Japanese Feeding Standard for Growing-Finishing Pigs

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It has been said that even one who has just a little experience in feeding growing-finishing pigs could feed them without much trouble. But today is the time when the efficiency of production has to be contrived, and it is important to change effectively "material" called feed into "product" called pork, especially lean meat. Besides, it is necessary to compare and examine the performance of growing-finishing pigs as "machine" of meat production as to some types.

Feeding standard of growing-finishing pigs which is, in a sense, a compass in sailing could be an indicator showing what quality of feed and how much feed should be given.

Accordingly, in advanced countries the feeding standards are settled based on the studied results of each country, and they are popularized.

In Japan, however, these types of research have not been conducted yet, and the setting of feeding standard suitable for such conditions as types of pigs being bred in Japan, feeding conditions and weather conditions has been demanded.

This paper aims at setting up Japanese feeding standard. The testing method and the outlines of result are as follows:

Study concerning nutrient requirements

1) Protein and Energy

A series of feeding tests concerning requirements of protein (the unit is DCP) and energy (the unit is TDN or DE) have been carried out at seven national and public testing organizations for six years.

The types of pigs were meat type (Yorkshire, Birkshire), bacon type (Landrace) and these crossbreed (F_1) [Yorkshire (Birkshire) ♀ × Landrace ♂], and the total number of pigs were approximately 840. The feeds were 24 kinds of formula feed which mainly consists of corn, barley and sweet potato as local feedstuffs, where DCP content was in the range of 7 to 14 per cent, and TDN content was within the range of 63 to 70 per cent.

These feeds were fully given in the state of air-dryness being divided into the former and the later periods. The period when the weight of pigs grew from 20 to 90 kilograms was assumed every type, and they were brought up by group feeding of 2 head on the same sex of 4 head as a set (♀ 2, ♂ 2).

In this study the matter which was taken seriously as an index for judging the result was the efficiency of feed (DCP) for lean meat production—the weight of lean meat stored in dressed carcass per one kilogram of feed (DCP).

On the basis of the preparatory stage study, the weight of lean meat increased in dressed carcass through the test period was obtained from assuming the stored weight both at the times of beginning and ending of the test by the regression of live weight and deducting the former from the latter.

Besides, the combined judging score of main measurements (daily gain, feed conversion ratio, length of rib, rib eye area, percentage of ham in dressed carcass and thickness of back fat) obtained following the progency test of meat production was also reflected on judging the results.

The above mentioned three kinds of main results are shown at various levels of DCP and TDN in Tables 1 and 2. The results are shown as index when the value on the fixed levels of DCP and TDN at each test is 100. The results standardized for expressing the results in index are shown on each test in Table 3 as a reference.

Now, for each test, the average index between two lots where DCP or TDN level is the same value, or the difference of DCP or TDN level between the former and the later periods is the same value, was obtained and examined.

Consequently, the following tendency was generally seen.

(1) The weight of lean meat stored in dressed carcass per one kilogram of feed was more influenced by TDN level than by DCP. With a few exceptions in bacon type, the weight increased when TDN level was high. With meat type, it increased also when DCP level was high, but this was not clear with the bacon type and the crossbred. Besides, generally the weight of lean meat had a tendency to increase a little when the difference of DCP level between the former and the later periods was small.

(2) The weight of lean meat stored in dressed carcass per one kilogram of DCP obviously increased with decrease of DCP level in the case of every type of pigs. On the same level of DCP, the weight was more increased when TDN level was high than when the level was low.

(3) The tendency of combined judging results was almost similar to that of the production weight of lean meat per one kilo-

Table 1. Index of results influenced by DCP and TDN level (Trial 1)

Trial		1—1				1—2			
DCP level %		14—12		11.5—9.5		11.5—9.5		9—7	
TDN level %		69	63	69(a)	63(b)	69(a)	63(b)	69	63
Lean meat production in dressed carcass per kilogram of feed	M	107	96	105	95	104	96	99	90
	B	103	98	106	94	104	96	96	92
	C	106	95	105	95	102	98	103	95
Lean meat production in dressed carcass per kilogram of DCP	M	87	77	107	93	106	94	129	114
	B	85	80	107	92	108	92	128	118
	C	88	76	106	94	103	97	136	125
Combined judging results	M	108	96	104	96	105	95	85	84
	B	104	112	104	96	103	97	87	74
	C	106	100	105	95	104	96	103	87

Note: 1. DCP level is shown as level of former period—level of later period. TDN level is common to both periods

2. Figures are shown as index when the average level of a) and b) is 100 in both trials respectively

3. M and B indicate the meat and bacon types, respectively. C indicates the crossbreed of two types and so on

Table 2. Index of results influenced by DCP or TDN level (Trial 2)

Trial		2—1 (trial on DCP level)				2—2 (trial on TDN level)			
Average level of former and later period		11.5		9.5		6.9		6.5	
Difference in level between former and later period		+3.5[a]	+0.5	+3.5	+0.5[b]	+3.0[c]	−3.0	+3.0	−3.0[d]
Lean meat production in dressed carcass per kilogram of feed g	M	100	101	96	100	101	104	99	99
	B	97	101	102	102	101	97	94	99
	C	99	101	99	101	103	102	100	97
Lean meat production in dressed carcass per kilogram of DCP g	M	94	93	104	106	102	105	99	98
	B	92	92	112	108	98	96	91	102
	C	93	97	108	107	103	105	101	97
Combined judging results	M	100	109	100	100	100	104	104	100
	B	89	91	93	111	111	91	93	89
	C	100	109	102	100	103	103	107	97

Note:

1. + Indicates when level of former period is higher, and − indicates when level of later period is higher
2. Figures are all shown as index when the average level of a) and b) in trial 1, or c) and d) in trial 2 is 100 respectively
3. TDN level of trial 1 is 67.0%. DCP level of trial 2 is 11.5% in former period and 9.5% in later period

Table 3. Results standardized for calculating index

Trial		Daily gain g	Feed conversion ratio	Rib eye area cm^2	Thickness of back fat cm	Weight of lean meat stored in dressed carcass kg	Lean meat production in dressed carcass per kilogram of feed g	Lean meat production in dressed carcass per kilogram of DCP g	Combined judging results
1—1	M	576	4.09	17.2	3.35	22.2	74.6	726	26.3
	B	610	3.79	15.6	3.10	24.6	89.9	867	25.0
	C	651	3.85	17.0	3.28	24.5	83.2	801	25.6
1—2	M	594	4.02	18.2	3.50	21.7	75.5	729	26.6
	B	608	3.78	15.5	2.95	24.9	89.5	844	25.8
	C	660	3.85	17.1	3.37	24.9	82.9	793	25.3
2—1	M	509	3.84	18.1	3.17	19.4	79.6	766	25.2
	B	617	3.76	15.3	3.16	23.5	90.4	871	25.3
	C	652	3.74	17.3	3.26	24.4	85.7	830	26.5
2—2	M	520	4.02	17.9	3.06	19.6	76.4	733	25.1
	B	648	3.61	15.7	3.05	24.8	93.7	918	28.5
	C	646	3.65	16.6	3.29	24.2	87.6	846	26.0

gram of feed, although it was partially different. Especially with bacon type, the results were exceedingly influenced by the DCP fluctuation when TDN level was low. Moreover, the results were excellent when the difference of TDN level between the former and the later periods was large.

As a result of synthetical examination of the nutrient level necessary for each type of growing-finishing pigs laying stress on the

result of these feeding tests, especially on the weight of lean meat stored in dressed carcass per one kilogram of feed, the recommended DCP level with meat type was estimated to be 12 per cent at the former period, 10 per cent at the later period, and the recommended TDN level was more than 67.5 per cent at both periods.

In like manner, DCP level for bacon type was 11.5 per cent at the former period, more than 9.5 per cent at the later period, and TDN level was more than 66.0 per cent at both periods. DCP level for crossbreed was concluded to be similar to bacon type, and TDN level to meat type.

1) Examination of conversion ratio of nutrients

At the National Institute of Animal Industry, by using Yorkshire, the composition of dressed carcass of pigs finished the feeding test and of young pigs appropriate for the age at the beginning of test was quantitatively determined, and the efficiency of protein and energy in the feed conversed and stored in edible portion in dressed carcass, that is, lean meat and fat meat, was examined. This is an experiment to substantiate the result of the feeding test.

As a result, the conversion ratio of protein into edible portion was higher when DCP level was medium and TDN level was high, and it reached 14 per cent at maximum. The nutrient level where the protein was utilized to the fullest almost agreed with the recommendatory level on the basis of the result of the feeding test. It was considered to be natural that recommended level of DCP makes a little difference between the former and the later periods.

On the other hand, the conversion ratio of energy into edible portion was roughly in the range of 20 to 30 per cent and it had a tendency to increase exceedingly in the feed of which TDN level was high and DCP level was low. The conversion ratio of energy into lean meat, however, was about 4 per cent and the influence by nutrient level was not observed.

2) Calcium and phosphorus

Requirements of calcium and phosphorus were examined using about 40 young Yorkshire pigs at the National Institute of Animal Industry. Three levels of calcium in the feed were chosen in the range of 0.5 to 0.9 per cent. The feeds were fully given for about two months with a Ca:P ratio in the range of 0.6 to 1.3.

As a result, the daily gain of growing-finishing pigs was higher when calcium level was low, and Ca:P ratio effective to gain decreased with increase of calcium level. The weight of femur tended to increase with gain.

Unlike the daily gain, ash content of femur was higher when calcium level was high, but content ratio of calcium and phosphorus of femur was about 2.2, and it was definite regardless of fluctuation of both levels. The result of daily gain and ash content of femur accompanying calcium-phosphorus level are shown by index in Fig. 1.

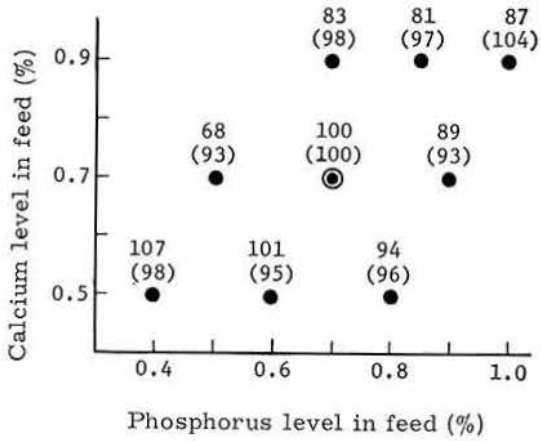
Requirements of calcium and phosphorus were decided by collective judgment of the results adding the weight of femur and conversion ratio of feed to daily gain and ash content of femur, and by special consideration of phosphorus content of practical feed in Japan.

From the viewpoint of ossification of bone, requirements of calcium and phosphorus at the former period were considered to be slightly higher than those at the later period, and the requirements of bacon type were higher than those of meat type estimating from the yield rate of bone.

3) Setting up of feeding standard

The nutrient requirements of growing-finishing pigs gained from this study are shown in Table 4 dividing into the former and the later periods as the content in the feed. These indications would be rational in a sense that they are adaptable for practical management by group feeding system.

As the values in Table 4 are mean values



Note: Index when levels of calcium and phosphorus are both 0.7% is shown

Fig. 1. Index of daily gain (ash content of femur) on calcium-phosphorus level

of each type of growing-finishing pigs, it may be considered that they could be applicable to all types of pigs being fed in Japan.

The requirements of DCP and TDN (DE) divided into growing stage of growing-finishing pigs as the weight per day with expected daily gain and total feed per day are shown in Table 5.

Comparing the feeding standard (nutrient content in feed) obtained from this study with NRC feeding standard in the United States, protein level is not much different, but Japanese energy level is considerably low where it is equivalent to 90 to 95 per cent of NRC.

On the other hand, calcium or phosphorus level is slightly higher than that of NRC, and Ca:P ratio is 1.0. This may be owing to the fact that emphasis is laid on the increase of

Table 4. Nutrient requirements of growing-finishing pigs

——Percentage in feed or gram per kilogram of feed——

		Liveweight 20 to 50 kg (former period)	Liveweight 50 to 90 kg (later period)
Percentage of total feed to liveweight %		6.5~4.4	4.4~3.8
DCP (digestible crude protein)	%	11.5	9.5
TDN (total digestible nutrients)	%	67.0	67.0
DE (digestible energy)	%	2,950	2,950
Calcium	%	0.60	0.50
Phosphorus	%	0.60	0.50
Salt (NaCl)	%	0.50	0.50
Vitamin A	IU	1,300	1,300
Vitamin D	IU	160	130
Thiamine	mg	1.1	1.1
Riboflavin	mg	2.6	2.2
Pantothenic acid	mg	11	10
Niacin	mg	13	11
Vitamin B_6	mg	1.1	—
Choline	mg	880	—
Vitamin B_{12}	mcg	11	11

Note:
1. DE was calculated on the assumption that 1 kilogram of TDN has 4,400 kcal of DE, and the conversion rate has confirmed the reliability in this study
2. Requirements of vitamins have been quoted from provisional Japanese Feeding Standard (Morimoto)

Table 5. Requirements of DCP and TDN (DE) in each stage

—per head per day—

Stage		Former period				Later period			
Liveweight kg		20	30	40	50	60	70	80	90
Expected daily gain	kg	0.53	0.60	0.69	0.69	0.69	0.70	0.70	—
Total feed (air dry)	kg	1.30	1.60	1.90	2.25	2.60	2.95	3.20	3.40
Requirements of nutrients:									
DCP (digestible crude protein)	kg	0.15	0.18	0.21	0.24	0.26	0.28	0.30	0.32
TDN (total digestible nutrients)	kg	0.87	1.07	1.28	1.51	1.74	1.96	2.14	2.28
DE (digestible energy)	kcal	3,830	4,710	5,630	6,640	7,660	8,620	9,420	10,030

lean meat production rather than daily gain in the Japanese feeding standard. It is convinced that this will be useful for modernization to raise pigs in the future.

Study concerning nutritive value of feed

As a result of digestion trials of main feedstuffs and examination of chemical composition of feed, which were carried out as a link of experimental studies concerning feeding standard, the nutritive value of feedstuffs for pigs became clear.

Instead of the conventional table in common with cows and pigs, an original table on the composition of feedstuffs for pigs—8 kinds of grain, 7 kinds of bran, 7 kinds of oil meal, 8 kinds of animal feed, 7 kinds of by-product feed, 5 kinds of meadow grass, and 8 kinds of root crop and so on—50 kinds in total are concluded—could be drawn up. The table is important to make practical application of feeding standard. The rational composition of feed could not be done until it is utilized.

Owing to the study of formula feed, a clear account was given of the difference in digestibility and nutritive value according to breed or sex distinction of pigs, and the accuracy to presume the nutritive value from feedstuffs.

Applied study of feeding standard

The feeding trial for practical use of feeding standard for growing-finishing pigs which was done by agreement of five prefectural experiment stations was carried out as an applied study for feeding standard. The feed for the former and the later periods was increased or decreased within the range of 10 per cent of the prescribed quantity, the feed being used with average quality.

As a result, the feeding quantity considered to be proper in the case of restricted feeding could be obtained. Moreover, it was revealed that full feeding of low nutritive feed mixed with fibrous materials such as rice hull and starch pulp was not always expected to give excellent result, and that reduced feeding of high nutritive feed mixed with about 10 per cent of animal fat (tallow) was effective to improve greatly the efficiency of feed, although some economical question still remains.

As the study for nutrients of pigs is fairly late in starting comparing with other livestock, the scientific basis has been lacking in order to raise rationally growing-finishing pigs.

From this point of view, the elucidation of fundamental subject to manage growing-finishing pigs such as setting up of feeding standard and drawing up of the table on the composition of feedstuffs has been accomplished in this study. The result could be considered to be useful for a basis of development for feeding technique in the future.

References

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