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COBALT DEFICIENCY IN CATTLE IN JOHORE. LIVEWEIGHT CHANGES AND RESPONSE TO TREATMENTS

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RINGKASAN

Kekurangan zat cobalt telah didapati di kalangan lembu-lembu jenis Kedah-Kelantan yang meragut dalam pastura rumput/kekacang yang telah diberi baja. Perubahan berat badan sebelum rawatan (treatment) dan tindakbalas kepada pemberian Cobalt, Vitamin B_{12}, Copper dan Terramycin diterangkan. Terdapat kenaikan berat badan yang amat tinggi hasil dari pemberian Vitamin B_{12} dan cobalt, tetapi pemberian copper dan Terramycin tidak memberi kesan.

Kegunaannya untuk industri ternakan lembu di Malaysia dibincangkan.

INTRODUCTION

During the initial stages of pasture development research carried out by MARDI on its research station near Kluang, Johore, Friesian crossbred and Kedah-Kelantan cattle (DEVENDRA *et al.*, 1973) failed to thrive. The animals were listless, had rough coats and lost weight leading to severe emaciation *(Plate 1)*, often resulting in death.

Various tests and post-mortem investigations failed to indicate the presence of infectious disease, as is reported in detail by JAKOB *et al.* (in press). This paper presents evidence to show that the disorder was due to cobalt (Co) deficiency.

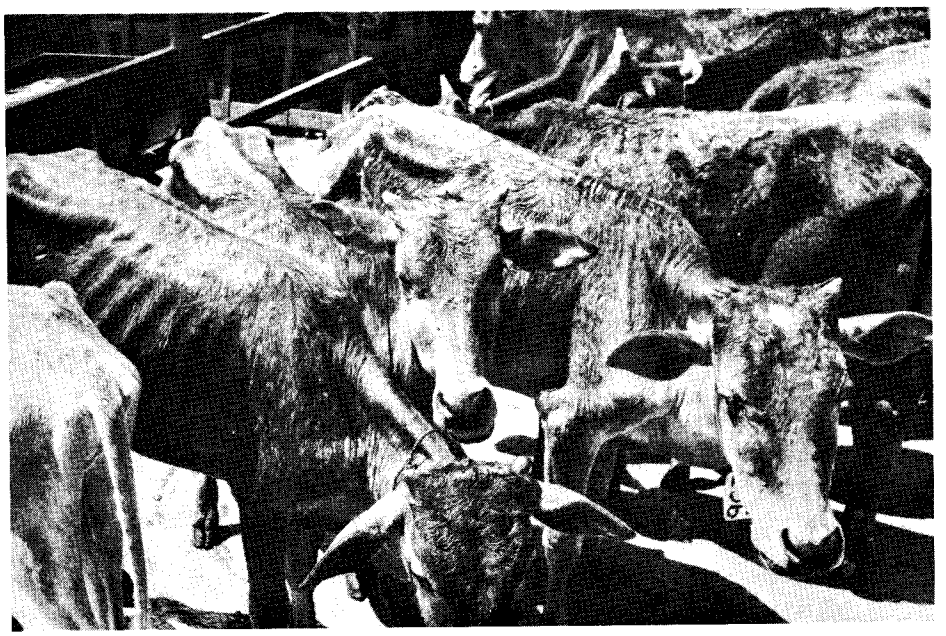

Plate 1. Kedah-Kelantan bulls between 6 and 12 months of age suffering severe cobalt deficiency.

The cases occurred at the MARDI Research Station near Kluang, Johore, (2°N, 103°20'E) on Soil of the Rengam Series (ANON, 1966; COULTER, 1972). Kedah-Kelantan bulls, 6 to 12 months of age, were obtained from Besut, Trengganu, after vaccination against haemorrhagic septicemia. They were treated regularly against worms and ticks. The animals arrived at the Station on four dates, viz. 15 June, 11 July, 20 November and 4 December, 1974. Seventy-two were used in a grazing experiment to investigate the effects of phosphate fertilisation and stocking rate on liveweight gain.

The mean pasture composition in September, 1974 was 77 percent common guinea grass *(Panicum maximum)*, 16 percent puero *(Pueraria phaseoloides)*, 5 percent stylo *(Stylosanthes guianensis* cv Schofield*)*, 1 percent centro *(Centrosema pubescens)* and 1 percent other herbs. The dry matter yield varied with time of the year and stocking rate, but was in excess of 4000 kg/ha at all times. The mean chemical composition of the last fully expanded leaves of the main components for October, 1974 is shown in *Table 1*. These figures indicate adequate levels of N, P, K, Ca, Mg and Cu for normal growth of young beef cattle. (National Research Council, 1963). On account of the low Na contents the animals were provided with common salt (NaCl), but no other supplements were given. Clean drinking water and shade were available.

From 21 August, 1974 all 72 animals in the grazing experiment were weighed every four weeks. As each animal had been identified on arrival at the station, it was possible to relate the liveweight chance over the previous four weeks to the number of weeks the animals had been on the pasture. There was a highly significant negative linear relation between liveweight changes and time spent on the pasture. The regression equation was

$$Y = 371 - 14\ X\ (r = -0.65),\ (P < 0.001)$$

where Y represents average daily weight gain (g/day) and X number of weeks on the pasture. It follows from this relation that the animals had to spend an average of 26 weeks on the pasture before weight losses were recorded.

Clinical examinations (JAKOB *et al.*, in press) suggested that Co or copper (Cu) deficiency could be implicated. In addition, a chance treatment of 9 animals in very poor condition *(Plate 1)* with 1000 μg of vitamin B_{12} plus 3 ml of Terramycin on 7 April 1975 resulted in remarkable recovery. However, since the two treatments were combined the recovery could not be attributed to either one. Consequently, a research project was undertaken to investigate the effects of vitamin B_{12} Co, Cu and Terramycin on liveweight changes of Kedah-Kelantan cattle.

TABLE 1. MEAN CONCENTRATION OF MINERALS OF GREEN LEAVES OF THE MAIN PASTURE SPECIES AT THE MARDI RESEARCH STATION NEAR KLUANG ON 14 OCTOBER, 1974.

Species	Percentage of the dry matter						ppm
	N	P	K	Ca	Mg	Na	Cu
Guinea grass	2.0	0.14	2.6	0.32	0.17	0.01	8
Stylo	4.1	0.16	2.6	1.56	0.39	0.01	9
Puero	4.6	0.20	3.1	0.47	0.26	0.01	8

MATERIALS AND METHODS

On 17 April 1975, 23 Kedah-Kelantan bulls between 6 and 12 months of age that were grazing pastures adjacent to the grazing experiment were divided into two groups according to body condition. Group I consisted of 16 animals with a mean weight of 68 kg, that were in reasonable to poor condition, showing the symptoms described above. The animals had either maintained or lost bodyweight since December 1974. Group II consisted of seven animals in good condition, mean weight 93 kg, which had gained weight consistently since December 1974.

The animals of Group I were randomly allocated to the following treatments with four animals in each:

(a) Control, no treatment;

(b) 1000 μg vitamin B_{12} injected intramuscularly on each of the 17, 19 and 24 April 1975;

(c) Co bullet plus steel grinder (DEWEY, LEE and MARSTON, 1958) deposited in the reticulum on 17 April and another cobalt bullet on 17 May 1975 (the steel grinder was included to avoid calcium deposition on the Co bullet, thus rendering the Co unavailable).

(d) 5 ml of Terramycin injected intramuscularly daily for one week from 17 April 1975.

On 17 and 24 May 1975 two animals from the control group (a) and two from the Co group (c) were given 3 g Cu SO_4 by drenching. This allowed for a Cu effect and a Cu x Co interaction to be detected if present.

Treatments (a), (b) and (c) were also used on two animals each of Group II. One animal of Group II received Cu SO_4 as indicated above.

All animals of Groups I and II grazed together on a nitrogen fertilized pasture of *Setaria anceps* cv. Kazungula.

When the first indications of a response to vitamin B_{12} and cobalt became evident, all 72 animals on the grazing experiment (mean weight 99 kg) received 2000 μg of vitamin B_{12} on each of the 29 April, 1 and 3 May 1975. On 29 May the 36 animals grazing one replicate of the experiment were also given a Co bullet plus grinder. This allowed for the measurement of residual effect of the vitamin B_{12} treatment.

From the beginning of the treatment period till 24 June 1975 the animals were weighed every two weeks and at other times every four weeks. Overnight fasting without water for 16 hours was applied before each weighing.

RESULTS

1. Responses to treatments.

Group I.

Figure 1 indicates that both vitamin B_{12} and Co were capable of restoring good liveweight gains, but the effect of vitamin B_{12} lasted only till 13 October. The animals treated with either Cu or Terramycin held their weights and even gained some compared to the control animals but after October all lost weight rapidly and several died *(see Fig. 1)*. There was no advantage in animal performance by adding Cu to the Co treatment.

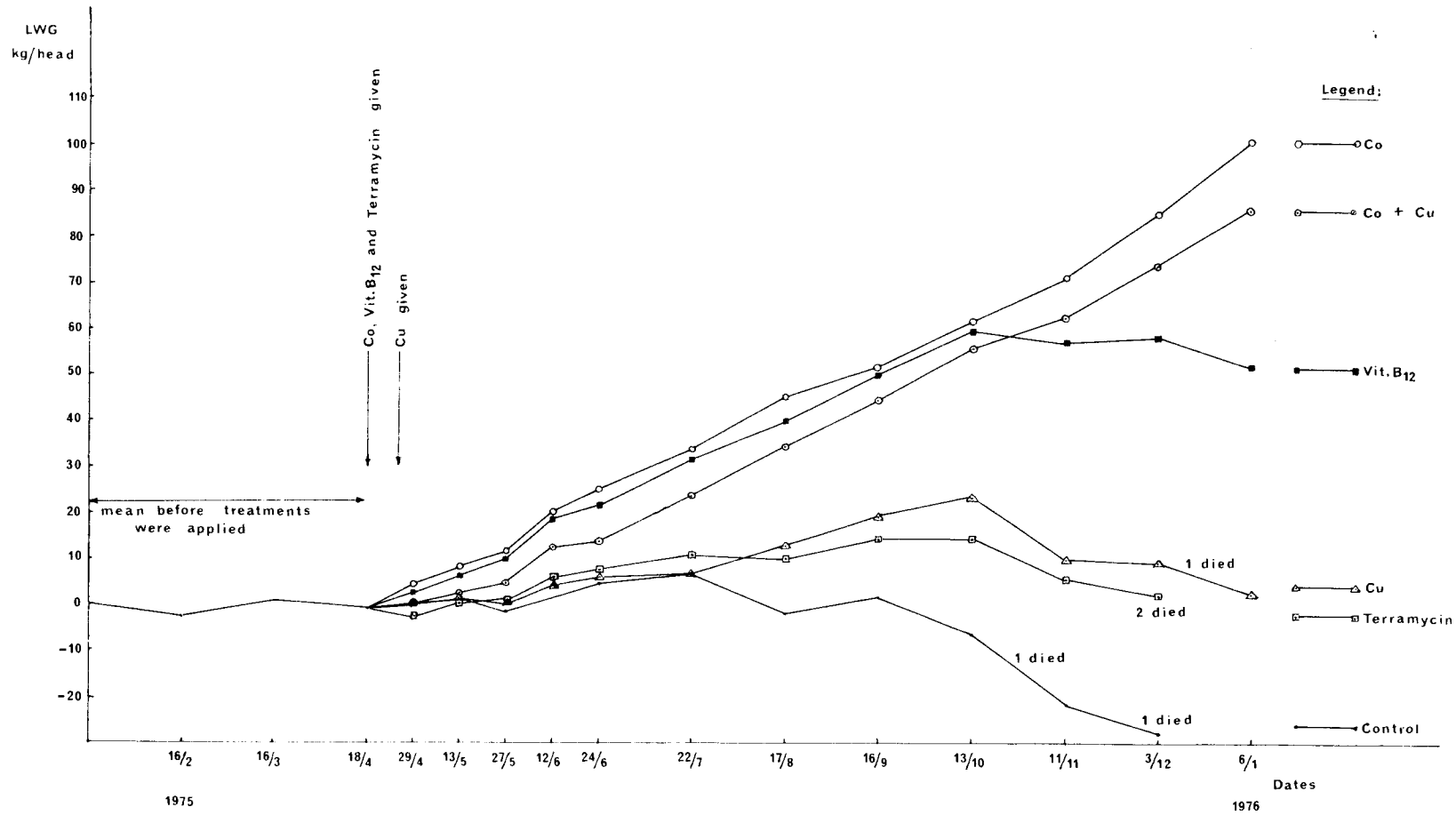

Figure 1. Cumulative liveweight changes of Kedah-Kelantan bulls in poor condition before and after treatment with cobalt, copper, vitamin B_{12} and Terramycin.

Group II

These animals had not lost weight since December 1974 and the responses to the treatments given in April 1975 were not as consistent as with Group I *(Fig. 2)*. One control animal lost weight, whereas the other continued to gain until 13 October and then lost. One animal treatment with vitamin B_{12} continued to gain weight, while the other lost weight after July and died in December. All the other animals gained at much the same rate, although those that had received Co appeared to gain at a slightly higher rate after 11 November than animals treated with vitamin B_{12} or Cu.

2. Animals on the grazing experiment

The two groups of 36 animals behaved very similarly before and after the vitamin B_{12} treatment on 29 April, which had a very pronounced effect *(Fig. 3)*. Animals that received Co bullets as well continued to gain weight at the same rate, while those that had received vitamin B_{12} only showed reduced gains after 27 August and failed to gain weight after 11 November.

3. Cobalt content of herbage.

Of the main species growing in the grazing experiment, green leaves of Guinea grass and puero had a Co content of less than 0.009 ppm on a dry matter basis and those of stylo 0.014 ppm on samples taken in June 1975.

DISCUSSION

The data presented show that the animals suffered from Co deficiency. There was no evidence of Cu deficiency. The slight improvement of copper-treated animals in Group I between 22 July and 13 October cannot be explained, but one of these animals died and animals treated with Co and Cu showed no advantage over those treated with Co alone. The one animal of Group II treated with Cu continued to gain weight, but it was in good condition and had arrived at the station only in November 1974.

The Co content of the herbage in the grazing experiment was extremely low at around 0.01 ppm. The minimum concentration required in the diet of cattle is stated to be about 0.07 ppm (UNDERWOOD, 1966), although recent research has suggested a minimum level of 0.04 to 0.05 ppm. (MACPHERSON, MOON and VOSS, 1973).

Co is required by ruminants for the synthesis of vitamin B_{12} (UNDERWOOD, 1966), which explains the response to this compound by injection. An interesting aspect of this response, is its long-lasting effect. The shortest residual response, in only one case, was two months, but most animals were still showing beneficial effects after more than five months. Vitamin B_{12} in the amounts given in this study may therefore be regarded as a useful treatment of Co deficiency, with very rapid results, in cases where Co bullets are unavailable, or in anticipation of them being obtained. Another way of overcoming Co deficiency is by the provision of cobalt-containing licks; the minimum content needed in the lick is 0.1 percent Co according to UNDERWOOD (1966). In New Zealand and Australia Co deficient areas have been fertilised with cobalt sulphate at the rate of 560 g per ha every three or four years. However, for Malaysian conditions the administration of a Co bullet plus grinder may be the most attractive means of overcoming the problem. SKERMAN, O'HALLORAN and MUNDAY (1961) found that Co bullets were retained by 3 out of 36 cows for less than three months, by 26 for at least three months and by 7 for at least eight months. As there is no known definite retention time for Co bullets these may be applied at say six monthly intervals or when an

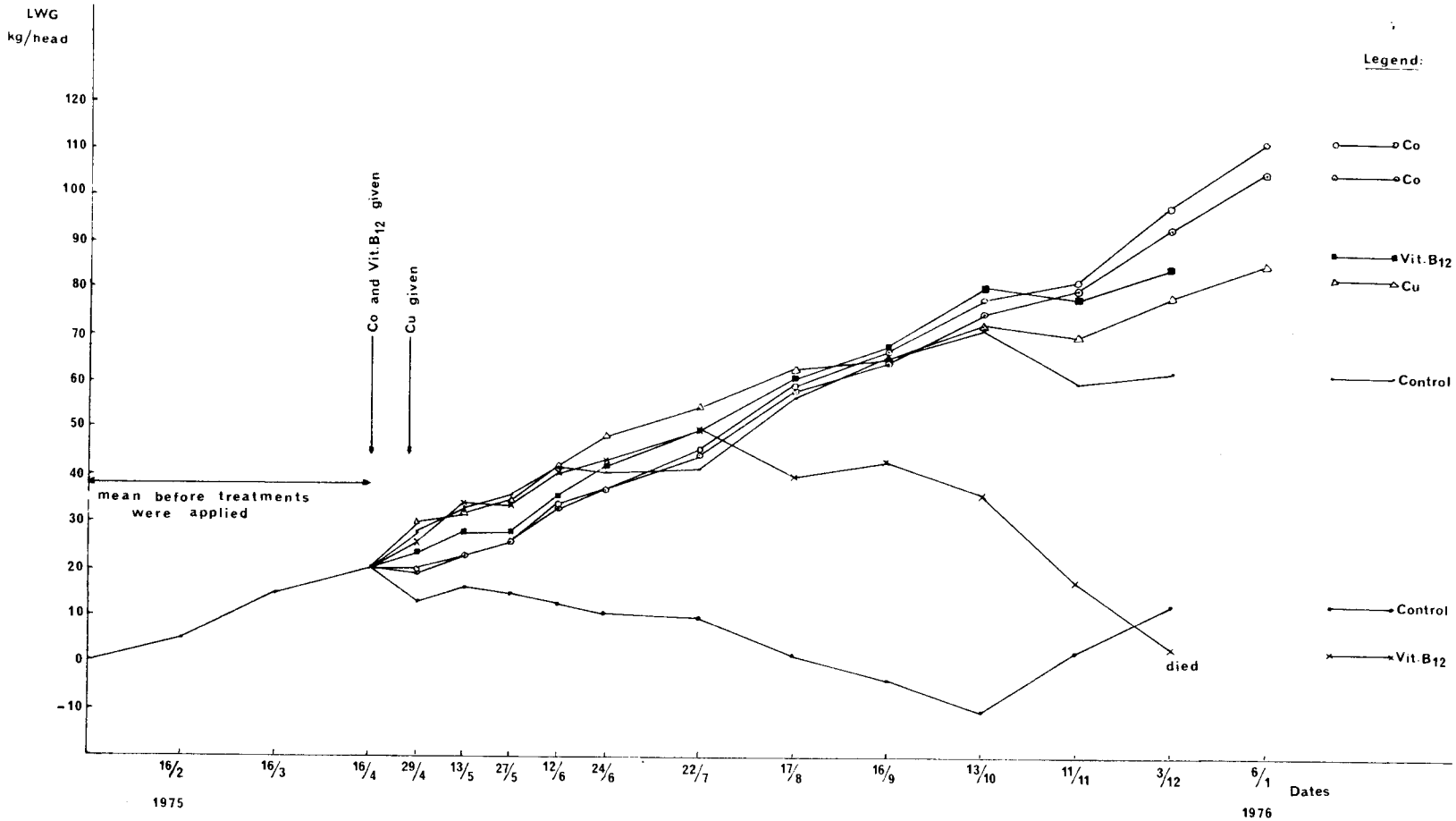

Figure 2. Cumulative liveweight changes of Kedah-Kelantan bulls in good condition before and after treatment with cobalt, copper and vitamin B_{12}.

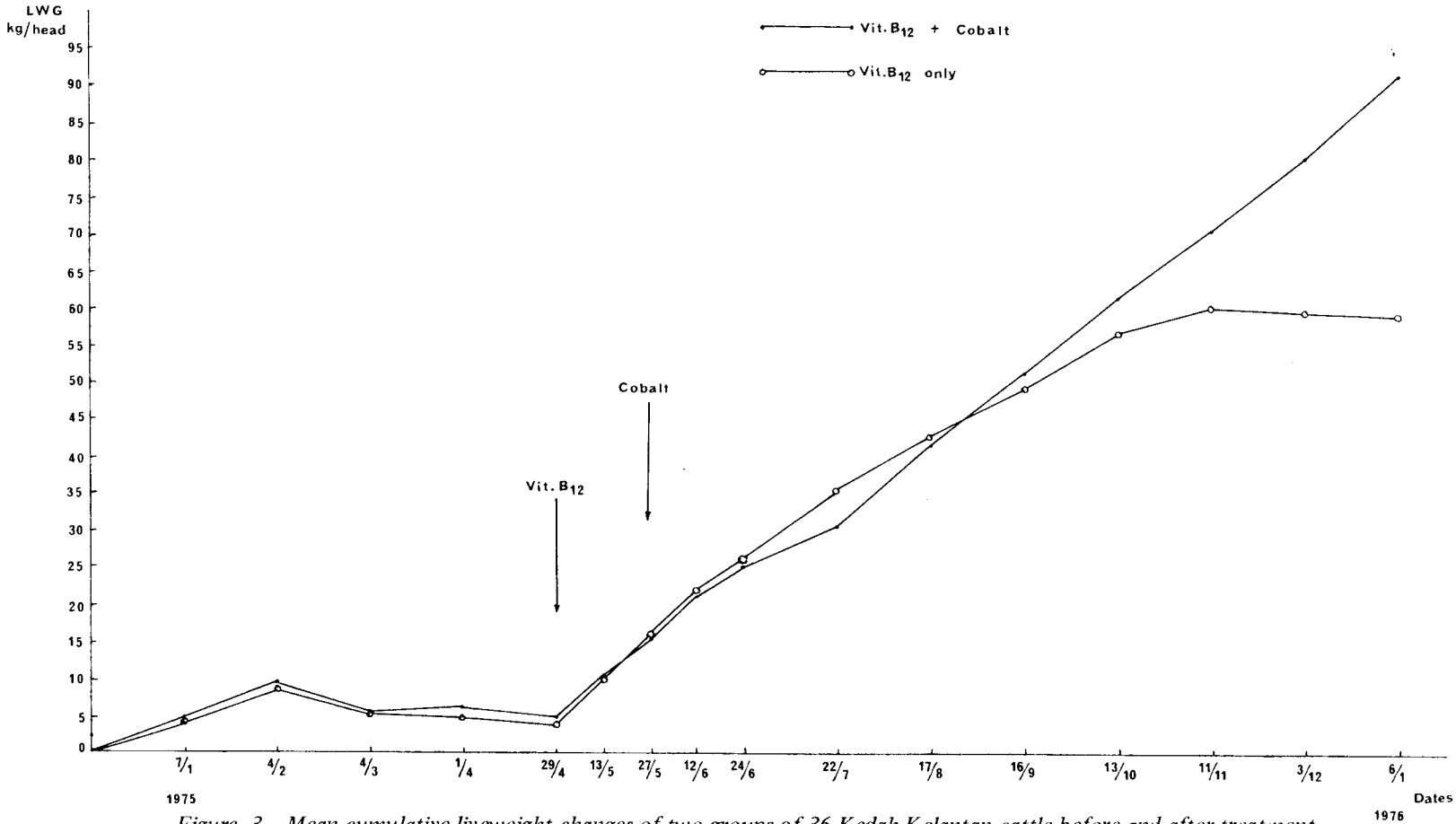

Figure 3. Mean cumulative liveweight changes of two groups of 36 Kedah-Kelantan cattle before and after treatment with vitamin B_{12} or vitamin B_{12} plus cobalt.

animal shows symptoms of Co deficiency. The latter would be the most economic way of treating a herd, but it requires fairly close observation.

Co deficiency in cattle and sheep was discovered in Australia (MARSTON, 1935; LINES, 1935; UNDERWOOD and FILMER, 1935), and the most recent cases described there occurred in tropical Cape York Peninsula (WINTER, SIEBERT and KUCHEL, 1976). It has been encountered in many other countries, e.g. in New Zealand (ANDREWS 1956), the United States (RAY *et al.*, 1948), Kenya (HOWARD, 1970) and in various European countries.

With the severity of the symptoms as found in this study, it is surprising that Co deficiency has not been described previously in Malaysia. It is possible that Co deficiency is restricted to the Rengam soil type, which is associated with the granites of the foothills of the main ranges, whereas the traditional livestock areas are developed on riverine or marine alluvium. Another possibility is that Co deficiency is quite widespread, but at a subclinical level, resulting in reduced production. This is much more difficult to detect than severe cases as described in this paper. It may also be hidden by the provision of mineral licks which contain as little as 0.04 percent Co, perhaps sufficient to avoid severe deficiency, but resulting in reduced productivity.

In conclusion, we have shown that Co is severely deficient in the Rengam soil type at the MARDI Research Station near Kluang and that the shortcoming can be easily overcome. However, it has not been established how widespread this condition is in Malaysia. Unthrifty animals in other parts of the country may well suffer from other deficiencies or diseases. Co is only one of many requirements for healthy cattle, the main ones being adequate feed of sufficient protein content and digestibility and the absence of parasites and diseases.

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SUMMARY

Cobalt deficiency in Kedah-Kelantan cattle was discovered on a fertilized grass/legume pasture. Livestock changes before treatment and the responses to cobalt, vitamin B_{12}, copper and Terramycin treatments are described. There was a dramatic increase in liveweight gain as a result of vitamin B_{12} and cobalt administration, but there were no effects from copper or Terramycin.

The practical significance for the Malaysian cattle industry is discussed.

REFERENCES

ANON. (1966). Standard Series descriptions. Department of Agriculture, Kuala Lumpur. Mimeo.

ANDREWS, E.D. (1956). Cobalt deficiency. *N.Z. J. Agr., 92* : 239.

COULTER, J.K. (1972). Soils of Malaysia. A review of investigations on their fertility and management. *Soils and Fertilizers, 35* : 475.

DEVENDRA, C., MOHD. NORDIN HASSAN, HODGE, R., LEE KOK CHOO, T. and PATHAMASINGAM, M. (1973). Kedah-Kelantan cattle of Malaysia. *Malays. Agric. J., 49* : 25.

DEWEY, D.W., LEE, H.J. and MARSTON, H.R. (1958). Provision of cobalt to ruminants by means of heavy pellets. *Nature,* London. *181* : 1367.

HOWARD, D.A. (1970). The effects of cobalt and copper treatment on the weight gains and blood constituents of cattle in Kenya. *Vet. Rec., 87* : 771.

LINES, E.W. (1935). The effect of the ingestion of minute quantities of cobalt by sheep affected with "coast disease": a preliminary note. *J. Counc. Scient. Ind. Res.,* Aust. *8* : 117.

MARSTON, H.R. (1935). Problems associated with "coast disease" in South Australia. *J. Counc. Scient. Ind. Res.,* Aust. *8* : 111.

MACPHERSON, A., MOON, F.E. and VOSS, R.C. (1973). Some effects of feeding young steers a diet deficient in both cobalt and copper. *Brit. Vet. J., 29* : 414.

National Research Council (1963). Nutritional requirements of beef cattle. National Academy of Sciences, Washington D.C., U.S.A.

RAY, S.M., WEIR, W.C., POPE, A.L., BOHSTEDT, G. and PHILLIPS, P.H. (1948). Studies on the role of cobalt in sheep nutrition. *J. Anim. Sci., 7* : 3.

SKERMAN, K.D., O'HALLORAN, M.W., MUNDAY, B.L. (1961). The effect of cobalt bullets on milk production of dairy cattle. *Aust. Vet. J., 37* : 1811.

UNDERWOOD, E.J. (1966). The mineral nutrition of livestock. FAO and Commonwealth Agricultural Bureaux, England.

UNDERWOOD, E.J. and FILMER, J.F. (1935). Enzootic marasmus: the determination of the biologically potent element (cobalt) in limonite. *Aust. Vet. J., 11* : 84.

WINTER, W.H., SIEBERT, B.D. and KUCHEL, R.E. (1976). Cobalt and copper therapy of cattle grazing improved pasture in northern Cape York Peninsula. *Aust. J. Expe. Agric. Anim. Husb.* (In press).