THE FEEDING OF LIVESTOCK

By P. FOWLIE.

This subject has been dealt with in papers by Messrs. Edelman and Campbell at the Sugar Conferences held in 1926 and 1927. However in view of its importance, and the undoubted fact that it does not as a rule receive the attention it merits, no apology is considered necessary in again discussing it.

In this paper the constituents of foodstuffs will first be described and the uses to which they are put by the animal will be dealt with as simply and briefly as possible.

This knowledge of the first principles to be followed in the economical feeding of animals is necessary to understand and appreciate the practical discussion of rations which is to follow.

When a chemist makes an analysis of a feeding stuff, he determines the percentage of certain groups of substances in it, but for the valuation of a food something more is required than a chemical analysis.

It is necessary to know how much of each substance can be digested and made use of by animals. To find this out large numbers of experiments have been conducted. In each trial an animal has been fed a weighed amount of feed, the composition of which has been determined. The excrements from the animal have been collected, weighed, and analysed. The amount of each nutrient actually digested and used by the animal has then been found by substracting the amount found unchanged in the excrements from the total amount supplied in the feed.

The results of large numbers of such trials and the averages of many analyses of feedstuffs have been collected and tables have been prepared showing at a glance the percentage of digestible nutrients in almost every foodstuff in general use for animals. Of course these tables are not quite correct for individual samples of feed, but they may be taken as being near enough for the purpose of arranging suitable rations. Such tables are to be found in the standard book on " Feeds and Feeding," by Henry and Morrison.

The following figures giving the composition of cane tops and fresh green cowpeas are taken from these tables to show the method of stating an analysis and to show the variation in composition between these feeds :—

	CANE TOPS.		COW PEAS.	
	Total. per cent.	Digestible. per cent.	Total. per cent.	Digestible. per cent.
Water	76.6	—	83.7	—
Ash	1.9	—	2.0	—
Crude Proteins	1.3	0.5	3.0	2.3
Carbohydrates and Fibre	19.8	12.2	10.8	8.0
Fat	0.4	0.2	0.5	0.3
	100.0		100.0	
Nutritive Ratio	1 : 25.2		1 : 3.8	

It will be seen from the above that the three groups of substances mentioned in the " digestible nutrients " column are Protein, Carbohydrates, and Fat. In addition to these the animal requires some of the substances found in the ash for bone formation. As a rule these ash substances are present in feeds in sufficient quantities to supply animal requirements, but there are exceptions. For instance, in parts of this country, salt and bone meal are fed because the ordinary ration is deficient in ash constituents which these substances supply.

The Protein Group is the most complex and in many ways the most important of the substances in feeding stuffs. Proteins are sometimes called " flesh formers," because the muscles, the gelatinous part of bone, and nearly all the tissues of the body, except fatty matter, are built up and maintained almost entirely by them.

Proteins are essential to all life, and the percentage of digestible protein in the feed requires special attention. Many feeds contain too little protein for the needs of animals, and need to be supplemented with other feeds richer in protein to give good results. In plants proteins are found in greatest abundance in the germs of the seeds, and in the young actively growing green parts. Some families

of plants are richer in proteins than others. By referring to the table given above it will be seen that cowpeas contain nearly five times as much digestible protein as cane tops.

Besides building up the various tissues of the body, the proteins can be used by the animal to produce heat and energy.

The Carbohydrate Group comprises a large number of different substances, of which starch, sugar and fibre are the best known examples. These substances all consist of the three elements, carbon, hydrogen, and oxygen. The last two are present in the proportion to form water, and the name really implies compounds of carbon and water. They are built up in plants from the carbon dioxide gas in the air and water, and form the largest percentage of the nutrients in feedstuffs. Their chief function in the animal's body is to act as fuel for the production of heat and energy. When consumed in excess of immediate requirements for that purpose they can be changed into animal fat and stored in the body in that form. Carbohydrates are not stored up by the animal, except when changed into fat, and they cannot take the place of protein for the maintenance of body tissues.

The fats found in foods are similar to those found in the animal body, but they are not identical. Animals have the power of converting one kind of fat into another, and the fat of each kind of animal has something distinctive about it. Thus the fat of the ox and the sheep are not the same even if both are fed on the same feeds.

The fat in the food is either used as a source of heat and energy, or it is stored up as fat. Fat has a greater value as a heat and energy producer than any other ingredient of the feed. Fat stored up in the animal body is a reserve to be drawn upon in case of need.

The nutritive ratio given at the bottom of the table is the proportion between the digestible crude protein and the digestible carbohydrates and fats taken together, the amount of fat being multiplied by 2¼ before adding it to the carbohydrates, because it will produce 2¼ times as much heat as do carbohydrates.

The nutritive ratio of cane tops is 1 of digestible crude protein to 25.2 parts of carbohydrates and fat equivalent. This is known as a wide ratio because the proportion of digestible crude protein is small. In the case of cowpeas the ratio is 1 : 3.8. This is known as a narrow nutritive ratio.

In making up rations a knoweldge of the nutritive ratio is useful, because if a ration is to be economical it must have a nutritive ratio suitable for the class of animal being fed. If the nutritive ratio is too wide, too large an amount of food has to be consumed before the animal obtains enough protein for maintaining and building up its tissues. On the other hand, if the nutritive ratio is too narrow, valuable proteins are used unnecessarily for heat and energy production, and the ration is usually too expensive.

The feed requirements of different kinds and sizes of animals have been determined with sufficient accuracy to give very useful guidance in the economical use of feedstuffs, by feeding trials in which all the feed used has been carefully weighed.

Tables of feeding standards giving the average requirements of all classes of farm livestock are to be found in " Feeds and Feeding," by Henry & Morrison, and in various other books on Feeding.

The most concentrated and most digestible feedstuffs are those derived from seeds, such as cakes made from cotton seed, and monkey nuts, grains, such as mealies and oats, and bye-products from the milling and brewing industries, such as bran, hominy chop and brewer's grains.

Next to these come feeds derived from the legumes, such as lucerne, cowpeas and beans of various kinds. These may be fed either in the green state or as hay.

Young grass, unripe maize and even cane tops have a moderately high feeding value and are fairly easily digested.

Old grass, dry mealie stalks, and the straw of grain crops, after the ripe grain has been thrashed off, have a much lower feeding value. The nutrients in such substances may go so low that although animals eat as much of them as they are able to consume, they are unable to digest enough to supply their full requirements.

When an animal only receives a semi-starvation diet of this kind it draws on its reserves and loses condition. If the process is continued till its reserves are completely exhausted it will die of poverty. Unfortunately, examples of this are not at all uncommon in South Africa. On the sugar belt animals are not often allowed to die of starvation, but badly nourished work animals are seen all too frequently.

When work animals are allowed to get into low condition they are quite unable to do a full day's work. As the day's task goes down the cost of team work rises rapidly, because the wages of drivers' and other costs go on as usual.

The reason for the work animals on sugar estates losing condition is not usually that they do not get enough to eat, but that the feed they have is deficient in the all important proteins. How to remedy this is the chief question which confronts the sugar planter. This problem varies somewhat according to whether oxen or mules are being considered. Oxen and other ruminant animals have a very large stomach capacity. The four stomachs of the ox can contain about ten times as much as the stomach of the horse or mule. The small intestines of the ox are also much longer than those of the mule. The mule makes up for this to some extent by having a greater capacity in the large intestine. The ox and the mule can digest concentrated feeds, such as meal, about equally well, but the ox is able to digest bulky feeds of low quality much more thoroughly than the mule, and can live and work on a ration on which the mule would starve. It is this power to live on a low grade diet that has enabled the ox to maintain his place as the most widely used draught animal in South Africa.

Oxen used on sugar estates seldom receive any feed except grazing in summer and cane tops along with a little dry grazing during the winter. Whilst the grass is young and succulent, they do quite well on grazing alone, but in seasons when the grass is old and poor, and only cane tops are added to help it out, oxen are generally not able to work hard and keep in fit condition. This is no wonder, because a ration of poor quality grass and cane tops is very deficient in digestible crude protein, and also in total digestible nutrients when compared with feeding standards.

The digestible carbohydrates can be easily and cheaply supplemented by giving a feed of treacle. Oxen get very fond of this as a rule when used to it, and can be given up to 10 lbs. per head per day if the quantity is gradually increased.

The supplying of additional protein is more difficult and expensive, but the writer is convinced that it would often pay handsomely to supply it.

It could be done by growing legumes on the long fallow, making them into hay and allowing the oxen a small ration of about 10 lbs. per head of legume hay daily. But perhaps the easiest way is to purchase monkey nut cake and feed each ox 2 lbs. daily. The feeding standards indicate that at least 3 lbs. per day ought to be given, but the writer, knowing South African oxen, is convinced that 2 lbs., or perhaps even less, would make a wonderful difference to their condition and ability to do hard work, provided they were not allowed to become poor before the cake ration was started. It is an axiom amongst feeders of animals that it is much easier to keep condition than to put it on.

Mules are now coming more and more into favour on sugar estates, especially where limited grazing makes it difficult to feed oxen. They are usually much better cared for than oxen. The ration most frequently given consists chiefly of cane tops and maize and sometimes a little treacle. All these feeds are easily digestible and well supplied with all the necessary nutrients except protein. The easiest way of correcting this is to give 1 lb. of monkey nut cake per day in place of some of the mealies. It will usually be found that if 1 lb. of cake is given the mealies can be reduced by 2 lbs., and still the animals will show an improvement.

Cane tops are not an ideal roughage for feeding to mules as the only bulky food. Most feeders would say that mules ought to have at least part of their roughage in the form of hay, but on the sugar estates this would add considerably to the expense. It has been found that for mules doing farm work on the estates hay is not essential.

Mules are fond of salt, and ought to be given lumps of rock salt in their mangers to lick when they like.

In conclusion, to sum the whole question up from an economical point of view, it is cheaper to feed work animals well enough to keep them fit rather than to allow them to get into poor condition for the want of a little extra food, costing not more than 2d. per day, because fewer of them will do the same work with fewer drivers and attendants. Even the total food used is less if the number of animals is fewer.

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CHAIRMAN: I think it is a very good thing to have a paper on feeding, as applied to transport animals on the sugar plantations, expressed in this lucid and interesting way. It is a subject to which I feel many of our planters pay too little attention, and I hope this paper will be read and absorbed by a far greater audience of planters than we have here to-day.

Mr. PALAIRET: I entirely agree that this is a very valuable paper, and it thumps away at what is undoubtedly one of the many mistakes the average planter makes; but there are one or two points I would like to raise in connection with this paper. Personally I would prefer to see a comparison of these analyses on a dry basis. For instance, these cane tops are shown to have 1.3 crude protein, 19.8 carbo-hydrates and fibre and 76.6 per cent. of water. It gives on a dry basis something rather better than I expected. These are from the softer cane tops. It is possible the Uba top will show a different analysis. The Uba top may be a little richer in protein and considerably richer in very valuable ash. Now there is another thing I believe is rather open to question, and that is the method of obtaining the percentages, and particularly of protein. You test the actual protein consumed and the protein evacuated, but the difference is by no means the amount absorbed. The protein evacuated includes a fairly large amount of bacteria. Now who is going to say these bacteria have been feeding in the alimentary tract? They may have been feeding on the tissues, that is to say, some of the nitrogen has already been used in the body, and there is a great possibility that much more of that protein is absorbed from these feeds than these tests show. Point is given to that by one fact here in the test shown, which gives a nutritive ratio of 1 to 25 for cane tops. There are many cases where oxen have been carried through seven or eight months of fairly hard work on cane tops only and have not lost condition anything like that nutritive ratio would indicate, because that ratio is approximately half what it should be. It seems these oxen are able to carry on on a nutritive ratio of 1 to 25, and if that is so there is a good deal of research needed here. I have given a considerable amount of legume hay to my animals. Mr. Fowlie gives us an interesting suggestion and points out the possibilities of

legumes on the long fallow. I am with him. I would like to add something; on a cane farm you have to have fire-breaks, and mine carry legumes, and much of the seed comes from them when I want seed for planting. At the same time every opportunity I get I am planting a legume in my fire-breaks for that specific purpose. The policy I am trying to follow is this, and I would like Mr. Dodds to give an opinion on the correctness of my ideas. In planting between about September and the New Year I use a velvet bean. From the New Year to the middle of March the cow pea, and for any other months the vetch. I would like Mr. Dodds' and Mr. Fowlie's opinions on this point.

Mr. FOWLIE: Taking the last question first. I think Mr. Palairet's ideas are good. I agree with these planting periods. There is one legume I suggest be added, and that is the Soya bean. It does not give a very great quantity of crop, but if a very concentrated feeding is required, it beats anything else that can possibly be grown. The best time for the Soya bean is in the summer. It can be planted as late as January, but I would not recommend it to be planted later—any time from October to January is most satisfactory. I do not think I want to say much more upon the points raised by Mr. Palairet. The question of nutrient or protein digestion is a very complicated one, and I made it as simple as I possibly could in my paper. The figures I have taken are from a very recent book on the subject embodying the latest researches.

CHAIRMAN: The analysis of the cane tops quoted in the paper were taken from Henry & Morrison's book. I think in Australia they have done a series of analyses of cane tops from varieties, such as Uba, compared with thick canes, and as far as I recollect, they found that Uba tops were lower in point of water and rather higher in what might be regarded as nutrients. But that is a work that should be done also under our conditions, and Mr. Zietsmann at the Experiment Station has begun work on these lines. I would like to endorse what Mr. Fowlie says about the Soya bean, which is particularly adaptable to our soils. It is a wonderfully easy crop to grow, not only at the coast but far inland. The beans are being grown very successfully at Cedara, for example. They seem to be adaptable to a very wide range of soils, and I do not know of any representative soils to which they are unsuited.

Mr. FOWLIE: I think the Soya bean will be more generally suited to all soils than almost any other legume we have. They seem to do well on our heavy soils, as well as the sandier ones at Cedara. The soil there is a sort of red loam, rather light and poor, unless it is fed, and they do remarkably well if they are planted at the right time. I have seen them at numerous places throughout the country and have often been surprised that they do not take on more generally than they do. I think people hardly know the best way to use them as feed. It is rather expensive to thresh them out. This makes them rather costly by the time they are bagged, and people think it hardly worth while growing them. I think they should be made into hay before the seed is formed. Although rather a rough hay, it is a very nitrogenous form. They are excellent beans as human food. I have prepared them for food in various ways and they are very good. I think consideration might be given to getting Natives fond of them and save part of our bill for native rations. Originally this was a Chinese bean, and they are highly regarded by the Chinese people as a food.

Mr. BOOTH: What is considered a practical daily figure in the feeding of treacle to mules?

Mr. FOWLIE: We feed treacle at the Experiment Station to the mules as a matter of routine, and I do not think we yet feed them as much as they might possibly get. I have not gone into it very carefully, but I may say that before going to the Experiment Station at Mount Edgecombe I had a lot of experience in feeding treacle to cattle. We fed the quantity recommended in this paper to oxen, along with some maize stalks and maize silage, and they thrived on it. I do not think it advisable to give this quantity to mules all at once, but when they are accustomed to the treacle they would take up to 5 lbs. per day and possibly more. In books referring to the feeding of treacle you will find in most cases they refer to the beet sugar treacle, and the warning issued in books against feeding treacle on account of its excessive laxative effect, applies more to beet sugar treacle than to cane sugar treacle. I know if animals are put to it gradually they can take considerable rations without being injuriously affected as far as cane sugar treacle is concerned, but that is not the case with beet sugar treacle, and smaller rations of beet treacle have to be used.

The Chairman moved a hearty vote of thanks to Mr. Fowlie for his paper, which was carried by acclamation.

Tea adjournment at 4.55 p.m.