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THE RELATIVE VALUE OF POTATOES
AND CORNMEAL AS FEED FOR SWINE

Thesis for the Degree of B. S.

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THESIS
ON
THE RELATIVE VALUE OF
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OF THE RELATIVE VALUE OF POTATOES AND CORN MEAL AS FEED FOR SWINE.

The great age of economic living is pressing upon the farmer as well as upon the merchant. The farmer is turning every fence-corner into a garden or pasture lot. He must raise such crops as return the largest yield and the best prices. In many parts of the state we find great fields of potatoes which, if brought into market in the fall, would cause such a surplus as to make it impossible to sell them at any price. In such cases they must be fed to stock or allowed to rot. If he is to feed them, the question naturally arises to the farmer, as to the kind of stock he can best use to reap the largest profits. As in all other residual products, so it is with potatoes, the farmer feeds them to his hogs. He knows that hogs will eat almost anything and that there is always some kind of a market for them. He does not stop to think whether it will pay. It is for this reason that the following experiment has been tried.

I could find but one experiment on record, where potatoes have been fed to pigs and that was at the Wisconsin Experiment Station. In 1890 they tried to determine the value of potatoes as compared with corn meal for swine. They found that 440# of corn meal would produce 100% of gain, and that 262# of corn meal with 789# of potatoes would produce 100% of gain. This would show that 789# of potatoes was equal to 178# of corn meal in producing gain, or that 100% of corn meal was equal to 443% of potatoes.

For my experiment, thirty selected pigs were divided into four pens the first two containing five Duroc-Jerseys and five Poland Chinas each, and the second two containing five Duroc Jerseys each. The Duroc Jerseys in pens I and II were from two litters of five each. One litter was farrowed August 24th, 1896 and contained numbers 27, 33, 34, 35, and 36; the other was farrowed September 6th, 1896 and contained numbers 29, 31, 28, 30, and 32. The Poland Chinas in the same lot were farrowed September 14th 1896. The Duroc Jerseys in lots III and IV were from three litters, farrowed respectively: August 29th, July 17th, and September 8, 1896. The pigs were all eligible to register except the two litters of Duroc Jerseys farrowed July 17th and August 24th which were inferior in quality though possibly fool bloods.

The feed and care previous to the experiment was as follows:- Those in pens I and II were allowed to run with the sows until November 6th. They were then divided into two lots of ten each, Ten Poland Chinas in one and ten Duroc Jerseys in the other. They all received the same kind of food, but the Duroc Jerseys consumed the most. From November 6th 1896 to Jan. 9th, 1897 the Duroc Jerseys consumed 232 $\frac{1}{2}$ lbs of butter-milk, 3385 $1\frac{1}{2}$ lbs of sweet milk, and 1678 lbs of grain. The Poland Chinas consumed 117 $\frac{1}{2}$ lbs of butter-milk, 2733 $\frac{1}{2}$ lbs of sweet milk and 1541 $\frac{1}{2}$ lbs of grain. The Duroc Jerseys gained 543 $\frac{1}{2}$ lbs during the period while the Poland Chinas gained only 474 $\frac{1}{2}$ lbs. The care and feeding of the ten Duroc Jerseys in pens III and IV is unknown, though the fact that, when purchased, they were in very poor condition indicates that it had been far from satisfactory.

The whole four pens were given one week of preliminary feeding from

Jan.9th to Jan.16th, before beginning the experiment. Lots I and III were fed on corn meal and sweet milk and lots II and IV were fed on boiled potatoes and sweet milk. Lot I contained numbers 27, 28, 33, 31, and 36 (Duroc Jerseys) and 17, 19, 20, 22, and 24 (Poland Chinas); lot II contained numbers 33, 37, 32, 34, and 35 (Duroc Jerseys) and 18, 21, 23, 25, and 26 (Poland Chinas); lot III contained numbers 43, 45, 46, 49, and 51 (Duroc Jerseys); lot IV contained numbers 44, 47, 48, 50, and 52 (Duroc Jerseys). Lot I consumed 130" of corn meal and 1335" of skim milk and gained 36" in the preliminary week. Lot II consumed 425" of potatoes and 1335" of skim milk and gained 18" in the preliminary week. Lot III consumed 66" of corn meal and 515" of skim milk and gained 36" in the preliminary week. Lot IV consumed 130" of potatoes and 515" skim milk and gained 10" in the preliminary week.

When the experiment was started it was intended to make the corn meal and potatoes the variables and have the milk the constant, but at the end of the third week the milk ran short and boiled beans were introduced in pens I and II, and into pens III and IV at the end of four weeks. It thus brought forth two experiments which will be reported separately.

Part I.

The feed of this period consisted of corn meal, potatoes, and skim milk.

TABLE I.

Pen I. Feed consisting of corn meal and skim milk.

Weights of pigs for weeks ending on dates given.

Duroc Jerseys.

E.T.	Jan. 9th.	Jan. 16th.	Jan. 23d.	Jan. 30th.	Feb. 6th.
	<u>lbs.</u>				
27s	89	95	104	108	116
29b	106	112	117	125	137
31b	105	114	115	125	138
33b	100	105	113	120	123
36b	124	134	143	150	162
Total-	534	560	592	628	681

Poland Chinas.

17b	80	79	86	89	97
19b	87	82	92	99	106
20b	74	74	84	87	89
22b	97	102	105	112	113
24b	76	76	76	87	93
Total-	414	419	443	474	503.

Pen II. Feed consisting of potatoes and skim milk.

Weights of pigs for weeks ending on dates given.

Duroc Jerseys.

N.T.	Jan. 9th.	Jan. 16th.	Jan. 23d.	Jan. 30th.	Feb. 6th.
<u>lbs.</u>					
236	94	98	99	102	109
306	95	99	107	104	108
326	97	100	98	100	102
346	110	120	126	135	142
356	129	136	136	143	151
Total-	533	546	556	584	612

Poland Chinas.

186	80	74	79	79	84
216	84	81	85	87	91
256	81	86	85	85	90
536	95	88	83	92	98
546	75	72	73	77	77
Total-	405	401	405	420	440.

Pen III. Feed consisting of corn meal and skim milk.

Duroc Jerseys.

N.T	<u>lbs.</u>	Jan.9th.	Jan.16th.	Jan.23d.	Jan.30th.	Feb.6th.	Feb.13.
436	55	61	59	66	74	74	
456	49	60	64	70	78	83	
466	42	48	54	60	65	73	
496	51	59	69	74	82	93	
516	49	54	61	66	75	80	
Total-	246	282	307	332	374	413	

Pen IV. Feed consisting of potatoes and skim milk.

Weights of pigs for weeks ending on dates given.

Duroc Jerseys.

H.T.	Jan.9th.	Jan.16th.	Jan.23d.	Jan.30th.	Feb.6th.	Feb.13
44B	44	48	51	56	65	67
47B	43	48	53	53	62	65
48B	32	35	35	40	46	53
50B	67	67	74	86	81	84
52B	63	61	62	60	64	60
Total-	249	259	275	295	313	349

TABLE II.

Feed consumed by weeks. For weeks ending on dates given:

	Jan.23d.	Jan.30th.	Feb.6th.	Feb.13th.
Pen I.	lbs.	lbs.	lbs.	lbs.
Corn meal.	210	210	224	
Skim milk.	1260	1228	1260	
Pen II.				
Potatoes.	420	420	448	
Skim milk.	1260	1135	1260	
Pen III.				
Corn meal.	63	63	70	106
Skim milk.	420	420	420	410
Pen IV.				
Potatoes.	84.	126	137	192
Skim milk	420	420	420	410.

TABLE III.

- Total gain of each pen for period between Jan.16th and Feb.6th
for pens I and II, and Jan.16th and Feb.13th for pens III and IV.

Pen I!	Duroc Jerseys.	Gain-	121 lbs.	Total
"	Poland Chinas.	"	89 "	--210 lbs.
Pen II.	Duroc Jerseys.	"	66 "	Total-
"	Poland Chinas.	"	39 "	--105 lbs.
Pen III.	Duroc Jerseys.	"	136 "	
Pen IV.	" "	"	80 "	

TABLE IV.

Total amount of skim milk, potatoes, and corn meal consumed
from Jan.16th to Feb.6th by pens I and II, and Jan.16th to
Feb.13th by pens III and IV.

	lbs.	Skim milk.	Corn meal.	Potatoes.
Pen I.		3748	644	
Pen II.		3655		1223
Pen III.		1260	196	
Pen IV.		1260		344

TABLE V.

Dry Matter consumed from Jan.16th to Feb.6th by Pens I and II,
and Jan.16th to Feb.13th by pens III and IV.

	lbs.	Skim milk.	Corn meal.	Potatoes.	Total.
Pen I		374.8	534		908.3
Pen II.		365.5		271.7	637.2
Pen III.		126	192.5		238.5
Pen IV.		126		72.6	198.6

TABLE VI.

Total amount of dry matter per pound of gain.

Pen I- 4.32 lbs. of dry matter per lb. of gain.

Pen II.- 6.06 " " " " " " " "

Pen III.- 2.12 " " " " " " " "

Pen IV.- 2.20 " " " " " " " "

TABLE VII.

Composition of food stuffs.

	Dry matter.	Protein.	Carbohydrates & fat
Skim milk.	10	3.5	5.7
Corn meal.	35.	5.5	71.7
Potatoes.	31.1	10.27	15.57
Beans.	67.8	3.3	53.21

We come next to consider the value of corn meal and potatoes, when skim milk sells at 20 cents per cwt. and pork, live weight, at \$3.80 per cwt.

Pen I. consumed \$7.50 worth of skim milk and sold for \$7.56 more than they would have done at the beginning of the experiment. If the work were disregarded it would leave \$.06 to be expended for the 644 $\frac{1}{2}$ of corn meal. It would be a little less than \$.01 per 100 $\frac{1}{2}$.

Pen II. consumed \$7.31 worth of skim milk and sold for \$3.78 more than they would have done at the beginning of the experiment. They did not pay for the milk that was consumed.

Pen III. consumed \$2.52 worth of skim milk and sold for \$4.30 more

than they would have done at the beginning of the experiment. This left \$1.53 to be expended for the 196¹/₂ of corn meal. This would value the corn meal at \$.70 per cwt.

Pen IV. consumed \$3.52 worth of skim milk and sold for \$3.24 more than they would have at the beginning of the experiment. This left \$.72 to be expended for 344¹/₂ of potatoes. This would value the potatoes at about \$.10 per bushel.

TABLE VIII.

Feeding ratios for first period.

	Total dry Matter, lbs.	Protein,	Carbohydrates and fat.	Ratio.
Pen I.	993.3	133.6	671.52	1:4
Pen II.	637.2	260.21	403.33	1:1.2
Pen III.	233.5	54.33	202.13	1:3.6
Pen IV.	132.6	79.43	125.33	1:1.5

It will be noticed by the weights that there was but very little difference in the weights of the first two pens and last two. Pen I gained just twice as much as pen II, and pen III about two-thirds more than pen II. Pens I and II consumed about the same amount of milk, but Pen II consumed just twice as many potatoes as pen I did corn meal. Pens III and IV consumed the same amount of skim milk, while pen IV consumed nearly twice as many potatoes as pen III. This would go to show that potatoes were a poor feed for cattle but pigs often used in connection with cattle, but it must be kept in mind that it takes about four and one-half pounds of potatoes to equal one pound of corn meal.

The first period was altogether too short to base any statements

on. It was hardly more than an introductory period, for they were all accustomed to corn meal and in making the change of potatoes it naturally caused a slackening of appetite. The weather was generally cold. The nearest proof we have of the superior qualities of the corn meal is the fact that it took nearly 2% more of dry matter to produce 1% of gain in Pen II than in pen I, and about .03% more in pen IV than in pen III. Pens III and IV ran one week longer than pens I and II and the pigs were in better condition for laying on flesh. The extra week may have given them better chance to become accustomed to potatoes. It will also be noticed that the nutritive ratio was more nearly correct in pens I and III than in pens II and IV. This lack of ratio was due to the fact that pens II and IV could not consume enough potatoes to make a proper ratio.

Part II.

When the change from milk to beans became necessary, it had to be made suddenly. The feeding of beans formed a second and main part to the experiment.

In this part the tables are arranged as in the first.

TABLE I.

Pen I. Feed consisting of corn meal and boiled beans.

Weights of pigs for weeks ending on dates given.

Durce Jerseys.	1st. 18th.	Feb. 20th.	Feb. 27th.	Mar. 6th.	Mar. 13th.	Mar. 20.
H. F.						
27	164	175	145	154	161	170
19	148	151	143	160	161	201
31	146	160	152	170	160	204
33	130	140	155	172	177	180
32	160	172	160	200	195	230
Total-	717	706	612	682	688	1007

Poland Chinas.

H.F.	Feb. 15th.	Feb. 26th.	Feb. 27th.	Mar. 6th.	Mar. 13th.	Mar. 20.
lbs.						
17	102	112	112	122	126	147
19	110	122	124	130	147	157
20	104	112	111	120	140	150
22	110	114	140	150	153	160
26	97	102	115	116	120	131
Total-	535	524	622	630	702	780

Pen II. Feed consisting of potatoes and boiled beans.

Weights of pigs for weeks ending on dates given.

Duroc Jerseys.

22	113	120	116	129	141	148
30	109	111	113	114	120	124
32	110	115	119	130	133	140
34	147	153	171	167	171	183
35	152	159	170	170	176	179
Total-	631	663	689	716	741	774

Poland Chinas.

18	83	91	95	107	103	116
21	93	93	105	109	116	122
25	93	93	103	112	111	113
53	100	105	114	119	125	130
54	80	87	89	94	94	104
Total-	449	479	506	541	554	591

Pen III. Feed consisting of corn meal and boiled beans.

Weights of pigs for weeks ending on dates given.

E.T.	lbs.	Feb.20th.	Feb.27th.	Mar.6th.	Mar.13th.	Mar.20th.
43		90	100	111	118	131
45		89	118	126	132	140
46		85	94	107	113	120
49		103	112	137	136	152
51		89	93	104	108	116
Total-		466	523	535	607	663

Pen IV. Feed consisting of potatoes and boiled beans.

Weights of pigs for weeks ending on dates given.

E.T.		Feb.20th.	Feb.27th.	Mar.6th.	Mar.13th.	Mar.20th.
44		68	76	85	89	92
47		73	72	74	79	80
48		54	59	62	61	67
50		89	102	106	114	123
52		83	87	93	91	98
Total-		372	396	425	434	460

TABLE II.

Feed consumed by weeks.

	Feb.13th.	Feb.20th.	Feb.27th.	Mar.6th.	Mar.13th.	Mar.20
	lbs.					
Pen I.						
Corn meal.	264	285	327	375	368	420
Beans.	124	326	390	444	552	420
Milk.	660	30				
Pen II.						
Potatoes.	524	570	654	750	840	840
Beans.	124	326	390	444	552	420
Milk.	660					
Pen III.						
Corn meal.		132	153	180	134	210
Beans.		82	111	143	142	126
Milk.		150	60			
Pen IV.						
Potatoes.		264	306	360	420	415
Beans.		82	111	143	142	126
Milk.		150	60			

TABLE III.

Total gain for the period between Feb.6th and Mar.20th for pens I and II, and Feb.15th and Mar.20th for pens III and IV.

Pen I.	Duroc Jerseys	Gained	322 lbs.
	Poland Chinas	"	252
			-Total -- 574 lbs.
Pen II.	Duroc Jerseys	"	162 "
	Poland Chinas	"	151 "
			Total --313 "

TABLE III Continued.

Pen III.	Duroc Jerseys	Gained -----	250 lbs.
Pen IV	" "	"	111 "

TABLE IV.

Total amount of food consumed between Feb.6th and Mar.20th for pens I and II, and Feb.13th and Mar.20th for pens III and IV.

	Lbs. Skim milk.	Corn meal.	Potatoes.	Beans.
Pen I.	690	2037		2256
Pen II.	660		4170	2256
Pen III.	210	809		604
Pen IV.	210		1765	604.

TABLE V.

Total amount of dry matter consumed from Feb.6th to Mar.20th by pens I and II, and Feb.13th to Mar.20th, by pens III and IV.

	Lbs. Skim milk.	Corn meal.	Beans.	Potatoes.	Total.
Pen I.	69	1689	1529.5		3287.5
Pen II.	66		1529.5	870.8	2975.3
Pen III.	21	670.8	409.5		1101.3
Pen IV.	21		409.5	372.4	802.9

TABLE VI.

Total amount of dry matter per pound of gain.

Pen I.- 5.72 lbs. of dry matter produced 1 lb. of gain.

Pen II.- 9.50 " " " " " " " " "

Pen III.- 4.40 " " " " " " " " "

Pen IV.- 7.23 " " " " " " " " "

Value of corn meal and potatoes when skim milk sells at 20 cents per cwt. and beans at \$4.00 per ton while pork is selling, live weight, at \$3.60 per cwt.

Pen I consumed 14cents worth of skim milk and \$3.06 worth of beans, making a total of \$3.20. The value of the gains of the pigs was \$20.66 during this period. Taking out the cost of the milk and beans there is \$17.46 left to pay for 2037 $\frac{1}{2}$ of corn meal. This would be equal to \$.86 per cwt. for the corn meal.

Pen II consumed 13 cents worth of skim milk and \$3.00 worth of beans, making a total of \$3.13. The value of the gains of the pigs was \$11.27 during this period. Taking out the cost of the milk and beans, there is \$8.14 left to pay for 4170 $\frac{1}{2}$ of potatoes. This would be equal to 1.005 per bushel.

Pen III consumed 42 cents worth of skim milk and \$1.11 of beans, making a total of \$1.63. The value of the gains of the pigs was \$9.00 during this period. Taking out the cost of the milk and beans there is \$7.37 left to pay for 800 $\frac{1}{2}$ of corn meal. This would be equal to \$1.10 per cwt. of corn meal.

Pen IV consumed 42 cents worth of skim milk and \$1.21 of beans,

making a total of \$1.63. The value of the gains of the pigs was \$4.00 during this period. Taking out the cost of the milk and beans there is \$2.37 left to pay for 1705 $\frac{1}{2}$ of potatoes. This would be equal to \$.07 per bushel.

TABLE VII.

Feeding ratios for second period.

	Total dry matter.	Protein.	Carbohydrates and fat.	Ratio.
Pen I.	1771.72 lbs.	421.92 lbs.	2682.06 lbs.	1:12.1
Pen II.	2475.44 "	536.92 "	1827.31 "	1:3.5
Pen III.	499.23 "	74.32 "	903.56 "	1:12.1
Pen IV.	802.93 "	211.69 "	608.17 "	1:2.9

The total gains in weight in the hogs in the first period was very similar to that in the second period. Pen I gained nearly twice as much as pen II and pen III gained more than twice as much as pen IV. In pens I and II there was a marked difference in gains between the Duroc Jersey and Poland Chinas. In pen I the Duroc Jerseys gained about one-third more than the Poland Chinas, during each period. In pen II the Duroc Jerseys gained nearly twice as much as the Poland Chinas during the first period, but only 11% more during the second period.

The food consumed by pens I and II varied about the same in the second period as in the first. The beans and the skim milk were almost equal, but the potatoes were twice the weight of the corn meal. The food consumed by pens III and IV was about the same proportion as in the first period and in the same proportion as pens I and II.

There was a great change in the proportional amount of dry matter per amount of gain in the two periods. Pen I required about one-third

more dry matter per pound of gain; Pen II about one-half; Pen III a little more than twice as much; Pen IV over three times as much.

The nutritive ratio was not as good for pens I and III as in the first period, but in pens II and IV it was better. However, none of the ratios were correct. The corn meal fed with beans proved to be of greater value by far than that fed with skim milk. The potatoes in pen II were of more value when fed with beans, but in pen IV they were of more value when fed with skim milk.

It is impossible to say why the Duroc Jerseys gained more than the Poland Chinas. They were all under like conditions, being out doors with cots to protect them from storms. The Duroc Jerseys seemed to be of quieter disposition than the others. They all seemed to eat well as long as it remained cold, but as soon as it grew warm and began to break up, they would leave their beans. They never left any of the other food, but simply sorted out the beans. The sows did not do as well, on the whole, as the barrows, as they were in heat a good deal of the time.

There was but one thing that would tend to make the experiment unsatisfactory and that was the presence of worms in pen III. The worm (*Echinorhynchus Gigas*), called Acanthocephalous ectozoon, was found present in the excreta of this pen, but not in any of the others. There were but two found during the experiment, the first one being found March 6th and the other March 8th. They varied from 3 inches to 11 inches in length. These worms have been found in the wild and domesticated hog and in the collared peccary. The embryo takes up its residence in the larva of the cockchafer (*Melolontha vulgaris*) before entering swine.

The worm works in the intestine, holding on to the mucous lining and causing irritation or boring holes through to the other organs. They may perforate the walls so as to cause fatal peritonitis. The symptoms are groaning during meals, trying to bite others, pale, sunken eyes, hard excrement, increase in debility, and finally ceasing to stand. The worm becomes most abundant at the end of winter. The only symptoms that were noticed in this lot was the irritability, which might have been due to the sows being in heat. There were so few worms that they probably did not affect the hogs much. However, as they were not dissected, I cannot say for certain what the number was.

March 4th there was some charcoal given each pig as the ground was frozen hard. Later, coal cinders were put in front of the troughs.

From the tables it can be seen that the Three Jerseys made the best gain and that corn meal is better for fattening purposes. The hogs can not consume enough potatoes to counter balance the corn meal, even though $4 \frac{1}{2}$ " of potatoes is equal to $1\frac{1}{2}$ " corn meal.

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