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Value added Indian flat breads with Ashwagandha and its glycemic response among normal healthy subjects

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ABSTRACT

The glycemic index (GI) provides an indication of carbohydrate quality whereas glycemic load (GL) provides carbohydrates quantity in a food and the insulin demand. Diet with low glycemic index and glycemic load have been shown to improve glucose tolerance on normal healthy subjects so there is a need for a more diversified range of foods with a low glycemic response. The objective of present work was to formulate ashwagandha based food products by utilizing their root powder as an ingredient and their glycemic responses on normal healthy subjects. The products (Chappati, Naan and Thepla) were developed by incorporation of 2%, 4%, 6% and 8% aswagandha root. The result showed that the products with 2% root powder were most acceptable by semi trained panels. Further, study was conducted on randomly selected 30 healthy subjects were fed most acceptable test recipe i.e. thepla and their glycemic response was anticipated. GI and GL values were 37.30 and 11.36 found to be lower 2% root incorporated in thepla while comparing with standard thepla. The data demonstrated that the test thepla belongs to low glycemic index and medium glycemic load. Thus, the inclusion of ashwagandha powder as a constituent can be used to achieve a wider range of low glycemic functional foods possessing sensory attributes that could be valuable for managing the diabetes mellitus.

Key words: Ashwagandha, Diabetes, Glycemic Index (GI), Glycemic Load (GL), Incremental area under curve (IAUC)

INTRODUCTION

Increased levels of blood glucose in the postprandial state may be considered as risk factors for the development of diabetes and cardiovascular disease. Conversely, improvement of lipid metabolism and prevention of cardiovascular disease may be caused by lowering the Glycemic Index (GI) of the diet (Wolever, 2003). The World Health Organization (WHO) and the Food and Agricultural Organization (FAO) recommend consuming foods with low GI as a part of healthy diets for the general population. It is important that such herbs should have no or little side effects. Traditionally, various plant species have been used for their hypoglycemic properties (Yeh *et al.*, 2003) which can be used as a self-care option for maintaining health and for improving the quality of life has received a great deal of public interest (Broudhurst, 2000). Among such species that are commonly used in India are *Trigonella foenumgraecum, Senna auriculata, Cinnamomum zeylanicum, Hibiscus rosasinensis, Syzygium cumini and Aegle marmelos* (Elavarasi, *et al.*, 2013).

Ashwagandha (*Withania somnifera)* belongs to Solanaceae family widely used in Ayurvedic system of medicine in India. Several studies on this plant indicated that it possesses anti-inflammatory, anti-tumour, anti-stress, antioxidant, immunemodulatory, hemopoetic and rejuvenating properties besides its positive influence on the endocrine, cardiopulmonary and central nervous system (Singh, *et al.*, 2011). Ashwagandha has a reputation as a general energy-promoting, disease preventing tonic may be its effect on the immune system and regulate blood sugar which aids in suppressing sugar cravings (Anwer, *et al.*, 2008). Thus, the present study was taken up to investigate the effect of low GI products based on *W. somnifera* root powder on blood glucose in healthy subjects.

MATERIALS AND METHODS

• **Sample collection:** Ashwagandha roots were collected from local market of Delhi and authenticated by scientist of National Institute of Ayurveda , Jaipur (Rajasthan). Roots were washed and dried in open air for 2-3 weeks at 35-40º C and then dried material was pulverized in an electric grinder and stored in plastic containers in refrigerator (5^0C).

• **Product development:** Indian flat breads (Chappati, Naan and Thepla) were developed with variation in each food products. The appropriate amounts (2%, 4%, 6% and 8%) of ashwagandha root powder was added in the flour and stored in air tight containers for further use.

• **Sensory evaluation:** The sensory evaluation was carried out in order to get consumer response for overall

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acceptability of the ashwagandha root powder based products which were compared with control product**.** These test products were evaluated by 30 semi-trained panels for different sensory quality characteristics such as colour, appearance, texture, taste, after taste by 5-point composite score (1-poor to 5-very good) and overall acceptability was evaluated by structured hedonic scale (1; dislike extremely to 9; extremely liked) (Almeida, *et al.*, 2002 and Desai, *et al.*, 2010)**.** The best selected products were used further investigated for glycemic response.

• **Study subjects:** Thirty normal healthy subjects of the age 22-23y, height 155-160 cm, weight 52-55 kg and BMI 22-25 kg/m^2 were randomly selected from Banasthali University campus. The purpose of the study was explained to each subject and consent to participate in the study was taken. The subjects were given general instructions to avoid any physical exertion, medication, fasts and feasts during the experimental period.

• **Assessment of glycemic response:** On the first day of the study, Glucose Tolerance Test (GTT) was conducted on overnight fasted subjects. A 50g glucose dissolved in 200ml water was given to the subjects. The subjects were instructed to finish the glucose solution within 15 min and to avoid physical exertion during the experimental period. The blood glucose level was measured at 0mins, ½ hr, 1 hr, 1 ½ hr & 2 hr with the help of a glucometer using glucostix which is based on the action of glucose oxidase. The tests on the reference food should be repeated two times in order to reduce the variability within the subjects. The food products were Chapatti, Naan and Thepla incorporated with 2%, 4%, 6% & 8% and evaluated for two consecutive days. The subjects were asked to follow the same instructions as for the glucose tolerance test. The incremental area under the blood glucose curve is calculated for each blood glucose response curve geometrically by the trapezoid rule, disregarding the area below baseline using methods described by Wolever *et al.* (1991). Briefly, areas below baseline values were subtracted from total area under the curve. If blood glucose values fell below baseline, IAUC at those data points were also subtracted from the total.

$$\frac{At}{2} + At + \frac{(B-A)t}{2} + Bt\,\frac{(D-C)}{2} + Dt + \frac{(E-D)t}{2} + Et \ldots\ldots\ldots\ldots \text{etc}$$

Where A, B, C, D and E represent positive blood glucose increments; t is the time interval between blood samples. If the blood glucose increments D is positive (i.e. greater than baseline) only the area between D and E above the baseline is included.

• **Determination of glycemic index (GI) and glycemic load (GL)**

The glycemic index (GI) of selected test Indian flat breads was determined by feeding the healthy subjects. The GI of each food was expressed as % mean glucose response of the test food divided by the standard food taken by the same subject and was determined by the following formula:

$$\text{Glycemic Index} = \frac{\text{IAUC of test food}}{\text{IAUC of glucose}} \times 100$$

The glycemic load was calculated based on the quantity of the recipe per serving and the respective available carbohydrate content.

$$\text{GL} = \text{Available Carbohydrate (g)}\ X \frac{\text{Glycemic Index}}{100}$$

Statistical analysis: All data were triplicate and expressed as Mean ± Standard Deviation. The results of the study were statistically analyzed to ascertain its significance. The analytical data obtained from ashwagandha root powder based product was subjected to paired *t*-test. The significant difference at ($p \leq 0.05$ level) was estimated.

RESULTS AND DISCUSSION

All thirty-panel completed sensory evaluation of test Chappati, Naan and Thepla incorporated with ashwagandha root powder at different concentrations with their standard products. A result comparing sensory characteristics by overall acceptability of corresponding food products is summarized in Table 1.The VA_1- 2% incorporated with ashwagandha which was non-significant at $P \leq 0.05$ level as compared to the standard whereas other variants such as VA_2, VA_3& VA_4 were ranging from 6.8±0.83 to 2.7±0.69 which showed significant difference at $P \leq 0.05$ level when compared to standard . The Indian flat breads incorporated with 15% and 20% ashwagandha powder were not liked by panel due its astringent and bitter taste. The most acceptable product was VA_1- Thepla with 2% incorporation of ashwagandha which had higher value i.e.

Table 1: Mean hedonic rating scores of overall acceptability of indian flat breads

Overall Acceptability	Chapatti	Naan	Thepla
Std (A)	8.5±0.50	8.8±0.40	8.6±0.49
VA1	8.0±0.50^{ns}	7.5±0.80^{ns}	8.5±0.47^{ns}
VA2	6.4±0.16*	6.26±0.78*	6.8±0.83*
VA3	5.0±0.83*	5.2±0.69*	5.4±0.83*
VA4	2.7±0.69*	3.4±0.90*	3.8±0.83*

Data are reported as Mean±Standard Deviation group of 30 panel members each. All test recipes grouped as VA_1; 2%, VA_2 ;4%, VA_3 ;6%, VA_4 ;8% incorporated with ashwagandha root powder .* significant, ^{ns}- non-significant when compared with their Standards (S) at $P \leq 0.05$.

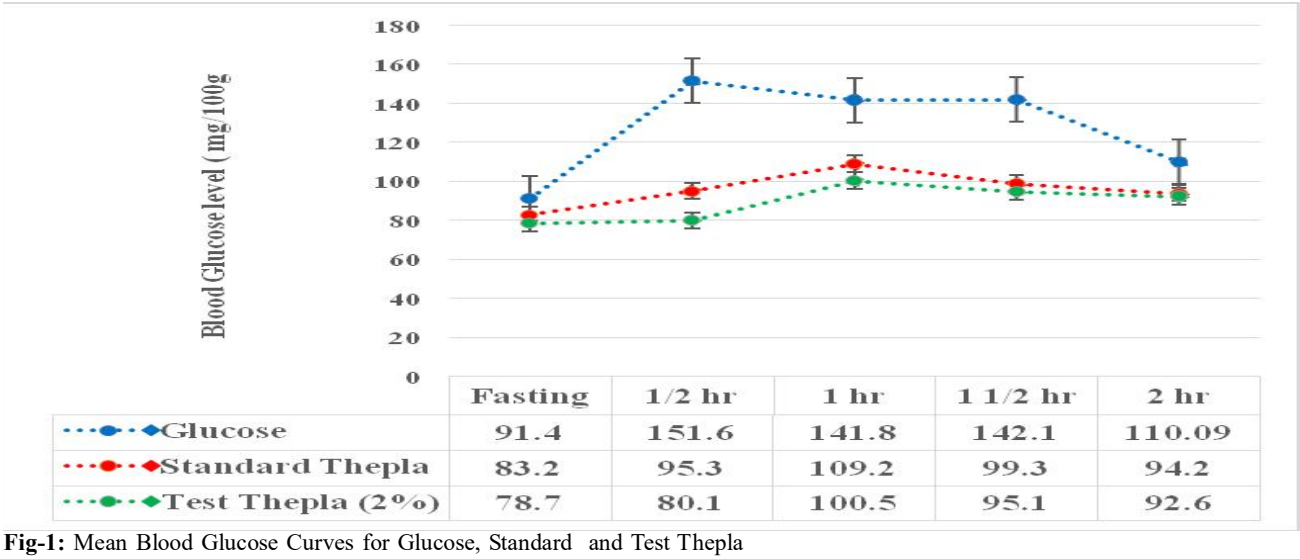

Fig-1: Mean Blood Glucose Curves for Glucose, Standard and Test Thepla

Table 2: Incremental Area under Curve (IAUC), Glycemic Index (GI) and Glycemic Load (GL) of Food product

Products	IUAC for test product (mg.min/100ml)	IUAC for Glucose (mg.min/100ml)	GI	GL
Thepla (2%*ashwagandha root powder)*	1139	3053.4	37.30	11.36
Thepla (Standard)	1769		57.77	17.33

High; GId"55% (Low), 55-70% (medium), >70%; (High) GL-Lowd"10, Medium 11-19 and e"20 High

8.5±0.47 in terms of overall acceptability. This study was conducted on 30 normal subjects of age group 22-23 years female randomly selected from student hostel of Banasthali University. The Mean±SD of weight, height, BMI, pulse rate and HbA1c of the subjects was (53.36±4.72) kg and (157.62±4.72) cm, (22.5±1.98) kg/m^2, (76.4±3.16) $min^{-1}$and (5.5±0.07 %) respectively. A total of 150 tests were performed on normal subjects. All subjects for the investigation fasted overnight. Their blood samples were collected through finger prick using a hypodermic needle. Each blood sample was placed on a test strip which was inserted into calibrated glucometer (Accu Check/one touch) which gave direct reading after 10 seconds. The determination of blood glucose level was done at interval i.e. 0 min (fasting level), ½ hr, 1 hr, 1 ½ hr and 2 hr.

The blood glucose responses of standard and test thepla (2% incorporated ashwagandha root powder) and control (50 g glucose powder dissolve in 200ml water) are summarized in Fig 1. Results shows that the IAUC values for test and standard Thepla were 1139 and1769 mg.min/ 100ml respectively which was lower value than control value (3053.4). The GI and GL values of test Thepla had 37.30 and 11.36 respectively as compared to standard thepla as deputed in Table 2 and the data revealed that test thepla had low glycemic index and medium glycemic load. Similar study was also observed in Chaturvedi, *et al,* (2014) showed that 10% enriched Dal Samosa with *Ficus religiosa* leaves had GI (35) and GL(13).The following cut-off limits between low, middle and high GI high have been proposed: <55% (low), 55-70% (medium), >70% (high) (Brand Miller, *et al.*, 2003). There is a scale to classify glycemic load (GL) similar to that GI that are Low≤10, medium 11-19 and ≥20 (Powell *et al.*, 2002).The nutritious and acceptable food products were prepared from ashwagandha root powder which is used as an effective supportive therapy in the treatment of diabetes mellitus (Gilberston, *et al.*, 2001). Reports stated by Salmeron *et al.*, 1997, have indicated a positive co relation between high GI and risk of Type 2 diabetes.

CONCLUSION

Ashwagandha root powder can be used as a useful ingredient to produce low glycemic food product with favourable sensory characteristics and also proves to be beneficial in the treatment and/or prevention of impaired glucose tolerance, insulin resistance and in addition being an effective means of controlling glucose levels. Thus, it is an essential means for healthy and nutritious products which may be advantageous in prevention and management of Type II Diabetes.

CONFLICT OF INTEREST STATEMENT

We declare that we have no conflict of interest.

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