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STOCK FOOD VALUES

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In considering the relative values of different animal foodstuffs it is necessary first to know something of their chemical composition, the means by which they are utilised by animals and the purposes for which they are used.

Composition of Plants and Animals

The main foodstuffs of animals are of plant origin and it is of interest therefore to compare the composition of plants and animals. The following table gives average compositions of grass and of sheep:—

TABLE I

	Grass %	Sheep %
Water	80	60
Carbohydrate	13	1
Protein	4	16
Fat	1	20
Minerals	2	3

Both plants and animals are composed of several different types of chemical constituents. These are as follows: Water, carbohydrate, protein, fat, minerals and vitamins. Water is common to all and varies widely from dry feeds such as hay and grains which contain only 10-15% of water, to wet succulent feeds such as grass and mangolds which contain 80-90% of water. Carbohydrate is the name given to a class of substances of which sugar, starch, cellulose and fibre are typical. They form the main constituent of plants but occur only to a very small extent in animals. Protein is another type of material. It varies fairly widely in plants but is one of the main constituents of animals, muscle being composed almost entirely of protein. Fat is a familiar substance occurring only in small amounts in plants but often reaching high proportions in animals. Minerals form the skeletal structure or bones of animals as well as occurring in small amounts in the other tissues. They also occur in small amounts in plants. The vitamins are substances which are required for growth of animals but in such small quantities that special methods of analysis are necessary to determine their concentrations.

It will be seen from Table I that whereas animals are composed, apart from water, mainly of protein and fat, grass is mainly carbohydrate with lesser amounts of protein.

Animals are able to build up fat from any of the constituents carbohydrate, protein or fat, but they are not able to build up body protein or muscle from anything except the protein in the food. Thus in the growing animal the food must be sufficient both in regard to the total food given and also in the total amount of protein contained in the food.

Utilisation of Food.

When the food is eaten it is acted upon by the digestive juices in the stomach and intestines of the animal. The part which is digested is absorbed into the bloodstream and is utilised by the animal. That which is not digested is eliminated from the body in the form of dung. Herein lies one of the biggest differences between foods, for the fraction left undigested is the biggest loss in their ultimate utilisation. Some foods such as young grass, milk, crushed grains, etc., are 80-90% digestible, whereas in coarser foods such as hay and straw, less than 50% of the food is digestible, the rest being of no use to the animal. We refer to the digestibility of a food as the percentage which is actually digested and utilised by the animal.

That portion of the food digested

can now be used by the animal for a number of purposes. First priority goes to supplying the energy required to keep the animal alive. The energy derived from food is required to keep the heart beating and the brain functioning, to enable the animal to move about, to digest its food, and to keep itself warm. For these purposes not only is a minimum total amount of food value required but also a certain amount of protein is necessary for replacement and wear and tear of the muscle and other tissues. This is analogous to overhead costs, representing food given for the sole purpose of keeping the animal alive. The amount of food thus required for any animal is known as the maintenance requirement.

When this requirement has been satisfied the remainder of the digested food is available for productive purposes such as growth in young stock, milk in dairy cows, fattening in bullocks and sheep, etc. Since animals can build up fat from any of the food constituents all that really matters in fattening mature stock is the total amount of food digested irrespective of whether it is high or low in protein. It is necessary to be more careful with growing animals and milking cows. In the former, muscle and bone are being built up as well as fat so that we do have to pay attention to protein and mineral content of the food as well as to its total food value. In the case of dairy cows, too, milk is rich in protein so that protein content of the food is important in feeding high producing cows.

From a large number of experiments it is now known how much total food and how much protein must be fed over and above the maintenance requirement to produce each lb. of live weight increase in growing or fattening animals and each gallon of milk from the cow.

From the above discussion one is now in a better position to appreciate the value and also the limitations of the food values of individual animal foodstuffs.

Derivation of Food Values.

Systems of deriving food values aim at giving each foodstuff a single numerical figure which will indicate the value of that food. There are two main systems in existence today. One is the starch equivalent (S.E.) system developed and used in European countries in which the food value of any foodstuff is compared with starch. The other is the net energy system developed and used in America in which food values are expressed in terms of energy. The two are essentially the same. As the starch equivalent system is easier to use, it has become the custom in New Zealand to prefer it.

Starch is taken as the reference standard because it occurs widely in foods of plant origin and especially in grains and roots. It is also a pure carbohydrate and is readily available. To derive the system numerous experiments were conducted to compare the various foodstuffs with starch as regards their fattening value for mature stock. Starch is arbitrarily given a value of 100. Hay was found to have a much lower fattening value; in fact it took 100lbs. of hay to produce as much fat as 40lbs. of starch. Hay was therefore given a starch equivalent of 40. Similarly, grass has a S.E. of about 14-15 which means that 100lbs. of grass has the same value as 14-15lbs. of starch. The S.E. of a foodstuff is thus the amount of starch which is equivalent to 100lbs. of the foodstuff. It is expressed this way because the figures are of convenient dimensions and because a good foodstuff has a higher numeral S.E. than a poor foodstuff and is thus easier to understand.

After much experience it was found possible to calculate with sufficient accuracy the S.E. of any food from a knowledge of its chemical composition and its digestibility. This has been done for the whole range of animal foodstuffs so that we now have tables giving the composition and feeding value of all common feeds. Some of these are given in Table II.

There is a further point about using the S.E. tables. It is desirable to include the column headed dry matter (DM). Without this, one would deduce from the table that hay or oats were better than grass which we know not to be true. It is explained by the fact that hay or oats are dry and contain only a little water (10-15%) whereas grass is about 80% water (20% DM). Thus, using the S.E. column only, one is comparing dry hay with fresh grass. If one brought them all to the same DM, say 100%, by increasing the hay 15% and multiplying the grass by 5 one obtains a truer picture of the relative values of S.E.

The S.E. is a measure of the total food value, the fattening value or the energy value of the food

to the animal. As such it is highly important because we know from experiments how many lbs. of S.E. are required to maintain animals and how many lbs. of S.E. are required for each lb. of live weight increase or for each gallon of milk. In other words, assuming the feed is satisfactory in other respects, the S.E. is a good measure of the total food value of any individual foodstuff. The S.E. is good for comparative purposes. For instance, reference to Table II shows crushed oats to have a S.E. of 60 and linseed meal to have one of 75. This means that linseed meal has a higher food value and that if one is feeding it in addition to good grass to cows for milk production or to fattening lambs, wintering hoggets or ewes 60lbs. of linseed meal is equivalent to 75lbs. of crushed oats.

Protein Equivalent:

From what was said in the section entitled "Utilisation of Food" it is obvious that the S.E. value alone has limitations. It would be expecting too much to give any individual foodstuff a single figure to indicate its value under all circumstances. The S.E. does not take into account the protein content of the food which we know to be of importance to growing animals and to dairy cows; nor does it give any index of the mineral or vitamin content. Consequently in regard to protein we must have a figure to represent the amount of protein available to the animal from 100lbs. of the foodstuff.

By giving a foodstuff a value for its protein as well as its total food value, the usefulness of the system has been considerably improved. Since we know the number of lbs. of S.E. and P.E. necessary for growing animals, for fattening stock and for milk production, it is possible to determine from the tables whether the food the animals are getting is balanced for their requirements. For instance, a dairy cow must not only obtain sufficient S.E. to produce milk, but it must also obtain sufficient P.E., and if either one of these is deficient the milk yield will suffer. To give a further example of its usefulness, reference to Table II shows that allowing for the high water content good young grass is high both in S.E. and P.E. so that if one wished to feed a concentrate supplement one would use the cheapest available. But if the cows were obtaining mangolds and a little hay which are rather deficient in P.E. one would be careful to select a concentrate supplement which was high in P.E.

To allow in our system for minerals and vitamins would complicate the system considerably. As one gains more experience one learns of the few cases where these are of any importance. In this case a reference to the chemical composition of the foodstuff will indicate whether or not it is high or low in these substances, and due allowance can then be made.

Bulk in Foodstuffs:

Animals differ in their ability to utilise different classes of foodstuffs. Pigs require concentrated foods with little fibrous matter whilst sheep and cattle must have a certain amount of bulky fibrous food in their ration. These factors are taken into account in the feeding of the different species of animals.

Foodstuffs can be classified roughly into the following classes which help in using the tables:—

(1) Roughages: Dry, fibrous. Low in both S.E. and P.E., e.g., hay and straw.

(2) Succulents: Wet and succulent. Contain some fibre. Sub-divided into those high in both S.E. and P.E. such as grass, rape, chou moellier and those high in S.E. but low in P.E., such as turnips, mangolds, potatoes, etc.

(3) Concentrates: Dry, very little fibre, concentrated foodstuffs. All are high in S.E. Some, such as meat meal, linseed meal, crushed peas are also high in P.E., others such as maize, oats and wheat tend to be low in P.E.

Use under Practical Conditions:

The system outlined above is used widely in Britain and other European countries. Under New Zealand methods of farming it has much less application. It is of little value to the purely grassland farmer but a knowledge particularly of chemical composition and food values together with maintenance and production requirements (not included in this bulletin) is of assistance to those who grow special crops or buy in food whether it be for wintering ewes or the feeding of dairy cattle and pigs. It would assist the farmer in the choice of feeds to be grown or bought, in the most efficient way of feeding them, and in ensuring that the stock always received food which is adequate both in quantity and more especially in quality. At present, in buying in food availability is the chief prob-

lem but where a selection can be made a knowledge of the S.E. can also be put to good use in assessing the relative value of foods in terms of £.s.d.

Finally, this bulletin aims at being merely an introduction to the system of food evaluation. The detailed application to the practice of feeding different animals is given in other bulletins.

TABLE II

Foodstuff	D.M. %	S.E.	P.E.
Hay (average)	85	35-40	5
Lucerne Hay	85	35	12
Wheat Straw	86	20	0.5
Grass (good)	20	14-15	4
Rape	15	12	2-3
Chou Moellier	15	12	2-3
Lupins	25	17	4
Mangolds	12	7	0.5
Turnips	9	5	0.5
Potatoes	24	20	1
Oats	87	60	8
Wheat	87	72	10
Pollard	86	65	12
Bran	86	45	10
Peas	86	70	19
Linseed Meal	88	74	25
Meat Meal	89	90	65

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