International Journal of Animal Science, Husbandry and Livestock Production ISSN: 2141-5191 Vol. 1 (2), pp. 029-034, October, 2014. Available online at www.advancedscholarsjournals.org © Advanced Scholars Journals

Full Length Research Paper

Relative study on the performance of the hybrid offspring of wild argali and Bashibay sheep

Zhang Hu

Department Of Animal Science and Livestock Production, Faculty of Agricultural Science, University of Hong-Kong, China.
E.mail:Zhanghu@yahoo.co.uk

Accepted 03 September, 2014

The increase in world population has also increased the demand of meat with low fat and high protein to satisfy their protein requirements. In this study, we have measured and analyzed the growth, body shape and appearance, meat performance and meat ingredients of the hybrid offspring of wild argali and pure Bashibay sheep and also their comparison was made with pure Bashibay sheep. The results showed that, hybrids were similar as wild argali on body shape and appearance, with less fat buttocks; some ewes had almost no fat rump. Meanwhile, with similar wool quality and color as Bashibay sheep, hybrids inherited the characteristics of rapid early growth of Bashibay sheep for its early growth speed and strength and improved gradually with the increased breeding performance of backcrossing generations; total fat of second backcross generation reduced 3870 g comparing with pure Bashibay sheep, lean meat increased 1500 g, the thickness of thigh muscle and waist muscle increased 0.5 cm respectively, the thickness of back fat layer reduced 1 cm and waist fat layer reduced 1.5 cm, fat rump reduced 85.3% and lean meat increased 15.0%.

Key words: Wild argali, Bashibay sheep, hybrid, meat performance, meat.

INTRODUCTION

China has more than 78 sheep breeds, including 61 local breeds which are basically buttocks fat sheep with semi-coarse or coarse wool, mainly from three original breeds with coarse wool including Mongolian sheep, Tibetan sheep and Kazakh sheep (State Commission of Genetic Resources Management of Livestock and Poultry, 2003). However, with the development of society and continuous improvement of people's living standard, changes in diet and diversification, increasing demand of low fat with high protein meat has diverted our direction to cultivate low-fat and high-protein type mutton. Therefore, we have successively introduced more than ten breeds such as Charolais sheep, Suffolk sheep, Poll Dorset sheep, Texel sheep, Tsigai sheep, Corriedale sheep, German Mutton Merino sheep, Australian Merino, Romney sheep, Lincoln dozen sheep or local sheep breeds and fine wool sheep to be improved for hybrid and achieved remarkable results.

However, these cross-breeding sheep only grow well under the conditions of feeding or semi-yard feeding (Zong, 2002; Chen et al., 2009), difficult to spread in western China with pure grazing conditions. Taking into account these factors, we started hybridization of Bashibay sheep and wild argali in 2002 and carried out backcross generations gradually, the quantity has reached more than 3,000 in 2008.

Wild argali is the largest breed of sheep. The weight of ram is about 200 kg. The breed has brown-gray body, horns featured by short and coarse coat and white rump patch. The breed is featured by large size, lean meat with low fat, no fat buttocks, disease resistance, cold tolerance and also drought resistance (Ryder, 1983; Geist, 1990). The breed is distributed in Xinjiang, Tibet, Qinghai and other provinces of China. In this study, we have focused on the wild relative species of domestic Bashibay sheep, the Asian Mouflon sheep or (Asian Mouflon, Ovis orientalis). Wild argali belongs to European and Asian

Table 1. Comparative measured results of weight and body size of first-filial generation and pure Bashibay lamb from birth to weaning age (unit: kg, cm).

Breed	n	Month	Body weight	Height	Body length	Girth	Circumference
Bashibay	30	Birth	4.5±0.58	38.0±3.56	32.5±3.57	35.5±3.70	5.5±0.35
Hybrid F_1	30		4.2±0.46	40.5±2.96	32.0±4.16	34.5±3.65	4.5±0.30
Bashibay	30	1 month	14.5±1.50	46.5±4.10	43.5±3.46	52.5±4.56	6.2±0.40
Hybrid F_1	30		13.5±1.52	50.5±3.76	48.5±4.32	55.0±3.98	6.0±0.30
Bashibay	30	3 months	28.0±1.40	57.5±3.92	56.0±3.89	65.0±4.66	7.0±0.50
Hybrid F_1	30		27.5±1.48	62.5±3.78	60.0±3.95	70.0±5.10	7.0±0.45
Bashibay	30	5 months	35.5±2.94*	65.5±3.45	66.5±3.30	78.5±4.56	7.5±0.85
Hybrid F_1	30		33.5±2.80	68.5±3.68*	66.5±4.80	77.5±5.35	7.5±0.68

* Significant difference of the same indexes during the same growth period ($p < 0.05$).

category groups (Ryder, 1983; Geist, 1990). Bashibay sheep, also known as lamb producing sheep (Hamiti et al., 1995), originated from Yumin County. Xinjiang, province of China, is also an important branch of Kazakh sheep since 1940s (Academy of Chinese Science ACS, 1964). Studies conformed that, Bashibay or sheep of lamb production wean at (4.5 months) grow fast, mature early, high meat performance, strong adaptability, disease resistance, drought resistance and cold resistance, low cholesterol content of meat, tender and juicy and good quality. Four indexes of meat production of weaned lamb (slaughtering percentage 56%, carcass weight 19 kg, pure meat percentage 45%, flesh and bone ratio 1:4) ranking first in China (Jueken et al., 2006; 2007a, 2007b, 2010; Kemunisihan et al., 2002). The average weight of adult Bashibay ram under completely grazing condition was 88.0 kg, up to a maximum of 120 kg; the average weight of adult ewes was 55.0 kg, up to a maximum of 75 kg, conception rate, 97%, lambing rate, 105%, lamb survival rate, 98%, respectively (Hamiti et al., 1995).

This study aims at worthier improving the production performance of Bashibay sheep, reduced mutton fat and fat buttocks, increasing the meat performance, lean meat rate, meat quality, so as to provide the basis for breeding a new-type Bashibay sheep.

MATERIALS AND METHODS

The male wild argali was captured (Xinjinag Uyghur Autonomous Region) and semen was collected by electrical stimulation. The 93 Bashibay ewes were carried out with artificial insemination. The output of first-filial generation of year, 2003 was 69 with 46 survived including 19 male lambs and 27 female lambs.

In the fall of 2004, continuous backcross was made according to literature (Inner Mongolia Institute, 1987). The first backcross was made between the first-filial generation (including ½ wild bloods) ram (ewe) and pure Bashibay ewe (ram), first backcross generation was obtained in 2005 (including ¼ wild bloods). Second backcross generation was obtained in 2008 (including 1/8 wild blood), more than 3,000 herds in total.

In October 2008, (20), 5-month-old lambs of pure Bashibay and hybrid offspring of Bashibay and argali sheep were selected under similar condition of nutrition, body condition, health status (including five pure Bashibay male lamb and five female lambs, five male lambs and five female of the second generation backcross), slaughtered and meat samples were collected.

Determination of growth and development of hybrid offspring

From 2003 to the fall 2008, the systematic observation and record were made for the growth and development, appearance, physique and tail type (fat buttocks change) of lamb at different ages produced by pure Bashibay sheep and earlier-mentioned hybrid group and changes in meat properties, measurement and observation were conducted for body size and weight.

Slaughter identification

20 lambs aged 5 months (B≅each 5 lambs of pure Bashibay; B≅each 5 lambs of backcross generation) (description also given in method) were slaughtered. 1,000 grams of meat was taken from all parts (including back, front legs, waist, north, sides and neck meat) of each sheep, frozen and sent to Agricultural Products Quality Supervision and Testing Center, Department of Agriculture, Xinjiang Academy of Agricultural Sciences for determination of meat quality to observe the meat performance and nutritional content of conventional meat, fatty acids and amino acid were analyzed and other experiments carried out in Institute of Laboratory ,College of Animal Science, Xinjiang Agricultural University and Yumin Sergey slaughterhouses

All data were analyzed using SPSS statistical software.

RESULTS

Growth and development of first-filial generation

The results for the growth phases of first-filial generation of wild argali and Bashibay sheep and pure Bashibay lamb from birth to weaning (weaned at 5 months) are shown in Table 1. It is clear from Table 1 that the growth of first-filial generation was consistent with pure Bashibay lamb under the same grazing conditions. However, the weight of 5- month-old pure Bashibay sheep was significantly higher than first-filial generation ($P < 0.05$), while the body height of 5-month- old first-filial generation were significantly higher than pure Bashibay lamb ($P < 0.05$). The other growth indexes did not reach a significant level but

Table 2. Growth situation of weight and body size of second backcross generation at different ages (unit: cm, kg).

Table 3. Comparison of body size and weight of pure Bashibay sheep and various hybrid generations aged 5 months (unit: kg, cm).

Item	N	Body weight	Body height	Body length	Grith	Circumference
FirstGH	30	33±0.36	67.5±0.3*	65.5±0.4	77±0.5	7.2±0.3
FirstBG	30	34±0.50	64.7±0.5	64.7±0.6	78±0.8	7.5±0.5
SecondBG	30	36±0.60**	66±0.35	68.5±0.6	79±0.9*	7.5±0.5
Pure Bashibay	30	35±0.50*	65±0.4	66.5±0.5	78±0.7	7.5±0.3

*, significant difference in the same column; **, significant difference ($p < 0.01$). FirstGH, first generation of hybrids; FirstBG, first backcross generation; SecondBG, second generation of backcrossing.

appeared with some differences.

Growth and development of second-generation backcross lamb

The results for the growth phases of second generation back cross of wild argali and Bashibay sheep and pure Bashibay lamb from birth to weaning (weaned at 5 months) are shown in Table 2. The results of Table 2 shows that, each growth index such as the cumulative growth, absolute growth and relative growth of weight and body size of the second generation backcross lambs (average value of male and female lambs) were good from birth to weaning, and the weight of weaned lamb (5 months) was more than 50% of adult sheep weight, which showed that second-generation backcross has the genetic characteristics of fast growth and development like Bashibay lamp.

Comparison of measuring results of body size and weight of Bashibay sheep and various hybrid generations

Comparison of body size and weight of pure Bashibay sheep and various hybrid generations aged 5 months is given in the Table 3. It shows that, body height of first-filial generation was significantly higher than the other sheep ($P < 0.05$), the weight indexes of second backcross generation had especially significant difference with first-filial generation and first backcross generations ($P < 0.01$) and significant difference with pure Bashibay sheep ($P < 0.05$). Significant difference of weight was also seen between Bashibay sheep and first-filial generation and first backcross generation. This indicated that the optimum hybrid combination was wild argali and Bashibay sheep.

Comparison of slaughter performance results

For comparison of slaughter performance, 21 pairs of traits of meat performance of Bashibay sheep and backcross generation lambs were compared; the results for this are given in Table 4. It shows that, there was no significant difference in main meat indexes such as carcass weight, slaughter ratio, pure meat percentage and flesh and bone ratio of 21 slaughter indexes of second generation backcross lambs with pure Bashibay sheep ($p > 0.05$). Meanwhile, the lean weight of second backcross generation was significantly higher than the pure

Table 4. Results of slaughter experiment (unit: kg, %).

Item	N	Pure Bashibay sheep	Second BG	Change (%)
Pre-slaughter live weight	20	34.50*±2.41	31.50±3.10	
Carcass weight	20	19.40±1.73	17.64±1.86	
Net meat weight	20	14.25±1.62	14.20±1.48	
Bone weight	20	3.45±0.39	3.50±0.42	
Fat buttocks weight	20	1.70±0.78	0.25**±0.4	-85.30
Lean meat weight	20	10.60±1.26	12.10*±1.38	+15.00
Intramuscular fat	20	3.60±0.85	2.00*±0.12	-45.00
Kidney weight	20	0.13±0.05	0.10±0.02	
Kidney fat weight	20	0.39±0.05	0.29±0.01	-25.60
Omental weight	20	1.00±0.13	0.48±0.01	-52.00
Total fat weight	20	6.69±1.34	2.82**±0.67	-53.36
Dressing percentage	20	56.25±1.89	56.19±1.78	
Lean percentage	20	46.23±1.68	45.87±1.72	
Than flesh and blood	20	1:4.07±0.03	1:4.12±0.05	
Fat hip ratio total live weight	20	5.00±1.10	0.80**±0.06	-84.00
Total live weight ratio of total fat	20	19.39±1.67	8.95**±1.23	-53.84
Big leg thick	20	4.00±0.01	4.50±0.03	+12.50
Thick waist muscle	20	4.00±0.03	4.50±0.04	+12.50
Back fat thickness	20	1.30±0.11	0.30*±0.01	-76.90
Waist fat thickness	20	2.50±0.21	1.0**±0.10	-60.00
Loin eye area	20	15.60±1.33	15.6±1.35	0.00

*, significant difference in the same column; **, significant difference ($p < 0.01$).

Table 5. Comparison of conventional nutrients of Bashibay Sheep and hybrids mutton.

Group	Bashibay sheep	Second BG
Total moisture (%)	75.60	75.40
Crude protein (%)	19.48	19.64
Crude fat (%)	10.20	8.70*
Ca (mg/100 g)	1.10	1.80
P (mg/100g)	190	186
Cholesterol (mg/100 g)	42.68	41.00

Bashibay sheep ($P < 0.05$), the thickness of intramuscular fat and back fat was significantly lower compared with pure Bashibay sheep ($P < 0.05$), fat buttocks weight, total fat mass, total live weight rate of fat buttocks, total fat accounted for live weight ratio, waist fat thickness indexes were significantly lower compared with pure Bashibay sheep ($P < 0.01$), which showed that the lean perform-ance of backcross generations was higher than that of pure Bashibay sheep, an ideal basis for cultivating lean sheep.

Comparison of meat ingredients results

Conventional nutrients of Bashibay sheep and hybrids

The comparative analysis was made on mea t ingredients of pure Bashibay sheep and second backcross generation lamb, their results are given in Table 5. It shows that the conventional nutrients (moisture, protein, calcium, phosphorus and cholesterol) of two kinds of lamb meat had a certain value differences, but the difference was not significant ($P > 0.05$), while the fat content were significantly differences ($P < 0.05$), it is shown that the fat content of second generation backcross was lower than that of pure Bashibay sheep.

Comparison of fatty acid and trace elements of mutton of pure Bashibay sheep and second backcross generation lamb

By this test, determination of fatty acid and trace elements of mutton of pure Bashibay sheep and second backcross generation lamb was analyzed. The results for this are given in Table 6. It shows that, all the fatty acids contents of mutton of pure Bashibay and argali hybrids had no significant difference ($P > 0.05$). The zinc content of backcross generation mutton was significantly higher compared with pure Bashibay sheep.

Amino acid content of mutton of Bashibay sheep and hybrid offspring

This test determined the amino acid content of pure Bashibay sheep and second backcross generation. The

Table 6. Comparison of fatty acid and trace elements of mutton of pure Bashibay sheep and second backcross generation lamb.

Group	Bashibay sheep	Second BG
Palmitate acid (%)	31.12	30.74
Lauric acid (%)	0.36	0.86
Stearic acid (%)	18.32	13.68
Oleic acid (%)	33.72	34.16
Nutmeg acid (%)	5.08	9.28
Linoleic acid (%)	6.20	6.29
Linoleinic acid (%)	3.00	2.00
Mg (mg/100g)	22.34	20.33
Zn (mg/kg)	26.0	33.0*
Fe (mg/100 g)	1.70	1.87

Table 7. Amino acid content of mutton of Bashibay sheep and hybrid offspring (Unit: %).

Amino acid	Bashibay sheep	Second BG
Total protein	19.48	19.64
Asp#	1.88	1.43
Glu#	2.71	2.78
Gly#	0.80	0.96
Ala#	1.05	1.00
Thr*	0.83	0.77
Ser*	0.82	0.70
Cys*	0.32	0.23
Val*	0.84	0.77
Met*	0.70	0.54
Ile*	0.76	0.86
Leu*	1.48	1.47
Tyr*	0.60	0.62
Phe*	0.79	0.82
Lys*	1.69	1.61
Arg	1.09	1.32
Pro	0.60	0.88
TAA	17.3	17.3
TEAA	8.83*	8.39
FAA	6.44*	6.17

#, Stands for flavor amino acid; *stands for essential amino acid. *Means significant difference of the same row ($p < 0.05$).

results for this are given in Table 7. It shows that there was no significant difference among each kind of amino acid of pure Bashibay sheep and second backcross generation; however, total value had significant difference between essential amino acid and flavor amino acid ($P < 0.05$). It is shown that the amino acid of pure Bashibay sheep was better compared to second backcross generation.

DISCUSSION

It can be seen from Table 1, that the appearance and body size of first-filial generation basically inherited the characteristics of wild argali, featured by small and erect ears, small and short tail, short and thick wool, large nostril, easy to panic, wild, with four legs longer than Bashibay sheep. With increasing of backcross generation of Bashibay sheep, the fat buttocks of its descendants was gradually increased, the tail-type of second back-cross generation was getting close to that of pure Bashibay sheep. The growth and development of hybrid generation and the pure Bashibay sheep were consistent under the same grazing conditions and the weight of first-filial generation lamb was significantly lower than pure Bashibay sheep ($P < 0.05$), while the body height was significantly higher than that of pure Bashibay lamb ($P < 0.05$). Although, other growth indexes have some value difference, they were not significant ($P > 0.05$).

Table 3 also revealed that the growth indexes of cumulative growth, absolute growth and relative growth of body weight and body size of second backcross generation lambs were good from birth to weaning (5 months), lamb weaning weight was more than 50% of that of adult sheep. It was also found that second backcross generations inherited the wildness, adaptability, cold tolerance, drought resistance of wild argali; meanwhile, inherited the characteristics of Bashibay sheep (ewes) on meat performance and wool color.

It is shown in Table 3, that the weight of second backcross generation sheep had especially significant difference between first-filial generation and first backcross generation ($P < 0.01$) and significant different with pure Bashibay sheep ($P < 0.05$). Significant difference of weight was among pure Bashibay sheep and first-filial generation and first backcross generation ($P < 0.05$). It is shown that the optimum hybrid combination of wild argali and Bashibay sheep should be second backcross gene-ration. Whether body weight, body size, wool color and quality, second backcross generations were the best. Therefore, it should be the best to cultivate lean lines after horizontal fixing for second backcross generations.

The size and appearance of first backcross generation hybrids were partial to Bashibay sheep, with their wool color similar to Bashibay sheep and their fat buttocks became bigger.

Along with the increase in the number of backcross generations, wool quality of hybrid sheep becomes better, but the volume of wool decreased. The change of inverse ratio of decrease of wool along with the increase of backcross generations showed that the wool quality and quantity belonged to typical quantity property. It seems that, it was controlled by multiple genes, whether major gene existed or not, it needs to make deeper research.

Reproductive performance study confirmed that, hybrids of wild argali and Bashibay could be bred; second backcross generations had the best effect (106%). Ram and ewe of first-filial generation was relatively late maturing, became sexual maturity after two years, twining rate was very low. But with the increase of backcross generations, their reproductive performance increased gradually,

suggesting that the reproduction rate of hybrids can be improved.

Among the 21 indexes, carcass weight, dressing percentage, pure meat percentage, and flesh and bone ratio had no significant difference with those of pure Bashibay sheep; remaining the feature of high output of meat (Table 4). Lean mutton weight of second backcross generations was significantly higher than that of pure Bashibay sheep ($P < 0.05$) and intramuscular fat and back fat thickness was significantly lower than those of pure Bashibay lamb ($P < 0.05$), fat buttocks weight, total fat mass, total live weight fat buttocks ratio, total live weight ratio of total fat, waist fat thickness were significantly lower than those of pure Bashibay sheep ($P < 0.01$), which showed that, lean mutton performance of second backcross generations was better than that of pure Bashibay sheep, an ideal foundation for fostering lean sheep (Qi et al., 2007; Zhang et al., 2008; Wang, 2008), fully in line with expectations.

Total fat of second backcross generation sheep reduced 3910 g compare with pure Bashibay sheep, pure meat weight increased 15.0%, fat buttocks weight reduced 85.3%, thickness of waist and thigh muscle increased 0.5 cm, respectively, the fat layer of waist and back reduced by 1.5 and 1.0 cm respectively, total fat content decreased 53.36%, tail fat, intramuscular fat, kidney fat and omentum (fat) had a decreasing trend. This confirmed the increase in lean mutton was not only relevant with fat buttocks reduction, but also closely related to the increasing of thickness of thigh muscle, muscle layer of waist and back.

It is shown in Table 7 that, amino acid content of pure Bashibay sheep and second backcross generations had no significantly difference, but the total value of essential amino acids and fresh amino acids had significant difference ($P < 0.05$).

The stated results showed that the favorable genes of wild argali had been introduced into Bashibay sheep; the fat buttocks and fat content of second backcross generations were low and meat performance and meat quality improved (and compared with the results of others (Zhao, 2009; Zhangquan et al., 2005), Bashibay sheep have good hybrid performance than any other domestic sheep in China). It laid a good foundation for cultivating new varieties of lean Bashibay sheep in the future.

ACKNOWLEDGEMENTS

The research was supported by the National Natural Sciences Foundation of China (No. 30671503) and Programs for Scientific and Technological Department development of Xinjiang Uyghur Autonomous region (No. 200431101) and Key Project for Scientific and Technological Department development of Xinjiang Uygur Autonomous region (No. 200731135).

REFERENCES

Academy of Chinese Science (1964). Animal Husbandry in Xinjiang, Science Press of China, Beijing, in Chinese.

Chen T, Xiong C, Luo J (2009). Research on meat performance of Awang sheep. In Chinese with English abstract. China Herbivores, 29: 26-28.

Geist V (1990). Onthetaxonomy of giant sheep. Can. J. Zool. 69: 70-72.

Hamiti H, Jueken A, Maimaitiming B (1995). Research on Bashibay Sheep. J. Chinese. Xinjiang Agric. Univ. 2: 1-5.

Jueken A, Hamiti H, Kemunisihan J (2006). Research on slaughter of emil lamb in Yemin County. in Chinese with English abstract. Xinjiang Agric. Sci. 44: 402-406.

Jueken A, Hamiti H, Kemunisihan J (2007a). Research on hybrid of wild Argali and Bashibay Sheep, in Chinese with English abstract. Xinjiang Agric. Sci. 5: 702-705.

Jueken A, Hamiti H, Kemunisihan J (2007b). Determination of rules of growth and development of hybrid II of wild Argali and Bashibay Sheep, in Chinese with English abstract. Xinjiang Agric. Sci. 2: 212-216.

Jueken A, Hamiti H, Kemunisihan J (2010). Cultivation of lean lines of Bashibay sheep, determination of production performance, in Chinese with English abstract. Xinjiang Agric. Sci. 47: 212-216.

Kemunisihan J, Yang X, Hailati H (2002). Discussion on rules of weight increasing of Bashibay lamb., in Chinese. Xinjiang Anim. Husbandry, 3: p. 20.

Qi Yuxiang, Yu Z (2007). Research on slaughter test of Oula-type Tibetan sheep. in Chinese with English abstract. Sichuan Anim. Husbandry and Vet. Med. 4: 25-28.

Ryder ML (1983). Sheep and Man, London: Duck Warth ix, p. 846 .

State Commission of Genetic Resources Management of Livestock and Poultry (2003). China Genetic Resources Situation of Livestock and Poultry. Beijing: China Agriculture Press, in Chinese.

Wang X (2008). Research on meat performance of breeding group of new variety of modern mutton sheep in Gansu. Thesis, Gansu: Gansu Agricultural University.

Zhang Q, Bao Y, He-Wen (2008). Germplasm characteristics of Ganjia sheep. in Chinese with English abstract. China Herbivores, 28: 66-68.

Zhangquan M, Zhao J, Huang L (2005). Germplasm characteristics of Dorper mutton sheep. in Chinese with English abstract. China Herbivores, 25: 63-64.

Zhao Y, Li F, Zhang Z (2009). Research on Germplasm Properties and Applications of Poll Dorset Sheep, in Chinese with English abstract. China Eng. Sci. 11: 88-93.

Zong X (2003) Morphological and biological characteristics of mutton sheep. in Chinese. Breed. Feed, 6: 7-8.