

The British Blue Cattle Society

The Secretary, Fell View, Blencarn, Penrith, Cumbria CA10 1TX
t. 00 44 (0)1768 88775 f. 00 44 (0)1768 88779
www.britishbluecattle.org info@britishbluecattle.org



Rumen management = Rumen health: Rumen health = Animal health.

With the onset of volatile feed costs for both energy and protein and the escalating variable, overhead and fixed costs, attention to detail in formulating and structuring rations for future production systems, and specifically this winter, will be essential. Managing rumen requirements, maximising the benefits of 'home' produced feeds and reducing feed wastage will help to trim costs and improve performance.

The one and only aspect of total control a livestock manager has over all his management decisions, whether it be a breeding policy, production system, marketing, geographical and climatic conditions, or cost control, is what the animal eats: animal nutrition. Whilst differing breeds, crosses, ages, gender and required performance have influence on an animals nutritional needs, given the correct parameters and managed efficiently and accurately, the rumen essentially always works in the same way:

'Remember the livestock producer and breeder feeds the rumen; the rumen feeds the animal'.

Therefore, establishing dry matter requirements, feeding sufficient energy and protein in the right balance and ratio with forages, and building the physical structure of the ration will be vital, regardless of what performance is required. The critical factor will be to ensure performance targets are met at least possible costs: therefore increasing voluntary dry matter intake, (DMI), formulating a balanced structural and palatable ration and monitoring performance will be central.

However, when considering beef production systems and their related feed programmes, other business factors should not be overlooked, but intrinsically linked:

- to add value and manage farm production, (feed and livestock):
- to spread farm overhead and fixed costs:
- to maximise throughput efficiency and therefore boost cash flow:
- to utilise and maximise farm resources:
- to produce to market forces and requirements:
- to control and reduce the unit cost of production through feed conversion efficiency (FCE), and 'manage the rumen'.

To achieve these and to 'manage the rumen' efficiently, an understanding of the ruminant digestive system and its nutrient requirements is important: crucially, rumen health contributes significantly to overall animal health.

Rumen Anatomy:

Ruminant animals have a highly evolved digestive system, capable of utilising fibrous feeds such as grass, forage/silages, hay, crop residues (straw) etc. and fibrous by-products from the human food industry. A majority of these feeds are beyond the capacity of the single stomach system, or a mammalian gastro-intestinal digestive tract.

The ruminant's digestive system includes a modified 'first' stomach and hindgut like most other animals, but what sets it apart is the large fore-stomach or rumen, which constitutes over 50% of the digestive tract, and where digestion of cellulose and other cell wall materials takes place. Rumen micro-organisms (bacteria, protozoa and fungi) break down cellulose, and who's by-products, (volatile fatty acids, mainly acetic, propionic and butyric, and proteins), are absorbed into the blood stream as an energy source: in rudimentary terms the rumen is a large fermenting vat which continually needs replenishing.

The process of rumen digestion begins in the mouth in the form of cudging. Feeding diets containing sufficient "structural", or "chewing fibre", (between 50 to 100mm in length), to stimulate rumination and cudging is an essential step in breaking down food particles and eliminating rumen acidosis and it's associated metabolic problems. At the same time the 'concentrate' component of the diet also may contain a high proportion of finely milled grains and by-products, which ferment very rapidly producing lactic acid, which lowers pH below its normal operating range, (6.2-6.5 pH). A low rumen pH causes a reduction in rumen function, loss of appetite and decrease in energy intake and microbial protein production, and irregular rumen contractions.

Rumen function will be most efficient and stable where rations are formulated to satisfy both the requirements of the rumen microbes and those of the animal itself: feeding the rumen to feed the animal.

Rumen pH condition:

Normal/healthy -	6.2 - 6.5 pH
Marginal -	5.8 - 6.1 pH
Danger/rumen acidosis -	>5.8 pH

Rumen physiology and stability:

Rumen capacity will differ with breed, age of maturity and maintenance requirements and therefore the balance of forage, energy and protein will also differ, however the physiology remains the same.

- Large capacity 100-200lts with 3 'zones', gas - liquid - solid
- Optimum digestion is at pH 6.2-6.5
- 50 - 150 litres of saliva produced daily to buffer acids
- Mixes contents of the rumen through rumination by contracting 1-3 times per minute.
- Cattle should spend 6-8 hours/day cudging
- Each cud bolus should be chewed at least 30 times before swallowing
- Most digestive problems originate from the rumen, so make diet changes gradually
- The rumen can take up to 21 days to acclimatise to new rations
- Mimic nature and grazing as far as possible by feeding little and often

Rumen stability:



The correct formulation and structure of the ration; the correct forage/fibre to concentrate ratio; the good accessibility and palatability; the best use of high quality feeds, (physical, not necessarily nutritionally), increases dry matter in-take and facilitates the animal to ruminate and cud to produce saliva to buffer the rumen, therefore enhancing rumen health and FCE.

It can take the rumen up to 21 days to fully acclimatize to new feeds and rations, so any nutritional change needs to be managed efficiently to allow for stability. However, accurate, effective and palatable rationing increases production and reduces cost; every business's prerequisite.

Ruminant nutriment requirements:

The nutrient requirements of the ruminant are completely interlinked to maintenance, production and growth rates and the type and characteristic of feeds. This synergy influences the amount of metabolised energy required, which in turn will affect the amount and type of protein.

Therefore, when contemplating a ration the four major factors that need to be considered are dry matter intake, the energy requirements and their source, the type and quality of protein and the physical structure of the ration.

Dry matter intake, (DMI):

Knowledge of the total dry matter intake requirement of the animal being fed is the single most important factor to consider. Dry matter intake should be encouraged at every opportunity and rations should be formulated to maximise palatability, metabolised energy and crude protein levels to match the expected performance

Dry matter intake is calculated as a percentage/day of the animals bodyweight: as a general guideline dry matter intake will be in the region of 2.25 to 2.5% of bodyweight for growing and dry stock, 2.5 to 2.8% of bodyweight for finishing stock, and 2.5 to 3% of bodyweight for lactating suckler cows.

A majority of feeds have accepted dry matters, especially 'dry' feeds, however, when including wet feeds, notably forages, it's important to know their specific DM. Forage analysis should ideally be carried out on a regular basis in order to pick up changes between fields, cuts, and as a result of changing fermentation patterns. A visual assessment is also a useful guide to dry matter: leaf to stem ratio, fermentation quality, effluent, etc.

Nutrient Requirements:

Having established the anatomy and physiology of the rumen it is just as important to understand the basic nutrient requirements.

The main nutritional pre-requisites are:

Water:

Energy:		
Sugar	}	<i>fermentable</i>
Starch		<i>fermentable</i>
Fibre/Forage		
Fermentation acids		<i>fermented</i>
Oils & fats		<i>non-fermentable</i>

Protein:	
Soluble Nitrogen	
Rumen Degradable	RDP
Un-degradable	UDP

Minerals:	
Major minerals:	Calcium, Phosphorus, Magnesium, Sodium: calculated as %
Trace elements:	Copper, Selenium, Iodine, Manganese, Zinc, Cobalt, calculated as milligrams/kg and in general with a maximum iron content of 2000mg/kg
Vitamins:	A, D, E & B12: calculated as international units/kg, (IU, [million units], /kg)

Water:

An obvious necessity to all life, although often forgotten, water is the major and most essential nutrient for all animals. The water content of the animal's body varies with age: The newborn calf is 75 to 80% water, but this falls to about 50% in the mature animal.

Water functions in the body as a solvent in which nutrients are transported about the body and in which waste products are excreted: many of the chemical reactions brought about by enzymes take place in solution and involve hydrolysis. Equally, the evaporation of water from the lungs and skin has a critical role in the regulation of body temperature.

As a general guide, cattle will require between 5 - 7 litres of water/kg dry matter consumed on a daily basis. The lower end of this range will reflect the requirements of dry stock, and the upper end that of high performance. It is also worth bearing in mind that cattle, being herding animals, will drink together and in many cases after feeding, so the water supply must be adequate to accommodate this period of peak demand.

In essence, all stock must have an uninterrupted supply of fresh, clean and easily accessible water at all times: water tanks should be inspected at least weekly and if contaminated cleaned immediately.

Energy:

The chart below shows daily ME requirements for maintenance and growth for growing and finishing cattle, (megajoules/head, [MJ/kgDM]). Note that to produce a 1kg/head gain/day requires over twice the energy density than for just maintenance. In general terms approximately half the food eaten by an animal growing at 1kg/day is for maintenance, with the other half for growth.

Total ME requirement, (MJ/kgDM) for maintenance and gain:

Live-weight	Maintenance	Kg/day	0.5	0.75	1.0	1.25	1.5
100kg	17		26	32	40		
150	22		34	41	50	61	
200	27		41	49	59	72	91
250	31		47	56	68	82	103
300	36		53	63	76	92	116
400	45		65	77	85	112	139
450	49		70	83	100	121	150
500	54		76	90	107	129	160
550	59		81	96	114	138	171
600	63		86	101	121	146	183
650	68		91	108	129	157	195
700	75		99	116	137	168	207

Source MAFF Technical bulletin 33

Crude Protein:

Traditionally, protein requirements and individual feed protein values are referred to as Crude Protein, (CP), which is derived from a measurement of total nitrogen in the feed (N x 6.25, or 16%). Science has attempted to refine this method in order to better meet the needs of the ruminant animal.

Crude protein was originally split into two fractions - RDP (rumen degradable protein) and UDP (Un-degradable dietary protein). Further refinements have led to the RDP fraction being split into QDP (quickly degradable protein) and SOP (slowly degradable protein) and attempts have also been made to measure rates of protein degradation.

Metabolisable protein is the total absorbed protein derived from microbial protein, (rumen) and digestible un-degradable dietary protein, (abomasum and intestine/hind gut). The most significant development has been the acceptance that the energy and protein supply are inextricably linked

Minerals, trace elements and vitamins:

Major and trace minerals along with vitamin supplementation should be routinely included in all rations.

The normal approach is to use a combined ready to use supplement designed specifically for the class of stock being fed. Variations in forage and feed-base, soil and climatic conditions may necessitate a more specialist approach using straight mineral components in addition to the standard supplementation, (e.g. higher magnesium in spring and autumn to prevent grass staggers; copper supplementation, etc.).

Minerals play a key role in every process within the body and deficiencies will lead to substandard performance: focus on the correct formulation for each category of stock.

Fibre:

The term 'fibre' refers to the requirement for efficient rumen function and can be described as either a structural or digestible proportion of the ration.

Structural fibre is supplied by fibrous "long stemmed" materials, and ideally chopped to 50 to 100mm, such as straw, haylage or hay, and is an essential component in the diet for stimulating rumination and cudging: this in turn encourages the production of large amounts of saliva, which contains essential rumen buffering agents, (bicarbonate, phosphate).

The structural description of fibre, which is a physical assessment, should not be confused with digestible fibre which is slowly digested cell wall and expressed as NDF (Neutral Detergent Fibre containing lignin, cellulose and hemi-cellulose) and ADF, (Acid Detergent Fibre containing lignin and cellulose).

A ration ideally should have 25 to 40% NDF of total dry matter and with a 'concentrate'/forage ratio of approximately 40:60. It is quite possible for a feed to have a high fibre content, as determined by chemical analysis, but for that feed to provide no structural fibre.

An example of this is the difference between sugar beet pulp and straw, both being described as having high 'fibre' levels: the former being a highly digestible fibre source which will make a significant energy contribution, the latter being a low energy feed but a very effective source of structural fibre.

Forage chop length also has a major impact, with finely chopped silages and whole crops requiring the addition of longer chopped material in order to provide sufficient structural fibre. When determining the length of structural fibre in the ration, base the fibre length on muzzle width: i.e. 25mm for sheep to 125mm for suckler cows.

Cattle dung:

A final factor to consider is dung. Pay as much attention to what comes out as dung, as goes in as feed!

Evaluation of manure can provide information on rumen function and digestion of the ration: by understanding the factors that cause changes in appearance, consistency and particle size, an interpretation of what's happening in the gut can be readily made.

In context with other 'observations, manure evaluation can help to diagnose areas for improvement in both ration formulation and management. More feed wastage takes place through bad rumen function than losses when storing, preparing, and feeding the ration!

In conclusion:

Developing and managing rumen function will have a central impact on all other aspects of management: it will improve animal performance and health, will reduce waste, will help to reduce overall costs of production and will help maximise returns.

Feeding the rumen to feed the animal will have a huge impact on achieving the full genetic potential of the animal, and is an essential management tool.

David Hendy.

[Rumen development: Rumen management'](#)

Independent Beef and Sheep Production Nutritionist.

Tel: 01206 271313

Mobile 07887 730747

E-mail 'david.hendy@blackbrookfarm.co.uk'