Proposals for the Rational Control and Prevention of Bovine Brucellosis in Nigeria

by

DR G. O. ESURUOSO
*Department of Veterinary Public Health
and Preventive Medicine
University of Ibadan, Ibadan.*

SUMMARY

In an earlier presentation and in relevant publications (Esuruoso, 1972; 1974), it was shown that Nigeria could be divided into free, moderately infected and heavily infected areas with regard to bovine brucellosis. In this paper, it is recommended that where there is little or no infection at the moment the disease could be prevented by annual serological and bacteriological surveillance and removal by culling of any positive reactors. In moderately infected areas the few reactors should be identified by branding after the appropriate tests have been performed. They should then be separated from clean animals and allowed to complete their reproductive life without contact with clean herds. Offsprings of the infected cattle which later turn out to be clean after necessary testing before they reach the breeding age, could then be mixed with the clean herd.

Heifer calves in heavily infected herds should be inoculated with *Brucella abortus* strain 19 (S19) attenuated vaccine at the age of 3 to 6 months. Cows and mature heifers in these herds should be tested annually and separated into clean and infected groups. The infected group should be kept on separate pastures from the clean group. They should also be confined for calving and their manger beddings should be destroyed by incineration.

At slaughter as well as during abortions and infective calvings, the *Brucella abortus* serotypes causing the disease should be isolated, identified completely and propagated for further study and vaccine production. Under no circumstance should indiscriminate vaccination be carried out on any herd in this country, as this will confuse the situation and confound any rational attempts at control or eradication.

INTRODUCTION

The aim of a control programme is to reduce the incidence or prevalence of a disease already existing in a group of animals or people. In prevention we seek to protect clean animals and uninfected men

from being infected. Therefore, where there has been no infection the logical measure should be prevention. But where infection already existed a control programme will be more appropriate. Then of course we have to choose between partial control or eradication.

In other words, before we can make a rational proposal for the prevention and control/eradication of a disease we must seek to know whether and where the disease exists in the various parts of the country and to what extent in each area.

With regard to bovine brucellosis in Nigeria some basic information already exists in the form of the brucellosis map of Nigeria (Esuruoso, 1974). According to this map cattle herds in certain areas are known to be virtually free from the disease while others are known to be heavily infected. Further investigations have shown that animals introduced into new areas from some of the infected herds had carried with them the trail of brucellosis. It is therefore possible in certain cases to predict the presence of brucellosis in some virgin herds. Such predictions recently made were later confirmed by actual testing (Esuruoso, 1975).

Nevertheless the brucellosis picture in the country today is far from complete and more work still needs to be carried out on this subject. But what is already known is enough to guide us in the formulation of a control or preventive programme. And as we are now aware, any such programme should fit the status of the flocks in different places. A general vaccination programme that will fit all herds will be empirical, unnecessary, wasteful and in some cases causing more harm than good to the animal industry of this country.

PREVENTION

It is recommended that before a new cattle herd is started the location should be investigated with regard to the ecology of both livestock and wildlife. We should know whether animals infected with brucellosis and other diseases are likely to have been or still be in the area. This is essential because grazing in the same area with infected animals may lead readily to infection of otherwise clean beasts. By the nature of brucellosis the discharges from the reproductive tracts of infected animals are the main sources of infective agent.

The need to prevent contact between members of infected herds and the new ones should be obvious. Naturally we should therefore endeavour to choose an area free from the disease and if possible ensure that such area will continue to be free from the disease. Measures to ensure this freedom may include the installation of physical constructions for the separation of the new herd from other livestock and wildlife in the locality. This expensive programme is not always necessary.

Animals to be used as foundation herds should be tested and found free from the disease before being brought into the new herd. In this connection the mixing of disease free animals with those of unknown status should be avoided at all costs. To ensure this, routine testing of all animals newly acquired should be carried out. The rapid agglutination test is a useful procedure to adopt in such cases. Where facilities are available the tube agglutination test should also be carried out and the results expressed in international units of antibodies. Once the herd is established, the animals found free at the beginning should be tested twice a year for about 3 years and any reactors removed immediately. After this period all that will be necessary will be an occasional testing to ensure that the animals remain clean.

Although bulls do not usually transmit the disease through coitus, an infected bull should not be used on a clean heifer. Where artificial insemination is to be used, the sources of the semen should be known to be free from brucellosis. Proper precau-

tion and testing should also be carried out on batches of semen obtained for the purpose. The acquisition of replacement bulls should be followed by usual testing before the animal is used in a clean flock.

It should be noted from the above that it is not enough to start with a clean herd; it is also necessary to ensure that the herd remain clean by routine testing and observations as described earlier.

CONTROL

Various control measures have been tried in various countries of the World with variable degrees of success. But it is generally agreed that control measures should always be designed to meet the needs of particular areas. In this connection consideration should be given to the level of infection, the number and age of infected animals, local customs which may promote or militate against the programme, probable cost of the programme, and the maintenance of the status once achieved. There must be some means of evaluating the progress of such programmes and of introducing innovations or modifications from time to time. The decision must be made from the start whether partial control or eradication is the aim of the programme.

In countries like the U. S. A. where control measures have been carried out for many years; it has been discovered that the earlier costs of the operation in heavily infected areas are usually less than the expenses towards the end of the operation. Reduction in incidence is usually easy and comparatively cheap to attain but total eradication is usually very expensive in terms of personnel, equipment and surveillance costs. In Nigeria, it is recommended that limited control should be our first step, but this should be so designed that eradication in individual herds may be achieved later.

Control in Low Infection Areas

In herds where the infection rate is low, the best procedure is to test and permanently brand infected animals and then separate them from other members of the

herd. During calving period they should be isolated and allowed to calve in an area or enclosure where all the fomite contaminated by uterine discharges during abortion or normal parturition may be totally disposed of by incineration. By this means the spread of the disease to clean herds may be prevented. It should be obvious from the fore-going that vaccination either with attenuated strain 19 (19) which may interfere with serological diagnosis of subsequent infections or with killed adjuvant vaccines which give only limited protection is not recommended. The failure of S19 vaccinations has been discussed by various people (Field, 1968). It is now generally accepted that such failures include possible infections as well as some cases of abortions inspite of vaccinations. The need to achieve new vaccines is therefore relevant.

Control in Heavily Infected Herds

In heavily infected herds, vaccination may be considered as the first step in the control measure. In this case an early decision should be made as to the ultimate aim of the control programme. If eradication is envisaged the use of killed adjuvant vaccines may be considered in the early stages and not vaccination at all in the later stages. The adjuvant vaccines are recommended in this case because they are non-agglutinogenic and therefore their use will not interfere with diagnostic procedures of animals which later become infected. By this method some measure of protection will be achieved and yet infected animals could easily be detected and handled accordingly.

The idea of adjuvant vaccine application is to ensure that all the young clean animals are protected to a certain extent and that infected adults could still be easily identified and removed one by one as they pass their reproductive age. The use of S19 is not recommended where the ultimate aim is eradication because in some cases the vaccine may lead to clinical infection. This will introduce a further

complication in the diagnosis of the disease. In any case S19 vaccination does not always prevent infection or re-infection of susceptible cattle.

It should be stated as a general information that both the S19 vaccines and the killed adjuvant vaccines may be obtained in Nigeria through the Director of the National Veterinary Research Institute in Vom, who will also give advice in such matters. What we should not do is to start any vaccination programme in new herds without investigating the herd and without taking advice from the right quarters.

At the moment, because of a research programme now well established in the department, request for testing, advice and recommendations on suitable vaccination programmes could be made also to the Department of Veterinary Public Health and Preventive Medicine, at the University of Ibadan. In most cases a collaborative programme is established between the academic veterinarians in the University department and the practising Veterinary Officers in the areas affected. In the past such joint programmes have always been a success. Unless a definite policy is established now to control bovine brucellosis, the disease will continue to spread, to affect newly acquired animals and to cause abortions, infertility and human sufferings.

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The Effects of Graded Levels of Copper in the Diets of Growing Rabbits on their Performance Characteristics and Carcass and Organ Measurements

by

T. A. OMOLE
Department of Animal Science
University of Ife
Ile-Ife, Nigeria

SUMMARY

THE effects of feeding diets supplemented with 0, 100, 150 and 225 ppm copper to growing rabbits was studied with respect to life performance and carcass characteristics. Added copper significantly ($P < 0.01$) improved daily rate of gain and efficiency of feed utilization. Carcass yield and kidney fat deposition were also significantly ($P < 0.05$) increased by all levels of supplementary copper. Dietary copper did not significantly effect liver, kidney and stomach weights. The thickness of caecum was non-significantly increased by 100 and 150 ppm copper, while the small intestine was significantly ($P < 0.01$) thickened by these levels of supplemental copper.

INTRODUCTION

Numerous workers including Barber, Braude & Mitchell (1960), Castell and Bowland (1968) and DeGoey, Wahlstrom & Emerick (1971) have demonstrated the growth promoting effect of copper in diets of swine. In fact the practice of using copper as a feed additive for pigs is already well accepted in some parts of Europe (Braude, Mitchell and Pitman, 1973). Braude (1967) and Wallace (1967) have published reviews which indicate that 250 ppm of copper produces a beneficial growth response under most conditions. A recent investigation into the effects of dietary copper on pigs in the tropical environment confirmed this report (Omole, Adebayo & Ilori 1974). Generally, the levels of copper supplement recommended to give maximum response is between 125 and 250 ppm in the diet.

A few observations on the response of chicks to dietary copper supplementation have indicated that there may be a growth stimulating effect in this species (Smith, 1969 and Jenkins, Morris & Valamotis 1970). There is very little information on

the effect of copper on growth performance of growing rabbits. The recent work of King (1975) has indicated that rabbits may also respond favourably to supplemental dietary copper as the pigs.

The present study was undertaken to observe the influence of varying levels of supplemental copper on the life and carcass performance of fryer rabbits.

MATERIALS AND METHODS

Forty-eight 7-week old New Zealand White rabbits of 1188 g average initial weight were randomly allotted in groups of 12 to four treatments of varying supplemental copper levels. The basal diet which contained no added copper served as the control (Table 1), while the three other treatments consisted of the basal + 100 ppm copper, the basal + 150 ppm copper and the basal + 225 copper. Supplemental copper was supplied by $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$. Feed copper was determined using the Perkin-Elmer 305B Atomic Absorption Spectrophotometer.

The experimental animals were housed in groups of 4 and maintained in cages with wire screen floors raised to a height of 90 cm from the concrete floor. Row cages of size 76 cm x 62 cm x 42 cm each were used. The wire screen floor was such that it permitted faeces to fall out of reach of the rabbits, hence coprophagy was not allowed. Animals were weighed at weekly intervals while daily feed consumption was recorded by the weigh-back technique. Because of group feeding, record of feed intake and efficiency of feed utilization were kept on cage basis. Feed and water were available *ad libitum* in all trials.

Two rabbits from each cage representing six rabbits per treatment were selected

TABLE 1
Composition of Basal Diet

<i>Ingredient</i>	<i>%</i>
Yellow corn	13.0
Guinea corn	44.0
Groundnut cake	15.0
Brewer's Dried Grain	15.0
Fishmeal	4.0
Fat (Palm Oil)	1.0
Stylo ¹	3.0
Cystershell	2.0
Di- Calcium phosphate	2.0
Salt	0.5
Vitamin-menereal premix ²	0.25
Ofurason ³	0.25
Total	100
Crude Protein (Analyzed on DM basis)	18.20
Copper (ppm)	22.10

¹ Stylo is a forage legume (*stylosanthes gracilis*)

² To supply the following per 100 kg of the diet; 440 mg riboflavin, 860 mg calcium pantothenate, 2g niacin, 2.2g choline chloride, 15 mg folic acid, 1 mg vitamin B₁₂, 500,000 I.U. vitamin A, 6,6000 I.U. vitamin D₂ and 1000 I.U. vitamin E. It also supplied 17 ppm copper, 2 ppm iodine, 34 ppm manganese, 50 ppm zinc and 100 ppm iron.

³ A commercial coccidiostat with nitrofurazone base.

RESULTS

Average Daily Feed Intake

Supplementation of the basal diet with copper resulted in a marked ($P < 0.01$) improvement in feed intake (Table 2). Animals receiving the control diet consumed significantly ($P < 0.01$) less feed than animals fed any of the copper-fortified diets. Increasing supplementary copper from 100 ppm to 150 ppm resulted in enhanced feed intake. However, the difference was not statistically significant ($P > 0.05$). When 225 ppm supplementary copper diet was fed, there was a significant ($P < 0.01$) depression in rate of food consumption as compared with animals fed 150 ppm added copper diet. The reduced rate of daily food consumption resulting from feeding diets supplemented with 225 ppm copper was not significantly ($P > 0.05$) different from a higher daily rate intake obtained for animals fed 100 ppm supplementary copper.

Average Daily Gains

The feeding of supplemental copper to growing rabbits resulted in significant

for post-mortem studies eight weeks after the commencement of the experiment. Each rabbit was killed by dislocating its neck while the skin, head, stomach, kidney, kidney fat, intestine, liver, lungs and heart were removed before weighing the hot carcass. The carcass yield was computed from the sum of carcass and skin weights expressed as a proportion of final live weight. The small intestine and caecum (without the appendix) were measured while lying on a wet, coated ply-wood draining board, so as to avoid any artificial stretching. The stomach, small intestine and caecum were then opened and their contents removed under a gentle stream of water and allowed to drain for ten minutes before weighing. Water or blood that might adhere to the liver and kidney was removed with filter paper. The kidney fat (being a reasonable estimate of overall fatness as postulated by Rico and Menchacha, 1973) was also weighed. The data were treated statistically by analysis of variance and Duncan's multiple range test as outlined by Steel and Torrie (1960).

TABLE 2

EFFECTS OF SUPPLEMENTARY COPPER ON LIFE PERFORMANCE OF GROWING RABBITS.

	<i>Supplemental Copper levels (ppm)</i>				<i>S.E.M.</i>
	0	100	150	225	
No. of Rabbits	12	12	12	12	
Av. initial weight (g)	1234	1088	1216	1213	
Av. final weight (g)	2097	2200	2483	2292	
Daily feed weight (g)	77.16a	85.62bc	88.71c	80.49ab	± 1.584
Daily gain weight (g)	15.40a	19.84b	22.16c	19.26b	± 0.625
Feed/gain ratio	5.02a	4.32b	3.95b	4.18b	± 0.130

a, b, c. Means with a common superscript in the same row are not statistically different at ($P > 0.01$)

TABLE 3

EFFECTS OF SUPPLEMENTARY COPPER ON CARCASS AND ORGAN MEASUREMENTS OF FRYER RABBITS.

	<i>Supplemental Copper levels (ppm)</i>				<i>S.E.M.</i>
	0	100	150	225	
No. of Rabbits	6	6	6	6	
Av. initial weight (g)	1234	1088	1216	1213	
Av. final weight (g)	2097	2200	2483	2292	
Dressing percentage	62.50a	65.47ab	67.00b	66.27b	± 1.070
Kidney fat (% body wt.)	0.50a	0.65b	1.02d	0.85d	± 0.042
Liver (% body wt.)	3.30	3.20	3.20	3.45	± 0.130
Kidney (% body wt.)	0.619	0.432	1.341	0.567	± 0.440
Stomach (% body wt.)	0.954	0.818	0.805	0.938	± 0.055
Caecum (wt. of 1 cm length) (g)	0.289	0.320	0.307	0.270	± 0.016
Small Intestine wt. of 1 cm length (g)	0.153a	0.190c	0.173b	0.159a	$\pm 0.004^*$
Skin (% body wt.)	12.52ab	12.01ab	12.73bc	13.00c	± 0.180

a,b,c,d. Values in each row with a common letter or with no letter are not significantly different at ($P > 0.05$).

* Significantly different at ($P < 0.01$)

increase in daily rate of gains. The animals fed diets containing 100 ppm added copper gained significantly ($P < 0.01$) more than those fed the basal ration. Similarly, rabbits fed 150 ppm copper supplementary diet grew significantly more rapidly ($P < 0.01$) than those fed 100 ppm. Rabbits that were fed 225 ppm supplemental copper diets however, made a significantly slower ($P < 0.01$) rate of gains when compared with the daily gains of rabbits fed diets containing 150 ppm added copper.

Average Efficiency of Feed Utilization

The basal diets was significantly ($P < 0.01$) less efficiently utilized than any of the copper-supplemented diets. The diet supplemented with 150 copper was more efficiently utilized than either the diet containing 100 ppm or 225 ppm added copper, although the differences were not statistically significant ($P > 0.05$).

Carcass & Organ Measurements

The treatment means for post-mortem measurements appear in (Table 3). Car-

cass yield was significantly influenced by supplemental copper. Animals fed the basal diet had a significantly ($P < 0.05$) lower dressing percentage than animals fed any of the copper-supplemented diets. Dressing percentage increased with increased copper supplementation but declined slightly on 225 ppm copper diet. The carcass yield means amongst the copper-fed groups were, however, not significantly different ($P > 0.05$).

Dietary copper affected kidney fat. Animals fed the control diet had significantly ($P < 0.05$) lower kidney fat percentage than the rabbits on all the other diets containing copper. Animals fed 150 ppm supplementary copper diets laid the greatest amount of fat which was significantly greater than the kidney fat percentages of the rabbits on the other diets ($P > 0.05$).

The liver weights, expressed as a percentage of body weight, were not consistently influenced by the addition of graded levels of copper to rabbit diets. It appeared that a reduction was observed initially, but then 225 ppm copper diets produced a higher percentage which was not significantly higher than the rest ($P < 0.05$). The kidney weights were not directly affected by copper supplementation of the diet. The stomach weights as percentages of body weights were non-significantly ($P < 0.05$) decreased by feeding of copper while caecum weights were increased by feeding 100 ppm and 150 ppm copper diets relative to the control, but decreased when 225 ppm supplemental copper diet was fed. The differences were, however, not statistically significant ($P < 0.05$). Feeding diets containing 100 ppm and 150 ppm added copper resulted in significant ($P > 0.01$) increase in weight of unit length of small intestine. However, the increase in weight of unit of length of small intestine obtained from animals fed 225 ppm copper diet was not significantly different from the control ($P < 0.05$).

DISCUSSION

The significant improvement in food consumption, rate of growth and efficiency of feed utilization obtained by feeding supplemental copper at both 100 ppm and

150 ppm levels clearly indicated that copper sulphate could be a satisfactory food additive for rabbits when fed to supply these levels of copper. Similar results have been obtained by Castell and Bowland (1968), DeGoey *et al.* (1974) and Omole and Bowland (1974), working with pigs, and King (1975), who observed that rabbits grew very rapidly and utilized their feed more efficiently when 200 ppm copper was incorporated in their diets. In the present study, feeding up to 225 ppm of copper resulted in reduced feed intake, rate of growth and feed utilization as compared with feeding 150 ppm supplemental copper. It is important to mention that the animals fed 225 ppm supplemental copper in this experiment received a total of 247 ppm copper in their diet as the basal ration contained 22 ppm copper. This level (247 ppm copper) may be too high for growing rabbits and probably resulted in growth depression in comparison with the rabbits fed 150 ppm supplementary copper that received a total of 172 ppm dietary copper. Omole *et al.* (1974) observed growth depression in pigs fed 274 ppm dietary copper as against those that received a total of 149 ppm copper in their diet.

The significant increases in carcass yield and kidney fat deposition of copper fed rabbits were probably a reflection of the feed consumption data, as these rabbits grew faster and were heavier at slaughter time than the control. Barber *et al.* (1960), observed higher dressing percentages for pigs fed 250 ppm copper.

A similar pattern of increase in thickness (weight of 1-cm length) was obtained for both caecum and small intestine in copper fed rabbits. Hawbaker, Speer, Flays and Catron (1961) observed that copper significantly altered the gut flora population in pigs; copper at 100 ppm and 150 ppm levels in this experiment probably induced growth of caecum and small intestine by influencing the microbial population in them. Caecum wall has been known to be thicker in germ-free animals than normal animals as a result of microbial effect (Asano, 1969). Contrary to this observation, however, King (1975) reported that feeding copper resulted in thinning of the caecum in rabbits. Envi-

ronment and other dietary factors probably influenced response of rabbits to added copper.

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