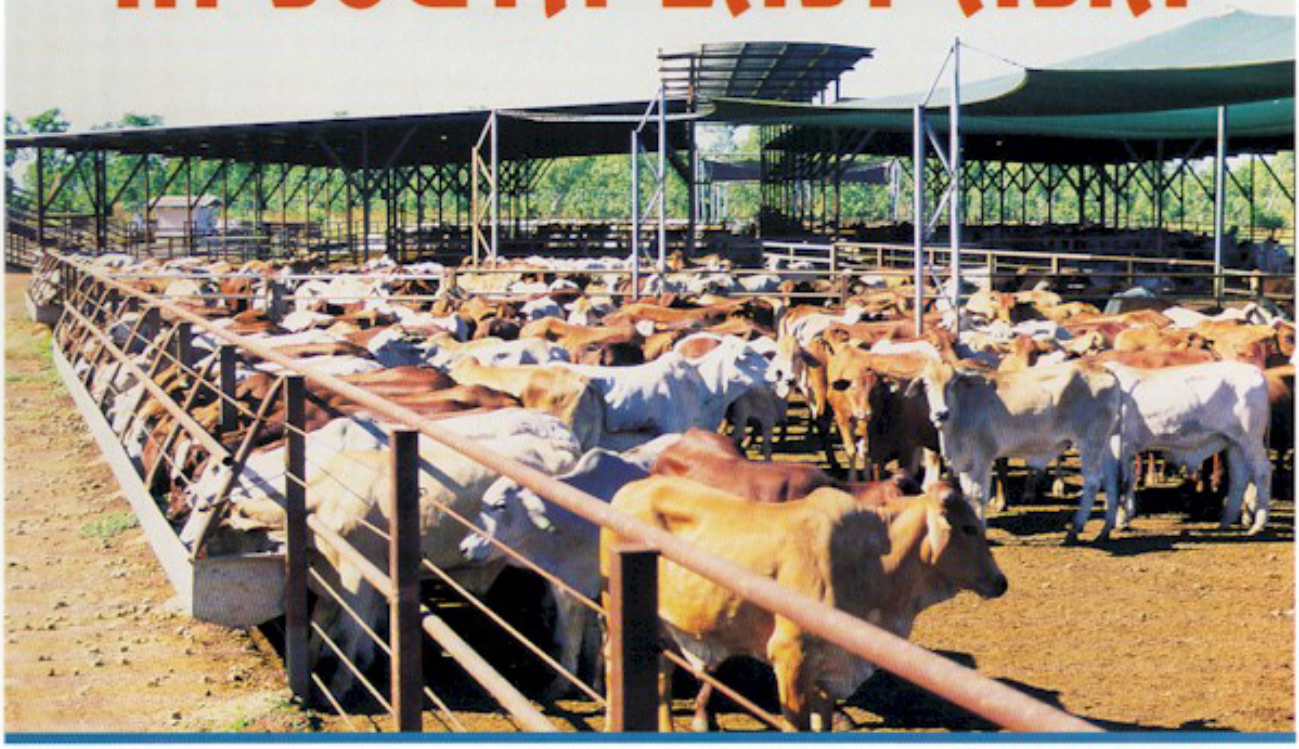
AUSTRALIAN MEAT AND LIVE-STOCK CORPORATION

NORTHERN TERRITORY LIVESTOCK EXPORTERS ASSOCIATION INC.

FEEDING AUSTRALIAN COMMERCIAL CATTLE IN SOUTH EAST ASIA



Export Yards, Berrimah, Darwin

INTRODUCTION

Over half a million feeder cattle are exported from Australia to Asia each year and this trade is expected to continue to grow. Asian feedlotters usually prefer 50% or more Brahman cross steers/heifers and liveweights (LW) of 280-400 kg (Malaysia), 330 kg (Philippines) and 350 kg (Indonesia). Cattle are finished at 380-450 kg LW and processed/marketed either within the operation or sold by liveweight to traders and butchers. Meat outlets range from the wet market to the supermarket and restaurant trade.

Lot feeding in Asia is based on the availability of a range of agricultural byproducts, whereas in the USA and Australia, cereal grains such as Corn/Maize and Sorghum make up the bulk of the feedlot ration. Agricultural byproducts tend to be much more variable in terms of their feed value compared with grains. The purpose of this technical brochure is to provide guidelines on how to feed and maximise productivity from a range of feedstuffs that are commonly available in Asia.

This Technical Brochure has been prepared from selected references, original work and field experience by:
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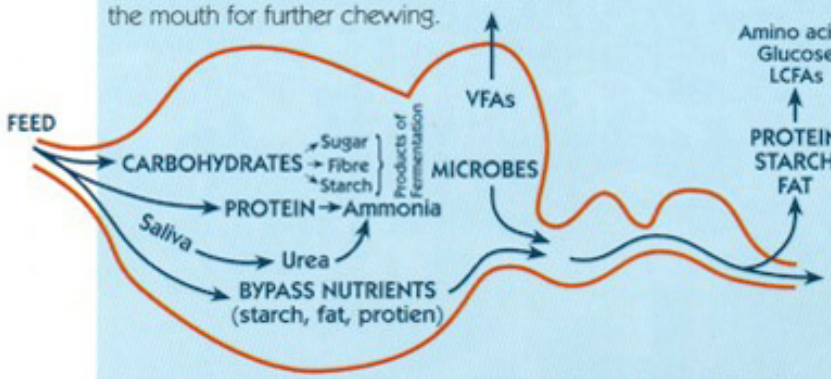
PRINCIPLES OF RUMINANT NUTRITION

The main difference in the way feed is digested by ruminant animals (cattle, buffalo, sheep and goats) compared with other livestock such as horses and pigs is that ruminants have a forestomach (rumen) in which grass, and other feedstuffs consumed, are broken down (digested) by colonies of microorganisms to provide essential nutrients to the animal.

The forestomach contains billions of bacteria, protozoa and fungi which digest most of the feed into smaller particles, helped by the grinding action of the back teeth when the animal is chewing. Ruminant animals chew their food twice, once just after eating, and then later when lumps of food are regurgitated from the forestomach into the mouth for further chewing.



The process of digestion in the forestomach is called fermentation and the nutrients formed by this process are used by the microorganisms for their own growth and biological functions. The digestion process also produces nutrients which are used by the host animal, namely:

- energy-yielding substances called volatile fatty acids (VFAs), and
- microbial protein, derived mainly from ammonia nitrogen released from the breakdown of feed proteins.

The energy yielding fatty acids pass through the rumen wall into the blood system, providing up to 70% of a productive animal's requirements for energy. The cells of the microorganisms are continuously propelled from the rumen by contractions of the rumen wall, and flow as part of the digesta into the small intestine. Here, the components of the cells, which consist of protein, carbohydrate and fat, are digested by gastric juices and the resulting nutrients (namely amino acids, glucose and long chain fatty acids) are absorbed across the intestinal wall into the blood and carried to body tissues.

Some feed may also reach the small intestine without being completely digested or degraded by the rumen microorganisms. This fraction provides the animal with extra nutrients (sometimes known as bypass or escape nutrients) in a more direct form. The Figure left shows a schematic diagram of the process of digestion in the ruminant.

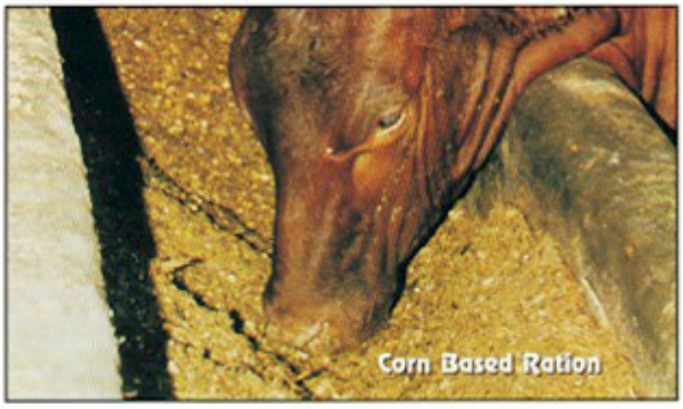
A key to formulating high performance rations with tropical feedstuffs is knowing the extent to which nutrients are used in the rumen and small intestine. The supply and balance of feed nutrients can then be directed towards maximising the growth of the microorganisms in the rumen as well as providing bypass nutrients to support the animal's productivity potential.

In practical terms, high performance rations consist of 70-95% concentrate feed and the rest is supplied by forage sources. The level of concentrate offered is determined by the quality of the forage available.

ROUGHAGES & FIBROUS ENERGY FEEDS Crude Fibre > 20%

Providing energy and maintaining rumen motion.

Forage Maize: Harvested at grain dough stage (±75 days), this forage is very palatable and a good source of digestible energy for fast growing cattle, but not sufficiently balanced in protein and energy to support maximum growth rates. Forage maize silage can be a less palatable feed and addition of 0.5-1.0% limestone as a buffer when making silage normally improves its quality. Urea (mixed with molasses) is also commonly used to boost the nitrogen content of the silage (5 kg urea/tonne silage).


Corn Based Ration

Maize (Corn) Stover: This refers to the maize plant after the corn has been picked. It is considered a poor quality forage because of its relatively low protein and energy content and digestibility (<50% dry matter). For this reason, its use is restricted to providing a roughage source for high concentrate rations by feeding 10-20% of the diet (dry feed basis), or up to about 50% fresh basis.

Elephant Grass: The use of this grass, and the hybrid King Grass, as a forage source for cattle is popular throughout SE Asia because of its potentially high-yielding source of digestible fibre. It is particularly suited for cultivation by smallholder farmers supplying nearby feedlots and it can also be used for making silage. King Grass requires at least 3 months of growth before the first cut, thereafter it can be cut at intervals of 6-8 weeks and should be replanted every 5-6 years. To prepare for feeding, fresh grass should be chopped (3-5 cm) and mixed into the concentrate feed and fed at rate of 15-30% of the whole ration (dry feed basis) or about 55-65% as fed.


Elephant Grass

Sugarcane Tops: Used extensively as a forage source to maintain smallholder livestock, the fresh leaves with a dry matter digestibility of ±60% can be used as a roughage source in high performance rations at a rate of up to 25% of the diet (dry matter basis) or about 50% as fed.

Pineapple Pulp: The pulp, consisting of the outer skin and inner core of the fruit, is a bulk energy source for cattle, only limited by its relatively high fibre content. It is therefore usually fed as part of the roughage component of the diet (up to 60% fresh basis). The fresh material is very wet containing ±85% water, and may be dried into a bran for convenience of transport and feeding. Because of its acidic nature, the pulp should be gradually introduced to new cattle. The addition of 50 g/head/day of sodium bicarbonate in the concentrate feed during the introduction period may improve rate of uptake by new animals.


Pineapple Pulp

Rice Straw: While this is one of the most abundant feedstuffs in Asia, it is also one of the lowest in nutritive value. Protein and energy content is not sufficient to maintain the liveweights of cattle and intake is limited by its poor digestibility (±43% of dry matter) due to a high content of lignin and silica. Whole straw can be treated to increase its digestibility by 2-6%. A common method is to soak or spray batches of straw with solution of 4% urea per 100 kg of fresh material before stacking and storing under a sealed cover for at least 21 days. The straw is left uncovered for 24 hours before feeding. There are very few reports of high growth rates in cattle fed rations containing rice straw. Its use therefore in fattening diets should be limited to 5-10% of the ration as a filler or as a temporary roughage source in the event of no other forage being available.

RUMEN DEGRADED CONCENTRATES

Providing extra nutrients to balance the requirements of rumen microorganisms.

Maize (Corn): This cereal grain and its byproducts are the most common ingredients found in cattle fattening rations. It is also usually the most expensive feed component because of its demand for human consumption. The grain contains 70% starch which provides a high value concentrated energy source, but protein content is relatively low at ±9%. Some of the starch is digested in the intestine as glucose which be may used in the formation of intramuscular fat (marbling). Yellow maize is rich in the precursor of vitamin A, which is a pigment that causes yellow fat when cattle are fed high levels in the ration. Maize can comprise up to 85% of fattening rations and should be hammer milled through screen sizes of 10-19 mm or cracked by a roller, but not finely ground.

Maize (Corn) Bran: This is strictly the outer coating of the grain kernel which is separated from the grain and therefore has a much lower energy value and more fibre. In practice however, the bran is usually a mixture of milling byproducts including the germ and gluten. The nutritive value of this product is comparable with maize but with a higher fibre content. It is very desirable to have 15-25% of this feed as a fermentable energy source in concentrate feeds containing oil cake and seed byproducts.

Wheat Pollard: A byproduct of flour mills, the pollard consists of bran (wheat kernel and inseparable flour), germ and feed flour, which together form a very palatable energy and protein source for fattening cattle and can be fed up to 45% of high concentrate rations. Wheat pollard is also a good source of phosphorus and vitamin E.

Rice Bran: This is an excellent protein and energy source, with relatively high levels of unsaturated oil (±15 g oil/kg dry matter) making the product prone to rancidity during storage and producing soft subcutaneous fat. The fibre content of rice bran can vary due to contamination with rice hulls. Good quality bran (< 9% crude fibre) may be fed up to 50% of the total ration (dry feed basis), however it is usually restricted to 15-25% of the diet avoid deposition of soft fat.

Spent Grains: This is a byproduct of the brewing industry and consists mainly of mashed cereal grains. It is a relatively digestible bulk feed containing 15-20% crude fibre and a good energy and protein source for cattle rations. Wet spent grains contain 80% water making transport over long distances prohibitively expensive, unless they can be dried to 10% moisture and preserved with 5% salt.

Approximate feed value and level of ration ingredients used for lotfeeding Australian cattle in SE Asia (dry feed basis).

DM Dry Matter

CP Crude Protein

RDP Rumen Degradable Protein

CF Crude Fibre

ME Meta-bolisable Energy

MJ Megajoules

Ca Calcium

P Phosphorus

FEEDSTUFF	DM (%)	CP (%)	RDP (%)	CF (%)	ME (MJ/kg)	Ca (%)	P (%)	Max Level
ROUGHAGE								
Forage Maize (75 Days)	25	8.00	53	30	9.9	0.34	0.23	25%
Forage Maize (Stover)	25	5.50	65	30	8.9	0.60	0.10	10-20%
Sugarcane Tops	28	6.00	65	35	7.7	0.50	0.20	25%
Napier Grass (75 Days)	21	8.50	65	34	7.5	0.50	0.30	25%
Rice Straw	92	3.90	75	39	5.5	0.50	0.20	10%
Pineapple Pulp	12	3.30	75	26	10.1	0.40	0.10	20%
CONCENTRATE								
Palm Kernel Cake	89	19.00	74	13	12.2	0.30	0.70	<50%
Copra Meal	90	20.00	35	7	12.5	0.20	0.70	25%
Corn (Cracked/Ground)	91	10.00	75	3	12.5	0.03	0.30	85%
Corn Bran	90	9.60	60	13	12.5	0.06	0.73	15-25%
Wheat Pollard	88	17.60	79	8	11.0	0.20	1.00	45%
Rice Bran	91	14.00	66	13	11.8	0.07	1.60	15-25%
Tapioca Waste	90	2.00	90	3	12.0	0.60	0.20	<50%
Sago Rasps	89	0.50	75(?)	5	10.0	0.04	0.02	30%
Soyabean Meal	89	47.20	65	8	13.7	0.27	0.70	5-10%
Groundnut Meal	86	34.00	80	27	11.7	0.20	0.60	25%
Meat/Bone Meal	90	50.00	51	0	10.5	9.00	4.70	10%
Spent Grains	22	24.00	73	15	10.0	0.33	0.13	15%
Cotton Seed (Whole)	93	21.10	65	22	14.0	0.16	0.76	10-15%
Kapok Seed Meal	90	31.00	45	30	8.7	0.50	1.30	10%
Cocoa Bean Shell	91	22.60	45	14	12.6	0.15	0.27	10%
Leucaena (Ipil-Ipil) Leaf Meal	92	26.70	45	21	10.9	2.20	0.30	10%
Green Bananas	22	5.75	80(?)	4	13.0	0.06	0.20	<60%
Molasses	75	5.00	100	0	12.5	0.60	0.10	15, 90%
Urea	100	(287)	100	0	0	0	0	<2%
MINERALS								
Limestone	100	0	0	0	0	34.00	0	
Dicalphos	100	0	0	0	0	22.00	19.30	

Tapioca Waste (Onggok): Tapioca or cassava waste is the residue from extraction of starch from the tuber. It is an energy feed that is readily digested in the rumen, however since it contains very little protein it should be fed with urea or a protein source that is also readily degraded in the rumen. This feedstuff when dried may be fed as the major energy source in the concentrate feed and can be included at levels of up to 50% of the ration.

Sago: Sago Palms are cut down when starch reserves in the trunk peak just before flowering when the plant is 10-15 years old. The trunk is either split and internal tissues scooped out or the exterior removed and the internal tissues rasped to produce sawdust. The sawdust containing starch can be washed and strained to free the starch, called sago meal, leaving behind a fibrous refuse which ferments rapidly unless dried. Dried sago pith/rasps should be limited to 30% in the concentrate feed as an energy source.

Molasses: This feedstuff is a residue from sugar production containing 50% soluble sugars which are readily fermented in the ruminant foregut. The byproduct also contains a wide range of minerals, particularly potassium, but is low in phosphorus. High levels of molasses in the diet inhibit digestion of forages in the rumen and therefore its use as a cattle feed is usually restricted to about 10% of the ration as an attractant and carrier for urea, or as a binder for pelleting. Fattening rations based on *ad libitum* molasses should contain 3% urea to provide a nitrogen source for rumen microorganisms, only small amounts of roughage (0.5-1.0% LW) to stimulate rumen motility and a high quality protein supplement which is relatively resistant to degradation in the rumen.

Green Bananas: An excellent source of energy which is in the form of starch (±73%), however protein content is low and tannin-bound. As with molasses, feeding high levels of bananas in the ration (eg 60% of ration) should be accompanied by a non-protein nitrogen source such as urea (as 10% urea/molasses offered free-choice). Cattle relish bananas and no processing is required, however salt should be added.

Urea: Fertiliser grade urea (46% N) is a concentrate source of fermentable nitrogen which can be used in small quantities to supplement basal diets fed to older cattle. However, urea must be administered properly to avoid poisoning cattle. To raise the protein equivalent of a ration by 2% requires 7 g urea/kg dry feed. This is administered by dissolving urea in a molasses solution or micromixing with a suitable dry concentrate feed such as rice bran before thorough mixing in the ration concentrate.

CONCENTRATE FEED SUPPLEMENTS

Resistant to breakdown in rumen and providing extra nutrients to the animal.

Copra: The byproduct of oil extraction process from coconuts, usually by mechanical press, copra is relatively high in good quality protein which is resistant to rumen degradation (pelleting increases this resistance). Oil residues may also be high (2.5-6.5%) depending on efficiency of processing. Copra oil is uniquely high in the saturated fatty acid laurate which is beneficial for marbling of meat. Copra readily absorbs molasses making it more palatable as a cattle feed. In the pelleted form, copra can be fed up to 25% of the diet (dry feed basis).

Palm Kernel Cake (PKC): This is the solid residue left after extraction of oil from the oil palm kernel. PKC has been used in Malaysia as the only source of protein and energy in cattle fattening rations. The protein is good quality and the oil is mostly saturated, but the feed is not very palatable if the oil content is high (expeller pressed PKC has 6-10% oil content) and needs a long adaptation period facilitated by adding molasses if high levels are to be fed. It is recommended not to feed more than 50% of the ration as PKC.

Soyabean Meal: This is a high quality concentrate feed and one of the best plant protein sources with up to 50% protein (dry matter basis). Soyabeans contain anti-digestive substances (trypsin) which are toxic to pigs and poultry if not inactivated by heat treatment. Older ruminants are not affected by these substances in the unprocessed feed. Soyabean meal is usually too costly as a cattle feed because of its demand for pig and poultry rations, but if it is economical to use, rates of 5-10% of the concentrate feed can be given.

Cotton Seed: The delinted whole seed contains ±20% of oil which is 50% unsaturated and ±20% good quality protein for cattle rations. It also contains 0.5-1.5% of the pigment gossypol which is particularly toxic to pigs and poultry. Cotton seed can be safely included in feedlot rations at a rate of 10-15%.

Cocoa Bean Shell: This is usually a mixture of bean shell and fragments of bean meal after the beans have been roasted. This combination has a high nutritive value for ruminants including vitamin D, however it also contains a toxic substance called theobromine which limits its use as a feed to small amounts (<10% in concentrate feed).

Groundnut/Peanut Meal: A variable product depending on whether the peanut shells have been removed (decorticated) or not. Oil is mechanically extracted leaving residues of 5-10% in the meal and relatively high levels of protein. There is some concern over contamination of groundnut meal with the fungus Aspergillus which produces aflatoxin. Levels fed in the ration should not exceed 25% in the concentrate feed.

Kapok Seed Meal: The seeds are ground to make a high protein meal which may be included in the concentrate feed at a rate of 10%. Higher levels have been fed in cattle rations without any problems being reported.

Leucaena (Ipil-Ipil) Leaf Meal: The leaves and small stems from this shrub legume are sun-dried to produce a good quality protein supplement for cattle feed. Leucaena leaves contain the toxin mimosine and its derivative dihydroxy piridin (DHP) (2-4% DM). Local cattle in most parts of Asia have the ability to breakdown the DHP in the rumen, but not all Australian cattle have this ability and therefore leucaena should be restricted to about 10% of the ration (as fed). Its inclusion in the ration may give rise to yellow fat.

MINERALS & VITAMINS

Calcium (Ca) and Phosphorus (P): Standard feeders require about 35 g Ca and 25 g P daily. The Ca requirement can be met by adding 100 g limestone to the diet, or 150 g of dicalcium phosphate which will provide the needs for both these minerals.

Salt: Provision of adequate salt in the ration at a rate of about 13 g per head daily is important particularly in hot climates.

Sulphur: This mineral is necessary for the formation of proteins required by growing colonies of microorganisms, particular in diets containing urea. About 13 g/head daily of elemental sulphur can be used or 100 g of ammonium sulphate which will also provide 10 g of nitrogen (equivalent to 62.5 g protein and 22 g Urea).

Trace Minerals and Vitamins: Cattle feeding on high concentrate rations need Vitamin A as an oral dose (0.3 g or 1 million IU) or daily supplement (4.5 mg β-carotene or 2,000 IU). This is less critical where green forage is being fed. Trace minerals and vitamins are conveniently supplied in the form of commercial premixes or lick blocks to provide the following levels of nutrients in the feed (dry basis).

Nutrient	Premix (Amount/kg Feed)	Nutrient	Premix (Amount/kg Feed)
Vitamin A	1,800 IU	Copper	4 mg
Vitamin E	20 IU	Cobolt	0.1 mg
Magnesium	700 mg	Zinc	10 mg
Iron	10 mg	Selenium	0.1 mg

Vitamin D: It is not necessary to supplement this vitamin unless animals are housed for long periods indoors.

FEED ADDITIVES

Sodium Bicarbonate: This additive stabilises (buffers) acid levels in the rumen and helps prevent acidosis in cattle adapting to high levels of concentrate feed. Add 50 g/head/day or 1% of a starter ration.

WATER

Cool clean water should be available at all times and buried water pipes help to keep water cool. The water requirements of cattle increase as the temperature gets hotter. Adding salt to the diet tends to increase drinking rate and high levels of salt in the water (>3000 ppm) can depress feed intake.

Water Intake of Brahmans* (Litres/day)			
Liveweight	25°C	30°C	35°C
300 kg	30	50	55
350 kg	35	55	65
400 kg	37	60	70

*European breeds require approximately 25% more water

FEED MANAGEMENT

Introduction to ration: Starter rations are designed to give new arrivals a smooth transition from the ship's ration to the feedlot ration. The aim is to minimise production losses from shipping stress and to maximise feed intake as rapidly as possible. Animals should not be offered high levels of concentrate feeds until they have recovered from shipping stress and the rumen is functioning normally. It is recommended to feed a good quality green forage (10-12% CP in dry matter) to appetite for the first 3-5 days before gradually introducing concentrate feed. An example of an adaptation program is given below.

DAYS	ROUGHAGE	CONCENTRATE
1-3	100%	
4-6	80%	20%
7-9	60%	40%
10-12	40%	60%
13-15	20%	80%
16+	<20%	>80%

Electrolytes: A solution of electrolyte and energy supplements administered to trough water can help to stimulate cattle to eat during recovery from stress. A simple supplement (100%) contains salt (5%), potassium chloride (KCl) (5%), magnesium sulphate (5%), mixed with water (35%) and molasses (50%), and the solution added to drinking water at the rate 2% (2 litres solution per 100 litres water).

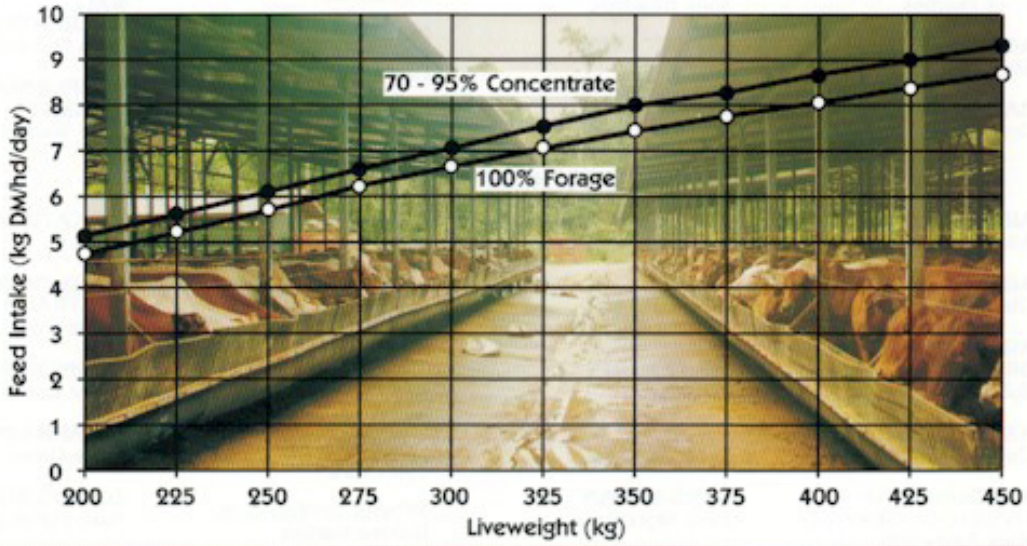
Shade and Shelter: Provision of at least 50% shade cloth is recommended for temperatures above 35°C to avoid heat stress. Shelter is recommended over feed troughs to keep feed dry.

Inconsistency of diets: Ration ingredients should be changed as little as possible, or gradually over a period of time to allow the populations of microorganisms in the rumen to adapt slowly to new feedstuffs. Different types of feeds and conditions in the rumen favour the predominance of different types of rumen microorganisms. If the composition of the ration is variable, conditions in the rumen become unstable and prevent the establishment of a balance of microbial populations. This results in an inefficient fermentation process.


Feed Mixer and Auto Delivery


Forage Chopper

Feed Intake (Dry Matter Basis) of Growing Brahman Cross Cattle



Frequency of feeding: Stability of rumen conditions is also maintained by offering fresh feed to cattle at least twice a day - early morning and in the evening. If animals do not feed because the trough is empty or the feed is stale, then nutrients needed by the microbial populations in the rumen may become exhausted and the microganisms stop growing, making the fermentation process inefficient. Never leave troughs empty for more than a few hours.

Method of feeding: The best method is to chop fresh forage and mix it with the concentrate feed so that each animal gets the required amount of ingredients. If mixing is not possible, the concentrate should be fed first followed by green forage when the concentrate has been cleaned up. This is then repeated at the next feed. Dry roughages may be fed to appetite from hay racks or separate feeders once animals are consuming sufficient concentrate.

Examples of Rations As Fed (Dry Matter Basis)

INGREDIENTS	RATION A	RATION B	RATION C	RATION D	RATION E	RATION F
Forage Maize						58% (28%)
Napier Grass	4% (1%)	4% (1%)	15% (4%)		45% (16%)	
Sugarcane Tops				55% (30%)		
Palm Kernel Cake				24% (39%)		
Rice Bran	56% (58%)	40% (42%)	16% (18%)	17% (26%)	25% (38%)	
Copra Meal						10.5% (18%)
Cocoa Pod Meal					4.5% (7%)	
Cracked Corn	32% (33%)		2% (2%)		5% (8%)	10.5% (18%)
Wheat Pollard						20.5% (35%)
Soyabean Meal	8% (8%)	6% (6%)				
Tapioca Waste		50% (51%)	45% (51%)		20% (30%)	
Molasses			10% (9.5%)	3.5% (4.5%)		
Kapok Seed Meal			5% (7%)			
Leucaena Leaf Meal			5% (6%)			
Urea			2% (2.5%)	0.3% (0.5%)	0.5% (1%)	
Limestone				0.7% (1%)		0.5% (1%)

Premixes and other additives not shown.

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