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Mastitis : its prevention and control. 1. The udder in health and disease

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This is the first of a series of four articles on mastitis which will appear in consecutive issues of the Journal of Agriculture. This is an introductory article describing the cow’s udder in health and disease.

The second will describe the organisation of a milking shed in preparation for a programme to control mastitis.

The third will tell how to introduce a mastitis control programme.

The final article will discuss the progress to be expected from the instigation of the control programme.

Specially designed recording sheets will be available, free on application, to assist those interested in carrying out the control programme. After the second article has appeared a series of field days will be arranged in each dairying district for the purpose of discussing the suggested programme, so that farmers can see at first hand the recommendations made in the articles and discuss problems as they relate to their own dairy sheds.

The articles in this series are being published for the Department of Agriculture’s Mastitis Committee, which was formed in 1963 to evaluate the mastitis problem on West Australian dairy farms and eventually formulate an overall approach to control of the disease. The Committee is made up of representatives of the Department’s Dairying and Animal Divisions. Its co-ordinator is Mr. E. Munch-Peterson, who is seconded to the Department from C.S.I.R.O.

An extensive survey is now under way in which a detailed study is being made of the mastitis position on a large number of dairy farms. The field work for the survey is done by dairy and veterinary officers working in co-operation so that on each farm the disease can be studied in detail and, where necessary, veterinary and dairy management advice given to help the farmers involved to overcome their problems.

A series of trials is being carried out in conjunction with the survey and progress results of this work have allowed a basic control programme to be worked out. This is being used in a number of herds and is giving good results in the control of staphylococcal mastitis.

This programme is described in this series of articles.
1. The udder in health and disease

By F. C. WILKINSON, B.V.Sc., Veterinary Surgeon

By selective breeding, man has produced cattle having udders of milk-secreting potential far in excess of the requirements of the new-born calf. However, due to size, position and adaptation to rapid removal of large volumes of milk by mechanical methods, the udders of present-day dairy cows are especially prone to injury and infection. Inflammation often follows such occurrences, producing the disease called mastitis.

Before the causes and effects of mastitis can be understood it is necessary to have a knowledge of the normal udder and let-down of milk and how the milk is withdrawn by the milking machine.

The udder of a cow is a very complex organ. All dairy farmers are very familiar with the outside of the udder, but the inside is to most a mystery. The accompanying photograph gives an excellent view of the structure of the teat and the lower part of the udder in cross section.

The honey-comb appearance is in fact made up of numerous milk-collecting ducts. These ducts, the streak canal and milk sinus are lined by a delicate lining. The milk secreting portion cannot be seen very well in the photograph but is depicted in the accompanying diagrams. The tiny alveoli "manufacture" milk from nutrients obtained from the blood. Groups of alveoli make up lobules which in turn make up lobes of udder tissue. Surrounding the alveoli is non-milk-secreting tissue carrying blood vessels, nerves and muscle fibres.

Milk secreted in the alveoli is stored until milking time, when it is squeezed into the ducts, small at first, but enlarging as they are joined by other ducts, to empty into the sinus of the teat.

MILK "LET-DOWN" occurs when the alveoli contract. This is brought about by a hormone, oxytocin, which causes the muscle contraction shown in the diagram. Various stimuli associated with milking cause release of oxytocin into the blood stream; about 60 seconds after its release oxytocin has reached the alveoli and is causing contraction. Its action generally lasts for only 5 to 10 minutes.

MILK "HOLD-UP" occurs when no stimulus takes place, that is, when oxytocin is not released. It also occurs when milking is attempted after the effect of oxytocin has passed or is decreased in efficiency due to the release of another hormone, adrenalin. Adrenalin may be released when the cow is exposed to fear
This sketch depicts the clusters of alveoli which make up the milk secreting tissue in the udder or pain by the milker or the milking machine. Any interference with milk let-down results in loss of production at that milking and pre-disposition to mastitis.

NORMAL MILKING is accomplished by the use of a negative pressure within a mechanical system. A constant vacuum is applied to the end of the teat to suck out the milk, which is forced down into the teat sinus and streak canal under pressure when the alveoli contract. If this vacuum is applied for too long it causes the tip of the teat to swell and become damaged. For this reason, teat cups have collapsible rubber linings which collapse on to the teat when the pulsator admits air into the system, massaging the teat and allowing blood to circulate, thus preventing damage. The rubber lining expands when negative vacuum pressure is re-applied, allowing the teat cistern to expand and fill with milk which is available for removal through the streak canal by the pull of the constant vacuum. This is depicted in the accompanying diagram.

Bacteria and Udder Infection

Bacteria are microscopic forms of life often called “germs” or “microbes.” There are innumerable types of bacteria, but the main ones entering the udder and causing damage are staphylococci (“staphs”) and streptococci (“streps”). Staphylococci are well known as a common cause of boils while streptococci can be the cause of sore throats in man. These bacteria have no power of movement but are conveyed on or in solids or liquids. Once carried to a suitable site, they multiply rapidly, causing damage and inflammation to the surrounding tissues. In the udder this is seen as mastitis.
The pulsation cycle of the teat cup consists of two phases: collapse and expansion.

During the collapse phase (A), air enters the vacuum tube causing the liner to collapse onto the teat and allowing blood to circulate. Milk flow stops briefly. During the expansion phase (B), vacuum is applied via the vacuum tube, the liner expands and the constant vacuum at the teat orifice causes milk to flow, and be removed via the milk tube.

The important differences to the dairyman between "streps" and "staphs" can be listed as follows:

- **Survival outside the udder**
  - Common mastitis-causing "streps" do not live for long outside the udder.
  - "Staphs" can live on the skin of the cow and in the milking shed for long periods of time.

- **Survival inside the udder**
  - "Streps" live in the milk in the teat ducts or alveoli and only affect the lining cells.
  - "Staphs" live in the milk but also commonly invade the udder tissue, secreting and non-secreting.

- **Susceptibility to treatment drugs**
  - "Streps" are killed by most, including penicillin.
  - "Staphs" are commonly not killed by treatment drugs.

- **Their ability to multiply and invade normal tissues.**

If milk from an udder infected with "staphs" is conveyed through the teat opening into a non-infected quarter, then mastitis will almost certainly develop immediately. If, however, some "staphs" are collected from the skin of a cow and placed through the teat opening, mastitis may not develop unless the udder tissues are first damaged. Any factor which allows bacteria to enter the udder or damage the udder, that is, help bacteria present to become established, is called a predisposing cause.

**Predisposing Causes**

Predisposing causes usually result from inefficient milking techniques which permit:

- Damage to the teat orifice; or
- Damage to the delicate lining tissues, for example, leaving the cups on after milk has ceased flowing.

The role of the milking machine as a possible pre-disposing cause is discussed further in a separate article.
MASTITIS

Once bacteria have entered the udder and the conditions are suitable they multiply very rapidly.

"Streps" remain in the collecting ducts and alveoli, damaging the lining cells. Inflammation occurs with the formation of fluids and tissue debris which causes discolouration of the milk and the presence of clots.

"Staphs" invade the non-secreting tissues as well as the lining tissues. The type of inflammation which develops is spoken of as acute or chronic.

ACUTE MASTITIS is obvious as the whole of one or more of the quarters becomes hot, swollen and painful to the touch. The cow herself may appear sick and the milk is grossly altered. In this case there is bacterial infection and inflammation in nearly all the ducts and alveoli.

CHRONIC MASTITIS is not so obvious. The udder changes are not readily noticed, and the milk changes are often slight and not detectable. This is because only a few ducts and alveoli are affected at the one time. Infection may progress slowly to involve more and more of the ducts in which case gradual udder changes in the form of hardening and/or shrinkage may be detected and sometimes very small clots of slightly discoloured milk may be observed. Cases of acute mastitis which have been treated but in which infection still remains in some parts of the udder are also referred to as chronic mastitis.

The udder tissue which is not badly damaged during an attack of mastitis may fully recover its secreting function. If, however, ducts are blocked off, alveoli fall into disuse and become full of inflammatory fluid and either disappear or are replaced by non-secreting tissues. The replacement with non-secreting tissue is common in "staph" infection and results in the quarter becoming hard. In both acute and chronic mastitis four main changes, which cannot be seen without using special tests occur. The two most important are:

- bacteria are present in the milk often in large numbers;
- white blood cells, the body's natural protective cells, appear in greatly increased numbers.

The use of the Rapid Mastitis Test gives an indication of the number of cells in the milk from each quarter. This will be discussed in the suggested control programme.

TREATMENT OF MASTITIS

Treatment is aimed at assisting the cow to overcome the bacterial infection, so allowing healing to take place. The treatment drug is placed into the quarter through the teat canal where it may pass into the milk ducts to the alveoli and also diffuses into the tissues surrounding the ducts and alveoli, so contacting the bacteria present.

If the bacteria are susceptible to the drug they stop multiplying and may be killed. They are then removed by the cow's white blood cells and healing can take place. Unfortunately this desirable course of events does not always occur, for one or more of the following reasons:

- The drug does not kill the bacteria.
  This may be because—
  The bacteria are resistant,
  or
  The bacteria stop multiplying but start again as soon as the drug is withdrawn.

- The drug does not reach the bacteria. This may stem from the fact that the bacteria are enclosed in inflammatory tissue, or
  The drug is destroyed by inflammatory products before it reaches the bacteria,
  or
  The milk ducts are blocked by inflammatory products.

There are over 30 different preparations available for the treatment of mastitis and a comparison between their efficiency is not possible.

The commonly-available preparations contain penicillin, and these are highly efficient in commonly found cases of "strep" mastitis, but not always so efficient in cases of "staph" mastitis because the bacteria are often resistant to penicillin or cannot be reached by it.
A combination of streptomycin and penicillin has been used quite successfully in routinely treating “staph” mastitis and can be recommended.

Once ducts are blocked or bacteria are enclosed in non-secreting tissue the chances of successful treatment are greatly reduced, no matter what drug is used. Treatment before much permanent damage has occurred is therefore desirable for best results.

When using any treatment it is essential to give at least two doses at times recommended by the manufacturers, otherwise the medicament does not stay in contact with the bacteria in high enough levels for sufficient time to kill them.

**PREVENTION**

“Prevention is better than cure” certainly applies to the disease mastitis. To prevent mastitis, it is fairly obvious from the foregoing that all cows in the herd must be milked in a consistent routine, allowing best use of normal milk let-down. The milking machine must efficiently remove the milk and be used correctly so that udder damage does not occur.

The possible entry of bacteria through the teat canal at milking must be decreased to a minimum.

Any inflammation should be rapidly detected before irreparable damage occurs and effective treatment immediately instigated. If such a system is used, an excellent degree of control can be obtained over mastitis.

Such a system has been devised and used successfully in several dairies.

- *A method of carrying out a control programme in your herd is the subject of three further articles in this series.*

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**Book Review**

**NEW BOOK ON AN OLD SKILL**

In an age when it is generally believed that the horse is fading the way of the Coolgardie safe, it is mildly surprising to receive, hot from the presses, a new book on shoeing horses. But the horse is not fading. At the last count a year ago there were 39,285 horses on W.A.’s agricultural and pastoral properties, an actual increase of 44 in the year.

So J. A. Springhall’s book “Elements of Horseshoeing” makes good horse sense at a time when farriers are fewer than they were and saddlers, wheelrights, harness-makers and coach-builders are elements of an almost-forgotten era.

Why is there need for a new book about a skill developed more than half a century ago? “While there have been no marked changes in the accepted methods of horseshoeing in the past 50 years,” says the author, “most of the books on the subject are out of print.” (One could wish that in other spheres authors and publishers would follow this lead and give us some of the good things of the past.)

In clear, straightforward writing, “Elements of Horseshoeing” deals, in seven logical chapters, with the anatomy of the hoof, the tools of the trade, forging and fitting shoes, special shoes and the shoeing of racehorses and trotters. As well as describing in detail what to do at all stages, the book very usefully warns what not to do. The dimensions of shoes and their construction are fully detailed and it will intrigue some readers to learn that the shoe of a racehorse can weigh between two and four ounces, that of a draught horse between four and five pounds or that the shoes of racehorses are changed before and after they race.

The 42-page book has 16 pages of excellent pictures showing all important aspects of shoeing, including how to lift each leg of the horse. The book is well-indexed, printed on heavy quality art paper and its extra-thick, hard cover fits it for hard living in the workshop.

“Elements of Horseshoeing” by J. A. Springhall, M.B.E., B.VSc., Lecturer in Animal Husbandry, University of Queensland. Published by University of Queensland Press, 1964 (19s. 6d.)

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