II.
糖蜜を含まない最小費用飼料の決定(線型計画法による最小費用養豚飼料の決定に関する研究)(農学科)

LINEAR PROGRAMS FOR LEAST-COST HOG RATIONS ON OAHU, HAWAII

Ⅱ. COMPUTED LEAST-COST RATIONS WITHOUT MOLASSES

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I. INTRODUCTION

In the previous study,[20] the least-cost hog rations with molasses for given hog groups were derived by using the linear programming and the electronic computer. The present study is devoted to find the least-cost hog rations without molasses for given hog groups. With the exception of molasses, the data and procedures used for this study are identical to those used in the previous study.

The rations without molasses were compared with the rations with molasses.

II. COMPUTED LEAST-COST RATIONS WITHOUT MOLASSES FOR GIVEN HOG GROUPS

The initial tableau for determining the least-cost rations without molasses for 35 to 99 pound pigs, 100 to 149 pound hogs and sows, and 150 pound to market hogs is given in Table 1.

1. Computed Least-Cost Ration without Molasses for 100 Pounds of Feed for Weight Group of 35 to 99 Pound Pigs

The computed ration without molasses for 100 pounds of feed for 35 to 99 pound pigs is shown in Table 2.

Eleven ingredients are included in the ration. The cost of the ration is $4.88 per 100 prounds of feed mixed. Milo enters the ration with the largest quantity, 34.46 pounds. The second largest quantity of ingredient is barley with 29.71 pounds. These two ingredients constitute 64.17 per cent of the ration. The cost of these two ingredients represents 57.89 per cent of the total cost of the ration. Less than one pound each of limestone, DL methionine, T. M. salt, Vitamin premix, and Antibiotic are included in the ration.

The least-cost ration is checked to see whether it is consistent with the specified nutrient requirements and ingredient limitations (Table 3). It will be noted in all cases that the specified nutrient requirements and restrictions and ingredient limitations are met. For example, the protein level of 16.00 pounds in the ration just meets the specified minimum nutrient requirement for protein. It is specified that calcium in the ration could

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Table 1. Initial tableau for computed least-cost rations without molasses for three weight groups of swine

ROW NAME		COLUMN NAME Corn	Wheat	Barley	Milo	Millrun	Middlings	Fat
Obj. function Value		.0475	.0528	.0435	.0445	.0423	.0465	.10
Constraints	Yield	1	1	1	1	1	1	1
	Portein	.085	.13	.09	.10	.13	.135	0.0
	Digestible energy	1,600	1,600	1,576	1,580	1,400	1,540	3,640
	Calcium	.0002	.0004	.0008	.0003	.0011	.0009	0.0
	Phosphorus	.0027	.0039	.003	.003	.01	.0093	0.0
	Methionine	.0022	.0023	.0017	.0011	.004	.0028	0.0
	Methionine plus cystine	.0033	.0049	.004	.0011	.01	.0052	0.0
	Lysine	.0021	.0042	.004	.0028	.005	.0046	0.0
	Tryptophan	.0007	.0017	.0015	.0011	.002	.002	0.0
	Fat	.038	.02	.02	.03	.043	.049	.90
	Fiber	.024	.026	.06	.025	.035	.073	0.0
	Cottonseed meal	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Fish meal and tuna meal	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Meat and bone meal, and meat meal	0.0	0.0	0.0	0.0	0.0	0.0	0.0

[a]Feed for 35 to 99 pound pigs
[b]Feed for 100 to 149 pound hogs and for sows
[c]Feed for 150 pound to market hogs

Source : Department of Animal Science, University of Hawaii.

Pineapple bran	Soybean meal	Cottonseed meal 41%	Cottonseed meal 44%	Fish meal	Tuna meal	Meat and bone meal	Meat meal	DL methionine
.0285	.0626	.0621	.0545	.0841	.0605	.0367	.0387	1.15
1	1	1	1	1	1	1	1	1
.038	.44	.41	.44	.65	.55	.53	.54	1
1,090	1,560	1,460	1,500	1,440	1,200	1,280	1,320	0.0
.0016	.0025	.0015	.0023	.06	.033	.10	.08	0 0
.0015	.006	.01	.0112	.03	.031	.03	.04	0.0
.0002	.0079	.006	.0066	.017	.017	.007	.008	1
.0003	.0141	.0145	.016	.027	.025	.013	.0146	1
.0008	.026	.016	.016	.05	.0625	.025	.034	0.0
.0012	.0033	.003	.005	.0034	.009	.0035	.0061	0.0
.016	.005	.04	.04	.02	.039	.035	.06	0.0
.19	.07	.13	.103	.01	.01	.02	.02	0.0
0.0	0.0	1	1	0 0	0 0	0 0	0 0	0.0
0.0	0.0	0.0	0 0	1	1	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	1	1	0.0

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Dehy. alfalfa meal	Limestone	Tri. ca. phosphate	Tri. sodium poly phosphate	Rations without molasses Ration 1[a]	Ration 2[b]	Ration 3[c]
.0445	.012	.0625	.116			
1	1	1	1	= 99.15	= 99.20	= 99.20
.17	0.0	0.0	0.0	≥ 16	≥ 14	≥ 12
1,080	0.0	0.0	0.0	≥ 150,000	≥ 150,000	≥ 150,000
.016	.38	.30	0.0	≥ .60 ≤ .75	≥ .60 ≤ .60	≥ .50 ≤ .60
.002	0.0	.18	.253	≥ .50	≥ .40	≥ .40
.0032	0.0	0.0	0.0	≤ .65 ≥ .35	≤ .50 ≥ .30	≥ .50 ≤ .20
.0057	0.0	0.0	0.0	≥ .55	≥ .45	≥ .30
.0075	0.0	0.0	0.0	≥ .75	≥ .68	≥ .50
.0027	0.0	0.0	0.0	≥ .17	≥ .13	≥ .09
.025	0.0	0.0	0.0	≤ 7	≤ 7	≤ 7
.28	0.0	0.0	0.0	≤ 5	≤ 5.5	≤ 6
0.0	0.0	0.0	0.0	≤ 8	≤ 8	≤ 8
0.0	0.0	0.0	0.0	≤ 5	≤ 5	≤ 5
0.0	0.0	0.0	0.0	≤ 5	≤ 5	≤ 5

Table 2. Composition and cost of least-cost ration without molasses (100 pounds of feed for 35 to 99 pound pigs)

1 Ingredient	2 Pounds of ingredient	3 Price of ingredient $/lb.	4 Cost of ingredient in the ration $
Milo	34.46	.0445	1.5335
Barley	29.71	.0435	1.2924
Millrun	19.35	.0423	.8185
Soybean meal	9.14	.0626	.5722
Tuna meal	5.00	.0605	.3025
Meat and bone meal	1 08	.0567	.0612
Limestone	.39	.0120	.0047
DL methionine	.02	1.1500	.0230
T. M. salt*	.50	.0374	.0187
Vitamin premix*	.25	.6400	.1600
Antibiotic*	.10	.9400	.0940
Total	100.00		4.8807

* T. M. salt, Vitamin premix (NOPCOSOL M—3) and Antibiotic (AUREOFAC—10) were not programmed into the ration but were added later.

not go below .60 or exceed .75 pound. The calcium content in the computed ration is .60 pound. Similarly, it is specified that the maximum restriction for fat is 7.00 pounds while the actual fat composition in the ration is 3.04 pounds. The amounts of protein, digestible energy, calcium and methionine in the ration just meet the specified minimum nutrient requirements. The quantities of phosphorus, fiber and fish meal and tuna meal in the ration are at their maximum limitations.

Table 3. Comparison of the nutrient and ingredient levels in the computed ration with the specified nutrient requirements, restrictions and ingredient limitations (100 pounds of feed without molasses for 35 to 99 pound pigs)

1 Nutrient and ingredient	2 Nutrient and ingredient levels calculated from the ration		3 Specified nutrient requirements and ingredient limitations[a]	
Yield[b]	99.15 *lbs.*	equals	99.15	*lbs.*
Protein	16.00 *lbs.*	min	16.00	*lbs.*
Digestible energy	150,000.00 *kcal.*	min	150,000.00	*kcal.*
Calcium	.60 *lb.*	min-max	.60—.75	*lb.*
Phosphorus	.65 *lb.*	min-max	.50—.65	*lb.*
Methionine	.35 *lb.*	min	.35	*lb.*
Methionine plus cystine	.64 *lb.*	min	.55	*lb.*
Lysine	.89 *lb.*	min	.75	*lb.*
Tryptophan	.22 *lb.*	min	.17	*lb.*
Fat	3.04 *lbs.*	max	7.00	*lbs.*
Fiber	5.00 *lbs.*	max	5.00	*lbs.*
Cottonseed meal	0.0	max	8.00	*lbs.*
Fish meal and tuna meal	5.00 *lbs.*	max	5.00	*lbs.*
Meat and bone meal, and meat meal	1.08 *lbs.*	max	5.00	*lbs.*

a The specified nutrient requirements and ingredient limitations are reproduced from Table 9 (Nutrient requirements and restrictions) and Table 10 (Maximum quantity limitations for ingredients).

b The programming yield requirement was 99.15 pounds; .85 pound of additives were added later to make 100 pounds of feed.

The ranges in which purchase prices of ingredients can vary without changing the least-cost ration are shown in Table 4. Unstable ingredients such as barley, milo and millrun have very low upper price ranges. For example, if the price of barley were to increase more than 2.11 per cent, the quantity of barley (29.71 pounds) in the ration would decrease to 16.71 pounds. In that case, fat will enter the ration and the quantities of most of the other ingredients in the ration will be changed. The new composition of the ration will be:

Milo	39.54 *lbs.*
Millrun	26.75 *lbs.*
Barley	16.71 *lbs.*
Soybean meal	9.79 *lbs.*
Tuna meal	5.00 *lbs.*
Fat	.68 *lb.*

Limestone	.67 *lb.*
DL methionine	.01 *lb.*
T. M. salt	.50 *lb.*
Vitamin premix	.25 *lb.*
Antibiotic	.10 *lb.*

Conversely, if the price of barley were decreased more than .48 per cent, the quantity of barley in the ration would increase to 35.76 pounds. In that case, no new ingredient enters the ration but composition of most of the present ingredients in the ration will be changed. The new composition of the ration will be:

Barley	35.76 *lbs.*
Milo	31.04 *lbs.*
Millrun	16.06 *lbb.*
Soybean meal	9.02 *lbs.*
Tuna meal	5.00 *lbs.*
Meat and bone meal	1.60 *lbs.*
DL methionine	.02 *lb.*
Limestone	.65 *lb.*
T. M. salt	.50 *lb.*
Vitamin premix	.25 *lb.*
Antibiotic	.10 *lb.*

The upper price ranges of soybean meal, tuna meal, and meat and bone meal are relatively high. For example, the quantity of soybean meal in the ration will not decline unless the price of soybean meal increases by more than 11.10 per cent. Limestone and DL methionine are both very stable. DL methionine will remain in the ration in present quantity even if there would be a 97.57 per cent increase in its price. An increase of more than 219.23 per cent in the price of limestone is needed before the amount of this ingredient in the ration would decline.

Table 4. Ranges in which purchase prices of ingredients can vary without changing the least-cost ration (100 pounds of feed without molasses for 35 to 99 pound pigs)

1 Ingredient	2 Quantity in the ration *lbs.*	3 Input price $/*lb.*	4 Lower & upper quantity *lbs.*	5 Unit cost $	6 Upper and lower price $/*lb.*	7 Pirce increase and decrease %	8 Entering activity
Barley	29.71	.0435	16.71	.00092	.04442	2.11	Fat
			35.76	.00021	.04329	.48	None
Milo	34.46	.0445	31.04	.00038	.04488	.88	None
			64.37	.00122	.04328	2.74	None
Millrun	19.35	.0423	16.06	.00040	.04270	.95	None
			26.75	.00161	.04069	3.81	Fat
Soybean meal	9.14	.0626	1.88	.00695	.06955	11.10	Cottonseed meal 44%
			10.65	.00415	.05845	6.63	None
Tuna meal	5.00	.0505	1.31	.00856	.06906	14.15	Fish meal
			5.00	Infinity	-Infinity	—	None
Meat and bone meal	1.08	.0567	-2.00	.00577	.06247	10.18	None
			1.60	.00253	.05417	4.46	None
Limestone	.39	.0120	-.27	.02631	.03831	219.25	Pineapple bran
			.65	.00502	.00398	41.83	None
DL methionine	.02	1.1500	.01	1.12209	2.27209	97.57	Fat
			.02	.32874	.82126	28.59	None

The price reductions of the excluded ingredients are shown in Table 5. Among the excluded ingredients, corn has the lowest price reduction. Corn could be forced into the ration at an additional cost of $.00188 per pound to the extent of 12.54 pounds. In other words, when the price of corn falls by $.00188 per pound it will enter the ration to the extent of 12.54 pounds. Middlings and pineapple bran also have low price reduction. So. tri. poly phosphate has the higest price reduction of $.13729 per pound. If one pound of so. tri. poly phosphate were used in the ration the cost of the ration would be increased by $.13729. However highest feasible price of so. tri. poly phosphate is $-.02129, indicating that even if the price of tri. so. poly phosphate were reduced to zero this ingredient would not come into the ration. Tri. ca. phosphate also has high price reduction.

Table 5. Price reduction required to permit each excluded ingredient to enter the ration (100 pounds of feed without molasses for 35 to 99 pound pigs)

1 Ingredient	2 Input price $/lb.	3 Price reduction $/lb.	4 Upper quantity lbs.	5 Highest feasible price to enter the ration $/lb.	6 Leaving activity
Corn	.0475	.00188	12.54	.04562	DL methionine
Wheat	.0528	.00557	22.97	.04723	DL methionine
Middlings	.0465	.00200	11.51	.04450	Meat and bone meal
Fat	.1000	.01756	.68	.03244	Meat and bone meal
Pineapple bran	.0285	.00277	3.71	.02573	Limestone
Cottonseed meal 41%	.0621	.00731	8.00	.05479	None
Cottonseed meal 44%	.0645	.00631	8.00	.05819	None
Fish meal	.0341	.01477	5.00	.06933	Tuna meal
Meat meal	.0687	.00870	1.43	.03000	Meat and bone meal
Dehy. alfalfa meal	.0445	.01369	3.00	.03081	Limestone
Tri. ca. phosphate	.0625	.07253	.32	-.01003	Meat and bone meal
Tri. so. poly phosphate	.1160	.13729	.28	-.02129	Meat and bone meal

The dual activities for nutrients and ingredients in the ration are shown in Table 6. Calcium is an inexpensive nutrient. The most expensive nutrient in the ration is methionine.

Table 6. Dual activities of nutrients and ingredients (100 pounds of feed without molasses for 35 to 99 pound pigs)

1 Nutrient and ingredient	2 Status	3 Quantity in the ration	4 Lower quantity Upper quantity	5 Dual activity $/lb.
Yield	EQ	99.15 *lbs.*	98.06 *lbs.*	- .00870
			99.98 *lbs.*	.00870
Protein	LL	16 *lbs.*	13.81 *lbs.*	- .03791
			17.11 *lbs.*	.03791
Digestible energy	LL	150,000 *kcal.*	148,640 *kcal.*	- .20258
			151,873 *kcal.*	.20258
Calcium	LL	.60 *lb.*	.37 *lb.*	-- .00868
			1.48 *lbs.*	.00368
Phosphorus	UL	.63 *lb.*	.60 *lb.*	.11854
			.72 *lb.*	- .11854
Methionine	LL	.35 *lb.*	.33 *lb.*	-1.10339
			1.38 *lbs.*	1.10339
Fiber	UL	5 *lbs.*	3.93 *lbs.*	.03446
			5.87 *lbs.*	- .03446
Fish meal and tuna meal	UL	5 *lbs.*	1.31 *lbs.*	.00856
			7.43 *lbs.*	-- .00856

2. Computed Least-Cost Ration without Molasses for 100 Pounds of Feed for Weight Group of 100 to 149 Pound Hogs and for Sows

The computed least-cost ration without molasses for 100 pounds of feed for 100 to 149 pound hogs and for sows is shown in Table 7.

Table 7. Composition and cost of least-cost ration without molasses (100 pounds of feed for 100 to 149 pound hogs and for sows)

1 Ingredient	2 Pounds of ingredient	3 Prices of ingredient $/lb.	4 Cost of ingredient in the ration $
Barley	47.14	.0435	2.0506
Milo	27.83	.0445	1.2384
Millrun	7.11	.0423	.3008
Soybean meal	7.08	.0626	.4432
Tuna meal	5.00	.0603	.3025
Pineapple bran	4.35	.0285	.1240
Limestone	.67	.0120	.0080
DL methionine	.02	1.1500	.0230
T. M. salt*	.50	.0374	.0187
Vitamin premix*	.25	.6400	.1600
Antibiotic*	.05	.9400	.0470
Total	100.00		4.7162

* T. M. salt, Vitamin premix (NOPCOSOL M—2) and Antibiotic (AUREOFAC—10) were not programmed into the ration but were added later.

Eleven ingredients are included in the ration. The cost of the ration is $4.72 per 100 pounds of feed. Barley comes into the ration with the largest quantity of 47.14 pounds. Its cost represents about 43 per cent of the total cost of the ration. The second largest quantity of ingredient is milo with 27.83 pounds. Tuna meal enters the ration to its maximum allowable quantity of five pounds. Limestone and DL methionine, T. M. salt, Vitamin premix, and Antibiotic are included in the ration in quantities of less than one per cent each.

The nutrient and ingredient levels of the least-cost ration are compared with the specified nutrient requirements and ingredient limitations in Table 8. The yield in the ration meets exactly the specified yield requirement of 99.20 pounds. The contents of protein, digestible energy and methionine in the ration just meet their specified minimum nutrient requirements. The quantities of fiber, and fish meal and tuna meal meet their specified maximum limitations. All other nutrient and ingredient levels in the ration meet the specified nutrient requirements and ingredient limitations.

Table 8. Comparison of the nutrient and ingredient levels in the computed ration with the specified nutrient requirements, restrictions and ingredient limitations (100 pounds of feed without molasses for 100 to 149 pound hogs and for sows)

1 Nutrient and ingredient	2 Nutrient and ingredient levels calculated from the ration		3 Specified nutrient requirements and ingredient limitations [a]
Yield [b]	99.20 *lbs.*	equals	99.20 *lbs.*
Protein	14.00 *lbs.*	min	14.00 *lbs.*
Digestible energy	150,000.00 *kcal.*	min	150,000.00 *kcal.*
Calcium	.60 *lb.*	min-max	.50—.60 *lb.*
Phosphorus	.50 *lb.*	min-max	.40—.50 *lb.*
Methionine	.30 *lb.*	min	.30 *lb.*
Methionine plus cystine	.54 *lb.*	min	.45 *lb.*
Lysine	.80 *lb.*	min	.68 *lb.*
Tryptophan	.20 *lb.*	min	.13 *lb.*
Fat	2.63 *lbs.*	max	7.00 *lbs.*
Fiber	5.50 *lbs.*	max	5.50 *lbs.*
Cottonseed meal	0.0	max	8.00 *lbs.*
Fish meal and tuna meal	5.00 *lbs.*	max	5.00 *lbs.*
Meat and bone meal, and meat meal	0.0	max	5.00 *lbs.*

[a] The specified nutrient requirements and ingredient limitations are repoduced from Table 9 (Nutrient requirements and restrictions) and Table 10 (Maximum quantity limitations for ingredients).

[b] The programming yield requirement was 99.20 pounds; .80 pound of additives were added later to make 100 pounds of feed.

The price ranges for the ingredients in the ration are shown in Table 9. Barley, milo and millrun are very unstable in the ration. For example, the quantity of barley in the ration would decline from 47.14 pounds to 42.96 pounds if the barley price would increase as little as .78 per cent. Soybean meal, tuna meal and pineapple bran are relatively stable in the ration. The quantity of soybean meal will remain in the ration even if there would be a 11.47 per cent price increase in its price. Limestone and DL methionine are both very stable in the ration. The prices of limestone and DL methionine could increase by as much as 45.83 per cent, and 130.41 per cent without changing the quantities in the ration.

Table 9. Ranges in which purchase prices of ingredients can vary without changing the least-cost ration (100 pounds of feed without molasses for 100 to 149 pound hogs and for sows)

1 Ingredient	2 Quantity in the ration *lbs.*	3 Input price *$/lb.*	4 Lower & upper quantity *lbs.*	5 Unit cost $	6 Upper & lower price *$/lb.*	7 Price increase & decrease %	8 Entering activity
Barley	47.14	.0435	42.96	.00034	.04384	.78	None
			69.24	.00152	.04198	3.49	None
Milo	27.83	.0445	11.05	.00200	.04650	4.49	None
			31.41	.00040	.04410	.90	None
Millrun	7.11	.0423	-8.25	.00110	.04340	2.60	Meat and bone meal
			19.20	.00168	.04062	3.97	None
Soybean meal	7.08	.0626	-- .36	.00718	.06978	11.47	Cottonseed meal 44%
			9.80	.00747	.03513	11.93	None
Tuna meal	5.00	.0605	1.56	.00590	.06640	9.75	Fish meal
			5.00	Infinity	-Infinity	—	None
Pineapple bran	4.35	.0285	1.04	.00515	.03465	21.53	None
			5.18	.00172	.02678	6.04	None
Limestone	.67	.0120	.41	.00350	.01750	45.83	None
			1.14	.04411	-.03211	367.58	None
DL methionine	.02	1.1500	-.02	1.49973	2.64973	130.41	Corn
			.04	.39819	.75181	34.63	Meat and bone meal

Table 10 gives the price reduction information for the ingredients which are too high priced to be used in the least-cost formulation. Corn and middlings have very low price reductions. For example, the use of corn would increase the ration cost by only $.00197 for each pound used in the ration. If the corn price were reduced to $.04553 (column 5) , 14.44 pounds of corn would be included in the ration. In that case, DL methionine will leave the ration and also the quantities of the other ingredients in the present ration will be changed. Tri. ca. phosphate and tri. so. poly phosphate have very high price reductions. If one pound of so. tri. poly phosphate were used in the ration, the cost of the ration would be increased by $.16343.

Table 10. Price reduction required to permit each excluded ingredient to enter the ration (100 pounds of feed without molasses for 100 to 149 pound hogs and for sows)

1 Ingredient	2 Input price $/lb.	3 Price reduction $/lb.	4 Upper quantity lbs.	5 Highest feasible price to enter the ration $/lb.	6 Leaving activity
Corn	.0475	.00197	14.44	.04553	DL methionine
Wheat	.0528	.00578	36.12	.04702	Milo
Middlings	.0465	.00264	8.45	.04386	Millrun
Fat	.1000	.02826	2.33	.07174	None
Cottonseed meal 41%	.0621	.00731	7.97	.05479	Soybean meal
Cottonseed meal 44%	.0545	.00668	7.62	.05782	Soybean meal
Fish meal	.0841	.01593	5.00	.06815	Tuna meal
Meat and bone meal	.0567	.00671	1.16	.04999	Millrun
Meat meal	.0687	.01378	1.51	.05492	Millrun
Dehy. alfalfa meal	.0445	.01112	4.68	.03338	Pineapple bran
Tri. ca. phosphate	.0625	.09551	.28	-.03301	Millrun
Tri. so. poly phosphate	.1160	.16343	.20	-.04743	Millrun

The dual activities of nutrient and ingredient of the ration are shown in Table 11. The quantity of protein, digestible energy and methionine in the ration are at their lower levels. On the other hand, calcium, phosphorus, fiber, and fish meal and tuna meal are included in the ration at the upper level. Calcium is an inexpensive nutrient. On the other hand, digestible energy, phosphorus and methionine are expensive nutrients. If digestible energy were increased by one unit (1,500 *kcal.*), the cost of the ration would be increased by $.14915.

Table 11. Dual activities of nutrients and ingredients (100 pounds of feed without molasses for 100 to 149 pound hogs and for sows)

1 Nutrient and ingredient	2 Status	3 Quantity in the ration	4 Lower quantity Upper quantity	5 Dual activity $/lb.
Yield	EQ	99.20 *lbs.*	97.82 *lbs.* 101 60 *lbs*	-.01745 .01745
Protein	LL	14 *lbs.*	12.05 *lbs.* 15.31 *lbs.*	-.03913 .03913
Digestible energy	LL	150,000 *kcal.*	143,693 *kcal.* 152,252 *kcal.*	-.14915 .14915
Calcium	UL	.60 *lb.*	.34 *lb.* 1.12 *lbs.*	.01434 -.01434
Phosphorus	UL	.50 *lb.*	.45 *lb.* .56 *lb.*	.25643 -.25643
Methionine	LL	.30 *lb.*	.28 *lb.* 1.51 *lbs.*	-1.09342 1.09342
Fiber	UL	5.50 *lbs.*	4.22 *lbs.* 6.38 *lbs.*	.03423 -.03423
Fish meal and tuna meal	UL	5 *lbs.*	1.56 *lbs.* 7.02 *lbs.*	.00590 -.00590

3. Computed Least-Cost Ration without Molasses for 100 Pounds of Feed for Weight Group of 150 Pound to Market Hogs

The computed ration without molasses for 100 pounds of feed for 150 pound to market hogs is shown in Table 12. The ration consists of nine ingredients. The cost of 100 pounds of the ration is $4.53. The largest quantity of ingredient in the ration is barley with 52.51 pounds (52.51 per cent of the ration) . The cost of barley in the ration is $2.28 representing about 50 per cent of the total cost of the ration. Milo ranks second with 29.03 pounds. Barley and milo represent 81.54 per cent of the ration quantity.

Table 12. Composition and cost of least-cost ration without molasses (100 pounds of feed for 150 pound to market hogs)

1 Ingredient	2 Pounds of ingredient	3 Price of ingredient $/lb.	4 Cost of ingredient in the ration $
Barley	52.51	.0435	2.2842
Milo	29.03	.0445	1.2916
Pineapple bran	9.72	.0285	.2770
Meat and bone meal	3.32	.0367	.1722
Soybean meal	2.75	.0626	.1131
Tuna meal	1.87	.0605	.1882
T. M. salt*	.50	.0374	.0187
Vitamin premix*	.25	.6400	.1600
Antibiotic*	.05	.9400	.0470
Total	100.00		4.5522

* T. M. salt, Vitamin premix (NOPCOSOL M—2) and Antibiotic (AUREOFAC—10) were not programmed into the ration but were added later.

A check is made in Table 13 to determine whether the least-cost ration (Table 12) resulting from the linear programming analysis meets the specified nutrient requirements and ingredient limitations. It will be noted that the ration complies in all instances with the specified nutrient requirements and restrictions and ingredient limitations. For example, the calcium in the ration amounts to .50 pound, consistent with the specified min.-max. range of .50 to .60 pound. Protein, digestible energy, calcium and methionine come into the ration at their minimum limits. Phosphorus and fiber enter at their maximum limits.

Table 13. Comparison of the nutrient and ingredient levels in the computed ration with the specified nutrient requirements, restrictions and ingredient limitations (100 pounds of feed without molasses for 150 pound to market hogs)

1 Nutrient and ingredient	2 Nutrient and ingredient levels calculated from the ration		3 Specified nutrient requirements and ingredient limitations[a]
Yield[b]	99.20 *lbs.*	equals	99.20 *lbs.*
Protein	12.00 *lbs.*	min.	12.00 *lbs.*
Digestible energy	150,000.00 *kcal.*	min.	150,000.00 *kcal.*
Calcium	.50 *lb.*	min.-max.	.50—.60 *lb.*
Phosphorus	.50 *lb.*	min.-max.	.40—.50 *lb.*
Methionine	.20 *lb.*	min.	.20 *lb.*
Methionine plus cystine	.37 *lb.*	min.	.30 *lb.*
Lysine	.57 *lb.*	min.	.50 *lb.*
Tryptophan	.17 *lb.*	min.	.09 *lb.*
Fat	2.53 *lbs.*	max.	7.00 *lbs.*
Fiber	6.00 *lbs.*	max.	6.00 *lbs.*
Cottonseed meal	0.0	max.	8.00 *lbs.*
Fish meal and tuna meal	1.87 *lbs.*	max.	5.00 *lbs.*
Meat and bone meal, and meat meal	3.32 *lbs.*	max.	5.00 *lbs.*

[a] The specified nutrient requirements and ingredient limitations are reproduced from Table 9 (Nutrient requirements and restrictions) and Table 10 (Maximum quantity limitations for ingredients.)

[b] The programming yield requirement was 99.20 pounds; .80 pound of additives were added later to make 100 pounds of feed.

The price ranges for the ingredients in the ration are presented in Table 14. Barley and milo are very unstable in the ration. The upper price ranges of these ingredients are only 1.49 per cent in barley and 1.17 per cent in milo. That is, if the prices of barley and milo increase by as little as 1.49 per cent and 1.17 per cent, respectively, the quantities of these ingredients in the ration will decrease from 52.51 pounds to 46.96 pounds and from 29.03 to 26.31 pounds. Tuna meal is the most stable ingredient. Tuna meal could stay in the ration even if its price increases by 7.9 per cent.

Table 14. Ranges in which purchase prices of ingredients can vary without changing the least-cost ration (100 pounds of feed without molasses for 150 pound to market hogs)

1 Ingredient	2 Quantity in the ration *lbs.*	3 Input price *$/lb.*	4 Lower & upper quantity *lbs.*	5 Unit cost $	6 Upper&lower price *$/lb.*	7 Price increase & decrease %	8 Entering activity
Barley	52.51	.0435	46.96	.00035	.04415	1.49	None
			55.59	.00046	.04304	1.72	Limestone
Milo	29.03	.0445	26.31	.00052	.04502	1.17	Limestone
			35.04	.00060	.04390	1.35	None
Pineapple bran	9.72	.0285	9.02	.00201	.03051	7.05	Limestone
			18.33	.00457	.02393	16.04	Fat
Soybean meal	2.75	.0526	2.12	.00362	.06622	5.78	None
			2.81	.00447	.03813	7.14	None
Tuna meal	1.87	.0503	1.58	.00478	.06528	7.90	Limestone
			2.94	.00212	.03838	4.50	None
Meat and bone meal	3.32	.0567	2.71	.00371	.06041	6.54	None
			3.48	.00913	.04757	16.10	Limestone

The price reductions calculated for the ration are presented in Table 15. Corn, millrun and middlings have low price reductions, while DL methionine or so. tri. poly phosphate have rather high price reductions. That is, corn, millrun and middlings are more economically included in the ration than DL methionine and tri. so. poly phosphate. For example, if one pound of corn were used in the ration the cost of the ration would be increased by only $.00311. However, the cost would be increased by $.89339 if one pound of DL methionine were added in the ration.

Table 15. Price reduction required to permit each excluded ingredient to enter the ration (100 pounds of feed without molasses for 150 pound to market hogs)

1 Ingredient	2 Input price *$/lb.*	3 Price reduction *$/lb.*	4 Upper quantity *lbs.*	5 Highest feasible price to enter the ration *$/lb.*	6 Leaving activity
Corn	.0475	.00311	16.22	.04439	None
Wheat	.0528	.00616	4.18	.04664	None
Millrun	.0423	.00113	.33	.04117	None
Middlings	.0463	.00209	.36	.04441	None
Fat	.1000	.01689	2.33	.08311	None
Cottonseed meal 41%	.0621	.00493	.40	.05717	None
Cottonseed meal 44%	.0645	.00452	.37	.05993	None
Fish meal	.0341	.01307	2.76	.07103	Tuna meal
Meat meal	.0387	.00921	4.54	.03949	Meat and bone meal
DL methionine	1 1500	.89339	.02	.25661	None
Dehy. alfalfa meal	.0445	.00990	5.09	.03460	Soybean meal
Limestone	.0120	.00568	.25	.00632	None
Tri. ca. phosphate	.0625	.07804	.05	−.01554	None
Tri. so. poly phosphate	.1160	.14040	.01	−.02440	None

The dual activities of nutrients in the ration are presented in Table 16. The dual activity of the yield indicates that if yield were permitted to increase up to 100.53 pounds, the ration cost would be increased by $ .00632 per pound of increase of feed. If yield were permitted to decrease down to 97.62 pounds, the ration cost would be reduced by $ .00632 per pound of decrease of feed. Digestible energy, phosphorus and methionine are expensive nutrients. To increase digestible energy by one unit (1,500 *kcal.*) would increase the ration cost by $ .21096.

Table 16. Dual activities of nutrients (100 pounds of feed without molasses for 150 pound to market hogs)

1 Nutrient	2 Status	3 Quantity in the ration	4 Lower quantity Upper quantity	5 Dual activity $/*lb.*
Yield	EQ	99.20 *lbs.*	97.62 *lbs.*	−.00632
			100.53 *lbs.*	.00632
Protein	LL	12.00 *lbs.*	11.31 *lbs.*	−.05350
			12.67 *lbs.*	.05350
Digestible energy	LL	150,000.00 *kcal.*	145,517.00 *kcal.*	−.21096
			152,766.00 *kcal.*	.21096
Phosphorus	UL	.50 *lb.*	.50 *lb.*	.12144
			.54 *lb.*	−.12144
Methionine	LL	.20 *lb.*	.18 *lb.*	−.19679
			.21 *lb.*	.19679
Fiber	UL	6.00 *lbs.*	5.75 *lbs.*	.01425
			6.88 *lbs.*	−.01425

III. SUMMARY OF COMPUTED LEAST-COST RATIONS WITHOUT MOLASSES

The least-cost rations without molasses for the given hog groups are summarized as follows:

(1) The cost of the ration ranges from $4.55 for ration for 150 pound to market hogs to $4.88 for ration for 35 to 99 pound pigs.

(2) The cost of the ration declines for growing and finishing hogs as the weight increases.

(3) Rations for 35 to 99 pound pigs and for 100 to 149 pound hogs and for sows consist of 11 ingredients each and ration for 150 pound to market hogs only of 9.

(4) Milo, barley, soybean meal and tuna meal are included in every ration. The composition of milo and barley in the rations represents from 64.17 to 81.54 per cent.

(5) Ration for 35 to 99 pound pigs includes milo in the largest quantity with barley ranking second. In contrast, barley is the ingredient with the largest quantity in rations for 100 to 149 pound hogs and for sows and for 150 pound to market hogs with milo second in quantity.

(6) Although rations for 35 to 99 pound pigs and for 100 to 149 pound hogs and for

sows include millrun, limestone and DL methionine, ration for 150 pound to market hogs does not include these ingredients. Pineapple bran is an ingredient in rations for 100 to 149 pound hogs and for sows and for 150 pound to market hogs but not in ration for 35 to 99 pound pigs. Meat and bone meal enters rations for 35 to 99 pound pigs and for 150 pound to market hogs, but not ration for 100 to 149 pound hogs and for sows.

(7) Tuna meal enters rations for 35 to 99 pound pigs and for 100 to 149 pound hogs and for sows to its maximum limit.

(8) The contents of protein, digestible energy and methionine in all rations just meet the specified minimum requirements.

(9) Phosphorus and fiber are at their maximum limits in all rations.

(10) Milo and barley are very unstable in every ration. The average upper price ranges of milo and barley are 2.17 and 1.46 per cent, respectively. That is, if the average prices of these ingredients increase by as little as 2.17 and 1.46 per cent respectively, the quantities of these ingredients in the rations will decrease. Tuna meal, relatively stable in all rations, would not decrease even if the average price of tuna meal would increase by 10 60 per cent per pound. Limestone and DL methionine in rations for 35 to 99 pound pigs and for 100 to 149 pound hogs and for sows are very stable. The price of limestone could increase by as much as 219.25 per cent in ration for 35 to 99 pound pigs and 45.83 per cent in ration for 100 to 149 pound hogs and for sows without changing the least-cost ration. Similarly, the price of DL methionine could increase by 97.57 per cent in ration for 35 to 99 pound pigs and 130.41 per cent in ration for 100 to 149 pound hogs and for sows without changing the least-cost ration.

(11) The price reductions of corn and middlings are very low in all rations. For example, the use of corn would increase cost of the formula by only $.00232 on the average for each pound used. The price reductions of tri. ca. phosphate and so. tri. poly phosphate are very high. Tri. so. poly phosphate, for example, would increase the formula cost $.14704 on the average for each pound used.

(12) In all rations calcium is an inexpensive nutrient. Digestible energy and methionine are very expensive nutrients. If another pound of digestible energy were added the cost of the rations would be increased by $.18756 on the average.

IV. COMPARISON OF COMPOSITION AND COST BETWEEN RATIONS WITHOUT MOLASSES AND RATIONS WITH MOLASSES

1. Comparison of Composition and Cost Between Ration without Molasses and Ration with Molasses for 35 to 99 Pound Pigs

The ration without molasses is compared with the ration with molasses in Table 17. The following are the findings of the comparison:

Table 17. Comparison of composition and cost between ration without molasses and ration with molasses for 35 to 99 pound pigs

1 Ingredient	2 Ration without molasses	3 Ration with molasses
	(*lbs.*)	
Barley	29.71	67.99
Soybean meal	9.14	11.15
Tuna meal	5.00	5.00
Meat and bone meal	1.08	3.39
Milo	34.46	.89
DL methionine	.02	.04
Fat	0.0	.69
Millrun	19.35	0.0
Limestone	.39	0.0
Molasses	0.0	10.00
T. M. salt*	.50	.50
Vitamin premix*	.25	.25
Antibiotic*	.10	.10
Total	100.00	100.00
Cost per 100 *lbs.* ($)	4.88	4.71

* T. M. salt, Vitamin premix and Antibiotic are additives.

(1) The two rations contain eleven ingredients.

(2) Barley, soybean meal, tuna meal, meat and bone meal, milo and DL methionine come into both rations. In the ration without molasses milo is the ingredient included in the greatest quantity, namely 34.46 pounds. Barley and millrun are second and third largest in quantity with 29.71 and 19.35 pounds, respectively. These three ingredients represent 83.52 per cent of the ration. On the other hand, in the ration with molasses barley is the ingredient included in the largest amount, namely 67.99 pounds. Soybean meal and molasses rank second and third with 11.15 and 10.00 pounds, respectively. These three ingredients account for 89.14 per cent of the ration.

(3) Tuna meal is included in both rations to the maximum limit. Fat is included only in the ration with molasses, while millrun and limestone are included only in the ration without molasses.

(4) Protein, digestible energy and metionine are included in both rations to the specified minimum nutrient requirement. Fiber is included in both rations to the maximum limit. The calcium content of the ration without molasses is at its minimum nutrient requirement while the calcium content of the ration with molasses is at its maximum limit.

(5) The upper price ranges of barley and milo in both rations are very low. That is, these two ingredients are unstable. In both rations tuna meal is relatively stable and DL methionine is very stable.

(6) The price reductions of corn and middlings in both are low while those of tri. ca. phosphate and tri. so. poly phosphate are high.

(7) Calcium is an inexpensive nutrient, while digestible energy and methionine are expensive nutrients.

(8) The cost of 100 pounds of feed with molasses is $4.71 or $.17 less than the cost of the ration without molasses. As far as the cost of 100 pounds of feed is concerned, the ration with molasses is cheaper than the ration without molasses. However, experimental data from the Hawaii Agricultural Experiment Station indicate that pigs fed diets containing molasses grew more slowly and required more feed and digestible energy per unit of gain than pigs on the basal diet containing corn and no molasses.[5] Therefore, we have to take into consideration the efficiency of the rations. According to the Department of Animal Science, the efficiency of 100 pounds of feed without molasses is equal to the efficiency of 103 pounds of feed with molasses. The costs of 100 pounds of feed without molasses and 103 pounds of feed with molasses are $4.83 and $5.07 respectively. It is thus more profitable to feed hogs a ration without than with molasses. The cost of the ration without molasses is $.19 cheaper than that of the ration with molasses.

2. Comparison of Composition and Cost Between Ration without Molasses and Ration with Molasses for 100 to 149 Pound Hogs and for Sows

The comparison of the ration without molasses and the ration with molasses is shown in Table 13. The following findings are derived from the comparison:

Table 18. Comparison of composition and cost between ration without molasses and ration with molasses for 100 to 149 pound hogs and sows

1 Ingredient	2 Ration without molasses	3 Ration with molasses
	(*lbs.*)	
Barley	47.14	59 94
Soybean meal	7.08	11.51
Tuna meal	5.00	5.00
DL methionine	.02	.02
Milo	27.83	0.0
Millrun	7.11	0.0
Pineapple bran	4.35	0.0
Limestone	.67	0.0
Fat	0.0	2.41
Meat and bone meal	0.0	.32
Molasses	0.0	20.00
T. M. salt*	.50	.50
Vitamin premix*	.25	.25
Antibiotic*	.05	.05
Total	100.00	100.00
Cost per 100 *lbs.* ($)	4.72	4.41

* T. M. salt, Vitamin premix and Antibiotic are additives.

(1) The ration without molasses includes eleven ingredients and the ration with molasses ten ingredients.

(2) Barley, soybean meal, tuna meal and DL methionine are contained in both rations. Millrun, pineapple bran and limestone are included only in the ration without molasses. Fat, and meat and bone meal are included only in the ration with molasses.

(3) Barley is included in both rations and is the ingredient with the largest quantity. Tuna meal is used to the maximum limit. DL methionine has the same quantity in both rations.

(4) The contents of protein, digestible energy and methionine in both rations just meet the specified minimum requirement. Calcium in the ration without molasses is at the maximum while calcium in the ration with molasses is at its minimum requirement level.

(5) Barley in both rations is very unstable. Tuna meal is relatively stable. Soybean meal and DL methionine in the ration without molasses are stable while these ingredients in the ration with molasses are unstable.

(6) The price reductions of corn and middlings in both rations are low. Cottonseed meal 41%, cottonseed meal 44%, fish meal, meat meal, tri. ca. phosphate and so. tri. poly phosphate have higher price reductions. Of these, tri. so. poly phosphate has the highest price reduction.

(7) Calcium is an inexpensive nutrient while digestible energy and methionine are expensive nutrients.

(8) The cost of 100 pounds of feed with molasses is $4.41, $.31 lower than that of the ration without molasses. However, to obtain the same feeding efficiency, 8 per cent more of the ration with molasses must be fed than of the ration without molasses. The following is thus the comparison of actual costs between the two rations: $4.72 for 100 pounds of feed without molasses and $4.76 for 108 pounds of feed with molasses. The ration without molasses is thus $.04 cheaper than the ration with molasses. Therefore, it is still cheaper to feed the weight group 100 to 149 pound hogs and sows the ration without molasses rather than the ration with molasses.

3. Comparison of Composition and Cost Between Ration without Molasses and Ration with Molasses for 150 Pound to Market Hogs

The ration without molasses is compared with the ration with molasses in Table 19. The following are the findings of the comparison:

Table 19. Comparison of composition and cost between ration without molasses and ration with molasses for 150 pound to market hogs

1 Ingredient	2 Ration without molasses	3 Ration with molasses
	(*lbs.*)	
Barley	52.51	51.00
Meat and bone meal	3.32	3.13
Soybean meal	2.75	10.28
Tuna meal	1.87	.60
Milo	29.03	0.0
Pineapple bran	9.72	0.0
Fat	0.0	4.19
Molasses	0.0	30.00
T. M. salt*	.50	.50
Vitamin premix*	.25	.25
Antibiotic*	.05	.05
Total	100.00	100.00
Cost per 100*lbs.* ($)	4.55	4.13

* T. M. salt, Vitamin premix and Antibiotic are additives.

(1) Both rations contain nine ingredients each.

(2) Barley, meat and bone meal, soybean meal and tuna meal are included in both rations. Milo and pineapple bran are included only in the ration without molasses. Fat enters only the ration with molasses. Barley is the most important ingredient by weight in both rations.

(3) Protein, digestigle energy and methionine are included in both rations at their minimum requirements. Calcium is included at its minimum requirement in the ration without molasses and at its maximum limit in the ration with molasses. The ration without molasses contains phosphorus at the maximum limit while the ration with molasses contains only the minimum required.

(4) Barley in both rations is a very unstable ingredient. The most stable ingredient in the ration without molasses is tuna meal while in the ration with molasses it is molasses.

(5) Millrun has the lowest price reduction in the ration without molasses while milo has it in the ration with molasses. DL methionine has the highest price reduction in both rations.

(6) Calcium in both rations is a very cheap nutrient. Digestible energy and methionine in both rations are very expensive nutrients.

(7) The cost of 100 pounds of feed with molasses is $ 4.13, $ .42 lower than the cost of the ration without molasses. The efficiency of the ration with molasses is lower than that without molasses. To eliminate this inefficiency, the ration with molasses must be fed 8 per cent more than the one without molasses. The

comparison of the costs between the two rations after eliminating the inefficiency of the ration with molasses is shown below:

The cost of 100 pounds of feed without molasses is $4.55 and the cost of 103 pounds of feed with molasses is $4.46. The cost of the ration with molasses is thus $.09 cheaper than the cost of the one without molasses. Therefore, for the weight group of 150 pound to market hogs, feeding the ration with molasses is slightly less expensive than feeding the ration without molasses.

V. CONCLUSION

The study was made for determining least-cost rations without molasses for given hog groups. The computed least -cost rations without molasses were compared with the least-cost rations with molasses which were derived in the previous study. The following are the conclusions of the study:

(1) Barley, soybean meal and tuna meal are included in all six rations. Barley is the most important ingredient by weight in five of the six rations. Only in the ration without molasses for 35 to 99 pound pigs is milo the major ingredient by weight. Tuna meal enters four rations(rations for 35 to 99 pound pigs and rations for 100 to 149 pound hogs and for sows) to the maximum limit.

(2) The quantity of protein, digestible energy and methionine in all rations just meets the specified minimum requirement.

(3) Barley in all rations is very unstable while tuna meal is relatively stable. Molasses and DL methionine are highly stable in the rations.

(4) Corn is an inexpensive potential substitute ingredient among the excluded ingredient in all rations. On the other hand, tri. ca. phosphate and tri. so. poly phosphate are very expensive ingredients.

(5) Calcium is an inexpensive nutrient while digestible energy and methionine are expensive.

(6) The cost of the rations declines for growing and finishing hogs as the weight of hogs increases.

(7) As far as the cost of 100 pounds of feed is concerned, the rations with molasses are lower in cost than the rations without molasses. After considering the efficiency of the rations, we may conclude the following:

(a) It is more economical to use the rations without molasses for the weight groups of 35 to 99 pound pigs and of 100 to 149 pound hogs and for sows.

(b) It is more economical to use the ration with molasses for the weight group of 150 pound to market hogs.

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線型計画法による最小費用養豚飼料の決定に関する研究

Ⅱ. 糖蜜を含まない最小費用飼料の決定（要約）

吉　田　茂*

ハワイにおける養豚農家にとって養豚経営上最も重要な課題はいかにすれば飼料費をきりつめることができるかと云うことである。前の研究では，ハワイにおける入手可能な全ての飼料要素を用いて最小費用飼料の配合方法を検討した。本研究では入手可能な飼料要素から糖蜜を除いて，糖蜜を含まない最小費用飼料を算出した。前の研究と同様に35～99*lb*の育成豚，100～149*lb*の肥育豚および母豚，ならびに150*lb*～出荷にいたるまでの肉豚を対象として3種類の最小費用飼料を算出した。算出方法も前の研究と同一方法で行なった。最後に糖蜜を含まない最小費用飼料と糖蜜を含む最小費用飼料を飼料効率（糖蜜を含む飼料と含まない飼料では飼料効率に相違が認められ，糖蜜を含む飼料は含まない飼料にくらべ飼料効率がいく分下がる）を考慮に入れて比較検討した。以下は本研究の要約である。

（1）　大麦，ダイズ粉およびマグロ粉は全ての最小費用飼料に含まれている。大麦は35～99*lb*の糖蜜を含まない育成豚用飼料を除く，他の5つの最小費用飼料に最大の構成要素として含まれている。35～99*lb*の糖蜜を含まない育成豚用飼料にはマイロが最大の構成要素で含まれている。マグロ粉は35～99*lb*の育成豚用および100～149*lb*の肥育豚および母豚用の飼料にその最大許容量5*lb*が含まれている。

（2）　タンパク質，digestible energy および methionine は全ての最小費用飼料に本研究で限定した最小要求量が含まれている。

（3）　大麦は全ての最小費用飼料に非常に不安定な構成要素として含まれ，マグロ粉は比較的安定した要素である。糖蜜と DL methionine は非常に安定した要素である。

（4）　全ての最小費用飼料にとって，トウモロコシは，最小費用飼料に含まれなかった要素の中では安価な要素である。すなわちトウモロコシは現在最小費用飼料に含まれているある要素の価格が騰貴した場合に，他の除外された要素にさきがけて最小費用飼料の構成要素となりうるチャンスがある。それにひかえ，Tri. ca. phosphate および Tri. so. poly phosphate は非常に割高な要素であり，最小費用飼料の構成要素となる可能性はほとんどない。

（5）　カルシウムは安価な栄養素であるが，digestible energy と methionine は割高な栄養素である。

（6）　最小費用飼料のコストは育成豚，肥育豚，および肉豚と飼料給与対象豚の体重が増すにつれて低下する。

（7）　単に100*lb*当たりの飼料費に関するかぎりにおいては，糖蜜を含んだ飼料の方が糖蜜を含まない飼料より安いと云えるが，飼料の効率を考慮に入れて両飼料を比較すると結論は次の通りである。

a）　35～99*lb*の育成豚と100～149*lb*の肥育豚および母豚に対しては糖蜜を含まない飼料を給与する方がより経済的である。

b）　150*lb*～出荷にいたるまでの肉豚に対しては糖蜜を含んだ飼料を給与する方がより経済的である。

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