# EFFECTS OF DIFFERENT OILS AND FATS ON THE BLOOD LIPIDS OF NORMAL SERVICE PERSONNEL

by

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## ABSTRACT

A trial was undertaken to study the relative effects of rations containing oil hydrogenated, a vegetable oil (mustard oil) and milk ghee on serum cholesterol of 30 recruits obtained from one of the Regimental Centres. The study was carried out for a total period of 3 months.

The results of the study indicated that there is significant decrease in the average serum cholesterol of the subjects when they were maintained on rations containing vegetable oil. The study thus confirms the current trend and thoughts on the effect of diets high in saturated fat and low in essential fatty acids in increasing serum cholesterol as compared to a diet high in essential fatty acids.

## Introduction

A great deal of interest has been shown recently on the effects of dietary fats upon the metabolism of body lipids in human being and in the serum cholesterol lowering properties of certain oils with a high content of poly-unsaturated fatty acids. Reports from various laboratories indicate that high blood cholesterol levels are obtained when diets contain large amounts of saturated and mono-unsaturated fats in the form of fats from dairy and animal sources. It has also been shown that the ingestion of a variety of vegetable oils, under precisely controlled conditions was associated with a major and sustained fall in the level of plasma cholesterol and phospholipids (Kinsell, Partridge, Boling, Margen and Michaels[1]; Kinsell, Michaels, Partridge, Boling, Balch and Cochrane[2]; Bronte-stewart, Antonis, Eales and Brock[3]). Clinical observations of Groen[4] *et al* have also indicated significant differences between the effects of fats of animal and vegetable origin, in regard to plasma cholesterol levels and possibly in relation to some of the manifestations of atherosclerosis as it has been suggested that relative deficiency of essential fatty acids caused by over consumption of saturated hydrogenated fats accelerated the process of atherosclerosis. Further, some experiments have shown that addition of fatty acids to plasma with or without Russelviper venom shortens the clotting time[5], and it has also been shown that in man consumption of fat tends to a rise in the concentration of fatty acids in the plasma and this concentration is within the range in which an effect on the blood clotting time can be demonstrated *in vitro*. It is therefore possible that free fatty acids contribute to the coagulation changes which follow fatty meals.

It cannot be ignored that dietary factor is one of the many factors which are concerned in the pathegensis of coronary heart diseases. Equally important factors are stress, strain, physical activity, sex, endocrinology and to some extent heredity.

Most of the studies on this subject have been conducted on subjects employed on sedentary duties as is common to the civilians and so the judgement as to the significance of the findings with a view to apply them in the dietary of the armed forces, must be reserved until the work can be repeated using subjects drawn from the armed forces of India. It was therefore thought necessary to undertake a study to determine the relative effects of rations containing oil hydrogenated, pure vegetable oil and milk ghee on the serum cholesterol and other lipids of normal service personnel and on the coagulability of the blood of the normal subjects as well as in patients of coronary disease. The present paper reports the results of the study on part of the work *i.e.*, effects of rations containing oil hydrogenated, vegetable oil (mustard oil) and milk ghee on the serum cholesterol levels of normal young recruits of 6 months service.

**Methods and Materials**

The study was carried out with 30 volunteers obtained from an Infantry Training Centre at Delhi Cantt. The subjects, all recruits of about six months service and of the same age group (18—22 yrs.), were thoroughly examined beforehand before they were accepted for the study. A detailed clinical examination as to the weight, blood pressure, linearity and muscularity, state of the arteries (including eye ground), family history with respect to cardiovascular diseases and a special check for diseases affecting lipid metabolism, *i.e.* diabetes, atheromatosis, hereditary hyperlipemia, were recorded.

The subjects were housed in a barrack within the Regimental Centre and a special kitchen was provided to them for the preparation and serving of the food for these experimental subjects only. Ration for each day for the thirty people was weighed according to the standard ration scale (vide Appendix I) and meals (breakfast, lunch, tea and dinner) were prepared. Care was taken to see that each subject received his share of the ration. Arrangement was also made to collect any surplus food not consumed by the subjects, so that it was possible to calculate, by difference, the amount of food consumed per subject.

In the first month of trial the subjects were maintained on ration in which the cooking oil/fat consisted of oil hydrogenated. Fasting blood was collected from the subjects at the beginning, at the end of 2 weeks and again at the end of 4 weeks of this experimental period for determination of the serum cholesterol. After the end of this period, oil hydrogenated component of the ration was replaced by identical quantity of pure mustard oil and the subjects were kept on this ration for a further period of 4 weeks after which serum cholesterol was again determined. The subjects were further maintained for a period of 4 weeks on ration, the cooking fat of which was pure milk ghee obtained from Military Dairy Farm. After the end of this period the serum cholesterol concentration was determined.

The physical and chemical properties of the different fats and oils used in the study are shown in Table I.

TABLE I

*Properties of fats and oils*

| Nature of fat | Iodine value% | Saturated fatty acid % | Mono-etheroid Fatty acid% | Poly unsaturated fatty acid% |
|---|---|---|---|---|
| Milk ghee | 33 | 58 | 38 | 3·3 |
| Hydrogenated oil (Dalda) | 63 | 26 | 52 | 3 |
| Mustard oil | 103 | 20 | 65 | 25 |

Fortnightly records of weight were also kept for these experimental subjects.

Determination of the serum cholesterol was made by the method of Abell *et al*[6].

**Results**

*Changes in serum cholesterol*

The results of the study as given in Table II indicate that during the first period of the trial, there has been slight decrease in the serum cholesterol of the subjects. The average serum cholesterol of the subjects at the beginning of the trial was $130 \pm 3 \cdot 3$ mg%, whereas it was $124 \cdot 4 \pm 3 \cdot 3$ mg% at the expiry of this period.

TABLE II

*Effects of dietary oils/fats on serum cholesterol*

| Period | Dietary oil fat | Mean Serum Cholesterol (mg%) | | Mean Change during the period |
|---|---|---|---|---|
| | | Initial | Final | mg. |
| I | Oil hydrogenated | $130 \cdot 0 \pm 3 \cdot 3$ | $124 \cdot 4 \pm 3 \cdot 3$ | — 6 |
| II | Mustard oil | $124 \cdot 4 \pm 3 \cdot 3$ | $113 \cdot 0 \pm 3 \cdot 3$ | —11 |
| III | Milk ghee | $113 \cdot 0 \pm 3 \cdot 3$ | $133 \cdot 1 \pm 3 \cdot 3$ | +20 |

In view of the alleged linear correlation between serum cholesterol and caloric intake (Yudkin[7]), this decreased cholesterol probably reflects the effects of slight decrease in the caloric intake of the subjects who were made to subsist on the ration supplied according to their ration scale. It may be mentioned here that it has been the common practice among the recruits to supplement their ration with milk ghee obtained from their houses or with milk from the canteen. As this was not allowed during the course of investigation, there is every reason to believe that the caloric intake of the subjects was slightly less than that they were having at other times and this has been reflected in the slight reduction of the serum cholesterol.

On changing over to the period when the dietary fat consisted of the mustard oil, the serum cholesterol at the end of the 4th week was reduced to $113 \pm 3 \cdot 3$ mg%. It has been observed, however, that the extent of decrease has not been of that order as has been reported in literature with other vegetable oils[8]. But the subjects were all of lower age group, all within 18—22 years and undergoing a high level of physical activity due to training/P.T. etc. Both these factors are known to have effects on serum cholesterol. In order to establish definitely that the drop in serum cholesterol is due to these factors, it is necessary to carry out another trial with service personnel of higher age group. This trial, if completed will also show whether the results obtained in the present study can be applicable to all segments of the service population. It is of significance that in some of the cases the drop of the serum cholesterol was very marked indeed.

The average level of serum cholesterol at the end of period III when the dietary fat consisted of milk ghee, containing 3·5% essential fatty acids was 133·1 mg% indicating an increase of 20 mg% over the entire period. This confirms the previous reports that a diet high in saturated fat containing very little unsaturated fatty acids increases the serum cholesterol to an appreciable extent.[9]

**Correlation of body build and serum cholesterol**

Correlation as to the body build (Ecto, meso or endo) and the response in the cholesterol level to dietary fat could not be conclusive, though it has been suggested that muscular mesomorphic types tend to have higher cholesterol level in their blood. This may be because the subjects were of young age-group when morphism was not so well defined. The results are shown in Table III.

No clear cut correlationship could be established between the respective body weight and blood pressure and the serum cholesterol level as the subjects were young recruits and were neither over-weight nor had high blood pressure.

**Discussion**

The results in this trial thus confirms the current trends and thoughts that so far as the maintenance of a low level of serum cholesterol is concerned, vegetable oils containing high amount of polyunsaturated fatty acids are better than either milk ghee or oil hydrogenated. This seems to indicate that the demands of the body with respect to polyunsaturated fatty acids are not fulfilled when the dietary fat consists of either oil hydrogenated or milk ghee. Though complete knowledge of the requirement of polyunsaturated fatty acids is not available

with us at the present moment, it has been tentatively decided that the diets containing 15% of the fat intake in the form of polyunsaturated fatty acids would probably meet the minimum requirement in adults. It is hoped that we would be able to study the problem of exact requirement of these acids when our isotopic laboratory becomes equipped with all modern facilities for studying tissue metabolism with isotopic tracers.

TABLE III

*Body Build and Serum cholesterol level*

| Build | No. of subjects | Initial serum cholesterol level(mg%) | Serum cholesterol level at the end of | | |
|---|---|---|---|---|---|
| | | | Oil hydrogenated period | Vegetable oil (mustard oil) period | Pure milk ghee period |
| Mesomorph | 6 | 137·5 | 121·1 | 110·83 | 134·5 |
| Ectomorph | 6 | 138·0 | 133·88 | 106·8 | 141·2 |
| Endomorph | 3 | 112·5 | 112·83 | 113·25 | 129·0 |
| Ecto/Endomorph | 2 | 90·25 | 101·75 | 96·0 | 108·75 |
| Ecto/Mesomorph | 7 | 137·3 | 133·33 | 119·33 | 134·75 |
| Endo/Mesomorph | 3 | 128·0 | 137·50 | 125·67 | 132·67 |

In the present trial mustard oil has been used as the source of polyunsaturated fatty acids, but any other pure vegetable oil like sesame, safflower, groundnut containing high amounts of polyunsaturated fatty acids may also be used. Coconut oil which contains very small amounts of polyunsaturated fatty acids may not be suitable in this respect.

The greatest difficulty in introducing vegetable oil to service personnel would be that of accustoming our troops coming from North West India (e.g. Rajasthan, Punjab, U.P. and part of Central India) to the use of these oils. Normally in their homes they generally consume either milk ghee or hydrogenated oils and consequently introduction of vegetable oils would result in the loss of palatability of the ration. We have also observed in our study that during the first few days of the mustard oil period the average food consumption of the subjects was slightly less, though very soon they became adapted to the taste of mustard oil. This slight reduction in food consumption has also been reflected in the slight reduction in the weight of the subjects during this period, though by no means this decrease could be considered as pathological and not within normal limits of variation of weight. It is hoped that many of the difficulties such as that of taste may be overcome through a period of adaptability and continued use.

One of the difficulties encountered in the use of vegetable oils is that it becomes difficult to make 'Paratha' or 'Puree' which is normally used for breakfast by the troops. Milk ghee or hydrogenated oils serve this purpose better though the former is recommended because of its nice appetising aroma which is rather lacking in hydrogenated oils. However as hydrogenated oils contain some unnatural isomers which are produced during hydrogenation, the exact role of which in human nutrition is not yet clearly defined, it is better not to advocate its use in Service ration until it has been cleared of all allegations.

As our troops are drawn from all parts of India, where people differ so much with respect to dietary habits, it may not be possible to recommend any particular vegetable oil for the whole segment of the population but to start with, option may be given to them to select any one out of the three indicated above. It is suggested, therefore, 1 oz. of milk ghee and 1½ oz. of any of the vegetable oil mentioned above may be introduced in the Service ration for daily use, if administratively there be not much difficulty.

It has been argued that vegetable oils would not be very suitable as a component of Service ration as it would be very difficult to transport them from one part of the country to another. It may be mentioned here that many of the essential stores like petrol, gasoline etc. are also liquid and vast amounts of these are transported from one part of the country to another. Further though oil hydrogenated and milk ghee are solid at usual temperature, during summer months in most parts of North India these melt and become almost like liquid. Thus there is no reason to believe that introduction of vegetable oils would in any way create much difficulties of transport and storage.

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## APPENDIX I

*Scales of ration for Indian Recruits**

| Standard Items | Scale oz |
|---|---|
| Atta | 22 |
| Oil hydrogenated | 2½ |
| Dal | 3 |
| Sugar | 2 |
| Tea | 1/3 |
| Salt evap. | 2/3 |
| Milk fresh | 15 |
| Potatoes fresh | 4 |
| Onions fresh | 2 |
| Vegetable fresh | 7 |
| Fruit fresh | 3-3/7 |
| Firewood common | 2 |

*2½ % cut in the scale of rations are applicable to all items including fresh supplies.