ISSN: 2754-477X

Journal of Food Technology & Nutrition Sciences

SCIENTIFIC Research and Community

Research Article

Open Access

Differences in Physical Characteristics between Low-Carb and High-Carb Meals Using Food Nutrition Segmentation Analysis (GH-Method: Math-Physical Medicine)

Gerald C. Hsu

EclaireMD Foundation, USA

***Corresponding author**

Gerald C. Hsu, EclaireMD Foundation, USA. E-mail: g.hsu@eclairemd.com

Received: May 15, 2020; **Accepted:** May 19, 2020; **Published:** May 23, 2020

Introduction

In this paper, the author describes the differences in physical characteristics between low-carb and high-carb meals. This research verifies his hypothesis regarding the brain stimulator and its associated simulation model of predicted postprandial plasma glucose (PPG).

Method

The author used a continuous glucose monitoring device (Sensor) applied to his upper left arm and has collected ~74 glucose data each day since 5/5/2018. In this particular case study, he selected the entire Sensor period of 543 days (5/5/2018 - 10/29/2019) with 40,182 Sensor glucose data and 2,172 Finger glucose data. The main focus is the use of the sensor data to examine their respective PPG waveforms (i.e. curves) to find differences in physical characteristics between low-carb intake and high-carb intake amounts. Finger PPG data are only used for comparison purposes.

The author has segregated his 1,688 meals into two subgroups, 1,121 low-carbs (<14.9 grams of carbs/sugar) and 577 high-carbs (>15 grams of carbs/sugar). He further subdivided them into three low-carb segments (0-5, 0-10, 0-14.9 grams) and five high-carb segments (15-20, 15-30, 15-50, 15-100, 15-150 grams). He then processed his collected 40,182 sensor glucose data to plot out eight respective waveforms according to the carbs/sugar amounts, including some prominent data such as open, peak, 120-minutes, close, averaged finger and averaged sensor, carbs/sugar intake amounts.

Results

In this section, those prominent data are listed in the following format:

(Meals#, Meals%, Open PPG, Peak PPG, 120-min PPG, Averaged Sensor PPG, Averaged Finger PPG)

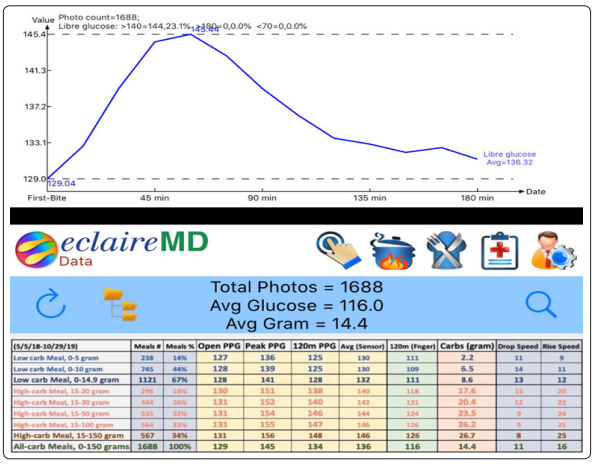
(A) Meals with low carbs/sugar
(0-14.9 grams with averaged 8.6 gram):
(1121, 67%, 128, 141, 128, 132, 111)

(B) Meals with high carbs/sugar
(15-150 grams with averaged 26.7 gram):
(577, 33%, 131, 156, 148, 146, 126)

In comparison to his high-carb meals (1/3 of total) with low-carb meals (2/3 of total), those summarized differences among the prominent data are:

1. Averaged Sensor PPG: 146 vs. 132 (14 mg/dL significant difference, 11%)
2. Averaged Finger PPG: 126 vs. 111 (15 mg/dL significant difference, 14%)
3. Open PPG: 131 vs. 128 (only 3 mg/dL minor difference, 2%)
4. Peak PPG: 156 vs. 141 (15 mg/dL significant difference, 11%)
5. 120-minutes PPG: 148 vs. 128 (20 mg/dL big difference, 16%)
6. Averaged Sensor PPG vs. Averaged Finger PPG: high-carbs 146 vs. 126 (20 mg/dL big difference, 16%) and low-carbs 132 vs. 111 (21 mg/dL big difference, 19%).

Figure 1 is the waveform with prominent data table of the total 1,688 meals. From Figure 2 through Figure 9, a "progressive movement" of waveform changes according to eight different food nutrition segment changes can be observed easily.



(5/5/18-10/29/19)	Meals #	Meals %	Open PPG	Peak PPG	120m PPG	Avg (Sensor)	120m (Finger)	Carbs (gram)	Drop Speed	Rise Speed
Low carb Meal, 0-5 gram	238	14%	127	136	125	130	111	2.2	11	9
Low carb Meal, 0-10 gram	745	44%	128	139	125	130	109	6.5	14	11
Low carb Meal, 0-14.9 gram	1121	67%	128	141	128	132	111	8.6	13	12
High-carb Meal, 15-20 gram	296	18%	130	151	138	140	118	17.6	13	20
High-carb Meal, 15-30 gram	446	26%	131	152	140	142	121	20.4	12	22
High-carb Meal, 15-50 gram	535	32%	131	154	146	144	124	23.5	9	24
High-carb Meal, 15-100 gram	564	33%	131	155	147	146	126	26.2	9	25
High-carb Meal, 15-150 gram	567	34%	131	156	148	146	126	26.7	8	25
All-carb Meals, 0-150 grams	1688	100%	129	145	134	136	116	14.4	11	16

Figure 1: Total meals PPG and Prominent Data

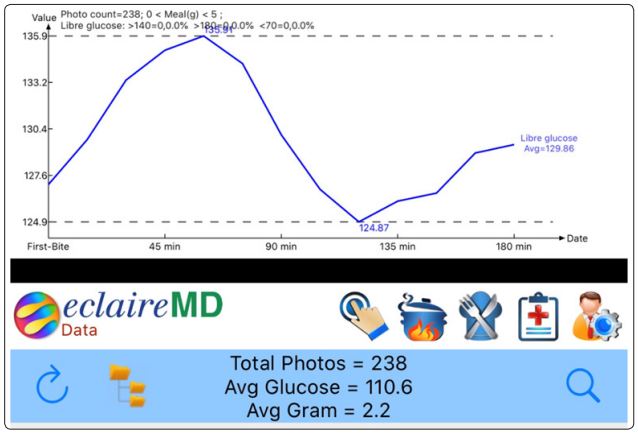


Figure 2: Low-carb meals (0-5 grams)

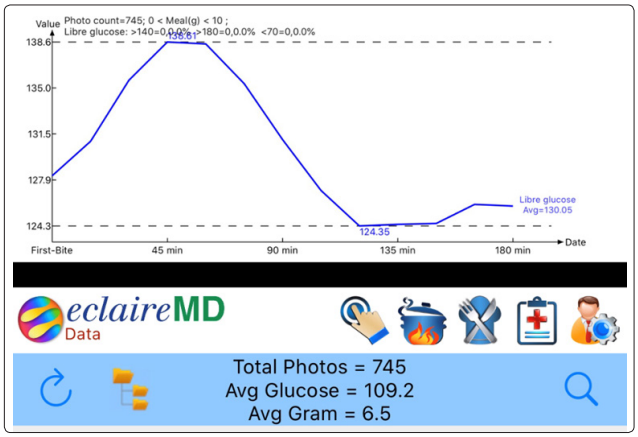


Figure 3: Low-carb meals (0-10 grams)

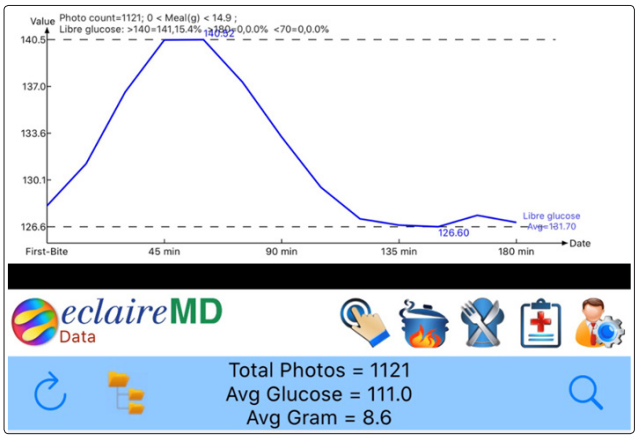


Figure 4: Low-carb meals (0-14.9 grams)

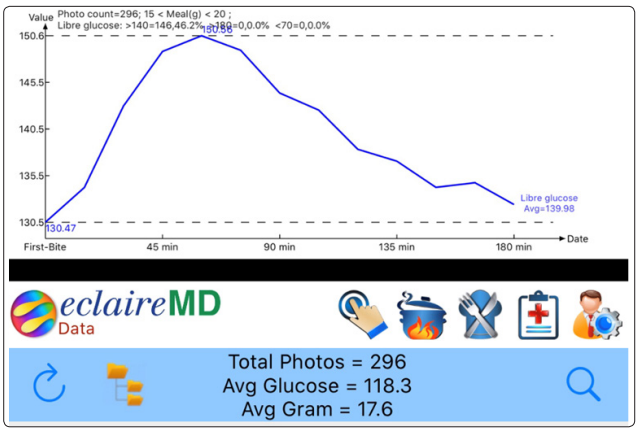


Figure 5: High-carb meals (15-20 grams)

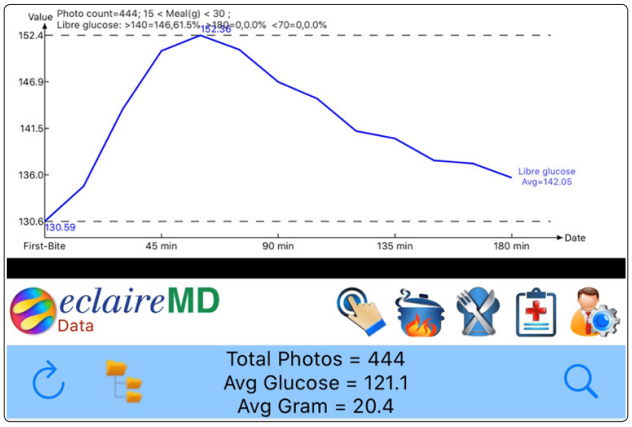


Figure 6: High-carb meals (15-30 grams)

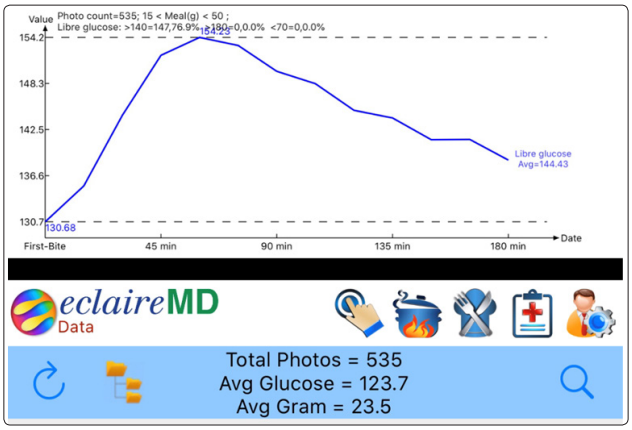


Figure 7: High-carb meals (15-50 grams)

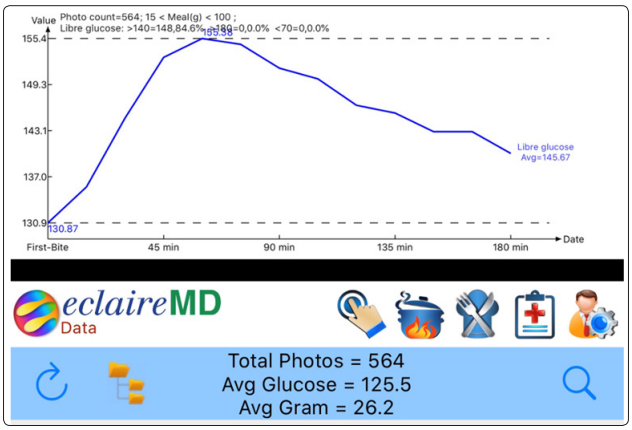


Figure 8: High-carb meals (15-100 grams)

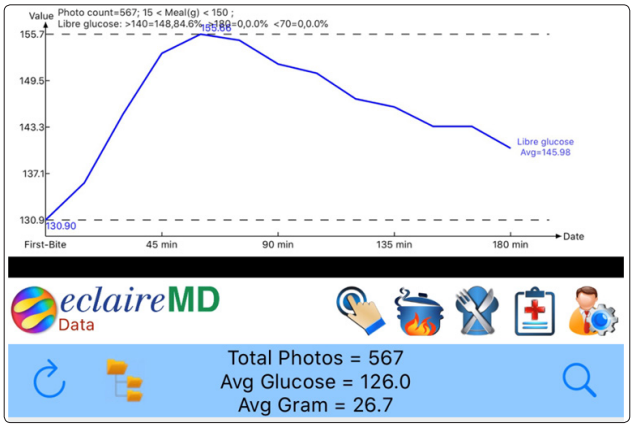
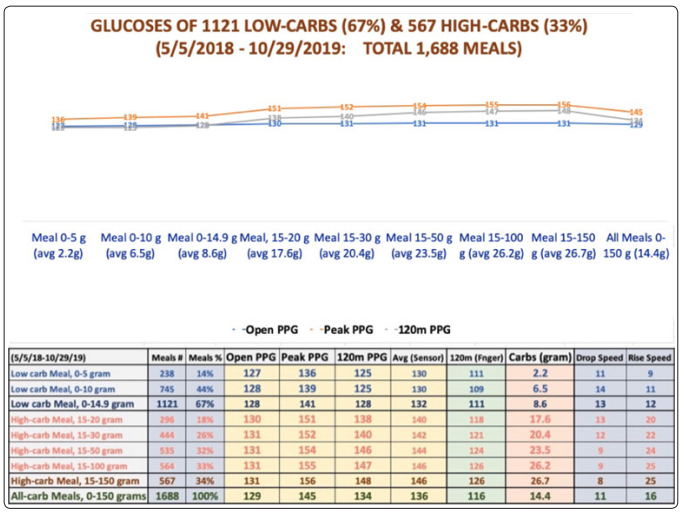


Figure 9: High-carb meals (15-150 grams)

There are three additional conclusive findings related to the brain neuroscience which are listed below:

1. Open PPG values are very close to each other. These open glucoses are resulted from "carry over" effect of both FPG and pre-meals of lunch and dinner. These are "calm periods" which lack of stimulations to our brain in the area of diabetes.
2. When all kinds of food, especially those with "high pure sugar" content, entering into the gastrointestinal system for digestion, the brain immediately senses its entry and issues an order to the liver within 5 to 10 minutes, to start producing glucose. However, during this time period of 0 to 60 minutes after the first bite of food, different detailed ingredients and amounts of combination of carbohydrate and sugar will create different height of peak PPG values. This is why the high-carb peaks are 11% higher than the low-carb peaks.
3. After 60 minutes of the first bite of food, the glucose curve starts to decrease due to exercise and elapsed time effect ("energy diffusion"). The low-carb glucose drops at 13 mg/dL per hour which is faster than high-carb glucose at only 8 mg/dL per hour. Therefore, the 120-minutes PPG values of high-carb meals are much higher than low-carb meals. This is due to the "insufficient fuel" associated with low-carb meals. On the other hand, the "unburned fuel" associated with high-carb meals will then turn into "excessive left-over energy" which will circulate within the blood throughout the body and then damage the internal organs.

Figure 10 summarizes the open, peak, and 120-minutes PPG waveforms in one diagram which includes both three low-carb meals and five high-carb meals together. It also re-displays the calculated prominent data table.



(5/5/18-10/29/19)	Meals #	Meals %	Open PPG	Peak PPG	120m PPG	Avg (Sensor)	120m (Finger)	Carbs (gram)	Drop Speed	Rise Speed
Low carb Meal, 0-5 gram	238	14%	127	136	125	130	111	2.2	11	9
Low carb Meal, 0-10 gram	745	44%	128	139	125	130	109	6.5	14	11
Low carb Meal, 0-14.9 gram	1121	67%	128	141	128	132	111	8.6	13	12
High-carb Meal, 15-20 gram	296	18%	130	151	138	140	118	17.6	13	20
High-carb Meal, 15-30 gram	444	26%	131	152	140	142	121	20.4	12	22
High-carb Meal, 15-50 gram	535	32%	131	154	146	144	124	23.5	9	24
High-carb Meal, 15-100 gram	564	33%	131	155	147	146	126	26.2	9	25
High-carb Meal, 15-150 gram	567	34%	131	156	148	146	126	26.7	8	25
All-carb Meals, 0-150 grams	1688	100%	129	145	134	136	116	14.4	11	16

Figure 10: Open, Peak, and 120-minutes PPG of both Low-carb and High-carb meals with Prominent Data

Conclusion

This physical characteristics analysis of low-carb vs. high-carb meals match the existing knowledge and common sense of the healthcare community. However, this particular research report not only provides a quantitative proof of existing knowledge but also gives a reasonable interpretation of the author's neuroscience hypothesis of inter-relationships between the brain and other internal organs such as the stomach, liver, and pancreas in the area of diabetes [1-4].

References

1. Hsu, Gerald C (2018) Using Math-Physical Medicine to Control T2D via Metabolism Monitoring and Glucose Predictions. Journal of Endocrinology and Diabetes, 1:1-6.
2. Hsu, Gerald C (2018) Using Signal Processing Techniques to Predict PPG for T2D. International Journal of Diabetes & Metabolic Disorders, 3:1-3.
3. Hsu, Gerald C (2018) Using Math-Physical Medicine and Artificial Intelligence Technology to Manage Lifestyle and Control Metabolic Conditions of T2D. International Journal of Diabetes & Its Complications, 2: 1-7.
4. Hsu, Gerald C (2018) Using Math-Physical Medicine to Analyze Metabolism and Improve Health Conditions. Video presented at the meeting of the 3rd International Conference on Endocrinology and Metabolic Syndrome 2018, Amsterdam Netherlands.