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THE CONTROL OF FOOD INTAKE

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Operant conditioning methods, in which animals learn to perform simple responses such as pushing a panel in order to obtain a measured portion of food, permit the detailed examination of the pattern of food intake. The hypothalamus has been the main region implicated in the neural control of food intake, with the ventromedial region acting as an inhibitory 'satiety' mechanism and the lateral region serving to facilitate food intake.

The role of the hypothalamus has been studied by means of discrete lesions, and also by localized electrical or chemical stimulation. The recording of the electrical activity from this region of the brain during states of hunger and satiety has also provided evidence that it is of importance in the regulation of food intake.

The relation between thermoregulatory control systems and those concerned with food and water intake has been demonstrated using localized thermal stimulation of the hypothalamus.

The neural control system is influenced not only by sensory factors such as olfaction and taste but also by the post-ingestional consequences of feeding which may generate satiety signals from the gastro-intestinal tract, particularly the stomach and duodenum. The role of hormones such as cholecystokinin is of special interest.

Humeral factors such as blood levels of glucose, amino acids and possibly substances liberated from the body fat depots may also influence the neural control system.

It is unlikely that any single factor is paramount in the control of food intake.

FACTORS AFFECTING THE RATE OF FEED INTAKE OF COMPOUND FEEDS BY DAIRY CATTLE

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Increased rates of through-put of dairy cows in modern parlour systems limit the amount of concentrates which can be offered to each

cow without disruption of the routine. Interest has thus developed in methods of increasing rates of concentrate feed consumption. A trial was conducted to evaluate palatability of different diets. Six treatments were compared using six blocks of four cows over four periods of a week. Within each block four of the six treatments were tested such that treatment comparisons were partially balanced. Over the four weekly periods the treatments were changed in a Latin Square design. There were six observations in each weekly period. The time taken for each cow to eat two 4 lb lots of food with a ten minute interval between them was recorded.

Results showed no significant differences due to palatability of the different feeds offered nor to differences between weeks. The cows ate the first four pounds offered significantly faster than the second four pounds. They ate significantly faster on the last recorded period of the week compared to the first two.

Although not part of the original plan, observations showed a family effect on rate of feed consumption. Results from four cows of each of five families were analysed, and these showed highly significant family effects suggesting that breeding can have a marked effect on rate of compound feed intake and therefore through-put in modern parlour systems.

THE GRAZING BEHAVIOUR AND HERBAGE INTAKE OF CATTLE AND SHEEP

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The daily herbage intake of grazing animals is the product of the time spent grazing, the rate of biting during grazing and the size of individual bites. Recent studies on these variables, and the ability of the animal to modify grazing behaviour in order to maintain herbage intake under conditions of pasture restriction, were reported.

The size of individual bites of herbage fell sharply from 2.0-3.0 mg OM/kg LW to

0.5-0.7 mg OM/kg LW as the weight of standing crop of herbage was reduced from 3500 kg OM/ha to less than 2000 kg OM/ha (measured to ground level). Simultaneously grazing time increased to maxima of 10.5 h and 12.0 h for calves and lambs respectively, and the rate of biting increased to maxima of 60-65 bites/min for calves and 45-50 bites/min for lambs, but tended to decline on particularly sparse pasture.

The total number of grazing bites per day is unlikely to exceed 96 000 for cattle or sheep. Thus a mean bite size of at least 0.8 mg OM/kg LW is required to ensure an intake of 30 mg OM/kg; when bite size falls below this level the animal is unable to compensate by increasing biting rate and/or grazing time. Under strip-grazing management animals made no attempt to compensate for a reduction in bite size by increasing grazing time. These responses are explained in terms of the balance between the feeding drive and conflicting drives related to either the difficulties of grazing short pasture or the demands of alternative activities.

Changes in herbage intake in response to increasing pasture restriction were similar in calves and cows, and in calves and lambs, despite differences between and within species in grazing time and rate of biting.

DIET SELECTION BY THE GRAZING SHEEP

By J. A. MILNE *ARC Hill Farming Research Organization, Edinburgh*

The major factors influencing diet selection by the grazing sheep were reviewed and discussed with particular reference to intrinsic animal factors and to factors related to the characteristics of the sward. Factors of animal origin discussed included sensory perception, experience and the food requirements of the sheep. Sward characteristics considered were quantity and composition of the sward and distribution of plant components within the sward. The complexity of the relationships between the grazing sheep and plant communities was stressed.

From current research the importance of factors influencing diet selection by sheep from three hill vegetation types was examined. The vegetation types were (a) Common heather, *Calluna vulgaris*, (L. Hull) illustrating selection from a single species sward (b) a grass and heather sward as an example of a two-species sward where the species are spatially distributed and (c) a *Trichophorum/Eriophorum* bog where five co-dominant species are found in close association.

A simple conceptual model of diet selection by sheep grazing these hill vegetation types was presented.

HERBAGE INTAKE OF GRAZING SHEEP

By M. J. GIBB *The Grassland Research Institute, Hurley, Berks*

Recent studies with grazing sheep at the Grassland Research Institute have been mainly concerned with defining the effects of herbage allowance on the intake of perennial ryegrass swards.

Within the range of herbage allowances of 25-120 g of herbage OM/kg live weight of sheep/day, intakes by lambs can generally be shown to have an asymptotic relationship with allowance; progressive increments in allowance resulting in progressively smaller increments in intake. Artificially reared lambs weaned at 28 days and turned out to graze at 40 days had intakes of 21-27 g OM/kg LW/day at 12 weeks of age, and 23-30 g OM/kg LW/day at 16 weeks of age. However, lambs sucking their ewes and grazing at allowances over this range had lower intakes of 17-23 and 19-27 g herbage OM/kg LW/day at 12 and 16 weeks.

Using the same range of allowances as in the lamb studies intakes of herbage by ewes reached a maximum during the third week of lactation of 30-42 g OM/kg LW/day, and declined to 19-29 g OM/kg LW/day by the 12th week of lactation. However, changes in live weight of lactating ewes makes the interpretation of intakes expressed per kg difficult. Intakes of herbage by dry ewes were not effected by allowance within the range 25-120 g OM/kg LW/day.

On pure perennial rye grass and red clover swards weaned lambs consistently ate more red clover than ryegrass.

GRAZING PATTERNS ON PASTURE DRESSED WITH SLURRY

By B. F. PAIN*, J. D. LEAVER* AND D. M. BROOM† **National Institute for Research in Dairying, Shinfield, Reading, †Zoology Department, Reading University*

Cow slurry is most beneficial as a grassland fertilizer, when applied in the spring, but this may affect the acceptability of the sward to grazing cattle.

Applications were made in January or in March at rates up to 100 tonnes/ha on paddocks to be grazed at the beginning of May and re-grazed at intervals during the season by dairy heifers. Animal intakes were not affected by the slurry treatments, even at

the beginning of the season, but grazing pressures were then low. The pattern of grazing was affected up to the beginning of June by slurry spread in March. The time between lowering the head to graze and raising it again, i.e. grazing bout length, was shorter on paddocks receiving the heaviest and most recent slurry applications. The animals also spent less time lying and ruminating on these paddocks.

In a second experiment heifers were allowed a choice of swards dressed at 0, 25, 50 and 100 tonnes slurry/ha seven weeks before grazing and they showed preferences for areas with little or no slurry. On the first day of grazing this was evident whether the animals were 'standing', 'lying' or grazing. As the grass on the no-slurry plots was eaten down, the time spent on the areas with slurry increased, but over the four-day period herbage consumption and time spent grazing were inversely related to slurry application rate. Changes in the location of lying with time followed a similar pattern to grazing.

During the second grazing 13 weeks after slurry application preferences for areas with little or no slurry had almost disappeared.

These results emphasize that grazing patterns are affected by time and rate of slurry application and grazing pressure.

WATER INTAKE OF DAIRY CATTLE

By M. E. CASTLE *Hannah Research Institute, Ayr*

The intake of drinking water of lactating and dry dairy cows receiving a wide range of winter rations and also under grazing conditions in summer was recorded. In winter the major factors affecting the voluntary intake of drinking water were the milk yield, the total dry matter intake, and the dry-matter content of the ration. In summer the main factors influencing water intake were rainfall, maximum air temperature and the dry-matter content of the grazed herbage. These results obtained in controlled feeding experiments were confirmed by data collected in fourteen herds of cows with a total of 840 animals. From these results, and from a series of behaviour studies of the pattern of drinking, recommendations are made for the provision of drinking water for dairy cows under modern conditions of housing, feeding and management.

SUCKING BEHAVIOUR OF LAMBS

By J. BAREHAM *UFAW, Potlery Bar, Herts.*
A multitude of inter-related factors affect the time lambs take to first suck.

Compared with multiparous ewes, in general primiparous mothers have a longer labour and are slower to stand and lick their lamb after birth. The ewe poorly fed in late pregnancy tends to produce a small lamb and since cooling, with subsequent loss of energy reserves is proportional to surface area, this lamb is more adversely affected by bad weather. There is an inverse correlation between birthweight and standing time, hence single, male lambs which are heavier than female, twins, stand up quicker. The time between standing and sucking is relatively constant.

As the ewe licks her immobile lamb soon after birth 72% of the lamb's teatseeking activities are directed to her head region. At this time the ewe licks the front (62%) rather than the back of her lamb (38%). Once the lamb stands the ewe mainly licks the lamb's back end (63%) but does not direct her offspring to the udder. The lamb's initial teatseeking movements are randomly directed back and forth along the mother's flank. Once the udder is first contacted, but before sucking, teatseeking then increases to its maximum level (55% of observation period) and is concentrated in the udder area. Initially most contacts with the udder area are preceded by teatseeking in other regions of the ewe's flank. By 15-24 hours after birth, visits to the udder are direct in the majority of cases. This learnt discrimination appears to depend on an intact visual sense as 1-2 day-old blindfolded lambs, placed with their mother after a period of food deprivation, do not suck, whereas their twins wearing an 'open', control blindfold do.

The development of sucking behaviour in sheep was discussed in relation to other ungulate species. After the initial post-partum period ungulate young can be classified as 'hidlers', which suck infrequently but for long periods, and 'followers', which suck little and often. The evolutionary significance of these two trends was discussed. The aberrant sucking patterns which can develop in lambs reared artificially was also discussed.

PRELIMINARY EXPERIMENTS ON COLOUR VISION IN CATTLE

By G. THINES AND M. SOFFIE *Centre de Psychologie Expérimentale et Comparée de l'Université de Louvain—3041 Pellenberg, Belgium*

A series of experiments was conducted on six Friesian heifers (age 18 months) using six chromatic stimuli in a conditioning situation. For the first 18 trials, each individual was

reinforced with food pellets presented in an experimental trough in front of which a spectrally calibrated coloured paper was displayed vertically. Each animal was presented with a single colour (blue, green, yellow, orange, red or purple). Then each animal was tested in a discrimination experiment, in which it was offered a choice between the training colour and a grey of equivalent luminosity. In the third stage, each animal had to make a choice between the training colour and five greys of different shades, one of which was equivalent to the training colour in luminosity. In the final test, the animals which had showed significant discriminative responses in the second and third stages, were offered a choice between the six colours. In all cases, only the training colour was reinforced. Results showed discrimination for all colours used, except for blue and purple. Orange was, however, confused with yellow. This preliminary experiment is now being completed with further controls to ascertain the relative influence of perceptual discrimination as such and inter-individual variability.

GRAZING PATTERNS OF HORSES

By M. ARCHER *Equine Research Station, The Animal Health Trust, Newmarket*

Horses show a selective pattern of grazing, with some areas of a pasture being used for excretion and some for feeding. Two series of experiments demonstrated the relative palatability of some grasses and herbs and showed the horses' marked preferences for some species. They preferred short and young growth and many of the more fibrous grasses which cattle do not like.

Horses avoided grazing near their faeces, but did not avoid urine placed separately on the pasture. If left unchecked there is a build-up of potassium salts in the soil where the horse excretes; in extreme cases there can be about 300% more potash on the ungrazed areas than the feeding areas, and this adversely affects the growth of the plants. The severity can be estimated by observation. Once the pattern has been established it persists and may lead to as little as 10% of the pasture being grazed. On an area severely over-grazed for a number of years, ploughing and reseeding sections annually showed that even after two years of cereal crops the same areas were being grazed, plus additional patches of 15% to 20%.

Heavy grazing by cattle evens out the grasses and also the potash levels. Additionally, cattle will graze the lush grasses that are not liked by horses. Application of farmyard

manure appeared to disguise the horse excreta to a certain extent and allowed even grazing throughout a paddock for a period of time.

COMPARATIVE AND DEVELOPMENTAL STUDIES OF FEEDING BEHAVIOUR IN DOGS AND CATS

By R. A. MUGFORD *Animal Studies Centre, Pedigree Petfoods, Melton Mowbray, Leics*

Available information on prey selection, hunting strategies and feeding behaviour by representative wild species of the *Canidae* and *Felidae* was briefly reviewed, and compared with that for the domestic and feral dog and cat. The domestic dog (and to a lesser extent, the cat) is capable of adaptation to great variations of nutritive values, food origins and feeding schedules. Both dogs and cats generally select novel foods in preference to those more familiar, recency being more important than primacy in establishing the neophyllic selection pattern. Cats select food offered at body temperature in preference to the same offered at higher or lower temperatures. The dog is not so temperature sensitive in its eating habits as the cat.

Food intake regulation and consumption rates were discussed from a comparative standpoint, and related to early feeding and social contacts, genetic and hormonal factors. The precision with which both dogs and cats eat to meet energy requirements depends upon the timing and social context of the meals, and the variety and palatability of available foods.

Both species can develop strong and persistent conditioned dietary aversions and attachments. Odours from distinctive food items can provide the sole basis for both normal and toxicoses induced patterns of dietary selection and recognition. Domestic dogs have been observed to maintain their young entirely upon regurgitated food, though this is rarely seen under normal husbandry conditions. Experimentally epimeletic vomiting can be provoked in the post-lactating bitch if her puppies are not allowed direct access to food.

BEHAVIOURAL PROBLEMS IMPLICIT IN GRAZING BEHAVIOUR

By M. KILEY *Ethology and Neurophysiology Group, School of Biological Sciences, University of Sussex*

Behavioural problems encountered in grazing domestic species were reviewed. Grazing is not only affected by the availability of the herbage, its phenology, structure and species composition. It is also affected by such factors

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as the presence of disliked species in the sward, the contamination of herbage by the species' faeces, the animal's own characteristics such as its age, sex, experience during early life, whether it is pregnant or not, the presence of companions on the pasture, the frequency of herding, availability of water and pasture during the night, and severity of the weather. Although there is little information available on many of these aspects, it is emphasized that such factors must be borne in mind when planning grazing systems.

An outline grazing system taking these factors into account, was suggested for 1) intensive grazing management of improved pasture, and 2) more extensive management, applicable in Britain to the moorlands and hills.

Although productivity is vitally important in the management of grasslands in Britain today, other aspects such as the long term effects on the countryside and amenity interests must be considered.

PATTERNS OF WATER INTAKE IN CAGED BIRDS

By J. A. HILL* AND A. J. POWELL† *ADAS, Gleadthorpe, †Huddersfield Polytechnic

There is considerable evidence of a reciprocal relationship between food intake and water intake in the domestic fowl. The possibility of rationing food intake by regulating water intake was discussed. From the welfare point of view, such a method of rationing food could be particularly attractive since it seems that birds on regulated feeding regimes may voluntarily restrict their water intake.

A brown and white strain of laying hen were maintained in experimental plots at 18°C or 24°C and were fed on a six hour, an eight hour or an *ad libitum* regime. Each treatment was replicated once. Water was monitored automatically to each of these plots over the major part of the laying cycle. The water consumption within each plot was recorded for each of 49 intervals during the 24 hour day, and food consumption within each plot was estimated separately in four week periods.

The daily pattern of water intake of birds on the six and eight hour feeding regimes suggested that feeding and drinking are closely correlated in time. Those birds on the *ad lib.* feeding regime spread their water intake throughout the 'day', although they drank most of their water in the latter part of the light period.

Quantitative relationships between water intake and the experimental variables were revealed by multiple regression analysis. Strain, food intake and ambient temperature

all affected water intake. However, these data, viewed in the context of subsequent experiments on individual birds, suggested that the quantitative relationship between food and water intake may differ substantially between birds. Regression analysis of the pooled data may undervalue the relationship.

FEEDING PATTERNS AND FOOD SELECTION OF CAGED BIRDS

By J. ALLEN AND G. C. PERRY *Department of Animal Husbandry, University of Bristol*

Twenty-four hour patterns of feeding activity were automatically recorded for laying birds in three sizes of groups each maintained at two different floor area allowances, all kept on a 16 h light-day regime. In most cases three peaks of feeding activity were observed. The first and third peaks were found in all cages and occurred early and towards the end of the light-day respectively. The second peak appeared in most recordings but was less consistent than the other two.

When the photoperiod was divided into four 4 h periods and the feeding counts analysed, significantly greater feeding activity in all groups was found to take place in the last quarter of the day. A significant interaction was also found between group sizes and floor area allowance.

A preliminary investigation was also conducted into the selection of food from the trough. Food samples were taken at 4 h intervals and compared with zero hour samples in all cases. There was a steady decline in the percentage of particles greater than 2.0 mm and an increase in those below 1.00 mm over the 24 h period. Qualitative analyses were also carried out and these revealed changes in the composition of the available food with time. The percentages of protein, fat, fibre and calcium increased, that of energy decreased and ash fluctuated.

DIET DILUTION AND FOOD INTAKE OF JAPANESE QUAIL

By C. J. SAVORY AND M. J. GENTLE *Poultry Research Centre, Edinburgh*

Experiments were described which investigated the relationship between food consumption, dietary manipulation, the size of the digestive tract, and factors affecting the short-term control of feeding.

Quail reared on a diet diluted with oak sawdust (20% by weight) ate more and had larger guts than birds kept on the same undiluted food. Gut size also varied with sex and age, being larger in females and in older birds. Dietary dilution had very little

effect on the microstructure of the gut or on the rate of passage of food. The variation in gut size could be accounted for mainly by differences in the amount eaten, and not by any inherent effect of the sawdust itself.

Quail kept on either diet took eight to 10 days to fully adjust their consumption when their diets were exchanged. Body weights of both groups changed rapidly after the change, birds weighing less when fed on the diluted food. However, all digested about the same weight of nutrients in a day, irrespective of diet, and it was suggested that the variation in body weight was due mainly to differences in the energy expended in feeding. The gut dimensions of both groups of birds changed at similar rates after the change-over, reaching the appropriate sizes for their new diets in three to four weeks.

The feeding activity of quail decreased markedly one to two hours after their diet was changed from a diluted mash (40% powdered cellulose by weight) to normal mash. This reduction was due mainly to an increase in the interval between meals whereas the size of meals did not change. Their feeding activity also decreased some six hours after a change from mash to pelleted food. This was due mainly to a reduction in meal size while the interval between meals remained much the same. It was suggested that the size of meals may be regulated by critical levels of food in the crop, or gizzard, and that meal frequency may depend on the rate at which food leaves the crop.

ASPECTS OF INGESTIVE BEHAVIOUR WHICH MAY INFLUENCE THE PRODUCTIVITY OF PIGLETS AND SOWS

By C. T. WHITTEMORE, D. FRASER AND R. L. DARROCH *School of Agriculture, University of Edinburgh*

Classification of the milk ejection phase of suckling allows the identification of nursings which, while apparently normal, yield only insignificant quantities of milk. Such nursings may comprise more than 25% of the total. The frequency and success of nursing also influences the intake of supplementary feed (creep-feeding) by piglets, creep-feeding activity being greatest in the 20-minute period following suckling. Other factors influencing the ingestion of creep feed may be the weight of the piglet, the time of day, the provision of fresh feed and the availability of trough space. An important determinant of piglet growth to the age of three to four weeks is milk intake; thereafter the level of creep-feed intake becomes the more important determinant of variation in rate of growth.

Young piglets may balance the intake of creep-feed with the supply of milk; thus there may be a negative correlation between the ingestion of milk and creep feed. Larger piglets, however, have a higher demand for nutrients earlier in life, growth potential only being satisfied by the intake of supplementary creep feed.

In the early-weaned pig the feeding pattern changes, intake increases greatly, and belly-nosing activity becomes apparent amongst some litters. Over-eating, with consequent looseness of faeces, appears to be associated with aggressiveness. Live-weight gain is positively, but weakly correlated to time spent feeding ($r = +0.37$) and negatively correlated to time spent belly-nosing ($r = -0.36$).

The appetite of the pregnant sow is about three times greater than the amount of cereal-based diet which satisfies the nutrient requirement. The ingestion of fibrous feed-stuffs may therefore serve both dietary and recreational functions. Pregnant sows given access to straw spend more time lying and less time bar-biting and head-waving. Again, in sows due to farrow, the presence of straw reduces restlessness and decreases the incidence of displacement activities. However, evidence that ingestion of fibrous feeds leads to improved productivity in sows remains insubstantial.

SOME OBSERVATIONS ON THE PERFORMANCE OF INDIVIDUAL FATTENING PIGS IN VARIOUS GROUP SITUATIONS

By I. J. LEAN AND M. K. CURRAN *Wye College (University of London)*

Conventionally, growing pigs are grouped at some point after weaning into single sex, evenly matched weight groups for fattening. Group size may vary from a minimum of four pigs in some experimental situations up to perhaps 50 per group in large commercial enterprises. Within these groups various environmental and social factors interrelate and consequently affect the overall performance of the individual.

Two series of trials are in progress. In the first series, pigs have been grouped at approximately nine weeks of age into single sex, pens of four or eight animals to give a range of allocation weights about a common mean. Liveweight gain and per feed conversion efficiencies have been recorded, and feeding has followed a time based scale. In the second series, pens of eight pigs have again been formed with a range of starting weights.

Pigs have been individually fed and the time taken to eat their meals monitored throughout the growing period.

The range of groupings so far studied had little effect on overall production and it is possible to empty fattening pens at the same time for all treatments. Examination of the between-treatment variation demonstrated differences in the weight order and ranking of

pigs within pens and the pattern in which variation between pigs occurred. The food intake/timing studies partly explained the formation of a weight based rank. For example, small differences in weight between pigs at 20 kg were associated with large differences in rates of eating. This effect was shortlived and not demonstrated at heavier weights.

