Studies on the availability of iron in potatoes

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1. Iron availability in potatoes and ferrous sulphate was measured in rats in a 10 d balance study and from a single meal using ^{59}Fe and ^{55}Fe as extrinsic labels.

2. Dried potato samples were incubated in gastric juice in vitro and the amount solubilized was compared with other foods. The relationship between ascorbic acid content of dried potato and Fe solubilization was examined in vitro.

3. In the balance study, the rats absorbed (mean with SE) 15·2 (2·7)% Fe from the diet containing 660 g dried potato/kg and 32·1 (2·8)% Fe from the semi-synthetic diet containing $FeSO_4$. Absorption was higher from the extrinsically-labelled single meal: 49·6 (1·1)% Fe from ^{59}Fe-labelled potato and 62·4 (1·2)% Fe from $^{59}FeSO_4$.

4. The in vitro experiments showed a much greater solubilization of Fe from potato than from the other foods examined. There was a correlation between Fe solubilization and ascorbic acid content of potatoes (r_s 0·76, $P < 0·01$).

5. It appears that potatoes contain Fe of moderate availability, possibly higher than most vegetables. They also provide ascorbic acid which may enhance Fe absorption from a meal if present in sufficient quantities. Thus potatoes may make a useful contribution towards the Fe nutriture of the UK population.

The amount of iron contributed by potatoes (*Solanum tuberosum*) to the average UK daily diet is 6·2% (Ministry of Agriculture, Fisheries and Food, 1980) which is more than any other single vegetable. Main-crop potatoes contain approximately 3 mg Fe/kg and new potatoes 4 mg Fe/kg (Paul & Southgate, 1978) which is lower than most green vegetables, e.g. Savoy cabbage (var., *Brassica oleracea*) 7 mg Fe/kg and Brussels sprouts (var., *Brassica oleracea*) 5 mg Fe/kg. However, potatoes are consumed daily and usually in larger quantities than other vegetables. Indeed, people from low-income groups, particularly families with several children consume greater amounts of potato than the national average. Thus potatoes make a small but measurable contribution towards Fe intake and, after liver, bread and canned beans, they are considered good nutritional value for money, contributing 0·3 mg Fe/penny (Ministry of Agriculture, Fisheries and Food, 1980).

Since only approximately 10% of total dietary Fe is absorbed, absolute values for Fe intake are meaningless unless accompanied by some indication of availability. The limited number of reports in the literature suggest that the availability of Fe in vegetables is low. For example, Layrisse *et al.* (1969) found that Fe absorption from spinach (*Spinacea oleracea*) by human subjects was 1·7%, from black beans (*Phaseolus vulgaris*) 3·2% and from lettuce (*Lactuca sativa*) plus tomato juice 5·8%. In comparison, Fe from meat and fish was better absorbed with meat values ranging from 16 to 20%. In order to standardize the results and make them comparable with other studies, ferrous ascorbate absorption was also measured in each individual. The food Fe:ferrous ascorbate values were 0·11 for spinach, 0·17 for black beans, 0·31 for lettuce, 0·4 for fish and 1·31 for veal. There is, however, no information to date on the availability of Fe in potatoes.

In any meal haem- and non-haem-Fe enter two separate pools which are absorbed by different pathways: non-haem-Fe is generally less well-absorbed than haem-Fe but absorption can be improved in the presence of certain substances such as ascorbic acid. Potatoes contain significant levels of ascorbic acid (40–140 mg/kg), the actual amount being dependent on the maturity of the tuber, length of storage and the type of cooking. It is,

therefore, quite possible that the Fe in potatoes when consumed alone is reasonably well-absorbed, and that when potatoes are eaten with a meal the ascorbic acid present will enhance Fe absorption from the non-haem pool.

Rats appear to absorb non-haem-Fe as well as or better than haem-Fe (Amine & Hegsted, 1971) which is different from man. They are, therefore, considered to be of limited use in Fe absorption studies involving haem-Fe but, because of the problems inherent in using radiotracers to measure Fe absorption in man accurately, they are still frequently used in studies of non-haem-Fe absorption. Indeed, the Association of Official Analytical Chemists' method for measuring bioavailability of Fe uses the technique of haemoglobin repletion in anaemic rats (Fritz *et al.* 1974). In the present study, Fe availability in potatoes and ferrous sulphate was measured in rats by the conventional balance technique and by using extrinsic radio-labels.

Recent work has shown good agreement between in vivo and in vitro methods for determining the availability of Fe in foods (Schricker *et al.* 1981). Dried samples of potato were therefore incubated in gastric juice in vitro by the method of Lock & Bender (1980) and the amount of Fe solubilized was compared with other foods. The relationship between ascorbic acid and Fe solubilization was examined in vitro.

MATERIALS AND METHODS

Animal experiments

Diets. Main-crop potatoes (var. Maris Piper) were baked in their skins in a microwave oven. The skins were peeled off and the potato was mashed, freeze-dried and then ground to a powder in a Moulinex coffee-grinder with tungsten-carbide blades and analysed for ascorbic acid. For the balance experiment the dried potato was incorporated into a semi-synthetic diet with the following composition (g/kg): dried potato 660, casein 200, maize oil 80, mineral mix 40, vitamin mix 20. The control diet in which the main source of Fe was ferrous sulphate contained (g/kg) maize starch 315, sucrose 315, casein 230, maize oil 80, mineral mix 40, vitamin mix 20. The mineral mix contained (g/kg diet): calcium hydrogen phosphate 13·0, calcium carbonate 8·2, potassium chloride 7·03, disodium hydrogen phosphate 7·4, magnesium sulphate 4·0, manganese sulphate 0·18, zinc carbonate 0·10, copper sulphate 0·015, potassium iodate 0·001. $FeSO_4$ was added to the control diet to bring the Fe level up to that of the potato diet. The vitamin mix contained (mg/kg diet): nicotinic acid 60, cyanocobalamin in mannitol 50, calcium D-pantothenate 40, thiamin hydrochloride 10, riboflavin 10, pyridoxine 10, pteroylmonoglutamic acid 5, D-biotin 1, menadione 1, Rovimix E-25 (Roche) 300, Rovimix A-500 (Roche) 25, Rovimix A-500/D3 (Roche) 15, choline bitartrate 1800.

Balance experiment

Twenty weanling male Wistar rats (mean weight 70 g) were randomly allocated to two groups of ten each and given the control semi-synthetic diet for 2 d. One group was then given the diet containing potato, the main source of Fe, whilst the other remained on the control diet where the Fe was derived from added $FeSO_4$. Food intakes were measured and faecal collections made for 10 d. Diets and faeces were analysed for Fe and absorption calculated.

Radioisotope experiment

Twenty-six weanling male Wistar rats (mean weight 80 g) were divided into two groups of thirteen each and trained to meal-feed on the semi-synthetic control diet. After 1 week, following an overnight fast (day 1), group 1 was given a meal of 3 g dried potato (containing 79 μg Fe) mixed to a paste with 10 ml distilled water and group 2 was given 12 g starch-

sucrose (50:50, w/w) paste (containing 52 μg Fe as $FeSO_4$). Both meals were extrinsically labelled with 5 μCi ^{59}Fe (ferric chloride in 0·1 M-hydrochloric acid; Amersham International, Amersham, Bucks.). The following day (day 2) they were given the control diet. On day 3 the procedure was repeated, except that group 1 received $FeSO_4$ and group 2 potato. The meals were labelled with 12 μCi ^{55}Fe (carrier-free; Amersham International). The following day they were returned to the control diet. Daily faecal collections were carried out from day 1 onwards for 12 d and the ^{59}Fe content counted in a gamma-counter. On day 12 the animals were weighed and killed. Blood was removed by cardiac puncture whilst the animals were anaesthetized with diethyl ether, and placed in a heparinized tube for subsequent ^{55}Fe and ^{59}Fe measurement. Blood volume was calculated assuming it to be 7·2 % body-weight (Metcoff & Favour, 1944). Packed cell volume was measured and the liver, heart, kidneys and spleen were removed and the ^{59}Fe content directly measured in a gamma-counter.

In vitro iron availability measurements

Gastric juice was collected from a human subject on several occasions after an overnight fast. The subject swallowed a Ryles tube (size 10 FG) and then drank 0·5 l distilled water. After 15–20 min the gastric contents were removed with the aid of a syringe and filtered through Whatman 41 filter paper into a plastic bottle. Samples were stored frozen and bulked before carrying out the in vitro measurements. The pH was adjusted to 2·0 with dilute HCl and the pepsin activity measured.

A series of foods was prepared as for human consumption and oven-dried at 50°. They were ground to pass through a 300 μm nylon sieve and 0·5 g samples were incubated in plastic tubes at 37° for 1·5 h with 5 ml gastric juice. The tubes were centrifuged and the supernatant fraction analysed for Fe by atomic absorption spectrophotometry (AAS). The foods were analysed for total Fe by AAS. The Fe solubility in gastric juice of a number of samples of instant potato, some of which had been fortified with ascorbic acid during manufacture, was also measured together with the ascorbic acid level.

Analytical methods

Ascorbic acid. This was measured by extraction from the food with metaphosphoric acid followed by titration against 2,6-dichlorophenol indophenol (Horwitz, 1975).

Pepsin. The peptic activity was assayed by measurement of the concentration of peptides released from a haemoglobin substrate when incubated for a fixed time with gastric juice (Anson, 1938). One unit of activity is equivalent to the absorbance resulting from reaction of the reagent with 0·001 M-tyrosine.

Fe. Dried samples were ashed at 480° in silica crucibles for 48 h, the ash taken up in warm, concentrated HCl, the solution filtered and analysed by flame spectrophotometry on a Varian AA6 AAS with background correction. Solutions of supernatant fraction from the in vitro gastric juice incubation were analysed directly using appropriate standards.

Radioactivity. The ^{59}Fe content of faeces and organs was measured in a Philips PW4580 Automatic Gamma Counter with a 75 × 75 mm sodium iodide crystal, centre 535, width 30, gauge 20.

Liquid-scintillation counting. Portions of 0·1 ml heparinized blood were counted by a modification of the dual-label technique of Eakins & Brown (1966). The samples were digested with 1·5 ml Soluene 350 (Packard Instruments, Berks.) propan-2-ol (1:1, v/v) for 12 h and then 0·5 ml hydrogen peroxide (300 g/l) added and left to stand for 3 h. Finally 15 ml Instagel (Packard)-0·5- M-HCl (9:1, v/v) was added and the vials counted in a Philips liquid-scintillation counter. The settings used were channel 1: attentuation 3·9, 40–1000; channel 2: attenuation 3·9, 40–120; channel 3: attenuation 0·0, 40–400. The channels ratio method of standardization was used for the preparation of quench curves and counting efficiencies were 84% for ^{59}Fe and 19% for ^{55}Fe.

Table 1. *Iron intakes and excretion (mg/10 d) of rats given either a diet containing 660 g potato/kg or a semi-synthetic diet containing ferrous sulphate**

(Mean values with their standard errors for eight animals on the potato diet and ten animals on the control-$FeSO_4$ diet)

	Potato diet†		Control-$FeSO_4$ diet		Statistical significance of difference between groups
	Mean	SE	Mean	SE	
Fe intake	1·64	0·07	1·60	0·05	NS
Fe excretion	1·38	0·05	1·09	0·05	$P < 0·001$
Fe absorbed	0·26	0·05	0·51	0·05	$P < 0·002$
Percentage absorption	15·2	2·7	32·1	2·8	$P < 0·001$

NS, not significant.
* For details, see p. 16.
† Two animals were excluded from the experiment because of respiratory illness.

Table 2. *Iron absorption from extrinsically-labelled potato and ferrous sulphate*

(Mean values with their standard errors for thirteen animals in each group)

Source of Fe...		Potato		$FeSO_4$		Statistical significance of difference between groups
	Fe label	Mean	SE	Mean	SE	
Faecal excretion (% of dose)	^{59}Fe	50·4	1·1	37·6	1·2	$P < 0·001$
Blood content* (% of dose)	^{59}Fe	40·4	1·4	49·1	2·0	$P < 0·001$
	^{55}Fe	45·3	2·1	49·3	1·7	NS

NS, not significant.
* Blood volume estimated as 7·2% body-weight (Metcoff & Favour, 1944).

Statistical analysis

Where appropriate unpaired *t* tests were performed to see if there was a significant difference between groups (Snedecor & Cochran, 1967). Paired *t* tests were carried out on the values for ^{59}Fe and ^{55}Fe content of blood in the radioisotope experiment. The Spearman rank correlation coefficient was calculated for the in vitro experiment measuring Fe solubilization from potatoes (Siegel, (1956).

RESULTS

Balance experiment

The Fe content of the control semi-synthetic diet was 15·2 μg/g and of the potato diet was 17·4 μg/g. Fe balance values for the 10 d period, shown in Table 1, indicate that the Fe from potatoes was about half as available as the well-absorbed $FeSO_4$. There were no significant differences in weight gain or food intakes between the groups although the potato group ate slightly less (9·4 g/d *v.* 10·7 g/d in the controls). Ascorbic acid analysis showed that the cooked, freeze-dried potato powder had lost most of its ascorbic acid. Immediately after freeze-drying the concentration of ascorbic acid was 67 mg/kg dried potato and it may

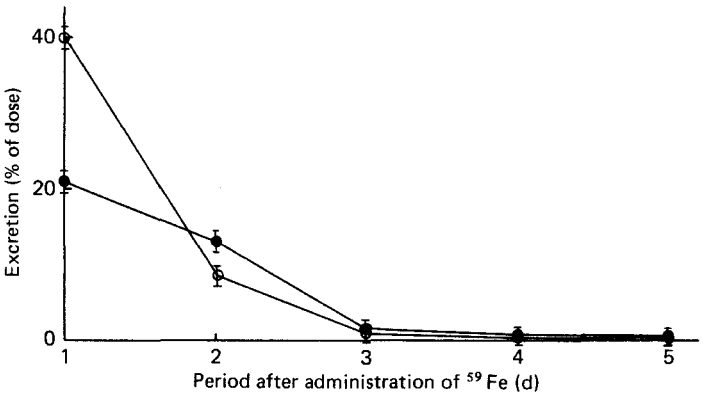

Fig. 1. Daily faecal excretion of ^{59}Fe by rats given ^{59}Fe-labelled potato (○) or ^{59}Fe-labelled ferrous sulphate (●). Points are mean values with their standard errors represented by vertical bars.

Table 3. *^{59}Fe content of organs (% of dose) of rats given extrinsically-labelled potato and ferrous sulphate*

(Mean values with their standard errors for thirteen animals in each group)

Group...	1		2		
Source of Fe...	^{59}Fe-labelled potato		$^{59}FeSO_4$		Statistical significance of difference between groups
	Mean	SE	Mean	SE	
Liver	1·61	0·10	2·35	0·14	$P < 0·001$
Heart	0·27	0·02	0·30	0·01	NS
Kidneys	0·55	0·02	0·58	0·05	NS
Spleen	0·35	0·02	0·38	0·01	NS

NS, not significant.

well have fallen further on storage. Fresh potatoes contain 80–200 mg ascorbic acid/kg wet weight which is equivalent to 400–1000 mg ascorbic acid/kg dried potato, i.e. ten times that of the freeze-dried potato.

Radioisotope experiment

The dried potato contained 19·7 μg Fe/g, thus the 3 g meal contained 59·1 μg Fe. Absorption from $FeSO_4$ (52 μg Fe) in a starch-sucrose paste was compared with that from potato and the results are shown in Table 2. Fe absorption calculated from faecal excretion was significantly higher ($P < 0·001$) from $FeSO_4$ (62·4%) than potato (49·6%). ^{59}Fe faecal excretion was more rapid after the potato meal than the $^{59}FeSO_4$ in starch-sucrose paste, as shown in Fig. 1, probably because of the higher fibre content of the potato. Excretion had fallen to less than 1% of the administered dose after 3 d. Analysis of the blood showed a significantly higher content of ^{55}Fe from $FeSO_4$ than from ^{59}Fe-labelled potato. There was, however, no significant difference between $^{59}FeSO_4$ and ^{55}Fe-labelled potato. The ^{59}Fe content of the organs is shown in Table 3. The ^{59}Fe content of the liver was significantly higher in the $^{59}FeSO_4$ group. There was no difference in blood packed cell volume between the two groups: packed cell volume (mean with SE) was 44·1 (0·8) in group 1 and 43·4 (0·5) in group 2.

Table 4. *Iron content and amount of Fe solubilized by gastric juice in a range of foodstuffs*
(Mean values with their standard errors)

Food (and source)	Total Fe (μg/g)	Fe solubilized in gastric juice		
		μg/g		%
		Mean	SE	of total
All-Bran® (Kellogg's)	129·1	17·4	0·6	13·5
Bran (Prewett's)	121·8	23·9	0·8	19·7
Kidney beans (canned red Californian beans)	64·3	6·7	0·3	10·5
Baked beans (Heinz)	48·9	5·9	0·3	12·1
Wholemeal flour (Prewett's)	46·5	5·2	0·3	11·1
Wholemeal bread (Sainsbury's)	41·2	2·8	0·2	6·8
Wholemeal flour (Jordan's)	39·0	5·1	0·1	13·1
White flour (Sainsbury's plain home-milled)	21·4	3·4	0·2	16·1
White bread (Sainbury's)	20·1	1·2	0·1	6·1
Dried Maris Piper potato	19·7	8·7	0·5	44·3
Instant potato (Cadbury's Smash®)	19·1	12·9	0·3	67·5

In vitro Fe availability measurements

The bulked gastric juice had a pH of 2·2, which was standardized to 2·0 with HCl, and a pepsin activity equivalent to a solution of pepsin containing 260 mg/l. The Fe content and amount of Fe solubilized by gastric juice in a range of foodstuffs (mean of at least four separate duplicate determinations) are shown in Table 4. Although the Fe content of instant and laboratory-dried potato was lowest, the Fe solubility when expressed as a percentage of total Fe was highest, notably from the instant potato with added ascorbic acid.

The ascorbic acid content of potato samples and Fe solubilization is shown in Table 5. The different levels of ascorbic acid were related to time of storage, most of the samples having originally been fortified with ascorbic acid. There was a significant correlation between ascorbic acid content and amount of Fe solubilized in gastric juice (r_s 0·76, $P < 0·01$).

Ascorbic acid was added to some of the other foods and at a level of 20 mg/g dried food it increased Fe solubilization from bran by a factor of 0·5, from baked beans by 1·3 and from wholemeal flour by 3·1. It only increased Fe solubilization from instant potato by a factor of 0·15, which is not surprising since the potato already contained significant amounts of ascorbic acid.

DISCUSSION

It is difficult to compare results from different studies measuring Fe availability in foods or meals. It is well-known that Fe absorption varies widely between different individuals, depending, for example, on their Fe status and there are also day-to-day variations in the same individual. Wherever possible, it is common practice to standardize the results by comparing Fe availability from a food with that from a well-absorbed Fe salt such as ferrous sulphate. This value gives some indication of the extent of availability of the food Fe. The second problem with Fe availability studies is in the interpretation of results, i.e. making

Table 5. *Ascorbic acid content of potatoes and iron solubilization*

Ascorbic acid (mg/kg)	Fe solubilized in gastric juice (μg/g potato)
820	12·7
770	12·7
740	12·7
730	12·4
160	10·1
105	11·2
100	11·7
75	10·2
67	8·7
50	8·2
45	11·4
35	9·9

Spearman, r_s 0·76, $P < 0·01$.

allowances for differing Fe requirements. Thus Fe-deficient individuals will absorb more Fe than normal individuals (Brise, 1962). Similarly, growing rats appear to absorb more Fe than adult rats, presumably because their requirements are greater. Therefore, it can be misleading to compare figures for Fe absorption in the rat and man directly, although Schricker *et al.* (1981) have demonstrated a correlation between human and rat in vivo studies of Fe availability. When human studies are not possible, the best way of estimating non-haem-Fe availability in foods is a rat in vivo study comparing the food Fe with $FeSO_4$ coupled with in vitro studies of availability, as discussed later.

The experiments with rats indicate that the Fe in potatoes is at least half as available as that of the well-absorbed salt $FeSO_4$, even though 90% of the potatoes' ascorbic acid had been lost in the preparation. Rats given a single meal of ^{59}Fe extrinsically-labelled potato absorbed 50% of the Fe compared with 62% of Fe from $^{59}FeSO_4$. Because of the difficulties of measuring ^{55}Fe in faeces it was not possible to compare Fe absorption from $FeSO_4$ and potatoes in the same animals using the technique of faecal monitoring.

Since most of the absorbed Fe was incorporated into the blood by the end of 12 d, with only a small amount in the liver, the blood content is a useful indicator of Fe absorption However, blood volume cannot be measured accurately and the values for ^{55}Fe and ^{59}Fe content of the blood shown in Table 2 are merely an indication of total amounts circulating in the blood. It is clear that there was little difference in Fe absorption from $FeSO_4$ and potato; paired *t* tests showed a significant difference in one group but not in the other. It can be concluded that Fe availability was marginally higher from $FeSO_4$ than potato.

The 10 d balance study in which the rats were fed *ad lib.* a diet where potato was the main source of Fe or a diet comparable in protein, energy and Fe content in which $FeSO_4$ was the main source of Fe, showed that the potato Fe was about half as available as $FeSO_4$. Absorption was 32% from $FeSO_4$ and 15% from potato which is lower than from single meals, even though the animals were of a similar age. This is not an unexpected finding since it has been shown that Fe absorption is increased on fasting (Brise, 1962).

The availability of Fe in potatoes compares well with that of Fe naturally present in bread. Previous work (Fairweather-Tait, 1982) has shown that the absorption from wholemeal bread by weanling rats on a 14 d balance study was half that from $FeSO_4$. When the animals were given a single-labelled meal absorption was greater, as was found with the potato study,

and the wheat: $FeSO_4$ value was 0·77. Mahoney *et al.* (1974) showed that the efficiency of converting wheat Fe into haem-Fe in young, anaemic rats was two-thirds that of ferrous ascorbate. These results using rats compare well with results from normal human subjects in which Fe absorption from intrinsically-labelled wheat was two-thirds that from ferrous ascorbate (Hussain *et al.* 1965). There was an inevitable loss of ascorbic acid when the cooked, dried potato was prepared for the animal experiments. Ascorbic acid enhances non-haem-Fe absorption because it is not only a powerful reducing agent but also binds Fe in equimolar concentrations. The promoting effect of ascorbic acid has been shown to be dose-dependent (Sayers *et al.* 1973). When ascorbic acid is added to the diet the increase in Fe absorption above the basal level follows a log-linear relationship (Bothwell *et al.* 1979), but there is a minimum level which must be reached before the Fe absorption is affected. Thus Sayers *et al.* (1974) found that, whereas 60 mg ascorbic acid added to a rice meal containing 4 mg Fe as $FeSO_4$ significantly increased Fe absorption in adult subjects, 35 mg was not enough to improve Fe availability. This threshold effect possibly indicates two types of action of ascorbic acid on Fe, one being the reduction of ferric to ferrous ions and the other the formation of an ascorbic acid–Fe chelate. An average helping of 150 g boiled potato would provide 5–20 mg ascorbic acid, which on its own would probably not be enough to influence Fe absorption significantly. However, when other sources of ascorbic acid are consumed at the same meal, such as another vegetable or some fruit, the amount of ascorbic acid might be enough to increase Fe absorption from the whole meal.

It has been suggested that Fe solubilization is the initial determinant of Fe availability from a food or meal and a variety of in vitro methods have been proposed to measure Fe availability. To be absorbed the Fe must first be ionized and this is only possible with Fe in solution. Thus it is likely that a measure of high solubilization indicates an Fe source of potentially-high availability. Miller *et al.* (1981) used an in vitro technique to estimate Fe availability from meals in which the homogenized foods were subjected to simulated digestion. They were incubated at 37° for 2 h in a pepsin–HCl mixture (5 g pepsin/kg meal) at pH 2·0. Dialysis was then used to adjust the pH to intestinal levels and the digestion was continued after the addition of pancreatin and bile salts. They tested the effect of adding enhancing or inhibiting factors on Fe availability and found the results very promising. They then went on to compare in vivo and in vitro methods for determining the availability of Fe in meals (Schricker *et al.* 1981). They found substantial agreement between the in vitro and human in vivo methods. However, because the meals they used contained meat the correlations between rat in vivo and human in vitro results were less significant although, possibly surprisingly, there was a reasonable corrleation between the rat in vivo and human in vivo results. Using a simpler system, as described in the present study, Lock & Bender (1980) showed a reasonable correlation in a range of foods between Fe solubilization in gastric juice and in vivo availability.

The in vitro results in Table 4 show that a much higher proportion of Fe was solubilized in gastric juice from fortified or unfortified potato than any of the other foods tested. The two vegetables, kidney beans and baked beans had 10·5 and 12·1% of total Fe solubilized whereas dried main-crop potato had 44·3% and instant potato (fortified with ascorbic acid) had 67·5% of total Fe solubilized. As shown in Table 5, Fe solubilization in potato samples was correlated with ascorbic acid content (r_s 0·76, $P < 0·01$) despite the fact that the potato samples were of different origins and possibly of different composition. Other work (S. J. Fairweather-Tait, unpublished results) has shown that there was a closer correlation between Fe solubilization from a single food and added ascorbic acid (which followed a log-linear relationship) since the Fe content and chemical composition of the food remained constant, unlike the samples of potato. Despite the fact that most of the ascorbic acid had been removed in drying the main-crop potato a high proportion of Fe was solubilized in

gastric juice although the proportion of Fe solubilized from instant potato which had been fortified with ascorbic acid was in fact greater.

Most vegetables are considered to be a poor source of Fe, despite reasonably high Fe levels, because the Fe is poorly absorbed. According to Layrisse & Martinez-Torres (1971), 1–7% of the Fe in vegetable staples such as rice, maize, black beans, soya beans and wheat are absorbed if they are consumed as single items, the Fe in wheat and soya beans being the most available. The rat studies described in this paper show the Fe in potatoes to be as well absorbed or better absorbed than wheat Fe. This evidence alone suggests that potatoes contain Fe of moderate availability. The in vitro studies show a distinct difference in solubilization between potatoes and other foods, such as beans, which suggests superior availability. Account must be taken of the fact that there was an inevitable loss of most of the ascorbic acid in the preparation of the potato samples; potatoes as normally eaten will contain at least five times more ascorbic acid. Thus, when eaten with other foods the ascorbic acid will contribute towards the total in the meal and if this reaches a high enough level it will enhance non-haem-Fe absorption from the meal. Therefore, potatoes may make a useful contribution towards the Fe nutriture of the UK population.

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