

# HIGH PROTEIN, LOW CARBOHYDRATE, 100% WHEY BASED ENTERAL FORMULA IS ASSOCIATED WITH LOWER BLOOD GLUCOSE RESPONSE IN TYPE 2 DIABETES ADULT PATIENTS

AUTHORS: Maureen B. Huhmann<sup>1</sup>, Joel M. Neutel<sup>2</sup>, Sarah S. Cohen<sup>3</sup>, Juan B. Ochoa<sup>1,4,5</sup>

<sup>1</sup>Nestlé Health Science, Bridgewater, NJ; <sup>2</sup>Orange County Research Center, Tustin, CA; <sup>3</sup>EpiStat Institute, Ann Arbor, MI; <sup>4</sup>Geisinger Medical Center, Danville, PA; <sup>5</sup>University 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 =  $(\text{Insulin}_{t_{30}} - \text{Insulin}_t) / ((\text{Glucose}_{t_{30}} - \text{Glucose}_t) * 0.0555)$

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

## RESULTS

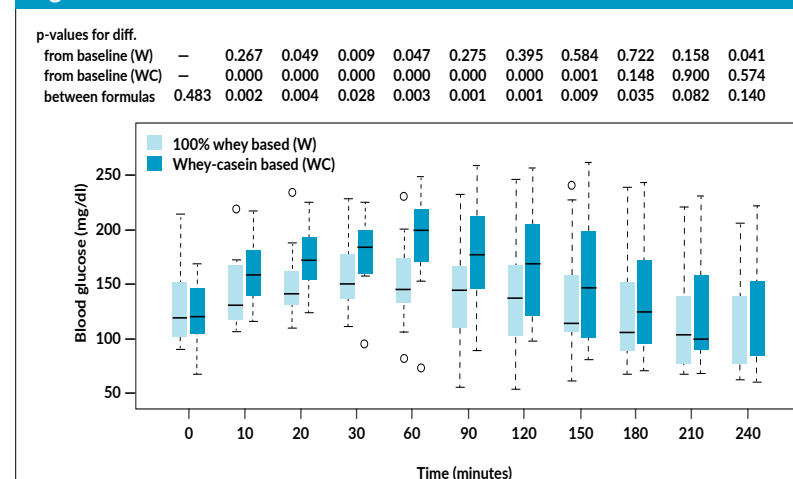
### Blood glucose concentration:

- At baseline, the mean concentrations were not significantly different ( $p=0.48$ ).
  - 100% whey:  $136.6 \pm 37.7$  mg/dl
  - Whey-casein:  $129.8 \pm 29.9$  mg/dl
- From baseline, significant increase at 20, 30, 60 min with 100% whey ( $p < 0.05$ , **Figure 1**). \*Bonferroni correction
- From baseline, significant increase at 10-150 min with whey-casein ( $p < 0.001$ , **Figure 1**). \*Bonferroni correction
- 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 ( $p=0.003$ ).
- Significantly smaller mean AUC with experimental ( $p=0.025$ , **Table 3**)
  - 100% whey:  $1297.1 \pm 10724.0$
  - Whey-casein:  $8155.4 \pm 6331.2$
- 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:  $10.9 \pm 12$
  - Whey-casein:  $6.6 \pm 10.4$
- The mean first-phase insulin responses (AUC 0-30 min) were not significantly different ( $p=0.23$ ).
  - 100% whey:  $244.6 \pm 227.6$
  - Whey-casein:  $521.5 \pm 749.3$

Figure 1: Blood Glucose Concentration



## 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.

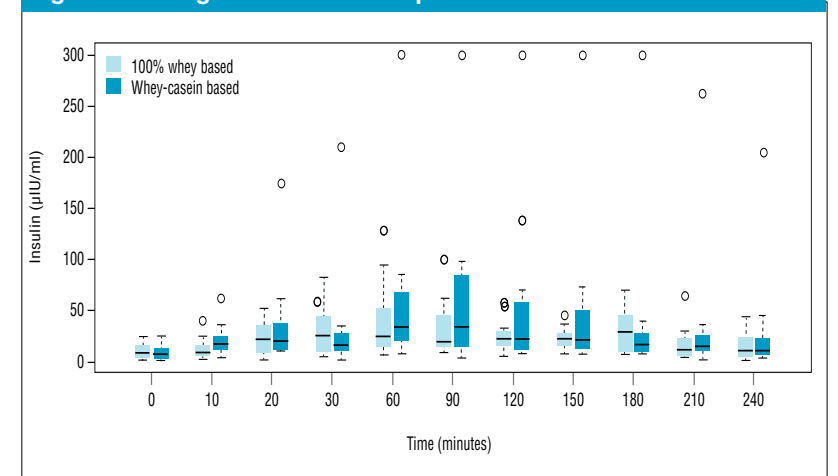
Table 2: Demographics

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 <sup>2</sup> )		33.5±5.5
Comorbidities	Hypertension	10 (83%)
	Hyperlipidemia	8 (67%)
	Neuropathy	1 (8%)
Medication usage	Metformin	9 (75%)
	Antihyperlipidemic	4 (33.3%)
	Antihypertensive	8 (67%)
Other drugs		7 (58%)

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	9710	15540	248	253	120	90
102	2445	5750	118	132	30	10
103	17815	22245	230	263	150	150
104	-27285	4585	127	189	30	30
105	4110	4045	159	201	60	60
106	-1040	2875	149	176	60	60
107	-3450	3485	167	217	120	60
108	5550	12010	167	210	90	60
109	3050	14030	151	226	30	90
110	5450	6785	192	210	20	150
111	-3795	1930	184	205	30	60
112	3005	4585	144	163	60	30
Mean	1297.1	8155.4			66.7	70.8
SD	10724.0	6331.2			43.6	43.6
p-value	$p=0.025$					$P=0.780$

Figure 2: Endogenous Insulin Response



Originally presented at: ESPEN Congress, 2017, The Hague, Netherlands. Sponsored by Nestlé Health Science. Nestlé® is a registered trademark of Société des Produits Nestlé S.A., Vevey, Switzerland