Mineral and Nitrogen Content of Some South Indian Pasture Grasses

By (the late) Dr. A. S. Menon

(University Biochemical Laboratory, Chepauk, Madras)

OF the inorganic constituents constantly found in the animal body the following are now known to perform important metabolic functions: iron, calcium, magnesium, manganese, copper, sodium, potassium, chlorine and iodine. Their indispensability in nutrition is well recognised in practice, in the scientific feeding of farm animals in European countries. But as Sir A. D. Hall[1] has written: "In various parts of the world, cases have been found from time to time of deficiency diseases in grazing live-stock due to the lack of particular minerals in the soil and consequently in the herbage. As a rule, these troubles are found in the old countries only through long-continued grazing of uncultivated pastures, or in the newer countries where grazing has been attempted without consideration of the specific deficiencies of the soil." Both these conditions are prevalent in India and there is reason to believe that malnutrition leading to high mortality, sterility, and low milk yield due to mineral deficiency in pastures is widespread in India. (For a summary see Orr.[2]) The nutritional efficiency of Indian pastures appears, however, to have been little investigated from this point of view. Aiyer and Kayasth[3] working on the mineral composition of fodders in the Central Provinces and Bihar found that the grasses grown in these areas are deficient in phosphorus and calcium. The calcium, phosphorus and nitrogen content of certain varieties of hay and straw have been recorded by Warth, Viswanath Iyer & Krishna Ayyar,[4] and Viswanath Iyer & Krishna Ayyar.[5] Ramiah[6] has made a study of the seasonal variations in the mineral and nitrogen content of spear grass.

In the present investigation a comparative study has been made of the mineral and protein contents of some common grasses from the Madras City on the east, and Malabar on the west coast of the Presidency. The two areas

TABLE I

Mineral content in terms of dry weight

Variety and place	Silica-free ash %	I γ/100 gm.	Cl %	CaO %	P_2O_5 %	Fe %	K_2O %	Na_2O %	N %
Madras									
Cyanodon dactylon	8·24	84·0	0·675	0·605	0·501	Traces	1·997	0·332	2·20
Panicum ramosum	6·25	15·4	0·868	0·948	0·682	0·102	1·832	0·243	1·41
Setaria verticillata	10·36	118·0	1·837	0·564	0·512	0·059	2·64	0·413	2·96
Chloris barbata	4·59	..	1·480	0·896	0·578	Traces	1·093	0·210	2·40
Ergrostis tenella	3·96	69·0	0·571	0·493	0·613	Nil	1·441	0·162	1·02
Ergrosiis pilosa	3·02	16·4	0·214	0·435	0·411	0·067	1·722	0·198	1·71
Malabar									
Cyanodon dactylon	3·89	15·0	0·349	0·326	0·356	Traces	1·510	0·285	0·89
Panicum ramosum	4·44	30·0	0·363	0·132	0·358	Traces	..	..	1·40
Andropogan pertusus	6·71	46·0	0·553	0·515	Traces	Traces	1·831	0·222	1·59
Rice Straw (i)	4·50	11·0	0·615	0·325	0·096	0·037	1·690	0·202	0·35
Rice Straw (ii)	2·20	11·0	0·384	0·248	0·027	0·077	1·262	0·154	0·45
British Isles (From Orr, 1929)[2]									
Cultivated pasture	6·64	..	0·95	1·00	0·74	..	3·18	0·25	2·83
Natural pasture	5·85	..	0·64	0·65	0·67	..	2·66	0·37	2·50
Poor hill pasture	5·49	..	0·60	0·56	0·60	..	2·60	0·41	2·54

present striking differences not only in climatic and physical features, but also in the quality of the live-stock, the cattle on the hilly wet regions of the west coast where green grass is available practically throughout the year being notoriously poor in quality both in size and milk yield compared to those on the dry eastern plains; a mineral deficiency in the soil caused by the heavy rains and reflected in the composition of the herbage provides an extremely probable explanation of the poor quality of the Malabar cattle.

The Madras grasses were obtained from the outskirts of the City and the Malabar samples either from Kollengode (a hilly tract near Palghat or from Calicut. The samples were cut in the months of August and September immediately after the grasses had come to flower. Identification was kindly carried out by Prof. K. Ekambaram of the Presidency College, Madras.

The following constituents were determined on nine common grasses and two varieties of straw: silica-free ash, iodine, chlorine, calcium, phosphorus, iron, sodium and potassium. Determinations of nitrogen were carried out at the same time as the protein content is also known to be a factor dependent on the state of the soil.

The methods of analysis were those of the Association of official Agricultural Chemists (1935) with the following exceptions: iodine was determined by von Fellenberg's method as described by Harington[7], nitrogen according to Pregl, and phosphorus according to Fiske and Subbarow.[8]

Conclusions

Taking into consideration only the most important constituents, *viz.*, calcium, phosphorus, potassium, sodium, silica-free ash and nitrogen for which standards of comparison are available, it is obvious from Table I that all grasses analysed are poor in quality, only one of the samples, *viz.*, *Panicum ramosum* from Madras showing a mineral content even approximately equivalent to that of good quality natural British pasture. This species contain adequate amounts of silica-free ash, calcium, phosphorus and chlorine, but is deficient with respect to potassium, sodium and protein. The deficiencies in *Setaria verticillata* are such that this grass would be a suitable supplement to *Panicum ramosum*.

Comparing the grasses from the two localities with each other the west coast varieties are seen to be very much inferior in essential minerals to those grown in Madras; this is strikingly brought out in the case of the two species *Cyanodon dactylon* and *Panicum ramosum* which are common to both groups. The Malabar grasses are particularly deficient in calcium, phosphorus, iodine and protein.

The two kinds of rice straw from Malabar are characterised, as was to be expected, by a mineral content which is extremely low compared even to the grasses from the same locality.

1 Hall, Sir A. D., *The Feeding of Crops and Stock*, (John Murray, London), 1937.

2 Orr, Sir J. B., *Minerals in Pastures* (Lewis, London), 1929, p. 112.

3 Aiyer and Kayasth, *Agriculture and Live-stock in India*, 1931, 1, 526.

4 Warth, Iyer and Ayyar, *Ind. J. of Vet. Sci. and Anim. Husb.*, 1932, 2, 325.

5 Iyer and Krishna Ayyar, *ibid.*, 1934, 4, 108.

6 Ramiah, P. V., *ibid.*, 1933, 3, 65.

7 Harington, *The Thyroid Gland*, Oxford University Press, 1933.

8 Fiske and Subbarow, *J. Biol. Chem.*, 1925, **66**, 375.

Effective Phosphates in Cane Juices

By S. N. Gundu Rao and Kripa Shankar

(Imperial Institute of Sugar Technology, Cawnpore)

ALTHOUGH the importance of the phosphate content of juices in determining their behaviour towards clarification is generally recognised, the exact phosphate requirements reported by different authors vary within wide limits (Walker,[1] McAllep and Bomanti[2]). Some have concluded (Lanier[3]) that the initial colloid content is more responsible for the efficiency of clarification than the phosphate content itself.

In Natal, where the juice colloids are high and the soil deficient in phosphates, the P_2O_5 content of juices is raised to 0·05–0·06 per cent.[4] to secure good clarification. The work of Keane and Hill[5] on the filtrability of raw cane sugars, of Carrero[6] on P_2O_5 contents P.O.J. 2878 juices, of Beater[7] on South African juices and of McRae[8] on the nature of the phosphates present, shows that the entire phosphorous in the juices is not available for clarification. The authors believe that it is only the phosphate which is in true solution or which gets into solution on heating which reacts with the added lime to form the calcium phosphate precipitate; this portion of the phosphate is known as the *effective phosphate.*

The Separation of 'effective' and 'non-effective' phosphates.—The 'effective' phosphate was dialysed out through a cellophane membrane, at 80° C. against distilled water, employing a muslin-filtered sample of juice (50 c.c.) obtained by crushing in a three roller vertical mill, under moderately heavy pressure. 50 c.c. of the juice is then separately analysed for total phosphates.

The dialysate in the beaker is collected and