibres and nitrogen free extract.

Also, sugars and carbohydrates were determined in the different plant samples. Plant stems showed maximum reducing sugars content, whereas the highest concentration of non-reducing and total sugars were recorded in the leaves. The mineral analysis revealed that sodium, potassium magnesium and calcium were found in relatively higher level, iron, zinc and manganes were measure in moderate concentration, while copper, lead and cobalt were detected in plant tissues in minor amounts. The content of the determined minerals were depended mainly on the sampling date and the plant organ.

INTRODUCTION

Water-hyacinth ***(Eichhornia crassipes)*** is one of the most important Literature showed that the chemical composition of water-hyacinth varies considerably according to the location and season.

Salveson (1971) mentioned that constituents of dried water-hyacinth on dry weight basis were 10 % crude protein, 11 % ash and 79 % organic matter. Hathout *et al.* (1980) showed that the dry matter content of different plant organs of waterhyacinth being 6.87, 4.22 and 7.88 % for leaves, stems and roots, respectively.

Singh and singh (1982) found that the hay prepared from water-hyacinth contains 10.76 crude protein, 4.94 % fat, 17.9 % crude fibre, 44.3 % nitrogen free extract, 22.1 % ash, 1.42 % calcium and 0.58 % phosphorus.

Abou-Bakr *et al.* (1984) reported that water-hyacinth contains 49.6 % tein, 16 % total lipids, 26.9 % total carbohydrates 11.7 % fibre and 5.8 %

On the other side, Austin *et al.* (1985) and Jamil *et al.* (1985) showed water-hyacinth has the ability to absorb toxic heavy metals such as nium, zinc, copper and lead In turn, such plants could be used as a ogical indicators for environmental pollution as stated by Abdel-Halcem *et* 1992). Mineral analysis of water-hyacinth showed the following ranges: 63 - , 220 - 280 , 55 - 60 , 5 - 10 and 0 - < 5 ppm for Fe , Mn , Zn ,Cu and Pb , ctively as determined by Kaiser *et al.* (1983) and El-Falaky *et al.* (1988) .

There has been an emphasis on converting aquatic weeds into useful rces, for example as an animal feed, compost fertilizer or for energy uction (Welverton, 1975 and singh and singh 1982).

Several experiments were achived to study the possibilty of making use ter-hyacinth as animal feed stuff (Hegazi *et al.* 1985 and Mishra *et al.*

Similary, several attempts were conducted for utilization of water- th as a compost fertilizer (El-Kadi, 1978; Ahmed *et al.*, 1982 and Gamal and Badr El-Din, 1986).

The most economic value, however, of aquatic plants is its effectiveness iciency for removing elements (especially heavy metals) from the waste inated polluted water. Several reports showed that water-hyacinth has y to coliect up and remove heavy metals from the polluted water (Jamil *et* 5 ; Satyakala *et al.*, 1986 and Goel *et al.*, 1985).

The present work was conducted to through light on the chemical ition of water-hyacinth in Egypt

MATERIALS AND METHODS

Samples of water-hyacinth were collected from the main stream of Nile ar the location of El-Kanater El-Khayria. Plants were harvested at October and December, 1992 and 1993 to represent different stages of

Samples were washed and brough to the laboratory in polyethylene ch plant sample was subdivided

dried at 70°C for 24 hrs. The dried plant materials were kept for the other chemical analysis

Determination of ash :

Ashing was carried out in a muffle furnace by heating at 800°C for 24 hrs (A.O.A.C., 1985).

Determination of nitrogen and protein :

Total organic nitrogen and crude protein were determined by the usual Kjeldahl method (A.O.A.C., 1985).

Determination of crude fat :

Total lipids were extracted in a soxhlet apparatus using petroleum ether (60-80°C) for 8 hrs according to (A.O.A.C., 1985).

Determination of crude fibers :

Crude fibers were estimated by the subsequent boiling in sulphuric acid (200 ml, 1.25 % W/V) and sodium hydroxide (200 ml, 1.25 %) as described in (A.O.A.C., 1985).

Determination of the nitrogen free extract :

Nitrogen free extract was calculated by difference .

Determination of total carbohydrates and sugars content :

Total carbohydrates were hydrolyzed using 1 N sulphuric acid in sealed tubes at 100°C for 24 hrs. Total soluble sugars were extracted by 80% ethanol for 6 hrs. Total carbohydrates and sugars were determined using the method described by Dubois *et al.* (1956). Reducing sugars were determined in the ethanolic extract using the A.O.A.C. method (1985).

Determination of minerals content:

The dried samples were digested in Kjeldah flasks using a mixture of nitric-perchloric-sulphuric acid mixture (3 : 2 : 1 V/V/V). After complete digestion, the solution was cooled and transferred into a volumetric flash and made up to the volume with distilled water. Mn, Cu, Pb, Ca, Mg, Fe, Na, Co, K and Zn were determined in the sample solution using Unicam Sp 1900 Atomic Absorption.

RESULTS AND DISCUSSION

roteins showed higher values in samples collected during March or August ather than those harvested in December. That holds true for both the studied easons (1992 & 1993). On the other side both leaves or stems exhibited slight ncrease in their proteins content as compared with the roots. Ash content owed maximum concentration during March. The highest ash content was tected in leaves during both the successive seasons.

Naturally, fat was found in relatively law concentration of water-acinth plant organs. Samples collected during December showed the aximum fat content rather those collected during March or August for both the nsequent seasons. The leaves exhibited comparatively more fat content than at of stems or roots.

ber content showed the following trend during the two seasons of study:

March > December > August . However the plant organs exhibited the lowing order : roots > stems > leaves in relation to their fibres content.

Nitrogen free extract was the predominant fraction as compared with other determined component in water-hyacinth. However, its fluctuation ring the different sampling dates could be arranged as follows: December ugust >March.

Thus, it could be deduced that there was negative correlation between rogen free extract content and both crude protein and ash content. On the er side no detectable variation could be found between the different plant ans with concern to their nitrogen free extract content.

Previous investigators mentioned more or less values for the chemical lysis of water-hyacinth as compared with the data given herein. For instance, veson (1971) declared that water-hyacinth contain 10 % crude protein, 11 % and 79 % organic matter.

On the other side, Abou-Bakr *et al.* (1984) reported that water-hyacinth ained 49.6 % protain, 16 % total lipids, 26.9 % total carbohydrates, 11.7 % and 5.8 % ash, such variation is expected and should be atributed to the ronmental condition in which the plant grown in.

ugars and carbohydrates content :

Leaves, stems or roots of water-hyacinth showed considerable variations regard to their sugars and carbohydrates content. In this connection, stems ted maximum reducing sugars content. On the other side, leaves of water inth exhibited

Table (1) : Chemical composition of the dried water_ hyacinth (values are expressed as gm / 100 gm D.Wt).

Sampling dates	Season,1992				Season, 1993			
	March	August	December	Mean	March	August	December	Mean
1 Crude Protein								
Leaves	15 86	16 81	13 86	15 51	16 81	17 35	14 85	16 34
Stems	17 21	16 03	12 51	15 25	18 35	18 21	13 21	16 57
Roots	16 43	15 21	12 33	14 66	17 26	17 22	12 98	15 82
Mean	16 5	16 02	12 9		17 47	17 59	13 66	
2 - Ash								
Leaves	17 11	12 83	12 33	14 09	18 08	13 51	12 53	14 71
Stems	14 83	10 16	10 22	11 74	15 13	12 26	11 82	13 07
Roots	15 22	11 25	11 85	12 77	16 28	10 35	10 31	12 31
Mean	15 72	11 41	11 47		16 49	12 04	11 55	
3-Crude fat								
Leaves	2 85	4 36	5 96	4 36	3 08	5 11	5 92	4 70
Stems	1 89	3 25	3 98	3 04	2 11	4 21	4 36	3 56
Roots	2 08	3 93	3 11	3 04	2 43	3 85	4 08	3 45
Mean	2 27	3 85	4 32		2 54	4 39	4 79	
4- Fibres								
Leaves	21 15	18 87	18 35	19 46	19 11	17 65	19 16	18 64
Stems	25 30	19 36	22 45	22 37	23 56	18 34	21 35	21 08
Roots	24 86	20 21	23 16	22 74	25 11	19 85	22 38	22 45
Mean	23 77	19 48	21 32		22 59	18 61	20 96	
5- Nitrogen free extract								
Leaves	43 03	47 13	49 60	46 59	42 92	46 38	47 54	45 61
Stems	40 77	51 20	50 84	47 60	40 85	46 98	49 31	45 71
Roots	41 41	49 40	49 55	46 79	38 92	48 73	50 31	45 99
Mean	41 74	49 24	49 99		40 89	47 36	49 05	

Table (2) : Sugars and carbohydrates content of dried water_hyacinth (mg / g.d. wt)

Sampling dates	Season, 1992				Season, 1993			
	March	Augest	December	Mean	March	August	December	Mean
1-Reducing Sugars								
Leaves	12 35	11 15	15 16	12 89	14 31	13 61	16 15	14 69
Stems	22 31	22 35	13 31	19 32	20 51	22 08	14 16	18 92
Roots	10 15	12 61	14 56	12 44	14 61	15 55	12 15	14 10
Mean	14 94	15 37	14 34		16 48	17 08	14 15	
2-Non_reducing sugars								
Leaves	38 25	40 15	32 15	36 85	40 15	45 61	38 11	41 29
Stems	25 16	30 61	18 61	24 79	32 11	25 38	20 16	25 88
Roots	20 33	18 51	12 11	16 98	19 85	21 08	18 11	19 68
Mean	27 91	29 76	20 96		30 70	30 69	25 46	
Total sugars								
Leaves	50 6	51 30	47 31	49 74	54 46	59 22	54 26	55 98
Stems	47 47	52 96	31 92	44 12	52 62	47 46	34 32	44 80
Roots	30 48	31 12	26 67	29 42	34 46	36 63	30 26	33 78
Mean	42 85	45 13	35 30		47 18	47 77	39 61	
Total carbohydrates								
Leaves	283 51	335 11	311 92	310 18	295 53	345 08	308 40	316 34
Stems	298 70	336 81	275 60	303 70	308 2	356 15	297 45	320 60
Roots	247 08	324 15	265 31	278 85	267 11	311 7	286 51	289 11
Mean	276 43	332 02	284 28		290 28	337 64	298 12	

The same trend was noticed for total carbohydrate content regarding its distribution in the different organs of water-hyacinth, i.e leaves > stems > roots. That holds true for both the successive seasons.

On the other side, reading of sugars and carbohydrates content showed no fixed trend alongside the different sampling dates. In other wards some fluctuations were detected during the course of study. In most of cases, water-hyacinth samples harvested in August exerted maximum sugars and carbohydrates content rather than those collected in March and December.

3 - Minerals content :

Data presented in Table (3) demonstrate the elements content of the dried water-hyacinth during different sampling dates.

It could be easily noticed that sodium, potassium, magnesium and calcium are the predominant element. Iron, Zinc and manganese are occured in relatively moderate concentrations. On the other side, copper, lead and cobalt were detected in low levels in comparison with the above mentioned elements.

In both the studied seasons, sodium was found in high level in samples taken in March or August rather than those of December. While leaves of water-hyacinth showed maximum sodium content in season, 1992, however, roots exerted the highest sodium level in the second season (1993).

More or less similar pattern could be observed with regard to potassium and magnesium as they exhibited higher levels in the earlier sampling dates (March or August). However, the distribution of both potassium or mangnesium in the different organs was varied according to the sampling date and the growing season. Maximum potassium was detected in leaves of plants havrested in 1992, however, highest potassium level was shown in roots of plants collected in 1993.

Calcium showed maximum content in August, 1992 and March, 1993 respectively. Manganese, Zinc and ferric exhibited another trend in response to their fluctuation in water-hyacinth tissues during the different sampling dates. Sampling date of August gave the maximum levels for the last mentioned three element. However, comparatively less amounts were found in plants sampled in March or December of both the studied seasons.

No regular trend could be noticed in response to the distribution of these elements in the different plant organs.

Table (3): Minerals content of dried water_hyacinth as mg / 100 g d wt.

Sampling dates	Season, 1992				Season, 1993			
	March	August	December	Mean	March	August	December	Mean
1-Sodium								
Leaves	1325 2	1033 5	883 5	1080 7	1453 6	1225 5	936 8	1205 3
Stems	1158 6	1105 4	936 7	1066 9	1533 8	1186 3	1018 5	1246 2
Roots	1083 5	1125 6	745 5	984 9	1644 9	1221 5	1145 3	1337 2
Mean	1189 1	1088 2	855 2		1544 1	1211 1	1033 5	
2-Potassium								
Leaves	1125 5	1221 5	925 5	1090 8	1325 6	1535 5	1143 0	1334 7
Stems	1236 4	1155 6	843 4	1078 5	1435 5	1643 2	1256 5	1445 1
Roots	1145 5	1030 5	716 5	964 2	1611 4	1745 9	1125 3	1494 2
Mean	1135 8	1135 9	828 5		1457 5	1641 5	1174 9	
3-Copper								
Leaves	68 3	83 4	58 8	70 17	79 8	91 33	60 25	77 13
Stems	54 5	65 1	48 8	56 14	66 5	66 8	63 18	65 49
Roots	53 2	73 6	41 2	56 02	54 8	71 8	48 61	58 4
Mean	58 7	74 0	49 6		67 03	76 6	57 35	
4-Mgnesium								
Leaves	835 5	783 5	516 5	711 8	911 5	815 5	483 5	736 8
Stems	683 4	611 3	443 7	579 5	833 2	733 6	566 6	711 1
Roots	715 2	583 4	411 4	570 0	954 8	683 5	453 3	697 2
Mean	744 7	659 4	457 2		899 8	744 2	501 1	
5-Manganese								
Leaves	436 3	583 4	327 8	449 2	531 8	673 2	435 2	546 7
Stems	325 2	617 5	435 4	459 4	614 5	711 5	531 3	619 1
Roots	411 5	538 1	311 5	420 4	533 1	615 4	387 8	512 1
Mean	391 0	579 7	358 2		559 8	666 7	451 4	

Continue : Table (3): Minerals content of dried water_hyacinth as mg / 100 g d wt.

Sampling dates	Season, 1992				Season, 1993			
	March	August	December	Mean	March	August	December	Mean
6 Zinc								
Leaves	435 6	511 6	318 7	421 9	531 7	598 8	425 5	518 7
Stems	531 8	631 7	323 5	495 7	666 8	687 4	398 6	584 3
Roots	518 4	598 4	411 8	509 5	618 5	683 1	325 4	542 3
Mean	495 3	580 6	351 3		605 7	656 4	383 2	
7-Calcium								
Leaves	853 5	897 4	683 4	811 4	983 6	925 4	781 5	896 8
Stems	711 8	808 2	761 5	760 5	835 4	731 5	613 4	726 8
Roots	643 5	765 4	645 4	684 8	806 1	811 5	633 8	750 5
Mean	736 3	823 7	696 8		875 1	822 8	676 2	
8-Lead								
Leaves	2 3	18 6	7 8	9 58	4 5	21 3	9 4	11 73
Stems	4 2	19 2	5 1	9 51	5 3	25 6	7 5	12 8
Roots	3 5	8 6	4 3	5 48	4 7	22 8	9 5	12 33
Mean	3 3	15 5	5 7		4 8	23 2	8 8	
9-Ferric								
Leaves	416 5	561 3	337 8	438 5	533 4	665 5	216 5	471 8
Stems	325 4	611 5	215 5	384 1	466 8	638 4	245 3	450 2
Roots	319 5	525 1	208 6	351 1	401 0	559 4	200 6	387 0
Mean	353 8	565 9	253 9		467 1	621 1	220 8	
10-Cobalt								
Leaves	30 11	35 8	37 8	34 57	25 6	23 4	25 8	24 9
Stems	25 2	30 5	35 5	30 40	21 8	26 5	27 3	25 2
Roots	22 7	28 4	31 8		20 2	28 4	21 5	20 0
Mean	26 0	31 6	35 0		22 5	22 8	24 9	

December. Goel *et al.* (1985) reported that the accumulation of mineral in water-hyacinth depends on the initial concentration of nutrients in water, the period of growth and the plant part. Abdel Haleem, *et al.* (1992) reported that water-hyacinth plant is a good tool for water profile enrironmental monitoring and it could reflect the situation of the investigated water-profile.

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دراسات على نبات ورد النيل النامى فى مصر

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تم اخذ عينات نبات ورد النيل من المجرى الرئيسى لنهر النيل فى منطقة القناطر الخيرية حيث تتراكم بها سنويا كميات كبيرة من ورد النيل. وقد تم اخذ العينات فى اشهر مارس-أغسطس وديسمبر فى اعوام ١٩٩٢- ١٩٩٣ حيث تم فصل النباتات الى اوراق - ساق - جذر لاداء التحاليل الكيماوية الاساسية وهى البروتين - الرماد - الدهون - الالياف وبالطرح تم حساب نسبة المستخلص الحالى من النتروجين و الى ذلك تم تقدير السكريات والكربوهيدرات الكلية فى اجزاء النبات المختلفة حيث اظهرت الساق اعلى تراكم السكريات المختزلة فى حين كان اعلى تركيز للسكريات الغير مختزلة والكلية فى الاوراق وذلك خلال موسمى الدراسة.

ولقد اظهر تحليل العناصر وجود كل من الصوديوم - البوتاسيوم - الماغنسيوم والكالسيوم بتركيزات مرتفعة نسبيا فى حين كانت نسبة الحديد - الزنك - والمنجنيز متوسطة . اما العناصر الثقيلة مثل الكوبلت والرصاص فقد وجدت بتركيزات منخفضة ولقد اعتمد تركيز هذه العناصر بصفة عامة على موعد اخذ العينة والعضو النباتى .

حوليات العلوم الزراعية بمشتهر

كلية الزراعة بمشتهر — جامعة الزقازيق / فرع بنها

المجلد الثانى والثلاثون . العدد الرابع — ديسمبر ١٩٩٤