Paper No.: 07

Paper Title: TECHNOLOGY OF MILK AND MILK PRODUCTS

Module – 30: Technology of Dried Milk Products – II: Humanized Milk Powder, Malted Milk Powder, Cream Powder, Buttermilk Powder

HUMANIZED MILK

INTRODUCTION

Milk is nature's ideal food for infants and growing children, except in rare cases of lactose intolerance. Mother's milk is not only desirable but essential from the time the child is born and hence the baby is recommended to be breast-fed until it is normal. It has always been an accepted fact that the best food for babies younger than six months is mother's milk due to the composition and content of various vitamins and essential amino acids. In each species, the milk meets the specific needs of the off-spring. The milk of one animal cannot be a real substitute for that of another. Hence, the most ideal situation for infant feeding would be to feed the child with human milk during the early stage of his growth. However, situation may arise when a human baby may be required to be given milk other than from mother. The substitute of breast milk serves as a saver of precious life during vulnerable stages of infancy in the event of lactation failure, insufficient milk secretion and in case of mothers inflicted with transmittable diseases, like tuberculosis, breast cancer etc.

CHEMICAL COMPOSITION OF HUMAN MILK

Chemical composition of human milk differs from that of cow or buffalo milk as shown in Table 1 & 2 below:

Table 1: Chemical composition of human, cow and buffalo milks

Components, g/100 ml	Human milk	Cow milk	Buffalo milk
Proteins	1.2	3.3	4.2
Fat	3.8	4.1	7.0
Carbohydrate	7.0	4.5	5.1
Ash	0.21	0.72	0.82

(Ganguli, 1977)

Table: 2 Major differences in the make up of different constituents of human, cow and buffalo milk

Components	Human milk	Cow milk	Buffalo milk
Proteins			
▪ Caseins, % of total protein	40	82.3	75.6
▪ Whey proteins, % of total protein	60	17.7	24.4
▪ Immunoglobulins (g/100 ml)	1.0-1.5	0.5	NA
▪ Lactoferrin (mg/ml)	1.39	0.09	0.32
▪ Lysozyme (mg/100 ml)	40	0.013	NA
Lipids			
▪ Oleic acid (mg/lit)	14.9	10.3	9.5
▪ Linoleic acid (mg/lit)	3.4	0.8	0.5
▪ Linolenic acid (mg/lit)	Traces	0.2	0.3
▪ Arachidonic acid (mg/lit)	0.33	Traces	NA
▪ Cholesterol (mg/lit)	0.2	0.14	NA
Lactose	6.9	4.8	5.1
Minerals			
▪ Total (%)	0.21	0.68	0.82
▪ Ca (mg/100 ml)	31	128	210
▪ P (mg/100 ml)	15	87	128
▪ Fe (mg/100 ml)	0.15	0.14	6.2
Vitamins & Growth factors			
▪ Vit A (mg/100 ml)	0.05	0.03	0.05
▪ Vit E (mg/100 ml)	0.54	0.07	NA
▪ Nicotinic acid (mg/100 ml)	0.24	0.08	0.1
▪ Bifidus factor (units)	40	1	NA

NA – Data not available (Mathur & Pahwa, 1980)

Striking Features of Human Milk

The striking features of human milk when fed to infants are as under:

- Digestion of milk by a baby is speedy - due to formation of soft curd.
- Quite less load on the kidney - due to low calcium content.
- Easy digestion and faster absorption of casein-due to smaller size of casein micelles.
- Proper development of brain constituents - due to higher lactose content and presence of relatively more amount of PUFA.
- Bactericidal and anti-infective properties - due to presence of lysozyme, secretory IgA, bifidus factor and lactoferrin

HUMAN MILK SUBSTITUTES

While human milk is superior for the new born infant, human milk substitutes (HMS) play a necessary role in infant nutrition when breast feeding is not possible, desirable or sufficient. Since the advent of first commercial formula developed by scientists of Nestlé's research group in 1866, a wide range of infant formulas have been developed by the manufacturers as shown in Table 3.

Table 3: Range of infant formulas available in the market

Type of Formula	Description
Standard Formula	▪ Use of cow/buffalo milk to replace / supplement human milk. ▪ Adjustments made for protein : fat : carbohydrate ratio. ▪ Vitamins and iron fortified.
Soy-based milk-free (SBMS) Formula	▪ Use of soy flour or water soluble soy protein isolate. ▪ Useful to infants allergic to milk proteins, having lactase deficiency and who show signs of galactosemia.
Specialized / Predigested Formula	▪ Meant for infants having a variety of nutritional problems due to digestive malfunctions, physiological underdevelopment or gastro intestinal infections. ▪ Usually nitrogen is supplied through hydrolyzed proteins, energy through easy to assimilate simple carbohydrates, with minimal load on digestive enzyme.
Humanized / Materialized Formula	▪ Development of nutritionally superior formulas having varying degree of chemical and biochemical similarity of αs-casein and β-lg from cow/buffalo milk. ▪ Adjustment of casein: whey protein ratio, PUFA and mineral contents.

APPROACHES TO MANUFACTURE HUMANIZED MILK

New generation of nutritionally superior humanized milk formulas has been developed,

having varying degree of chemical and biochemical similarity with human milk. There are two types of approaches tried for this:

- Removal/reduction from cow/buffalo milk substances like αs-casein and β-lg through enzyme treatments. However, αs-casein is hydrolyzed in the digestive tract of the infant and thus formula containing hydrolyzed casein may not serve any useful purpose nutritionally.
- Modifications justifiable from nutritional angle-for example adjustment of casein: whey protein ratio in cow / buffalo milk so as to simulate human milk.

Suggestions for improvements

- Modification of proteins of cow / buffalo milk to make them similar to human milk (whey protein: casein=60:40). This will help in enhancing nitrogen utilization and in minimizing renal osmolar load.
- Modification of triglyceride makeup of cow / buffalo milk fats so as to simulate ratios of short, medium and long chain triglycerides as well as that of saturated to unsaturated fatty acids to that of human milk fat. This will enhance linoleic acid and vitamin E contents.
- Adjustment of proteins: fat: carbohydrate ratio. This will reduce the protein content and increase the carbohydrate content of cow / buffalo milk and make it similar to that of human milk.
- Modification of calcium: phosphorous ratio as well as reduction in total ash content. This will enhance mineral utilization and minimize renal osmolar loads.
- Enrichment of cow / buffalo milk with factor to support growth of *B. bifidum* in intestines.
- Enrichment of cow / buffalo milk with lactoferrins, transferrins and immunoglobulins to promote resistance towards enteropathogenic bacteria and to enhance iron absorption.
- Partial substitution of cow / buffalo milk fat with oils rich in PUFA, as well as use of carbohydrate sources such as maltodextrins may help in reducing the cost.

Achievements so far for humanization of Buffalo Milk

- αs-casein reduced to human milk level by renneting.
- Total protein concentration reduced to human milk level by proteolysis.
- Calcium level reduced by electrodialysis

- Curd tension reduced by ion-exchange
- Level of unsaturated fatty acids improved by corn oil fortification with milk fat.

Figure 1 shows Preparation of humanized buffalo milk powder

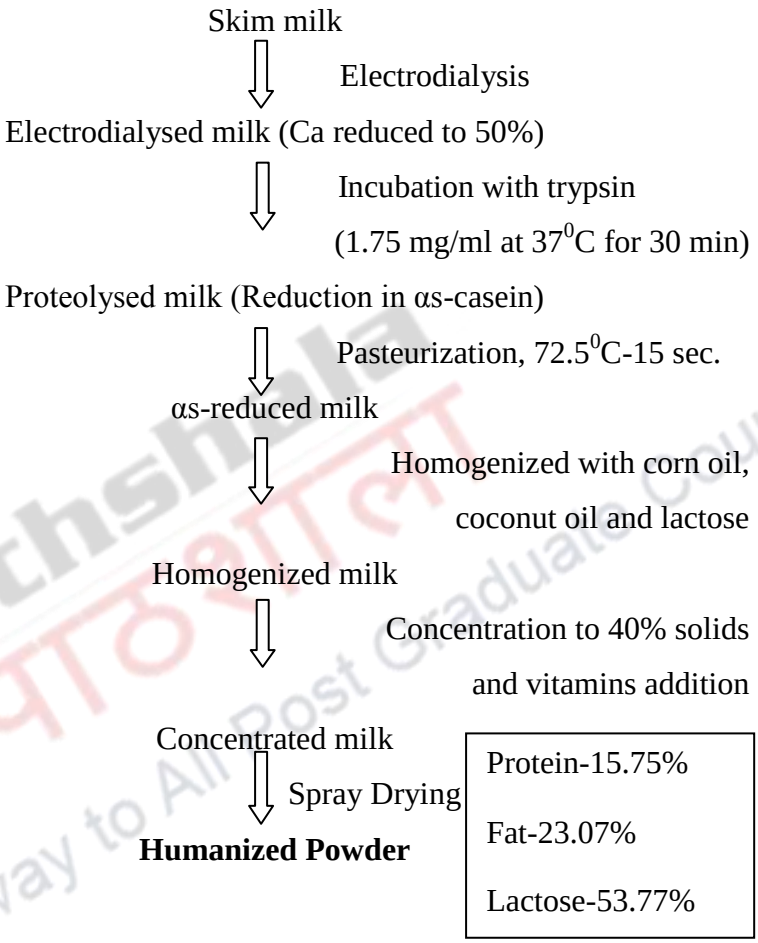

Figure 1: Preparation of humanized buffalo milk powder

(Ganguly and Kuchroo, 1979)

MALTED MILK

INTRODUCTION

A British pharmacist James Horlick developed ideas for an improved, wheat and malt-based nutritional supplement for infants. In 1873, James and his brother William formed a company to manufacture their brand of infant food. The company originally marketed its new product as “Diastoid,” but trademarked the name “malted milk” in 1887. Despite its origins as a health food for infants and invalids, malted milk found unexpected markets due to its nutritive value, convenience, digestibility and palatability. It is also appreciated for its

lightweight, non-perishable and high-calorie qualities worldwide. Malted milk is a powdered food product made from a mixture of malted barley, wheat flour, and whole milk, which is evaporated until it forms a powder.

MALTING

Malting is a process applied to cereal grains, in which the grains are made to germinate by soaking in water and are then quickly halted from germinating further by drying/heating with hot air. Thus, malting is a combination of two processes: the sprouting process and the kiln-drying process.

Malting grains develops the enzymes that are required to modify the grain's starches into sugars, including monosaccharides (glucose, fructose, etc.) and disaccharides (sucrose, etc.). It also develops other enzymes, such as proteases, which break down the proteins in the grain.

DRYING OF MALTED MILK

The malted milk food is generally prepared by tray-drying method under vacuum which is essentially a batch operation and hence adds to the cost. Spray drying method reduce the cost of product owing to high volume of continuous and automated operation. Thus the production of good quality, low cost malted milk food with improved physical characteristics appears to be better proposition than continuing with the traditional tray-drying method. The method employing spray process is shown in the following flow chart Figure 2.

BUTTER MILK POWDER

Method of Processing

The method of processing of dry buttermilk by either the spray or drum process is similar to that of nonfat dry milk. Care should be exerted to cool the buttermilk to 4°C immediately upon drainage from the churn. When intended for human consumption, buttermilk should be stored in stainless steel lined tanks. A common practice is to preheat to 32° to 49°C and separate the buttermilk to reclaim a portion of the fat. The preheating is continued to 85 °C with a 15 min hold. After increasing the total solids by condensing to 16% for drum or ~ 40 to 45% for spray process, the concentrate is preheated to 71° to 79 °C and dried to a moisture content of 3.0 to 4.0%. After sifting (12-mesh screen), dry buttermilk is usually packaged in kraft paper bags with a plastic liner or in a fiber drum with or without a plastic liner.

Malted Milk Product

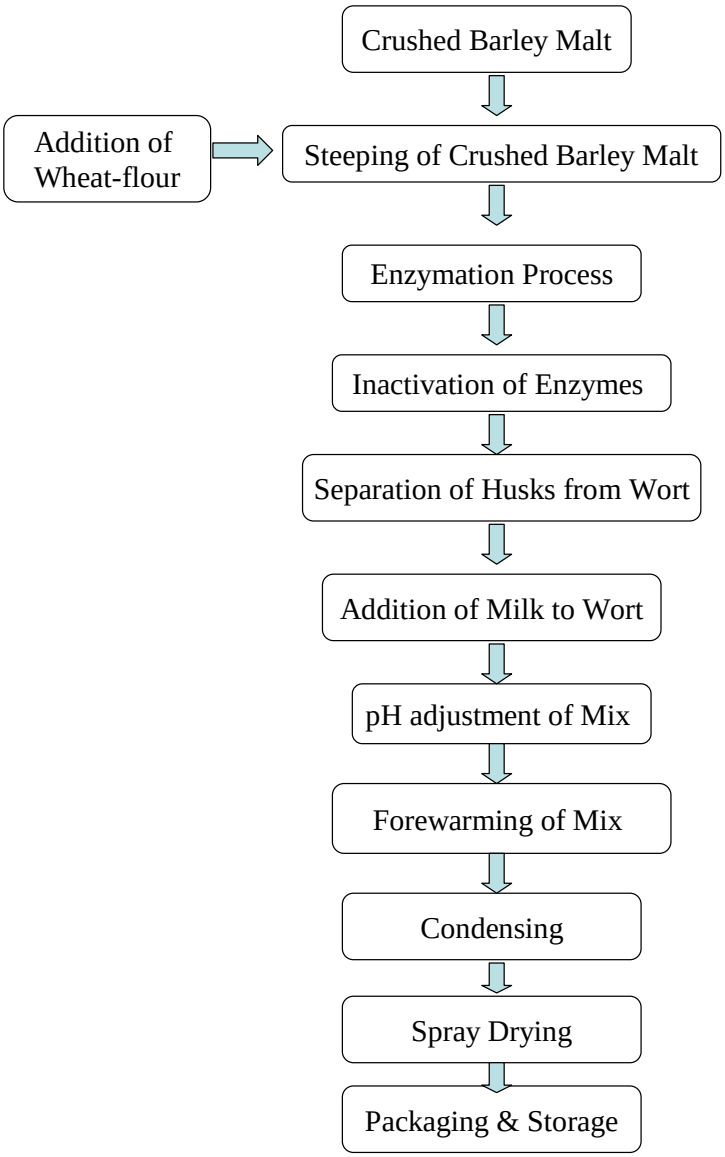

Figure 2: Flow diagram for the manufacture of spray dried malted milk product

CREAM POWDER

Cream Powder means the product obtained by partial removal of water from cream obtained from milk of cow and/or buffalo. The fat and/or protein content of the cream may be adjusted by addition and/or withdrawal of milk constituents in such a way as not to alter the whey protein to casein ratio of the milk being adjusted. It shall be of uniform colour and shall have "pleasant taste and flavour free from off flavour and rancidity. It shall also be free from vegetable oil/fat, mineral oil, added flavour and any substance foreign to milk.

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