TECHNICAL PAPERS

The Effect of Vitamin B_{12} Concentrate on the Growth of Weanling Pigs Fed Corn-Soybean Diets[1]

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In experiments with chicks, Ott, Rickes, and Wood (*2*) have shown that crystalline vitamin B_{12} gave a growth response comparable to that obtained with crude sources of the "animal protein factor." Johnson and Neumann (*1*) have obtained growth stimulation from a vitamin B_{12} concentrate fed to suckling pigs.

The present experiment was undertaken to determine whether crude vitamin B_{12} concentrate exhibited a growth-stimulating effect in weanling pigs fed a diet in which the protein souree was entirely of plant origin.

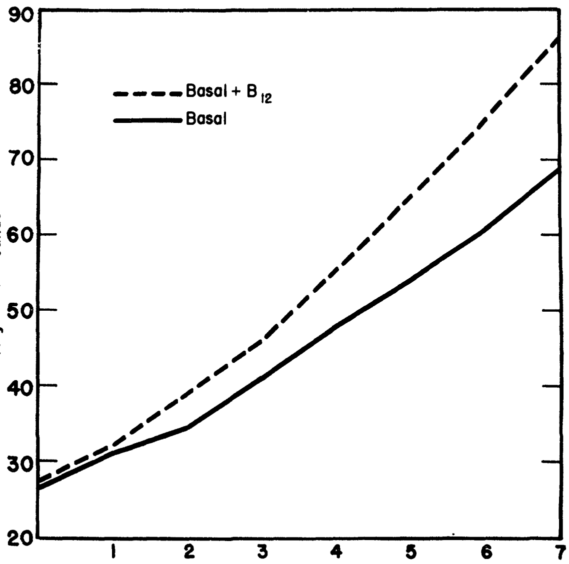

FIG. 1. Effect of vitamin B_{12} concentrate on growth rate.

The pigs used in the experiment were farrowed by Chester White gilts which had never been fed any known source of the "animal protein factor." At the time of weaning, 12 pigs were selected and divided into two lots of six pigs each. The basal ration was the same as that fed to the gilts during their growth, gestation, and lactation period and contained corn, 77%; soybean oil meal, 20%; and a complex mineral mixture, 3%. This ration was supplemented with the following B vitamins expressed in mg per lb of feed: thiamine, 5; riboflavin, 5;

TABLE 1

EFFECT OF ADDITION OF VITAMIN B_{12} CONCENTRATE TO A CORN-SOYBEAN DIET

	Lot 1 (Fed basal ration)	Lot 2 (Fed basal ration + vitamin B_{12})
Number of pigs	6	6
Initial age in weeks	6	6
Number of weeks on trial	7	7
Average initial weight (lb)	26	27
Average daily gain (lb)*	0.87 ± .09	1.20 ± .08
Average daily feed consumption (lb)	2.57	3.21
Lb of feed per lb of gain	2.94	2.65

* Lifference in average daily gain between lots 1 and 2 is statistically significant.

calcium pantothenate, 20; niacin, 25; and pyridoxine, 2. Choline chloride was also added at a level of 0.1%. Vitamins A and D were added to the ration in amounts which supplied 2,000 I.U. of vitamin A and 200 I.U. of vitamin D per lb of feed. This ration contained 16.5% crude protein by Kjeldahl analysis. All of the pigs in the experiment were fed *ad libitum.* The pigs in lot 1 were fed the basal ration and their growth response is shown in Fig. 1 and in Table 1. The pigs in lot 1 gained an average of 0.87 lb per day and consumed 2:57 lb of feed. It required 2.94 lb of feed to produce a 1-lb gain in body weight.

The pigs in lot 2 were fed the same ration as those in lot 1, but in addition, this ration was supplemented with 0.5% vitamin B_{12} concentrate. The vitamin B_{12} concentrate had been assayed in comparison with crystalline vitamin B_{12} and the preparation standardized to contain 2 mg of vitamin B_{12} activity per lb as measured by the chick-growth method. The growth curve for the pigs in this lot is shown in Fig. 1. It can be seen that as the experiment progressed, the differences in rate of gain between pigs in lots 1 and 2 became significantly greater, and by the end of the seventh week pigs in lot 2 averaged 17 lb heavier than animals in lot 1. Table 1 shows that pigs in lot 2 gained an average of 1.20 lb of body weight and consumed an average of 3.21 lb of feed per day. The animals in lot 2 utilized their feed more efficiently since it only required 2.65 lb of feed to produce a 1-lb gain in body weight as compared with 2.94 lb of feed for pigs in lot 1. From a practical standpoint the growth rate of pigs in lot 2 was excellent, especially since the protein content of the ration is considerably lower than one would recommend for pigs of that age

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and weight. It seems valid to conclude, therefore, that the significantly greater gains made by pigs in lot 2 were due to the addition of vitamin B_{12} concentrate. However, since this preparation undoubtedly contains impurities, it cannot be stated definitely that the growth-promoting activity of the concentrate was due to vitamin B_{12} *per se*, alhough the latter hypothesis seems likely.

References

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A Technique for Chronic Remote Nerve Stimulation[1]

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Chronic remote nerve stimulation is the usual terminology applied to a technique whereby a nerve in an intact animal is stimulated for periods of weeks or months by an electrical current, the ultimate source of which is removed from and not connected to the animal. By this method the effect of stimulation of a specific nerve in unanesthetized, intact animals can be assayed, thus eliminating disturbing emotional factors due to restraint. Chronic remote nerve stimulation permits close imitation of normal and certain abnormal physiological states.

Various methods for attaining remote stimulation have been tried in the past. Loucks (*12*), and Chaffee and Light (*2*) reported techniques in which a secondary coil was buried beneath the integument, leads from this being connected to electrodes on given nerves. A primary coil positioned over or around the buried unit induced a current in the secondary coil. High currents are required in the primary circuit to induce adequate currents in the secondary. This proves cumbersome and inefficient. These disadvantages can be partially offset by restraining the animal and closely approximating the two coils as Harris (*9*) is doing. However, since restraint of the animal must be employed, such techniques eliminate many of the desirable features of chronic remote excitation. Its great advantage over systems of chronic stimulation by means of lead wires brought out through the skin, as utilized by Hess (*10*), Cannon (*1*), Manning and Hall (*13*), Cressman and Blalock (*3*), Kottke, Kubicek, and Visscher (*11*), is that there is no possibility of infection traveling down the leads. This method also restricts the wave form of the stimulating voltage developed across the secondary coil.

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Newman, Fender, and Saunders (*14*), and Greig and Ritchie (*8*) have reported success using radiofrequencies to provide an electromagnetic field for exciting the buried secondary coil. Fender utilized a frequency of 430-kc while Greig and Ritchie employed a 100-kc frequency. Along with other technical difficulties, polarization at the stimulating electrodes and broken lead wires due to intra-animal motion were the major factors in preventing the attainment of chronicity. Fender (*4–7*) did report one period of 5½ months of successful splanchnic stimulation but broken leads and polarization were always major handicaps in his experiments.

For the past year we have had in operation a system of remote stimulation utilizing radiofrequency for transmission of the signal to the receiver. Detailed studies of polarization with various wave forms have been made. Buried units have been devised and subjected to all the traumata possible in unanesthetized, unrestrained animals. Following is a description of the system which has met our minimal standards of chronicity and remoteness, i.e., stimulation over periods of 4 months in a cage 8 ft. in diam.

The receiver circuit consists of a flat pickup coil tuned to resonate at 1 megacycle by a condenser connected in parallel with it. The r-f voltage output from this is rectified by a germanium crystal and then applied to the nerve which is to undergo stimulation. A by-pass condenser is connected across the output terminals of the receiver to prevent r-f voltage from being applied to the nerve and to increase the receiver sensitivity.

An analysis of the receiver circuit shows that there are optimum values of the circuit elements for maximum sensitivity. The voltage output of the coil under optimum conditions is proportional to the 3/2 power of the coil diameter and to the 1/2 power of the radiofrequency. This would indicate that, within the limits of the experiment, optimal conditions may be obtained with a pickup coil as large in diameter as possible and of a high radiofrequency. The crystal rectifier should have as low a resistance as possible. The number of turns on the coil should be adjusted so that the product of its inductive reactance and Q is equal to the equivalent load resistance presented by the nerve and crystal rectifier. Sufficient capacitance should be added across the coil to produce resonance.

Two types of receivers were constructed: one was a flat disk with a single pickup coil and the other was a sphere with three coils mounted mutually at right angles. The flat receiver is used in experiments where the subject is held fixed for a time in such a position that the receiver coil is properly oriented with respect to the r-f magnetic field. The exciting field may be induced by a large primary coil which entirely surrounds the subject or by a small coil held in close proximity to the receiver. The spherical receiver is essentially three separate receivers with their output terminals connected in parallel. By mounting the pickup coils mutually at right angles the receiver will respond to an r-f magnetic field in any direction. With this receiver the subject may move around freely within a single primary coil 6–10 ft in diam and receive nearly uniform stimulation at all times.