GLYCAEMIC AND INSULINAEMIC RESPONSES TO A NEW HYDROGENATED STARCH HYDROLYSATE IN HEALTHY AND TYPE 2 DIABETIC SUBJECTS

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SUMMARY - Background: Industrialists are searching for a sugar replacement in confectioneries such as hard candies, gum and chocolate. Lycasin® HBC is a suitable candidate. Nevertheless, no information on its plasma glucose and insulin responses exists. Therefore, we aimed to evaluate the glycaemic and insulinaemic indices of Lycasin® HBC in healthy subjects and in subjects with type 2 diabetes mellitus.

Methods: Six healthy and six type 2 diabetic men participated in the study. Each subject absorbed, after an overnight fast, a challenge of either 50 g of glucose or 50 g of Lycasin® HBC using a randomised double-blind crossover design. Blood samples for measuring plasma glucose and insulin concentrations were collected during a 3 hour period.

Results: The calculated glycaemic index of Lycasin® HBC was 47 ± 10% in healthy subjects and 25 ± 6% in patients with type 2 diabetes mellitus. The insulinaemic index of Lycasin® HBC was 23 ± 4% and 39 ± 14%, respectively. As glucose levels oscillate in a very limited range in normal healthy subjects, the insulinaemic index must be considered here. On the other hand, it is the glycaemic rather than the insulinaemic index that must be assessed in diabetic subjects due to impairment of insulin secretion.

Conclusions: The tested Lycasin® HBC showed a low insulinaemic index in healthy subjects (23 ± 4%) and a low glycaemic index (25 ± 6%) in type 2 diabetic patients. Thus, it might be considered as an interesting sucrose substitute in confectionery for individuals with or without diabetes.

Key-words: Lycasin® HBC, glycaemic index, insulinaemic index, healthy subjects, type 2 diabetic subjects.

RÉSUMÉ - Réponses glycémiques et insulinaémiques à un sirop de maltitol, le Lycasin® HBC, chez des sujets normaux et chez des sujets diabétiques de type 2.

Contexte : Il s’agit de déterminer les index glycémique et insulinaémique d’un produit dérivant d’hydrolysats d’amidon hydrogéné : le LYCASIN® HBC (LB 2212).

Méthodes : Deux populations de 6 sujets normaux et de 6 diabétiques de type 2 ont participé à la réalisation de cette étude. Chaque sujet a absorbé dans un ordre aléatoire une charge équivalente à 50 g de glucide soit sous forme de D-glucose soit sous forme d’une solution LYCASIN® HBC testé dans l’eau (volume final : 150 ml). Chaque test a été effectué à une semaine d’intervalle. Les prélèvements sanguins ont été effectués durant 3 heures.

Résultats : L’index glycémique calculé du LYCASIN® HBC était 47 ± 10 % chez les sujets normaux et 25 ± 6 % chez les sujets diabétiques de type 2. L’index insulinaémique du LYCASIN® HBC chez les sujets normaux et chez les sujets diabétiques, étaient respectivement 23 ± 4 % et 39 ± 14 %. Comme les valeurs de glycémies varient dans une très faible fourchette chez le sujet normal, l’index insulinaémique donne une meilleure mesure de la réponse physiologique pour une telle population. Par contre chez les sujets diabétiques, l’utilisation de l’index glycémique donne une meilleure information que l’index insulinaémique en raison d’un défaut de l’insulinosécrétion.

Conclusions : Le LYCASIN® HBC a montré un index insulinaémique bas chez les sujets normaux (23 ± 4 %) et un index glycémique bas (25 ± 6 %) chez les sujets diabétiques. Dans cette optique, le LYCASIN® HBC est un produit intéressant à considérer en confiserie, comme édulcorant, chez le sujet sain et chez le sujet diabétique.

Mots-clés : LYCASIN® HBC, index glycémique, index insulinaémique, sujet sain, sirop de maltitol, diabète.
High postprandial plasma glucose and insulin excursions are assumed to be independent predictors of risk for atherosclerotic diseases. Epidemiological evidence [1] shows that the relationship between plasma glucose concentration and cardiovascular disease extends well below the glucose level defined for diabetes and even that for impaired glucose tolerance. Recently, attention has been focused on finding the carbohydrate that elicits low postprandial plasma glucose and insulin levels.

Differences in metabolic responses to carbohydrates can be classified by their glycaemic index (GI) which compares the levels of plasma glucose after equal carbohydrate portions of foods and ranks them relative to a standard (glucose [2] or white bread [3, 4]).

For sugars and sweeteners, attention has been paid to sugar-alcohols that have physical and chemical properties similar to sucrose. Because of their bulking, sweetening and non-cryogenic properties, they can be used as sugar replacers in hard candies. Lycasin® HBC is a new sugar alcohol. It is obtained by hydrogenation of starch hydrolysate containing 50-55% maltitol, 5-8% sorbitol and 35-40% hydrogenated saccharides. It might be an interesting sweetening agent for hard candies. There is no available information, however, concerning its postprandial glycaemic and insulinaemic responses. Therefore, the aim of the present study was to evaluate the glycaemic and insulinaemic indices of Lycasin® HBC in healthy subjects and in subjects with type 2 diabetes mellitus.

## SUBJECTS AND METHODS

### Subjects

Six healthy men and six men with type 2 diabetes mellitus, aged 20-60 years, were included in the study. The clinical and biological characteristics of subjects are given in Table I. The ethical committee of the Hôtel-Dieu Hospital approved the protocol and each volunteer gave a written informed consent. Subjects with abnormal digestive, hepatic or renal functions as determined by past history, physical examination, blood cell count and standard biochemical blood profile were excluded. The 6 diabetic patients were selected on the basis of having fasting plasma glucose of > 7.00 mmol/L. They were treated with diet alone and/or oral antidiabetic agents (sulfonylurea and/or metformine). All subjects kept the same treatment during the experimental period. On the study day, patients took their respective antidiabetic treatment as usual.

### Methods

#### The tested product

The syrup tested was Lycasin® HBC (lab 2212, Roquette, Lestrem, France), obtained by hydrogenation of starch hydrolysates containing dextrose, maltose and oligo-maltosides. The final product contained 50-55% maltitol, 5-8% sorbitol and 35-40% hydrogenated oligo-saccharides.

Glucose was used as a standard in the determination of glycaemic and insulinaemic indices. For each test, a challenge of either 50 g of Lycasin® HBC or 50 g of glucose was diluted in a final volume of 150 ml of water.

#### Experimental design and method

The study followed a randomised double-blind crossover design. After an overnight fast, each subject absorbed a challenge of either 50 g of glucose or 50 g of Lycasin® HBC, in a random order with an interval of one week. Blood samples were collected before the challenge (time – 30 min and time 0) and then at 15, 30, 60, 90, 120, 180 min to measure plasma glucose and insulin concentrations.

Plasma glucose was measured by the glucose oxidase method with a glucose analyser (Beckman Fullerton, Palo Alto, CA). Plasma insulin was determined by a radioimmunoassay (RIA Diagnostic Paster, Marnes la Coquette, France). The antiserum used in the test showed a cross-reactivity of 100% with human insulin and of 40% with proinsulin.

Glycaemic and insulinaemic indices of Lycasin® HBC were calculated as previously described [5, 6]. Areas under curves were calculated for plasma glucose and insulin concentrations according to the trap-
The elevated (when compared to healthy subjects, p < 0.001) insulinaemic index (II%) of Lycasin values during each test (p < 0.05) two tests at 15, 30 and 60 min compared to baseline values for each test (p < 0.001). The calculated glycaemic index (GI%) of Lycasin was 25% which was similar to the insulinaemic index in normal subjects. Therefore, Lycasin HBC (lab 2212) is a sugar with a very low glycaemic index in diabetic subjects and a very low insulinaemic index in normal subjects. Compared to traditional sweeteners, Lycasin HBC, the hydrogenated starch hydrolysate used in the present study, has much lower glycaemic and insulinaemic indices than sucrose and fructose. This difference in glycaemic and insulinaemic responses was maintained when sucrose, fructose or isomalt (which was taken into consideration and not the insulinaemic index. In fact, Lycasin showed a low insulinaemic index of 23 ± 4%.

Because diabetic patients have impaired pancreatic insulin secretion, it is the glycaemic index that has to be taken into consideration and not the insulinaemic index. Indeed, in diabetic patients, the glycaemic index of Lycasin was 25% which was similar to the insulinaemic index in normal subjects. Therefore, Lycasin HBC (lab 2212) is a sugar with a very low glycaemic index in diabetic subjects and a very low insulinaemic index in normal subjects.
has a similar composition to Lycasin® HBC) were integrated into milk chocolate as demonstrated in a previous study in type 2 diabetic subjects [7].

In diabetic subjects, the glycaemic index of Lycasin® HBC is similar to the glycaemic index of maltitol (Maltisorb®, GI: 25%), but lower than that of Lycasin 80/55 (80%: dry material, 55% maltitol, GI%: 46%), non-published data. This might be explained by the fact that the new Lycasin® HBC contains higher proportion of hydrogenated polysaccharides than the old Lycasin 80/55 (50% vs 21%, respectively [8]) and is less digestible but exerts low osmotic potential in the gut [9]. In addition, the insulinaemic index in normal subjects of Lycasin® HBC was lower than that of Maltisorb (33%) and that of Lycasin 80/55 (58%).

During the past 10 years many studies have identified the low glycaemic index diet as beneficial in the prevention and/or treatment of the metabolic syndrome [2, 3, 5, 10-12]. Several short and long term dietary interventions are available for healthy subjects and subjects with diabetes or hyperlipidemia. With few exceptions, these studies have shown that a low glycaemic index diet improves plasma glucose control, lipid profiles and insulin resistance. Thus, low
glycaemic index carbohydrates appear to play an important role in the metabolic fate of carbohydrates. Consequently, such a diet might affect the risk of cardiovascular diseases, diabetes and obesity.

From the above data, it seems relevant to promote consumption of low glycaemic index sugars. This has been done recently by the joint Food and Agriculture Organisation (FAO) and World Health Organisation (WHO) Expert [13]. The last European dietary recommendation [14] for patients with type 2 diabetes suggest that most of the dietary energy intake should come from a combination of carbohydrates with low glycaemic index and mono-unsaturated fatty acids. In this optic the new Lycasin®HBC appears to be a very good candidate as a sugar replacer in candies for diabetic and non-diabetic subjects.

Acknowledgements – This paper has been sponsored by Roquette Frères, Lestrem, France.
REFERENCES


