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Estimation of glycemic index of developed *Heartdiabocare* functional snack

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A functional food might be functional for all members of a population or for particular groups of the population, which might be defined, for example, by age or by genetic constitution. Glycemic index, or GI, measures how a carbohydrate-containing food raises blood glucose. Foods are ranked based on how they compare to a reference food– either glucose or white bread. A food with a high GI raises blood glucose more than a food with a medium or low GI. Hence an attempt was made to develop a functional snack using functional ingredient and to its nutrient content and glycemic index. Results evidenced that moisture, protein and fat content of functional snack were 2.33 per cent, 17.11 per cent an 12.08 per cent, respectively. Dietary fibre content of functional snack was 22.28 per cent. The soluble and insoluble dietary fibre was 3.86 and 18.42 per cent, respectively. The estimated micronutrients were calcium 296.56 mg, iron 7.5 mg, zinc 1.48 mg, copper 0.397 mg and manganese 1.65mg per 100 g. Invitro protein digestibility of developed functional snack was 82 per cent. The glycemic index value calculated by determining the ratio of area under the glucose response curve for the heartdiabocare snack and the area for the glucose was 26.27 which was categorized as low per the classification of glycemic index. Hence, it can be concluded that though equicarbohydrate portion of heartdibiocare snack was fed to the subjects, the rise in the blood glucose was significantly less which proves that the developed snack being low in GI is suitable for diabetic patients.

Key Words : Glycemic index, Functional snack, *Heartdiabocare*

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INTRODUCTION

A food can be described as functional food if it satisfactorily improves our health beyond nutritional necessity. These improvements include an improved state of health, a reduction of risk of any type of disease and enhanced physical and mental well-being of consumers (Menrad, 2003).

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A functional food can be a natural food, a food to which a component has been added, or a food from which a component has been removed by technological or biotechnological means. It can also be a food where the nature of one or more components has been modified, or a food in which the bioavailability of one or more components has been modified, or any combination of these possibilities. A functional food might be functional for all members of a population or for particular groups of the population, which might be defined, for example, by age or by genetic constitution. By utilizing the functional ingredients available in our country the formulation of functional foods to prevent deficiency diseases and non communicable diseases is essential.

Health is one of the frequently mentioned driving

forces for conscious consumers. Consumer awareness of the relationship between diet and health has increased considerably in recent years, based on recent studies that a healthy diet can contribute to reduced risk of common diseases such as coronary heart problems, diabetes and cancer (Blandon *et al.*, 2007).

There is increasing evidence that both the amount and type of carbohydrate play an important role in weight management and risk of chronic diseases. Classifying carbohydrates according to their post-prandial glycemic effect (*i.e.*, the glycemic index of foods) has yielded more useful insights than the historical distinctions of simple versus complex chemical structure. Diets based on carbohydrate foods that are more slowly digested and absorbed (*i.e.*, low glycemic index diets) have been independently linked to reduced risk of type 2 diabetes, cardiovascular disease, and some types of cancer (Marsh and Brand Milter, 2008). Glycemic index, or GI, measures how a carbohydrate-containing food raises blood glucose. Foods are ranked based on how they compare to a reference food– either glucose or white bread. A food with a high GI raises blood glucose more than a food with a medium or low GI.

Hence glycemic index (GI) is an important parameter of food quality which compares the hyperglycemic effect of a tested meal with pure glucose (or of another defined standard food). The GI is a measure of the food power to raise β-glucose concentration after a meal. The GI is defined as relation of the incremental area under the β-glucose response curve (IAUC) of a tested meal containing 50 g of digestible carbohydrates and the incremental area under the β-glucose response curve of the standard food, *i.e.* 50 g pure glucose (IAUCS). Carbohydrates that breakdown quickly during digestion have a high GI because their β-glucose response is fast and high. Carbohydrates that breakdown slowly have a low GI (Chlup *et al.,* 2004 and Jenkins *et al.,* 2002).

During the last few years, there has been a large body of data that suggests a diet composed of low GI foods has a role to play in the prevention or treatment of a number of chronic diseases including type 2 diabetes mellitus, cardiovascular disease and cancer.

By definition, the GI compares equal quantities of carbohydrate and provides a measure of carbohydrate quality but not quantity. In 1997 the concept of Glycemic Load (GL) was introduced by researchers at Harvard University to quantify the overall glycemic effect of a portion of food. Thus, the GL of a typical serving of food is the product of the amount of available carbohydrate in that serving and the GI of the food. The higher the GL, the greater the expected elevation in blood glucose and in the insulinogenic effect of the food. The long-term consumption of a diet with a relatively high GL (adjusted for total energy) is associated with an increased risk of type 2 diabetes and coronary heart disease (Liu *et al.*, 2000 and Liu and Willet, 2002).

While it may present challenges for food manufacturers to develop low glycemic index foods, it is well worth to develop these products because of the prevalence of diabetes and pre-diabetes in the region and beyond. It is estimated that by 2030, more than 16 per cent of the global population will have a blood sugar problem. "Most of the risk factors are things that can be managed and modified." "We can reverse pre-diabetes and prevent it from becoming diabetes. Food has become the reason for what's ailing us, but it can actually be a solution in a number of different ways" (IFT, 2012). Hence an attempt was made to develop a functional snack using functional ingredient and to its nutrient content and glycemic index.

METHODOLOGY

Chemical and nutritional analysis :

The final product of functional snacks was analyzed for nutritional quality assessment. The parameters analyzed were moisture, total minerals, protein, total fat, dietary fibre, calcium phosphorus, iron, zinc, copper, manganese by AOAC procedures (1990).Apart from these the in vitro protein digestibility of the product was determined using the method described by Moulishwar *et al.* (1993). The values of carbohydrate energy, water soluble vitamins such as thiamine, riboflavin and niacin were calculated by using the food composition tables (Gopalan *et al.,* 2010).

A step by step procedure to estimate the GI of tested samples: as per WHO and FAO protocol (Jenkins *et al.*, 2002).

Selection of 10 healthy adult female, normal BMI, male volunteers aged between 25-30 years were selected (Table 1) from the Rajmata Jijau Girls Hostel VNMKV, Parbhani to perform a formal experiment. The volunteers showed no family history of diabetes or any food allergies, were not on any medication and also were not on weight loss diet. Since, Estimating glycemic index can only be

done in a controlled environment with a control substance and the test food sample.

Step 2 :

50 g of glucose in 300ml water was given to the samples (10 volunteers).

Step 3 :

A single venous blood sample was taken in the fasting state and at 30 min, 1 hr, 1 hr 30 min and 2 hourly after consuming each sample. The area under the resulting curve is what is measured, and it is called the incremental area under the blood glucose response curve, or IAUC.

Step 4 :

The test food was given to the volunteers after they have been in fasting mode for at least 10-12 hours was administered; the test was performed in the morning along with a drink of water which was often given with the test meal.

Step 5 :

The blood plasma glucose level for the next two hours was charted the same way as charted for 50 g glucose. The IAUC was also calculated the same way, as the area under the resulting curve.

Step 6 :

By dividing the IAUC of the test food by the IAUC of the control food and multiplying it by 100. The GI of the test food for each test subject was calculated.

Calculations of individual GI values in every volunteer :

The incremental area under the curve (IAUC) was calculated for each meal in every volunteer separately. The IAUCS for the standard reference food (*i.e.* 50 g of pure glucose) was obtained, in the IAUC/IAUCS calculations, all β-glucose values in the course of the test lower than the first value (at time 0) were equalized to the respective first value. In each volunteer, the GI (%) was calculated by dividing the IAUC for the tested food by the IAUCS for the standard food and multiplying by 100.

IAUC – Incremental Area Under the blood glucose response Curve for the tested meal.

IAUCS – Incremental Area Under the blood glucose response Curve for the standard meal.

Final calculation of the GI for each tested food:

The GI for each tested food was calculated as the mean from the respective average GI's of the 10 volunteers.

Statistical analysis :

To analyze the data't' test and analysis of variance (ANOVA) were used to compare the differences in blood glucose level of test food and glucose. The statistical analysis was carried out by following the procedures prescribes by Panse and Sukhatme (1985).

OBSERVATIONS AND ASSESSMENT

Nutritional evaluation of functional snack is presented in Table 1. Results evidenced that moisture, protein and fat content of functional snack were 2.33 per cent, 17.11 per cent an 12.08 per cent, respectively. Dietary fibre content of functional snack was 22.28 per cent. The soluble and insoluble dietary fibre was 3.86 and 18.42 per cent, respectively. The estimated micronutrients were calcium 298 mg, iron 7.5 mg, zinc 1.48 mg, copper 0.397 mg and manganese 1.65mg per 100 g. Invitro protein digestibility of developed functional snack was 82 per cent.

The data with regard to calculated nutrient content indicated that the developed functional snack had 43.97 per cent carbohydrates, can supply 349 Kcal energy per 100 g while the values of thiamine, riboflavin and niacin were 0.225, 1.031 and 1.85 mg/100g of snack.

Recent studies from Harvard School of Public Health indicate that the risks of diseases such as type 2 diabetes and coronary heart disease are strongly related to the GI of the overall diet. In 1999, the World Health Organisation (WHO) and Food and Agriculture

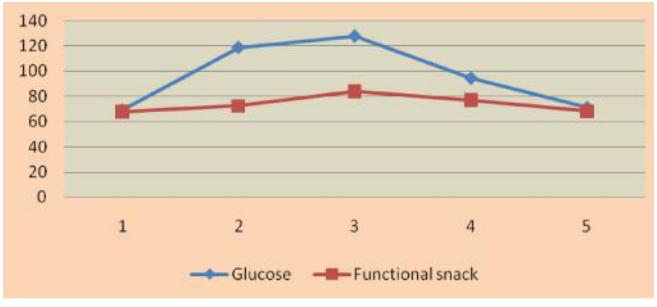

Fig. 1 : glucose curve of glucose and test sample (Functional snack)

Table 1 : Nutrient content of developed functional *Heartdiabocare snack*/ 100 g

Estimated nutrients		Calculated nutrients	
Nutrients	Amount	Nutrients	Amount
Moisture (g)	2.33	Carbohydrate (g)	43.97
Protein (g)	17.11	Energy (Kcal)	349
Fat (g)	12.08	Thiamin (mg)	0.225
Total dietary fibre (g)	22.28	Riboflavin (mg)	1.031
Insoluble fibre (g)	3.86	Niacin (mg)	1.85
Soluble fibre (g)	18.42		
Calcium (mg)	298		
Iron (mg)	7.5		
Zinc (mg)	1.48		
Copper (mg)	0.397		
Manganese (mg)	1.657		
Protein digestibility (%)	82		

Organisation (FAO) recommended that people in industrialised countries base their diets on low-GI foods in order to prevent the most common diseases, such as coronary heart disease, diabetes and obesity Jenkins *et al.* (2002).

Glycemic index of heartdiabocare snack :

Glycemic index (GI) is an important parameter that measures how a food raises blood glucose. Foods are ranked depending on their ability to raise the blood glucose in comparison with a reference food mostly glucose. A food with a high GI raises blood glucose more than a food with a medium or low GI. Foods with low GI are recommended to diabetics and to keep normal spectrum of lipoproteins (Subhashini and Ushadevi, 2014). GI of the heartdiabocare snack was estimated to check its suitability to feed to the diabetic subjects. The glycemic response of the subjects after ingestion of glucose and heartdiabocare snack was measured and the data is presented in Table 2. The mean fasting blood glucose of the subjects was 69.7 mg/dl. It was raised gradually after ingestion of 50 g glucose upto 119.9 mg/dl in 30 minutes and reached to peak after 60 minutes to 133.7 mg/dl. Thereafter the blood glucose was reduced to 93.1 mg/dl within 90 minutes and slided down almost to base level within two hours (69.4 mg/dl). The similar trend of blood glucose was noticed in the subjects after consumption of heartdiabocare snack. The initial value of blood glucose was 67.6 mg/dl. It increased and searched to peak (86.2 mg/dl) within half an hour. After that it started declining and reduced to 83.4, 75.4 and 68.4 mg/dl at the assessments intervals of 60, 90 and 120 minutes, respectively. The statistical comparison of data indicated that at the blood glucose assessment intervals of 30, 60 and 90 minutes the difference in the blood glucose levels was significant between the two foods. The increase in the glucose content of blood was significantly less after consumption of developed heartdiabocare snack than the increase due to ingestion of glucose at 30,60 and 90 minutes.

The glycemic index value calculated by determining the ratio of area under the glucose response curve for the heartdiabocare snack and the area for the glucose was 26.27 which is categorized as low per the

Table 2 : Glycemic responce and glycemic index of heartdiabocare snack

Sr. No.	Time (min)	Blood Glucose Level (mg/dl) (mean ± SD)		't' Value	GI of heartdiabocare snack
		After ingesion of glucose	After ingesion of test food		
1.	0 (Fasting)	69.7 ± 5.12	67.6 ± 2.75	1.14^{NS}	
2.	30	119.9 ± 26.66	86.2 ± 8.76	3.76**	26.2 ± 3.83
3.	60	133.7 ± 21.5	83.4 ± 10.16	6.66**	
4.	90	93.1 ± 20.19	75.4 ± 8.56	2.55**	
5.	120	69.4 ± 4.78	68.4 ± 4.32	0.49^{NS}	

** indicate significance of value at P=0.01, NS=Non-significant

classification of glycemic index.

The data with regard to glycemic response of the selected subjects towards the glucose and developed heartdiabocare snack evidenced that the mean blood glucose level significantly increased within 60 minutes when 50g of glucose was given to them, its well known fact that glucose is monosaccharide and is readily absorbed in the blood stream m gut. That is the reason why glucose is used as a reference food for conducting glycemic index studies (Wolever and Jenkins, 1986). The data emerged from blood glucose levels of the subjects after consumption of heartdiabocare snack showed that there was significant increase in the blood glucose values upto 60 minutes over the initial one. The peak value of blood glucose was noticed after 60 minutes.

The significantly lower blood glucose level of the subjects after consumption of test food can be attributed to its ingredient composition. The test food under study was prepared by using various ingredients such as flax seed, wheat bran, oats, soya chunk powder, gum acacia, jowar flour and wheat flour etc. These ingredients may have different partial sizes. The starch type and granules may be different from different foods and hence may affect the physical characteristics of starch with regard to its cooking quality and digestibility. Some starches may be resistant to cooking and digestibility. Some starches may be resistant to cooking and digestion. The flaxseed gum and gum acasia may help in flattering the glucose curve as they behave like typical viscous fibres. Flax seed portion may also influence blood glucose of its interaction with the gums and also by stimulating insulin secretion (Oomah, 2001). Many foods contain antinutrients such as enzyme inhibitors, phytates, tannins and lectins which have been found to influence starch digestibility and can correlate negatively with glycemic responce (Mani *et al.*, 1997). Hence it can be concluded that though equicarbohydrate portion of heartdibiocare snack was fed to the subjects, the rise in the blood glucose was significantly less which proves that the developed snack being low in GI is suitable for diabetic patients.

Food factor such as food from particle size, processing, preparation and cooking methods, type of starch structure, the presence of other nutrients may affect the GI value (Aston *et al.*, 2008 and Bjorch *et al*., 1994).

An important effect attributable to the results associated with low GI in Functional snack when compared to the raw ingredients quoted in the study, It is important to note that pearl millet are rich in fibre which provides bulk to Gastro-Intestinal tract contents and slows transit time of matter through the tract (Bjorch *et al*., 1994).

Soluble fibre also decreases the rate of starch digestion by pancreatic amylase in vivo, probably by delaying the interaction between enzymes and substrates (Aston *et al.,* 2008).

Conclusion :

According to the results, the average GI value for functional snack was found to be 26 classified as low GI food.

Hence the intake of functional snack can be consistent favourable to diabetics who require low GI foods in the daily diet and it is also a good choice for healthy eating habits and also could be good alternative cereal food.

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LITERATURE CITED

AOAC (1990). (Association of Official Analytical Chemists) official methods of analysis of AOAC International 18th edition.

Aston, L.M., Gambell, J.M., Lee, P.M., Bryant, S.D. and Jebb, S.A. (2008). Determination of the glycemic index of various staple carbohydrate rich foods in UK. *Eur. J. Clin. Nutr.*, **62** : 279-285

Blandon, J., Cranfield, J. and Henson, S. (2007). Functional Food and Natural Health Product Issues: The Canadian and International Context. International Food Economy Research Group. Department of Food, Agricultural and Resource Economics Guelph, Ontario, Canada.

Bjorch, J., Granfeldt, Y., Liljeberg, H., Torar, J. and Sp, N.G. (1994). Food properties affecting the digestion and absorption of carbohydrates. *Am. J. Clin. Nutr.*, **59** (Suppl) : 6965-7055.

Chlup, R., Bartek, J., Øezníèková, M., Zapletalová, J., Doubravová, B., Chlupová, L., Seèkaø, P., Dvoøáèková, S. and Šimánek, V. (2004). *Biomed. Papers*, **148**(1) : 17–25.

Gopalan, C., Sastri, B.V.R. and Balasubramanian, S.C. (2010). ICMR-Food Composition tables, Nutritive value of Indian

Foods, revised and updated by Rao, B.S.N. Deosthale Y.A. and Pant K.C, NIN, ICMR, Hyderabad, Pp. 47-95.

IFT (2012). Glycemic Index Foods at Breakfast Can Control Blood Sugar Throughout the Day.

Jenkins, A.L., Jenkins, D.J., Zdravkovitz, U., Wursch, P. and Vuksan, V. (2002). Depression of glycemic index by high levels of beta-glucan fi ber in two functional foods tested in type 2 diabetes. *Eur. J. Clin. Nutr.*, **56** : 622–628.

Liu, Simin, Willett, Walter C., Stampfer, Meir J., Hu, Frank B., Franz, Mary, Sampson, Laura, Hennekens, Charles H. and Manson, JoAnn E. (2000). A prospective study of dietary glycemic load, carbohydrate intake, and risk of coronary heart disease in US women. *American J. Clinical Nutri.*, **71** (6) : 1455–1461,

Liu, S. and Willett, W.C. (2002). Dietary glycemic load and atherotrombotic risk. *Curr. Atheroscler. Rep.*, **4** : 454–61.

Lee, B.L. (2011). Dietary guidelines in singapore. *Asia Pac. J. Clin. Nutr.*, **20**(3) : 472-476.

Marsh, Kate and Brand-Miller, Jennie (2008). State of the art reviews: Glycemic index, obesity, and chronic disease. *American J. Lifestyle Med.*, **2**(2) : 142-150.

Menrad, K., (2003). Market and marketing of functional food in Europe. *J. Food Engg.*, **56**: 181–188.

Mouliswar, P., Kurien, S.,Daniel, V.A., Malleshi, N.G and Venkat Rao (1993). *In vitro* digestibility of protein and starch of energy food and its bulk reduction. *J.Food. Sci Technol.*, **30**(1): 36-39.

Oomah, B.D. (2001). Flaxseed as a functional food source. *J Sci. Food Agric*., **81**:889-894.

Panse, V.G. and Sukhatme, P.V. (1985). *Statistical Methods for Agricultural Workers*. ICAR publications, New Delhi, 58-60, 97-110.

Shubhanshini, V. and Ushadevi, C. (2014). Estimation of Glycemic index of Foxtail Millet. *Internat. J. Sciet. Res.*, **5** (12) : 2210-2213.

Wolever, T.M.S. and Jenkins, D.J.A.(1986). The use of glycaemic index in predicting the blood glucose response to mixed meals. *Am. J. Clin.Nutr*., **43**: 167- 172.

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