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BRUCELLOSIS (Contagious Abortion, Bang's Disease) OF CATTLE

By C. R. TOOP, B.V.Sc., Chief Veterinary Surgeon

BRUCELLOSIS, or contagious abortion as it is commonly called, seems to have been introduced into Western Australia with the early importation of cattle from the Eastern States and during the period of rapid expansion which took place in the dairying industry between the two World Wars it exacted a heavy toll. Abortion storms which at times caused the loss of more than half of the calf drop were common, and infertility was rife. More important was the heavy loss of production arising from the failure of aborting cows to return to full lactation and the long interval that often elapsed before they were again safely in calf.

During recent years the disease has been controlled by inoculation with Strain 19 vaccine which has been widely used throughout the dairying districts and has proved very effective as an immunising agent.

CAUSE OF THE DISEASE.

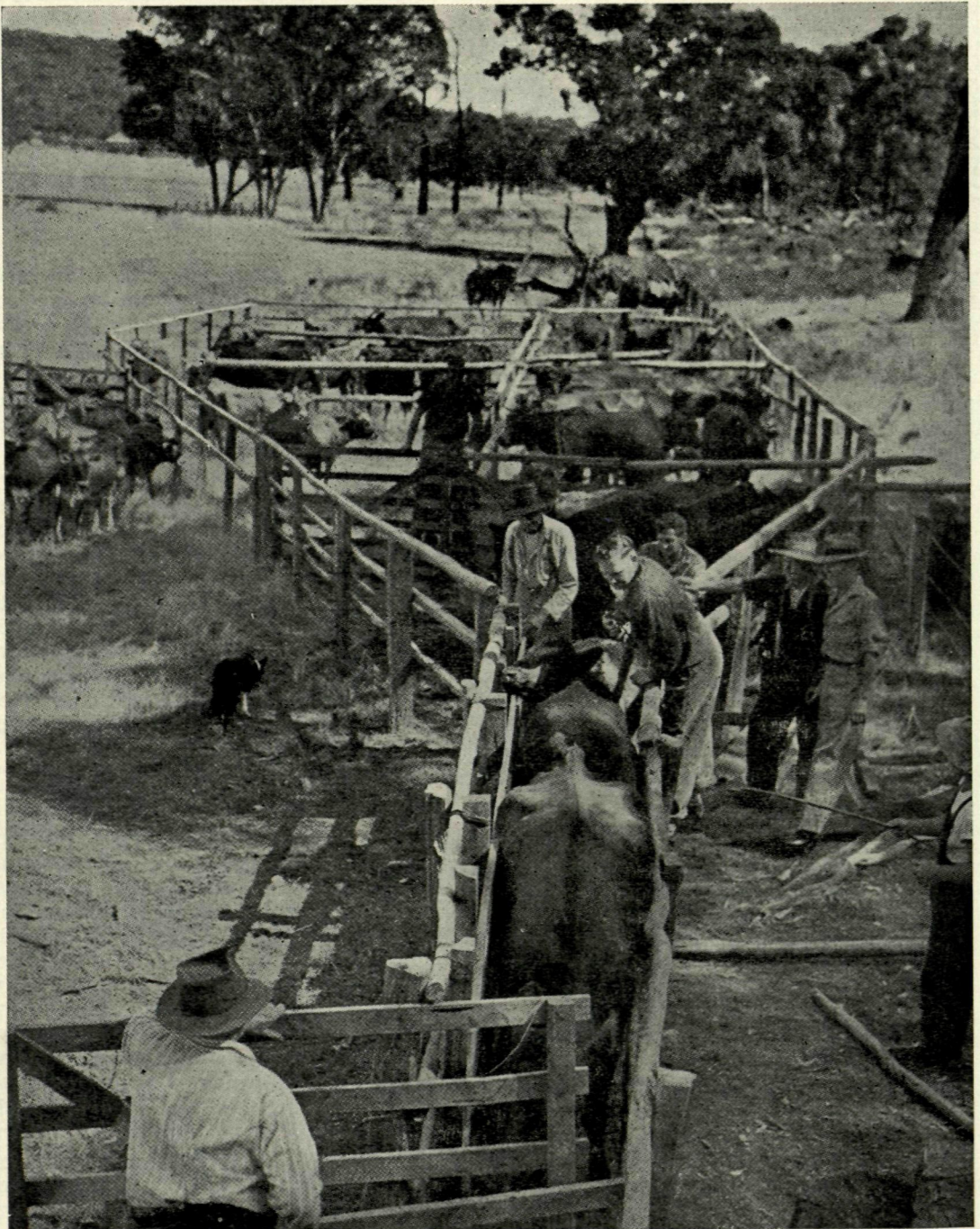
The disease is caused by the microbe *Brucella abortus*, and the consumption of food material contaminated by the discharges of affected cows provides the principal mode of infection. In the non-pregnant female, the organisms remain localised in the lymph glands but when pregnancy has become established, they invade the developing foetus and the membranes which envelop it, where conditions are especially favourable to their growth. Here they multiply and set up an inflammatory condition which involves both the uterus and foetal membranes and is followed by the death and expulsion of the foetus. This inflammatory process is particularly marked at the cotyledons or button-like masses of tissue which attach the foetal membranes to the uterus and through which the foetus receives from the maternal blood supply the nutrients necessary for its growth. Coincident with the infection of the uterus, the *Brucella* organisms may invade and become established in the udder where they remain localised for long periods and are excreted in the milk. The uterus usually becomes

free of infection within a few weeks after abortion or calving whereas udder infections may persist for months or years. Cattle become susceptible upon reaching sexual maturity but calves are resistant to infection. When fed infected milk they harbour the organisms in the digestive tract and pass them out in the droppings but this infection is completely eliminated within a few weeks after the feeding of the milk has ceased.

SYMPTOMS.

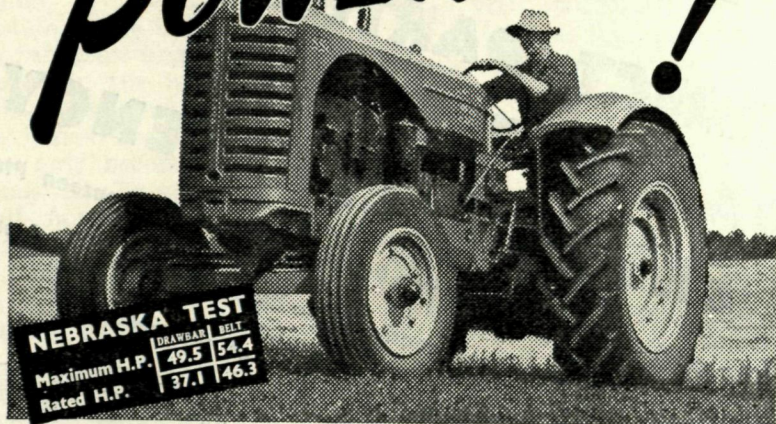
Cows affected by Brucellosis do not suffer any disturbances to their general health. The act of abortion is the most common and often the only symptom and the discovery of an aborted calf usually provides the first evidence of the presence of the disease in the herd. Abortion may, however, be preceded by the usual signs of approaching parturition (normal calving) which include enlargement of the vulva and the presence of a mucous discharge, and in dry cows and heifers a well-marked increase in the size of the udder.

The majority of abortions occur between the fifth and seventh months of pregnancy but the foetus may be expelled at any time after the second or third month, or towards the end of the gestation period, when a live but weak and sickly calf which frequently dies, may be delivered. Following abortion a yellowish or chocolate-coloured discharge, which usually persists



Cattle being inoculated with Strain 19 vaccine at an inoculation centre near Donnybrook. Since this vaccine became available in Western Australia, during 1946, over 170,000 heifers have been immunised against Brucellosis by this means.

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for several weeks, may issue from the vagina. With early abortions the foetal membranes (afterbirth) are usually expelled with the foetus but after the fifth month retention of the afterbirth is a frequent and troublesome complication. Temporary infertility or sterility resulting from inflammation of the uterus is a common sequel to infection and may become a serious problem in the herd. Enlargement of the joints (hygroma) and particularly the knee joints, one and sometimes both of which may become affected, is occasionally observed. These swellings are large, soft and non-painful and result from the invasion of the joint by the brucella organisms.

SYMPTOMS IN THE BULL.

In the bull, *Brucella* organisms may invade the testicles and associated glands where they cause inflammation and swelling. One or both testicles may show considerable enlargement. Bulls affected by lesions of the testicles are frequently sterile.

MODE OF INFECTION.

In the vast majority of cases infection occurs by the mouth as the result of the consumption of pasture or fodder contaminated by *Brucella* organisms. At the time of abortion, the foetus, foetal membranes and fluids which are voided from the uterus contain enormous numbers of these organisms which escape to the exterior and contaminate the pastures. The discharges voided after normal calving by infected cows which do not abort are similarly infective. The consumption of food material contaminated in this manner provides the principal means by which the disease is spread. Cows may also become infected by licking themselves or other cattle soiled by these discharges.

Experimentally the disease may be transmitted without difficulty by instilling a few drops of a culture of *Brucella abortus* into the eye of a susceptible animal. This suggests that infection might be spread through the agency of flies but the available information does not suggest that transmission by this means is a factor of any practical importance. It has also been shown that infection may occur through the unbroken skin so that

the possibility of cows becoming infected by lying on ground contaminated by the discharges of an aborting cow or from splashing with urine containing infective material, cannot be ignored.

THE ROLE OF THE BULL.

It was at one time believed that the bull played an important part in the transmission of the disease but this view has since been proved erroneous. While infected bulls may pass out *Brucella* organisms in their semen it has not been found possible to transmit the disease experimentally by mating infected bulls with healthy cows. All of the available evidence indicates that the part played by the bull in the spread of brucellosis is of minor importance.

THE INTRODUCTION OF INFECTION.

The introduction of the disease into a herd is almost invariably associated with the purchase of infected cows or heifers which spread it to other cattle after calving or abortion. Similarly the disease may be introduced after cattle have been allowed to graze on public roads or common pastures frequented by other cattle, or when they have been transferred to another property for service or agistment. Other factors which may play a part in the introduction of infection include the transfer of an aborted foetus or portion of the afterbirth to a "clean" property by dogs, foxes or birds, or the infection of "clean" pastures by drainage or flood waters from neighbouring properties. The transmission of infection on the footwear or clothing after a visit to an infected herd is a further possibility. While none of these factors may be excluded they are probably of little importance in actual practice.

INFECTED HORSES.

The horse is susceptible to infection with *Brucella abortus*. Horses running with infected cattle sometimes give a positive reaction to the agglutination test and may pass out the organisms in their droppings. The organisms may also be found in the abscesses which form in horses affected by fistulous withers and poll evil. These conditions will be recognised as large painful swellings which develop in the region of the withers and poll and finally rupture

and discharge pus for a prolonged period. Although horses play only a minor part in the spread of the disease to cattle the precaution should be taken of isolating or disposing of horses suffering from these conditions.

SURVIVAL OF INFECTION ON THE PASTURES.

The length of time during which the infection is able to survive on contaminated pastures depends largely upon seasonal conditions. The organisms are destroyed within the space of a few hours when exposed to direct sunlight but may survive for a considerably longer period in well shaded areas.

Observations made at Glenfield, New South Wales, have shown that the organisms will live for less than a month during spring or summer, but may survive for as long as 100 days during winter. This would suggest that in order to free a pasture from infection it would be necessary to leave it unstocked for a month in summer and for at least three months in winter.

INCUBATION PERIOD.

The incubation period of the disease i.e., the period which elapses from the time of exposure to infection to the time of abortion or the first occurrence of a positive reaction to the agglutination test is usually about three months, but it may vary from six weeks to as long as six months. In some cases a positive agglutination reaction does not develop until after abortion has occurred. A consideration of the length of the incubation period is important when measures for the prevention and control of the disease are being applied.

COURSE OF THE DISEASE.

Upon gaining entrance to a "clean" herd the disease frequently runs an acute course causing a large number of abortions or premature births extending over a period of one to two years. During this period a number of abortions may occur in rapid succession giving rise to the so-called "abortion storm." After the storm has subsided the disease passes on to a chronic stage. As the result of exposure to infection the herd is now largely com-

posed of animals which have developed an immunity or resistance to the disease which enables them to carry their calves to full term. Cows which have aborted on one occasion do not usually abort a second time but two or more abortions may occur in a small percentage of cases. Furthermore, many infected cows do not abort at all and this is more likely to be the case if they have been exposed to infection when non-pregnant. Such resistant animals however may still harbour the infection which they are capable of spreading to other animals following normal calving. In these resistant herds, sporadic abortions may continue to occur but they are largely confined to heifers and newly-introduced cows. As a sequel to the acute phase of the disease, retention of the afterbirth and infertility may become a serious problem in the herd.

RETENTION OF THE AFTERBIRTH.

Retention of the afterbirth is frequently observed in herds affected by Brucellosis. In consequence of the inflammatory condition caused by the organisms, adhesions may occur between the uterus and foetal membranes (afterbirth) which may be retained for many days during which time putrefactive changes take place. Gross infection of the uterus occurs and this may later be followed by infertility which is a frequent sequel to this condition. The general health of the animal is usually unaffected but sometimes as the result of absorption of toxic products from the uterus there are symptoms of sickness including loss of appetite and condition and reduction of milk yield, while in some severe cases death may occur from septic inflammation of the uterus and blood poisoning. Normally the afterbirth is shed within a few hours of the delivery of the calf, but this may be delayed for as long as twenty-four hours and need cause no concern. When, however, the afterbirth is retained for more than two to three days, treatment becomes necessary.

Provided the cow shows no evidence of sickness, the membranes may be safely left until they become detached by sloughing at the cotyledons and they may then be completely removed by gentle traction with a hand inserted into the vagina. This is usually possible after an interval of

seven to ten days and in the meantime the uterus should be irrigated daily with an antiseptic solution (a tablespoonful of salt to a gallon of water or a 1 per cent solution of Dettol) introduced by means of a large funnel and a length of $\frac{1}{2}$ in rubber tubing. Antiseptic capsules may be inserted into the uterus as an alternative to irrigation.

When circumstances render manual removal necessary, the hand should be introduced deeply into the uterus and the membranes gently detached, by manipulation with the fingers, from the cotyledons or button-shaped areas at which they are adherent, but under no circumstances should they be forcibly torn from these attachments. Several attempts repeated at daily intervals may be necessary before the membranes can finally be removed and the uterus should be irrigated in the manner described above until this result has been obtained. Antiseptic precautions should always be observed and should include thorough washing of the hands and arms of the operator and the external parts of the cow with an antiseptic solution.

Retention of the afterbirth must be regarded as a serious problem and veterinary assistance should be obtained whenever it is available.

INFERTILITY.

In herds affected by Brucellosis, infertility or failure to hold to service is a frequent complication. *Brucella* organisms which are present in the uterus, set up a chronic inflammatory condition known as metritis which may persist for a considerable period after abortion or normal calving has occurred. This inflammation is accompanied by the formation of discharges which destroy the sperms of the male so preventing the fertilisation of the ovum or egg of the female. These discharges do not usually persist for more than three or four weeks, but a period of several months may elapse before the uterus returns to its normal healthy condition. It is therefore advisable to withhold cows from service for at least three months after abortion has occurred.

In addition, other bacteria may gain a foothold in the already affected uterus, increasing the severity and duration of the

inflammatory process and producing a more obstinate type of infertility which in some cases may be permanent. This is particularly likely to occur when the after-birth has been retained.

Infertility resulting from inflammation of the uterus is however not necessarily associated with Brucellosis and may occur in herds that are free of this disease. It is, however, much more prevalent in herds in which *Brucella* infection exists. Infertility of this type usually responds very satisfactorily to treatment which involves the irrigation of the uterus with a weak antiseptic solution, after a catheter (irrigation tube) has been passed through the cervix or neck of that organ. Treatment of this kind however is beyond the capacity of most laymen and requires the services of a veterinary surgeon.

While Brucellosis is a common cause of infertility, this condition may result from a variety of other causes including other infections such as vibriosis, abnormalities of other portions of the genital tract, infertility of the bull and nutritional deficiencies. Before any treatment is undertaken, a correct diagnosis is necessary and veterinary assistance should be sought whenever this condition becomes a problem in the herd.

DIAGNOSIS.

Brucellosis is responsible for the majority of the abortions which occur among dairy cattle. Consequently, when one or more abortions occur on a property, the presence of the disease should be suspected and precautions should be taken against the further spread of infection. Abortions may result from other causes including accidents and injuries, nutritional deficiencies (Vitamin A) and the presence of other infections (vibriosis, leptospirosis) but Brucellosis should not be excluded until definite proof has been obtained. The disease may be diagnosed with a high degree of accuracy by the application of the agglutination test. Blood samples may be forwarded to this Department for testing when the diagnosis is in doubt.

THE AGGLUTINATION TEST.

For the application of the agglutination test, a small sample of blood is required which is collected into a sterile half-ounce

bottle either from the jugular vein or a small incision of the ear or tail. After collection, the sample is labelled for identification and allowed to stand until clotting occurs. The clear straw-coloured fluid which separates from the clot on standing is the serum which is used for testing purposes.

In carrying out the test, small measured amounts of serum are added to measured amounts of a milky suspension of *Brucella* organisms contained in test tubes and the result is read after the mixture has been allowed to stand in an incubator for 24 hours. The serum of an animal affected by Brucellosis contains specific antibodies known as agglutinins which are produced within the body of the animal to assist it to resist the infection. When the serum under test contains these agglutinins, the organisms become clumped together or agglutinated and fall to the bottom of the test tube forming a white deposit which is accompanied by clearing of the overlying fluid. This constitutes a positive reaction. In the case of a negative reaction there are no agglutinins present in the serum, clumping of the organisms does not occur, and the suspension retains its milky appearance.

The application of the agglutination test to a dairy herd will reveal the extent of infection. It may frequently be observed that a proportion of the animals giving a positive reaction to the test have no history of abortion and that others although exposed to the disease have been able to resist infection.

PREVENTION AND CONTROL.

When a herd is free of Brucellosis every endeavour should be made to maintain it in that condition. Since the disease is usually introduced by the purchase of infected cows or heifers, the most favourable prospects for success will be provided by the maintenance of self-contained herds which are able to breed their own requirements and are not reliant on an outside source for replacements. In such herds new purchases should be confined to young bulls but, should the introduction of females become necessary, purchases should be made subject to a negative agglutination test. Owing to the long in-

cubation period of the disease even this procedure is not without risk. Complete reliance cannot be placed upon a single test and a greater margin of safety is provided by two tests separated by an interval of 60 to 90 days, the animals in the meantime being held in isolation.

CONTROL BY THE APPLICATION OF HYGIENIC MEASURES.

It has previously been pointed out that the infection is spread by the contamination of the pastures by the aborted foetus and its membranes, as well as by the discharges voided by infected animals following abortion of calving. Consequently it should be possible to control the disease by separating such animals from the herd prior to abortion or calving and holding them in isolation until all discharges have ceased. To effectively apply this method of control, maternity or calving stalls must be provided, and pregnant cows and heifers must be kept under daily observation. When there is evidence of impending abortion or approaching calving, the animal is removed immediately to the maternity stall where it is segregated until discharges have ceased and the aborted foetus and afterbirth are disposed of by burning or burial with quicklime. The cow is irrigated daily with a weak antiseptic or a solution of salt in water in the strength of a tablespoonful to the gallon so long as the discharge persists. Precautions are taken to prevent the transfer of infection on the clothing and footwear of attendants to other members of the herd. The maternity stall is thoroughly disinfected after the animal has been removed.

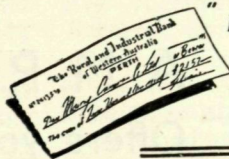
Although this method of control has proved effective in other countries it is rarely practicable under Australian conditions. It should, however, be possible on most dairy farms to provide a small isolation paddock where cows which have aborted or are showing signs of approaching abortion can be segregated and subjected to daily irrigation until there is no further evidence of discharge.

Where there is evidence that an abortion has occurred a search should be made for foetus and afterbirth which should be burned or buried deeply, the surrounding area being liberally coated with quicklime. While these incomplete measures cannot

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be regarded as an effective means of control, they should do much towards checking the spread of the infection and may prevent the development of an abortion storm.

THE TEST AND SLAUGHTER METHOD.

This is based upon the agglutination test and aims at the complete eradication of the disease from infected herds. All cattle above the age of six months are included in the test and those which give a positive reaction are removed for immediate slaughter. Testing is repeated at intervals of 30 days when any additional reactors are similarly removed. When two consecutive completely negative tests have been obtained the herd is declared abortion-free and thereafter is subjected to an annual retest. After the disease has been eradicated, new introductions are confined to cattle from other abortion-free herds and to cattle which have passed two agglutination tests separated by an interval of 60 days. Eradication should never be attempted during the acute stage of the disease while frequent abortions are occurring, when, in consequence of the heavy contamination of the premises, it presents a most difficult problem. The difficulty of eradication is however greatly reduced after the disease has progressed to the chronic or resistant stage.

The test and slaughter method has been widely applied in the United States where a nation-wide campaign for the complete eradication of brucellosis is now in progress. This scheme was introduced in 1934 as a drought relief measure for the disposal of surplus cattle and has since made remarkable progress. Compensation is paid to the owners of reacting cattle.

While the advantages to be derived from the eradication of the disease are obvious, being reflected in an increase in the number of calves produced, greater breeding efficiency and increased milk production, it is a very costly procedure and there are few other countries in which it could be adopted as a general method of control. In Western Australia where the infection is widely distributed throughout the dairying areas and its incidence may be high

in many herds, there is little scope for control by the test and slaughter method and except in herds where the initial incidence of infection is low and which are so isolated that the re-introduction of the disease is remote, it may be regarded as neither practicable nor economically possible. Furthermore, the abortion-free herd is composed of highly susceptible cattle which are extremely vulnerable to infection. Should this occur, an abortion storm accompanied by heavy loss would be likely.

IMMUNISATION WITH STRAIN 19 VACCINE.

Prior to the advent of Strain 19 vaccine there was no effective method of control which was capable of practical application under local conditions. This product is a live vaccine prepared from strains of *Brucella abortus* of low virulence and while it is unable to produce abortion when injected into susceptible cattle it stimulates the formation of antibodies in their blood and tissues which enables them to resist the disease if subsequently exposed to fully-virulent field strains. Although this immunity is not absolute and may be broken down by exposure to massive infections it is of a high order and appears to endure for the life of the animal.

Strain 19 Vaccine became available to the veterinary profession in Western Australia in 1946 and since that time about two-thirds of the heifers bred in the dairying districts have been immunised as yearlings annually. This has reduced the abortion rate to a low level and the disease is no longer regarded as a serious problem. The vaccine has also proved effective in dissipating impending abortion storms in dairy herds in which several abortions have already occurred, and in our experience adult cattle may be safely inoculated regardless of the duration of pregnancy. Further information on Strain 19 vaccine and the vaccination service provided by the Department is contained in Leaflets 875 and 1095, copies of which will be supplied on application.

DANGER TO THE HUMAN HEALTH.

Undulant fever in man may be caused by the same organism which causes Brucellosis in cattle. The disease in man

may be contracted by the consumption of milk from cows harbouring the infection in their udders, or by contact with infected cattle at the time of abortion or calving. Infections of the latter type are occupational, occurring most frequently amongst veterinarians and dairy farmers who may be required to assist at a difficult calving or in the removal of a retained afterbirth. Cases occurring in cities are almost invariably associated with the consumption

of infected milk. Although a very small proportion of persons who are exposed to infection actually develop symptoms of undulant fever, the severity of the condition may be such that precautions should be taken for its prevention. Strict antiseptic precautions should always be taken during the handling and treatment of infected animals. Boiling or efficient pasteurisation will render milk safe for human consumption.

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