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Effects of Carrot Residue Fibre on Body Weight Gain and Serum Lipid Fractions

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ABSTRACT

Effects of carrot residue fibre on body weight gain and serum lipid fractions were studied in albino rats. The rats were fed on control and test rations for a period of one month and their serum lipid fractions were determined before and weekly after feeding the rations. The results obtained showed that weight gain by control increased by 95% of initial value; whereas, weight gain by high fat with high carrot fibre and moderate fat with high carrot fibre were 54% and 93% of the controls, respectively. In addition, carrot residue fibre significantly decreased the serum cholesterol, triglycerides, LDL-cholesterol and carcass fat. However, non-significant (P>0.05) change was observed in the serum HDL-cholesterol. It was concluded that carrot residue fibre may be used for the dietary management and control of hyperlipidaemia.

Key Words: Carrot residue fibre; Body weight gain; Serum lipid fractions

INTRODUCTION

Cardiovascular disease is directly related to plasma concentration of low density lipoprotein cholesterol (LDL-C) and inversely related to high density lipoprotein cholesterol (HDL-C; Chobanian *et al.,* 1991). High carbohydrate diets may also result in a decrease in HDL-cholesterol, an important protective fraction against atherosclerosis. Sugars, particularly sucrose, may have a greater triglyceride and cholesterol raising effect than starch. Dietary fibre, on the other hand, may have a triglyceride lowering effect (Anderson, 1980). In addition, a causal relationship has been observed between low dietary fibre intake and the increased incidence of hyperlipidaemia, coronary heart disease, obesity and cholelithiasis. Reduction in serum lipid levels have been reported to reduce the incidence of coronary heart disease (CHD; Weber *et al.,* 1991).

Carrot residue is a good source of dietary fibre and is available in abundance i.e. 37200 kg/year as a byproduct which generally goes waste (Anonymous, 1996). Carrots have preventive medicinal properties having soluble fibres, decreases blood cholesterol and regulate intestinal functions (Musavi, 1997). This paper describes the effects of carrot's residual fibre on body weight gain, serum lipid fractions and carcass fat in albino rats.

MATERIALS AND METHODS

Carrot residue fibre and fat used. The carrots (*Daucus carota*) available in the local market of Faisalabad were used in this study. Carrot residue was collected after extraction of juice from carrots by the electric juicers. The carrot residue was dried in oven at 100°C for one hour and then at 40°C until constant weight. The dried carrot residue was powdered with an electric grinder and stored in air-tight plastic bottles until used. The hydrogenated fat (Kashmir Banaspati Industries, Faisalabad) was purchased from the local market.

Chemical Analyses

Proximate analysis. The dried carrot residue was subjected to proximate analysis to determine moisture, crude proteins, total fat, crude fibre, ash and nitrogen free extract contents of the carrot residue by using standard AOAC methods (AOAC, 1990).

Fibre analysis. The cell wall (neutral detergent) and acid detergent fibres were determined by calculating the difference in their hemicellulose. Whereas, cellulose, lignin and silica were determined by acid detergent method (Van Soest, 1963; Holst, 1973).

Biological Evaluation

Plan of work. Biological evaluation was done by feeding carrot residue and hydrogenated fat (Banaspati ghee) to two-month-old rats for a period of one month. The experiment was run according to CRBD. A total of 14 albino rats of mixed sex were used. At the start of trial, two rats were picked up randomly, killed and their body cavities opened and dried at 105°C to a constant weight. The fat contents of their carcasses were determined and the remaining 12 rats were divided into three groups. They were placed separately at 28 ± 5°C in metabolic cages. All the rats were weighed before the start of experiment and thereafter at weekly intervals to determine the gain in weight.

Experimental diets. Three diets A, B and C were prepared whose composition is shown in Table I. Diet A served as control, containing 24% fat but no carrot residue was added. Diet B contained 24% high fat with 22% carrot residue; whereas, diet C had moderate (10%) fat with 22% carrot residue. These three diets were randomly assigned to 12 rats in a way that there were four rats on each diet. The diets were fed *ad libitum* to all the groups of rats for one month. Fresh potable water was provided to them all the times.

Collection of blood samples. Weekly two rats from each group were picked up randomly. Two ml of blood was collected directly from heart of each rat under anaesthetized condition. The blood samples collected were allowed to clot and serum separated by centrifugation at 1500 rpm for 4-5 minutes. The serum samples were stored at 10°C to be used subsequently for biochemical determinations. At the end of trial, two rats randomly selected from each group were killed and their carcasses were analyzed for fat contents.

Table I. Composition of experimental diets

Ingredients	Diet A (g)	Diet B (g)	Diet C (g)
Carrot residues	–	22.0	22.0
Banaspati ghee	24.0	24.0	10.0
Corn starch	20.0	–	13.3
Potato starch	1.10	–	0.7
Skimmed milk	42.8	42.8	42.8
Glucose	6.2	6.2	6.2
Vitamin & Mineral mixture	5.0	5.0	5.0

Biochemical determinations. The serum samples were analyzed for the estimation of cholesterol (Lieberman-Burchard reaction; Oser, 1965), triglycerides (kit method; Stadtman, 1979), HDL-cholesterol (kit method; Schettler & Nasal, 1975) and LDL-cholesterol (Friedewald *et al.,* 1972).

Statistical analysis. The body weight gain data were analysed by applying least squares analysis of variance (ANOVA) technique. The effects on serum cholesterol, triglycerides, HDL-cholesterol, LDL-cholesterol and carcass fat were compared by Duncan Multiple Range (DMR) Test ((Steel & Torrie, 1984).

RESULTS AND DISCUSSION

Weight gain. Results of weight gain have been presented in Fig. 1. Mean body weight was increased from 75.75 ± 19.75 g to 147.75 ± 15.25 g showing highly significant increase in weight in control diet (A). Their mean gain in weight attained was 72 g at the end of experiment. The weight of rats fed on high fat with high fibre diet (B) at the end of four weeks increased from 64.7 ± 20.3 g to 104.67 ± 20.33 g showing quite higher gain in weight due to high fat with high fibre diet. This group of rats gained 39.73 g weight at the end. However, weight of rats fed on moderate fat with high fibre diet (C) increased from 71.5 ± 4.5 g to 138 ± 0 g showing gain in weight of 58.88 g.

Fig. 1. Weight gain of rats fed on fibrous and non-fibrous diets

The higher weight gain ($P<0.01$) in rats fed moderate fat with high fibre may be due to higher consumption of feed as compared to those fed high fat with high fibre and control groups. This is in agreement with Hylander and Rossner (1983) who observed that addition of extra dietary fibre immediatly before meals decreased hunger feelings but had no effect on weight reduction.

Fig. 2. Cholesterol levels of rats fed on fibrous and non-fibrous diets

Serum cholesterol. Serum cholesterol levels in rats fed on control and test diets are shown in Fig. 2. The level of rats fed on control diet was raised from 110.12 ± 1.047 to 114.51 ± 0.87 mg/dl at the end; whereas, cholesteol level of rats fed on high fat with high fibre diet was decreased to 93.67 ± 1.37 mg/dl. However, the level of rats fed on moderate fat with high fibre diet was decreased to 59.60

mg/dl after four weeks. The effect of moderate fat with high fibre diet appeared to be more than that of high fat with high fibre diet as revealed by much reduced serum cholesterol level in moderate fat and high fibre diet group of rats. The greater serum cholesterol lowering action of moderate fat with high fibre diet against that of high fat and high fibre diet might be due to different levels of fat in both groups. These findings are in agreement with Anderson and Clydesdale (1980) who observed that oat bran intake lowers serum cholesterol concentration much more effectively when dietary cholesterol and fat are restricted. Baig and Cerda (1981) have also observed *in vitro* interaction between grape fruit pectin and various human serum lipo-proteins and thus may cause lowering of cholesterol levels.

Fig. 3. Triglyceride levels of rats fed on fibrous and non-fibrous diets

Serum triglycerides. A highly significant increase in serum triglycerides levels was observed in rats fed on control diet (Fig. 3). However, rats fed on high fat with high fibre diet showed a highly significant (P<0.01) drop in serum triglycerides level as compared to rats fed on moderate fat with high fibre and control diets. The influence of high fat with high fibre diet was even more than moderate fat with high fibre diet. This may be due to greater consumption of feed by the rats in moderate fat and high fibre group as compared to high fat with high fibre group. Similarly, Madar (1985) has observed that plasma triglycerdies and cholesterol remained unchanged, while the triglycerides concentration in liver and epididymal fat was lower in soyabean fibre fed rats than in those given no fibre. However, Hillman *et al.* (1985) found non-significant effect of pectin, cellulose and lignin on serum triglycerides, cholesterol, HDL-cholesterol and the ratio of high density lipoproteins to total cholesterol.

Fig. 4. Serum HDL-cholesterol of rats fed on fibrous and non-fibrous diets

Serum HDL-cholesterol (HDL-C). Test diets showed non-significant (P>0.05) effect on serum HDL cholesterol but with the passage of time, it was increased (Fig. 4). Its level in high fat with high fibre and moderate fat with high fibre groups did not differ to the control diet. This observation was in line with those of Behall *et al.* (1984) who reported that addition of four refined fibres, cellulose, carboxy methylcellulose gum, locust been gum and Karaya gum lower serum cholesterol without decreasing the HLD-cholesterol. The present results are not in agreement with Malinow *et al.* (1979) who observed that cellulose, pectin, guar gum and oat bran had reducing effects on plasma cholesterol and increasing effects on high density plasma lipoprotein cholesterol.

Fig. 5. Serum LDL-cholesterol levels of rats fed on fibrous and non-fibrous diets

Serum LDL-Cholesterol (LDL-C). The rats fed on moderate fat with high fibre diet caused significant (P<0.05) decrease of serum LDL cholesterol level as compared to control diet (Fig. 5). The effect of moderate fat with high fibre diet was more than that of high fat with high fibre diet. Greater serum LDL cholesterol lowering action of moderate fat with high fibre diet against that of high fat with high fibre diet might be due to different levels of fat in both groups. The present results agree with Kirby *et al.* (1981) who observed that oat bran intake selectively lowers plasma LDL-C, while HDL-C was not changed. Anderson *et al.* (1990) have also observed that oat bran cereal diet with the corn flakes diet lowered serum total cholesterol and serum LDL-C significantly.

Fig. 6. Fat % in rats fed on fibrous and non-fibrous diets

Carcass fat. The carcass fat percentage in control rats was significantly ($P<0.01$) higher than high fat with high fibre and moderate fat with high fibre diets (Fig. 6). These findings are in agreement with those of Kesaniemi *et al.* (1990) who showed that high fibre diet had significant effect on serum total cholesterol, serum LDL cholesterol, serum HDL cholesterol and carcass fat composition.

CONCLUSIONS

The carrot fibre has significant effect on weight gain, reduction in serum cholesterol level, triglycerides level, LDL-cholesterol level and carcass fat. However, carrot fibre has no effect on serum HDL-cholesterol level. It is, therefore, suggested that since carrot residue fibre has good taste, smell and flavour, it may be used in bakery industry as a source of natural dietary fibre for preparation of products for the diabetic patients.

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