

Glycemic Index of Products Derived from Sweetpotato When Compared to Their Analog White Potato Product

Sofia Feng¹, Jonathan C. Allen^{2*}

^{1,2}Department of Food, Bioprocessing and Nutrition Sciences, North Carolina State University, Raleigh, NC 27695, USA.

Abstract

Glycemic index (GI) ranks carbohydrate-containing foods according to their effect on blood sugar as low (55 or less), moderate (56-69) and high (70 or above) categories. Our objective was to study the GI for processed sweetpotato (SP) (chips, fries, dehydrated granules and juice) compared to a similar white potato (WP) food. Continuous glucose monitoring (CGM) was compared to glycemic index using capillary blood from finger-pricks.

Ten subjects consumed each food on three separate occasions. From glucose responses for each product and method of collection (capillary and CGM), incremental AUC and net AUC were calculated from trapezoidal areas in graphs.

GI (mean $\pm$ SEM) for SP chips were significantly lower than WP chips, with capillary blood iAUC values of 32.7 ± 1.96 and 53.1 ± 3.21 mg*min respectively. Sweetpotato fries and WP fries were 48.7 ± 2.85 and 57.9 ± 3.76 ($p > 0.05$). Sweetpotato and WP granules had GI means of 39.6 ± 3.24 and 69.8 ± 4.15 respectively, and SP juice GI was 79.1 ± 4.82 mg*min. For all products, data collected from CGM or from capillary blood were not different.

Conclusion: GI of SP chips and powders were lower than WP analogs and lower than previous reports for fresh SP, possibly due to factors like fat content, creation of poorly-digestible resistant starches during processing, insoluble fiber, and other non-digestible carbohydrates in powders and juice. GI values for WP fries were consistent with previous GI values. The iAUC and net AUC calculation were similar. CGM may be a simpler method for future glycemic index studies.

Keywords: sweet potato products, glycemic index, glycemic response, continuous glucose monitor, potato, French fries, sweetpotato chips or crisps

Practical Application:

The application and functionality of a glucose biosensor for glycemic index (GI) testing was explored during this study as an alternative to the traditional finger-prick method. The determination of GI for different sweet potato and white products from this research can help consumers to understand the short-term changes in blood and tissue glucose levels after consumption of carbohydrate-dense and highly processed products made from different ingredients.

INTRODUCTION

Sweetpotatoes (SP) are cultivated in more than 100 different countries, mostly in warm-temperate, tropical and developing regions (Heuzé et al., 2015; Woolfe, 1992). In the U.S., sweetpotato production has been increasing since the year 2000, with a peak in 2017 (Shahbandeh, 2024) especially in states like North Carolina (NC), California and Mississippi (Department of Agriculture, United States (USDA), 2015). Orange-fleshed sweetpotatoes (OFSP) have a broad genetic base that can vary the color of their skin and flesh (Loebenstien and Thottappilly, 2009). They

also differ in the size and shape of the roots and leaves, in the depth of rooting, the time to maturity, the resistance to disease and in the texture of the cooked products (Woolfe, 1992).

***Corresponding Author:** Jonathan C. Allen, Department of Food, Bioprocessing and Nutrition Sciences, North Carolina State University, Raleigh, NC 27695, USA.

The Typical U.S. No. 1 storage roots of 'Covington' variety are described as oblong-elliptic or round-elliptic in shape (Yencho et al., 2008). Sizes of roots to be considered U.S. No. 1 shall meet the following measurements: 5.1 to 8.9 cm in diameter and 7.6 to 22.9 cm in length. Culls are described as larger than 2.5 cm in diameter and so misshapen or unattractive that they could not fit as marketable roots (Yencho et al., 2008). Culls are often left in the field as unusable; however, further processing can create added-value products and expand the market to this part of the crop. Examples of these applications are: dehydrated fibrous granules from SP that can be turned into a powder and further used into fortified blended foods or cereal snacks (Truong and Avula, 2010). Culls can also be processed into juice and further concentrated to be added into juices, sauces, dressings and desserts. Sweetpotatoes can be fried and processed into French fries (SPF) or chips (SPC) in a process similar to that used for white potato (Truong et al., 2014; Truong et al., 2018).

Glycemic index (GI) is derived from a ratio that ranks carbohydrate-containing foods and classifies them according to their immediate effect on blood sugar level into low (55 or less), moderate (56-69) and high (70 or above) GI categories (Brand-Miller et al., 2003). In an effort to help reduce variability in the determination of the GI of a product (Wolever et al., 2008), one must follow the procedures outlined under the first international standard for measuring the GI of foods under ISO 26642:2010 (International Organization for Standardization 2010). Incremental (iAUC) and Net Incremental (Net incremental AUC) areas under the glucose curve (AUC), excluding area below fasting, can be calculated using the trapezoid rule (Brouns, 2005; Wolever, 2008, ISO. 2010). To calculate GI, the AUC for each test meal at each time point has to be expressed as a percentage of the mean AUC glucose standard taken by the same subject. At least 10 healthy subjects should be studied in each location but some laboratories have included as many as 800 subjects (Zeevi et al., 2015). iAUC stands for the area over the baseline under the curve, ignoring the area beneath the curve. Net incremental AUC accounts for all increments (positive and negative).

Diabetes continues to be a major worldwide epidemic (Shrivastav et al., 2018). Self-monitoring of blood glucose via finger pricks method using a glucose meter and A1C testing are frequently used to monitor patients with diabetes. These methods are repetitive, invasive, and painful. Glucose sensors fall under the category of biosensors (Prasad, 2014). Continuous glucose monitors (CGMs) were originally intended to continuously record glucose levels in persons with diabetes mellitus (T1DM

and T2DM) in order to offer a stricter control over carbohydrates consumed. Tracking glucose levels can be a preventive marker by avoiding episodes of either hypo- or hyperglycemia. This type of prevention has proven to prolong life expectancy by enabling diabetics to avoid physiological complications such as diabetic ketoacidosis or chronic-degenerative complications (Ferrante do Amaral and Wolf, 2007; Nathan, 2014). Lately, its use has also been extended as a preventive treatment to healthy people (Fox et al., 2010). CGM devices have now been approved for over-the-counter purchase to diabetic and non-diabetic consumers (Terry, 2024).

The purpose of this research was to study the glycemic index for four types of foods and ingredients processed from sweetpotato when compared to a similar ingredient or food derived from white potato. The study follows the traditional outline for data collection and calculation of iAUC and offers a comparison when calculating the NetAUC and the comparison of data collected when utilizing a continuous glucose monitor.

2. MATERIALS AND METHODS

The determination of GI was done in 7 commercially available food products: sweetpotato chips and white potato chips (WPC) (UTZ Foods, Hanover, PA), sweetpotato fries and white potato fries (WPF) (Alexia Foods, Conagra Brands) (Chicago, IL). Carolina Innovative Food Ingredients (CIFI) (Nashville, NC) provided SP powder in the form of granules and SP juice. Potato powder was obtained from Bob's Red Mill (Milwaukie, OR). The chemical composition for all products was performed by Microbac Laboratories Inc. (Warrendale, PA). The portion size of each test food contained 50 g available carbohydrate (defined as total carbohydrate minus dietary fiber) based on the nutrition information provided by the compositional analysis (Table1).

Use of human subjects in research was approved by the North Carolina State University Institutional Review Board as IRB protocol No. 9415 and informed consent was obtained from each subject prior to their participation in the study. The study followed the protocol for GI studies (Brouns et al., 2005), according to ISO-26642 (2010), which indicates that at least 10 healthy subjects should be studied. The participants completed an inclusion questionnaire to determine the eligibility for the participation in the study. Participation included males and non-pregnant, non-lactating females aged 18 to 65 years, who did not have diabetes or any pre-diabetic condition, with BMI ranges (in kg/m²) from 20 to 29.9 from the Raleigh-Durham area. The participants also had to refrain from consuming alcohol and exercising vigorously during the duration of the trial.

Table 1. *Composition of the test foods*

Product	Weight	Fat	Protein	Total Carbohydrates	Dietary Fiber	Available Carbohydrates
	<i>G</i>	<i>g</i>	<i>g</i>	<i>g</i>	<i>g</i>	<i>g</i>
Sweetpotato chips	103.34	35.44	5.43	56.84	6.84	50
White Potato chips	88.13	23.0	7.47	52.61	2.61	50
Sweetpotato fries	175.13	13.37	4.52	58.84	8.84	50
White Potato fries	145.14	10.14	7.20	58.34	8.34	50
Sweetpotato powder (granules)	91.91	0.56	6.66	75.82	25.82	50
White potato powder	64.41	0.23	5.61	52.75	2.75	50
Sweetpotato juice-75	77.29	0.07	3.75	51.01	1.01	50

The trial was a randomized block design with repeated measurements. Each subject consumed eight different food samples on three separate days in the morning after they had fasted overnight for 12h. On occasions they consumed test foods and on other occasions their meal consisted of the reference food. Each reference food and each tested food was consumed three times. The reference food consisted of 50 g of orange glucose tolerance test beverages (Thermo Scientific™) in a total volume of 150 mL. The method for GI indicates that each test meal should be served with 250 mL of water or tea (Wolever et al; 2008). When subjects consumed the test meal the volume was adjusted by difference to account for 250 mL total volume (for example when mixing the potato powder with water). The test meals were consumed within 10 minutes. The timing for blood samples started with the first bite of the test meal.

A capillary fasting blood sample was taken on the day of the testing. The subjects consumed the test meal and had further blood samples drawn at 15, 30, 45, 60, 90, and 120 min after starting to eat. The method for GI indicates that capillary blood must be obtained from finger-pricks for greatest sensitivity (Wolever et al., 2008). Blood glucose response levels were obtained using a glucose monitoring system, ONETOUCH Verio® manufactured by LifeScan (Cilag International GmbH, Zug, Switzerland); self-retracting safety lancets (Fisherbrand™, Thermo Fischer Scientific) were used to obtain larger (150µL) blood samples for further hormonal analysis at time 0 and at 1 hour.

A continuous glucose monitor (CGM), iPro2 system, manufactured by Medtronic (Minneapolis, MN) was placed on each participant. The CGM system places a fine flexible sensing wire into the skin in the abdomen using a retracting inserter. A sensor is connected to a data

recorder that is taped in place. This system is designed for 7 days of continuous blood glucose measurement with data points recorded at 5-minute intervals (FDA, n.d.). In order to calibrate the biosensor, the participants had to take 3 additional finger pricks each day and record their blood glucose (BG) results before breakfast, lunch and dinner. An advantage of the iPro2 CGM system is that both subjects and investigators are blinded to the glucose concentration measurements until the conclusion of data collection.

Additionally, each participant was trained on how to record a 24-h food diary throughout the study annotating each meal or snack content and portion size. Participants were provided with a pedometer wristband (Willful Direct, China) to record the number of steps at the end of every day along with their exertion level (low, medium, high) and any detail of physical activity performed.

The net and incremental areas under the glucose response curve (AUC) above the fasting glucose concentration, ignoring the area beneath the fasting glucose concentration were calculated using the trapezoid rule (Brouns et al., 2005; Food and Agriculture Organization (FAO), 1998; Wolever et al., 2008). All the calculations were performed separately for the AUC collected via finger prick and for the CGM. For each participant the AUC elicited after the consumption of each test food was expressed as a percentage of the mean divided by the AUC for the reference food in the same subject. The mean and CV ($CV = 100 \times SD / \text{mean}$) of the AUC values for repeated trials of the reference food were calculated to ascertain that CV was less than 30 for each subject ($CV < 30$). The result of each subject's mean was labeled reference AUC. The AUC values for the repeated test foods were calculated and divided by the reference AUC. The mean values and $2 \pm SD$ for test foods were calculated. Individual values greater

than the mean plus 2 SDs were considered to be outliers and were excluded from the final results.

The reported estimated energy requirements (EER) were calculated using the predictive calculator retrieved from Centers for Disease Control and Prevention (CDC) as explained by Gerrior et al. (2006). The calculation accounts for individual's basic metabolic rate including age, sex, weight, height, and total energy expenditure accounting for individual physical activity level determined by the step count on their pedometer.

Statistical Analysis

Multivariate analysis of variance (ANOVA) was used to compare GI values between botanical vegetables (sweetpotato vs. white potato), between measuring devices or method for data collection (finger picks and CGM) and between the different methods of GI calculation for AUC (Incremental AUC and Net Incremental AUC). The significance of differences among means was assessed using Tukey's test to adjust for multiple comparisons with

two-tailed $p \leq 0.05$. Analysis was performed using R Version 1.1.383 (R Core Team, 2016).

3. RESULTS

3.1 Characteristics of the studied population

A total of 14 people were involved in the study, from whom 2 dropped out during the first and second week respectively and 2 were excluded because of incomplete readings on the CGM data. Of the 10 participants who were included, 5 were female with an average age of 25 ± 2.64 years (mean $\pm$ S.E.M) and BMI of 24.6 ± 1.50 and 5 were male with an average age of 35.8 ± 6.81 years and BMI of 23.6 ± 1.22 (Table 2). All the participants reported their use of medication; of these, 1 participant reported the daily use of doxycycline oral, for acne treatment. None of the participants were smokers and all participants reported low physical activity throughout the study with an average number of steps of 7128 ± 710 for females and 7077 ± 812 for males.

Table 2. Characteristics of the studied population

	Males	Females
Age (y)	35.80 $\pm$ 6.81	25 $\pm$ 2.64
Gender (n)	5	5
Height (ft)	5.90 $\pm$ 0.08	5.56 $\pm$ 0.06
Weight (lbs)	170.80 $\pm$ 6.40	157.00 $\pm$ 11.61
BMI	23.66 $\pm$ 1.22	24.58 $\pm$ 1.50
Underweight <18.5	0	0
Ideal Weight (18.5-24.9)	5	4
Overweight (>25.0-29.9)	0	1
Obese >30	0	0
Estimated Energy Requirement (Kcal)	2500 $\pm$ 105	2000 $\pm$ 102
Daily Caloric Intake (Kcal)	2200.00 $\pm$ 55.67	1720 $\pm$ 64
Number of steps	7077 $\pm$ 812	7128 $\pm$ 710

Values are means $\pm$ S.E.M

Glycemic index of chips

All participants were fed with SPC, WPC, SPF and WPF. Because the food form influences the rate of gastric motility (Haber, 1977), the chips were handpicked from the batch to feed only chips with a standard thickness and a similar width. The fries were also selected after baking to feed fries with a standard thickness and similar length.

Even though the most common method for calculation of GI is the area over the baseline under the curve, ignoring the area beneath the curve (iAUC), the G.I. calculations were performed for both iAUC and net incremental (netAUC); these variables are termed "methods of calculation" in data analysis. Since data were collected using both finger pricks (FP) with handheld glucometer

and a continuous glucose monitor (iPro2) and comparison of both measurements were of interest, they are termed, "methods of data collection".

GI values of SPC (32.7 $\pm$ 1.96, 32.6 $\pm$ 2.13, 28.8 $\pm$ 2.04, 27.2 $\pm$ 2.92 for FP iAUC, FP NetAUC, CGM iAUC and CGM NetAUC, respectively) were significantly lower than WPC (53.1 $\pm$ 3.21, 55.1 $\pm$ 3.83, 42.3 $\pm$ 3.08, 43.3 $\pm$ 3.57 for FP iAUC, FP NetAUC, CGM iAUC and CGM NetAUC, respectively), regardless of the method of calculation or data collection (Figure 1A). The only significantly different results were in the method of calculation between FP net, which was significantly higher than iPro2 Net and iPro2 incremental. Overall values for both types of chips result in a low GI value.

Glycemic index of fries

GI values of SPF (48.7 ± 2.85 , 49.7 ± 3.11 , 47.4 ± 2.87 , 48.9 ± 4.06 for FP iAUC, FP NetAUC, CGM iAUC and CGM NetAUC, respectively) did not result in a significant difference when compared to GI values of WPF (57.9 ± 3.76 , 59.3 ± 4.50 , 48.4 ± 2.51 , 46.1 ± 2.89 for FP iAUC, FP NetAUC, CGM iAUC and CGM NetAUC, respectively) (see Figure 1B). There were no significant differences between the methods of calculation, even though the values for netAUC in most cases resulted higher values than iAUC. There were no significant differences between the methods of data collection. All calculated GI values for SP fries result in low GI. For the FP method, GI net and incremental calculated values result in a moderate GI and iPro2 values resulted in a low GI.

Glycemic Index Of Sweetpotato And White Potato Powder And Juice

GI values of sweetpotato powder (39.6 ± 3.24 , 39.9 ± 3.34 , 45.1 ± 2.99 , 47.9 ± 3.83 for FP iAUC, FP NetAUC, CGM

iAUC and CGM NetAUC, respectively) were significantly lower than white potato powder (69.8 ± 4.15 , 69.2 ± 4.72 , 73.4 ± 2.94 , 76.5 ± 4.19 for FP iAUC, FP NetAUC, CGM iAUC and CGM NetAUC, respectively), classifying this product as low glycemic index, regardless of the method of calculation or data collection and white potato powder values are high GI. The mean values for netAUC in all cases were higher than iAUC, although these values were not significantly different. There were no significant differences between the methods of data collection (Figure 1C).

Calculated GI values of sweetpotato juice were 79.1 ± 4.82 , 79.5 ± 3.79 , 74.9 ± 3.79 , 73.8 ± 3.82 for FP iAUC, FP NetAUC, CGM iAUC and CGM NetAUC, respectively, classifying this product as high in GI (Table 3). There are no comparable white potato juice products, so this comparison is only to the glucose tolerance beverage used for GI calculations. The mean values for netAUC in all cases were higher than iAUC, although these values were not significantly different. There were no significant differences between the methods of data collection (Figure 2).

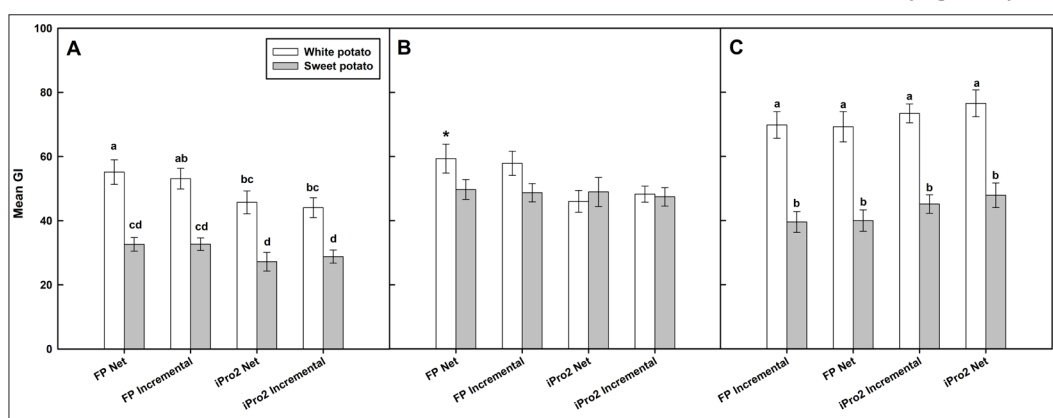


Figure 1. Glycemic index values for A. chips, B. fries, C. powder (granules), comparing type of botanical vegetable, calculation and data collection method. Bars not sharing a common letter are significantly different ($P < 0.05$)

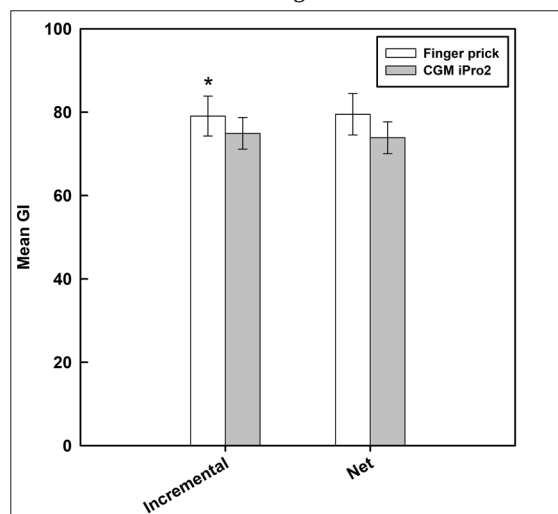


Figure 2. Glycemic index values comparing calculation and data collection methods across all product trials. Asterisk indicates a significant difference in data collection method ($P < 0.05$).

4. DISCUSSION

GI of a food is determined by multiple interaction factors, including physical and chemical components of the ingested food, the rate of carbohydrate digestion, its gastric passage and emptying and insulin response elicited after the consumption of the food (Phillipou, 2017). For fries and chips the GI of SP products were lower than in previous reports for SP cooked with different methods (Allen, et al., 2012). These differences may be due to a combination of factors. The cooking preparation methods previously studied allowed for a higher GI (Pi-Sunyer, 2002). Highly processed foods require less digestive processing because disrupted starch granules that gelatinized are readily susceptible to enzymatic hydrolysis. Chemical structure and physical form determine the carbohydrate availability (Englyst and Englyst, 1994). Chips and fries possess a complicated food matrix that can influence starches to be slowly digested or not digested at all. The values in this study remain consistent with GI previously reported values for French fries (54 to 70) (Atkinson et al., 2012). The GI values for WP chips are also consistent with the previously-reported index of 57 (Foster-Powell et al., 2002). As seen in Table 1, the commercial chips in this study contained a high percentage of fat (34% for SPC and 26% WPC). It is likely that the presence of amylose-lipid complexes has a direct impact in lowering GI values for chips. Amylose-lipid complexes decrease the enzyme-mediated digestion of starches (Lau et al., 2016). These complexes are formed during the heating process of the starch. After starch gelatinization, amylose that has leached outside the granule can complex with lipids and other complexes can also be formed inside the granule. Some of these complexes can generate resistant starch (RS) and lower the hydrolysis index (Putseys et al., 2010). Resistant starch is defined as starch that escapes digestion in the human small intestine (Englyst et al., 1992).

The traditional way of preparing commercial fries includes washing, peeling, cutting into strips, blanching, par-frying and freezing (Pedreschi, 2012). Blanching is an important step for the final product. The blanched strips are partially dried before the partial frying process (par-frying). The par-fried strips are frozen at -18°C and sold in retail for further frying or roasting. The change in structure of starches during gelatinization and retrogradation can have a significant influence on starch digestibility, formation of indigestible RS complexes, and degree of glucose absorption in the gastrointestinal tract (Greenwood et al., 2013; Pi-Sunyer, 2002; Allen et al., 2012). Repeated cycles of heating and cooling can further increase the retrogradation lowering the GI (Pi-Sunyer, 2002).

No prior studies that we are aware of have provided values of GI for SPC, SPF or SP powder. Sweetpotatoes can be dehydrated and used as a functional ingredient in other applications. Sweetpotatoes naturally contain non-starchy polysaccharides such as cellulose and hemicellulose, which are known as non-available carbohydrates (Cummings and Stephen, 2007). Such components might explain the difference in GI values between sweetpotato powder and white potato powder. The majority of reports for different white potato products suggest a fairly wide range in GI (Kinnear et al., 2011).

Some fructose and the presence of resistant short-chain carbohydrates (non-digestible oligosaccharides) can contribute to the GI value for sweetpotato juice that was lower than pure glucose solution (reference GI=100). SP juice can be obtained after the roots are cleaned, steamed and pasteurized (Truong, 1994). OFSP can yield beverages with pleasant color and aromas (Truong, 1992). Sweetpotato starch can be converted to glucose syrup or high fructose syrup (Loebenstein and Thottappilly, 2009). GI values reported in our study can be a result of the combination of fructose molecules, fructo-oligosaccharides or fructan as well as glucose and sucrose molecules, present in high concentrations in vegetable concentrates (Loebenstein and Thottappilly, 2009). Despite having the same chemical formula, fructose and glucose are metabolized in two different ways due to the hepatic extraction and rapid hepatic conversion of fructose into glucose, glycogen, lactate, and fat (Tappy and Lê, 2010). The glycemic index of fructose is lower when compared with glucose (19 and 100, respectively) (Tappy and Lê, 2010). No prior studies have provided values of GI for SP juices.

In this study, overall netAUC resulted in higher values than when iAUC was calculated. Consistent with the literature, the calculations using different methods result in different GI values (Brouns et al., 2005). The method of AUC calculation had a substantial effect on the GI value as well as the variability (Matthan et al., 2016). iAUC has been and continues to be the recommendation when conducting and publishing GI studies (FAO, 1998).

5. CONCLUSION

The postprandial effects of carbohydrate-dense, highly processed, high GI foods often correlate to metabolic responses that can result in multiple health risks associated with inflammatory processes and chronic diseases. The main goal of nutrition guidance is to encourage the population to adopt recommendations based on scientific studies that will help improve healthy eating habits to prevent these types of diseases. At the same time, these

guidelines recognize the importance of carbohydrate food choices for the greatest portion of energy intake and the ample carbohydrates options that allow for a healthy diet. Food industry strategies are trending toward innovation for more food formulations that include whole grains, lower sugar and lower sodium. The present study aimed to characterize certain foods that might not often be categorized as healthy choices. Further opportunities exist for the promotion of healthy options based for example, on the utility of the amylose-lipid complexes and resistant starches into the design of products that can result in an option that can better support healthy eating patterns. The study also characterized the GI of sweetpotato powders and juices that have not been previously investigated.

Acknowledgments

Special acknowledgement to the USDA-ARS Market Quality and Handling Research Unit, Raleigh, NC, USA. Dr. Van-Den Truong provided valuable advice on the experimental design and Dr. Lisa Dean, proofread the first draft of the manuscript and provided valuable feedback.

Author Disclosures

This work is supported by the Research Capacity Fund (HATCH) project award no. NC04000 from the U.S. Department of Agriculture's National Institute of Food and Agriculture. Additional funding for this research was possible with the support from the North Carolina Sweetpotato Commission and the North Carolina Agricultural Research Service. Authors report no conflict of interest with the conduct or publication of this research.

REFERENCES

- Allen, J. C., Corbitt, A. D., Maloney, K. P, Butt, M. S, & Truong, V.-D. (2012). Glycemic index of sweetpotato as affected by cooking methods. *The Open Nutrition Journal*, 6(1), 1–11. <http://doi.org/10.2174/1874288201206010001>
- Atkinson F.S., Foster-Powell K., & Brand-Miller, J. C. (2008). International tables of glycemic index and glycemic load values. *Diabetes Care*, 31(12), 2281–2283. <https://doi.org/10.2337/dc08-1239>
- Brand-Miller, J. C., Wolever, T. M. S., Foster-Powell, K., & Colagiuri, S. (2003). *The New Glucose Revolution* (2nd ed). New York, NY: Marlowe & Company.
- Brouns, F., Bjorck, I., & Frayn, K.N., Gibbs, L., Lang, V., Slama, G., & Wolever, T.M.S. (2005). Glycaemic index methodology. *Nutrition Research Reviews*, 18, 145–171. <https://doi.org/10.1079/NRR2005100>
- Cummings, J., & Stephen, A. (2007). Carbohydrate terminology and classification. *European Journal of Clinical Nutrition*, 61(Suppl), 5–18. <http://doi.org/10.1038/sj.ejcn.1602936>
- Department of Agriculture, United States. (2015). National nutrient database for standard reference. Retrieved from <http://www.ars.usda.gov/nutrientdata>. Accessed, November, 2016
- Englyst, K. N., & Englyst, H. N. (1994). Carbohydrate bioavailability. *British Journal of Nutrition*, 94(1), 1–11. <https://doi.org/10.1079/BJN20051457>
- Englyst, H. N., Kingman, S. M., & Cummings, J. (1992). Classification and measurement of nutritionally important starch fractions. *European Journal of Clinical Nutrition*, 46, S333–350.
- Ferrante do Amaral, C. E., & Wolf, B. (2007). Current development in non-invasive glucose monitoring. *Medical Engineering and Physics*, 30(5), 541–549. <http://doi.org/10.1016/j.medengphy.2007.06.003>
- Food and Agriculture Organization. (1998). Carbohydrates in human nutrition: Report of a joint FAO/WHO expert consultation. *FAO Food and Nutrition Paper*, 66.
- Food and Drug Administration (FDA). (n.d.). iPro2 Continuous glucose monitoring system - P150029. Retrieved from <https://wayback.archive-it.org/7993/20171101175611/https://www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/DeviceApprovalsandClearances/Recently-ApprovedDevices/ucm517304.htm>. Accessed January, 2018
- Foster-Powell, K., Holt, S., & Brand-Miller, J. (2002). International table of glycemic index and glycemic load. *American Journal of Clinical Nutrition*, 76(2), 5–56. <https://doi.org/10.1093/ajcn/76.1.5>
- Fox, L., Beck, R., Xing, D., Chase, H., Gilliam, L., Hirsch, I., Kollman, C., Laffel, L., Lee, J., Ruedy, K., Tamborlane, W., Tansey M., & Wilson, D. (2010). Variation of interstitial glucose measurements assessed by continuous glucose monitors in healthy, nondiabetic individuals. *Diabetes Care*, 33(6), 1297–1299. <http://doi.org/10.2337/dc09-1971>
- Gerrior, S., Juan, W., & Basiotis, P. (2006). An easy approach to calculating estimated energy requirements. *Preventing Chronic Disease. Public Health Research Practice and Policy*, 3(4), 1–4.
- Greenwood, D.C., Threapleton, D.E., Evans, C.E., Cleghorn, C.L., Nykjaer, C., Woodhead, C., & Burley, V.J.

- (2013). Glycemic index, glycemic load, carbohydrates, and type 2 diabetes: Systematic review and dose-response meta-analysis of prospective studies. *Diabetes Care*, 36(12), 4166–4171. <http://doi.org/10.2337/dc13-0325>
16. Haber, G.B., Heaton, K.W., Murphy, D., & Burroughs, L. F. (1977). Depletion and disruption of dietary fibre. Effects on satiety, plasma-glucose, and serum-insulin. *The Lancet*, 310(8040), 679–682. [https://doi.org/10.1016/S0140-6736\(77\)90494-9](https://doi.org/10.1016/S0140-6736(77)90494-9)
 17. Heuzé, V., Tran, G., Hassoun P., & Renaudeau, DBD. (2015). Sweetpotato (*Ipomoea batatas*) tubers. Feedipedia, a programme by INRA, CIRAD, AFZ and FAO. Retrieved from <http://www.feedipedia.org/node/745>. Accessed January, 2018
 18. International Organization for Standardization. (2010). Food products—Determination of the glycaemic index (GI) and recommendation for food classification. *ISO 26642*. PDF file.
 19. Kinnear, T., Wolever, T. M., Murphy, A. G., Sullivan, J. A. Liu, Q. & Bizinmungu B. (2011). Effect of preparation method on the glycaemic index of novel potato clones. *Food and Function*, 2, 438–444. <http://doi.org/10.1039/c1fo10042d>
 20. Lau, E., Zhou, W., & Henry, C. J. (2016). Effect of fat type in baked bread on amylose-lipid complex formation and glycaemic response. *British Journal of Nutrition*, 115(12), 2122–2129. <http://doi.org/10.1017/S0007114516001458>
 21. Loebenstein, G & Thottappilly, G. (2009). *The sweetpotato*. New York, NY: Springer.
 22. Matthan, N. R., Ausman, L. M., Meng, H., Tighiouart, H., & Lichtenstein, A. H. (2016). Estimating the reliability of glycemic index values and potential sources of methodological and biological variability. *American Journal of Clinical Nutrition*, 104 (4), 1-10. <http://doi.org/10.3945/ajcn.116.137208>
 23. Nathan, D.M. (2014). The diabetes control and complications trial/epidemiology of diabetes interventions and complications study at 30 years: Overview. *Diabetes Care*, 37(1), 9–16. <http://doi.org/10.2337/dc13-2112>
 24. Pedreschi, F. (2012). Frying of potatoes: physical, chemical, and microstructural changes. *Drying Technology*, 30(7), 707–725. <http://doi.org/10.1080/07373937.2012.663845>
 25. Philippou, E. (2017). *The glycemic index: applications in practice*. Boca Raton: Taylor & Francis.
 26. Pi-Sunyer, XF. (2002). Glycemic index and disease. *American Journal of Clinical Nutrition*, 76(suppl), 290–298.
 27. Prasad, S. (2014). Nanobiosensors: the future for diagnosis of disease? *Nanobiosensors in Disease Diagnosis*, 3, 1–10. <http://doi.org/10.2147/NDD.S39421>
 28. Putseys, J. A., Derde, L. J., Lamberts, L., Östman, E., Bjorck, I. M., & Delcour, J. A. (2010). Functionality of short chain amylose-lipid complexes in starch-water systems and their impact on in vitro starch degradation. *Journal of Agricultural and Food Chemistry*, 58(3), 1939–1945. <http://doi.org/10.1021/jf903523h>
 29. R Core Team (2016). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Retrieved from <http://www.R-project.org/>. Accessed on October, 2017
 30. Shrivastav, M., Gibson, W., Shrivastav, R., Elzea, K., Khambatta, C., Sonawane, R., Sierra, J. A., & Vigersky, R. (2018). Type 2 diabetes management in primary care: The role of retrospective, professional continuous glucose monitoring. *Diabetes Spectrum* (7), 1–9. <https://doi.org/10.2337/ds17-0024>
 31. Shahbandeh, M. (2024) U.S. sweet potato production from 2000 to 2023. Retrieved December, 2024 from: <https://www.statista.com/statistics/193218/us-sweet-potato-production-since-2000/#statisticContainer>
 32. Tappy, L., & Lê, K.A. (2010). Metabolic effects of fructose and the worldwide increase in obesity. *Physiological Reviews*, 90(1), 23–46. <http://doi.org/10.1152/physrev.00019.2009>
 33. Terrie, Y. C. (2024). Provide counseling about OTC blood glucose tools. *Pharmacy Times*, 90(11) Retrieved December 2024 from <https://pharmacytimes.com/view/provide-counseling-about-otc-blood-glucose-tools/>
 34. Truong, V.-D. (1992). Sweetpotato beverages: Product development and technology transfer. In C. K. B. and P. A. L. W.A. Hill (Ed.), *Sweetpotato Technology for the 21st Century* (pp. 389–399). Tuskegee, AL: Tuskegee University.
 35. Truong, V. (1991). Development and transfer of processing technologies for fruity food products from sweet potato. In *Symposium on Tropical Root Crops in a Developing Economy; Acta Horticulture* 380, 413–420.

36. Truong, V.-D., & Avula, R. Y. (2010). Sweetpotato purees and powders for functional food ingredients. In: Ray, R. C. & Tomlins, K. I. (Eds.), *Sweetpotato: Post Harvest Aspects in Food* (117-161). New York, NY: Nova Science Publishers, Inc.
37. Truong, V. D., Avula, R. Y., Pecota, K. V., & Yencho, G. C. (2018). Sweetpotato production, processing, and nutritional quality. In M. Siddiq, & M. A. Uebersax (Eds.), *Handbook of Vegetables and Vegetable Processing* (pp. 811-838). John Wiley & Sons, Ltd. <https://doi.org/10.1002/9781119098935.ch35>
38. Truong, V.D., Pascua, Y.T., Reynolds, R., Thompson, R.L., Palazoğlu, T.K., Atac Mogol, B. & Gökmen, V. (2014). Processing treatments for mitigating acrylamide formation in sweetpotato French fries. *Journal of Agricultural and Food Chemistry*, 62(1), 310 -316. <http://pubs.acs.org/doi/10.1021/jf404290v>
39. Wolever, T. M. S., Brand-miller, J. C., Abernethy, J., Astrup, A., Atkinson, F., Axelsen, Björck, I... Valsta, LM. (2008). Measuring the glycemic index of foods : interlaboratory study 1 – 5, 87. *American Journal of Clinical Nutrition*, 87, 247S–257S.
40. Woolfe, JA. (1992). Sweetpotato: An Untapped Food Resource; Cambridge University Press.
41. Yencho, G.C., Pecota, K.V., Schultheis, J.R., Zvezdana-Pesic, V.E., Holmes, G.J., Little, B.E., Thornton, A.C., & Truong, V-D. (2008). ‘Covington’ sweetpotato. *HortScience*, 43(6), 1911–1914. <https://doi.org/10.21273/HORTSCI.43.6.1911>
42. Zeevi, D., Korem, T., Zmora, N., Israeli, D., Rothschild, D., Weinberger, A... Segal, E. (2015). Personalized nutrition by prediction of glycemic responses. *Cell*, 163(5), 1079–1095. <http://doi.org/10.1016/j.cell.2015.11.001>

Cite this article: Sofia Feng, Jonathan C. Allen. *Glycemic Index of Products Derived from Sweetpotato When Compared to Their Analog White Potato Product. International Journal of Research in Medical and Clinical Sciences.* 2025; 3(1): 149-157.

Copyright: © 2025. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.