CALORIC REQUIREMENT OF A SOLDIER

by

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ABSTRACT

Studies on daily energy expenditure and actual consumption of food of troops during collective training period have been made and it has been found that the present ration scale is not adequate.

5 per cent cut in rations should be abolished during collective training period. Further work is required on the energy expenditure and food consumption of soldiers in summer.

Similar studies should be carried out for the Navy and the Airforce.

Adequacy of animal protein content of the existing Army ration requires investigation.

Introduction

Feeding of the Armed Forces personnel is a responsibility of the Government. It is desirable that their diet should not only provide minimum calorific and nutrient requirements but should also be enough to keep their nutritional reserve full so that they can withstand the stress and strain of training, field service duties, disease and injury.

The existing service rations for the three branches of the Armed Forces are not identical. The Airforce and the Navy have the same ration scale but the Army scale is slightly inferior. In 1950 due to cereal shortage in the country, 5 per cent cut was introduced in the rations. The present ration scale in peace station after 5 per cent cut is shown in Table 1.

TABLE 1

Nutrient Analysis of Service Rations After 5 per cent cut

	Total calories	Animal protein (g)	Vegetable protein (g)	Carbohydrate (g)	Fat
Army ration	3660	19·5	92	567	107
Navy & Airforce Ration ..	3880	40	91	552	123

It will be seen from Table 1 that the Navy and the Airforce ration scale is higher than the Army by about 200 Cal., 20 gm of animal proteins and 16 gm of fat. There is a separate J & K scale for the Army which supplies 4300 Cal. per day and there is no cut in it.

It was recommended by the Ration Advisory Committee, that there should be a common ration scale for the three services. Due to financial difficulties it was decided to achieve the aim in 4 stages. It was, however, suggested that 5 per cent cut should be abolished and the original rations scale restored in the first 2 stages.

A scientific study was desired to be undertaken to determine the necessity for restoration of the previous ration scale and to lay down the calorific level for the proposed common ration scale. It was decided to study the problem by:—

(1) Measuring metabolic cost of various activities of a soldier.
(2) Studying the influence of environmental temperature on energy expenditure.
(3) Recording the time spent by the soldier in various activities in 24 hours.
(4) Determining the amount of nutrients absorbed from the service ration and wastage during preparation of food.
(5) Recording the actual consumption of food during collective training period of an infantry battalion.

The present paper indicates the progress made on the various aspects mentioned above.

Metabolic cost of various activities

The metabolic cost of most of the activities of the Armed Forces has been determined by using the Kofrani Michaelis Respirometer. The results are shown in Table 2. The figures indicate the total cost inclusive of standing/sitting values.

TABLE 2

Metabolic Cost of different Activities for a person weighing 140 lbs.

Type of Activity	Consumption (Litres/min)	Cals/min
1. B. M. R.	0·21	1·04
2. Sitting	0·24	1·16
3. Standing	0·26	1·27
4. Marching (3½ m.p.h.)	0·95	4·67
5. Parade	1·29	6·27
6. P.T.	1·73	8·39
7. Rifle Drill	0·73	3·55
8. Typing (40 words/min)	0·39	1·89
9. Cycling (10 m.p.h.)	1·20	5·83
10. Hockey	1·80	8·74
11. Sentry Duty	0·48	2·40
12. Trench Digging	1·45	7·20
13. Bayonet Fighting	1·50	7·53
14. Field Craft	1·09	5·47
15. Arms cleaning	0·58	2·90
16. Clearing Bushes	1·22	6·10
17. Cleaning Floor	1·18	5·90
18. Bathing	0·50	2·50
19. Washing clothes	0·60	3·00
20. Levelling the ground	0·80	4·00
21. Males	0·30	1·50
22. Loading the truck	1·20	6.00

Further, it was seen that for the tasks which required the carriage of body from one place to another, viz, marching, P.T., bayonet fighting etc. the energy cost was proportional to the body weight (see Fig. 1)

Influence of Environmental Temperature on Energy Expenditure

The studies were made on metabolic cost of various activities both in summer and in winter to determine the influence of environmental temperature, if any, on the energy expenditure. As the winter uniform is heavier than the summer one, the total weights of the subjects were more in winter. For comparison, therefore, the total energy expenditure for summer and winter for each individual was calculated per lb. of their total weight. The results are shown in Fig. 2. The temperature ranged from 67°F to 108°F during the studies.

It will be seen from Fig. 2 that values for summer and winter are almost identical for different grades of activity and statistically there is no significant difference between them. Studies on B.M.R. of 12 Indian subjects recorded fortnightly for a year, also showed no seasonal change. This shows, that if a person is comfortably clothed, there is no difference in the energy cost of his activities with change in environmental temperature. Extra load of the winter clothing, however, does result in a little higher energy expenditure in 24 hours in winter than in summer. Our results appear to confirm the findings of other workers[1], that so far as practical nutrition is concerned, the linear relationship between energy expenditure and mean annual temperature as proposed by Keys[2] does not hold good.

Daily activity Routine in an Infantry Battalion

Records of the daily activities of 8 soldiers minute by minute were collected for 2 weeks during collective training period. The time spent in various activities for 14 days was averaged to get the values for a day. This was done to cover half working days and holidays when the activities were comparatively less strenuous. The mean daily activity routine is shown in Table 3.

TABLE 3

The Daily Activity Routine of a Soldier in an Infantry Battalion during Collective Training Period

Serial No.	Activity	Time (Hrs. Mts.)	Calories consumed
1	Sleeping	6-11	385
2	Sitting	5-52	408
3	Standing	1-00	76
4	Bathing	0-22	55
5	Washing clothes	0-33	69
6	Dressing	0-19	57
7	Marching	2-58	831
8	Meals	1-52	168
9	Sentry Duty	0-32	76
10	Advance to contact	0-06	27
11	Defence	0-11	170
12	Area cleaning	0-14	60
13	Cutting Bushes	0-29	177
14	Road Repairs	0-06	24
15	Loading the truck	0-18	108
16	Arms cleaning	0-09	26
17	Trench Digging	0-48	346
18	Parade on night attack	0-47	48
19	Playing Games (Hockey)	0-13	113
		24-00	3254

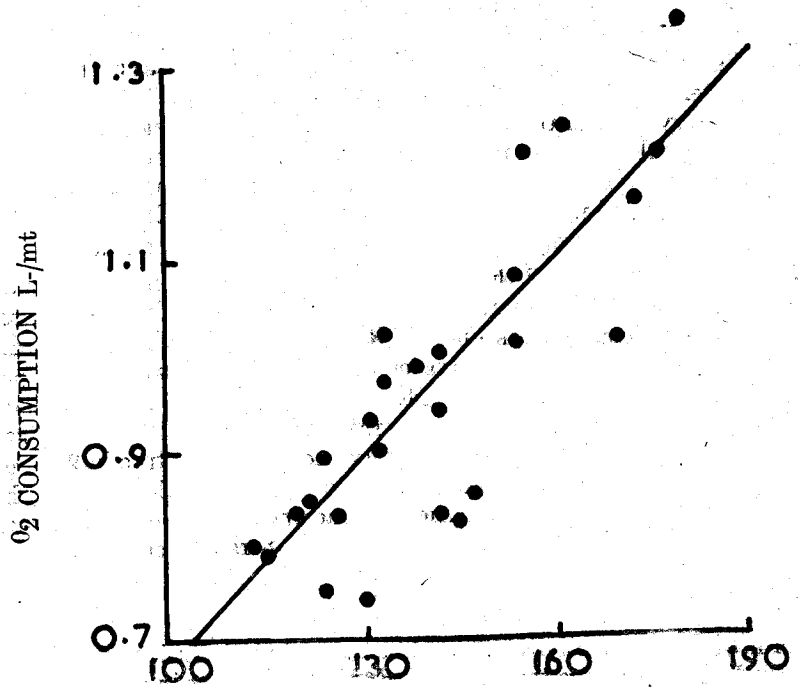

FIG. 1—Oxygen consumption during marching at 3·6 m. p. h. for persons of different weight groups.

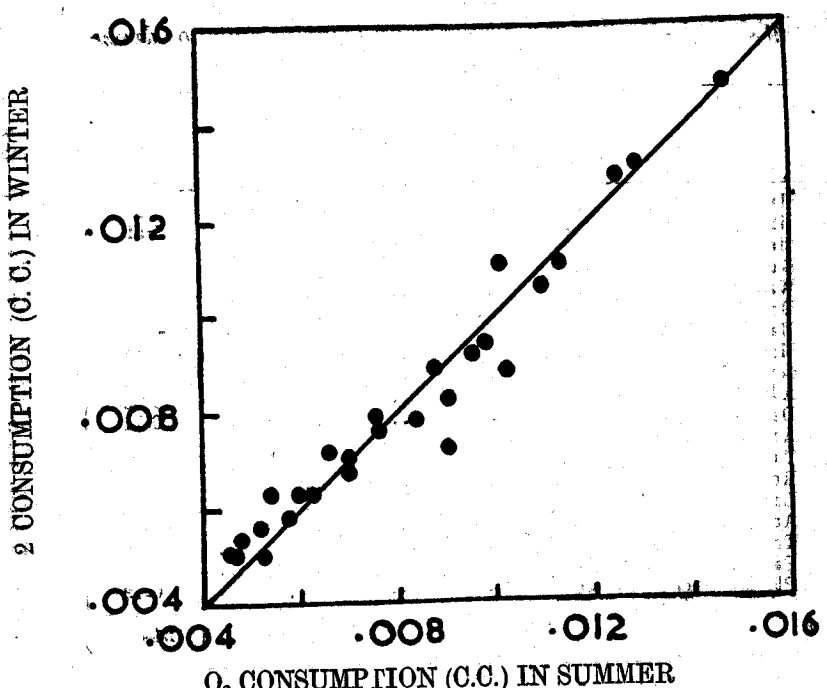

FIG. 2—Oxygen consumption (c. c.) per pound body wt. during summer and winter for the same activities.

From the record of daily activity and the values for energy cost of different activities the average Calorie expenditure of soldiers during the collective training period works out to 3200 Cal./day with a range of 3,000 to 3,400 Cal. Some companies of the Battalion were engaged in comparatively strenuous type of exercises and so had higher energy expenditure.

The daily activities have been classified according to the degree of severity of work and are given in Table 4.

TABLE 4

Average duration of daily activity and energy expenditure of a soldier in an infantry battalion during collective training period

Nature of Activity	Average Duration (Hr. mts.)	Energy Expenditure (Cal)
Sleep	6-15	400
Light work	11-15	1100
Moderate work	4-45	1060
Heavy work	1-45	640
Total	24 00	3200
Calories to be provided in the food—		
Daily Energy Expenditure		3200
Specific Dynamic Action		320
Wastage during absorption and cooking etc.		390
Total Intake		3910

Wastage of Nutrients during Cooking and Absorption

In order to determine the food intake which would provide 3,200 Cal. to the body, it is required to know the wastage of food during preparation and cooking and due to lack of absorption from the alimentary canal. In addition extra calories required for specific dynamic action (S.D.A.) of food are to be added.

Studies on wastage during preparation, cooking and abosrption of different nutrients on service rations showed that about 10-11 per cent of food is wasted in this way for which allowance must be made in the diet [3].

The S.D.A. depends on the type of food consumed. F.A.O's Committee on calorie requirement[4] has suggested its value to be about 10 per cent of the total energy expenditure. We have not worked on the problem but have taken F.A.O's figure for calculation of the calorie intake.

The calorie requirement on this basis works out to about 3,910 Cal per day, with a range of 3,660 to 4,160 Cal. The ration after 5 per cent cut provides only 3,660 Cal. When 5 per cent cut is abolished, it will supply above 3,900 Cal. *ie.* just the minimum required.

Actual Consumption of Food by Troops

Studies were also made on the actual consumption of food by two infantry battalions during collective training period, in the month of November 1957 in Northern India. The quantity of food issued from the stores to the kitchen was recorded and left over and plate wastage was noted. There was practically no plate wastage. In addition quite a number of jawans supplemented their rations from the canteen. In one of the battalions (Sikh) most of the jawans had brought milk ghee from their homes and were using it with their meals. In addition every platoon had a couple of oil stoves, which they carried in their haversacks during the exercises, to make extra tea on the way. Extra milk was bought from the villages near by.

Special financial sanction had been obtained to issue extra rations to the cook house to meet the requirement of the soldiers, if necessary, so that soldiers could eat to their requirements. Extra ration was kept in the cook house and cooked only when required. The results of a month's trial are given in Table 5

TABLE 5

Statement of Rations issued to Infantry Battalions during collective training period

	Actual ration strength	No. of rations issued after 5% cut	Average Height (inches)	Average body weight (lbs)	Excess used percentage of rations issued				
					Atta/ Rice	Dal	Sugar	Ghee	Fire-wood.
Sikh Regt.	21,148	20,091	67·1	139·6	4·97	0·96	0·36	1·04	12·68
Madras Regt.	18,715	17,779	65·6	129·5	14·12	3.89	0·7	2·96	27·65

It will be seen from Table 5 that Sikh Regt. used 4·97 per cent extra atta, while the consumption of other food-stuffs was not much in excess. There was however, shortage in firewood by about 12 per cent. On enquiry it was found that the shortage in cereals was being made up by subscription from jawans. The position with the Madras regiment was still worse. They had deficiency of 14·12 in cereals, 3·89 per cent in dal, 2·96 per cent in ghee and 27·65 per cent in fire wood.

The average weight of this Bn. was less than that of the Sikhs by about 11 lb. but still the consumption of food was more. This was most probably due to the fact, that this Bn. had recently returned from J & K where they were getting higher ration scale and consequently were used to high intake. Satiety is a matter of habit. If a person gets used to eating a large bulk, he will not be satisfied with a small amount. Therefore, apart from the calorific value of food, consideration has to be given to the satiety value of the food.

Sales from the Canteen were also recorded for one month in the Madras Bn. The correct data of the canteen in the Sikh Bn. could not be obtained, but it was noticed that about 2 Mds of milk was sold daily in the canteen. The quantity of food-stuff used in the Canteen of the Madras Bn. is shown in Table 6. It was the experience of the canteen manager, that only 30 per cent of the soldiers were regular visitors, 30 per cent occasional visitors and the remainder never used the Canteen.

TABLE 6

Expenditure in Canteen for a month for an Infantry Battalion

Name of Food Stuff	Qty. (lbs.)
1. Rice	253
2. Sugar	240
3. Dal	375
4. Milk	400
5. Ghee	165
6. Coffee	13
7. Tea	12½

From the studies so far completed it has been seen that the energy expenditure of a soldier during collective training period in winter varies from 3,000 to 3,400 Cal. per day and this amount is provided by supplying rations with calorific value of 3,670 to 4,150 Cal. It has been further seen that there is not much difference in the energy expenditure during summer and winter. It is, however, a common experience that food intake is higher in winter than in summer. This is most probably due to the fact that the maximum training programme of the Battalion is in the winter. In summer the activity of the soldiers is comparatively less, and the hours of work are restricted as a precautionary measure against heat stroke. Further work is necessary to determine the actual food consumption and level of activity of troops in summer.

Another problem which requires investigations is whether the quantity of animal proteins in the army ration is enough or not. As has already been pointed out, the army ration supplies 20 gm of animal and 22 gm of vegetable proteins. Theoretically this amount should be quite enough. Recent studies by Hegsted[5] have shown that the minimum requirement of protein with biological value of 100 is only 20g/day for an adult. In another study[6], we did not find any significant difference between vegetarians and non-vegetarians in the Army, Navy and Airforce, with respect to their hæmoglobin content, body weight, general health and physical efficiency.

References

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Concluding remarks by the Chairman

The Chairman strongly stressed the need for restoration of 5% cut in the ration which was imposed in 1950 due to shortage of cereals in the country. He mentioned that this cut is not desirable since a soldier is not only to be adequately fed, but he should also be allowed to build up adequate nutritional reserves so that he can stand the strain of military duties and injury/diseases and would still be able to survive with fitness. He referred to the investigations carried out by Surg. Lt. Cdr. Malhotra who had shown that the energy expenditure of troops during collective training peroid was about 3100 calories per day. After making due corrections for specific dynamic action of food and their metabolic waste it was found that this amount of energy could be obtained from a ration something like 3900 calories per day leaving aside another margin of 200 cal. The daily requirement of troops appears to be about 4,000 cal. and as such the cut in ration is unjustified.