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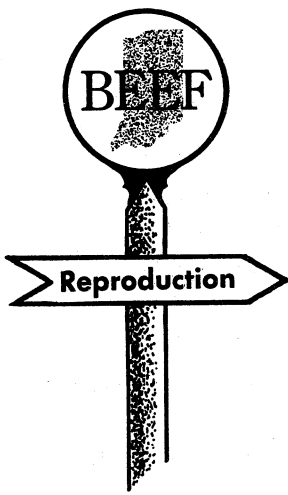
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Structure and Function of the Cow's Reproductive System

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This publication is designed as a teaching aid for the intensified cattle reproduction schools conducted by the Indiana Cooperative Extension Service. It is also included in the Beef and Dairy Production Handbooks for County Extension Workers. The purpose of this publication is to help producers more clearly understand the structures and functions of the reproductive tract of the cow.

Introduction

The primary product of the cow's reproductive tract is the egg (ovum). However, a rather elaborate, well organized system of passage ways is also necessary for successful completion of the reproductive process.

For instance, a normal egg must be released from the ovary to unite with a sperm from the male. The fertilized egg must then pass to another part of the system where growth and development can occur. Finally, the reproductive system must allow a successful delivery of the calf and then return to a condition which will permit another normal pregnancy.

The ovaries

The principal female organs are the ovaries which, unlike the bull testes, are located inside the abdominal cavity. The ovaries are about 1 to 1.5 inches in diameter and are oval-shaped. The ovary consists of

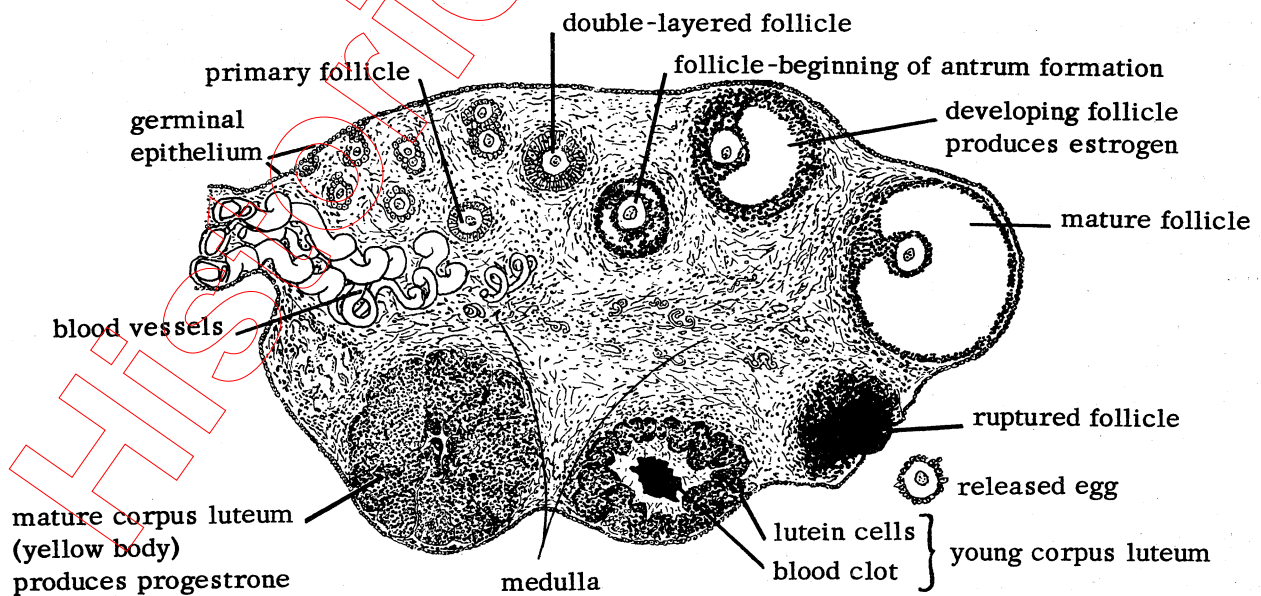


Figure 1. Changes in the ovary

two principal sections; the cortex, or outer shell, and the medulla, or inner core. The cortex is composed of germinal epithelium cells. These cells give rise to the egg through a series of specialized cell divisions. The medulla contains many blood vessels and nerves and is responsible for nourishing the developing egg.

During the 21-day estrous cycle there are several changes which occur on the ovary. These changes are illustrated in Figure 1.

The primary follicle is one of the early stages of egg development, and may occur at any point on the ovary surface.

When the primary follicle has started to divide (through meiosis), cells start to multiply and grow around the follicle. The developing egg seems to move away from the cortex and into the medulla.

As the surrounding cells continue to divide and grow, an antrum or cavity forms inside the follicle. As the antrum enlarges it becomes filled with fluids which are secreted by specialized cells surrounding the developing egg. The fluids in the antrum contain estrogen, the primary female sex hormone. Estrogen passes into the blood system and is responsible for many of the special reproductive events in the cow.

Around the follicle, the blood system gradually becomes more highly developed. This allows more blood circulation to and from the follicle. Eventually, because of its great increase in size (to about .75 inches in diameter), the follicle extends through the thickness of the cortex, resembling a "blister" on the surface of the ovary.

The follicle ruptures when it is mature and the follicular fluids flow out carrying the egg. The exact cause of follicle rupture or ovulation is not known. The egg then proceeds down the reproductive tract.

Soon after ovulation the walls of the follicle collapse and a blood clot forms in the antrum. Near this time certain of the cells which surround the follicles start to form the corpus luteum or "yellow body." The corpus luteum is composed of lutein cells. The corpus luteum secretes progesterone, a hormone important in maintaining pregnancy.

If the newly ovulated egg is not fertilized and pregnancy does not occur, the corpus luteum degenerates, and a new 21-day estrous cycle begins. However, if pregnancy occurs, the corpus luteum remains functional until the delivery of the calf.

Accessory Structures

Figure 2 presents a sketch of the overall reproductive tract of the cow.

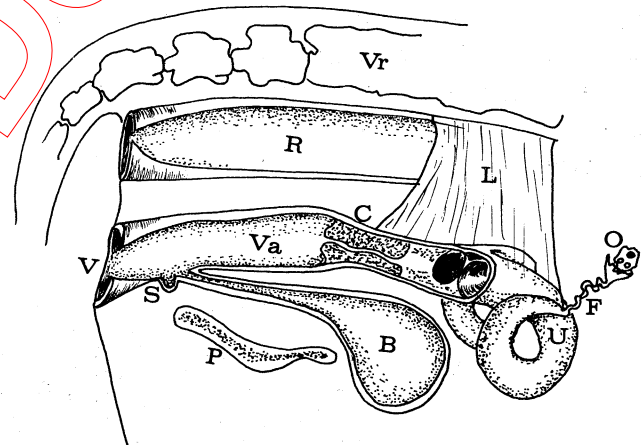


Figure 2. Reproductive tract of the cow (side view)

B = urinary bladder, C = cervix, F = fallopian tube, L = broad ligament, O = ovary, R = rectum, P = pelvic bone, S = suburethral diverticulum, U = uterine horn, Va = vagina, V = vestibule, Vr = vertebral column

At ovulation the egg normally enters the fimbriae, a funnel shaped structure below the ovary. From the fimbriae the egg passes into the 8 to 10 inch long oviduct. Muscular contractions, and perhaps fluid secretions from the upper part of the oviduct, assist in moving the egg downward. Fertilization occurs in the upper portion of the oviduct.

The horns and body of the uterus are usually about 18 inches long. On the inner surface of the uterus are 70 to 120 specialized circular areas called caruncles. During pregnancy the caruncles attach to cotyledons, which are located on the membranes surrounding the fetus. The caruncle-cotyledon attachments furnish sites for nourishing the fetus.

The cervix is about 4 inches long and 2 inches in diameter. The walls of the cervix are very thick and have only a small spiral pathway between the non-pregnant uterus and the vagina. In natural service semen is deposited in the forward part of the vagina. However, in artificial insemination semen is deposited in or through the cervix.

During pregnancy the uterus is sealed from the outside by a mucus plug in the cervix which protects the developing fetus from contamination from outside sources. Disturbance of the mucus plug in a pregnant cow may result in abortion. This is the reason for the technician depositing semen in the vagina or mid-cervix on the second artificial service of a cow.

The vagina is about 10 inches long and has relatively thin and elastic walls. It extends from the cervix to the urethral opening. The reproductive and urinary systems share a common passageway from this point for the short distance to the exterior. It is called the vestibule. The vulva is the external opening of the reproductive and urinary tract. These combine to guide the penis into the vagina during natural mating and form a passage for the calf during birth.

Pregnancy

The fertilized egg goes through three distinct periods during gestation; the zygote, embryo, and fetal periods. The first period is characterized by cell division and movement of the egg down the oviduct (about 4 days). The egg then remains free in the uterus for about another 9 days.

The embryo period begins with a weak attachment of the round mass of cells to the uterine wall. This period lasts from the 13th to the 45th day. During this time all the organ systems are developed from three primary cell layers. Entoderm is the internal layer that gives rise to the primitive gut. The outer layer is the ectoderm from which the nervous system, sense organs, and other glands develop.

At the same time, placental membranes around the embryo are being formed to provide a dependable source of nutrients for the developing embryo. Transfer of nutrients, oxygen, and carbon dioxide between the dam and the embryo occurs at the caruncle-cotyledon attachment by diffusion. There is no mixing of the embryonic and maternal blood.

The period from the 46th day until calving is called the fetal period. Increased size and weight is the most important characteristic of this period. Figure 3 shows the relationship between the days of pregnancy and the weight of the reproductive tract and fetus.

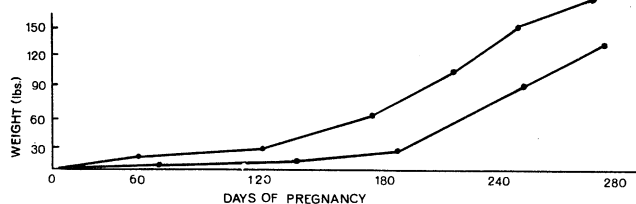


Figure 3. Weight change in fetus and reproductive tract during pregnancy

As shown in figure 3, the entire tract and fetus weighs only about 45 pounds at 150 days of gestation. Therefore, the general requirements for energy, protein and minerals to adequately nourish the calf during the first 5 month period of pregnancy are not much greater than normal maintenance requirements. However, since approximately 110 pounds of weight is added to the tract and

fetus from the 5th month through termination of pregnancy, the energy, protein and mineral requirements are greater during the last 4.5 months and during lactation. Adequate vitamin A levels are critical in all of the reproductive periods, and the ration must be supplemented if a deficiency exists.

During pregnancy the uterus greatly enlarges to accommodate the calf. The uterus pushes into the abdominal cavity and the vagina may stretch to twice normal length. Figure 4 shows the normal position of the calf near delivery. During delivery the elastic walls of the vagina expand to the limits of the pelvic bones in response to the uterine contractions which are brought about by specific hormones.

The length of the gestation period varies with the breed, sex of calf and other factors. Use of Table 1 will enable more accurate estimation of the calving date for the different breeds of cattle.

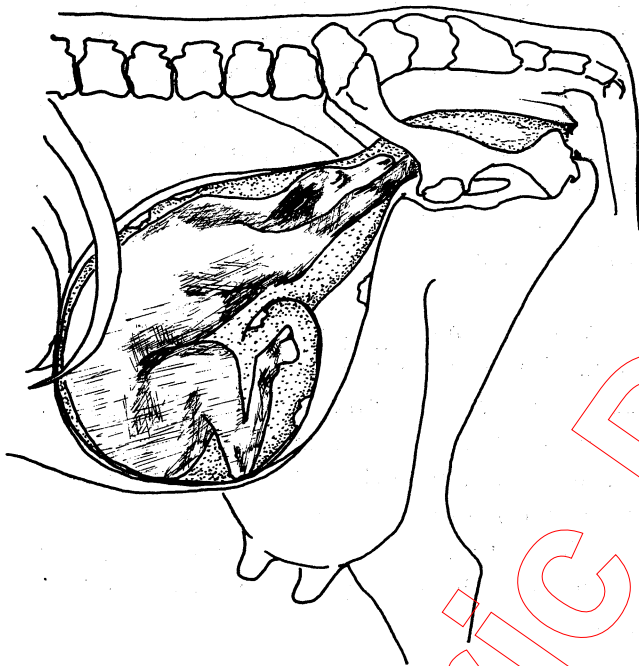


Figure 4. Reproductive tract of cow near normal calving

Table 1. Average gestation length

<u>Breed</u>	<u>Days</u>
Aberdeen Angus	281
Ayrshire	279
Brown Swiss	290
Guernsey	283
Hereford	285
Holstein-Friesian	279
Jersey	279
Shorthorn	281