DETERMINATION OF GLYCEMIC LOAD OF QPM INCORPORATED EXTRUDED NUTRI RICH SNACK PRODUCT FOR DIABETES

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ABSTRACT

Glycemic response of the selected Quality Protein Maize based nutri rich product was determined. The selected product was an extruded ready to eat snack product which was developed and standardized with the combination of QPM, pearl millet and Morigna leaf powder in the Lab of College of Dairy and Food Science Technology, Udaipur for its processing parameters and acceptability scores. Moisture, protein, fat, carbohydrate, ash and fibre content of the product were 6.05 gram, 11.24 gram, 6.71 gram, 63.81 gram, 6.48 gram, and 5.71 gram per 100 gram respectively. An interview schedule was developed to collect the information on general profile, health habits and food habits. Glucose Tolerance Test was conducted for the glucose and test recipe at fasting (0), 30, 60, 90 and 120 hours after feeding the test recipe to determine glycemic index. It was found that glucose response of the subjects reached its peak at half an hour whereas for the test recipe it reached at one an hour for majority of the subjects which indicates delay in absorption of test recipe. Glycemic index calculated from Area Under Curve for the test recipe was 48.10 which is low when compared with classification suggested by Monro *et.al.* (2008). Further glycemic load calculated using standard formula was 9.20 which is also low suggesting the positive effect of test recipe in the management of diabetes.

KEY WORDS – QPM, Pearl millet , Morigna leaf powder, Glycemic index , Glycemic Load Area Under Curve, Insulin

INTRODUCTION

Diabetes is chronic illnesses that lead with highly risk factors; there are several different reasons to develop diabetes. Diabetes is the problem of the body when pancreas does not secrete insulin that causes blood sugar level rise in blood or blood sugar passes with urine. That is called hyperglycemia. There are different types of diabetes – type 1, type 2, and gestational diabetes.

Type 2 Diabetes Mellitus found in present study was 4.6% with equal prevalence in both the sex. Higher prevalence of diabetes in males was found in the age group of >60 years while in females prevalence occurred a decade earlier i.e. in 51-60 years. Abdominal obesity in females and family history of diabetes were found positively associated with diabetes while there was no significant association found between diabetes and physical activity. The study reported that 26 million Americans have diabetes another 79 million Americans are categorized as "pre-diabetic" i.e. at risk of developing diabetes in the next ten years due to unhealthy lifestyle. Swidorski (2014).

The glycemic index ranks carbohydrate-containing foods on how quickly they elevate blood sugar levels. glycemic index classification of foods provides a numeric physiologic

classification of relevant carbohydrate foods in the prevention and treatment of diseases such as diabetes. Since then, low-glycemic-index diets have been shown to lower urinary C-peptide excretion in healthy subjects, improve glycemic control in diabetic subjects and reduce serum lipids in hyper lipidemic subjects. Furthermore, consumption of low-glycemic index diets has been associated with higher HDL-cholesterol concentrations and decreased risk of developing diabetes and cardiovascular disease Jenkins *et al.* (2002).

The goals in the management of Type 2 diabetes mellitus are alleviation of symptoms through normalization or near normalization of fasting and postprandial blood glucose levels and prevention of acute and long-term complications. The American Diabetes Association (ADA) reviewed the evidence on glycemic index as a nutrition therapy intervention for diabetes and concluded that the total amount of carbohydrate is more important than the sources (starch or sugar) or type (low or high GI) while acknowledging that low GI foods may reduce postprandial blood glucose levels. Glycemic Index (GI) is a number associated with a particular type of food that indicates the food's effect on a person's blood glucose (also called blood sugar) level. Low GI foods are helpful in maintain normal blood sugar level in body. Low glycemic index is now an established method for achieving good glycemic control in diabetes.

Ready to eat (RTE) foods are increasing consumption these days for ease and comfort. They provide to make these food techniques of extrusion is most commercial employed. Extrusion cooking technology plays a central role in the modern cereal-based food industry, especially for the production of snack and breakfast cereal products from maize, wheat, rice and oats. Since maize flour is widely used to elaborate extruded products, there is a need to improve the nutritional value of this kind of food. Quality Protein Maize (QPM), improved variety of maize has added advantages of higher biological value due to its amino acid content. Utilization of QPM, as food ingredients instead maize helps in adding benefits of amino acid lysine and tryptophan which are generally lacking in common maize. Extrusion-cooking technique can also be used to produce specific precooked pasta or pasta-like products. Such precooked products do not require the traditional cooking process before serving and are more convenient requiring only addition of hot water for a brief period for preparation (Dong *et al*. 2010).

The (GI) compares the potential of foods containing the same carbohydrate amount to raise blood sugar. The amount of carbohydrate contained in a food serving also affects blood

glucose concentrations. The consumption of high GI and high glycemic load (GL) diets for several years may result in higher raise blood sugar concentration and excessive secretion of insulin. The concept of glycemic load (GL) was developed by scientists to simultaneously describe the quality and quantity of carbohydrate in a food serving, meal, or diet. The GL of a single food is calculated by multiplying the GI by the amount of carbohydrate in grams (g) provided by a food serving and then dividing the total by 100 reported by Monro *et. al* (2008).

METHODOLOGY

Snack food product developed and standardized at Centre of Excellence (COE) on Maize Processing and Value Addition, CDFST was taken for the study. The product comprised of combination of QPM flour, pearl millet and morigna leaf powder.QPM was selected as a source of good quality protein, pearl millet due to its high dietary fiber and mineral content. Moringa leaf powder was selected due to its high dietary fiber and protein content. Besides these, secondary raw material such as chilli, salt, maggie masala (spices), baking powder and benzoic acid were added for taste and flavor.

(a) Proximate Analysis: One serving of the recipe was homogenized and used for analyzing the proximates in triplicate. The analysis was conducted in the laboratory of Agricultural University, Junagadh, Gujarat in the academic year of 2016 by the researcher.

Selection of Subjects: A total of 30 female subjects residing in Udaipur city were selected randomly in the age group between 30-50 years and having no biochemical evidence of any other known disease. An informal written consent was taken from each participant for prior to the study.

(b) Determination of glycemic index of snack product

Oral glucose tolerance test

On the first day after overnight fast the blood glucose fasting (0 hour) was estimated, than 30 gm of glucose diluted in 100ml of water was given orally to the subjects. Blood glucose levels were estimated at 30, 60, 90, 120 minutes using glucometer (Alera GI) based on glucose – oxidase mediated reaction.

Feeding of test recipe

Next day 30gm carbohydrate selected snack product was served to each member after an overnight fast taking fasting (0 hour) blood sample. The subject was asked to consume the snack product sitting comfortably within a time span of 15-20 minutes. The blood glucose levels were estimated at 30, 60, 90, 120 minutes.

Blood glucose test

Serial estimation of blood glucose used for deriving area under the 2 hour glucose curve (AUC-G) as per the given formula.

$$GI = \frac{\text{Area under blood glucose response curve for 30 gm of test carbohydrate food}}{\text{Area under blood glucose response for 30gm of glucose}}$$

The glycemic load was also calculated for the selected snack product .It was calculated in the study by using the formula of GL_{Food} = (GI_{Food} x amount (g) of available $carbohydrate_{Food}$ per serving)/100. Glycemic loads below 10 to be "low," and Glycemic Loads above 20 to be "high." Because Glycemic load is related to the food's effect on blood sugar, low Glycemic load meals are recommended for diabetic control. Monro *et. al* (2008).

(C) Data analysis: The data on religion, caste family type size, food habits, educational information, marital status, family history, blood pressure and food consumption pattern was expressed as frequencies and percentages. Height, BMI, Waist circumference, hip circumference, WHR was calculated. Area Under Curve (AUC) formula was used to calculate glycemic index and Mean $\pm$ SD were also calculated of glycemic values of the subjects. Mean $\pm$ SD were also calculated by help of statistical software. (SSPS).

RESULTS AND DISCUSSION: A total of 30 females in the age group between 30-50 years were included in the study.

(a) Proximate composition of the product:

The minimum ash content was 6.48per cent. Protein content was 11.24 per cent in the selected snack product. Carbohydrates content was 66.45 per cent in the snack product. According to Sumbo and Ikujenlola (2014) carbohydrate content was 73.98 per cent in

QPM whereas the available carbohydrate content of peal millet was 59.80 per cent. Dietary fibre content of the selected extrudate was 5.71gram. Fat content of extrudate was 6.71 per cent obtained through Soxhlet method (Table 1).

Table 1: Proximate composition of product per 100gm

S. No.	Name of Nutrients	Per cent
1	Moisture	6.05
2	Ash	6.48
3	Fat	6.71
4	Protein	11.24
5	Carbohydrate	63.81
6	Crude Fibre	5.71

(b) Glycemic index:

The findings revealed that the glycemic index was low of the selected snack product prepared with pearl millet, morigna powder and QPM. was 48.10 . Similarly in a study conducted by Nambiar *et.al* (2011) reported that the pearl millet is rich in several nutrients as well as non-nutrients such as phenols. It has high energy, less starch, gluten free, high fiber (1.2g/100g, most of which is insoluble), 8-15 times greater α-amylase activity as compared to wheat and has low glycemic index. In another study by Panlasigui *et.al* (2010) results show that the average glycemic index for milled rice (119.89) was higher while that of the pure QPM grits (80.29) was lower than the control food. The mixed rice-QPM grits had higher GI (91.29) than the pure QPM grits. The GI of the selected product may be low due to use of Pearl millet having lower glycemic index. Similarly selection of morigna leaf powder has medicinal application. It is used as potential antioxidant, anticancer, anti inflammatory, ant diabetic and anti microbial agents which medicinal values deals with nutrition, commercial and pharmacological properties of this miracle tree. QPM is high in energy and content approximately 9-12 per cent crude protein with two essential amino acids lysine and tryptophan.

(c) Glycemic load: Glycemic load (GL) was developed by scientists to simultaneously describe the quality and quantity of carbohydrate in a food serving, meal, or diet. The GL

of a single food is calculated by multiplying the GI by the amount of carbohydrate in grams (g) provided by a food serving and then dividing the total by 100 reported by Monro *et. al* (2008).

Since the serving size was 30gm which provides 19.14 carbohydrates, the glycemic load of selected snack product is 9.20 which indicates low glycemic load.

$$GL= (48.10x19.14/100) = 9.20$$

In the present study the selected snack product has low glycemic index of 48.10 with a very low glycemic load of 9.20. Hence it can be said that use of pearl millet. QPM flour and moringa leaves can help in creating low glycemic index product. This may be attributed to the fact that may be affected in partical size, cooking methods also due to influence in their physiochemical characteristics.

CONCLUSION: The selected snack product was standardized with the combination of QPM, pearl millet and morigna leaf powder. Pearl millet has lower glycemic index (55). Similarly selection of morigna leaf powder has medicinal application. It is used as potential antioxidant, anticancer, anti inflammatory, ant diabetic and anti microbial agents which medicinal values deals with nutrition, commercial and pharmacological properties of this miracle tree. QPM is high in energy and content approximately 9-12 per cent crude protein with two essential amino acids lysine and tryptophan. Presence of amino acids and protein content QPM was selected in this study. So that we concluded that this selected snack product has low glycemic index with low glycemic load that is beneficial for diabetic patients.

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Acknowledgements

The support of Mr. Sushant Khote under the guidance of Prof. N.K. Jain is acknowledged for creating the product.

The Present study was conducted in the Lab of centre of Excellence on Maize established by the authors at College of Dairy and Food Science Technology, Udaipur. In the lab about 13 recipes of maize were commercially developed and standardized. About 42 trainings have been conducted and more then 1500 beneficiaries have been trained for the same. Below mentioned is a list of publications of the same:

1. Murdia L.K.,Wadhawani R.,Wadhawan N., Bajpai P. and Shekhawat S.(2016). **Maize Utilisation in India: An Overview**. American Journal of Food and Nutrition Vol 4 (6) 169-176.
2. L. K. Murdia, Nikita Wadhawan, Seema Shekhawat and Preeti Bajpai(2016). **Evaluation of Textural Properties of QPM Based Puffed Corns .Advances in Life Sciences.Vol.20(5).**
3. L. K. Murdia, Nikita Wadhawan, Preeti Bajpai and Seema Shekhawat**. Value addition in maize**. Invited paper in 5th National seminar proceedings on coarse cerals development-Challenges & opportunities in the country. 20-21st March 2016, CCSHAU, Hisar. 55-58.
4. Dr. Nikita Wadhawan **"Showcasing Value added products of maize for commercialization"** Paper presented in Industrial interface on 21st -22nd Feb 2016 organized at Indian Institute of Millets Research (IIMR) Hyderabad.

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5. Preeti Bajpai, Nikita Wadhawan, G.K. Mathur and Mani G. Singh. **Exploring market potential for QPM based commercial products**. International conference on community Nutrition & Health: A social responsibility & work environment. 7-9th December 2015, IIT Bombay. 84.
6. L. K. Murdia, Nikita Wadhawan, Preeti Bajpai and Mani G. Singh. **Organoleptic acceptability of QPM based value added bakery products.** National conference on food processing and technology. 25-26th February 2016, at Shoolini University, Solan. 51-52. ISBN No. 9782-93-82068-754.
7. L. K. Murdia, Nikita Wadhawan, Preeti Bajpai and Seema Shekhawat. **Enhance consumer acceptability of quality protein maize.** International Conference on Recent Advances in Food Processing and Biotechnology. 5-6th April 2016. Centre of Food Science and Technology, Institute of Agricultural Sciences Banaras Hindu University, Varanasi.
8. Tak J and Wadhawan N (2016). **Assessment of dietary Micronutrient Deficiency among Adolescent Girls.** Food Science Research Journal Vol 4(2) 333-337.
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