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ABSTRACTS OF COMMUNICATIONS

The One Hundred and Seventy-Sixth Meeting of The Nutrition Society was held in the new Nuffield Institute of Comparative Medicine, London, NW 1, on Friday, 3 December 1965 at 10.30 am, when the following papers were read :

Dietary sucrose and glucose as a source of serum lipid. By I. MACDONALD and J. B. ROBERTS, *Department of Physiology, Guy's Hospital Medical School, London, SE 1*

Six healthy adult male baboons, weighing approximately 10 kg were fasted for 10 h, and then given, intragastrically, a carbohydrate load of 4 g per kg body-weight of glucose or sucrose, containing 25 μC of the respective uniformly labelled ^{14}C isotope. As a control water only was given.

Blood samples were taken at half-hourly intervals up to 3 h and then at hourly intervals until 5 h. The serums were analysed for the concentration of various lipid fractions, and the radioactivity in these fractions was measured.

Over the 5 h period the level of total serum lipid showed little change. The radioactivity in the total serum lipid was similar for the glucose and sucrose experiments.

In all experiments the sterol and free cholesterol fractions showed no change and only a trace of radioactivity could be detected in these fractions. The phospholipid concentration tended to fall. There was no difference in the radioactivity of this fraction between glucose or sucrose-fed animals.

The concentration of serum glycerides rose during the first 2½ h after the administration of sucrose, whereas following glucose ingestion there was a steady fall in this fraction. In the control experiment the concentration of serum glycerides rose continuously, but at the end of 2½ h was significantly less than it was in the sucrose experiment.

The amount of radioactivity in the glycerides was significantly higher after sucrose than after glucose.

We are grateful to the British Heart Foundation for a research grant.

A relationship between carbohydrate tolerance and serum lipid concentrations in healthy young men. By J. N. CROSSLEY and ALICJA ROZANSKA (introduced by I. MACDONALD), *Department of Physiology, Guy's Hospital Medical School, London, SE 1*

It has been shown that when healthy young men eat a low-fat diet enriched with either sucrose, glucose or starch, there are marked changes in the concentrations

of lipids in the serum characteristic of each dietary carbohydrate (Macdonald, 1965). The effect that a particular dietary carbohydrate has on lipogenesis could depend not only on the nature of the end-products of its digestion but on the rate of their absorption. As lipids of the serum are derived in part from glucose in the blood, one of the means by which glucose, sucrose and starch could differ in their effect on lipid metabolism is by producing different increases in concentration of glucose for different periods of time.

The influence that this factor has on lipid metabolism has been studied by correlating the carbohydrate tolerance of healthy young men with their fasting serum lipid concentrations.

After a 12 h fast ten volunteers, aged 21–33 years, were given a single dose of 2 g/kg body-weight of either glucose, starch or sucrose. Venous blood was taken when fasting and then half-hourly until 2½ h after the meal for estimations of lipids and glucose in the serum. Lipids were estimated by a gravimetric method following fractionation by thin-layer chromatography. Glucose was estimated by a glucose oxidase method.

An index was derived for each subject expressing both the absolute increase in serum glucose concentration above his mean fasting level, and the length of time for which this increase persisted after each carbohydrate meal. From this the carbohydrate tolerance of each subject could be assessed.

Spearman rank-correlation testing revealed a significant ($P < 0.01$) correlation between the carbohydrate tolerance of the subjects and the mean fasting concentrations of their serum cholesterol, glyceride and phospholipid fractions. Although the increase in serum glucose after a sucrose meal was neither as great as when glucose was given, nor as prolonged as when starch was given, a more significant correlation was observed between the serum glucose response after a sucrose meal and the concentrations of lipid in the serum.

We wish to thank Guy's Hospital Endowment Fund for a research grant. We are particularly grateful to the volunteers.

REFERENCE

Macdonald, I. (1965). *Clin. Sci.* **29**, 193.

Dietary fructose and serum lipid levels in man. By I. MACDONALD, *Department of Physiology, Guy's Hospital Medical School, London, SE 1*

Previous work has suggested that differences in the lipid response to various dietary carbohydrates may be due, in part, to the fact that dietary fructose is metabolized differently from dietary glucose (Macdonald, 1965a).

To test this hypothesis a fat-free diet was devised in which the daily protein intake was 50 g calcium caseinate with 7 g/kg body-weight per 24 h of a carbohydrate mixture. Three carbohydrate mixtures were used: (1) 40% fructose: 60% starch, (2) 40% glucose: 60% starch, (3) 40% fructose: 60% glucose. Any mixture containing a greater proportion of fructose was liable to cause diarrhoea.

The subjects were healthy volunteers, five men aged 21–28 years, six women aged 21–30 years and three women aged 58–68 years. Each subject was given each of the three carbohydrate diets for 5 days and blood was obtained after a 10 h fast on day 0, 2, 4 and 5 of each dietary period. The serum lipids were analysed by methods previously described (Macdonald, 1965*a*). Results were expressed as a percentage change from the value obtained at day 0 for each subject.

Results showed that dietary fructose had a different effect on the serum glycerides from dietary glucose. The previous findings that dietary sucrose had a different effect on the lipid metabolism of pre-menopausal women when compared with post-menopausal women (Macdonald, 1965*b*, 1966) were confirmed in this study. Fructose caused a significant elevation of the serum glycerides in the men and the older women, but caused a significant fall in the serum glycerides of the young women.

The change in the serum lipids during the fructose: starch diet was not the same as that during the fructose: glucose diet. This indicates that glucose and starch are not equivalent in this context even though starch is usually thought to be broken down to glucose.

I am most grateful to the volunteers in these experiments, especially the Sisters of the Notre Dame Convent, St George's Road, London, SE 1. I also wish to thank Beecham Food & Drink Division Ltd and Glaxo Research Ltd for assistance.

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Dietary carotene and the metabolic rate of the dairy cow. By F. E. MOON, P. MUNRO and H. R. FERNS, *The West of Scotland Agricultural College, Auchincruive, Ayr*

Owen, Darroch & Proudfoot (1963) reported that carotene given to goats previously deprived of dietary vitamin A may have an antithyroid effect, so Ayrshire cows with depleted vitamin A reserves were fed (a) cut grass, (b) 4 g carotene daily as 'water-soluble' beadlets containing 15% colloidal carotene (Roche Products Ltd), or (c) grazed grass. The results in the table indicate the low initial level of vitamin A and the responses to carotene and grass.

Increases in heart rates and decreases in milk phosphatase show a marked thyroid stimulation from outdoor grazing but not from indoor feeding of cut grass, so the stimulation is not due to carotene. The small depressions in heart rates during indoor grass feeding were due to inadequate food consumption and disappeared when the grass dry-matter was increased from 6–8 lb daily to 10–12 lb daily. Supplementation of the diet with carotene had no effect on heart rates or milk phosphatase.

Effects of foods providing carotene on the heart rates of cows with depleted vitamin A reserves and on the milk vitamin A and phosphatase levels

Duration of treatment (days)	Feed treatments			Feed treatments			
	(a) Basal ration	(b) Cut grass	(c) Grazed grass	(a) Basal ration	(b) Carotene supplement	(c) Grazed grass	
	9	18	11	11-14	13-23	4-11	
	Heart rates (beats/min)						
Cow				Cow			
1	46.6 (b,c)	41.9 (a,c)	64.6 (a,b)	6	65.1 (b,c)	68.9 (a,c)	73.5 (a,b)
2	48.7 (b,c)	46.0 (a,c)	64.3 (a,b)	8	52.6 (c)	52.8 (c)	63.3 (a,b)
4	52.3 (b,c)	48.6 (a,c)	70.6 (a,b)	9	56.6 (c)	55.2 (c)	74.9 (a,b)
	Milk vitamin A ($\mu\text{g}/100\text{ ml}$)						
1	3.9	24.4	31.2	6	3.6	35.7	36.5
2	10.6	40.7	37.2	8	7.3	30.7	36.5
4	6.8	33.3	37.1	9	6.4	48.8	40.4
	Milk phosphatase (μg <i>p</i> -nitrophenol liberated/ml milk in 10 min)						
1	91.3 (c)	88.8 (c)	60.0 (a,b)	6	63.2 (c)	57.2 (c)	45.4 (a,b)
2	209.8 (c)	195.4 (c)	120.3 (a,b)	8	47.0	50.1 (c*)	36.0 (b*)
4	79.0 (c)	73.9 (c*)	59.0 (a,b*)	9	33.0 (c*)	29.7 (c*)	22.3 (a*,b*)

A suffix letter to any value indicates significant difference from the corresponding value for the feed treatment designated by that letter. An asterisk indicates significance at a probability level between 1% and 5%; in other cases the probability is less than 1%.

REFERENCE

Owen, E. C., Darroch, R. A. & Proudfoot, R. (1963). *Proc. Nutr. Soc.* **22**, xv.

Effects of raw soya-bean meal on germ-free and conventional chicks. By W. S. MILLER and M. E. COATES, *National Institute for Research in Dairying, Shinfield, Reading*

Chicks and rats given diets containing raw soya-bean meal grow poorly and develop pancreatic hypertrophy; these effects have been attributed to trypsin inhibitors that are inactivated by heat treatment. Reports that antibiotic supplementation of the diet may partially overcome the growth depression in rats, chicks and poults (Braham, Bird & Baumann, 1959; Linerode, Waibel & Pomeroy, 1961) suggest that the gut microflora may be associated with the harmful effects of the raw meal. In this laboratory supplementation of diets containing raw or heated soya-bean meals with 1000 ppm procaine penicillin produced slightly, though not significantly, greater growth increments in chicks given the raw meal.

Two experiments were conducted to compare the effects of raw or heated soya-bean meals on germ-free and conventional chicks after preliminary tests had shown that the growth-depressing effect of raw meal was not destroyed by the γ -irradiation procedure used to sterilize the diets. In the first, raw and heated commercial meals were incorporated at a level of 34.5% in a cereal basal diet; twenty-nine chicks were started on each treatment. In the second, the heated sample was prepared by autoclaving the raw meal for 15 min at 15 lb. Each was incorporated at a level of 50%

as the sole protein source in a purified basal diet supplemented with methionine and glycine; fifteen chicks were started on each treatment. The mean body-weight (g) of the surviving chicks (number in parentheses) and pancreas weights (g/100 g body-weight) at 3 weeks of age were as follows:

	Expt 1				Expt 2			
	Germ-free		Conventional		Germ-free		Conventional	
	Body- wt	Pancreas wt	Body- wt	Pancreas wt	Body- wt	Pancreas wt	Body- wt	Pancreas wt
Raw meal	194(28)	0.72	149(28)	0.79	186(13)	0.82	122(11)	0.84
Heated meal	210(29)	0.40	209(29)	0.48	238(15)	0.34	212(15)	0.31

In both experiments the growth-depressing effect of raw soya was significantly greater ($P < 0.01$ in the first and $P < 0.05$ in the second) in conventional compared with germ-free chicks, but the pancreatic hypertrophy was similar in both. Thus the hypertrophic effect of raw soya-bean on the pancreas and part of its growth-depressing effect, which may or may not be correlated, are independent of the presence of micro-organisms. However, since the raw meal allowed much poorer growth in conventional chicks the gut microflora must play an important role in increasing its growth-depressing action.

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Housewives' beliefs concerning past and future food trends. By C. W. GOLBY and J. C. MCKENZIE, *Department of Nutrition, Queen Elizabeth College, London, W 8*

As a continuation of our previous studies we have investigated the attitude of British housewives towards some aspects of food and nutrition. One thousand and fifty-four housewives were interviewed. Quota controls were set for age, social class and area.

First we asked in what way they thought they had changed their food habits over the past 10 years and in what ways they expected further changes in the future. Chicken, butter, eggs and coffee were most frequently mentioned as the foods they were increasingly consuming; the first three together with meat were also thought to be the foods they would consume more of in the future. Foods that were said to have decreased were bread, potatoes, jam and cake and these were expected to decrease still further. When compared with the trends shown by the Domestic Food Consumption Tables, the results indicate that housewives have a fairly accurate idea of the ways in which food habits are changing.

Housewives were then asked which foods they would increasingly consume if more money were available. More than half mentioned meat and this was followed by chicken, apples and oranges. Conversely these foods, after chocolate and cakes, were seen as the foods they would cut down on when money was short.

When asked which foods they thought would it be difficult to do without for a month or two butter, milk, tea, meat, eggs and sugar were most frequently indicated. On the other hand over half felt they should eat less potatoes for health reasons, and many others mentioned cakes and bread, chocolates and sugar.

Eighteen % of housewives had a member of their family on a diet at the present time. Nearly half of these were to do with slimming and a quarter with ulcers. Most of the people slimming were women and most of the people with ulcers were men.

We acknowledge with thanks the support of the Westminster Research Bureau Limited who undertook the field work for us at a nominal cost.

The effect of changing environmental temperature on the urinary nitrogen excretion of young pigs. By M. F. FULLER*, *Department of Veterinary Clinical Studies, University of Cambridge*

Four litter-mate Landrace pigs were weaned at 3 days of age and reared at 30° until they were 14 days old. They were castrated at 10 days of age and after the 14th day were kept for 4 successive 15-day periods in metabolism cages in rooms at 10° or 30°, being transferred from one to the other according to the plan shown in the table. They were fed, *ad lib.*, a 22% protein diet (Amvilac no 2; Glaxo Research Ltd), the consumption of which was recorded. Urinary nitrogen excretion was determined in twenty successive 3-day subperiods.

After a change from 30° to 10° food consumption per kg^{0.73} always increased, but maximum intakes were not reached for about 7 days following the cooling.

When all the values of urinary N excretion were plotted against their corresponding values of N intake (excluding pig B, days 61-75), there was no evidence of any

Days	Temperature (°C)	Mean wt (kg)	Food intake (g/kg ^{0.73} day)	Temperature (°C)	Mean wt (kg)	Food intake (g/kg ^{0.73} day)
Fig A				Fig B		
15-30	10	6.2	154	10	5.8	154
31-45	30	11.9	105	10	11.1	140
46-60	10	21.2	179	10	17.7	147
61-75	10	33.6	157	30	19.6	Nil
Fig C				Fig D		
15-30	30	5.7	126	30	6.7	132
31-45	30	11.5	106	10	13.3	156
46-60	30	18.8	113	30	21.8	135
61-75	10	27.0	137	30	29.9	102

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consistent effect of temperature on the relationship between the two, and all the data together could be fitted by the equation.

$$\text{Log}_{10} N_U = 4.1 \text{ log}_{10} N_I - 0.85 (\text{log}_{10} N_I)^2 - 3.07,$$

with $\text{RSD} = \pm 0.076$, where N_U and N_I represent, respectively, urinary excretion and dietary intake in g N/day.

The author is grateful to the Pig Industry Development Authority for a scholarship and to Miss C. Jones for technical assistance.

Meat diets for rats. By T. MOORE*, *Dunn Nutritional Laboratory, University of Cambridge and Medical Research Council*

(1) *The absorption of copper from raw and cooked beef.* In continuation of previous work (Moore, 1964) rats fed upon raw minced meat (beefsteak) developed signs of copper deficiency as shown by severe anaemia (mean Hb 6.1%), advanced hypochromotrichia, and dental depigmentation. Rats fed upon autoclaved meat were not anaemic (Hb 12.8%); hypochromotrichia and partial dental depigmentation were developed in only about half the animals. Chemical analyses of the Cu contents of the livers gave means of 1.22 $\mu\text{g/g}$ for twelve rats that received raw meat, and 2.28 $\mu\text{g/g}$ for eleven rats that received autoclaved meat. It appears therefore that Cu is better absorbed from cooked than from raw meat. The cooking of the meat had no appreciable effect on the skeletal abnormalities caused by the low calcium content of the meat diet.

(2) *Cuprophagy in meat-fed rats.* One rat, out of many used in similar experiments, failed to become anaemic when fed upon raw meat. An explanation was found in an irregularity in the construction of its cage. Cu wire, instead of the usual galvanized iron, had been used for the attachment of the label holder. A considerable quantity of metallic Cu had been gnawed away. Another meat-fed rat was given access to Cu wire intentionally. Over a period of 11 weeks a total of 112 mg of Cu was consumed, as measured by the loss of weight of the wire. Anaemia was prevented (Hb 16.9%), but from the persistence of patchy hypochromotrichia and partial dental depigmentation it appeared that Cu is less well absorbed as metal than as CuSO_4 .

(3) *The dietary defects of corned beef.* A diet of raw minced beef, supplemented by Ca, Cu and fat-soluble vitamins, is even more effective than an ordinary stock diet in promoting rapid growth in young rats. A diet of corned beef, however, was found to promote only slow growth when given to rats with the same supplements. The difference between raw and corned meat could be made up partially by adding meat extract to the corned beef, or completely by adding a mixture of B vitamins. Subsequently it was found that thiamine (3 mg/kg meat) was completely effective without the addition of other B vitamins.

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My thanks are due to Dr I. M. Sharman, Mr J. C. Hanlon and Mr S. G. Impey for help in various parts of this work.

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The effect of heat on defatted groundnut flour. By A. A. WOODHAM and R. DAWSON, *Rowett Research Institute, Bucksburn, Aberdeen*

Groundnut kernels were hand-skinned, coarsely ground, thoroughly extracted in the cold with diethyl ether and dried at room temperature to yield defatted groundnut flour (DGF). Batches were subjected to dry heating in a forced draught oven or to steam heating in an autoclave under different conditions of time and temperature so that a progressive decrease in the quantity of salt-soluble protein resulted. Fractions corresponding to arachin and conarachin in the unheated meal were obtained from the heated samples by successive treatment of a 10% (w/v) NaCl extract with 40% (w/v) ammonium sulphate followed by trichloroacetic acid at 10% (w/v).

'Available lysine' (ALV) was measured by the fluoro-2: 4-dinitrobenzene (FDNB) method (Carpenter, 1960) in the various DGF samples as well as in the isolated protein fractions. Trypsin inhibitor activity was measured by a modification of the method of Anson (1939) and some of the samples were evaluated by the gross protein value (GPV) method (Duckworth, Woodham & McDonald, 1961).

The effect of heat on defatted groundnut flour (DGF)

Treatment	GPV (casein = 100)	NaCl- soluble fraction (% of total protein)	'Arachin' fraction (% of total protein)	'Conarachin' fraction (% of total protein)	Trypsin inhibitor units/ml extract $\times 10^{-3}$	ALV (g/16 g N)
Unheated DGF	48	95.3	67.0	18.0	26	2.91
Dry heat:						
125°/½ h	47	93.4	69.1	17.6	18, 9	2.91
125°/5 h	32	90.0	64.8	3.9	1.6, 2, 3.5	2.64
150°/1 h	10	6.7	2.6	2.3	0.75	1.53
Unheated DGF	48	95.3	67.0	18.0	26	2.91
Moist heat:						
108°/¼ h	47	84.4	67.0	16.4	0	2.89
108°/¾ h	50	70.3	56.2	6.6	0	2.58
108°/5 h	NI	5.0	0	0	0	2.15

NI, no information.

GPV fell progressively on dry heating and so did trypsin inhibitor activity and the isolated protein fractions expressed as a percentage of the total protein. A very rapid destruction of trypsin inhibitor activity occurred in the moist heated samples and the proportions of isolated protein fractions fell: the GPV was not however affected. Both 'moist' and 'dry' heating progressively lowered the ALV of the DGF.

The results suggest that the rapid destruction of trypsin inhibitor in the moist heated samples is balanced by the fall in ALV resulting in unchanged GPV, while

in the dry heated samples the slower destruction of the inhibitor fails to compensate for falling ALV.

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Changes due to heating of defatted groundnut flour on the composition of a protein fraction. By R. DAWSON and A. A. WOODHAM, *Rowett Research Institute, Bucksburn, Aberdeen*

Samples of a defatted groundnut flour prepared in the laboratory were subjected to various heat treatments and protein fractions were isolated as described in the preceding communication. The 'conarachin' fractions were hydrolysed by refluxing in 6 N-HCl for 18 h and amino acids were determined in aliquots of the hydrolysates by the ion-exchange chromatographic technique of Moore, Spackman & Stein (1958). Cystine was determined as cysteic acid by the method of Moore (1963). Tryptophan was not determined.

Amino acid composition (g/16 g N) of the 'conarachin' extracted from defatted groundnut flour subjected to various heat treatments
 (Means of duplicate determinations)

	Unheated	125°/0.5 h	125°/5 h	150°/1 h
Aspartic acid	10.63	10.20	11.09	10.40
Threonine	2.48	2.18	1.89	1.23
Serine	4.65	4.35	4.50	4.30
Glutamic acid	17.97	18.28	21.11	21.25
Proline	4.10	3.54	3.38	3.10
Glycine	3.68	3.50	3.72	4.61
Alanine	2.88	2.70	2.06	1.39
Valine	4.36	3.84	3.03	1.68
Cystine	1.43	1.78	3.60	4.11
Methionine	2.05	2.39	3.17	1.53
Isoleucine	3.29	2.92	2.33	2.10
Leucine	5.49	5.13	5.11	5.20
Tyrosine	2.28	1.79	2.08	2.78
Phenylalanine	3.88	3.13	2.49	2.23
Lysine	4.65	3.67	2.84	1.49
Histidine	2.07	1.74	1.55	1.41
Arginine	11.25	11.10	13.53	13.80
NH ₃	3.11	4.07	2.52	2.56
	87.14	86.31	88.11	85.17

The results given in the table show quite marked differences in the amino acid compositions of the various 'conarachin' fractions. The concentrations of threonine, proline, alanine, valine, isoleucine, phenylalanine, lysine and histidine decreased with increase in the severity of the heat treatment but several of the remaining amino acids increased in concentration with increasing severity of heat treatment, the most marked increase being shown by cystine. The concentration of methionine was maximal when the flour had been heated at 125° for 5 h.

It was shown in the previous paper that the 'conarachin' fraction decreased in amount with increase in the severity of the heat treatment and the results reported here could be explained by postulating that either those amino acids which increase in concentration following heat treatment are less heat-labile than those which decrease in concentration or that a component of the 'conarachin' fraction rich in these amino acids is more stable to heat treatment than the remaining components of the fraction.

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Moore, S., Spackman, D. H. & Stein, W. H. (1958). *Analyt. Chem.* **30**, 1185.

Metabolism of riboflavine. By E. C. OWEN, R. PROUDFOOT and D. W. WEST,
Biochemistry Department, Hannah Dairy Research Institute, Ayr

Doses of riboflavine produce metabolites in the milk and urine of the goat (Crossland, Owen & Proudfoot, 1958). Of these RM_I which is very similar to ethanoflavine (6,7-dimethyl-9-(2-hydroxymethyl)-isoalloxazine) (Stadtman, 1958; Owen, 1962) is the most abundant. Incubation of beef kidney, beef liver, kid kidney or kid liver with riboflavine (Owen & Dzialoszynski, 1965*a*) does not produce RM_I. Incubation of rumen contents for less than 48 h does not produce RM_I from added riboflavine and it is known that only in the first few hours do the rumen flora and fauna recognizably resemble those of fresh rumen contents; neither does incubation of faeces of cow or goat with riboflavine give RM_I. Since the newborn milk-fed kid does not have a microbial type of digestion in its rumen, we studied the fate of riboflavine in two young kids which initially had neither riboflavine nor RM_I in their urine. The kids were each given 1 g riboflavine in their milk at noon. Collections of urine made 11, 21, 26, 36 and 45 h later all contained riboflavine in amounts which gave strongly u.v.-fluorescent spots on paper chromatograms. RM_I was strongly evident at 45, less at 36 and even less at 21 h collections. At 11 and 26 h it was not seen at all. Yellow-fluorescent metabolites of R_F less than riboflavine were seen at 11, 36 and 45 h in both kids and 21 h in one of them. Thus there was a periodicity in the excretion of the metabolites such that the metabolism of the kid resembled that of the adult goat at some times and at others resembled that of dog or man (Owen & Dzialoszynski 1965*a,b*). In spite of our failure to find RM_I in fresh rumen contents, even in samples taken from a fistula into the rumen of a goat which was giving abundant RM_I in its urine, we still believed it to be a product of the animals' symbionts so, after giving an older kid riboflavine, we examined the caecum which is a capacious part of the ruminant's gut and is a known site of microbial activity. We found RM_I on the chromatograms. We are now examining the fate of riboflavine in the rabbit which has no analogue of the rumen but has a caecum which is by far the most capacious part of its gut and is known to function cyclically.

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Riboflavine metabolism in the newborn kid. By E. C. OWEN, R. PROUDFOOT and D. W. WEST, *Biochemistry Department, Hannah Dairy Research Institute, Ayr*

In the urine of newborn kids we found neither riboflavine or any other material fluorescing yellow in u.v. light (Owen, Proudfoot & West, 1966). When such a kid receives 1 g riboflavine in its milk the metabolites of riboflavine appear, but the ratio of RM₁ to riboflavine is less than would be expected from the results of similar experiments with adult goats. In some samples of a kid's urine, in which riboflavine was plainly evident, RM₁ did not appear at all. We therefore tested the power of the kid to excrete RM₁ by feeding two kids on their dam's milk after the dam had received a 5 g dose of riboflavine. The dam's milk was bright yellow from the presence of excess riboflavine and its metabolites. Paper chromatograms of the dam's milk and urine showed the expected pattern of metabolites and the kids' urines showed, as strongly fluorescent spots, riboflavine, RM₁ and metabolites of R_F less than that of riboflavine.

The results and those in our previous reports favour the hypothesis that RM₁, 2 and 3 are symbiotic products.

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Owen, E. C., Proudfoot, R. & West, D. W. (1966). *Proc. Nutr. Soc.* **25**, x.

Laboratory studies on grass composition and the quality of vacuum preserved silage. By D. I. H. JONES, *Welsh Plant Breeding Station, Aberystwyth*

Considerable interest has been recently shown in the making of vacuum silage. In this technique the grass is enclosed and sealed in a thin Polythene sheet and the air removed by evacuation using a suitable pump. Apart from excluding air, this evacuation also results in considerable compression of the stack. It was felt that these conditions could be satisfactorily reproduced on a laboratory scale using Polythene bags.

The technique used has been to place 250 g of chopped grass into a 12 × 8 in Polythene bag fitted with a valve. The open end is then sealed by folding over a glass rod and clipping the Polythene to the glass by means of a split semi-rigid Polythene tube. The bags are then evacuated using a water suction pump.

Good-quality silage has been prepared using this technique, the pH falling to around 4 in a few days. In preliminary studies the quality of silage produced from grasses subjected to different levels of nitrogen fertilizer is being assessed together with the effect of adding sucrose to low soluble carbohydrate grasses prior to ensilage.

Table 1 gives the pH and lactic acid content of silages produced from some grasses of different water-soluble carbohydrate content. In these the fermentation was allowed to proceed for 2–3 weeks before the bags were opened.

Table 1. *Composition of experimental silages*

Grass	pH	Lactic acid (% of dry matter)
Perennial ryegrass -N (19.8% soluble carbohydrate)	4.0	14.9
Perennial ryegrass +N (13.8% soluble carbohydrate)	4.2	11.3
Cocksfoot (7.8% soluble carbohydrate)	4.5	4.8
Cocksfoot + 10 g sucrose	4.0	9.4

The two samples of perennial ryegrass were grown with (+N) and without (-N) nitrogen fertilizer. Both the perennial ryegrass samples showed a high soluble-carbohydrate content and produced good-quality silages, the cocksfoot was low in soluble carbohydrate and the silage showed a high pH and had a slightly unpleasant smell. These results are similar to those of Wilson & Tilley (1964) who report that grasses of low soluble-carbohydrate content tended to produce a high pH silage.

The technique described allows a large number of silages to be studied at the same time and further work is in progress to study in more detail the significance of soluble carbohydrate level in relation to silage quality.

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Assessment of sugar intake: methods and implications. By JOHN YUDKIN and JANET RODDY, *Department of Nutrition, Queen Elizabeth College, London, W 8*

We have recently presented evidence that subjects suffering from myocardial infarction or from peripheral arterial disease have been taking a greater amount of sugar than control subjects (Yudkin & Roddy, 1964). One of the criticisms of our work was that the questionnaire method that we used to assess sugar intake is inadequate, and that only something like a 7-day weighed record can be accepted as an adequate method of assessing dietary components. A reply to this criticism on theoretical grounds has been published (Yudkin, 1964), and we now present experimental evidence to validate our method.

We have measured sugar intake in twenty-three individuals both by a 7-day record (with household measures) and by our questionnaire. We found a very highly significant correlation between the two methods ($r=0.75$, $P<0.0001$). This is a better agreement than has been found for most dietary components measured by the method of 7-day weighed intake on two separate occasions (e.g. Marr, 1965).

The second criticism of our publication on arterial disease and sugar intake is that other workers were not able to confirm our findings (Little, Shanoff, Csima, Redmond & Yano, 1965). In this study the patients had had their attack of coronary thrombosis some months or years before the assessment of their diets; we believe that such patients are likely to have reduced their intake of sugar spontaneously (Yudkin, 1965).

This suggestion has been confirmed. We have re-examined the sugar intake of as many as possible of the subjects of our first study, after an interval of about 18

months. The sugar intake of the control subjects had not changed significantly. That of the subjects with myocardial infarction or peripheral arterial disease showed a significant reduction.

There is no one ideal method for assessing intake. The method that is most suitable depends on the dietary component(s) to be studied, and on the purpose for which the information is required.

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Carbohydrate preference in rats under two conditions of husbandry. By R. H. J. WATSON, *Department of Nutrition, Queen Elizabeth College, London, W 8*

It has been shown previously (Watson, 1964) that rats exhibit marked individual preferences for different forms of carbohydrate. The present experiments investigated the effect of a difference in husbandry on this preference. The difference in husbandry chosen was the difference between animals being housed singly or in pairs.

Previous work on the social facilitation of eating in rats, e.g. Harlow (1932), showed that it occurs when an element of competition is present. Since the carbohydrate preferences to be measured were to be obtained under *ad lib.* feeding conditions, it was first necessary to show that social interaction could affect feeding behaviour when the competitive element was minimal. Otherwise any failure to demonstrate an effect on carbohydrate preference might have been due to the fact that social facilitation did not occur anyway.

First experiment. In addition to investigating the difference in feeding behaviour of rats housed singly or in pairs, the experiment was replicated in two rooms in which other environmental factors were different. Room A had soundproofing, the cages had solid sides, and there was a minimum of disturbance from persons attending to the animals. Room B was not soundproofed, had cages with open sides, and there was disturbance throughout the day from people working with other animals in the room.

Thirty-two male rats aged 40 days were randomly assigned to the following groups:

	Room A	Room B
Housed: Singly	8	8
In pairs	8	8

Animals were maintained on a synthetic diet which together with water was provided *ad lib.* Food intakes and body-weights were measured daily. The results showed that for both rooms those housed in pairs ate more food than those housed singly, and they correspondingly grew faster.

Second experiment. Having established that social facilitation could operate under *ad lib.* feeding conditions, sixteen new male rats aged 40 days were assigned to two groups, eight being housed singly and eight in pairs. In each cage animals were offered a choice of either a diet containing 60% sucrose, or an identical one save that the sucrose was changed to dextrin. Pot positions were randomized to counteract position preferences. Food intakes and body-weights were measured daily. Preliminary results show that rats housed in pairs selected a diet containing a higher percentage of dextrin than those housed singly.

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Diets in Manchester and Dukinfield in 1841. By J. C. MCKENZIE, *Department of Nutrition, Queen Elizabeth College, London, W 8*

As part of our research designed to indicate the various factors influencing food choice, we are examining nineteenth century diets. The present paper is based on a detailed analysis of nineteen working-class families living in Manchester and Dukinfield in 1841 (Neild, 1842).

Flour (mainly in the form of bread) was clearly the staple food; average consumption was 5 lb a week and this accounted for one-third of total food expenditure. It provided 50% of the calories and 40% of the iron and protein in the diet. The weekly consumption of potatoes was 5 lb a head providing some 20% of the calories and protein intake. Potatoes were virtually the only source of vitamin C. The average weekly consumption of meat was only 1 lb, and one family was eating as little as 5 oz a head. However on average meat still took 15% of the money spent on food and provided 25% of the protein and 20% of the iron. Only 7 oz of sugar were consumed a head as against 35 oz today.

It has usually been assumed that in times of hardship people increasingly buy cheap filling foods such as bread and potatoes in preference to more expensive items. However these figures do not substantiate such a picture. The poorer families certainly eat less meat but they still buy some. However they also eat less carbohydrate foods. It seems that in times of hardship the maintenance of the established pattern of intake albeit in smaller quantities was considered of greater significance than a feeling of satiety.

The comparison between nutrient intake and recommended allowances shows that on average the picture was similar to the poorer groups analysed by Boyd-Orr (1936) in the nineteen thirties. The position was however better than that for many of the developing countries today. The main problem concerned the poorer five or six families whose calorie and protein intake was about 20% below the recommended figure.

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The variability of resting energy metabolism in man. By J. V. G. A. DURNIN, M. M. RAHAMAN and A. FERRO-LUZZI, *Institute of Physiology, University of Glasgow and National Institute of Nutrition, University of Rome*

More people now spend more and more of their time sitting at rest or are employed in jobs which permit sitting at work. The rate of metabolism while sitting is frequently the most important measurement to take when assessing total energy expenditure. Yet the variability in any one individual and between individuals in the resting metabolism (in distinction to the 'basal' metabolism) is little known.

The present paper describes measurements of this variability on various groups of healthy men and women when studied under controlled laboratory conditions and in their own natural home surroundings. Three separate investigations were done: (1) the energy expended in sitting quietly in a chair was measured on three young men and three young women in Glasgow at intervals of 2-6 days during a period of 3 months; (2) a comparison between the energy output while sitting quietly in an upright chair and in an armchair was made on twenty-seven young men and twenty-six young women in Rome; (3) from field experiments on various population groups in Scotland, we have extracted the results of the energy expenditure while sitting in their own homes, of seventy-six male and sixty-one female adolescents, nineteen young men and twenty-one young women and seventy-five elderly men and seventy-seven elderly women.

The standard deviation was of the order of 5-10% of the mean for the laboratory studies and about 15-20% of the mean for the field investigations.