

## Hybridization

The goal of crossbreeding or hybridization is to combine desirable traits of the breeds being hybridized from the additive genetic effects. In some cases the resulting the hybrid will actually exceed the average of the two parental types as a result of non-additive genetic effects. This is called *heterosis* or *hybrid vigor*.

Most hybridization of yak has taken place in Tibet, China and Mongolia for thousands of years as nomads crossed yaks with indigenous *bos indicus* cattle seeking to develop increased milk and meat production as well as a larger draught animal. The problem they faced was that while the hybrid had these improvements it no longer had the capacity to survive at the altitude yak herds lived in. As such, much of the hybridization was at lower altitudes. It was not until the 1950's with the advent of artificial insemination that yaks were crossed with *bos taurus* (initially Holstein-Friesians and Simmentals).

It has not been possible to rigorously study whether heterosis was present in crossing yaks with the *bos indicus* or *taurus* cattle resultant hybrids, *bos taurus* and *indicus* could survive in the yak environment for a side-by-side trial. Yet, "the performance of hybrids and that of yaks, and where possible, cattle are highly suggestive of the part played by heterosis." (YAK, The Second Edition, Gerald Weiner) The hybrid vigor (heterosis) that was attributed to the yak was primarily in terms of the ability to survive at higher altitudes and on poorer forage than *bos indicus* or *taurus* cattle.

### Hybrid Birth Weights:

The following Table shows the birth weights of different hybrids of yaks at different locations in China (different elevation and environment) and body weight of the local yak dams.

Table 1: Birth weights of calves of yak and different hybrids of yak at various locations (differing in elevation and environment) and body weight of local yak dams (average of male and female calves)

Sire of calf	Xinjiang <sup>[1]</sup>		Longri, Sichuan <sup>[2]</sup>		Gannan, Gansu <sup>[3]</sup>		Shiqu, Sichuan <sup>[4]</sup>		Ganzi, Sichuan <sup>[5]</sup>	
	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)	No.	(kg)
Local yak	25	14.8	25	12.4	91	14.0	71	11.5	40	9.4
Local cattle									19	12.2
Holstein-Friesian			32	23.4	40	22.0	59	19.1		
Simmental	10	26.9	9	19.5						
Charolais	18	27.2	6	24.7			20	19.1		
Hereford	16	24.1	7	20.3	17	22.5	18	16.4		
Aberdeen Angus					22	23.1	17	17.9		
Shorthorn			9	18.2						
Body weight of yak dam (kg)	257		222		210		200		179	

## Gains In F1 Hybrids:

**Meat:** The 1989 study of growth rates of F1 (Hereford, Simmental, Charolais and Shorthorn ) yak hybrids (Table 2 below) found that at 17 months slaughter weights of the hybrids were 50% greater and had already achieved an adequate degree of finish by the end of the second summer. According to Zhang Rongchang (1989) the loin-eye area was two thirds larger in the hybrids than the yak. Reports from Altai (former Soviet Union) “noted that hybrids (Simmental.or Shorthorn sires) had reached up to twice the slaughter weight of yaks at 21 months of age and were also much fatter but had very similar dressing percentages.”

Table 2: Body weights and linear body dimensions, at 6 and 17 months of age of yak and hybrids with different "improved" breeds of cattle at Longri, Sichuan (means and [SD]) [Source: Cai Li, 1989]

Yak female mated to male of:	Sex	No.	6-month weight (kg)		17-month weight (kg)		17-month linear body dimensions (cm)		
			Mean	[SD]	Mean	[SD]	Height at withers	Body length	Heart girth
							mean	mean	mean
Yak	m	14	68.9	7.4	129.8	11.0	95.3	107.8	135.4
	f	11	68.5	11.9	121.0	16.7	89.6	104.8	132.9
Holstein-Friesian	m	11	123.0	11.0	234.6	18.6	114.6	128.8	158.4
	f	21	111.6	13.6	202.4	17.3	110.8	123.7	154.3
Simmental	m	3	115.2	13.0	210.0	24.1	105.8	118.0	143.7
	f	6	77.5	15.6	162.8	24.6	102.3	114.0	133.8
Charolais	m	3	93.0	7.0	184.5	18.8	98.8	112.3	133.0
	f	3	81.3	5.7					
Hereford	m	3	81.3	10.7	181.3	12.8	100.7	109.0	139.3
	f	4	88.6	6.6	182.8	11.5	101.4	109.3	143.8
Shorthorn	m	2	86.0		162.0		102.5	112.5	139.0
	f	7	86.1	5.0	169.2	15.3	102.9	113.4	138.1

*Note: It is important to note that the data for the previous two charts was for forage and environmental conditions in regions of China. Yak dams in the United States typically weigh between 280 kg and 310 kg (600-700 lbs). One would expect calf weights in the US to be slightly higher due to improved forage and a less harsh environment. Weight losses over the winter during the study were between 11 and 12% of their body weight at the start of winter in the hybrids and the pure yak.*

## Meat Considerations:

1. The basic and ongoing research on yak hybrids has taken place in China, Mongolia and India. Because of the high altitude and harsher environment resulting in limited forages, one would assume relative F1 gains weight gains and milk production as compared to pure yak will be greater in parts of the country where yak do well on local forage

2. A 2023 study by the University of Kentucky which looked at the crude protein, crude fat and moisture content levels of grass fed yak sirloin and angus sirloin (including USDA choice and prime) yielded the following results:

	CP %	Fat %	Moisture %
Yak	22.75	0.85	83.43
Angus	20.70	5.41	75.30

A hybrid F1 (angus – yak) should have crude protein and fat roughly midway between that of grass fed yak without any feed or special finishing as a result of the genetic gain from the yak and reduced time to a possible 50% larger than yak slaughter weight to the genetic gain from the angus. A carcass with close to 23% protein and overall fat of approximately 97% will rival that of both yak (and bison) on the time line of beef and the reduced inputs of yak.

This Yak-Angus F1 hybrid could be both a large and small scale niche market. Due to the small size of the birth canal of yaks, the dams would have to be angus which can easily handle F1 calf size a yak could not without high risk of dystocia and death.

Given the small size of the US yak herd at under 7000 nationally, such a hybrid with close to the meat quality (protein and fat) of yak (and bison) could be a solution to the supply vs. demand problem of yak meat as people seek leaner high protein red meat,

The unknown at this point is a study on the taste and texture of a grass fed yak-angus F1. Will it be differentiable from yak?

Milk Production: Local yak females in the Ruergai and Hongyuan regions of Sichuan, China averaged 4.4 pounds of milk per day at peak period with 6.3% fat content. F1 Holstein-Friesian yak hybrids averages 17.6 pounds with a fat content of 5.4 percent. As would be expected a F1 H-F yak cross when bred to an H-F lower milk production than the F1 (12.1 pounds at peak).

Table 3 gives milk yield totals after 149 days for F1 (Yak x Holstien-Friesian) of different ages and parity all of who, were simply on pasture. What is unique to yak and also found in the F1 is they have a second lactation in the year following first calving without a further pregnancy (referred to as a “half-lactation”).

**Table 3:** Daily milk yield and fat percentage of yak cows and F1 and backcross cows involving the yak and its hybrids with bulls of local cattle and with Holstein-Friesian (or 75 percent HF and 25 percent local cattle) bulls - in Hongyuan and Ruergai counties of Sichuan province ten females per group [Pooled data from several farms; Source: Cai Li, 1989]

Type of animal	Daily milk yield (kg) (at peak period)	Fat (%)
Local yak	2.0	6.3
Yak (f) × Holstein-Friesian (m) ("improved" F1)	8.0	5.4
Yak (f) × local (yellow) cattle (m) (local F1)	3.0	6.0
F1 (f) × Holstein-Friesian cattle (m) ("improved" B)	5.5	
F1 (f) × local (yellow) cattle (m) (local B1)	0.5-1.0	6.2

B = backcross, f = female, m = male

A lactating yak cow produces only several quarts of milk a day. If a calf is to be supported there is little "excess milk" available impacting the calf's development.

On the other hand an F1 yak-dairy hybrid would produce approximately two gallons of milk per day. This opens up a number of options:

The F1 yak-dairy cross could become the new "family milk cow" producing a more manageable amount of milk for a household to utilize on lower forage quality requirements;

The F1, being "half-yak" could be the basis for a niche :Yak x "Specific dairy breed" dairy product (milk, butter, yogurt, cottage cheese and cheese) market at a higher price. Furthermore, being an F1 yak cross would reduce forage/feed costs compared to pure dairy breeds.

#### Fertility of Hybrids:

Hybrid Heifers: F1- first generation hybrid heifers are fertile as are their back-crosses.

Hybrid Bulls: F1 bulls are sterile. They produce semen but no sperm. They will act like a bull in all ways and can be used as "teaser bulls" in breeding programs. If one backcrosses hybrid yak females some bull offspring will be fertile after the second backcross (75% yak). However, 31/32 is the accepted percentage of yak for bull fertility.