

## EFFECTS OF DIFFERENT LEVELS OF COCONUT FIBER ON BLOOD GLUCOSE, SERUM INSULIN AND MINERALS IN RATS

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**Abstract :** The effect of neutral detergent fiber (NDF) from coconut kernel (*Cocos nucifera L*) in rats fed 5%, 15% and 30% level on the concentration of blood glucose, serum insulin and excretion of minerals was studied. Increase in the intake of fiber resulted in significant decrease in the level of blood glucose and serum insulin. Faecal excretion of Cu, Cr, Mn, Mg, Zn and Ca was found to increase in rats fed different levels of coconut fiber when compared to fiber free group. The result of the present investigation suggest that inclusion of coconut fiber in the diet results in significant hypoglycemic action.

**Key words :** coconut fiber  
minerals

serum insulin

blood glucose

### INTRODUCTION

There are reports that dietary fiber may absorb a number of organic and inorganic substances in gastrointestinal tract. Several workers reported reduced glucose absorption with high fiber diet associated, with lower insulin levels (1, 2). The possible interference by high fiber diet associated with the absorption of various minerals was also reported (3). The chemical composition of the fiber and its physico-chemical properties are involved in the absorption of these substances. Much work has been done in this respect and most of these studies with fiber indicate that the effect of dietary fiber on the absorption of nutrients in the gut varies according to the source of the fiber and the nutrient in question. In Kerala,

coconut kernel is a major dietary component and a rich source of fiber. Therefore, detailed investigations have been carried out on dietary fiber from coconut kernel. This fiber had significant cholesterol lowering action (4). In this communication we have studied the effects of different level of coconut fiber on blood glucose, serum insulin and excretion of minerals viz., Cu, Mg, Ca, Zn, Cr and Mn.

### METHODS

#### a) Preparation of NDF from Coconut Kernel

Coconut kernel was dried at 60°C, powdered to 20-30 mesh and defatted exhaustively with petroleum ether (40-60°C). The dry defatted material was extracted with

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neutral detergent solution as described by Goering and Vansoest (5). The NDF was subjected to digestion with  $\alpha$ -amylase to remove residual starch. The yield of NDF obtained from coconut kernel was 7.24%. The NDF obtained contained cellulose-43.28%, hemicellulose-45.1%, lignin-8.15%, cutin-3.28% and silica-0.25%. It did not contain any pectin or other soluble components.

#### b) Animal experiments

Male albino rats (Sprague-Dawley strain) body weight 80-100 g were divided into four groups and fed as follows.

Group 1	-	Fiber free diet
Group 2	-	5% Coconut NDF diet
Group 3	-	15% Coconut NDF diet
Group 4	-	30% Coconut NDF diet

The composition of the diet (g/100 g) was as follows:

Group 1: Corn starch, 71; Casein (vitamin and fat free), 16; Ground nut oil, 8; Salt mixture, 4; Vitamin mixture, 1. Coconut fiber (5%, 15% and 30%) was included in the diets of Group 2, Group 3 and Group 4 at the expense of Corn starch.

Rats were housed in individual, polypropylene cages in a room with temperature maintained at  $25 \pm 1^\circ\text{C}$ . Deionised distilled water was available to the rats *ad libitum*. The caloric intake in rats fed NDF and fiber free group was kept the same by adjusting the quantity of food intake. No minerals were added to the diets above

those supplied with the mineral mixture. All animals were fed continuously for 60 days. At the end of this period, 24 hour stool samples were collected in metabolic cages for the estimation of minerals. Care was taken to exclude contamination by extraneous minerals in the collection and processing of the stool for the analysis of minerals. At the termination of the experimental period, the rats were deprived of food overnight and killed. Blood was removed to ice cold containers for the estimation of glucose and insulin.

#### Analytical procedures

The estimation of blood glucose was carried out using the modified procedure of Asatoor and King (6). Serum insulin levels were measured by Radioimmunoassay using Coat-A count insulin procedure (BARC, Mumbai). For the estimation of minerals, faecal samples were digested with hydrochloric acid (1:1 Wt/V) and were analysed by using atomic absorption spectrophotometry (Model-Sepctr AA/10 Single Beam instrument; Make-Varian).

#### Statistical analysis

Statistical analysis was performed using one-way analysis of variance (ANOVA). Difference between treatment means were determined by Bonferroni multiple comparison procedure.

#### RESULTS

The gain in body weight of rats was comparable in the three fiber fed group and fiber free group. This shows



that the inclusion of fiber in the diet does not affect the normal growth of rats.

Concentration of blood glucose and serum insulin are shown in Table I. Rats fed different levels of coconut fiber (5%, 15% and 30%) showed significantly lower level of blood glucose and serum insulin. The blood glucose and serum insulin lowering effect was maximum in rats fed 30% fiber followed by 15% and then 5% fiber compared to fiber free group.

Faecal excretion of minerals (Cu, Zn, Mg, Ca, Cr and Mn) are shown in Table II. Faecal excretion of Mg, Zn and Mn was significantly higher in rats fed. 5%, 15%

and 30% levels of fiber, while the excretion of Cu, Ca, and Cr was higher only in 15% and 30% fiber groups when compared to fiber free group.

DISCUSSION

The present study shows that inclusion of fiber in the diet results in significant alteration in the level of blood glucose, serum insulin and faecal excretion of minerals. Increase in the intake of fiber increases the hypoglycemic effect and also faecal excretion of minerals. Serum insulin levels was decreased with increase in fiber in the diet. The decreased concentration of blood glucose in rats fed different levels of coconut fiber may be due to two factors:- One is the binding of glucose by the fiber making less glucose available for absorption. Another factor is the decreased transit time caused by the fiber. The decrease in blood glucose concentration due to binding of glucose by the fiber have been reports earlier (7). The decreasing blood glucose causes the pancreas to decrease its insulin secretion. The pancreas responds to a decrease in blood glucose with less release of insulin. The lower levels of serum insulin in rats fed coconut fiber in this study are in agreement with this observation.

TABLE I: Concentration of blood glucose and serum insulin.

Group	Blood glucose (mg/100 ml)	Serum insulin ( $\mu$ lu/100 ml)
1	83.09 $\pm$ 5.57	149.8 $\pm$ 10.2
2	71.19 $\pm$ 5.12 <sup>a</sup>	140.0 $\pm$ 9.3
3	58.90 $\pm$ 3.95 <sup>a</sup>	116.0 $\pm$ 7.6 <sup>a</sup>
4	47.60 $\pm$ 3.19 <sup>a</sup>	99.0 $\pm$ 6.5 <sup>a</sup>

Group 1 has been compared with group 2,3 and 4, <sup>a</sup>P<0.01  
Results were expressed as mean  $\pm$  SD of six rats in each group.

TABLE II: Faecal excretion of copper, zinc, calcium, chromium, magnesium and manganese (mg/rat/day).

Group	Copper	Zinc	Calcium	Magnesium	Chromium	Manganese
1	0.065 $\pm$ 0.003	2.97 $\pm$ 0.17	39.29 $\pm$ 2.7	1.59 $\pm$ 0.09	0.039 $\pm$ 0.002	0.0980 $\pm$ 0.005
2	0.069 $\pm$ 0.005	3.98 $\pm$ 0.23 <sup>a</sup>	42.96 $\pm$ 30.0	1.80 $\pm$ 0.11 <sup>a</sup>	0.041 $\pm$ 0.002	0.0111 $\pm$ 0.005 <sup>a</sup>
3	0.083 $\pm$ 0.005 <sup>a</sup>	7.39 $\pm$ 0.6 <sup>a</sup>	50.07 $\pm$ 3.5 <sup>a</sup>	2.05 $\pm$ 0.1 <sup>a</sup>	0.053 $\pm$ 0.003 <sup>a</sup>	0.0123 $\pm$ 0.0007 <sup>a</sup>
4	0.103 $\pm$ 0.006 <sup>a</sup>	10.39 $\pm$ 0.8 <sup>a</sup>	80.63 $\pm$ 5.6 <sup>a</sup>	3.70 $\pm$ 0.22 <sup>a</sup>	0.076 $\pm$ 0.004 <sup>a</sup>	0.2200 $\pm$ 0.010 <sup>a</sup>

Group 1 has been compared with group 2, 3 and 4; <sup>a</sup>P<0.01;  
Results were expressed as mean  $\pm$  SD of six rats in each group.

Increase in the intake of coconut fiber resulted in increased excretion of all minerals studied. Similar results were also reported by others (8). The results of in vitro studies indicate significant binding of NDF on mineral (9). In this connection it has stated that in rats significant amount of dietary fiber are digested by gut microflora (10). Apart from monosaccharides, oligosaccharides of various chain lengths are believed to be formed. The NDF isolated from coconut kernel is rich in hemicellulose (45.1%). In the case of hemicellulose an arabinoxylan of unknown chain length is believed to be one of the products. It is possible that the products of digestion as well as the undigested fiber components may be involved in binding. This binding may

involve hydroxyl and carboxyl group of uronic acid of hemicellulose. The increased excretion of minerals in rats fed different levels of fiber is due to this binding process and also due to decreased transit time which result in less time available for absorption of these minerals and resultant increased excretion. In this connection it is relevant to note that the minerals present in the faeces is derived from dietary origin and also from endogenous secretions: In the present study no attempt has been made to differentiate between unabsorbed minerals of dietary origin and endogenous secretions into intestinal tract of previously absorbed minerals. In conclusion, the present study with varying levels of coconut fiber indicate significant hypoglycemic action in rats.

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