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ited to 4 lb per calf daily), alfalfa hay, and reconstituted milk. The latter, containing 11.6% solids-not-fat and 2.64 or 0.88% fat (milk fat in cream, or lard oil) plus vitamins and an antibiotic, was fed daily at 8, 6, and 5% of birth weight for Weeks 1-4, 5, and 6, respectively. Mean body weight gains (lb) to 4, 8, and 16 wk for 2.64% milk fat, 0.88% milk fat, 2.64% lard oil, and 0.88% lard oil, respectively, were 26, 47, and 178; 26, 47, and 178; 22, 46, and 170; 20, 44, and 158. Differences in body weight gain to 16 wk, due to source of fat, were significant at $P = 0.05$, but those due to level of fat were not. Differences in increases in height at withers were not significant. Starter consumption was greater during the early weeks for groups fed the low-fat diets. Total starter and hay consumption was greater for the milk-fat groups. The incidence of diarrhea was low.

P106. Early effects of dietary glycerides and fatty acids on serum fatty acids (free and combined) levels in young dairy calves. A. P. MA, D. K. HOTCHKISS, AND R. S. ALLEN,* Iowa State University, Ames.

After approximately 2 wk on a reconstituted skimmilk diet, five Holstein calves (ranging in age from 3 to 7 wk) were fed, by nipple pail, single test meals of reconstituted skimmilk, to which were added various lipids at a 3% level. The lipids (triolein, tristearin, tripalmitin, monoolein, monostearin, and oleic, stearic, palmitic, and linoleic acids) were tested using a partially balanced incomplete block design. Serum fatty acids (free and combined) of blood samples taken at 0, 3, 6, 9, 12, and 24 hr after feeding the test meal were analyzed by gas-liquid phase chromatography. There were definite but variable changes in the serum fatty acid levels with respect to time after consumption of the test meals. Tripalmitin gave significantly higher ($P < .05$) serum palmitic acid levels than all other dietary lipids except oleic acid. Tristearin and monostearin gave higher ($P < .05$) serum stearic acid levels than triolein. Oleic acid and triolein gave higher ($P < .05$) serum oleic acid levels than tristearin and stearic acid. Linoleic acid gave higher ($P < .01$) serum linoleic acid level than the other lipids. Tripalmitin gave higher ($P < .05$) serum arachidonic acid levels than either monoolein or oleic acid.

P107. Fate of digesta throughout the alimentary tract of calves. M. G. YANG* AND J. W. THOMAS, Michigan State University, East Lansing.

Male Holstein calves fed equicaloric and equinitrogenous rations consumed significantly more of a 27% fiber ration per 100 lb of body weight than a 7% fiber ration. This increase in consumption was accompanied by a 66% increase in the dry matter found in the rumen, abomasum, small intestine, and cecum, although the proportion of dry digesta in respective parts of the tract was similar for both groups. Digestibility of nutrients between successive portions of the tract was measured, using the lignin ratio technique. Calves fed the 7% fiber ration had higher total and rumen digestibility for Ca, P, ash, dry and organic matter than those fed 27% fiber ration. The reverse was found for fiber. The rumen accounted for 75 to 106% of the total digestibility of these nutrients. Ration differences for other tract segments were small. More nutrients were secreted than absorbed in the proximal half of the small intestine. The whole tract contained two moles of VFA from the 7% fiber and six moles from the 27% fiber; 79 and 75% of this was in the rumen, respectively. Molar per cent of acetic and propionic acids were 66 and 24 versus 75 and 17 for the rumen and lower tract, respectively.

P108. Use of a re-entrant ileal fistula technique to study utilization of carbohydrates by the young bovine. J. L. MORRILL,* N. L. JACOBSON, AND A. D. MCGILLIARD, Iowa State University, Ames.

Four calves were fitted at 3 wk of age with re-entrant ileal fistulae located about 5 in. orad to the ileo-cecal junction. The calves were fed milk, or milk with sucrose or starch added, at various ages from one to four and one-half months. The diet was supplemented with vitamins, trace minerals, and an antibiotic. Polyethylene glycol (PEG) was added as a marker. Ileal and fecal samples were taken at 0, 3, 6, 9, and 12 hr after the morning feeding.

The utilization of lactose orad to the fistula was high, and digestion in the entire digestive tract was essentially complete. The average for apparent digestion of sucrose by the four calves was 84%. The recovery of sucrose at the fistula varied with time of sampling and was usually highest at 3 and 6 hr after feeding. Limited observations indicated that 87% of the ingesta that passed the fistula in the 12-hr period passed in the 6-hr interim from 1.5 to 7.5 hr after feeding. Based on these data, sucrose digestion orad to the fistula averaged 41% for the four calves. Digestion of starch orad to the fistula could not be determined, since the starch did not pass at the same rate as PEG.

P109. Forage-milk relationships of Cs^{137}, I^{131}, and Sr^{90} in one herd of cows. G. M. WARD* AND J. E. JOHNSON, Colorado State University, Fort Collins.

Composite milk samples were collected three times a week from two groups of cows in the University herd. One group received some hay and free-choice consumption from an irrigated pasture. The other group was fed

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(about 25 lb per head per day) green-cut alfalfa and free-choice hay. The milk levels of Ca^{45} and I^{131} were determined by gamma spectrometry. Forage samples were collected and analyzed bi-weekly. Composited weekly milk samples and forage samples were analyzed for Sr^{90} by the Health and Safety Laboratory, New York City.

Radionuclide levels were consistently higher and more variable in the milk of pasture cows than those in dry lot. Several peak levels of I^{131} were found during this period. On changing to stored feed, milk levels of the pasture group decreased within several weeks to levels produced by the control group.

Seasonal trends in Ca^{45} and Sr^{90} concentrations of the forage were reflected in milk levels, but on a day-to-day basis they were not, indicating that transport from forage to milk is very fast or influenced by other factors involved in the passage of fallout into milk.

P110. Relation of milk secretion to iodine in milk. J. K. Miller, E. W. Swanson,* and R. G. Cragle, UT-AEC Agricultural Research Laboratory, Oak Ridge, Tennessee.

Eight cows averaging 23.2 lb daily milk yield and their identical twins in later lactation averaging 10.7 lb were dosed with 2 mc NaI^{131}. Average seven-day I^{131} excretions for higher compared to lower yielders were 6.8 and 3.6% ($P < .01$) in milk, 42.8 and 46.6% ($P > .24$) in urine, and 31.5 and 24.6% ($P < .01$) in feces. Percentage of milk I^{131} associated with protein averaged 12.1 and 13.9 ($P < .01$), respectively. Iodine^{131}/milliliter milk indicated greater secretion of iodine by higher yielders was primarily due to greater yield. Milk I^{131}/plasma I^{131} ratios were 1.6 in higher vs. 1.4 in lower yielders. In eight experiments with five cows, right (R) and left (L) udder halves were milked at 8- and 32-hr intervals, respectively, resulting in 41% ($P < .01$) lower daily production from L. Two millicuries NaI^{131} were administered i.v. after R was milked and L contained a 24-hr milk accumulation. Concentration of I^{131}/ml L milk averaged 26% ($P < .01$) higher than R for 144 hr following dosing. R vs. L milk PBI^{131} values were 11.9 vs. 7.1% ($P < .05$) at 8 hr, 12.5 vs. 15.7% ($P < .05$) at 40 hr, and 14.3 vs. 17.6% ($P < .05$) at 72-hr post-dosing.

P111. Improved apparatus for perfusion of isolated organs. J. B. Holter,* R. D. McCarthy, and E. M. Kesler, Pennsylvania State University, University Park.

A perfusion apparatus was designed and built for maintaining an isolated organ under conditions simulating the in vivo state. Provision was made for maintenance of nearly constant temperature, control of humidity, oxygenation of the venous blood, and measurement of blood pressure and flow rate. The artificial heart, built by H. C. Reynolds, was designed so that the number of strokes and the volume per stroke could be varied. In routine use it was found that blood pressure could be reduced by the addition of dibenamine·HCl. If desired, evolved carbon dioxide can be collected. The apparatus is mounted on a cart, permitting easy transport. It is constructed mostly of plastic, thus eliminating contact between metal and blood. It is easily disassembled for cleaning. As built, it is of a size suitable for perfusion of livers, rumens from goats or sheep, and mammary glands from goats. These organs have been successfully perfused. Details of construction and operation will be presented.

P112. Ruminal tissue metabolism of blood organic acids and glucose. S. L. Spahr,* E. M. Kesler, and J. B. Holter, Pennsylvania State University, University Park.

The metabolism of blood organic acids and glucose by rumen tissue of the goat was investigated using the rumen perfusion technique. Defibrinated blood with added glucose, butyrate, propionate, and acetate-1-C^{14} was perfused for 60 min through the circulatory system of an emptied rumen (Experiment 1) and a full rumen (Experiment 2). A vasodilator (dibenamine·HCl) was used to reduce vasoconstriction. In Experiment 1 blood concentrations of glucose, butyrate, propionate, acetate, and formate decreased, whereas concentrations of lactate + betahydroxybutyrate increased. In Experiment 2, considerable quantities of valerate, butyrate, propionate, and acetate were absorbed. Blood concentrations of glucose decreased, lactate + betahydroxybutyrate increased, and formate varied at different sampling times. In both experiments radioactivity in blood acetate decreased to about 50% its original level. These studies indicate that blood organic acids and glucose are metabolized by rumen tissue to a considerable extent. It is suggested that attempts to measure the rate of absorption of organic acids and glucose in intact ruminants should include not only blood flow rate, arterial and venous metabolite concentrations, but also metabolite production by the organ, utilization of arterial metabolites, and utilization of metabolites being absorbed.

P113. Oxidation of acetate by sheep liver homogenates. E. D. Mayfield,* Jack L. Smith, and B. Connor Johnson, University of Illinois, Urbana.

It has been previously reported (Proc. Soc. Exptl. Biol. Med., 99:580. 1958.) that perfused goat liver did not remove acetate from perfusing blood which contained added acetate. In addition, Gallagher and Buttery (Biochem. J., 72:575. 1959) could not demonstrate the oxidation of acetate by sheep liver mitochondria. However, in vivo the acetate

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Isotonic solutions buffered each at pH 5.0, 7.6, or 9.0 were perfused through the uterus at .0188 ml/min. Each solution contained 10 mg/100 ml of the drug. Perfusion was stopped after 4 ml had been introduced. The uterus was then blown out with a clean syringe, the material collected, and its volume and pH determined. Ten milliliters of drug-free solution were passed through the uterus, collected, and volume was measured. Total drug concentrations were determined and percentage absorption calculated. Lipid-solubility was determined by measuring percentage absorption of each drug in chloroform. Each drug was perfused into 10 uteri at pH 7.6. Statistical analyses showed that both the pKa and lipid-solubility of the drug have an effect on the percentage absorption ($P < .05$). Then each drug was perfused at pH 5.0 and 9.0. The percentage absorption increased significantly ($P < .01$) when the drug was in acid solution. These acids appear to cross the guinea pig uterine membrane by passive diffusion.

P121. Relationship of milk fat and body fat concentrations of organochlorine compounds in cows. G. F. Fries* and G. S. Marrow, Jr., Animal Science Research Division, USDA, Beltsville, Maryland.

Data were pooled from 4 experiments with dieldrin, DDT, DDD, DDE, or a polychlorinated biphenyl (Aroclor 1254). The constant intake ranged from 10 mg/day DDE to 200 mg/day Aroclor 1254. Samples of body fat were obtained at several times during and after feeding, and ranging from .15 to 60 μg/g. At any given time during feeding and at all times after feeding, the milk fat-body fat relationship was described for all compounds by the general equation $Y = bX$, where Y is μg/g in milk fat, X is μg/g in body fat, and b is a constant. During feeding, b was greater than 1 and decreased as the feeding period increased. At 60 days b was 1.53 (1.38 to 1.70, $P < .05$). After feeding stopped, pooled data for all times and all compounds were described by the same b, .74 (.71 to .77, $P < .05$). When the source of contamination is removed, body fat levels reliably estimate future milk levels of organochlorine compounds if the cows are not lactating. Similarly, compounds in milk fat reliably estimate those in body fat if the cow is lactating.

[redacted] C. C. Calvert* and L. W. Smith, Animal Science Research Division, USDA, Beltsville, Maryland.

Four lactating Holstein cows were fed dried manure from broilers fed 3-nitro-4-hydroxyphenylarsonic acid as a feed additive. The amount was slowly increased so that each cow received approximately 3.5 kg of manure per day for the last 5 days of 18 days. The broiler manure contained 18.1 mg/kg arsenic. Arsenic consumption averaged 40 mg/cow/day. Arsenic did not appear in milk from cows as a result of this arsenic intake. Therefore, in a second experiment four groups of two cows each were fed either 3.2 or 1.6 mg arsenic per kilogram of body weight from arsanilic acid or 3-nitro-4-hydroxyphenylarsonic acid. These arsenicals were fed by capsule daily for 5 days. Arsenic in milk increased from .015 to .028 mg/kg in cows fed the 3.2 arsenic from arsanilic acid. Arsenic concentration in milk did not appear to be increased in the other three groups. Blood arsenic concentrations increased in cows fed 3.2 mg of both arsanilic acid and 3-nitro-4-hydroxyphenylarsonic acid but not in those cows receiving 1.6 mg of either arsenical.

[redacted] M. R. Bennink, R. A. Frobish*, C. L. Davis, J. H. Clark, and B. O. Brodie, University of Illinois, Urbana.

The present recommendation for dairy cows contaminated with chlorinated hydrocarbons is to feed phenobarbital (PB) and activated charcoal to decontaminate the animal. However, little is known about the metabolism and excretion of barbituates in the lactating cow. To study this problem, sodium PB (6 g/day) was administered for 10 days into the rumens of two lactating Holstein cows. On the 10th day ^{14}C-labelled PB (5-ethyl-5-phenobarbituric-2-^{14}C acid) was mixed with the unlabelled material prior to dosing. Total milk, urine, and feces were collected with 68 and 92% of the isotope being recovered after 6 days. Percentages of the recovered dose in milk, urine, and feces were 5.6 and 9.6, 93.1 and 94.1, 1.3 and 2.5. Half lives were: milk, 41.3 and 39.8 hr; urine, 30.6 and 28.5 hr; and feces, 46.5 and 46.5 hr. Highest specific activity occurred 10 and 16 hr after dosing in the milk and urine. If 6 g of PB/day is fed continuously, less than .5 ppm/day would be expected in the milk 7 days after the last dosage.

[redacted] W. J. Miller, E. P. Gentry, and D. M. Blackmon, University of Georgia, Athens.

Following a standardization period, a high beet pulp, low zinc diet (14 ppm) was fed without and with supplemental zinc (35 ppm total Zn) to 10 first-lactation Holstein cows for 6 weeks. The low zinc diet did not adversely affect milk production, fat-corrected and solids-corrected milk, milk fat, solids-not-milk, or feed intake, indicating that zinc intake was adequate for these functions. However, zinc content of the milk was 23% lower. Likewise, dietary zinc in milk increased from 9 to 18%. Thus, the first adjustment on the low zinc diet was a reduction in zinc content in milk combined with

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more efficient absorption and translocation of zinc to milk. Milk zinc content of a cow was highly repeatable from one measurement period to another, indicating that factors affecting milk zinc can be investigated more efficiently if standardization period data are used in covariance analyses.

P126. "Zinc metabolism [illegible] cows fed supplemental mineral zinc diets." R. E. Stake*, M. W. Neathery, W. J. Miller, R. P. Gentry, and D. M. Blackmon, University of Georgia, Athens.

Ten first lactation Holstein cows were given a single tracer oral ^{65}Zn dose 4 weeks after initiation of a low-zinc diet (14 ppm) which was fed without and with supplemental zinc (35 ppm total Zn). Net ^{65}Zn absorption (not excreted in feces for 14 days) increased from 34.8 to 53.4% of the dose with the low-zinc intake. Following dosing, 6.2 and 14.3% of the dose were secreted into the milk of control and low-zinc fed cows over 14 days with highest amounts on Day 3. Thus, the low-zinc diet resulted in a higher percentage of the dose being absorbed, a higher percentage of which went into milk. The more biologically active tissues (such as liver, spleen, lung, and pancreas) contained higher ^{65}Zn concentrations than the less active ones such as muscle, bone, and skin. In every major body tissue ^{65}Zn was higher in cows fed the low-zinc diet. Likewise, zinc specific activity was measurably higher in milk and tissues of cows fed the low-zinc diet, indicating greater affinity for dietary zinc.

P136. Calcium, phosphorus and magnesium absorption in dairy cows fed starch supplemented diets. J. F. Bargeloh*, J. W. Hibbs, and H. R. Conrad, Ohio Agricultural Research and Development Center, Wooster.

In Ca, P, and Mg balances starch was added to a ration of alfalfa meal, diammonium phosphate, and alfalfa hay (Experiment 1) or starch replaced ground corn in a ration of alfalfa meal with either bone meal or monosodium phosphate and grass hay (Experiment 2). Phosphorus content of rations was equalized. In Experiment 1, Ca and P digestibility coefficients were 17.3 and 19.3, with starch, and 26.1 and 23.0 without added starch. In Experiment 2, Ca, P, and Mg digestibility coefficients were 4.7, 22.8 and 18.3, with starch, and 3.7, 23.8 and 17.4 where ground corn replaced starch. The marked increase in Ca absorption previously shown when grain was added to alfalfa diets did not occur when P was equalized. Rate of passage of undigested dry matter was the most important variable controlling Mg absorption. Fecal Mg increased at an increasing rate with increased fecal dry matter.

P137. Calcium:phosphorus ratio and intake effects on parturient paresis and milk production responses to methionine analog. R. W. Gardner*, and D. J. McClellan, Brigham Young University, Provo, Utah.

A ration of 2 kg alfalfa hay, 20 kg corn silage, and 1.8 kg soybean meal was group fed to 50 dry Holstein cows (D1) for comparison with a ration of 7.0 kg alfalfa hay, 4 kg corn silage, and 1.8 kg of a concentrate mix (87% soybean meal, 4% cane molasses, and 9% monosodium phosphate) fed to 45 dry cows (D2). Average daily calcium and phosphorus intakes were 62, 27 g (D1) and 140, 65 g (D2), with Ca:P ratios of 2.3:1 (D1) and 2.1:1 (D2). Incidences of parturient paresis were 0 of 50 (D1) and 1 of 45 (D2). Lactation rations were: 13.6 kg corn silage, 7.3 kg alfalfa hay, and 10 kg of a concentrate mix. Three protein sources were compared using 35 cows per treatment: cottonseed meal plus 22 g methionine hydroxy analog/cow/day (R1); meat and bone meal (R2); cottonseed oil meal (R3). Milk, fat, and solids-not-fat production (kg/day) for the first 105 days of production were: 29.2, 1.02, 2.47 (R1); 30.6, 1.07, 2.62 (R2); 30.0, 1.07, 2.57 (R3), ($P > .05$).

P138. Effects of dietary calcium:phosphorus on parturient paresis and blood composition. D. J. Burkhart*, D. C. Beitz, and N. L. Jacobson, Iowa State University, Ames.

Twenty-six Jersey cows (second lactation and beyond) were allotted to two groups according to lactation number, milk production, and previous incidence of parturient paresis (PP). Fourteen cows were fed (for up to 12 months before parturition) a complete feed of corn silage and concentrate with Ca:P of 1.1:1. The others were fed similarly except $CaCO_3$ was added to increase the Ca:P to 2.3:1. Phosphorus and total protein as percentage of dry matter averaged .25 and 14.5 for each diet. Venous blood was collected regularly from 4 weeks prepartum to 4 weeks postpartum. Plasma was analyzed for Ca and Mg by atomic absorption and for inorganic P (P_i) by colorimetry. Hypocalcemic animals were treated with a P- and Mg-free borogluconate solution. Seven of the 14 cows on the 1.1:1 diet and 9 of the 12 on the 2.3:1 required treatment for PP. Time on the diets before parturition had no apparent effect on incidence of PP. Plasma Ca and P_i were lower from 48 hr prepartum to 48 hr postpartum in PP than in non-PP cows. Magnesium was inversely related to Ca. There were no major dietary effects.

P139. Effects of sulfur source on ration digestion, nitrogen utilization and sulfur balance in growing steers. L. S. Bull* and J. H. Vandersall, University of Maryland, College Park.

A diet of corn silage, corn meal, and urea was fed to eight growing Holstein steers either alone (C) or supplemented with Na_2SO_4 (Na), DL-methionine (M), or M-analog (MA). Sulfur content (DM) of C was .19% and was .32% in

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