##  Sengamala Thayaar Educational Trust Women’s College

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**NUTRITION THROUGH LIFE CYCLE**

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**NUTRITION THROUGH LIFE CYCLE**

**LACTATION AND BREASTFEEDING**

**Definitions**

**Lactation:** the secretion of milk from the mammary glands of the breast.

**Breastfeeding:** the feeding of an infant at the mother's breast; nursing.

The stages of lactation

**There are four stages of lactation:**

1. Mammogenesis (growth of the breasts)
2. Lactogenesis (the functional change of the breasts so that they can secrete milk)
3. Galactopoiesis (maintaining the production of milk)
4. Involution (the termination of milk production).

**The important hormones involved in lactation are:**

* prolactin
* oestrogens
* progesterone
* adrenal corticoids (cortisol)
* insulin
* growth hormone

**Brief timeline of milk secretion**

During pregnancy the high levels of progesterone and oestrogens inhibit milk secretion.

During the last few days before parturition and some days after, a fluid called COLOSTRUM is secreted. Colostrum has a different composition to milk and is produced at a slower rate. It is made up of lactose and proteins; however milk is made of lactose, proteins and fat.

After parturition, the loss of the placenta reduces the levels of oestrogen and progesterone in the mother’s blood so that the hormones no longer have an inhibitory effect on the breasts. Over the next 1-7 days the breast begin to secrete a greater volume of milk instead of colostrum.

**Mammogenesis**



The inactive breast is mainly made up of adipose tissue; however the lactating breast has a greater proportion of glandular tissue.

During pregnancy the breasts enlargen; the nipple pigment darkens; the skin becomes thinner and the veins in the breast become more prominent.

In mammogenesis the ductal system grows and branches; the amount of connective tissue and supporting cells increases and fat is laid down in the breast. This is stimulated by the oestrogens, growth hormone, prolactin, insulin and the adrenal corticoids.

Progesterone is involved in the last stages of mammogenesis after the ductal system has grown. It acts with the other hormones to develop the breast lobules and alveoli, and adapts the alveoli to have secretory properties.

**Lactogenesis**

There are two main stages of lactogenesis:

**Lactogenesis I:**the ability of the mammary glands to secrete milk from mid-pregnancy to late pregnancy.

Lactogenesis I starts from mid-pregnancy till 2 days after birth. It involves the differentiation of alveolar epithelial cells and the stimulation of milk synthesis by prolactin.

**Lactogenesis II:**the formation of large amounts of milk after parturition.

Lactogenesis II starts from day 3 postpartum to day 8. It is triggered by the reduction of progesterone. The breast become full and warm and produce large amounts of milk.

Lactogenesis is the onset of milk secretion and includes all of the changes in the mammary epithelium necessary to go from the undifferentiated mammary gland in early pregnancy to full lactation sometime after parturition. Based on work in ruminants, Hartmann[22](http://www.sciencedirect.com/science/article/pii/S0031395505702844%22%20%5Cl%20%22bib21) and Fleet and colleagues[17](http://www.sciencedirect.com/science/article/pii/S0031395505702844%22%20%5Cl%20%22bib16) divided lactogenesis into two stages.

Stage I occurs during pregnancy, when the gland becomes sufficiently differentiated to secrete small quantities of specific milk components, such as casein and lactose. In humans, stage I occurs at approximately midpregnancy and can be detected by the measurement of increased plasma concentrations of lactose and α-lactalbumin.[4](http://www.sciencedirect.com/science/article/pii/S0031395505702844%22%20%5Cl%20%22bib4) After lactogenesis stage I has been achieved the gland is sufficiently differentiated to secrete milk, but secretion is held in check by high circulating plasma concentrations of progesterone[27](http://www.sciencedirect.com/science/article/pii/S0031395505702844%22%20%5Cl%20%22bib26) and, possibly, in some species such as humans, estrogen. The secretion product, often called colostrum, which can be extracted from the breasts of pregnant women,[2,30](http://www.sciencedirect.com/science/article/pii/S0031395505702844%22%20%5Cl%20%22bib2) contains relatively high concentrations of sodium; chloride; and protective substances, such as immunoglobulins and lactoferrin. Casein is not present[10,54](http://www.sciencedirect.com/science/article/pii/S0031395505702844%22%20%5Cl%20%22bib10) and the lactose concentration is low[2](http://www.sciencedirect.com/science/article/pii/S0031395505702844#bib2) at this time.

Stage II is the onset of copious milk secretion associated with parturition. In many species, such as cows, goats, and rats, this stage begins before birth of the young, brought about by the sharp decrease in plasma progesterone that also initiates parturition. In humans, the progesterone level does not decrease prepartum but decreases approximately 10-fold during the first 4 days after birth, accompanied by a programmed transformation of the mammary epithelium, which leads to transfer to the infant of 500 to 750 mL/d of milk by day 5 postpartum.[10,46](http://www.sciencedirect.com/science/article/pii/S0031395505702844#bib10) This transformation requires a concerted change in several processes, including changes in the permeability of the paracellular pathway between epithelial cells; changes in the secretion of protective substances, such as immunoglobulins, lactoferrin, and complex carbohydrates; and an increased rate of secretion of all milk components. Lactogenesis stage II can be monitored by changes in milk composition and volume in women and other species in which large milk samples can easily be obtained.[47](http://www.sciencedirect.com/science/article/pii/S0031395505702844%22%20%5Cl%20%22bib46) The terms colostrum and transitional milk, traditionally used to describe the mammary secretion product during the first 4 days postpartum and from days 4 to 10 postpartum, respectively, do not define clear-cut temporal changes in milk composition and are not useful distinctions. Rather, the changes in milk composition that occur postpartum should be viewed as part of a continuum wherein rapid changes in composition occur during the first 4 days postpartum followed by slow changes in various components of milk throughout the course of lactation.

**Galactopoiesis**

 Galactopoiesis starts around 9 days after birth and finishes at the beginning of involution. It is the maintenance of milk secretion controlled by hormones. Breast size starts to diminsh betwwn 6 to 9 months after birth. The rate of milk formation normally decreases after 7-9 months; however milk production can continue for years if the child continues to suckle.

**Involution**

 Involution is the loss of secretory function of milk, due to the accumulation of inhibiting peptides. It normally starts 40 days after the last breastfeed. The epithelial cells no longer require their secretory properties so they are removed by the process of apoptosis and replaced by adipocytes.



**The importance of prolactin in lactation**

Prolactin secretion starts in the 5th week of pregnancy. The levels of serum prolactin gradually increases until parturition; afterwards quantity of prolactin returns to the non-pregnant level. It is secreted by the anterior pituitary gland, cells in the breast and the decidua of the uterus. It is transported via the blood to the breasts, where it acts on cells in the alveoli.

**Control of Prolactin:**

Prolactin secretion is inhibited by prolactin-inhibitory factor produced by the hypothalamus.

Angiotensin II**,** vasopressin and gonadotrophin-releasing hormone (GnRH) control the release of prolactin.

**Functions of prolactin:**

**Prolactin is involved in mammogenesis.**Prolactin causes the mammary ducts and alveoli to mature; increases breast size and initiates the final stage of cell differentiation in the alveoli cells. The epithelial cells in the alveoli differentiate to become secretory cells; however the cells need to have come in contact with cortisol and insulin before prolactin can complete its role.

**Prolactin stimulates milk secretion.**

Normally, when a new mother nurses her baby, hears her baby or plays with her baby, nervous signals are sent from the nipples to the hypothalamus. This causes a surge in the levels of prolactin released, which lasts for about a hour.  Prolactin makes the mammary glands secrete milk into the alveoli. If the surge is absent or blocked as a result of hypothalamus or pituitary gland damage, or if nursing does not continue; the breasts start to lose their ability to produce milk in about a week or two.

The importance of oxytocin in breastfeeding

**Ejection ("Let down") process in milk secretion**

Milk is continuously secreted into the alveoli of the breast, however to get the milk from the alveoli and into the ducts it needs to be ejected. Ejection is a neuronal and hormonal reflex involving oxytocin.

Composition of breast milk

**Composition Percentage (%)**

Water 88.5

Fat 3.3

Lactose 6.8

Casein 0.9

Lactalbumin and other milk proteins 0.4

Ash (calcium and minerals) 0.2

Growth hormone, cortisol, parathyroid hormone and insulin provide the amino acids, fatty acids, glucose and calcium needed for milk formation.

The advantages and disadvantages for breastfeeding

**Advantages**

* Readily available
* Affordable
* The baby acquires natural passive immunity because breast milk contains the mother's antibodies and other anti-infectious agents.
* Breastfeeding prevents menustration, which could be a method of natural birth control; however it is not fail safe.
* Helps the woman return to her pre-pregnancy weight, because lactation uses a lot of energy.
* It may reduce the risk of breast and ovarian cancer.
* It is thought to reduce rates of obesity, therefore it reduces the risk of Type-2 diabetes, hypercholesterolaemia and hypertension.
* There is evidence that those who have been breastfeed achieve better in intelligence tests

**Disadvantages**

* Risk of transmission of diseases like HIV and Hepatitis C from baby to mother.
* May not be economically viable because some women have to return to work, so they cannot breastfeed their child exclusively.
* Sometimes breastfeeding can become uncomfortable, with some mothers suffering from nipple pain.
* Breastfeeding in public is still taboo; so feeding "on demand" may not be socially acceptable.
* If a mother does not replenish the quantity of calcium phosphate in the milk, the body responds by enlarging the parathyroid glands which causes her bones to decalcify, making her more susceptible to fractures.

**WHO recommendations for breastfeeding**

* Breastfeeding should begin within an hour after birth.
* Breastfeeding should be "on demand", day and night.
* Bottles or dummies should be avoided.
* Exclusive breastfeeding (only breast milk given-not even water consumed) should occur until the baby is 6 months.
* After 6 months complementary breastfeeding (breast milk and other foods) should occur until the age of 2.
* New mothers should have at least 16 weeks off work after birth, so that she can rest and breastfeed her baby.

**Alternatives to breast feeding**

* **Infant formula**

Infant formula is not recommended because it does not contain antibodies; it can increase the risk of water-borne disease in areas that have unsafe water; can lead to malnutrition; is not always readily available and can be expensive.

* **Breast pumps**

Used when: the mother is lactating too much; breastfeeding becomes uncomfortable; the mother is busy or if the mother will not be there to feed her baby.

* **Donor milk banking**(more common in United States and Canada)

Normally used in circumstances when the mother cannot produce milk or enough milk for their child's needs, or in the unfortunate case of a mother's death.

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