of arginine had a more marked effect on lysine absorption which fell to 30% of its former value, while the rate of arginine absorption increased almost sixfold. This suggests that arginine may compete more successfully for absorption sites than lysine.

The Two Hundred and Twenty-second Meeting of the Nutrition Society was held at the Royal Society of Medicine, 1 Wimpole Street, London, W1, on Friday, 29 May 1970, at 11.00 hours, when the following papers were read:

A comparison of two sets of food composition data. By BETTY R. STANTON, *King Edward's Hospital Fund for London* and ERICA F. WHEELER, *Department of Human Nutrition, London School of Hygiene and Tropical Medicine*

Two sets of food composition tables have been used to estimate the intakes of forty residents in old people's homes, in the course of a 7 d weighed dietary-intake study. Energy, protein, fat, calcium and iron intakes were calculated from the 280 records. The first set of composition data (A) consisted mainly of figures from *The Composition of Foods* (McCance & Widdowson, 1960) supplemented by analysis figures from manufacturers, and by some values for cooked dishes calculated from recipes. The second set (B) had been compiled by the Department of Health for use in food surveys of the general public. For our purposes, it was also supplemented by information from the manufacturers of frozen foods used in one of the homes, and by some calculations from recipes used in the homes.

Using these tables and averaging the weekly intakes of all the residents in each home, it was found that estimates of energy, fat and protein intakes agreed to within less than 10%. Calcium and iron intakes agreed to within 20%. Correlation coefficients (A *v.* B) ranged from 0·99 (energy) to 0·53 (iron).

Table 1 shows the distribution of the percentage differences between estimate A and estimate B for each subject's average weekly intake. The distribution for the 280 individual daily intakes is similar. Both for the weekly average intakes and for the day's intakes, the two estimates agree to within 10% for approximately 90% of the energy values, 70% of the protein values, 60% of the fat values, and only 40% of the mineral values.

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Table 1. *Distribution of the percentage differences* $\frac{(100\ (B-A))}{B}$ *between estimates of the intake of forty elderly people, obtained by using two sets of food composition data, A and B*

(Calculated on forty average weekly intakes)

Percentage differences	Energy		Protein		Fat		Calcium		Iron	
	No.	%	No.	%	No.	%	No.	%	No.	%
0–5	29	72	18	46	16	40	7	18	3	7
5–10	10	25	11	27	18	46	11	27	3	7
10–20	1	3	11	27	6	14	17	42	16	40
Over 20	0	0	0	0	0	0	5	13	18	46
All	40	100	40	100	40	100	40	100	40	100

We have examined the occurrence of percentage differences greater than 10%, and find that 17% of these were due to clerical and coding errors (mostly affecting fat and protein intake), 8% to differences in the selection of a 'nearest equivalent food' when dietary records were coded, 36% to differences between the two tables in respect of single foods, and 39% to the use of different recipes for cooked dishes. Most of the large number of discrepancies in estimates of mineral intake were due to differences in recipes or simply to different analyses for mineral content used by the compilers of the tables.

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Correlation of protein intake and nitrogen and urea in urine. By R. LUYKEN, B. DUBOIS, D. C. LEEGWATER, N. A. PIKAAR and W. VAN STAVEREN, *Central Institute for Nutrition and Food Research TNO, Zeist, Netherlands*

In the last few years, various ratios and indices of nitrogen and N compounds present in urine have been used to estimate the protein intake of population-groups. Platt & Heard (1958) suggested the use of the ratio urea N: total N, which others have called the urea index. Powell, Plough & Barker (1961) advised the ratio N: creatinine as a criterion. Urea per g creatinine has also been used for this purpose by Arroyave (1963).

It is not necessary to have urine collected for 24 h. The results are intended to give an impression of groups of people, not of individuals.

We have assessed the first two indices in several population-groups whose protein intake differs considerably:

(1) Papuans, from the Central Highlands of New Guinea, who live under the most primitive conditions, which can rightly be described as 'stone age' conditions.

Their food consists almost solely of sweet-potatoes and sweet-potato leaves. The average protein intake is 20–30 g/d (Luyken, Luyken-Koning & Pikaar, 1964).

(2) Bush negroes in Surinam who also still live under primitive conditions. Their diet consists of cassava, rice, some meat and game. The protein content of their food is not high, although detailed data are not known.

(3) The Creole population in Paramaribo, capital of Surinam, who have rice and bread as their staple food, and who have adopted many Western feeding customs. The daily protein intake has been calculated to be 55 g/d (van der Kuyp, 1963).

(4) Some Dutch groups. The average protein intake of the Dutch population was calculated to be in 1968 more than 80 g/d (Mulder, 1969).

In preschool children of groups 2, 3 and 4, the average N/g creatinine was found to be 7·8, 10·4 and 13·2 g, and the urea indices were 72, 80 and 87 respectively. Schoolchildren in the groups 1, 3 and 4 had an average of 3·2, 8·0 and 11·4 g N/g creatinine, and urea indices of 51, 85 and 83.

Lastly, children of two boarding-schools in Surinam were compared. In school A, approximately 45 g protein were consumed in the form of a mixed rice diet. School B had the same diet with an extra share of 400 ml milk daily (Luyken & Luyken-Koning, 1969). In group A, the average amount of N/g creatinine was 6·8 g and in group B 9·3 g. The urea indices were 82 and 89 respectively.

There was generally a clear correlation between the protein content and the indices with some exceptions. As may be expected, the N content per g creatinine decreases much more on a low-protein diet than the urea index does. The N/g creatinine shown by the Papuan children was less than one-third of that of the Dutch children, while the average urea index of the Papuans was not quite half that of the Dutch. In school A, N/g creatinine was two-thirds of the quantity found in school B, although the urea index was only 8% lower.

Of course, these are only superficial observations under field conditions. The results are dependent on many other factors: when there is a protein shortage, the creatinine excretion can decrease too; the excretion of creatinine is related to age; when protein stores have to be replenished, the retention of N can be considerable.

However, in our opinion the indices described are useful tools—the N/g creatinine index seems to be the more sensitive of the two.

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Can nitrogen balance be maintained on 1000-kcalories-diet? By D. J. NAISMITH and M. DIANE HOLDSWORTH, *Department of Nutrition, Queen Elizabeth College, London, W8*

Adult non-obese rats restricted to 40% of their customary calorie intake have been found to maintain a positive nitrogen balance for 7 d when the protein concentration of the diet was raised to 40% (Naismith & Winchester, unpublished results). The aim of the present study was to determine whether N balance could be achieved in obese adult human subjects on a low-calorie high-protein regimen.

Two subjects were studied, one male (P.T.) aged 24 years and one female (S.P.) aged 20 years, who were 21% and 38% respectively above their desirable body-weights. Normal calorie intakes were established by measuring food intakes for 7 d. The volunteers were then fed 1000 kcal/d for 42 d, 50% of the calories being contributed by protein which was supplied as lean meats, fish, eggs, vegetables and a small amount of whole milk. The diet was supplemented with 400 mg calcium. Urine was collected daily and analysed for N. Protein-rich foodstuffs were also analysed, and the composition of the vegetables was calculated from food tables (McCance & Widdowson, 1960). Faecal N was found to be 8% of the N intake by direct estimation, using cuprous thiocyanate as a continuous faecal marker. An allowance of 0·08 g N/d was made for skin losses (Department of Health and Social Security, 1969).

Anthropometric measurements were made at the beginning and end of the investigation, and the urine was tested regularly for ketone bodies.

The results of the study are summarized below.

Subject	Normal calorie intake (kcal)	Initial body-wt (kg)	Final body-wt (kg)	Mean daily N balance				
				Intake (g)	Urine (g)	Faeces (g)	Skin (g)	Balance (g)
S.P.	2453	88·6	80·4	21·83	17·22	1·75	0·08	+2·79
P.T.	3256	95·5	83·2	22·58	18·25	1·81	0·08	+2·44

For S.P., who lost 8·2 kg, the diet supplied 41% of her normal calorie intake; P.T., who was subjected to a more severe dietary restriction (31% of normal intake), lost 12·3 kg. A positive N balance was shown by both subjects throughout the 6-week period of study. Urinary ketone bodies did not rise above normal values.

It is noteworthy that at no time during the experiment did either of the subjects experience hunger, which is the bête-noire of most dieters.

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A reappraisal of the 'fattening' property of cyclamate. By D. J. NAISMITH and ARJON SMITS, *Department of Nutrition, Queen Elizabeth College, London, W8*

In a growth study on rats in which dietary sugar was replaced with an equivalent sweetening power of sodium cyclamate ($\frac{1}{30}$ of the weight of sugar), it was noted that rats receiving cyclamate ate more food, gained more weight, and showed a higher efficiency of food conversion (Dalderup & Visser, 1969). These authors concluded that, if the same response were shown by man, then the therapeutic use of cyclamate would make weight reduction more difficult.

An alternative interpretation of their findings occurred to us. The diet used was based on the average diet of Holland, and contained approximately 11% protein and 17% sugar. When cyclamate was introduced into the diet, non-protein calories were replaced with a non-calorigenic substance, thus raising the protein concentration in the diet and stimulating growth.

To test this hypothesis, a semi-synthetic diet, which simulated in composition the diet of Dalderup & Visser, was fed to three groups of eight weanling rats. Group A received the basic diet. In the diet of group B, sugar was replaced with $\frac{1}{30}$ of its weight of sodium cyclamate, while the rats of group C consumed the basic diet to which was added the same amount of cyclamate as was used for group B. Food consumption was measured and growth recorded for 5 weeks. The rats were then killed, and the carcasses and livers were analysed. The results are summarized below:

	Group A	Group B	Group C
Total weight gain (g)	98	118*	85*
Total food intake (kcal)	2107	2208*	1989*
Gain (g/100 kcal)	4·65	5·34*	4·27*

*Value significantly different from that for group A.

Modification of the diet by the addition of cyclamate alone retarded growth, whereas cyclamate in conjunction with an increase in the dietary protein concentration from 10·6% to 12·8% stimulated growth.

No differences were found in carcass or liver composition, but liver weights (g liver/100 g body-weight) were significantly reduced in the rats of group C.

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An alternative explanation for 'specific dynamic action' in adult man. By J. S. GARROW, *Medical Research Council, Department of Obstetrics, Royal Free Hospital, Liverpool Road, London, N1*

The increase in metabolic rate which occurs after a protein meal (sometimes called the specific dynamic action or SDA) has been explained on the basis of heat losses which occur when ATP is made from amino acids, rather than from carbohydrate

or fatty acids (Krebs 1964; Davidson & Passmore, 1969). On this hypothesis, SDA is partly due to the work of digesting the protein meal and partly a result of the thermochemically inefficient oxidation of protein to urea.

An alternative hypothesis is that the influx of amino acids after a protein meal stimulates the more rapid turn-over of tissue proteins, with a consequent increase in metabolic rate and, incidentally, an increased output of urea. This hypothesis is supported by the observations of Ashworth (1969) that there is a very large SDA after meals in malnourished children who are in a phase of rapid growth, and hence rapid protein turn-over, but when the growth rate slackens the SDA effect virtually disappears. This phenomenon is not explicable on the first hypothesis.

In order to test the two theories in an adult subject, an experiment was designed in which digestion, protein synthesis and urea formation were dissociated in time, and continuous measurements were made of metabolic rate over a period of 7 h using a ventilated hood technique (Ashworth & Wolff, 1969). Oxygen consumption and carbon dioxide production were recorded continuously by on-line paramagnetic and infrared analysers. The meal under test was given by intra-gastric tube without disturbing the subject and hydration was maintained so as to support a urine flow rate of at least 10 ml/min. Urine was collected in 15 min periods and analysed for urea, creatinine, sodium and potassium.

When the meals provided no calories, 1000 kcal with no protein, or 1000 kcal with 70 g milk protein, the effect on metabolic rate was similar to that reported by other workers. However, when the meal provided 1000 kcal with 70 g gelatin, there was a transitory increase in metabolic rate (attributable to the digestion of the gelatin) but thereafter no evidence of SDA despite the fact that gelatin, being devoid of tryptophan and hence useless for protein synthesis, was quantitatively recovered from the urine within 5 h as excess urea.

It is concluded that the thermochemical losses in the production of urea from protein make only a minor contribution to SDA in adult humans. It is proposed that the effect of a protein meal in stimulating tissue protein turn-over is a more significant factor.

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Protein quality of meat meals. By J. ATKINSON* and K. J. CARPENTER, *Department of Agricultural Science and Applied Biology, University of Cambridge*

A series of five meat meals had low net protein utilization (NPU) values of 24–37

*Present address: Société assistance technique pour les produits Nestlé, S.A., CH 1350 Orbe, Switzerland.

(Atkinson & Carpenter, 1970), approximately 50% of the value for white fish meal (WFM) and 40% of that for freeze-dried (FD) meat (striated muscle) or gut (smooth muscle), but higher than the values for FD tendon or ossein. The true digestibility of nitrogen (TD) of meat meals ranged from 81 to 87%, slightly lower than the values for muscle or WFM. Muscle protein was found to be high in all total essential amino acids, collagen low and meat meal intermediate. Autoclaving, followed by oven-drying (AOD), an attempted laboratory imitation of meat meal production, substantially reduced the protein quality of meat and gut, lowering the TD and percentage amino acid availability below those found for meat meal, indicating a greater degree of damage than in commercial processing:

Sample and code no.		NPU (%)	TD (%)	Methionine Total *a*	Methionine Available *b*	Methionine Available *c*	Lysine Total *d*	Lysine Available *e*	Tryptophan Total *f*	Tryptophan Available *b*	Tryptophan Available *g*
Meat meal raw materials:											
Meat											
FD	X724	74	93	2·5	2·9	2·8	8·4	8·0	1·24	1·15	1·46
AOD	X823	32	70	2·2	0·8	1·2	7·4	4·9	1·08	0·30	0·82
Gut											
FD	X752	75	88	—	2·2	3·1	6·5	6·1	0·92	0·91	1·05
AOD	X831	17	79	1·5	0·9	1·2	5·1	3·8	0·91	0·22	0·57
Tendon											
FD	X599	24	—	0·8	1·0	—	3·0	2·9	0·13	0·02	—
AOD	X832	11	—	—	0·8	—	3·1	2·7	0·13	0·03	0·11
Meat meal sample:											
(MM101)	X804	35	87	1·1	0·9	1·1	5·1	4·5	0·66	0·24	0·63
White fish meal sample:	X759	58	94	—	2·6	3·2	7·0	6·7	1·05	0·69	—

a, ion-exchange chromatography on oxidized samples; *b*, *Strep. zymogenes* (Ford, 1962), with standardized papain; *c*, chick assay (Miller, Carpenter, Morgan & Boyne, 1965); *d*, ion-exchange chromatography (Roach *et al.* 1967); *e*, difference procedure (Roach *et al.* 1967); *f*, alkaline hydrolysis (Miller, 1967); *g*, chick assay (Atkinson & Carpenter, 1970).

With some samples, difficulties were encountered in that: (1) *Streptococcus zymogenes* total methionine values were higher than those chemically determined, (2) available lysine values determined by the difference procedure (Roach, Sanderson & Williams, 1967) were higher than those determined by the direct procedure (Carpenter, 1960), and (3) *Strep. zymogenes* available tryptophan values were lower than those determined by chick assay.

It can be concluded that the variation in proportions of raw materials is as important as processing damage in determining the final nutritive value of a meat meal, and that the difference in protein quality between meat and white fish meals can be explained by the difference in available amino acid content.

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The effect of zinc level on protein utilization in the chick and quail. By J. ATKINSON* and F. H. KRATZER, *Department of Avian Sciences, University of California, Davis, California, USA*

Several workers (e.g. O'Dell & Savage, 1957) have reported that chicks fed isolated soya-bean protein (ISP) require a higher dietary zinc level (30–35 ppm) than necessary for maximal growth on, for example, casein or egg-white diets (10 ppm). For quail, 10 ppm zinc were found to be inadequate when ISP was included in the diet (Fox & Harrison, 1964). In the experiments reported here, ISP or a casein–gelatin mixture were added to high-calcium diets at the expense of maize starch (Expts 1 and 3) or glucose (Expt 2). The birds were kept in stainless-steel cages and were given distilled water. The digestibility trial was run using chromic oxide as an inert marker (Nesheim & Carpenter, 1967).

Table 1. *Net protein utilization* (NPU) *and true digestibility* (*TD*) *of proteins at varying levels of available zinc in the diet*

Expt no.	1	2	3
Species	Chick	Quail	Chick
Test period (d of age)	10–21	7–14	42–49
Dietary N level (%)	2·0	5·1	3·1
Measurement	NPU	NPU	TD
ISP:			
control	64·9 (16)	44·9 (28)	90·9 (19)
plus zinc oxide	73·6 (47)	46·0 (126)	95·3 (132)
plus Na_2EDTA*	74·3 (15)	—	95·4 (18)
Washed ISP:			
control	—	41·1 (9)	—
plus zinc oxide	—	45·3 (106)	—
Casein–gelatin			
control	62·8 (9)	—	93·9 (10)
plus zinc oxide	67·2 (37)	—	—
plus Na_2EDTA*	67·6 (9)	—	—
Standard error of mean:	1·1	1·0	0·9

Values in parentheses are ppm zinc in the diet.
*200 ppm.

The NPU results are in line with previously published values (e.g. Summers & Fisher, 1961), excepting that the value for casein–gelatin is higher than published values for casein alone. Oberleas & Prasad (1969) found poorer utilization of soya-bean protein (as judged by rat growth) in the absence of supplementary zinc. However, it has also been reported that there was no reduction in the rate of protein digestion or absorption in zinc-deficient rats, although a lowered carboxypeptidase activity was seen (Mills, Quarterman, Williams, Dalgarno & Panić, 1967).

*Present address: Société assistance technique pour les produits Nestlé, S.A., CH 1350 Orbe, Switzerland.

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Measurement of amino acid levels in portal blood plasma of pigs and of rate of portal blood flow. By R. BRAUDE, I. R. CUTTS, A. W. MYRES and J. W. G. PORTER, *National Institute for Research in Dairying, Shinfield, Reading RG2 9AT*

Braude, Mitchell, Myres, Porter & Williams (1969) found in pigs, after feeding, increased plasma levels of essential, but not of non-essential, amino acids in blood taken by vena cava puncture. To obtain a more direct measure of the availability of dietary amino acids and of their rate of uptake in the pig, catheters were inserted into the portal and jugular veins of 25–30 kg animals receiving a basal diet used previously (containing 0·54% lysine) and the same diet supplemented with lysine to a total content of 0·90%. Comparison of the levels of amino acids in samples of portal and jugular blood plasma taken before, and at hourly intervals after, feeding showed that, after feeding, the levels of essential amino acids in portal blood were generally higher than in jugular blood, but not markedly so. With the basal diet, levels tended to be highest about 1 h after feeding, and with the lysine-supplemented diet between 1 and 2 h after feeding.

The rate of blood flow in the portal vein was measured in a 35 kg pig fitted with a double lumen catheter into the portal vein and using the dilution method, with ^{131}I as indicator, as described by Shillingford, Bruce & Gabe (1962). There was a considerable variation in the flow-rate measured before and after feeding (980–1570 ml/min before feeding; 1390–2600 ml/min after feeding).

It is apparent that such a large increase in the rate of portal blood flow can account for the rapid removal of amino acids from the intestine without marked increases in amino acid levels in portal blood relative to those in jugular blood.

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The amino acid requirements of ruminants. By A. E. WAKELING and D. LEWIS, *Department of Applied Biochemistry and Nutrition, University of Nottingham* and E. F. ANNISON, *Unilever Research Laboratory, Colworth House, Nr Bedford*

The determination of amino acid requirements in ruminants is complicated by the

intervention of the rumen microbial population in the digestive processes. Conventional methods, for example the construction of a growth response curve, are not directly applicable. It is more profitable to seek some easily measured physiological response which allows identification of a requirement. The measurement of plasma amino acid levels in relation to the quantities of amino acids passing the duodenum of the sheep has been examined in this respect.

If protein synthesis is restricted by the supply of a limiting amino acid, increasing the quantity of the limiting amino acid should increase protein synthesis, stimulating demand for the other essential amino acids. This increased demand would lead to a decrease in the plasma concentration of the other essential amino acids. Supplements of L-methionine and L-lysine, or both, infused into the duodenum of mature, wether lambs receiving a low-protein diet led to decreases in the plasma concentration of most of the other essential amino acids. The depressions were most pronounced for mixed methionine–lysine infusions: it would seem that both methionine and lysine were somewhat limiting in the basal diet. This technique can be readily used to identify the limiting amino acid but lacks the sensitivity necessary to evaluate a requirement.

In a series of experiments in which graded levels of L-methionine were infused, over 36 h periods, into the duodenum of the sheep, the plasma methionine level responded in a sigmoid manner. The curve relating duodenal methionine flow and plasma methionine remained flat at lower infusion levels but deflected sharply upwards at higher infusion levels (Fig. 1). It is proposed that the inflexion point of the curve identifies a requirement in terms of methionine passing the duodenum (equivalent to 2·1 g/d for a 50 kg sheep). Similar experiments with lysine showed that plasma lysine concentration increased linearly with increasing passage of lysine in the duodenum over the whole range of infusion, in agreement with the assumption that lysine was not limiting under the imposed experimental conditions (lysine requirements are therefore less than 5·0 g/d).

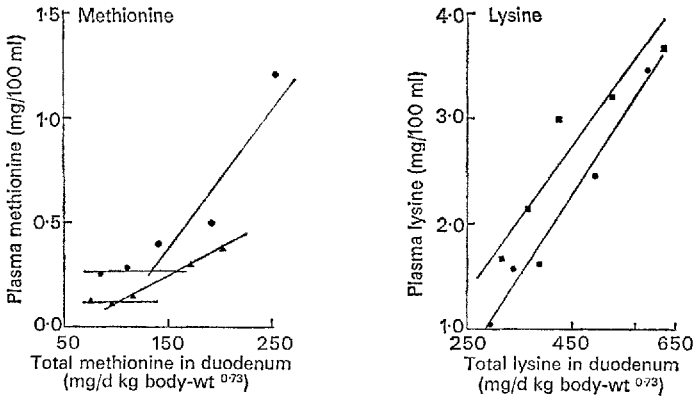

Fig. 1. Response of plasma methionine and lysine to increasing passage of methionine and lysine in the duodenum of the sheep. ●–●, Sheep 39; ▲–▲, Sheep 23; ■–■, Sheep 38.

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Relation between rumen fermentation and milk fat secretion in cows given low-roughage rations. By J. D. SUTTON, *National Institute for Research in Dairying, Shinfield, Reading RG2 9AT*

Substitution of starchy concentrates for much of the hay in the normal ration for dairy cows often causes severe falls in the secretion of milk fat. However, the amount of starchy concentrates needed to induce this change varies with different cows.

To examine the cause of this variation, the daily ration for four lactating, Friesian cows, each with a rumen fistula, was changed over 3 weeks from 8 kg hay and 10 kg dairy concentrates to 1 kg hay, 6 kg dairy concentrates and 4 kg flaked maize. The percentage of milk fat was severely depressed in only two of the four cows (Table 1).

Table 1. *Milk fat percentage and molar proportions of volatile fatty acids (VFA) in the rumen of cows given normal or low-roughage rations*

Cow	Rumen VFA (molar %) Acetic	Propionic	n-Butyric	Milk fat (%)
	8 kg hay:10 kg concentrates			
All cows (mean)	64·1	17·2	15·3	3·6
	1 kg hay:6 kg concentrates:4 kg maize			
G-9	52·3	30·1	11·4	1·5
B-20	47·9	36·5	8·6	1·6
G-10	53·3	19·5	22·3	3·3
G-27	52·8	21·5	20·6	4·1

On the low-roughage ration, the molar proportion of acetic acid in the rumen was reduced and that of propionic acid was increased in all the cows. However, the increase in propionic acid was much greater in those cows in which milk fat percentage was severely depressed and was accompanied by a reduction in the proportion of butyric acid whereas in the cows maintaining milk fat above 3·0% the proportion of butyric acid was markedly increased.

More flaked maize was substituted for dairy concentrates in the rations of cows G-10 and G-27 until milk fat percentage was below 2·0. At this stage, cow G-10 was receiving 1:1:9 and cow G-27 1:5:5 kg/d of hay, concentrates and flaked maize respectively. The molar proportions of acetic, propionic and n-butyric acids respectively were 61·4, 25·5 and 7·5 for cow G-10, and 45·2, 40·4 and 8·4 for cow G-27. Thus, in all the cows the severe depression in milk fat secretion only occurred when propionic acid was increased and n-butyric acid was decreased. The proportion of acetic acid was less closely related to the milk fat percentage than were the proportions of propionic or butyric acids.

The results confirm the previous observations of the close relationship of milk fat secretion to rumen volatile fatty acid proportions (Storry & Rook, 1966) and the wide variation in those proportions on low-roughage rations (Sutton & Johnson, 1969). They demonstrate that the extent of the milk fat depression on low-roughage rations can be closely related to the variation in rumen fermentation.

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Replacement of sucrose by dried glucose syrup in the diet of rats susceptible to dental caries. By T. H. GRENBY, *Department of Oral Medicine and Pathology, Guy's Hospital, London, SE1*

Of a wide variety of carbohydrates tested in the diets of laboratory rodents, sucrose gives rise to the most dental caries. Trials are in hand on the replacement of sucrose in foods by other sweetening agents or carbohydrates, such as glucose syrup BPC (dextrose equivalent 41). This is a partial hydrolysate of maize starch containing (dry weight) 19·3% dextrose, 14·3% maltose, and 66·4% tri- and higher saccharides. It was spray-dried as a powder for comparison with sucrose (as castor sugar) in this work.

The diets were in the form of dry powders, and contained 32% skim-milk powder, 2% dried liver powder and 66% sucrose or dried glucose syrup. They were fed *ad lib.* to rats for 8 weeks from weaning, then the mandibular molar teeth were examined for dental caries and a 'caries score' was compiled for each rat, taking into account the incidence and severity of the carious lesions.

A total of eighty-six rats were used in two separate experiments, and divided into groups matched as evenly as possible for sex and litter. The rats were drawn from two distinct strains whose susceptibility to caries differed. In the more severely afflicted Osborne–Mendel strain, the mean caries scores were (with numbers of rats):

Expt 1 sucrose 15·4 (10); glucose syrup 16·6 (11).

Expt 2 sucrose 24·4 (16); glucose syrup 23·3 (12).

The corresponding figures for the more resistant Wistar strain were:

Expt 1 sucrose 8·2 (11); glucose syrup 10·9 (11).

Expt 2 sucrose 14·8 (8); glucose syrup 14·4 (7).

In both experiments and in both strains of rats, the differences in caries scores between the sucrose and glucose syrup diets were not statistically significant ($P > 10\%$ in all cases). The distribution of the carious lesions, mainly in the occlusal fissures of the molars, was similar on both diets.

These results suggest that replacing sucrose in foodstuffs by glucose syrup may not reduce the level of fissure caries, but it should be observed that in this work the glucose syrup was in a spray-dried (solid) form, and not in the usual solution form in which it is more often incorporated into foods and beverages.

I am grateful to Beecham Foods (UK), Ltd for supplying the glucose syrup, and to Mrs F. M. Paterson for her help.

Tissue lipogenesis in rats fed different carbohydrates. By D. J. NAISMITH and N. A. KHAN, *Department of Nutrition, Queen Elizabeth College, London, W8*

Measurements of the activities of enzymes involved in the synthesis of fatty acids in the rat indicate that a high-sucrose diet enhances lipogenesis in the liver and depresses lipogenesis in the adipose tissue (Naismith & Rana, unpublished results). The present experiments, using isotopically-labelled glucose and fructose, confirm

that the substitution of sucrose for starch in the diet brings about a change in the site of fat synthesis in the body which is conducive to hyperlipidaemia.

Groups of eight rats were fed, for 50 d, diets containing 68% of starch, sucrose, maltose, fructose or glucose. 10 μCi of uniformly labelled [^{14}C]glucose or [^{14}C]-fructose were then administered intraperitoneally to each rat in the fed state and specific activities of the tissue lipids were measured after 2 h.

The monosaccharides and disaccharides, when compared with starch, included a large and significant increase in the plasma triglyceride and cholesterol concentrations, the rise in cholesterol being confined to the esterified fraction.

With both tracers, the specific activities of the plasma lipids of rats fed sucrose were double those of rats fed starch. Likewise, sucrose feeding doubled the rate of incorporation of the labelled sugars into liver triglycerides and raised the rate of incorporation into esterified cholesterol by 50%. In the adipose tissue, the pattern was reversed; the specific activity of the triglycerides from sucrose-fed rats, following the injection of [^{14}C] glucose, was less than half the value found for rats maintained on the starch diet.

Approximately 90% of the radioactivity of the triglycerides in plasma, liver and adipose tissue was located in the fatty acids, labelled fructose giving the same results as labelled glucose.

Feeding maltose or glucose gave values for specific activities of plasma and liver lipids which were very similar to those produced by sucrose-feeding (i.e. twice the values found with starch), while fructose-feeding gave values approximately four times as great as those found with starch.

These differences in the rates of incorporation of labelled-glucose or fructose into the tissue lipids resulting from the prolonged ingestion of different carbohydrates reflect precisely the activities of the key enzymes which regulate lipid synthesis.

Differences in the throughput of triglycerides in the plasma of rats fed various carbohydrates. By D. J. NAISMITH and N. A. KHAN, *Department of Nutrition, Queen Elizabeth College, London, W8*

A study of 'meal tolerance' curves in rats maintained on diets containing sucrose, maltose, fructose or glucose has shown that these sugars are digested and absorbed much more rapidly than is starch. The flow of monosaccharides at relatively high concentrations from the intestinal tract into the liver induces a rise in the activities of enzymes involved in lipogenesis (Naismith & Rana, unpublished results) and, *pari passu*, an increased rate of incorporation of isotopically-labelled monosaccharides into liver lipids (Naismith & Khan, 1970).

The discovery that the detergent Triton WR1339 abolishes the action of the plasma-clearing enzyme, lipoprotein lipase (Byers & Friedman, 1960), offered a means of studying the throughput of triglycerides in the plasma during the ingestion of different carbohydrates.

Groups of eight rats were fed, for 7 weeks, diets containing 68% of starch, sucrose, maltose, fructose or glucose. Fasting blood samples were then taken, Triton was injected intraperitoneally, and the animals were allowed to consume their customary diets for a further 24 h before killing by exsanguination. The fasting and final blood samples were analysed for lipids and for Triton. The results were as follows:

Dietary carbohydrate	Plasma lipids (mg/100 ml)				Plasma Triton (mg/100 ml)
	Pre-Triton		Post-Triton		
	Triglycerides	Cholesterol	Triglycerides	Cholesterol	
Starch	46	129	1177	526	11·0
Sucrose	79	151	2453	884	11·1
Maltose	73	153	2615	988	10·8
Glucose	78	130	2022	639	10·7
Fructose	87	153	5049	966	11·1

Triton administration did not influence food consumption.

The experiment demonstrates that the consumption of simple sugars gives rise to a great increase in the flow of triglycerides from the liver to the adipose tissue.

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