Lowering Effect on Postprandial Glycemic Response of Nopales Added to Mexican Breakfasts

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The burden of diabesity is increasing rapidly in Mexico (1). Culturally based diets with low glycemic index and glycemic load might be a low-cost approach for a population with a high index of socioeconomic marginality. Mixed meals are the usual manner of food intake, and they are different among regions of Mexico. Consumption of nopales (prickly pear cactus pads) in middle and low socioeconomic populations of central and southern Mexico is generally three times weekly. Nopales can be purchased at any food market in Mexico. The purpose of this study was to estimate the glycemic index of three usual Mexican breakfasts and to measure the effect of adding cactus pads (nopales) on postprandial glucose response in type 2 diabetic subjects.

RESEARCH DESIGN AND METHODS

— Thirty six volunteers with type 2 diabetes (47–72 years of age) were recruited. Their mean ± SD fasting blood glucose was 8.0 ± 2 mmol/l. All subjects were treated with glibenclamide, metformin, or both. None of the patients were treated with insulin. Their mean ± SD BMI was 24.86 ± 3.76 kg/m^2. All participants gave informed consent, and the study was approved by the Nutrition Institute of Baja California Ethics Committee.

Subjects were randomly assigned to eat one of the three test breakfast meals with and without nopales. Ten subjects were assigned to each experimental breakfast and white bread on separate mornings with a period of 7 days between each test. With each experimental breakfast and white bread, 250 ml unsweetened tea was served. All subjects were instructed not to eat legumes or nopales and not to drink alcohol the evening before testing (2).

Subjects came to the clinic on the morning after an overnight (10–12 h) fast. They were seated and remained seated throughout the test. A baseline finger-prick blood sample was taken with a Softclix Lancet device, placed on a test strip, and read with an Accu-chek Active blood glucose meter (Grupo Roche Syntex de México, S.A. de C.V., Mexico D.F.). Subjects ate the white bread, and at 15, 30, 45, 60, 90, and 120 min after consumption finger-prick blood samples were taken and analyzed. All subjects consumed the same experimental breakfast every Thursday for three consecutive weeks.

Reference food was white bread containing 50 g available carbohydrate. Experimental breakfasts were as follows: chilaquiles (casserole made with corn tortilla, vegetable oil, tomato sauce, fresh farmer's cheese, and boiled pinto beans) with and without nopales, burritos (scrambled egg with diced red tomato and onions, vegetable oil, flour tortilla, and boiled pinto beans) with and without nopales, and quesadillas (flour tortilla, low-fat Monterey cheese, avocado, and boiled pinto beans) with and without nopales.

The incremental area under the blood glucose response curve (IAUC) was calculated separately for white bread and experimental breakfast in each subject. In each subject, three IAUCs for the white bread and three IAUCs for each experimental breakfast were obtained and the average calculated. The average IAUC of the white bread tests was used as the reference value for calculating the glycemic index values for the experimental breakfast. Glycemic index for each experimental breakfast was calculated by dividing the average blood glucose area under the curve for the experimental breakfast by the subject's average blood glucose area under the curve for white bread × 100.

Statistical differences between blood glucose IAUC and glycemic index of each experimental breakfast, with and without nopales, were assessed with Student's *t* test for paired samples. One-way ANOVA was performed to assess the blood glucose IAUC differences of white bread between the three experimental breakfast groups.

RESULTS

— Eleven, nine, and nine subjects completed the chilaquiles, burrito, and quesadilla test breakfasts, respectively. At baseline, the mean fasting blood glucose was not statistically different among the three experimental breakfast groups. Differences in means of IAUC and glycemic index values between each breakfast tested are shown in Table 1. All differences of blood glucose IAUCs between each breakfast with and without nopales were statistically significant. The mean ± SEM blood glucose IAUC of white bread for chilaquiles, burrito, and quesadilla breakfasts were 432 ± 51, 621 ± 84, and 488 ± 41.5, respectively ($P = 0.029$).

CONCLUSIONS

— These findings demonstrate that the addition of nopales to the usual Mexican breakfast among type 2 diabetic subjects induced a reduction in glucose concentration after the meal. The reduction in glycemic index obtained for the three meals was 21, 12, and 15 glycemic index units. Results are consistent with the low glycemic index and glycemic load of the nopales (3). The addition of a very low glycemic index and

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Abbreviations: IAUC, incremental area under the blood glucose response curve.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

Table 1—*IAUC and glycemic index for each breakfast tested and mean differences between tested breakfast with and without nopales*

	Chilaquiles			Burrito			Quesadilla		
	Without nopales	With nopales	*P*	Without nopales	With nopales	*P*	Without nopales	With nopales	*P*
IAUC mmol × min/l	262 ± 20	178 ± 29	0.013	337 ± 64	272 ± 63	0.011	231 ± 38	120 ± 21	0.019
Glycemic index, white bread	71 ± 12	50 ± 11	0.018	53 ± 6	41 ± 4.5	0.025	50 ± 5	35 ± 4.9	0.027
Glycemic index, glucose	51 ± 9	35 ± 8	0.018	37 ± 4	29 ± 3.2	0.025	36 ± 3	25 ± 3.5	0.025

Data are means ± SEM.

glycemic load plus 3 g fiber from nopales shows a significant reduction of IAUC in all breakfasts. Calculated glycemic index and glycemic load of 85 g nopales was 7 and 35, respectively (4), which might explain the reduced IAUC when nopales was added. A 30% reduction of IAUC was found with chilaquiles, 20% with burritos, and 48% with quesadillas, suggesting that the potential reduction effect on IAUC of nopales will vary depending on the macronutrient content, the amount of soluble fiber, or other components of each mixed meal. The reduction was greater with a breakfast with a higher content of energy and protein, whereas it was lower with the breakfast with a lower fat content. Results obtained in the current study are supportive of those obtained in previous mixed-meal glycemic index studies by Bornet et al. (5) and Brand-Miller et al. (6).

Adding nopales to usual Mexican breakfasts may increase treatment adherence and provide added benefit for the prevention of diabesity and improved metabolic control for diabetic people. Although the glycemic index ranking of the foods assessed individually still held true in the mixed meals, limitations of the study are that glucometers were used for glucose analysis, and we did not control for varying degrees of insulin resistance, overweight, and obesity.

The promising results shown with these typical Mexican breakfasts provide Mexican patients with a broader and more culturally based choice for the management of diabetes.

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