DETERMINATION OF GLANDULAR TISSUE DEVELOPMENT IN THE UDDER OF BUFFALOES AND CATTLE

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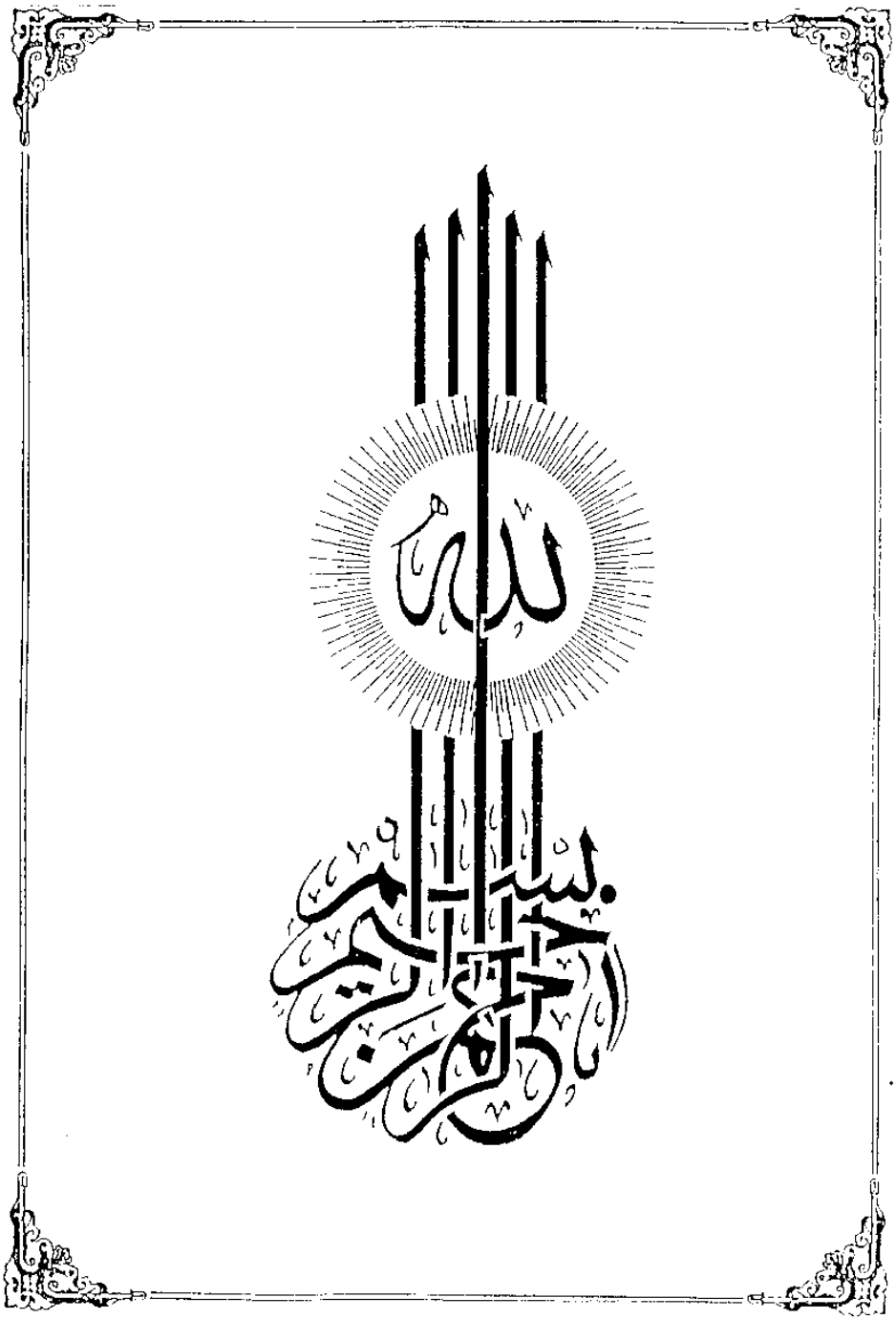

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INTRODUCTION

The lowered productivity of the Egyptian buffaloes, compared with Friesian cattle is a major problem in raising buffaloes in Egypt. Since most of the milk produced in A.R.E. is from buffaloes, it was extremely important to investigate the reasons behind this low milk yield of Egyptian buffaloes.

To my knowledge, there is no published information on the developmental characteristics of buffloe udder, and the trials carried on evoking udder growth in buffaloes by the use of sex hormones (Elsheikh *et al.*, 1967) were unsuccessful. It was, therefore, a very interesting topic to investigate and I was particularly interested in comparing buffaloes with a quite sensitive animal to such hormone treatments i.e. Friesian cattle in determining the histological structure of the mammary glands of both buffaloes and cattle.

Methods of estimation of the secretory functioning tissue in the mammary glands depend mostly on two methods of determination i.e. the quantitative histological and the quantitative chemical determinations of both DNA and RNA contents in udder tissue.

In the present work I will discuss only the quantitative histological architecture of udders of cattle and buffaloes. The differences between these two species with respect to milk production and fat percentage reflect major variations in the type and nature of the secretory tissue in these two species.

In this investigation, I will try to clarify these differences between the udders of buffaloes and Friesian cattle, that, may cause the differences in milk production. The histological study, presented here, was done to describe the micro-structure architecture of the buffaloe udders and comparing it with that of Friesians. A quantitative estimation of the glandular tissue and its proportion to the udder components was also studied.

Further investigations on the chemical composition and the biochemical processes involved in milk synthesis within the secretory cells of the mammary glands are of great importance. The cell activity and the amount and function of the nucleic acids should be considered.

PART I

HISTOLOGICAL STUDY OF THE UDDER

REVIEW OF LITERATURE

Developmental changes of the Mammary Glands:

Schafer (1929) found that the mammary gland of the virgin mamma composed of very few and small groups of alveoli, scattered in abundant thick connective tissue. In the case of pregnancy the gland ducts bud out ertensively and the alveoli enlarged until the greater part of the connective tissue in the mammary region was permeated by them. The same author and many other investigators, Wallace (1953) in calves and lambs, Yamamato and Turner (1955) in heifers, Griffith and Turner(1959) in rats, Misonu and Hikman (1959) in rats, Moon,Griffith, Turner, Powell and Mary (1959) in rats, Williams and Turner (1962) in heifers, Anderson and Turner (1962) in mice, Hindary and Turner (1963) in heifers, Bresciani (1968) in mouse, Sud, Tucker and Meites (1968) in heifers, Tucker (1969) in rats and Wiknam, (1969) in mice, proved that the growth of the duct system was caused by the action of oestrogen hormone. However, the development of alveoli was brought about by progestrone hormone. The same findings were confirmed by Maximow (1952) who found that, in the mature mamma periodical changes took place in connection with the

sexual cycle of the ovaries and uterus. It is probable that the changes in the breast consist in hyperplasia and perhaps edema of the interstitial connective tissue; the claim that the ductule and acinar progravid changes in the endometrium is probably undoubtful.

The electron microscopical invistigetion made by Waugh, Hoven and Van Der (1962) demonstrated that the fine structure of the resting and pregnant breast in human was found to be similar to that reported by other workers for mice, rats and cows.

Sabantsev and startsev (1954) found in purebred Siberian calves, siberian x simmental, corssbreds and the progeny of kostroma ♂ on siberian x simmental ♀♀, that differences in growth from birth to twelve months old were significant and were confined to fat and connective tissue. The mammary growth was intensive during the period between twelve and twenty months. This was due to the developmental changes of ducts and alveoli. They also found that regular massage of the mammary gland during the same period (12-20 months) doubled the size of the gland and the increase was due to greater glandular

tissue and alveolar development and to less fat development.

The histological examination of developing calves aged between 3 and 8 months showed considerable variation between individuals in the glandular tissue (Nesini 1961). There was some degree of differentiation even in the tissue of 3 months old calves.

The histological changes in the mammary gland of the sow embryos were studied by Krok (1960). He showed that the glands were first noticable at 20 to 22 days and the teats at 22 to 30 days. At 90 days the ducts began to branch and terminal distensions were formed. He also mentioned that marked changes occurred in the histological structure of the gland during the transition from embryonic to post-embryonic stage and the development up to 7 months postpertum was rather slow consisting of proliferation and branching of milk ducts and the formation of alveoli. At twelve months old, he found that the secretory elements were still inadequately developed, the glands consisting chiefly of connective tissue and there were no symptoms of secretory activity.

Solovi and Ektov (1961) found in gilts aged between four and eighteen months that the development trends of the mammary gland in gilts of four months old were continued in those of six months. At nine, twelve and eighteen months, the glands contained alveolar tissue at widely differing stages of development, even in gilts of the same stage. They added that the proportion of the gland connective tissue was higher in cross-bred than in purebred pigs. A slight increase of the same pattern observed in the alveoli. Adomiker and Glowishing (1967) reported that the morphological structure of the gland in hamster, guinea pig and rat were very similar.

Ahren, Etienne and Monique (1957) studied the development of the mammary gland in normal and castrated male rats at 21-29 days. In both groups the glands showed only restricted duct systems at 21-27 days and duct and bud development at 53-60 days was still similar except that alveolar development was obvious in normal rats (at 84-92 and 98-115) although the mammary gland area seemed similar in both groups, alveolar development was extensive in the normal and scarce in the castrated rats but was composed

of two or more layers in the normal three months old rats.

Meibenco (1960) observed varying degrees of activity in mammary glands of untreated female rats of 350 to 950 days of age. Older animals have enlargements along the breast lines, which contained milk-like fluids. He also declared that secretion was associated with ductal and lobule-alveolar proliferation.

In the mouse mammary gland, Sekhri, Pitelka and Doeme (1967) found that the featal and one day old glands have rudimentary duct system, terminating in end buds which were absent in one to three week glands and reappeared at the four week stage.

Turner (1952), Mayer and Klein (1961) described the histological structure of the mammary gland as follows:

i) Mammary parenchyma: has different epithelial structure at the ducts and acini levels, both as regards the epithelium and periepithelial structures.

ii) Mammary Stroma: contains inter-lobar connective,

smallest lobule was consisted of elongated tubes of sacs, alveolar ducts, covered by round evaginations and the alveoli.

The alveoli:

The acini or alveoli which together form the lobulo-alveolar system, were described by Schafer (1952) in human and Mayer and Klein (1961) in cow and goat, They are small vesicles or sacs of unequal sizes, made up of a basement or vitreous membrane, alayer of myoepithelial cells and a layer of secretory cells. The same descritpion was mentioned by Maximow (1952) in human; Turner (1952) in cows, goats, sows, gilts and pigs; Weber, Wyand, Phillips and Mary (1957) in bovine, Chumakov (1963) in eighteen months old heifers; and Helimnin (1968) in rats. The conструcture of the alveoli in these different species was almost alike. Schafer (1929), Maximow (1952) and Ham (1965) in human observed that the epithelial cells linning the alveoli were columnar in shape. Weber et al. (1957) in bovine described them as low columnar, and Mayer and Klein (1961) revealed that they may be cuboidal or columnar.

Schafor (1929) stated that the epithelial

Biborski (1956) found that the alveoli in Black Pied calves aged 7 to 25 days were fairly large and less branched than in polish Red calves at the same age.

Giebina, Puticuva and Kudryavtsev (1940) found in various age groups of large white pigs ranged between six and twelve months age, fully developed alveoli, with clear indications of secretory process in the epithelium linning present at twelve months.

Gross, Goodwin and silver (1958) examined the alveoli in normal and agalactic sows before farrowing and showed that, they were small and filled with a hyaline oesinophilic secretion. The alveoli became progressively distended and the eosinophilic material was replaced by basophilic material and fat secretion began. At farrowing, the alveoli contracted and their contents were evaculated. Evolution in engorged glands was shown by solidification of the alveoli and by swollen and degenerating epithelial cells and later stromal proliferation.

The ducts:

Schafer (1929), Maximow (1952) and Ham (1965) mentioned that each mamma actually represents a group

of glands, which open by numerous ducts upon the apex of the nipple. Each duct is dilated into a small reservoir, the sinus lactiferous, just before reaching the nipple, lying between and around the ducts plain muscular tissue. The ducts are found to commence in groups of saccular alveoli. Ham (1965) added that in the resting breast epithelial parenchyma, such as is present consists only of single ducts or little clusters of ducts widely separated from one another by connective tissue.

Giebina, et al. (1940) showed that the mammary gland in various age groups of large white pigs c contains one to four ducts, most, frequently two, open in the teats with small openings at the lip of the teat. Each duct has a corresponding gland which has no contact with the adjacent glands openning into the same teat.

In the mammary glands of human (Maximow 1952 and Ham (1965) and goat and bovine (Turner 1952 and Mayer and Klein (1961), the ducts are grouped into small lobules. These pass over without definite boundaries into the primary excretory ducts by a simple constriction. The latter, in turn gradually unite,