

High protein, low carbohydrate, 100% whey based enteral formula is associated with lower blood glucose response in type 2 diabetes adult patients

Maureen B. Huhmann¹, Joel M. Neutel², Sarah S. Cohen³, Juan B. Ochoa^{1,4,5}

¹Nestlé Health Science, Bridgewater, NJ; ²Orange County Research Center, Tustin, CA; ³EpiStat Institute, Ann Arbor, MI; ⁴Geisinger Medical Center, Danville, PA; ⁵University of Pittsburgh, Pittsburgh, PA

BACKGROUND & OBJECTIVES

- Hyperglycemia is prevalent among critically ill patients and, similar to type 2 diabetes mellitus (T2DM), is associated with insulin resistance.
- The role of diet, particularly protein, has been insufficiently studied in this setting.
- The objective of this study was to determine if a high protein, low carbohydrate, 100% whey based enteral nutrition (EN) formula could provide better control of postprandial blood glucose relative to a high protein whey-casein based formula.

METHODS

Study design, population, interventions:

- Randomized, crossover clinical trial of 12 adults (mean age 56, range 40-66; 50% male) with T2DM.
- Assessed glycemic and insulin responses following ingestion of an isocaloric amount of two EN formulas.
- Randomized to a 450 ml bolus of one of two interventions following an overnight fast on two separate days, 1 week apart.

Interventions (Table 1):

- **100% whey based: Peptamen® Intense VHP** (1.0 kcal/ml, P 37%, C 29%, F 34%)
- **Whey-casein based: Vital® HP** (1.0 kcal/ml, P 35%, C 45%, F 20%)

Outcomes:

- Blood glucose and insulin concentrations were collected at 0, 10, 20, 30, 60, 90, 120, 150, 180, 210, and 240 minutes.
- No antidiabetic medication was provided during this time.

Statistical analysis:

- 17 patients were screened, 12 patients were randomized into the trial and completed it.
- Demographics and baseline measures were summarized using percentages, means, and standard deviations.
- Differences in glucose and insulin concentrations, AUCs, and insulinogenic indices were assessed using random effects model.
- AUCs were calculated using Trapezoid rule.
- Insulinogenic index = $(\text{Insulin}_{130} - \text{Insulin}_{10}) / ((\text{Glucose}_{130} - \text{Glucose}_{10}) * 0.0555)$

Table 1: Macronutrient Profiles

Formulas (per 450 ml)	100% whey	Whey-casein
Calories	450 kcal	450 kcal
Total protein	42 g Enzymatically hydrolyzed whey	39 g Whey protein hydrolysate, partially hydrolyzed sodium caseinate
Total carbohydrate	34 g Maltodextrin, corn starch	51 g Corn maltodextrin, sugar, cellulose gel
Dietary fiber	2 g Fructooligosaccharide, inulin	0 g
Total fat	17 g MCT, fish oil, high linoleic safflower oil, soybean oil	10 g MCT, marine oil, corn oil

MCT: medium chain triglycerides

Table 2: Demographics

Characteristic	100% whey	N (%) or Mean±SD
Race	Caucasian	6 (50%)
	African American	3 (25%)
	Hispanic	2 (17%)
	Other	1 (8%)
Sex	Female	6 (50%)
	Male	6 (50%)
Age (years)		56.0±7.5
Height (cm)		172.3±12.8
Weight (kg)		99.5±19.0
BMI (kg/m ²)		33.5±5.5
Comorbidities	Hypertension	10 (83%)
	Hyperlipidemia	8 (67%)
	Neuropathy	1 (8%)
Medication usage	Metformin	9 (75%)
	Antihyperlipidemic	2 (17%)
	Antihypertensive	8 (67%)
Other drugs		7 (58%)

RESULTS

Blood glucose concentration:

- At baseline, the mean concentrations were not significantly different (p=0.48).
100% whey: 7.59±2.09 mmol/l
Whey-casein: 7.21±1.66 mmol/l
- From baseline, significant increase at 20, 30, 60 min with 100% whey (p* < 0.05, **Figure 1**).
- From baseline, significant increase at 10-150 min with whey-casein (p* ≤ 0.001, **Figure 1**).
- Between formulas, significantly smaller increase with 100% whey at 10-180 min (p < 0.05, **Figure 1**).
- At 60 min (peak), the between-group difference in change from baseline in mean glucose was 45.2 mg/dl (2.5 mmol/l, p=0.003).
- Significantly smaller mean AUC with experimental (p=0.025, **Table 3**)
100% whey: 72.06±595.78
Whey-casein: 453.08±351.73

*Bonferroni correction

- Lower peak concentrations (C_{max}) with 100% whey in all patients (**Table 3**).
- Time of C_{max} (T_{max}) varied depending on patients and formulas (**Table 3**).
- **Endogenous insulin production:**
- At the baseline, the mean concentrations were not significantly different (p=0.23).
- A trend towards lower average insulin production with 100% whey at 10-240 min (p > 0.1) (**Figure 2**).
- The mean insulinogenic indices were not significantly different (p=0.15):
100% whey: 10.9±12
Whey-casein: 6.6±10.4
- The mean first-phase insulin responses (AUC 0-30 min) were not significantly different (p=0.23).
100% whey: 244.6±227.6
Whey-casein: 521.5±749.3

CONCLUSION

- This study demonstrated improved blood glucose levels in adults with T2DM following high protein, low carbohydrate, whey-based EN formula compared with a whey-casein based formula.
- This suggests a potential role of EN as a co-therapeutic for glucose management in critically ill patients with hyperglycemia.

FIGURES and TABLES

Figure 1: Blood glucose concentration

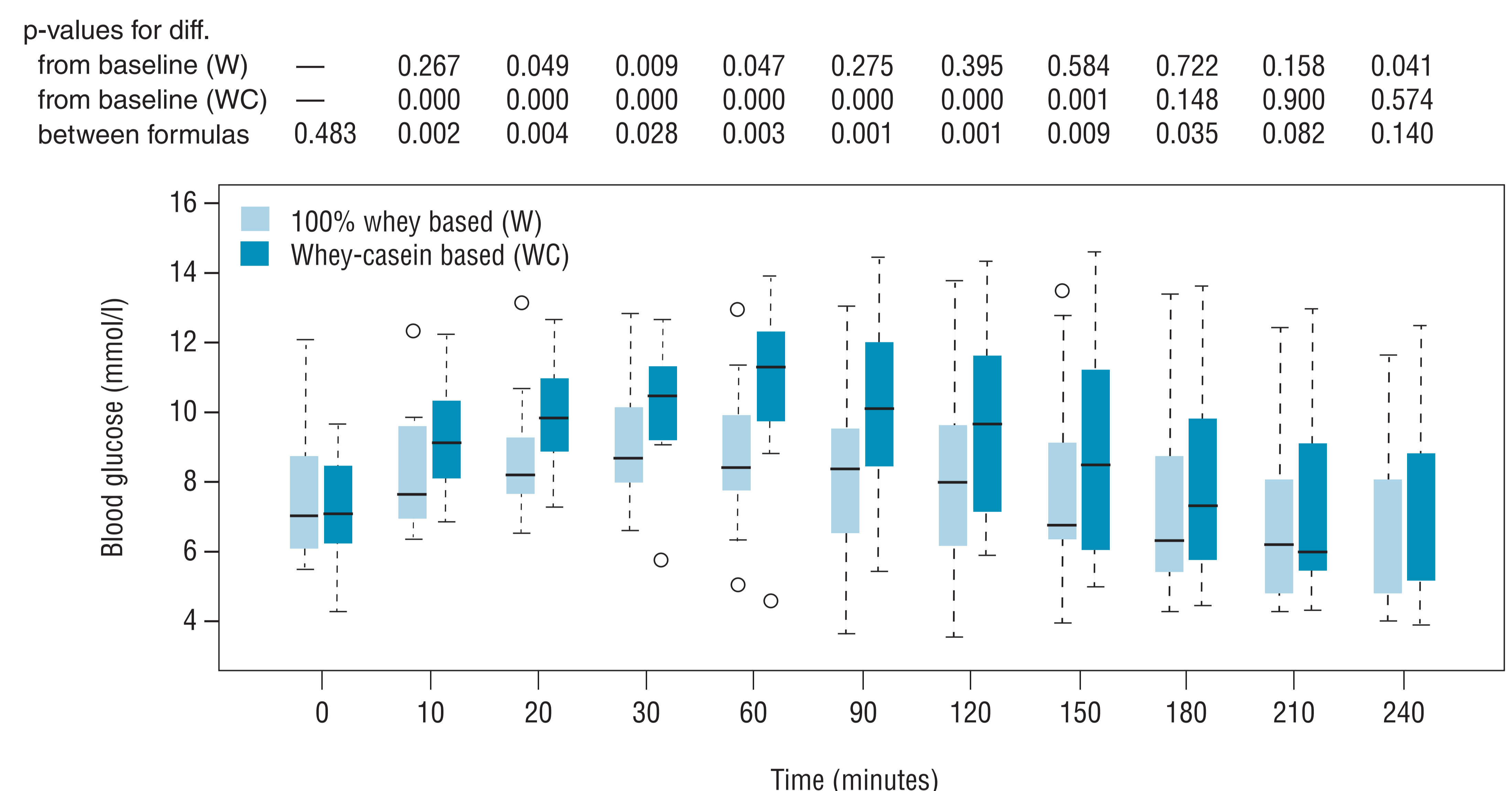


Table 3: Blood glucose AUC, C_{max}, and T_{max}

Patient	AUC		C _{max}		T _{max}	
	100% whey	Whey-Casein	100% whey	Whey-Casein	100% whey	Whey-Casein
101	539	863	13.78	14.06	120	90
102	136	319	6.56	7.33	30	10
103	990	1236	12.78	14.61	150	150
104	-1516	255	7.06	10.5	30	30
105	228	225	8.83	11.17	60	60
106	-58	160	8.28	9.78	60	60
107	-192	194	9.28	12.06	120	60
108	308	667	9.28	11.67	90	60
109	169	779	8.39	12.56	30	90
110	303	377	10.67	11.67	20	150
111	-211	107	10.22	11.39	30	60
112	167	255	8	9.06	60	30
Mean	72.06	453.08			66.7	70.8
SD	595.78	351.73			43.6	43.6
p-value	p=0.025				P=0.780	

Figure 2: Endogenous Insulin Response

