SURVEY OF THE COPPER AND PHOSPHATE STATUS OF CATTLE IN PAPUA NEW GUINEA

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ABSTRACT

A survey of the copper and phosphate levels of cattle grazing in various locations near Lae has been carried out. At several stations, analysis of biological specimens has indicated an immediate need for supplementation of the animals' diet, followed by further laboratory investigation.

INTRODUCTION

MINERAL nutrition studies have an important place in any developing cattle industry if diseases caused by deficiencies of minerals and trace elements are to be completely eliminated. Over the past five years, field observations together with biochemical analyses have indicated that such deficiencies do exist in this country, and that in particular copper and phosphate are lacking in a number of areas.

In severe cases of mineral disorders obvious symptoms exist which characterise the various diseases. A depraved appetite, resulting in a tendency to gnaw at bark or stones, and bone disorders may be evident if a phosphate deficiency exists. Copper, on the other hand, has a vital role in animal metabolism in the processes of pigmentation of hair, formation of blood and bone, reproduction and myelination of the spinal cord, and a deficiency of this element may impair one or more of these processes.

More often the imbalance is mild and as such is difficult to diagnose by observation alone, as most forms of malnutrition cause symptoms such as poor development, loss of weight, impaired reproductive performance and general unthriftiness.

During 1970-71, a survey was carried out to investigate existing levels of copper and phosphate in an important cattle breeding region of the Morobe district, as earlier observations and estimations had indicated a deficiency in several areas. Both suspect and non-suspect properties were included in the survey in order to map exactly the deficient areas, and to obtain a range of mineral levels to be expected from cattle in non-deficient areas.

MATERIALS AND METHODS

Plasma samples were submitted from cattle on each of the properties marked on the map, all within 80 miles of Lae, and pasture samples were collected at Asak. Wanaru, Sunkist Dairy and Asak were suspect areas, while several other stations carried some cattle in poor condition. Field observations at the time of sampling included sex, condition and age of each animal.

At Bulolo and Erap, samples were collected from cattle up to eight years old, and at all other stations animals from 2-4 years old were used. Twenty-five to 50 samples were collected from cows, steers and heifers on the various properties.

Collection of Samples

1. Blood was collected from cattle by tail-bleeding in the field and from slaughtered animals at the abattoir in 25 ml acid-washed bottles containing the anti-coagulant ethylene diamine tetra-acetic acid (E.D.T.A.). The samples were centrifuged as soon as possible for 15 minutes at 3,000 R.P.M. and the plasma pipetted off. Care was taken to keep the plasma as cool as possible during transport from

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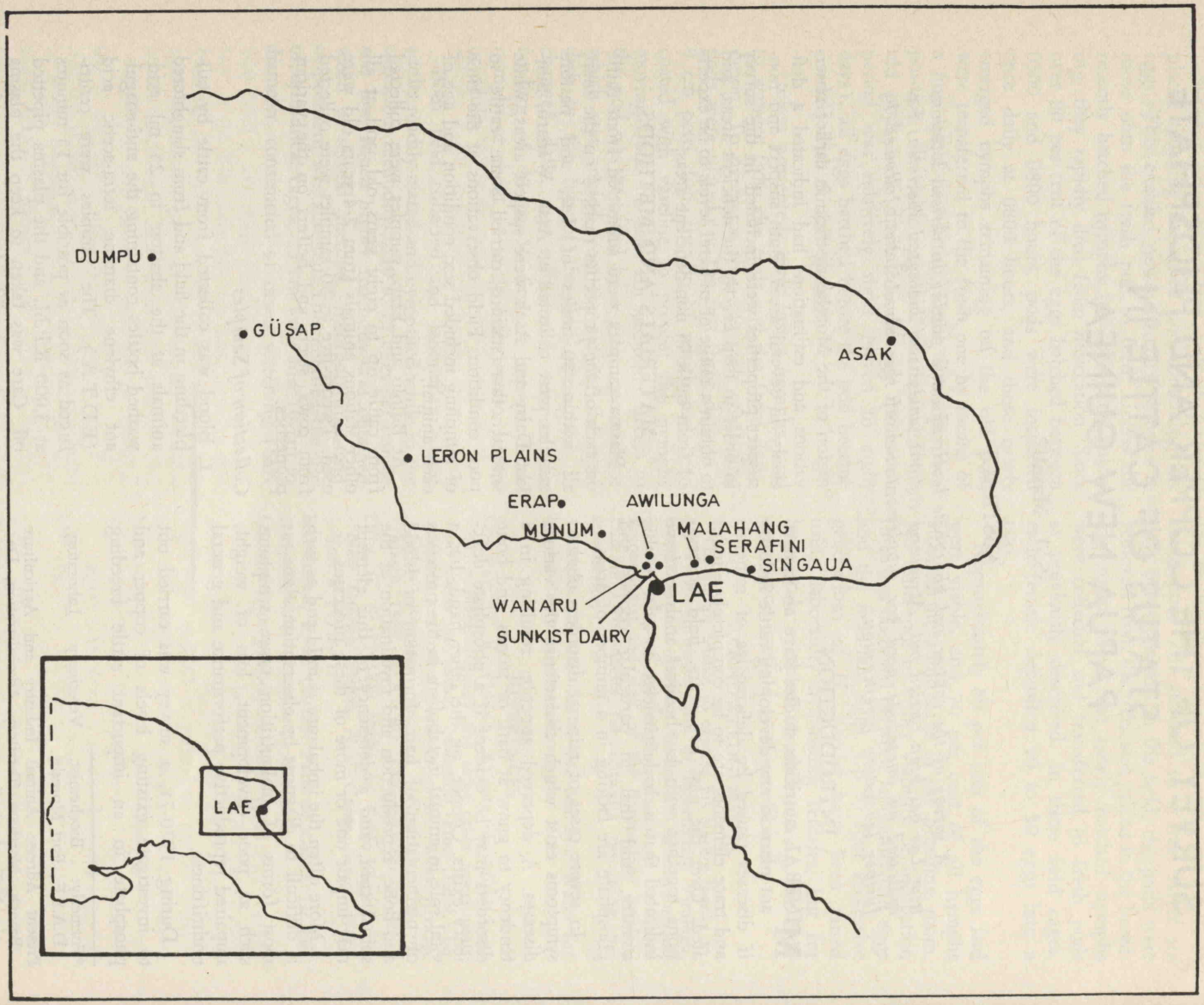
DUMPU
GÜSAP
ASAK
LERON PLAINS
ERAP
AWILUNGA
MUNUM
MALAHANG
SERAFINI
SINGAUA
LAE
WANARU
SUNKIST DAIRY
LAE

Lae to the laboratory in Port Moresby for analysis. It has been found that bovine plasma with the use of a suitable anti-coagulant is a more reliable faction for phosphate determinations than serum, and the phosphate level remains stable for up to eight days (Newman, 1968).

2. Eight different pasture samples were received from Asak cattle station, and each of these had been selected from a mixture of many samples of the same type. Each sample was dried and ground, then 0.5 g was digested with 6 ml of the acid mixture: nitric acid/sulphuric acid/perchloric acid (4:2:1). The acid digest was filtered and made up to 50 ml with glass-distilled water.

Copper Determinations

An atomic absorption spectrophotometer (AA-100) was used for copper estimations. Trichloro-acetic acid (T.C.A.) 8 per cent was shaken with 1 ml of each plasma sample, allowed to stand for five minutes, centrifuged for five minutes and the supernatant aspirated into the burner. The absorbance was read at 3,247 A°, and standard solutions contained 0.1, 0.25, 0.5, 1, 2 p.p.m. copper in 4 per cent T.C.A.

An extraction procedure was employed to estimate copper in pasture samples. One ml 1 per cent ammonium pyrrolidine dithiocarbamate (A.P.D.) was shaken with the pasture digest; the copper complex was extracted with 5 ml iso-butyl methyl ketone, pipetted off and aspirated. Standards were prepared in the same way.

Phosphate Determinations

Inorganic phosphate was estimated in plasma and pasture samples by the method of Gomorri (1942).

RESULTS

For each cattle station, the average and range of bovine plasma phosphate levels obtained are shown in *Table* 1, and the plasma copper levels are shown in *Table* 2. The number of cattle bled at each station and the time at which biochemical estimations were carried out are indicated in *Tables* 1 and 2 respectively.

Table 1.—Average phospate levels in bovine plasma from various cattle stations in the Morobe District, and range of values obtained

Cattle Station	No. of cattle in each sample	Av. phosphate level (mg%)	Range of values (mg%)
Asak	100	6.5	4.9-7.7
Wanaru	25	6.3	4.2-9.9
Munum Plantation	50	6.9	3.8-10.5
Singaua Plantation	56	8.0	5.0-8.7
Bulolo	25	6.5	3.8-10.1
Erap	25	7.6	5.6-9.6
Sunkist Dairy	25	7.3	5.2-10.6
Malahang	50	6.9	4.6-9.2
Serefini	50	7.1	5.4-9.2
Gusap Downs	35	6.3	4.4-8.5
Dumpu	30	6.5	4.6-9.2
Dolarene	6	6.8	4.0-8.9

Table 2.—Average copper levels in bovine plasma from various cattle stations in the Morobe District, with range of values obtained. For each station the month in which both copper and phospate estimations were carried out is indicated

Cattle Stations	Time of Year	Av. Copper Level (p.p.m.)	Range of Values (p.p.m.)
Asak	Sept. 1970 Sept. 1971	0.7	0.65-1.0
Wanaru	Nov. 1970	0.06	0.04-0.12
Munum Plantation	Feb. 1971	0.8	0.50-1.1
Singaua Plantation	March 1971	0.8	0.30-1.3
Bulolo	April 1971	0.6	0.40-0.9
Erap	April 1971	1.0	0.60-1.4
Sunkist Dairy	Nov. 1970	0.3	0.17-0.55
Malahang	Aug. 1971	0.9	0.50-1.4
Serefini	Aug. 1971	1.0	0.50-1.2
Gusap Downs	Oct. 1971	1.2	0.40-1.7
Dumpu	Oct. 1971	1.1	0.80-1.5
Dolarene	Oct. 1971	1.1	0.80-1.5

In *Table* 3, the results of analysis of each of the average grass types are shown.

The average plasma phosphate level of cattle grazed on both suspect and non-suspect areas lay between 6.0 mg per cent and 8.0 mg per cent.

The average plasma copper level of animals in non-suspect areas fell between 0.6

Table 3.—Copper and phospate levels in eight types of pasture from Asak cattle station

Type of Grass	Copper (p.p.m.)	Phosphate (p.p.m.)
Desmodium	42	82
Kunai	22	86
Elephant	28	94
Stylo	25	170
Para	40	650
Kangaroo	30	270
Centro	20	190
Siratro	20	190

p.p.m. and 1.2 p.p.m. The level at Asak fell within this range (0.7 p.p.m.), but values obtained from Wanaru and Sunkist Dairy samples were very much lower.

DISCUSSION

Cattle slaughtered at the Lae abbatoirs included cows and steers from Gusap Downs, Dumpu, Erap and Dolarene, and these animals were reported to be in excellent condition. The range of plasma phosphate levels obtained from these stations was 4.4 to 9.6 mg per cent, which may be taken as the "normal" range.

Since the figures in *Table* 1 for cattle from all other stations fell within this range, phosphorus is not a deficient element within this region of Papua New Guinea.

The range of plasma copper levels obtained from healthy animals was 0.5 to 1.7 p.p.m. It is evident from the figures in *Table* 2 that a copper deficiency exists in two suspect areas: at Wanaru, the range of values 0.04 to 0.12 p.p.m. was well below the lower limit of the "normal" range (0.5 to 1.7 p.p.m.). At Sunkist Dairy the deficiency was less severe, the range of plasma copper levels being 0.17 to 0.55 p.p.m, and the average value at this station of 0.3 p.p.m. was well below that of non-suspect areas. Remedies to this deficiency include pasture improvement or copper therapy.

A detailed project was undertaken in 1970 to investigate the poor condition of cattle at the Lutheran Mission cattle station as Asak. The symptoms indicated a copper deficiency, but the copper levels of samples of plasma, hair and liver from each of five herds, together with pasture samples were all within the normal range. In these tissues, if the level falls below 0.6, 8 and 20 p.p.m. respectively or if 5 p.p.m. or less is detected in pasture a mineral imbalance is indicated. A cobalt treatment trial was then undertaken, as a cobalt deficiency often produces unthriftiness in young stock and loss of weight. However, cobalt did not improve the condition of the animals.

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