The Losses of Edible Food Due to Plate Waste, in Army Dining Halls

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Cathcart & Murray (1939), Andross (1946) and Gray & Dubois (1947) have all contributed to our knowledge of the loss of calories due to plate waste in the civilian population. This type of information, vital in calculating ration scales for the Armed Forces, is not available for the British soldier. The following data on the loss of edible food by plate waste were obtained in the course of an investigation of the dietary habits of the British Army (Arneil, unpublished data).

METHOD

The diets of 114 men, selected by random sampling in five different types of unit totalling 2578 persons, were investigated over a period of 7 days. These units were in widely separate parts of Britain, and the kind of work performed in each was different, varying from light to heavy. The men were mostly in the 18–20 years age group. All foods served, and the quantity of each component of the meal remaining on the plate of each subject after each meal, were carefully determined by highly trained personnel using spring balances suitable for weighing food to 2 g. For foodstuffs of known constitution the calorie value was calculated from the tables of McCance & Widdowson (1946); otherwise direct chemical analyses were made. Materials analysed included soups, stocks, gravies, ciders, beers, and the like.

The calculation of percentage loss of edible material and percentage loss in calorie value due to plate waste is based on the method of Atwater & Bryant (1896), as used by Cathcart & Murray (1939), i.e. on the formulas

$$\text{Percentage loss of edible material} = \frac{\text{Total weight of plate waste}}{\text{Total weight of food issued}} \times 100,$$

$$\text{Percentage calorie loss} = \frac{\text{Total calorie value of plate waste}}{\text{Total calorie value of food issued}} \times 100.$$

In each case 'food issued' refers to the actual edible portion as served on the man's plate.

RESULTS

The values for plate waste and calorie waste found by us in five camps are shown in Table 1. It is interesting to compare these results with those obtained by Cathcart & Murray (1939) for unemployed families. These workers found calorie losses, due to

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plate wastage, varying from 0·60 to 2·67%. It is only to be expected, however, that, in the home, economic circumstances and cooking for, and serving to, small numbers and to individual tastes will result in a smaller plate waste than in the Army, or, indeed, in

Table 1. *Plate waste and calorie loss by plate waste in five separate Army units*

Unit	No. of men	Type of work	Calorie value of ration eaten*	Weight loss by plate waste (%)	Calorie loss by plate waste (%)
A	55	Hard	2932	4·92	2·35
B	12	Moderate	2748	6·01	1·57
C	12	Hard	2798	11·7	6·23
D	14	Light	2279	9·28	3·68
E	25	Hard	3016	7·31	2·04
Mean	—	—	—	6·27	2·76

* The calorie intake given is that derived from the Army ration, not the total intake of the man from all sources.

Table 2. *Percentage plate waste of certain foodstuffs by weight in five separate Army units*

Food	Unit A	B	C	D	E	Mean
Cereals:	1·33	4·65	10·5	5·38	2·94	4·96
Bread						
Porridge	4·00	—	1·14	—	2·76	2·63
Meat:						
Liver, braised	7·68	—	—	7·29	9·57	8·18
Lamb, roast	6·88	—	32·0	29·5	7·40	18·9
Beef, roast	1·97	0·80	3·45	24·3	—	7·63
Sausage	1·10	0·94	1·90	1·63	—	1·39
Vegetables:						
Potatoes, boiled	4·51	1·06	4·95	5·5	1·42	3·49
Cabbage	8·13	4·95	2·99	22·9	4·84	8·76
Carrots	7·98	3·68	24·0	11·1	—	11·7
Turnips	8·01	—	12·6	—	—	10·3
Peas	2·62	1·05	2·42	—	0·19	1·57
Fats:						
Margarine and butter	2·30	1·98	1·25	1·12	0·14	1·36
Miscellaneous:						
Custard	5·31	—	0·18	5·2	—	3·56
Gravy	1·62	1·21	1·79	1·95	—	1·64

Dashes indicate that the foods were not served at the camp during the survey.

any large-scale catering establishment. Moreover, large-scale feeding frequently results in cold plates and food; this fact, together with the very old kitchens and dining halls used by some Army units, especially by units C and D, accounts for a higher plate wastage. Another factor which must be considered is the actual proportions of the various constituents in the diet. War has altered dietary patterns since Cathcart & Murray (1939) published their observations. They noted that waste of bread and vegetables was responsible for a comparatively high percentage of the calorie loss, and it is these very components of the diet which have increased. Table 2 shows the

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percentage plate waste for a few common foods which were served at the camps during the week in question. It confirms the view that, where cookhouse and dining facilities are poor, all types of plate waste are greatly increased. This is especially so with hot dishes, e.g. boiled potatoes, carrots, and meat.

In agreement with the findings of Cathcart & Murray, a great deal of the loss was found to be due to waste of bread and vegetables. Gray & Dubois (1947) studied the percentage plate waste in the diet of students in the United States, and a comparison

Table 3. *Comparison of percentage plate waste by weight of American students and British soldiers*

Food	American students*	British soldiers†
Bread	20	4·96
Potatoes, boiled	20	3·49
Carrots	10	11·7
Cabbage	10	8·76
Meat	20	1·39–18·9
Peas	10	1·57

* Gray & Dubois (1947). † Present investigation.

of their results with those of the present investigation is given in Table 3. It appears that the bread and potato waste of the British soldier is substantially below that of the American student.

DISCUSSION

Application of results to Army dietetics

It has long been assumed, although only recently proved (Arneil, unpublished data), that the calorie value of the British soldier's diet, as calculated on the ration scale, is 10% higher than the calorie value of the food actually eaten by the soldier. This is in agreement with the findings of Howe & Berryman (1945) for the American Army. Whereas several factors contribute to this loss, the present investigation tends to show that plate waste, amounting to 6·27% by weight, accounts for a loss of 2·76% of the theoretical calorie value of the ration scale as calculated. It is suggested that, for active service, 4% is a reasonable safety margin to allow for this form of waste. Howe & Berryman found the figure for plate and kitchen waste to be 8·1% in the U.S. Army. Cathcart & Murray (1939) regarded 5% as the safety margin for families in this country.

SUMMARY

1. The loss in calorie value of army rations, due to plate waste, had a mean value of 2·76%. These results were obtained by individual study of 114 men over a period of 1 week. These men were a random sample of 2578 men, in five Army units, in widely separated parts of Scotland and England.

2. The standard of cooking and manner of presentation of the food produced a wide fluctuation in the extent of plate waste.

3. In calculating Army ration scales, 4% should be allowed for calorie loss by plate waste.

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REFERENCES

Andross, M. (1946). *Proc. Nutr. Soc.* **4**, 155.
Atwater, W. O. & Bryant, A. P. (1896). *Rep. Storrs agric. Exp. Sta.* no. 9.
Cathcart, E. P. & Murray, A. M. T. (1939). *J. Hyg., Camb.*, **39**, 45.
Gray, C. & Dubois, R. (1947). *J. Amer. diet. Ass.* **23**, 231.
Howe, P. E. & Berryman, G. H. (1945). *Amer. J. Physiol.* **144**, 588.
McCance, R. A. & Widdowson, E. M. (1946). *Spec. Rep. Ser. med. Res. Coun., Lond.*, no. 235, 2nd ed.

Diet and Resistance to Experimental Tuberculosis in Mice

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On clinical and epidemiological grounds it is generally accepted that nutrition has an important influence on resistance or susceptibility to tuberculosis (see, e.g. Long, 1941*a*, *b*; Orr, 1941–2; Day, 1942, 1948; Keers, 1943, 1945, 1948; Leitch, 1945; Rich, 1946; Daniels & Hart, 1948). But in field studies it is difficult to isolate diet from the other agents known to determine resistance or susceptibility to infection—for example, housing and ventilation, physical and mental strain, age, sex, heredity, previous contact with the infection, and the number of infecting organisms encountered. Cuthbertson (1940–1, p. 11) stated: 'It is difficult to distinguish the many separate factors that may be concerned. There certainly appears to be an inverse relationship between the incidence of tuberculosis and social prosperity in which diet plays a part.' In view of this, laboratory studies on diet and tuberculosis are clearly required, keeping all other conditions as uniform as possible in order to bring out the effect of differences in diet. In Rich's (1946) words: 'Considering the importance of the matter, there has been surprisingly little pointed experimental study of the relation of nutrition to resistance in tuberculosis. The little that has been done in this direction has not shed any significant or conclusive light upon the problem.' In the past few years, interest in the mouse as an experimental animal for tuberculosis (Browning & Gulbransen, 1926; Schwabacher & Wilson, 1936–7) has been revived by the work of Glover (1944), Youmans & McCarter (1945), Martin (1946), and Dubos (1947). Dubos (1947) indeed studied the effect of various diets of natural food and reported (p. 51) that: 'Animals kept on a poor diet (comprising a very large proportion of starch and gelatin) developed more numerous and extensive pulmonary lesions than animals maintained on a more

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