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Yield and Quality of Meat of Co, Bach Thao and F_1(Bach Thao X Co) Goat Raised in Dak Lak

Phạm The Hue, Le Anh Dương, Tran Quang Hanh, Tran Quang Han
Email: huephamthe58608587@gmail.com

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Abstract: The study was carried out in goat farming householdes in Dak Lak province from 2015 to 2017 to evaluate the growth, yield and meat quality of 120 Co, crossbred (BT x Co) and Bach Thao goats. The results showed that weight of 3 groups of goats at 12 months in Dak Lak was 22.55 kg; 29.28kg and 33.85kg respectively. Weight increase of goats gained 58.34 g/day/head; 75.47g/day/head and 88.58 g/day/head respectively. The percentage of carcass meat was high (43.32; 45.82 and 46.70%) respectively, the percentage of pure meat was 32.34; 35,30 and 36,7%. Meat of Bach Thao, Co and F_1 (Bach Thao x Co) goats had a reddish pink color. L* value was 38.42 (Bach Thao); Co (38,46) and F1 (Bach Thao x Co) (38,84). Meat yield of F_1 (Bach Thao x Co) goats have been significantly improved. On the other hand, meat quality is well appreciated and goats were easy to farm, suitable for nursing in Dak Lak.

Key words: Bach Thao goat, Co goat, F1 crossbread (Bach Thao x Co), meat quality

1. Introduction

Goats, a type of ruminants that feed a variety of plant foods, do not compete with food for humans. Goat farming bring about benefit for humans, low investment, fast capital turnaround, use of many type of plants, agricultural by-products. Goat production plays an important role in the livelihood of rural people, helping farmers escape poverty. Goat farming in the Central Highlands has made encouraging progress due to favorable livestock conditions, good growth plants, large market, high market icreasing demand for milk and goat meat in the area. The increase in demand for goat meat in recent years has led to a rapid increase in domestic goats. According to statistics (Department of Statistics, 2017), the number of goats in the country is 2556268 heads, producing 26259.3 tons of meat annually.

Corresponding author: Phạm The Hue. Email: huephamthe58608587@gmail.com

In order to have a basis for developing this kind of animal in Daklak, the assessment of characteristic of appearance, growth, yield and quality of meat of Co, F_1 (Bach Thao x Co) and Bach Thao goats farming in Dak Lak province is necessary.

2. Material and Research Method

2.1 Research material

The research was carried out on 120 goats (each group of 40 goats) of Co, Bach Thao and F_1 crossbred (Bach Thao x Co). Goats selected in goat farms in Buon Ma Thuot city were kept in stalls, supplemented with concentrates (0.2 kg/head) and salt, forage and water was ad libitum.

2.2 Research content

Appearance characteristcs of Co, F1 crossbred (BT x Co) and Bach Thao goats, Growth of Co, F1 crossbred (BT x Co) and Bach Thao goats, Performace and quality of meat.

2.3 Research method

The characteristic of appearance, feather color were evaluated by observation, individual monitoring, direct statistical classification and percentage on total population of goat.

Growth was assessed by weighing goats at birth, 1, 3, 6, 9 and 12 months of age. Goats were weighed in the morning before feeding by 100 kg Nhon Hoa scale (± 100 g). Newborn weight is weighed after birth.

- The absolute weight gain (g/ head/day) is calculated by the formula:

$$\text{A (g/head/day)} = \frac{W2 - W1}{T2 - T1}$$

W1: Innitial weight

W2: Finishing weight

T1: Innitial time

T2: Finishing time

Yield and quality of meat were evaluated after slaughtering. Each type of goat included 5 males at 12 months of age. Slaughted goats has average weight of goats in the study.

Indicators of meat performance included slaughter weight, carcass percentage, pure meat, and loin muscle area (M. longisimus dorsi). Carcass percentage (%) = (carcass weight/live weight) x 100. Pure meat (%) = (Pure meat/live weight) x 100. Bone percentage (%) = (Bone weight/live weight) x 100. The area of loin

muscle (cm2) was determined at the cross section of the final rib, the area of loin musce was defined by the method of Nguyen Hai Quan (1977)

Meat quality indicators were analysed at Livestock biology laboratory, Tay Nguyen University.

Table 2.1 Indicators and time assessed meat quality

Indicators	1h	24h
pH	+	+
Color	-	+
Preservation dehydration (%)	-	+
Processing dehydration (%)	-	+

Note: +: Time evaluated; -: Time not evaluated;

- pH value: Determined by the Testo 230 (German) pH meter on the musculature at the final rib position. The pH value of one hour post-slautering was measured directly on the carcass after slautering and 24h on a 2.5 cm thick muscle sample at the laboratory. Measurements were repeated three times at a time. The pH value of slaughtered goat meat was classified according to the standards of the French National Institute of Animal Husbandry (2006) (pH at 48h post-slaughtering)

pH 5.5 - 5.7: normal meat

pH 6.3 - 6.7: DFD meat (dark, hard, dry meat)

pH 5.2 - 5.5: PSE (pale, watery, pastey)

- Meat color: Measured in a loin-muscle sample using the Minolta CR-410 colorimeter (Japan) and expressed by the L*, a* and b* indexes according to the D brightness standard and the observation angle of standard 65° (CIE, 1976) (Honikel, 1997; Baublits, 2006).

+ Preservation dehydration : Preservation dehydration (%) at each time of 24 hour was determined on the loin- muscle sample by the following formula:

$$\text{Preservation dehydration (\%)} = \frac{W1 - W2}{W1} \times 100$$

Processing dehydration: Processing dehydration (%) at 24 each time of 24 hour was determined by the following formulas:

$$\text{Processing dehydration (\%)} = \frac{W1 - W2}{W1} \times 100$$

Of which::

W1: Loin muscle sample weitht before processing

W2: Loin muscle sample weitht after processing

The post-processing dehydration weight was determined by the loin muscle after steam-insulated by Waterbath Memmert at 75°C during 60 min.

2.4 Data processing

Growth data of goats were preliminarily processed by Excel 2003 and software and analyzed by Minitab 16 software.

3. Results and Discussion

3.1 Appearance characteristics

Table 3.1 Color distribution of Co, BT and F1 (BT x Co) goats

Feather characteristic	Co goat		(BT x Co) goat		Bach Thao goat	
	N	Rate (%)	n	Rate (%)	n	Rate (%)
Yelllo	145	51.79	79	32.78		
Dark	43	15.36	78	32.37	13	18.24
Grey	33	11.79	30	12.45		
White	15	5.36	18	7.47	6	3.53
Black-white	23	8.21	10	4.15	120	70.59
Other	21	7.50	26	10.79	31	7.65
Total	280	100	241	100	170	100

Goat appearance of groups differed in color of feathers. Co and Bach Thao crossbred goats showed 6 common colors of yellow, black, gray, white, black - white and other colors. Bach Thao goat appear black, white, black-white and other colors without yellowish, grayish as two groups of Co and crossbred goat. Color of Co goat was not uniform, yellow color accounted for the largest proportion (51.79%), followed by black goat group (15.36%). Results of goat color are similar to that of Nguyen Ba Mui and Dang Thai Hai (2010), Le Van Thong (2004), Le Anh Duong (2007). The group of crossbred goat (BT x Co) has two main colors: yellow and black, (32.78% and 32.27%) respectively.

The color of Bach Thao goats was mainly white with dark spots and black with white spots which acount for 70.59%, the black was 18.24%. Le Anh Duong (2007) showed that the crossbred (BT x Co) goat color was 32.24%, the black color was 31.43%. The rest is the other colors. Nguyen Ba Mui and Dang Thai Hai (2010) reported that crossbred (BT x Co) goats was yellow feathers (32.98%) and the black was 30.60%. In general, the color of the Co goat, (BT x Co) goat and Bach Thao goats did not change compared with previous research results.

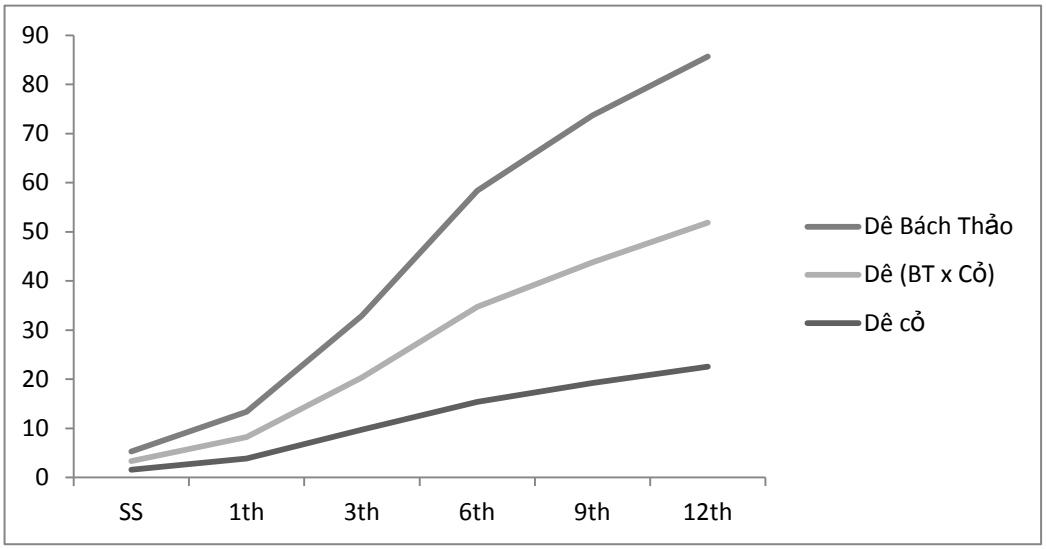
3.2 Growth of goats

Table 3.2 Weight of goats over the months (kg)

Month	Co goats (n = 40)		(BT x Co) goats (n =40)		Bach Thao goats (n = 40)	
	Mean ± SE	Cv%	Mean ± SE	Cv%	Mean ± SE	Cv%
At birth	1.55^{c} ± 0,02	8.28	1.75^{b} ± 0.03	10.76	1.98^{a} ± 0,05	15.61
1	3.85^{c} ± 0,07	11.72	4.35^{b} ± 0.09	12.93	5.19^{a} ± 0,08	9.96
3	9.7^{c} ± 0,24	15.52	10.60^{b} ± 0.21	12.42	12.6^{a} ± 0,22	11.20
6	15.40^{c} ± 0,25	10.27	19.33^{b} ± 0.44	14.47	23.63^{a} ± 0,49	13.17
9	19.20^{c} ± 0,30	9.95	24.60^{b} ± 0.75	18.41	28.88^{a} ± 0,50	10.48
12	22.55^{c} ± 0,38	10.53	29.28^{b} ± 13.42	13.62	33.85^{a} ± 0,44	8.15

Note: Values in the same row with different characters were significantly different (P <0.05).

Graph of goat growth over months



Results of goat weight over months in table 3.2 showed that the weight of (BT x Co) goats and Bach Thao goats were higher than that of Co goats at all monitoring time. The birth weight of Co goats, (BT x Co) goats and Bach Thao goats were 1.55kg; 1.75 and 1.98 kg respectively. Bach Thao goat weith at birth was the highest, birth weight of (BT x Co) goat has medium weight between Bach Thao and Co goat, the difference between birth weight of two groups was statistically significant (P <0.05) .

The weight at 12 months of age of Co goats, (BT x Co) goats and Bach Thao goats were 22.55 kg; 29.28 kg and 33.85 kg espectively, Bach Thao goats had higher weight than Co goats and (BT x Co) goats (P <0.05). Le Van Thong (2004) showed that (BT x Co) goat in Ninh Thanh, Thanh Hoa had the weight of 19.43 kg ; 24.93

and 30.20kg at 6, 9 and 12 months. Le Anh Duong (2007) reported that (BT x Co) goats in Dak Lak at 6 months reached 19.86 kg and at 12 months was 29.4kg. Dinh Van Binh and Nguyen Kim Lin (2008) reported goats of Boer x (BT x Co) at birth, 3 months old, 6 months old, corresponding to 2.99 kg; 14.75kg and 22.85kg.

The weight of (BT x Co) goats was 29.28 kg while Co goats was 22.55 kg (P <0.05). (BT x Co) goat expressd direction of increasing the weight of Bach Thao goat clearly.

Table 3.3 Effects of sex on goat weight (kg) of goats over the months of age

Month	**Sex**	**Co goat (n = 20)**		**(BT x Co) goat (n =20)**		**Bach Thao goat (n = 20)**	
		Mean ± SE	Cv%	Mean ± SE	Cv%	Mean ± SE	Cv%
At birth	Male	1.59^{c} ± 0.02	6.58	1.78^{b} ± 0.03	8.36	2.05^{a} ± 0.07	14.92
	Female	1.50^{c} ± 0.03	8.92	1.70^{b} ± 0.05	12.51	1.92^{a} ± 0.07	16.01
	P	0.017		0,000		0.000	
1	Male	4.11^{c} ± 0.08	9.20	4.56^{b} ± 0.09	8.86	5.48^{a} ± 0.11	9.12
	Female	3.59^{a} ± 0.08	10.14	4.13^{b} ± 0,14	15.00	4.91^{a} ± 0.08	7.29
	P	0,000		0.011		0.000	
3	Male	10.45^{b} ± 0.31	12.98	10.85^{b} ± 0,30	12.06	1335^{a} ± 0.23	7.79
	Female	8.95^{c} ± 0.29	14.26	10.35^{b} ± 0,29	12.65	$11,85^{a}$ ± 0.03	11.38
	P	0,001		0.024		0.000	
6	Male	15.95^{c} ± 0.37	10.47	21.20^{b} ± 0.55	11.72	25.60^{a} ± 0.43	7.54
	Female	14.85^{c} ± 0,29	8.81	17.45^{b} ± 0.35	9.01	21.65^{c} ± 0,63	13.00
	P	0.012		0.000		0.000	
9	Male	19.90^{a} ± 0.49	11.05	28.20^{b} ± 0.49	7.77	31.95^{a} ± 0.54	7.49
	Female	18.50^{b} ± 0.29	6.90	21.00^{b} ± 0.71	15.6	27.80^{b} ± 0,52	8.30
	P	0.018		0.000		0.000	
12	Male	23.60^{a} ± 0.61	11.62	32.40^{b} ± 0.55	7.52	37.75^{a} ± 0.35	4.34
	Female	21.50^{c} ± 0.30	6.13	26.15^{b} ± 0.55	9.47	31.95^{a} ± 0.53	7.43
	P	0.004		0.000		0.000	

Note: Values in the same row with different characters were significantly different (P <0.05). P value expressed average in sex at a monitering time.

Results of weitht of male and female goats in Dak Lak showed that the birth weight of males was higher than that of females. The difference was statistically significant in Co goat group (P<0,05) and the difference between of (BT x Co) goats and Bach Thao goats was not statistically significant (P> 0.05). The weight of goats at 3, 6, 9 and 12 month in 3 goat groups showed that the males had higher than females (P<0.05). At 12 month, Co male goats reached 23.6kg; female only gained 21.5kg; (BT x Co) male goat reached 32.4kg and (BT x Co) female goat reached 26.15kg; Bach Thao male goats reached 37.75 kg and Bach Thao female goats

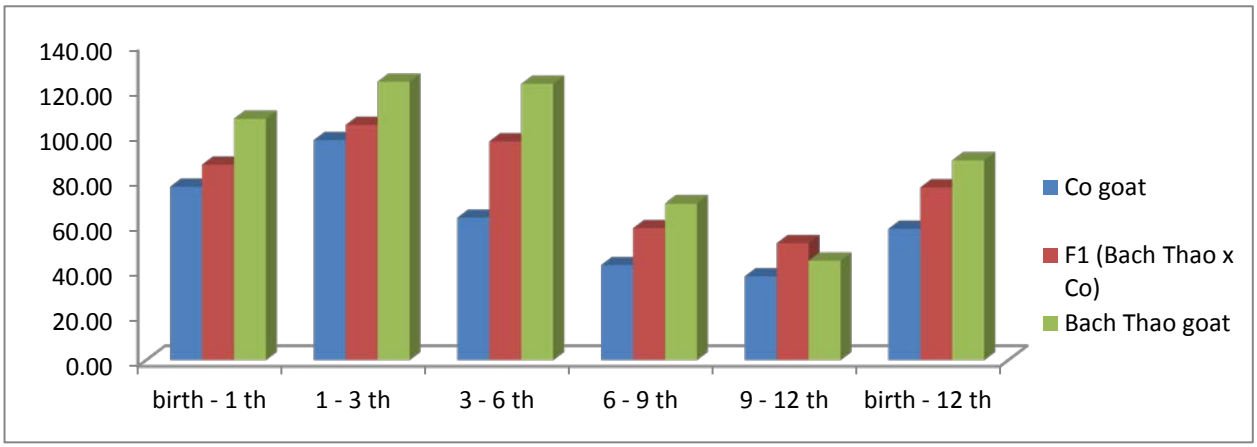
reached 31.95 kg. At 12 months of age, male goats were 4.9% bigger than female goats, 23.9% for (BT x Co) goats and 18.15% for Bach Thao goats. Le Van Thong (2004) revealed weight of (BT x Co) goats at 6, 9, 12 months of age was 20,99 kg, 27,81 kg, 31,7 kg for males and 17,87 kg, 22 , 81kg, 29.34kg for female goats. Le Anh Duong (2007) reported that crossbred goats (BT x Co) at 12 months had a weight of 32.40 kg for males and 26.40 kg for females. The differences in male and female weight are related to the consumption market of meat goat, food sources, and feeding conditions.

Table 3.4 Weight increase (g/day) of goats over the months

Period (month)	**Co goats (n = 40)**		**(BT x Co) goats (n = 40)**		**Bach Thao goats (n = 40)**	
	Mean ± SE	Cv%	Mean ± SE	Cv%	Mean ± SE	Cv%
At birth – 1	$76.75^{c} \pm 2.24$	18.49	$86.58^{b} \pm 2.98$	21.79	$107.00^{a} \pm 2.49$	14.74
1 -3	$97.50^{b} \pm 3.84$	24.90	$104.25^{b} \pm 3.17$	19.20	$123.50^{a} \pm 3.49$	17.86
3 – 6	$63.33^{c} \pm 2.82$	8.15	$96.94^{b} \pm 5.11$	33.34	$122.50^{a} \pm 4.73$	24,43
6 – 9	$42.22^{c} \pm 2.46$	36.83	$58.61^{b} \pm 5.57$	60.10	$69.14^{a} \pm 4.72$	42.99
9 – 12	$37.22^{b} \pm 3.04$	51.73	$51.94^{a} \pm 4.14$	50.43	$44.17^{a} \pm 3.99$	57,11
At birth – 12	$58.34^{c} \pm 1.03$	11.20	$75.47^{b} \pm 1.72$	14.21	$88.53^{a} \pm 1.20$	8.58

Note: Values in the same row with different characters were significantly different (P <0.05).

Weight increase (g/day) of Co goat, (Bach Thao x Co) goats and Bach Thao goats from birth to 12 months of age was 58.34g/head/day; 75.47g/head/day and 88.53g/head/day, the highest growth rate was in Bach Thao goats, following was (Bach Thao x Co) goats and the lowest was Co goats (P<0.05). From 1 to 3 months of age, weight increase respectively was Co (97.50 g/head/day), (Bach Thao x Co) (104.25g/head/day), Bach Thao goats (123.50g/head/day) (P <0.05), high growth during this period belonged to Bach Thao goats. It must be certainly related to lactation ability of their mother. From 9 to 12 months, the growth rate was slower; Co goat was 37.22g/day/head; (BT x Co) goat was 51.94 g/head/day and Bach Thao was 44.17g/head/day. From newborn to 12 months, weight increase respectively was Co 58,34g/day/head; (BT x Co) goat was 75,47 g/head/day and Bach Thao was 88,53 g/head/day (P<0,05). General, the goats raised in Dak Lak were well grown thank to the abundant and high quality of feeds in this area.



Absolute weight increase of goats over minht

Table 3.5 Meat yield of Co, (Bach Thao x Co) and Bach Thao goats

Indicators	**Unit**	**Co goats** (n = 5)	**(BT x Co) goats** (n = 5)	**Bach Thao goats** (n = 5)
		Mean ± SE	Mean ± SE	Mean ± SE
Live weitht	Kg	23.10^{c} ± 0.27	30.90^{b} ± 0.52	34.00^{a} ± 0.58
Carcass rate	%	43.32^{b} ± 0.33	45.82^{a} ± 0.45	46.70^{a} ± 0.37
Pure meat	%	32.34^{b} ± 0.55	35.30^{a} ± 0.70	36.7^{a} ± 0.36
Bone rate	%	10.76 ± 0.365	11.10 ± 0.4	10.86 ± 0.50
Loin muscle area	Cm^2	11.90^{b} ± 0.33	12.76^{ab} ± 0.34	13.50^{a} ± 0.32

Note: Values in the same row with different characters were significantly different (P <0.05).

Five male goats (each group) in total goats at 12 months of age were slaughtered to evaluate meat performance. The weight of Co, (BT x Co) and Bach Thao goats were 23,1kg/head; 30.9kg/head and 34kg/head (P < 0.05) respectively.

The percentage of carcass, Co, (BT x Co) and Bach Thao goats was 43.32%, 45.82% and 46.70%, respectively. Bach Thao goats had the highest rate of carcass compared to Co and (BT x Co) goats (P <0.05). The percentage of pure meat is 32.34%; 35.30%; 36.7% respectively, percentage of pure meat of (BT x Co) goats was medium between Co and Bach Thao goats (P <0.05). (BT x Co) goats has dominant meat capacity (35.30%) compared to Co (32.34%).

The area of loin muscle of Co, (BT x Co) and Bach Thao goats gained 11.90 cm^2; 12.76 cm^2 and 13.50 cm^2 respectively (P <0.05). (BT x Co) showed hybrid advantage of meat ability compared to Co goats. The area of

loin muscle and pure meat of (BT x Co) and Bach Thao goats was dominant to the Co goats from 107.22% to 113.45% respectively.

Table 3.6 Meat quality of Co, (BT x Co) and Bach Thao goats

Indicators	**Co goats** (n = 5)	**(BT x Co) goats** (n = 5)	**Bach Thao goats** (n = 5)
	Mean ± SE	Mean ± SE	Mean ± SE
pH (1h)	6.18^{ab} ± 0.01	6.25^{a} ± 0.04	6.14^{c} ± 0.01
pH (24h)	5.61 ± 0.02	5.65 ± 0.03	5.63 ± 0.03
L^*	38.42 ± 0.18	38.46 ± 0.20	38.84 ± 0.19
a^*	15.75 ± 0.07	15.81 ± 0.06	16.04 ± 0.20
b^*	5.58 ± 0.23	5.80 ± 0.16	5.92 ± 0.10
Preservation dehydration (%)	2.41^{b} ± 0.03	2.50^{ab} ± 0.03	2.58^{a} ± 0.02
Processing dehydration (%)	30.76^{ab} ± 0.87	32.18^{b} ± 0.50	33.67^{a} ± 0.57

The quality of goat meat at pH60 indicated the pH value of 3 groups of goats: Co, (BT x Co) and Bach Thao was 6.18; 6,25 and 6,14, respectively. This indicator in (BT x Co) had pH higher than Co and Bach Thao goats, difference was statistically significant (P <0.05). pH60 in Co and (BT x Co) were 6.18 and 6.25 respectively (P> 0.05).

The value L* (light color) of Co, (BT x Co) and Bach Thao goats 38.42; 38.46; 38.84% respectively. L* value of Bach Thao goats were higher than Co and (BT x Co) goats (P> 0.05). In general, the color of goat meat in the experiment was bright red, light color, suitable for consumer tastes.

The rate of dehydration of Co, (BT x Co) and Bach Thao was 30.76%; 32.18% and 33.67% respectively. The percentage of processing dehydration of goat meat of Bach Thao goats was higher than that of Co and (BT x Co) goats (P <0.05). The percentage of dehydration of met of Co and (BT x Co) goats was not statistically different (P> 0.05).

In general, meat of Co, (BT x Co) and Bach Thao classified according to indicators at pH60, pH24, meat color (L*), the percentage of processing dehydration, preservation dehydration have good quality, meet the taste damand of consumers.

4. Conclusion

The weight of Bach Thao goats raised in Dak Lak province was highest, followed by (BT x Co) and the lowest was Co goats. Weight of male goats is always higher than female goats at different age.

Weight increase of Bach Thao goats over period of month (from birth to 12 months) is the highest, the indicator is lowest in Co goat. Weight increase of male goats is always higher than female goat's at all stages.

Meat yield of Bach Thao goat was the highest and lowest was Co goat. Meat yield of (Co) goat was medium between Co and Bach Thao goats.

The percentage of pure meat of (BT x Co) and Bach Thao goats was 35.30 – 36.7%, higher than that of Co goats (32.34%).

The quality of meat of Co, (BT x Co) and Bach Thao goats are good and expressed by value of pH, light color (L*), preservation dehydration and processing dehydration. In general, goat meat meets the quality requirements of consumers.

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