UNIT 11: MILK AND MILK PRODUCTS

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1.0 Introduction

This unit deals with milk and milk products. Milk has been defined as the sole natural food of the human infant for few months of life (Davidson et al 1975). It is produced by the female mammals. As a result of its importance to mankind and as a result of the quality of the nutrients in it, there is a need to have a discussion of it. This unit therefore treats milk and milk products.

2.0 Objective

At the end of this unit you would be able to:

- Describe the characteristics of fresh milk
- Describe the composition of milk
- Discuss spoilage of milk
- Discuss various armaments on milk
- Distinguish between various milk products

3.0 Main Content

3.0 Characteristics of Fresh Milk

Milk is produced by female mammals including human beings primarily for the feeding of their infants at the early stage of life. It is creamy white liquid containing protein, carbohydrate, fats mineral salts, vitamins and water.

Milk is defined as the most single perfect food. The most significant sources of milk are women, cows and goats. The milk from human being is only used to feed human infants. The milk from cow is also used by infants and adults. Though milk from goats is rich in nutrients, it however contains caproic acid which gives it an undesirable odour. In the milk, there are tint globules that are tinted by by carotene and a small amount of xantophyl. These pugments confers the creamy tint of milk on it. When the milk is allowed to stand for sometime the fat globules that are surrounded by protein wall rises to the surface of the milk to form a layer of cream. The other part of the milk remaining contains the soluble nutrients and it is called skimmed milk.

In milk, we have the "Skim" and the "cream". The cream can be removed by separator or by skimming.

If we allow the milk to stand for some days, Coagulum known as "Curd" is formed at the surface of the milk. The watery liquid under the curd is "whey". Lactic and converts it to lactic acid. This acidic condition of the milk causes the coagulation of the milk protein, case in and the Curd is formed.

Clotting of milk that is used in the preparation of Cheese is brought about by an enzyme called "Renin" contained in rennet. From this discussion, we see that curdling of milk is different from clothing of milk.

3.2 Composition of Milk

Milk consists mostly of water (87.5%) and it also consists solid such as protein, fat, sugar and minerals (about 12.5%). The compositions of human milk have been shown by various studies to be largely independent of the level of nutrition of the mothers. Even with prolonged lactation by Africa women, the composition of their milk appears to be well maintained in quality though the quantity may reduce. The composition of cow milk has been found to vary with the breed of the cow, the stage of lactation and the type of feed. However, the composition of the cow milk has been given by Lake and Waterworth (1980) as:

Water	87 %
Protein	3.4%
Fat	3.60%
Sugar	4.70%
Mineral	0.75%

The human milk contains more sugar and less protein than cow milk. The protein in human milk is about 1.5% while that of cow milk is about 3.5%.

Milk Protein

The milk proteins are mostly casein, lactabumin and lactoglubin. For production of Cheese the casein is used. The casein is used when there is action of rennet on it. There can also be the coagulation of lactabumin at a temperature of 70◦C. You should also remember that the protein in milk envelopes the fat globules so as to stabilize the emulsion.

Milk Fat

The milk fat contains both simple and mixed glycerides, branch chain fatty acids and some fatty acids with odd numbers of carbon from 11 - 19 as well as short chain fatty acids such as brutyric, caproic etc.

The most significant fatty acids is the oleic acid. Apart from this milk fat also contains lecitin and cholesterol.

Milk fat also contains carotenoid which has influence on the colour of the milk. The presence of tocopherol (antioxidant) in the milk influences the keeping quality of the milk by preventing oxidative rancidity.

Milk Sugar

The characteristic milk sugar is lactose which amounts to 40% and 6.2% respectively in cow and human milk. The action of lactic acid bacteria produces lactic acid which impacts the sour taste of butter milk and whey.

Mineral in Milk

These are sodium, Potassium, Calcium, Magnesium and Iron and they exit as Phosphate, Chlroides, Sulphates and Carbonates. The presence of calcium salt and phosphate has positive

effect on the presence of Vitamin B in milk. The iron content of milk is low and iron content of cow milk is lower than human mi k.

Vitamins in Milk

Most of the commonly recognized vitamins are found in milk. However, milk contains more fiboflavin•than any other vitamins. Milk fat is a very good source of vitamin A and milk also contins vitamin B. Ascorbic acid in milk is easily oxidized and this is why ascorbic acid is absent in pasteurized milk.

3.3 Spoilage of Milk

Milk is a good source of nutrients for animals, man and even microorganisms especially bacteria. In view of this, milk is highly susceptible to bacterial spoilage. Some microbial actions of milk are desirable especiall in fermentation for the production of yoghurt and in coagulation of milk for the production of cheese. Some undersirable microbial actions can cause spoilage of milk. Bacterial contaminations of milk are at various stages.

(i) Fromcow'sudder
(ii) Cow'sbody
(iii) Fromtheatmosphericair (iv) Fromthemil
ker

The milk of the udder of a very healthy cow may even not be completely sterile hence, milk of diseased animal should be avoided to prevent microbial contamination from the udder.

There can also be microbial contamination of micro-organisms from the body of the cow and from the atmospheric air . during milking of the cow, the milker and the utensils used should be clean to prevent microbial contamination. The micro-organisms found in milk are:

a. Lactic acid bacteria, streptococcus lactis
b. Baccilus coli

All these micro-organisms are used to ferment sugar.

a. Casein digesting bacteria
b. Bacteria that cause colour changes
c. Pathogenic bateria that can cause food poisoning.

In view of these, there must be sanitary conditions for the processing of milk and milk products.

3.4 Treatment of Milk

Milk during processing is subjected to various treatments:

a. Pasteurization
b. Sterilisation
c. Homogenization

Pasteurization: is done at temperature below 100 °C to destroy the pathogenic and the spoilage organisms without affecting the quality attributes of the milk. Pasteurization is a heat treatment and the temperature must be below 100°C. There could be low temperature long time and high temperature short time methods of pasteurization being holder's method and flash pasteurization respectively. The temperature of the holder's method is between 63°C -65°C and the heat treatment is about 30 minutes. For flash method, the temperature is about 72°C for about 15 minutes. Heat resistant micro-organisms can survive pasteurization method hence, milk can be further subjected to sterilization.

Sterilization: Sterilization destroys the organisms more completely than pasteurization and sterilization is done in the autoclave at temperature higher than 100°C (121°C) for about 30-40 minutes.

Homogenization of Milk: For the production of a number of milk products, there is need for homogenization of milk. Homogenization casuses the breaking down of fat globules, makes the milk to be uniform and prevents the separation of the cream, the skim. Homogenization can be affected by forcing the milk through a tiny valve under pressure.

Pasteurization and sterilization have some adverse effect on milk. In pasteurization about 10% of thiamin and vitamin B 12 and 10-20% of ascorbic acid are destroyed.

Sterilization also causes the destruction fo about 50% ascorbic acid, 30% thiamin and almost all the riboflavin. Sterilization also causes the reduction of some biological values of milk protein.

Student Assessment Exercise 11.1

14/111, is milk highly susceptible to microbial contaminations?

3.5 Milk Products

Some of the milk products are cream, ice-cream, skimmed milk, butter milk, condensed milk, both sweetened and unsweetened, spray-dried milk, butter, cheese, yoghurt and fermented milk.

However, these products can be subdivided into:

a. Soured and fermented milk
b. Evaporated and condensed milk

3.5.1 Soured and Fermented Milk

In some countries, milk is drunk soured or curdled. The bacteria used for this are lactobacillus, acidophilus found in man Lactobacillus bifibus found in alimentary tract of infant and bulgaricus found in cow. These bacteria act on lactose in milk and cause the formation of lactic acid. Yoghurt, a soured milk contains all the protein, fat and vitamins of the original milk.

Curd: curds are prepared when fresh milk is inoculated with rennet to cause the clotting of the milk protein.

Whey: This is the liquid that is separated from the clot when curd is made, that is the liquid remaining after the curd has been removed and it contains most of the lactose in the original milk and a little of lactolbumin.

Cream: The cream contains all the fat, about one-third to half of the protein and lactose in the milk.

3.5.2 Evaporated and Condensed Milk

Evaporated milk is produced by the partial removal of water from milk or skimmed milk. We should note that skimmed milk is the whole milk minus the cream.

Condensed milk is produced by removing water from either the milk or the skimmed milk and by adding some sugar to the product.

Skimmed Milk: This is the whole milk minus the butter or the cream. We should note that milk contains the cream and the skim. Skimmed milk is the by-product of the butter industry. It is readily dried. It contains most of the protein and almost all the calcium in the original milk. It also contain the B group vitamins. It is a very good food.

Cheese: Cheese is produced by the action of rennet on the milk protein. The milk may or may not be soured first before rennet is introduced. The whole process involves the clotting of milk by relect at a temperature of about 30°C. The clot formed contains almost all the protein in the milk and many other nutrients. Since we have been told that protein in the milk envelopes the fat globules, the clot also contains fat. The clot is gently removed from the and slat is added to it. We should note that after the clot is formed, the watery liquid left is know as "whey". The clot is pressed to remove moisture and to form a firm cake. The cheese is then put in cheese bags and kept in a cool room so that it can undergo ripening. During ripening bacteria and mould fermentation occurs. The products of the fermentation are responsible for the characteristic texture and flavour of cheese.

Student Assessment Exercise 11.2

*Discuss the production of curd, *skimmed milk and cheese.*

4.0 Conclusion

In this unit, the characteristics of fresh milk, composition of milk treatment of milk, spoilage and milk products are discussed. Some subsequent units will still build on this unit by discussing some other classes of food.

5.0 Summary

Milk is defined as a creamy white liquid produced by the female mammals for the feeding of their infants at the early months of their lives. This milk can be obtained from female human being, cow and goat. The milk from female human being are mainly used for the feeding of their infants and the composition of human milk is relatively stable irrespective of the period of lactation and the level of nutrition.

The milk from cow varies in composition depending on the breed, the period of lactation and the feed.

Human milk has greater percentage of sugar than cow milk and less percentage of protein than cow milk.

Milk is considered to be a perfect food since it contains almost all the nutrients needed by the body. In view of this high nutritional quality of milk, milk encourages microbial growth. Some microbial actions leading to formation of curd and production of cheese are desirable. Some other microbial actions by the pathogenic organism brought about by

contamination through the udder of the cow, body of the cow, atmospheric pollution and the milker are undesirable.

Milk undergoes some treatments, either to destroy the micro-organisms and or to maintain the keeping quality. This treatments are pasteurization and sterilization to destroy micro-organisms. Homogenization is also done to improve the consistency and the textural integrity of milk.

Milk can be processed into fermented or soured milk or evaporated and condensed milk. some of the examples of fermented or soured milk are Yoghurt, curd and whey and some the evaporated milk or condensed milk are evaporated milk, skimmed milk and cheese.

6.0 Tutor Marked Assignment

Discuss causes of milk spoilage and pasteurization and sterilization of milk.

Answers to Students Assessment Exercise

11.1 Milk is highly susceptible to microbial contamination because of the various nutrients contained in milk as discussed in this unit.

11.2 See the answer in section 3.5 of this unit

7.0 Reference and other Sources

Davidson .S et al (1975) Human Nutrition and Dietetic 6th ed;
Longman Group Ltd

Lake B. and Waterworth M. (1980) Foods and Nutrition 13th ed; Mills and Boon Ltd., Brook's Mews, London.