SHORT COMMUNICATION

EFFECT OF CELLULOSE AND ISPAGHULA HUSK ON FASTING BLOOD GLUCOSE OF DEVELOPING RATS

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Summary : Fasting blood sugar was measured at the beginning and end of a 4-wk dietary period during which weanling rats were fed either a fibre-free diet, or a similar diet containing cellulose or ispaghula husk. The fibre-free group showed no significant change, but the groups fed cellulose or ispaghula showed a significant fall in fasting blood sugar.

Key words : blood glucose dietary fibre cellulose ispaghula

INTRODUCTION

There are several reports suggesting improvement in glucose tolerance as a result of prolonged intake of high fibre diets (-, 5, 7, 8). But human diets are complex, and it is not always possible to ascribe an effect to a specific chemical constituent of the diet. Further, fibre is also a heterogenous entity, different components of which have varying physiological effects. We report here a simple study on fasting blood glucose of weanling animals fed chemically defined diets of known composition.

MATERIAL AND METHODS

Thirty three weanling rats were divided into three groups and were put on a fibre free diet (FF) (12 rats), or a high fibre diet containing cellulose (HF-C) (10 rats) or ispaghula (HF-I) (11 rats) for 4 weeks. The composision of the three diets is given in Table I. Fasting blood samples were obtained from the tail at the beginning and end of the dietary period.

Blood sugar was determined using Dextrostix reagent strips and a reflectance colorimeter with a digital output (Ames).

TABLE I : Composition of diets used.

Ingredient	*Quantity*		
	FF	*HF-C*	*HF-I*
Casein (g)	20.0	20.0	20.0
Starch (g)	15.0	15.0	15.0
Sucrose (g)	50.0	50.0	50.0
Refined groundnut oil (g)	5.0	5.0	5.0
Standard mineral mix (g)[1]	3.5	3.5	3.5
Multivitamin tablet[2]	¼ tab	¼ tab	¼ tab
Cellulose[3] (g)	0	10.0	0
Ispaghula husk[4] (g)	0	0	10.0

[1]As recommended by the American Institute of Nutrition (1)
[2]Vitaminets Forte (Roche)
[3]Nutrition grade (CSIR Biochemicals Unit)
[4]Sat Isabgol (Sidhpur Sat Isabgol Factory)

RESULTS

While the FF group showed no significant change during the period of observation, both the HF-C and HF-I groups showed a significant decrease (Table II).

TABLE II : Blood sugar in rats on different diets.

Diet	*Blood sugar (mg%)*[1]		*% change*
	Intitial	*Final*	
FF	63.3±10.7	68 2±8.3	+7.7
HF-C	65.1± 3.7	61.7±4.7*	−5.2
HF-I	62.4± 7.9	57.8±6.3*	−7.1

[1]Values are mean±SD, *$P<0.05$

DISCUSSION

The uncluttered design of the study, and the purified sources of fibre used, illustrate that fibre, by itself, can bring about a small but consistent fall in the fasting blood sugar. The effect is produced both by a water insoluble non viscous fibre like cellulose, as well as by a water soluble viscous fibre like ispaghula. A similar hypoglycaemic effect was also observed with guar in guinea pigs (11). Guar contains guar gum, which is also a viscous fibre like ispaghula. The mechanism underlying the effect may be an increase in sensitivity of B cells

of the islets of Langerhans to glucose, or of peripheral tissues to insulin, or both (9). Guar gum has been shown to increase the activity of hepatic glucose-6-phosphate dehydrogenase and phosphofructokinase (12). This is likely to result in enhanced utilisation of glucose for lipogenesis and secondarily a fall in blood sugar. We found in a recent human study that cellulose, but not pectin, had an insulinotropic effect (Siddhu, Sud, Bijlani, Karmarkar and Nayar, unpublished), which may explain the present observation. We also found that rats and hamsters on the HF-C and HF-I diets grew slower than on the FF diet (6) as has been reported also by other authors (3, 10). If the slower growth is because of reduced adipose tissue, it may be expected to be associated with enhanced sensitivity of peripheral tissues to insulin (4).

REFERENCES

1. Anon. Report of the American Institute of Nutrition ad hoc committee on standards for nutritional studies. *J. Nutr.*, **107** : 1340-1348, 1977.
2. Bijlani, R. L., B. M. Gandhi, M. C. Gupta, S. Manocha and B. N. Tandon. Effect of whole buckwheat (Fagapyrum esculentum) flour supplementation on lipid profile and glucose tolerance. *Ind. J. Med. Res.*, **81** : 162-168, 1985.
3. Johnson, I. T. and J. M. Gee. Gastrointestinal adaptation in response to soluble non-available polysaccharides in the rat. *Br. J. Nutr.*, **55** : 497-505, 1986.
4. Kolterman, O. G., J. Insel, M. Saekow and J. M. Olefysky. Mechanisms of insulin resistance in human obesity. Evidence for receptor and postreceptor defects. *J. Clin. Invest.*, **65** : 1272-1284, 1980
5. Mahalko, J. R., H. H. Sandstead, L. A. K. Johnson, L. F. Imman, D. E. Milne, R. E. Warner and E. A. Haunz. Effect of consuming fibre from corn bran, soy hulls, or apple powder on glucose tolerance and plasma lipids in type II diabetes. *Am. Clin. Nutr.*, **39** : 25-34, 1984.
6. Mahapatra, S. C., R. L. Bijlani and U. Nayar. Effect of fibre-free and high-fibre diet on growth of weanling animals. *Ind. J. Physiol. Pharmac.*, **30** : (Suppl. 1) : 60-61, 1986.
7. Miranda, P. M. and D. L. Horwitz. High fibre diets in the treatment of diabetes mellitus. *Ann. Internal. Med.*, **88** : 482-486, 1978.
8. Munoz, J. M., H. Sandstead and R. A. Jacob. Effects of dieiary fibre on glucose tolerance of normal men. *Diabetes*, **28** : 496-502, 1979.
9. Pederson, O., E. Hjollund, H. O. Lindskov, P. Helms, N. S. Sorensen and J. Ditzel. Increased insulin receptor binding to monocytes from insulin-dependent diabetic patients after a low fat, high-starch high fibre diet. *Diabetes Care*, **5** : 284-291, 1982.
10. Southon, S., G. Livesey, J. M. Gee and I. T. Johnson. Differences in intestinal protein synthesis and cellular proliferation in well nourished rats consuming conventional laboratory diets. *Br. J. Nutr.*, **53** : 87-95, 1985.
11. Srivastava, A., G. S. Longia, S. P. Singh and L. D. Joshi. Hypoglycaemic and hypolipidaemic effects of *Cyamopsis tetragonoloba* (guar) in normal and diabetic guinea pigs. *Ind. J. Physiol. Pharmac.*, **31** : 77-83, 1987.
12. Stanley, J. C. and E. A. Newsholme. The effect of dietary guar gum on the activities of some key enzymes of carbohydrate and lipid metabolism in mouse liver. *Br. J. Nutr* , **53** : 215-222, 1985.