# EFFECT OF SIEVED BUCKWHEAT (*FAGOPYRUM ESCULENTUM*) FLOUR SUPPLEMENTATION ON LIPID PROFILE AND GLUCOSE TOLERANCE

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**Summary :** Buckwheat *(Fagopyrum esculentum)* was picked up for a study of its effects on lipid profile and glucose tolerance in view of its relatively high fibre content. In earlier studies, we demonstrated that supplementing the daily diet with 100 *g whole* buckwheat flour raised the high density lipoprotein cholesterol (HDL-C)/cholesterol ratio and improved glucose tolerance. In the present study, 12 human volunteers replaced part of their cereal intake at lunch by a preparation made from 100 *g sieved* buckwheat flour for a period of 4 weeks. At the end of 4 wk, there was a significant rise in HDL-C from 42.8 ±11.4 *mg/100 ml* to 55.2±15.3 *mg/100 ml* ($P<0.05$), and in HDL-C/cholesterol ratio from 26.7±7.0% to 33.8±10.2% ($P<0.02$)'. The other changes in lipid profile were not significant. There was also no significant change in fasting blood glucose or oral glucose tolerance in the 5 subjects on whom the test was done. Comparing the results with the observations made earlier on whole buckwheat, it is still not possible to say to what extent the effects of buckwheat on lipids may be attributed to its fibre content. The effects on glucose tolerance, on the other hand, seem to be more directly related to the fibre content.

**Key words :** buckwheat, fibre, dietary fibre, cellulose, lipoproteins, glucose tolerance, cholesterol

## INTRODUCTION

Buckwheat (*Fagopyrum esculentum)* is a minor millet, the flour of which is commonly consumed in some parts of India during prolonged 'religious' fasts. Its crude fibre content is 8.6% as compared to 0.2% 1.9%, 1.6%, and 1.2% in case of rice, whole wheat flour, jowar and bajra respectively (6). In view of the reported effects of dietary fibre on serum lipids (2,3,8,9) and glucose tolerance (7,12), it was decided to study the effects of buckwheat on these parameters. Administration of 100 *g* whole buckwheat flour to normal volunteers at breakfast resulted in a significant rise in high density lipoprotein cholesterol (HDL-C)/total cholesterol ratio and an improvement in glucose tolerance (4). Having made these observations on whole buckwheat, further experiments with sieved buckwheat were considered essential for two reasons. First, the effects of whole

buckwheat may be attributed to fibre only if removal of fibre abclishes these effects ; second, whole buckwheat is hard to eat, and hence buckwheat flour is generally consumed only after sieving.

## MATERIAL AND METHODS

The study was conducted on human volunteers who had been explained the nature of the study. The design of the study was in accord with the standrads prescribed by the Ethics Committee of our Institute. Informed signed consent was obtained from each subject. The study was conducted in two phases of four weeks each. The first phase was conducted in August-September and the second phase in March-April.

*Subjects* : Seven healthy young male. volunters (age 18-22 yr, weight 47-61 *kg*) completed phase I of the study. In phase II, we had five healthy young male volunteers (age 20-21 yr, weight 55-75 *kg*). Phase I and II had no subject in common.

*Diet* : The subjects were expected to replace their cereal intake at lunch, partially or completely, by a preparation (two *paronthas)* made from 100 g sieved buckwheat flour. The dough for the preparation was made in boiled potato and minimal quantity of water It was rolled into a 3-4 mm thick round *chapatie* which was cooked on a flat hot plate in the presence of groundnut oil. The daily diet duing the study remained the same as that before the study in every other respect.

*Measurements* : All subjects underwent a routine clinical examination at the beginning of the study. Serum lipid fractions were determined at the beginning and the end of the 4-week dietary period. The levels reported here are the mean of two fasting blood samples taken on consecutive days. The lipid fractions were separated by the dual precipitation method of Wilson and Spiger (14). Cholesterol was determined by the ferric chloride method of Chiamori and Henry (5), and triglycerides by that of van Handel and Zilversmit (13).

The five volunteers of phase II also underwent the glucose tolerance test at the beginning and the end of the study. The test was performed by oral administration of 100 g glucose in the form of 25% ice-cold solution, flavoured with lemon juice. Venous blood samples were drawn for glucose estimation just before, and 0.5, 1.0, 1.5 and 2.0 h after ingestion of glucose. Blood glucose was determined by the o-toluidine method (11).

The dietary fibre content of buckwheat was determined by acid and neutral detergent extraction (1).

*Analysis of results* : Lipid profile, fasting glucose and glucose tolerance after being on buckwheat were compared with those at the beginning of the study using t-test for paired data, each subject serving as his own control.

## RESULTS

The acceptability of sieved buckwheat was good, and no unpleasant side effects were reported by the volunteers. The fibre content of sieved buckwheat flour (per 100 *g*) was found to be : neutral detergent fibre (total cell wall content). 17.3 *g* acid detergent fibre (cellulose and lignin), 10.6 *g*; and lignin, 3.1 *g*. Thus the cellulose content was 7.5 *g*, and hemicellulose content 6.7 *g* per 100 *g* edible material. There was no significant change in body weight during either phase of the study.

*Serum lipid profile* : The serum lipid profile at the beginning and the end of the 4-wk buckwheat supplementation is given in Fig. 1. The significant changes are a rise in HDL-C ($P<0.05$) and in HDL-C/cholesterol ratio ($P<0.02$).

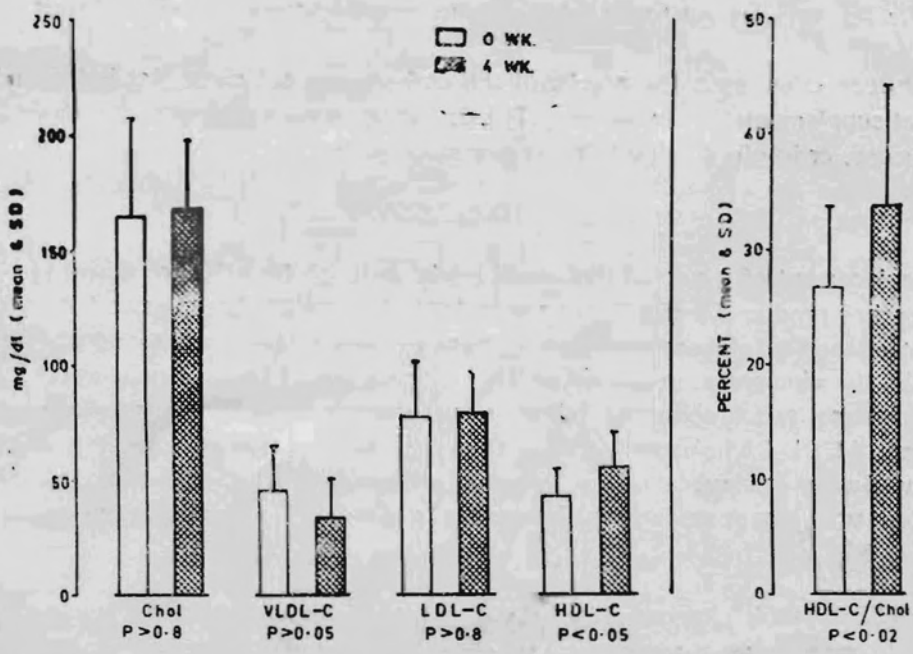


**Fig. 1 :** Lipoprotein profile before and after supplementation with sieved buckwheat (n=12).

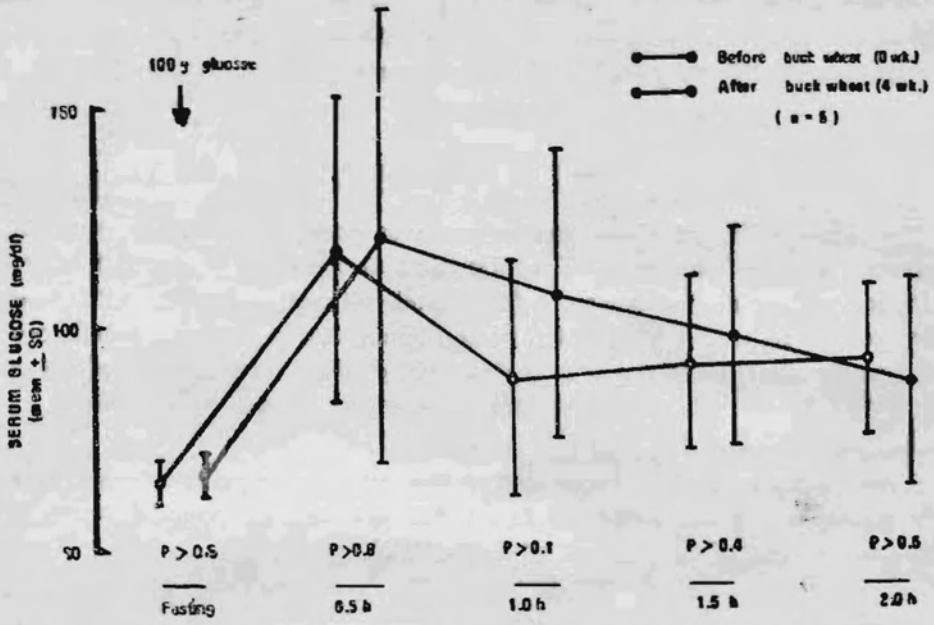


Fig. 2 : Oral glucose tolerance before and after supplementation with sieved buckwheat.

*Glucose tolerance* : The results of the oral glucose tolerance test before and after buckwheat supplementation are given in Fig. 2. There is no significant change in fasting blood glucose, or in glucose level during any stage of the test.

## DISCUSSION

Replacement of a part of the cereal intake at lunch by a 100 g sieved buckwheat preparation has produced a significant rise in HDL-C and HDL-C/cholesterol ratio, but no significant change in glucose tolerance. There appears to be a great deal of individual variation in the changes seen in lipid profile. Thus 7 out of 12 subjects showed a rise in serum cholesterol and 5 showed a fall after buckwheat intake. The variability was much less in case of HDL-C/cholesterol ratio. Thus only 2 of the subjects had a fall in the ratio after 4 weeks on buckwheat. The selective effect on HDL-C and HDL-C/cholesterol is consistent with recent studies which have reported selective effects on certain lipoprotein fractions (2,3,8).

The lipid profile changes observed with sieved buckwheat are quite comparable to the changes observed by us in response to whole buckwheat (4). Change from 100 *g* whole buckwheat flour to 100 *g* sieved buckwheat flour involves a fall in fibre content from 32.6 *g* neutral detergent fibre to 17.3 *g*. But the content is still higher than that of 100 *g* wheat

flour by about 6 *g*. Thus sieved buckwheat is still a high fibre supplement. Hence it is not possible to say whether the changes in lipid profile are due to the fibre content or some other characteristic of the buckwheat supplement. Besides fibre, buckwheat protein may also have hypolipidaemic effects. It has been postulated that the hypolipidaemic effect of soy protein is due to its high arginine/lysine ratio (10). Arginine/lysine ratio is 0.44 for milk proteins, 1.12 for soy protein and 1.90 for buckwheat protein (6). Thus, according to this criterion, buckwheat is even more hypolipidaemic than soy protein. The possibility that some minor component of buckwheat, present in only minute amounts, may be responsible, at least partly, for the observed changes also cannot be ruled out. From the point of view of practical application, however, it appears that buckwheat, whether whole or sieved, is likely to retard the atherosclerotic process to the extent that rise in HDL-C/cholesterol ratio does so.

Supplementation with sieved buckwheat has shown no significant effect on glucose tolerance. This is in contrast with the marked improvement in glucose tolerance observed earlier with whole buckwheat (4). Thus the effect on glucose tolerance seems to be more directly related to fibre intake.

Further studies on buckwheat are needed with preparations containing the minimum of other ingredients, if at all and with buckwheat protein isolate. Such studies would further clarify the active components of this millet which has a good potential for use in prevention of atherosclerosis.

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