UNIVERSITY OF MINNESOTA.

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 42.

CHEMICAL DIVISION.

1895
December, 1995.

THE COMPOSITION, DIGESTIBILITY AND FOOD VALUE OF POTATOES.

MINNEAPOLIS:
HARRISON & SMITH, PRINTERS.
1896.

UNIVERSITY OF MINNESOTA.

BOARD OF REGENTS.

The HON. JOHN S. PILLSBURY, MINNEAPOLIS, - *Regent for Life*
The HON. GREENLEAF CLARK, M. A., ST. PAUL, - - - 1900
The HON. CUSHMAN K. DAVIS, M. A., ST. PAUL, - - - 1900
The HON. WM. H. YALE, WINONA, - - - - - - - 1896
The HON. JOEL P. HEATWOLE, NORTHFIELD, - - - 1897
The HON. L. S. SWENSON, ALBERT LEA, - - - - - 1897
The HON. ALPHONSO BARTO, ST. CLOUD, - - - - - 1896
The HON. WM. M. LIGGETT, BENSON, - - - - - - 1897
The HON. S. M. OWEN, MINNEAPOLIS, - - - - - - 1901
The HON. STEPHEN MAHONEY, B. A., MINNEAPOLIS, - - 1901
The HON. DAVID M. CLOUGH, MINNEAPOLIS, - - - *Ex-Officio*
The Governor of the State.
The HON. W. W. PENDERGAST, M. A., HUTCHINSON, - *Ex-Officio*
The State Superintendent of Public Instruction.
CYRUS NORTHROP, LL. D., MINNEAPOLIS, - - - - *Ex-Officio*
The President of the University.

THE AGRICULTURAL COMMITTEE.

The HON. WILLIAM M. LIGGETT, Chairman.
The HON. J. S. PILLSBURY.
The HON. S. M. OWEN.
The HON. W. W. PENDERGAST.

OFFICERS OF THE STATION:

WM. M. LIGGETT, - - - - - - - - - - - - Chairman.
WILLET M. HAYS, B. S. A., - - Vice Chairman and Agriculturist.
SAMUEL B. GREEN, B. S., - - - - - - - Horticulturist.
OTTO LUGGER, Ph. D., - - - - Ent mologist and Botanist.
HARRY SNYDER, B. S., - - - - - - - - - Chemist.
T. L. HÆCKER, - - - - - - - - - - Dairy Husbandry.
M. H. REYNOLDS, M. D., V. M., - - - - - - - Veterinarian.
THOS. SHAW, - - - - - - - - - Animal Husbandry.
J. A. VYE, - - - - - - - - - - - - - - Secretary.
ANDREW BOSS, - - - - - - - - - - Farm Foreman.

☞ The Bulletins of this Station are mailed free to all residents of the state who make application for them.

THE COMPOSITION, DIGESTIBILITY AND FOOD VALUE OF POTATOES.

HARRY SNYDER.

The value of any food depends upon its composition, or what materials the food is made up of; the digestibility of these materials, that is, the extent to which they are capable of being made use of when consumed as food; and finally, the palatability, or agreeableness, of the food to the taste. With potatoes, then, as with any other food, it is necessary to consider, first, the composition.

COMPOSITION OF POTATOES.

The average composition of twenty samples of potatoes grown in different parts of the state, on different kinds of soil, and representing different varieties, shows that, as ordinarily used, potatoes are about three-fourths water; the remaining fourth is made up largely of starch, with smaller amounts of nitrogenous compounds, ash, fat, fiber, pectose (jelly) substances, malic acid and other compounds. The average of the analyses shows the presence of the following amounts of each compound in one hundred pounds of potatoes: Water, 75.45; dry material, 24.55. Composition of the dry material: Starch, 19.87; fat, .08; fiber, .33; ash, 1.00; total nitrogenous, 2.50; malic acid, pectose substances, etc., .77.

The potato is subject to limited variations in its composition, caused by climatic conditions, soil, length of growing season and variety, as early or late. With a long growing season, a late variety and an impoverished soil, the potato will develop decidedly on the side of starch and pectose (jelly) compounds, and be very poor in the important nitrogenous or bone and muscle forming compounds. These factors, it is to be noted, are all in favor of imparting a higher value to potatoes grown

under the conditions prevailing in this state, particularly to the earlier varieties and those grown on rich soil. In many analyses 3 per cent. of nitrogenous compounds was not an unusual amount found, while from the analyses of potatoes grown in many other sections of the country, 1.25 per cent. is as frequently reported.

Potatoes for Feeding and for Starch Making.—For feeding purposes the earlier varieties of potatoes are preferable because they contain less starch and a larger proportional amount of protein. This is due to the fact that in the early part of the growth of the potato, the nitrogenous (protein) compounds are formed, while the starch is added in the later stages. For starch making purposes, the medium-sized, later varieties are preferable; excessively large potatoes are not as valuable for starch purposes as are the medium-sized ones, even of the same variety. In the very large potatoes the pectose (jelly) and other substances replace the starch. As with sugar beets, the medium-sized ones contain a larger amount of sugar than the large pulpy beets, so with potatoes, the medium-sized ones contain more starch.

The Nitrogenous Compounds of the Potato.—These compounds are not as valuable, pound for pound, for muscle making purposes, as the nitrogenous compounds of grains and milled products. In the potato, only about half of the total nitrogenous compounds are in the form of protein, mostly vegetable albumen, while the other half is in less valuable forms, known as amides, etc. In the grains and milled products about 95 per cent. of the total nitrogen is in the form of protein. Hence, in comparing the food value of potatoes with the food value of other materials, it is necessary to assign only half the value to the potato crude protein, as to the crude protein of grains. That is, potatoes which contain 2.50 per cent. crude protein, and wheat which contains 14 per cent. crude protein, are compared by estimating that the 2½ per cent. potato crude protein is worth 1¼ per cent. crude protein in the wheat. In this work the correction for the difference in the food value of the potato crude protein and the crude protein of other products has been made in all cases. The comparative value of potatoes and other food articles will be considered more in detail after discussing the digestibility.

The Fat.—The amount of fat in potatoes is very small, a hundred pounds of potatoes contain less than a tenth of a pound of fat. The fat of the potato, when separated, is a very soft fat, in which olein, as in olive oil, largely predominates. The small amount of fat in the potato does not materially lessen its food value, because the large amount of starch compensates for the absence of this non-nitrogenous compound.

The Fiber.—The amount of fibre in the potato is also very small, about a third of one per cent. One argument which is frequently heard against potatoes as an article of human food is that they "contain too much woody (fiber) material." The truth is, there is no greater amount of fiber in potatoes than is in many of the best grades of patent flour and not as much as is present in many food articles which are highly prized.

The mineral matter of the potato is composed largely of potash salts, which are present mainly in the juices. Although growing under ground there is only a very small amount of silica (sand) in the tissues of the potato, about the same amount as is present in the wheat kernel.

Glucose.—When potatoes have been stored for some time, and especially when they begin to sprout, a small amount of glucose is also found. The glucose is produced from the starch by the action of micro-organisms. When the potato is first dug there is no glucose present, but after storing and sprouting, and particularly after freezing, glucose is frequently present in quite large quantities.

Malic Acid.—The small amount of malic acid in potatoes, without doubt, does much to improve the palatability. The reaction of malic acid in potatoes upon copper is quite noticeable; a dull penny, when placed in a raw potato and left for a day, will appear very bright, due to the malic acid of the potato dissolving some of the copper.

Pectose Substances.—The pectose substances (jellies) are usually present from a half to three-quarters of one per cent. When the potatoes are large and pulpy the amount of pectose substances is frequently as high as four per cent. The pectose substances may be obtained by reducing the potato to a pulp and squeezing the pulp through a close linen cloth. The potato juice is then warmed so as to coagulate the albumen, which separates in a white flocculent mass. The juice is then

passed a second time through the linen cloth so as to remove the coagulated albumen; a little hot water may be used this time for washing. The filtered (strained) liquid is put into a glass and a few drops of alcohol added, which will coagulate the jelly substances. The albuminous materials are first removed by heating and straining, otherwise the alcohol would also coagulate these compounds. The jelly obtained from the potato is very white in appearance. The pectose substances possess about the same food value as starch.

Starch.—About a fifth of the weight of the potato is starch. The starch is present in the form of small grains. The starch grains are from a 300th to a 600th part of an inch in size, and are composed of separate layers overlapping each other in the way shown in the figure. The potato starch grains are much larger than the starch grains from many other sources. The walls of the starch grains are composed of cellulose materials, and between the walls there is a material known as granulose or pure starch. From the structure of the starch grain it is easily understood why starch will not dissolve in cold water, because each grain is composed of cellulose walls which protect the pure soluble starch within. The starch grains are all packed in closely together, and when viewed with a magnifying glass, after staining with iodin, appear like so many small potatoes. In a square inch of the potato there is over a million starch grains like those shown in the illustration.

The value of starch as a food is due solely to its heat producing, and, to a less extent, its fat producing powers. A pound of starch when burned will produce about the same amount of heat as a pound of albumen. The albumen is capable, not only of producing heat, but also of producing new muscular tissues, and supplying the waste matter from old ones. An animal, if fed entirely on starch, would soon die from the want of proper muscle forming materials.

Composition of potato illustrated. In figure No. 14 the composition of the potato is illustrated. The figure, a cross section of a potato, shows the relative amount of water, starch, ash, and other compounds which are present. If all of the water of the potato were separated and placed by itself it

would occupy the space marked water in the figure, while the starch, fat, ash, fibre, pectose substances, etc., and total nitrogenous compounds would each be represented by the spaces shown in the illustration. This figure emphasizes the statement made at the opening of the bulletin, that potatoes are about three-fourths water, one-fifth starch, while the remainder is made up of smaller amounts of other compounds.

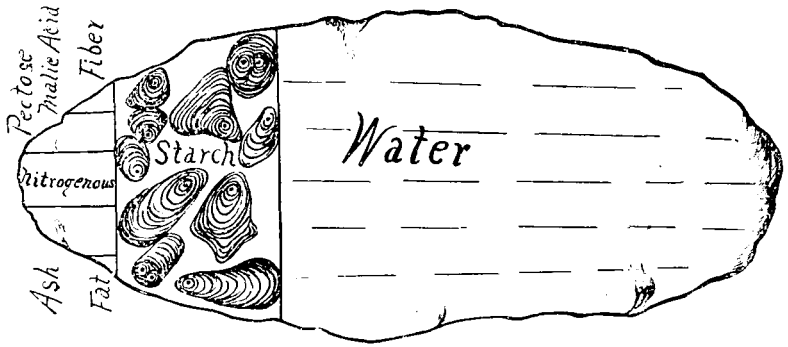

Figure No. 14, Illustrating the Composition of the Potato.

Potatoes are a very concentrated starchy food. When fed alone they are incapable of supplying all of the wants of the body, but when fed with grain or some of the milled products like oil meal, pea meal, shorts, beans, or good wheat screenings, they are a very valuable food for fattening purposes.

In one of our experiments, two pigs, each weighing 170 pounds when fed an average of 3¼ pounds of shorts, and ten pounds of potatoes per day, made a total gain of fifty pounds each in 44 days; an average gain of 1¼ pounds per day. The shorts, 3¼ pounds per day, was barely enough to supply all of the waste matters of the body, that is just about enough to evenly maintain the pig. When the ten pounds of potatoes were added to the ration, there was enough of all of the food nutrients to supply the wants of the body, and leave a small margin for growth. When potatoes are fed in this way, just enough grain to supply all of the requirements of the body, and then potatoes in as large quantities as the animals can comfortably consume, both the potatoes and grain are fed to mu-

tual advantage. If potatoes alone were fed, it would be necessary for a pig weighing 175 pounds to eat nearly sixty pounds of potatoes per day in order to get enough protein to supply all of the waste tissues of his body. This would mean in bulk a pile of potatoes above one-third as large as the pig; of course it would be an impossibility for the pig to consume and digest so large a quantity in one day.

DIGESTIBILITY OF POTATOES.

Pigs weighing from 170 to 220 pounds were used in the experiments. Four separate trials, with two pigs, were made. In two of the trials the potatoes were cooked, and in two of the trials they were fed raw. The ration fed consisted of ten pounds of potatoes, and a little over three pounds of shorts per day. The trials extended over a period of nearly two months. Every care was taken to secure all of the accuracy possible.

In order to determine the digestibility of any food it is necessary to weigh, and make a complete chemical analysis of all of the food consumed. The amount of each separate nutrient, as fiber, fat, protien etc., is calculated and charged to each pig. All of the manure is carefully collected and analyzed, and the indigestible nutrients in the manure are subtracted from the total amount in the food, which gives the amount which has been digested by the animal. In case two foods are fed, the digestibility of one of the foods must be separately determined, and then the digestibility of the other food determined by difference.

In this digestion work, special digestion boxes were used, so as to collect the dung and urine separately. The room in which the work was carried on was provided with a tile floor, hence the pigs could be allowed a reasonable amount of exercise in the presence of an attendant, so as to avoid the usual difficulty in digestion experiments of too close confinement.

The nitrogen in the solid excrements was determined in three forms: the total nitrogen, the albumenoid nitrogen, and the biliary nitrogen. Without entering into all the minute

details and a discussion of the separate analyses of the food, manure, etc., the results obtained were as follows:

TABLE NO. XXVIII.---Digestibility of Raw Potatoes.

	First Trial		Second Trial		Average. 4 trials
	Duke	Prince	Duke	Prince	
Total dry matter (dry potato)	97.4	96.2	96.4	98.1	**97.0**
Total nitrogenous	85.6	83.4	82.0	86.8	**84.5**
True protein	81.6	82.0	81.4	83.0	**82.0**
Starch, pectose, etc.	97 7	97.5	98.5	98.6	**98.1**
Ash	45.5	40.0	41.0	52.0	**44.6**

These results show that the potato is very digestible. When a hundred pounds of potatoes are fed to pigs, 23.8 pounds dry matter are digestible, while only .75 pounds are indigestible. The digestibility of the shorts was also separately determined. The range in digestibility of the dry matter, protein, starch, etc., of the potato is very limited. On account of the very small amount of fat in the potato, less than a tenth of one per cent., it is not safe to calculate the absolute amount digestible. But from the high digestibility of the dry matter, and the physical appearance of the fat when separated, it is safe to assume that the small amount of fat is also easily digested. The fiber is also calculated along with the starch and other non-nitrogenous compounds.

These figures for the digestibility of the potato are much higher than those reported with sheep by the Maine experiment station, giving the digestibility of the dry matter as 77, the protein as 44, and the fat as 13.

Experiments made at the Hohenheim and Proskau experiment stations upon the digestibility of potatoes, as quoted by Armsby, Manual of Cattle Feeding, show that "they may, for practical purposes, be assumed to be completely digestible." It is to be noted that this is practically the result obtained in our digestion trials.

Cooking Potatoes.—As stated, two duplicate trials were also made with cooked potatoes. The cooking of the potatoes did not materially effect the digestibility, as far as the digestive powers of the pig were concerned. In fact the average for the

protein is just a little lower than when the potatoes were fed raw.

TABLE NO. XXIX.—Digestibility of Cooked Potatoes, Average of Four Trials.

Total dry matter	95.
Total nitrogenous	82.
True Protein	80.
Starch, pectose substances, etc	97.6
Ash	40.

When the potatoes were cooked, the pigs could be induced to eat a larger *quantity*. When a pig consumed 9 pounds of raw potatoes per day, he could by cooking the potatoes, be induced to eat two or three pounds more. The cooked potatoes were consumed with a greater relish than the raw ones. Whatever is gained by cooking potatoes is due to inducing the pigs to consume a larger quantity, and not to increasing the digestibility.

Different Ways of Cooking Potatoes. The different ways in which a potato is cooked has much to do with its food value. Inasmuch as nearly 85 per cent. of the total albumenous compounds of the potato are present in the juices in soluble forms, it is not so surprising that with some methods of cooking this albumen is extracted in the water employed for boiling. When the potatoes are peeled, and placed in cold water, the water in warming up, extracts a large amount of the albumenous materials, and if the potatoes are used for human food, there is a large amount of the vegetable albumen lost in the water used for cooking. On the other hand, if the potatoes are placed directly in boiling water, the albumen is coagulated and retained in the potato. The average of trials made in the station laboratory, when potatoes were cooked in several ways, gives the following results:

TABLE NO. XXX.—Loss of Albumen in Cooking Potatoes.

	Peeled Potatoes started in cold water.	Peeled Potatoes started in hot water.	Potatoes not peeled.	
			Started in cold water.	Started in hot water
Total albumenous compounds extracted and lost..	80 per ct.	10 per ct.	50 per ct.	2 per ct.

These results show, that when potatoes are peeled and started in cold water there is a loss of 80 per cent. of the total

albumen, and when the potatoes are not peeled and are started in hot water, the loss is reduced to 2 per cent.

A bushel of potatoes weighing sixty pounds contains about two pounds of total nitrogenous compounds. When improperly cooked, one-half pound is lost, containing .60 of a pound of the most valuable proteids. It requires all of the protein from nearly two pounds of round beef steak to replace this loss of protein from improperly boiling the bushel of potatoes.

Use of Salt in the Feeding of Potatoes.—In the feeding of potatoes a more liberal use of salt is necessary than in feeding almost any other kind of food. The mineral matter of the potato is largely composed of potash salts, and there is only a small amount of sodium chloride (common salt) present. In the excretion of the potash salts from the body, a larger amount of sodium salt is required.

FOOD VALUE OF POTATOES.

The cheapness of other foods and milled products at the present time (Jan. 1, 1896) has created much interest and discussion in regard to the comparative value of potatoes at 8, 10 and 12 cents per bushel with other foods.

In table No. XXXI, the amounts of digestible nutrients, which can be purchased for one dollar, are given, when potatoes, bran, shorts, oil meal, screenings, barley, corn and oats are at the prices stated. This table will give some information upon this topic. In comparing one food with another, the table should be used as a guide, and not as an absolute rule. When the difference between the digestible nutrients of two foods is small, the preference should be given to the one which the farmer is the more familiar with in feeding.

The table should also be used in the following way; take 50 cents worth of potatoes, and 50 cents worth of shorts, or oil meal, and then compare the *dollars worth* of mixed foods with the dollars worth of some other grain. Frequently combinations of concentrated starchy foods like potatoes, and concentrated nitrogenous foods like oil meal, shorts, bran, peas, or wheat screenings, are much cheaper and better than a single food like corn, or oats.

A dollar, expended in purchasing potatoes at eight cents per bushel, and also shorts or bran at six dollars per ton—

fifty cents worth of potatoes, and fifty cents worth of shorts or bran—will procure more food nutrients than if the dollar were expended for corn at 25 cents per pushel, or oats at 15 cents per bushel.

The special food value of potatoes will be obtained with favorable combinations with concentrated nitrogenous foods as bran, shorts, oil meal, pea meal, or wheat screenings, and not from feeding the potatoes alone, which is an impossibility. When combined in this way, the palatability of the mixed ration is greater than that of a single food. In the tables, the protein of the potato is calculated as comprising about half of the total nitrogenous compound; for the reasons stated in discussing the nitrogenous compounds of the potato.

Ordinarily, potatoes command such a high price as not to admit of their use in the feeding of animals, hence the literature on the feeding value of potatoes is very limited. Experiments conducted by Professor Henry, of Wisconsin, in the fattening of pigs showed "that it required nearly 4½ pounds of potatoes to take the place of one pound of corn meal." The digestible nutrients in one pound of corn meal, and in four and a half pounds of potatoes are:

	Dry Matter.	Fat.	Protein.	Starch, etc.
One pound corn meal.....	.8	.03	.09	.67
Four and half pounds potatoes.	1.1	..	.06	1.

In addition to the .06 lbs. of protein in the potatoes there is also 05 lbs. of amide compounds.

Potatoes are more valuable, pound for pound, for fattening purposes, than any of the root crops. Potatoes do not contain as much water as do carrots, mangels, red beets, turnips, nor ruta bagas. Potatoes are good for producing fat, but alone they cannot produce muscle nor supply the waste materials of the body.

TABLE XXXI.—Digestible Nutrients Bought for One Dollar.

	Price.	Pounds Digestible.			
		Dry Matter.	Protein.	Fat.	Starch & other non-nitrogenous.
Potatoes	8 cts Bu.	179	8.3	.....	170
Potatoes	10 "	143	6.6	.....	137
Potatoes	12 "	119	5.5	.....	113
Corn	20 "	224	25.7	8.7	192
Corn	25 "	179	20.1	6.3	151
Oats	15 "	140	19.7	8.3	109
Oats	12 "	175	25.6	10.5	139
Bran	$6.00 ton	200	40	12	142
Bran	$7.00 "	171	35.6	10.3	120
Shorts	$6.00 "	221	33	7.6	162
Shorts	$7.00 "	190	28.5	7.1	152
Wheat screeni'gs (1st qual.)	$5.00 "	292	44	6.	232
Oil meal	$14.00 "	102	38	10.	48
Barley	30cts.Bu.	112	14.6	2.8	94
50 cts. worth potatoes and 50 cts. worth shorts	.....	**200**	**20.8**	**3.8**	**166**
50 cts. worth potatoes and 50 cts. worth bran	.....	**190**	**24.3**	**6**	**156**
50 cts. worth potatoes and 50 cts. worth oil meal	.....	**131**	**23.1**	**5**	**110**
50 cts. worth potatoes and 50 cts. worth screenings	.....	**236**	**26.3**	**3**	**201**

Experiments conducted with pigs by this station in 1892, and published in bulletin No. 26, show the amount of digestible protein, and non-nitrogenous compounds necessary to supply all of the waste materials of the body, and also the amount necessary to produce rapid or slow increase in live weight. A part of the results are set forth in condensed form in the following table:

TABLE XXXII.—The Nitrogen in the Food Supply.

KIND OF FOOD.	Pounds of food per day.	Initial weight of pigs.	Total lbs of nitrogen per week in				Pounds per day of digestible protein in food.	Pounds of grain per week.
			Food.	Dung.	Urine.	Retain'd in body.		
Barley and Shorts.....	9 5-7	254	1 37	.32	.57	.48	.95	19
Barley	6	271	.76	.14	.58	.04	.56	3
Corn and Shorts.....	5 1-7	256	.66	.14	.53	.00	.52	loss 1½
Corn.....	6½	247	.80	.10	.52	.18	.75	8

A pig weighing 250 must receive at least .50 lb of digestible protein along with the digestible non-nitrogenous compounds, in order to supply [illegible] of the waste materials from the body which are carried off in the urine. If the pig consumes four pounds of shorts per day and can be induced to eat 15 pounds, of potatoes, he will consume nearly .6 of a pound of protein, which is sufficient to supply all of the waste of the body and leave a small margin for growth.

Table XXXIII has been constructed on the basis of the amount of grain, or milled products which it is absolutely necessary to feed along with potatoes, when the potatoes are fed in as large quantities as the animals will comfortably consume. In feeding it will be found more economical to add about half a pound more per day of each of the grains than is given in the table, because in the feeding of all animals the chief benefits which come from the food are derived from the small amount which is in excess of that required to supply waste tissues, and to maintain the complicated machinery of the animal body.

TABLE XXXIII.—Potatoes Fed in as Large Quantities as the Animals will Reasonably Consume.

	Shorts Lbs.	Bran. Lbs.	Oil meal Lbs.	Wheat screenings. Lbs.	Oats. Lbs.	Barley Lbs.
Pigs, 100 lbs.	2½	.....	1.	2¼	.....	2 4-5
Pigs, 125 "	2¾	.....	1¼	2½	.....	3¼
Pigs, 170 "	3¼	.....	1½	3.	.....	3¾
Pigs, 250 "	4.	.....	1¾	3 4-5	.....	4½
Growing Cattle, 500 lbs.	8.	7½	3½	7¾	8	8¼
Growing Cattle, 700 "	8½	8.	3⅔	8¼	8½	8¾
Growing Cattle, 850 "	9½	9.	4.	9¼	9½	9¾
Fattening Cattle, 1,000 lbs. 1.50	10½	10½	5.	10.	10½	10½
Sheep, 60 lbs.	1¼	.....	½	1.	1¼	.....
Sheep, 75 "	1¼+	.....	½+	1 +	1¼+	.....
Sheep, 85 "	1½	.....	¾	1¼	1½	.....

In the case of growing and fattening cattle, oat straw or some other rough fodder of its kind is also calculated as being fed. With good prairie hay, the results, of course, would be even better, and possibly a slight saving of the grain could be made; with clover hay two to three pounds less of the grains, or their food equivalents, could be fed. In the case of oil meal, other grains should be fed with it, rather than feeding the full amount of clear oil meal and potatoes. In case peas have been raised, the peas can be used in about the same proportion as the oil meal, or preferably using one-third more of the peas than the amount given for the oil meal.

For dairy stock it is doubtful, when foods are as cheap as they are at present, whether it would pay to feed very large quantities of potatoes, because a dairy ration necessarily requires more protein than a fattening ration.

Potatoes cannot be fed to young animals as safely as to more mature ones. If fed in too large quantities they have a tendency to prematurely fatten the animal and build up a lighter frame work. With more mature animals, when the fattening period is largely a period of the addition of fat to the body, the potatoes can then be fed to advantage, and more economically.

In the feeding of large quantities of potatoes, no more should be fed than the animals can comfortably dispose of in one day. In one of the digestion trials, when ten pounds of potatoes per day were offered, the pig refused about half of them; when only nine pounds were offered there were none left over. Rolling the potatoes in the grain was found to be another way of encouraging a large amount to be eaten.

It is impossible to state, at the present time, the actual money value of potatoes in the production of pork and beef. When fed in proper combinations potatoes will, without doubt, yield a larger return than their present market price, of about ten cents per bushel.