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# Trace nutrients

## 5*. Minerals and vitamins in the British household food supply

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1. The amounts of magnesium, copper, zinc, phosphorus, manganese, potassium, vitamin $B_6$, vitamin $B_{12}$, folate, pantothenic acid, biotin, vitamin E and dietary fibre in the British household diet were calculated by applying appropriate values from recent analytical studies to the amounts of foods recorded in the National Food Survey during 1986.

2. National average intakes were (mg/person per d): Mg 247, Cu 1·25, Zn 9·0, P 1249, Mn 3·43, K 2694, vitamin $B_6$ 1·73, vitamin $B_{12}$ 6·33 $\mu$g, folate 230 $\mu$g, pantothenic acid 6·07, biotin 35 $\mu$g, vitamin E 8·4. Regional and income-group differences were estimated, and found to be small. Additional contributions from alcoholic drinks and confectionery were also determined.

3. Dietary fibre was estimated both as unavailable carbohydrate and as non-starch polysaccharide. The national average intakes were 21·8 and 12·9 g/d respectively.

4. Intakes were compared with Canadian (Department of National Health and Welfare, 1983) and American (National Research Council, 1980) recommended dietary allowances (RDAs). With the exception of biotin, the Canadian RDAs were met by the household diet but the much higher American RDAs were only met for vitamin $B_{12}$ and pantothenic acid.

The National Food Survey (NFS) has monitored the nutrient content of the British diet since the Second World War, but the Annual Reports record intakes of only three minerals (iron, calcium and sodium) and six vitamins (thiamin, riboflavin, niacin, vitamin A, vitamin C and vitamin D). From time to time, the Ministry of Agriculture, Fisheries and Food (MAFF) has, however, undertaken special studies to investigate intakes of other nutrients (see, for example, Spring *et al.* 1979; Wenlock *et al.* 1979; Bull & Buss, 1982; Gilbert *et al.* 1985). This paper updates and extends this information. The nutrients calculated for the present study were magnesium, copper, zinc, phosphorus, manganese, potassium, vitamin $B_6$, vitamin $B_{12}$, folate, pantothenic acid, biotin, vitamin E and dietary fibre. Dietary fibre was calculated both by the Southgate (1978) method and by the Englyst method (Englyst & Cummings, 1984).

### METHODS

The method of calculating the amounts of these nutrients in the household food supply was similar to that which is routinely used for the nutrients presented in the Annual Reports of the NFS Committee (see Ministry of Agriculture, Fisheries and Food, 1987, appendix A).

The study related to 1986, and in that year 6925 randomly selected British households containing 18855 people participated. The survey methodology was as follows.

Each housewife recorded in detail the exact type and quantity, and the cost, of each food purchased, and any obtained free during the week in which she (or he) participated. The age and sex of the people present at each meal were recorded, but meals and snacks consumed outside the house were not, unless made from the household food supply (e.g. packed lunches). Alcoholic drinks and confectionery were also not included. Each food was then assigned to one of 200 different groups of food. The amounts of each of these food

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groups obtained by households in each of the main regions of Britain, and with different incomes and family composition, as well as national averages were then calculated, and published elsewhere (Ministry of Agriculture, Fisheries and Food, 1987).

The most appropriate analytical or literature values were applied to each food within each food group for Mg, Cu, Zn, P, Mn, K, vitamin $B_6$, vitamin $B_{12}$, total folic acid, pantothenic acid, biotin, vitamin E and two different estimates of dietary fibre (Englyst & Cummings, 1984; Southgate, 1978). The majority of values were obtained from recent MAFF-funded analytical studies. Although information on the nutritional value of a wide range of UK foods already exists in *McCance and Widdowson's The Composition of Foods* (Paul & Southgate, 1978), it needs to be regularly updated because foods themselves are changing. Details of the studies used (both published and unpublished) are summarized in the twenty-third report of the Steering Group on Food Surveillance (Ministry of Agriculture, Fisheries and Food, 1988). Some values, especially for meat and fish, were from food tables (Paul & Southgate, 1978). Where no analytical information was available, appropriate literature values and occasionally manufacturers' values were used. Finally, for a few foods where no values could be ascribed by any of the previously described methods, estimates were made from the values for major ingredients or for the most-similar foods. Allowance was made for the proportion of each food which is not edible, but not for any further losses of nutrients which might occur during cooking.

Potential contributions of alcoholic drinks and confectionery to average intakes of nutrients in the present study were estimated separately. Consumption was taken as the total amounts available per person in the UK during 1986, that of alcoholic drinks being derived from H.M. Customs and Excise (1987) and that of confectionery from the Biscuit, Cocoa, Chocolate and Confectionery Alliance (1987). Each value was divided by the total population of the UK and contributions were calculated as above.

Nutrient intakes were also compared by country (England, Scotland and Wales), and for income groups A and D (i.e. when the earned income of the head of household was $\geqslant$ £335 per week and $<$ £90 per week respectively). For geographical calculations, it was differences in the amounts of foods consumed rather than any geographical differences in nutrient composition of foods that were important. Any geographical differences in the nutrient contents in foods are unlikely to be important in Britain, since very few foods are now produced and consumed locally.

The significance of the results was assessed by comparing the nutrients in the household food supply with recommended intakes. Since no detailed recommendations have been made in this country for any of the nutrients in the present study (Department of Health and Social Security, 1979) comparisons were made (where available) with the intakes recommended in the USA (National Research Council, 1980) and Canada (Department of National Health and Welfare, 1983). The numbers of people of each age and sex in Britain in 1986 have been estimated (Office of Population Censuses and Surveys, 1985), and these were combined according to the age and sex groupings of the American and Canadian RDAs. Each nutrient recommendation was then multiplied by the number of people in the appropriate categories and the totals were divided by the total population of Britain to obtain weighted recommendations for each nutrient expressed per person per d.

## RESULTS

The amounts of Mg, Cu, Zn, P, Mn, K, vitamin $B_6$, vitamin $B_{12}$, folate, pantothenic acid, biotin, vitamin E and dietary fibre in the household diet, and the contributions made to the totals by each major group of food, are summarized in Tables 1 and 2. The potential contributions from alcoholic drinks and confectionery are also shown.

Table 1. *Contributions (mg/person per d) made by groups of foods to selected minerals in the British household food supply in 1986*

| | Magnesium | Copper | Zinc | Phosphorus | Manganese | Potassium |
|---|---|---|---|---|---|---|
| Milk and milk products | 44 | 0·022 | 1·73 | 406 | 0·03 | 529 |
| Meat and meat products | 21 | 0·328 | 3·01 | 215 | 0·10 | 305 |
| Fish and fish products | 5 | 0·028 | 0·14 | 41 | < 0·01 | 61 |
| Eggs | 5 | 0·031 | 0·60 | 91 | 0·01 | 62 |
| Fats | 1 | 0·012 | 0·05 | 5 | < 0·01 | 3 |
| Sugars and preserves | 1 | 0·017 | 0·06 | 1 | 0·01 | 9 |
| Potatoes | 19 | 0·104 | 0·28 | 44 | 0·15 | 411 |
| Other fresh and processed vegetables | 27 | 0·110 | 0·58 | 96 | 0·39 | 482 |
| Fruit and fruit products | 14 | 0·056 | 0·12 | 24 | 0·16 | 194 |
| Bread | 46 | 0·221 | 1·17 | 149 | 1·06 | 175 |
| Flour, cakes and biscuits | 12 | 0·089 | 0·36 | 59 | 0·26 | 81 |
| Other cereals and cereal products | 22 | 0·094 | 0·58 | 80 | 0·36 | 98 |
| All other foods | 30 | 0·134 | 0·32 | 38 | 0·90 | 284 |
| Total | 247 | 1·246 | 9·00 | 1249 | 3·43 | 2694 |
| Alcoholic drinks | 31 | 0·130 | 0·01 | 59 | 0·49 | 174 |
| Confectionery | 16 | 0·130 | 0·04 | 41 | 0·10 | 88 |

Table 2. *Contributions (/person per d) made by groups of foods to selected vitamins in the British household food supply in 1986*

| | Vitamin $B_6$ (mg) | Vitamin $B_{12}$ ($\mu$g) | Folate ($\mu$g) | Pantothenic acid (mg) | Biotin ($\mu$g) | Vitamin E (mg) |
|---|---|---|---|---|---|---|
| Milk and milk products | 0·28 | 1·50 | 23 | 1·34 | 8 | 0·5 |
| Meat and meat products | 0·31 | 2·87 | 16 | 1·01 | 3 | 0·3 |
| Fish and fish products | 0·06 | 0·67 | 2 | 0·08 | 1 | 0·2 |
| Eggs | 0·05 | 1·06 | 6 | 0·79 | 11 | 0·7 |
| Fats | 0 | 0 | 0 | 0·01 | 0 | 3·9 |
| Sugars and preserves | 0 | 0 | 0 | 0 | 0 | 0 |
| Potatoes | 0·30 | 0 | 34 | 0·37 | 0 | 0·1 |
| Other fresh and processed vegetables | 0·25 | 0 | 55 | 1·22 | 1 | 1·0 |
| Fruit and fruit products | 0·07 | 0 | 18 | 0·16 | 1 | 0·5 |
| Bread | 0·10 | 0 | 34 | 0·45 | 3 | 0 |
| Flour, cakes and biscuits | 0·04 | 0·03 | 7 | 0·15 | 1 | 0·5 |
| Other cereals and cereal products | 0·22 | 0·15 | 11 | 0·20 | 2 | 0·4 |
| All other foods | 0·05 | 0·05 | 24 | 0·29 | 4 | 0·3 |
| Total | 1·73 | 6·33 | 230 | 6·07 | 35 | 8·4 |
| Alcoholic drinks | 0·18 | 0·46 | 29 | 0·22 | 1·9 | — |
| Confectionery | — | — | 2 | 0·12 | 0·6 | 0·1 |

The amount of dietary fibre in the household food supply was 21·8 g/person per d when calculated by the Southgate method (Southgate, 1978) which estimates the unavailable carbohydrate content of foods, and 12·9 g/person per d when calculated as non-starch polysaccharide by the Englyst method (Englyst & Cummings, 1984). Table 3 shows the contributions made by each food group to the fibre intake in 1986.

Table 3. *Contributions (/person per d) made by groups of foods to dietary fibre intake in 1986*

| | As unavailable carbohydrate* (g) | As non-starch polysaccharide† (g) |
|---|---|---|
| Milk and milk products | 0·2 | 0·1 |
| Meat and meat products | 0·8 | 0·2 |
| Fish and fish products | 0 | 0 |
| Eggs | 0 | 0 |
| Fats | 0 | 0 |
| Sugars and preserves | 0·1 | 0 |
| Potatoes | 1·9 | 1·4 |
| Other fresh and processed vegetables | 6·1 | 3·9 |
| Fruit and fruit products | 1·8 | 1·3 |
| Bread | 6·6 | 3·1 |
| Flour, cakes and biscuits | 1·7 | 1·2 |
| Other cereals and cereal products | 2·3 | 1·5 |
| All other foods | 0·3 | 0·2 |
| Total | 21·8 | 12·9 |

* Southgate (1978) method.
† Englyst method (Englyst & Cummings, 1984).

Table 4. *Intake of trace nutrients in 1986 compared with previous estimates (including amounts for alcoholic drinks and confectionery)*

| | 1986 | Previous estimate | % Change |
|---|---|---|---|
| Magnesium (mg) | 294 | 288* | +2 |
| Copper (mg) | 1·51 | 1·81* | −17 |
| Zinc (mg) | 9·05 | 9·20* | −2 |
| Phosphorus (mg) | 1349 | 1223‡ | +10 |
| Manganese (mg) | 4·02 | 4·60§ | −13 |
| Potassium (mg) | 2956 | 2990‖ | −1 |
| Vitamin $B_6$ (mg) | 1·91 | 1·43* | +33 |
| Vitamin $B_{12}$ ($\mu$g) | 6·79 | 7·10* | −5 |
| Folate ($\mu$g) | 261 | 235¶ | +10 |
| Pantothenic acid (mg) | 6·41 | 5·50† | +16 |
| Biotin ($\mu$g) | 37·5 | 35·5† | +5 |
| Vitamin E (mg) | 8·5 | 8·4† | +1 |

* Spring *et al.* (1979).
† Bull & Buss (1982).
‡ Gilbert *et al.* (1985).
§ Wenlock *et al.* (1979).
‖ Bull & Buss (1980).
¶ Tan *et al.* (1984).

The differences between the intake of these trace nutrients and previous estimates are shown in Table 4. These values all include the contributions from alcoholic drinks and confectionery.

Calculated intakes were also compared with American and Canadian RDAs after deduction of 10% of each nutrient as an allowance for wastage (Table 5).

Table 5. *Comparison of trace nutrients with selected recommended dietary allowances (RDAs) (after deduction of 10% of the intake as a conventional allowance for wastage)**

| | Percentage of weighted American RDAs† | Percentage of weighted Canadian RDAs‡ |
|---|---|---|
| Magnesium | 95 | 147 |
| Copper | 61 | — |
| Zinc | 62 | 111 |
| Vitamin $B_6$ | 97 | 185 |
| Vitamin $B_{12}$ | 228 | 375 |
| Folate | 67 | 142 |
| Pantothenic acid | 114 | 127 |
| Biotin | 26 | 41 |
| Vitamin E | 98 | 118 |

* Values include contributions from alcoholic drinks and confectionery.
† National Research Council (1980).
‡ Department of National Health and Welfare (1983).

Table 6 shows the intake of trace nutrients separately for England, Scotland and Wales, and for households in income group A ($\geqslant$ £335 per week) and income group D ($<$ £90 per week).

## DISCUSSION

In most households, the foods purchased in any 1 week are not exactly the same as those eaten during that period. However, averaged over a sufficiently large group of households or a sufficiently long period of time, household stock increases should differ little from household stock depletions. NFS records thus provide a good indication of the dietary intake of the British population (Derry & Buss, 1984). This domestic food supply will be supplemented by alcoholic drinks and confectionery and meals consumed outside the home, but on the other hand some of the foods brought into the home will be discarded and not eaten. To compensate for this, before comparison of intakes with American and Canadian RDAs, allowance was made for meals eaten out and a deduction of 10% of each nutrient was also made as an allowance for wastage, as in the NFS (Ministry of Agriculture, Fisheries and Food, 1987). No allowances have been made for cooking losses.

### *Mg*

The average household diet provided 247 mg/person per d compared with 249 mg/person per d in 1976 (Spring *et al.* 1979). Alcoholic drinks and confectionery provided a further 47 mg/d on average, giving a total of 294 mg/d. This is equivalent to 147% of the Canadian RDA and 95% of the American RDA (after a deduction of 10% of the intake as an allowance for food wastage). The intake was higher than the range calculated by Pennington *et al.* (1986) of 184–288 mg/d for American adults. It was also markedly higher than the 199 mg/d consumed by American women involved in the second American National Health and Nutrition Examination Survey (NHANES II) (Murphy & Calloway, 1986).

The main food sources of Mg were cereals (33% including 19% from bread), vegetables and vegetable products (18% including 7% from potatoes) and milk and its products (18%). These were also the main sources in 1976, although liquid milk, which made the largest single contribution to Mg intake in 1976, has now been overtaken by bread. With the

Table 6. *Intakes (/d) of trace nutrients in selected regions and income groups in 1986*

| | Mg (mg) | Cu (mg) | Zn (mg) | P (mg) | Mn (mg) | K (mg) | Vitamin $B_6$ (mg) | Vitamin $B_{12}$ (μg) | Folate (μg) | Pantothenic acid (mg) | Biotin (μg) | Vitamin E (mg) | NSP (g) | Unavailable carbohydrate (g) | Energy (MJ) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| National average | 247 | 1·25 | 9·0 | 1249 | 3·43 | 2694 | 1·73 | 6·33 | 230 | 6·07 | 35 | 8·4 | 12·9 | 21·8 | 8·7 |
| England | 245 | 1·24 | 8·9 | 1239 | 3·40 | 2667 | 1·73 | 6·31 | 232 | 6·03 | 35 | 8·4 | 13·0 | 21·7 | 8·7 |
| Scotland | 247 | 1·24 | 9·3 | 1275 | 3·47 | 2659 | 1·69 | 6·11 | 215 | 6·12 | 37 | 7·8 | 12·0 | 21·0 | 8·8 |
| Wales | 257 | 1·25 | 9·0 | 1272 | 3·65 | 2771 | 1·81 | 6·06 | 239 | 6·14 | 36 | 8·2 | 13·8 | 22·8 | 9·0 |
| Income group A | 229 | 1·11 | 8·2 | 1156 | 3·08 | 2460 | 1·59 | 5·21 | 220 | 5·40 | 32 | 8·3 | 12·4 | 20·3 | 7·7 |
| Income group D | 228 | 1·22 | 8·6 | 1202 | 3·25 | 2600 | 1·69 | 6·28 | 219 | 6·09 | 35 | 7·4 | 12·3 | 21·5 | 8·5 |

NSP, non-starch polysaccharide.

drop in milk consumption from 382 to 247 ml/d since 1976, there was a decrease in the amount of Mg from this source, whereas even though total bread consumption has declined, the amount of wholemeal has increased and it is richer in Mg than white bread.

### *Cu*

The average household intake of Cu was 1·25 mg/d, which was 17% less than that calculated in 1976 (Spring *et al.* 1979). This was partially due to a decreased consumption of offal, but also due to new analytical values giving lower Cu values for some foods. A further 0·26 mg/d was available from alcoholic drinks and confectionery which brought the total to 1·51 mg/d.

The daily intake of Cu was 61% of the American RDA after deduction of 10% as an allowance for wastage. The Canadians suggest that 2 mg/d is a safe level of intake. Although Cu intake is well below these RDAs, no signs of deficiency have been reported in the UK. Compared with other studies, the calculated Cu intake is not unusually low; Klevay *et al.* (1980) found that the majority of American diets analysed since 1966 contained less than 1·30 mg/d. Similar results have been obtained since then: for example, 1·16 mg/d in American women involved in the NHANES II (Murphy & Calloway, 1986); 1·50 mg/d in pregnant Scottish women (Tuttle *et al.* 1985); 1·20 mg/d in American adults (Patterson *et al.* 1984); 1·12 mg/d in Hungarian adults (Muranyi-Szeleczky, 1983); 2·2 mg/d in female American athletes (Deuster *et al.* 1986); 1·90 mg/d in Canadian women (Gibson & Scythes, 1982). It is thus possible that Cu RDAs have been set unnecessarily high.

### *Zn*

The average Zn content of the household diet was 9·0 mg/d, which was very similar to the 9·1 mg calculated in 1976 (Spring *et al.* 1979). This intake, together with the contribution from confectionery and alcoholic drinks, was equivalent to 111% of the Canadian RDA but only 62% of the American RDA (after allowance for food wastage).

Again the value obtained in the present study is not dissimilar to those in other studies, for example, 8·11 mg/d by women participating in NHANES II (Murphy & Calloway, 1986); 9·9 mg in American adults (Patterson *et al.* 1984); 9·1 mg/d in pregnant Scottish women (Tuttle *et al.* 1985); 12·2 mg/d in Australian women (Record *et al.* 1985).

The major sources in the household diet were meat and meat products (34%), cereals and cereal products (23% including 13% from bread) and milk and milk products (19%). The contribution from milk has decreased compared with 1976, but the amount from cereals has increased.

Since meat and meat products account for 34% of dietary Zn on average, some vegetarians may be at risk of an inadequate intake. A study by Freeland-Graves *et al.* (1980) showed that a group of vegans had a Zn intake of 7·9 mg/d compared with 12·7 mg/d for non-vegetarians. Also, a study carried out in London on pregnant women, comparing Hindu vegetarians with non-vegetarian women of European origin, found intakes of 7·5 and 11·6 mg Zn/d respectively (Campbell-Brown *et al.* 1985).

### *P*

The average household diet provided 1249 mg P/d, compared with 1223 mg/d in 1982 (Gilbert *et al.* 1985). An extra 100 mg/d was also available from confectionery and alcoholic drinks, the total providing 143% of the American RDA. Other studies have shown comparable intakes, for example, Pennington *et al.* (1986) found a range of 882–1532 mg/d in American adults; Freeland-Graves *et al.* (1980) 827–1564 mg/d in American adults; and Kim *et al.* (1984) found an average intake of 1183 mg/d in American women and 1825 mg/d in American males.

The main sources of P in the diet were milk and milk products (32%, including 19% from liquid milk), cereals and cereal products (23%) and meat and its products (17%). This was very similar to the pattern in 1982.

*Mn*

The average household intake of Mn was 3·43 mg/d (plus 0·59 mg from confectionery and alcoholic drinks) compared with 4·6 mg/d in 1976 (Wenlock *et al.* 1979). This reduction was almost entirely due to a reduced intake of tea from 63 to 49 g/person per week. Tea is known to be a rich source of Mn (Wenlock *et al.* 1979).

The main sources of Mn in the diet were cereals and cereal products (50% including 31% from bread), tea (21%) and fruit and vegetables (20%). Income group A had a Mn intake of only 3·08 mg/d due to their lower tea consumption.

Human requirements for Mn are unknown (World Health Organization, 1973), although balance studies have found people in positive balance on intakes of 2 mg/d (Schroeder, 1965) whereas intakes as low as 0·71 mg/d lead to a negative balance (World Health Organization, 1973). The Americans have not defined an RDA for Mn, but instead recommend as safe and adequate intakes between 2·5 and 5·0 mg Mn/d.

The Mn intake calculated in the present study compares well with the amounts in other studies, for example, Patterson *et al.* (1984) found an intake of 3·0 mg/d in American adults; Muranyi-Szeleczky (1983) calculated an intake of 2·82 mg/d in Hungarian adults; and Szalay *et al.* (1982) found 3·29 mg/d in the diets of adults from the North Karelian population in Finland.

*K*

The average household intake of K was 2694 mg/d (with an extra 262 mg/d from confectionery and alcohol) compared with 2990 mg in 1978 (Bull & Buss, 1980). The main sources of K were vegetables and vegetable products (33%), milk and milk products (20%) and cereal products (13%). This intake was similar to that seen in American adults by Pennington *et al.* (1986), who calculated a range of 1983–2889 mg/d.

The Americans' estimated safe and adequate daily intake for K is 1875–5625 mg/d (National Research Council, 1980). The average household intake falls within this range.

*Vitamin $B_6$*

The average household intake of vitamin $B_6$ from food was 1·73 mg/d, 21% higher than in 1976 (Spring *et al.* 1979). In addition the contribution from alcoholic drinks was 0·18 mg/d on average (1·91 mg/d in total). After deducting 10% to allow for wastage, the diet provided 97% of the American RDA.

The Canadians recommend an intake of 0·015 mg/g dietary protein (Department of National Health and Welfare, 1983). In 1986, the household protein intake was 69·3 g/d (Ministry of Agriculture, Fisheries and Food, 1987), which leads to a recommendation of 1·04 mg vitamin $B_6$/d. After allowance for wastage the intake of vitamin $B_6$ met 185% of this RDA.

The main sources of vitamin $B_6$ were vegetables (32% including 17% from potatoes), cereals and cereal products (22%) and meat and meat products (18%). In 1976, cereals provided only 12·5% of the total intake. The increased consumption of breakfast cereals (the most popular of which are fortified with vitamin $B_6$) and of wholemeal bread accounts for most of the increase.

*Vitamin $B_{12}$*

The average household consumption of vitamin $B_{12}$ was 6·33 $\mu$g/d, an amount which greatly exceeds both the weighted American and Canadian RDAs, even after deduction of 10% of the intake as an allowance for wastage (see Table 5). Recommendations for dietary vitamin $B_{12}$ have declined steadily since they first appeared. Recently, the World Health Organization have revised their RDA (Bates, 1987) and have suggested an intake of 1 $\mu$g/d as adequate for health, which is one-third that recommended by the USA (National Research Council, 1980) and half that recommended by Canada (Department of National Health and Welfare, 1983). The intake was 4% lower than that calculated in 1976 (Spring *et al.* 1979).

The main sources of vitamin $B_{12}$ were meat and meat products (45%), and milk and milk products (24%). In 1976, 38% of total vitamin $B_{12}$ intake was from offal, but this dropped to 20% in 1986 due to decreased consumption of liver.

### *Folate*

The average intake of folate was 261 $\mu$g/d, of which 31 $\mu$g came from alcoholic drinks and confectionery. After deducting 10% to allow for wastage, the diet provided 141% of the Canadian RDA but only 67% of the higher American RDA.

In other studies, Murphy & Calloway (1986) estimated an intake of 174 $\mu$g/d by women involved in NHANES II; Black *et al.* (1986) found average intakes ranging from 125 to 205 $\mu$g/d in different groups of pregnant and lactating mothers in Cambridge; and Ahrens & Boucher (1978) estimated intakes of 152 $\mu$g/d when analysing a simulated American diet.

Folate intakes appeared to be 10% higher than in 1981 (Tan *et al.* 1984) but this apparent difference is largely due to new analytical results (Finglas & Faulks, 1984). The values ascribed to potatoes in the present study are two to three times higher than previous estimates. Thus, even though consumption of potatoes decreased between 1981 and 1986 (from 1·19 to 1·10 kg/week respectively), the new analytical values mean that the amount of folate calculated as coming from potatoes rose from 18 to 34 $\mu$g/d.

The main sources of folate were vegetables (39% of which potatoes contributed 15%) and cereals (23% of which 15% came from bread and 2% came from breakfast cereals, which were not fortified in 1986). These relative contributions from vegetables and cereals are similar to those estimated in 1981 (35 and 26% respectively).

### *Pantothenic acid*

The average household intake of pantothenic acid was 6·07 mg/d, compared with 5·1 mg/d in 1979 (Bull & Buss, 1982). American women participating in NHANES II were found to consume 3·56 mg pantothenic acid/d (Murphy & Calloway, 1986), while Hoppner *et al.* (1978) found intakes of 6·8 and 6·1 mg/d by calculation and analysis respectively from a composite Canadian diet.

The main sources of pantothenic acid in the diet were vegetables and vegetable products (26%), milk and milk products (22%), meat and meat products (17%), and eggs (13%). This has changed since 1979, when liquid milk was the main source of pantothenic acid in the diet (25% of total), with vegetables and vegetable products providing only 17% of the total intake (Bull & Buss, 1982).

Dietary deficiencies of this vitamin are unlikely in man since it is so widespread in food, and the diet provides 114% of the mid-point of the American estimated safe and adequate intakes and 127% of the Canadian RDA, even after deduction of 10% as an allowance for wastage.

### *Biotin*

The average household intake of biotin was 35 $\mu$g/d, compared with 33 $\mu$g/d in 1979 (Bull & Buss, 1982). Confectionery and alcoholic drinks provided an extra 2·5 $\mu$g/d on average.

Biotin deficiency does not occur in man except under extraordinary conditions. The few reported cases have been associated with high intakes of raw eggs (Davidson *et al.* 1986). There is a general lack of certainty of the human requirement for biotin. Rather than define an RDA, the USA (National Research Council, 1980) has published an estimated 'safe and adequate daily dietary intake' which, when weighted for the British population, is 141 $\mu$g/d. The Canadians (Department of National Health and Welfare, 1983) have suggested a dietary intake of 1·5 $\mu$g/kg body-weight for all age-groups, which would give a weighted RDA of 88 $\mu$g/d. On this basis, the household diet provides only 26% of the mid-point of the American estimated safe and adequate intakes, and 41% of the Canadian RDA (after 10% allowance for food wastage).

American women in NHANES II consumed 39·9 $\mu$g biotin/d (Murphy & Calloway, 1986), and Hoppner *et al.* (1978) found intakes of 60 $\mu$g/d in Canada.

In view of the lack of biotin deficiency symptoms in man, it is possible that the estimated range of safe and adequate intakes is too narrow.

### *Vitamin E*

The intake was calculated to be 8·4 mg/d, which compares with 8·3 mg/d in 1979, and a further 0·1 mg/d was available from confectionery. However, in 1979, tea was calculated as contributing 2·2 mg to total vitamin E intake. It has been suggested that the vitamin E available from tea is negligible (Bull & Buss, 1982), so in the present study it was assumed that no vitamin E was available from tea. There was, therefore, an increase in vitamin E from other sources from 6·1 to 8·4 mg/d.

American women participating in NHANES II consumed 5·84 mg/d (Murphy & Calloway, 1986), whereas Bieri (1984) calculated an intake of 13·1 mg/d in American adults and Ahrens & Boucher (1978) found 8 mg available by analysis of a simulated American diet.

Vitamin E intake was 98% of the weighted American RDA and 118% of the weighted Canadian RDA, after deduction of 10% for wastage.

The main contributors to vitamin E intake were oils and fats (46%, compared with 26% of the total in 1979). Since 1979, there has been a rapid increase in the consumption of fats and oils rich in polyunsaturated fatty acids (e.g. in 1979 only 7% of margarine was of this kind compared with 20% in 1986). Other significant sources of vitamin E were vegetables (13%) and cereals (12%).

### *Dietary fibre*

Dietary fibre intakes were calculated by both the Englyst (Englyst & Cummings, 1984) and the Southgate (1978) methods. Englyst fibre is defined as 'non-starch polysaccharide', whereas the Southgate method also includes some of the starch which is resistant to digestion and lignins (which are not polysaccharides). For many foods, the latter method gives substantially higher values than the former (see Table 3). When using the Southgate method, the average household intake of dietary fibre was calculated as 21·8 g/d, showing little change from the value of 22·2 g/d calculated in 1982 (Wenlock *et al.* 1984). Other studies have shown intakes of 19·9 g/d in adults in Cambridgeshire (Bingham *et al.* 1979); 15·1 g/d in women in South Wales (Barasi *et al.* 1983); and 21·4 g/d in adults in Oxfordshire (Gear *et al.* 1979).

The average household consumption of non-starch polysaccharide was 12·9 g/d. By both methods of analysis, however, cereals and cereal products provided nearly half the total dietary fibre (49% by the Southgate method and 45% by the Englyst method). Vegetables and vegetable products were the next best source of fibre in both cases (37% by the Southgate method; 41% by the Englyst method).

In income group A, the Southgate fibre value was 1·5 g lower than the national average, and the Englyst fibre value was 0·5 g lower. This was due to the below average consumption of bread and potatoes in the higher-income group.

There are no official recommendations for fibre intake but the National Advisory Committee on Nutrition Education (NACNE)(1983) recommended a 50% increase in fibre consumption for the nation as a whole. In the present study, the value calculated from the NFS was 8% higher than the intake of 20 g/d estimated by NACNE when the report was published.

Despite the changes in the British diet in the 1980s (Buss, 1988), most nutrient intakes show very little change since the values were previously calculated. The largest percentage changes were in intakes of vitamin $B_6$ (+33%), pantothenic acid (+16%) and Cu (−17%). It can be seen from the results that, with the exception of biotin, the Canadian RDAs were met by the household diet; when compared with American RDAs, however, the only RDAs met were for vitamin $B_{12}$ and pantothenic acid. This does not necessarily indicate that the household diet is lacking in these nutrients, as the American RDAs tend to be amongst the highest in the world (International Union of Nutritional Sciences, 1983).

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