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# ERADICATION OF BRUCELLOSIS FROM THE NEW ZEALAND CATTLE POPULATION

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## SUMMARY

This paper describes the work done in New Zealand by H. S. Cameron to eradicate brucellosis from dairy herds by whey agglutination tests of individual cow's milk (Cameron, 1960). Comparison with blood serum agglutination tests showed the whey test to be reliable. Cameron's work was put into practical application at Lincoln College in herds supplying Christchurch with milk. Repeated tests finally eradicated brucellosis from the Christchurch town milk supply.

An eradication scheme for the New Zealand dairy and beef industry is then discussed and means of carrying out the work suggested. The loss due to slaughter could be estimated at 5% or a little more and compensation is suggested at £8 per animal.

BRUCELLOSIS is a world-wide disease of livestock affecting mainly cattle, sheep, goats and pigs and causing undulant fever in human beings.

The causative organism belongs to the genus *Brucella*, varying species affecting animals, but each causing undulant fever in man. Curative treatment is not as a rule successful and preventive methods only can be employed to control the disease.

In cattle, brucellosis causes an endometritis and mastitis in the female and an orchitis and inflammation of accessory sex glands in the male. Synovitis also is sometimes caused by *Brucella*. The organism is picked up and spread by ingestion of contaminated food and water, by fly carriage of organisms to eyes of cattle, by infection of damaged skin surfaces, by passage of organisms from udder to udder through machine milking and by service of infected bulls.

Antibodies are readily produced after entry of the virulent field organism into the host body, and also by injection of an attenuated live vaccine. A live vaccine, Strain 19, is regularly used on 4 to 8-month-old dairy calves, and on 10 to 12-month-old beef animals to protect the female genitalia to the point where endometritis does not occur, or occurs in too mild a form to cause foetal death and abortion. The vaccine does not protect the mammary gland or supramammary lymph nodes so that in New Zealand approximately 5% of dairy cows are likely to have infected udders. This is a danger to human health. Vaccination of bull calves is

risky as the attenuated strain can cause orchitis and sterility. Vaccination of older females produces a stronger and more lasting immunity but increased antibody formation interferes with laboratory tests. At present, more than 60% of calves are vaccinated each year to prevent abortion, this procedure having reduced abortion in the dairy industry from 16% to less than 2%. In beef herds, less vaccination has taken place and is practised mainly where brucellosis is known to exist in a herd.

### TESTING

*Brucella* agglutination testing of blood serum and of whey is common practice in diagnostic laboratories in New Zealand. In blood serum, a titre of 1:40 or 1:80 is considered suspicious, while 1:160 and above is positive. Where blood serum has given a 1:40 or 1:80 titre, no cases of whey agglutination have occurred in herds, whereas at 1:160 whey is always positive.

In rapid plate whey testing, an agglutination of 0.08 ml whey is suspicious and requires single four quarter tests, while 0.04, 0.02 and 0.01 ml whey are considered to be positive. A number of cows show infection in only one quarter. The ring test applied to a herd composite milk sample is sensitive enough to pick out one positive animal in up to 100 cows. The coloured antigen used and made in New Zealand is as sensitive as the Beltsville antigen used in Cameron's work. Care must be taken in the whey agglutination test to see that cows are not sampled fewer than 10 to 14 days after calving and some four weeks before drying-off because agglutination resulting from vaccination can appear in the milk even though the mammary gland is not infected. Also, it sometimes happens that acute cases of mastitis may give a positive result owing to seepage of blood plasma into the quarter where a cow is producing vaccination antibody. Not all cows retain antibody for a long period following vaccination. However, there is usually sufficient protection by vaccination to prevent cows aborting up to the fifth calf, unless a virulent field strain of *B. abortus* enters the herd. Abortions which do occur in a vaccinated herd are possibly due to nutritional causes, injury or to leptospirosis. Pasteurization of milk and cream is able to kill brucella organisms with ease, thus affording protection to the human population. Undulant fever appears in some 150 persons per annum, either by contact with an infected cow or through drinking infected milk or cream, though occasionally the

diagnosis is faulty and the sick person is suffering from leptospirosis which usually responds more readily to antibiotic treatment. There is thus an occupational hazard for veterinarians, slaughtermen in abattoirs and dairy farmers.

In 1960, Dr H. S. Cameron, from the Veterinary School, Davis, California, worked at Wallaceville Animal Research Centre on brucellosis of dairy cows. He had already performed considerable work in U.S.A. on the subject of tests and had formed the view that simple testing of milk in lactating cows would be sufficient to recognize all positive cases in a herd.

Cameron (1960) compared blood serum agglutination tests with whey agglutination tests over some 12,000 cows. Agreement between results of tests was very close but in a few cases where a blood serum test was positive and the whey test negative or suspicious, the antibody content was considered to be due to vaccination. This point has been further demonstrated at Lincoln College. Ring tests of composite milk invariably led to finding agglutination-positive animals in a herd, and, when these cows were eliminated, the ring-positive reaction disappeared and the test remained negative. The ring test and whey agglutination test were therefore sufficient to recognize cows with brucellosis in a herd without recourse to blood serum testing. This is important, for farmers dislike bleeding of dairy cows in production.

#### ERADICATION OF BRUCELLOSIS IN CHRISTCHURCH MILK SUPPLY

Following Cameron's work in New Zealand, the two Christchurch milk companies in 1959 asked Lincoln College to continue testing of the milk supply with a view to eradicating the disease under a suppliers' voluntary scheme. Both companies set a compensation at £10 per head on stock slaughtered plus the meat value of the carcass and one company offered a premium of ½d. a gallon to suppliers for ring test-negative milk. In tests and retests, 1,230 cows have been slaughtered to give Christchurch a milk supply completely free from brucellosis except for an occasional breakdown through purchase of infected animals, but these, through monthly ring tests of suppliers' milk, are quickly recognized and eliminated. When the dairy farmer does not get rid of infected animals quickly, there is danger of spread via milking machines and in three instances 17, 17 and 27 cows have become infected and have had to be slaughtered.

This quick spread has not been recognized by other workers who believe that spread from udder to udder is slow. It suggests that the New Zealand field strain is a virulent one.

#### CONTROL IN OTHER AREAS OF NEW ZEALAND

Control of brucellosis has also been carried out on selected farms in the Helensville area where the dairy company sends frozen cream to U.S.A. This export product has to be certified free from tubercle bacilli and brucella organisms.

Testing of milk for brucella organisms has been carried out for most of the South Island towns. In some cases, individual farmers have had infected cows slaughtered voluntarily, but most areas are awaiting a compensation scheme before commencing eradication.

Recently, Western Germany has prohibited import of meat from animals positive to the brucellosis test. New Zealand's meat trade (12,000 tons last year) requires protection, and it has become necessary to test muscle juice from the diaphragm of cattle after slaughter in meat works' laboratories to ensure that Western German regulations are observed.

#### CONTROL IN OTHER COUNTRIES

New Zealand has no national policy of control in existence as yet. Many countries in the world have been attempting control for a number of years and have reduced brucellosis to less than 1%, thus being considered free. These countries include U.S.A., Netherlands, Denmark, Switzerland, Northern Ireland, Finland and Germany. Russia, Italy and France rely on vaccination of calves as a method of control. Britain is about to commence a national control system. It will be noted that the main suppliers in Europe of dairy produce to the British market are free from tuberculosis and brucellosis and this alone, together with future British control, means that New Zealand must quickly follow suit and commence eradication. True, pasteurization renders products safe but it would be better to have herds free from disease to meet European competition.

Brucellosis is a notifiable disease in European countries except in England, Wales and Scotland. It is to become notifiable in New Zealand together with compulsory branding of vaccinated calves.

## ERADICATION PROGRAMME FOR NEW ZEALAND

How to set about eradication in New Zealand is the problem. Tuberculosis will be under control within two years and areas already free from tuberculosis could commence eradication of brucellosis at once. The work in Christchurch can be looked upon as a pilot scheme for the consumer milk industry and because of the success of the scheme could be adopted for the dairy industry as a whole.

The first stage should be the setting up of a Brucellosis Advisory Committee, similar to the Tuberculosis Advisory Committee, and, if desirable, a non-governmental technical committee could also be formed, reporting either to the Advisory Committee or to the Director-General of Agriculture.

The number of animals to be tested in New Zealand, leaving out calves and yearlings, is as follows:

			<i>Beef</i>	<i>Dairy</i>
North Island	.....	.....	1,172,517	2,418,745
South Island	.....	.....	235,267	230,863
Totals	.....	.....	1,407,784	2,649,608

The South Island has many fewer cattle than has the North Island and is now practically free from tuberculosis, so obviously the first area for eradication should be in the South Island. As Christchurch already has a nucleus of 12,000 *Brucella*-free dairy cows, this district could readily be used to commence eradication. A large dairy factory manufacturing butter collects cream from 21,000 cows between the Ashley River and the Rakaia River. This area includes Banks Peninsula. The total cattle population in the area is 88,555 animals, 48,527 being in milk, the remainder being dry cows or beef stock. This would be a useful, compact area to commence operations and could be extended north and south as the work of eradication progressed.

With the experience gained at Lincoln College, the milking test and whey agglutination test could be put into operation in dairy herds as the results of these tests conform to those of blood serum tests. With dry animals and beef breeds, blood serum testing would be necessary. Unfortunately, samples of cream easily obtained from the butter factory do not lend themselves to reliable ring tests\* ;

\* Further work has shown that a ring test for cream samples can now be satisfactorily carried out.

this necessitates farm collection of composite milk samples from factory supply herds, or collection of individual cow samples for the whey agglutination test. Where blood has to be taken, bleeding from the mammary vein in lactating cows is easy in ordinary bail sheds but more difficult in herring-bone sheds. In beef and dry cows, another site for sampling is necessary and for practical purposes that might be the caudal vein at the base of the tail. Jugular bleeding is not practical in New Zealand bails and tip-of-tail bleeding is messy.

Trials of bleeding beef animals and applying a rapid full blood agglutination test while cows are still in the race are under way\*. If this is found to be a practical method and free from too many false positives resulting from late vaccination, it could well be used as a routine method. The advantages are obvious.

Antigen for testing has been obtained from Tasman Vaccine Laboratory and the strain used is quite sensitive and could be used in future control work. A change in colour for rapid blood testing is necessary. Repeat testing of cattle is imperative at as short an interval as is practical in an area, and preferably at not more than a three-months interval. Beef herds could possibly be tested at annual intervals because there is no spread by milking machines. Without consistent retesting for at least two years, the scheme would collapse. When taking milk samples for test, milk from each quarter is required in the sampling bottle because of the frequency with which one quarter alone is infected. Milk samples should not be taken until a fortnight after calving and four weeks before drying-off because of the effect of calf vaccination. Vaccination of adult cattle or even of heifers of 12 to 15 months of age must not be allowed, for in New Zealand it takes nine months for a herd to return to normal, not 90 days as is reported from other countries.

In any scheme, identification of animals is imperative. As plastic tags are not reliable, metal ear or tail tags might be used. Branding of vaccinated calves is necessary and the escutcheon site could be used, for the escutcheon brand is easily observed in the shed. Perhaps beef calves could be branded elsewhere.

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\* Whole blood tests have more recently been tried out in the meat works. These tests have shown that the whole blood method is practical for preliminary eradication of brucellosis in beef herds and dry dairy cows.

Laboratory testing of blood or milk from animals is necessary and a smooth flowing intake of samples is required for 4 to 5 days of the week. Possibly (and this would have to be confirmed), 500 samples of milk and 300 of blood per day could be tested by each bench worker. The apparatus required consists of water baths and metal racks, incubators, drying ovens, refrigerators, rapid agglutination plate boxes, pipettes, etc., in sufficient numbers. The washing of bottles and packing of boxes will require a kitchen staff of at least two women, and plenty of hot water.

An efficient field staff for taking blood samples is required, each sampler being able to take 200 to 300 blood samples per day if the day be organized efficiently. For milk samples, farmers themselves have been relied upon to fill McCarthy bottles and these could be collected and tested before souring takes effect or placed in refrigerators until the staff is ready to deal with them. Regular despatch to the laboratory of the day's sampling could be arranged.

All cows found positive to test have to be slaughtered and not sold at auction or privately. Therefore, affected animals must be tagged. Dairy animals should be slaughtered as soon as convenient and not kept more than a month in case of spread of infection by milking machines. In the case of beef herds, more latitude could be given. Perhaps protective clothing might be required for butchers processing infected animals, though the risk is not very serious.

In the early stages of the area eradication schemes, vaccination of calves should be compulsory, but when an area is known to be clean, vaccination could be dispensed with. This is the attitude adopted in Finland, Switzerland and some other countries and it would assist in recognizing infected animals on laboratory test.

Compensation for slaughter resulting from tuberculosis has been fixed at £8 per head plus salvage of carcass. The same figure could apply in the case of brucellosis eradication with the knowledge that all carcasses would be edible and not liable to be condemned. Bleeding of cows by private operators could be paid for at the rate of 1s. per head plus mileage or as arranged.

It is suggested that, until diagnostic stations of the Department of Agriculture are built and staffed, Lincoln College could readily carry out the laboratory side of the work. The Department could very well have a veterinarian and bench staff under training at Lincoln College for this work. Were this arrangement considered feasible by the Department, work could commence very quickly, as soon

as a compensation rate was arranged with the Minister of Agriculture.

With experience gained and bearing in mind the future pressure from exports to Common Market countries and the U.K., there is no reason why a national scheme of control should not be considered seriously and put into operation.

#### REFERENCE

Cameron, H. S., 1960: *N.Z. vet. J.*, 8: 41.

#### DISCUSSION

DR A. H. KIRTON: *What proportion of cows are falsely diagnosed (a) to have brucellosis, (b) not to have brucellosis?*

I do not think there is a problem of false diagnosis of brucellosis as there is in testing for tuberculosis. The percentage is very small.

J. W. STICHBURY: *Because of the low level of actual abortions in the dairy industry as a result of brucellosis vaccination, it does not appear that an eradication campaign would be profitable from a farm production point of view. Thus, the desirability of an eradication programme appears to depend on the effects on the marketing of livestock produce and on losses involved in slaughtering reactors. What percentage of cows would have to be slaughtered if an eradication campaign was undertaken?*

Percentage of infection in the South Island is likely to be about 5%. In the North Island, the percentage is likely to be higher but no surveys have been conducted on an area basis.

DR A. T. JOHNS: *What are the likely costs of eradication?*

Costs are difficult to assess until the percentage of infection is known for all areas of New Zealand.

I. M. CAIRNEY: *What was the cost of the Christchurch eradication scheme? Did those farmers have difficulty in getting herd replacements?*

It has cost Christchurch £12,500 in compensation over five years because of the difficulty of obtaining clean replacements. Administration and laboratory costs are additional. The total cost was possibly £30,000.

E. A. SHORTRIDGE: *Could Dr Hopkirk give the criteria on which he bases his opinion that the herds are free from brucella infection?*

We consider herds free which consistently give a negative ring test from month to month. Such herds remain free until an infected animal is introduced. In such cases, the whey agglutination test has easily picked up an infected animal. Where spread by

milking machine has occurred, further cases appear and further whey agglutination tests are carried out until the ring test is negative.

D. J. JULL: *Are any figures available of the initial incidence of reactors in self-contained herds that have practised calfhood vaccination for a number of years, and is there any indication that this rate may be lower than in herds that are not self-contained or practised vaccination?*

No figures are available. However, all calves in herds on Christchurch milk supply are vaccinated at 4 to 8 months of age.

V. GRIFFITHS: *A test and slaughter policy might be expensive if the incidence of brucellosis is high. What are the views on a preliminary period of compulsory vaccination of 4 to 8 months heifer calves in order to build up a national herd unlikely to react when the test and slaughter policy is applied?*

As brucellosis is readily spread from udder to udder by milking machines, and the mammary gland is not fully protected by vaccination with Strain 19, vaccination of calves will never eradicate the disease.