CHAPTER V.

RESULTS OF URANIUM ESTIMATION.

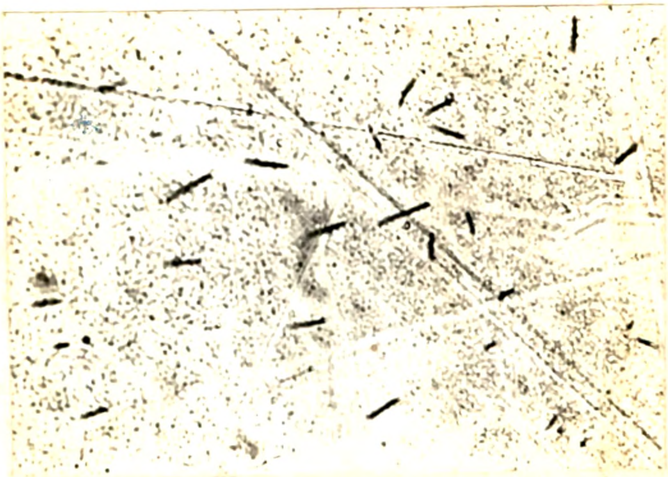
Uranium contents of seventy-three samples, prepared out of the twenty medicinal plants, mentioned in the previous Chapter, have been estimated. The results and discussions are presented in the following sections.

5.1. DISTRIBUTION OF TRACKS:

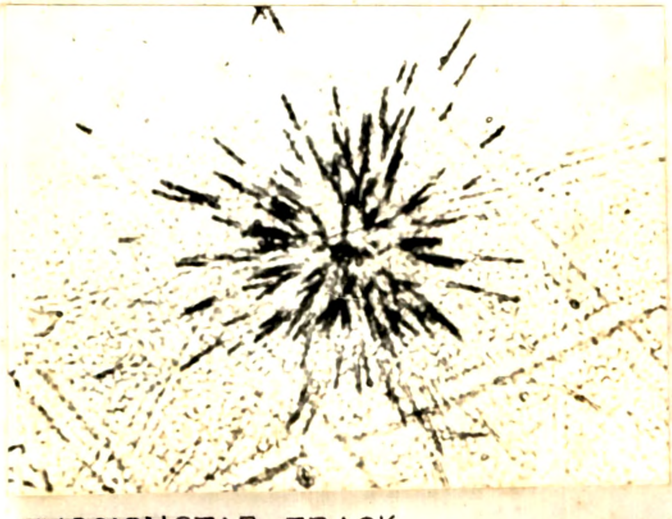
The fission tracks, revealed in the lexan pieces are similar to those presented in plate V. There are occasional clusters, but the overall track distribution is uniform.

5.2. EXPERIMENTAL DATA:

The results of uranium estimation are presented in table 5.1. In the first column of this table, the scientific names of the plants are given. Parts studied in each of these plants are shown in the second column. The corresponding values of the track densities, as observed, and uranium contents, as estimated, are presented in the third and fourth columns respectively. The errors shown are statistical errors of counting.



FISSION TRACK



FISSION STAR TRACK

TABLE 5.1

Uranium contents of various samples.

Sl. No.	Names of plants	Parts studied	Track density x $10^4/cm^2$	U-Concentration ppm.
1.	Acorus caleamus Linn	1. Leaves	2.901	0.566±0.011
		2. Root	4.419	0.847±0.016
2.	Adhatoda vasica Nees	1. Leaves	2.478	0.475±0.011
		2. Root	3.036	0.582±0.012
		3. Flower	2.301	0.441±0.008
3.	Alstonia scholaris R.Br.	1. Leaves	5.702	1.093±0.031
		2. Bark	4.570	0.876±0.020
		3. Root	8.723	1.672±0.040
		4. Latex	9.860	1.896±0.020
4.	Asparagus racemosus Willd.	1. Leaves	2.671	0.512±0.010
		2. Root	3.344	0.641±0.011
5.	Azadirachta indica A.Juss	1. Leaves	1.753	0.336±0.009
		2. Bark	3.156	0.605±0.010
		3. Root-bark	3.688	0.707±0.012
		4. Fruit	3.605	0.691±0.012
6.	Butea monosperma Lam.	1. Leaves	2.713	0.520±0.010
		2. Bark	2.901	0.556±0.011
		3. Root	2.880	0.552±0.010
		4. Flower	2.629	0.504±0.010
		5. Seed	2.243	0.430±0.010

Uranium content of standard glass used- (0.77±0.006)ppm.
$k = 1.028 \times 10^{11}$

(TABLE 5.1. Contd.)

Sl. No.	Names of plants	Parts studied	Track density x $10^4/cm^2$	U-concentration ppm.
7.	Caesalpinia crista Linn.	1. Leaves	3.777	0.724±0.017
		2. Bark	3.761	0.721±0.017
		3. Root	4.320	0.828±0.019
		4. Seed	2.671	0.512±0.013
8.	Calotropis gigantea R.Br.	1. Leaves	14.743	2.826±0.060
		2. Root	1.523	0.292±0.006
		3. Flowers	2.301	0.441±0.008
		4. Latex	10.434	2.006±0.040
9.	Datura metel Linn.	1. Plant	3.015	0.578±0.009
		2. Root	3.375	0.647±0.009
		3. Seed	7.257	1.391±0.031
10.	Euphorbia neriifolia Linn.	1. Leaves	1.325	0.254±0.008
		2. Stem	1.962	0.376±0.008
		3. Root	6.036	1.157±0.021
		4. Latex	8.832	1.698±0.038
11.	Mallotus Philippinensis Muell Arg.	1. Leaves	1.857	0.356±0.007
		2. Bark	1.696	0.325±0.006
		3. Root	2.635	0.505±0.008
		4. Fruit	5.713	1.095±0.020

(TABLE 5.1 Contd.)

Sl. No.	Names of plants	Parts studied	Track density x $10^4/cm^2$	U-concentration ppm.
12.	Moringa oleifera Lam.	1. Leaves	4.627	0.887±0.020
		2. Bark	5.437	1.025±0.023
		3. Root	5.170	0.991±0.023
		4. Flowers	4.038	0.774±0.017
		5. Fruits	5.546	1.063±0.025
13.	Pongamia glabra Vent.	1. Leaves	2.551	0.489±0.007
		2. Bark	1.205	0.231±0.005
		3. Root	2.582	0.495±0.008
14.	Ricinus Communis Linn.	1. Leaves	1.497	0.287±0.004
		2. Root	2.212	0.424±0.008
		3. Flowers	1.325	0.254±0.006
		4. Seed	4.549	0.872±0.011
15.	Saraca indica Linn.	1. Leaves	3.939	0.755±0.020
		2. Bark	3.908	0.749±0.018
		3. Root	4.476	0.858±0.016
16.	Tamarindus indica Linn.	1. Leaves	6.772	1.298±0.010
		2. Bark	2.332	0.447±0.010
		3. Root	1.174	0.225±0.015

(TABLE 5.1 Contd.)

Sl. No.	Names of plants	Parts studied	Track density x $10^4/cm^2$	U-concentration ppm
17.	Terminalia arjuna W & A.	1. Leaves	1.993	0.382±0.011
		2. Bark	2.629	0.504±0.012
		3. Root	3.396	0.651±0.012
18.	Thevetia neriifolia Juss.	1. Leaves	3.688	0.707±0.016
		2. Bark	1.054	0.202±0.005
		3. Root	2.645	0.507±0.008
		4. Kernel	8.608	1.650±0.037
		5. Flowers	1.962	0.376±0.007
		6. Latex	8.144	1.561±0.016
19.	Vitexnegundo Linn.	1. Leaves	3.219	0.617±0.013
		2. Bark	2.822	0.541±0.010
		3. Flower	2.102	0.403±0.009
		4. Root	5.817	1.115±0.018
20.	Vitis quadrangularis Wall.	1. Leaves	1.508	0.289±0.006
		2. Stem	2.348	0.450±0.009
		3. Root	1.821	0.349±0.007

The values in the table 5.1 show that the uranium contents of the samples vary from 0.202 ppm (in the barks of Thevetia neriifolia) to 2.826 ppm (in the leaves of Calotropis gigantea). In previous works by earlier observers,[1-9] the uranium contents are found to vary from 0.24 ppm. to 4.4 ppm for plants grown in average climatic conditions. But in accumulator plants and/or hydrophytes the ranges are quite high. Thus it appears that the uranium content values of the plants, studied here,are normal values.

5.3. GRAPHICAL REPRESENTATIONS OF THE DATA:

(a) In figures 5.1A & 5.1B the data in table 5.1 are represented by the bar diagrams, which show marked variations in uranium contents in different parts of some of the plants, and not much variations in some others.

(b) Histograms of the frequency distribution , along with the proportional distribution, of the uranium contents in the samples are shown in figure 5.2. The mode of this right-wordly skewed distribution lies between 0.442 ppm to 0.682 ppm (34% of the values). There is the lone value of 2.826 ppm. ppm for the leaves of <u>C. gigantea</u>. This high value may be due to foliar absorption or more likely due to the inherent capacity (not known so far) of that part for uranium absorption.

(c) Out of the various samples, the average uranium content of the leaves is 0.698 ppm, and those of barks and roots are 0.543 ppm and 0.702 ppm respectively. Flowers have average uranium content of 0.456 ppm and fruits and seeds (taken together),

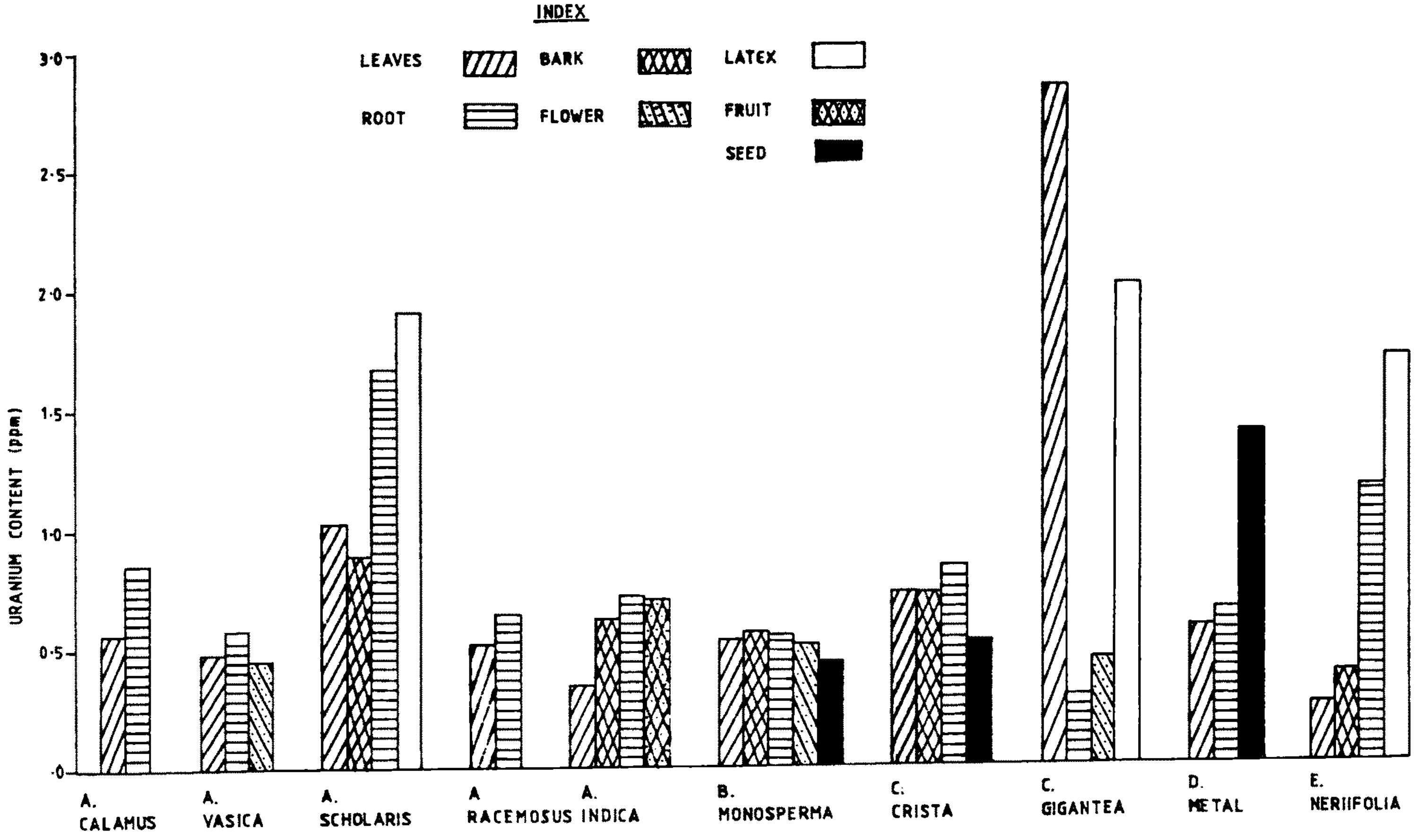


FIG. 5·1A BAR DIAGRAMS SHOWING URANIUM CONTENTS OF VARIOUS PLANT SAMPLES.

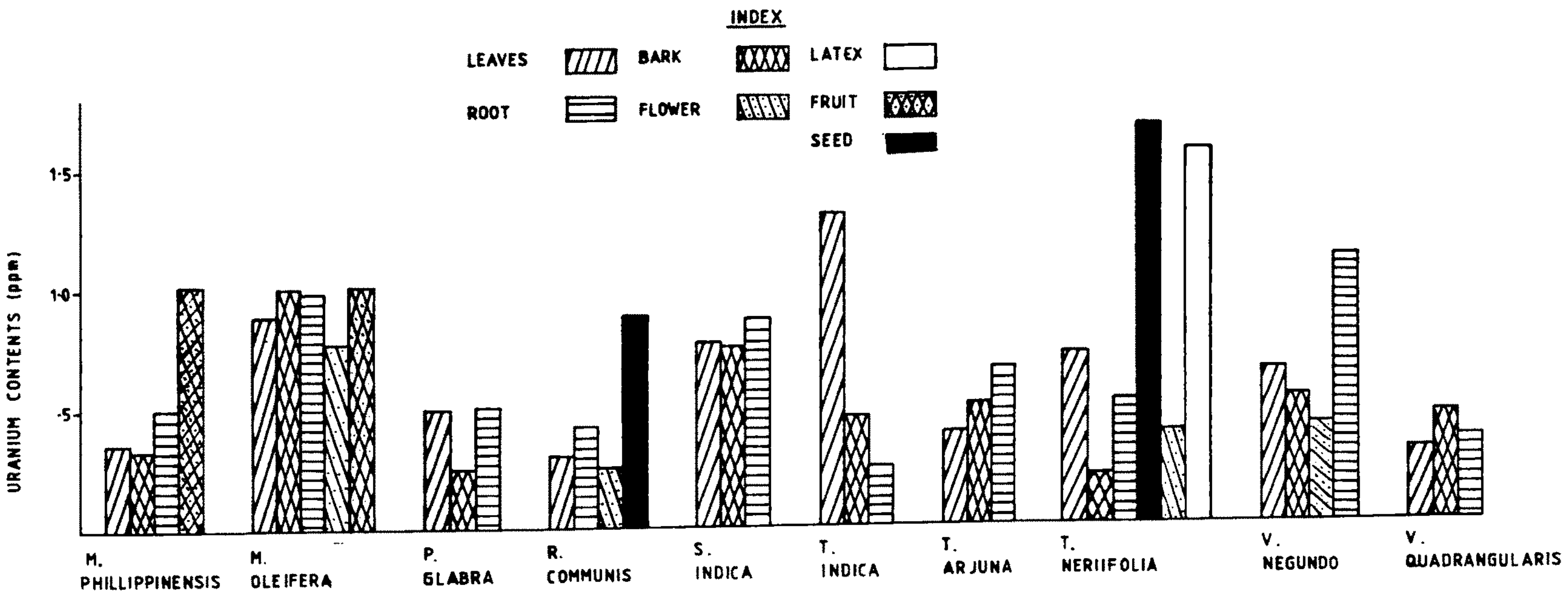


FIG. 5·1 B BAR DIAGRAMS SHOWING URANIUM CONTENTS OF VARIOUS SAMPLES.

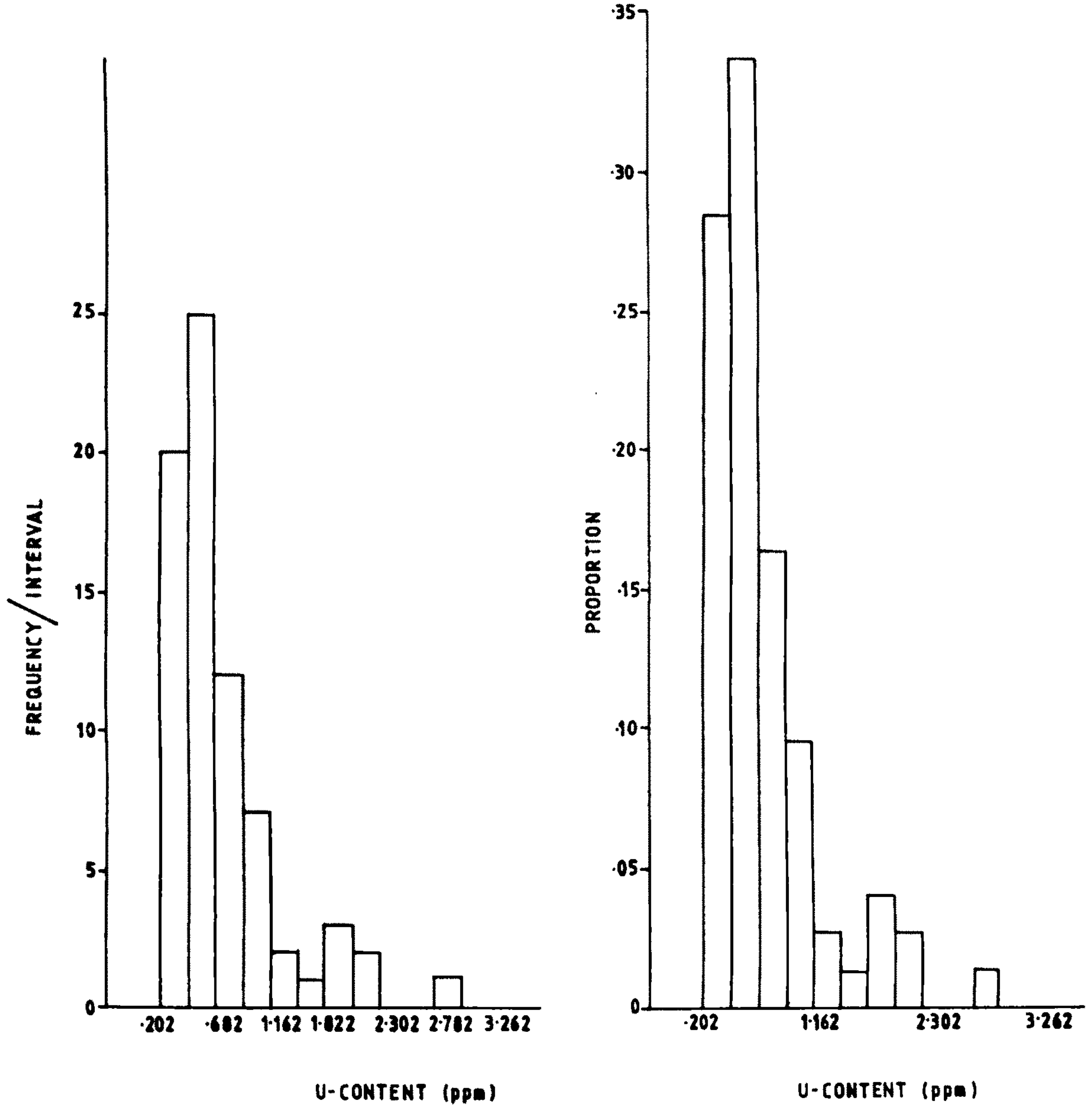


FIG. 5·2 FREQUENCY DISTRIBUTION OF URANIUM CONTENTS OF THE SAMPLES.

0.963 ppm. The uranium content of the latex is seen to be high, the average value for the few cases taken here being 1.786 ppm. These average uranium contents values are shown in figure 5.3. Histograms showing the frequency distributions of the uranium contents of these parts separately are shown in figure 5.4.

In figure 5.4, it is seen that in leaves, the uranium contents vary from 0.254 ppm to 2.826 ppm, 35% of them lying between 0.474 ppm and 0.704 ppm. In roots, the values are mostly from 0.455 ppm to 0.685 ppm, while they vary from 0.225 ppm to 1.672 ppm. The values vary from 0.202 ppm to 1.052 ppm in barks, 43% of them lying between 0.432 ppm to 0.662 ppm, from 0.430 ppm to 1.650 ppm in seeds and fruits, and from 0.254 ppm to 0.774 ppm in flowers.

5.4. SOIL SAMPLES:

Uranium contents of the soil samples are given in table 5.2. It is seen that these values are not much different, the

TABLE 5.2

Uranium contents of the soil samples.

Sl. No.	Samples	Uranium contents ppm	Mean uranium content ppm
1	No. 1	2.828±0.044	
22	No. 2	2.773±0.045	2.808
3	No. 3	2.824±0.044	

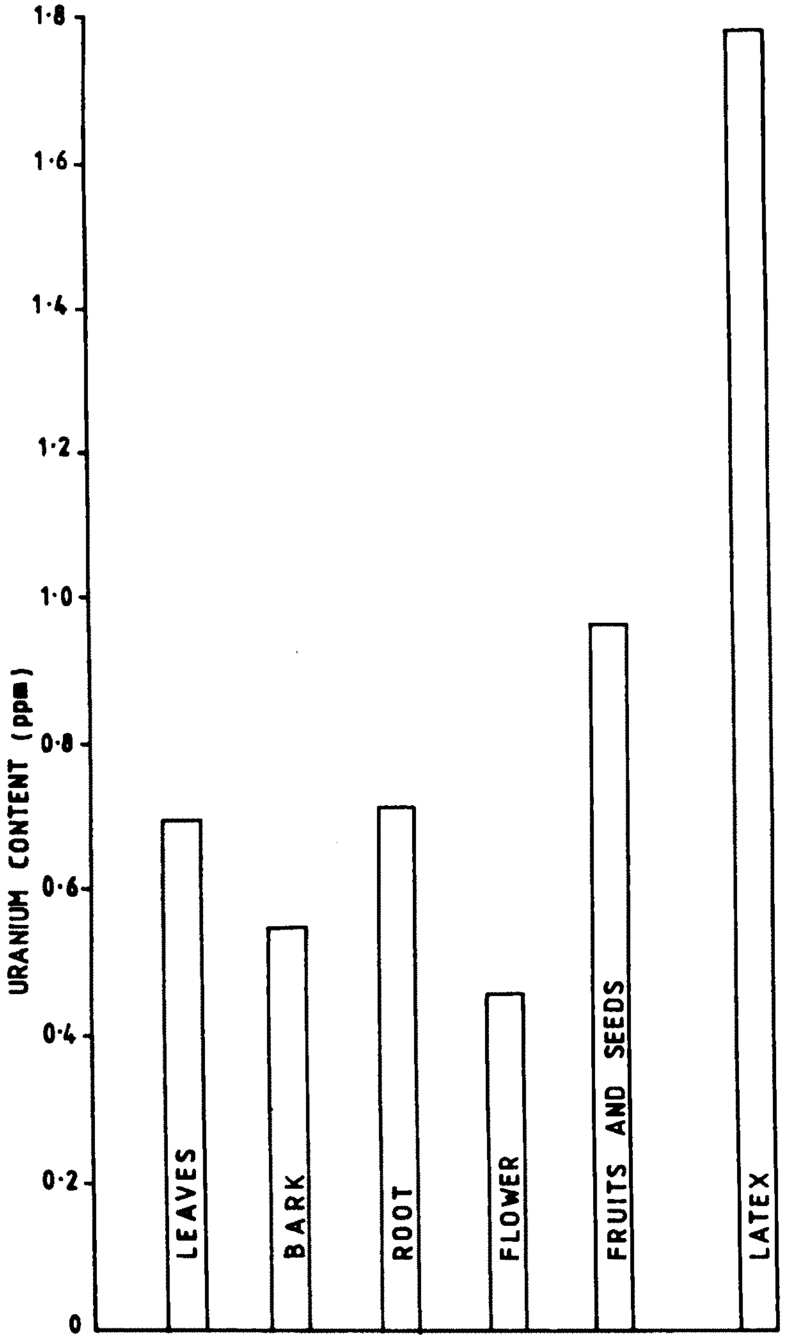


FIG. 5·3 AVERAGE URANIUM CONTENTS OF DIFFERERENT PARTS OF PLANTS.

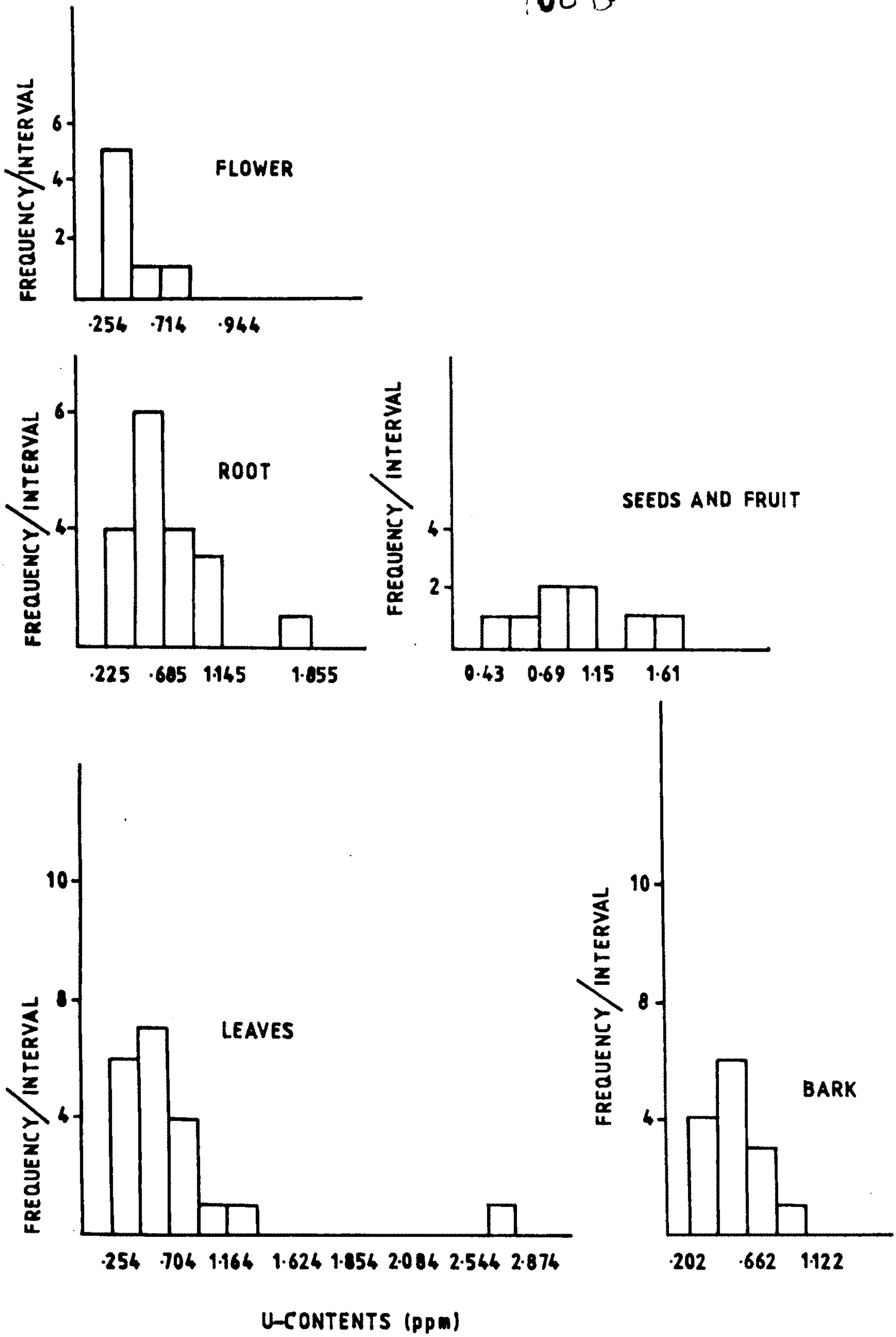


FIG. 5·4 FREQUENCY DISTRIBUTIONS OF URANIUM CONTENTS OF DIFFERENT PARTS OF PLANTS.

mean value being 2.808 ppm. This may be considered to be higher than that of plants in general. This is in conformity with the expectation, as most of the trace elements should enter the plants from the soil through roots; and foliar absorption of this heavy element may be small.

5.5. VARIATION OF URANIUM CONTENTS OF VARIOUS PARTS OF A PLANT:

The test for significance of difference in uranium contents of various parts of a plant are carried out statistically (t - test, appendix II) and the results are discussed below, keeping in view, their medicinal properties as mentioned in section 4.2.

(a) Acorus calamus Linn.
(Eng:Sweet flag)

The uranium content of the rhizome, the medicinally used part of this plant, is significantly higher than that of the plant part, i.e. the leaves. *(t = 7.749)

(b) Adhatoda Vasica Nees.
(Eng: Malabar Nut Tree)

Here uranium contents of the root differs significantly from those in leaves and flowers. Although some medicinal properties of these parts of the plant are same, the commonly

* The observed t-values are compared with the tabular t-value, 1.960 at 5 percent level of confidance. The degrees of freedom in all cases are from 50 to about 300.

used parts are leaves and flower, between which the difference is insignificant, (t_{l-r}=3.760, t_{r-fl}= 1.363 and t_{r-fl}= 4.659, l,r and fl stands for leaves, root and flower respectively).

(c) <u>Alstonia Scholaris</u> R.Br.
(Eng: Ditta Bark Tree)

The uranium contents differ significantly among the various parts of this plant. Although bark and root possess the same medicinal properties, the bark is only used for medicinal purpose. (t_{l-b}= 2.922, t_{L-r}= 2.935, and t_{b-r}= 5.271, where b denotes bark)

(d) <u>Asparagus racemosus</u> Willd.
(Sans. Shatavari)

The plant and root have different uranium contents which are statistically insignificant. The properties possessed by the plant part are also present in the root, which however, has a number of other properties in addition to the common ones and the root is more frequently used for medicinal pruposes. (t_{l-r}= 1.651)

(e) <u>Azadirachta indica</u>, A Juss.
(Eng: Margosa Tree)

In this plant,also the uranium contents of various parts differ significantly. The root-bark and fruit, with the same medicinal properties are found to have uranium contents of insignificant difference (t=0.280). It is to be noted that the bark and fruit,with the properties-emetic and antiemetic, are found to have significantly different uranium contents (t = 2.840).

(f) Butea monosperma Lam.
(Eng: Flame of the Forest Tree)

The differences among the uranium contents of various parts of this plant are insignificant. The uranium content of the seeds is however found to be significantly different from most of the other parts. Some of its medicinal properties are also different from those of other parts of the plant, which possess mostly similar properties. (t_{l-s}= 2.627, t_{b-s}= 2.545, t_{r-s}= 2.511 and t_{fl-s} = 1.800 where s stands for seed).

(g) Caesalpinia crista Linn.
(Eng: Fever Nut Tree)

The variation of uranium contents of leaves and bark of this plant are statistically insignificant (t=0.092); their medicinal properties are also same. The uranium contents among other parts differ significantly (t_{L-r}=2.810, t_{l-s}= 4.060, t_{b-r}= 2.482, t_{b-s}= 3.370 and t_{r-s} = 7.003).

(h) Calotropis gigantea R. Br.
(Eng: Giant Milk Weed)

Uranium content of the leaves of this plant varies much prominantly from other parts, viz., root and flowers. Medicinal properties of the leaves also, differ from those of the root and flower. Root and flowers also have significantly different uranium cotents. But the medicinal properties of these two parts are not much different. The latex with similar medicinal properties as the leaves, also have high uranium content. (t_{l-r}= 38.377; t_{l-fl}= 21.436 and t_{r-fl}=4.391).

(i) Datura metal Linn.
(Eng:Green Thorn Apple)

Here, the uranium content in seeds varies significantly from those in roots and leaves (t_{l-s}= 2.949, t_{r-s}=3.659). Roots and leaves have traces of uranium, the content of which are not statistically different (t=0.219). The medicinal properties of these parts are more or less similar, though there is difference in the extents of effectiveness of these properties.

(j) Euphorbia neriifolia Linn.
(Eng:Snuhi)

The various parts of this plant contain uranium, the amounts of which significantly vary from one another. The medicinal properties are common in some senses and not so in some other ways (t_{l-b}= 3.812, t_{l-r}= 23.670 and t_{b-r}=27.303).

(k) Mallotus phillipinensis Muell. Arg.
(Eng: Indian Kamila Tree)

The uranium content of the root is significantly different from those of the leaves, fruit and bark. The medicinal properties of the leaves are different from those of fruits and roots. The bark is not medicinally used. The difference in uranium contents of the leaves and bark is insignificant. The leaves and fruits, having constipative and lexative properties respectively, have significantly different uranium contents (t_{l-fr}= 18.023 where fr stands for fruit).

(l) Moringa oleifera Lam.
(Eng: Ben Oil Tree)

Here the uranium contents of leaves with fruit and flowers with bark, root and fruit vary significantly and those among other parts do not vary so. Few medicinal properties are common in some of these parts (t_{L-fr}= 2.465, t_{b-fl}= 2.057, t_{r-fl}= 2.044, t_{fl-fr}= 2.806).

(m) Pongamia glabra Vent.
(Eng: Pongam)

The difference in uranium contents of leaves and root is insignificant, (t = 0.084) while those of root-bark and bark-leaves are significant. (t_{b-r}= 5.267, t_{b-l}= 7.305). The medicinal properties also vary in these parts, while those in leaves and root are almost similar.

(n) Ricinus communis Linn.
(Eng: Castor Oil plant)

The uranium content of seeds varies significantly from those in leaves, root and flowers (t_{s-l}= 17.775, t_{s-r}=2.739, t_{s-fl}= 7.351). Most of the medicinal properties of the seeds are also different from those in other parts. The difference of uranium content in root is also significant from that of leaves (t = 3.307). The differences between uranium contents of leaves and root from flower are insignificant (t_{l-fl}=1.243, t_{r-fl} = 1.691). These parts have some common medicinal properties also.

(o) Saraca indica Linn.
(Eng: Ashoka Tree)

Roots and bark of this plant, with same medicinal properties, have uranium contents, the difference of which is statistically insignificant ($t = 1.096$). Leaves, however, do not possess all the medicinal properties as the bark and roots do. Yet its properties are common in the other two parts also. There is no significant difference of its uranium content from those of root and bark.

(p) Tamarindus indica Linn
(Eng: Tamarind Tree)

Bark and root have the same medicinal properties and their uranium contents also do not vary significantly ($t=1.353$). Leaves, with different medicinal properties, have significantly different concentration of uranium from bark and root ($t_{l-b}=4.693$, $t_{l-r}= 6.529$).

(q) Ternainellia arjuna W. & A.
(Eng: Arjun Tree)

The uranium content of the leaves differs significantly from those of the bark and roots ($t_{l-b}= 4.309$, $t_{l-r}=15.561$). There is no significant difference between uranium contents of the root and bark ($t = 1.485$). Also, in this plant, the medicinal properties of the root and bark are the same. The leaves differ in medicinal properties from root and bark.

(r) Thevetia neriifolia Juss
(Eng: Yellow Oleander)

Here, the uranium content of each part differs significantly from that of every other part. There is variation of medicinal properties also, but the bark and root possess the same medicinal properties. The latex, which is poisonous, has higher uranium content.

(s) Vitex negundo Linn.
(Eng: Indian Privet)

The leaves and bark of this plant contain uranium of insignificantly different amounts (t = 1.555). The medicinal properties of these two parts are also the same. The uranium contents of other parts vary significantly (t_{l-r}=9.859, t_{l-fl}= 6.272, t_{b-r}= 12.249, t_{b-fl}= 2.787. Some of the medicinal properties of these parts vary.

(t) Vitis quadrangularis Wall

The leaves contain significantly different value of uranium content than does the stem, (t_{l-b}= 4.430 while the difference between the uranium content of roots and leaves is insignificant (t = 1.330). Regarding medicinal properties, the same are different in the stem, from those in leaves and root.

In the above discussion, it is observed that, in most of the cases, parts with identical medicinal properties in a plant have uranium contents, whose variations are insignificant. Again although some parts have the same medicinal properties as some other parts, they are discarded for medicinal use. In such cases significant differences in uranium contents are seem (e.g. bark and root of A. Scholaris plant). Also, the uranium contents of some parts of a plant having medicinal properties of opposite action are found to vary significantly.

Thus there seems to be a clear indication that medicinal properties may have a relation with uranium contents of plants. That is to say, uranium, present as a trace element in plants, may have some contribution to their actions as drugs.

5.6. URANIUM CONTENTS OF VARIOUS GROUPS OF SAMPLES WITH IDENTICAL MEDICINAL PROPERTIES:

The samples of plants, shown in table 5.1, possess medicinal properties as described in section 4.2. Samples with a particular medicinal property are grouped together and the mean uranium contents of twenty two groups, so formed, are computed. The results are presented in table 5.3. The number of samples in each group are shown in the second column. The third column gives the mean uranium contents of the groups (averaged over the numbers shown in the third column). The errors shown are standard errors. The standard deviation of the mean in each case is shown in the fifth column (appendix III). These results are also presented in figure 5.5 by the bar diagrams.

In table 5.3 it is seen that the uranium contents of the various groups, with a particular medicinal property, vary from 0.466 ppm in the stomachic group to 1.700 ppm in the abortifacient group.

TABLE 5.3

Uranium contents of various group of samples possessing identical medicinal properties.

Sl. No.	Groups of samples with medicinal properties	No. of samples	Mean uranium content ppm	Sample S.D. ppm
1.	Stomachie	19	0.466±0.039	±0.172
2.	Expectorant	17	0.490±0.034	±0.140
3.	Emollient	19	0.504±0.037	±0.162
4.	Antiemetic	7	0.514±0.024	±0.064
5.	Astringent	25	0.528±0.032	±0.160
6.	Antidysenteric & Antidiarrhoeic	14	0.533±0.043	±0.163
7.	Antitubercular	9	0.555±0.021	±0.062
8.	Febrifuge	31	0.571±0.037	±0.206
9.	Aphrodisiac	12	0.604±0.032	±0.111
10.	Diuretic	17	0.607±0.058	±0.237
11.	Antispasmodic	20	0.653±0.081	±0.362
12.	Anthelmintic	31	0.706±0.059	±0.331
13.	Antiseptic	18	0.782±0.136	±0.576
14.	Resolvent	24	0.791±0.067	±0.327
15.	Antiarthritic	17	0.836±0.098	±0.402
16.	Conception Preventing	4	0.862±0.198	±0.396
17.	Anodyne	16	0.941±0.081	±0.323
18.	Emetic	14	1.063±0.181	±0.677
19.	Useful in ulcer	18	1.170±0.148	±0.626

(Table 5.3 Contd.)

Sl. No.	Groups of samples with medicinal properties	No. of samples	Mean uranium content ppm	Sample S.D. ppm
20.	Laxative	11	1.225±0.213	±0.706
21.	Caustic	9	1.579±0.200	±0.599
22.	Abortifacient	5	1.698±0.305	±0.681

5.7. POSSIBLE CORRELATION BETWEEN URANIUM CONTENTS AND MEDICINAL PROPERTIES OF PLANTS:

Uranium contents, as seen in table 5.3, are comparatively low in some groups and much higher in some other groups. The possible significance of these variations can be inferred as follows:

(a) Stomachics, which improve digestion and appetite have low uranium content. Radiation exposure affects the human body by impairing the digestive system and appetite. Hence the fact that remedial agents for digestion have a low content of this radioactive element appears significant.

(b) Expectorants are of low uranium content. This also appears significant, as radiation exposure can cause sore throat.

(c) Antiemetics have low uranium content as compared to emetics. As radiation exposure can cause nausea, this is a significant factor.

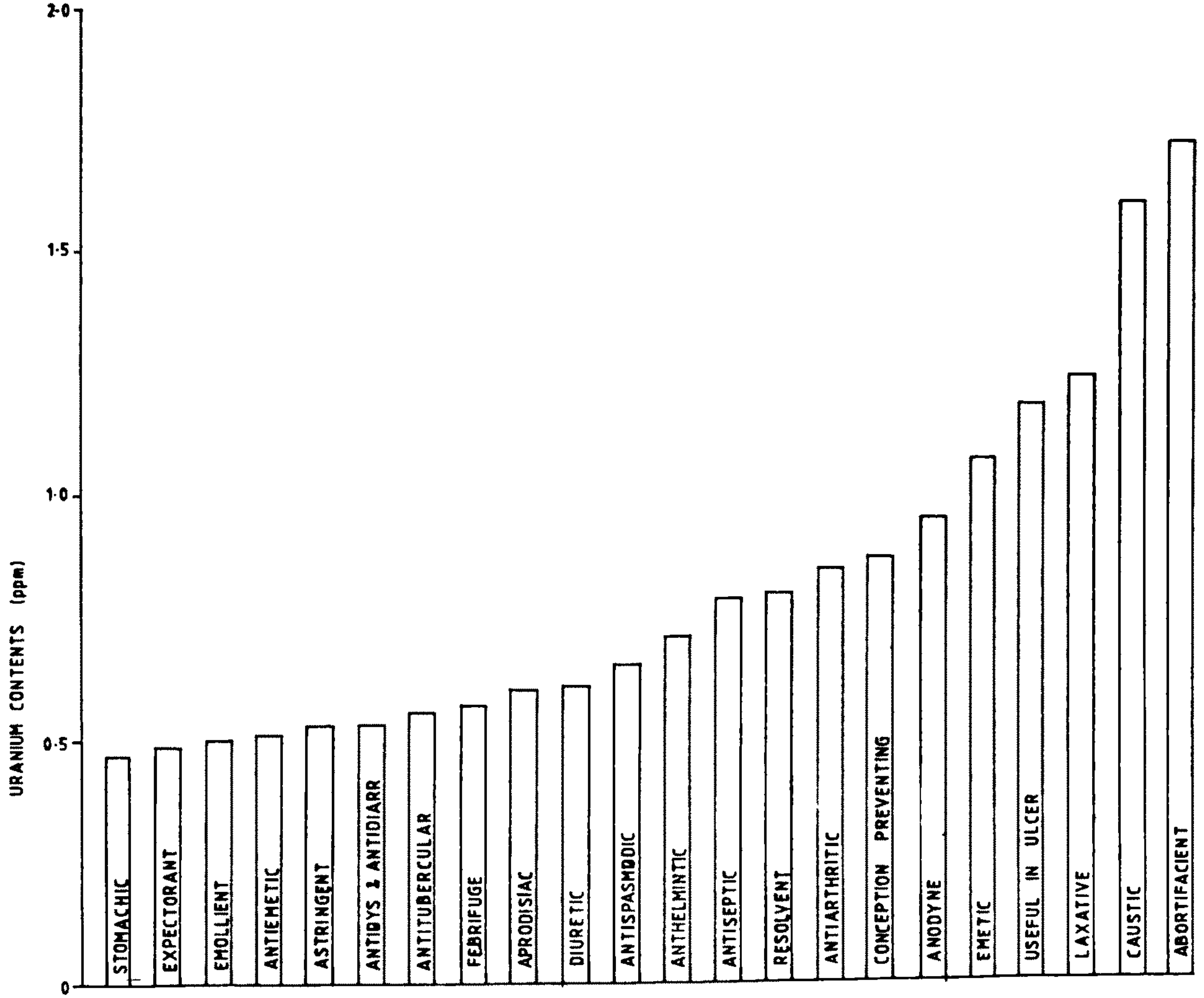


FIG. 5·5 BAR DIAGRAMS SHOWING URANIUM CONTENTS OF VARIOUS GROUPS OF SAMPLES WITH A PARTICULAR MEDICINAL PROPERTY.

(d) Emollients, which have soothing action on the skin against various irritations have low content of uranium. Exposure to radiation affects the skin with production of irritation and reddening leading to tumours. The two facts seem to be related.

(e) Radiation exposure induces haemmorrhage, which is also arrested by astringents. The uranium contents of astringents is low, which may be advantageous for agents possessing this property.

(f) Development of diarrhoea is another effect of moderate exposure to radiation. Antidysenterics and antidiarrhoeics to have low, and laxatives to contain high content of this radioactive element is also significant.

(g) Antitubercular group also has low content of uranium. This may be expected as radiation exposure can cause consumption.

(h) Antispasmodics, used against respiratory troubles, convulsions etc. have low uranium content. This may be a helpful factor in deciding the action of the plants having this property.

(i) Febrifuges to have low uranium content is also significant, as radiation exposure causes fever.

(j) The group with antiseptic property has moderately high uranium content. This is in conformity with the expectation.

(k) Radiactive isotopes are, used to relieve pain in radiation therapy. Antiarthritics to have moderately high uranium content is,therefore, significant.

(l) Resolvents have moderately high uranium content. Radiactive isotopes are used to kill tissues of tumours in nuclear medicine. The radiations may help in killing the unhealthy tissue and the heat developed in resolving the inflammatory swelling of the tumour.

(m) The group of samples,which are useful in ulcer.also, has moderately high uranium content. They are used to heal ulcers and sores. This may be due to the fact that the emitted radiations can kill bacteria upon the sores, thereby helping other active principles in healing wounds.

(n) Anodynes have high uranium contents. These are agents which relieve pain by inducing sleep or inactivating the nerves. Moderate exposure to heat rays is useful in soothing pain, thus the moderately high concentration of uranium may contribute to this medicinal property of plants.

(o) Caustics, which irritate the skin, contain high uranium content. Also exposure to radiation causes irritation of the skin leading to tumours. Hence the high uranium content may be one of the factors which impart this property to the plants.

(p) Fertility is impaired as a result of exposure to radiation. The group of samples, which prevents conception have high uranium content. Again aphrodisiacs have low uranium content. This is significant.

(q) Induction of abortion is another radiation exposure effect. Abortifacients are found to contain high uranium content (highest in this present work). Radiation exposure produces convulsion, which may be the cause of abortion. Hence high content of uranium in the plants (or their parts) may play a role in the action of their abortifacient property.

5.8. TEST FOR SIGNIFICANCE OF DIFFERENCE IN VARIOUS GROUPS OF SAMPLES:

As discussed in the preceeding section, the low or high contents of uranium in the groups with a particular medicinal property may be an indication in deciding the medicinal properties of the plant.

Thus, we may presume that groups like stomachic-antidysenteric and antidiarrhoeics-antiemetic, febrifuge-diuretic, expectorant-antispasmodic, anodyne-antiarthritic-resolvent, resolvent-useful in ulcer, emetic-laxative-abortifacient, etc. have no significant difference in uranium contents. Concomitantly, groups like stomachic-laxative, antidysenteric and antidiarrhoeics-laxative, emetic-antiemetic, caustic-emollient, etc. are likely to have significant differences in uranium contents. With these presumption, statistical t-test have been performed (appendix IV) for significance of differences among the various possible combinations of the groups of samples, shown in table 5.3.

The results of t-test are in conformity with the above assumptions. Some significant ones are given below.

(i) Actions of stomachics (a) are identical to those of antidysenterics and antidiarrhoeics (b) and antiemetics (c).

These groups have uranium contents of insignificant differences (t_{a-b}= 1.096; t_{b-c}= 0.283, t_{a-c}= 0.692 with degrees of freedom (d.f) 31, 19 and 24 respectively). The actions of these groups are, again, opposite to those of laxatives (d) and emetics(e). The uranium contents of these latter two groups vary significantly from the former three (t_{a-d}= 4.312, t_{a-e}= 3.572, t_{b-d}= 3.404, t_{b-e}= 2.744, t_{c-d}= 2.506 and t_{c-e}= 2.036 with d.f. 28, 31, 23, 26, 16 and 19 respectively).

(ii) Expectorants and febrifuges have no significant difference in uranium contents (t = 1.418 with d.f. 46). The actions of these properties are analogous.

(iii) Febrifuges and diuretics, with parallel actions, have no significantly different contents of uranium (t=0.537 with d.f. 46).

(iv) Aphrodisiacs and conception preventing groups of samples have significant difference in uranium contents (t= 1.899 with d.f. 14). Again, the latter group has no significant difference from uranium contents of abortifacients (t = 1.921 with d.f.7) and emetics (t = 1.700 with d.f. 17).

(v) The groups of samples with anodyne (f), anti-arthritic(g) and resolvent (h) properties, have no significant difference in uranium contents (t_{f-g}= 0.799 with d.f. 31, t_{f-h}= 1.392 with d.f. 38, and t_{g-h} = 0.385 with d.f. 38). The actions of these properties are also analogous.

Caustics and emollients are of opposite actions and these two groups have signfficantly different uranium contents (t = 7.016 with d.f. 26). Caustics may lead to tumours. Resolvents, which are used to resolve tumours have significantly different value of uranium content from that of the caustics (t = 4.663 with d.f. 31).

The observations described above lead to an inference that the radioactivity due to uranium contents of plants may be an additional active agent in determining their medicinal properties in addition to the generally accepted active, principles (Chapter I).

5.9. SIGNIFICANCE OF URANIUM CONTENTS OF SOME INDIVIDUAL SAMPLES:

An observation of the values of uranium contents of the samples, presented in table 5.1 needs speculation, which may lead to some significant revealations and throw some new light on actions of plants as drugs.

(i) Uranium accumulates in the seeds of Datura metal in a much higher concentration (1.391 ppm) than in other parts of it (0.578 and 0.647 ppm). Seeds are unlikely to come in direct contact with the environment and hence, this accumulation is, perhaps, preferential. In Sec. 4.2 we find that Datura seeds have the property of preventing conception, whereas this property is absent in the other parts of the plant. Also the narcotic property of the seeds is much greater than that of the other parts. It is not unlikely that the higher uranium concentration in the seeds is partly responsible for these properties. This observation is supported by the fact that the conception preventing group has comparatively high uranium content (table 5.3).

(ii) The leaves of Calotropis gigantea are seen to contain a much higher content of uranium (2.826 ppm) while the other parts of the plant contain low uranium content (0.292 and 0.441 ppm). The value is also higher than the uranium contents of all other samples taken in this work. These leaves possess some special medicinal properties, viz., they are drastic purgative, often used as a powerful abortifacient, narcotic and are used to remove hair from skin (depilatory). The leaves are also used to cover boils, which are then ruptured and also to cover painful joints. A powder of the dried leaves is dusted on wounds to destroy excessive granulation.[10] Calotropis juice is caustic when applied to unbroken skin or mucous membranes. It causes contraction of the isolated rabbit uterus. Forcing the juice down the throat is a common method of infanticide employed by castes among which female infanticide prevails.[11] The latex with similar properties as the leaves, contain much higher content of uranium (2.006 ppm).

The medicinal properties of this plant (leaves and latex) seem to be related with higher uranium concentration in it. Because, moderate exposure to radioactive radiations causes purgation, convulsion (which may lead to abortion), hair loss, (the result is depilatory action), reddening and irritation of skin (causticity) and so on.

Concomitantly it may be possible that the much lower concentrations of uranium, found in the roots and flowers of this plant, are due to the fact that the medicinal properties possessed by these parts are almost opposite in action to those possessed by the leaves. (Sec. 4.2.8)

(c) The leaves of Tamarindus indica accumulates much more uranium (1.298 ppm) than the bark (0.447 ppm) and root (0.225 ppm) of the plant. The properties possessed by the leaves are almost opposite to those possessed by the bark and root. The following few lines may be noted in regard of the leaves of this plant.

"Country people have a prejudice against sleeping under the Tamarindus tree, because, they say, the tree exudes unhealthy vapours. The cloth of tents pitched under this tree in wet weather becomes discoloured and rotten after a times many plants would not grow beneath this tree."[12]

It is not unprobable that the "unhealthy vapours" may be due to the radiations emitted by the spreading leaves, which have the capacity of accumulating the major portion of the available uranium.

(d) Seeds (Kernel) of Thevetia neriifolia also absorb much more uranium (1.650 ppm) than other parts of the plant do. The seeds of this tree possess medicinal properties, which appear to be related to higher uranium concentration. The latex also contain high content of uranium (1.561 ppm). Also they are poisonous by nature.

The present observations appear to be a strong indication regarding a definite role played by radioactivity in the action of plants as drugs. This will be in addition to the generally accepted active principles based on chemical constituents present in plants. Thus the role of trace elements such as uranium may be a supporting active agent in the determination of medicinal properties of plants.

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