digestibilities of the dry matter in hay were 73·0 and 71·1% for the broken- and sound-mouthed ewes, respectively.

Evidence for greater selection of herbage by the sound-mouthed ewes on the bare pasture in period 1 was obtained; the variation in FDM and in FN within groups was greater ($P<0·05$) for the sound-mouthed ewes. There were no significant differences in FDM and FN between the groups in period 1 (Behrens–Fisher test) and in period 2, indicating that the complete loss of incisors had no effect on the intake of herbage dry matter by the grazing ewe. No significant differences in dry-matter digestibility, FDM and FN between groups occurred when the ewes were on a constant diet in period 3.

The Two Hundred and Nineteenth meeting of The Nutrition Society was held in the Nutrition Department, The Atkins Building, Queen Elizabeth College, Campden Hill, London W8, on Friday, 20 March 1970, at 15.00 hours, when the following papers were read:

Influence of the addition of molybdenum on the digestibility and palatability of a diet for sheep. By G. VARELA, J. J. ESCRIVA and J. BOZA, *Department of Animal Physiology Experimental Station of Zaidin, Granada, Spain*

With the object of discovering the effect of the addition of molybdenum, at non-toxic levels, on the nutritive value and acceptability of a diet for sheep (castrated lambs 1 year old), digestibility and palatability tests have been carried out, using a diet rich in fibre composed of barley and wheat straw with the addition of calcium carbonate. The molybdenum content of this diet was 0·27 ppm and was supplemented by sodium molybdate up to the following five levels of molybdenum: 2·27, 4·27, 6·27, 8·27 and 10·27 ppm.

Six digestibility experiments designed on a 'Latin square' following the 'direct method', have been carried out, with the results shown in Table 1. Addition of 8·27 and 10·27 ppm of molybdenum significantly ($P<0·001$) increased the digestibility of the fibre and, to a lesser extent, the total digestible nutrient (TDN) content; no statistically valid differences in the digestibility of protein, fat and nitrogen-free extracts (NFE) were observed.

Mo content (ppm)	Digestibility (%)				TDN content (%)
	Protein	Fat	Fibre	NFE	
0·27	58·4	74·7	35·7	80·5	67·8
2·27	58·8	74·0	36·2	80·1	67·6
4·27	58·9	72·9	36·1	79·0	66·8
6·27	59·3	71·3	36·4	78·6	66·5
8·27	59·9	74·2	40·8	80·2	68·4
10·27	58·5	73·7	43·7	81·0	69·2

On increasing the molybdenum content of the diet, its acceptability by the animals increased, the results being significant at 5%. There was a highly significant ($P<0.001$) correlation between the g food ingested and ppm of molybdenum in the diet.

Lastly, the equation $y=101.49+10.78x$ expresses the regression of the amount (g) of food ingested (y) on the molybdenum content (ppm) of the diet (x).

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Energy intake and energy utilization in the laying hen in relation to ambient temperature. By R. H. Davis, O. E. M. Hassan and A. H. Sykes, *Wye College (University of London), Ashford, Kent*

The relation between ambient temperature and energy utilization has been reinvestigated in high-producing light hybrid layers by means of energy balances and the comparative slaughter method. Groups of eight birds were studied over 3 weeks at constant ambient temperatures of 7·2°, 15·6°, 23·9°, 29·4° and 35·0°; at the higher temperatures the birds were previously acclimatized by intermittent exposure over a period of 3 weeks. Carcass energy was determined at the end of each experimental period and on a separate control group of birds at the start of the trial. The intake of metabolizable energy (ME) and the output of egg energy were determined directly by bomb calorimetry. The results are summarized in Table 1.

Table 1. *Energy utilization (expressed per bird per d) in relation to ambient temperature*

Temperature (°C)	7·2	15·6	23·9	29·4	35·0
Dry-matter intake (g)	101·5	93·3	88·4	83·3	76·1
Egg production (%)	76·2	86·3	85·1	82·1	79·2
ME intake (kcal)	311	286	272	257	235
Heat loss (kcal)	231	204	189	179	166
Egg energy (kcal)	77·8	82·0	79·5	76·9	71·5
Carcass energy change (kcal)	+2·3	+0·5	+1·4	+0·9	−2·9
Gross energetic efficiency of egg production (%)	25·0	28·5	29·4	29·9	30·4

Over the period of the trial, egg production was not significantly affected by the temperature of the environment. Feed intake, and hence energy intake, declined as the temperature increased; heat loss also decreased and there was no evidence of a clearly defined thermoneutral zone. Heat production at the highest temperature was not increased despite the almost continuous panting activity associated with the heat stress. The gross energetic efficiency of egg production increased with increasing temperature and since body-weight changes were small this increase represented a real improvement in the utilization of dietary energy.

Further observations on the influence of meat and fish meals on the survival of chicks inoculated with *Salmonella gallinarum*. By I. M. SMITH and R. HILL, *Royal Veterinary College, London*, NW1

Meat meal promoted greater survival than fish meal in chicks inoculated with *Salmonella gallinarum* (Hill & Smith, 1969; Hill, 1969), and the difference varied with the level of meat and fish meals. Diets containing 10, 20 and 40% fish or meat meal were used, each in four experiments, giving a total of 156 birds inoculated on each diet. Percentage survival values for fish and meat were 71 and 78 at the 10% level (difference not significant), 51 and 78 at 20% (difference significant $P<0{\cdot}001$) and 31 and 86 at 40% (difference significant $P<0{\cdot}001$). When higher levels of fish and meat were compared, the difference in survival remained greatest with 40% of fish or meat.

Samples of meat meal (all contained bone as do commercial products) prepared from single species of animal, sheep, cattle, pig and poultry, were compared in three experiments. All gave high survival, similar to that of commercial meat meal, but there was a strong tendency for percentage survivals for meals from sheep (75) and cattle (69) to be greater than those for meals from pig (59) and poultry (57).

On comparing freshly prepared sprat meal with freshly prepared or stored (3 months) white fish meal, each at 10 and 40% of the diet, no differences in survival were observed; whale meat meal gave results more similar to fish than meat meal.

When meals prepared from cod or haddock fillets were used at the same protein level as fish meal, survivals of inoculated chicks were even poorer than with fish meal. Mean percentage survivals in two experiments were for cod 16, and fish meal 54, and in two other, for haddock 5 and fish meal 20.

In two experiments, the diets of groups of birds were changed 4 d after inoculation, when the disease is well established, from fish to meat or from meat to fish meal. The course of the disease was modified so that birds changed from fish to meat survived in larger numbers than those remaining on fish, and birds changed from meat to fish survived in smaller numbers than those remaining on meat.

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Influence of diet on the relationship between endogenous faecal loss of magnesium and plasma magnesium concentration in sheep. By T. F. ALLSOP and J. A. F. ROOK, *School of Agricultural Sciences, University of Leeds*

The contribution of endogenous magnesium to the high faecal Mg output of cattle and sheep receiving roughage or succulent diets is uncertain. Wether sheep are being given various artificial 'Mg-free' diets with Mg supplied as the chloride by continuous intravenous infusion into the jugular vein, to determine the influence of diet composition and of plasma Mg concentration on the endogenous Mg loss in the faeces. Two diets have been studied. One consisted of acid-washed barley straw (4 parts) and a casein, mineral and vitamin supplement (1 part) and contained

14 mg Mg/kg dry matter, the other of acid-washed barley straw (2 parts), purified cellulose (2 parts) and the casein, mineral and vitamin supplement (1 part) and contained 45 mg Mg/kg dry matter. Treatment periods were of 14 d duration and measurements were made over the last 7 d. The mean daily values are shown in Table 1.

Table 1

Sheep	Diet	Dry-matter intake (g/d)	Infused Mg (g/d)	Plasma Mg concentration (mg/100 ml)	Faecal Mg output g/d	Faecal Mg output mg/g dry matter
1	Barley straw + concentrates	375	0	0·73	0·092	0·47
2		380	0·7	1·88	0·163	0·59
		280	0	0·74	0·082	0·49
3	Barley straw + concentrates + cellulose	450	0	0·70	0·108	0·90
		430	1·07	2·67	0·136	1·01
4		450	0	0·37	0·085	0·72
		540	1·07	3·39	0·138	1·18
5		400	0·52	2·67	0·100	0·63
		440	0·98	2·75	0·134	0·69
6		640	0·11	1·91	0·121	0·46
		720	0·55	2·53	0·129	0·49
		710	1·00	2·70	0·186	0·54
		380	2·20	4·48	0·200	1·40

The results do not reveal any difference between the diets or any effect of intake or faecal output of dry matter, but demonstrate a relationship between the endogenous faecal loss of Mg and the plasma Mg concentration.

One of us (T.F.A.) is in receipt of a grant from the New Zealand Department of Agriculture.

The effect of grinding and pelleting a roughage on its digestion by sheep.

By A. H. Alwash and P. C. Thomas, *School of Agricultural Sciences, University of Leeds LS2 9JT*

When ground and pelleted roughage is included in ruminant diets, the digestibility is reduced and decreases in rumen liquor pH and increases in total volatile fatty acid (VFA) concentration and the molar percentage of propionic acid have been reported (Moore, 1964). The effect of roughage preparation is influenced by the level of feeding (Alwash & Thomas, 1969) but any associated change in rumen fermentation has not been established.

An artificially dried grass ration of high digestibility was offered in a chopped or in a finely ground and pelleted form to four male sheep fitted with ruminal cannulas. Two animals were maintained at a low level of feeding (24·5 g DM/kg$W^{0·73}$ per d) and two at a higher level (75·9 g DM/kg$W^{0·73}$ per d). The digestibility of organic matter, retention time of food residues in the digestive tract and the rates

of disappearance of cotton threads suspended in the rumen were assessed. On 2 d, samples were withdrawn from the rumen immediately before, and at 1, 2, 3, 4, 6, 8, 10, 12 and 24 h after, feeding. The pH of the rumen liquor was estimated and samples were analysed for ammonia and total VFA contents and individual VFA percentages.

As observed in previous experiments (Alwash & Thomas, 1969), the digestibility of organic matter was reduced both by grinding and by increased food intake. The rate of disappearance of cotton threads was similarly affected and in one sheep given a high intake of ground diet there was no loss of threads even after 200 h. Feeding ground and pelleted grass, especially at the higher level of intake, also resulted in lower ammonia and total VFA concentrations and rumen pH, except for one sheep maintained at the low intake which ate the pellets only slowly. There were for both diets wide differences between sheep in the composition of VFA in the rumen liquor but in all animals the molar percentage of butyric acid was higher with the ground and pelleted diet than with the chopped.

These results suggest that the grinding and pelleting of rations caused, in addition to the well-known physical effect on cellulose digestibility, a reduction in cellulolytic activity within the rumen. This may reflect an alteration in the supply of nutrients, ammonia in particular, to the cellulolytic organisms.

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β-Hydroxybutyrate as a precursor of the fat of goat's milk. By S. McCARTHY, G. H. SMITH and J. A. F. ROOK, *School of Agricultural Sciences, University of Leeds LS2 9JT*

The stimulatory effect of rumen butyrate production upon milk fat secretion has been attributed to the utilization of β-hydroxybutyrate (BHBA) as a precursor for milk fat synthesis. Using tissue slices and cell-free extracts, Smith & McCarthy (1969) demonstrated that the incorporation of DL-[3-^{14}C]BHBA into fatty acids in cow udder tissue took place through the provision of a 4-carbon unit elongated by 2-carbon units from acetate.

In separate experiments with lactating goats, [1–^{14}C]acetate and DL-[3–^{14}C]BHBA were infused intravenously into the jugular vein, and [1–^{14}C]butyrate into the portal vein at rates of 1·0 μg and 1·0 or 1·5 μCi per min for 4 h. Measurements of the activity of constituents in the carotid blood plasma and in milk were made over 24 and 48 h respectively.

Infusion of [1–^{14}C]butyrate gave extensive labelling of BHBA and acetate in the carotid plasma, and the activity associated with butyrate in the plasma was negligible. The transfer of activity to milk constituents was consistent with the separate effects of BHBA and acetate in the other two experiments.

Following infusions of [1–^{14}C]acetate, radioactivity in milk fatty acids was distributed evenly among the odd-numbered carbon atoms except for the 4 carbons at the methyl terminal end. For these, there was evidence of dilution with an unlabelled precursor, more pronounced in the C_{12}–C_{18} than in the C_4–C_{10} acids. Following infusion of [3–^{14}C]BHBA, radioactivity was mainly in the penultimate carbon atom at the methyl end of each fatty acid, and 83% of the incorporated BHBA was as intact 4-carbon units.

About 10% of the total weight of milk fatty acids arose from BHBA, 30% from acetate. The percentage of each fatty acid arising from acetate or BHBA was:

	C_4	C_6	C_8	C_{10}	C_{12}	C_{14}	C_{16}	C_{18}
[1–^{14}C]acetate	47·5	65·3	70·3	79·1	83·6	64·5	42·3	9·4
DL–[3–^{14}C]BHBA	51·9	40·0	28·0	19·4	18·8	10·6	3·8	0·7
D–[^{14}C]BHBA	49·8	38·7	28·7	19·7	19·4	9·9	2·6	0·2

(following [^{14}C]butyrate infusion).

The results suggest at least two routes for the synthesis of short-chain fatty acids in goat's milk, through complete synthesis from 2-carbon units and through elongation of a primer 4-carbon unit derived from BHBA.

This work was supported by a grant from the Agricultural Research Council.

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The effect of processing maize on its digestion in sheep. By D. E. Beever*, J. F. Coehlo Da Silva and D. G. Armstrong, *Department of Agricultural Biochemistry, University of Newcastle upon Tyne*

Armstrong & Beever (1969) drew attention to the difference in amounts of starch reported to be entering the small intestine of ruminants fed ground-maize diets compared with those fed diets comprising either rolled barley or flaked (i.e. heat-treated) maize. Karr, Little & Mitchell (1966) and Tucker, Mitchell & Little (1968), using ground-maize containing diets fed to cattle or sheep found, on average, 28% of the ingested starch to enter the small intestine, such values being much larger than the value of 6·3% reported in the United Kingdom by several workers for barley and flaked-maize diets. However, appreciable differences were noted by Armstrong & Beever (1969) in the experimental techniques.

To examine this effect further, sheep equipped with re-entrant cannulas at both the proximal duodenum and the terminal ileum were used in order to study the sites of digestion of the starch contained in ground- and in flaked-maize diets. Three sheep were fed the ground-maize diet and subsequently they and one other sheep received the flaked-maize diet. The daily ration (950 g dry matter), comprising one part dried grass (chopped) and either four parts ground or four parts flaked maize,

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was fed in two equal feeds at 9.00 and 16.00 hours. There were no feed refusals. After a 3-week preliminary feeding period, followed by a 7 d collection of faeces, 24 h collections of duodenal and ileal contents were made, using chromic oxide as an indigestible marker (MacRae & Armstrong, 1969*a*). Starch content was estimated enzymically using vacuum-dried material (MacRae & Armstrong, 1968) and expressed as α-linked glucose polymer.

The amounts of polymer given in the two diets were similar and in both were completely digested in passage through the digestive tract (Table 1). However, on the ground-maize diet some 22% of the apparently digested starch entered the small intestine, representing an almost fivefold increase over the amount on the flaked-maize diet. That which entered the small intestine was largely digested therein (97·9% for ground maize, 92·8% for flaked maize).

Table 1

	Ground maize	Flaked maize
α-Linked glucose polymer (g/24 h):		
in feed	612·6	625·5
at proximal duodenum	136·2 ± 21·0	27·6 ± 2·26**
at terminal ileum	2·9 ± 1·04	2·0 ± 0·35NS
in faeces	2·5 ± 1·8	0·8 ± 0·08NS
Apparent digestibility of polymer (%)	99·6 ± 0·4	99·9 ± 0·0 NS
Disappearance of apparently digestible polymer (%):		
before the small intestine	78·0 ± 3·2	95·7 ± 0·4**
in the small intestine	21·9 ± 3·4	4·1 ± 0·3**
in the caecum and colon	0·1 ± 0·2	0·2 ± 0·1NS

** $P < 0.01$; NS, not significant.

The results confirm that when maize is processed into flakes appreciably less starch enters the small intestine than when fed ground but otherwise unprocessed. After the above studies were completed, Ørskov, Fraser & Kay (1969) reported results of a similar investigation with young lambs; the present results agree with their findings. The difference would not appear to be due to physical form (i.e. finely ground *v.* flaked) since no differences were observed between barley fed ground and rolled (Ørskov *et al.* 1969), nor between barley fed whole or rolled (MacRae & Armstrong, 1969*b*) to sheep. Kerr (1950) showed raw maize to have a horny portion in the endosperm. Ørskov *et al.* (1969) have suggested that this might lead to a reduction in the breakdown of raw maize within the reticulo-rumen, an effect that could be overcome by steam-treatment of the maize before feeding.

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The influence of propionylation and heat treatment on the value of proteins as sources of amino acids for chicks. By SHIRLEY A. VARNISH and K. J. CARPENTER, *Department of Agricultural Science and Applied Biology, University of Cambridge*

Oral supplements of ϵ-*N*-propionyl-L-lysine failed to produce any response in rats fed on a lysine-deficient diet (Bjarnason & Carpenter, 1969). The same compound has now been assayed with chicks and has shown, mole/mole, nearly 80% the activity of L-lysine itself. These results are in agreement with those of Leclerc & Benoiton (1968) who found a significant rate of hydrolysis of the propionyl compound with the ϵ-lysine acylase isolated from chicken kidney, but not from the corresponding rat enzyme.

When 95% of the ϵ-NH_2 groups of the lysine moieties of lactalbumin were propionylated, the value of the protein as a source of lysine for rats was greatly reduced (Bjarnason & Carpenter, 1969).

Table 1. *The amino-acid content (g/16 g N) of lactalbumin and chicken breast muscle, together with the relative total and available values in both control and modified samples in parentheses*

	Lysine			Methionine			Tryptophan		
	Total	Chick* assay	FDNB† available	Total	Chick‡ assay	*Strep.*§ assay	Total	Chick‖ assay	*Strep.*§ assay
Lactalbumin	9·9			2·9			2·4		
1 Control	(100)	(126)	(105)	(100)	(86)	(69)	(100)	(96)	(62)
2 Propionyl lactalbumin	(100)	(61)	(3)	(100)	(86)	(76)	(104)	(92)	(62)
Chicken breast meat	8·8			3·2			1·3		
1 Control	(100)	(126)	(85)	(100)	(87)	(94)	(100)	(108)	(92)
2 Autoclaved (116°, 27 h at 13·8% moisture)	(94)	(70)	(66)	(81)	(56)	(37)	(92)	(46)	(38)

*Procedure of Carpenter, March, Milner & Campbell (1963) modified with autoclaved groundnut meal replacing sesame seed meal in the basal diet.

†Carpenter (1960).

‡Procedure of Miller, Carpenter, Morgan & Boyne (1965) with the basal diet modified to include a small amount of a glycine–glutamic acid mix.

§Ford (1962), using *Streptococcus zymogenes* with the stronger papain pre-digestion.

‖Harwood & Shrimpton (1969).

Table 1 shows that propionylation has approximately halved the value of lactalbumin as a source of lysine for the chick, though its value as a source of methionine or of tryptophan as assayed with both chicks and *Streptococcus zymogenes* is unaffected. These results contrast with the effects of heat-damage studied in the same series of tests. Although autoclaving chicken meat reduced the availability of lysine

to fluorodinitrobenzene (FDNB) by only 20–25%, there was severe damage to all three amino acids as judged by the chick.

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The nutritive value of field beans (*Vicia Faba*) for pigs. By R. M. LIVINGSTONE, V. R. FOWLER and A. A. WOODHAM, *Rowett Research Institute, Bucksburn, Aberdeen AB2 9SB*

The nutritive value of a spring-sown variety of bean (Maris Bead) and of a winter-sown variety (Throws M.S.) was examined by chemical analysis, and by digestibility and growth studies with pigs.

The compositions of the spring and winter varieties respectively were: crude protein (N×6·25) concentration in the dry matter, 32 and 26%; available lysine per 16 g N, 7·1 and 7·0 g (determined by the method of Carpenter, 1960); and total lysine per 16 g N, 6·6 and 7·5 g.

Apparent digestibility of nitrogen and dry matter in the beans was determined in forty-eight balance trials. Four diet types were used; these were basal (97·5% barley and 2·5% white fish meal), basal + 20% beans, basal+40% beans, and 100% beans. When beans were included at 20 and 40%, apparent digestibilities were calculated by linear extrapolation to 100% beans; at these concentrations, the apparent digestibility of dry matter in the beans was 83 and 84%, and of N, 83 and 87% for the spring and winter varieties respectively. With all-bean diets, apparent digestibility of dry matter was reduced to 73% for the spring and 80% for the winter variety.

In a growth trial involving 100 pigs, the performances of groups given diets with various proportions of fish meal and beans were compared. The control group was given the basal diet of 94% barley and 6% fish meal, and its performance compared with that of those given diets in which half or all the fish meal was replaced by either spring or winter beans. Dietary substitution ratios of either 2% or 3% of beans for each 1% of fish meal in the diet were used, with appropriate adjustments to barley concentration; the proportions of the main constituents in each of the experimental diets are shown in Table 1. There were no significant effects of variety, and the results given in Table 1 are pooled values for the spring and winter beans.

None of the groups which received beans in the diet matched the performance of the control group. Groups having only half the fish meal replaced by beans tended to be nearer the control group in rate of live-weight gain and feed conversion ratio than to the groups receiving diets with no fish meal. The dietary substitution

Table 1. *Summary of results*

	Substitution ratio (% beans:% fish meal)	2:1		3:1		
	Control					
Beans % (spring or winter)	0	6	12	9	18	
Fish meal	6	3	0	3	0	
Barley	94	91	88	88	82	
						SE of difference
No. of pigs	20	20	20	20	20	
Live-weight gain/d (g)	638	615	589	628	607	±9·4
kg feed/kg gain	3·56	3·70	3·86	3·62	3·75	±0·057
Specific gravity of side of carcass [(sp.g. −1) × 10^4]	510	470	463	488	474	±13

ratio (% beans : % fish meal) is clearly higher than the 3:1 used in this experiment, and very much higher than a theoretical rate of 2·4:1 calculated using the total lysine content of the diets as the criterion of equivalence. The substitution ratio, as measured by performance may, however, be improved if supplementary synthetic amino acids were used to improve the quality of the bean protein.

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Iron-deficiency anaemia evaluated by the cardio-respiratory responses to muscular exercise. By HARALD T. ANDERSEN, *Institute for Nutrition Research, University of Oslo, Blindern, Norway*

Iron deficiency with or without anaemia is not necessarily combined with poor health. Scott & Pritchard (1967) found that one-third of the subjects in a population of 114 women did not have stainable iron in their bone-marrow. Although these authors realized that more than 30% of their subjects were iron-deficient, they nevertheless reported all of them to be in excellent health. When iron deficiency becomes severe enough to cause anaemia it is more difficult to maintain the point of view that health is not appreciably affected. At any rate, iron-deficiency anaemia can hardly be said to be compatible with an optimal health condition.

Anaemia is frequently being blamed for a variety of vague complaints and unspecific symptoms, not always with evidence heavily supporting such a diagnosis. Consequently, epidemiologists have argued that a moderately lowered haemoglobin level may not matter unless it causes decreased capacity for physical work by an increased load on cardio-respiratory mechanisms (Elwood, 1968).

The investigation reported here was undertaken in order to study the possible relationship between variations in blood haemoglobin concentrations and the

ability to perform physical work measured by changes in the cardio-respiratory functions.

It has been found that when the blood level of haemoglobin drops below 11·5 g/100 ml it is easy to demonstrate a significant deficiency of the transport capacity for respiratory gases. Moreover, the time required by the cardio-pulmonary function of anaemic patients to recover from brief periods of muscular exercise (500 or 1000 kp m performed on a bicycle ergometer) is much increased compared to the values found in the same subjects after having been successfully treated.

These observations clearly show that the cardio-respiratory function is impaired in the anaemic patients studied.

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Adipose tissue fatty acids of young and mature Jersey cattle. By W. M. F. LEAT and G. A. EMBLETON, *ARC Institute of Animal Physiology, Babraham, Cambridge*

It is generally accepted that the high degree of saturation of depot fat in the ruminant is mainly the result of deposition of stearic acid formed by the hydrogenation of dietary lipids in the rumen (see Hilditch & Williams, 1964). In the newborn ruminant the rumen is underdeveloped but during the first 3 months of life it becomes fully functional. It might be expected, therefore, that the degree of saturation of tissue lipids would increase as the ruminant animal develops. From the limited information available this appears to be true in the sheep (Leat, 1970). For comparison, we have now studied the composition of adipose tissue from cattle of differing ages.

Table 1 shows that, as expected, the stearic acid content of perinephric fat from yearling cattle is higher than that from the newborn calf (cf. Garton & Duncan, 1969). However, the depot fats from yearling cattle were also found to be more saturated than those of mature cows. This increasing unsaturation with age is associated with a rise in the percentage of monounsaturated C_{14}, C_{16} and C_{18} acids at the expense of stearic acid.

Some explanations for these differences between yearling and mature cattle, e.g. possible effects of pregnancy and lactation, are considered and eliminated. Preliminary evidence indicates that the increase in unsaturation of depot fatty acids occurs between 1–2 years of age and may reflect a change in the desaturase activity of adipose tissue at this time.

Table 1. *Major fatty acids (%) of adipose tissue from young and mature Jersey cattle*

	Subcutaneous			Perinephric		
Fatty acid	Newborn	1 year	4–7 years	Newborn	1 year	4–7 years
14:0	2·7	2·3	2·8	2·6	2·6	4·6
14:1	0·6	1·1	3·9	0·9	0·6	1·2
16:0	34·6	18·2	20·2	35·7	20·1	28·5
16:1	5·0	4·7	13·1	7·2	1·6	3·5
18:0	15·6	15·1	2·9	10·6	39·2	16·6
18:1	39·6	49·6	51·3	41·6	27·0	41·1

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Performance and the fatty acid composition of the contents of the small intestine of baby pigs given milk substitute diets containing different fats. By R. BRAUDE, M. J. NEWPORT and J. W. G. PORTER, *National Institute for Research in Dairying, Shinfield, Reading RG2 9AT*

Butterfat was substituted in cow's milk by coconut oil, soya-bean oil or beef tallow and the resulting mixture homogenized and spray-dried. The spray-dried powders, which contained 27% fat, were reconstituted to give liquid diets containing 20% total solids, supplemented with fat-soluble vitamins and given to baby pigs removed from the sow when 2 d old. The Shinfield automatic feeders were used and the rearing routine with twelve pigs per treatment was as previously described, using initially the low feeding scale (A) and increasing to a higher scale (C) by 14 d of age (Braude, Mitchell, Newport & Porter, 1970). The test lasted for 28 d and the performance of the pigs during the 1st week and for the whole period is shown in the table.

	2–7 d of age		2–28 d of age	
Dietary fat	Live-weight gain (g/d)	Feed conversion ratio (g milk solids/g gain)	Live-weight gain (g/d)	Feed conversion ratio (g milk solids/g gain)
Butter†	219	0·59	387	0·82
Butter‡	224	0·57	401	0·81
Coconut oil	204*	0·62	381*	0·82
Beef tallow	199*	0·64*	377*	0·83
Soya-bean oil	197*	0·65*	394	0·79
SEM	4·4 (44 df)	0·019 (44 df)	6·1 (41 df)	0·010 (41 df)

*Significantly worse ($P<0·05$) than the diet containing replaced butterfat.
†Spray-dried whole milk.
‡Butterfat added to liquid skim-milk before spray-drying.

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The utilization by baby pigs of the different fats will be discussed in relation to the fatty acid composition of the digesta in the small intestine.

REFERENCE

Braude, R., Mitchell, K. G., Newport, M. J. & Porter, J. W. G. (1970). *Br. J. Nutr.* **24**, 501.

Nucleic acids in bovine nutrition. 4. Products of nucleic acid breakdown in the rumen. By R. H. SMITH and A. B. MCALLAN, *National Institute for Research in Dairying, Shinfield, Reading RG2 9AT*

When RNA or DNA were added to the rumen of the calf or were incubated with rumen contents in vitro they were rapidly destroyed (Smith & McAllan, 1970). The degradation products formed have been separated and identified by means of column chromatography on Sephadex and thin-layer chromatography on cellulose.

Calves equipped with rumen and duodenal cannulas were used. Similar results were obtained whether the calves were given a stall diet of flaked maize and hay or were allowed to graze pasture.

Principal findings after incubating nucleic acids with samples of rumen fluid at 37° in an atmosphere of 95% N_2, 5% CO_2 were as follows. RNA was rapidly (within 1 h) converted into ultrafilterable poly- and oligo-nucleotides together with some mononucleotides, nucleosides and purine and pyrimidine bases. After 4 h, the bases had increased at the expense of the other constituents and accounted for most of the added RNA. DNA gave similar degradation products but with a much greater proportion of ultrafilterable polynucleotides which persisted as a major component even after 4 h. The only bases found in appreciable amount were thymine (from DNA only), uracil, xanthine and hypoxanthine. It appeared that cytosine, guanine and adenine were deaminated to give the corresponding oxy-compounds.

After adding RNA or DNA to the rumen, the same products as were formed in vitro accumulated temporarily in rumen fluid and were found also in corresponding samples of duodenal contents. They disappeared, however, at a much greater rate than polyethylene glycol added as a marker and were scarcely detectable after 4 h. It is not clear whether this difference between the in vitro and in vivo results was due to absorption of degradation products through the rumen wall or more efficient microbial breakdown under in vivo conditions.

Appreciable amounts of nucleic acids are present in some foodstuffs given to ruminants (Smith & McAllan, 1970) and further quantities may be provided by micro-organisms dying and being digested in the rumen. It seems probable that there is normally an appreciable turn-over of the breakdown products described above although these have only rarely been detected in rumen fluid unsupplemented with pure nucleic acids.

REFERENCE

Smith, R. H. & McAllan, A. B. (1970). *Br. J. Nutr.* **24**, 545.

Lysine and arginine interactions affecting their absorption from the duodenum of the pig. By S. BURACZEWSKI, A. G. CHAMBERLAIN,* F. HORSZCZARUK and TERESA ZEBROWSKA, *Institute of Animal Physiology and Nutrition, Jablonna, Warsaw, Poland*

The interactions between lysine and arginine affecting the absorption of these amino acids from the distal duodenum and proximal ileum were studied in a pig fitted with two pairs of re-entrant cannulas.

Solutions of these amino acids were made in Krebs-Ringer buffer solution (without phosphate) and were passed through the loop of gut lying between the inlet of the first and the outlet of the second pair of cannulas. During the 1st hour of each experiment, 100 ml of solution were poured into the loop at 5 min intervals to wash the lumen free of undigested food. Lysine concentrations were 3·42 and 34·2 m-moles and arginine 2·27 or 22·7 m-moles. At the start of the 2nd hour, a known amount of ^{14}C-labelled amino acid was introduced together with polyethylene glycol (PEG). For the next 2·5 h, 70 ml of unlabelled amino acid solution were introduced each 5 min. Table 1 shows the amounts introduced in this period.

The fluid issuing from the loop was collected over 0·5 h periods, the volume was measured and samples were analysed. Table 1 shows the amounts of free lysine, free arginine and total radioactivity apparently absorbed. Recoveries of PEG were generally close to 100%. When buffer alone was used, the effluent contained very little free amino acid.

Table 1. *Amounts of lysine, arginine and radioactivity introduced and apparently absorbed* in a 2·5 h period*

Introduced			Apparently absorbed†		
Lysine (m-moles)	Arginine (m-moles)	Radioactivity	Lysine (m-moles)	Arginine (m-moles)	Radioactivity (%)
7·2	4·8	4 μCi lysine	6·7 (93)	4·6 (96)	75
7·2	4·8	2·9 μCi arginine	6·6 (92)	4·6 (96)	91
72·0	4·8	2·9 μCi arginine	34·9 (49)	2·5 (52)	55
7·2	47·7	4 μCi lysine	2·0 (28)	26·1 (55)	40

*Values shown are the means of three experiments.
†Figures in parentheses are percentage apparent absorption.

The analyses for free lysine and arginine, and radioactivity, showed that the rate of absorption of each amino acid depended not only on its own but also on the concentration of the other amino acid. Raising the concentration of one lowers the rate of absorption of the other. A tenfold increase in lysine concentration lowered the rate of absorption of arginine to 54% of its former rate, while increasing the rate of lysine approximately fivefold. A tenfold increase in the molar concentration

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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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