

Performance of Meat Production and Meat Quality in Wagyu Cattle (Japanese Cattle)

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Introduction

Wagyu cattle is a general term for the Japanese indigenous cattle which have been improved during the past 70 years. Current Wagyu cattle include the following four breeds: Japanese Black, Japanese Brown, Japanese Polled, and Japanese Shorthorn. As shown in Table 1, there is a total of 1,368,800 Wagyu cattle in Japan. Of the four breeds the Japanese Black is the most predominant breed. It accounts for about 88% of Wagyu cattle in 1974. The ratio of Wagyu cattle to total cattle for beef production has decreased from almost 100% to about 73% during the past 10 years. The figures suggest that a large proportion of beef production in Japan is now from the dairy industry. In fact, about 64% of total beef carcass production of 293,000 tons was from dairy cattle in 1974.

Table 1. Population of the cattle for beef production in Japan

Breed	1965	1974
Japanese Black	1,454,800	1,204,100
Japanese Brown	309,000	121,300
Japanese Shorthorn	22,400	38,300
Japanese Polled	7,900	5,100
Hereford	300	7,100
Aberdeen Angus	700	2,700
Chrolais	—	700
Crossbred	1,200	8,100
Dairy steers	—	491,600
Total	1,796,300	1,879,000

Growth performance of breeding stocks

In former time Wagyu cattle were raised for the purpose of ploughing paddy fields or transporting goods rather than producing beef. It is after the War II that Wagyu cattle have become to be more important as beef producer. The trend has been accelerated by the development and spread of agricultural machines. As the demand for beef has increased, the body size of Wagyu cattle has been improved greatly year by year. According to the mean growth curves reported in 1955 by Chugoku National Agricultural Experiment Station²⁾ the body weights at birth, 6, 12, and 24 months of age of the Japanese Black heifers were 27, 147, 230, and 327 kg respectively, while the new mean growth curves proposed in 1974 by the Japanese Cattle Registry Association¹⁵⁾ showed that the figures were 27, 169, 324, and 479 kg respectively. It is recognized that such a rapid progress in growth as this has been achieved partially by breeding through the selective registry accompanied with performance and progeny testings, and partially by improvement of the feeding levels. Mature size in body weight and withers height of the breeding stocks in the current Japanese Black cattle are considered to be 510 to 610 kg and 125 to 131 cm for cows, and 890 to 990 kg and 139 to 146 cm for bulls, respectively.

Growth rate is economically important and is generally associated with economy of gain.

It has a high heritability hence individual selection based on performance testing will achieve improvement. Therefore, most of young bulls intended for A.I. use are first selected on the basis of own performance for growth traits in a performance test. They usually have the growth rate and feed conversion efficiency tested for a period of 16 weeks under a given feeding program. In this testing program the weaned male calves of high grade, which are 6 to 7 months old and weigh 200 to 300 kg, are raised by *ad libitum* feeding of a given ration and good roughage. According to the 1969 to 1972 records of the performance tests on 774 young Japanese Black bulls, the average live weight adjusted for 365 days of age, daily gain on test, and feed conversion efficiency as expressed by TDN consumption per 1 kg of gain were 411.3, 1.15, and 4.76 kg, respectively¹⁷⁾.

Performance of meat production of fattening steers

Progeny testing is useful to evaluate the general performance of meat production of young steers, although the purpose is a comparison between groups of progeny of particular sires. In the progeny testing program six paternal half-sib steers, which are 7 to 8 months old and weigh 200 to 280 kg, are raised for a period of 43 weeks under a given feeding program. The feeding program for progeny testing is applied to the young steer fattening program, which is one of the most popular program for finishing beef cattle in Japan. The average 1970 to 1972 figures on the performance of meat production of total 252 young steers in the progeny tests for 42 Japanese Black sires are shown in Table 2¹⁸⁾.

Evaluation of the results of a progeny test is made by considering the following eight characteristics: (1) final live weight, (2) daily gain on test, (3) TDN consumption per 1 kg of gain, (4) dressing percentage, (5) marbling score, (6) rib-eye muscle area, (7) fat thickness, and (8) carcass grade. The average figures are 500.6 kg for final live weight,

Table 2. Performance of meat production of the Japanese Black young steers in progeny testing program¹⁸⁾

Character	Mean±S.D.
Final days of age	563.2±12.6
Final live weight (kg)	500.6±35.4
Daily gain on test (kg)	0.85±0.10
TDN consumption per 1 kg of gain (kg)	6.58±0.49
Carcass weight (kg)	301.0±21.1
Dressing percentage (%)	63.7±1.6
Marbling score	2.7±0.5
'Rib-eye' muscle area (cm ²)	42.7±5.1
Fat thickness (mm)	17±3

0.85 kg for daily gain on test, 6.58 kg for TDN consumption per 1 kg of gain, 301.0 kg for carcass weight, and 63.7% for dressing percentage, respectively¹⁸⁾. In Japan beef carcass quality is measured primarily in term of marbling. Evaluation of marbling in grading beef carcass is usually made on the cut surface of rib-eye muscle exposed by ribbing the carcass between the 7- and 8-th ribs. Marbling is scored 0 for the lower limit to 5 for the upper limit. The average marbling score was 2.7 for fattening steers in progeny testing programs¹⁸⁾, though the variation in marbling score was relatively large (Fig. 1)¹⁹⁾. Rib-eye muscle area is also considered important in the determination of carcass quality.

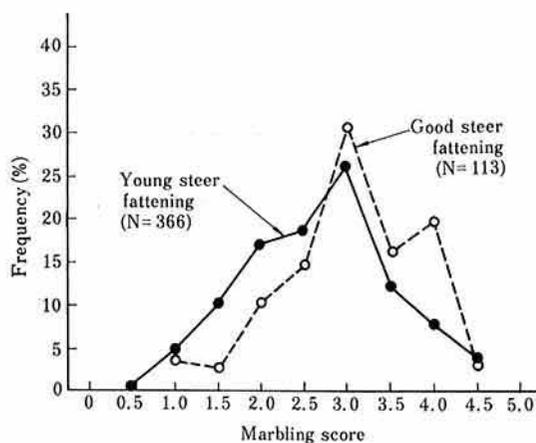


Fig. 1. Frequencies of marbling scores of carcasses in fattening Japanese Black steers

It is measured on the same cut surface that marbling was scored on. The average rib-eye area was 42.7 cm².¹⁸⁾ Fat thickness is fat cover over the 5- to 6-th thoracic vertebrae. The average fat thickness was 17 mm¹⁸⁾. Carcass grade is determined on the three major factors: (a) carcass weight, (b) appearance (conformation, fleshness, fat covering, and finish), and (c) meat quality (marbling, color of the lean, texture and firmness of the lean, and color and quality of the fat). In the Japanese grade, beef carcasses are classified into the six grades: Tokusen, Gokujo, Jo, Chu, Nami, and Togai. 'Tokusen' is the highest grade, which may be equivalent to 'Prime' in the U.S.D.A. grade, for example. Most carcasses of fattening young steers are graded 'Jo' which is the third grade.

Another popular type of finishing for steers is called good steer fattening²¹⁾. Good steer fattening program is done to produce high grade beef. Weaned steer calves of high grade, which are 7 to 8 months old and weigh about 250 kg, are used as feeder. After raising for 6 months they are fed with finishing ration for another 10 to 12 months before slaughter. Recently a modified good steer fattening program has been developed by Kyoto University^{12), 22)}. In the fattening program high grade feeder steers, which were 6 to 8 months old and weighed 200 to 250 kg,

were raised for 64 to 70 weeks by ad libitum feeding of a given finishing ration and good roughage. The average figures for the performance of meat production of the Japanese Black steers in good steer fattening program are summarized in Table 3^{12), 16), 22)}.

Genetic parameters for economically important traits

The heritability estimates for several economically important traits in the Japanese Black cattle are summarized in Table 4^{2-10), 13)}. Birth weight was of medium to high heritability, while preweaning gain and weaning weight were of low to medium heritability. As to feedlot traits, final live weight and final live weight per day of age were highly heritable, while average daily gain and feed conversion efficiency were of medium heritability. Carcass traits such as dressing percentage and carcass grade were highly heritable, though rib-eye muscle area was lowly heritable. Marbling score was of medium to high heritability.

Some estimates of phenotypic and genetic correlations among several economically important traits were calculated from the records of the progeny tests on the Japanese Black sires^{9), 10)}. As shown in Table 5, initial live weight has positive genetic relationships with final live weight, average daily gain on test and feed conversion efficiency, while it has no genetic correlations with carcass and beef quality characteristics. There is a lack of genetic correlation between final live weight and feed conversion efficiency, though there is a high genetic correlation between final live weight and average daily gain on test. Final live weight has also positive genetic relationships with marbling score and carcass grade, while it has no genetic relationship with dressing percentage. There is a lack of genetic correlations between dressing percentage and growth and other carcass characteristics. A positive genetic correlation exists between carcass grade and marbling score.

Table 3. Performance of meat production of the Japanese Black steers in good steer fattening program^{12), 16), 22)}

Character	Range of means
Final days of age	702 to 731
Final live weight (kg)	594 to 648
Daily gain (kg)	0.76 to 9.82
TDN consumption per 1 kg of gain (kg)	7.27 to 10.30
Carcass weight (kg)	366 to 418
Dressing percentage (%)	64.6 to 66.2
Marbling score	3.0 to 3.2
'Rib-eye' muscle area (cm ²)	41.8 to 47.2
Fat thickness (mm)	20 to 27

Table 4. Heritability estimates for several economically important traits in the Japanese Black cattle^(9)-10),13)

Character	Approximate level	Heritability %
Prewaning traits:		
Birth weight	Medium to High	34 to 57
Prewaning gain	Low	8 to 16
Weaning weight	Low to Medium	12 to 31
Feedlot and slaughter traits:		
Final live weight	High	53 to 92
Final live weight per day of age	High	70 to 91
Average daily gain	Medium	20 to 49
Feed conversion efficiency	Medium	37 to 51
Dressing percentage	High	51 to 77
Marbling score	Medium to High	45 to 56
'Rib-eye' muscle area	Low	0
Carcass grade	High	67

Table 5. Estimates of phenotypic (P) and genetic (G) correlations among several economically important traits in the Japanese Black cattle⁹⁾

Character	(2)	(3)	(4)	(5)	(6)	(7)
(1) Initial live weight (P)	0.67	0.14	0.62	0.16	0.02	0.19
(G)	0.90	0.63	0.42	.15	0.09	-0.00
(2) Final live weight (P)		0.82	-0.27	0.07	0.10	0.29
(G)		0.91	0.01	0.03	0.53	0.43
(3) Average daily gain (P)			-0.71	-0.03	0.12	0.24
(G)			-0.42	-0.08	0.91	0.80
(4) Feed conversion efficiency (P)				0.12	-0.09	-0.10
(G)				0.17	-0.69	-0.78
(5) Dressing percentage (P)					0.06	0.11
(G)					-0.06	0.07
(6) Marbling score (P)						0.61
(G)						0.91
(7) Carcass grade						—

Comparison of performance of meat production among the breeds

Although there is no direct comparison of performance of meat production among the four breeds of Wagyu cattle, it may be concluded from the results of partial comparison experiments^(1),11),14),16),20),23) that Japanese Blacks are generally superior in carcass quality to other three breeds, while Japanese Browns, Japanese Polleds and Japanese Shorthorns are superior in growth traits to Japanese Blacks respectively. As summarized in Table 6, the

carcasses of Japanese Blacks are most superior in marbling on the cut surface of rib-eye muscle, hence they are usually graded higher than those of other three breeds. There seems to be a tendency that the dressing percentage of Japanese Blacks is higher than those of Japanese Browns and Japanese Shorthorns but is lower than that of Japanese Polleds. The mean 'rib-eye' muscle area of Japanese Blacks seems to be smaller than those of Japanese Polleds and Japanese Browns. Japanese Blacks have a tendency to have less fat cover over the thoracic vertebrae. There is general agree-

Table 6. Comparison of performance of meat production in young fattening steers between the Japanese Black and other breeds of the Japanese cattle^{(21)~(23)}

Character	Reference					
	(23)	(1)	(16)	(11)	(14)	(20)
Final liveweight	B < Br	B < P*	B < P*	B < S*	B < S	B < S
Daily gain on feedlot	B < Br	B < P*	B < P*	B < S*	B < S*	B < S
TDN consumption per 1 kg of gain	B ≈ Br	—	B < P	B > S	B < S	B > S
Dressing percentage	B > Br	B < P	B < P*	B > S	B > S	B > S
Marbling score	B > Br	B > P	B > P	B > S	B > S*	B ≈ S
'Rib-eye' muscle area	B < Br	B < P*	B < P*	B ≈ S	B ≈ S	B < S
Fat thickness	—	B < P*	B < P*	B < S	B ≈ S	—
Carcass grade	B < Br	B > P	B > P	—	B > S	B > S

B: Japanese Black, Br: Japanese Brown, P: Japanese Polled.

S: Japanese Shorthorn.

*: Significant differences.

ment as to the inferiority of Japanese Blacks with respect to daily gain on feedlot as compared with other three breed.

Conclusion

Recently, the Japanese Cattle Registry Association proposed an idea for the target after next ten years of the performance of meat production in young fattening Wagyu steers⁽¹⁹⁾. According to the proposal, in the young steer fattening program, feeder steers which are 7 months old and weigh 250 kg should be finished after 10 months of feeding with the following target:

- (1) 550 kg for final live weight,
- (2) 1.0 kg for daily gain,
- (3) 330 kg for carcass weight,
- (4) 65% for dressing percentage,
- (5) 3.0 for marbling score,
- (6) 52 cm² for 'rib-eye' muscle area, and
- (7) less than 20 mm for fat thickness.

Considering the average figures for the traits described in the foregoing paragraphs, these figures proposed seem to be suitable for the target of performance of meat production in young steer fattening program in the near future. In order to attain this goal, however, closer co-operations among people in the related fields will be essentially important.

References

- 1) Hosoyamada, F. et al.: Studies on the management practices for the herd raising of Japanese cattle. IV. Grazing capacity of improved pasture and beef production of growing steers grazed in the raising period. *Bull. Chugoku Nat. Agr. Exp. Sta.*, B17, 41-75 (1969) [In Japanese, English summary].
- 2) Kumazaki, K. et al.: Studies on the growth of Japanese breed of cattle. I. Functional study of the normal growth of Japanese Black breed. *Bull. Chugoku Nat. Agr. Exp. Sta.*, B4, 73-108 (1955) [In Japanese, English summary].
- 3) Kumazaki, K. et al.: Studies on the growth of Japanese breed of cattle. II. A genetic consideration on the growth of Japanese Black breed. *Bull. Chugoku Nat. Agr. Exp. Sta.*, B5, 57-76 (1956) [In Japanese, English summary].
- 4) Kumazaki, K. et al.: Statistic and genetic studies on meat productivity of Japanese breed of cattle. I. Estimates of the genetic parameters for growth traits. *Bull. Chugoku Nat. Agr. Exp. Sta.*, B9, 85-95 (1962) [In Japanese, English summary].
- 5) Kumazaki, K. & Matsukawa, T.: Statistic and genetic studies on meat productivity of Japanese breed of cattle. II. Estimates of parameters at birth, weaning and 12 months of the genetic parameters for body measurement. *Bull. Chugoku Nat. Agr. Exp. Sta.*, B11, 27-42 (1963) [In Japanese, English summary].

- 6) Kumazaki, K. & Matsukawa, T.: Statistic and genetic studies on meat productivity of Japanese breed of cattle. III. Repeatability estimates for birth weight, weaning weight and gain from birth to weaning. *Bull. Chugoku Nat. Agr. Exp. Sta.*, B12, 19-26 (1964) [In Japanese, English summary].
- 7) Kumazaki, K. & Matsuo, T.: Genetic and environmental factors affecting birth weight and weaning weight of beef calves. *Agr. Res. Bull. Saga Univ.*, 24, 61-71 (1969) [In Japanese, English summary].
- 8) Kumazaki, K. & Matsuo, T.: Adjustment for environmental factors on birth weight and weaning weight of beef calves. *Jap. J. Zootech. Sci.*, 39, 426-431 (1968) [In Japanese, English summary].
- 9) Kumazaki, K. & Sasaki, Y.: Statistic and genetical studies on the meat productivity of Japanese Black cattle. *Jap. J. Zootech. Sci.*, 42, suppl. (1971) [In Japanese].
- 10) Matsukawa, T.: Selection of Japanese beef cattle for meat performance. *Bull. Tohoku Nat. Agr. Exp. Sta.*, 45, 117-170 (1973) [In Japanese, English summary].
- 11) Matsukawa, T. & Imamura, T.: Growth and carcass characteristics of Japanese Shorthorn and Japanese Black steers under different planes of nutrition. *Jap. J. Zootech. Sci.*, 44, 397-403.
- 12) Namikawa, K. et al.: Possibility of good steer fattening by outdoor rearing. *Bull. Univ. Farm of Kyoto*, 47, (1974) [In Japanese].
- 13) Obata, T. et al.: Application of liveweight records from local auction markets to the progeny test of Japanese Black bulls. *Bull. Chugoku Nat. Agr. Exp. Sta.*, B20, 63-69 (1973) [In Japanese, English summary].
- 14) Sawazaki, H. et al.: Effect of the rearing in mountainous regions on the productivity of beef cattle. IV. Results of the fattening experiments. *Japan. J. Zootech. Sci.*, 46, 469-476 (1975) [In Japanese, English summary].
- 15) The Japanese Cattle Registry Association: Growth curves for Japanese Black cattle. (1973) [In Japanese].
- 16) The Japanese Cattle Registry Association: Performance of meat production in Japanese cattle. I. (1967), II. (1971) [In Japanese].
- 17) The Japanese Cattle Registry Association: Results of performance tests in Japanese cattle. I-III. (1974) [In Japanese].
- 18) The Japanese Cattle Registry Association: Results of progeny tests in Japanese cattle. I. (1974) [In Japanese].
- 19) The Japanese Cattle Association: A research report on the technique of rearing sires and the method of progeny testing in Japanese cattle. (1975) [In Japanese].
- 20) Tokachi National Livestock Breeding Station: Experimental reports on beef cattle. No. 9 (1974) [In Japanese].
- 21) Uesaka, S.: Beef cattle in Japan. (1970).
- 22) Uesaka, S. et al.: Possibility of finishing steers at 600 kg of liveweight by outdoor rearing. *Bull. Lab. Anim. Breed. Feed. Kyoto Univ.*, 312 (1972) [In Japanese].
- 23) Yoshida, S. et al.: Studies on the feeding standard for the Japanese beef cattle. 1. Nutrient intakes and meat production in the fattening young steers. *Bull. Chugoku Nat. Agr. Exp. Sta.*, B16, 1-56 (1967) [In Japanese, English summary].