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Formulae for Enteral Nutrition

Module 8.4

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General characteristics

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European Commission Directive 1999/21/EC on dietary foods for special medical purposes regulates

Composition

- Standard or disease specific
- Nutritionally complete or nutritionally incomplete

Labelling requirements

- Nutrient content
- Origin & nature of protein
- Important notices

Micronutrient content

- 1500 kcal of feed must include daily recommended intakes (RDA) of all listed micronutrients

General characteristics

Enteral formulae (usually) do not contain:

- Lactose
- Gluten
- Cholesterol
- Purines

Typical Standard Formulae

- 15-20% of energy from whole protein
- ~30% of energy from lipid – mostly LCT
- 50-55% of energy from carbohydrate
- ~1kcal/ml (normal energy density)
- ~85% water
- Fibre (fibre-free options are available)

Overview of types of EN formulae

standard formulae

modified standard formulae

- **reduced** water → high energy
- **minus** fibre → fibre-free
- **plus** protein → high protein
- **minus** LCT / **plus** MCT → MCT-rich

disease-specific formulae

for instance renal formulae

- energy↑
- electrolytes↓
- protein ↓/↑

etc...

The very similar composition of different standard formulae

Per 100 ml	Jevity	Nutricomp Standard Fibre	Fresubin Original Fibre	Nutrison Complete Multifibre
	Abbott	B.Braun	Fresenius	Nutricia
Protein g	4.0	3.8	3.8	5.5
Fat g	3.5	3.3	3.4	3.7
Carbohydrates g	14	13.8	13.8	11.3
Prot:Fat:CH ratio	16:30:54	15:30:55	15:30:55	16:35:49
Energy kcal/ml	1.0	1.0	1.0	1.0
Osmolality mosm/l	249	250	300	210
Fibre g	1.1	1.5	1.5-2	1.5

Peptide-based formulae

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Whole protein formulae

- polymeric
- nutrient - defined
- high molecular weight

Peptide-based formulae

- oligomeric
- chemically - defined
- low molecular weight

Peptide-based formulae

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Proteins → Peptides

Polysaccharides / maltodextrins → Maltodextrins

Long-chain triglycerides → MCT

Oligomeric formulae

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Proteins → Peptides

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Oligomeric formulae should be considered

- When whole protein formulae are not tolerated
- When capacity for absorption is severely impaired
- Initially, after prolonged starvation
- In ICU patients and those with severe acute pancreatitis due to be fed via a jejunal tube
- In selected patients with short bowel syndrome
- In selected patients with fistulating Crohn's disease

Druml W, Roth E, Jadrna K. AKE, 2004, McClave SA,et al. AJG 2016.

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None of these is an absolute requirement for an oligomeric feed

Free Amino Acid, Elemental or Monomeric Formula

- Oligopeptides are generally better absorbed than free amino acids and have lower osmolarity

- Very **limited indication**:
  - Some forms of congenital metabolic disease
  - Particularly severe allergy to dietary protein

- Free amino acid formula must be avoided in SBS, even if other formula are not tolerated

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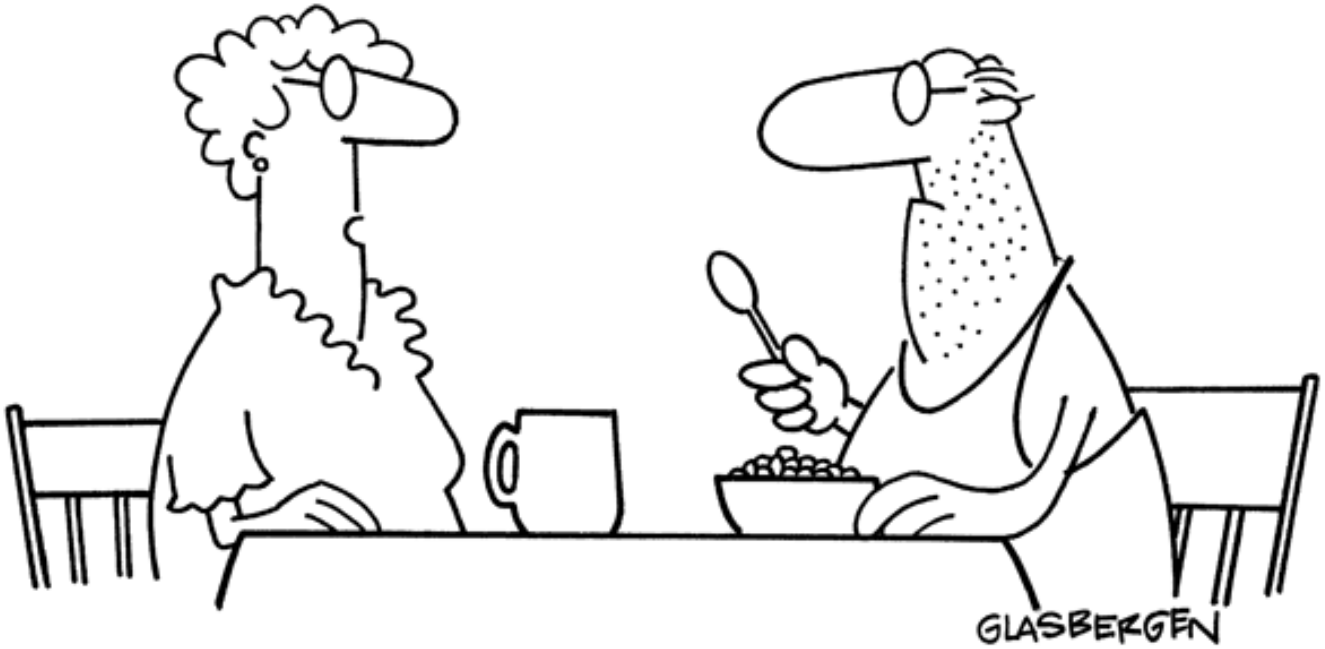
Disease-specific Formulae

Macro- and Micronutrient composition adapted needs of specific disease, digestive or metabolic disorder

VU medisch centrum

EN Formulae in Diabetes

EN Formulae in Diabetes



"You can still have your favorite cereal, but I replaced the marshmallow bits with fish oil capsules."

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The "classical" diabetes formula

- Part of the glucose is replaced by fructose
- Higher amounts of polysaccharides
- Higher proportion of lipid (?)

Can generally be recommended for uncomplicated well-controlled DM

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High MUFA diabetes formulae

- Up to 35% energy as mono-unsaturated fatty acids
- Higher total fat
- Decreased carbohydrate

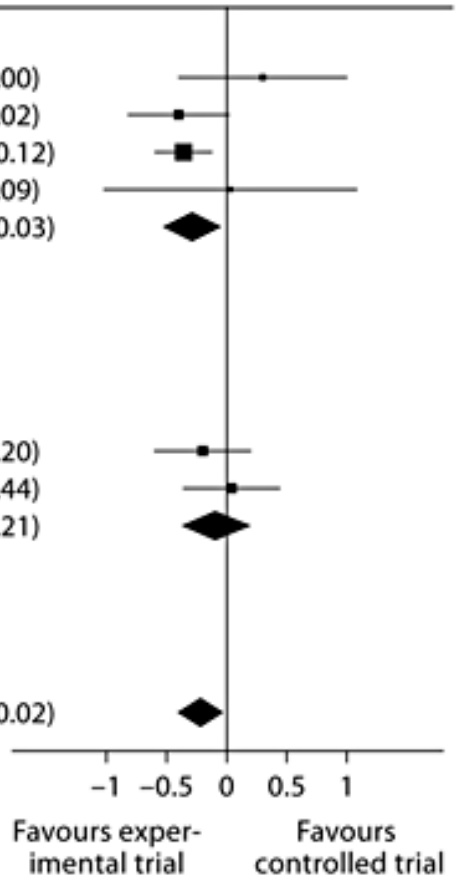
Beneficial in complicated,

poorly controlled DM

Increasingly advocated more generally

High MUFA vs standard formulae – complex slide

Study or sub-group	High MUFA mean	SD	total	Low MUFA mean	SD	total	Weight %	Mean difference IV, random (95% CI)
1.7.1 High MUFA vs. LF								
Brehm et al., 2009	7.5	1.95	43	7.2	1.44	52	6.6	0.30 (–0.40 to 1.00)
Elhayany et al., 2010	6.3	1.4	61	6.7	0.9	55	16.4	–0.40 (–0.82 to 0.02)
Esposito et al., 2009	6.85	0.9	108	7.21	0.9	107	38.4	–0.36 (–0.60 to –0.12)
Shai et al., 2008	7.31	1.03	8	7.28	1.19	9	3.0	0.03 (–1.03 to 1.09)
Subtotal			220			223	64.4	–0.28 (–0.52 to –0.03)
Heterogeneity: $\tau^2 = 0.01$, $\chi^2 = 3.63$, d.f. = 3 (p = 0.30), $I^2 = 17\%$								
Test for overall effect: Z = 2.19 (p = 0.03)								
1.7.2 High MUFA vs. LGI								
Elhayany et al., 2010	6.3	1.4	61	6.5	0.8	63	17.8	–0.20 (–0.60 to 0.20)
Wolever et al., 2008	6.62	0.938	50	6.58	1.117	50	17.7	0.04 (–0.36 to 0.44)
Subtotal			111			113	35.6	–0.08 (–0.37 to 0.21)
Heterogeneity: $\tau^2 = 0.00$, $\chi^2 = 0.68$, d.f. = 1 (p = 0.41), $I^2 = 0\%$								
Test for overall effect: Z = 0.55 (p = 0.58)								
Total (95% CI)			331			336	100.0	–0.21 (–0.40 to –0.02)
Heterogeneity: $\tau^2 = 0.01$, $\chi^2 = 5.89$, d.f. = 5 (p = 0.32), $I^2 = 15\%$								
Test for overall effect: Z = 2.22 (p = 0.03)								
Test for subgroup differences: $\chi^2 = 1.03$, d.f. = 1 (p = 0.31), $I^2 = 2.9\%$								



Schwingshackl L, Strasser B, Hoffmann G. 2011

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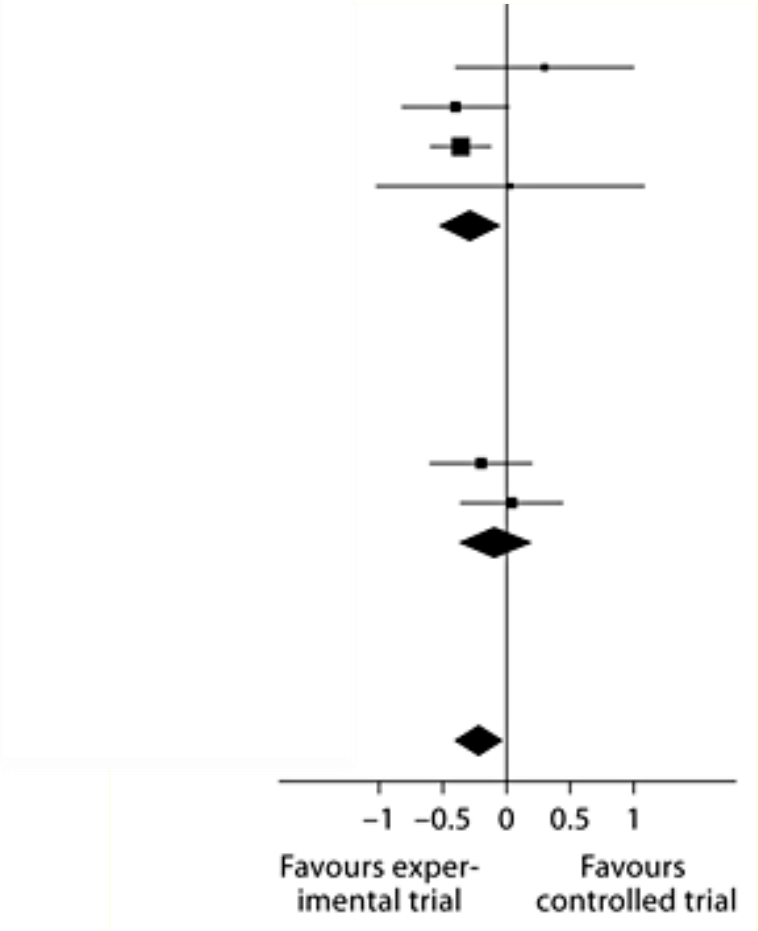
High MUFA vs standard formulae - the important bit



Schwingshackl L, Strasser B, Hoffmann G. **2011**

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Blood glucose control in ICU

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- Standard or ICU-specific formulae ?
- Tight glycaemic control
- How tight ?
- Exogenous insulin is most important

Van den Berghe,2006

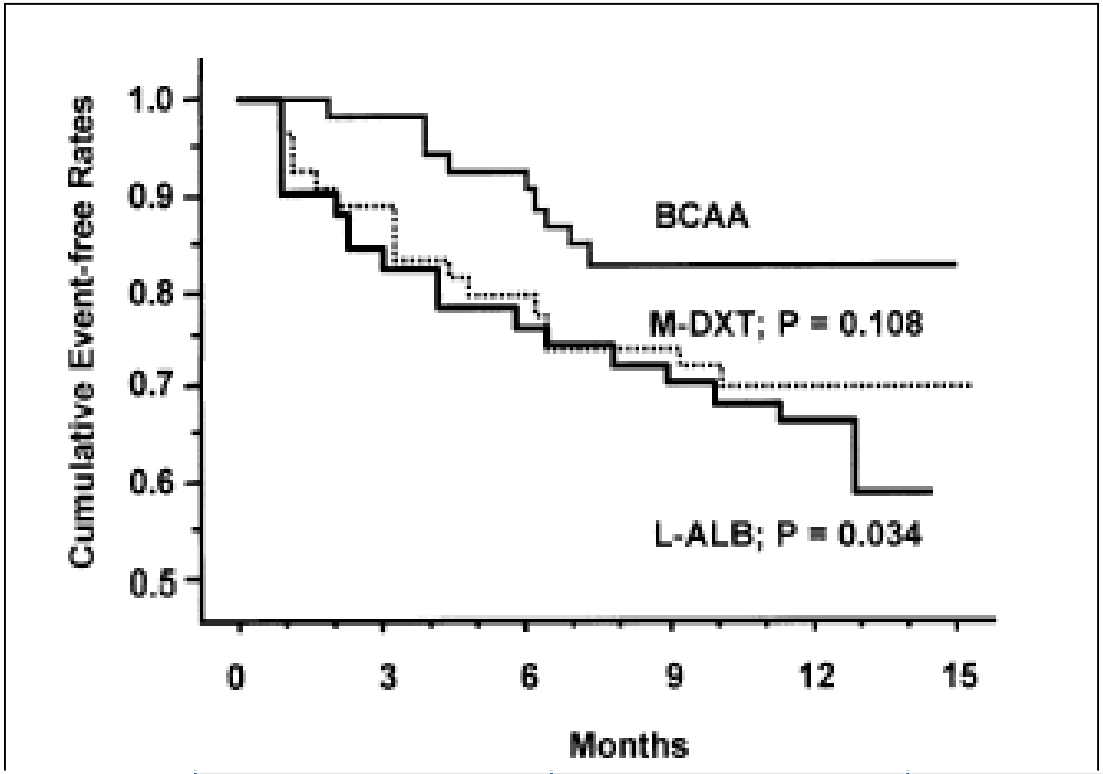
EN formulae in liver disease

Liver vs Standard Formulae

Per 100 ml	LIVER		High-Energy
	Nutricomp Hepa B.Braun	Fresubin Hepa Fresenius - Kabi	Fresubin Energy Fibre Fresenius - Kabi
Energy density / ml (Kcal)	1.3	1.3	1.5
Protein g	4	4	5.6
BCAA (% N)	46%	35%	18%
Fat g	5.8	4.9	5.8
MCT (% Fat)	50%	35%	14%
Carbohydrates (CH) (g)	15.5	17,9	18.8
Prot:Fat:CH ratio	12:40:48	12:38:50	15:35:50
Fibre (g)	0,6	1	2.0

Druml W, Jadrna K. AKE 2005/2006

Oral BCAA in cirrhosis



	BCAA	L-Alb	MDXT
Admissions	15/58	27/56	28/59
Mortality	5	11	9

Marchesini. Gastroenterology 2003

Chronic liver disease
Alcoholic steatohepatitis/cirrhosis

Recommendation	Grade
Standard formulae are generally recommended	C
Consider high energy formulae in patients with ascites	C
Use BCAA-enriched formulae in patients with hepatic encephalopathy arising during enteral nutrition	A
Oral BCAA supplementation can improve clinical outcome in advanced cirrhosis, after transplantation and after variceal haemorrhage	B

Plauth 2006, Yoshida 2012, Sakai 2015

Immune-modulating formulae

Immune-modulating formulae

Contain supranormal / pharmacological amounts of nutrients with potentially immune-modulating effects

- ω-3 fatty acids
- Arginine
- Glutamine
- Nucleotides
- Antioxidant vitamins & minerals

Glutamine

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Natural glutamine content in conventional formulae (2000 ml)

Whole protein formulae, normal protein	**4-6 g**
Whole protein formulae, high protein	**6-8 g**
Peptide-based formulae	**2-3 g**
Amino-acid based formula	**0 g**
Impact ©	**6.3 g**

Immune-modulating formulae enriched with glutamine (2000 ml)

Impact Glutamine ©	**20 g**
Nutricomp Immun ©	**21 g**
Reconvan ©	**20 g**

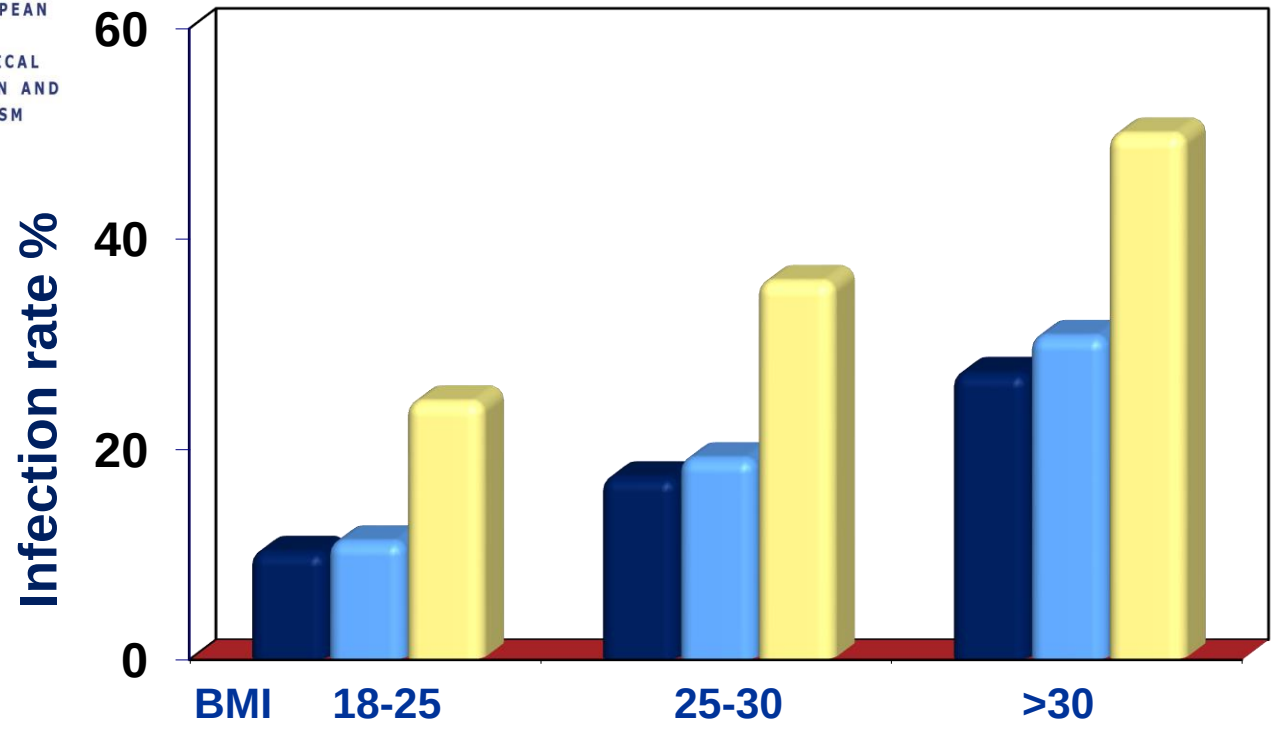
Immune-modulating formulae

Recommendation	Grade
Perioperatively in:	**A**
• Major head & neck surgery for cancer	
• Major upper abdominal cancer surgery	
After severe trauma	**A**
In intensive care patients with:	
• Mild sepsis (APACHE II < 15)	**B**
• ARDS (formulae containing ω-3 fatty acids)	**B**

CAVE! Severe sepsis → increased mortality CAVE!

ESPEN Guidelines, Clin. Nutr., 2006

Pre/peri-operative immunonutrition



- 305 patients with GI tumours
- 45% with gastro-oesophageal resection

Gianotti, Gastroenterology 2002

Indications for Renal Formulae

Predialytic formulae:

- low protein (0.55-0.6 g/kg/d),
- high energy,
- low phosphate,
- low potassium

- In conservatively treated chronic renal failure on EN > 5 days **(C)**
- Essential amino acids and ketoanalogues, in association with very low protein formulae, may help to preserve renal function **(B)**

ESPEN Guidelines, Clin Nutr, 2006

Indications for Renal Formulae

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Predialytic formulae: low protein (0.55-0.6 g/kg/d), high energy, low phosphate, low potassium

- In conservatively treated chronic renal failure on EN > 5 days **(C)**
- Essential amino acids and ketoanalogues, in association with very low protein formulae, may help to preserve renal function **(B)**

Dialytic formulae: high protein (1.4-2.0 g/kg/d), high energy, low phosphate, low potassium, water soluble vitamins

- For tube feeding in patients on maintenance haemodialysis therapy **(C)**
- In acute renal failure in the event of electrolyte derangements **(B)**

EN formulae for lung disease

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Characteristics

Higher percentage of total energy from fat – theoretical advantages from reduced RQ and CO_2 retention

ESPEN Guidelines, Clin Nutr, 2006

EN formulae for lung disease

Characteristics

- Higher percentage of total energy from fat – theoretical advantages from reduced RQ and CO_2 retention

Indications

Stable COPD

- No additional advantage of pulmonary ONS compared to standard high protein or high energy ONS **(B)**

ESPEN Guidelines, Clin Nutr, 2006

EN formulae for lung disease

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Characteristics

- Higher percentage of total energy from fat – theoretical advantages from reduced RQ and less CO_2 retention

Indications

Stable COPD

- No additional advantage of pulmonary ONS compared to standard high protein or high energy ONS **(B)**

Acute respiratory distress syndrome (ARDS)

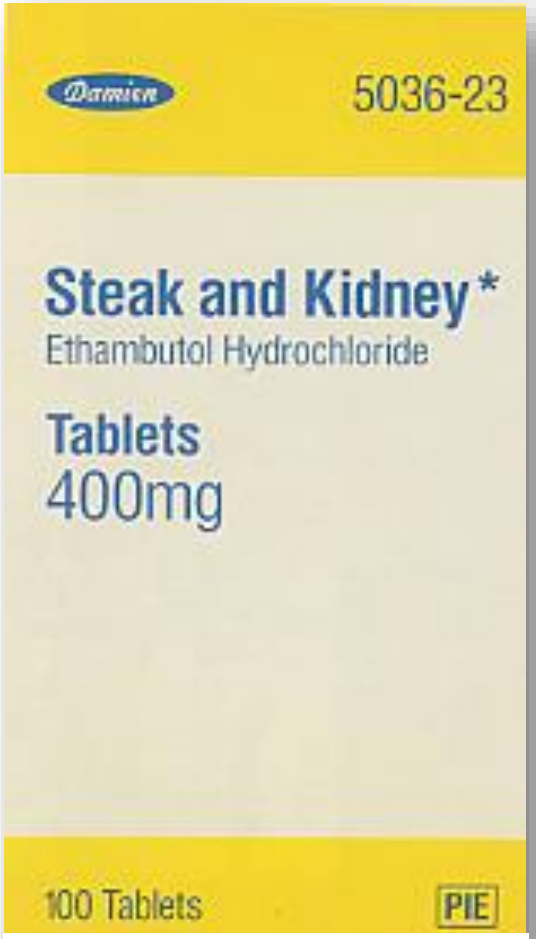
- Survival advantage from pulmonary formulae enriched with ω-3 fatty acids and antioxidants **(C)**

ESPEN Guidelines, Clin Nutr, 2006

Conclusions

- **Enteral formulae are available for a wide array of indications.**
- **Standard formulae (including high energy & high protein formulae) are appropriate for the great majority of patients.**
- **Enteral formulae are designer foods, but their energy components are “natural” as they are based on high quality staples.**
- **Although some formulae may contain nutrients in pharmacological amounts, enteral formulae are to be considered primarily as food, not as drugs.**

Conclusions



Damien Hirst, MOMA, NY

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