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The Elemental Diet

INTRODUCTION

Elemental diets (EDs) have been around for over 50 years, yet few recognize what they are and their importance in clinical practice.[1] A review of the scientific literature reveals robust data validating the use of EDs for the dietary management of patients with limited or impaired capacity to digest, absorb, and/or metabolize foods.[1] The conditions referenced in the literature on EDs were initially confined to inflammatory bowel disease (IBD), Crohn's disease (CD)[2,3], and inflammatory ulcerative colitis (UC).[4–7] However, evidence is now suggesting that EDs can also help with small intestinal bacterial overgrowth (SIBO)[8,9], irritable bowel syndrome (IBS)[10], and other conditions that manifest outside the gastrointestinal system.[11–22]

A study published in the *Journal of Pediatric Gastroenterology and Nutrition* showed that an ED is as effective as corticosteroids in treating children with acute CD. In fact, the researchers concluded that the ED is a preferred therapy for these children as there are none of the side effects associated with steroid use.[3] Interestingly, even with the data and supportive literature, very few clinicians have used EDs for such conditions. One possible reason was the palatability of EDs, which led to poor compliance. However, EDs are now available that address this issue to drive patient compliance.

WHAT IS AN ELEMENTAL DIET (ED)?

As the name suggests, an ED is a "basic" medical food that contains all the daily recommended allowances for essential fatty acids, vitamins, minerals, and other nutrients required by the body for proper physiological functioning. An ED can be described as similar to a meal replacement for the day, however there is one major distinguishing characteristic: it has no whole proteins. Instead, it features pure, free-form amino acids. This allows the ED to be absorbed into the bloodstream within the first half metre (about 2 ft), or proximal part, of the small intestine – an almost immediate assimilation.

This immediate absorption is possible because the ED consists of individual essential dietary compounds in their simplest forms, rendering the bulk of digestion unnecessary. The outcome is that it prevents food particles from reacting with the majority of the gastrointestinal tract, thus reducing many of the symptoms associated with various gastrointestinal conditions. But this is not the only advantage of the ED. Several other key effects result from an easy absorption of and lowered reactivity to food, which are detailed in the following sections.[23]

MECHANISMS OF ACTION

EDs have numerous applications, with continued research on their effectiveness. The trials on EDs are impressive, however the work and clinical experience of health care practitioners are also confirming and expanding these very applications. While we still do not fully understand how EDs work, there is a number of proposed mechanisms of actions with supportive scientific literature, outlined below.

1. Improves nutritional status

EDs have been shown to support the uptake of essential nutrients, correct negative nitrogen balance, improve nutritional status, and restore gut mucosal integrity in patients with IBD. It is thought that EDs may also improve omega-3 to omega-6 ratios, promote iron storage, improve bone remodelling, and increase muscle mass of patients with IBD.[24]

2. Reduces the production of gastric acid, pancreatic enzymes, and bile, all leading to a reduction in epithelial cell loss

Elemental formulas slow down the emptying of the stomach, but concomitantly reduce acid secretion and the release of pancreatic enzymes. This is because the volume of ingested food by itself activates mechanoreceptor responses, which in turn activate neuronal negative feedback loops. A lower volume will activate a signal to decrease the acid secretion. When the formula is sipped or infused at a slow rate, the mechanoreceptor responses may be decreased. Enteral nutrition provides obvious caloric nutritional support and is trophic (either directly or through neuronal loops) for the intestinal epithelial compartment, an effect likely to be beneficial, especially for ulcerative colitis (UC).[1,24–26]

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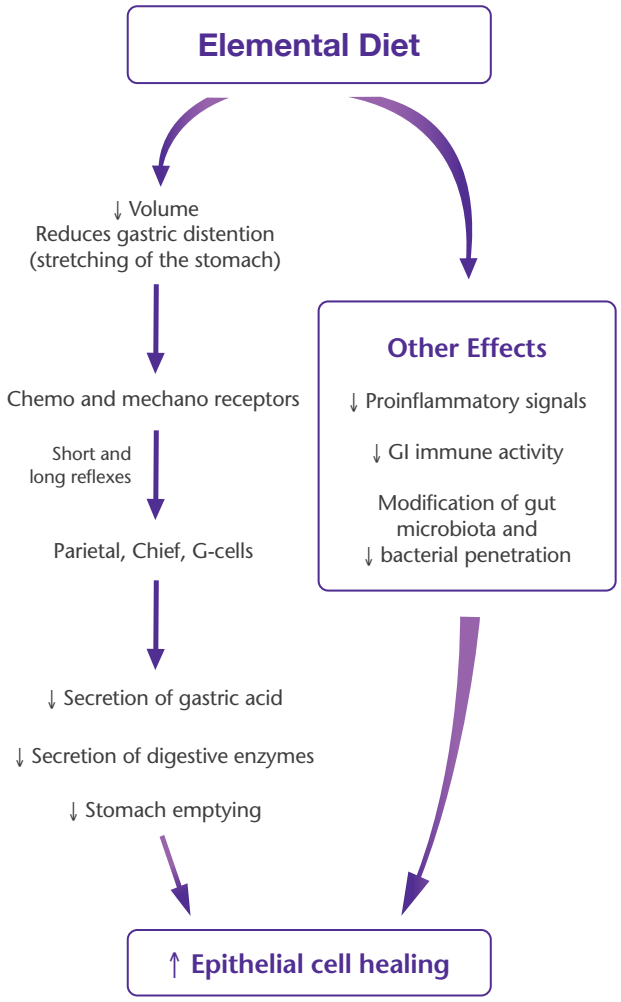

3. Decreases free radicals
EDs decrease free radicals by increasing nutritional and therefore antioxidant status.[27]

4. Gives the gastrointestinal tract (small intestine) a rest
EDs are thought to rest the gastrointestinal tract by reducing the workload of digestion and absorption, and in peristalsis, allowing the promotion of epithelial healing.[24–26]

5. Decreases antigenicity
The decrease of total fat and elimination of whole proteins may lower the antigenicity in the intestinal lumen, thereby reducing inflammation in the gastrointestinal tract. Improved nutritional intake and status may also limit luminal antigen exposure and allow the improvement of barrier function.[24]

6. Improves the microbiome composition
EDs lead to a reduction in pathogenic bacteria and malabsorption in IBS and IBD, such as Crohn's disease. In IBD, the proportion of firmicutes is decreased, whereas the fraction of proteobacteria and actinobacteria is increased. Enteral nutrition has low residue and contains important prebiotic properties that modify the gut microflora. Thus, it is plausible that EDs affect gut microbiota composition by changing fecal metabolic activity. Various studies also indicate that enteral nutrition reduces intestinal permeability via modulation of tight junctions and downregulates the production of inflammatory cytokines by modulating the intestinal microbiome. EDs target gut microbiota as well as inflammation; in addition to suppressing NF-κB levels (a critical regulator of inflammation), they significantly lower the population of *Bacteroides fragilis*, a species linked to IBD and colorectal cancer.

One study of patients with CD revealed that the success of EDs in children with active small bowel/colonic CD was associated with an anti-inflammatory short-chain fatty acid pattern, further suggesting the importance of ED-dependent microbiome changes. Furthermore, a clinical trial of patients given the ED for two weeks showed that the lactulose breath test (LBT) was normalized in the majority of IBS patients who initially showed an abnormal breath test. This indicates that the ED can drastically improve enteric flora composition and confirms its efficacy in a clinical setting. Another clinical trial of patients with CD supports this by showing a normalization of their lactulose/L-rhamnose permeability ratios coinciding with improvement in their clinical symptoms.[10,24,27–30]

7. Decreases intestinal permeability
Susceptibility to CD and IBD has been linked to genetic polymorphisms, leading to Paneth cell dysfunction or defective autophagy. This results in bacteria in the gut that would normally be nonpathogenic being allowed to adhere, translocate, and penetrate the epithelial barrier that has already been partially broken down as a result of an inflammatory diet. Persistent exposure to these bacteria then trigger an adaptive immune response, which gives way to inflammation and further breakdown of the epithelium and then more migration and sensitization to these bacterial species. A vicious bacterial penetration cycle therefore results.

An ED is thought to decrease the exposure to offending dietary components and subsequently decrease the penetration of harmful bacteria. An ED may also remove certain dietary agents (usually processed/industrialized foods), affecting microbial composition and decreasing inflammation as well as promoting the restitution of the epithelial barrier. Both of these suspected mechanisms of action lead to breaking the disease-forming, bacterial penetration cycle. As a result, intestinal permeability and inflammation from the microbiome are considerably reduced.[24–26,31]

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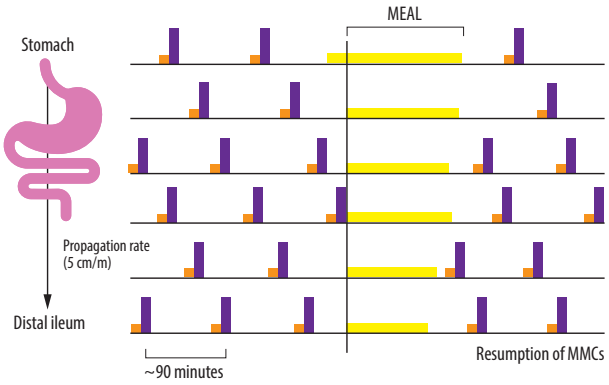
8. Decreases inflammatory response

It is well known that cytokines are key to the regulation of the intestinal immune system and therefore mucosal inflammation. It has been shown that proinflammatory cytokines such as interleukin (IL)-1β, IL-6, IL-8, tumour necrosis factor (TNF)-α, and anti-inflammatory mediators like IL-1 receptor antagonist (IL-1ra) are increased in IBD. The ED plays a role in decreasing the antigen load and therefore effecting a decrease in intestinal inflammation. However, recent studies have suggested that there may also be an effect on the actual production of mucosal proinflammatory and anti-inflammatory cytokines. Studies have shown that patients with existing IBD, when placed on an ED for 2–4 weeks exclusively, had increased levels of vascular endothelial growth factor and transforming growth factor-beta 1 (TGF-β1). In addition, the levels of IL-1β, IL-8, IL-1ra, IL-6, TNF-α, and interferon-γ were reduced.

These studies also showed that the ED reduced production of mucosal cytokines and apparently corrected an imbalance between proinflammatory and anti-inflammatory cytokines in these patients. Simultaneous endoscopic and histologic healing of mucosal inflammation was associated with a decline in mucosal inflammatory cytokines. Subsequently, the ED appears to exert remarkably strong immune system attenuating effects.[24–26]

Migrating motor complexes (MMCs)



Phases of MMC

Phase I	No spike potentials, no contractions	45–55 minutes
Phase II	Irregular spike potentials and contractions	25 minutes
Phase III	Regular spike potentials and contrations	10 minutes

Note that the complexes move down the gastrointestinal tract at a regular rate during fasting, that they are completely inhibited by a meal, and that they resume 90–120 minutes after the meal.

9. Stimulates the migrating motor complex (MMC), a key in moving bacteria out of the small intestine and into the colon between meals

One of the most common underlying causes of SIBO is the impairment of the MMC. The MMC corresponds to cleansing waves activated approximately every 45–180 minutes in the small intestine to prevent the accumulation of debris and excessive amounts of bacteria. Pimentel and colleagues found that the MMC is decreased by 70% in SIBO patients. Apart from snacking, stress also negatively impacts the MMC. By implementing the ED, the MMC can be restored to 50% of its capacity. This is because the ED is absorbed in the first half metre (about 2 ft) of the small bowel, meaning it leaves the rest with no food. The ED literally starves out 80% of the bacteria in the small intestine, significantly reducing the bacterial load.[10,25,26]

10. Restores mesenteric adipose tissue

Mesenteric adipose tissue (MAT) plays an important role in the pathogenesis of CD. It is well known that mesenteric fat hypertrophy, fat wrapping or creeping fat, in patients with CD is highly typical. A study by Feng and colleagues evaluated the effects of EN on CD patients, with a focus on MAT alterations, such as adipocyte size and adipokine production. They showed that EDs ameliorate mesenteric fat alteration in IBD, apparently by restoring adipocyte morphology and diminishing the inflammatory environment of the mesenteric fat.[32]

A plethora of simultaneous mechanisms of actions may be occurring as a result of the ED. The nutritional status of patients is not only improved, there is also an improvement in the epithelial barrier, a reduction of antigenic load, and a counteraction of dysbiosis, while intestinal immunity and adipose compartment are also directly affected. Although so far studies have been relatively promising, more need to be conducted to confirm these proposed mechanisms.

Research summary

Numerous studies have validated the effectiveness of an ED in improving the symptoms of not only Crohn's disease[2,3], but also a number of other conditions such as IBS[10] and SIBO.[8–10]

Moreover, studies have shown that EDs can improve immunoglobulin levels[26], eradicate pathogenic gut bacteria better than antimicrobials[24], be as effective as corticosteroids in acute CD[3], and even have an effect on rheumatoid arthritis.[20]

In 2004, researchers published a retrospective study on 93 patients demonstrating that an ED had 80% efficacy in treating the symptoms of SIBO and IBS. Researchers found that patients not only had improved symptoms, but also normalized LBT.[10]

Appendix I provides a summary of some significant clinical trials that show the efficacy of the ED against the various conditions mentioned above.

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ElementAll® Biological Diet

Chocolate

Code	9236
Size/Form	1404 g Powder

Product Overview

- Provides a hypoallergenic formula, with 100% of protein supplied from free-form amino acids, particularly L-glutamine, a key fuel for intestinal cells
- Contains easily assimilated and tolerated carbohydrates
- All nutrient requirements met, while needing little-to-no digestive functionality for macronutrient breakdown
- Excellent taste for improved compliance

Ingredients

Nutritional Information

	Per 100 g	Per 1 Mixed Serving Ready to Serve Formula*:
Calories (Energy)	395 Cal	616 Cal
Protein	**	***
Fat	8.2 g	13 g
Linoleic Acid	1.0 g	1.5 g
Carbohydrate	58 g	90 g
Dietary Fibre	2.3 g	3.6 g
Vitamin A	1795 IU	2800 IU
Vitamin D	147 IU	230 IU
Vitamin E	26 IU	40 IU
Ascorbic Acid	51 mg	80 mg
Thiamine	1.3 mg	2.0 mg
Riboflavin	1.3 mg	2.0 mg
Niacin	8.3 mg	13 mg
Vitamin B6	1.7 mg	2.6 mg
Vitamin B12	184 mcg	287 mcg
Folic Acid	172 mcg	268 mcg
d-Pantothenic Acid	8.3 mg	13 mg
Biotin	128 mcg	200 mcg
Vitamin K2	26 mcg	40 mcg
Choline	85 mg	133 mg
Calcium	256 mg	400 mg
Phosphorus	199 mg	311 mg
Iron	3.8 mg	6.0 mg
Iodine	44 mcg	68 mcg
Magnesium	85 mg	133 mg
Copper	0.428 mg	0.668 mg
Zinc	5.3 mg	8.3 mg
Sodium	224 mg	349 mg
Potassium	785 mg	1225 mg
Manganese	0.833 mg	1.3 mg
Selenium	56 mcg	88 mcg
Molybdenum	21 mcg	32 mcg
Chromium	44 mcg	68 mcg
Boron	0.641 mg	1.0 mg

*1 mixed serving equals 4 scoops (approx. 156 g) mixed with 500 mL water.
**Contains 19 g of amino acids – key building blocks of protein.
***Contains 30 g of amino acids – key building blocks of protein.

Ingredients: Organic tapioca dextrose, Organic tapioca maltodextrin, L-glutamine, Natural flavours, L-leucine, Safflower oil, Modified palm oil (medium chain triglycerides), L-arginine hydrochloride, Organic alkalized cocoa powder, Sunflower lecithin, L-lysine hydrochloride, Calcium glycerophosphate, L-isoleucine, L-valine, Potassium citrate monohydrate, Sodium citrate dihydrate, Silica, L-cysteine hydrochloride, L-phenylalanine, L-threonine, L-histidine hydrochloride, Magnesium citrate, L-tyrosine, L-methionine, L-aspartic acid, L-proline, Choline dihydrogen citrate, Tricalcium phosphate, Magnesium glycerophosphate, L-tryptophan, Methylcobalamin, Sodium molybdate, L-alanine, Glycine, L-serine, Sodium ascorbate, L-carnitine tartrate, *dl*-Alpha tocopheryl acetate [fish], Taurine, Ferrous fumarate, Menaquinone MK-7 [soy], Zinc sulfate monohydrate, Biotin, Selenomethionine, Calcium *d*-pantothenate, Niacin, Sodium borate decahydrate, Vitamin A palmitate, Copper sulfate, Manganese citrate, Pyridoxal 5′-phosphate, Riboflavin 5′-phosphate, Thiamine hydrochloride, Cholecalciferol, Potassium iodide, Folate (from (6S)-5-methyltetrahydrofolic acid (MTHF), glucosamine salt, Quatrefolic®), Chromium picolinate.

Suggested Use: Mix one serving (4 scoops) in 500 mL of water or as directed by a health care practitioner. You can adjust by adding more water if desired. To be consumed promptly. Take 3 servings per day or as directed by a health care practitioner. 3 servings (12 scoops) provide 1848 calories.

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APPENDIX 1

FIRST AUTHOR, YEAR	METHODS	RESULTS
CONDITION: CROHN'S DISEASE		
Heuschkel, R.B., 2000[3]	Randomized clinical trials comparing exclusive enteral nutrition with corticosteroids were identified. Two independent reviewers extracted data from selected studies. Studies were assessed for heterogeneity, and relative risks for remission induction with enteral nutrition were obtained. Sensitivity analyses were performed in partially randomized studies. Estimates were made of the number of studies needed to overturn the current result. Other outcome measures were qualitatively assessed.	In 5 randomized clinical trials comprising 147 patients, enteral nutrition was as effective as corticosteroids at inducing a remission (RR = 0.95 [95% confidence interval 0.67, 1.34]).
O'Morain, C., 1984[33]	A controlled trial was conducted in which 21 patients acutely ill with exacerbations of CD were randomized to receive either 0.75 mg/kg/day of prednisolone or an ED (Vivonex) for 4 weeks.	Assessment at 4 and 12 weeks showed that patients treated with the ED had improved as much as, and by some criteria more than, the steroid-treated group. **CONCLUSION:** The ED is a safe and effective treatment for acute CD.
Tagaki, S., 2009[34]	Fifty-one CD patients in remission were randomly assigned to a half-ED group (n=26) or a free diet group (n=25). The primary outcome measure was the occurrence of relapse during a two-year period. This study investigated the QOL of the patients and medical costs of a half-ED as secondary outcomes. QOL was evaluated using the Japanese version of the IBDQ scoring system, and monthly medical costs were calculated from receipts.	Patients on the half-ED diet had a relapse rate of 34.6%, while those on the free diet had a rate of 64%. After multi-variate adjustment, those in the half-ED group had a 60% lower risk for relapse. IBDQ score was not significantly different between the two groups at 1 and 13 months after the start of maintenance treatment. Medical costs were also not significantly different between them. **CONCLUSION:** This study confirms that the half-ED therapy reduces the risk of relapse for patients with CD, without impairing quality of life or increasing medical costs.
Sanderson, I.R., 1987[28]	Fourteen children aged 11–17 years with active small bowel CD were given an ED for 6 weeks.	Investigations with iso-osmolar oral test solutions before and after this treatment showed that all 14 children had abnormally raised lactulose/L-rhamnose permeability ratios, which fell significantly after the ED. This change coincided with marked clinical improvement, as assessed by a disease activity index score.
Feng, Y., 2014[32]	Sixteen patients who underwent resection for ileum CD were studied. As a control group, 8 patients without IBD were enrolled. Before operation, 8 CD patients received exclusive enteral nutrition for 4 weeks, and the other patients had no nutritional therapy. The mesenteric fat samples were obtained during operation. Adipocyte size, adipokine production, and topical C-reactive protein level were assessed.	The adipocyte size from patients treated with exclusive enteral nutrition was much larger than that from CD patients without nutritional therapy. Furthermore, protein levels of proinflammatory adipokines such as TNF-alpha and leptin were lower, while protein levels of adiponectin were higher in these patients. In terms of mRNA level, the expression of adiponectin was upregulated and leptin was downregulated in the patients who received enteral nutrition. **CONCLUSION:** Exclusive enteral nutrition could ameliorate mesenteric fat alterations, which are associated with intestinal injury in patients with CD, by restoring adipocyte morphology and diminishing the inflammatory environment of mesenteric fat.
Okada, M., 1990[35]	A controlled trial was conducted on 20 patients with acute CD who had never received specific treatment. The first 10 patients were put on the EDs and the remaining 10 were prescribed prednisolone for 6 weeks at an initial dose of 0.7 mg/kg/day. Patients were assessed using the simple activity index, body weight, erythrocyte sedimentation rate, C-reactive protein and alpha 2 globulin, serum albumin, and radiographic findings of bowel lesions.	At 6 weeks, the patients on the EDs showed a significantly greater improvement in the activity index, inflammatory signs such as C-reactive protein and alpha 2 globulin, and radiographic findings of bowel lesions than did those on the steroid. Patients who were given steroids for 6 weeks and then treated with the EDs for 4 weeks showed improvement in the radiographic findings of bowel lesions and inflammation. **CONCLUSION:** The study strongly suggests that EDs are superior to steroids for treating active CD.

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APPENDIX 1 *continued*

FIRST AUTHOR, YEAR	METHODS	RESULTS
CONDITION: IBS AND SIBO		
Pimental, M., 2004[10]	This study evaluated the ability of an ED to normalize the LBT in IBS subjects with abnormal breath test findings. Consecutive subjects with IBS and abnormal LBT suggesting the presence of bacterial overgrowth underwent a two-week exclusive ED. The diet consisted of Vivonex Plus in a quantity based on individual caloric requirement. On day 15 (prior to solid food), subjects returned for a follow-up breath test and those with an abnormal LBT were continued on the diet for an additional 7 days. The ability of an ED to normalize the LBT was determined for days 15 and 21. A chart review was then conducted to evaluate any clinical benefit one month later.	Of the 93 subjects available for analysis, 74 (80%) had a normal LBT on day 15 of the ED. When subjects who continued to day 21 were included, 5 additional patients normalized the breath test (85%). On chart review, subjects who successfully normalized their breath test had a 66.4 +/–36.1% improvement in bowel symptoms, compared to 11.9 +/–22.0% in subjects who failed to normalize ($P < 0.001$). **CONCLUSION:** An ED is highly effective in normalizing an abnormal LBT in IBS subjects, with a concomitant improvement in clinical symptoms.
CONDITION: RHEUMATOID ARTHRITIS (RA)		
Haugen, M.A., 1994[36]	To evaluate the extent of food allergy/intolerance in RA, an elemental (hypoallergenic) diet was studied in a controlled, double-blind pilot study. Ten patients were allocated to an experimental group and 7 to a control group. The patients in the experimental group received an ED for 3 weeks, whereas the patients in the control group received a control soup consisting of milk, meat, fish, shellfish, orange, pineapples, tomatoes, peas, and flour from wheat and corn. During the fourth week of the study, the patients in both groups resumed their regular diet.	A significant improvement was found in the number of tender joints ($p = 0.04$) in the experimental group, whereas improvement was found in the erythrocyte sedimentation rate (ESR) ($p = 0.03$) and in the thrombocyte count ($p = 0.02$) in the control group. Three patients in the ED group and 2 patients in the control group improved in all of the measured disease variables during the dietary treatment period. There was no significant difference in disease activity variables between the two groups. These results suggest that some RA patients may respond to the elimination of offending food items. However, the results do not encourage treatment with an ED in unselected RA patients.
CONDITION: ECZEMA		
Devlin, J., 1991[21]	A total of 37 children with refractory widespread atopic eczema were treated with an antigen avoidance regimen comprising hospitalisation, exclusive feeding with an elemental formula for a median duration of 30 days, and measures to reduce exposure to pet and dust mite antigens at home. After the initial period of food exclusion, food challenges were performed at intervals of 7 days, and the patients followed up for at least 12 months.	Improvement in the eczema was seen in 27 of the 37 (73%) patients. By discharge from hospital, their disease severity score had fallen to a median of 27% of the pretreatment figure, and only 3 of the 27 required topical corticosteroids.
CONDITION: DERMATITIS HERPETIFORMIS		
Kadunce, D.P., 1991[22]	At entry, 8 patients with dermatitis herpetiformis who were consuming unrestricted diets were stabilized on their suppressive medications at dosage levels that allowed individual lesions to erupt. Six patients were then given an ED plus 30 g of gluten daily for 2 weeks, followed by the ED alone for 2 weeks. Conversely, 2 patients received an ED alone for 2 weeks followed by an ED plus gluten during the final 2 weeks. Small bowel biopsies, skin biopsies, and clinical assessments were done at 0, 2, and 4 weeks.	Suppressive medication dose requirement decreased over the 4 weeks by a mean of 66%. Six of 8 subjects significantly improved clinically during the gluten-challenge phase of the ED and all were improved at the end of the study. The amount of IgA in perilesional skin did not change significantly, but the amount of C3 increased in 5 of 7 evaluable subjects after gluten challenge. Circulating anti-gluten and anti-endomysial antibodies were not significantly affected by the diets. All subjects completing evaluable small bowel biopsies (7) demonstrated worsening of their villus architecture (by scanning electron microscopy and intraepithelial lymphocyte counts) during gluten challenge and improvement (6 subjects) after 2 weeks of ED intake. **CONCLUSION:** Researchers concluded that there is a significant improvement in clinical disease activity on an ED, independent of gluten administration; small bowel morphology improves rapidly on an ED; and complement deposition. However, neither IgA deposition nor circulating antibody levels correlate with gluten intake. It seems likely that dietary factors other than gluten are important in the pathogenesis of the skin lesions in dermatitis herpetiformis.

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REFERENCES

1. Russel, R.I. (1975). Elemental diets. *Gut, 16*(1), 68-79.
2. Teahon, K., Bjarnason, I., Pearson, M., et al. (1990). Ten years' experience with an elemental diet in the management of Crohn's disease. *Gut, 31*(10), 1133-7.
3. Heuschkel, R.B., Menache, C.C., Megerian, J.T., et al. (2000). Enteral nutrition and corticosteroids in the treatment of acute Crohn's disease in children. *J Pediatr Gastroenterol Nutr, 31*(1), 8-15.
4. O'Sullivan, M., & O'Morain, C. (2006). Nutrition in inflammatory bowel disease. *Best Pract Res Clin Gastroenterol, 20*(3), 561-73.
5. Sitrin, M.D. (1992). Nutrition support in inflammatory bowel disease. *Nutr Clin Pract, 7*(2), 53-60.
6. Voitk, A.J., Echave, V., Feller, J.H., et al. (1973). Experience with elemental diet in the treatment of inflammatory bowel disease. Is this primary therapy? *Arch Surg, 107*(2), 329-33.
7. Richman, E., & Rhodes, J.M. (2013). Review article: Evidence-based dietary advice for patients with inflammatory bowel disease. *Aliment Pharmacol Therapeut, 38,* 1156-71.
8. Rezaie, A., Pimentel, M., & Rao, S.S. (2016). How to test and treat small intestinal bacte¬rial overgrowth: an evidence-based approach. *Curr Gastroenterol Rep, 18*(2), 8.
9. Chedid, V., Dhalla, S., Clarke, J.O., et al. (2014). Herbal therapy is equivalent to rifaxi¬min for the treatment of small intestinal bacterial overgrowth. *Glob Adv Health Med, 3*(3), 16-24.
10. Pimentel, M., Constantino, T., Kong, Y., et al. (2004). A 14-day elemental diet is highly effective in normalizing the lactulose breath test. *Dig Dis Sci, 49*(1), 73-7.
11. Hopman, W.P., de Jong, A.J., Rosenbusch, G., et al. (1987). Elemental diet stimulates gallbladder contraction and secretion of cholecystokinin and pancreatic polypeptide in man. *Dig Dis Sci, 32*(1), 45-9.
12. Winitz, M., Adams, R.F., Seedman, D.A., et al. (1970). Studies in metabolic nutrition employing chemically defined diets. *Am J Clin Nutr, 23*(5), 546-9.
13. Bury, K.D., Stephens, R.V., & Randall, H.T. (1971). Use of a chemically defined, liquid, elemental diet for nutritional management of fistulas of the alimentary tract. *Am J Surg, 121*(2), 174-83.
14. Bounous, G. (1989). Elemental diets in the prophylaxis and therapy for intestinal lesions: An update. *Surgery, 105*(5), 571-5.
15. Voitk, A., Brown, R.A., Echave, V., et al. (1973). Use of an elemental diet in the treatment of complicated pancreatitis. *Am J Surg, 125*(2), 223-7.
16. Ikeura, T., Takaoka, M., Uchida, K., et al. (2014). Beneficial effect of low-fat elemental diet therapy on pain in chronic pancreatitis. *Int J Chronic Dis, 2014,* 862091.
17. Mukau, L., Talamini, M.A., & Sitzmann, J.V. Elemental diets may accelerate recovery from total parenteral nutrition-induced gut atrophy. *J Parenter Enteral Nutr, 18*(1), 75-8.
18. Johnston, B.T., & McFarland, R.J. (1995). Elemental diet in the treatment of pneumatosis coli. *Scand J Gastroenterol, 30*(12), 1224-7.
19. Olaussen, R.W., Løvik, A., Tollefsen, S., et al. (2005). Effect of elemental diet on mucosal immunopathology and clinical symptoms in type 1 refractory celiac disease. *Clin Gastroenterol Hepatol, 3*(9), 875-85.
20. Darlington, L.G. (1994). Dietary therapy for rheumatoid arthritis. *Clin Exp Rheumatol, 12*(3), 235-9.
21. Devlin, J., David, T.J., & Stanton, R.H. (1991). Elemental diet for refractory atopic eczema. *Arch Dis Childhood, 66*(1), 93-9.
22. Kadunce, D.P., McMurry, M.P., Avots-Avotins, A., et al. (1991). The effect of an elemental diet with and without gluten on disease activity in dermatitis herpetiformis. *J Invest Dermatol, 97*(2), 175-82.
23. Merriam-Webster. (n.d.). Definition of "elemental." Retrieved from https://www.merriam-webster.com/dictionary/elemental
24. Tan, X., Mao, J., Tang, H., et al. (2017). Mechanisms underlying clinical efficacy of enteral nutrition in inflammatory bowel disease. *Int J Clin Experiment Med, 10*(2), 2026-35.
25. Wędrychowicz, A., Zając, A., & Tomasik, P. (2016). Advances in nutritional therapy in inflammatory bowel diseases. *World J Gastroenterol, 22*(3), 1045-66.
26. Triantafillidis, J.K., Vagianos, C., & Papalois, A.E. (2015). The role of enteral nutrition in patients with inflammatory bowel disease: current aspects. *Biomed Res Int, 2015,* 197167.
27. Kajiura, T., Takeda, T., Sakata, S., et al. (2009). Change of intestinal microbiota with elemental diet and its impact on therapeutic effects in a murine model of chronic colitis. *Dig Dis Sci, 54*(9), 1892-900.
28. Sanderson, I.R., Boulton, P., Menzies, I., et al. (1987). Improvement of abnormal lactulose/rhamnose permeability in active Crohn's disease of the small bowel by an elemental diet. *Gut, 28(*9), 1073-76.
29. Shiga, H., Kajiura, T., Shinozaki, J., et al. (2012). Changes of faecal microbiota in patients with Crohn's disease treated with an elemental diet and total parenteral nutrition. *Dig Liver Dis, 44(*9), 736-2.
30. Zamani, S., Hesam Shariati, S., et al. (2017). Detection of enterotoxigenic Bacteroides fragilis in patients with ulcerative colitis. *Gut Pathog, 9,* 53.
31. Levine, A., & Wine, E. (2013). Effects of enteral nutrition on crohn's disease: clues to the impact of diet on disease pathogenesis. *Inflamm Bowel Dis, 19,* 1322-9.
32. Feng, Y., Li, Y., Mei, S., et al. (2014). Exclusive enteral nutrition ameliorates mesenteric adipose tissue alterations in patients with active Crohn's disease. *Clin Nutr, 33,* 850-8.
33. O'Moráin, C., Segal, A.W., & Levi, A.J. (1984). Elemental diet as primary treatment of acute Crohn's disease: a controlled trial. *Brit Med J (Clin Res Edu), 288(*6434), 1859-62.
34. Takagi, S., Utsunomiya, K., Kuriyama, S. et al. (2009). Quality of life of patients and medical cost of "half elemental diet" as maintenance therapy for Crohn's disease: secondary outcomes of a randomised controlled trial. *Dig Liver Dis, 41(*6), 390-4.
35. Okada, M., Yao, T., Yamamoto, T., et al. (1990). Controlled trial comparing an elemental diet with prednisolone in the treatment of active Crohn's disease. *Hepatogastroenterology, 37(*1), 72-80.
36. Haugen, M.A., Kjeldsen-Kragh, J., Førre, O. (1994). A pilot study of the effect of an elemental diet in the management of rheumatoid arthritis. *Clin Exp Rheumatol, 12(*3), 275-9.

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Elemental Diet (ED) Protocol

Assessment

Depending on the patient's condition, various means of assessment may be applied. For example, clinical trials for participants with Crohn's disease typically monitor the frequency of remission, though one trial assessed small bowel permeability with sugar markers of permeability. All children enrolled in this trial had an elevated lactulose/rhamnose ratio before beginning dietary therapy, and by six weeks of an ED all had significant improvement, with 50% achieving normal values.[1] For individuals with increased intestinal permeability, sugar ratios may be one simple method of monitoring progress.

For individuals with suspected SIBO, a common noninvasive test is the lactulose breath test (LBT). Among participants with IBS and SIBO, after two weeks of an ED, 80% had normal LBTs, while 85% achieved normal results after an additional week of dietary therapy. Normalization of LBTs also correlated closely with clinical improvement in bowel symptoms.[2]

For individuals with rheumatoid arthritis (RA), standard clinical measures can be used for assessment, such as early morning stiffness, pain on a visual analog scale, etc.[3]

General Recommendations

With any dietary supplement or medical food, administration and dosing are important components in achieving desired outcomes, and EDs are no different. Understanding these protocols can help the health care practitioner achieve the treatment objectives. An important factor in the administration and selection of an ED protocol is the health care practitioner's assessment and purpose for using it. These considerations will be important in calculating the proper protocol for each patient.

The most clinically studied of the EDs is the full ED, with most clinical trials employing 100% of calories from an ED for a two-week period, though some have extended it for 4–6 weeks. This type of ED was first used in patients with limited or impaired capacity to digest, absorb, and/or metabolize foods. As mentioned earlier, an exclusive ED is implemented in inflammatory bowel disease (IBD) and those conditions that go hand in hand with IBD, such as SIBO and even IBS. Continued research into the microbiome and the relationship between gut health and systemic health, including the brain-gut connection, has also led to the development and use of shorter EDs, which may help jump-start gut healing.

In addition to being used as a short-term therapy, a half ED may extend the benefits achieved with a full ED. In clinical practice, once the ED has produced the required effects, a half ED can be implemented. In this type of diet, half of the human physiological caloric requirements are met with the ED formula and the other half through whole, hypoallergenic foods. Clinical studies have shown that patients have better overall long-term effects when they employ a half ED immediately following a full ED in the management of conditions such as CD.[4,5]

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Protocols

Part A: Calculating nutritional requirements

1. First calculate the patient's basal metabolic rate (BMR):
    a. Women: **BMR** = 655 + (4.35 x weight in lb) + (4.7 x height in in) – (4.7 x age in years) **OR**
    b. Women: **BMR** = 655.1 + (9.563 × weight in kg) + (1.850 × height in cm) – (4.676 × age in years)
    c. Men: **BMR** = 66 + (6.23 x weight in lb) + (12.7 x height in in) – (6.8 x age in years) **OR**
    d. Men: **BMR** = 66.5 + (13.75 × weight in kg) + (5.003 × height in cm) – (6.755 × age in years)[6–8]

2. Final calculation with the Harris-Benedict equation. This formula uses the calculated BMR and then applies an activity factor to determine the patient's actual total daily energy expenditure in calories. The more active a person is, the more calories they will use. Harris-Benedict factors are the following:
    a. Little-to-no exercise: BMR x 1.2 = total daily calories
    b. Light exercise/sports 1–3 days/week: BMR x 1.375 = total daily calories
    c. Moderate (moderate exercise/sports 3–5 days/week): BMR x 1.55 = total daily calories
    d. Very active (hard exercise/sports 6–7 days/week): BMR x 1.725 = total daily calories
    e. Extra active (very hard exercise/sports 6–7 days/week): BMR x 1.9 = total daily calories[6–8]

PART B: Different forms of the ED

1. Full ED

The patient consumes 100% of caloric requirements using the ED. This becomes the patient's sole source of nutrition for the designated time period, which normally spans 14 days (as evidenced by clinical trials).[9–19]

Application: CD, SIBO, and IBS.[11,18]

Dosage: To accurately calculate the patient's total caloric needs, determine their BMR and then use the Harris-Benedict equation above to calculate total caloric requirements (approximately 1,800 calories per day). Advise the patient to take the calories in divided doses during the day: approximately 200–300 calorie servings every 2–3 hours over a 30-minute period until the caloric requirements are met.

Duration: Two weeks has been clinically validated. This time period can be extended at the sole discretion of the health care practitioner, if necessary.

2. Half ED

The patient consumes 50% of their daily caloric needs from the ED and the other 50% from a wholefood diet. The scientific literature has found that half EDs (sometimes called partial EDs) help with maintaining remission of CD.[20] They can also be used when compliance becomes difficult for patients on full EDs for SIBO and IBS. In addition, half EDs can be used as starting and exiting conduits to full EDs, easing the patient's experience and possibly improving compliance.[5]

Application: Maintaining remission of CD after completion of the full ED, used as conduits to full EDs and in place of full EDs for patients having difficulty with compliance. This will be at the discretion of the health care practitioner.[5]

Dosage: The dose supplied by the half ED is 50% of the daily total calories divided into 200–300 calorie servings, consumed every 2 hours (use either first or second half of day). Whatever part of the day where the half ED is not used, the patient consumes a wholefood diet.

To accurately calculate the patient's total needs, determine their BMR and then use the Harris-Benedict equation (see above) to calculate total caloric requirement (divide this by half to give the calories needed from the half ED, which should be approximately 900 calories per day).[5]

Duration: There are no published reports specifically demonstrating the optimal duration of a half ED; however, 4–6 weeks can be a good starting point. The duration would be calculated at the discretion of the health care practitioner, considering patient symptomatology and other markers deemed important.

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3. Short ED
This can be used to give the gastrointestinal tract a "rest" by avoiding all the complex processes involved in digestion, including allergen and by-product exposure created through digestive and absorption processes. This can be useful in helping support gut mucosal healing processes. As a result of the short duration, compliance is usually very good and may be used as a "bridge" to introduce the full ED.

Dosage: In a short ED, dosing can follow either the full-ED or half-ED directives, and calculations can be made accordingly.

Duration: There is no published data regarding the duration of a short ED; however 1–3 days is generally the accepted time frame.

4. Intermittent ED
Although intermittent EDs have no clinical research, some health care practitioners believe that some benefit could be gained from giving the gastrointestinal tract a period of "rest" during parts of the day. In particular, the possible restoration of the migrating motor complex and, in turn, overall gastrointestinal health may benefit from an intermittent ED acting as a type of fast without compromising nutritional status.

Dosage: Intermittent EDs will entail consuming 300 calories over a 15-minute period.

Duration: There are no published studies on this type of use of the ED, but much like intermittent fasting, it can go on for several months. It is important to always be under the guidance of a health care practitioner during this time.

Note: No food or beverages should be consumed during the ED (water is unrestricted); however, in specific cases there can be continued observable therapeutic effects with the addition of chicken or steak (no fat), herbal or black tea, or black coffee.

Part C: After the ED
Upon completion of the ED, a transition diet is recommended along with prokinetics with meals to prevent bloating and help with motility.

- Prokinetics with meals:
  - Ginger: 500 mg with each meal
  - Prescription medication at night
- Transition diet:
  1. Days 1–2: No fibre, meats, eggs, lactose
  2. Days 2–3: Add cooked pureed low-FODMAP/fibre vegetables (e.g., carrots, zucchini)
  3. Day 4: Back to wholefoods diet

Part D: Patient monitoring
EDs are completed under the supervision of a health care practitioner, where several markers are monitored:

1. Compliance – Ensure that patients report the correct number of calories being consumed per day, according to directives.[21]
2. Weight – Monitoring weight is important as there will be some weight reduction in the first week of treatment on the full ED. Monitoring this marker also ensures that caloric consumption needs are met during the diet.[21]
3. Symptoms – Monitor symptoms throughout the program, such as cramping and diarrhea because of osmolality, constipation, and nausea. The patient should report all of these symptoms as the diet may need to be adjusted as a result.[21]
4. Lactulose breath test (LBT) – This test helps diagnose SIBO, a condition that often goes hand in hand with IBS and IBD. Lactulose is a large sugar that is not digested by the body and thus has the ability to travel through the entire small intestine. During the test, patients are given a bolus of lactulose and then they collect breath over a period of time. Bacteria will take the lactulose and produce gases that include hydrogen and methane, depending on the type and quantity of bacteria. If certain percentages of gases are found in the breath, a diagnosis of SIBO is given.[22] As noted previously, the vast majority of individuals with IBS and abnormal lactulose breath tests had normal values after three weeks of following an ED diet. Repeat testing may be considered if symptoms return, particularly if the ED diet has been discontinued.

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REFERENCES:

1. Sanderson, I.R., Boulton, P., Menzies, I., et al. (1987). Improvement of abnormal lactulose/rhamnose permeability in active Crohn's disease of the small bowel by an elemental diet. *Gut, 28*(9), 1073-6.
2. Pimentel, M., Constantino, T., Kong, Y., et al. (2004). A 14-day elemental diet is highly effective in normalizing the lactulose breath test. *Dig Dis Sci, 49*(1), 73-7.
3. Podas, T., Nightingale, J.M., Oldham, R., et al. (2007). Is rheumatoid arthritis a disease that starts in the intestine? A pilot study comparing an elemental diet with oral prednisolone. *Postgrad Med J, 83*(976), 128-31.
4. Ueno, F., Matsui, T., Matsumoto, T., et al. (2013). Evidence-based clinical practice guidelines for Crohn's disease, integrated with formal consensus of experts in Japan. *J Gastroenterol, 48*(1), 31-72.
5. Takagi, S., Utsunomiya, K., Kuriyama, S. et al. (2009). Quality of life of patients and medical cost of "half elemental diet" as maintenance therapy for Crohn's disease: Secondary outcomes of a randomised controlled trial. *Dig Liver Dis, 41*(6), 390-4.
6. Douglas, C.C., Lawrence, J.C., Bush, N.C., et al. (2007). Ability of the Harris Benedict formula to predict energy requirements differs with weight history and ethnicity. *Nutr Res, 27*(4), 194-9.
7. Roza, A.M., & Shizgal, H.M. (1984). The Harris Benedict equation reevaluated: Resting energy requirements and the body cell mass. *Am J Clin Nutr, 40*(1), 168-82.
8. Mifflin, M.D., St Jeor, S.T., Hill, L.A., et al. (1990). A new predictive equation for resting energy expenditure in healthy individuals. *Am J Clin Nutr, 51*(2), 241-7.
9. Russel, R.I. (1975). Elemental diets. *Gut, 16*(1), 68-79.
10. Teahon, K., Bjarnason, I., Pearson, M., et al. (1990). Ten years' experience with an elemental diet in the management of Crohn's disease. *Gut, 31*(10), 1133-7.
11. Heuschkel, R.B., Menache, C.C., Megerian, J.T., et al. (2000). Enteral nutrition and corticosteroids in the treatment of acute Crohn's disease in children. *J Pediatr Gastroenterol Nutr, 31*(1), 8-15.
12. O'Sullivan, M., & O'Morain, C. (2006). Nutrition in inflammatory bowel disease. *Best Pract Res Clin Gastroenterol, 20*(3), 561-73.
13. Sitrin, M.D. (1992). Nutrition support in inflammatory bowel disease. *Nutr Clin Pract, 7*(2), 53-60.
14. Voitk, A.J., Echave, V., Feller, J.H., et al. (1973). Experience with elemental diet in the treatment of inflammatory bowel disease. Is this primary therapy? *Arch Surg, 107*(2), 329-33.
15. Richman, E., & Rhodes, J.M. (2013). Review article: Evidence-based dietary advice for patients with inflammatory bowel disease. *Aliment Pharmacol Ther, 38,* 1156-71.
16. Rezaie, A., Pimentel, M., & Rao, S.S. (2016). How to test and treat small intestinal bacterial overgrowth: An evidence-based approach. *Curr Gastroenterol Rep, 18*(2), 8.
17. Chedid, V., Dhalla, S., Clarke, J.O., et al. (2014). Herbal therapy is equivalent to rifaximin for the treatment of small intestinal bacterial overgrowth. *Glob Adv Health Med, 3*(3), 16-24.
18. Pimentel, M., Constantino, T., Kong, Y., et al. A 14-day elemental diet is highly effective in normalizing the lactulose breath test. *Dig Dis Sci, 49*(1), 73-7.
19. Hopman, W.P., de Jong, A.J., Rosenbusch, G., et al. (1987). Elemental diet stimulates gallbladder contraction and secretion of cholecystokinin and pancreatic polypeptide in man. *Dig Dis Sci, 32*(1), 45-9.
20. Levine, A., & Wine, E. (2013). Effects of enteral nutrition on crohn's disease: Clues to the impact of diet on disease pathogenesis. *Inflamm Bowel Dis,* 19, 1322-9.
21. Koretz, R.L., & Meyer, J.H. (1980). Elemental diets — facts and fantasies. *Gastroenterol, 78*(2), 393-410.
22. Mattsson, J., Minaya, M.T., Monegra, M., et al. (2017). Outcome of breath tests in adult patients with suspected small intestinal bacterial overgrowth. *Gastroenterol Hepatol Bed Bench, 10*(3), 168-72.

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