SHORT COMMUNICATIONS

A NOTE ON THE SALT CONTENTS OF SOME HALOPHYTES OF WEST PAKISTAN

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Halophytes are known to accumulate in their bodies large quantities of salts. The present investigations were undertaken in order to find out the quantities of salts absorbed by some members of the halophytic flora of West Pakistan with a view to exploring the possibilities of utilizing them for the reclamation of saline soils by growing and removing them from the fields. In West Pakistan there are large areas with high concentration of salts in the top soil and only a few salt-tolerant plants can grow in it. At present, the method of flooding and leaching is the one commonly employed in reclamation of such saline areas. The drawbacks of this method are that total salts in the system remain the same, sufficient irrigation water for this purpose is not available and heavy irrigation employed in this method tends to increase waterlogging.

For the present study, a total of nine plants growing in saline soils were selected. Of these *Arthrocnemum indicum* Moq., *Suaeda monoica* Forsk, and *Suaeda nudiflora* Moq. were from the saline swampy areas of Karachi coast. *Suaeda fruticosa* Forsk and *Salsola foetida* Del were selected as representatives of the flora of inland saline alluvial soil, while *Haloxylon recurvum* Bunge, *Zygophyllum simplex* L., and *Zygophyllum coccineum* L. were selected from the halophytic flora of calcareous arid hills. All the above-mentioned plants showed varying degrees of succulence. The plants after collection from the field were weighed immediately for determining their fresh weight. These were then dried in the oven and placed in the muffle furnace at a temperature ranging from 500°C. to 600°C. for ashing. The results of analysis are shown in Table 1.

Table 1.—Salt Contents in Leaves, Stems and Roots of Some Halophytic Species of West Pakistan.*

No.	Name of the species	Place of collection	Leaves			Stems			Roots		
			Fresh wt. g.	Dry wt. g.	Salt content. % of dry wt.	Fresh wt. g.	Dry wt. g.	Salt content. % of dry wt.	Fresh wt. g.	Dry wt. g.	Salt content. % of dry wt.
1.	*Suaeda fruticosa* Forsk.	Hyderabad	100.0	22.0	41.2	100.0	65.0	6.6	100.0	64.5	5.5
2.	*Salsola foetida* Del.	Jamshoro	100.0	44.5	39.5	100.0	68.7	5.2	100.0	64.0	4.6
3.	*Haloxylon recurvum* Bunge.	Jamshoro	100.0	24.1	38.3	100.0	34.4	19.1	100.0	45.0	5.9
4.	*Haloxylon salicornicum* Bunge.	Jamshoro	leafless	—	—	100.0	63.0	16.8	100.0	68.0	5.2
5.	*Zygophyllum coccineum* Linn.	Jamshoro	100.0	24.0	32.0	100.0	65.0	5.2	100.0	65.0	5.1
6.	*Zygophyllum simplex* Linn.	Jamshoro	100.0	21.2	41.2	100.0	44.0	10.7	100.0	62.0	4.5
7.	*Arthrocnemum indicum* Moq.	Karachi	leafless	—	—	100.0	25.0	37.1	100.0	49.8	4.0
8.	*Suaeda nudiflora* Moq.	Karachi	100.0	21.8	38.8	100.0	61.6	4.2	100.0	68.7	5.2
9.	*Suaeda monoica* Forsk.	Karachi	100.0	26.1	37.6	100.0	50.9	4.8	100.0	67.5	4.3

*Plants were collected towards the end of their growing period when they are known to contain maximum quantities of salts.

The results show that accumulation of salts in different parts of the plant is not uniform. The accumulation of salts mostly takes place in the leaves or where leaves are absent in the stem. There seems to be a correlation between the transpiration and the accumulation of salts in different parts of the plant. Thus leaves or stems in the case of leafless plants which have the maximum rate of transpiration are also the centre of accumulation of salts. The salt accumulating organs are very succulent in nature. As is apparent from the data presented in Table 1 these plants contain high proportions of salts in their accumulating organs which may form up to 41% of the dry weight. It was observed that after an active period of growth in all these plants the salt accumulating organs are shed, thereby getting rid of the accumulation of excessive quantities of salts in the plant body. This apparently results in the deposition of salts on the top soil. Thus, halophytic plants absorb salts from the deeper layers of soil and ultimately deposit them on the top soil. It seems, therefore, that they are responsible for further deterioration of the saline soils. In case the accumulating organs are removed before they are shed, there may ultimately result a reduction in the salt concentration of the soil. In West Pakistan there is a well established industry for manufacturing 'Sajji' by burning some of the above mentioned halophytic species. Details of the manufacture of 'Sajji' have been discussed by Watt.[1] 'Sajji' is a crude product mostly consisting of sodium carbonate and is used for cleaning and bleaching purposes. Thus there seem to be very good possibilities of growing some of the salt accumulating plants in saline soil with a view to reducing salinity and then harvesting them for conversion into 'Sajji.' There is also another possibility. These plants were found to be browsed by camels and goats. Other cattle seem not to relish them probably because of the higher concentration of salts in these plants.

Summary

Investigations on salt accumulation in the nine halophytic species found in West Pakistan were carried out in order to find out the possibility of their utilization in reducing saline concentration in the soil. The results are very encouraging because as much as 41% of the dry weight of accumulating organs in some plants consist of salts. Thus, there appears to be good possibility of growing some of the salt accumulating plants in saline soils with a view to reduce salinity. For this purpose they should be harvested before the leaves and other accumulating organs are ready to be shed on the ground.

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Reference

1. G. Watt, *The Commercial Product of India* (London, 1908).

SOME DIETARY CONSTITUENTS AND ENERGY VALUES OF EAST AND WEST PAKISTAN DIETS*

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A good deal of information about the nutritional status of the people can be obtained by an examination of the dietary of the country. A lot of work regarding the dietary constituents of foodstuffs has been reported but very little information regarding food as eaten by man is available in the literature. With the development of modern technique of freeze-drying it is now possible to make a diet or dish as actually consumed and to obtain the desired information by chemical analysis or biological assay.

Pakistan is a big country with a population of approximately 93 millions. The diets and dietary habits of the people differ from region to region. People living in Northwest Pakistan consume more fat and animal protein as compared to the people of other parts of Pakistan, while milk and milk products form the chief sources of animal protein in the former Punjab province. Diets of the people of East and West Pakistan differ markedly in that the chief source of calories in East Pakistan is rice, while that in West Pakistan is wheat. No dietary survey has been carried out since Independence in 1947.‡ However, some information is available from the dietary surveys made in the sub-continent before 1947. The coverage of these surveys is not very extensive and some of the areas now lie outside the boundaries of Pakistan but in the absence of any other reliable information this data has been used in the construction of East and West Pakistan diets,

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‡At the time of writing this report, a nation-wide dietary survey is under way under the Directorate of Nutrition Research and Survey, Government of Pakistan.

since Sukhatme[1] has shown that the average intake of food-stuffs has not materially changed since 1935. The two diets thus prepared were analysed for their important dietary constituents and energy values, the results of which are reported in the present paper.

Experimental

Preparation of Diets.—The average of dietary surveys carried out by Wilson and Mitra,[2] Mitra,[3] and Wilson and Widdowson[4] for former Punjab, Bengal and Assam provinces of the pre-Independence India were made use of for the construction of the two national diets which are shown in Table 1. Food consumption per caput per day was converted to dry weight basis using Food Composition, Tables.[5] Pulses were represented by lentil and gram in equal parts. They were first of all soaked in water for one hour and then cooked in a pressure cooker at 15 cm. pressure for 15 minutes and freeze-dried in a freeze-drying unit developed at the Human Nutrition Research Unit, Medical Research Council, London. Vegetables were represented by freeze-dried potato, swede and cabbage powders. Since they form a small part of the total intake, any differences in the dietary constituents of other vegetables eaten are likely to be insignificant. Because of the large scale use of hydrogenated oil during the last ten years, 25 per cent of the fat was replaced by hydrogenated oil (Dalda vanaspati). The various constituents on dry weight basis are set out in Table 2.

The dry powders were weighed out and thoroughly mixed in an electric food mixer for two hours and mixing continued until the fat was evenly distributed throughout the mixture.

Methods.—Moisture, fat (petroleum ether extract), crude fibre, ash were estimated according to standard procedures.[6]

Nitrogen was determined by a semi-micro Kjeldahl method[7] and converted into 'conventional' protein by multiplying by 6.25.

Carbohydrates were calculated as the residue after substraction of protein, fat, ash and crude fibre.

Thiamin was estimated by the thiochrome method adopted from *Methods of Vitamin Assay*[8] with the following modifications:

1. One ml. of redistilled methyl alcohol was added to the acid KCl elute acting as a stabilizer for thiochrome.

TABLE 1.—CONSUMPTION OF DIFFERENT FOOD-STUFFS PER CAPUT PER DAY AMONGST MUSLIMS IN THE FORMER BENGAL, ASSAM, PUNJAB AND DELHI PROVINCES.

Food-stuff	Bengal-Assam oz.	Punjab-Delhi oz.
Rice	21.8	3.9
Wheat	—	12.0
Maize	—	0.8
Pulses	0.9	1.1
Leafy vegetables	0.5	3.0
Non-leafy vegetables	6.0	2.7
Milk and milk products	0.9	5.3
Butter or ghee	—	0.9
Eggs	0.9	0.1
Meat		1.1
Fish		0.4
Vegetable oils	0.4	1.1
Sugar	—	1.8
Condiments	0.2	0.2
Fruits	0.3	0.1

TABLE 2.—FOOD ITEMS USED FOR THE CONSTRUCTION OF EAST AND WEST PAKISTAN DIETS.

Food item	East Pakistan (parts)	West Pakistan (parts)
Whole wheat flour	—	52.86
Rice	88.7	17.18
Maize	—	3.30
Lentils	1.95	2.32
Gram	1.94	2.31
Potato mash powder	0.84	3.02
Swede powder	—	1.01
Cabbage powder	0.35	2.17
Whole milk powder	0.51	3.06
Butter	—	3.20
Mustard oil	1.31	0.44
Hydrogenated oil (Dalda)	0.44	1.21
Meat powder	0.09	1.41
Fish meal	0.9	0.43
Sugar	1.0	5.14
Curry powder	0.86	0.86
Salt	1.0	1.0
Apple powder	0.04	0.04

2. After the addition of potassium ferrocyanide and alkali, the solution was agitated with nitrogen gas passed from a cylinder instead of hand shaking.

3. One ml. of redistilled absolute ethyl alcohol was added to 10 ml. of the isobutyl alcohol containing thiochrome instead of using anhydrous sodium sulphate for dehydrating the isobutyl alcohol. These modifications of the method gave a low blank and fairly reproducible results. The florescence obtained in the isobutyl alcohol was read in terms of quinine sulphate standard in a Unicam S.P. 500 spectrophotometer with fluorometer attachment. The results were checked against microbiological assay using *L. arabinosis* as test organism.[8]

Riboflavin and niacin were determined according to the procedure described in *Methods of Vitamin Assay*[8] and *Microbiological Assay of the Vitamin B Complex and Amino Acids*.[9]

Calories were determined by the method of Miller and Payne[10] by means of a ballistic bomb calorimeter.

Results and Discussion

The results of the chemical and microbiological determinations of the two diets are given in Table 3.

From the data given above it is evident that both the East and West Pakistan diets are characterised by a high proportion of carbohydrates (86 and 74%, respectively). The West Pakistan diet is slightly better in containing more fat and protein than the East Pakistan diet. But the proportion of protein especially animal protein in both the diets is much less compared to the normal standards. The inadequacy of proteins in Pakistani diets in respect of the requirements of growing children and nursing mothers will be discussed in a subsequent paper.

An examination of the data of vitamin B complex shows that the West Pakistan diet is satisfactory for all age groups. In the case of East Pakistan diet thiamin content is adequate, niacin is on the border line, while riboflavin is grossly inadequate. The daily allowances per thousand calories recommended by the Nutrition Committee of the British Medical Association[11] are thiamin, 0.4 mg.; riboflavin, 0.6 mg. for children and adults and 0.7 mg. for lactating mothers, and niacin, 4 mg. for all ages. According to Finn Bro-Rasmussen[12] minimum requirements for riboflavin are the same as optimum in early life, which is 0.7 to 0.8 mg. per thousand calories.

TABLE 3.—SOME DIETARY CONSTITUENTS OF EAST AND WEST PAKISTAN DIETS.

	East Pakistan	West Pakistan
Protein (N × 625)%	9.28	14.08
Fat (petroleum ether exct.)%	2.64	6.81
Crude fibre %	0.42	2.01
Ash %	2.15	3.17
Carbohydrates % (by difference)	85.51	73.95
Thiamin (μg./g)	2.45	3.09
Niacin (μg./g)	15.10	18.40
Riboflavin (μg./g)	0.40	1.13
Calories	403.0	413.40
Calories from carbohydrates %	84.8	71.6
Calories from proteins%	9.2	13.6
Calories from fat %	6.0	14.8

Thiamin, niacin, riboflavin intake per 1,000 calories are computed as follows:

	Thiamin mg.	Niacin mg.	Riboflavin mg.
East Pakistan diet	0.61	3.8	0.10
West Pakistan diet	0.73	4.4	0.27

Note. :—All figures are reported on dry weight basis.

For the adult man it is between 0.25 to 0.27 per thousand calories but it again rises to 0.7 mg. during pregnancy and lactation.

The information provided by the determination of vitamin content is limited by the variation of the quality of the foodstuffs and the method of cooking. It is more so in East Pakistan diet where losses of B vitamins on washing and cooking of rice are considerable. Where parboiled rice is eaten, this may be much less due to the passage of the vitamins and other water soluble nutrients, originally concentrated in the germ and aleurone layer, towards the interior of the the grain.[13,14] In areas where parboiled rice is eaten, the chances of B vitamin deficiency are rare. Riboflavin deficiency is common in rice eating areas and the recent survey of the armed forces of Pakistan[15] recorded a border line intake of this vitamin in certain troops stationed in East Pakistan. This finding may be quite significant in relation to the dietary of the common people who are not in such a privileged position as the soldiers are.

Since both the national diets are based on rice or wheat or both and contain very little vegetables, deficiency of vitamins A and C and calcium is expected. Suggestions for the improvement of diets of a similar nature have been put forward by Indian workers Patwardhan and Ranganathan.[16] The habit of chewing betel leaves smeared with slaked lime, which is very common in the Pakistani women, helps in contributing to their calcium requirements during pregnancy and lactation, but as will be shown in a subsequent publication the diets already limited by protein, cannot be improved by the addition of minerals. It would, therefore, be an unsound practice to make up for calcium deficiency only, without paying due regard to protein deficiency.

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THE EDTA COMPLEX OF ANTIMONY (III)

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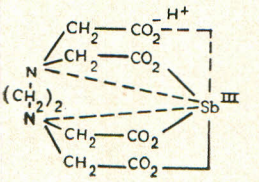
Although the EDTA complexes of a very large number of metals have been prepared and characterised in recent years,[1] no information about the antimony-EDTA complexes are available. We have found that a 1:1 antimony (III)-EDTA complex is formed when Sb_2O_3 or $SbCl_3$ reacts with either free EDTA acid or the disodium EDTA, in a boiling aqueous solution. This could be isolated in the pure form as colourless rhombic plates of the composition $C_{10}H_{13}O_8N_2Sb$ and it behaves as a complex acid of the type $HMe^{+3}Y$ (Me being the central metal atom and Y the tetrabasic EDTA anion) usually formed by other trivalent metals.[2] This complex is, however, very weak and readily decomposes to form free EDTA acid when treated with dilute alkali or sulphide.

On adding a saturated aqueous $SbCl_3$ solution to a boiling solution of disodium EDTA, at first, SbOCl is produced which subsequently dissolves. If addition of $SbCl_3$ is continued to such a point that some SbOCl remains undissolved, and the solution filtered, the filtrate on cooling yields a crystalline mass. This consists of a mixture of free EDTA acid, $C_{10}H_{16}O_8N_2$ (needles) and the antimony(III) complex (rhombic plates). These two differ very little in their solubility in water and thus could be separated only partially by fractional crystallisation.

If a boiling aqueous solution of free EDTA acid (30.0 g. in 1000 ml.) is treated with excess of Sb_2O_3 (60.0 g.) and the mixture thoroughly boiled and filtered, the filtrate on evaporation and cooling yields crystalls of the pure antimony (III) complex which can be dried over fused $CaCl_2$ under vacuum. Yields were 40.0 to 42.0 g., i.e., over 95% on the basis of EDTA acid input. (Found: C, 29.20; H, 3.52; N, 6.94; Sb, 29.31. $C_{10}H_{13}N_2O_8Sb$ requires, C,29.22; H, 3.19; N, 6.82; Sb, 29.63%.)

The compound has no sharp melting point but starts decomposing at 290°C. It is insoluble in common organic solvents, sparingly soluble in water (solubility 0.76% w/w at 30°C.) and in dilute mineral acids but dissolves readily in concentrated acids, often with decomposition (in H_2SO_4 and HNO_3). Dilute alkali decomposes it readily producing Sb_2O_3, and H_2S or soluble sulphides attack it to give Sb_2S_3, free EDTA acid being simultaneously formed in both cases.

Alkalimetric titration of the complex in cold or boiling solution does not give any sharp end point in the presence of phenolphthalein or phenol red indicators. On the addition of alkali however, decomposition sets in and Sb_2O_3 is quickly precipitated. A rough estimate of the acidity of the complex shows that three or more equivalents (~3.2) of alkali are consumed by each molecule. This indicates that in the presence of alkali, hydrolysis, to Sb_2O_3 and free EDTA acid takes place and the latter is then titrated, although incompletely. On this basis and also from composition derived from analysis, the complex can be regarded to have the same structure as that of other trivalent metal-EDTA complexes, namely:



but it is decidedly a weaker complex than those formed by other metals.

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