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PROCEEDINGS OF THE NUTRITION SOCIETY

ABSTRACTS OF COMMUNICATIONS

A Scientific Meeting was held at the Royal College of Physicians, London on Wednesday, 19 February 1997, when the following papers were presented.

All abstracts are prepared as camera-ready material by the authors.

https://doi.org/10.1079/PNS19970117 Published online by Cambridge University Press

The effect of early nutritional supplementation with Nutrifil or Corn Soya Blend on the nutritional and immune status of adults with HIV infection in Uganda. By G. JAMES BAKEINE[1], PAUL M. MATHIAS[2] and PETER N. MUGYENI[3], [1]*Trinity College, Dublin,* [2]*Dublin Institute of Technology, Dublin, Ireland,* [3]*Joint Clinical Research Centre, Kampala, Uganda*

Loss of body weight is a debilitating feature in the natural history of HIV infection, with the resulting malnutrition predisposing to increased risk of infectivity (Chandra, 1993). The objective of the present study was to evaluate the effects of early supplementary feeding using commercial nutritional products, Nutrifil or Corn Soya Blend (CSB), on the nutritional and immune status of HIV-infected patients.

Twenty-two early stage (CDC I-III) (Centers for Disease Control, 1987) largely asymptomatic patients (seven males, fifteen females), mean age 31 (SD 12) years, attending the Joint Clinical Research Centre, Kampala, were randomly assigned to two groups. In addition to their normal diet patients received a daily 4.2 MJ supplement of either Nutrifil (150g protein, 110g fat, 650g carbohydrate/kg), a nutritionally complete supplementary food (Nutrifil Ltd, Ireland) or CSB (160g protein, 60g fat, 660g carbohydrate/kg), a standard supplementary food used by the World Food Programme, for a period of 8 weeks. Variables evaluated at days 1 and 56 were weight, triceps skinfold thickness (TSFT) serum albumin and lymphocyte T-cell sub-populations (CD_4) cell counts.

	Nutrifil-supplemented group (*n* 11)				CSB-supplemented group (*n* 11)			
	Day 1		Day 56		Day 1		Day 56	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Body weight (kg)	53.4	2.9	55.5**	3.0	60.4	3.3	61.3*	3.5
TSFT (mm)	11.6	1.4	14.7**	1.9	11.8	2.4	13.3*	2.5
Serum albumin (g/L)	37.6	1.3	41.8**	1.0	37.2	1.0	40.2*	1.2
CD_4/ mm^3	423	81	400	81	456	97	328*	45

Significantly different from day 1, same group: $*P < 0.05$, $**P < 0.005$, (paired tests).

The results are shown in the Table. Consumption of the two formulas was associated with weight gain. The mean increase in the Nutrifil group (2.14 (SE 0.6) kg) was greater than that in the CSB group (0.98 (SE 0.5) kg). Increments in TSFT and serum albumin were also seen in both groups with increases again being greater in the Nutrifil group. Mean CD_4 cell counts decreased in the CSB group but remained unchanged in the Nutrifil group. Weight change was positively correlated to changes in the CD_4 cell count in the Nutrifil group (r 0.66, $P < 0.05$), but not in the CSB group (r 0.03, NS). Furthermore, five patients (45%) in the Nutrifil group experienced a rise in CD_4 cell count at the end of the study, compared with two (18%) in the CSB group.

These results indicate that early therapeutic nutrition intervention can improve nutritional and immune status in patients with HIV infection. The halt in decline of the CD_4 cell count in the Nutrifil group is the first demonstration of nutritional immunomodulation in HIV infection. The greater performance of Nutrifil over CSB can be attributed to compositional differences. Nutrifil is cow's-milk-based, is highly digestible, contains a wide range of micronutrients, and has been shown to support rapid weight gain in malnourished children (Mathias & Byrne, 1995). CSB is soya-bean-based, has a lower digestibility and contains anti-nutritional components, especially phytic acid, which with prolonged consumption could reduce the bioavailability of trace metals. These data may have important consequences for the therapeutic management of populations with high incidences of AIDS, such as those in Africa, where the cost of anti-retroviral drug therapy is prohibitive.

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Haem and non-haem iron intake in Britain. By KERINA I. TULL, SUSAN M. CHURCH and ANITA J. CROSBY, *Consumers and Nutrition Policy Division, Ministry of Agriculture, Fisheries and Food, Nobel House, 17 Smith Square, London SW1P 3JR*

Certain groups of the British population are more vulnerable to Fe deficiency, for example, due to increased physiological requirements to meet tissue growth, or high menstruation losses or poor absorption (Department of Health, 1991). The proportion of women with intakes below the Lower Reference Nutrient Intake (LRNI) (Department of Health, 1991) has been estimated at 33% for those aged 16-18 years, and 26% for 19-50-year-olds (Ministry of Agriculture, Fisheries and Food, 1994).

Haem Fe is absorbed more easily than non-haem Fe. Total Fe intake in Britain is routinely recorded in the National Food Survey, but there is limited information on the proportion of haem Fe in the diet (Ministry of Agriculture, Fisheries and Food, 1996). The amount of haem and non-haem Fe in British household diets in 1995 was therefore estimated by assigning haem and non-haem Fe values to all food codes in the National Food Survey for that year. The assumption used was that 40% of the Fe in all animal tissues including meat, liver, poultry and fish was haem (Monsen *et al.* 1978). The amounts of fish and meat in various products and dishes were assumed to be those required by law (The Meat Products and Spreadable Fish Products Regulations, 1984 as amended in 1986) or were estimated from recipes.

		Fe intake mg/person per d		
		Haem	Non-haem	Total
Milk, milk products and eggs		0.00	0.53	0.53
Meat		0.48	0.98	1.44
of which:	beef	0.11	0.16	0.28
	lamb	0.03	0.05	0.08
	pork	0.02	0.03	0.05
	offal	0.04	0.06	0.09
	poultry	0.06	0.08	0.14
	meat products and dishes	0.22	0.60	0.82
Fish		0.04	0.18	0.23
Fats, sugars and preserves		0.00	0.11	0.11
Vegetables		0.00	1.75	1.75
Fruit		0.00	0.36	0.36
Cereals		0.00	4.92	4.92
All other foods		0.00	0.65	0.65
Total		0.53	9.47	9.99

The Table shows the main dietary sources of haem and non-haem Fe in 1995. As expected, meat and meat products provided about 90% of haem Fe intake. The national average intake of haem and non-haem Fe in the diet was lower than similar estimates in 1977, which were 1.29 mg haem and 9.66 mg non-haem Fe (Bull & Buss, 1980). The proportion of haem Fe was also lower in 1995 (5% compared with 12% of total Fe in 1977). These differences are mainly due to slight differences made in the assumptions on levels of haem Fe in the animal tissues. The latest estimates of haem and non-haem Fe intake are however comparable with the average intake of 0.3 mg and 5.3 mg respectively reported in children aged 1½ to 4½ years (Gregory *et al.* 1995).

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Iron absorption from fortified breakfast cereals. By CATHERINE GEISSLER and GEORGINA AGBLEY, *Department of Nutrition and Dietetics, King's College London, Campden Hill Road. London W8 7AH*

Fe deficiency is prevalent in many countries including the UK (British Nutrition Foundation, 1995). Cereal products provide almost half the average household Fe intake (Ministry of Agriculture Food and Fisheries, 1994) as most wheat flours and many breakfast cereals in the UK are fortified with Fe. However the bioavailability of Fe from cereals is low and depends on other enhancing or inhibiting factors in the diet. Breakfast cereals provide 14% of the Fe but are usually consumed with milk which inhibits Fe absorption (Gleerup *et al*, 1995). However some people replace the milk with fruit juice, which is also frequently drunk separately with breakfast and contains ascorbic and other acids that enhance absorption.

A study was conducted to compare the absorption of Fe from three test breakfasts: cereal with milk (CM); cereal with orange juice (CO); orange juice before cereal with milk (O+CM). Fourteen healthy subjects (ten women, four men, aged 18-35 years) were selected, from mainly student volunteers, for low capillary blood haemoglobin levels (women <120 g/l, men <140 g/l), and absence of adverse reactions to cereals, milk or orange juice. Each subject consumed the three breakfasts administered in random order after an overnight fast on the morning of three separate days with at least 4 d between. The quantities consumed were: cereal (Kellogg's Special K) 60 g, containing Fe 14 mg; sucrose 10 g; orange juice (Del Monte Fresh) 300 ml, containing ascorbic acid 120 mg: semi-skimmed milk 300 ml, containing Ca 330 mg.

Venous blood samples were taken immediately before and 1.5 h after the breakfast for serum Fe measurements (Crosby & O'Neil-Cutting, 1984) carried out by colorimetric assay without deproteinization (Boehringer Mannheim). Increases in serum iron were taken to indicate Fe absorption and calculated from pre- and post-meal values for each individual. Significance of differences between meals was assessed by ANOVA and Student's paired *t* test.

	Increase in serum Fe (μg/dl)		
Meal	Mean	SD	SE
Cereal with milk (CM)	11.4	11.0	2.94
Cereal with orange juice (CO)	35.3	13.4	3.58
Orange juice before cereal with milk (O+CM)	23.0	11.7	3.13

$F=47.95$, $P<0.0001$ Student's *t* test: CM *v.* CO $P<0.001$; CM *v.* O+CM $P<0.02$; CO *v.* O+CM $P<0.02$

Fe absorption was significantly different between each of the three breakfast combinations, the mean increase in serum Fe after cereal with orange juice being three times the increase after cereal with milk. The prior glass of orange juice doubled the increase observed with cereal plus milk, showing a value midway between that given by milk or juice poured over the cereal.

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The effect of a new fermented milk product on total plasma cholesterol, LDL-cholesterol and apolipoprotein B concentrations in middle-aged men and women.

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It has recently been claimed that a milk product fermented with a culture of *Enterococcus faecium* and *Streptococcus thermophilus* specifically reduces plasma cholesterol concentrations in males (Agerbæk *et al.* 1995). The object of the present investigation was to test the effect of a regular intake of this product on total plasma cholesterol, LDL-cholesterol (LDL-C) and apolipoprotein B (apoB) concentrations in healthy middle-aged men and women with moderately raised plasma cholesterol levels.

The study was randomized, double blind, multi-centre and placebo controlled. Healthy male and female volunteers (*n* 460; 30-55 years) were screened and 173 with plasma cholesterol values of 5.2-8.0 mmol/l started the trial. The test and placebo products were of identical composition but the former was bacterially fermented and the latter produced with an organic acid (delta-gluco-lactone). Subjects were asked to consume 200 ml daily of either test or placebo product for a period of 12 weeks. Both products were well tolerated and 160 subjects completed the trial. Habitual diet and changes to this diet were assessed by completion of a 3 d food diary before and during the study.

Fasting venous blood samples were collected on two occasions 1 week apart before the start of the study, further blood samples were collected after 6 and 12 weeks of consuming the test or placebo product and the plasma concentrations of cholesterol, LDL-C and apoB determined. The baseline measurements were averaged. The results are shown in the Table.

	Total plasma cholesterol (mmol/l)				ApoB (g/l)				LDL-C (mmol/l)			
	Test	*n* 68	Placebo	*n* 56	Test	*n* 68	Placebo	*n* 56	Test	*n* 68	Placebo	*n* 56
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Baseline	5.8	0.70	5.8	0.63	0.74	0.11	0.75	0.13	4.2	0.74	4.3	0.62
6 weeks	5.8	0.79	5.9	0.82	0.72	0.14	0.72	0.13	4.1	0.80	4.2	0.81
12 weeks	5.8	0.72	5.9	0.60	0.72	0.13	0.74	0.15	4.0	0.71	4.1	0.67

Total plasma cholesterol, LDL-C and apoB concentrations did not change significantly with either treatment. We conclude that the addition of 200 ml of either the bacterially or the chemically produced milk product to the diet does not significantly influence total plasma cholesterol, LDL-C or apoB concentrations in moderately hypercholesterolaemic subjects.

Agerbæk, M., Gerdes, L.U. & Richelsen, B. (1995). *European Journal of Clinical Nutrition* **49**, 346-352.

https://doi.org/10.1079/PNS19970117 Published online by Cambridge University Press

Influence of a short period of de-training on postprandial lipaemia and insulinaemia in endurance-trained individuals. By JANET E.M. LAWRENCE, SARA L. HERD, ADRIANNE E. HARDMAN and M. HARRISON, *Sports Nutrition and Exercise Biochemistry Research Group, Loughborough University, Leicestershire LE11 3TU*

Postprandial lipaemia, which is characteristically low in endurance-trained individuals, increases rapidly when training is interrupted (Nelson *et al.* 1994). As a poor biological response to insulin leads to high postprandial plasma triacylglycerol (TAG) concentrations (Frayn, 1993) one contributory mechanism might be rapid reversal of the enhanced insulin action evident in trained people (King *et al.* 1995). The purpose of the present study was to compare the time courses of changes in postprandial lipaemia and insulinaemia when endurance-trained individuals refrained from training for 6 d.

Nine men and one woman aged 18.3-55.4 years, with BMI 24.1 (SD 3.2) kg/m^2 participated. Seven were runners, two were triathletes and one was a cyclist. They were currently training 7.5 (SD 5.0) times each week and had been training regularly for at least the last 4 years. Oral fat tolerance tests were conducted on three occasions during 1 week of de-training, i.e. 12 h, 60 h and 6.5 d after subjects' last training session. Blood samples were obtained by venous cannulation in the fasted state and 0.5, 1, 2, 3, 4, 5 and 6 h after consumption of the test meal. This comprised cereal, coconut, nuts, chocolate, fruit and whipping cream (1.2 g fat, 1.2 g carbohydrate/kg body mass, 70% energy from fat, 29% energy from carbohydrate). Subjects weighed and recorded the food they consumed the day before their first test, replicating this diet the day before each subsequent test. Plasma was analysed for TAG, total cholesterol (TC), HDL-cholesterol (HDL-C) and non-esterified fatty acids (NEFA). Serum was analysed for insulin. Lipaemic and insulinaemic responses were determined as the areas under the TAG concentration *v.* time curve and the insulin concentration *v.* time curve respectively. Comparisons between tests were made using ANOVA, adopting a 5% level of significance.

Time after last training session	Fasting TAG (mmol/l)		Fasting TC (mmol/l)		Fasting HDL-C (mmol/l)		Fasting NEFA (mmol/l)		Lipaemic response (mmol/l.h)		Insulinaemic response (μIU/ml.h)	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
12 h	0.85	0.15	4.56	0.24	1.17	0.06	0.62	0.05	8.44	1.39	81.57	11.30
60 h	1.09*	0.12	4.72	0.20	1.14	0.07	0.39*	0.04	11.39*	1.39	87.64	11.40
6.5 d	1.10*	0.11	4.74	0.24	1.12	0.07	0.34*	0.05	11.99*	1.49	94.46	9.40

*Significantly different from 12 h values, $P<0.05$.

The Table shows that postprandial lipaemia increased rapidly with de-training, i.e. by 35% at 60 h and by 42% at 6.5 d, compared with 12 h values. This would be partly due to the increase in fasting TAG (Table) but the incremental area (above the fasting level) under the TAG concentration *v.* time curve also increased with de-training (12 h, 3.34 (SE 0.64) mmol/l.h; 60 h, 4.85 (SE 0.76) mmol/l.h; 6.5 d, 5.42 (SE 0.90) mmol/l.h, $P<0.05$ compared with 12 h). Postprandial insulinaemia increased with de-training (16% by 6.5 d) but changes were not statistically significant. These findings indicate that mechanisms other than changes in insulin action are responsible for the rapid reversal of low levels of postprandial lipaemia in endurance-trained people once training is interrupted.

This research was supported by the British Heart Foundation.

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Quercetin is a potent inhibitor of oxidative damage to human LDL isolated from fresh and frozen plasma. By JAMES O'REILLY[1], LUCIE POLLARD[1], DAVID LEAKE[2], TOM A.B. SANDERS[1] and HELEN WISEMAN[1], *[1]Nutrition, Food and Health Research Centre, King's College London Campden Hill Road, Kensington, London W8 7AH and [2]School of Animal and Microbial Sciences, University of Reading, Reading RG6 6AJ*

Epidemiological evidence suggests that the dietary intake of foods rich in plant flavonoids may be associated with a decreased risk of cardiovascular disease (Hertog *et al.* 1993). Dietary flavonoids of significance include the flavonol, quercetin which is found in apples, onions, tea and red wine and the oestrogenic isoflavones, genistein and daidzein found in soyabean products (Wiseman, 1996). One mechanism by which flavonoids might afford protection is by inhibiting the oxidation of LDL which in turn is believed to be an important step in atherosclerosis (Witzum, 1994). We report the influence of different flavonoids (dissolved in ethanol) on the Cu(II)-induced oxidation of LDL (final concentration of Cu(II) used was 5 μM) isolated by density gradient ultracentrifugation (Redgrave *et al.* 1975) from fresh plasma and from plasma stored at -70° with 100g/l sucrose for up to 3 months (Rumsey *et al.* 1994). LDL oxidation was continuously monitored by spectrophotometric measurement of conjugated diene formation (Esterbauer *et al.* 1989). Resistance to oxidation was determined by the length of the lag phase that occurs prior to exponential appearance of conjugated dienes.

Compound 1.25 μM	LDL[a] from fresh plasma Lag phase (min)			LDL[a] from preserved plasma Lag phase (min)		
	n	Mean	*SD*	*n*	Mean	*SD*
Control	6	45.3	2.6	11	46.9	3.5
Quercetin	6	275***	42.4	11	258***	40.2
Genistein	5	62***	4.8	6	60***	4.3
Daidzein	6	55***	4.6	5	52*	3.8

Mean values were significantly different from control: *$P < 0.05$, ***$P < 0.001$.
[a]LDL protein concentration was 0.1mg/ml.

The Table shows that there was no significant difference between fresh and preserved plasma with respect to LDL oxidation and its inhibition by flavonoids. This suggests that plasma preserved with sucrose is comparable to fresh plasma as a suitable source of the human LDL needed for preliminary *in vitro* screening of flavonoids. Quercetin was the most potent antioxidant of the compounds tested and significantly increased the lag phase compared with that of the control. In comparison, genistein and daidzein were much weaker antioxidants. These results suggest that quercetin is a potent inhibitor of LDL oxidation *in vitro*. Further studies are needed to confirm whether this also occurs *in vivo*.

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Antioxidant activity of wine polyphenols *in vivo*. By S. NIGDIKAR, N. R.WILLIAMS and A. N. HOWARD, *COAG Laboratory, Papworth Hospital, Papworth Everard, Cambridge CB3 8RE*

The beneficial effects of red wine in preventing death due to CHD have been the subject of much debate. One possible mechanism is via the antioxidative protection of LDL. Wine polyphenols have potent antioxidant activity *in vitro* (Frankel *et al.* 1993). Red wine, but not white wine, increases the polyphenol content of LDL and inhibits its oxidation *in vivo* (Fuhrman *et al.* 1995). In the present study, red wine, white wine and a preparation of wine polyphenols were compared *in vivo*. Healthy volunteers (twenty men aged 35 - 65 years) were asked to discontinue wine consumption for 2 weeks, and consume daily for 2 weeks: either 375 ml red wine, 375 ml white wine, or a preparation containing 1 g of a total pool of wine polyphenols (prepared by adsorption and elution of the same Cabernet Sauvignon red wine from an absorbant resin column) as capsules, or 375 ml white wine with 1 g wine polyphenols added. There was at least a 2 - week gap between each supplementation period. Wine or polyphenol supplements were consumed after meals twice daily for 2 weeks. Blood samples (at the start and end of the 2 - week intervention period) were drawn into K_3 EDTA (1 mmol/l) after an overnight fast and centrifuged to obtain plasma. LDL was separated by density gradient ultracentrifugation using a Beckman bench top model Optima TLX, dialysed overnight, against 10 mM phosphate-buffered saline, and the lag time of diene formation, using a Cu catalyst (5 μmol/l) determined, according to the method described by Fuhrman *et al.* (1995). Total polyphenols were measured by the method of Singleton & Rossi (1965) and LDL lipid peroxides by the method of El-Saadani *et al.* (1989).

Table *Differences in LDL measurements before and after supplementation*

		Polyphenols (mg/g LDL protein)		Lag phase (Min)		Lipid peroxides (μmol/g LDL protein)	
Supplementation	*n*	Mean	SD	Mean	SD	Mean	SD
Red Wine	9	8.77**	5.20	7.8**	15.1	-81.2**	46.1
White Wine	9	-0.74	9.43	-0.22	11.2	+17.3	39.5
Polyphenol (PP)	9	10.6***	6.74	14.2**	11.6	-67.8***	51.8
White wine+PP	6	20.7***	14.6	11.7***	6.4	-88.6*	45.0

Mean values were significantly different from those for before supplementation: * $P< 0.05$, ** $P<0.01$, *** $P< 0.001$ (paired *t* test, 2- tail).

The polyphenol content of the red wine was 1.6 g/l and that of the white wine, 0.2 g/l and that of the polyphenol pool, 0.45 g/g. Those supplements containing abundant wine polyphenols produced an increase in LDL polyphenols and antioxidant activity as measured by the increased lag phase in Cu-catalysed-diene formation, and a decrease in LDL lipid peroxides. There were no changes with white wine, a poor source of polyphenols. It is concluded that the antioxidant effects of red wine *in vivo* can be reproduced by a preparation containing an equivalent amount of total wine polyphenols.

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Supplementation with olive oil: effect on membrane fatty acid composition and platelet aggregation. By I. VICARIO-ROMEO, D. MALKOVA, E.K. LUND, J.C. STANLEY and I.T. JOHNSON, *Institute of Food Research, Norwich NR4 7UA.*

Epidemiological studies have suggested that populations consuming a Mediterranean type diet, rich in olive oil, tend to have lower morbidity and mortality from CHD (Keys et al. 1986). Changing the fat profile of the diet is known to induce modifications in membrane composition of the circulating cells (Pagnan *et al.* 1989), and alter homeostatic variables (Saynor *et al.* 1992). However, information on the effects of olive oil is not so extensive. The present study was designed to investigate changes induced by supplementation with virgin olive oil on platelet aggregation and the fatty acid composition of platelet phospholipids. Ten healthy, normolipidaemic volunteers, consuming a Western style diet, were given a daily supplement of 30 g olive oil for 42 d as a milk shake. Fasting blood samples were taken before commencing the study and after 21 and 42 d of supplementation and also at 30 d after finishing the supplement (wash out).

Platelet fatty acid composition was determined by GC using the Hammond method (Hammond 1989) and individual fatty acids were calculated as a percentage of the total. The fatty acids were also grouped as saturated (SFA), monounsaturated (MUFA) and polyunsaturated (PUFA). Platelet aggregation was induced in response to ADP at a final concentration of 2×10^{-5} mol/l. A platelet aggregation profiler (model PAP-4 Bio/data corporation Horsham, PA, USA) was used. The Table shows changes in the main fatty acids in the phospholipid fraction from platelets in response to olive oil supplementation.

Time (d)...	0		21		42		Wash out	
Fatty acid	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
16:0	13.24^{a}	0.43	12.60^{a}	0.40	12.87^{a}	0.24	15.17^{b}	0.35
18:0	17.88^{ab}	0.26	17.34^{ab}	0.36	16.95^{a}	0.34	18.34^{b}	0.24
18:1	14.15^{a}	0.31	15.88^{ab}	0.44	18.32^{c}	0.99	15.04^{ab}	0.34
18:2	5.83	0.20	5.73	0.47	5.15	0.17	5.72	0.16
20:4	33.33	1.05	32.48	1.10	31.95	0.76	32.37	0.49
SFA	36.13^{a}	0.68	34.21^{b}	0.36	34.10^{b}	0.54	37.38^{a}	0.28
PUFA	23.03	2.13	19.42	2.09	22.74	1.09	20.28	1.54
MUFA	20.20^{a}	0.83	23.01^{ab}	0.75	24.72^{b}	0.95	20.23^{ab}	0.43

a,b,c Mean values within a row not sharing a common superscript letter were significantly different ($P<0.05$).

Supplementation with olive oil induced a significant increase in monounsaturated oleic acid (18:1) and decrease in saturated stearic acid (18:0) content. No significant changes in linoleic (18:2) and arachidonic acid (20:4) content were obtained. However, the level of oleic acid in the phospholipids of platelet dropped to the initial values after volunteers stopped consuming olive oil. The olive oil supplementation did not influence platelet aggregation in response to ADP (baseline 61.14 (SEM 3.73), end value 62.29 (SEM 1.77)). The current results suggest that although olive oil supplementation changes the membrane profile of platelets this does not significantly affect platelet aggregation.

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Day-to-day variation in fat intake of high and low fat consumers: implications for understanding the relationship between dietary fat intake and obesity. By JENNIE I. MACDIARMID[1], JANET E. CADE[2] and JOHN E. BLUNDELL[1], *BioPsychology Group, Department of Psychology[1] and Nuffield Institute for Health[2], University of Leeds, Leeds LS2 9JT*

The relationship between dietary fat intake and obesity, measured in many epidemiological studies, is often weaker than might be expected. A review of epidemiological studies has revealed that the correlation coefficients between dietary fat intake (% energy) and BMI vary from -0.18 to 0.26. Why is this relationship not stronger considering the metabolism and storage capacity for fat within the body? Typically, these studies examine only the mean daily dietary intake and usually little attention is given to the day-to-day variation.

To explore this issue, daily eating patterns (derived from 7 d weighed food diaries) of high (>42% energy as fat) and low (≤35% energy as fat) fat consumers from a community survey were examined. This study formed part of the Leeds High Fat Study (Macdiarmid *et al.* 1996) which carried out a sequential examination of dietary intakes, from inter-individual comparisons to meal-by-meal observations within the same individuals. Of particular interest was the magnitude of variation in daily fat intake (g/d). The CV was used to assess the percentage variability about the mean intake for each of the fifty-two subjects. As a group, low fat consumers had a higher CV (38.1 (SD 14.0) %) than high fat consumers (32.4 (SD 11.6) %). This difference tended towards significance ($F(1,46) = 3.2$, $P = 0.08$), after adjustment for age, sex and BMI. The profiles of fat intake (Fig.) over one week revealed wide daily fluctuations, which were marginally significant within subjects over time ($F(6,276) = 2.0$, $P = 0.06$).

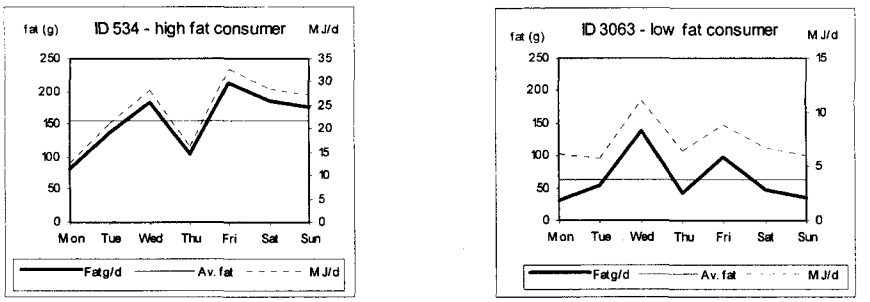

Fig. The fluctuation in fat intake (g) of typical high and low fat consumers.

Individual eating episodes revealed that both high and low fat consumers periodically consume meals containing extremely large amounts of fat (up to levels of 148g per single eating episode in high fat consumers and 131g in low fat consumers). This demonstrates the capacity for potent overconsumption of fat in both groups of consumers under free-living conditions. The wide variability and high intake of fat have potential implications for weight gain and obesity. The adaptation of fat oxidation to a change in fat intake takes several days. Thus periodic overconsumption of fat would lead to cumulative positive fat balances which could potentially result in greater fat deposition, even among low fat consumers. In turn this could weaken the apparent relationship between mean daily dietary fat intake and BMI.

Supported by the Biotechnology and Biological Sciences Research Council (FG24/627)

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Stimulation of fat intake by meat extract. By JANE VIGUS and CATHERINE GEISSLER, *Department of Nutrition and Dietetics, Kings College London, London W8 7AH*

Meat extracts have been used in many countries to stimulate appetite and increase food intake after illness. This crossover study was undertaken to provide quantified information on the ability of a commercial extract (BEC), which contains protein, peptides and amino acids (total 6 g) and no fat or carbohydrate, to stimulate appetite in twenty healthy young male volunteers, compared with an isoenergetic polydextrose Control after administration of the appetite suppressant diethylpropion (DP). At mid- morning after a standard breakfast, subjects received DP and rested for 2 h in a comfortable chair. After 1 h 70 ml (105kJ) of BEC or Control was administered and at the end of the second hour an *ad libitum* lunch was provided. Total energy and macronutrient intakes at the lunch were measured and are shown in the table.

	BEC		Control		*p*
	Mean	sd	Mean	sd	
Energy (kJ)	4464	1603	4142	1452	0.176
(kcal)	1067	383	990	347	
Protein (g)	56.5	25.4	53.6	26.1	0.518
(% energy)	21.6	8.0	22.1	7.9	0.784
Fat (g)	53.3*	22.5	45.5	23.0	0.019
(% energy)	44.3*	11.6	39.7	10.5	0.001
Carbohydrate (g)	96.7	43.5	97.7	37.7	0.863
(% energy)	36.4*	9.9	40.7	10.9	0.002

*Mean values were significantly different from Control. $P<0.02$

The table shows a significant increase in fat intake after BEC compared with the Control, both in absolute terms and as a percentage of total energy, and a corresponding significant reduction in carbohydrate as a percentage of total energy. There was a non significant 8% (322 kJ) increase in total energy intake at the lunch with BEC.

Mixed meals with a high protein content in comparison with high carbohydrate meals have been shown to reduce overall appetite for energy at a subsequent meal (Leibowitz & Shor-Posner, 1986; Hill & Blundell, 1986), but earlier work has indicated that protein supplements increased daily energy intakes (Dole *et al* 1953). The effect of protein and carbohydrate preloads on appetite for carbohydrate and protein is controversial (Blundell & Tremblay, 1995) and only minor attention has been paid to their effect on fat intake. Overall there appears to be little evidence in the literature to explain the observed effects of BEC although its effect on fat consumption in particular suggests its mode of action may be via dopaminergic and endogenous opioid mechanisms.

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Consequences of perceived food intolerance for nutrient intake. AISLING ARMSTRONG, ANITA MACDONALD, IAN W. BOOTH, ROSEMARY PLATTS, REBECCA KNIBB, DAVID BOOTH, *Institute of Child Health and School of Psychology, University of Birmingham, Edgbaston, Birmingham B15 2TT*

Using a mailed questionnaire similar to that of Young *et al.* (1994), randomly selected electors from socio-economically diverse Wards within the West Midlands were asked if anyone in their household experienced adverse symptoms which they attributed to foods.

Respondents who perceived themselves food intolerant (PFI) were recruited to conduct 4 d weighed food records (WFR: Bingham *et al.* 1994) as also were age- and sex-matched controls who were those respondents not professing food intolerance. Individuals' usual intakes of twenty-six nutrients were estimated from the WFR using Microdiet 9 software (University of Salford).

This present report is of the first twenty-four PFI and their twenty-four controls with complete WFR. There were fourteen women and ten men in each group with a mean age of 36 (SD 18 years) ($P = 0.9$). BMI (kg/m^2) of PFI was 25.7 (SD 6) and of controls 27.2 (SD 7) ($P= 0.44$). The twenty-four PFI reported intolerance to forty-seven foods. The proportions of food categories reported to cause symptoms were: dairy produce (21%) fruit and vegetables (10%), nuts (6.5%), fish and meat (11%), additives (8.5%), chocolate (8.5%) and miscellaneous (25%).

MANOVA between the two groups for mean intakes of the twenty-six nutrients showed no significant difference and no differences were noted between mean intakes of any nutrient in either group and its dietary reference value (Department of Health 1991).

Because of the high prevalence of perceived intolerance to dairy produce, fish, meat and nuts, estimated protein intake was compared between eight avoiders of high-protein foods, eight avoiders of non-protein foods and eight controls. The three-group MANOVA was significant for Cu ($P = 0.03$) and retinol ($P = 0.038$), with protein intake approaching significance ($P = 0.07$) however, no comparison of pairs of sub-groups was significant. Avoiders of a particular high-protein food may be compensating by selection of other protein-containing foods.

Use of dietary supplements may have contributed to the lack of difference in nutrient intake between PFI and controls. When supplements were excluded from the dietary assessment, MANOVA showed no significant difference, but retinol and copper intakes appeared to be lower in PFI compared to controls: retinol (365 SD 175 *v.* 753 SD 886 μg/d) ($P = 0.04$); Cu (1.2 SD 0.3 *v.* 1.5 SD 0.6 μg/d) ($P = 0.03$). When individuals who were taking dietary supplements (10 PFI and 7 controls) were excluded from the analysis, MANOVA was not significant but PFI still appeared to have a lower intake of Cu than controls: (1.1 SD 0.2 *v.* 1.5 SD 0.7 μg/d) ($P = 0.03$) while retinol intake was not different ($P = 0.17$). One PFI took large doses on Zn/Cu supplements during the WFR periods but when he and his control were excluded from the MANOVA there was still no difference in any nutrient intake between the groups. The use of dietary supplements may enhance the nutritional adequacy of the diet in this group of PFI.

This research is funded by the Ministry of Agriculture, Fisheries and Food, London.

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A blind comparison of the effects of fat and carbohydrate on appetite and mood. By MARIE REID[1] and RICHARD HAMMERSLEY[2], [1]*Department of Consumer Sciences, Glasgow Caledonian University, Park Campus, Park Drive, Glasgow G3 6LP, and* [2]*Department of Psychological Medicine, University of Glasgow, Gartnavel Royal Hospital, Glasgow G12 OXH*

Fat and carbohydrate preloads were compared in a between-subjects design. Adults (*n* 80; forty-three male, thirty-seven female) received blind at 11.00 hours one of four yoghurt preloads; all were 80 g of low-fat, unsweetened yoghurt (188 KJ), containing additionally (1) saccharin, or 669 KJ of (2) sucrose, (3) maize oil, (4) 50% sucrose, 50% maize oil. Subjects were normal eaters of normal weight. After Reid & Hammersley (1995) food intake was measured by food diary and mood with ten single Likkert scales.

The time of the next solid food (i.e. 'lunch') and the meal's energy content were examined with ANOVA using preload (saccharin, sucrose, oil, sucrose + oil), sex (male or female), breakfast time (no breakfast, early, or late) as factors. There was a marginal main effect of preload on time of lunch ($F(3,58)=2.6$, $P=0.063$) with no other effects. The energy content of lunch was affected by preload ($F(3,58)=4.1$, $P<0.05$), sex ($F(1,58)=14.9$, $P<0.05$) and time of breakfast ($F(2,58)=3.6$, $P<0.05$). There was also a significant preload x sex interaction ($F(3,58)=5.1$, $P<0.05$). Trends can be seen in the Table: subjects who received saccharin mostly ate between 12.00-13.00 hours and all before 14.00 hours. Most subjects who received one of the other preloads ate between 13.00 and 14.00 hours, sixteen ate even later. A few men who received oil or oil + sucrose ate between 11.00 and 12.00 hours Post-hoc comparisons were made separately for men and women using one-way ANOVA with preload as the factor, and Tukey-HSD tests. Among men, preload did not affect lunch time, but those who received saccharin consumed more energy at lunch than all other groups. Among women, preload significantly affected lunch time, but not energy intake: Women who received the oil preload ate later than those who received saccharin.

No. of subjects eating lunch at: (hours)	Saccharin preload (*n* 20)	Sucrose preload (*n* 20)	Oil preload (*n* 20)	Oil & Sucrose preload (*n* 20)
11.00-11.59	0	0	2	1
12.00-12.59	12	5	2	4
13.00-13.59	8	10	8	12
14.00 -	0	5	8	3

Mood scores were corrected against baseline and analysed using repeated measures ANOVA with time of test (immediate, 60 min, 120 min) as the repeated measure and preload as the independent variable. On tired - energetic there was a preload x time interaction ($F(6,152)=3.1$, $P<0.05$). Compared with saccharin, by post-hoc Tukey tests subjects receiving the sugar-only preload felt more tired than the saccharin group at 120 min, but there no other significant differences. On anger - calmness, there was a main effect of preload ($F(3,75)=5.5$, $P<0.05$) and a main effect of time of test ($F(2,74)=6.0$, $P<0.05$), as well as a preload x time of test interaction ($F(6,146)=2.6$, $P<0.05$). Compared with saccharin, by Tukey tests at 60 min subjects receiving sugar preloads and oil and sugar preloads both felt calmer than the saccharin group. At 120 min subjects receiving oil + sugar felt calmer than the saccharin group, with no other significant differences. There were no effects on the remaining eight mood scales. These included rated illness, confirming that none of the preloads made subjects nauseous. By paired *t* tests within each preload group (1) saccharin, sucrose and oil + sucrose preloads all led to a significant increase in rated energy immediately after eating compared with baseline. (2) The saccharin group continued to rate themselves more energetic and angry for the entire 2 h test period. (3) The sucrose and oil + sucrose groups tended to feel calmer and less energetic at 60 and 120 min, compared with immediately after eating, but compared with baseline, the only significant effects were that the oil + sucrose group felt significantly calmer at 60 and 120 min.

To conclude: Sucrose and oil both delayed eating to the same extent. Women were less likely to eat more to compensate for a low energy preload.The mood effects found in the present study suggest a general increase in arousal after eating which decreases over 2 h if the food contains carbohydrate.

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