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Original research article

Comparative assessment of the Glycaemic Responses of Low Fat Milk Incorporated with Whey Proteins and Oats Powder

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Abstract

Aim: The aim of the present study was to determine of Glycaemic Responses of Low Fat Milk Incorporated with Whey Proteins and Oats Powder in koshi region.

Materials and methods: This was a cross-sectional study conducted in the Department of Home Science, Purnea University, Purnea, Bihar, India, for 15 months. Fat was reduced (5.45%) in cow milk (15 L) and was spray dried to reduce moisture up to 4%. Oats powder and whey protein powder were obtained from reputed commercial brands and ground to make a fine powder (particle size 0.05–0.01 mm). For 100 g of milk powder, 20 g of whey and 10 g of oats powder were incorporated. Glucose was used as the standard food (GI=100). The test food (within 2 hours following preparation) and the standard food were served to the same individual on separate occasions randomly. Following an overnight fast of 8 - 12 hours, a finger prick capillary blood sample was obtained from the subject. **Results:** Proximate compositions of fresh cow milk powder and the formulated new powder sample were used and Significant differences were observed ($p<0.05$) in all three macronutrient contents (fat, protein, digestible carbohydrates) between the two samples. Crude fibre contents in both samples were not measurable. A lowering of GI about three times in the new powder formulation was achieved due to incorporation of whey and oats powder to replace great amount of milk fat. **Conclusions:** Incorporation of whey powder have significantly reduced the Glycaemic index of milk ($p<0.05$). Although digestible carbohydrate content was increased by addition of oats and also being lower in fat; low GI milk powder formulations can be developed by incorporating whey proteins and cereal grains like oats.

Keywords: Glycaemic index; Low fat milk; Whey proteins; Oats.

Introduction

In many non-Western countries, cereal-based carbohydrates provide ~60% of total energy intake[1] compared with 42% for Caucasians.[2] The consumption of such high carbohydrate diets yield high glucose and insulin response, thus contributing to insulin resistance. Nonetheless, the quality of carbohydrate consumed is as important as the quantity. Poor quality carbohydrates are quickly digested and absorbed, thereby giving rise to high blood glucose and insulin 'spikes'. Observational studies have shown that the consumption of low glycaemic index (GI) foods is associated with a lower risk of type 2 diabetes mellitus (T2DM)[3] , significantly less insulin resistance and a lower prevalence of the metabolic syndrome[4] The GI is defined as a numerical figure used to represent the ability of a carbohydrate food to raise blood glucose levels. It is expressed as a percentage of the incremental area under the glycaemic response curve (AUC) elicited by a portion of food containing 50 g available carbohydrate in comparison with the AUC elicited by a standard reference food of 50 g glucose or white bread in the same participant.[5] The principle is that the slower the rate of carbohydrate absorption into the bloodstream, the lower the rise of blood glucose level and the lower the GI value. A GI value of ≥70 is considered high, a GI value 56–69 inclusive is medium and a GI value ≤55 is low, where glucose = 100. Following the approach of these authors, we are for the first time providing a compendium of GI values of non-western foods.[6] Since many of these GI values were published in uncommon journals or located in various sources, it is not surprising that many previous authors may have found it a challenge to access and retrieve such information. With a global pandemic of T2DM escalating, especially in emerging countries[7] , it is now recognised that the GI food-based intervention is an important tool in the management and prevention of T2DM.[8] Ironically, in regions of the world where there is a pandemic of T2DM, there is a shortage of a taxonomy of GI data of non-Western foods (e.g. Middle East, South Asia, Indian sub-continent) in contrast to the current international GI .[6,9] the aim of the present study was to determine of Glycaemic Responses of Low Fat Milk Incorporated with Whey Proteins and Oats Powder in koshi region.

Materials and methods

This was a cross-sectional study conducted in the Department of Home Science, Purnea University, Purnea, Bihar, India, for 15 months. Fat was reduced (5.45%) in cow milk (15 L) and was spray dried to reduce moisture up to 4%. Oats powder and whey protein powder were obtained from reputed commercial brands and ground to make a fine powder (particle size 0.05–0.01 mm). For 100 g of milk powder, 20 g of whey and 10 g of oats powder were incorporated.

Preparation of breakfast meals

Skimmed milk powder was mixed with powdered oats and whey. The ratios of food ingredients for each food were selected by considering the palatability test decided via a panel (non-trained).

Analysis of proximate composition

Proximate compositions of the powder mixture was determined. The moisture and ash contents were measured by AOAC official methods.[10,11] The digestible carbohydrate content, fat and soluble & insoluble dietary fiber was determined with Holm's method[12] Croon and Guchs[13] and by the method of Asp[14] respectively. The crude protein was by Kjeldahl method using Copper/ Selenium catalysts.[15]

Determination of the GI was carried out as a randomized crossover study, reviewed by Brouns et al. in 2005.[16] Healthy volunteers (n=20) including both sexes (12 males and 8 females), aged 20 - 30 years and with a body mass index of 18.5-23.5 were included in this study. The subjects were asked to refrain from smoking, taking alcohol and to restrict vigorous physical activities the day before.

Glucose was used as the standard food (GI=100). The test food (within 2 hours following preparation) and the standard food were served to the same individual on separate occasions randomly. Following an overnight fast of 8 - 12 hours, a finger prick capillary blood sample was obtained from the subject. The subject was served with standard or test food containing 50 g of digestible carbohydrate portions to be consumed within 10 minutes with 250 ml drinking water. Capillary blood samples were collected at 30, 45, 60, 90 and 120 min following the first bite of the meal. Serum glucose concentrations were determined with a Glucose-Oxidase kit. The GI was calculated using the mean of the individual incremental area under the curve of the test food and of the standard food.[16] The glycemic load (GL) value of the test food was calculated. (GL= GI*digestible starch per serving (g))/100).

Results

Proximate compositions of fresh cow milk powder and the formulated new powder sample are stated in **table 1**. Significant differences were observed ($p<0.05$) in all three macronutrient contents (fat, protein, digestible carbohydrates) between the two samples. Crude fibre contents in both samples were not measurable. The remainders were considered to be mineral ash. GI for the prepared formulation was 13 ± 2 (Low GI) and that is significantly ($p<0.05$) lower compared to the stated GI of fresh milk, that is 36 as was found by David et al.[17] A lowering of GIabout three times in the new powder formulation was achieved due to incorporation of whey and oats powder to replace great amount of milk fat. The average maximum peak value for glucose is 160.5, and the average peak value for the newly formulated powder was greatly reduced up to 100.7 (**Table 1**). Hence the peak reduction is by 38.45% (**Table 3**). The glycemic response of the prepared powder formulation, clearly indicated a lower peak value compared to the standard (Glucose). The peaking time was observed earlier by 15 minutes compared to glucose . According to the Glycaemic Load scale GL values ≥ 20 are considered as high, between 12 to 20 as intermediate and GL ≤ 10 as low. The calculated GL value for the formulated powder sample was **2.5** (**Table 3**); that indicates of a very low GL value.

Table 1: Comparison of nutrion composition (grams in 100 g of powder

	Fat	Protein	Carbohydrate
Newly formulated	4.45	35	55
Fresh milk powder	30.25	20	45

Table 2: Average blood glucose values with time

Food	**0 min**	**15 min**	**30 min**	**45 min**	**60 min**	**90 min**	**120 min**
Standard (Glucose)	92.4	127.9	151.1	160.5	136.5	119.8	95.8
Formulated sample	91.4	98	100.7	94.7	94.1	96.9	92.7

Table 3: Detailed glycemic response results in newly formulated powder

Mean GI	**13 ±2**
Standard error mean	1.5
Portion size	375 mL
Peaking time	30 min.
Peak reduction	65.8 mg/dL
% Peak Reduction (compared to Glucose)	38.45
% GI reduction (Compared to fresh milk)	67.6
Glycaemic Load	2.5

Discussion

The beneficial effect for blood glucose of increased protein content of milk is consistent with other reports that proteins in general[18] and milk proteins specifically[19] reduce glycemic response compared with carbohydrate alone. Dairy proteins have been shown to attenuate postprandial hyperglycemia and prevent impairments in vascular endothelial function in adults with prediabetes.[20] Several studies from our laboratory have reported improved glycemic regulation following the consumption of different forms of dairy products, before or during an ad libitum meal or with a high glycemic carbohydrate at a breakfast meal. This effect has been attributed to milk proteins and more specifically to whey protein.[21] Since there was a significant reduction in GI compared to fresh milk in the newly formulated powder; it can be assumed that whey proteins has a great impact in reducing glycemic responses. The digestible carbohydrate content was higher due to incorporation of oats powder. The fat; which is a known factor for reducing GI, was lower in the new formulation compared to fresh milk. The results of proximate analysis did not reveal of a considerable inclusion of dietary fibre by oats powder to the new formulation as well. Hence, the addition of whey proteins can be considered as the crucial factor affecting the significant reduction observed in GI. Cow milk contains, many essential nutrients which helps to maintain the healthy human life style. According to some scientists, there is no evidence to achieve essential nutrients requirement by a dairy free diet.[22] The problem is that; may Asians including India carry the habit of incorporating sugar when drinking milk. Hence, it is of utmost importance to decrease the initial GI of milk as low as possible. It was unknown that how the reduction of fat and increment of whey proteins together impact on the glycemic impact on milk; especially when the digestible carbohydrate content too is increased by addition of cereals like oats. Both the increment of digestible carbohydrate content by addition of cereal powder, and also reduction of fat can increase the GI, but this study reveals that; incorporation of a considerable amount of whey proteins can overcome both those impacts. Glycaemic load allows comparisons of the likely glycaemic effect of realistic portions of different foods, calculated as the amount of carbohydrate in one serving times the GI of the food. Majority of the volunteers mentioned that the portion size (90.5 g of powder in total of 375 mL volume) of newly formulated powder product as ‘larger’. Therefore, the GL value for the considered powder formulation may be lower, when considering the actual portion size of a daily consumption. This study reveals of a very negative impact on blood glucose elevations by whey proteins which exceeds such an impact by the milk fat content. Hence, these findings may be of importance for dairy powder producers in future.

Conclusion

Whey protein has a great impact on reducing glycemic responses of milk. That can overtake the impact to increase the GI in milk by reduction of fat and also a little increase of digestible carbohydrates by addition of cereal powders such as oats. Hence, this information can be used by industrial producers in formulating low fat-high protein milk powder products.

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