Management of the allergic infant often includes extensive dietary restriction in addition to avoidance of milk. A milk-free formula may thus become a major or even sole source of most essential nutrients for many months. Furthermore, the occasional coexistence of anorexia and intercurrent infection in children with allergic manifestations, and losses of protein through the skin of patients with severe eczema, makes adequacy of diet a major concern of the physician caring for such patients.

Published reports of deficiency diseases developing in infants receiving various milk-free formulas indicate the importance of an awareness of composition and nutritional properties of these diets. Deficiencies of vitamin A, thiamine, and thiamine have occurred in infants receiving milk-free formulas not fortified with vitamins, and goiter due to iodine deficiency (or increased iodine requirement) has been reported to occur in infants receiving a soya bean formula unsupplemented with iodine.

The present report provides information regarding composition and nutritional adequacy of certain infant formulas commonly employed as cow milk substitutes.

Soya Bean Products

Composition

Information on the composition of the most frequently used commercial preparations is given in Table I.

Soylac: Liquid and powder products are prepared from an aqueous extract of whole soya beans to which has been added soya oil, sucrose, dextrose, dextrins, maltose, and iodized sodium chloride. When diluted with water to supply 67 cal/100 ml (20 cal/oz), Soylac liquid supplies 2.05 gm of protein/100 ml, the least protein content of commercially available soya bean formulas. Formulas of Soylac powder with the same caloric strength provide 2.85 gm of protein/100 ml and differ in other important respects from Soylac liquid (Table I). Attention is directed especially to the fact that vitamins A, B12, and D are not added to Soylac powder.

Mull-Soy: The liquid product is prepared from soya flour, soya oil, sucrose, dextrose, maltose, dextrins, calcium phosphate, monoglycerides of hardened soya bean oil, sodium chloride, calcium hydroxide, potassium iodide, and vitamins. The powder product is prepared from soya flour, soya oil, sucrose, dextrose, calcium and sodium phosphates, soya lecithin, sodium chloride, and potassium iodide. Mull-Soy powder contains no added vitamins. Both Mull-Soy liquid and powder approximate whole cow milk in proportions of protein, fat, and carbohydrate. It is, therefore, a relatively high-protein, low-carbohydrate feeding when compared with most infant formulas, being similar in composition to evaporated milk. In preparing formulas with Mull-Soy, carbohydrate is frequently added.

Sobee: Liquid and powder products are prepared from soya flour, soya oil, coconut oil, Dextri-Maltose, sucrose, calcium carbonate, iodized sodium chloride, dicalcium phosphate, chondrus extract, vitamin A palmitate, calciferol, and water. As is true of Mull-Soy, the protein content after reconstitution with water is relatively high, being nearly identical to that of undiluted whole cow milk. However, the carbohydrate content is higher and the fat content lower than that of either whole cow milk or Mull-Soy, and additional carbohydrate is not usually added in preparation for feeding.
Nutritional Adequacy

GROWTH: Published studies have generally provided only qualitative statements concerning growth. Glaser and Johnstone reported that 42 infants fed a soya bean formula (Mull-Soy) from soon after birth until 5 to 9 months of age demonstrated satisfactory growth. Twenty-five other infants received the feeding for shorter periods and nine of these infants were thought to be intolerant to the soya bean milk as evidenced by occurrence of diarrhea, emesis or colic. Collins-Williams reported that 24 infants fed a soya bean formula (Sobee) demonstrated satisfactory weight gain during the period of observation. Although some of these infants were observed for as long as 4 or 5 months, the majority were apparently studied for much shorter periods, some for only 1 week.

Two published studies have provided quantitative data demonstrating normal growth in length and weight of full-term infants fed a soya bean formula (Mull-Soy) from birth until 3 months of age. However, only 7 infants were included in one study and 14 infants in the other. One larger study with 102 infants fed a soya bean formula (Sobee) has been reported by Kane, although less detailed information about growth is supplied. Sixty-five of these infants were less than 1 month of age at the time the soya bean formula was introduced into the diet; 25 were 1 to 2 months of age, and the remainder were more than 2 months of age. Growth was said to progress normally as measured by Wetzel grids. During the first month that the infants received the diet, the average gain in weight was stated to be 30 oz and the average increase in length 1½ inches.

PROTEIN: Concentrations of Protein in Serum. Two reports suggest that hypoproteinemia and edema are not rare in chronic atopic eczema, especially when weeping of the skin is present. However, information provided in these reports does not warrant the conclusion that feeding of milk substitutes contributes to the development of hypoproteinemia. Concentrations of total protein, albumin, and globulin in serum of normal infants fed a soya bean formula (Mull-Soy) have been reported to be normal.

Metabolic Balance Studies. Fomon reported similar rates of gain in weight and retentions of nitrogen by infants 4½ to 6 months of age receiving pooled human milk or an experimental formula providing a similar intake of protein from soya bean. However, only four infants received the soya bean formula and periods of observation with these infants were short (4 to 8 weeks). In contrast to these results, DeMaeyer and Vanderborgh demonstrated greater retention of nitrogen from protein of cow milk than from similar amounts of protein from soya bean in studies with 3-to-12-year-old African children recovering from kwashiorkor. When analysis of the data is restricted to studies in which intakes of nitrogen ranged from 500 to 700 mg/kg/day (approximately 75 to 85% being supplied from cow milk or from soya bean flour), the mean intake in 11 studies with six infants receiving cow milk was 589 mg/kg/day and the mean retention 267 mg/kg/day. Corresponding values in 16 studies with 10 infants receiving soya bean flour were 635 and 215 mg/kg/day. In spite of the greater mean intake of nitrogen by children fed soya bean protein than by those fed cow milk protein (635 compared with 589 mg/kg/day), retention of nitrogen was significantly greater by infants fed cow milk (t = 2.2; 0.05 > p > 0.02). This observation does not necessarily indicate that protein from soya bean is inferior to that from cow milk because, as pointed out by the authors, cooking of the soya bean flour may have been insufficient to promote optimum nutritional value. It has long been recognized that treatment of raw soya bean meal with moist heat improves the nutritional adequacy of the protein.

Heat-labile Substances. A number of heat-labile, physiologically active substances, including a trypsin inhibitor, have been isolated from raw soya bean meal.
Presumably because of the presence of these substances, adverse effects are noted when raw soya beans are employed as food for animals. Rats demonstrate poor growth, low protein efficiency ratios (i.e., grams of weight gained per gram of protein consumed), and pancreatic hypertrophy when raw soya meal serves as the sole source of protein. These heat-labile substances are destroyed in the processing of the commercially available infant soya bean formulas considered in this report.

**Sulfur-containing Amino Acids.** In comparison with the FAO reference protein, the first two limiting amino acids in toasted soya bean meal are methionine and tryptophane. The content of cystine is also of primary interest because of its ability to spare methionine. It has been found that the amounts of sulfur-containing amino acids (methionine and cystine) and tryptophane differ considerably between various fractions of soya bean meal. Thus, in whole meal the content of methionine is 1.56 and the content of cystine 1.58 gm/16 gm nitrogen (total sulfur-containing amino acids 3.14 gm/16 gm nitrogen). Corresponding values in acid-precipitated protein are 1.33 and 1.00 (total sulfur-containing amino acids 2.33 gm/16 gm nitrogen).

In studies of infants fed mixtures of L-amino acids, Holt and Snyderman have found the minimum requirement for methionine (in presence of moderate amounts of cystine) to be between 33 and 45 mg/kg, and the minimum requirement of tryptophane to be 15 to 22 mg/kg.

Since soya bean meal provides approximately 98 mg of methionine per gram of nitrogen (15.7 mg of methionine per gram of protein), the estimated minimum requirement for methionine will presumably be provided by intakes of protein slightly greater than 2 gm/kg of body weight. Ingestion of any of the soya bean feedings listed in Table I in amounts sufficient to provide 100 cal/kg, would supply more than 3 gm of protein per kilogram, and considerably more methionine than the estimated minimum requirement.

In the study by Fomon, intakes of protein during metabolic balance studies ranged from 1.4 to 2.4 gm/kg/day but the concentration of methionine (139 mg methionine per gm of nitrogen) was greater than that mentioned above for soya bean meal and intakes of methionine varied from 31 to 55 mg/kg/day.

**Carbohydrate:** The soya formulas considered in this report contain soya carbohydrate and additional carbohydrates consisting of sucrose, dextrins, and maltose. Since they contain no galactose, with the exception of small amounts that may arise from hydrolysis of soya carbohydrate, it is not surprising that they have been recommended for feeding of infants with galactosemia. The importance of galactose contributed by soya carbohydrate has not yet been ascertained. Soya bean extracts contain stachyose, a tetrasaccharide consisting of two molecules of galactose, one of glucose, and one of fructose. Since soya beans contain approximately 35% protein and 3.5% stachyose, and since stachyose contains 50% galactose, the amount of bound galactose will be approximately 50 mg per gram of soya bean protein. Cow milk, on the other hand, supplies approximately 700 mg of nutritionally available galactose per gram of protein.

Although the trisaccharide, raffinose (one molecule of galactose, one of glucose and one of fructose), which is closely related to stachyose in structure, is apparently not metabolized by the rat nor by the normal adult human, conclusive data on digestibility of stachyose in man are not available. Concentrations of galactose-1-phosphate in erythrocytes of infants with galactosemia are apparently not greater when they are receiving soya formulas than when they receive galactose-free diets.

**Fat:** All of the soya formulas listed in Table I contain soya oil. Sobee also contains a small amount of coconut oil. Since soya oil is a rich source of linoleic acid, liberal amounts of this essential fatty acid are provided.

**Vitamins:** When organic solvents are
TABLE I

COMPOSITION OF VARIOUS MILK SUBSTITUTES COMPARED WITH AVERAGE COMPOSITION OF WHOLE COW MILK
(diluted to 80 calories per ounce)

<table>
<thead>
<tr>
<th>Composition</th>
<th>Cow Milka</th>
<th>Sobee*</th>
<th>Mull-soy Liquid</th>
<th>Mull-soy Powder</th>
<th>Soyalac Liquid</th>
<th>Soyalac Powder</th>
<th>Meat Base†</th>
<th>Nutra-ingen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major constituents (gm/100 ml)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td>3.3</td>
<td>3.2</td>
<td>3.1</td>
<td>3.1</td>
<td>2.05</td>
<td>2.85</td>
<td>2.78</td>
<td>2.2</td>
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<tr>
<td>Fat</td>
<td>3.7</td>
<td>2.6</td>
<td>3.6</td>
<td>4.0</td>
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<td>3.20</td>
<td>3.20</td>
<td>2.6</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>4.8</td>
<td>7.7</td>
<td>5.2</td>
<td>4.5</td>
<td>6.0</td>
<td>5.40</td>
<td>6.48</td>
<td>8.5</td>
</tr>
<tr>
<td>Ash</td>
<td>0.7±</td>
<td>0.5</td>
<td>0.8</td>
<td>0.7</td>
<td>0.28</td>
<td>0.63</td>
<td>0.60</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Content of vitamins and minerals per quart:

| Calcium, mg | 1,250 | 1,000 | 1,200 | 1,240 | 390 | 813 | 980 | 1,000 |
| Phosphorus, mg | 960 | 900 | 800 | 1,150 | 300 | 370 | 660 | 700 |
| Na, meq | 25.0 | 20.8 | 15.0 | 15.0 | 12.6 | 28.2 | 16.3 | 16.7 |
| K, meq | 35.0 | 31.2 | 38.0 | 38.0 | 21.7 | 25.7 | 11.0 | 26.6 |
| Iodine, µg | 60 | 45 | 150 | 150 | 34 | 34 | 45 | 45 |
| Iron, mg | 1.0 | 6.0 | 5.0 | 4.0 | 10 | 10 | 9.2 | 13 |
| A, I.U. | 1,070 | 2,500 | 2,000 | 2,500 | 94 | 1,500 | 1,500 | 1,500 |
| D, I.U. | 25± | 400 | 400 | 400 | 400 | 400 | 400 | 400 |
| Vitamin E, mg | 0.57 | .. | 4.0 | 4.0 | .. | .. | .. | 5.0 |
| Ascorbic acid, mg | 15¶ | .. | 30 | .. | .. | .. | 40 | 30 |
| Folic acid, µg | 2.2 | 290 | 1.5 | 1.5 | .. | .. | .. | 50 |
| Niacin, mg | 0.80 | 2.0 | 7.0 | 3.5 | 1.1 | 1.64 | 10.0 | 4.0 |
| Pantothenate, mg | 3.3 | 1.2 | 1.0 | 1.0 | .. | .. | .. | 3.2 |
| Riboflavin, µg | 1,490 | 290 | 800 | 860 | 120 | 350 | 1,300 | 1,800 |
| Thiamine, µg | 400 | 190 | 500 | 80 | 220 | 360 | 190 | 460 |
| Vitamin B6, µg | 455 | 440 | 400 | 235 | 290 | 210 | 660 | 500 |
| Vitamin B12, µg | 5.9 | .. | 1.0 | .. | .. | .. | 7.5 | 4.5 |

* When diluted to supply 67 cal/100 ml (20 cal/oz), content of powder and liquid products are the same.
† Content based on typical formulation: 15 fluid oz (1 can) meat base formula, 2 tablespoons (24 gm) of corn syrup, diluted with water to volume of 1 qt.
‡ The omission of a value indicates that the nutrient has not been added and that the Committee does not have information concerning the amount present.
§ In milk marketed in the United States (but not in Canada) vitamin D is ordinarily added to insure a content of 400 I.U./qt.
¶ Concentration of vitamin C is gradually reduced during collection, processing and marketing of fluid milk.

employed for extraction of fat from soya bean flour (or flaked soya beans), the fat-soluble vitamins native to the bean are lost. Bleaching or treatment with sulfur dioxide results in loss of vitamins of the B-complex, depending on the solvents employed and conditions of treatment.

Although various vitamins are now added to most of the commonly employed commercially available soya bean formulas (exceptions: Mull-Soy powder and Soyalac powder), it is essential that physicians employing these formulas inform themselves of the vitamin content and provide for adequate supplementation of the diet when indicated. Reports of development of vitamin A deficiency in infants fed soya bean formulas not fortified with these vitamins should serve as a warning with respect to the possibility of development of other vitamin deficiencies. The fact that vitamin C has not been added to some of these formulas (Table I) should be particularly noted.

IODINE: Enlargement of the thyroid gland develops when young rats are fed a diet of raw soya beans or soya bean flour without additional intake of iodine. The goitrogenic effects of soya bean flour in rats can be diminished by treatment with organic
solvents (presumably extracting some goitrogenic agent) or by heating, and rats are protected against the goitrogenic effects by supplementation of the diet with iodine. Several investigators reported development of goiter in infants fed Mull-Soy before supplementation of this formula with iodine.

All of the soya bean formulas listed in Table I are now fortified with iodine or iodized salt. Studies with weanling rats have been reported to demonstrate (1) no thyroid enlargement from feeding Sobee before supplementation with iodized salt or as currently supplemented; (2) no thyroid enlargement from feeding Mull-Soy as currently fortified with iodine although thyroid enlargement could be produced by feeding unsupplemented Mull-Soy; (3) occurrence of thyroid enlargement from feeding unsupplemented Soyalac (no reports available concerning thyroid enlargement from feeding Soyalac as currently fortified with iodine).

Available data regarding iodine requirement of infants are meager. However, it seems unlikely that the daily requirement is greater than the amount supplied by a liter of human milk (approximately 70 μg). Curtis and Fertman have estimated the requirement to be 3 μg/kg/day and Salter has estimated the requirement to be 22 to 44 μg/day. The usual daily intake (presumably of normal adults) has been stated to be 150 μg/day. It seems probable that the soya bean formulas mentioned in this report supply adequate amounts of iodine.

**Iron:** Although all of the soya bean formulas contain greater amounts of iron than does cow milk, considerable difference in iron content of the various formulas may be noted (Table I).

**MEAT BASE FORMULA**

Meat base formula (Gerber) is prepared from beef heart, sesame oil, sucrose, tapioca flour and calcium salts. Additional carbohydrate is customarily added when the formula is reconstituted with water (Table I).

As in the case of the other feedings being considered, few satisfactory growth studies are available. Albanese et al. reported results of study of five infants ranging from 2% to 8 months of age who were fed an enzymatic digest of meat for two 5-day periods and a milk formula for two other 5-day periods. Similar rates of weight gain and retention of nitrogen were found with the two feedings. Ziegler has reported satisfactory balances of nitrogen, calcium, and phosphorus in studies of two infants (age 2 months and 2½ months), two small children (age 3 years and 4½ years) and two older children (age 10 years and 13 years) when fed mineral-enriched meats instead of milk. McQuarrie and Ziegler had previously reported similar retentions of nitrogen when two adolescent boys were fed standard diets with milk and when they were fed a diet in which meat was substituted for milk. Sisson et al. reported that retentions of nitrogen, fat, and minerals by 11 premature infants serving as their own controls were similar whether they received a meat base formula or a milk formula. Three additional premature infants retained nitrogen, fat and minerals as well with a meat base formula as did four control infants receiving a milk formula.

Although a trace of galactose is present in meat base formula, presumably arising from a galactoside in beef heart muscle, unpublished data indicate that the formula has proved satisfactory in management of patients with galactosemia.

**PROTEIN HYDROLYSATE**

Nutramigen is a product in which the antigenic properties of the original protein (casein) have been removed by enzymatic hydrolysis. Approximately 65% of the amino acids in this formula are present in the free form and the remainder are present as polypeptides. The essential amino acids are present in the same proportions as in casein. The other components of the formula are sucrose, arrowroot starch, corn oil, minerals, and vitamins. Its composition is set forth in Table I.

Stools of patients consuming this food are
generally thin, semifomed and small in amount. The flavor of the product may adversely affect its acceptance by older infants.

As is true of the other formulas discussed, few long-term studies have been reported. Hill43 reported observations of 36 infants with atopic eczema who received Nutramigen for periods ranging from 2 weeks to 3 months. “Satisfactory results” were reported in 19 of the infants, although weight gains were stated to be less than “average normal,” a finding mentioned by Hill as common for infants with eczema. Results were reported as unsatisfactory in nine instances because of refusal of the feeding, poor weight gain, diarrhea, or vomiting, while results were reported as inconclusive in eight instances.

Hartmann et al.44 reported retentions of nitrogen by children receiving Nutramigen to be similar to those by children receiving milk, meat, and eggs. Scott and Kety45 reported that Nutramigen was useful in treatment of diarrhea of the newborn.

Nutramigen contains a trace of lactose (approximately 16 mg/100 ml at a formula dilution of 67 cal/100 ml), believed to represent a contaminant of the casein from which the hydrolysate was prepared. The formula has been used successfully by Isselhachen46 and by Donnell et al.47 in management of patients with galactosemia.

GOAT MILK

In 1939 Hill48 challenged the long-accepted belief that whey proteins of goat milk and cow milk exhibit species specificity. Twenty-five of 44 eczematous infants with positive skin tests to lactalbumin of cow milk exhibited identical positive skin tests to lactalbumin of goat milk. Additional evidence against the existence of species specificity between whey proteins in milk of these two species has been provided by more recent studies.49,50 Antisera produced against bovine alpha-lactalbumin and beta-lactoglobulin reacted with the analogous proteins of goat milk. In addition, antisera to bovine whey and bovine serum reacted with the euglobulin fraction of goat milk.

In view of the above reports it would appear that additional studies are needed before use of fresh goat milk is to be generally recommended in treatment of the child with sensitivity to cow milk. The processing involved in production of evaporated goat milk (or evaporated cow milk) may decrease the antigenicity of the feeding.

The wide clinical experience with goat milk as a food for infants and children in many parts of the world suggests that it is nutritionally adequate. Surprisingly little information is available concerning growth, concentrations of protein in serum, or metabolic balance studies with infants fed goat milk as a sole source of protein.

Although goat milk supplies nearly the same amount of folic acid as cow milk (1 to 3 μg/liter) while providing much less vitamin B12 (0.15 μg vs. 4.0 μg),51,52 infants developing macrocytic hyperchormic megaloblastic anemia while receiving goat milk respond more readily to therapy with folic acid than to therapy with vitamin B12.53 It has therefore been suggested54 that the requirement for folic acid may be increased in infants receiving diets low in vitamin B12.

RENUAL SOLUTE LOAD

Calculations based on content of protein and electrolytes indicate that the renal solute load presented by the feedings discussed in this report are similar to or less than those arising from ingestion of whole cow milk.55 Renal solute load is therefore an important consideration in choosing between these feedings only when renal concentrating ability is impaired or excessive losses of fluid occur through extrarenal routes.

PROTEIN EFFICIENCY RATIOS

Little information is available concerning relative nutritive values of the various infant formulas discussed in this report. Protein efficiency ratios (i.e., ratios of grams of body weight gained by rats to grams of protein consumed), provide an indication of
nutritive value and, in many circumstances, results with this method appear to relate reasonably well to results with other methods of determining nutritive values of proteins. Block and Mitcile26 found close correlation between protein efficiency ratios and biologic values, and between protein efficiency ratios and chemical score based on amino acid composition. Bender77 reported good correlation between protein efficiency ratio and net protein utilization. Limitations of the method with respect to interpretation in terms of infant nutrition are mentioned below.

György et al.28 have reported protein efficiency ratios of 2.20 for Sobee, 1.83 for Mull-Soy, and 1.39 for Soyalac, in comparison with a value of 2.63 for a reference skin milk.

Through the kindness of Dr. E. E. Howe, Director of Nutrition, Merck Institute for Therapeutic Research, Rahway, New Jersey, results of a more extensive study of protein efficiency ratios have been made available to the Committee on Nutrition. The method of Chapman et al.25 was utilized with 10 weaning male rats of the Holtzman strain assigned to each test group. The casein control was tested with duplicate groups of rats located in different positions on the animal racks. Studies of concentrated liquid products were made after freeze-drying. Since some of the samples contained relatively high percentages of fat, a third casein control sample providing 20% rather than 10% of the diet as fat was included. Mean rates of gain in weight, amounts of food consumed, protein efficiency ratios (PER), and protein efficiency ratios adjusted to casein at 2.5 are presented in Table II. Casein with added fat supported a slower rate of growth than did casein alone but yielded almost identical protein efficiency ratios. Adjusted protein efficiency ratios ranged from 1.3 to 2.4.

As a basis of comparison, it may be noted that the protein of white bread made with 4% milk solids has a protein efficiency ratio of about 0.8, whereas that of whole egg protein is approximately 3.5.69

In interpreting the data presented in Table II in terms of infant feeding, it is necessary to note that the sulfur-containing amino acids, methionine and cystine, are probably limiting for the rat receiving soya bean protein under the conditions of study. Somewhat different results might be anticipated if a greater percentage of the caloric intake were provided by protein (e.g., 14% of the calories as protein rather than the 10% employed in the method of Chapman et al.).59 The commercially available soya bean formulas considered in this report all

* The freeze-drying was carried out by the Gerber Company under the direction of Dr. R. A. Stewart.

TABLE II

| Protein Efficiency Ratios of Various Infant Formulas Used as Cow Milk Substitutes |
|---|---|---|---|---|---|---|
| Diet | Average Initial Weight (gm) | Average Weight Gain (gm) | Average Food Consumption (PER) | Adjusted PER |
| | | Number of Days | 5 | 10 | 15 | 20 | 25 |
| 1 Casein | 64.2 | 15.5 | 36.5 | 36.5 | 56.7 | 76.4 | 94.1 | 354.2 | 4.8 | 4.5 |
| 2 Casein+10% additional fat as Cricos | 64.2 | 8.9 | 33.9 | 49.4 | 44.6 | 63.8 | 72.3 | 400 | 4.7 | 3.4 |
| 3 Whole milk powder | 64.1 | 12.0 | 34.1 | 41.4 | 38.1 | 77.5 | 91.4 | 305 | 5.5 | 4.2 |
| 4 Evaporated milk powder, lyophilized | 64.0 | 9.7 | 31.2 | 38.8 | 37.3 | 74.4 | 84.3 | 306 | 5.5 | 4.2 |
| 5 Infant casein hydrolysate formula, powder | 64.1 | 11.8 | 31.3 | 39.3 | 38.1 | 75.3 | 95.4 | 340 | 7.7 | 6.4 |
| 6 Infant casein base formula, lyophilized | 64.1 | 11.2 | 30.5 | 38.1 | 34.0 | 67.6 | 86.5 | 360 | 7.8 | 6.0 |
| 7 Infant soya bean formula 1, lyophilized | 64.1 | 7.6 | 25.5 | 31.7 | 31.8 | 61.8 | 75.5 | 354 | 7.3 | 6.0 |
| 8 Infant soya bean formula 2, powder | 64.1 | 7.4 | 25.5 | 30.4 | 45.1 | 57.5 | 69.0 | 241 | 1.1 | 1.9 |
| 9 Infant soya bean formula 3, lyophilized | 64.1 | 6.1 | 20.6 | 25.7 | 37.1 | 45.1 | 56.0 | 197 | 1.9 | 1.7 |
| 10 Infant soya bean formula 4, powdered | 64.1 | 7.8 | 27.4 | 34.4 | 30.0 | 64.7 | 80.0 | 354 | 5.5 | 4.0 |
| 11 Infant soya bean formula 5, powdered | 64.1 | 10.1 | 31.1 | 39.0 | 39.4 | 68.5 | 86.5 | 354 | 7.3 | 6.0 |
| 12 Infant soya bean formula 6, powdered | 64.1 | 9.8 | 17.2 | 20.3 | 32.1 | 41.7 | 56.0 | 298 | 1.8 | 1.6 |
| 13 Casein | 64.1 | 10.5 | 34.3 | 37.2 | 51.0 | 75.7 | 94.0 | 354 | 7.3 | 6.0 |

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supply 15 to 19% of the calories as protein. Furthermore, the requirement of the rat for sulfur-containing amino acids is known to be somewhat greater in relation to requirements for total essential amino acids than is that of man. For these reasons, the data presented in Table II cannot be interpreted directly in terms of infant feeding. The Committee merely wishes to call attention to the occurrence of considerable differences in nutritive value that may result from differences in processing.

**COMMENT**

Wide clinical use of the milk-free formulas mentioned in the present report has demonstrated their general acceptability and gross adequacy. However, the Committee would like to point out the fragmentary nature of published data concerning long-term observation with these products as a sole or major source of nutrients for infants. At the same time, it seems appropriate to mention that few diets containing milk have been satisfactorily investigated and milk-free diets are therefore not to be considered unique in this respect.

Reports of long-term, well-controlled investigations carried out with large numbers of human infants would obviously be highly desirable in evaluating the nutritional adequacy of various milk-free as well as milk-containing formulas. Knowledge of composition of milk-free formulas is necessary because they are so often employed in association with restriction of intake of other foods.

Development of vitamin deficiencies can be prevented if the physician acquaints himself with the vitamin content of the particular product and supplements the diet appropriately when indicated. If the infant has been born to a healthy mother and can therefore be assumed to have adequate endowment with vitamin B₁₂ at birth, evidence is insufficient to indicate that supplementation with this vitamin would be beneficial.

The potential goitrogenic properties of soya bean formulas seem to have been eliminated by the methods of processing and by fortification with iodine.

While the major purpose of this document is review of data concerning nutritional adequacy of commercially available milk-free formulas commonly used in infant feeding, it will be recognized that other dietary restrictions are commonly recommended in association with use of milk-free formulas. It is therefore imperative that nutritional adequacy of these formulas be thoroughly studied.

Milk-free formulas are useful in management of infants with galactosemia. Whether liberation of galactose occurs during digestion of stachyose (a galactose-containing soya carbohydrate) is not yet known.

**COMMITTEE ON NUTRITION**

Richard W. Blumberg, M.D.

David H. Clement, M.D.*

Gilbert B. Forbes, M.D.

Donald Fraser, M.D.

Arild E. Hansen, M.D.

Charles U. Lowce, M.D.

Nathan J. Smith, M.D.

Michael J. Sweeney, M.D.

Samuel J. Fomon, M.D., Chairman

**REFERENCES**


6. Cochrane, W. A., Collins-Williams, C., and Donohue, W. L.: Superior hemorrhagic polioencephalitis (Wernicke’s disease) occurring in an infant—probably due to thia-

* Dr. Clement, although no longer a member of the Committee, prepared the initial draft of this manuscript and consulted with the Committee during the preparation of subsequent drafts.
REPORT OF THE COMMITTEE ON NUTRITION

42. Stewart, R. A.: Personal communication.


This volume is uneven in its impact. A few good chapters, e.g., that by John Clements on respiratory mechanics in resuscitation, are combined with some very poor presentations. Thirty-six pages are devoted to expired air methods without accessory apparatus, and these are immediately followed by 42 more pages on insufflation methods with simple equipment. There just is not enough "meat" to justify this length. The reviewer would suggest elimination of the 12 pages of case reports in Chapter 7 as one way of reducing the size of the book. A shorter, less-contrived offering would educate more readers; the present volume is too detailed, too heavy, and too long to capture one's imagination.

The topic presented is unquestionably of importance. The authors are well known in the field, although it seems strange that Safar did not appear among the group.

It is customary in a review to recommend potential readers, The material is well known to anesthesiologists and would not in all likelihood interest them. The reviewer believes that the individual with minimal knowledge would be overwhelmed. Perhaps the work will be useful as a source of reference.

ROBERT D. DRIPPS, M.D.
REPORT OF THE COMMITTEE ON NUTRITION: APPRAISAL OF NUTRITIONAL ADEQUACY OF INFANT FORMULAS USED AS COW MILK SUBSTITUTES

*Pediatrics* 1963;31;329

<table>
<thead>
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