



# Journal of Biological Sciences

ISSN 1727-3048

**science**  
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## Growth Performance, Carcass and Meat Characteristics of Female and Male Kadon Pigs

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**Abstract:** This study describes the carcass and meat characteristics of native, Thai Kadon pigs. Female and male Kadon pigs were either housed individually or in groups and growth performance was measured. At the end of the feeding period, the pigs were killed and organ weights were determined. Carcass characteristics were measured as percentage ham and loin weight and thickness of back fat. There were 8 females and 8 males housed in individual pens for a period of 45 days. Another 8 females were housed together and so were 8 males, both females and males being kept for 90 days. The female pigs were heavier than the male pigs, the difference being most pronounced in the individually housed animals. For individually housed males with initial weight of 8 kg and final weight of 20 kg, average daily gain was about 290 g day<sup>-1</sup> and for the females with initial weight of 10 kg and final weight of 25 kg, it was 315 g day<sup>-1</sup>. For the group-housed pigs there were no significant differences in weight gain, carcass weight, percentage of carcass and back fat between female and male pigs. The carcass weight was about 65% of slaughter weight. The weight of head, tail, heart, liver, lung, spleen, kidney and large intestine were not different between males and females, but the stomach and small intestine were heavier in females than in males. The loin meat contained about 8.7% fat and 21.4% protein as measured by proximate analysis. Palmitic and oleic acid represented about 26 and 40% of the total loin fatty acids as measured by gas-liquid chromatography. There was no gender difference in carcass composition and fatty acid profile of meat. It is appreciated that the data presented will be affected by diet composition and management, but this study is the first to document reference data for Kadon pigs.

**Key words:** Kadon pig, growth performance, carcass composition

### INTRODUCTION

In the North-East of Thailand, native, so-called Kadon pigs are kept on small-holder farms. It is assumed that the Kadon pigs are on the edge of extinction. Therefore in 2003, this Thai native pig was listed as preserved species (Ratanawarasa, 2000). Within the framework of the Kadon pig project in the Department of Animal Science, Sakon Nakhon Agricultural Research and Training Center, 20 Kadon pigs were purchased in the Kudbark district in Sakon Nakhon province. These animals were used for breeding. In a recent study in Kadon pigs fed on rice bran as a basal diet, weight gain was found to be approximately 200 g day<sup>-1</sup> (Vasupen *et al.*, 2004), which would make the pig suitable

for production under conditions of limited resources on small-holder farms. Furthermore, the Kadon pig attains puberty at low body weight, reproduces on a low plane of nutrition and has good disease resistance (Serres, 1992).

The meat from Kadon pigs is well appreciated by the local people in the North-East of Thailand. It is said that Kadon meat has better texture and flavor than the meat of exotic pigs (Vasupen *et al.*, 2004). Nevertheless, on small-holder farms the Kadon pigs have been replaced by commercial pigs kept in intensive pig production systems. Preservation of the Kadon pig on small-holder farms may be stimulated by objective information on its technical and meat characteristics. Thus, in this study, we collected data on growth performance, carcass and meat characteristics.

**MATERIALS AND METHODS**

The Kadon pigs used were bred in the Department of Animal Science, Sakon Nakhon Agricultural Research and Training Center. This study were conducted in 2003. There were ten sows which were mated with unrelated boars. The piglets produced from the ten sows were monthly monitored as to body weight, body length and height at the shoulder and the rump. Two different groups of pigs were used in two feeding trials described below.

Eight male growing pigs with average body weight 8.4±1.7 kg and 8 females with average body weight 10.4±1.8 kg were housed individually in a metabolic cage. They had free access to water from a nipple drinker. The pigs were fed ad libitum (4% dry matter of body weight) twice daily at 07:00 am and 04:30 pm. The diet contained 160 g crude protein per kg Dry Matter (DM). The diet composition was as follows (g kg<sup>-1</sup> diet): rice bran, 820; soybean meal, 160, premix, 15, salt, 5. Feed consumption was determined as the difference between the amount of feed offered and that refused. Pigs were weighed weekly for the 45 days experimental period. Changes in live weight were used to estimate Average Daily Gain (ADG). Feed Conversion Ratio (FCR) was calculated as the ratio of the amount of consumed feed to 1 kg gain of body weight.

Another group of pigs were housed 8 animals of the same sex per pen. The males had an average body weight of 8.44 kg and the females had an average body weight of 8.73 kg. Feed and water were freely available throughout the study. Body weight and feed consumption were measured for the 90 days experimental period. At the end of the experiment, four pigs per group were slaughtered. Carcass characteristics evaluation was performed according to the Thai style of carcass cutting (Jaturasitha, 2004). The weights of the head, tail, liver, kidney, spleen, heart, lungs, full digestive tract and hot carcass were recorded. In addition, dressing percentage, thickness of back fat and ham proportion were determined. The loin muscles (longissimus dorsi) were collected to determine

proximate composition and fatty acid profile of the fat component. The meat samples were dried at 60°C for 72 h in a forced-hot air oven to quantify the percentage of moisture and were subsequently analyzed for crude protein, crude fat and ash (AOAC, 1990). Total fat in dried meat (loin) was extracted with a chloroform-methanol (2:1, v/v) mixture (Folch *et al.*, 1957). Then, the fat was saponified with 0.5 N methanolic sodium hydroxide and methylated with boronitride-trifluoride-methanol according to the procedure of Metcalfe *et al.* (1966) followed by gas chromatography to determine individual fatty acids.

The data were evaluated for statistical significance of sex differences by the Student's t-test (SPSS, 1998). All results are expressed as mean and pooled SE.

**RESULTS AND DISCUSSION**

As from birth, female pigs tended to be heavier than male pigs until 12 months of age. However, when mature at 12 months of age, the male pigs tended to be taller with large body length, pointing at a better body conformation (Table 1). Kadon pigs raised in groups tended to have lower growth rate than those raised in individual pens (Table 2, 3). This may be related to more activity, more competition for feed and more feed losses in the group-housed pigs (Georgsson and Svendsen, 2002). Furthermore, the growth interval was 60 days for the pigs housed individually and 90 days for those housed in groups. During the last 30 days in the group-housed pigs, growth rates were lower than in the preceding period.

There were no sex differences in daily feed intake, ADG and FCR. ADG was consistently higher for the females versus males (Table 2, 3), but the difference did not reach statistical significance. Average back fat thickness tended to be higher in females than in males (2.23 vs. 1.81 cm) (Table 3). In the females, the higher back fat thickness may be related to retention of energy for reproductive performance (Gaughan *et al.*, 1997; Booth *et al.*, 1994). The full digestive tract of female pigs was heavier than that of male pigs.

**Table 1: Mean body weight and body conformation in group-housed of males and females Kadon pigs as from birth**

Age	Weight (kg)			Height at shoulder (cm)			Height at rump (cm)			Body length (cm)		
	M	F	pSE	M	F	pSE	M	F	pSE	M	F	pSE
Birth	0.57	0.58	0.02	11.29	11.54	0.12	11.56	11.68	0.12	14.34	14.29	0.20
30 days	3.04	3.08	0.09	17.92	18.46	0.39	19.00	19.69	0.37	22.08	22.46	0.53
60 days	6.09	6.11	0.30	22.83	23.36	0.47	25.50	26.25	0.41	30.13	32.89	0.78
90 days	12.43	12.58	0.47	27.76	29.16	0.53	30.71	33.04	0.66	39.76	45.54	1.41
120 days	18.93	19.13	0.64	32.11	34.52	0.64	35.76	38.26	0.69	46.42	50.41	1.10
150 days	24.11	25.79	0.75	35.27	38.13	1.00	39.18	43.07	0.97	49.00	56.13	1.45
180 days	30.82	37.50	1.35	37.00	40.67	0.94	41.44	45.93	1.01	51.33	59.27	1.42
365 days	65.50	74.20	2.41	55.67	51.50	1.07	58.33	56.90	0.70	77.00	74.70	1.63

Piglets birth weight is between 0.4-1.0 kg with an average of 0.58 kg, There were 16 males and 20 females, \*Means in the same rows and same item column with differ significantly for females versus males (p<0.05). M: Male, F: Female, pSE: pooled standard error

Table 2: Growth performance of Kadon pigs that were raised in individual pens

Items	Male pigs (n = 8)	Female pigs (n = 8)	Pooled SE
Initial weight (kg)	8.40	10.40*	0.62
Final weight (kg)	21.20	24.60*	1.02
Average daily gain (g day <sup>-1</sup> )	285.60	315.00	18.32
Feed consumption (g DM day <sup>-1</sup> )	741.10	816.70	46.29
Feed conversion ratio	2.74	2.67	0.12

\*Means in the same rows with differ significantly for females versus males (p<0.05)

Table 3: Carcass characteristics of Kadon pigs that were raised in groups

Items	Male pigs	Female pigs	Pooled SE
No. of pigs	8.00	8.00	-
Initial weight (kg)	8.44	8.73	0.60
Slaughter weight (kg)	23.20	26.10	1.11
Weight gain (kg)	14.76	17.38	1.03
Average daily gain (g day <sup>-1</sup> )	164.13	193.00	11.48
Feed consumption (g DM day <sup>-1</sup> )	551.88	619.47	20.99
Feed conversion ratio	3.36	3.21	0.06
Hot carcass weight (kg)	15.08	17.49	0.90
Percentage of carcass (%)	64.85	66.75	1.19
Loin weight (kg)	0.82	0.94	0.07
Percentage of loin/carcass weight	5.40	5.40	0.34
Back fat (cm)	1.81	2.23	0.17
Ham percentage (% of live weight)	14.35	13.51	0.80
Head (kg)	2.32	2.26	0.11
Tail (g)	37.50	41.87	3.34
Heart (g)	117.50	123.13	11.04
Liver (g)	560.63	578.75	33.44
Lungs (g)	266.25	268.13	41.37
Spleen (g)	50.00	48.44	4.92
Kidneys (g)	110.63	111.25	7.77
Stomach (g)	383.13	521.87*	36.89
Small intestine (kg)	0.91	1.13*	0.64
Large intestine (kg)	1.37	1.59	1.58

\*Means in the same rows with differ significantly for females versus males (p<0.05)

There was no significant effect of sex on the composition of loin (Table 4). The average amount of intramuscular fat in loin of the Kadon pigs was 8.74% of the DM, which is in agreement with data from the study of Sun and Lu (2002), showing a fat content of 8.27% in loin muscle from Lianguang Xiaohua pigs. However, the amount of intramuscular fat in Kadon meat was higher than that in various native Chinese pigs (Jinhua pigs, 3.70%, Wujin pigs, 3.08%, Ming pigs, 5.2%, Wuzhishan pigs, 2.26%) (Sun and Lu, 2002).

It was found that the content of polyunsaturated fatty acids in Kadon meat was relatively low (Table 4), whereas the contents of saturated monounsaturated fatty acids were relatively high, when compared with the commercial breeds of pigs (Nguyen *et al.*, 2003). However, when compared with the fatty acids composition of Wuzhishan pig meat, the fatty acid composition of Kadon meat was not very different (Sun and Lu, 2002). It should be noted that the fatty acid composition of the diet is a major determinant of the fatty acid composition of intramuscular fat in pigs (Mitchoathai *et al.*, 2007).

Table 4: Proximate composition (on as is and on dry matter basis in parenthesis) and fatty acid profile of Kadon loin

Items	Male pigs (n = 4)	Female pigs (n = 4)	Pooled SE
Dry matter (%)	30.88	32.35	2.02
Crude protein (%) (% of DM)	20.81 (67.40)	21.96 (67.87)	0.99
Ash (%) (% of DM)	1.03 (3.35)	1.14 (3.53)	0.27
Total fat (%) (% of DM)	8.62 (27.93)	8.85 (27.36)	0.82
<b>Fatty acids (g/100 g methyl esters)</b>			
14:0	1.29	1.20	0.04
16:0	25.89	25.91	0.38
18:0	13.53	15.58	0.88
18:1 (n-9)	40.48	40.07	0.49
18:2c (n-6)	8.92	8.16	0.84
18:3 (n-3)	0.36	0.20	0.03
20:0	0.28	0.37	0.03
20:1 (n-9)	0.88	1.11*	0.06
20:2 (n-6)	0.35	0.33	0.04
20:4 (n-6)	0.40	0.20	0.09
Total SFA	43.12	44.81	1.36
Total MUFA	46.58	46.11	0.85
Total PUFA	10.30	9.09	0.96

\*Means in the same rows with differ significantly for females versus males (p<0.05), DM: Dry Matter

### CONCLUSIONS

The present experiment provides quantitative information on growth performance, organ weight, carcass composition and the fatty acid profiles in meat from Kadon pigs. The data indicates that sex of Kadon pigs is not a major determinant of growth performance and carcass composition. The Kadon pigs raised under semi-intensive conditions, had relatively low growth performance and dressing percentage of carcass. However, the nutritional requirements of Kadon pigs are not well defined and they may differ from those of commercial pigs, whereas the nutrient requirements of the latter are generally used for Kadon pigs as well. It could be suggested that growth performance of Kadon pigs may be improved by nutrition more tailored to the species. Thus, research is needed to determine the nutritional requirements of Kadon pigs.

### ACKNOWLEDGMENTS

The authors express their gratitude to Henk Everts and Robert Hovenier for valuable discussions and sample analyses. This research was supported by the Rajamangala University of Technology Isan.

### REFERENCES

- AOAC., 1990. Official methods of analysis. Association of Official Analytical Chemists, Washington, DC.
- Booth, P.J., J. Craigan and G.R. Foxcroft, 1994. Nutritional manipulation of growth and metabolic and reproductive status in prepubertal gilts. *J. Anim. Sci.*, 72: 2415-2424.

- Folch, J., M. Lees and G.H. Sloane-Stanley, 1957. A simple method for the isolation and purification of total lipids from animal tissues. *J. Biol. Chem.*, 226: 497-509.
- Gaughan, J.B., R.D.A. Cameron, G.L. Mc Dryden and B.A. Young, 1997. Effect of body composition at selection on reproductive development in Large White Gilts. *J. Anim. Sci.*, 75: 1764-1772.
- Georgsson, L. and J. Svendsen, 2002. Degree of competition at feeding differentially affects behavior and performance of group-housed growing-finishing pigs of different relative weights. *J. Anim. Sci.*, 80: 376-383.
- Jaturasitha, S., 2004. Meat management. Department of Animal Science, Faculty of Agriculture, Chiangmai University, pp: 83-85 (Thai Version).
- Metcalf, L.D., A.A. Schmitz and J.R. Pelka, 1966. Rapid preparation of fatty acid esters from lipids for gas chromatographic analysis. *Anal. Chem.*, 318: 514-515.
- Mitchaothai, J., C. Yuangklang, S. Wittayakun, K. Vasupen, S. Wongsutthavas, P. Srenanul, R. Hovenier, H. Everts and A.C. Beynen, 2007. Effect of dietary fat type on meat quality and fatty acid composition of various tissues in growing-finishing swine. *Meat Sci.*, 76: 95-101.
- Nguyen, L.Q., M.C.G.A. Nuijens, H. Everts, N. Salden and A.C. Beynen, 2003. Mathematical relationships between the intake of n-6 and n-3 polyunsaturated fatty acids and their contents in adipose tissue of growing pigs. *Meat Sci.*, 65: 1399-1406.
- Ratanawarasa, A., 2000. Commercial animals production system: Major factor of indigenous animal destruction. *Livestock Prod. Mag.*, 18 (403): 46-49 (Thai Version).
- Serres, H., 1992. *Manual of Pig Production in the Tropical*. Redwood Press, Melksham, London, pp: 57-67.
- SPSS., 1998. *SPSS for Windows*. SPSS Inc., Chicargo, Illinois, USA.
- Sun, J.S. and F. Lu, 2002. Study on pork characteristics of Chinese Wuzhishan mini-pig. *Pak. J. Nutr.*, 1: 169-173.
- Vasupen, K., C. Sarnklong, C. Yuangklang, S. Wongsuttravas, P. Srinanuan and P. Kesorn, 2004. Effect of dietary protein levels on growth performance of native swine in Sakon Nakhon province. In: *Proceedings of the Agricultural Seminar, Animal Science/Animal Husbandry*, Department of Animal Science, Faculty of Agriculture, Khon Kaen University, Thailand, pp: 599-605.