Breast milk is not a very rich source of vitamin C, although the amount present is twice that present in cow's milk. Fruit juice should be introduced after the 4th month as a ready source of vitamin C.

◆ **Fluid :** Fluids are necessary for all age groups and infancy is no exception. Breast milk supplies the necessary fluid for the growing infant and later on, sterile water may be introduced along with fruit juices, soups, stews, etc.

▲ Table 2.2.1 ICMR recommended dietary allowances for infants ▲

Nutrient	Months	
	0–6	*6–12*
Body weight kg	5·4	8·6
Energy kcal/kg	108	98
Protein g/kg	2·05	1·65
Calcium mg	500	500
Vitamin A µg	350	350
β carotene µg	1400	1400
Thiamin µg/kg	55	50
Riboflavin µg/kg	65	60
Niacin µg/kg	710	650
Pyridoxine mg	0·1	0·4
Vitamin C mg	25	25
Folic acid µg	25	25
Vitamin B_{12} µg	0·2	0·2

If the nutritional requirements of an infant is completely met, then the infant can grow successfully, both in terms of physical and mental status.

This tremendous nutritional demand of the infant is generally met by the mother, who produces breast milk, which is a complete food, providing everything that the infant requires till he is an **independent feeder**.

◆ **Breast Milk :** Breast milk is the natural food for infants. There are roughly 3 stages through which breast milk passes during its secretion.

❑ **(1) Colostrum (1st stage of milk secretion) :** It is the first secreted milk after delivery, lasting for about 2–3 days. It is a thick, yellowish fluid and secreted in small quantities, about 10-40 ml The nutritional contributions of colostrum are—

(a) It is rich in protein.

(b) The fat content is less than mature milk.

(c) Concentration of arachidonic acid and decosahexaenoic acid (DHA) is higher in colostrum than in mature milk.

(d) It has more vitamins A and K.

(e) The concentration of lactose is less.

(f) The levels of niacin, pantothenic acid, biotin and riboflavin are also low.

(g) Vit C level is similar to that of mature milk.

(h) Zinc content is 20 mg/l, much higher than the 2.6 mg/l in mature milk.

Composition of colostrum is as follows :

▲ Table 2.2.2 Composition of colostrum ▲

Nutrient	*Amount*
Energy kcal.	58
Fat g	2 9
Calcium mg	31
Phosphorus mg	14
Iron mg	0 09
Protein g	2 7
Lactose g	5 3
Carotene I.U.	186
Vitamin A.I.U.	296

Source : Guthrie A.H., 1989, Introductory Nutrition, Times Mirror/Mosby College Publishing, St. Louis.

Other than nutrients, colostrum also has the following advantages :

- It contains anti infective substances like interferons. Interferon has antiviral activity.
- Colostrum has a protein which binds vit B_{12}, making it unavailable for the growth of *E. coli* and other bacteria.
- It contains antibodies against viral diseases like small Pox, Polio, Measles, Influenza etc.
- Enzymes like lysozymes, peroxidase and xanthine oxidase are present which promote cell maturation and also help in preventing infections.
- It contains large quantities of protective substances and enhances the development and maturation of the baby's gastrointestinal tract.
- It helps the baby to pass his/her first stool.

❑ **(2) Transition milk :** This is secreted after colostrum for the next two weeks. The quantity is increased and the appearance as well as the composition changes. It has the following characteristics.

- Protein content decreases.
- Fat and sugar contents increase.
- Immunoglobulins decrease.
- Contains some anti-infective substances that protect the baby against infections.

❑ **(3) Mature milk :** This is secreted after transition milk and is the main milk that is secreted throughout the major part of the lactation period.

The milk that comes out at the start of the feed is the **foremilk**. It is watery, with low level of fat, high levels of lactose, proteins, vitamins and minerals. The milk that comes later in feed is richer in fat and thus supplies more energy to the baby. It is known as **hind milk**. The extra fat in the hind milk makes it look whiter than foremilk.

Mature milk has the following composition.

▲ Table 2.2.3 Calorie percentage from protein, fat and carbohydrate in human milk ▲

Nutrient	*Human milk*
Total energy (per 100 ml)	65
Protein	7
Fat	47
Carbohydrates	31

◆ Advantages of Breast Milk :

The breast milk is beneficial for the infant as well as the mother.

❑ **A. For the Infant** : The following are some of the areas where breast milk is advantageous for the infant :

★ **I. Nutritional Aspects** :

- The composition of breast milk is correct for the infant.
- It is easily digestible and bioavailable.
- The main nutritional contributions are—

◆ **Calories** : (a) Human breast milk provides 65 kcal energy/100 ml of milk which is enough for the infant.

(b) The main sources of calorie are glycogen, glucose, free fatty acids.

(c) The carbohydrate calorie percent is higher in human breast milk.

◆ **Carbohydrates** :

Human milk is very sweet due to the presence of high amounts of lactose.

(a) Lactose help in absorption of magnesium and calcium as well as amino acids.

(b) Galactose, present in lactose is essential for the formation of myelin, which is a protective covering of nerve fibres and helps in nerve impulse transmission.

(c) Galacto-lipids present help in rapid brain growth.

◆ **Protein** : 1.1 gm % protein is present in human milk.

(a) The protein is made up of 20% β-casein and 80% whey proteins which constitutes lactalbumin and lacto ferrin.

(b) Lactalbumin has an amino acid pattern that is similar to the body proteins and provides more essential amino acids.

(c) The amino acid, glutamic acid is maximum in breast milk whereas glycine is absent.

(d) Due to the low protein content, there is very little stress on the immature kidneys of the infant.

(e) Breast milk is rich in sulphur-containing amino acids and the cysteine to methionine ratio is high ; these factors are beneficial for the infant.

(f) Taurine, an important neurotransmitter and a neuromodulator for brain and retina, is present in large amounts in breast milk.

(g) Tryptophan, needed for serotonin (neurotransmiter) synthesis is also present in large amounts.

(h) Binding proteins for thyroxine, corticosterol, vitamin D, folate and vitamin B_{12} are also present.

(i) Non-protein nitrogenous substances like amino acids, peptides, nucleic acids are all present.

(j) Protein-splitting enzymes, amylase-like enzymes are all present in breast milk.

◆ **Lipids :** Breast milk has unsaturated fats, essential fatty acids, prostaglandin precursors, fat soluble vitamins, steroids, phospholipids and cholesterol.

(a) Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), both extremely important for brain development, are present in breast milk.

(b) Carnitine, a fatty acid carrier needed for fatty acid oxidation, is also present in human milk.

(c) Cholesterol is present, which helps in synthesis of myelin sheath.

(d) The PUFA : SFA in breast milk is 1 2 : 1

(e) The fat content of breast milk changes according to the satiety value of infants.

◆ **Minerals :** The mineral content of breast milk is influenced by the mother's stores.

(a) The calcium content in human milk is 28 mg and the Ca : P ratio is 2 : 1 which is favourable for infants.

(a) Low sodium content does not create a load on the kidneys.

(b) Iron content is low but is made available by the presence of lactoferrin.

(c) Human milk increases zinc absorption.

(d) The Cu : Zn ratio is 1 : 5 which helps in growth.

(e) Bioavailability of trace elements like copper, cobalt, iron, zinc and selenium is high in human milk.

◆ **Vitamins :** Breast milk contains more vit. A, C and E than cow's milk.

(a) Both fat soluble and water soluble vit D are present in breast milk.

(b) Vit K is low in breast milk.

(c) Vit B_2, B_6 and B_{12} contents depend on the mother's intake.

(d) The heat labile vitamins like B_1 and C are available since breast milk is not heated, like Cow's milk.

(e) About 25-30 µg of folic acid is available for the infant from breast milk.

★ **II. Immunological Aspects :**

(a) Colostrum particles have anti-infective properties.

(b) **Macrophages** are present which engulf and digest bacteria and also help to synthesize **complement**, an immunity-conferring chemical protein.

(c) Both **T** and **B lymphocytes** are present.

(d) Lymphocytes produce the antiviral substance called **interferon.**

(e) **Immunoglobins** or **antibodies** are present which protect against various antigens like viruses, bacteria, etc.

(f) **IgG, IgM** are present but **IgA** is present in the highest level.

(g) Lactoferrin is an iron—containing protein found is both colostrum and mature milk. It inhibits the growth of *Staphylococcus* organisms, and *E. Coli.*