DETERMINATION OF GLYCEMIC INDEX (GI) OF A NUTRITIONAL PRODUCT: ANMUM MATERNA - NON-ADDED SUGAR

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ABSTRACT

Objective: To determine the glycemic index (GI) of a nutritional product: Anmum Materna - non-added sugar. **Method:** The study applied the method of determining the GI of food according to the National Standard TCVN10036: 2013 on fifteen adults aged 20-35 years old. **Result:** The GI value of Anmum Materna - non-added sugar was determined to be twenty 25. **Conclusion:** Anmum Materna - non-added sugar product's GI is 25, classified as a low GI product, which can be used with a balanced diet for people with diabetes, or those at risk of diabetes or in need of blood glucose control and pregnant women with high blood sugar.

Keyword: *GI, glycemic index, diabetes, gestational diabetes*

I. INTRODUCTION

The importance of the glycemic index (GI) of food is being increasingly recognized, particularly in the prevention of metabolic illnesses that are on the rise internationally, such as obesity and diabetes. These diseases are becoming a major health problem in many countries around the world, spanning from high-to-low-income countries, according to statistics. According to International Diabetes Federation, gestational diabetes is increasing rapidly in developing countries, resulting 223 million women living with diabetes in 2019 (projected to increase to 343 million by 2045) and 1 in 6 births was affected. Diabetes involves a variety of health consequences, including cardiovascular diseases, stroke, and renal disease. Gestational diabetes has a significant influence on the mother's and fetus' health.

It is critical to develop products that are appropriate for diabetes, particularly pregnant women with diabetes. Anmum Materna - non-added sugar is a product that helps pregnant women get the important nutrients needed. However, the glycemic index - an essential indication - has not yet been analyzed and assessed for this product. As a result, this research was carried out to determine the GI index of Anmum Materna - non- added sugar product.

II. MATERIALS AND METHODS

Study design: Clinical trial.

Applying the standard method of determining the GI of foods in Vietnam according to TCVN10036:2013 [1], which is equivalent to international standard ISO26642:2010.

Study population:

Inclusion criteria: healthy adults from 20-35 years old, who: do not have blood sugar disorders (fasting blood glucose level < 5.6 mmol/L), not allergic or intolerant with cow milk, do not have blood lipid disorders (cholesterol < 5.2 mmol/L and triglycerid < 1.7 mmol/L and LDL-cholesterol < 3.4

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mmol/L and HDL-cholesterol>1.03mmol/L), do not have liver or kidney dysfunctions, have a normal BMI (18.5≤BMI≤23), and do not use medicines that have effect on glucose tolerance.

Exclusion criteria: adults with these problems were not included in the research: mental health problems, chronic diseases, pregnant women, lactating women, and using stimulation drugs.

Time of study: from November 2021 to January 2022

Sample size and sampling method:

According to TCVN10036:2013 and ISO 26642:2010, choosing at least 10 healthy adults based on inclusion and exclusion criteria [1]. Anticipating the dropout rate was 20%, in total, there were 20 eligible individuals included in the study.

Nutritional values of tested product:

Tested product is a nutritional product named Anmum Materna - non-added sugar manufactured by Fonterra Brands (Viet Nam) company limited. The nutritional values of 100 grams product include: energy (349 kcals), protein (29.4g), carbohydrate (51.02g), lipid (2.8g), Inulin (6.9g), acid linolenic (36g), acid a-linoleic (17g), DHA (69.4mg), choline (100mg) and other vitamins and minerals such as (calcium, iron, zinc, phosphor, iodine, vitamin A, vitamin D3, vitamin E, vitamin C, vitamin B complex…)

The tested product was mixed according to manufacturer's introduction to provide 20g carbohydrate. The 20g glucose mixed with 200ml of water was used as control.

Study progress:

An online form was available for volunteers to register. Based on the inclusion and exclusion criteria, 20 eligible individuals were chosen. Each individual was tested every 05 days, including 03 times with 20g glucose as control and 02 times with tested product.

The subjects had to fast for 8-10 hours the night before tested day. Then they came to study location in the next morning, taking fasting blood and using products according to study plan. The mix product had to be used within 5-10 minutes. The starting point of time to drink was recorded to calculate the time of subsequent blood collection.

Blood collection and blood analysis:

Each time 2ml of venous blood was taken from the subject by vacuum blood collection technique to reduce the risk of red blood cell rupture, pain, and fear in the subject. Blood samples are stored in Chimigly test tubes, which are used specifically for blood glucose testing (maintaining blood sugar unchanged for 36 - 48 hours after blood collection and containing anticoagulants Heparin and NaF) and analyzed after 30 minutes by automatic machine system at Medlatec Laboratory, meeting ISO 15189:2012 for medical testing standards.

At testing day, the individuals had blood drawn 7 times: prior to product consumption, after 15 minutes, 30 minutes, 45 minutes, 60 minutes, 90 minutes, and 120 minutes. The individual was in resting state for 120 minutes while waiting for blood to be obtained. Eating was not allowed as subjects were only allowed to drink extra water (150-200ml).

Data analysis: the data analysis included only individuals who participated in all 05 tested days and has taken enough blood collection in each day (07 times per day)**.** Data then coded, cleaned, and analyzed by Microsoft Excel 365 software. The area under curve (AUC) and the GI was calculated according to instructions of TCVN10036:2013 [1].

Ethical approval: The study was approved by the Ethics Council of Vietnam

Institute of Applied Medicine. To prevent hypoglycemia, fainting, or other problems, the blood collection process is properly prepared with all essential equipment, including shockproof boxes, sugar water, milk, snack, etc.

III. RESULTS

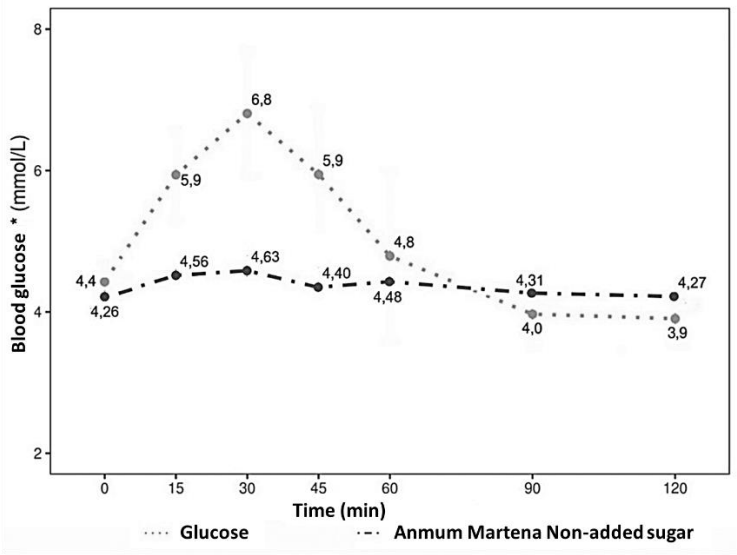
At the end of the study, there were 15 individuals who completed the tests. Characteristics of subjects were shown in the table below.

Table 1. Characteristics of subjects at the beginning of the study

Index	Mean	Standard deviation
Age	23.2	2.8
BMI (kg/m^2)	20.3	1.2
Fasting blood glucose (mmol/L)	5.2	0.2
HbA1C (%)	5.4	0.2
Urea (mmol/L)	3.9	0.7
Creatinin (mg/dl)	69.6	16.6
AST (UI/L)	17.7	7.1
ALT (UI/L)	24.3	6.4
GGT (UI/L)	20.0	7.4
Cholesterol (mmol/L)	4.1	0.7
Triglyceride (mmol/L)	1.0	0.4
HDL (mmol/L)	1.5	0.3
LDL (mmol/L)	2.1	0.6

The mean age of 15 subjects was 23,2±2,8 years old. All of them had normal BMI (from 18,5 to 23kg/m^2; mean BMI: 20,3±1,2kg/m^2). None of them had abnormal results regarding liver and kidney function, blood glucose, AST, ALT, creatine, or urea index.

Figure 3.1 showed the changing of blood glucose levels after using 20g glucose as control and tested product within 120 minutes.



*(*Results represent the average for 3 times with the glucose (control) and 2 times with the test product)*

Figure 1. The changing of blood glucose after using 20g glucose as control and tested product within 120 minutes

The mean fasting blood glucose of 15 subjects was 4.4mmol/L. After using glucose, the mean blood glucose increased by 2.4 mmol/l and reached 6.8mmol after 30 minutes, then decreased. At the end of the test, the mean blood glucose was 3.9mmol/L, lower than that at the starting time 0.5mmol/L. There was a significant difference between the blood glucose values at 30 and 60 minutes.

After using tested product, the blood glucose of all subjects was increasing and reached 4.6 mmol/L after 30 minutes. Although the blood glucose was decreasing at the 30 minute mark, it was still higher than the starting point (4.27mmol/L compared to 4.26 mmol/L)

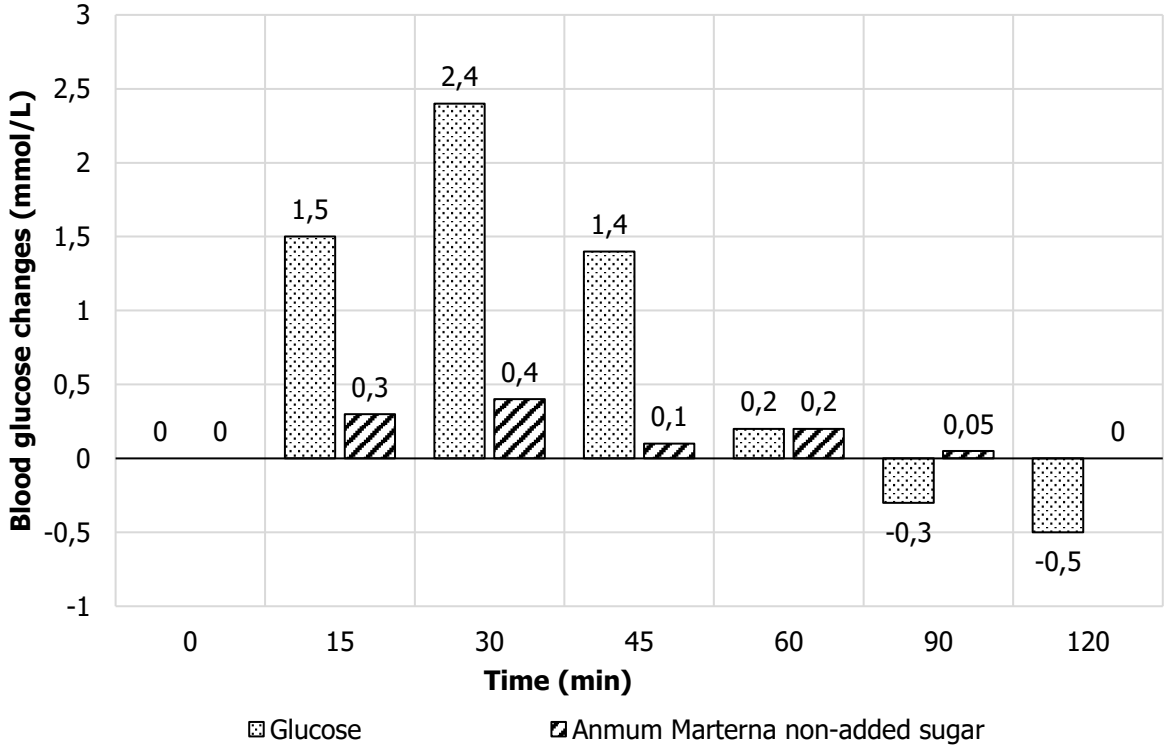


Figure 2. Increase in blood glucose at each test time compared to fasting blood sugar

Figure 3.2 shows the change of blood glucose concentration after taking Glucose and the test product over a period of 120 minutes for 15 research subjects. In general, for either glucose or the test product, blood glucose levels peak at 30 minutes and decrease gradually from 45 minutes to 120 minutes.

However, when taking 20g glucose (control), blood glucose concentration decreased rapidly after 30 minutes. From 90 minutes, the blood glucose concentration has decreased lower than the baseline, and significantly lower than the blood glucose concentration at the same time when taking the test product. When the test product was taken, blood glucose levels decreased slowly after 30 minutes. At the 90-minute and 120-minute time points, blood glucose concentration remained at the same or higher levels than at baseline.

Table 2. The glycemic index of tested product

Subject	$\overline{AUC_{Glucose}}$	$\overline{AUC_{tested\ product}}$	GI_{tested}*
1	79.3	23.9	30
2	124.6	23.3	19
3	44.0	9.3	21
4	78.5	18.5	24
5	62.9	18.3	29
6	34.6	10.6	31
7	82.8	24.4	29
8	128.0	27.9	22
9	86.7	21.8	25
10	102.3	20.1	20
11	45.5	9.5	21
12	167.9	45.5	27
13	165.4	31.8	19
14	108.5	37.6	35
15	126.0	28.6	23
Mean	**95.8 ± 41.3**	**23.4 ± 10.1**	**25 ± 1.3**

** GI were expressed to the nearest whole number*

Table 3.2 showed the result of the AUC after using the tested product. The AUC after using glucose ranged from 34.6 to 167.9, while the AUC after using tested product ranged from 9.3 to 45.5.

Result: The glycemic index of tested product was 25.

IV. DISCUSSION

The glycemic index of nutritional product: Anmum Materna - non-added sugar was calculated using standard protocol. The result showed that this product has the glycemic index of 25±1.3, which is categorized as low GI food according to TCVN10036:2013 and ISO 26642:2010. The cause that makes the blood glucose of subjects decrease after using the tested product might be due to the product's contents including fiber and protein, which prevent blood glucose from raising too high after usage. Blood glucose is also affected by a variety of other factors, including the amount and type of carbohydrate in the food, the nutritional composition of the food (protein, lipid, amylopectin ratio, dietary fiber), and some biologically active substances (such as polyphenol)...[1-4].

The fiber level of the product used in the study was 6.9g per 100g of powder, which was higher than the fiber content of several goods for pregnant women in Vietnam with average fiber level ranging from 6-6.5g/100g powder. Fiber slows glucose absorption and lowers gastric emptying. It also increases satiety by prolonging meal retention time in the stomach. So that fiber helps to manage blood glucose levels, blood lipid, prevent overweight, and obesity [2].

Protein can impact blood glucose levels in addition to fiber by influencing insulin

secretion due to its insulinotropic amino acid content or due to its effect on GIP and GLP-1 hormones [3]. Although fat and protein both lower glycemic responses, the effect is independent of each other when used in combination. Human and bovine milk with reconstituted bovine whey and casein drinks and white bread, all the milk products showed reduced glycemic response. Dairy products, in general, have properties that reduce the glycemic response compared to starch [4].

Foods with a medium or low glycemic index should be prioritized in diet since they do not produce a significant increase in blood glucose after eating, help to prevent and treat metabolic illnesses, and avoid complications due to high blood glucose in diabetes and obesity patients. Spieth et.al showed that using low GI food can help lose weight and BMI better than using low fat diet. In addition, low GI foods have also been demonstrated to help in treatment for obesity. A low GI meal's metabolism can contribute to weight reduction owing to lower insulin levels, whereas a high GI meal's metabolism tends to trigger higher insulin release [5].

Up to now, the majority of recommendation of dietary guideline for pregnant women often focus on adequate nutrition as the requirement for nutrients raises during pregnancy. However, these guidelines are not specific about the GI of foods, and most pregnant women have a moderate to high GI meal. Following a low GI diet during pregnancy is debatable as research on whether it might reduce the risk of low-birth-weight infants have been inconsistent [6].

When it comes to the health of pregnant women, research demonstrates that a low-GI diet in general and the consumption of low-GI foods in particular can be beneficial. health, particularly the body's metabolism. These benefits include: 1) Proven to keep satiety longer, thus beneficial in terms of not weight-gain reduction, reducing the increased risk of pregnancy complications, fetal overgrowth, or long-term health of both pregnant women and young children [7]; 2) Reducing postprandial hyperglycemia but not carbohydrate intake, ensuring nutrition for pregnant mothers; 3) Beneficial for the health of mothers after giving birth, especially mothers who plan on being pregnant again in the future[8].

V. CONCLUSION

The glycemic of Anmum Materna non - added sugar product was 25, which was categorized as low GI food. This product can be used with a balanced diet for people with diabetes, at risk of diabetes or in need of blood glucose control and pregnant women with high blood sugar

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