

Factors Influencing the Milk Yield, Composition and Its Nutritional Contribution

The nutritive value of milk :

Milk is the most nearly perfect food that supplies most of the nutritional requirements in the proper form and balanced proportions better than any other single food. Milk proteins have a high nutritive value because they contain all the essential amino acids. Milk fat contains the essential free fatty acids (FFA) and contains both oleic and linoleic unsaturated free fatty acids. Milk fat serves as a vehicle or carrier for carrying the fat soluble Vitamins. Milk supplies minerals and vitamins in proper form, kind and amount. Milk proves to be one of the cheapest and highly digestible foods. The nutritive value of one quart from a liter of whole milk is equal to the nutritive value of the 16 slices of bread or 5 large eggs or 5.5 ounces of liver or 6.35 ounces of fish or 5.75 ounces of beef steak or 4 ounces of peanut butter or 5 ounces of dried beans. Lactose and fat provide the body with heat and energy.

Note: 1 Quart=1 liter, 4Quart=1 Gallon and 16 ounces one pound. Milk is a valuable source of vitamins but contains only around 40 IU of Vitamin D per quart, whereas a child needs from 300-400 IU per quart. The amount of Vitamin D can be increased to adequate quantities by either irradiation of the milk (by exposing milk in a thin film to the action of Ultra-Violet light) to provide 400 IU per quarter or by the addition of Vit D concentrate direct to the milk. The largest source of Vitamin D to infants is the fish oils (cod liver oil). Milk is also considered as a poor source of Vitamin C i.e. don't have a sufficient amount of Vitamin C to fill the need of children and for that reason orange or tomato juice is given to children to ensure amount of Vitamin C to them. Milk supply minerals in proper form, kind and amount. Iron and copper are necessary for formation of haemoglobin. Milk alone after the nursing period doesn't contain sufficient iron and copper to prevent nutritional anemia. So the addition of iron and copper and Vitamin D for children will make milk a complete food for them.

Lactose is an important food constituent of milk for babies. Lactose is providing a much firmer flesh than other kinds of sugar. Lactose is a special nutrient for the growth and development of the central nervous system (CNS) of mammalian young. Early nutrition of the infant is of great importance in connection with brain development. Galactose is a constituent of CNS i.e. form part of the nerve and brain tissue, so lactose may be considered as a brain food. Milk is a good source of calcium and phosphorus and the lactose stimulate the absorption and the assimilation of calcium and phosphorus thus forming better and stronger bones and teeth and furthermore lessen the requirement of Vit. D needed and prevent rickets.

Lactose aids in the absorption and assimilation of magnesium which is required for proper structure of blood vessels. Lactose requires longer time than other sugars for complete digestion and such delayed action provides a suitable medium for the growth of beneficial or desirable bacterial flora such as *Lactobacillus acidophilus* which get rid or crowd out the putrefactive bacteria as well as many pathogenic microorganisms, for that reason sour milk

aids in the prolongation of life. The idea being that these acid producing organisms such as *Lactobacillus acidophilus* would develop in the intestinal tract and replace the putrefactive bacteria. *Lactobacillus acidophilus* produces four natural antibiotics such as:

Lactobacillin, Lactocide, Acidophilin and Acidolin.

Thus also is tending to minimize gas producing fermentation in the gut. Lactose has been shown to be an important in maintaining normal conditions in the intestines i.e. promotes the growth of normal flora in the intestine which in turn synthesize the vitamins such as Biotin, Riboflavin and folic acid. Also it aids to reestablish the desirable microflora in the gut after oral administration of antibiotics (treatment) Lactose has about 1/6 the sweetness of sucrose and is less soluble in water, this make it less liable to cause direct irritation of the stomach membrane and for this reason milk appear to be an excellent food for peoples who are suffering from Gastric and Duodenal ulcers.

Factors that decrease milk yield :

- 1- Advanced lactation i.e. toward the end of lactation period.
- 2- Advanced pregnancy.
- 3- Short dry period
- 4-Calving at summer
- 5-High environmental temperature.
- 6- High environmental humidity.
- 7- Udder infection.
- 8-Poor or underfeeding.
- 9- Diseases.

Factors that increase milk yield :

- 1- Increase of the body weight
- 2- High lactation age (as cows become older)
- 3- Good Feeding
- 4- Calving in late winter and early spring
- 5- Low environmental temperature
- 6-Good body conditions

The bases for milk payment :

- 1- Fat percentage of the milk
- 2- Quantity of the milk
- 3- Quality of the milk and its hygienic standards.

Factors influencing the milk composition:

The fat percentage of milk shows more variations constituents. In general, the variations in the fat content of milk are accompanied by changes in the same direction in the solids not fat (SNF) content but at a slower rate. In normal milk increase in 1% fat is accompanied by an increase about 0.4% SNF. Therefore, the factors that influence the fat content also influence the SNF% of milk.

The main factors that influence milk composition are the following :

1-Species of animals :

The following table shows the composition of the milk of different species .

Table 7 : Composition of milk of different species .

Species	Water %	Fat %	Protein %	Lactose %	Ash %	SNF %
Human	87.43	3.75	1.63	6.98	0.21	8.82
Cow	87.20	3.70	3.50	4.90	0.70	9.10
Goat	87.20	4.25	3.25	4.27	0.86	8.75
Sheep	80.71	7.90	5.23	4.81	0.90	11.39
Buffalo	82.09	7.96	4.16	4.86	0.78	9.95
Camel	87.61	5.38	2.68	3.26	0.70	7.01
Horse	89.04	1.59	2.69	6.14	0.51	9.37
Donkey	89.03	2.53	2.01	6.07	0.41	8.42

2-Variations among breeds:

The breeds that producing the large amount of milk such as Holstein (Fat%-3.4 %) and Ayrshire (Fat % -4%) secrete milk of a lower fat percentage, while the breeds that producing the small amount of milk such as Jersey (Fat%-5.3%) and Guernsey (Fat %-5%) secrete milk of a higher fat percentage. This relation holds true for animals of the same breed.

3- Variations among individuals of animals:

Milk of individual cow's within a given breed may show considerable variation in fat percentage of milk (secrete milk with either higher or lower fat %), even when conditions of management, environment and feed are identical. Inheritance or genetic factors are the principal causes of these differences, also udder infections.

4-Feeding:

Adequate feeding program after calving tend to increase the peak of milk production. Under feeding of dairy cows results in a 0.2% reduction in protein and solids not fat (SNF) percentages and a depression in milk yield. The effect of fat content in the feed on milk production is primarily a result of the energy value of the feed. High fat feeds result in slightly higher milk production than low fat feeds. Feeds high in fat such as linseed oil, Cottonseed oil and tallow increase the fat content of milk however, feeding of cod liver oil cause a marked depression in the fat content of milk. Some rations cause a decrease in the milk fat percentage, among these are high-concentrate, low roughage rations, high bread-low roughage rations (these depress acetic acid production and increase propionic acid production in the Rumen). Feed a ration containing at least 17% fiber will help to prevent a milk-fat depression.

5- Age of cow at calving:

It is well known that cows produce more milk as they become older i.e. increase in milk production with age. A general relationship exists between the body weight and the level of milk production; larger cows have more udder secretory tissue and larger digestive systems. Cows of most breeds are considered mature at 6-year old beyond which milk production remain fairly constant for three lactations and the gradually declines during the subsequent periods. When cows are 8 or 9 years of age a slight reduction in the level of milk production occurs and continues until they die. In addition to the increase in milk production with age, there is a slight decrease in the solids not fat (SNF%) and milk f percentages through the fifth lactation beyond which there is little change.

6- Lactation period :

A lactation period of 305 days is recommended. The cow reaches her peak production approximately six weeks after parturition and then gradual decline in the yield takes place. There is a general inverse relationship between milk yield and milk fat percentage. As yield increase the percentage of milk fat decreases. Milk fat percentage is at a low point during the peak of lactation then gradually increases toward the end of lactation. In the last few weeks of lactation, the fat % may increase markedly. Lactose content shows very slight decline toward the end of lactation and ash content shows a very slight increase with advancing lactation. The colostrum has high of protein fat and ash percentages and this may be related to the fact that the newborn calf needs a rich energy source.

7-Efficiency of milking or of the milker

An incomplete evacuation of milk fails to obtain the last-drawn milk which is extremely high in milk fat. complete evacuation of milk from the udder is necessary because the first drawn milk or fore milk may be as low as 1% milk fat whereas the last -drawn milk may be as high as 9% milk fat. The milk yield at the next milking is higher in milk fat content since it contains the leftover milk from the last milking with a high fat content and the normal yield and fat content from the present milking.

8- Intervals between milking:

Milking of cows at equal intervals produces milk that has a slight variation in fat test (10-12 hrs.). Milk yield was higher after long interval which tended to compensate for the lower fat test because there is a general inverse relationship between milk yield and fat test. The milk-fat test may vary as much as 1% between the night and morning milking when cows are milked at 14 and 10 hours intervals. Daily variation in milk yield is related to the completeness of evacuation of milk from the udder and longer duration of milking. The fat % in milk produced when cows were milked in equal or unequal intervals was lower in the morning milkings than in the evening milkings.

9-Season of the year :

The average fat content of the herd milk is lowest in late spring and early summer while highest in late fall or early winter. This Variation largely results from the temperature and humidity. A high environmental temperature and poor feeding cause a decrease in milk production. A decrease in feed consumption, an increase in water intake and increase in body temperature take place as a result of higher environmental temperature. The effect of

temperature has been investigated by several workers who found that the fat percentage increase about 0.2% for each 10°C decrease in the environmental temperature. Milk fat percentage as well as solids not fat percentage and milk yield increase with decreasing environmental temperature, conversely with increasing temperature there is a slight decrease in milk yield, and slight decrease in milk fat and solids not fat percentages. In the Middle East cows freshening in late winter and early spring produce more milk than those freshening in late spring and summer as a result of better feeding and management of cows.

10-Diseases

Freedom from metabolic diseases particularly milk fever (Hypocalcemia) and ketosis (Hypoglycemia decrease of glucose in the blood) allows the cow to attain high milk production.

In mastitis the following variations :

- a- A marked reduction in the overall yield of milk due to the destruction of the secretory tissues.
- b- Decreased percentages of total solids, solids not fat, fat and lactose. The normal content of lactose in milk is 4.5-5% and less than 4% indicates mastitis.
- c- A reduction in the concentration of potassium, Calcium, Phosphorus and short chain fatty acids.
- d-Increase in sodium, chloride and the long chain fatty acids. The normal content of chloride in milk is 0.12-0.14% and any reading of greater than 0.14% indicates mastitis.
- e- An increase in the pH of the milk because mastitic milk has a blood serum which lowers the acidity of milk (Blood serum is usually alkaline). The normal pH value of milk is 6.4-6.8 and any pH value of greater than 7 indicates mastitis.
- f- Significant increases in the serum albumin and non proteinous nitrogen (ammonia & urea), which is indicative of severe tissue damage within the udder.
- g-Mastitis also affects the activity of certain enzymes in milk including Catalase and acid phosphatase.

11-Gestation:

The rate of decline in milk yield is starting at the twenty-second week of pregnancy which occurs at approximately the seventh to eighth month of the normal lactation curve if the cow is bred back 60 days after calving and a marked drop in milk production occurs toward the end of pregnancy. A more reasonable explanation is that due to a change in hormone production, in which large amount of estrogen and progesterone flow into the blood stream occurs at that time.

12- Body condition at calving :

Cows must be in good body condition at calving to increase peak milk production. Cows having a thin body condition at the end of lactation require a dry period to replenish their

body supplies. Body fat can be utilized for milk production. Cows in good body condition at calving also have a slightly higher milk fat percentage than those in poor body condition.

13- Length of dry period:

Dry period is a resting period of the udder prior to lactation to regenerate secretory tissue and to replenishing body supplies if the cow is in poor body condition at calving. An increase in milk yield results with dry periods up to approximately 60 days. A dry period longer than 60 days does not improve yield in the next lactation. Cows with dry period of 4 days had slightly less production in the next lactation. Cows that were dried off for less than six weeks gave 65-75% of the milk yields of cows the were dried off for 8 weeks.