Enteral nutrition (EN) has traditionally been defined as delivery of a liquid formula beyond the esophagus via a feeding tube in a patient with insufficient or inadequate oral intake. Recently, the term EN has been expanded to encompass the provision of specialized nutritional formulation and includes the use of dietary foods for special medical purposes as defined in the European legislation [1], irrespective of the route of delivery. This new definition implies that formulations can be tailored not only to the age-related nutritional needs, but also to the individual patient’s requirement depending on the underlying disease, residual digestive function, and certain situations. In this presentation, nutritionally complete foods with a nutrient-adapted formulation specific for a disease, disorder or medical condition will be compared with a standard formulation for this age. For infants in whom human milk cannot be provided in sufficient quantity, an infant formula based on whole cow’s milk protein (whey and casein) with lactose as the only carbohydrate and an energy density of 0.6–0.7 kcal/ml would be considered as standard. In older children, a standard liquid nutritionally complete formulation is based on cow’s milk protein, polyglucose, a blend of long-chain triglycerides, and fiber with an energy density of 1 kcal/ml.
What Are the Reasons and Driving Force for Modified Formulations?

Table 1 summarizes five different scenarios for modifications

Table 1. Examples for specialized formulae used in infants and children for different purposes and situations

- Formulae for different age groups (preterm or term infant formulae, balanced formulae for young children)
- Formulae for infants and children with intolerance to one or more nutritional components (i.e. fat- or carbohydrate-free formulae, extensively hydrolyzed or amino acid-based formulae)
- Formulae for infants and children with chronic diseases and special nutritional needs.
  - Formulae for specific chronic diseases (i.e. renal, intestinal, hepatic, pancreatic insufficiency)
  - Infant formulae with increased energy density
  - Infant formulae with thickening agents
  - Pediatric formulae with fiber supplementation
- Exclusive EN to induce remission in children with active Crohn's disease
- Immunonutrition and pharmaconutrition in critically ill patients

1 Special formulations in relation to age. The supply of protein and other macro- and micronutrients per energy unit varies, particularly in preterm infants and during the first years of life compared to adulthood. The composition of formulae has been adapted to this physiological need.

2 At least one component of a standard formula is not tolerated and causes symptoms or disease. Cow’s milk protein allergy was the driving force for developing infant formulae based on extensively hydrolyzed protein, amino acids only or unrelated proteins, such as soy protein [2]. Other examples are metabolic diseases such as glucose/galactose malabsorption, primary or secondary lymphangiectasia, in which the feeding of a standard formulation is not tolerated.

3 This category includes formulae for infants with certain diseases or conditions who can be fed with a standard formula, but may benefit with some modification. Examples are special formulations for regurgitating infants, or children with intestinal, pancreatic, renal and hepatic insufficiency [3].
4 There are certain diseases in which the exclusive EN is considered to be an effective therapy of the underlying disease. Examples are the nutritional therapy of active Crohn’s disease [4] or the ketogenic diet using a special formulation for infants and children with glucose transporter defects or intractable convulsions.

5 The last category of new formulations covers the field of immunonutrition. Formulae are enriched with single components such as glutamine, arginine, essential fatty acids, particularly of the n-3 series, nucleic acids or a combination of key substrates that might play a crucial role during intermediary metabolism in sepsis, inflammation, tissue healing, and growth [5]. For pharmaconutrition, single components are investigated in a scientific stepwise procedure in order to identify effective disease-dedicated nutrition therapy.

Any new formula needs to be evaluated, if possible in comparison to a normal diet or the reference formulation to demonstrate its safety and efficacy (equal or superior to standard formula). A low cost/risk to benefit ratio is desirable for any new nutritional ingredients and formulations.

In conclusion, several formulae for EN in pediatrics over the last 20 years have improved patient care. Close collaboration between clinicians and food industry is needed to drive innovation in this field and to proof new concepts.

References