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RESEARCH ARTICLE

FUNCTIONAL CORRELATION OF CORPORA AMYLACEA IN INVOLUTION OF MAMMARY GLANDS OF MADRAS RED SHEEP

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ABSTRACT

The histology of corpora amylacea in mammary glands of Madras red sheep was recorded during various stages of physiological phases. The corpora amylacea were observed as round, oval or irregular cauliflower shaped concentrically laminated bodies. These were seen in their various stages of formation and located both in the lumen of alveoli and septal connective tissue. The occurrence of corpora amylacea increased gradually from lactating mammary glands and observed more in late lactation and dry mammary glands during involution. A gradual increase in both size and numbers of corpora from parturition to late lactation suggested that the development of these structures accelerated as lactation progressed and these structures may have a role in the involutionary process.

INTRODUCTION

The final stage of growth involves the functional differentiation process during pregnancy-associated lobuloalveolar development, followed by involution when nursing or milking ceases. Involutionary changes including degeneration of epithelial cells and alveolar ducts, appearance of dark parts of casein in alveoli, interstitium and lactiferous ducts (Corpora amylacea) is reported in domestic animals (Eurell and Frappier, 2006). The presence of corpora amylacea were reported in all the mammary glands of the animals (ewe, goat, and mares). They were generally comparable to the cow regarding to its distribution, frequency, size, morphological structure, and staining properties (Ludewig, 1998). Earlier studies on growth and development of mammary gland have been centered only on pregnant and lactating animals. Reports are available on histological and histochemical features of bovine and buffalo mammary glands (Uppal *et al.*, 1994) during lactation. The literature on the histomorphology of the mammary gland during various physiological phases in animals is supposedly limited. Therefore, the current histomorphological observation

is focused to record the occurrence of corpora amylacea in the mammary glands during different physiological phases of Madras red sheep.

MATERIALS AND METHODS

A total of 30 Madras red ewes of different age were divided into five age groups viz. prepubertal, (4 to 6 months), pubertal (7 to 18 months), pregnant (1.5 years to 2.5 years), lactating (2 to 4 years) and dry (4 to 8 years) with 6 animals in each. The samples of the mammary gland were collected randomly from the left and right halves. They were fixed in various standard fixatives viz., 10% neutral buffered formalin, Zenker's fluid, Carnoy's fluid, Bouin's fluid and Telly's fixative and processed by routine Alcohol-Benzene schedule and moulded in paraffin blocks. They were cut by digital microtome at 5-7 µm thickness for histological study. Semi-thin sections of 200-300 nm thickness were cut with a glass knife on a Leica Ultracut UCT-GA-D/E-1/00 ultra microtome and the sections were stained with Toluidine blue. The sections were stained with standard Haematoxylin and Eosin, Periodic acid Schiff (PAS) technique for mucopolysaccharides, Mercury-Bromophenol blue method for basic proteins, Von Kossa method for calcium, Oil red 'O' in propylene glycol for lipids (Bancroft and Gamble, 2003).

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RESULTS AND DISCUSSION

The mammary parenchyma consisted of branching ducts surrounded by abundant connective tissue comprised of adipose tissue with poorly defined lobes in early life. The adipose tissue was replaced by the growing connective tissue in the mammary glands of pubertal and pregnant animals. The relative proportion of the interlobular connective tissue increased at the pubertal period but decreased during pregnant and lactating mammary glands. The alveoli were mostly rounded in shape in pregnant animals, whereas they were round, oval or elliptical in shape mostly filled with acidophilic secretions in lactating mammary glands. The lumen of alveoli in the mammary glands during pregnant and lactation stages showed positive reaction for calcium. The alveolar size was maximum in lactating sheep than other age groups. The developing alveoli in the pregnant mammary gland comprised of large lipid droplets, whereas the alveoli in the lactating mammary gland had only smaller lipid droplets accumulated in the cytoplasm as observed under light microscope. The discharge of these vacuoles into the alveolar lumen was evident in the mammary gland of lactating sheep.

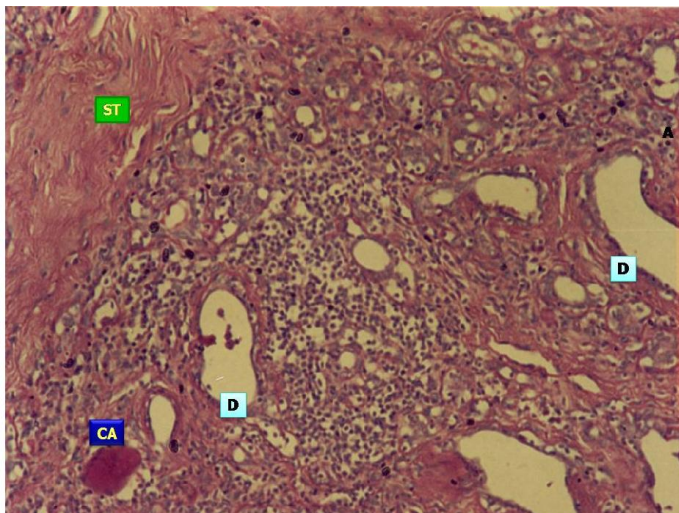


Figure 1. Photomicrograph of the mammary gland during late lactation showing the connective tissue (CT) surrounding degenerating alveoli and formation of corpora amylacea (CA) both in alveoli and interstitial tissue. H&E x 400

The alveoli in the dry animals showed degenerative changes and the lumen of alveoli and ducts became obliterated. In the mammary glands of dry sheep, the connective tissue fibres increased due to the involutionary effect (Fig.1). Similar findings were also reported by [Sincai et al. \(1984\)](#) in the mammary gland of non-lactating ewes which showed mainly stromal tissue with few alveoli in degenerative stages. Intra-alveolar migration of leucocytes chiefly the eosinophilic, mast cells and lymphocytes from the adjacent blood vessels (Fig.2) along with few plasma cells was an important feature at this stage of mammary gland development. The occurrence of corpora amylacea both in alveoli and connective tissue was frequent in these glands. The corpora amylacea were observed as round, oval or irregular cauliflower shaped concentrically laminated bodies with few droplets like structures in the centre. Corpora amylacea were reported to be common feature in the

ewe especially in non-lactating mammary glands. Their origin appeared to be cellular and the desquamated and infiltrated cells accumulated in the lumen became fragmented, degenerated and lysed to form a solid lump like structure of the corpora amylacea as has been described by [Tatarczuch et al. \(1997\)](#) in sheep. Corpora amylacea were strongly basophilic but found negative for mucopolysaccharides. The present observation is not in agreement with [Sulochana et al. \(1990\)](#) who have recorded neutral polysaccharides in these bodies. The framework of amorphous deposits showed filamentous aggregations in the corpora amylacea and spherical masses of fibrillar material (Fig.2).

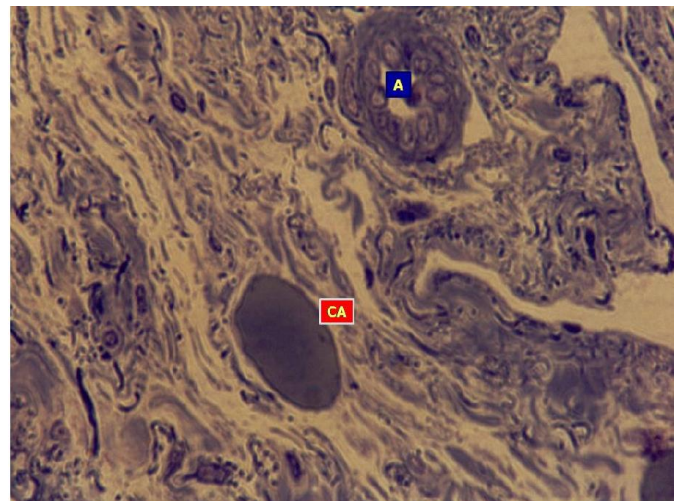


Fig.2. Photomicrograph of the mammary gland during dry period showing the interstitial Corpora amylacea (CA) and regressing alveoli (A). Toluidine blue x 630

Corpora amylacea were formed in alveoli lined with actively secreting cells. The initial stage of their formation involved the aggregation, fusion and compaction of casein micelles in the alveolar milk. The resulting structure acted as a nucleus for further growth which occurred by the addition of material of micellar origin to its surface. Bodies containing a large proportion of crystalline material as a common feature. Contact of corpora amylacea with the alveolar epithelium often caused flattening or irreversible damage to the secretory cells. Corpora amylacea were seen in their various stages of formation and located both in the lumen of alveoli (intra-alveolar bodies) and septal connective tissue (Interstitial bodies). The interstitial amylacea concretions were more in the involuting mammary glands. This is in agreement with the findings of [Sordillo and Nickerson \(1986\)](#) who described that in bovines, corpora amylacea were most abundant during the later stages of lactation and least abundant during early lactation.

In the current study, the corpora amylacea began to appear in mammary glands of pregnant and lactating animals and numerous in the non-lactating sheep as reported by [Sulochana et al. \(loc cit.\)](#) in the mammary gland of sheep during pregnancy. The occurrence of corpora amylacea increased gradually from lactating mammary glands and observed more in late lactation and dry periods and were found both in the alveolar lumen and interstitial connective tissue (Fig.1 & 2). During gestation they are located outside the alveolus and in

the interalveolar connective tissue. In lactating mammary glands they are mostly situated in the centre of alveoli. A gradual increase in both size and numbers of corpora amylacea from parturition to late lactation suggested that development of these structures accelerated as lactation progressed. Morphological relationship between deposits and parenchyma revealed that the corpora amylacea suppress milk secretion and flow during late lactation in isolated areas by engorging luminal spaces and clogging small ducts, leading to milk stasis and these structures may have a role in the involutionary process as evidenced by Ludewig (loc cit.) in bovines.

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