

Toward a Better Understanding of Hospital Feeding Formulas

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Abstract

Recent advances in the science and technology of human nutrition and human health have made possible the development of a variety of hospital feeding formulas tailored to meet the growing demands for total or supplemental nutrition for prevention, management or treatment of a disease. The use of a great variety of ingredients of plant, animal or chemical origin for their functional or nutritional qualities to fabricate an antidiarrheic, economically feasible, hypoallergenic, isotonic, long shelf-life, palatable, stable hospital feeding formula with electrolyte balance, low renal solute load and osmolality make the task all the more challenging and rewarding. Major nutritional rationale and functional considerations in the fabrication of a versatile hospital feeding formula designed to meet over 90 percent of the needs of any health care facility, fit for total or supplemental feeding - gavage or oral - are outlined. Need for commercial production of such a formula in the developing countries, particularly the Muslim countries, is emphasized.

Key Words: Hospital feeding formula, hypoallergenic formula, fabricated formula

The daily preparation of liquid foods for patient feeding from raw ingredients was a chore the dietitians and the nutritionists of today would like to forget. Now most health care facilities have access to a variety of formulas to meet the general and specialized needs of their clients. However, little is known to the medical community about the functional, nutritional and technological aspects of the all purpose formula that is economically viable. The need exists for the commercial production and wide distribution of these and other low cost fabricated products in Third World countries, particularly Islamic countries where imported formulas are expensive. I have suggested such a formula to local manufacturers in Islamic countries. This would be economically viable due to low cost indigenous manpower, and raw materials¹.

General considerations

Technology is available for the development and production of regular or new formulas to meet the growing challenges placed on the modern health care industry. Fabricated foods as defined by Glickson², however complex, can be engineered to meet supplemental or total needs of the patients. By fortification (increase in the content of specific nutrients by

addition before processing and packaging) and nutrification (addition of nutrients not present in the mix), economically feasible products can be tailor-made³. The infant feeding formula which I have previously described⁴ is a good example and is to infant feeding what the hospital feeding formula is to hospital feeding.

The lactose-free formula is a specialty product available for gavage or oral feeding under a variety of conditions such as pre- or post-operative care, maxillofacial or head and neck injury, orthopedic conditions restricting normal intake, anorexia nervosa and others. Ross Laboratories⁵ of Columbus, Ohio, manufacture "Ensure" brand of hospital feeding formula which is lactose-free. Balance, economy and safety are watch words in the production of these products by the manufacturers. The guidelines of the National Academy of Sciences⁶ in terms of the RDA (Recommended Daily Allowance) levels of nutrition for adults must be followed in the formulation of the product.

Functional considerations

The following functional characteristics are built into the liquid formulas in addition to low osmolality, low renal solute load and low fecal residue:

1. Shelf Life: Not less than about two years from the date of manufacture when held in storage at ambient temperature of about 70° F.
2. Physical stability: Homogeneous consistency with no evidence of separation, gelling, wheying off, creaming or sedimentation.
3. Flow property: Easy, smooth flowing when

From the Scientific American Foods Company,

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gavage-fed. Nonclogging. An 8 Oz. product to flow in less than 3 minutes, using standard gavage kit.

4. Viscosity: Not to exceed acceptable limits to adversely affect the flow properties or phase stability during the storage.

5. Nutritional parameter: Vitamin levels remain at levels claimed at the end of the expiration date.

6. Freedom from spoilage: No bacterial spoilage, no bloating from gas build up caused by spore formers like *B. Stearothermophilus*.

7. Flavor profile: The product continues to have high organoleptic (taste appeal) rating throughout the shelf-life.

Nutritional considerations

There are two types of Formulas:

1. Regular formula made from dairy ingredients except for milk fat being replaced by vegetable oil.

2. Hypoallergenic formula made from nondairy ingredients. Discussion will be limited to the second group which is complete, convenient and lactose-free.

This formula is composed of:

A. Macronutrients

Protein, carbohydrate and fat provide approximately 15, 30 and 55 percent of the calories.

1. Protein: Protein is derived from caseinates of high biological value. Small amount of soy protein isolate is added to lend functional stability to the product, without significantly affecting the protein quality.

2. Fat: Corn oil being fairly high in polyunsaturated fatty acids is used as the principal source of fat. At least 2.7 percent of the calories should be provided by linoleic acid. The oil keeps the cholesterol level low.

3. Carbohydrate: The lactose-free formula has sucrose for a sweetener. Cuatrecasas et al.⁷ have explained how the absence of enzyme lactase caused diarrhea and other gastro-intestinal complaints in lactose intolerant patients. Bayless and Roseweig⁸ have demonstrated that 90 - 95 percent of blacks and 5 - 10 percent of whites suffered from lactose intolerance. Walike and Walike⁹ have concluded that a majority of patients that were tube-fed, suffered from lactose intolerance. Hydrolyzed corn starch is also added to make up for calories and functional benefits.

B. Micronutrients

Minerals are added to meet the minimum daily requirement (MDR) levels for adult feeding. The sources and ingredients are

Table 1: Composition of Hospital feeding formulas

Composition	Ingredients
Water	Filtered mains water
Carbohydrate	Hydrolyzed corn starch, Corn syrup solids, Sucrose
Protein	Sodium, calcium caseinate Soy protein isolate
Fat	Corn oil
Minerals	Salts of Ca, Cu, Fe, K, Mn, Mg, Na, and Zn as chloride, citrate, iodide, phosphate, and sulphate
Vitamins	Vitamin A palmitate, Alpha-tocopheryl acetate, Ascorbic Acid, Biotin, Calcium pantothenate, Choline Chloride, Cynacobalamin, Vitamin D 3, Folic acid, Phylloquinone, Thiamine chloride hydrochloride
Stabilizer	Carrageenan
Emulsifier	Soy lecithin
Flavor	Dairy, fruits, chocolate or nut flavors

high quality, food grade and GRAS (Generally Recognized As Safe). Amphoteric properties, electrolyte balance and product stability over prolonged storage are acquired through careful selection of mineral salts.

Vitamin levels are provided by careful selection of compounds commercially available, and added in the aqueous or lipid blend during processing. Micronutrients are generally added at the end of processing cycle to ensure optimum retention.

C. Functional Ingredients

Carrageenan is added as a stabilizer to hold together the aqueous phase and prevent separation. The Soy lecithin is added as an emulsifier to hold together the lipid phase. Various popular flavors are added to improve product acceptability in the market place. The general composition of the formula is shown in Table 1.

Technological considerations

Fabricated and tailored products such as the hospital feeding formula require great care and sophistication during processing, testing, storage, evaluation, distribution and utilization. High standard manufacturing practices are followed to obtain high quality, reproducible product of extended shelf life, at low cost in large quantities. Stages of processing include:

1. Blending: Protein, carbohydrates, bulk minerals, stabilizer are blended in water to which oil, lecithin, vitamins are mixed.
2. Heating
3. Deaeration
4. Emulsification, homogenization
5. Standardization: Adjustment of solids, minerals, pH and flavoring.
Trace minerals and vitamins are added.
6. Filling: Filling and sealing of containers
7. Labeling, palletizing, warehousing: Product is labeled, filled in boxes which are stacked in warehouse.

The future of special feeding formulas

The growth and proliferation of hospital feeding formulas formulated to meet general or specific needs in the west are assured because of the technical achievements and continuing affluence. Pressure of demand from the health industry is bound to stimulate greater research and development activity. The time is not far when liquid whole meal replacers will be available in carbonated forms as instant meals that combine solid, liquid, gas into one, for the convenience, fun, nutrition and weight conscious Americans both in and out of the hospital as prophesied by Vickery¹⁰.

Urgent need for production in the Third World.

There is a crying need for the production and distribution of fabricated and processed dairy foods

in Third World countries including and more so in the Islamic countries largely concentrated in Africa and Asia as they are the worst victims of deficiency diseases, hunger, malnutrition and premature death¹¹. While the dairying resources of the Muslim countries are generally meagre with few exceptions such as Egypt, Pakistan and Turkey, lack of national policy and planning to achieve self-sufficiency and deliberate dependence on imports which are heavily subsidized by the governments, are the root causes of decline and deterioration. Pakistan is the habitat of the finest breeds of Zebu dairy cattle and water buffaloes in the entire tropical world and has a potential reservoir of milk that remains untapped. I have previously urged the Government of Pakistan to make use of this resource and demonstrated the need for joint ventures¹² in resource utilization among Muslim countries.¹²

Both dairy food analogs, fabricated and processed foods such as the hospital feeding formula could be produced at low cost using native resources to combat hunger and malnutrition. The lands of the Muslims are under military invasion, occupation or siege by one or the other superpower or their surrogates. There are 10.5 million refugees in the world who are Muslims out of the world total of 12.5million and freedom fighters like the Afghans, the Eritreans and others could use products like the hospital feeding formula or the infant formula made from surplus nonfat dry milk and vegetable oil in Muslim countries, available through aid agencies.

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