

An overview of mastitis in Sokoto red goat, Nigeria

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Introduction

Mastitis is an inflammatory disease affecting the mammary gland, characterized by an increased somatic cell count in milk and/or by pathological changes in mammary tissue. The disease is usually caused by pathogenic bacteria and other microbes entering the gland through the teat duct.

Small ruminants play an important role in the nutrition and income of people worldwide (Mbilu, 2007). It has been estimated that there are more than 460 million goats worldwide producing about 4.50 million tons of milk and 1.20 million tons of meat annually (Hansen and Perry, 1994).

In Africa both goats and sheep are widely distributed extending from arid and semi desert to humid rain forest regions and represent 20.2% and 28.9% of the total population of ruminants in Sub-Saharan Africa. In the subsistence sector, pastoralists and agro-pastoralists depend on them for their livelihood. Ironically, Sokoto State has maintained a large number of animals that graze and constituted a means of survival for the population.

Livestock survey showed that Sokoto State has a livestock population of about 1.18 million cattle, 2.90 million goats, 1.98 million sheep, 2.0 million chickens, 45,000 camels, 34,532 horses and 51,388 donkeys (FDLPCS, 1992).

Goat population in Nigeria was estimated to be 34.45 million of which the majority are found in the Northern parts of the country (FDLPCS, 1992). There are two main breeds of goat in Sokoto State, the white or dappled Balami and the Red Sokoto.

Sokoto Red Goats are kept in virtually every compound within the state. The Sokoto Red, Kano Brown or Maradi goat is probably the most widespread and well-known type in Nigeria (Haumesser, 1975). It is the usual village goat in the northern two-thirds of the country although it is less common with transhumant pastoralists. The distribution of Sokoto Red goats in Nigeria is shown in the fig. 1 below.



Fig. 1: Distribution of Sokoto Red Goat in Nigeria

There hardly exists a pure breed of the Sokoto Red goat; crosses are predominantly seen, due to unchecked cross-breeding with other breeds inhabiting its environment (Plates 1a-1c).



Plate Ia: Sokoto Red goat cross



Plate Ib: Sokoto Red goat cross



Plate Ic: Sokoto Red goat cross

The phenotypic manifestations of Sokoto Red goat closely related to the pure one are shown in plates IIa and IIb.



Plate IIa: Phenotypic manifestations of Sokoto Red goat



Plate IIb: Phenotypic manifestations of Sokoto Red goat

Constraints affecting the productivity of goats in smallholder farms include diseases, theft, land scarcity, labour shortage and, lack of veterinary extension services and capital. Mastitis is considered to be a major disease of economic importance in Nigeria, although no reports on the costs of the disease exist.

Currently, no much information on any aspect of the disease exists for the Sokoto Red Goat breed in Nigeria. There is therefore a pressing need to mount a research that would assess the disease costs, clinical prevalence, causal agents, and host's defense mechanisms, so as to develop specific treatment protocols for the breed and to enhance the breed's productivity in the country.

This paper discussed the general overview, aetiology and clinical signs, immunity and diagnosis and treatment of mastitis. Since the prevalence of mastitis among susceptible breeds, including Sokoto Red Goat, in Nigeria, has not been studied in any depth, we therefore recommended on establishing the status of the disease that may hopefully generate information which, when harnessed together, would enhance the breed productivity in the region.

Economic Implications

Mastitis is an inflammatory disease affecting the mammary gland, characterized by an increased somatic cell count in milk and/or by pathological changes in mammary tissue (Anon, 1971). Mastitis is usually caused by pathogenic bacteria and other microbes entering the gland through the teat duct (Schalm *et al.*, 1971).

Mastitis is generally considered the most costly disease of dairy animals. Financial losses due to mastitis occur for animals experiencing both subclinical and clinical disease. Losses resulting from clinical mastitis are usually apparent and consist of discarded milk and transient reductions in milk yield (Fetrow, 2000).

The prevalence of this disease in Nigeria has not been studied in any depth, although there is extensive literature on mastitis from countries with

farming practices similar to those followed in Nigeria (Kalra and Dhandra 1964; Hamir *et al.*, 1978; Falade *et al.*, 1989).

Based on national statistics for Nigeria, the cost of milk is 20-25 US\$/100kg. This is equivalent to costs in Brazil, Chile, Peru, Uruguay, Kenya, Ukraine, Kazakhstan, China, Australia and New Zealand (Shittu, 2006; and Eustace and Shittu, 2007). There is no report on costs of mastitis in Nigeria. There is therefore a pressing need to assess its costs, clinical prevalence and causal agents in the country.

Aetiology and clinical signs

Infectious agents can be classified as environmental (*Escherichia coli*) or contagious (*Staphylococcus aureus*). Organisms causing mastitis can be divided into five groups; gram-positive cocci, gram-negative bacteria (coliforms), *Corynebacterium*, *Mycoplasma*, and others, which include *Nocardia*, *Prototheca*, and yeasts (Sears *et al.*, 1991). Over 100 different microorganisms have been reported as a cause of intramammary infection (IMI) in dairy animals. Knowledge of the epidemiology of the various pathogens has resulted in grouping based on the primary source of the pathogens in a herd to infect mammary quarters. Three major pathogen groups are recognised and the coagulase-negative staphylococci, occasionally referred to as skin flora opportunists (Bramley and Dodd, 1984; Fox and Gay, 1993; Harmon and Langlois 1989; Smith and Hogan 1993; and Smith *et al.*, 1985). The contagious pathogens were clearly responsible for the majority of IMI prior to the advent of post-milking teat end disinfection (teat dipping) and dry cow therapy (Bramley and Dodd, 1984; and Fox and Gay, 1993).

Subclinical infections so no visible symptoms but result in a loss of milk production with bacteria present in the secretion. Clinical infections result in abnormal milk and udder swelling with the possible addition of systemic symptoms such as high fever and pyrexia. Environmental pathogens such as *Escherichia coli* are often responsible for most clinical cases.

Plate III shows the normal udder conformation. Based on our observations, mastitis in Sokoto Red Goat could be observed on any quarter of the udder (Plates IV and V), but most cases of the disease tend to occur on the right quarters, which. The reason may be because the bulk of the rumen is anatomically located on the left side of the animal. When the animal has fed to its full capacity, the incongruence in the symmetry of the body can be obviously noticeable on careful observation. When such engorged animal is lying down to rest, it is most likely that it will lie more on the less distended (right) side so as to allow the animal have some comfort. In the process of resting on the right

side, the teats of right udder quarters come into direct contact with the ground which naturally harbours microbes. During this time, these microbes can gain entry into the teat canal, depending on the level of dilatation of the teat sphincters. This seems to be a researchable topic for dissertation.



Plate III: Normal udder conformation in Sokoto Red Goat



Plate IV: Mastitis in Sokoto Red Goat

Immunity

Anatomical defences

Mastitis occurs when bacteria are able to gain entrance to the mammary gland via the teat canal. For this reason, the teat end is considered to be the first line of defense against invading pathogens. The teat contains sphincter muscles that maintain tight closure between milkings and hinder bacterial

penetration (Zeeconi *et al.*, 2000). The teat canal is lined with keratin, a waxy material that is derived from the stratified squamous epithelium that has antimicrobial properties. Accumulation of keratin can provide a physical obstruction to bacteria, hindering their migration into the gland cistern. In fact, the keratin structure can completely occlude the duct during the nonlactating period (Nickerson, 1987).

Cellular defences

Migration (diapedesis) of neutrophils into mammary tissue provides the first immunological line of defense against bacteria that penetrate the physical barrier of the teat canal. After an inflammatory response is initiated, neutrophils are the first cells to be recruited to sites of infection. While neutrophil numbers are relatively low in the healthy mammary gland ($<10^5$ cells/ml), their numbers can constitute greater than 90% of the total mammary leukocyte population during mastitis ($>10^6$ cells/ml). These non-specific cells travel from the blood to the mammary gland in response to a variety of inflammatory mediators in order to phagocytose and kill bacterial pathogens (Persson *et al.*, 1993).

Somatic cells are used as an index of milk quality for cow and goat milk. Somatic cell counts for uninfected goats are higher than milk somatic cell counts for uninfected cows (Dulin *et al.*, 1983; Poutrel and Lerondelle, 1983). A number of factors have been reported to contribute to the high milk somatic cell counts for goats. Milk secretion in the cow is merocrine, and secretion in the goat is apocrine (Wooding *et al.*, 1970). As a result, cytoplasmic particles are shed into milk from the apical portion of mammary secretory cells.

Macrophages represent the dominant cell type seen in milk and tissues of healthy, lactating mammary glands. During bacterial pathogenesis, macrophages may serve to facilitate either innate or acquired immune responses. Similar to neutrophils, the non-specific functions of macrophages are to phagocytize bacteria and destroy them with proteases and reactive oxygen species (ROS). The phagocytic rate of these cells can be increased dramatically in the presence of opsonic antibodies against particular pathogens (Miller *et al.*, 1988).

Lymphocytes are able to recognise antigens through specific membrane receptors which define the immunological characteristics of specificity, diversity, memory, and self/non self recognition. Subsets of lymphocytes are divided into 2 main groups: T and B lymphocytes (Shafer-Weaver *et al.*, 1996). Lymphoid cells in bovine milk also display a memory cell phenotype (Taylor *et al.*, 1994).

Soluble defences

Both specific and innate soluble factors represent an important line of defense within the mammary gland that can elicit effective protective responses to invading pathogens. The primary soluble effectors of the specific immune response are antibodies or immunoglobulins (Ig) produced by antigen activated B lymphocytes. IgG1 is the primary isotype found in healthy mammary secretions, but IgG2 increases substantially during mammary gland inflammation (Korhonen *et al.*, 2000).

Diagnosis and treatment

The somatic cell count provides a good quantitative estimate of the degree of inflammation. The identification of pathogens along with their antibiogram results should help in developing therapy protocols for dairy farms.

Collecting a suitable sample is a crucial step in obtaining reliable culture results that can be interpreted and used to identify problems and monitor herd health. Fewer contaminants occur when milk samples are collected post milking (Sears *et al.*, 1991).

Most treatments of clinical mastitis are based on clinical signs.

If *Escherichia coli* or *Klebsiella* is isolated from the clinical milk sample, supportive therapy including an anti-inflammatory should be continued until the milk and temperature have returned to normal. Coliforms do not generally require antibiotic therapy because most coliforms are eliminated from the gland in the first 12 hours (Erskine *et al.*, 2002). In severe and persistent cases, systemic antibiotic therapy may be of value (Dinsmore *et al.*, 1991) and may help reduce losses due to death or culling.

Cases of gangrenous mastitis (plate V) are being reported to the Large Animal Clinic of the Usmanu Danfodiyo University Veterinary Teaching Hospital, Sokoto, Nigeria. The therapeutic option being employed in greater percent of cases is surgical amputation of the affected udder (Plate VI).



Plate V: Gangrenous mastitis in Sokoto red goat



Plate VI: Gangrenous mastitic udder after surgical amputation.

Conclusion

In this paper, the general overview, aetiology and clinical signs, immunity and diagnosis and treatment of mastitis, with special reference to goats, were discussed. Some aspect of immunity to the disease in cows was also included due to either their similarity in goats or lack of literature in the area. Sokoto red goat, the susceptible breed, and its habitation were also discussed.

Infectious agents can be classified as environmental (*Escherichia coli*) or contagious (*Staphylococcus aureus*). Currently, no much specific information on any aspect of the disease exists for the Sokoto Red Goat breed in the northwestern Nigeria. There is therefore a pressing need to mount a research that would assess the disease costs, clinical prevalence, causal agents to predict the bacterial status of udders, host response to infection and/or particular defense mechanisms (using goat-specific reagents to characterise cell

populations, measure cytokines, etc), as well as develop specific therapeutic protocols.

Goat-specific reagents to characterise cell populations, measure cytokines etc are much rarer than for example antibodies specific for human or mouse cell surface markers or effector molecules. This may be considered a serious drawback for performing immunological research on other species and thus would be very important to collaborate with institutions which have a long standing track record on goat immunology and epidemiology. This collaboration will be aimed towards attempting at presenting a study design on the prevalence of mastitis in Sokoto red goat in Nigeria, and determining, within a specified period, a picture of existing cases of the disease in small ruminant populations. This study may serve as a measure for evaluation of surveillance as well as provide insight on decision-support systems for further control or eradication of small ruminant mastitis in Nigeria.

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