0–2 pints per week, twenty-eight gave expense as the reason for not taking more and nine said that they disliked milk.

Thirty-four per cent of those questioned used milk only in beverages or with cereal and their average consumption was 5·3 pints compared with 5·6 pints for those who used milk in cooking as well.

Storage does not seem to be a factor limiting milk consumption. Only five persons gave storage difficulties as a reason for not taking more milk. When asked specifically 117 said that they had storage problems and another 138 had problems in hot weather but the amount of milk consumed was no less than that consumed by people who had no storage problems.

As a very rough guide to their diet subjects were asked to list their daily menus. Fifty-eight subjects (7%) did not mention a main cooked meal and did not receive more than two meals per week from the Meals on Wheels Service or a lunch club.

It is concluded that while a price reduction might possibly result in increased milk consumption it would need to be accompanied by instruction in and encouragement of the use of milk in cooking.

The Two Hundredth Meeting of The Nutrition Society was held at the Royal Society of Medicine, 1 Wimpole Street, London, W1, on Friday, 17 May 1968, at 10.30 h, when the following papers were read:

Suggested new nutritional energy units. By J. W. Lucas, *Radiation Protection Service, Manchester University* and F. Wokes, *VNRC, Garston, Watford, Herts*

In a study of the role of plant foods in solving the world food problem comparisons were made on the global scale of the annual energy intakes in group I and group II countries from plant and from animal foods (Lucas, 1968). These were of the order of 10^{15} kcal. For clearer presentation of the facts it seems desirable to introduce two larger nutrition energy units for reference purposes. One of these is 10^{6} kcal, of a similar order to the Standard Nutritional Unit (Stamp, 1960) which represents the annual energy requirement for a person with an average daily intake of 2460 kcal allowing for a loss of about 10% in bringing the food to the table. The other is 10^{12} kcal, representing the average annual energy intake of a million persons. The possible uses of such reference units will be discussed and their nomenclature, which could be based on the suggestions of Pirie (1962) will be considered.

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The performance of laying hens on diets supplemented with non-protein nitrogen. By F. O. AKINTUNDE, R. H. DAVIS and A. H. SYKES, *Wye College (University of London), Wye, Ashford, Kent*

Recent reports (Young, Griffith, Desai & Scott, 1965; Chavez, Thomas & Reid, 1966) have indicated that the laying hen is able to utilize certain sources of non-protein nitrogen for egg production. A study has been made of two sources of non-protein nitrogen, diammonium citrate (DAC) and diammonium phosphate (DAP), in an attempt to confirm these findings.

Two basal diets were formulated, calculated to contain 12% and 14% crude protein respectively. The basal diets were supplemented with DAC, DAP or soya-bean meal, each at two levels designed to give either 2% or 4% protein equivalent. Each diet was fed over a 14-week period from 42 to 50 weeks of age to eight birds, selected for similarity of egg production and body-weight.

The 12% basal diet did not support maximum egg production since supplementation of this diet with soya-bean meal at both 2% and 4% levels gave significant increases ($P<0.05$). The values recorded for the % hen-day production were 80·7, 88·8 and 88·1 for the 12% basal, 2% soya-bean and 4% soya-bean diets respectively. Supplementation of the 12% basal diet with either DAC or DAP did not result in increased egg production.

The 14% basal diet supported a higher level of production (89·1%) than the 12% basal diet and supplementation with any of the nitrogen sources did not lead to increased levels of production. Decreased egg production was observed for both 2% DAP and 2% soya-bean meal diets (82·8% and 81·9% respectively).

These results, together with the results obtained for egg weight and food conversion efficiency, indicate that under the particular experimental conditions, the laying hen is unable to utilize these sources of non-protein nitrogen for egg production, a conclusion which is confirmed by Moran, Summers & Pepper (1967), whose paper appeared after this work had been completed.

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Some effects of nitrogen and water intake in sheep and red deer. By G. M. O. MALOIY, R. N. B. KAY and E. D. GOODALL, *Rowett Research Institute, Bucksburn, Aberdeen* and J. H. TOPPS, *School of Agriculture, University of Aberdeen*

The interaction of nitrogen intake and water intake has been studied in two ewes and two hinds. The ewes, weighing 40 and 45 kg, and the hinds, 53 and 55 kg, were fitted with rumen cannulas and housed in metabolism cages. Two pelleted diets were used; one contained 53% of barley straw and 43% of maize starch and groundnut meal (high-N; 2·7% N), the other 53% of barley straw and 43% of maize

starch and maize meal (low-N; 0·8% N). The sheep received 800 g and the deer 1200 g of food daily, given as two meals which were always fully consumed.

In the first part of the experiment one animal of each species was given the high-N diet and the other the low-N diet; in the second part the dietary treatments were reversed. Each part began with 10–18 days during which water was given *ad lib.* A high water intake was then achieved for 13–18 days by pouring water into the rumen at meal times and this was followed by 14–15 days on a low-water regime; faeces and urine were collected for analysis for the last 6 days of each period.

Table 1. *The influence of nitrogen and water intake on digestion and excretion in sheep and red deer (mean values for two animals)*

Animals	Diet	Water given (l./24 h)	Urine volume (l./24 h)	Faecal water (%)	Nitrogen (g/24 h)			Digestibility (%)	
					Food	Urine	Faeces	Dry matter	Cellulose
Sheep	High-N	5·0	3·7	58	21·2	14·7	5·4	61	33
		1·1	0·4	50	21·2	14·3	5·9	60	29
	Low-N	5·0	4·1	61	6·7	3·2	4·1	62	34
		1·1	0·4	53	6·7	2·1	4·5	60	30
Deer	High-N	7·0	4·5	66	31·8	22·9	8·7	57	24
		2·4	0·7	59	31·8	21·5	8·7	55	20
	Low-N	7·0	4·9	70	10·1	3·2	7·7	55	19
		2·4	0·9	67	10·1	1·7	7·6	53	14

Some results are shown in Table 1. The concentration of water in faeces was less in the sheep than in the deer and was reduced on the low-water regime. The excretion of N in the urine was reduced on the low-water regime by about 1 g daily but faecal N was not affected. The concentration of N in faecal dry matter was about the same in both species. Digestibilities of dry matter and of cellulose were substantially lower in the deer than in the sheep and both were slightly reduced when water intake was low.

Urinary excretion of nitrogenous compounds by sheep and red deer.

By J. H. Topps, *School of Agriculture, University of Aberdeen* and E. D. Goodall, R. N. B. Kay and G. M. O. Maloiy, *Rowett Research Institute, Bucksburn, Aberdeen*

Ruminants given diets high in starch and low in nitrogen excrete very little urea. The urea filtered by the renal glomerulus is largely reabsorbed from the nephron so that excretion depends only on urine volume (Schmidt-Nielsen & Osaki, 1958). Livingston, Payne & Friend (1962) showed that urea excretion by cattle may be reduced by restriction of water intake. Excretion of urea and of other nitrogenous compounds by sheep and red deer has been compared in an experiment described in the previous paper. The animals were given constant amounts of diets rich or poor in N, together with high or low water intakes, and the excretion of seven urinary constituents was measured. Results are summarized in Table 1.

Table 1. *The influence of nitrogen and water intake on urinary nitrogen excretion (g/24 h) by sheep and red deer*

Treatment	Animal	Total urinary N	Ammonia N	Urea N	Creatinine N	Creatine N	Hippuric acid N	Uric acid N	Allantoin N	N recovered (% of total)
High N, high water	Sheep B	14·33	0·18	12·38	0·39	0·17	0·38	0·10	0·45	98
	Sheep K	15·14	0·20	10·45	0·36	0·22	0·41	0·07	0·58	81
	Deer A	21·73	0·18	19·52	0·66	0·08	0·49	0·02	0·40	98
	Deer H	24·00	0·26	14·68	0·65	0·24	0·73	0·01	0·18	70
High N, low water	Sheep B	13·82	0·08	12·14	0·35	0·12	0·33	0·09	0·51	99
	Sheep K	14·87	0·06	10·16	0·36	0·20	0·42	0·05	0·42	78
	Deer A	22·15	0·14	19·38	0·53	0·06	0·41	0·02	0·31	94
	Deer H	20·94	0·12	16·50	0·60	0·14	0·51	0·02	0·16	86
Low N, high water	Sheep B	2·94	0·28	0·91	0·37	0·13	0·28	0·07	0·42	84
	Sheep K	3·37	0·16	1·50	0·39	0·17	0·23	0·07	0·47	89
	Deer A	2·76	0·14	1·04	0·51	0·06	0·29	0·01	0·15	80
	Deer H	3·55	0·25	1·79	0·62	0·02	0·28	0·01	0·20	89
Low N, low water	Sheep B	2·45	0·05	0·57	0·34	0·06	0·21	0·06	0·40	69
	Sheep K	1·77	0·05	0·30	0·37	0·10	0·19	0·06	0·46	87
	Deer A	1·52	0·04	0·16	0·51	0·02	0·28	0·01	0·15	79
	Deer H	1·88	0·06	0·38	0·62	0·01	0·22	0·01	0·19	80

Excretion of urea and hippuric acid was reduced on the low-N diet. In general, the loss of uric acid and allantoin by the animals was also reduced on the low-N diet. Restriction of water depressed the excretion of ammonia and creatine, and of urea on the low-N diet. Creatinine excretion was unaffected by either N or water intake.

Deer excreted approximately 50% more urea than sheep when given a high-N diet, which reflected the difference between species in N intake. On a low-N intake, which was also 50% greater for deer, deer and sheep excreted similar amounts of urea. Excretion by deer of uric acid and allantoin was substantially smaller than that by sheep, this species difference being more pronounced on the low-N diet.

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Selection of zinc-containing and protein-free diets by zinc-deficient rats.

By W. R. HUMPHRIES and J. QUARTERMAN, *Rowett Research Institute, Bucksburn, Aberdeen*

Zinc-deficient rats can discriminate between diets on the basis of their Zn content. They chose a diet containing Zn and rejected a diet lacking Zn. Their ability to discriminate between these diets was progressively lost as they recovered from Zn deficiency (Fig. 1). Addition of Zn to the Zn-deficient diet resulted in an increased food consumption observable within a few hours (Fig. 2).

Harper & Rogers (1965) have shown that poor food consumption results when rats are offered a diet with an imbalance of amino acids. This effect was associated with changes in the pattern of plasma amino acids and their rats would select a protein-free diet in preference to one with an amino acid imbalance. We have found that in Zn deficiency there is a reduced appetite, a change in the pattern of

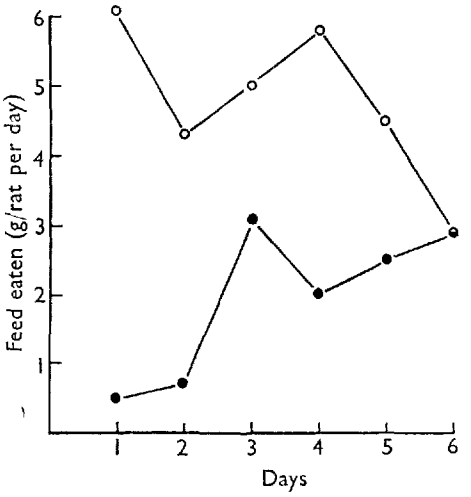

Fig. 1

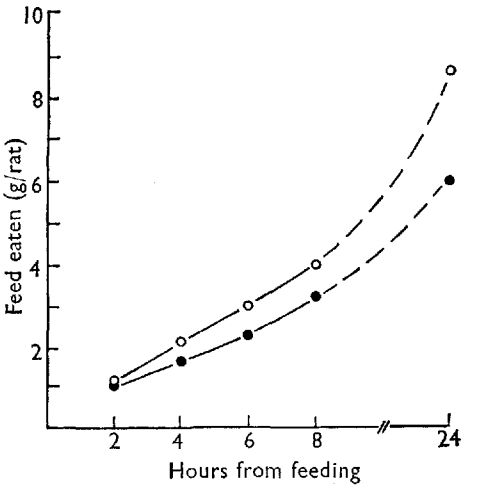

Fig. 2

Fig. 1. Mean weight of feed eaten on 6 consecutive days by each of four Zn-deficient rats offered two purified diets (Mills, Quarterman, Williams, Dalgarno & Panić, 1967) identical except that one contained 6 ppm Zn (○) and the other <1 ppm Zn (●).

Fig. 2. Mean weight of feed eaten at intervals during the first 24 h by twelve Zn-deficient rats given the high-Zn diet (○) and twelve given the low-Zn diet (●).

plasma free amino acids and also that the Zn-deficient rat similarly selects a protein-free diet in preference to one containing protein. We offered twelve Zn-deficient rats a choice of the usual Zn-deficient diet or one in which the protein had been replaced by starch. On average they each ate 0·08 g of the protein-containing and 6·97 g of the protein-free diet daily. Control rats, given a choice of high-Zn diets, with and without protein, ate nearly equal quantities of each. This type of feeding behaviour persisted for at least 15 days. Zinc, 100 μg/rat given orally or intraperitoneally, did not affect the selection of diets for at least 5 days. When Zn-deficient rats were transferred from the normal Zn-deficient-protein diet to a Zn-deficient-no-protein diet their daily food consumption increased.

Six Zn-deficient rats were given a choice of diets with or without Zn, both lacking protein. They ate equal quantities of each. Thus the selectivity for Zn illustrated in Fig. 1 is not observed in the absence of protein. An alternative explanation may be that of Rodgers (1967).

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The uptake of ^{64}Cu in the brain and other tissues of the rat. By A. D. Ryan and P. J. Warren, *Department of Biochemistry, The London Hospital Medical College, London, E1*

There is evidence that the rate of transport of some substances across the blood–

brain barrier changes during the growth and development of man and animals (Davison & Dobbing, 1966).

The main object of this study was to determine whether this effect could be demonstrated in the case of Cu, known to be important as a trace element in the normal nutrition and functioning of the brain.

In this work ^{64}Cu was administered by intraperitoneal injection to rats of different ages. The uptake of the isotope in the brain, liver, kidney and blood was measured by means of a 'coronet' arrangement of eight Geiger Müller counting tubes connected to conventional scaling equipment. Prior to and during these experiments, the male albino rats used were fed on a standard rat cake ration and tap water fed *ad lib.* One hundred and forty rats were selected at random and divided into different age groups varying from 3 to 9 weeks. The dosage of ^{64}Cu given to the rats was varied in most age groups from 20 to 60 μc/100 g body-weight. After 24 h, the tissues were removed and their radioactivity measured.

The average of the results obtained for each group was calculated and used to express the uptake of ^{64}Cu as the mean percentage of the initial radioactivity present in the tissues. The mean percentage of the initial radioactivity found in the liver (12·3) and the kidney (2·6) was similar in all the groups studied. The percentages for brain and blood were found to vary inversely with the age of the rats.

In the rats aged 3 weeks, the percentage of initial radioactivity in the brain was 0·88. This value decreased rapidly during the subsequent 2 weeks of life to a value of 0·17, and then decreased more slowly during the period from the 5th to 9th week to a value of 0·037.

The urinary and faecal excretion of ^{64}Cu was measured in some animals of all groups. The values found showed considerable variation between the groups of animals studied. The average percentage of initial radioactivity found after 24 h was 3·8 in urine and 25·6 in the faeces.

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Development of anaemia in protein–calorie deficiency. By SHAFIKA S. NASSER* and B. S. PLATT, *Department of Human Nutrition, London School of Hygiene and Tropical Medicine, London, WC1*

Little attention has hitherto been given to the iron content of animals on protein-calorie deficient diets but adequate iron intake. The results are now reported of experiments on groups of growing mice (six in each group) fed on diets of NDpCal% =5 (low protein) and NDpCal%=10 (high protein); all the animals received the same amount of iron. The feeding was continued until the animals on the diet of low protein value attained the same weight as those on the diet of high protein value (11 weeks of age). When the animals were sacrificed, haematological measurements were made and the carcasses analysed for iron.

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The results of two experiments (Tables 1 and 2) show that the animals on the diet of the lower protein value developed a mild form of anaemia, but the total carcass iron was markedly lower than that of the animals on the diet of high protein value.

Table 1. *Expt* 1. *Total carcass iron analysis done on the fat-free dry carcass*

Protein value of diet (NDpCal%)	Mean dry wt (g)	Mean FFDW* (g)	Mean total Fe (μg)	μg Fe/g FFDW*
10	13·0	6·6	1854	280·9
5	14·0	6·4	1605	250·8

*Fat-free dry weight.

Although both groups attained the same weight, the animals on the diet of lower protein value were iron-deficient and had 'iron-deficiency anaemia' in spite of an adequate iron intake. This observation explains why children recovering from

Table 2. *Expt* 2. *Iron analysis done on the total dried carcass*

Protein value of diet (NDpCal%)	Mean dry wt (g)	Mean Hb (g/100 ml)	Mean haematocrit (%)	Mean total Fe (μg)	μg Fe/g dry wt
10	12·0	13·3	42	1838	153·2
5	13·8	12·5	38	1575	114·1

kwashiorkor develop iron-deficiency anaemia (Trowell & Simpkins, 1957; Scrimshaw, Behar, Arroyave, Tejada & Viteri, 1957; Adams & Scragg, 1965).

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Daily occult blood loss and faecal iron excretion. By SHAFIKA S. NASSER and I. MCLEAN BAIRD, *West Middlesex Hospital, Isleworth*

Since McCance & Widdowson (1937) demonstrated that iron excretion from the body is very low, workers have concentrated on the mechanism governing iron absorption, paying little attention to iron losses.

Iron is lost in the faeces, urine and through the skin. Radioactive studies using ^{59}Fe and a total body counter combined with faecal collection have shown that faecal iron loss is largely in the form of haemoglobin iron (Saito, Sargent, Parker & Lawrence, 1964). This is due to minute daily blood loss into the intestines (Jones, 1958).

In the present work daily faecal blood loss was studied in sixteen non-anaemic and

two anaemic patients. Blood loss was determined by labelling the subjects' red cells with ^{51}Cr and re-injecting the labelled red cells. The faecal radioactivity was studied over a 6–10 days period in every patient.

Mean daily blood loss in the non-anaemic patients was $0{\cdot}5 \pm 0{\cdot}4$ ml. This meant an iron loss of 0·23–0·46 mg/day. This would constitute the bulk of daily faecal iron loss. Any increase of this undetected blood loss could result in a negative iron balance and iron deficiency anaemia.

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Effect of the antecedent diet on the rate of metabolism of alcohol (ethanol) in man. By G. L. S. PAWAN, *Medical Unit and Institute of Clinical Research, Middlesex Hospital, London, W1*

There are conflicting reports that various dietary procedures may alter the rate of metabolism of alcohol in man and animals. High-carbohydrate diets have been found to increase (Berg, Stotz & Westerfeld, 1944; Dontcheff, 1937, 1939) or have no effect (Clark & Morrissey, 1938; Klein, 1949; Loomis, 1950), low-protein diets to decrease (Carré & Tremolières, 1958; Kerner & Westerfeld, 1953) or be ineffective (Mikata, Dimakulangan & Hartroft, 1963), high-fat diets to decrease (LeBreton, 1936*b*), and fasting to decrease (Kerner & Westerfeld, 1953; LeBreton, 1936*a*; Leloir & Muñoz, 1938; Smith & Newman, 1959; Vitale, DiGiorgio, McGrath, Nay & Hegsted, 1953) and to produce no change (Kinard, Hay & Nelson, 1960) in the rate of ethanol metabolism.

This communication presents the results of gross alteration of diet on the rate of metabolism of alcohol in human volunteers. Three men and seven women (aged 33–54, mean 41 years) non-drinkers or moderate drinkers, apparently healthy except for obesity (body-weight 88–116, mean 103 kg) were given the following diets (after Kekwick & Pawan, 1957) for 5–7 day periods on each diet; (1) a control normal-proportioned diet of 2200 kcal/day, (2) 1000 kcal daily of normal proportion, (3) 1000 kcal daily containing 90% carbohydrate, (4) 1000 kcal daily of 90% protein, (5) 1000 kcal daily of 90% fat. The order in which the diets were given, varied in some of the subjects. In all the subjects, the rate of metabolism of a standard dose of ethanol was studied, after an overnight fast, at the beginning and end of each type of diet, as described by Pawan (1967), each subject acting as his own control. No significant effect on the rate of ethanol metabolism was produced by any of the diets, except for the high-fat diet (5), which caused a decrease in the rate of ethanol metabolism of 16–30% (mean 21%).

Four other obese patients, who for therapeutic reasons were being starved (water *ad lib.* and adequate vitamin supplements) were similarly studied at the beginning and end of a 7-day starvation period. This period of starvation decreased the rate

of metabolism of the standard dose of ethanol by 22% (actual values 12, 19, 25, 32%).

The author would like to thank Professor Alan Kekwick for permission to study these subjects in his wards.

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The use of an open circuit calorimeter for the determination of the specific dynamic action (SDA) of a diet. By ANTHEA J. PORTER-SMITH and D. H. SHRIMPTON, *Unilever Research Laboratory, Colworth House, Sharnbrook, Bedford*

A diaferometer (Noyons, 1937) has been used to measure the respiratory exchange of adult hens. The changes in the concentration of the O_2 and CO_2 with respiration are shown as a deflection on the recording micrograph, one division of the scale being equivalent to a change of 0·01%. The instrument is sensitive to differences of CO_2 of $\pm$0·016 ml/min and O_2 of $\pm$0·018 ml/min. The instrument spread on a typical deflection gives a range of 1146 kcal/h when total energy production is calculated, which is equivalent to 275 kcal/kg of feed consumed.

Measurements of fasting metabolism were carried out on Warren SSL birds (average live weight 2·66 kg). The RQs ranged from 0·72 to 0·85 with an average of 0·78 for birds fasted for 48 h. These figures included values between 0·60 and 0·70 (cf. Shannon, Brown & Waring, 1967). The values found by the present authors are similar to those measured by Romijn & Lokhorst (1964), in both cases recording of gaseous exchange being continuous, as opposed to a 24 h total.

The birds were tube-fed, the method of Kielanowski & Keller (1962) being used, so that the exact quantity of feed ingested and the time of feeding were known. A mixture of 2 parts feed to 3 parts water by weight was introduced into the crop at 3 hourly intervals, the quantity at each feed being varied. The diet used consisted of 85% maize with extracted soya protein, minerals and vitamins, and had a determined metabolizable energy (ME) value of 3148 kcal/kg.

Incremental quantities of feed were given and the total heat production associated with each level was calculated from the observed exchange of O_2 and CO_2. A linear relation was obtained between heat production and intake of ME and the gradient of this plot was taken as the SDA (heat increment) of the ration. For the ration fed (3148 kcal/kg ME) the SDA was calculated as 590 kcal/kg (18·7%). For these birds it was estimated that 40% of the energy available for production in a 24 h period was accounted for in the egg.

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Effects of UHT-processing and of subsequent storage on the vitamin content of milk. By J. E. FORD, J. W. G. PORTER, S. Y. THOMPSON, J. TOOTHILL and J. EDWARDS-WEBB, *National Institute for Research in Dairying, Shinfield, Reading*

For the first experiment, Tetra Pak cartons of milk sterilized by the indirect process and samples of the corresponding raw milks were supplied by two British dairy firms. Cartons of milk sterilized by direct injection of pressure steam were supplied, together with samples of the raw milk, by a Swedish dairy firm. The cartons of milk were held at room temperature (60–65°F) and samples analysed after storage for 0, 2, 14, 30, 60, 90 and 180 days. Vitamin A, carotene, vitamin E, riboflavine, ascorbic acid and dehydroascorbic acid were determined by chemical methods, and folic acid, vitamin B_{12}, vitamin B_6, pantothenic acid, thiamine, nicotinic acid and biotin were determined by microbiological assay.

Heat processing and subsequent storage caused no loss of vitamin A, carotene, vitamin E, riboflavine, pantothenic acid, nicotinic acid, biotin or thiamine.

The indirect heating process caused losses of vitamins B_6 and B_{12} (10%), folic acid (20%), reduced ascorbic acid (20%) and dehydroascorbic acid, which initially comprised about one-quarter of the total, (100%); the remaining ascorbic acid disappeared during 14 days storage. The residual vitamin B_6 and vitamin B_{12} decreased during storage, by 40% after 90 days. In milk from one dairy the residual folic acid content fell to zero during 14 days storage; in that from the other dairy it was stable.

The direct heating process caused little change in the content of any vitamin, but on storage there were significant losses of ascorbic acid, vitamin B_{12} and vitamin B_6, all of which fell by 50–60% at 180 days.

In a further experiment, cartons representing three different production runs from each British dairy were stored at 60–65°F and analysed after storage for 0, 2, 7 and 14 days for ascorbic acid, folic acid, vitamin B_6 and vitamin B_{12}. In addition, the oxygen content of all the samples was determined immediately on opening the

cartons. On this occasion, folic acid had disappeared from all the milks by day 14, as also had ascorbic acid; vitamins B_6 and B_{12} decreased by about 20%.

The marked differences in the stability of folic acid and ascorbic acid in these different milks were clearly related to the oxygen content of the milks. It is known that ascorbic acid in milk is stable in the absence of oxygen, and it is apparent that the presence of ascorbic acid is necessary to stabilize the folic acid in milk.

The effect of lysine infusion on the renal reabsorption of arginine in the cockerel. By K. N. BOORMAN, I. R. FALCONER and D. LEWIS, *Department of Applied Biochemistry and Nutrition, University of Nottingham*

The feeding of diets containing excess lysine to poultry causes a decrease in plasma arginine concentration (Jones, 1964; Lewis, 1967). This effect may result from increased activity of enzymes involved in the catabolism of arginine (Jones, Petersburg & Burnett, 1967; Shinwari & Lewis, 1968), or through competition between lysine and arginine for renal tubular reabsorption. Competition between these two amino acids has been shown in the mammalian kidney (Rosenberg, Downing & Segal, 1962) but no data are available for the avian kidney.

Twenty young cockerels (1·1–2·0 kg) were anaesthetized and continuously infused for 100 min periods with L-lysine in hypotonic saline. During the last 60 min of infusion urine was collected from the exposed ends of the ureters. Blood was sampled at the beginning and end of the collection period. Five rates of infusion of lysine were used and four birds were studied at each level of infusion. Inulin clearance was measured simultaneously for the determination of glomerular filtration rate and filtered loads of the amino acids.

The quantity of an amino acid reabsorbed by the kidney was calculated by subtracting the quantity excreted from the filtered load. The efficiency of renal reabsorption was expressed as the percentage of the filtered load which was reabsorbed. The efficiency of reabsorption (Table 1) shows considerable experimental variation,

Table 1. *The effect of lysine infusion on the efficiency of renal reabsorption of lysine and arginine (means* ± SE)

	Lysine		Arginine	
Infusion rate (μmoles/min kg)	Plasma concentration (μmoles/100 ml)	Efficiency of renal reabsorption (%)	Plasma concentration (μmoles/100 ml)	Efficiency of renal reabsorption (%)
0	48·7 ± 2·9	97·7 ± 0·8	16·0 ± 0·8	96·9 ± 1·3
0·5	51·8 ± 5·8	95·9 ± 2·0	19·6 ± 3·4	95·9 ± 2·7
1·0	65·1 ± 1·1	90·6 ± 3·9	18·1 ± 3·8	86·4 ± 5·3
2·0	66·6 ± 2·5	86·8 ± 3·9	15·5 ± 0·7	90·1 ± 2·6
4·0	103·2 ± 14·5	63·7 ± 12·4	16·1 ± 1·1	66·4 ± 12·7

but the regression coefficient for the reciprocal of percentage reabsorption of arginine, plotted against plasma lysine concentration is highly significant ($P < 0.001$).

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The increasing plasma concentration of lysine has apparently caused 'overloading' of the tubular transport system resulting in increased excretion and decreased efficiency of reabsorption of both lysine and arginine. The inhibitory effect can be seen with only small increases in plasma lysine concentration. It is apparent therefore that lysine can inhibit the renal tubular transport of arginine in the fowl. Data have also been obtained which show that lysine infusion inhibits the reabsorption of ornithine and an effect on histidine transport has been observed. No effect on any other commonly occurring amino acid can be recognized.

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Acidulated sunflower-oil soapstocks as fat supplements in broiler rations.

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In a growth trial with sixty-four hybrid chickens crude and refined acidulated soapstocks (Unilever procedure) from sunflower oil with a free fatty acid content of about 85% were compared with beef tallow and soya-bean oil as fat supplements for broiler rations. At 1 week of age the birds were allotted at random to single cages and to four groups. The four fat supplements were included in a broiler mash at a 5% level.

Fatty acid patterns of the supplements as determined by gas–liquid chromatography are shown in Table 1.

Table 1. *Fatty acid patterns* (%) *of fat supplements*

Fatty acid	Group A (beef tallow)	Group B (soya-bean oil)	Group C (acidulated soapstock) Crude	Group D (acidulated soapstock) Refined
<C 12	Traces	Traces	Traces	Traces
C 12:0	0·2	0·1	0·3	0·1
C 14:0	2·3	0·1	0·2	0·1
C 15:0	1·5	Traces	Traces	Traces
C 16:0	26·4	10·0	8·4	6·2
C 16:1	4·4	0·1	0·1	Traces
C 17:0	1·2	Traces	Traces	0·1
C 17:1	0·8	—	Traces	Traces
C 18:0	18·2	4·4	5·6	5·6
C 18:1	40·1	24·7	26·9	27·4
C 18:2	2·8	52·5	57·6	59·1
C 18:3	1·8	7·0	0·3	0·6
C 20:0	0·1	0·3	0·4	0·4
<C 20	Traces	0·9	0·1	0·1

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The fatty acid patterns of the acidulated soapstocks resembled closely the composition of soya-bean oil but for much lower contents of linolenic acid.

Average weights of the birds at 8 weeks of age were highest in group A (beef tallow) followed by group C (crude acidulated soapstock) and group B (soya-bean oil). Group D (refined acidulated soapstock) showed a significantly lower final weight ($P<0.05$). The differences in weight were due to similar differences in feed consumption.

Our results are in good agreement with the results of chicken experiments by Bornstein & Lipstein (1961, 1963) and Lipstein & Bornstein (1963, 1965) with cotton-seed- and sunflower-oil acidulated soapstocks and by Sibbald, Pepper & Slinger (1962) and Sibbald, Slinger & Ashton (1962) with non-specified acidulated soapstock. They show that in poultry rations a major part of the fat may be replaced by the cheaper crude acidulated sunflower oil soapstock.

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The estimation of body fat in young men using skinfold calipers and a transportable underwater weighing apparatus. By M. F. Haisman, *Army Personnel Research Establishment, West Byfleet, Surrey*

Body fat estimations have been carried out on fifty-five soldiers aged between 19 and 28 years using the two methods of skinfold thickness and body density. Skinfolds were measured, with Harpenden calipers, at nine sites on the trunk and arm on the right side of the body. Body density was determined by underwater weighing, allowance being made for the residual lung volume measured simultaneously by means of the nitrogen dilution technique. Underwater weighing was carried out in a transportable, polythene tank using scaffolding to support the weighing machine above the tank.

The accuracy of body density measurements, using this apparatus, has been assessed from fifty-eight duplicate determinations. The standard deviation of the differences between duplicates was 0·0022 g/ml, about the same order of accuracy as has been obtained by other workers using rather more elaborate apparatus (Pascale, Grossman, Sloane & Frankel, 1956). The accuracy of the skinfold measurements was assessed from fifty-seven duplications, and the standard deviations of the differences between duplicates was found to be 0·4 mm and 0·5 mm for the subscapular and triceps sites, respectively.

The mean values of age, height, weight and body density have been set out in Table 1. The estimated body fat contents have been derived, firstly from measured density using the equation of Siri (1956), secondly from three skinfolds using the

Table 1. *Age, height, weight and density of fifty-five subjects*

	Age (years)	Height (cm)	Weight (kg)	Density (g/ml)
Mean	22·6	173·0	68·67	1·0704
SD	2·2	5·2	7·41	0·0100

Table 2. *Comparison of body fat content of fifty-five subjects estimated from density and from two, skinfold to body fat formulae*

	Estimated body fat content (% body-weight)		
	From density	From 3 skinfolds (Pascale *et al.*)	From 4 skinfolds (Durnin & Rahaman)
Mean	12·5	10·7	13·3
SD	4·4	2·2	3·3

formula of Pascale *et al.* (1956), and thirdly from four skinfolds using the formula of Durnin & Rahaman (1967). These estimated body fat contents have been set out for comparison, in Table 2. The formula of Durnin & Rahaman has given body fat values similar to those derived directly from measured density, whereas the formula of Pascale *et al.* gave lower values.

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