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FINAL REPORT

Protocol GIL-9022

Glycemic Index Determination of Noodles

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Summary

The glycemic index (GI) value of noodles was determined in 10 subjects. The GI value is expressed on the glucose standard (i.e. the GI of glucose=100). The GI value (Mean±SEM) of the food tested was:

Noodles ……. 61.3±7.7

The meal was well tolerated. Palatability of the Noodles was not different from glucose. Glycemic index of the Noodles was significantly lower than control. Using the classification of Brand-Miller, products with a GI less than 55 are classified as being low GI, those with a GI between 55 and 70 are classified as medium, while those with a GI greater than 70 are high GI.

BACKGROUND

The glycemic index was proposed in the 80's as a means to classify carbohydrate food according to their effect on postprandial blood glucose levels (Jenkins et al, 1981). Low GI foods release their carbohydrate slowly and have a low glycemic response while high GI foods are rapidly digested with a corresponding high glycemic response. The rate of glucose absorption and extent and duration of elevated blood glucose levels induce many hormonal and metabolic changes that may affect health or disease parameters. Low GI diets may help in weight maintenance and weight loss (Ebbeling et al, 2003) in addition to being protective against chronic disease such as diabetes (Salmeron et al, 1997a,b), heart disease (van Dam et al, 2000; Lui et al, 2002) and certain cancers (Augustine et al, 2001; Francheschi et al, 2001). Interest in identifying low GI foods and the food factors responsible for the low GI of foods has therefore increased. Several food factors have been identified that influence *in vivo* absorption and therefore potentially the GI of a food or meal. Some of these factors include: the gross matrix structure, cell wall and starch structure (i.e. ripening), amylase to amylopectin ratio, and viscous fibre (Brand et al, 1985).

The methodology for determining the glycemic index is now well established (Wolever et al, 1991; Brouns et al, 2005) and has been shown to be reproducible by laboratories across the world (Wolever et al, 2003). At present, Glycemic Index Laboratories uses the glycemic index protocol as approved by the FAO/WHO (1998).

Study Objective: The objective of this study was to determine the glycemic response and glycemic index of the Noodles.

METHODS

Subjects

Ten (10) subjects (4 males and 6 females), aged 38±16 years with a body mass index of 23.0±2.7 kg/m² were recruited for the study. The individual details are shown in Table 1.

Table 1. Subject details

ID	Sex	Ethnicity	Age (yrs)	Height (cm)	Height (in)	Weight (kg)	Weight (lb)	BMI (kg/m²)
267	M	Korean	31	180.0	70.2	77.0	169.4	23.8
183	F	Filipino	23	151.5	59.1	49.0	107.8	21.3
464	F	Caucasian	58	158.4	61.8	53.0	116.6	21.1
379	F	Filipino	20	154.0	60.1	57.2	125.8	24.1
282	M	African	36	169.5	66.1	74.0	162.8	25.8
404	M	Filipino	33	171.0	66.7	66.5	146.3	22.7
247	F	Caucasian	59	165.5	64.5	78.0	171.6	28.5
249	M	Caucasian	65	180.0	70.2	75.0	165.0	23.1
411	F	Caucasian	27	171.0	66.7	56.7	124.7	19.4
383	F	South East Asian	28	162.0	63.2	54.0	118.8	20.6
MEAN			**38**	**166.3**	**64.9**	**64.0**	**140.9**	**23.0**
±SD			**16**	**9.9**	**3.9**	**11.2**	**24.7**	**2.7**

Protocol

The study used an open-label, randomized cross-over design. Each subject underwent treatments on separate days, with each subject performing up to 2 tests per week separated by at least one day. On each test day, subjects came to Glycemic Index Laboratories (36 Lombard St., Suite 100 or Mavety Rd.) in the morning after a 10-14 h overnight fast. After being weighed and having a fasting blood sample obtained by finger-prick, the subject then consumed a test meal within 10 minutes. Further blood samples were obtained at 15, 30, 45, 60, 90 and 120 minutes after the start of the test meal. Subjects remained seated quietly during the 2 hours of the test. After the last blood sample was obtained, subjects were offered a snack and then permitted to leave. The study was approved by the Western Institutional Review Board and written informed consent was obtained from all subjects.

Meals & Palatability

The test meals consisted of the test food or glucose control containing 50g available carbohydrate (defined as total carbohydrate minus dietary fiber). In addition to the test product, each subject also consumed a standard glucose drink on 3 separate occasions. The glucose drink was prepared by dissolving 50g of anhydrous glucose into 250ml of water. The meals were given in random order. The portion sizes were calculated based on the results of nutrition analysis provided by the client (Table 2). Subjects were also given a choice of 1 or 2 cups of water, coffee, or tea with or without 15-30ml of 2% butterfat milk if so desired. The amount and type of beverage consumed by each subject remained the same on each test day. To allow calculation of the glycemic index, the control meal was repeated three times. Meals were given in random order.

Table 2. Nutrient content of test meals

Test Meal	Abbr	Amount (g)	Protein (g)	Fat (g)	Total CHO (g)	Dietary Fibre (g)	Available CHO (g)
Glucose Standard	Gluc	50	0	0	50	0	50
Noodles	Noodles	78	5.5	0.8	63	13	50

* Note: calculation of available carbohydrate for the meal was based on macronutrient analysis provided by the client

After consuming the meal, subjects rated the palatability of the meal using a visual analogue scale anchored at very “unpalatable” at one end (0) and “very palatable” at the other (100). Therefore, the higher the number, the higher is the perceived palatability of the product.

Blood Samples

Blood samples (2-3 drops each) were collected into 5 mL tubes containing a small amount of sodium fluoride/potassium oxalate. The samples were mixed by rotating the tube vigorously and then refrigerated during the testing session. At completion of the testing session, samples were transferred to storage at -20°C prior to glucose analysis. Blood glucose analysis, using a YSI (Yellow Spring Instruments, OH) analyzer, took place within three days of collection.

Data Analysis

Incremental areas under the plasma glucose curves (iAUC) were calculated using the trapezoid rule and ignoring area beneath the baseline. The glycemic index was calculated by expressing each subject's glucose iAUC for the test food as a percentage of the same subject's average response after reference glucose drink. The blood glucose concentrations at each time and the iAUC values were subjected to repeated-measures analysis of variance (ANOVA) examining for the effect of test meal. After demonstration of significant heterogeneity, the significance of the differences between individual means was assessed using Tukey's test to adjust for multiple comparisons. In addition, the significance of the differences between blood glucose concentrations and increments for each test food and glucose were assessed by paired t-test.

RESULTS

Palatability

Palatability scores are given in Table 3. Generally the meal was well tolerated. Palatability of the Noodles was not different from glucose.

Glycemic Index

The GI value and category of the meals are shown in Table 3.

Table 3. Palatability, Glycemic Index and GI Category

Test Meal	Abbr	Palatability (mm)	Glycemic Index	GI Category^
Glucose Standard	Gluc	**53.8±9.4**	**100**	**High**
Noodles	Noodles	**60.8±6.6**	**61.3±7.7***	**Medium**

^Category from GI Factor (Brand-Miller et al)
* Significantly different from control ($p<0.05$)

Glycemic index of the Noodles was significantly lower than control. Using the classification of Brand-Miller, products with a GI less than 55 are classified as being low GI, those with a GI between 55 and 70 are classified as medium, while those with a GI greater than 70 are high GI. The Noodles are therefore classified as having a medium GI.

Blood Glucose Response

The blood glucose responses are shown on the pages labeled GIL-9022 with the graphs showing a comparison of the total and incremental blood glucose values in response to the test food and mean of the three glucose controls with significance determined by paired t-test.

Mean fasting blood glucose was identical before each test meal within each series. The blood glucose responses are not described in detail here but can be viewed on the analysis pages. The results of duplicate analysis are: n=32, mean 4.27±0.07, coefficient of variation (CV) was 1.49%.

Repeated Glucose Trials

There was no significant effect of order on the iAUC values after the repeated glucose meals. The mean within-subject CV of the iAUC values after the 3 repeated glucose tests was 18.6±4.2%.

The tests appeared to be technically satisfactory, as judged by the average within-subject variation of glycemic responses for the repeated glucose tests. Values <30% are considered to be satisfactory in the opinion of GI Testing®.

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