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# PROCEEDINGS OF THE NUTRITION SOCIETY

## ABSTRACTS OF COMMUNICATIONS

*The Three Hundred and Thirty-ninth Meeting of the Nutrition Society (One Hundred and Thirty-third of the Scottish Group) was held at the City Mills Hotel, West Mill Street, Perth, on Friday,* 1 *February* 1980 *when the following papers, were read:*

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**Assessment of thiamine status of patients with an alcohol problem.** By D. S. McLAREN, M. A. DOCHERTY and D. H. A. BOYD, *The Medical School, Teviot Place, Edinburgh EH8 9AG*

A significant proportion of patients admitted to medical wards of general hospitals in Scotland have an alcohol problem. (D. H. A. Boyd and D. S. McLaren, unpublished results). In our experience clinical evidence of nutritional deficiencies, other than of thiamine, is generally lacking. Of the seventy-three patients in our study, nine had Wernicke-Korsakoff syndrome, ten peripheral neuropathy, and over 70% a deficient intake of thiamine by 7 d dietary recall.

Currently, biochemical detection of thiamine deficiency depends upon measurement of transketolase activity in erythrocytes (ETKA). Most workers use the TPP effect (percentage increase in transketolase activity achieved by addition of thiamine pyrophosphate (TPP) in vitro) of Brin (1962). Others favour the maximum ETKA after in vitro TPP (ETKA max). Anomalous results in alcoholic liver and other disease have been attributed to deficiency of, or defect in, transketolase apoenzyme. Erythrocyte disorders, common in alcoholism, may also affect the results.

In twenty of our patients we estimated (in duplicate) ETKA and TPP effect and in twelve it was possible to repeat the tests 1–2 weeks after thiamine hydrochloride (200 mg IM). Because of the problems associated with the use of erythrocytes we also assayed TPP in plasma of seventeen of these patients (Ullrich, 1970). The results are given in the Table.

| | Before treatment | | | After treatment | | | |
|---|---|---|---|---|---|---|---|
| Test | Mean | SD | (*n*) | Mean | SD | (*n*) | *t* test‡ |
| 1. ETKA* | 535·3 | 132·6 | (20) | 581·3 | 160·1 | (12) | NS |
| 2. TPP effect (%)+ | 15·9 | 12·2 | (20) | 8·5 | 7·2 | (12) | $0{\cdot}1>P>0{\cdot}05$ |
| 3. ETKA max* | 620·0 | 153·7 | (20) | 631·6 | 145·9 | (12) | NS |
| 4. TPP plasma (nmol/ml) | 5·6 | 3·8 | (19) | 12·7 | 7·2 | (10) | $0{\cdot}1>P>0{\cdot}05$ |

NS, not significant.
*μg hexose/ml haemolysate (normal >850).
+Normal 0–15, marginal deficiency 15–25.
‡Only subjects with two values.

For all values of 1*v*.2, $r$ −0·66($P<0{\cdot}001$); 1*v*.4, $r$ +0·44($P<0{\cdot}01$); 2*v*.4, $r$ −0·53($P<0{\cdot}01$). Other correlations were not significant.

The difficulties of interpretation posed by ETKA measurements are confirmed. TPP plasma is advocated for further study as a simple and direct assessment of thiamine status.

Brin, M. (1962). *Ann.N.Y. Acad. Sci.* **98**, 528.
Ullrich, J. (1970). In *Methods in Enzymology*, vol. 18, part A, p. 109. [D. B. McCormick and L. D. Wright, editors]. New York: Academic Press.

0029–6651/80/3920–339A $00.35 

**Voluntary intake of oat straw by beef cattle as influenced by urea supplementation, given individually in a concentrate or by group-feeding in a feedblock.** By P. T. KENDALL*, M. J. DUCKER† and R. G. HEMINGWAY, *Glasgow University Veterinary School, Bearsden, Glasgow G61 1QH*

Many observations (Kendall, 1977) have demonstrated that consistently greater individual variation in intake by both cattle and sheep is recorded in group-feeding situations when offered a self-help feedblock than when given a single daily concentrate feed in a trough with ample space.

To assess the effect of giving supplementary urea in these two ways on the voluntary consumption of oat straw (28 g crude protein (CP; N×6·25), 416 g crude fibre/kg DM), twenty-four housed Hereford-cross cattle (227 kg) in six groups each of four animals and arranged in two 3×3 Latin Squares for an experiment with feeding periods of 17 d (10 d change-over and 7 d recording). Treatment A was an experimental feedblock (W291, BOCM Silcock Ltd; 8·5 MJ metabolizable energy (ME) and 226 g CP including 170 g CP as urea and having 174 g digestible CP (DCP)/kg DM), with 24 h access but partially covered to restrict consumption to under 1·0 kg DM/animal per d. The feedblock was weighed each day. Treatment B was a mineralized barley–urea cube (10·9 MJ ME and 235 g DCP/kg DM) the amount given individually each day in one feed at 08.00 hours being adjusted to give equal amounts of ME and DCP as for A. In treatment C mineralized barley (11·6 MJ ME and 86 g DCP/kg DM) was given individually to supply the same amount of ME but less DCP than A and B. All three supplements contained chromic oxide. Bulked faecal grab samples were obtained twice/d for 7 d for chromium estimation.

The mean intake of feedblock was 0·93 kg DM/animal per d and the mean amounts of B and C given were 0·69 kg DM. The voluntary straw intakes (kg DM/animal per d) were A, 3·77; B, 4·28 ($P<0·01$); C, 3·59 (SEM±0·070). The mean coefficients of variation (%) for the chromic oxide concentrations in the faeces were A, 31·5 ($P<0·01$); B, 13·0; C, 10·1 (SEM±2·70). Time-lapse photography (72 s between frames) confirmed that individual cattle spent very varied amounts of time at the feedblock and low chromic oxide contents of faeces were well correlated with low blood urea concentrations.

In a second experiment with two groups of six Hereford-cross cattle (279 kg) used in a change-over design with 17 d periods, 24 h group-access to the feedblock was compared with a single daily provision of a barley–urea concentrate allowing somewhat restricted trough space (600 mm/animal). Voluntary straw intakes (4·74 kg DM feedblock; 4·50 kg DM concentrate) and coefficients of variation for faecal chromium contents (34·0% feedblock; 40·5% concentrate) were then comparable.

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Kendall, P. J. (1977). PhD Thesis, University of Glasgow.

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**Inhibition of rat-liver Δ9-desaturase activity by dietary branched-chain fatty acids.** By K. W. J. WAHLE and W. R. HARE, *Rowett Research Institute, Bucksburn, Aberdeen AB2 9SB*

Methyl branched-chain fatty acids (Me-BCFA) accumulate in the adipose tissue triacylglycerols of sheep and goats fed on diets containing mainly cereal grain which has been rolled or bruised (Duncan *et al.* 1974, 1976). They are derived from methylmalonyl-CoA, an intermediate of propionate metabolism (Scaife *et al.* 1978; Wahle & Paterson, 1979).

Rats fed on diets containing 50 g concentrated mixture of the Me-BCFA/kg diet derived from sheep adipose tissue triacylglycerol accumulated these fatty acids to various extents in different tissues (cf. Smith *et al.* 1978). When compared with rats fed on diets containing 50 g tripalmitin/kg diet (control animals) the rats given Me-BCFA also had lower values for the ratio 18:1:18:0 fatty acids in their liver triacylglycerols (A. Smith, A. K. Lough and C. R. A. Earl, personal communication).

The rats receiving the diets containing 50 g Me-BCFA/kg diet showed a 55% reduction in the capacity of their liver microsomes to desaturate stearic acid when compared with the controls. The lower value for the ratio 18:1:18:0 fatty acids in the adipose tissue triacylglycerols of these animals was therefore consistent with the lower Δ9-desaturase activity in the liver.

The activity of the microsomal ω-hydroxylation reaction (another membrane bound mono-oxygenase reaction) towards added lauric acid or palmitic acid was not affected by dietary Me-BCFA. This finding suggested that the inhibitory effect of Me-BCFA on Δ9-desaturase activity was not due to a general membrane effect. Similarly the activity of the cytosolic fatty acid synthetase was not affected by dietary Me-BCFA, indicating that the effect of dietary Me-BCFA may be specific for Δ9-desaturase activity. Addition of Me-BCFA to liver microsomes prepared from rats fed on a standard laboratory diet reduced the Δ9-desaturase activity to a greater extent than the addition of a similar amount of palmitic acid.

These observations suggest that the Me-BCFA synthesized in sheep adipose tissue can have a marked and possibly specific effect on Δ9-desaturase activity of rat liver microsomes when they are included in the animals' diet at 50 g/kg. Any possible effect on Δ9-desaturase, with the possible impairment of polyunsaturated fatty acid metabolism, remains to be investigated.

We are grateful to Drs A. K. Lough and A. Smith for providing the animals used in this investigation.

Duncan, W. R. H., Lough, A. K., Garton, G. A. & Brooks, P. (1974). *Lipids* **9**, 669.
Duncan, W. R. H., Ørskov, E. R. & Garton, G. A. (1976). *Proc. Nutr. Soc.* **35**, 89A.
Scaife, J. R., Wahle, K. W. J. & Garton, G. A. (1978). *Biochem. J.* **176**, 799.
Smith, A., Lough, A. K. & Earl, C. R. A. (1978). *Proc. Nutr. Soc.* **37**, 76A.
Wahle, K. W. J. & Paterson, S. M. (1979). *Int. J. Biochem.* **10**, 433.

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**The effect of intraruminal infusions of propionic acid on milk composition in cows given silage diets.** By J. S. CHALMERS, P. C. THOMAS and D. G. CHAMBERLAIN, *The Hannah Research Institute, Ayr KA6 5HL*

Low dietary hay:concentrate values or intraruminal infusions of propionic acid in cows given hay and concentrate diets lead to a reduction in milk fat content and to an associated increase in milk protein content, linked with an increase in the blood plasma concentrations of certain non-essential amino acids (see Thomas, 1979). However, Chalmers *et al.* (1978) found that the effects of changes in dietary forage:concentrate value on milk protein content in cows given silage diets were small. This discrepancy led to the work reported here.

Two experiments were conducted with Ayrshire cows in the declining phase of lactation. Basal diets were of grass silage and barley–groundnut meal concentrates (53:47 w/w). In Expt 1, six cows and in Expt 2, four cows were paired and during three 3-week periods they were given continuous intraruminal infusions of water (W) or of propionic acid (P) in the sequence W–P–W or P–W–P.

In Expt 1 the infusion of propionic acid reduced food intake, equally for both silage and concentrates, so that the acid acted as a substitute in the diet rather than as a supplement; there was no reduction in food intake in Expt 2. The estimated ME intakes in both experiments and some of the results are shown in the Table. Propionic acid infusions led consistently to a reduction in mean milk fat content but there was no associated increase in mean milk protein content. In both experiments propionic acid infusions were associated with an increase in the mean plasma glucose concentration and a reduction in plasma urea but analysis of samples from Expt 1 showed no significant effects of propionic acid on the concentrations of plasma amino acids.

| | Expt 1 | | | Expt 2 | | |
|---|---|---|---|---|---|---|
| | | Propionic† | | | Propionic‡ | |
| | Water | Acid | SED | Water | Acid | SED |
| Estimated ME intake (MJ/d) | 126 | 123 | 1·6 | 141 | 151 | 1·7* |
| Milk yield (kg/d) | 12·57 | 11·21 | 0·45 | 17·84 | 18·70 | 0·24 |
| Milk fat content (g/kg) | 43·9 | 40·2 | 1·1 | 44·7 | 38·5 | 0·8* |
| Milk crude protein content (g/kg)‖ | 32·5 | 32·5 | 0·5 | 32·7 | 32·8 | 0·6 |

*$P<0.05$.
†20 l/d of a solution containing propionic acid (500 ml) and 300 ml NaOH (480 g/l).
‡45 l/d of a solution containing propionic acid (650 ml).
‖N×6·38.

Thomas, P. C. (1979). In *Factors affecting the yields and contents of milk constituents of commercial importance*, [J. H. Moore and J. A. F. Rook, editors]. International Dairy Federation: (In the Press).
Chalmers, J. S., Thomas, P. C. & Belibasakis, N. (1978). *Proc. Vth Silage Conference*, p. 18. Hannah Research Institute, Ayr.

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**Metabolism of microbial nucleic acids by preruminant and ruminant lambs.** By M. A. RAZZAQUE and J. H. TOPPS, *School of Agriculture, 581 King Street, Aberdeen AB9 1UD* and R. N. B. KAY and J. M. BROCKWAY, *Rowett Research Institute, Bucksburn, Aberdeen AB2 9SB*

Bacterial nucleic acids might be utilized for synthesis of ruminants' tissue nucleic acids (Smith *et al.* 1974). We have studied the absorption, deposition and excretion of $^{14}C$ microbial nucleic acid by lambs. The method of Smith & Mathur (1973) was used to incorporate [8–$^{14}C$]adenine into mixed rumen micro-organisms in vitro. This preparation was given with milk by bottle to two unweaned ram lambs (26 d old, 6 kg body-weight) and by rumen tube to two weaned ram lambs (59 d old, 18 kg body-weight). Each lamb was immediately placed in an open-circuit respiration chamber linked to an ionization chamber (Brockway *et al.* 1977) and was killed after 24 h (unweaned) or 48 h (weaned).

The unweaned lambs absorbed 59·8% of the total radioactivity measured after 24 h and the weaned lambs 66·5% of the total activity measured after 48 h. The distribution of the absorbed $^{14}C$ is given in the Table.

| | Faeces | Guts and contents | Carcase | Viscera* and blood | Urine | Respiratory gases | Total activity |
|---|---|---|---|---|---|---|---|
| Unweaned lambs | | | | | | | |
| $^{14}C$ (μCi) | 1·24 | 15·2 | 4·25 | 2·78 | 8·21 | 9·20 | 40·9 |
| $^{14}C$ absorbed (%) | – | – | 17·4 | 11·4 | 33·6 | 37·7 | – |
| Weaned lambs | | | | | | | |
| $^{14}C$ (μCi) 1st 24 h | 1·08 | – | – | – | 16·2 | 6·23 | – |
| $^{14}C$ (μCi) 2nd 24 h | 6·94 | – | – | – | 14·9 | 2·90 | – |
| Total for 48 h (μCi) | 8·02 | 29·8 | 27·9 | 7·41 | 31·1 | 9·13 | 113·3 |
| $^{14}C$ absorbed (%) 48 h | – | – | 36·9 | 9·8 | 41·1 | 12·1 | – |

*Liver, gall bladder and contents, spleen, heart, lungs, thymus gland, kidney, urinary bladder and contents and pancreas.

The unweaned lambs excreted 15·5, 47·5 and 37% of the total urinary radioactivity in hypoxanthine plus xanthine, uric acid and allantoin respectively. Corresponding values for the weaned lambs were 12·1, 13·4 and 74·4% respectively during first 24 h of the study and a similar pattern was observed during the second 24 h. The marked difference between the two pairs of lambs in the pattern of excretion may perhaps be attributed to partial degradation of the microbial preparation in the rumen of the weaned animal. The concentration of nucleic acids (RNA and DNA) was closely related to $^{14}C$ content of the various tissues of both types of lambs suggesting that absorbed $^{14}C$ purine or nucleosides are incorporated directly into tissue nucleic acids of the host.

Brockway, J. M., McDonald, J. D. & Pullar, J. D. (1977). *Ann. Rep. Rowett Res. Inst.* **33**, 106.
Smith, R. C. & Mathur, C. H. (1973). *Can. J. Microbiol.* **19**, 591.
Smith, R. C., Moussa, N. M. & Hawkins, G. E. (1974). *Br. J. Nutr.*, **32**, 529.

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**Rumen fermentation pattern and protozoal counts in sheep given silage and silage and barley diets.** By D. G. CHAMBERLAIN, P. C. THOMAS and FIONA J. ANDERSON, *The Hannah Research Institute, Ayr KA6 5HL*

Ruminal concentrations of ammonia–nitrogen were high in sheep fed formic acid-treated silages. Supplementation with barley resulted in only small reductions in $NH_3$–N concentrations. Furthermore, changes in ruminal fermentation pattern with barley addition were characterized by increased molar proportions of butyric acid and there was little change in the concentration of propionic acid (Thomas *et al.* 1980).

Fermentation pattern with diets of silage and barley was studied further in two experiments, the results of which are presented here. In Expt 1 a basal diet of silage (3·5 kg/d; DM 226 g/kg; crude protein (N×6·25) 199 g/kg DM) given at 11.00 hours and 17.00 hours was supplemented with barley (500 g/d); the barley supplement was given at either 11.00 hours, 10.00 hours or 9.00 hours. Differences between the three barley treatments were not significant ($P<0·05$) but compared with the silage only treatment, the addition of barley resulted in reduced ($P<0·01$) ruminal $NH_3$–N concentrations, reduced molar proportions of propionic acid and increased ($P<0·01$) molar proportions of butyric acid. These changes were accompanied by a marked increase ($P<0·01$) in the protozoal count in rumen fluid from 2·8 to $16·9\times10^5$/ml. In Exp 2 (see Table) defaunation with dioctyl sodium sulphosuccinate reduced ($P<0·05$) ruminal $NH_3$–N concentrations and increased molar proportions of butyric acid both with a diet of silage only (3·5 kg/d; DM 221 g/kg; CP 169 g/kg) (S) and with a diet of silage plus barley (500 g/d) (SB).

*Fermentation pattern in sheep receiving diets of silage (S) and silage plus barley (SB), both when faunated and when defaunated*

(Mean results for four animals)

| | pH | $NH_3$-N (mg/l) | mmol/mol | | |
|---|---|---|---|---|---|
| | | | Acetic acid | Propionic acid | Butyric acid |
| S† | 6·40 | 309 | 610 | 258 | 86 |
| S defaunated | 6·51 | 234 | 579 | 218 | 154 |
| SB | 6·24 | 222 | 586 | 237 | 128 |
| SB defaunated† | 6·25 | 176 | 577 | 218 | 149 |
| SED | 0·02** | 19·8* | 4·2 | 5·3 | 8·8 |

Statistical significance by $F$ test: *$P<0·05$, **$P<0·01$.
†Mean results for three animals.

It is concluded that protozoa in the rumen contribute significantly towards the high $NH_3$ concentrations which are observed with both silage and silage and barley diets. The occurrence of high butyrate fermentation patterns with silage and barley diets may be related to the presence of a large rumen population of protozoa but higher proportions of butyrate are formed through bacterial fermentation when protozoa are absent.

Thomas, P. C., Kelly, N. C., Chamberlain, D. G. & Wait, M. K. (1980). *Br. J. Nutr.* (In the Press).

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**Contributions of foods to sodium intakes.** By NICOLA L. BULL and D. H. BUSS, *Ministry of Agriculture, Fisheries and Food, London SW1P 2AE*

In an attempt to reduce the incidence of hypertension, the US Senate's Select Committee on Nutrition and Human Needs (1977) recommended that salt (NaCl) intakes be limited to about 5 g (i.e. 2 g Na)/d. They said this could be achieved by not adding salt to food and by avoiding foods with visible salt.

The relative importance of naturally-occurring sodium, salt added to manufactured foods and table salt in Britain is not well known and we have investigated it in two ways. The first was to determine the Na content of domestic food purchases by applying the values selected by Paul & Southgate (1978) to the quantities of food recorded in the National Food Survey in 1978 (Ministry of Agriculture, Fisheries and Food, 1980). The calculated intake was 2·60 g/person per d and contributions from groups of foods are given in the Table. Most of the total (2·23 g) was derived from processed foods including meat products, bread, butter and margarine and only 0·37 g from unprocessed foods. An additional 1·24 g Na/person per d was also purchased as 3·16 g table salt.

| | Sodium intake (g/person per d (% total intake)) | |
|---|---|---|
| Food | Calculated | Analysed |
| Cereal products | 1·05 (40) | 1·30 (41) |
| Meats (+eggs) | 0·71 (27) | 0·68 (21) |
| Fats (+cheese, cream and ice cream) | 0·41 (16) | 0·43 (13) |
| Milk | 0·19 (7) | 0·22 (7) |
| Root vegetables | 0·06 (2) | 0·21 (7) |
| Other vegetables | 0·11 (4) | 0·18 (6) |
| Fish | 0·05 (2) | 0·08 (3) |
| Fruits and sugars | Trace | 0·06 (2) |
| Beverages | Trace | 0·04 (1) |
| Total | 2·60 | 3·20 |

Some of the Na in these foods would be lost on cooking and some gained from salted cooking water. We therefore studied 'total diet' samples (Buss & Lindsay, 1978) from six areas of the UK. These included representative amounts of food prepared for eating, salted where appropriate but excluding salt added on the plate. Analysis indicated an average intake of 3·20 g (range 2·94–3·67 g; see Table).

These intakes are less than the total intakes expected from adult Na excretions of approximately 150 mEq (3·45 g Na)/d, but they indicate the relative importance of different sources to present-day Na intakes in the UK.

The authors thank the Laboratory of the Government Chemist for analysing the 'total diet' samples.

Buss, D. H. & Lindsay, D. G. (1978). *Fd Cosmet. Toxicol.* **16**, 597.
Ministry of Agriculture, Fisheries and Food (1980). *Household Food Consumption and Expenditure;* 1978. London: HM Stationery Office (In the Press).
Paul, A. A. & Southgate, D. A. T. (1978). *McCance and Widdowson's 'The Composition of Foods'*. London: HM Stationery Office.
Select Committee on Nutrition and Human Needs (1977). *Dietary Goals for the United States,* 2nd ed. Washington, DC: US Government Printing Office.

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**Contributions of foods to potassium intakes.** By NICOLA L. BULL and D. H. BUSS, *Ministry of Agriculture, Fisheries and Food, London SW1P 2AE*

The US Senate's Select Committee on Nutrition and Human Needs (1977) has expressed concern not only about increases in sodium intakes arising from food processing and preparation, but also about decreases in potassium intakes. Healthy adults are said to need about 2·5 g K/d (US National Academy of Sciences, 1974).

We have investigated present intakes of K in Britain in two ways as described previously (Bull & Buss, 1980). Application of the values selected by Paul & Southgate (1978) to the quantities of foods recorded in the National Food Survey in 1978 (Ministry of Agriculture, Fisheries and Food, 1980) showed an intake of 2·99 g K/person per d and contributions of individual foods are given in the Table. Unprocessed foods provided 2·02 g K and processed foods 0·97 g K.

| Food | Potassium intake (g/person per d (% total intake)) | |
|---|---|---|
| | Calculated | Analysed |
| Cereal products | 0·32 (11) | 0·40 (16) |
| Meats (+eggs) | 0·40 (13) | 0·34 (14) |
| Fats (+cheese, cream and ice cream) | 0·19 (6) | 0·06 (2) |
| Milk | 0·58 (19) | 0·54 (22) |
| Root vegetables | 0·82 (27) | 0·57 (23) |
| Other vegetables | 0·30 (10) | 0·23 (9) |
| Fish | 0·05 (2) | 0·06 (2) |
| Fruits and sugars | 0·19 (6) | 0·21 (9) |
| Beverages | 0·14 (5) | 0·09 (4) |
| Total | 2·99 | 2·51 |

Analysis of 'total diet' samples (Buss & Lindsay, 1978) from six areas of the UK indicated an average intake of 2·51 g K/person per d (see Table).

The authors thank the Laboratory of the Government Chemist for analysing the 'total diet' samples.

Bull, N. L. & Buss, D. H. (1980). *Proc. Nutr. Soc.* **39**, 30A.
Buss, D. H. & Lindsay, D. G. (1978). *Fd Cosmet. Toxicol.* **16**, 597.
Ministry of Agriculture, Fisheries and Food (1980). *Household Food Consumption and Expenditure:* 1978. London: HM Stationery Office (In the Press).
National Academy of Sciences (1974). *Recommended Dietary Allowances* 8th ed. Washington, DC: National Academy of Sciences.
Paul, A. A. and Southgate, D. A. T. (1978). *McCance and Widdowson's 'The Composition of Foods'*. London: HM Stationery Office.
Select Committee on Nutrition and Human Needs (1977). *Dietary Goals for the United States,* 2nd ed. Washington, DC: US Government Printing Office.

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**Magnesium status and intravenous requirements in patients with chronic inflammatory bowel disease requiring intravenous nutrition.**

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Patients with malabsorption syndrome (Booth *et al.* 1963) or inflammatory bowel disease (Beeken, 1975) may be magnesium deficient and at particular risk during intravenous nutrition (IVN) when an anabolic response is achieved (Shenkin & Wretlind, 1978). The recommendations for intravenous Mg have varied considerably and their rationale is not always clear.

We have studied eleven periods of IVN (2–7 weeks) in eight patients with severe inflammatory bowel disease, total fifty-one patient–weeks. The mean energy intake during IVN was 10·9 MJ (2600 kcal)/d (9·24–12·6 MJ/d) and mean intravenous nitrogen intake was 11·9 g N/d (9–14 g/d). Mg status was determined before and during IVN by measuring serum and repeated 24 h urine Mg levels. Mg depletion was considered to be present when low serum (<0·7 mmol/l) and urine (<2·0 mmol/d) Mg occurred and was probably present when only the urine level was low.

Mg depletion was present before four IVN periods (serum, mean 0·54 mmol/l (0·40–0·61); urine, mean 0·18 mmol/d (0·10–0·50)) and probably also present before a further three periods. Of the four periods before which definite Mg depletion occurred, three were readily corrected in the 1st week of IVN. One was not corrected till the 4th week. Of the remaining seven periods, in only one case did Mg status deteriorate during IVN. All patients gained weight and retained N.

The Table shows the relationship between intravenous Mg intake and Mg status during each of fifty-one patient–weeks on IVN, expressed as low levels/patient–weeks for each range of intravenous Mg intake.

*Proportion of patients with low serum and urine magnesium*

| Intravenous Mg intake (mmol/day) | Low serum Mg | Low urine Mg | Low serum and urine Mg |
|---|---|---|---|
| 5 | 5/8 | 3/8 | 3/8 |
| 5–10 | 2/20 | 0/20 | 0/20* |
| 10 | 4/23 | 1/23 | 0/23** |

Statistical significance of difference from 5 mmol Mg/d; *$P$=0·017, **$P$=0·012.

At least 5 mmol of Mg/d intravenously is required to maintain or replete Mg status.

Out-patient monitoring of serum Mg levels in six of these patients, 2–14 months after IVN has shown low levels in three, all of whom have had severe diarrhoea or steatorrhoea. In two, paraesthesiae and tetany, possibly caused by Mg deficiency have occurred. Mg deficiency in such patients would therefore seem to be a long-term problem and supplements should be given.

Beeken, W. L. (1975). *Archs. intern. Med.* **135**, 686.
Booth, C. C., Hanna, S. & Babouris, N. (1963). *Br. Med. J.* **2**, 141.
Shenkin, A., Wretlind, A. (1978). *Wld Rev. Nutr. Diet.* **28**, 1.

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**The effect of dietary inclusions of tallow on the citric acid and soluble calcium content of cow's milk.** By I. H. L. ORMROD and P. C. THOMAS, *The Hannah Research Institute, Ayr KA6 5HL* and J V. WHEELOCK, *University of Bradford, Bradford BD7 1DP*

Ormrod *et al.* (1979) found that in cows given high-concentrate diets, milk fat content was reduced and that there were closely correlated reductions in milk citric acid and soluble calcium contents. To examine these relationships further, four Ayrshire cows in mid-lactation were given a high-fat diet designed to reduce the contribution of fatty acids synthesized *de novo* in the mammary gland to milk fat without reducing milk fat content. The high-fat diet, which consisted of chopped hay–concentrate mixture (30:70) containing barley–soya-bean meal–tallow (55:33:12), was given during a 3-week experimental period which was preceded and followed by 3-week control periods when the animals received a similar diet but with a low-fat concentrate containing barley–soya-bean meal (80:20).

Some of the results of the experiment are shown in the Table. Inclusion of tallow in the diet increased milk fat content ($P<0.05$) and there was an associated increase in milk citric acid content ($P<0.01$) and soluble calcium content. Effects on soluble Ca were, however, smaller than observed in previous experiments with milk fat depressing diets.

| | Initial control period | | Experimental period | | Final control period | |
|---|---|---|---|---|---|---|
| | Mean | SE | Mean | SE | Mean | SE |
| Milk yield (kg/d) | 18·8 | 1·2 | 16·1 | 1·8 | 15·2 | 0·9 |
| Fat content (g/kg) | 31·7 | 3·5 | 38·1 | 2·9 | 35·3 | 3·5 |
| Citric acid content (mg/kg) | 1510 | 262 | 2010 | 154 | 1610 | 100 |
| Soluble calcium content (mg/kg) | 372 | 17 | 406 | 31 | 371 | 19 |

The effects of tallow inclusion on milk citric acid may be accounted for by the influence of the fat on the synthesis of fatty acids in the mammary gland. A large proportion of the $NADPH_2$ used in the malonyl pathway is derived through the action of isocitrate dehydrogenase and a reduced requirement for $NADPH_2$ may increase the citric acid concentration in the mammary cell and thus in milk.

Ormrod, I. H. L., Thomas, P. C. & Wheelock, J. V. (1979). *Proc. Nutr. Soc.* **38**, 121A.

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**Olive oil cake as feed for barbari lambs.** By M. A. RAZZAQUE, A. M. ABOAYSHA and F. E. OMAR, *Department of Animal Production, University of Alfateh, Tripoli, Libya*

In recent work (M. A. Razzaque and F. E. Omar, unpublished results) OOC has been successfully substituted for 50% of the concentrate mixture given to heifers. For further investigation an experiment was conducted to study the chemical composition and feeding value of OOC as a part of rations for weaned Barbari lambs.

In this experiment expeller processed OOC was used. The pulp and seed of the whole OOC were separated by screening and analysed by the method of the Association of Official Agricultural Chemists (1965). Table 1 shows the dry matter composition of olive oil cake. Most nutrients except carbohydrates were 1·5 to 3 times higher in pulp than either seed or whole OOC. OOC is a poor source of nitrogen but fairly rich in essential elements and minerals, especially potassium, copper, manganese and zinc.

| | g/kg DM | | | | | | | | | | mg/kg DM | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction | Crude protein | Crude fibre | Ether extract | Ash | Nitrogen free extract | Ca | P | Mg | Na | K | Cu | Mn | Zn |
| Seed | 35·7 | 272·3 | 75·8 | 34·1 | 582·1 | 3·3 | 0·4 | 0·4 | 0·5 | 5·9 | 7·2 | 65 | 8·8 |
| Pulp | 91·8 | 173·6 | 214·9 | 130·1 | 389·6 | 7·0 | 0·3 | 1·0 | 0·6 | 11·1 | 20·7 | 93 | 31·7 |
| Whole OOC | 63·7 | 222·9 | 145·3 | 82·2 | 486·0 | 5·1 | 0·8 | 0·7 | 0·6 | 8·5 | 13·9 | 79 | 20·2 |

In 8 weeks feeding trial forty weaned Barbari lambs were randomly divided into four groups (five male and five female). Oat-hay and concentrate mixture were used as basal ration. Concentrate mixture (140 g crude protein (N×6·25)/kg) was replaced by OOC at the rate of 0, 15, 25, and 50% in rations 1, 2, 3, and 4 respectively. All rations were made isonitrogenous by adding urea. Animals received 250–400 g mixture/d (adjusted weekly) and oat-hay *ad lib.* Daily feed intake and weekly weight gain of lambs were recorded. There was no significant difference on growth performances and dressing percentage between all four groups of lambs (Table 2). The results suggest that OOC could be potential source of feed substitute for growing lambs.

| Ration | Initial weight (kg) | | Final weight (kg) | | Daily gain (g) | | Dressing percentage | |
|---|---|---|---|---|---|---|---|---|
| | Mean | SE | Mean | SE | Mean | SE | Mean | SE |
| 1 | 26·6 | 0·86 | 32·6 | 1·34 | 114·8 | 11·6 | 40·2 | 0·54 |
| 2 | 27·1 | 1·21 | 34·4 | 1·40 | 129·7 | 13·1 | 37·5 | 1·20 |
| 3 | 25·9 | 1·60 | 32·5 | 1·92 | 117·3 | 13·3 | 38·8 | 1·45 |
| 4 | 26·0 | 0·99 | 30·9 | 1·30 | 87·0 | 12·2 | 37·7 | 1·05 |

Association Official Agricultural Chemists (1965). *Official Method of Analysis,* 10th ed. Washington DC: Association of Official Agricultural Chemists.

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**The effect of the concentration and type of protein in the diet on milk secretion and nitrogen retention in the goat.** By P. C. THOMAS, D. G. CHAMBERLAIN and N. BELIBASAKIS, *The Hannah Research Institute, Ayr KA6 5HL*

Eight Saanen goats in mid-lactation were divided into two equal groups and each group was used in a 4×4 Latin Square comparison of four dietary treatments. The diets, which were given for 21 d periods, provided approximately 1690 g digestible organic matter/d. In each treatment group the unsupplemented diet consisted of hay–barley concentrate (47:53 w/w) and in the three supplemented diets barley was replaced isoenergetically by an increasing proportion of a mixture of casein and ground-nut meal (50:50, group 1) or soya-bean meal (group 2).

The results (see Table) show that at low and medium levels of supplementation with both casein and soya-bean meal, milk yield and nitrogen retention were increased. The increase in milk yield was associated with an increase in the yield of all milk constituents although the effects on milk protein content were partly accounted for by an increased secretion of non-protein N. At the high level of protein supplementation N retention was further increased but milk yield reached a plateau or was reduced. The reduction in yield with casein was pronounced and was associated with a lowered secretion of mainly lactose and the milk salts; the yield of milk fat was unaffected. This effect may be related to the high rumen-degradability of casein and to the influence of absorbed ammonia on gluconeogenesis (Leonard *et al.* 1977).

| Nitrogen intake (g/d) | Milk yield (g/d) | Milk+ protein (N×6·38) (g/d) | Milk non-protein nitrogen (mg/100 g) | Milk lactose (g/d) | Nitrogen retention (g/d) |
|---|---|---|---|---|---|
| | | Group 1 (Casein+ground nut) | | | |
| 31·6 | 1663 | 54·9 | 32·0 | 71·2 | 0·6 |
| 41·3 | 1737 | 56·0 | 37·6 | 74·7 | 3·4 |
| 52·7 | 1852 | 60·4 | 44·3 | 80·4 | 4·3 |
| 63·3 | 1642 | 56·9 | 54·6 | 71·4 | 5·0 |
| | | Group 2 (Soya) | | | |
| 31·7 | 2092 | 67·6 | 30·4 | 92·4 | 1·3 |
| 42·9 | 2230 | 73·2 | 38·1 | 99·3 | 3·1 |
| 53·8 | 2363 | 79·5 | 45·5 | 105·2 | 5·5 |
| 64·4 | 2282 | 78·9 | 46·5 | 101·3 | 6·8 |
| SED | 74 | 2·0 | 4·4 | 4·1 | 1·1 |

Responses in N retention and, excepting the high levels of supplementation, milk yield per increment of supplementary protein tended to be greater for soya bean than for casein but the differences in response did not reach statistical significance ($P<0·05$).

Leonard, M. C., Buttery, P. J. & Lewis, D. (1977). *Br. J. Nutr.* **38**, 455.

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**Human selenium deficiency.** By G. S. FELL, A. SHENKIN, A. MAIN and R. RUSSEL, *Royal Infirmary, Glasgow* and A. BROWN and J. M. OTTAWAY, *Strathclyde University*

Clinically responsive selenium deficiency has been reported by Van Rij *et al.* (1979) in a New Zealand woman following 30 d intravenous nutrition. During the symptomatic period low concentrations of Se were found in blood plasma (<10 μg Se/l) and urine (<6 μg Se/24 h) with a reduced activity of red cell glutathione peroxidase (GSHPx; <8 u/g Hb). Severe muscle pains in the legs of the patient were relieved after infusion of selenomethionine, (equivalent to 100 μg Se/d) for about a week.

We report a patient with biochemical signs of Se deficiency which were corrected by oral Se therapy. The patient, a man in his thirties, has several years history of inflammatory bowel disease, with malabsorption of diet leading to persistent weight loss. Periods of intravenous nutrition were required to restore his body-weight and give bowel rest. During one period of hospital treatment we investigated his Se status. The initially low values of Se in plasma and urine, and low red cell GSHPx, were restored to near the reference range after several weeks of treatment with orally given sodium selenite, (2 mg, equivalent to 900 μg Se/d). Results are shown in the Table.

| | Before treatment | After 7 weeks | Reference range |
|---|---|---|---|
| Plasma Se (μg/l) | 22–25 | 70 | 80–120 |
| Urine Se (μg/24 h) | 28–20 | 189 | 30–70* |
| Red Cell GSHPx (u/g Hb) | 4·5 | 28·5 | 30–60 |

*Related to input.

No adverse effects were noted during Se supplementation, but neither was there a clinical benefit which could be related to Se therapy.

Clinically apparent Se deficiency may only present in patients with previous Se depletion, as occurs naturally in the New Zealand population. Severe nutritional disorders, and rapid body-weight loss together with intravenous therapy with Se poor nutrients may then precipitate the disorder. Biochemical evidence of Se deficiency will be more commonly found in a variety of nutritionally depleted patients. Although the biochemical importance of Se is established (Schwarz, 1976), the clinical relevance of varying degrees of Se deficiency is not clear.

Now that laboratory methods of determining Se status are available. The epidemiological studies relating Se deficiency to the incidence of cardiovascular disease (Editorial, 1979) or malignant disease (Burk, 1978) require detailed investigation.

Burk, R. F. (1978). *Wld Rev. Nutr. Diet.* **30,** 88.
Editorial (1979). *Lancet* ii, 889.
Schwarz, K. (1976). *Med. Clins N. Am.* **60,** 745.
Van Rij, A. M., Thomson, C. D., McKenzie, J. M. & Robinson, M. F. (1979). *Am. J. clin. Nutr.* (In the Press).

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**Glutathione peroxidase in human selenium deficiency.** R. J. SPOONER, ROSALYND A. CAMPBELL, A. G. RUMLEY and P. STROMBERG, *Department of Biochemistry, Royal Infirmary, Glasgow*

Glutathione peroxidase (GSHPx) is a seleno enzyme and has been shown to reflect selenium status in both animals and man (Thomson *et al.* 1976; Perona *et al.* 1977).

We have measured erythrocyte GSHPx (EGSHPx) activity (Beutler *et al.* 1977) at the beginning and end of fourteen courses of parenteral feeding. Five patients had initial levels below the reference range (30–60 u/g Hb) and of these only one rose into this range during standard therapy. Of the remaining four patients, three had chronic inflammatory bowel disease. Another patient with this condition showed a fall to <30 u/g Hb during intravenous feeding.

Twelve cases of tube feeding were similarly studied. Consistently low levels of EGSHPx were measured in three patients, one of whom had an inflammatory bowel disease. One patient with chronic inflammatory bowel disease, undergoing his third course of parenteral feeding was found to have an extremely low EGSHPx activity. A course of oral Se therapy was given (2 mg sodium selenite/d for 7 weeks) as described by Fell *et al.* (1979).

During therapy the EGSHPx activity rose from 4·5 to 30·5 u/g Hb. GSHPx activity in plasma was also measured. Both enzyme activities reached a plateau at the end of therapy and then began to decline. The fall in the erythrocyte enzyme was slower than that of the plasma enzyme activity which followed more closely the fall in plasma Se concentration.

The effects of oral Se on EGSHPx were studied in detail using red cells fractionated according to age on discontinuous density gradients (Spooner *et al.* 1979). This showed a rapid increase in EGSHPx activity in the youngest cells demonstrating a synthesis of new enzyme rather than saturation of an apo-enzyme.

The different rates of decline in erythrocyte and plasma enzyme activities on the cessation of therapy suggest the plasma enzyme may be a more sensitive index of early depletion than EGSHPx measurements.

From these studies it appears that patients with a history of inflammatory bowel disease may be Se depleted and that treatment by intravenous feeding may increase the degree of deficiency unless Se is included in the regimen.

Beutler, E., Blume, K. G., Kaplan, J. C., Lohr, G. W., Ramot, B. & Valentine, W. N. (1977). *Br. J. Haemat.* **35,** 311.

Fell, G. S., Shenkin, A., Main, A., Russel, R., Brown, A. & Ottaway, J. M. (1979). *Proc. Nutr. Soc.* **39,** 30A.

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Spooner, R. J., Percy, R. A. & Rumley, A. G. (1979). *Clin. Biochem.* (In the Press).

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