TOWARD A BETTER UNDERSTANDING OF INFANT FORMULAS

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INTRODUCTION:

Infant formulas are predominant source of infant nutrition in America. Fomon (5) reported that while 74% infants were fed infant formula, only 20% were fed breast milk. The remaining 6% were fed canned or fresh cow milk during the first month. Modern technology and the free enterprise system are providing a variety of infant foods to meet particularly all the nutritional needs of the new born. "Regular", "Hypoallergenic" and "Special" are three kinds of formulas available for infant feeding (14,15).

The regular formula is made from nonfat dry milk powder or concentrate and vegetable oil. The hypoallergenic formula is made from non-dairy ingredients such as soy protein, vegetable oil and added corn syrup solids. The special formula is made from protein hydrolysate and partially hydrolysed sweeteners (14).

Changing attitudes, life styles, industrial and technological advances, extensive urbanization, separation of the younger and the older generation, economic pressures, women's cry for liberation and declining influence of tradition and religion are some of few factors responsible for the continuing popularity of bottle feeding in America.

In this paper the author has made a modest attempt to sketch a brief account of the historical development in favor of formula feeding in the U.S.A. The constituents and processing proceedures of infant formulas have also been explained. The future of the formula in the developed and the developing world with special emphasis on the Muslim world is also projected.

HISTORICAL ORIGIN:

The historical origin of substitute feeding could be traced to the mother who could not or would not nurse her baby. She might have made this decision with or without the counseling or coercion of her husband or her mother-in-law or because of it. We all are familiar with the fact that there were wet nurses in Arabia during the time of our beloved prophet Muhammad (*peace be upon him*) and that he was nursed by one named Halima.

Canned sweetened milk was introduced in the U.S.A. in 1857 and represented an early gain in bottle feeding. The introduction of canned evaporated milk in 1885 was another landmark in this direction. Interest and effort continued towards developing a close substitute to human milk. The first humanised milk appeared in the market in 1916. The areas of primary concern in developing such milk were: low curd tension, a matching amino acid profile, substitution of butterfat with better utilised vegetable fat, an increase in the lactose content and additional fortification with vitamins and trace mineral. The need for consistency, safety and keeping quality led to mechanized production. Every effort was made to insure that the formula closely resembled human milk in physical, functional and nutritional qualities (3). Breast feeding has declined from 34% in the fiftees to 20% in the mid-seventees (17).

The use of nutritionally balanced formulas has contributed to a definite reduction in the incidence of deficiency diseases such as scurvy in the same manner as the earlier fortification of canned and market milks with vitamin D, which effectively eradicatd rickets (4,18).

Another major factor causing a switch in favor of bottle feeding was the increase in the number of working mothers. The per cent of working women increased from 10 in 1940 to 30 in 1960 and 40 in 1971 (17).

MOTHER'S MILK IS THE BEST:

There is no denying the fact that a healthy mother's milk has no replacer for an infant (1,2,3,7). Nutritionists and medical scientists are in total agreement on this subject. The human milk is

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perfectly balanced in proteins, fats, carbohydrate, vitamins and mineral. It is fresh, at optimum temperature,safe, easily accessible, available at all times in the right amount and practically free (2,7). Other advantages are : emotional for the mother and the baby, convenience and instant availability. It is a natural and uniquely designed system of supply and demand which best serves the total interest of the mother and the baby. It has backing of thousands of centuries of evolving perfection and proven long term clinical success. The La Leche League International (7) of America has dedicated itself to the encouragement of breast feeding for a wholesome and healthy cultural life in America.

Among the numerous benefits to the mother are: the involution of the uterus (9) by induced uterine contraction, conservation of maternal iron, delayed ovulation and consequent contraceptive affect and finally, a substancial saving in the family budget in terms of formula and baby-sitting costs.

NEED FOR THE INFANT FORMULAS:

Babies are totally dependent on adults for their nourishment. We do recognize that there are occasions when a substitute for breast milk must be found. Wayler (18) asserted that even the most willing mother who has tuberculosis, cardiac disease, epilepsy, or the like is likely to be discouraged from nursing by her family physician. Likewise, a mother who has involuted nipples or is chronically malnourished may be discouraged. So is the case of the mother who is mentally unstable or is high on drugs or intoxicants. Infants with cleft palates, or given for adoption or have inborn metabolic errors like lactose intolerance, have also to be bottle-fed (6). There are also mothers who are professionals, or have to complete their education or are raising adopted infants and have to depend on the bottle (16). Modern formulas are blessing for the busy pediatrician when an alternate source is needed.

COW MILK: An Excellent Base for Infant Formula

Cow milk provides an excellent source of essential nutrients for formula preparation (8,12). Before the development of the commercial formulas instant humanised milk used to be prepared by adding to fresh boiled cow milk, boiled water and sugar in a certain proportion to obtain the required mix containing 20 cal. per fluid oz. (3).

Cow milk and human milk are understandably dissimilar in composition and contain approximately 4.6 and 6.8% lactose, 2.9 and 0.8% casein, 0.5 and 1.2% lactalbumin, 3.5 and 1.8% total protein and 0.7 and 0.2% minerals (3,8,11) respectively. hence the need to modify it for infant feeding.

MODERN INFANT FORMULA ARE CLOSE SUBSTITUTES:

There is very little that can be said against infant formulas in regard to nutritional and functional qualities (1,2,4,11). It is made to provide balanced nutrition and energy, is of consistent quality and appears to contain fewer residual drugs and other toxic substances coming from a mother addicted to them (1,11,18). Most formulas are made from corn oil or in combination with other vegetable oils. Moores (10) cited a study on infants less than 7 months of age and reported that the digestibility coefficient for human milk fat and olive oil was 95% . corn oil, 97% and butter fat was 89% . Most infant formulas contain linoletic acid in an amount sufficient to furnish 3% of the total dietary calories (14), which helped in preventing skin ailments.

Infant formulas are subject to ultra-high heat treatment during processing in a commercial plant. Some conern is expressed about the denaturation of protein fractions and loss of heat labile vitamins. A complex bond between lysine and lactose due to the interaction between the epsilon amino acid group of lysine and the aldehyde group of lactose is formed in maillard reaction. This made part of the lysine unavailable. But even though this complex is resistant to enzymatic hydrolysis it is easily hydrolysed by strong acid. Total lysine availability is therefore undiminished. Also high heat renders some lactalbumin insoluble but it does not reduce its biological value. On the contrary it enhanced its digestibility (13). Losses of ascorbic acid and B12 are minimized by deaeration and compensated by carefully calculated overfortification during processing (14). The F.D.A. regulations require that the formula contained claimed amounts of all nutrients on the expiration date.

TYPES OF INFANT FORMULA:

There are three types of formula available (14,18). The regular formula is a dairy based product. The hypoallergenic formula is a nondairy product recommended for lactose intolerant kids. The special formula is a catch-all beverage made from hydrolysed caseinate or soy protein isolate and sugar for babies unresponsive to any of the above.

CONSTITUENTS OF THE FORMULA:

The details of the components of the formulas are presented in Table 1. The following categories of ingredients are used in preparing these formulas:

TYPES OF FORMULA	TYPICAL COMPONENTS
Regular (Dairy based)	Filtered water; nonfat dry milk or skim milk concentrate; corn oil; lactose; trace amounts of Cu, Fe, and Zn.; Vitamin A,C,D,Ca pantothenate, niacin pyridoxine, riboflavi and thiamin. Stabilizer and emulsifier.
Hypoallergenic (Nondairy-based)	Filtered water; soy protein isolate; corn oil; corn syrup solids, sucrose; added salts of Ca, Cu, Fe, Mg, Na, K, and Zn,; VITAMINS: A, C, D, E, Biotin, Ca pantothenate choline, cyanocobalamin, folic acid, niacin, phytonadione, riboflavin and thiamin. Stabilize emulsifier and L-methionine also added.
Special	Casein hydrolysate, dextrimaltose, corn oil salts and vitamins.

For further details, see Table — 1

NEED FOR PROCESSING:

There is need for processing of the formula to render it safe and lend it a long shelf life. Infant formulas are fabricated and processed products. Some of the ingredients listed above remain in solution some in colloidal dispersion and some others in suspension. The product has to maintain its phase stability, viscosity, flow propery and acceptable appearance during its shelf life of 18 months to 24 months. The heat treatment kills nost of the microflora, prevents bloater damage and increase shelf life.

STAGES OF PROCESSING	DESCRIPTION
Blending	Skim milk powder, oil, emulsifier stabilizer, lactose, vitamins, blended in water.
Heating	
Clarification	Removes dirt or foreign matter
Deaeration	Removes dissolved air, gasses.
Homogenization	Disperses oil as fine globules
Standardization	Adjusts solids, mineral, fat etc.
Filling	Fills containers and seals.
Sterilization	Sterlizes product
Labeling and Warehousing	Labels and stores product.

FORMS OF THE FORMULA:

Commercial formulas are available in several forms such as ready-to-feed liquid, concentrate liquid, or dry powder. The R.T.F. formula is available in 4 oz., 8 oz in glass, 8 oz., or 32 oz. in cans. Concentrate is available in 14 oz. cans and the powder is available in one pound size. Formulas are also categorized on the basis of energy content. There are 20 cal. per fluid oz. (standard), and 13, 27 and 40 cal. (concentrate) variations.

READY-TO-FEED [RTF] NURSERS:

Like any other consumer product, convenience also has entered the formula market. RTF formula packaged in non-returnable bottles, with nipples installed, are available for single service feeding.

RELATIVE COST:

The cost of the RTF formula on a unit basis increases in the following order: powdered, concentrate, RTF and ready nurser.

THE FUTURE OF INFANT FORMULAS:

In the developed world, it can be safely projected that the use of infant formulas would continue to gain ground and is there to stay. Continued urbanization, industrialization, affluence, separation of the generations, levelling of income between the sexes and continuing increase in the number of working mothers are factors that would work in favor of the bottle. Science and technology will continue to bridge the gap in humanising the formula.

In the developing countries and particularly the Muslim countries, breast feeding would be the rule rather than the exception, for a long time to come. If the current trend ot mimick the ways of the West continues, then history will repeat itself in the East. However, if the Muslims rediscover the values in Islamic culture and philosophy, and decide to express them in everyday living , then bottle feeding would be restricted to a supplemental role.

ACTION RECOMMENDED:

The state of nutrition among growing children in general and infants in particular is lamentable. The rate of infant mortality in most of the Mulim countries of Asia and Africa is among the highest in the world. The Muslim governments, under a uniform national policy must subsidize the supplemental feeding of infants and their nursing mothers. We should also introduce nutrition care programs for all school going children. This will eliminate all debilitating diseases such as Kwashiorkor and bring health and happiness to the little ones. To make such a massive undertaking feasible, we need to establish a string of dairy food plants in the Muslim world, making maximum use of our God-given resources.

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