

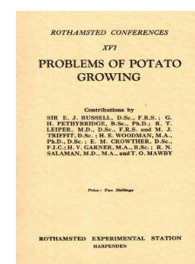
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Problems of Potato Growing

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UTILISATION OF EXCESS POTATOES ON THE FARM

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WHEN low prices rule for potatoes, and when even at such prices the markets are dull, it is advisable to consider how part, at least, of this crop may best be utilised for making good any shortage of feeding stuffs in other directions, as, for example, when the root crop has proved disappointing. Before any conclusions can be made, it is necessary to be quite clear about the composition of potatoes. In this way only can we decide what type of food is capable of being replaced by potatoes in the rations of live-stock.

Comparison of Potatoes with Swedes and Mangolds

The composition and feeding value of potatoes as compared with average swedes and mangolds are shown in the accompanying table :

	<i>Potatoes per cent.</i>	<i>Mangolds per cent.</i>	<i>Swedes per cent.</i>
Moisture	76.2	88.0	88.5
Albuminoids	2.1	1.0	1.3
Oil	0.1	0.1	0.2
Carbohydrate	19.7	9.4	8.1
Fibre	0.9	0.7	1.2
Ash	1.0	0.8	0.7
Dry matter	23.8	12.0	11.5
Starch equivalent	17.8	6.8	7.3
Protein equivalent	0.8	0.4	0.7

We note that potatoes contain about 76 per cent. of water and 24 per cent. of dry substance. By far the greater part of the food material consists of carbohydrate, the percentage of this constituent amounting to almost 20 per cent. It is noteworthy that potatoes contain only a small amount of protein and almost negligible amounts of fibre, oil and mineral matter. From these facts we learn that almost the sole function of potatoes in the ration is to furnish digestible carbohydrate. We must not rely on them to supply digestible protein and minerals. When feeding potatoes to live-stock, we must be careful to ensure that the ration also contains foods capable of providing the protein and mineral matter lacking in the potatoes.

If we examine the data in the table, we find that the food material of mangolds and swedes is very similar in character to that of potatoes. All these foods are rich in carbohydrate and poor in protein,

oil, fibre and minerals. Potatoes, however, contain rather more than twice the amount of carbohydrate found in swedes and mangolds. Weight for weight, therefore, potatoes have rather more than twice the feeding value of swedes or mangolds, a comparison which is further borne out by a consideration of the percentages of dry matter and starch equivalent in these foods. The stockfeeder will not be far wrong if he regards 1 lb. of potatoes as the equivalent of 2 lb. of swedes or mangolds when he wishes to feed potatoes in the place of roots. This is, however, a deliberately cautious estimate, for the evidence of the starch equivalents really signifies that 1 lb. of potatoes should be equal to about $2\frac{1}{2}$ lb. of roots.

I have said that the food constituents in potatoes and roots are very similar in nature. There is one important distinction, however. The carbohydrate in potatoes is almost wholly in the form of starch, whereas in swedes and mangolds it takes the form of sugar. From the feeding standpoint, I regard this difference as a point in favour of potatoes, since sugar has only three-quarters the fattening value of starch. The reason for this is that sugar, owing to its soluble character, suffers a greater degree of destructive fermentation by bacteria in the paunch of sheep and cattle than does starch.

Nature of Albuminoids in Potatoes

I ought at this stage to call your attention to certain peculiar features of the albuminoid constituent of potatoes, peculiarities which are shared also by the nitrogenous components of roots. We have seen that potatoes contain 2.1 per cent. of crude protein or albuminoid, of which, as can be demonstrated by animal experiment, 1.1 per cent. can be digested and utilised by farm animals. But of this small amount of digestible albuminoid, only 0.6 per cent. consists of the kind of true protein we find in milk, meat or egg-white. The remaining 0.5 per cent., that is to say, almost half of the digestible albuminoid in potatoes, consists of nitrogenous substances of much simpler nature than protein. The chemist knows them under such names as asparagine, amino acids, ammonium compounds, etc., and mistakenly groups them together under the name of "amides."

In order to understand completely the nutritive properties of the potato, we must inquire into the feeding value of these so-called "amides." The case of the potato has been satisfactorily settled by the Scandinavian chemist, Hindhede, who, by feeding experiments over long periods, has demonstrated that the assimilable albuminoid of potatoes is an extremely valuable type of protein for repairing and building up body tissue. Experiments in Denmark have led to the conclusion that when dairy cows are fed on rations containing the correct requirements of starch equivalent and digestible protein, almost 90 per cent. of the "amides" in the food are built up in the animal into milk protein. In Germany, Morgen has proved that if asparagine, a typical food amide, be added to a ration containing sufficient energy or starch equivalent, but deficient in digestible

protein, then it can serve not only for maintenance of the dairy cow, but also for milk production. At a later date, his fellow-countryman, Honcamp, obtained the surprising result that it is possible to replace part of the true protein in the rations of dairy cows by an amide like urea without seriously affecting milk yield. This savours of the magical when we remember that urea arises normally in the body as a waste product from protein breakdown and has to be eliminated through the kidneys into the urine.

In this country we have solved the question by means of what I may term "committee research" (as distinct from experimental inquiry). We have agreed to assume that the "amides" have a nutritive value equal to half that of digestible true protein. The so-called protein equivalent is the digestible true protein plus half the "amides." For potatoes this amounts to 0.8 per cent., and this, therefore, is the figure that should be used when assessing the contribution of potatoes to the digestible protein content of the ration.

The manner of utilisation of these "amides" is of interest. The bacteria which flourish in the paunch of the ruminant, and which incidentally are responsible for the digestion of fibre, develop and multiply at the expense of the nitrogen in these "amide" substances. By this means, "amide" nitrogen is built up into the protein of the bacteria, and on the decease of the latter, the so-called "bacterial protein" undergoes digestion like ordinary food protein, thus administering to the maintenance and production requirements of the animal.

I trust I have not dwelt too long on this peculiar feature of potato composition. In actual feeding practice, I do not think it has any great significance, because, as I have already pointed out, potatoes should be fed for the carbohydrate that they contain, and the stock-feeder should look to the other ingredients of the ration to supply the necessary digestible protein.

Comparison of Potatoes with Cereals

And now to come back to more practical issues. We have seen that potatoes belong to the class of carbohydrate-rich foods and as such may be fed in replacement of roots. But how do they compare with that other important class of carbohydrate foods, namely, the cereals, such as wheat, barley and maize? If we examine the composition of the dry substance of potatoes, we find that the main distinction between potatoes and cereals is largely a matter of moisture content. On the basis of dry matter, maize for example contains about 80 per cent. of carbohydrate, mainly as starch, and about 11.4 per cent. of protein, whereas potatoes contain about 83 per cent. of carbohydrate, also mainly as starch, and about 9 per cent. of protein. Both maize and potatoes are poor in fibre and minerals. Obviously we may regard the dry food substance in potatoes as being similar to the food material in the cereal grains.

Potatoes are, in fact, "watered" carbohydrate concentrates. They may be used, therefore, as a substitute for barley and maize, as in the rations of pigs, in which case it is important to remember that 1 lb. of cereal meal is equal to 4 lb. of potatoes. Incidentally, the more general use of potatoes in pig rations should enable our huge imports of maize to be cut down very considerably.

Vitamins in Potatoes

I may mention here that a very satisfactory feature of the composition of potatoes is their richness in the anti-scorbutic vitamin C. This renders potatoes peculiarly suitable for inclusion in the rations of farm animals during the non-grazing winter season. They also contain small amounts of vitamins A and B. The cooking of potatoes reduces slightly their vitamin potency, but even in this condition they are quite a good source of these accessory factors, particularly of vitamin C.

Precautions in the Use of Potatoes for Live-stock

Before passing on to illustrate in detail how, and in what amounts, potatoes may be included in the rations of the different classes of live-stock, it will be as well if I call attention to certain precautions which should be observed when potatoes are being utilised in this way.

- (1) Only clean, sound potatoes should be used for feeding. Dirty or rotting potatoes should be rigidly excluded, since they may cause internal irritation and give rise to inflammation of the linings of the digestive tract. This danger is particularly to be feared with young animals, especially in pig-feeding.
- (2) Raw potatoes, even when clean and in sound condition, are slightly acrid and bitter in taste, and have a laxative action on the bowels of the animal. If large allowances of raw potatoes are included in the rations of live-stock, therefore, digestive troubles such as "blowing" and "scouring" may result, and for this reason, especially in pig-feeding, many feeders prefer to cook or steam potatoes if more than small amounts are to be fed. This improves palatability and renders them a safer food by reducing their laxative character. Indeed, cooked potatoes have, if anything, a slightly constipating action. The water draining away from the potatoes after cooking should preferably not be used, because its inclusion increases the liability to digestive troubles.
- (3) Raw potatoes are frequently fed whole, but many feeders prefer to put them through the root slicer before use, thereby eliminating risk of choking. The important point to remember is that the daily allowances should at first be small, the amount being increased gradually to a maximum which should never err on the side of excess. They should on no account be fed *ad libitum*.

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- (4) In my opinion, although this might not be admitted generally, it is inadvisable to use raw potatoes at all for very young stock. Neither should I use raw potatoes in more than moderate amount for animals in the later stages of pregnancy, although again I am prepared for a division of opinion on this point.
- (5) When potatoes have sprouted during storage, the sprouts should in no circumstances be fed to live-stock, as they contain a poisonous substance known as solanine, a compound which appears to form a connecting link between the saponins and the alkaloids. This poison seems to be a regular constituent of all parts of the potato plant, the tubers containing about 0.01 per cent. Although the amount does not increase when the potatoes are stored, or when they decompose, the substance passes in large quantities into the young shoots when the tubers germinate, so that the sprouts may contain as much as 5 per cent. This means that the young shoots should not on any account be used in feeding. The same risk attaches in smaller degree to tubers that have turned green under the action of sunlight. If such tubers are to be fed to stock, they should be boiled before use to extract the solanine and the water allowed to drain away. It is safer, however, to avoid the use of such greened potatoes as far as practicable.

We may now go on to consider in more detail how potatoes may best be used in the feeding of live-stock, and because cattle are the least sensitive to the laxative action of raw potatoes, we will first deal with their use in the fattening of mature bullocks.

Potatoes in the Fattening Rations of Store Beasts

If the precautions I have enumerated are given due consideration, there is no reason why the allowance of raw potatoes in the fattening rations of store beasts should not be increased up to about 40 lb. per head. This is equivalent to a swedes allowance of about 80 lb. The potatoes should preferably be sliced, and care should be taken to ensure that only small quantities, say 5 to 7 lb. per head, should be given at first, the amount being increased gradually to the maximum. I do not advise going beyond the 40 lb. limit, although if the potatoes are steamed before use, rather bigger amounts can be fed with safety. The rest of the ration should consist, as when using roots, of the usual allowances of oil cake and hay or straw, with possibly some cereal to make up the full requirement of starch equivalent. The animals should also be provided with a salt lick, both for the sake of the mineral and for increasing palatability. German authorities recommend oil cakes with a sedative action, such as linseed cake or coconut cake, but many Lincolnshire feeders prefer to take advantage of the astringent qualities of cotton cake to counterbalance the laxative action of the potatoes.

Potatoes in "Baby Beef" Rations

That potatoes can be used with advantage in the rations of "baby beeves" seems clear from the following experience. A few years ago I was given the "finishing" ration of a farmer who was described as the best feeder of "baby beef" in Lincolnshire. I was not informed of the gentleman's name, so that I cannot "hold him up to honour" on this occasion. Being a Lincolnshire farmer, however, he may be with us to-day. We shall learn this perhaps when the time for discussion arrives. Indeed, I feel sure he will be found to be present, probably several times over!

The ration consisted of 7 lb. rye grass and clover hay, oat straw chaff *ad lib.*, 3 lb. sugar beet pulp, 1 lb. each of bean meal, ground oats, crushed wheat and linseed cake, together with 56 lb. of raw potatoes. I must confess I was surprised to note the heavy allowance of raw potatoes in the ration, but we must bear in mind that this was Lincolnshire feeding. Since an ounce of experience is said to be worth several tons of theory, I think we may safely conclude that raw potatoes may be used in the production of "baby beef." I should be inclined to counsel moderation, however, in their use for this purpose.

Potatoes in the Rations of Dairy Cows

In the feeding of dairy cows, raw potatoes may also be used, but in greater moderation than with fattening cattle. We recall in this connection the recent controversy about the feeding of roots to dairy cattle. The "breeze" of this controversy has at least served to clear the air, and it can now be stated that roots are a very serviceable ingredient of a cow's ration if restricted to about 40 lb. per head per day. Now 40 lb. of roots are equal to about 20 lb. of potatoes, and I regard 20 lb. of raw potatoes as a suitable maximum for dairy cows. Starting with 5 to 7 lb. of sliced potatoes, the amount may be gradually increased to about 20 lb. Excessive feeding of raw potatoes, however, must inevitably lead to "blowing" and other digestive disturbances, with consequent lowering of milk yield. For this reason, it is important to control the feeding of potatoes indoors rather than to cart them to the field and spread them on the pasture.

Owing to the absence of the yellow pigment, carotene, potatoes are inclined to give milk and butter of pale colour, but the milk will not suffer in other respects provided the rations are properly balanced. I should not be inclined to recommend the too liberal use of potatoes on cream and butter farms, unless it is possible also to feed pigmented food such as kale, cabbage or carrots to counteract the effect of the potatoes.

Before leaving this phase of the subject, I feel sure you will be interested in the following dairy rations recommended by Mr. J. Mackintosh, of the National Institute for Research in Dairying. They illustrate very clearly how potatoes may be used in the feeding of this class of live-stock.

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Rations including Potatoes for Dairy Cows

- (1) For maintenance only :
- | | |
|-------------------------|------------------------|
| (a) Hay 12-14 lb. | (b) Hay 7-10 lb. |
| Roots 20 lb. | Oat straw 5 lb. |
| Potatoes 12 lb. | Roots 28 lb. |
| | Potatoes 14 lb. |
- (2) For maintenance plus first gallon :
- | | | |
|-------------------|--------------------|---------------------|
| (a) Hay .. 14 lb. | (b) Hay .. 10 lb. | (c) Hay 7 lb. |
| Roots .. 35 lb. | Oat straw 5 lb. | Oat straw .. 5 lb. |
| Potatoes 15 lb. | Kale or .. | Beet pulp .. 6 lb. |
| Dec. ground .. | cabbage 30 lb. | Potatoes .. 15 lb. |
| nut cake 1 lb. | Potatoes .. 12 lb. | Dec. ground .. |
| | Soya bean .. | nut cake .. 1½ lb. |
| | meal .. 1 lb. | |

Potatoes in the Feeding of Sheep and Horses

I cannot speak from personal experience of the feeding of potatoes to sheep, but Kellner, the German authority, states that sheep can take raw potatoes almost as well as cattle. He recommends the feeding to fattening sheep at the rate of 4 lb. of raw potatoes per 100 lb. live-weight. Since 4 lb. of potatoes are equal to 8 lb. of roots, you will note that with such an allowance, there is still room in the ration for some roots or kale in addition to the customary small allowances of hay and concentrated supplement. Potatoes are also sometimes carted to the flock on pasture and fed in the raw, whole condition. If any of my listeners are in the habit of using potatoes for sheep-feeding, I should be very interested to hear of their experiences at discussion time.

I do not consider raw potatoes a suitable food for horses, since their digestive system is likely to be upset very easily by such a food. It is interesting to note, however, that certain authorities assert that small quantities of potatoes, say 3 to 5 lb. per head per day, have a beneficial effect on condition. I think I am right in stating, however, that the best feeders look askance on the feeding of raw potatoes to horses.

Potatoes in Pig Rations

I need not say much about the feeding of potatoes to pigs, since this is an old-established custom. The function of potatoes in this connection is to replace part of the carbohydrate food such as barley meal or maize meal, the replacement being based on the finding that 4 lb. of potatoes are equivalent to 1 lb. of meal. It is always advisable to cook or steam potatoes before feeding them to pigs. These animals have a relatively small and simple digestive tract and are readily liable to digestive disturbances from the use of more than small amounts of potatoes in the raw condition. I am aware that numbers of feeders use raw potatoes in the case of in-pig sows, but even with sows, my own preference is for cooked potatoes. I may point out that the almost negligible oil content of potatoes renders them a suitable food for baconers. In these days of bacon schemes, it is

perhaps advisable to avoid the use of foods containing more than a small percentage of oil. As examples of how cooked potatoes may with advantage be employed in pig-feeding, I need only quote the following rations suggested by Principal W. A. Stewart, of the Northampton Farm Institute.

Rations including Potatoes for Pigs

(1) Weaners :	(2) Early Stage of Fattening :	(3) Later Stage of Fattening :
Barley meal .. $\frac{1}{4}$ lb.	Barley meal $1\frac{1}{2}$ lb.	Barley meal $2\frac{1}{2}$ lb.
Potatoes .. 4 lb.	Potatoes 6 lb.	Potatoes 10-12 lb.
Weatings .. 1 lb.	Weatings $1\frac{1}{2}$ lb.	Weatings .. $1\frac{1}{2}$ lb.
Fish meal .. $\frac{1}{4}$ lb.	Fish meal $\frac{1}{2}$ lb.	Soya bean meal $\frac{3}{4}$ lb.
(4) In-pig Sows :	(5) Sows in Milk :	
Potatoes 8-12 lb.	Barley meal 2 lb.	
Weatings $1\frac{1}{2}$ lb.	Potatoes 8 lb.	
Fish meal $\frac{1}{4}$ - $\frac{1}{2}$ lb.	Weatings 4 lb.	
	Fish meal 1 lb.	
	Soya bean meal .. 1 lb.	

Conservation of Potatoes

In this final section I should like to deal very briefly with certain methods whereby surplus potatoes might be conserved for feeding at a later date. This may be done on a farm scale by the method of ensilage and on an industrial scale by artificial drying.

Ensilage of Potatoes

Ensilage of potatoes is conveniently carried out in the stack in conjunction with grass or other green crop, alternating a 3 ton layer of grass or green clover with a 1 ton layer of whole potatoes, preferably the small, unsaleable tubers. Owing to the heat engendered in the storage, the potatoes come out in a floury, semi-cooked condition. I was very agreeably impressed with the results of a trial of this kind which I saw carried out a few years ago, and I am confident that the process offers great possibilities. The protein-rich character of the grass, if mown at the correct stage, is balanced against the carbohydrate-rich nature of the potatoes.

Artificial Drying of Potatoes

The practice of artificially drying the surplus potatoes is now practised widely on the Continent. Two methods are in use, the first for the production of potato slices and the second for potato flakes. I am not aware that these processes have been taken up on any scale in this country. If they have not, it is to be regretted for the following reasons : (1) Artificial drying enables the small tubers to be disposed of profitably, and is a means of carrying over a surplus of potatoes from one season to another. (2) It would forge another link between agriculture and industry and give employment to many workers. The dried potatoes so produced would lead to a reduction of our imports of maize. (3) The dried product is in a convenient form for

transport and storage. It is more palatable than raw potatoes and constitutes a safer food. It can therefore be fed more liberally to livestock. Fattening cattle can be given up to 10 or 12 lb. per head per day, and even horses, which are very sensitive to raw potatoes, can have up to one-third of their corn ration replaced by dried potatoes.

The product may replace other carbohydrate foods according to the following scheme ; 1 lb. dried potatoes=1 lb. wheat=1 lb. barley = $\frac{9}{10}$ lb. maize = $1\frac{1}{5}$ lb. oats = $1\frac{1}{5}$ lb. dried beet pulp = $1\frac{1}{5}$ lb. molassed beet pulp.

Alcohol from Surplus Potatoes

By the terms of reference, I have been limited to considerations of a nutritional nature in dealing with the disposal of surplus potatoes. For that reason I have not referred to the many industrial processes in which the humble potato might play an honourable rôle. Amongst the brightest of these possibilities is the use to which potatoes might be put in the production of alcohol. I do not necessarily mean alcohol for consumption purposes, but power alcohol. I am told that there is already a strong movement in this direction, and as members of the great agricultural community of this country, we give this movement our blessing. We look with favourable eye on all proposals which have as their object the betterment of the farmer's lot in these stirring, though still difficult times.