

## CHAPTER 11

### METALS AND HYPOGLYCEMIC HERBS

Among the selected samples, GS, EJ and MC are widely used as antidiabetic herbs. During this study concentration of different metals were first estimated in these species and then compared with other samples. According to the results GS and MC were found very rich in metals. In GS about 83 mg/g and in MC 79 mg/g total metal present in selected herbs were found, however in EJ, only about 28 mg/g of metal was present (Table 11.1).

GS was found to be very rich in iron, although little amount was water soluble. As small amount of iron is required biologically, its high amount can produce indigestion and absorption of effective moieties in the herbs may be decreased in the intestinal region. The concentration of this metal was found high in non antidiabetic species.

Regarding the glucose tolerance factor, chromium is considered to be an effective metal. Although required chromium is very low but comparatively higher amount was found in antidiabetic species. In GS, zinc was found average and amount of copper as compare to other species was in excess, but its major part was insoluble in water (Table 11.2). As it was observed that usually water extract of this herb is used for control of diabetes. It means that consumable amount of metals is not high. In this specie (GS), manganese was also found in very high concentration.

During its comparison with other two famous antidiabetic species (Jaman and karela), it is important to note that, latter are taken as food constituent (EJ and MC), while GS has only medicinal use and for that purpose its small amount (dose) required, that does not have large amount of metal. It is also to be noted that however GS has high metal contents, only 16% of total is water soluble (Table 11.3). The samples discussed above were also found free of toxic metals.

The species which were not antidiabetic drugs, were found to have average concentration of metal. However in many species, concentration of iron, manganese

and cadmium was found high. In the leave samples of herbs concentration of manganese was found high.

Among these non diabetic species, CI was found to be very rich in copper and chromium and therefore sometime it is suggested as hypoglycemic. While PI. and HR. contain high cadmium contents, therefore might create toxic effect. The herbs which are not very known herb as antidiabetic (SH, EC, HR, PL) are also found to have high amount of chromium contents but TF had very high concentration of lead. Again their water extract did not indicate the high metal concentration. AS was found to have very low amount of metal contents but most of the metals (40%) were found water soluble (Table 11.3).

To calculate the average molecular weight of each specie, weight of the total metals was divided with total number of moles of the metals which were already estimated by complexometry. As sodium and potassium did not get complexed with EDTA, so they were not included in the total weight of metals.

According to the results, average molecular weight of EJ, ACV, PG and TF was found to be nearly 30 whereas in other samples, it was low (Table 11.4).

Fenugreek showed very high average molecular weight which may be due to presence of high lead content. Average molecular weight between 30 and 40 in EJ, ACV and PG was found, which might be due to the presence of excess amount of calcium, magnesium and potassium. The other species which were showing low average molecular weight, it might be due to the presence of some other metals, which were not detected and therefore their weights were not included in the total weight of metals, whereas total millimoles may contain them, due to formation of complex with EDTA. These metals might be  $Al^{3+}$  or  $Co^{2+}$ . The metals which were rarely found in plants were not studied in this work. Bulk metals present in these samples have not shown any effective relationship with hypoglycemic nature of the herbs.

In vitro study of glucose has been observed that some very important results are considered. For example, the water extract of most of the herbs were found more effective than its acid extract (Fig 10.1). For GS it was found 5 times more effective.

While for EJ, effectiveness was increased to 50 times. In case of MC, both extracts were found equally effective.

Water extract of TF was found highly effective as compared to its acid extract (approximately 250 times). This might be due to the low concentration of metals present in water extract including Pb and Cd. Toxic metal e.g. excess amount of lead was observed in fenugreek, but very low in water extract. It has been concluded that this specie in form of seed (widely used for many purposes) may not be utilized directly but its water extract should be preferred. From the above discussion following points may be concluded.

- Metals are not so important in hypoglycemic nature of the herbs.
- The excess of some metals e.g. iron and manganese might produce a negative effect.
- Effective herbs might contain a balance metal concentration.
- Non effective herbs might have a high concentration of toxic metals. So unknown species might be avoided to use.
- Water extract might be effective due to the presence of low metal concentration.

**Table 11.1**

**Estimation of All Metals in Acid Digested Samples**

S.#	Fe mg/g	Cr mg/g	Zn mg/g	Cu mg/g	Mn mg/g	Na mg/g	K mg/g	Mg mg/g	Ca mg/g	Pb mg/g	Cd mg/g	Ni mg/g
ACV	0.8512	9.49E-03	0.0620	0.0102	0.0565	1.3750	6.5000	2.3075	9.7925	0.0060	0.0060	0.018
MC	0.3866	7.21E-03	0.0723	0.0172	0.0363	19.3750	52.5000	3.9875	3.0700	0.0035	0.0030	0.008
EJ	0.2518	5.90E-03	0.0278	0.0168	0.0095	3.1250	18.7500	0.3723	0.0838	0.0033	0.0025	0.000
GS	1.2258	2.20E-02	0.1070	0.0293	0.6123	6.6250	55.0000	9.0650	10.6400	0.0045	0.0033	0.003
AS	0.1469	6.16E-03	0.0573	0.0102	0.0178	0.4000	24.3750	1.3125	0.2950	0.0003	0.0015	0.000
TF	0.8272	2.40E-02	0.1108	0.0267	0.0280	7.2500	23.7500	2.5313	1.0600	0.0155	0.0002	0.002
PG	0.2518	1.30E-02	0.0968	0.0345	0.0425	4.8750	39.3750	2.3000	1.0700	0.0008	0.0003	0.011
SH	1.6874	1.34E-02	0.0680	0.0223	0.1010	7.5000	55.0000	4.1725	2.4825	0.0043	0.0008	0.007
CI	1.1929	1.19E-02	0.0690	0.0309	0.1520	21.2500	39.3750	4.6475	4.1250	0.0050	0.0010	0.008
EC	1.1569	4.49E-03	0.0485	0.0119	0.3070	0.6375	8.2500	0.3645	0.2108	0.0020	0.0035	0.006
PL	0.7013	6.41E-03	0.0703	0.0155	0.1275	4.5000	36.2500	4.4000	1.3375	0.0038	0.0066	0.005
IIR	0.5695	5.51E-03	0.0570	0.0107	0.0948	29.3750	17.5000	5.0375	2.0925	0.0063	0.0095	0.003

**Table 11.2**

Estimation of All Metals in Water Extract of Samples

S.#	Fe mg/g	Cr mg/g	Zn mg/g	Cu mg/g	Mn mg/g	Na mg/g	K mg/g	Mg mg/g	Ca mg/g	Pb mg/g	Cd mg/g	Ni mg/g
ACV	0.0268	2.54E-03	0.0062	0.0004	0.0095	0.4933	2.5158	0.1833	0.0730	0.0007	0.0012	0.0007
MC	0.0345	1.81E-03	0.0189	0.0027	0.0077	5.4186	20.6893	1.0719	0.1892	0.0005	0.0003	0.0005
IJ	0.24	7.25E-04	0.0045	0.0020	0.0030	1.2192	6.3400	0.5735	0.2907	0.0016	0.0019	0.0016
GS	0.5999	2.54E-03	0.0116	0.0031	0.0701	1.7964	11.4771	1.3832	0.5758	0.0005	0.0006	0.0005
AS	0.1442	1.81E-03	0.0171	0.0013	0.0085	0.2780	8.9360	0.4031	0.3882	0.0007	0.0006	0.0007
TF	0.0357	2.54E-03	0.0016	0.0011	0.0011	1.3056	4.4763	0.1533	1.8838	0.0008	0.0000	0.0008
PG	0.0345	5.43E-03	0.0148	0.0024	0.0106	1.6759	12.4338	0.6649	0.4563	0.0002	0.0000	0.0002
SH	0.1787	4.35E-03	0.0080	0.0035	0.0106	2.1834	15.2328	0.5910	1.1089	0.0005	0.0002	0.0005
CI	0.0523	5.25E-03	0.0058	0.0014	0.0270	6.7755	12.5830	1.3348	1.5351	0.0002	0.0002	0.0002
EC	0.06	1.27E-03	0.0105	0.0014	0.0474	0.4769	17.9823	1.8935	0.5285	0.0001	0.0001	0.0001
PL	0.2183	2.54E-03	0.0037	0.0010	0.0208	0.2454	8.8358	0.9248	1.5070	0.0004	0.0004	0.0004
IIR	0.1519	1.63E-03	0.0029	N/D	0.0085	3.7708	3.7708	0.8946	0.1131	0.0005	0.0005	0.0005

**TABLE 11.3****Percentage Solubility of the Metal In  
Water Found In Selected Herbs**

Sample ID	mg/g of Total Metals in Acid Digested	mg/g of Total Metals in Water Extract	Percentage Solubility
ACV	20.99	3.31	15.78
MC	79.47	27.44	34.53
EJ	22.65	8.68	38.32
GS	83.34	15.92	19.10
AS	26.62	10.18	38.24
TF	35.63	7.86	22.07
PG	48.07	15.30	31.83
SH	71.06	19.32	27.19
CI	70.87	22.32	31.50
EC	11.00	20.90	189.96
PL	47.42	11.76	24.80
HR	54.76	8.72	15.92

**TABLE 11.4**

**Calculated Average Molecular Weight of  
Metal in The Samples**

Sample ID	Total weight of metal excluding K+Na	mmoles per g of sample	Average mol wt
ACV	13.1196	0.355	36.9567
MC	7.5913	0.315	24.0994
EJ	0.7738	0.2175	3.5575
GS	21.7118	0.955	22.7348
AS	1.8478	0.1975	9.3560
TF	4.6256	0.17	27.2091
PG	3.8204	0.11	34.7309
SH	8.5592	0.3625	23.6117
CI	10.2423	0.4525	22.1455
EC	2.1158	1.215	1.7414
PL	6.6737	0.37	18.0369
HR	7.8860	0.695	11.3468